



Witness Statement - Planning Panel Hearings Whittlesea Planning Scheme, Amendment C241

1. Name and Address

Mr Michael Asimakis

c/- GHD 180 Lonsdale Street Melbourne

2. Qualifications and Experience

- BSc Melbourne 2008
- Certified Air Quality Professional, CASANZ
 - Professional Experience
 - 2009 – 2020: Senior Air Quality Scientist, GHD

3. Areas of Expertise

I specialise in meteorological/air dispersion modelling and reporting. In the last 12 years, I have conducted many dust and air quality impact assessments for existing and proposed industries with potential off-site odour or dust impact. I have assisted with the development of buffer methodologies where meteorology and throughput is taken into account and have applied them to a range of industries.

4. Expertise to Prepare Report

I have reported on dust impact assessments on many cases for Planning Panel and VCAT proceedings and have conducted such assessments for a range of industries with off-site dust impact. I have applied the EPA Victoria buffer guidelines for numerous projects including for quarries, mines, industrial facilities and concrete batching plants.

5. Instructions which defined Scope of Report

I received instructions from Harwood Andrews acting for the Victorian Planning Authority (VPA) to prepare expert evidence in relation to the upcoming panel hearing for Amendment C241 with regard to the nature of air quality buffers and separation distances from the Woody Hill Quarry within the PSP area; and the Phillips Quarry adjacent to the southeast boundary of the precinct. I have previously (2017-2019) been instructed by The City of Whittlesea (CoW) and the VPA to prepare an Impact Assessment Report for the Shenstone Park Precinct Structure Plan (PSP) and associated investigation area to the south and east of the PSP boundary considering air quality (dust) impacts at the following sites:

- Existing Barro Group Woody Hill Quarry (WA 492)
- Approved basalt quarry (Phillips Quarry WA 160)

The assessments were to be used by CoW and the VPA to inform a detailed precinct-based design that will respond to the constraints on future land use posed by the operations at the two quarries.

6. Facts, Matters and Assumptions Relied Upon

- Site inspections around the perimeter of the quarry sites
- Review of information provided by CoW, VPA and EPA Victoria
- Review of documents supplied in the brief by Harwood Andrews
- My experience relevant to buffer and dust impact assessments
- My experience relevant to recommended separation distances for industrial residual air emissions

7. Documents to be taken into Account

- GHD December 2017 report #51460 (available at <https://vpa-web.s3.amazonaws.com/wp-content/uploads/2019/10/Quarry-Impact-Assessment-GHD-December-2017.pdf>)
- GHD, April 2018 report #70468 (available at <https://vpa-web.s3.amazonaws.com/wp-content/uploads/2019/10/Quarry-Impact-Assessment-Addendum-GHD-September-2019.pdf>)
- GHD, September 2019 report # 69174
- GHD letter October 2020 #12540645-71524-1

8. Identity of Persons Undertaking Work

- Michael Asimakis, and other GHD specialist staff: Craig McVie, Jayne Mooney, Tim Pollock, Simon Ritchie, Alastair McKenzie, Barry Cook

9. Summary of Opinions

- The substantive portion of my statement is given in the three GHD reports #51460, #70468, #69174 and #12540645-71524

10. My opinions are not provisional except where specifically qualified.

11. The analysis presented in this report is within my area of expertise.

12. I declare that I have made all enquiries that I believe are desirable and appropriate, and that no matters of significance have been withheld from the Panel.

Regards



Michael Asimakis

Senior Air Quality Scientist

28 October 2020

Attachments: GHD, September 2019 report # 69174
GHD letter October 2020 #12540645-71524-1



28 October 2020

Our ref: 12540645-71524-1
Your ref:

Amendment C241wsea Whittlesea Planning Scheme - Shenstone Park PSP - Air Quality Expert Witness Air Quality Buffers

1 Introduction

This report has been prepared for the upcoming panel hearing for Amendment C241 (the Amendment) to the Whittlesea Planning Scheme Shenstone Park Precinct Structure Plan (PSP). The Amendment seeks to incorporate the PSP into the Whittlesea Planning Scheme.

GHD understands that the VPA has prepared a draft PSP, including Buffers, Noise, Amenity and Measurement Length Plan and a draft Future Urban Structure (FUS). The PSP and the Amendment were on public exhibition between October 2019 and November 2019. A number of submissions were received from government agencies, stakeholders, landowners and developers.

The VPA has engaged GHD to prepare expert evidence with regard to the nature of buffers and separation distances from the Woody Hill Quarry within the PSP area; and the Phillips Quarry adjacent to the southeast boundary of the precinct.

This addendum letter covers the buffer/separation distance matter in relation to Air Quality only.

In relation to expert evidence, I, Michael Asimakis, have been instructed by Harwood Andrews acting for the VPA to:

- Prepare a report (this letter) in writing detailing my opinions in respect of:
 - Quarry Impact Assessment - Addendum - GHD September 2019
 - Quarry Impact Assessment - GHD December 2017
 - Exhibited Shenstone Park Precinct Structure Plan – October 2019
 - An assessment of different types of buffers and separation distances
 - The required buffer distance for each type
 - The type of factors which influence each buffer distance
 - The types of land uses / buildings etc that could occur within each type of buffer
 - An opinion on the starting point for the measurement of the buffer distance
 - An expert opinion of the distance(s) which the panel should recommend as the buffer distance for the Precinct
 - Consideration of submissions to the amendment regarding different buffer distances

2 Review of exhibited amendment and background materials

I have reviewed the relevant exhibited amendment and background material including the following:

- Quarry Impact Assessment - Addendum - GHD September 2019
- Quarry Impact Assessment - GHD December 2017
- Exhibited Shenstone Park Precinct Structure Plan – October 2019
- Submissions and tabled documents available as of 19 October 2020

2.1 Impact Assessment Report for the Shenstone Park Precinct Structure Plan (GHD, December 2017¹)

GHD was engaged by City of Whittlesea (CoW) to prepare an Impact Assessment Report for the Shenstone Park Precinct Structure Plan (PSP) and associated investigation area to the south and east of the PSP boundary. I, Michael Asimakis, was the technical lead and author of the document. In relation to quarries, the assessment considered air quality (dust) impacts at the following sites:

- Existing Barro Group Woody Hill Quarry (WA 492) located within the Shenstone Park PSP boundary
- Approved basalt quarry (Phillips Quarry WA 160) located immediately south of the Shenstone Park PSP boundary

The assessment was to be used by City of Whittlesea (CoW) to inform a detailed precinct-based design that will respond to the constraints on future land use posed by the operations at the two quarries.

Using the EPA Victoria recommended separation distance guideline (Publication 1518), I assessed the recommended default buffers for the quarries with the following conclusions made:

- An active quarry with blasting has a recommended buffer of 500 m
- A concrete batching plant (Woody Hill) has a recommended buffer of 100 m
- A rock processing plant (existing at Woody Hill Quarry and proposed at Philips Quarry) have a recommended buffer of 250 m
- All buffers should be scribed from the envelope of potential sources, as per Method 1 in EPA Victoria Publication 1518. It is my knowledge of the guideline and experience to take this envelope as the envelope of the existing and approved extraction boundaries for the two quarries rather than the Work Authority boundary.

It is my understanding that there are EPA Victoria site-specific criteria to vary a default buffer distance as detailed in Publication 1518. The six criteria identified in Table 4 of the separation distance guideline were considered. It was deemed likely that some of the factors listed in that table could vary the default buffer, if specific operational details about the industry is known.

It is my opinion that two criteria that allow for site specific variations that have the largest impact in varying the default buffers were considered to be size of the facility (de-rating a default buffer) and local meteorology (directional buffer).

¹ GHD report #51460

I considered that the relevant buffer for the active quarry area and approved quarry area with blasting should be the default 500 m buffer irrespective of the throughput of the quarry. It is my experience that the derating was not considered appropriate for the existing or approved quarry in relation to blasting, principally due to fly rock being able to be thrown this distance in all directions.

However, I opine that the directional buffer would apply to the default 500 m buffer given that the default buffer accounts for possible transport of dust particles, which would be subject to meteorological influences. The local meteorology would only apply during daytime hours for the quarries as blasting would only occur during the daytime.

The directional buffer assessment showed that the default buffer can be retracted and extended in the directions of good and poor dispersion. An extension of the default buffer occurred to the east and northeast into the PSP, while the default buffer retracted in the west due to anticipated meteorology conditions. I have longstanding knowledge as to the rarity of easterly component winds over the northern suburbs of Melbourne. Thus, the 500 m dust directional buffers from the approved extraction area boundaries of the two quarries are considered a conservative approach when informing future land uses and protecting future sensitive uses from dust amenity impacts,

The intent of the buffers from the quarries is to restrict additional sensitive land use intensification in these buffer areas (including land inside and outside of the PSP), due to the risks from dust amenity impacts.

It was recommended that the inclusion of buffer controls within the PSP should achieve separation of non-compatible uses and delineate land available for urban development. This is consistent with my understanding of the recommended separation distance guidelines.

Upon review of GHD December 2017, I still consider as valid the technical findings of the assessment.

2.2 Shenstone Park Impact Assessment Woody Hill Addendum (GHD, April 2018²)

Following on from GHD, December 2017, GHD was engaged by the CoW to conduct additional air quality technical investigations for the possible expansion of the Woody Hill Quarry.

The following scenarios were considered (refer to Figure 1 of GHD April 2018):

- Expansion to the south of the existing extraction area within the Work Authority 492 boundary
- Expansion of the Work Authority boundary and subsequently the extraction boundary to the north of the existing Work Authority boundary
- Expansion 20 m below the ground surface

As per GHD December 2017, the 500 m dust directional buffers from the approved extraction area boundaries for the expansion scenarios were considered a conservative approach when informing future land uses and dust amenity impacts.

Upon review of GHD April 2018, I still consider as valid the technical findings of the assessment.

² GHD report #70468

2.3 Shenstone Park Impact Assessment Woody Hill Addendum (GHD, September 2019³)

In September 2019, GHD was engaged by the VPA to update the Shenstone Park Impact Assessment Report (GHD December 2017). I was the technical lead and author of the document. A revision to the air quality buffers was required to account for an additional expansion scenario of the Woody Hill Quarry based on a revised Future Urban Structure plan. In order to undertake this assessment, VPA provided GHD a revised Future Urban Structure plan, which included State Government agency feedback including from the Department of Jobs, Precincts and Resources (DJPR) (Earth Resources). This revised Future Urban Structure plan incorporated an expanded resource east of the existing Woody Hill Quarry based on the extent of employment land within the Northern Growth Corridor Plan.

The following scenarios were considered (refer to Figure 1 of GHD September 2019):

1. Expansion to the south of the existing extraction area within the Work Authority 492 boundary
2. Expansion of the Work Authority boundary and subsequently the extraction boundary to the north of the existing Work Authority boundary
3. A new expansion of the Work Authority boundary and subsequently the extraction boundary to the east of the existing Work Authority boundary (as identified on the Future Urban Structure plan)
4. Expansion 20 m below the ground surface

The north and east scenarios were based on the Future Urban Structure plan (Appendix A of GHD September 2019) working backwards from the extent of the industrial/business land i.e. maintaining the default buffers within the industrial/business land and conservation area (refer to Figure 2 of GHD September 2019 – green line is the boundary of the industry/conservation land).

This allowed a working backwards from the extent of the industrial/business land to establish how much the Woody Hill Quarry could expand into the future while maintaining the 500 m buffer (minimising the risk of amenity impacts) from the quarry activities. This approach is consistent with that outlined in EPA Victoria Publication 1518, Section 10.2, which outlines interface land uses that are to be located within separation distances between industrial land uses and sensitive land uses.

An expansion of the quarry to the west was not assessed due to the quarry already being constrained by existing sensitive uses (with the closest resident located approximately 300 m from the current extraction boundary). I consider it unlikely that the quarry will be permitted to extend closer to these existing residents as I understand this to be against the intent of the separation distance guidelines.

The default 500 m buffer was used as the starting point to define the extraction boundary for the expansion scenario. The default buffer was shown to be contained within proposed industrial/business and conservation land shown in the Future Urban Structure plan. However, as per GHD December 2017, the 500 m dust directional buffers from the approved extraction area boundaries for the expansion scenarios were considered a conservative approach when informing future land uses and dust amenity impacts. Given the local meteorological effects, the extent of the possible extraction area was reduced in order for the 500 m dust directional buffer to be contained within the extent of the industrial/business and conservation land shown in the Future Urban Structure plan.

Upon review of GHD September 2019, I still consider as valid the technical findings of the assessment.

³ GHD report #69174

2.4 Exhibited Shenstone Park Precinct Structure Plan – October 2019

I have reviewed the exhibited Shenstone Park PSP with particular focus given to Plan 15 relating to Buffers, Noise Amenity and Measurement Length. From review, the buffer distances specified appear to be broadly in line with the GHD December 2017 and GHD September 2019 conclusions.

With regards to the Woody Hill Quarry, it appears that a 550 m sensitive use buffer has been designated to the outer envelope of the possible extraction expansion, which combines the outer envelope of the 500 m dust directional buffer and the 550 m blast generated vibration buffer. For greater transparency, I opine that the individual buffers relating to the separate impacts as per the GHD 2017 and 2019 reports be included on such a plan designating air quality buffers.

With regards to the Philips Quarry, it appears that the 550 m sensitive use buffer relates only to blast generated vibration and does not appear to include the outer envelope of the 500 m dust directional buffer and 550 m blast generated vibration as per the Woody Hill Quarry 550 m sensitive use buffer. I note that the 550 m sensitive use buffer appears to be scribed from a larger envelope of potential sources. It is not clear to me whether the proposed Phillips Quarry area used to scribe the buffer is based on a WA boundary, proposed extraction area or Special Use Zone. GHD 2017 and 2019 assessments were based on WA 160 and a proposed extraction footprint provided to GHD at the time of assessment. I note that WA 160 has since expired.

As per the recommendation for Woody Hill, I opine that the individual buffers relating to the separate impacts as per the GHD December 2017 and September 2019 reports be included on such a plan designating air quality buffers.

2.5 Submissions and tabled documents available as of 19th October 2020

2.5.1 Submissions

I have reviewed a total of 24 online submissions with respect to buffers and air quality.

I have provided a review of the EPA Victoria submission given that it provides an overview of the GHD assessments. I have also responded to broad themes identified by other submissions.

EPA Victoria Submission

Broadly, EPA Victoria is generally supportive of Amendment C241 and I am lead to the opinion that they support the approach taken in determining the appropriate separation distances from existing and proposed industry, and the land uses permitted within these areas.

With regards to the recommendation of directional buffers, EPA Victoria expressed an opinion that it is a problematic methodology. However, as the proposed separation distances are larger than those listed in Publication 1518 (550 m vs 500 m), for the land proposed to be used for sensitive uses, this was not considered an issue by EPA Victoria and was deemed a conservative approach.

I am of the opinion that EPA Victoria supports a precautionary method of consolidating both the recommended separation distances established in Publication 1518 and the directional buffers established in the Impact Assessments by adopting the largest of each buffer at any point.

Consistent with Publication 1518, EPA Victoria has an opinion that sensitive uses being prohibited in the applied Industrial 1 and 3 Zones, prohibiting certain sensitive land uses including accommodation, child care centre, education centre (other than business college, employment training centre or tertiary institution) or hotel within the Quarry Sensitive Use Buffers.

The assumptions and background research underpinning the GHD work do not accurately reflect the current and proposed operations on the Barro Group land

The GHD assessments (2017, 2018 and 2019) were based on a site inspection undertaken by myself on 4 August 2017 and information provided by CoW and the VPA. Further, DJPR (Earth Resources) was contacted by me during the preparation of the assessments for specific operational information pertaining to the two quarries. However DJPR (Earth Resources) were not able to provide this without the approval of the work authority holder and made reference to the publically available Work Plan for Woody Hill.

I sought input relating to operational details for the two quarries from stakeholders including Barro⁴, but they were not forthcoming. Hence, where there was no provision of information, I had to make a number of assumptions for the Impact Assessments.

Given the lack of available information pertaining to the Phillips Quarry, I assumed that the approved Phillips Quarry will be similar to the existing Woody Hill Quarry for both air and noise impact assessments. It is my understanding that both quarries have had to go through the same rigorous Work Authority assessment by DJPR (Earth Resources).

Therefore, I conclude that the assessment findings and recommendations in the absence of this information were estimates only but the best available at the time and suitably conservative.

The GHD Addendum notes that the assessment of the Woody Hill Quarry buffer is “based on the [Exhibited] Future Urban Structure Plan working backwards from the extent of the industrial/business land”. This method of calculating the buffer is not in accordance with relevant guidelines.

The VPA requested GHD during May, 2019 to investigate how much the Woody Hill Quarry could expand while maintaining the 500 m buffer distance.

GHD was provided a revised Future Urban Structure plan, which included State Government agency feedback including from DJPR (Earth Resources). This revised Future Urban Structure plan incorporated an expanded resource east of the existing Woody Hill Quarry based on the extent of employment land within the Northern Growth Corridor Plan.

I was able to do an assessment by working backwards from the extent of the industrial/business land to establish how much the Woody Hill Quarry could theoretically expand into the future while maintaining the buffers thereby minimising the risk of amenity impacts from the quarry's activities.

⁴ Email to Peter Barro dated 13 July 2017

It is my understanding that this approach is consistent with that outlined in Publication 1518, Section 10.2. This section on interface land uses (light industrial/ commercial) provides 'Examples of interface land uses and their suitability' (Table 5), which are to be located within separation distances between industrial land uses and sensitive land uses.

All three GHD Impact Assessments were to inform future land use planning associated with development of the PSP. This is clearly stated in the study objectives within each report. The GHD reports note that buffer distances were considered in terms of the existing operation at WA 492, proposed future expansion of Woody Hill WA 643 and extension of WA 492 south and the future operations at the Phillips Quarry (WA 160 now WA 6852) from the information made available to GHD at the time of each assessment.

With regards to Plan 15 on page 51 of the PSP why have the VPA applied the quarry buffers from the property boundary of the Phillips Quarry rather than from the point source of emissions shown by either the 'Approved extraction boundary' or the 'Stage 1 works area' on GHD Figure 32?

It is my understanding that the 550 m sensitive use buffer appears to be scribed from a larger envelope of potential sources compared to the GHD reports. It is not clear to me whether the proposed Phillips Quarry area on Plan 15 used to scribe the buffer is based on a WA boundary, proposed extraction area, special use zone or property boundary. The GHD 2017 and 2019 assessments were based on WA 160 and a proposed extraction footprint provided at the time of assessment. I now understand that WA 160 has since expired. It is my understanding that if a WA application was submitted for works anywhere within the Special Use Zone 4 (SUZ4) area in that land parcel, the 500 m dust directional buffer scribed from the envelope of potential sources (taken to be extraction area boundary) would be appropriate to mitigate against quarry operations for any proposed sensitive uses in the Shenstone Park PSP. It is my opinion that this is consistent with the intent of the Publication 1518 outlined in Section 12 Examples of how to apply this guideline.

In relation to existing concrete batching at Woody Hill Quarry, Clause 53.10 includes a threshold distance of 300 m.

It is my opinion that the application of Clause 53.10 to an existing industrial use in this instance is incorrect. The correct buffer to apply to an existing concrete batching plant is 100 m from the Publication 1518 – Recommended Separation Distances for Industrial Residual Air Emissions. My reasoning is explained below.

The Planning Policy framework seeks to ensure that planning resolves and does not create land use conflicts. This is typically achieved by providing separation distances between potentially conflicting land use zones that may result in incompatible uses.

Clause 53.10 of the Victorian Planning Provisions (VPPs) seeks to define those types of industries and warehouses, which if not appropriately designed and located, may cause offence or unacceptable risk to the neighbourhood.

The clause sets out the threshold distance that is the minimum distance from any part of the land of the proposed use of or buildings and works for specified uses that have adverse amenity potential.

The table to the Clause 53.10 includes three columns that refer to the type of production or use or storage (purpose), which may result in adverse amenity potential and includes the threshold distance in metres and notes:

- **Note 1** is where the threshold distance is variable, dependent on the process to be used and the materials to be processed or stored
- **Note 2** is where an assessment of risk to the safety of people located off the land may be required

Clause 53.10 does not itself trigger the need to obtain a permit, however Clause 66.02 – 7 (use and development referrals) requires that an application is referred to the EPA as the determining referral authority, if the proposal is to use land for an industry or warehouse for a purpose listed in the table to Clause 53.10 shown with a Note 1 or if the threshold distance is not met.

It is my experience that over the years there have been a number of VCAT, Planning Panel and Advisory Committee reports and recommendations in relation to the use and operation of the threshold distances (separation distances) included in under Clause 53.10 – Uses with adverse amenity potential.

The following Planning Panel commentary provides a snapshot as to the recent application of the threshold distances listed under Clause 53.10 and the separation distances included in Publication 1518 – *Recommended Separation Distances for Industrial Residual Air Emissions*.

Melbourne Planning Scheme Amendment C221 – West Melbourne waterfront (26 January 2017)⁵

I have read the Planning Panel decision in this matter and I am of the opinion that the purpose of the Panel Hearing was to consider submissions in response to a rezoning application to facilitate a mixed use development of approximately 2.8 hectares comprising substantial residential, retail, commercial and open space land uses. The subject land is proximate to both the Footscray Major Activity Centre and Melbourne's Central Business District.

The Panel considered odour and dust impacts from surrounding industry and considered whether the site could achieve adequate separation distances. I provide the following commentary in relation to the application of Clause 53.10 and Publication 1518 Guidelines as follows:

- *"The Panel reiterates that it is satisfied that the most relevant consideration in the establishment of appropriate separation distances between existing industries and proposed new sensitive land uses are the EPAV 1518 Guidelines". Pg.46*
- *"The Panel agrees with the views of the Advisory Committee, which notes that Clause 52.10 (now 53.10) does not act as a 'reverse buffer' (the concept of 'reverse buffer' is where an impact generating use is protected from encroachment by sensitive uses, rather than the sensitive use being protected from encroachment by a use with adverse impacts). It does not provide a statutory buffer for the location of residential uses that is a suitable distance from existing industries. Industries are not therefore completely protected from encroachment of residential uses". Pg 46*

⁵ <https://www.melbourne.vic.gov.au/SiteCollectionDocuments/c221-west-melbourne-waterfront-panel-report.pdf>

In considering the evidence, the Panel made the following conclusion:

- *“The Panel considers that the EPAV 1518 Guideline is the relevant guideline to inform separation distances between existing commercial/industrial uses and proposed sensitive uses. Informed by these Guidelines and the testing of the evidence, the Panel is satisfied that, subject to further assessment and detailed site planning, the introduction of sensitive uses on [sic] subject site can be accommodated in a manner that will afford adequate separation distances from existing commercial and industrial operations in the Dynon Precinct”. Pg 49*

Summary

The use of the *EPA Publication 1518 - Recommended Separation Distances for industrial residual air emissions (March 2013)* is the preferred approach to determining suitable separation distances between existing industrial and proposed new sensitive uses.

2.5.2 Tabled documents

I have reviewed the available tabled documents as of 18 October 2020 and have determined that only one document is relevant to quarry buffers in relation to air quality, which is the response to Directions 6 and 7⁶.

Directions 6 and 7

- a) A map which shows the extent of the Barro Group land and its current and proposed zoning (including applied zones under the UGZ7)**

Ponte Lawyers acting for Barro Group has provided maps showing the current and proposed zoning for the Woody Hill Quarry site. From my review of the provided material, it is my opinion that the current WA 492 is zoned SUZ4 while WA 6437 to the north is currently zoned FZ with the proposed zoning to be SUZ4.

- b) An explanation of current approvals and expansion applications for Woody Hill Quarry and Phillips Quarry**

Woody Hill Quarry

The documents provided reveal to me the following:

- WA 492 was approved in March 2003 with the resource being predominantly mudstone
- Work Plan variation of WA 492 statutorily endorsed on February 3, 2020 for the extension of the extraction area to the south of the existing extraction area of WA 492, with the resource being primarily mudstone
- Work Plan for WA 6437 was statutorily endorsed on August 16, 2019 for the extraction area north and east of the existing extraction area of WA 492 with the resource being primarily basalt, underlain by mudstone

⁶ Hubshare Shenstone Park PSP, Tabled documents, document 18, dated 2 October 2020

- WA 6437 will be part of an expanded integrated operation of WA 492 and will not operate on a standalone basis
- The resource extracted from WA 6437 will be processed in the existing area of WA 492
- A concrete batching plant obtained a planning permit in January 2009 and is located at the northern end of WA 492
- In terms of extraction process and processing methods for WA 492 and WA 6437 are confirmed to be:
 - Soil stripped and either hauled directly to rehabilitation areas or stockpiled for later use. Soil and overburden stripping involves an excavator loading haul trucks but can also include dozers, scraper and wheel loaders.
 - The fresher material will be extracted by conventional drilling and blasting techniques using a tracked hydraulic percussion drill rig and non-electric blast initiation.
 - The broken material loaded into dump trucks and taken to crushing and processing plant.
 - All material for crushing and screening processed through existing fixed and mobile facilities.

Phillips Quarry

The documents provided reveal to me the following:

- Planning permit 704901 amended June 20, 2014, was extended and Development must commence by July 8, 2024
- There are no endorsed plans for the permit
- WA 160 previously applied to the site
- WA 6852 was allocated to the Phillips Quarry on September 25, 2018
- WA 6852 covers the whole of the Phillips Quarry property with the resource comprising primarily of basalt
- Phillips Quarry will have its own fixed processing plant

c) Copies of relevant material that would assist the Panel to understanding the existing and proposed extraction limits

Annexure 6 (b) (vii) A Figure 1, Date 24 September 2018 shows the WA boundaries for WA 492, WA 6437 and WA 6852 along with the extraction area boundaries.

d) Anticipated lifespan of each quarry:

My interpretation of the provided materials reveals:

- The potential extraction life of WA 492 is expected to be more than 30 years
- The potential extraction life of WA 6437 is expected to be more than 25 years
- The potential extraction life of WA 6852 is expected to be more than 50 years

e) Staging and timing of proposed expansions

With regards to staging, it is my understanding that Barro have commenced WA 492 and expect to commence WA 6437 as soon as the relevant approvals are obtained. The northern portion is intended to be extracted first.

WA 6852 is also expected to commence as soon as the relevant approvals are obtained. The northeastern portion is currently intended to be fully extracted first, while the northwestern portion will initially be extracted to a level to site the fixed processing plant.

f) Information on the arrangements with Donnybrook JV about access to the Phillips Quarry

Of relevance to quarry buffers, item (vi) reveals to me that residential and associated development will not occur on the Barro Group and Donnybrook JV Pty Ltd (DBJV) land within 500 m of WA 492, WA 6437 and WA 6852. Barro have stated that they intend to extract the northeastern area of WA 6852 in a southerly direction as soon as practicable, so that DBJV can develop the area indicated as future residential area in the Future Urban Structure Plan as the extraction area within 500 m is exhausted. I am of the opinion that the processing plant located in the northwest of the site will still be subject to a buffer distance of 250 m.

2.5.3 Implications to GHD assessments

I can detail the following implications to the GHD assessments upon my review of the above information in section 2.5.2 pertaining to the two quarries:

Woody Hill Quarry

- The existing operational impact with regards to air quality buffers from Woody Hill Quarry WA 492 presented in GHD December 2017 is unchanged, namely;
 - The active quarry with blasting has a recommended buffer of 500 m as per Publication 1518
 - The concrete batching plant has a recommended buffer of 100 m as per Publication 1518
 - The rock processing plant has a recommended buffer of 250 m as per Publication 1518
 - All buffers scribed from the envelope of potential sources, as per Method 1 in Publication 1518. The envelope of potential sources being the extraction boundary rather than the Work Authority boundary
- The operational impact with regards to air quality buffers from the Work Plan variation of WA 492 endorsed on February 3, 2020, for the extension of the extraction area to the south of the existing extraction area of WA 492, is unchanged from that presented in GHD April 2018; namely a 500 m buffer from the extraction area boundary applies.
- The operational impact with regards to air quality buffers from WA 6437 for the extension of the extraction area to the north of the existing extraction area of WA 492 is slightly different from that presented in GHD April 2018. The 500 m buffer from the extraction area still applies, with the slight difference being the envelope of the extraction area itself. The plans provided by Ponte Lawyers indicate that WA 6437 extends slightly greater to the west but with no change to the eastern extraction boundary, thus the impacts to the east presented in GHD April 2018 remain unchanged.

Phillips Quarry

The operational impacts with regards to air quality buffers from Phillips Quarry WA 6852 has changed from GHD December 2017 due to my new understanding of a different extraction area boundary. The recommended 500 m buffer for an active quarry with blasting and 250 m for rock processing plant is unchanged from GHD December 2017. Due to the change in extraction area, which has increased to the north, northwest and west, it is my opinion that this will result in a greater buffer impact to land located to the north, northwest and west of Phillips Quarry.

2.5.4 Implications to FUS

It is my understanding that the main implication to the FUS from the provided material regarding the quarry operations are changes to the boundaries of the possible extraction areas. The Woody Hill possible extraction expansion will not occur as far east as displayed in the FUS (Plan 15) but will extend greater to north to what is indicated in the FUS (Plan 15). The result of the changed extraction boundary will result in the default and directional 500 m buffers not extending as far east and instead extend greater to the north than that presented in the FUS Plan 15. The 500 m default and directional buffers from Woody Hill Quarry will be contained within the industrial/commercial area with no constraints to the proposed sensitive uses as per the existing FUS.

With regards to Phillips Quarry, due to the FUS Plan 15 scribing the sensitive use buffer from what appears to be the property boundary, I am of the opinion that the default and directional 500 m buffer constraints will be closely aligned to that presented in Plan 15.

3 Updated Buffer Advice

The following section provides my updated opinion regarding air quality buffer/separation distances in relation to quarries impacting air quality.

3.1 An assessment of different types of buffers and separation distances

It is my understanding and experience that there are two classes of buffer/separation distance guidelines relevant in the context of planning in Victoria, namely threshold distances and buffer (or separation) distances.

3.1.1 Clause 53.10 - Threshold distances

The Planning Policy framework seeks to ensure that planning resolves and does not create land use conflicts. I understand this is typically achieved by providing separation distances between potentially conflicting land use zones that may result in incompatible uses.

Clause 53.10 of the Victorian Planning Provisions (VPPs) seeks to define those types of industries and warehouses, which if not appropriately designed and located, may cause offence or unacceptable risk to the neighbourhood.

The clause sets out the threshold distance that is the minimum distance from any part of the land of the proposed use of or buildings and works for specified uses that have adverse amenity potential.

The table to the Clause 53.10 includes three columns that refer to the type of production or use or storage (purpose), which may result in adverse amenity potential and includes the threshold distance in metres and notes:

- **Note 1** is where the threshold distance is variable, dependent on the process to be used and the materials to be processed or stored
- **Note 2** is where an assessment of risk to the safety of people located off the land may be required

Clause 53.10 does not itself trigger the need to obtain a permit. However, it is my understanding that Clause 66.02 – 7 (use and development referrals) requires that an application is referred to EPA Victoria, as the determining referral authority, if the proposal is to use land for an industry or warehouse for a purpose listed in the table to Clause 53.10 shown with a Note 1 or if the threshold distance is not met.

The Planning Scheme prescribes that the use of land for a quarry or sewerage treatment plant that are not categorised as industrial uses and therefore are not included in the Table to Clause 53.10. Clause 52.09 of the Particular Provisions manage use of land for Extractive Industry and Extractive Industry Interest Areas, which applies to an application to use or develop land:

- For extractive industry
- Within an Extractive Industry Interest Area; or
- Within 500 metres of an existing or proposed extractive industry operation.

It is my understanding that the purpose of this clause is:

- *'To ensure that use and development of land for extractive industry does not adversely affect the environment or amenity of the area during or after extraction.'*
- *To ensure that excavated areas can be appropriately rehabilitated.*
- *To ensure that stone resources, which may be required by the community for future use, are protected from inappropriate use and development.'*

The Clause is also prescriptive in that an application to use and develop land for extractive industry must be accompanied by:

- *A copy of a work plan or a variation to an approved work plan that has received statutory endorsement under section 77TD of the Mineral Resources (Sustainable Development) Act 1990.*
- *The written notice of statutory endorsement under section 77TD(1) of the Mineral Resources (Sustainable Development) Act 1990.*
- *Any conditions specified under section 77TD(3) of the Mineral Resources (Sustainable Development) Act 1990.*

3.1.2 EPA Victoria buffer guideline

It is my experience and understanding that in the case of an existing industrial use, EPA Victoria recommends that buffer distances should be considered when preparing a planning scheme, planning scheme amendment or planning permit application. EPA Victoria are of the opinion, via their guideline document, that a buffer distance is a planning instrument used to provide separation of sensitive land uses (i.e. residential, schools, hospitals) from existing premises with the potential for off-site emissions (odour or dust) that can cause disamenity in the event of an upset or malfunction. It is my understanding that under routine operations, any adverse impact is to be confined on-site (via the Work Authority process) so that an external buffer should not be required. I understand that it is the opinion of EPA Victoria (section 6 of Publication 1518) that unlike routine emissions, unintended emissions are often intermittent or episodic and may originate at or near ground level. Separation distances seek to avoid the consequence of upset industrial residual air emissions.

The purpose of the EPA separation distance guidelines (Section 2 of Publication 1518) is to provide recommended minimum separation distances between odour or dust emitting industrial land uses and sensitive land uses. Accordingly, the relevant sections of the guideline for this assessment are to:

- Provide clear direction on which land uses require separation
- Inform and support strategic land use planning decisions
- Prevent new sensitive land uses from impacting on existing industrial uses
- Prevent new or expanded industrial land uses from impacting on existing sensitive land uses
- Identify compatible land uses that can be established within a separation distance area

Publication 1518 has a preference for using “the term ‘separation distance’ to mean the space between industrial land uses and sensitive land uses” (EPA Victoria, 2013, p 2). Separation distances can be interchangeably called, as in the past, buffers (ibid.).

3.1.3 Summary

It is my understanding that there is no category listed in Clause 53.10 applicable to Quarries. In the case of the Shenstone Park PSP, the EPA Victoria recommended separation distance guideline (Publication 1518) will apply to the existing Woody Hill Quarry WA 492 operations and WA 6437 as it is statutorily endorsed. The EPA Victoria recommended separation distance guideline also applies to the Phillips Quarry WA 6852, which has also been statutorily endorsed and has obtained a planning permit. Therefore, the GHD reports refer to Publication 1518.

3.2 The required buffer distance for each type

It is my opinion that the following EPA Victoria separation distances apply to the various activities at the Woody Hill and Phillips Quarries respectively.

3.2.1 Concrete batching plant

Publication 1518 states that a concrete batching plant (producing greater than 5,000 tonnes per annum) is recommended to require a buffer distance of 100 m. It is my understanding and experience that the possible industrial residual air emissions from a concrete batching plant relate to dust.

3.2.2 Quarry processing plant

Rock crushing and screening is listed under the quarry category cited in EPA publication under 'quarry - without blasting' - and is set a buffer of distance 250 m. The possible industrial residual air emissions from a quarry processing plant relate to dust.

3.2.3 Active quarry with blasting

Publication 1518 (Table 1) states that an active quarry with blasting has a recommended buffer distance of 500 m. Though not specified in the guideline, it is my understanding, after conferring with EPA Victoria, that the 250 m difference in separation distance applying to blasting activities at 500 m and auxiliary activities, has been interpreted to account for dust particles associated with the blast that can be transported further distances⁷. The possible industrial residual air emissions from an active quarry with blasting relate to dust.

3.3 The type of factors which influence each buffer distance

EPA Victoria publication 1518 states that (EPA Victoria. 2013, p 5):

- 'It needs to be recognised that where there are industrial air emissions from premises, even with good pollution control technology and practice, there may still be unintended emissions which must be anticipated and allowed for. While it is an objective of SEPP (AQM) that such emissions should be eliminated it is recognised that even 'state of the art facilities are not always guaranteed to achieve this goal 100 per cent of the time. Equipment failure, accidents and abnormal weather conditions are among the causes that can lead to emissions affecting sensitive land uses beyond the boundary of the source premises. Unlike routine emissions, unintended emissions -- industrial residual air emissions (IRAEs) -- are often intermittent or episodic and may originate at or near ground level. Separation distances seek to avoid the consequence of IRAEs. An adequate separation distance should allow IRAEs to dissipate without adverse impacts on sensitive land uses. However, the recommended separation distances are not an alternative to source control'.

It is my understanding and experience that EPA Victoria does not condone uncontrolled off-site air emissions in contravention of SEPP (AQM) requirements, rather, the guideline acknowledges that SEPP (AQM) objectives might not always be met, and the beneficial uses specified in the SEPP (AQM) might not always be protected in the vicinity of a premises with non-routine (residual) emissions.

It is my understanding that a number of factors are identified by EPA Victoria, which may influence a buffer distance. Publication 1518 allows for site-specific variation to the default buffer distance for a given industry and identifies six criteria to consider in Table 4 of the guideline. These criteria are listed below with my interpretation and opinion on a definition (based on Publication 1518 and experience):

- Transitioning of the industry – If the industry has any plans to transition out of the area a reduced buffer may be negotiated for those industries
- Plant equipment and operation – If the plant has a high standard of emission technology or has evidence of no upset or malfunctions occurring then a reduced buffer may be appropriate

⁷ EPA email advice dated 02/11/2017 from Paul Torre - Senior Applied Scientist - Air & Odour / Principal Expert - Air

- Environmental risk assessment (ERA) – An ERA would need to be completed to assess this option, this will require specific knowledge of process operations, emission rates and modelling. While a quantitative assessment may indicate routine operational impacts, the results cannot be translated to a process-specific separation distance without also characterising: (i) the factor of increase of the emission above routine levels during the upset, (ii) the likely duration of the upset, and (iii) the upset event 'return interval'. An ERA could also involve dust monitoring
- Size of the plant – If the throughput is small for the particular industry compared to large examples within their industry, then it may be possible to de-rate the buffers based on throughput
- Topography or meteorology – Site-representative meteorology may be used to assess the impacts of local meteorological effects on dispersion of emissions
- Likelihood of IRAEs – The likelihood of residual emissions from the identified industries would need to be assessed once specific operational information was obtained regarding their operations including how frequently upset conditions occur, and the assessment would rely on a detailed complaint history from a residential area encompassed within a default buffer.

Most buffers in the Publication 1518 guideline are not specified as a function of the operation's size (with the exceptions of STPs, broiler farms and composting operations) and none explicitly take into account the effect of site-specific meteorological conditions. It is my opinion that these two factors greatly affect emissions and subsequent dilution, respectively, and can vary significantly between premises in the same industry category. Emissions during an upset/malfunction can thus extend beyond the buffer boundary, at levels that could cause disamenity. It is my understanding that the dust fallout relates to amenity rather than health, the latter dealt with by the SEPP (AQM) process.

The separation distance required for blasting at the active quarry face will be independent of throughput, as only either the frequency of blasting, or the linear extent of each blast will reduce with throughput. It is my opinion that the default 500 m to allow for blasting will remain unaltered, as it is not tenable to reduce this distance on the basis that the blasts would be less frequent for a small quarry.

I consider that the appropriate buffer for the active quarry area with blasting is the default 500 m buffer, irrespective of the throughput of the quarry. A reduction in the default value could only be contemplated based on specific information on the blast sequence to be adopted at each site.

It is my understanding and experience that the default EPA buffers are applied as a radial distance scribed from the envelope of potential odour and/or dust sources at the premises. In effect, a radial buffer distance is used in situations where there is no information on the local meteorology, i.e. the directions of good and poor dispersion are unknown. I am of the opinion that when site-representative meteorology are available, then these directions of good and poor dispersion can be assessed, and the default buffer can respectively be retracted and extended. When this is done, the directional buffer formed serves to provide the same degree of protection from upset odour and/or dust events, independent of the direction of the sensitive land use from the emitting premises.

Section 9.2 of Publication 1518 allows for site-specific variation based on topographical or meteorological features, which will affect dispersion of industrial residual air emissions. Based on many years of experience, GHD staff have developed an approach to provide directionally dependent buffers based on the dispersive ability of the atmosphere, as assessed using atmospheric dispersion modelling (Clarey & Pollock, 2004⁷). Where site-representative meteorological data is available, the directions of good and poor dispersion can be identified. Further, if the 12-month dataset is configured to a dispersion model format (deriving atmospheric stability category), then dispersion modelling can be conducted using a nominal air source emission rate to assess the directional change in extent from a default radial buffer⁸.

The buffer so formed is sized to have the same enclosed area as the radial default buffer and is termed a directional buffer. So, the directional 500 m buffer will have the same enclosed area as the default 500 m buffer.

Based on advice from EPA Victoria⁷, the separation distance for blasting at the active quarry face, is not independent of wind speed and direction, as the blast may create particles that can be transported further downwind. Therefore, my opinion considers that such 'dust plumes' will be subject to meteorological influences and therefore the directional buffers provide a precautionary approach when setting separation distances for future sensitive land use around the Woody Hill Quarry and Phillips Quarry to minimise the risk of dust amenity impacts. I am of the opinion that given blasting only occurs during the daytime, the directional buffer should only be calculated based on daytime hours only.

3.4 The types of land uses / buildings etc that could occur within each type of buffer

Publication 1518 states (Section 10.2) that interface land uses can be located within separation distances between industrial land uses and sensitive land uses.

It is my understanding from EPA Victoria (2104, p 14) that "interface land uses neither generate significant IRAEs, nor warrant protection from them." Moreover, "Interface land uses typically include zones that are for business, agricultural/rural activity, recreation and conservation, are public open spaces, and other special purpose zones, except where sensitive land uses are permitted" (ibid.).

Table 4 of Publication 1518 (EPA Victoria, 2013, p 15) provides examples of activities and their suitability as interface land uses to be encouraged and prevented:

- **"To be encouraged:** Agriculture, car parks, cinema-based entertainment facilities, emergency services facilities, natural systems, offices, research centres, service stations and veterinary clinics."
- **"To be considered (subject to assessment):** Light industry with no adverse amenity potential and utilities (except for sewage works)."
- **"To be prevented:** Sensitive land uses and industrial land uses that require separation distances as listed in the Publication 1518."

"Table 4 is not intended to be an exhaustive list of all activities. Other activities not listed should be assessed in accordance with the principles contained" (ibid) in Publication 1518.

⁸ Clarey P, Pollock T "Integrating Separation Distances with Dispersion Modelling" Enviro 04, 28 Mar – 1 April, Darling harbour, Sydney

Therefore, I am of the opinion that the types of uses outlined by EPA Victoria to be encouraged could occur within the Woody Hill Quarry and Phillips Quarry buffer distances outlined in section 3.2.

3.5 An opinion on the starting point for the measurement of the buffer distance

As per Publication 1518 *“Separation distances should be measured from the ‘activity boundary’ of the industrial activity to the nearest sensitive land use. The activity boundary of the industrial activity is the area (within a convex polygon) that includes all current or proposed industrial activities (including the plants, buildings or other sources) from which IRAEs may arise (including stockpiles, windrows, leachate ponds and odour-control equipment)” (EPA Victoria, 1518, p 12).*

My interpretation of the Publication 1518 guidance is that measuring from the activity area allows for any separation that is already provided within the property boundary (or WA boundary) of the quarry site (normally at least 30 m) to be considered. If a quarry “changes its use or moves a relevant activity within the [WA] property boundary, the requirement for a planning permit ... should trigger reassessment of adequate separation distances” (ibid.).

The method to measure the separation distance from Woody Hill Quarry and Phillips Quarry is as per Method 1 – Activity boundary to property boundary (the urban method) in Publication 1518. Method 1 is recommended to be used when (ibid.) “the nearest sensitive land use is either:

- In an urban area or township
- On a site less than 0.4 hectares, or in a zone allowing subdivision to be less than 0.4 hectares.”

It is my opinion that since the Shenstone Park PSP FUS proposes sensitive use in an urban area context, then Method 1 is applicable.

Therefore, it follows that the ‘activity boundary’ or envelope of potential sources of dust from Woody Hill Quarry and Phillips Quarry be the envelope of the extraction boundaries rather than the Work Authority boundary.

3.6 An expert opinion of the distance(s) which the panel should recommend as the buffer distance for the Precinct

It is my opinion that the relevant EPA Victoria separation distances be applied to the quarries to protect the air amenity of any future sensitive uses within the PSP. As per the GHD December 2017 report, the following buffers apply:

- An active quarry with blasting has a recommended buffer of 500 m
- A concrete batching plant has a recommended buffer of 100 m
- A rock processing plant have a recommended buffer of 250 m

The concrete batching plant and rock processing plant buffers will be contained within the 500 m active quarry with blasting buffer.

The default 500 m active quarry with blasting buffer scribed from the envelope of potential sources (extraction boundary) for WA 492, WA 6437 and WA 6852 is presented in Figure 1. I have scribed the buffers in accordance with the material provided by Barro⁹.

The 500 m default buffers from Woody Hill Quarry will be contained within the industrial/commercial area with no constraints posed to the proposed sensitive uses (i.e. residential area) as per the existing FUS. The 500 m default buffer from Phillips Quarry will pose some constraint to the southern portion of proposed residential area as presented in the existing FUS.

This approach that I adopt differs slightly to the approach outlined by Barro Group⁹, which states that residential and associated development will not occur on the DBJV land within 500 m of WA 492, WA 6437 and WA 6852 (assumed to mean the WA boundary and not the extraction boundary).

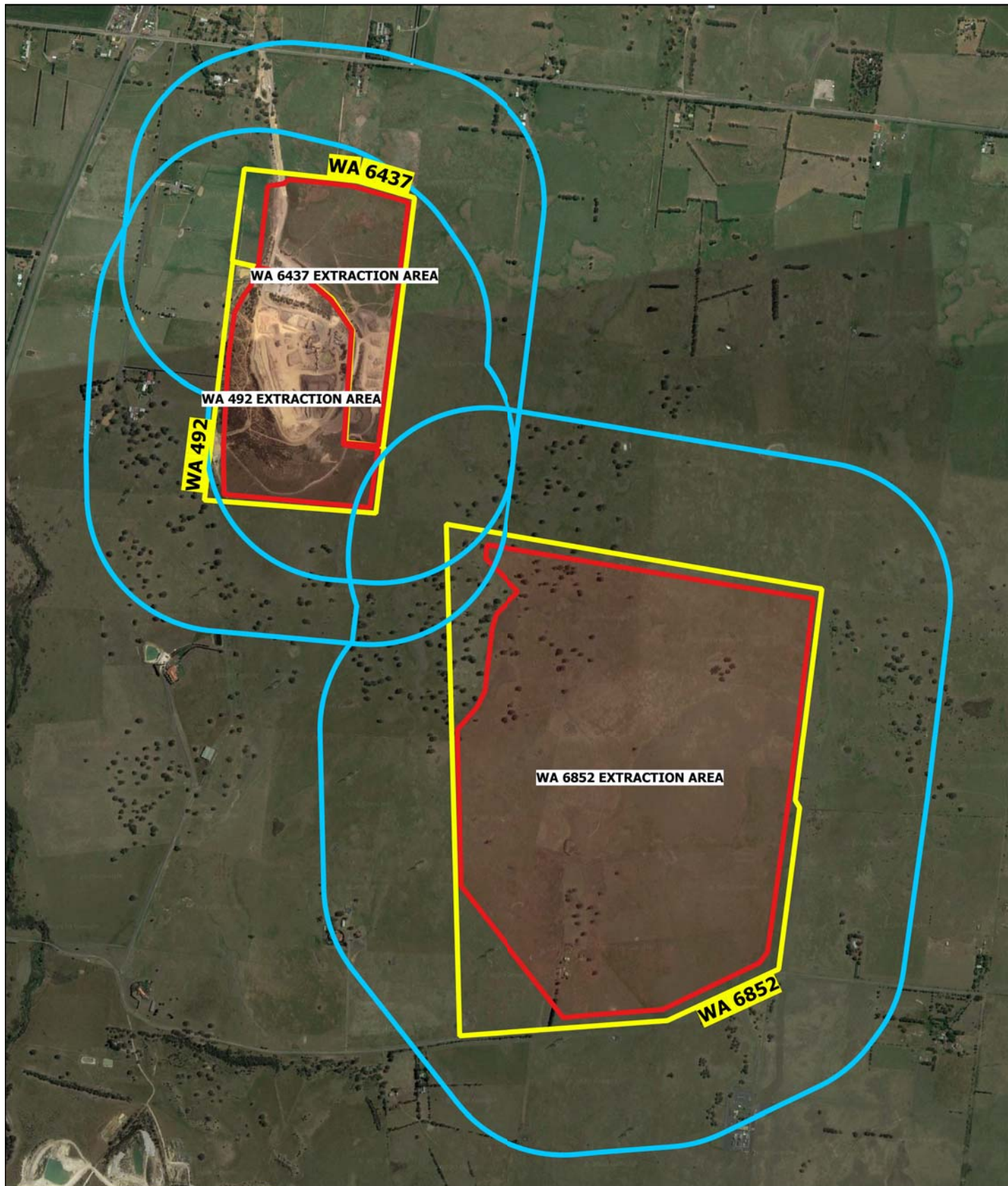
For a more precautionary approach, it is my opinion that the directional 500 m buffers apply to the extraction boundaries for WA 492, WA 6437 and WA 6852. This is presented in Figure 2. Note that the directional buffer for the Woody Hill Quarry has been combined for WA 492 and WA 6437, given that I understand that WA 6437 will be part of an expanded integrated operation of WA 492 and will not operate on a standalone basis⁹.

The 500 m directional buffer distance for Woody Hill is larger than the default 500 m in the directions for land proposed to be used for sensitive uses (i.e. residential), however does not pose any constraints to the residential component, as the directional buffers remain contained within the industrial/commercial proposed land as per the current FUS. I consider this to be a conservative approach but not problematic (refer to EPA Victoria response in section 2.5.1).

With regards to Phillips Quarry, again the 500 m directional buffer distance for the Phillips Quarry is larger than the default 500 m in the directions for land proposed to be used for sensitive uses (i.e. residential), with the constraints posed to be similar to that presented in the current FUS.

Should further possible extraction areas be proposed in the future or protected for future use, beyond those presented in the information provided by Barro⁹, i.e. further east beyond the current WA 492 and WA 6437 boundaries (i.e. as outlined in GHD September 2019) then the 500 m dust directional buffer scribed from the envelope of potential sources (taken to be extraction area boundary) would be appropriate to mitigate against quarry operations for any proposed sensitive uses in the Shenstone Park PSP. Any future quarry expansion proposal would also be subject to the appropriate approvals process.

⁹ Hubshare Shenstone Park PSP, Tabled documents, document 18, dated 2 October 2020



LEGEND

- Works Authority Boundary
- Extraction Area Boundary
- 500 m Default Buffer (From Extraction Area)

Paper Size A4
0 200 400 m

Map Projection: Spherical Mercator
Horizontal Datum: World Geocentric System 1984
Grid: Pseudo-Mercator

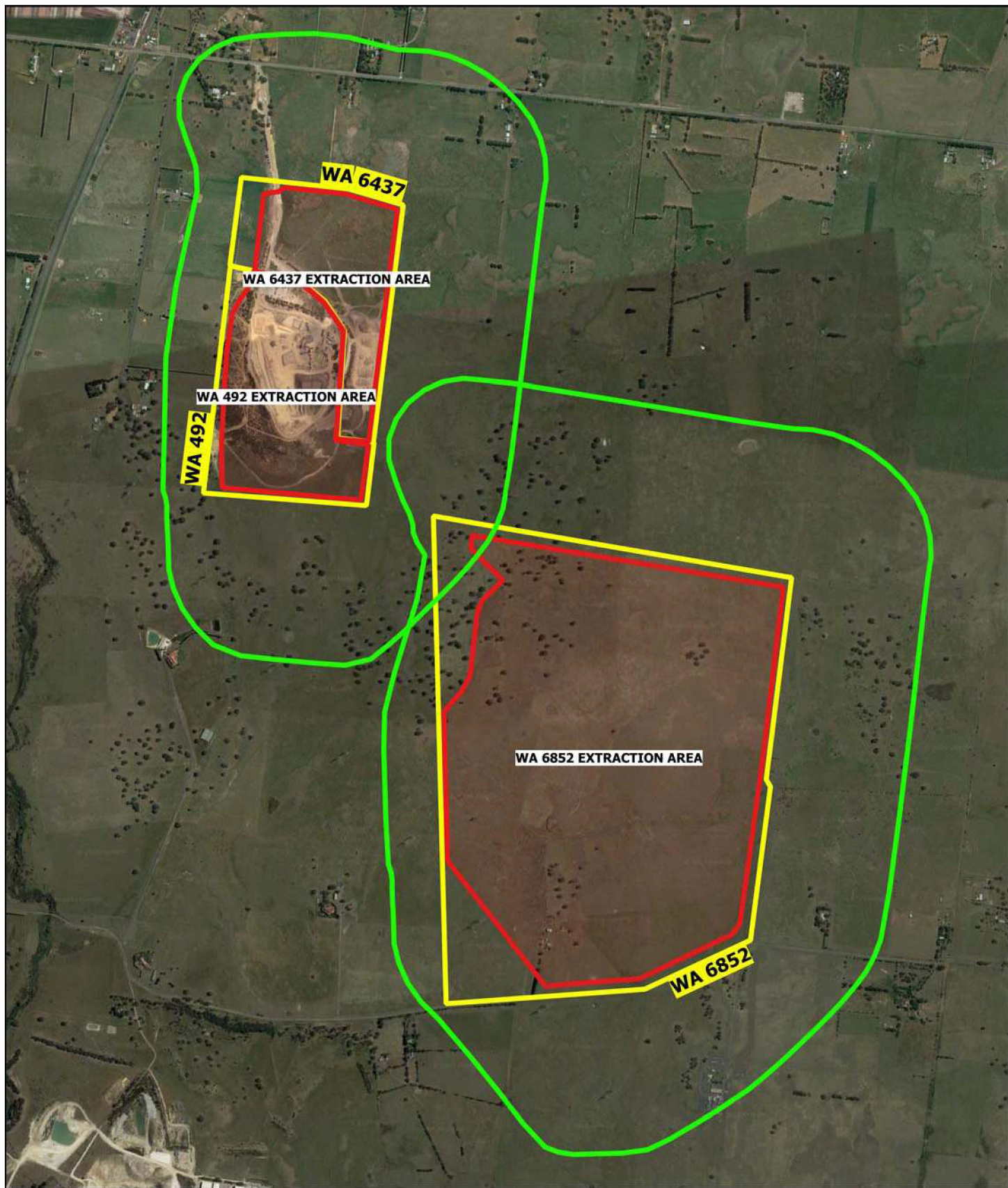


Victorian Planning Authority
Shenstone Park PSP - Air and Noise
Expert Witness

Project No. 12540645
Revision No. -
Date. 20/10/2020

Default buffers

FIGURE 1

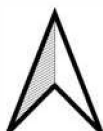


LEGEND

- Works Authority Boundary
- Extraction Area Boundary
- 500 m Directional Buffer (From Extraction Area)

Paper Size A4
0 200 400 m

Map Projection: Spherical Mercator
Horizontal Datum: World Geocentric System 1984
Grid: Pseudo-Mercator



Victorian Planning Authority
Shenstone Park PSP - Air and Noise
Expert Witness

Project No. 12540645
Revision No. -
Date. 21/10/2020

Directional buffers

FIGURE 2

3.7 Consideration of submissions to the amendment regarding different buffer distances

I can provide further opinion on submissions concerning different buffer distances provided by third parties when they are made available.

4 Limitations

This report has been prepared by GHD Pty Ltd (GHD) for the Victorian Planning Authority and may only be used and relied on by the Victorian Planning Authority for the purpose agreed between GHD and the Victorian Planning Authority as set out in section 1 of this report.

GHD otherwise disclaims responsibility to any person other than the Victorian Planning Authority 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.

This letter report must be read in conjunction with the previous GHD assessments namely:

- Impact Assessment Report for the Shenstone Park Precinct Structure Plan (GHD, December 2017)
- Shenstone Park Impact Assessment Woody Hill Addendum (GHD, April 2018)
- Shenstone Park Impact Assessment Woody Hill Addendum (GHD, September 2019)

Yours sincerely



Michael Asimakis

Senior Air Quality Scientist
+61 3 8687 8568



City Of Whittlesea Council

Shenstone Park Impact Assessment

Woody Hill Addendum

April 2018

Executive summary

GHD Pty Ltd (GHD) has been engaged by the City of Whittlesea (CoW) to prepare an air quality (including dust and odour), noise and vibration impact assessment report for the Shenstone Park Precinct Structure Plan (PSP) and the associated investigation area to the south and east of the PSP boundary. The impact assessment considered the following:

1. Existing mudstone quarrying operations at the Barro Group Woody Hill Quarry, which is located within the Shenstone Park PSP boundary
2. Approved basalt quarry (Phillips Quarry) located immediately south of the PSP
3. Proposed Yarra Valley Water (YVW) Wollert sewerage treatment plant (STP) also located immediately south of the PSP

The objective of this commission is to conduct additional air, noise and vibration technical investigations for the possible expansion of the Woody Hill Quarry.

The following scenarios have been considered in this report:

1. Expansion to the south of the existing extraction area within the Work Authority 492 boundary
2. Expansion of the Work Authority boundary and subsequently the extraction boundary to the north of the existing Work Authority boundary
3. Expansion 20 m below the ground surface

The focus of this study is in three parts:

- Review of available environmental, planning, quarry operations information in consultation with stakeholders
- Technical dust, noise, vibration and blasting assessments of current and approved quarry operations to identify site-specific offsite impacts in the Shenstone Park PSP area
- Provide recommendations for management and/or mitigation of environmental risks on land uses in a planning context

Default buffers

In the case of existing industries and uses, the EPA recommends separation distances that should be considered when preparing a planning scheme, planning scheme amendment or planning permit application.

A buffer (separation) distance is a planning instrument used to provide separation of sensitive land uses (i.e. residential, schools, hospitals and recreation reserves) from existing industrial premises with the potential for offsite emissions (odour or dust) that can cause disamenity in the event of an upset/malfunction. Note that the buffers are for upset¹ operational conditions only routine emissions must meet EPA SEPP (Air Quality Management) guidelines and have no impact offsite.

GHD has assessed and mapped the recommended default buffers for the identified possible expansion scenarios for the Woody Hill Quarry. This default buffer analysis shows that a portion of the PSP will be within the recommended default buffers from each scenario.

¹ Upset conditions refer to unintended emissions which do not occur under routine operations. Upsets may occur due to extreme weather conditions, mechanical breakdowns/malfunctions or operational failures.

Site specific variation to default buffer

Two criteria that allow for site specific variations which would have significant impact in varying the default buffers are considered to be the size of the facility (de-rating a default buffer) and local meteorology (directional buffer). GHD considers that the relevant buffer for the active quarry area with blasting should be the default 500 m buffer irrespective of the throughput of the quarry.

However, GHD considers that the directional buffer would apply to the default 500 m buffer given that the default buffer accounts for possible transport of dust particles, which would be subject to meteorological influences. The local meteorology would only apply during daytime hours for the quarry as blasting and excavation and transport of material would only occur during the daytime (6 am to 6 pm).

DEDJTR advice² indicates that a 200 m radial buffer distance from the extraction boundary of the extraction area is sufficient to mitigate against safety issues from flyrock during blasting, with which GHD agrees. This buffer is to be radial, as the flyrock component will be independent of wind speed and direction, as the projectile speed of flyrock is much larger than the wind speed.

The directional buffer assessment shows that the default buffer can be retracted and extended in the directions of good and poor dispersion. A large extension of the default buffer occurs to the east and northeast into the PSP area, while the default buffer is retracted in the west due to anticipated meteorological conditions.

Quantitative dust impact assessment

Dust dispersion modelling was undertaken for dust impacts from the two expansion scenarios using a number of conservative assumptions. The criterion for PM₁₀ extends into the PSP area for both scenarios. However, the criterion was predicted to be met at all existing sensitive receptors and contained within the default and directional separation distances for each quarry.

Noise and vibration impact assessment

It is understood that the Woody Hill Quarry operates during the EPA defined night-time period between the hours of 6:00 am and 7:00 am Monday to Friday and also during the EPA defined evening period on Saturday afternoons after 1:00 pm. Therefore noise from this quarry must be assessed across all three time periods (Day, Evening, Night), refer to Table 7.

It is expected that the daytime noise levels generated from the Woody Hill Quarry for both expansion scenarios will require a buffer of up to approximately 600 m from the northern and southern extraction areas at the Woody Hill Quarry to meet the daytime criteria of 48 dB(A), prior to any noise mitigation measures being implemented.

Modelling of the existing approved extraction area for the Woody Hill Quarry was also undertaken in the GHD report entitled '*City Of Whittlesea Council Impact Assessment Report for the Shenstone Park Precinct Structure Plan – December 2017*³'. In that report a buffer of 900 m was recommended, which is 300 m greater than that assessed in this report due to the elevated location of existing noise sources combined with the concrete batching plant. However, as the northern and southern extraction scenarios will be at a much lower elevation, this has enabled greater attenuation of the noise impact from each of these two scenarios reducing the buffer size by one third down to 600 m.

² Meeting with DEDJTR on 17 October 2017

³ GHD Report #51460

Blast generated noise is very dependent on site specific constants and can vary significantly based on the blast methodology being used. Onsite measurements would be required prior to any future development to understand the air blast overpressure from each quarry's operation and what restrictions this would have on future development.

It is expected that any vibrational impact from blasting at the Woody Hill Quarry would require a distance of approximately 550 m from the extraction boundary to provide sufficient attenuation for a blast with an MIC of approximately 100 kg.

The existing quarry will likely remain throughout the PSP development and the quarry asset owner will remain obligated to comply with the SEPP N-1 noise policy. However, it is expected any sensitive receivers proposing to build within the PSP in the future, will be required to design and build future structures in a manner so as to minimise any existing noise impacts on persons utilising the proposed building.

Development may still be able to occur within the 600 m buffer following appropriate mitigation either at the quarry or via building acoustic treatments at the sensitive receiver location.

Discussion with the asset owner may need to be undertaken to provide effective as well as agreed noise mitigation measures for the quarry, as necessary.

Should a control at source noise mitigation strategy not be possible or practicable, it is common that the indoor amenity of sensitive receivers subject to operational noise be acoustically treated using a control at receiver strategy, via building acoustic treatment. However, the limitation of this strategy is that it would not preserve the outdoor amenity of the receiver unless a combination of controls such as noise controls at the source of transmission be implemented.

Mitigation Measures

Noise mitigation strategies can generally be divided into four different areas from the most to the least preferred (NSW INP, 2000):

1. *Land-use Controls* (separating the location of noise-producing activities from sensitive areas)
2. *Control at Source* (reduce the noise output of the source to provide protection surrounding environment)
3. *Control in Transmission* (reduce noise levels at the receiver but not necessarily the environment surrounding the source, e.g. noise barrier, etc.)
4. *Receiver Control* (localised acoustic treatment at sensitive receiver)

Recommended Buffers

From the assessment, the following is recommended (refer to Figure 17) to provide a visual display of the impact assessments undertaken as part of this report):

- 500 m dust directional buffers from the extraction area boundaries for the two expansion scenarios.
- Operational noise buffer for the Woody Hill Quarry of 600 m from the extraction area boundaries for the two expansion scenarios (north and south), prior to any operational noise mitigation being implemented. Should further work be undertaken to determine the noise controls and operations in place at the quarry, it may be possible to reduce the extent of the noise buffer. It is expected operational noise from the operation of a basalt winning pit would generate less noise beyond the boundary due to the shielding effect of the pit walls, if the crushing and screening also occurred in the pit.

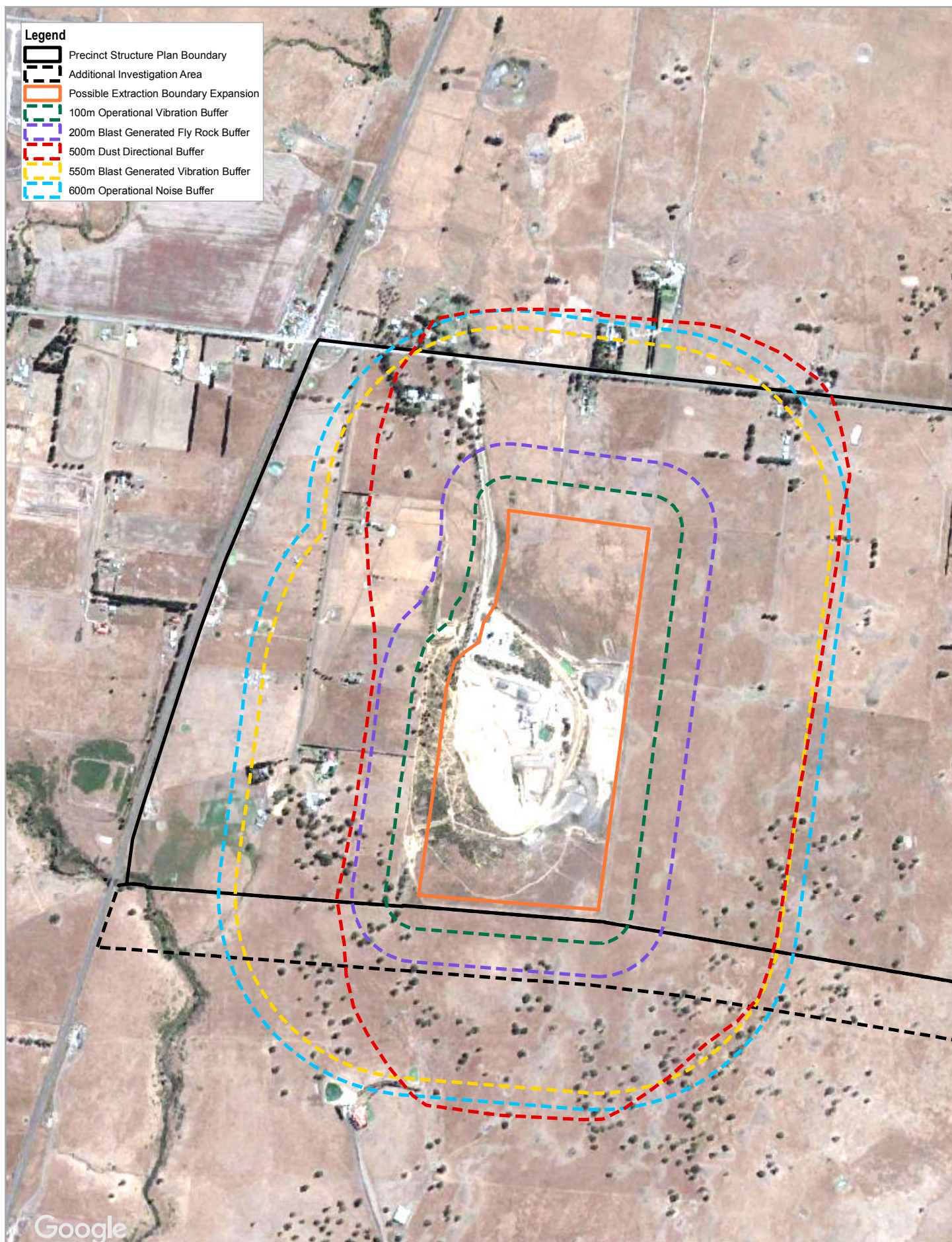
- 100 m operational vibration buffer from the approved extraction area boundaries for the two expansion scenarios (north and south).
- Blast generated flyrock buffer of 200 m from the approved extraction area boundaries for the two expansion scenarios (north and south).
- Blast generated noise would require empirical measurements prior to any proposed development to assess the site specific conditions experienced during a blast event. Any proposed development would be limited by the requirement to achieve 115 dB (linear) at the proposed development location.
- Blast generated vibration buffer of 550 m for the Woody Hill Quarry, from the approved extraction area boundaries for the two expansion scenarios (north and south) for an MIC of approximately 100 kg to meet the 2 mm/s (PPV) long-term regulatory goal for human comfort.

The intent of the buffers from the quarry would be to restrict additional sensitive land use intensification in these buffer areas (including land inside and outside of the PSP), due to the risk from, dust, operational noise and vibration, blast noise, blast vibration, and blast generated flyrock.

The inclusion of buffer controls within the PSP should achieve separation of non-compatible uses and delineate land available for urban development.

The PSP planning process must protect significant assets, whilst enabling sustainable development to occur. Inappropriate planning may adversely impact the operations and viability of the quarry into the future and, in turn, impact the amenity and health of the community.

This report is subject to, and must be read in conjunction with, the limitations set out in section 1.3 and the assumptions and qualifications contained throughout the report.

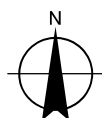


Paper Size ISO A4

0 150 300 450 600

Metres

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



City of Whittlesea
Shenstone Park PSP - Impact Assessment

Project No. 31-35311
Revision No. -
Date 12 Dec 2017

**Possible Buffer Areas -
Woody Hill Expansions**

FIGURE 17

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Appendices

Appendix A – Dust emission factors

Appendix B – AERMOD INPUT file

1. Introduction

1.1 Study objective

GHD Pty Ltd (GHD) has been engaged by the City of Whittlesea (CoW) to prepare an air quality (including dust and odour), noise and vibration impact assessment report for the Shenstone Park Precinct Structure Plan (PSP) and the associated investigation area to the south and east of the PSP boundary. The impact assessment considered the following:

1. Existing mudstone quarrying operations at the Barro Group Woody Hill Quarry, which is located within the Shenstone Park PSP boundary
2. Approved basalt quarry (Phillips Quarry) located immediately south of the PSP
3. Proposed Yarra Valley Water (YVW) Wollert sewerage treatment plant (STP) also located immediately south of the PSP

The findings of this assessment can be found in GHD Report #51460 and which will be used to assess those areas that are or will be subject to impact from the different quarry operations and the STP, and to inform future land use planning associated with development of the PSP. The PSP planning process is designed to protect significant earth resources and state significant infrastructure, whilst enabling sustainable urban development as established in Plan Melbourne and the North Growth Corridor Plan.

1.2 Scope of assessment

The objective of this project is to conduct additional air, noise and vibration technical assessments for the possible expansion of the Woody Hill Quarry and their potential impact on the Shenstone Park PSP.

This report should be read in conjunction with GHD Report #51460.

1.3 Limitations and assumptions

This report has been prepared by GHD for the City of Whittlesea and may only be used and relied on by the City of Whittlesea. GHD otherwise disclaims responsibility to any person other than the City of Whittlesea 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 section 1.2 and throughout 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 throughout 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 the City of Whittlesea and project stakeholders, which GHD has not independently verified or checked. 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. GHD disclaims liability for the identification of all relevant industries and any subsequent industries that may have been overlooked.

The opinions, conclusions and any recommendations in this report are based on information obtained from site inspection undertaken at or in connection with, specific areas. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, existing surrounding industries, services and vegetation, etc. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions may change after the date of this report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

The assessment in this report was based on onsite inspections undertaken by GHD on 4 August 2017 and onsite monitoring between 25 August 2017 and 6 September 2017. It is the nature of environmental assessment that all variation in environmental conditions as well as the existing Woody Hill Quarry operating conditions cannot be assessed and all uncertainty concerning the conditions of the ambient air and noise environment cannot be eliminated. In addition, it is not the intention of this assessment to cover every element of the air and noise environment but rather to conduct the assessment with consideration to the prescribed work scope. Professional judgement must be expected in the investigation and interpretation of observations.

The Department of Economic Development, Jobs, Transport and Resources (DEDJTR) was contacted during preparation of this assessment for specific information pertaining to the two quarries, however DEDJTR were not able to provide this without the approval of the work authority holder and referred GHD to the Work Plan for Woody Hill.

Input relating to operational details for the quarries were sought from stakeholders, including a site visit. As no information was provided, GHD has made a number of assumptions for the impact assessments.

Therefore, the assessment findings and recommendations, in the absence of information, are estimates only. Council should endeavour to source the relevant information from the quarry operator/s and revise/update this assessment once the information becomes available.

2. Woody Hill Quarry expansions

Specific information regarding the possible expansions and existing operations of Woody Hill Quarry were not available nor provided by stakeholders at the time this report was prepared. However, a preliminary description is provided, based on:

1. The existing Work Plan for Woody Hill Quarry
2. Information supplied by CoW
3. The perimeter site visits conducted by GHD on 25 August 2017 and 6 September 2017, and from aerial photographs

DEDJTR was contacted during preparation of this assessment for specific information pertaining to the quarry, however DEDJTR were not able to provide this without the approval of the work authority holder and referred GHD to the Work Plan.

All relevant stakeholders were contacted during the preparation of this assessment to provide inputs pertaining to operations. Where there was no provision of information, GHD has made a number of assumptions for the impact assessments.

A copy of the Work Plan⁴ was provided to GHD. The existing quarrying operations include extraction of mudstone rock and is subject to Work Authority 492. A planning permit is not required for the site, as it is operating under an existing use right. The site consists of several quartz veins interspersing Silurian sediments, predominantly consisting of silt shales. Basalt underlies the shale and other sedimentary rocks. The estimated volume of material within the proposed extraction area was 2.7 million cubic meters in-situ back in 2003. Current extraction is 150,000 tonnes per year for low- grade crushed rocks and sub base type material primarily for road construction. This would give a working life of approximately 30 years from 2003.

The existing stone extraction area is smaller than the current Work Authority boundary, however from the information provided to GHD, it may be possible that the quarry may expand in the future. The following scenarios have been considered in this report:

1. Expansion to the south of the existing extraction area within the Work Authority 492 boundary
2. Expansion of the Work Authority boundary and subsequently the extraction boundary to the north of the existing Work Authority boundary
3. Expansion 20 m below the ground surface

Figure 1 shows the investigation area and location of the possible expansions of the quarry.

The existing extraction techniques are a combination of soft rock and conventional drill and blast. The material is then ripped and pushed with a dozer and scraper. Drill and blasting⁵ is used for the harder material. It is expected that at the end of extraction, the entire hill will be removed leaving a flat topography.

Mobile plant used for extracting and processing rock comprises of dozers, excavators, off-road haul trucks, wheel loaders, mobile screening units and road registered tipping trucks. A grader is used at times during rehabilitation works and maintenance of the access road. A water cart is also used to control dust. Road registered tip trucks are used to transport material from the site.

⁴ Bell Cochrane and Associates, Work Plan for mudstone extraction, Extractive Industries Work Authority 492 prepared for Mitchell Sand and Gravel Pty Ltd, 12 February 2003

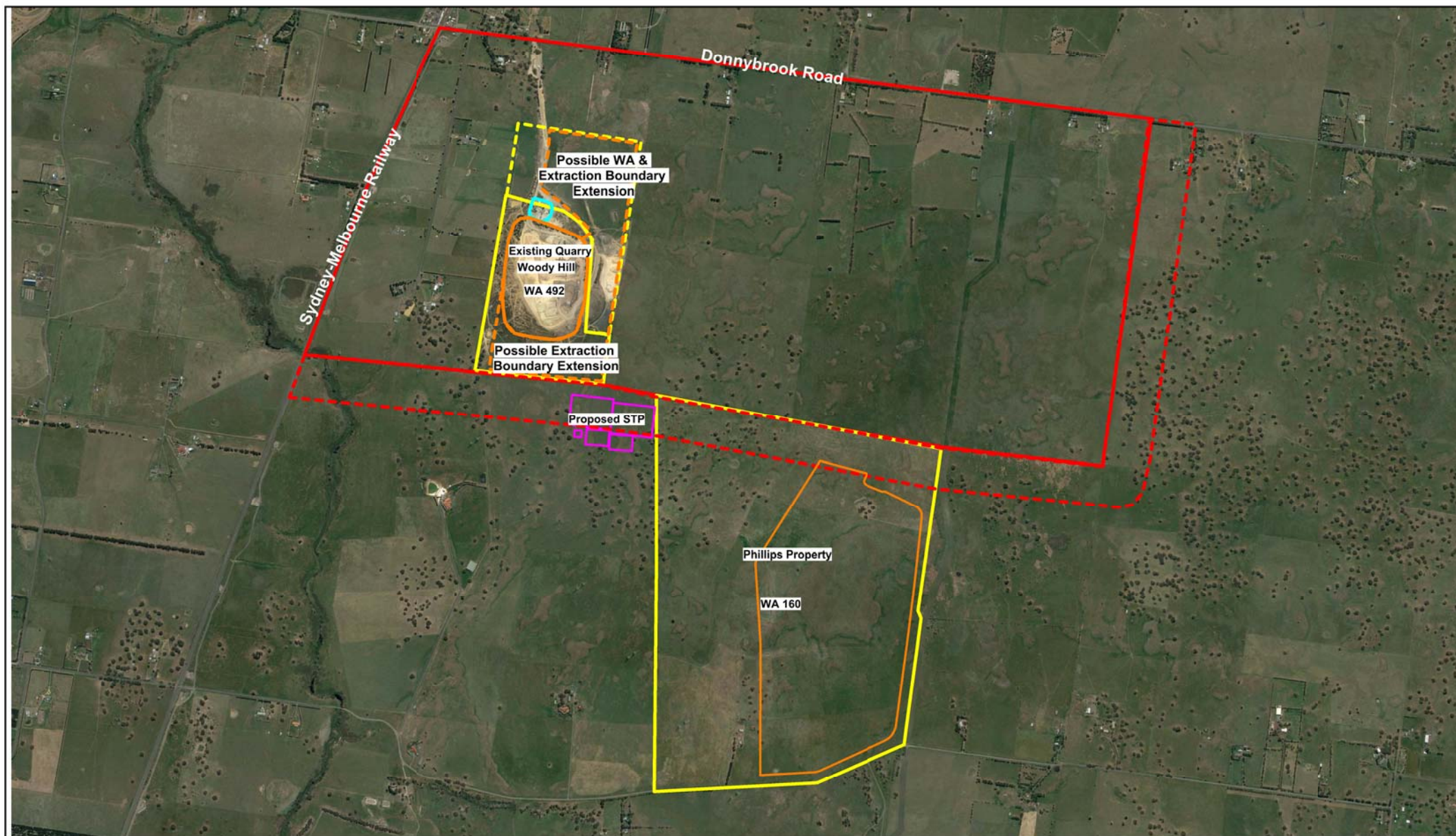
⁵ DEDJTR email dated 20 July 2017, confirming blasting does occur at WA 492

The Work Plan states that there is no fixed plant on site. The processing and crushing plant is portable/relocatable and brought to the site as required. The plant would consist of a primary and secondary crusher, and a series of control and product screens.

The process of extraction within WA 492 is assumed to be typical of a Stone Processing Plant as described in Chapter 11 of AP-42 (USEPA, 2004). It is assumed the operator proposes to supply only the coarser grades of aggregate, and neither a tertiary nor a fines crusher would be used for quarry operations. Instead, processed rock would pass through a screen to separate aggregate into the sizes.

The hours of operation are from 6.00 am to 6.00 pm Monday to Saturday.

An active quarry normally generates dust from blasting, rock breaking, loading, haul road traffic and wind erosion over the quarry site.



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metres (at A4)
Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid Of Australia, Zone 55



LEGEND

 PSP Boundary
 Additional Investigation Area

 Work Authority Boundary

 Approved Extraction Boundary

 Possible Work Authority Boundary Expansion

 Possible Extraction Boundary Expansion

 Concrete Batching Plant

 Proposed STP



City of Whittlesea
Shenstone Park PSP-
Impact Assessment

Investigation Area and
Possible Expansions
of Woody Hill Quarry

Job Number | 3135311
Revision | A
Date | 12/12/2017

Figure 1

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3. Existing environment

The existing environment including an overview of the local meteorology, background air quality and background noise monitoring are presented in the GHD Report #51460. Please refer to this report for the existing environment findings.

4. Buffer assessment

This section applies the generic separation distances for quarries as specified in EPA Publication 1518. The separation distances are based on EPA experience, as to the range at which complaints are received in the event of an upset, the separation distance would decrease to a minimum. The generic separation distance does not take account of the specific operations of the quarry. These are addressed for dust, noise and vibration blasting impacts in sections 5, 6, 7, 9 and 10 respectively.

Note these latter assessments are to quantify the impact of routine quarry operations, whereas the buffer assessment gives the required separation under upset/malfunction conditions, in order to minimise impact at sensitive land uses. The criteria to be met for routine emissions are more stringent than that provided by a separation distance because the likelihood of exposure to an upset/malfunction is very much lower than routine emissions.

While the quantitative assessments are specific to the Woody Hill Quarry operation, the results can't be translated to a process-specific separation distance without also characterising: (i) the factor of increase of the emission above routine levels during the upset, (ii) the likely duration of the upset, and (iii) the upset event 'return interval'.

4.1 Default separation distances

The EPA Victoria (EPA) recommended separation distance guidelines that apply to existing industries in the vicinity of the subject site are the relevant current guidelines to inform planning for land uses within the PSP.

EPA has published⁶ recommended separation distances for selected industry categories (EPA Guidelines) that replace the earlier buffer guideline. Separation distances can be used to define zones of land offsite from the industry premises, which are constrained from development for sensitive land uses.

GHD has applied the EPA separation distances to the possible expansions of the Woody Hill Quarry for the purposes of defining the appropriate required separation distances.

4.1.1 Active quarry with blasting

From the EPA guideline, an active quarry with blasting has a recommended buffer of 500 m, while an active quarry without blasting would have a separation distance of 250 m. Though not specified in the guideline, the 250 m increase in separation distance for blasting and auxiliary activities, has been interpreted to account for dust particles associated with the blast being transported further distances and is not related to flyrock, refer to section 4.2⁷.

Note that the buffer as per Method 1 in the EPA guideline requires it to be drawn from the envelope of potential sources. GHD has taken this envelope to be the envelope of the possible extraction boundaries rather than the Work Authority boundary.

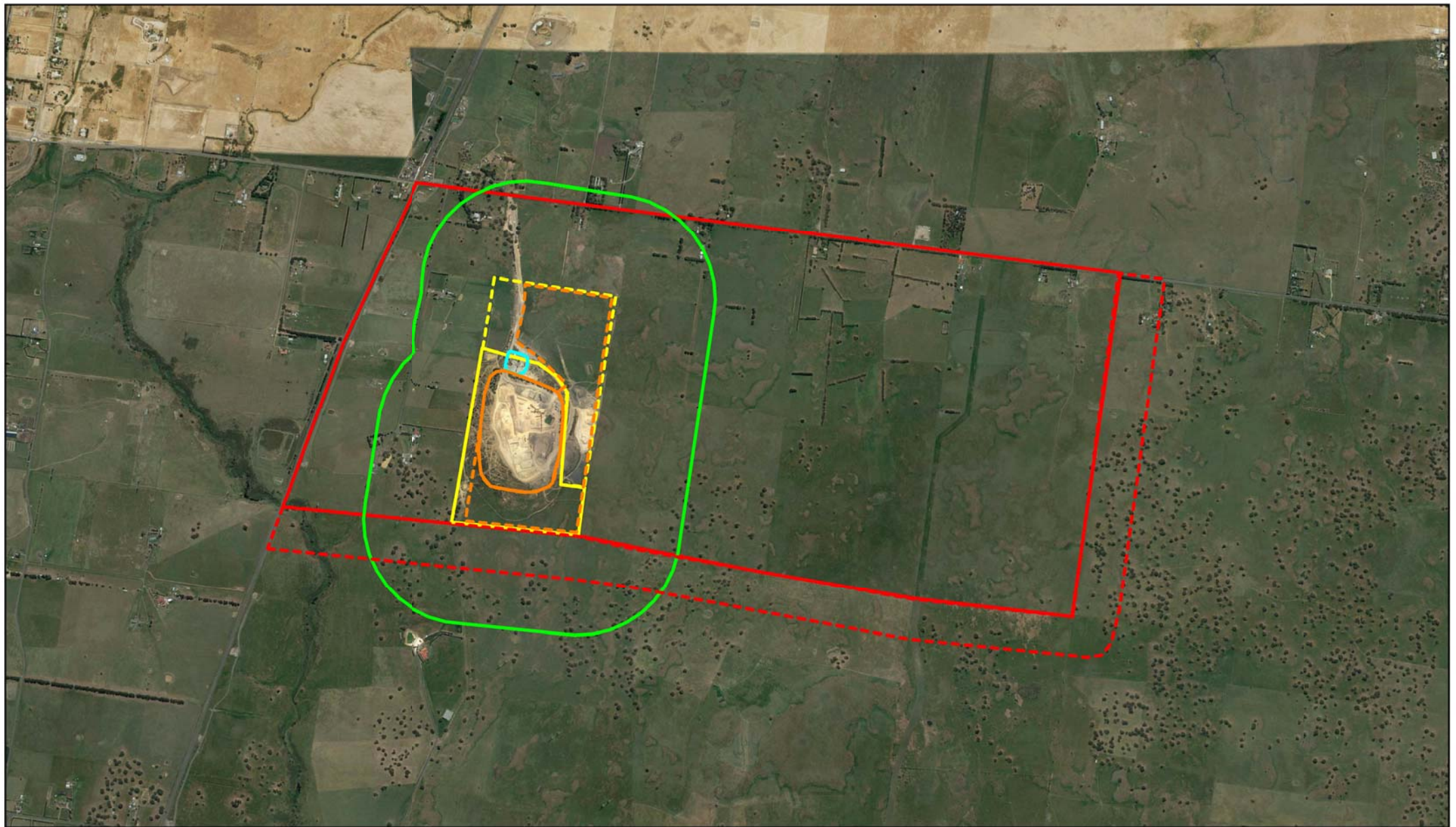
Further information on blast related impacts from quarry operations are discussed in sections 8, 9, and 10 in this report.

Figure 2 shows the 500 m buffer applied to two additional scenarios namely; (i) possible extraction boundary extension to the south of existing Work Authority boundary, and (ii) possible extraction boundary extension to the north of the existing Work Authority boundary.

The figures show that the possible expansion to the south and north extends the 500 m buffer further east and north within the PSP and south outside the PSP.

⁶ EPAV 2013 "Recommended separation distances for industrial residual air emissions" Pubn. 1518, March 2013

⁷ EPA email advice dated 02/11/2017 from Paul Torre - Senior Applied Scientist - Air & Odour / Principal Expert - Air



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metres (at A4)

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid Of Australia, Zone 55



LEGEND

 PSP Boundary
 Additional Investigation Area

 Work Authority Boundary

 Approved Extraction Boundary

 Possible Extraction Boundary

 Possible Work Authority Boundary

 Default 500 m Buffer

 Concrete Batching Plant



City of Whittlesea
Shenstone Park PSP-
Impact Assessment

Woody Hill
active quarry buffers
Possible Expansions

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Figure 2

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4.2 Site specific variation to default buffer

Two criteria that allow for site specific variations which would have a significant impact on varying the default buffers, are considered to be the size of facility (de-rating a default buffer) and the local meteorology (directional buffer). GHD considers that the relevant buffer for the possible expansion to the quarry area with blasting, should be the default 500 m buffer irrespective of the throughput of the quarry.

However, GHD considers that the directional buffer would apply to the default 500 m buffer given that the default buffer accounts for possible transport of dust particles, which would be subject to meteorological influences. The local meteorology would only apply during daytime hours for the quarry, as blasting would only occur during the daytime.

DEDJTR advice⁸ indicates that a 200 m radial buffer distance from the boundary of the extraction area, is sufficient to mitigate against safety issues from flyrock during blasting, with which GHD agrees. This buffer would be radial, as the flyrock component will be independent of wind speed and direction, as the projectile speed of flyrock is much larger than the influence of wind speed.

The daytime directional buffer that provides the same enclosed area as a 500 m radius circle (i.e. 785,398 m²) is presented in Table 1. Table 1 shows the extent of the directional contour is greater than the all-direction mean of 500 m towards the south, extending to 640 m. Similarly, the extent of the contour to the west is significantly less than 500 m, reduced to 219 m (west southwest). The contour shows the departure from the fixed 500 m radius that would be required, if an equal exposure to disamenity was to be given in the event of an upset/malfunction at the quarry when blasting occurs during the day.

Table 1 Directional variation in 500 m default buffer in response to local meteorology – Melbourne Airport (daytime hours)

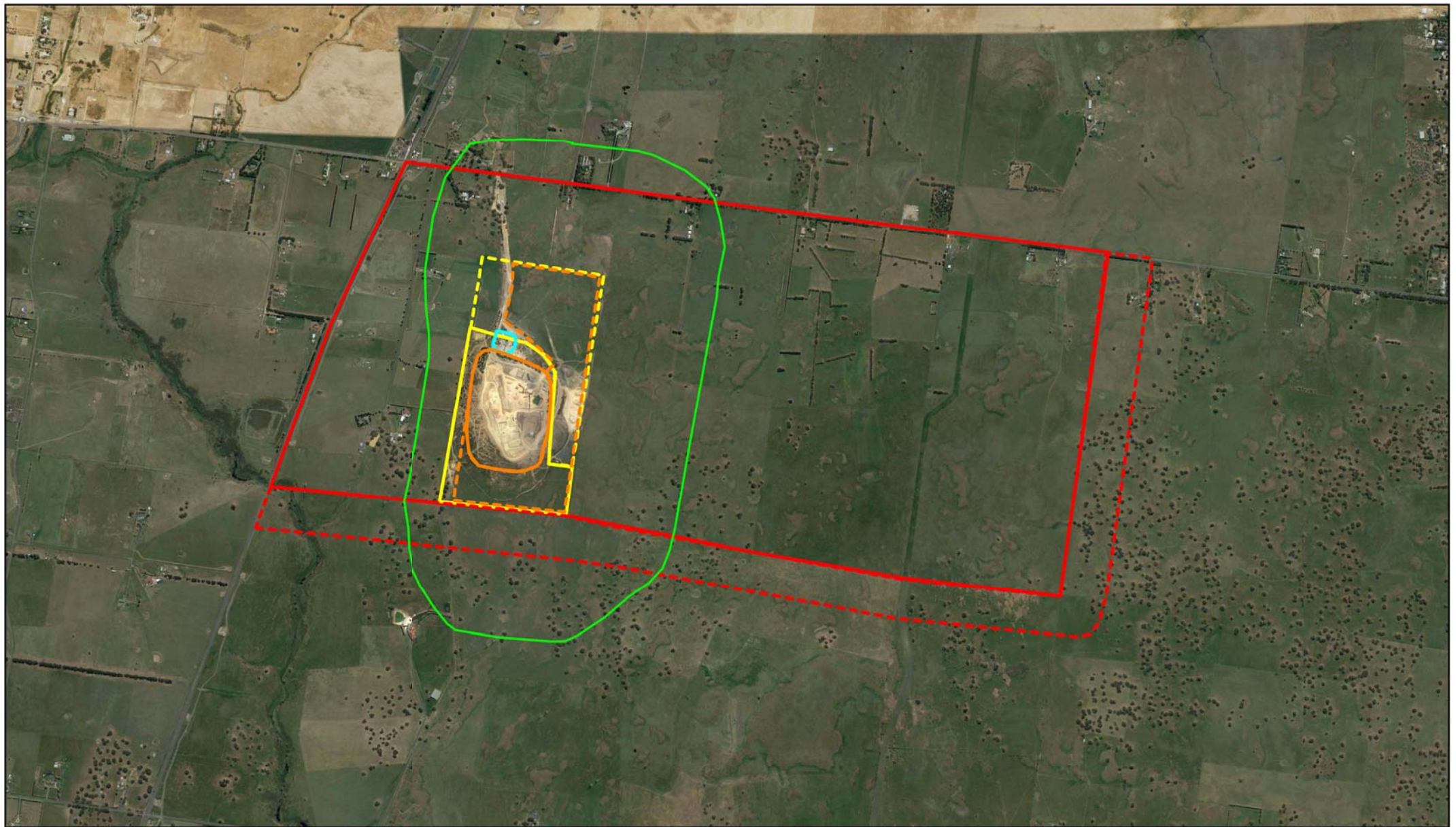
Direction Sector	Degrees	Range (m)	% of mean range	Direction Sector	Degrees	Range (m)	% of mean range
N	0	612	122	S	180	640	128
	15	625	125		195	524	105
	30	625	125		210	407	81
NE	45	625	125	SW	225	293	59
	60	625	125		240	245	49
	75	600	120		255	219	44
E	90	555	111	W	270	231	46
	105	522	104		285	242	48
	120	487	97		300	327	65
SE	135	475	95	NW	315	479	96
	150	490	98		330	565	113
	165	546	109		345	608	122

⁸ Meeting with DEDJTR on 17 October 2017

Directional buffer constraints

Figure 3 shows that the directional buffers for the possible expansions at the Woody Hill Quarry. Figure 3 shows that the directional buffers, which extend further than the default buffers to the east and northeast, encompassing additional land within the PSP compared to the default radial buffers. A significant reduction to the west is shown for each of the three quarrying areas.

A large extension of the default buffer is shown to the east and northeast into the PSP, while the default buffer was retracted in the west due to anticipated meteorological conditions.



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metres (at A4)
Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid Of Australia, Zone 55



LEGEND

 PSP Boundary
 Additional Investigation Area

 Work Authority Boundary

 Approved Extraction Boundary

 Possible Extraction Boundary

 Possible Works Authority Boundary

 Directional Buffer

 Concrete Batching Plant



City of Whittlesea
Shenstone Park PSP-
Impact Assessment

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Revision | A
Date | 12/12/2017

Directional Buffer for Woody Hill
Possible Expansions

Figure 3

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5. Dust impact assessment

5.1 Regulatory requirements

The Environment Protection Act 1970 (EP Act) is the primary legislative document that governs the protection of the environment in Victoria. Pursuant to the EP Act, the air quality environment is protected by the following policies:

- State Environment Protection Policy (Ambient Air Quality), February 1999 (SEPP (AAQ))
- State Environment Protection Policy (Ambient Air Management), December 2001 (SEPP (AQM))

In addition to the SEPP (AQM), the Protocol for Environmental Management: Mining and Extractive Industries (PEM 2007) was developed to set out the requirements for emissions to air from mining and extractive operations.

5.2 Victorian dust criteria

The SEPP-AQM provides dust concentration design criteria for PM_{2.5}, PM₁₀ and total suspended particulate (TSP). The PM₁₀ criterion of 80 µg/m³, 1 -hour average, 99.9th percentile is considered to be the most stringent. TSP has a criterion of 330 µg/m³ for a 3-minute average and 99.9th percentile.

Air-shed air quality goals relating to dust are also specified in SEPP – Ambient Air Quality (AAQ). The current 24-hour average for PM₁₀ is 50 µg/m³. There are also advisory reporting standards for PM_{2.5}, which are 25 µg/m³ (24-hours average) and 8 µg/m³ as a one-year average.

The relevant dust criteria for non-point sources of dust are specified in the Mining and Extractive Industries Protocol for Environmental Management (PEM) are:

- PM₁₀ at 60 µg/m³, 24 hour average
- PM_{2.5} at 36 µg/m³, 24 hour average
- Nuisance deposited dust, 4 g/m²/month (including background)

Basalt contains approximately 45-55% silica content, however due to the physiochemical properties of basalt, the silica is bound in a manner in which minimises the opportunity for creation of cleaved silica so that there is not expected to be offsite exposure to respirable crystalline silica (RCS) from the quarry operations. A series of occupational surveys (i.e. onsite exposure) conducted in the 1990s at Boral quarries by Kilpatrick and Associates, gave a direct measure of the likely percentage crystalline silica in PM_{2.5} dust emissions from their basalt quarry sites. The surveys were conducted to gauge the potential exposure of quarry workers in different activities. The percentage of RCS in the PM_{2.5} samples taken from the breathing zone of the workers was found to be approximately ~ 1%.

Given PM₁₀ is the lead indicator (i.e. critical constraint) for quarry impacts, GHD has conducted dispersion modelling for this constituent only.

5.2.1 Scenarios

GHD has had to make a number of assumptions regarding the operations of the Woody Hill Quarry based on similar quarry operations.

Three scenarios for Woody Hill Quarry were agreed upon in consultation with CoW namely:

- Scenario 1: Woody Hill proposed expansion to the south
- Scenario 2: Woody Hill proposed expansion to the north
- Scenario 3: Woody Hill expansion 20 m below the ground surface

5.2.2 Emissions inventory

Emissions rates for the fine fraction (PM₁₀) of dust emissions were developed from a number of published references, including:

- National Pollutant Inventory (NPI) Emissions Estimation Technique Manual for Mining and Processing of Non-Metallic Minerals, Version 2.0
- USEPA AP-42 Chapter 11.19.2 – Crushed Stone Processing and Pulverized Mineral Processing, version 8/04
- Air Pollution Engineering Manual (Buonicore & Davis, 1992)

Where emission factor data was not available in the NPI, then GHD sourced emission factors from AP42 and Buonicore & Davis.

Process emission rates are expressed as kg per tonne processed for static sources such as crushing, screening, conveyor transfer, dumping and loading. For mobile sources such as haul trucks, emission rates are expressed as kg per vehicle kilometre travelled (VKT), and for dozers emissions are expressed as kg per hour of operation.

These references account for various levels of dust control. Where water spray bars are installed at crushers, screens or conveyor transfer points, a reduction factor of between 70% and 90% can be applied to the uncontrolled emissions rate (Davis, 1992). Given GHD was not provided any specific operational detail, we have assumed dust controls at the crushers, screens or conveyor points are absent.

A list of source emission rate data for PM₁₀ is provided in Appendix A.

The mean PM₁₀ emissions rates for all identified process and erosion sources relevant to the maximum operational scenario (assumed to be 200 tph based on similar quarries) are summarised into the relevant process categories in Table 3. The mean PM₁₀ emission rates have been presented as the published upper limit maximum emission factors without controls applied.

5.2.3 Excavation of rock

The quarry Work Plan states that mudstone is extracted from the quarry by ripping of soft rock, and for isolated hard pockets, by more conventional drill and blasting. The material would be ripped and pushed with a dozer and scraper and then loaded onto haul trucks by excavators. It has been assumed that water spraying is undertaken to reduce the dust emissions from these sources. Extracted rock is transported to the crushing and screening plant described below. The operation of each mobile plant generates dust, as does the transportation of the rock along haul roads. Emission rates from these sources were obtained from the NPI (Environment Australia, 2000) and are listed in Appendix A.

Wheel generated dust from trucks entering and leaving the site and haul trucks moving between the pits and the crushing plant, overburden stockpiles and bunding areas have been included in the model. Line volume sources have been used to model the estimated truck routes onsite. The estimated distance travelled has been based on the extraction rate, size of haul trucks and average number of trucks entering and leaving the site.

A grader has also been included to maintain the haul roads.

It has also been assumed that water is applied to unpaved roads, resulting in dust control equivalent to Level 1 watering as defined in the NPI Emission EET for Mining (>1 litres/m²/hr).

The following mobile equipment has been assumed:

- Hyundai 770-7A wheel loaders (bucket size 5 m³) x 5
- Hitachi EX800 excavator (bucket size 5.5 m³) x 2
- Mine haul truck (Volvo A40) dump truck (30 m³ capacity) x 1
- Quad dogs with 35 tonne payload x 1.5/hr
- Grader x 1

Blasting can also create airborne dust and has been included in the dispersion modelling for PM₁₀. GHD has assumed blasting occurs once per month at 12 pm.

5.2.4 Processing of rock

The site currently uses mobile equipment for all crushing and screening. A primary crusher (jaw) accepts all extracted stone and removes scalps. Stone is then gradually sized and screened out through the primary crusher, secondary crusher and screen deck to different aggregate sizes and fines.

Within the rock processing, sources of dust are:

- From the screens (including fine screens)
- Conveyor transfer points
- Operating crushers (jaw and impact)
- Loading to the crushers
- Loading of the stockpiles
- Loading aggregate from stockpiles for transport offsite

Inputs described in Table 2 were combined to define the overall emission rate for crushing in Table 3.

Table 2 Crushing throughputs assumed for modelling

Dust Source	Max throughput (tph)
Primary Crusher	200
Secondary Crusher	160

Processing of stone assumed the following equipment:

- Primary Crusher
- Secondary Crusher
- Screening
- Fines Screening

5.2.5 Other dust sources

Wind generated dust is also produced from stockpiles and barren land. The amount of dust generated is dependent on wind speed, moisture content and erodability.

For modelling of exposed (non- vegetated) areas, wind generated dust was assessed using the standard emission factor from NPI of 0.2 kg/ha/hr.

Each transfer point of rock would also be a source of emissions. This occurs when rock is transferred from excavators to dump trucks, from trucks to mobile plant, and when it is loaded and unloaded from haul trucks. Five transfer points were used in the modelling to represent these interactions between various fixed and mobile plant. Whilst this number may vary depending on operations, as shown in Table 3, it provides a comparatively low percentage of overall dust emissions, at just 0.1 g/s per transfer point.

Dry depletion has not been accounted for in the model. Previous assessments conducted by GHD (refer to the New Chiltern Quarry Air Quality Assessment, GHD, 2009) have shown that accounting for dry depletion when assessing PM₁₀ for a rock quarry marginally reduces the impacts from the quarry dust plume. By not including dry depletion the level of conservatism in the model increases.

Table 3 Summary of dust emission rates for proposed maximum operation scenario (at 200 tph)

Activity		Typical Operating Hours	Mean Emission Rate during operation, without controls (g/s)	% of Total Emissions
Rock Winning	Dumping	6 am – 6 pm	0.24	66%
	Excavator	6 am – 6 pm	2.33	
	Loading	6 am – 6 pm	0.09	
	Blasting ¹	Once per month for 1 hr	0.86	
	Haul Roads	6 am – 6 pm	0.26	
	Grader	6 am – 6 pm	0.06	
Plant	Primary Crushing	6 am – 6 pm	0.07	34%
	Secondary Crushing	6 am – 6 pm	0.05	
	Screening	6 am – 6 pm	0.24	
	Fines Screening	6 am – 6 pm	1.60	
Transfer Points (x 5)		6 am – 6 pm	0.01	0.1%
Wind Erosion (product stockpile area and haul roads) ¹		24 hours	0.2	3%
TOTAL			5.81 g/s	
Notes				
¹ Based on an open area of 36,000 m ²				

5.2.6 PM_{2.5}

The emission rates of PM₁₀ from the sources modelled can be factored to give the PM_{2.5} (respirable fraction of fine dust) emission rates by reference to a background document cited in the USEPA AP-42 Chapter 11.19.2 – *Crushed Stone Processing and Pulverised Mineral Processing*. In this, dust emission rates are given as a function of particle size, in micron, for the controlled operations of; screening, tertiary crushing, fines crushing and conveyor transfer points.

The corresponding PM_{2.5}/PM₁₀ emission rate ratios were 0.13, 0.25, 0.125 and 0.33 respectively. Proportioning these ratios to the calculated PM₁₀ emission rates for each category of operation (as given in Table 3) gives a site mean PM_{2.5}/PM₁₀ emission ratio of 0.18. This ratio could be used to proportion the PM₁₀ modelling results so that predicted PM_{2.5} levels could be presented.

However, given PM₁₀ is the most critical constituent for quarry assessments, only PM₁₀ impacts have been presented for the scenarios.

5.2.7 Respirable crystalline silica (RCS)

There is a minimal amount silica in mudstone and as previously stated the physiochemical properties of basalt result in minimal opportunity for creation of cleaved silica, therefore minimal offsite exposure to RCS from the quarry operations. Previous assessments by GHD for rock/stone quarries have analysed the mean percentage of RCS as around 1% of PM_{2.5} (refer to Leongatha South Quarry Air Quality assessment, GHD, 2010).

5.2.8 Model set up

The EPA Victoria approved dispersion model AERMOD was used to predict offsite dust levels of PM₁₀ associated with the above scenarios. Contour plots of predicted peak levels of PM₁₀ resulting from the quarry emissions including background PM₁₀ levels were assessed by applying a representative 70th percentile background concentration and adding that value to the quarry 'signal' contours.

The AERMOD simulations were run with model settings outlined in Table 4. The model was set up using emissions from Table 3. This represents the maximum expected throughput of 200 tph operating at all hours within the production times of 6 am to 6 pm. Actual operations would be at significantly lower average throughputs, with expected maximum daily throughputs of around 500 tonnes, which equates to an average hourly throughput of around 50 tph. As such, predicted maximum concentrations are highly conservative and are based on the coincidence of worst-case dispersion conditions coinciding with maximum quarry operations. Sources are listed in Table 3 with their locations as shown in Figure 4. These locations provide an indicative estimate of source locations, however the actual locations will vary around the site but are not expected to significantly alter the patterns of dispersion presented.

Table 4 AERMOD settings

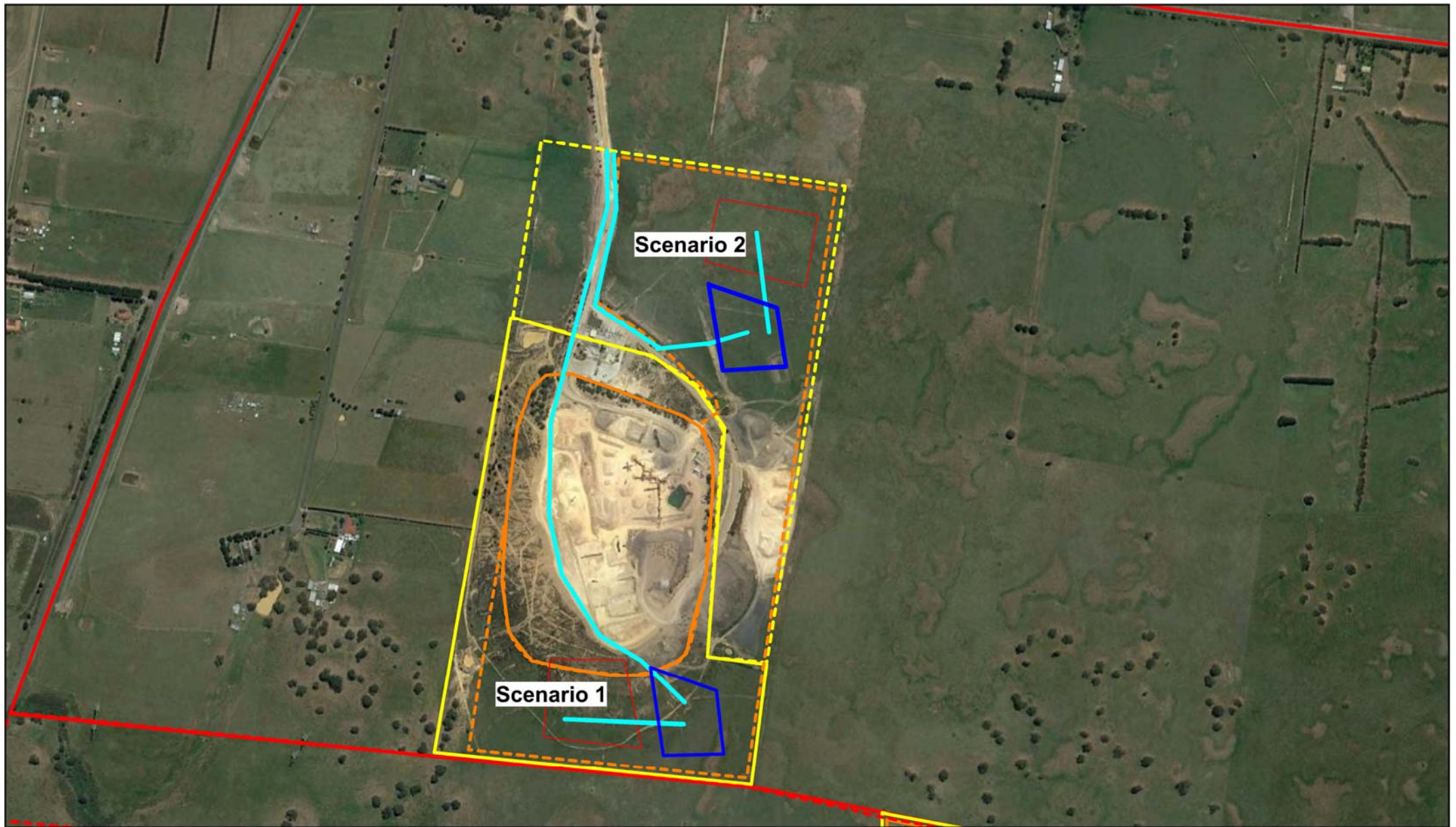
Parameter
Five 12 month meteorological datasets for the site for the years 2012, 2013, 2014, 2015 and 2016 were used from Melbourne Airport:
A 5 km x 5 km square receptor grid, centred over the each of the seven sites, using a grid resolution of 50 metres.
An averaging period of 24 hours.
Given that the topography of the broader region surrounding the site is relatively flat and the model domain of interest is confined to the near-field (e.g. site boundary and nearest receptors), the effects of terrain on dispersion were considered negligible and therefore not included in this assessment.
Rural dispersion coefficients.
Low wind adjustment factor, LOWWIND3, applied, as per latest USEPA guidance.
A surface roughness height of 0.1 metres was used, flat rural area.

Sources were defined in AERMOD according to the specifications outlined in Table 5. All volume sources were placed within the appropriate stage boundaries and were input as variable emissions sources dependent on the hour of day, whereby emissions were only applied between the hours of 6 am and 6 pm. The unsealed roads consisting of haul roads and the access road were input as line volume sources according to USEPA regulatory standards.

Table 5 AERMOD source characteristics

Source of Emissions	Source Type	Source Properties			
Excavator, Dumping, Grader, Loading, Transfer Points	Volume	2 m release height	4 m side length	1 m Initial lateral dispersion	1 m initial vertical dispersion
Primary Crusher, Secondary Crusher	Volume	3 m release height	20 m side length	5 m initial lateral dispersion	1.5 m initial vertical dispersion
Screening and Fines Screening	Volume	1 m release height	2 m side length	0.5 m initial lateral dispersion	0.5 m initial vertical dispersion
Haul Roads	Line Volume	Separated 2W configuration*	3 m vehicle width	4 m vehicle height	Factor of 1.7*
Blasting	Volume	2 m release height	4 m side length	1 m Initial lateral dispersion	7 m initial vertical dispersion
Wind Erosion	Area	Ground level release			
Notes					
* US EPA regulatory standard configuration					

Further details about the model configuration are given in the AERMOD input text file shown in Appendix B.



1:10,000
0 100 200 300
metres (at A4)

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid Of Australia, Zone 55



LEGEND

- Processing Plant
- Wind Erosion
- Haul/ Access Roads



City of Whittlesea
Shenstone Park PSP-
Impact Assessment

Location of modelled sources -
Woody Hill Expansions

Job Number | 3135311
Revision | A
Date | 12/12/2017

Figure 4

5.2.9 Dispersion modelling results

Assuming equivalent operations and the same peak 200 tph in the final stages of the quarry life, and with the finished quarry areas rehabilitated, it could be reasonably expected that the quarry would produce similar dust emissions over its operational life time.

As such, to simulate the predicted maximum concentrations of PM₁₀ for possible expansions of the quarry, the source array for existing operations has been translated to the southern and northern boundaries of the quarry – so as to demonstrate the likely extent of dust impacts at later stages of the quarry life. Note that operations can/will change over this period of time and that the resultant patterns of offsite impact are indicative only.

Figure 5 shows the predicted theoretical maximum 24-hour concentration of PM₁₀ for Scenario 1 (expansion to the south) based on a throughput of 200 tph and assuming a conservative background 70thile level of 14.8 µg/m³. The criterion for PM₁₀ (60 µg/m³) extends approximately 150 m to the east onto the PSP area. Even with moving all dust sources to the south of the quarry, the PM₁₀ 24 hour criterion is met at all existing sensitive receptors. The 60 µg/m³ criterion is also well contained within the default separation distance for the quarry.

Figure 6 shows the predicted theoretical maximum 24-hour concentration of PM₁₀ for Scenario 2 (expansion to the north) based on a throughput of 200 tph and assuming a conservative background 70thile level of 14.8 µg/m³. The criterion for PM₁₀ (60 µg/m³) extends approximately 230 m to the east and 270 m north into PSP area. With the moving of all dust sources to the northeast of the quarry, the PM₁₀ 24 hour criterion is met at all existing sensitive receptors. Again, the 60 µg/m³ criterion is well contained within the default separation distance for the quarry.

Scenario 3 for an expansion of 20 m below the ground surface would have very similar impacts to Scenario 1 (the current existing operations of the Woody Hill Quarry) presented in the earlier GHD Report #51460, albeit a slight 5% reduction for pit emission retention. Refer to the existing operational impact assessment presented in the earlier GHD Report #51460.

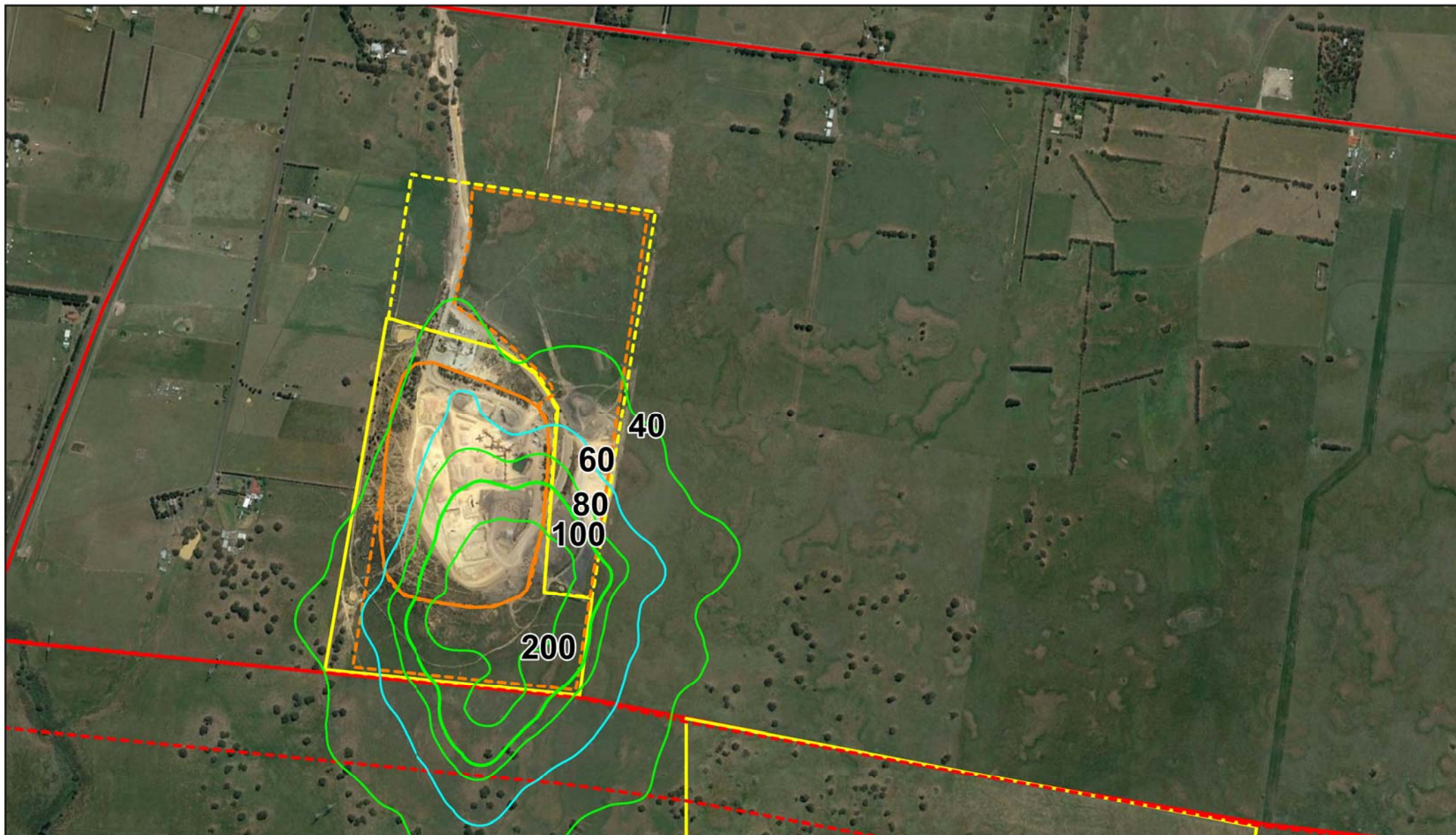
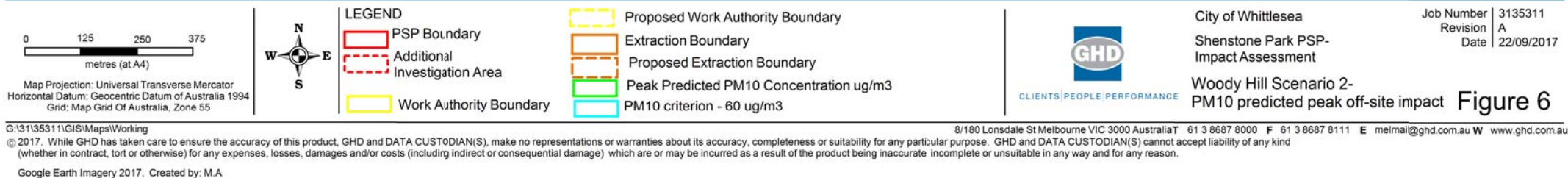
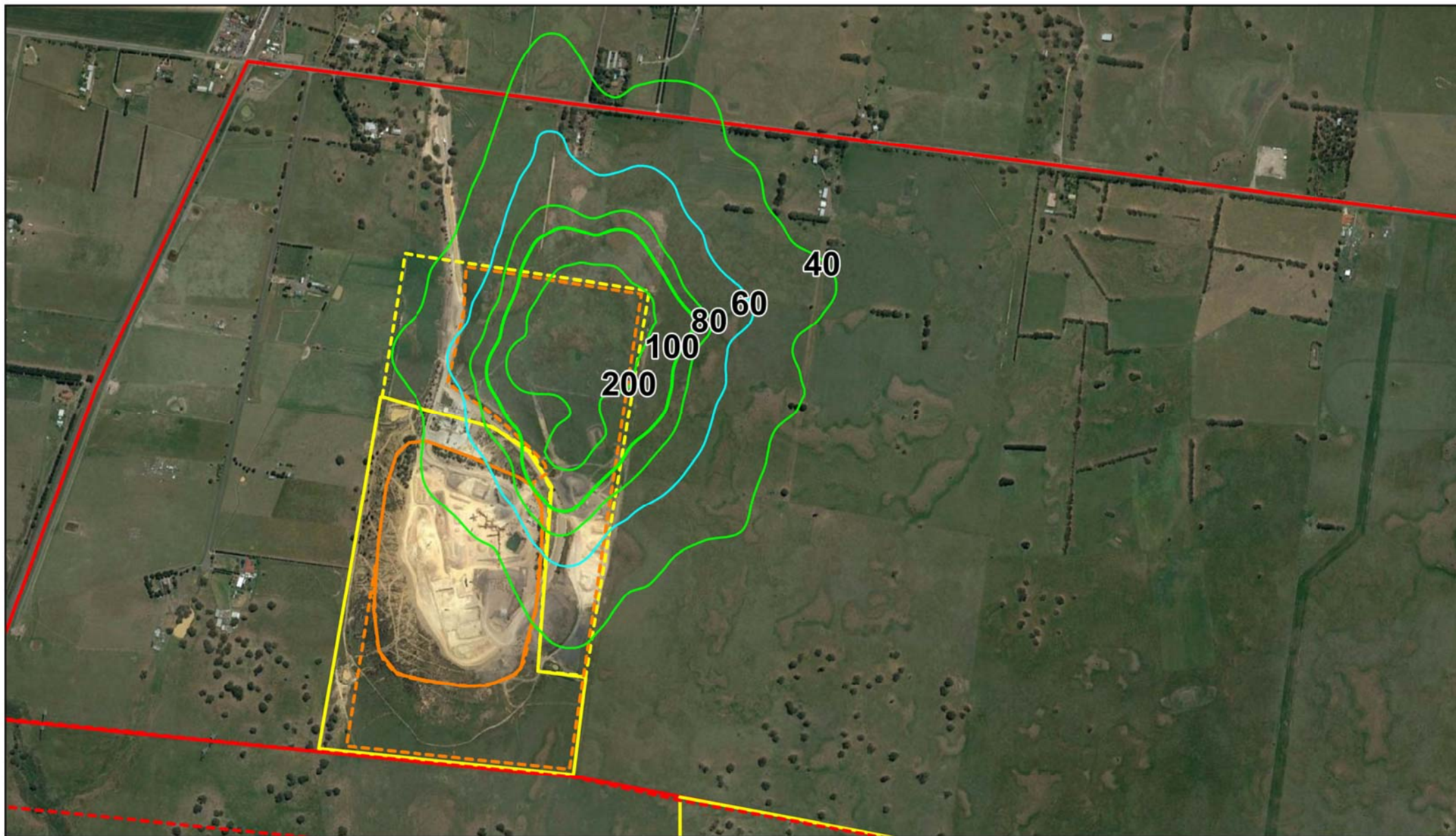


Figure 5



5.2.10 Potential for further dust emission reductions and mitigation

A number of conservative assumptions have been used in the prediction of maximum dust impacts from the quarry. These include:

- Assuming full quarry operations every day of the year, instead of Monday to Saturday
- Using a maximum assumed throughput of 200 tph for peak quarry operations, when the average throughput is more likely to be around 50 tph
- Not accounting for dry depletion, whereby larger particle sizes within the PM₁₀ range would settle faster and result in marginally lower concentrations of PM₁₀

In addition to this, modelling of PM₁₀ has assumed that no controls have been placed on sources of dust emissions at the quarry to estimate the maximum dust impacts, with the exception of haul road watering. It is likely that the operator of the Woody Hill Quarry would implement dust management practices for product handling and storage in accordance with BPEM (Best Practice Environmental Management) measures for to mitigate dust onsite. This includes water sprays and a water cart in and around the plant and stockpile areas. According to the NPI, this would result in further reductions of 50% for loading and unloading stockpiles, wind erosion from stockpiles and hauling, and up to 70% reductions for unloading operations.

6. Noise impact assessment (non-blasting)

The operation of the Woody Hill Quarry would have the potential to generate environmental noise impacts at the Shenstone Park PSP site.

The purpose of this noise assessment is to assess the likelihood of impact from the possible expansions.

6.1 Legislation, policy and guidelines

The Victorian Government provides guidance on operational noise levels for industry in Victoria, with one mandatory policy for metropolitan areas and one guideline for regional areas as follows:

- *State Environment Protection Policy – Control of Noise from Commerce, Industry and Trade No. N-1* (SEPP N-1) (Victorian Government, 1989) for metropolitan areas throughout Victoria
- *Noise from Industry in Regional Victoria (NIRV): Recommended Maximum Noise Levels From Commerce, Industry and Trade Premises in Regional Victoria* (EPA publication 1411) (EPA Victoria, 2011)

The SEPP N-1 policy is applicable for industry located in a Major Urban Area (MUA), with the potential to impact nearby sensitive receivers. A 'Major Urban Area' is defined as:

- *The part of Melbourne that is within the SEPP N-1 boundary (refer to Figure 7), or*
- *The part of Melbourne that extends beyond the SEPP N-1 boundary, but is within the Planning Urban Growth Boundary (UGB) (refer to Figure 7)*

The areas outside the MUA boundaries are managed by the NIRV guideline. The NIRV guideline is applicable for industry located in a *Rural Area*, with the potential to create noise impacts at nearby sensitive receiver locations. A 'Rural Area' is defined as:

- *Land that is not within a 'Major Urban Area', including land in cities or towns with a population below 7,000 and rural locations outside 'Major Urban Areas.'*

In addition, NIRV makes provision for land located outside the SEPP N-1 boundary that has a population greater than 7,000 to be assessed against the SEPP N-1 methodology.

For this assessment, the PSP site and the assessed quarries are all located within Urban Growth and SEPP N-1 boundaries (refer to Figure 7).

Hence, the surrounding industrial noise has been assessed in accordance with the SEPP N-1 policy.

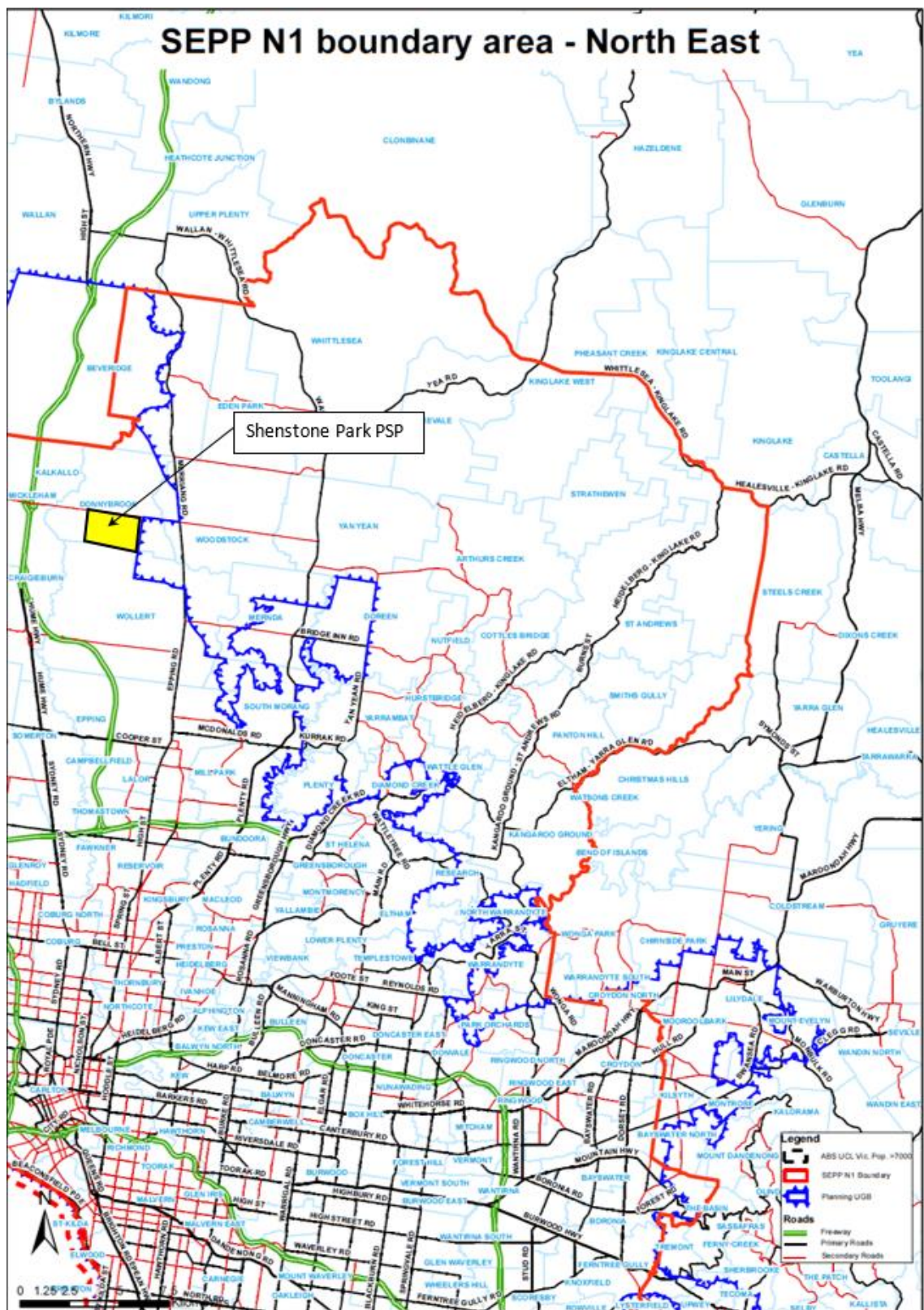


Figure 7 Areas covered by SEPP N-1 and planning UGB (EPA Victoria, 2013)

6.1.1 SEPP N-1

Noise from industry within Melbourne's Planning UGB must comply with SEPP N-1. SEPP N-1 provides limits on noise impacts on residential and other noise-sensitive uses and should be applied when siting or designing new or expanded industry or plant, and when government authorities are assessing applications for new and expanding industry.

SEPP N-1 sets the maximum noise limit allowed in a noise sensitive area emanating from commercial/industrial premises depending on the time of day, evening, or night, land use zoning and existing background noise levels.

The first step in assessing the noise limit is to calculate the prescribed upper noise limit (Zoning Level or Zoning Limit) for the particular land use according to Schedule B2 of the SEPP N-1. Once the zoning level has been developed, the background level is assessed as to whether they are neutral (i.e. not significantly higher or lower than the zoning level) or otherwise. If the background level is neutral, the noise limit adopted is the zoning level. If the background level is significantly lower or higher than the zoning level, then the noise limit is reduced or increased accordingly.

Section 6.1.2 details the derivation of SEPP N-1 noise limits applicable for the project site.

6.1.2 Determination of SEPP N-1 zoning levels

Schedule B2 of the SEPP N-1 outlines how zoning levels for a day period, evening period and night period must be determined using the following equations:

Day period: zoning level = 18 × Influencing Factor + 50

Evening period: zoning level = 17 × Influencing Factor + 44

Night period: zoning level = 17 × Influencing Factor + 39

Where, the Influencing Factor (IF) is calculated using the following formula:

$$IF = \frac{1}{2} \frac{(area\ type\ 3 + \frac{1}{2}(area\ type\ 2))}{(total\ area\ of\ circle)} 140m\ circle$$
$$+ \frac{1}{2} \frac{(area\ type\ 3 + \frac{1}{2}(area\ type\ 2))}{(total\ area\ of\ circle)} 400m\ circle$$

The two concentric circles of diameter 140 m and 400 m must be drawn or reproduced to scale on the relevant map, centered on the measurement point in the noise sensitive area. The area of all the SEPP N-1 Type 2 and 3 zones and reservations must be measured for each of the two circles from the same map. Following the above procedures and the land use zonings, the calculated zoning levels are then calculated as detailed in Table 6 for this project.

Table 6 Calculated SEPP N-1 zoning levels at the Shenstone Park PSP

Nearby sensitive receiver location	Period	Influencing factor	SEPP N-1 zoning levels dB(A)
Shenstone Park PSP site	Day	0.00	50
	Evening		44
	Night		39

6.1.3 Derived SEPP N-1 noise limits

Using the Zoning Levels in Table 6 and the measured background noise levels (refer to GHD Report #51460), the SEPP N-1 noise limits applicable for the project site can be derived in accordance with Schedule B1 and B3 of the SEPP N-1. The applicable noise limits are presented in Table 7.

Table 7 Derived SEPP N-1 industrial noise criteria for the Shenstone Park PSP

Sensitive receivers location	Period	Influencing factor	SEPP N-1 zoning levels dB(A)	Measured background noise levels dB(A) _{L₉₀}	Background classification	SEPP N-1 noise limits dB(A) _{L_{eq}(30mins)}
Shenstone Park PSP	Day	0.00	50	36	Low background	48
	Evening		44	29	Low background	40
	Night		39	28	Low background	37

Note that due to the wide variety of background noise monitoring results, the lowest background noise levels for each of the periods have been adopted.

6.1.4 Operational hours

The Woody Hill Quarry hours of operation are from 6.00 am to 6.00 pm Monday to Saturday.

The Woody Hill Quarry will be required to meet the night-time period criteria between 6.00 am and 7.00 am as the EPA defined night-time period is from 10:00 pm to 7:00 am Monday to Friday. The daytime period is 7:00 am to 6:00 pm, Monday to Friday, and Saturday 7:00 am to 1:00 pm. The evening time criteria applies after 1:00 pm on Saturday to 6:00 pm.

The night time limits are considered the most stringent criteria to be met at the identified sensitive receivers. Generally, if the night-time criteria can be met by the Woody Hill Quarry then the day and evening measurements are also likely to be met from this type of operation.

6.2 Industrial noise assessment methodology

Noise modelling was undertaken using the noise modelling software package Computer Aided Noise Abatement (CadnaA) (Ver. 2017 MR (BMP Set)) to predict the effects of airborne industrial noise from the possible expansions and produce noise impact contours for the adjacent PSP site.

CadnaA is a computer program for the calculation, assessment and prognosis of noise propagation. CadnaA calculates environmental noise propagation according to a number of different algorithms. In this assessment ISO 9613-2, "*Acoustics – Attenuation of sound during propagation outdoors*" was utilised (ISO, 1996). Propagation calculations using ISO 9613 take into account sound intensity losses due to hemispherical spreading, atmospheric absorption and ground absorption.

The ISO 9613-2 algorithm also takes into account the presence of a well-developed moderate ground based temperature inversion, such as that which commonly occurs on clear, calm nights or during 'downwind' conditions, which are favourable to sound propagation.

The noise assessment has been modelled based on available data at the time this report was prepared.

In the absence of quarry specific data, onsite plant and equipment with the potential to be a major noise source, fixed equipment locations, mobile equipment routes, quantity of equipment, and nature of the industrial operation, were based on information illustrated in the publicly available aerial imagery at the time of this report, as well as GHD site boundary inspections.

The following general settings were used in the model:

- Ground absorption was taken into account in the calculations. A general ground absorption coefficient of 0.75 was used throughout the model to represent the surrounding ground type comprising of predominantly vegetative grassland areas.
- All sensitive receptors were modelled at 1.5 m height above ground, in accordance with AS 1055: Acoustics – *Description and measurement of environmental noise*.
- Site topography and three-dimensional terrain with 1 m contour resolution have been used in the model.

6.3 Assessment scenarios

The noise assessment was undertaken for the following modelling scenarios:

- **Scenario 1:** Woody Hill expansion to the south
- **Scenario 2:** Woody Hill expansion to the north

Note that Woody Hill expansion 20 m below the ground surface scenario (refer to section 5.2.1) will not be assessed for noise impact due to the absence of quarry specific topographical design information available at the time this report was prepared. Moreover, it is anticipated that the two assessed scenarios would produce a higher noise impact than the below ground surface quarrying for day to day operations. However, depending on the method of winning rock, a greater number of blast events may be required, as GHD understand the lower rock formation consists largely of bluestone (basalt), a hard igneous rock formation.

6.4 General modelling assumptions

The following general assumptions have been made in undertaking the noise modelling assessment in this report.

- Existing ground topographical contour conditions will be used for assessing all modelling scenarios, due to the absence of quarry site-specific topographical contour data
- The existing orientation of all stationary equipment for the existing Woody Hill Quarry has been applied to all other modelled scenarios

6.5 Equipment modelled

Table 8 details the primary noise generating equipment assumed to be used within the quarry sites and the corresponding sound power levels used in the noise model. Equipment noise data was obtained from the following sources:

- Australian Standard AS 2436:2010 (reconfirmed 2016) – *Guide to noise and vibration control on construction, demolition and maintenance sites*
- BSI British Standards BS 5228.1:2009 – *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise* (BS 5228.1, 2009)
- Engineering Noise Control (ENC) software
- GHD internal database and past project experience

Table 8 Modelled equipment sound power levels SWL (10⁻¹² Watt)

Plant item	Quantity of equipment used within the model	Source height (m)	L _w dB(A) per unit	Octave centre frequency (Hz)/dB(linear)									Data source
				31.5	63	125	250	500	1000	2000	4000	8000	
Fixed equipment													
Primary crusher	1	6	113	107	115	114	111	107	108	106	101	96	Albury Waste Management Centre
Secondary crusher	1	6	113	107	115	114	111	107	108	106	101	96	Albury Waste Management Centre
Open conveyor	As per the aerial imagery	Assumed as per the aerial imagery	83/m	93	80	81	81	83	77	72	63	55	Clermont Coal Project
Screener	2	2	108	110	110	107	104	103	103	101	97	96	Kitsault Mine Project
Stacker/reclaimer	1	6	108	98	98	103	100	97	94	92	89	81	Kitsault Mine Project
Concrete batching plant	1	10	113	107	106	103	111	111	107	106	98	98	GHD Database
Mobile power crusher and screener	1	3	103	100	101	103	102	101	97	95	92	86	Hi-Quality Bulla Quarry Project – CR019
Mobile equipment													
Loader	5	2.5	114	108	105	108	111	112	108	105	103	94	Bengalla Development Project - Loader L1800
Haul truck	Refer to modelling assumptions	4	117	120	123	121	117	114	111	109	104	97	Ensham Central Project - CAT 773/777
Grader	1	2.5	110	110	111	113	113	106	99	102	99	91	Moranbah South Project CAT 14H or equivalent
Excavator	2	2.5	107	110	113	106	105	105	101	99	96	91	BS5228-1:2009 – Appendix C.2 Ref no 14
Truck and Dog	Refer to modelling assumptions	3	104	110	114	108	104	101	99	96	92	85	Hi-Quality Bulla Quarry Project
Water cart truck	1	2.5	87	84	92	81	77	80	84	80	74	69	Albury Waste Management Centre
Concrete Mixer Truck	Refer to modelling assumptions	2.5	87	84	92	81	77	80	84	80	74	69	Albury Waste Management Centre

6.6 Model assumptions

A number of conservative assumptions have been used in the prediction of operational noise impacts from the quarry. These include:

- Assuming full quarry operations Monday to Saturday from 6 am to 6 pm
- Assume continuous operation with 1.5 truck movements per hour on haul roads
- Conveyors were all modelled uncovered
- The existing concrete batching plant was modelled in continuous operation
- No reduction in noise due to pit depth and landform shielding has been modelled for Scenarios 1 and 2
- The concrete batching plant has also been modelled in its existing location, which is assumed to be unchanged during the life of the quarry

In addition to this, modelling of noise has assumed that no controls have been placed on noise emissions at the quarry. Reversing beepers have not been modelled.

6.6.1 Assessment

Resulting noise contours, in five-decibel increments for the noise assessments outlined above are shown in Figure 8 and Figure 9.

Scenario 1, when compared to the daytime criteria of 48 dB(A), shows predicted exceedances beyond the site's proposed WA 492 boundary of approximately 600 meters, 100 m beyond the 500 m default buffer prescribed for protection against fly rock.

Scenario 2, when compared to the daytime criteria of 48 dB(A), shows predicted exceedances beyond the site's proposed WA 492 boundary of approximately 600 meters, 100 m beyond the 500 m default buffer prescribed for protection against fly rock.

Modelling of the existing approved extraction area for the Woody Hill Quarry was also undertaken in the GHD report entitled '*City Of Whittlesea Council Impact Assessment Report for the Shenstone Park Precinct Structure Plan – December 2017*⁹'. In that report a buffer of 900 m was recommended, which is 300 m greater than that assessed in this report due to the elevated location of existing noise sources combined with the concrete batching plant. However, as the northern and southern extraction scenarios mentioned above will be at a much lower elevation, this has enabled greater attenuation of the noise impact from each of these two scenarios reducing the buffer size by one third down to 600 m.

Hence, it is recommended a 600 m buffer around the extraction area for the future possible expansions of the Woody Hill Quarry be prescribed prior to any noise mitigation being implemented. Should further work be undertaken to determine the noise controls and operations in place at the quarry, it may be possible to reduce the extent of the noise buffer.

⁹ GHD Report #51460

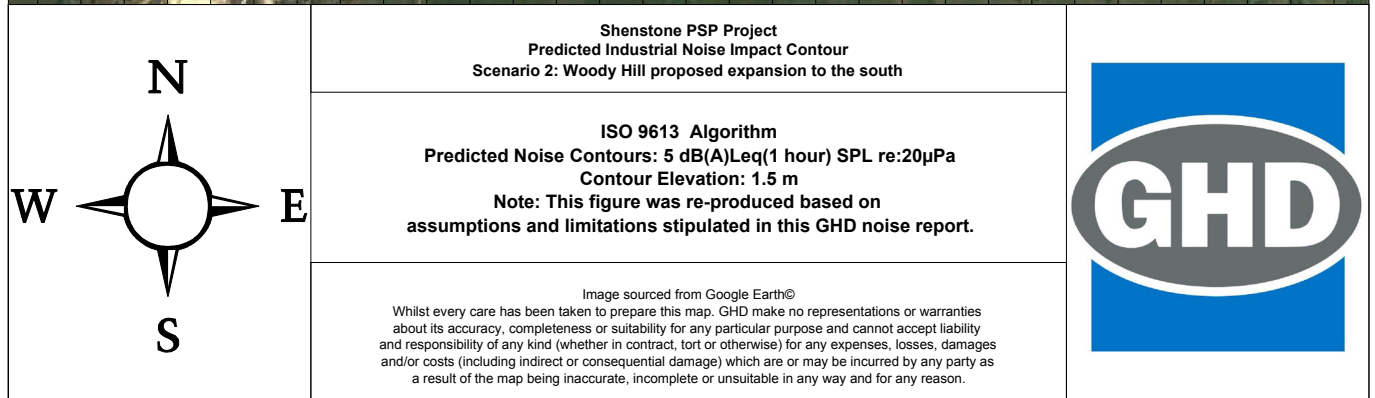
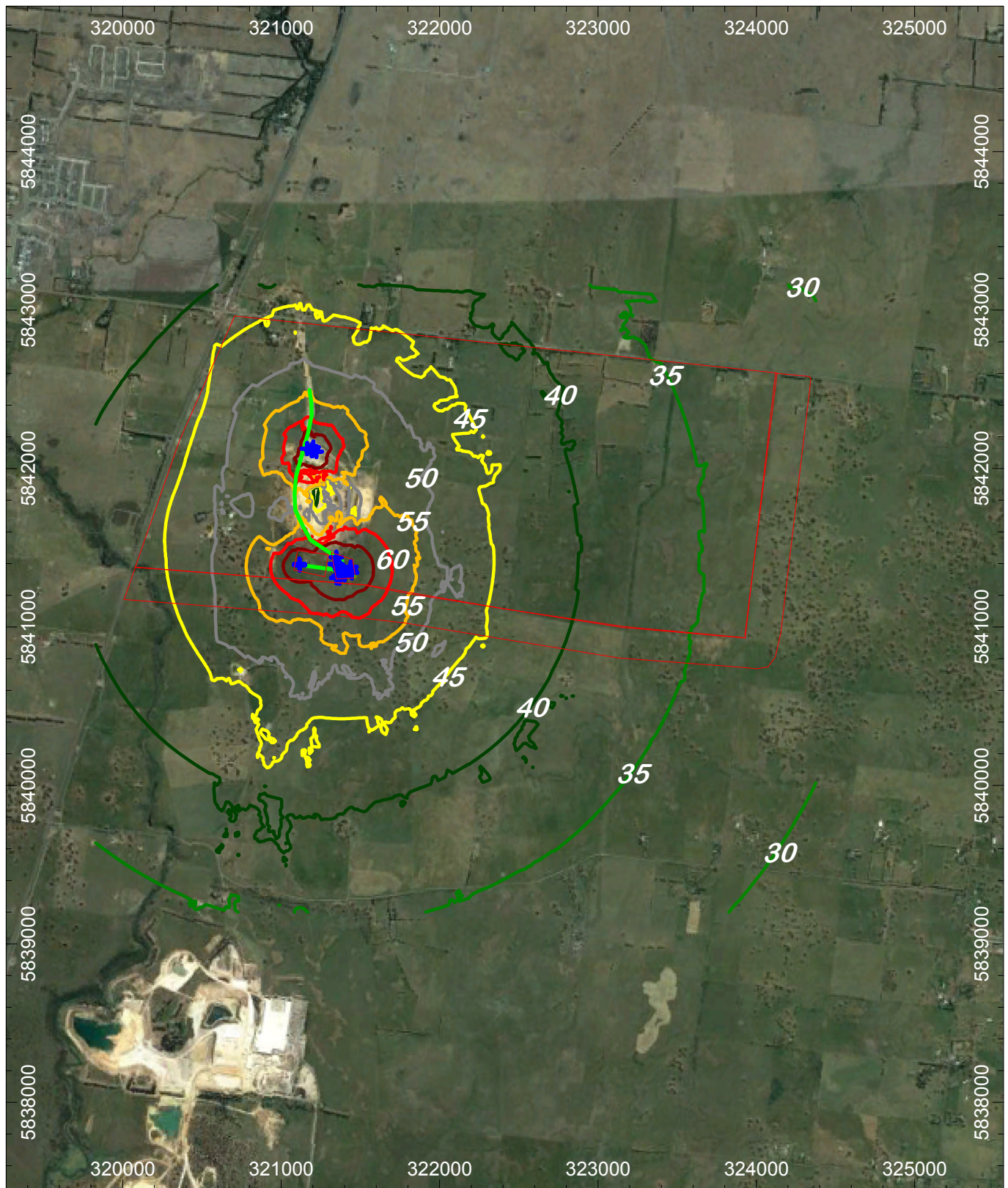


Figure 8 Scenario 1: Woody Hill proposed expansion to the south

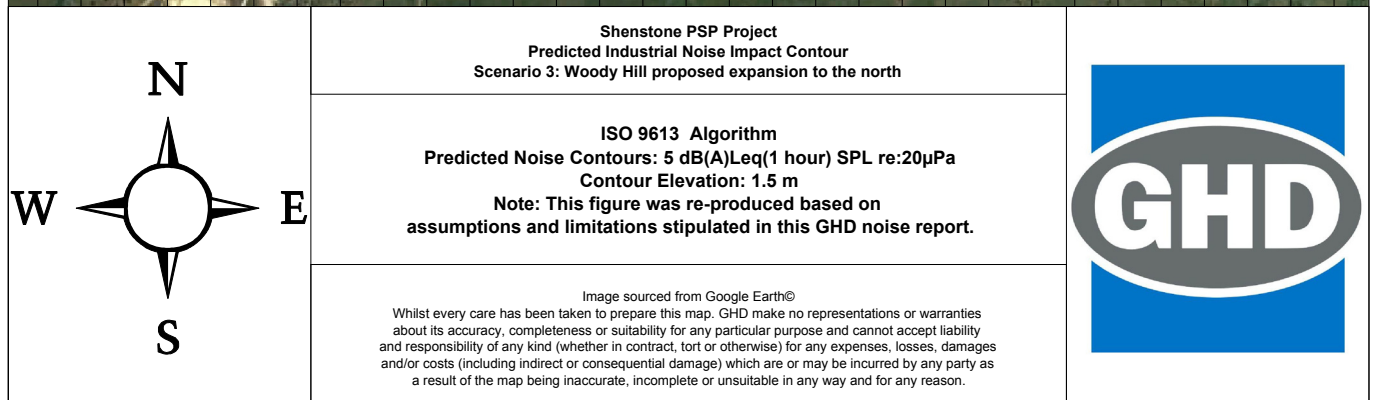
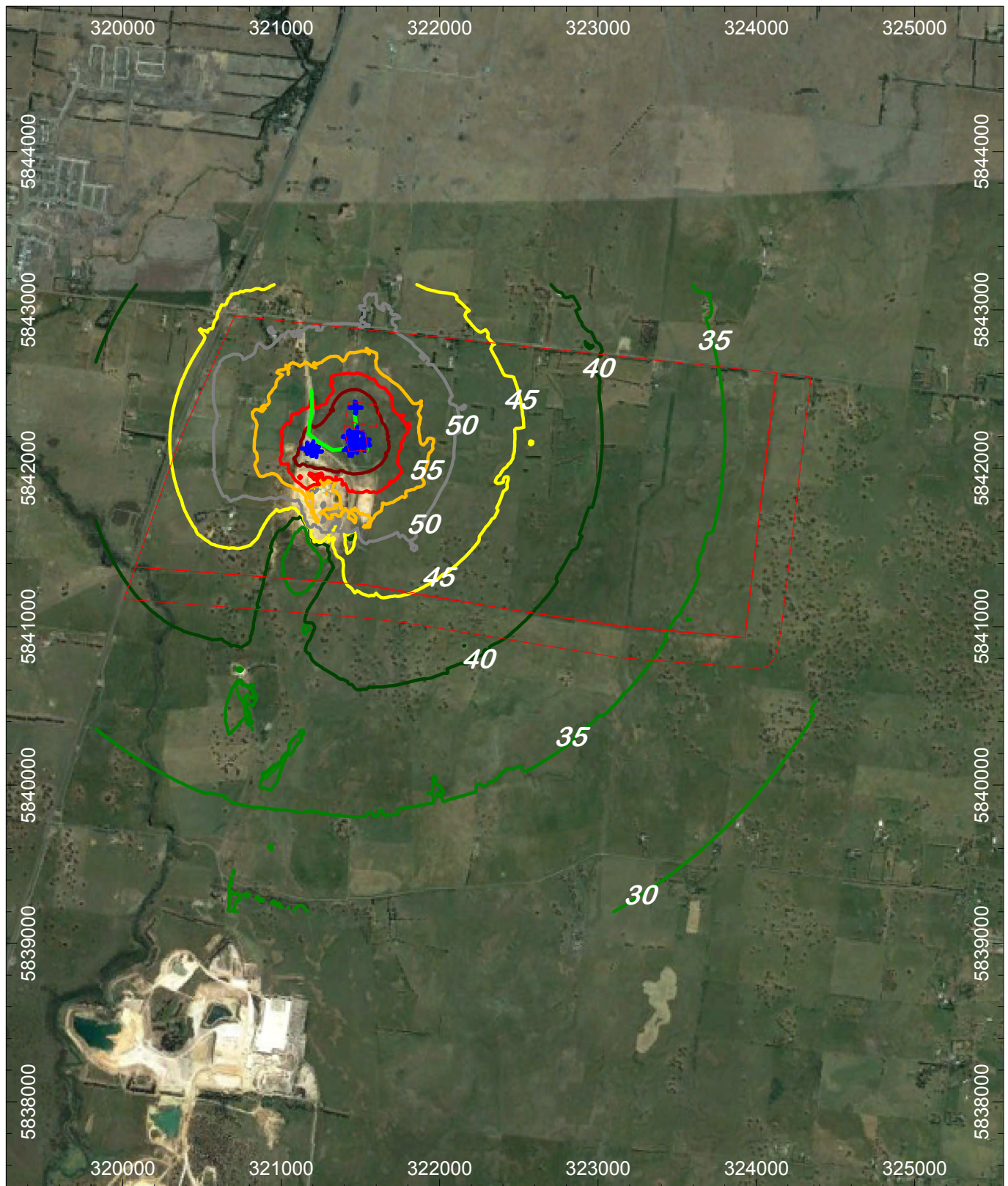


Figure 9 Scenario 2: Woody Hill proposed expansion to the north

6.7 Noise mitigation strategies

Noise mitigation strategies can generally be divided into four different areas from the most to the least preferred (NSW INP, 2000):

1. *Land-use Controls* (separating the location of noise-producing activities from sensitive areas)
2. *Control at Source* (reduce the noise output of the source to provide protection surrounding environment)
3. *Control in Transmission* (reduce noise level at the receiver but not necessarily the environment surrounding the source, e.g. noise barrier, etc.
4. *Receiver Control* (localised acoustic treatment at sensitive receiver)

Discussion with the asset owner may need to be undertaken to provide effective, agreed noise mitigation measures for the quarry, as necessary.

Should a control at source noise mitigation strategy not be possible or practicable, it is not uncommon that the indoor amenity of sensitive receivers subject to quarry operational noise be acoustically treated using a control at receiver strategy, via building acoustic treatments. However, the limitation of this strategy is that it would not preserve the outdoor amenity of the receiver unless a combination of controls aimed at reducing noise during transmission also be implemented.

Development may still be able to occur within the 600 m buffer following appropriate mitigation either at the quarry or via building acoustic treatments at the sensitive receiver location. Without mitigation at the source, ambient levels would remain the same and so some consideration of this would be required during planning as to what type of use was appropriate within the 600 m buffer. The mitigation strategies provided below are in-principle mitigation measures only, and each new sensitive use coming into the area would need to review and design for their site-specific requirements.

6.7.1 Land-use controls

There are several strategies involved in using the land-use control measures:

- **Setbacks strategy** (e.g. open space design adjacent to noisy industries, busy roads and/or railway corridors to provide noise reduction through setback distances to residential uses).
- **Setback distances** between the noise source and the noise sensitive receiver could be one form of treatment in reducing the noise exposure level at the proposed PSP. A setback strategy would also be effective in mitigating ground-borne vibration impacts from the nearby Donnybrook Road, quarry blasting activities, or other vibration sources.
- **Building locations and height controls** for example, taller buildings could be located adjacent to primary noise sources to provide a noise shielding effect to residential uses or the overall PSP.
- **Expansion of cycle and pedestrian facilities**, to discourage the use of motor vehicles and encourage the use of bicycles, scooters or walking, which would result in less noise emission within the area.
- **Impose acoustic control planning conditions on new developments**, this could be in the form of a council's planning permit condition, specifying acoustic treatment on noise sensitive developments.

6.7.2 Control at source

There are several strategies involved in using the Control at Source measure:

- Fit and maintain appropriate mufflers on earth-moving and other vehicles on the site
- Enclose noisy equipment
- Provide noise attenuation screens/shields such as buildings, earthen bunds directly adjacent noise sources, where appropriate Traffic management to reduce the need for multiple heavy vehicle deliveries to one location
- Acoustic treatment to specific noise sources from specific nearby industry
- Promoting the use of low pavement surfaces on new roads or the resurfacing of existing roads. The type of road surface has a significant effect on the level of noise generated by the tyre/road interface. Austroads Technical Report “*Austroads Review Report: Traffic Noise/Long-life Surfacing*” (Austroads, January 2011) provides relative noise emission levels of conventional road surfacings in Australia, based on studies conducted by (Campbell & Isles, 2001), (Parnell, 2006) and (Samuels, 2008) (refer to Table 9).

Table 9 Relative noise emission levels of conventional surfacings in Australia

Surfacing type	Noise level variation dB(A)		
	Traffic Noise	Individual vehicles pass-by noise	
		Cars	Trucks
Size 14 single/single seal	+4.0	+4.0	+4.0
Size 7 single/single seal	+1.0	-	-
Portland cement concrete (PCC) tyned and dragged	0 to +3.0	+1.0 to +3.5	=1.0 to +1.0
Cold overlay	+2.0	+2.0	+2.0
Dense Graded Asphalt (DGA)	0	0	0
Portland Cement Concrete (PCC): exposed aggregate	-0.5 to -3.0	-0.1	-6.7
Stone Mastic Asphalt (SMA)	-2.0 to -3.5	-2.2	-4.3
Open Graded Asphalt (OGA)	0 to -4.5	-0.2 to -4.2	-4.9

In general, sealed surfaces would not be recommended for low noise surfacing purposes, as they tend to generate higher traffic noise levels compared to asphalt surfacing. Similarly, to concrete surfacing, they tend to generate higher noise levels than asphalt surfacing. The ageing of pavement and its construction quality can also affect the noise performance, Table 10 details the change in acoustic performance of road pavement due to ageing.

Table 10 Change in acoustic performance due to aging

Road surface	Noise level variation dB(A)		
	When fresh	Several years old	Change
Sprayed seal	+4	+2	-2
Dense Graded Asphalt (DGA)	0	+1	+1
Open Graded Asphalt (OGA)	-4	-2	+2

For more detailed information on traffic mitigation please refer to GHD Report #51460.

6.7.3 Control in transmission

The noise reduction strategy used to control in noise transmission usually involves the installation of noise barriers. Noise barriers may include an existing feature, such as:

- An elevated road or a natural slope (e.g. earth mound)
- A purpose designed feature such as a solid boundary fence
- A purpose designed feature of the building, such as a partially enclosed carport
- A purpose designed building which acts as a barrier block

In general, the noise barrier should provide sufficient screening to avoid direct line of sight between the shielded noise sources and the protected sensitive receivers. Noise barriers would not be effective in reducing noise impacts if the line of sight from the noise source to the residence is not reduced. Hence, it may not be practical to install a noise barrier for elevated receivers.

6.7.4 Receiver control

There are several strategies involved in using the Receiver Control measure:

- Building orientation layout. This involves configuring the development's floor plan to have sleeping areas/habitable areas facing away from the noise sources
- Minimise lightweight external wall construction facing the dominating noise sources
- Thicker glazing construction for the window façade
- Minimise window size and maximise masonry external wall construction
- Minimise the use of openable window construction
- Configure any discharge/intake duct grill layout (above ceiling level) facing away from the noise sources
- Balustrade/balcony design/configuration to avoid direct line of sight from the balcony to the noise sources (this shall be confirmed following the design of the development and landscape layout)
- Installation of foam rubber pad along the required building foundation plate, where necessary, depending the magnitude of the potential exposed vibration across the building structures

7. Vibration impact assessment (non-blasting)

The operation of the Woody Hill Quarry would have the potential to generate vibration impacts within the Shenstone Park PSP site.

The purpose of this vibration assessment is to assess the likelihood of impact from possible expansions of the Woody Hill Quarry.

7.1 Legislation, policy and guidelines

7.1.1 Human comfort

In the absence of any local guidelines, human comfort vibration criteria have been set with consideration to the NSW EPA *Environmental Noise Management – Assessing Vibration: A Technical Guideline (AVTG)* (NSW EPA, February 2006). British Standard 6472:2008, *Guide to Evaluation of Human Exposure to Vibration in Buildings Part 1: Vibration Sources Other than Blasting* (BS 6472, 2008) is recognised by the NSW EPA AVTG as the preferred standard for assessing 'human comfort'.

BS 6472:2008 is commonly recognised in Australia as the preferred standard for assessing human comfort criteria for residential receptors. Table 11 includes the acceptable values of vibration dose for residential receptors during daytime and night-time periods.

These values represent the best judgement available at the time the standard was published and may be used for both vertical and horizontal vibration, providing that they are correctly weighted.

Table 11 Vibration dose value (VDV) ranges and probabilities for adverse comment to intermittent vibration (m/s^{1.75})

Location	Low probability of adverse comment ^[a]	Adverse comment possible	Adverse comment probable ^[b]
Residential buildings 16 hour day (7.00 am to 11.00 pm)	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 hour night (11.00 pm to 7.00 am)	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

Notes:

^a Below these ranges adverse comment is not expected.

^b Above these ranges adverse comment is very likely.

BS 6472 outlines vibration limits, which would cause minimal adverse reactions from the occupant. The assessment of response to vibration in BS 6472 is based on VDV, for construction related vibration (similar to quarry operations), it is considered more appropriate to provide guidance in terms of peak particle velocity (PPV) in millimetres per second, since this parameter is likely to be more routinely measured due to concerns over potential building damage.

BS 5228-2:2009 *Code of Practice for Noise and Vibration on Construction and Open Sites – Part 2: Vibration* (BS 5228.2, 2009) recommends that the guidance values presented in Table 12 are appropriate for construction type works, as it is easier to assess the intermittent vibration criteria against peak value rather than a dose value. BS 5228.2 also recognises that higher vibration levels are tolerable for short-term projects, as undue restriction on vibration levels can substantially prolong projects and result in greater annoyance.

Many of the types of equipment used at the Woody Hill Quarry are the same or similar to those commonly used in construction such as excavators, bull dozers, dump trucks and graders, and as such, BS 5228.2:2009 is considered to be relevant for this report.

Humans are capable of detecting vibration at levels that are well below those with the potential risk of causing damage to a building. The degree of perception for humans is suggested by the vibration level categories given in BS 5228-2:2009, as shown in Table 12.

Table 12 Guidance on the effects of vibration levels (BS 5228.2)

Approximate vibration level	Typical degree of perception
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

Based on Table 12, the human response to vibration could be summarised as:

- A vibration level in the range between 0.14 mm/s to 0.3 mm/s would generate a low probability of adverse comment or complaint
- A vibration level in the range between 0.3 mm/s to 1 mm/s would generate the possibility of adverse comment or complaint
- A vibration level greater than 1 mm/s would likely cause adverse comment or complaint

The vibration limits in Table 12 have been adopted for this assessment.

7.1.2 Structural damage

Currently, there is no Australian Standard that sets the criteria for the assessment of building or other structural damage caused by vibration. Australian Standard 2436:2010 – *Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites*; does refer to the control of vibration in Section 4.8.1. The supplied information in AS 2436 is general in nature and refers to other standards and guidelines if a more detailed assessment is required, i.e. quantification of vibration exposure. British Standard BS 7385.2:1993 – *Evaluation and Measurement for Vibration in Buildings: Part 2 – Guide to Damage Levels from Ground Borne Vibration* and British Standard BS 5228.2:2009 – *Code of Practice for Noise and Vibration Control on Construction and Open Sites: Part 2 Vibration*; are referenced in AS 2436 as being able to supply detailed vibration quantification.

Additional to the detailed British Standards, the German Standard *DIN 4150-3: 1999 Structural Vibration – Part 3: Effects of Vibration on Structures* (German Standards, 1999) provides more stringent vibration criteria as opposed to BS 7385.2:1993 for above ground structures, but less stringent criteria for below ground structures when compared to BS 5228.2:2009. Therefore, a combination of the German and British Standards is recommended, in the absence of specific criteria being supplied by the asset owner, as shown in Table 13.

Table 1 of Section 5 of DIN 4150.3:1999 presents guideline values for the maximum absolute value of the velocity “*at the foundation and in the plane of the highest floor of various types of building. Experience has shown that if these values are complied with, damage that reduces the serviceability of the building will not occur. If damage nevertheless occurs, it is to be assumed that other causes are responsible.*”

Measured values exceeding those listed in Table 13 “... *does not necessarily lead to damage; should they be significantly exceeded, however further investigations are necessary.*”

Table 13 Guidance values for short-term vibration on structures

Line	Type of structure	Guideline values for velocity $v(t)^{[a]}$ (mm/s)		
		1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz ^[b]
At grade structures (DIN 4150.3:1999)				
1	Buildings used for commercial purposes, industrial buildings, and buildings of similar design.	20	20 to 40	40 to 50
2	Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20
3	Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g. listed buildings under preservation order)	3	3 to 8	8 to 10
Underground structures (BS 5228.2:2009)				
Competent structure such as steel or concrete pipeline		30		
Dilapidated brickwork		15		

^a The term v_i refers to vibration levels in any of the x, y or z axis.

^b Where frequencies are above 100 Hz the values given in this column may be used as minimum values.

The vibration criteria presented in German Standard DIN 4150.3:1999 exceeds the human comfort criteria presented in Table 12. Therefore, for facilities that people occupy, the human comfort criteria should override the structural damage criteria for the assessment of any vibration.

7.2 Vibration assessment

Many of the types of equipment used in the quarry are similar in nature to those used in construction activities such as loaders, trucks and excavators and some of the equipment used has the potential to generate vibration.

Energy from the types of equipment used in the quarry is transmitted into the ground and transformed into vibrations, which attenuate with distance. The magnitude and attenuation of ground vibration is dependent on:

- The efficiency of the energy transfer mechanism of the equipment (i.e. impulsive, reciprocating, rolling or rotating equipment)
- The frequency characteristics of the vibrations produced

- The impact medium stiffness (where vibrations are passing through)
- The type of wave (surface or body)
- The ground type and topography (i.e. transmissivity and trough isolation effects)

Due to the above factors, there is an inherent variability in ground vibration predictions without site-specific measurement data. In lieu of Woody Hill Quarry based information, the NSW RTA *Environmental Noise Management Manual (ENMM) 2001* (RTA NSW, 2001) provides typical construction equipment ground vibration levels at 10 m.

The ENMM states that: “*in obtaining an initial indication of likely vibration levels, it can be assumed that the vibration level is inversely proportional to distance. Note, however, that field data show a wide variation in distance attenuation, with the distance relationship generally varying between $d^{-0.8}$ and $d^{-1.6}$ rather than being fixed at d^{-1} .*”, where d =distance.

The rate of vibration attenuation can be calculated from the following regression analysis formula:

$$V = kd^{-n}$$

Where:

V = PPV (peak particle velocity)

d = Distance

n = attenuation exponent. The value of n generally lies between 0.8 and 1.6 with a relatively common value of 1.5^[10].

k = Velocity (PPV) at $d=1$ unit of distance

The predicted ground vibrations at various distances are shown in Table 14 for typical equipment used at quarries and in construction of haul roads and movement of earthen materials.

Given the distances involved between site works and the nearest receivers, vibrations affecting human comfort and building integrity are not expected to be an issue.

Table 14 Predicted construction equipment vibration levels (mm/s PPV)

Plant item ^[11]	Human perception preferred criteria (mm/s PPV) (maximum criteria)		Predicted ground vibration (mm/s PPV)				
	Day	Night	10 m	50 m	100 m	200 m	500 m
15 t roller	0.28 (0.56)	0.2 (0.4)	7.5	0.7	0.2	0.1	<0.1
Dozer	0.28 (0.56)	0.2 (0.4)	3.3	0.3	0.1	<0.1	<0.1
7 t compactor	0.28 (0.56)	0.2 (0.4)	6.0	0.5	0.2	0.1	<0.1
Excavator ^[12]	0.28 (0.56)	0.2 (0.4)	3.6	0.3	0.1	<0.1	<0.1
Grader ^[13]	0.28 (0.56)	0.2 (0.4)	2.0	0.2	0.1	<0.1	<0.1

¹⁰ Construction Vibrations: State of the Art (Wiss, 1981)

¹¹ NSW RTA Environment noise management manual

¹² The predicted ground vibration values were based on data stipulated in Cenek.P.D, et al. *Ground vibration from road construction* (May 2012) Research paper.

¹³ Tynan, A.E. Ground Vibrations. Damaging effects to Buildings. Australian Road Research Board 1973

7.3 Summary

It is expected that any vibrational impact from equipment such as graders or excavators onsite within the Woody Hill Quarry would be not be perceptible by a human beyond a distance of approximately 100 m from the work authority boundary.

It is also unlikely that operational vibrations from the Woody Hill Quarry would be perceptible in residential environments after 50 m from the work authority boundary.

Given the distances involved between site works and the most likely future location of receivers, vibrations affecting human comfort and building integrity are not expected to be an issue beyond 100 m from a potential northern or southern quarry operation.

Hence, it is recommended a 100 m operational (non-blast) vibration buffer around the approved extraction area for the Woody Hill Quarry therefore be prescribed.

8. Blast generated fly rock

Fly rock and fly (other debris) occur when the explosive energy from the gas expansion in a blast event is vented violently into the atmosphere, and forces rocks and debris to be thrown outward from the blast location.

The major cause of fly rock is due to incorrectly drilled and stemmed charges or natural weakness in rocks causing premature gas venting. However, there are a number of contributing factors as outlined in AS 2187.2:2006 *Explosives – storage and use of explosives*, as follows:

- Weak rock structure
- Insufficient front row blast hole burdens
- Stemming depth
- Initiation sequence
- Blast hole diameter
- Blast pattern shape, or
- Stemming material

Generally, through carefully implemented control measures, most fly rock can be contained within the active pit area to approximately 50 m in front of the face. Industry practice is to allow at least a factor of four times this distance as a safety factor.

DEDJTR's advice¹⁴ indicates that a 200 m radial buffer distance from the boundary of the extraction area is sufficient to mitigate against safety issues from fly rock during blasting.

This 200 m buffer is to be radial in shape as the fly rock component will be independent of wind speed and direction due to the projectile speed of fly rock, negating any meteorological influence.

¹⁴ Meeting with DEDJTR on 17 October 2017

9. Blast generated noise

The quarrying operations at the Woody Hill Quarry would have the potential to generate environmental blast noise impacts onto the Shenstone Park PSP site. This section discusses the potential impacts for each of the possible expansion scenarios.

Air blast is the pressure wave (sound) produced by a blast event being transmitted through the air causing a pressure change at the human ear. The sources of air blast include:

- A small air pressure pulse generated by the ground vibration
- A direct air pressure pulse from rock movement
- A direct air pressure pulse from blast gas venting

An air blast can be heard when the frequencies are within the normal human hearing range of between 20 Hz and 20 kHz and can travel large distance during temperature inversions causing sound waves to reflect back to ground long distances from the source.

Air blast frequencies below the natural human hearing range (low frequency) are often noticed by residents as pressure waves that cause rattling of windows and sliding doors.

Air blast is normally heard after the ground vibration, as the waves travelling in the ground move faster than those through the air. Air blast is known to cause more complaints than vibration.

9.1 Legislation, policy and guidelines

9.1.1 Blast overpressure

Guidance on potential blast overpressure (noise) is provided from the Australian and New Zealand Environment Council (ANZEC) *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration (1990)*. This guideline recommends noise and vibration limits for human comfort for residential dwellings as shown in Table 15.

Table 15 Recommended ANZEC 1990 blasting limits for residential dwellings (human comfort)

Parameter	Vibration Criteria
Maximum level	115 dB(lin) peak
Allowances	The level of 115 dB may be exceeded on up to 5% of the total number of blasts over a period of 12 months, but never over 120 dB(lin) peak.

Table J5.4(A) of AS 2187.2 – 2006 provides a slight variation on the ANZEC guideline to differentiate between operations lasting less than 12 months and longer term operations, as well as providing guidance on criteria for occupied non-sensitive sites, such as factories and commercial premises, refer to Table 16.

Table 16 Air blast limits for human comfort chosen by some regulatory authorities (Table J5.4(A) of AS 2187.2 – 2006)

Category	Type of blasting operations	Peak sound pressure level (dBL)
Human Comfort Limits		
Sensitive Site*	Operations lasting longer than 12 months or more than 20 blasts	115 dBL for 95% blasts per year. 120 dBL maximum unless agreement is reached with occupier that a higher limit may apply.
Sensitive Site*	Operations lasting for less than 12 months or less than 20 blasts	120 dBL for 95% blasts. 125 dBL maximum unless agreement is reached with occupier that a higher limit may apply.
Occupied non-sensitive sites, such as factories and commercial premises	All blasting	125 dBL maximum unless agreement is reached with occupier that a higher limit may apply. For sites containing equipment sensitive to vibration, the vibration should be kept below manufacturer's specifications or levels that can be shown to adversely affect the equipment operation.

*A sensitive site is defined under AS 2187.2 as including houses and low rise residential buildings, hospitals, theatres, schools, etc., occupied by people.

Table J5.4(B) of AS 2187.2 – 2006 provides recommended air blast limits for structural damage control, refer to Table 17.

Table 17 Air blast limits for damage control (Table J5.4(B) of AS 2187.2 – 2006)

Category	Type of blasting operations	Peak sound pressure level (dBL)
Damage Control Limits		
Structures that include masonry, plaster and plasterboard in their construction and also unoccupied structures of reinforced concrete or steel construction	All blasting	133 dBL maximum unless agreement is reached with owner that a higher limit may apply.
Service structure such as pipelines power lines and cables located above the ground.	All blasting	Limit to be determined by structural design methodology

9.2 Blast generated noise assessment

Ground blast overpressure was estimated using the distance relationship calculation outlined in AS 2187.2 – 2006.

$$P = K_a \left(\frac{R}{Q^{1/3}} \right)^a$$

Where

P = pressure in kilopascals

R = distance from charge, in metres

Q = explosive charge mass, in kg

K_a = Site constant

a = Site exponent

The standard recommends a site constant of $K_a=10$ to 100 and site exponent of $a=-1.45$. Air blast is proportional to the cube root of the charge mass. A variety of factors are important in reducing the noise level (blast overpressure) from the blast event such as the blast design parameters such as charge size, stemming height, delay timing and site specific site constants.

A preliminary assessment of air blast overpressure impacts was considered using the three site constants of $K_a=10$, $K_a=50$, and $K_a=100$ and site exponent of $a=-1.45$. Blast distances are taken as distance from charge, however for the purpose of this report assume as being taken at the extraction limit boundary, as this would likely be the worst-case scenario.

As the blast size Maximum Instantaneous Charge (MIC) is unknown at this stage, the equation above was used to identify possible MIC values based on the receiver distance and air blast criteria at sensitive receivers.

Further analysis was undertaken to compare the airblast overpressure in relation to the MIC quantum using the same formula, however taken from the standpoint of charge selection. Three charge quantum's of $Q=10$, $Q=50$, and $Q=100$ and a site exponent of $a=-1.45$ were assessed for a range of K_a values.

Air blast overpressure predictions are presented in Figure 10 through Figure 15 below.

The variation in buffer distance demonstrated by the range of K_a and MIC values indicates that the residential development is feasible providing the blasts are implemented appropriately at the quarry. It is recommended that site constants be confirmed using small test blasts to further refine the predictions. Historical blast monitoring results may also be useful in providing additional information.

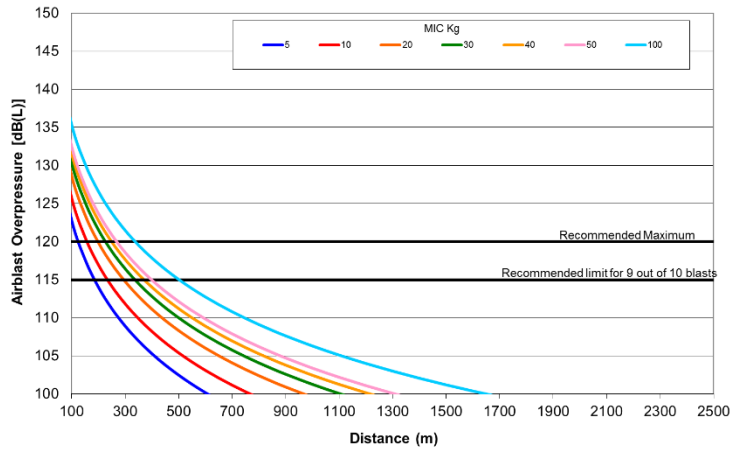


Figure 10 Airblast overpressure at distance over various maximum instantaneous charge (MIC) quantum in kilograms (where, $K_s=10$, and $a=-1.45$)

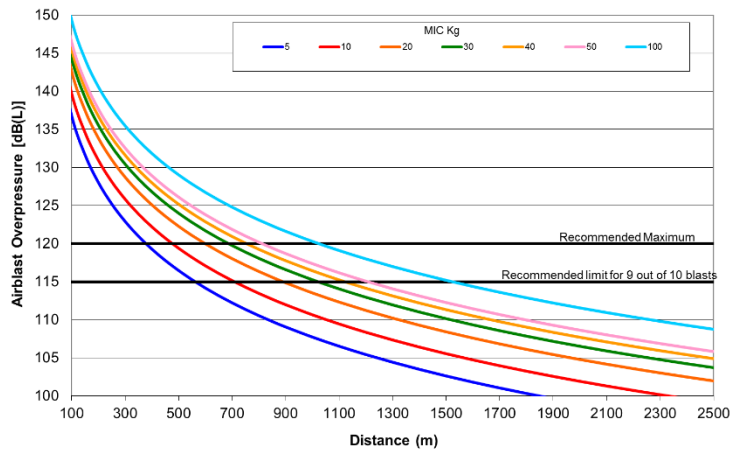


Figure 11 Airblast overpressure at distance over various maximum instantaneous charge (MIC) quantum in kilograms (where, $K_s=50$, and $a=-1.45$)

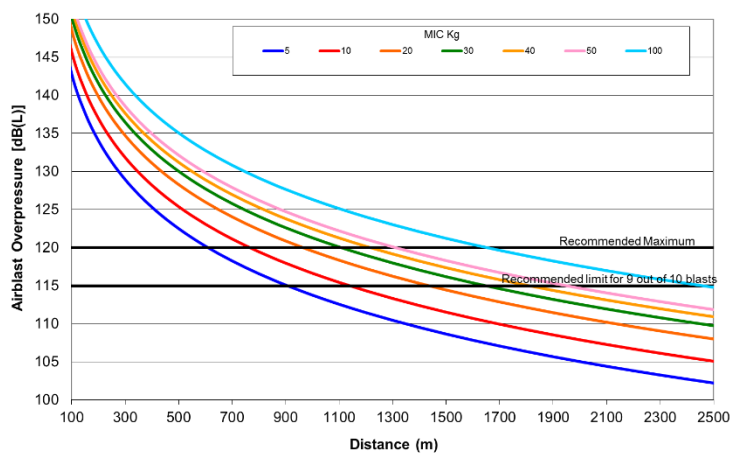


Figure 12 Airblast overpressure at distance over various maximum instantaneous charge (MIC) quantum in kilograms (where, $K_s=100$, and $a=-1.45$)

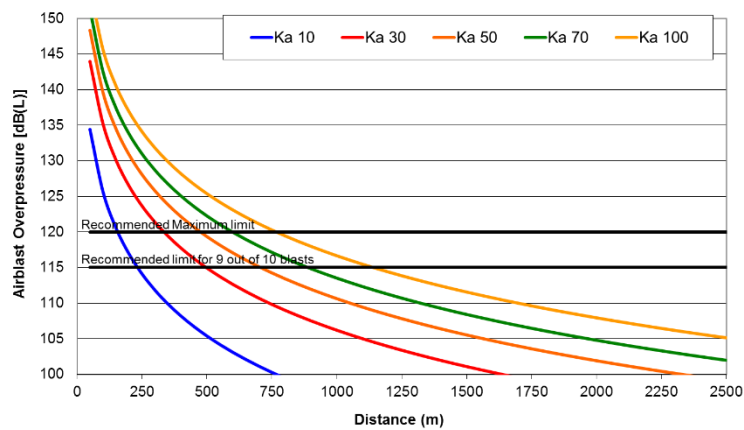


Figure 13 Airblast overpressure at distance over various site constants (K_a) (where, $Q=10$, and $\alpha=-1.45$)

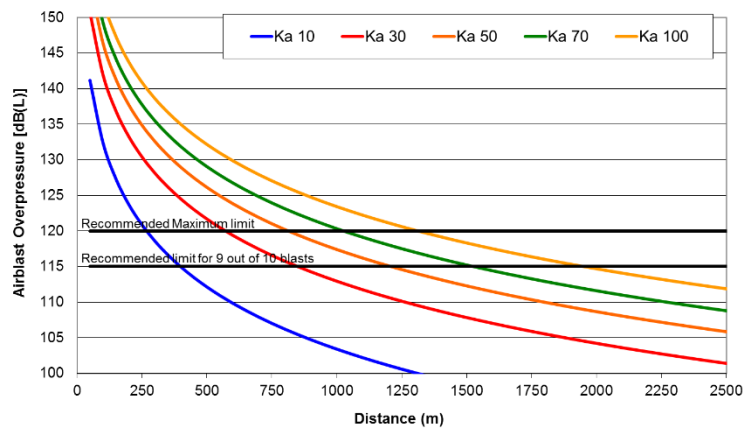


Figure 14 Airblast overpressure at distance over various site constants (K_a) (where, $Q=50$, and $\alpha=-1.45$)

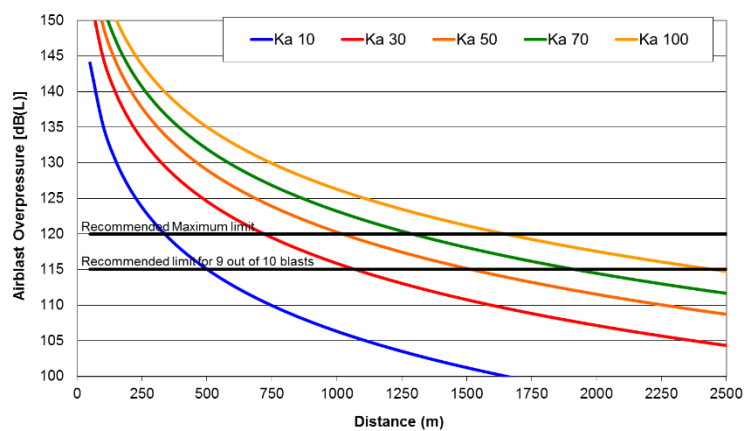


Figure 15 Airblast overpressure at distance over various site constants (K_a) (where, $Q=100$, and $\alpha=-1.45$)

9.3 Summary

The predictions summarised in Figure 10 through Figure 15 show the high sensitivity of blast overpressure to the various blast design parameters and site constants. The variation in buffer distance demonstrated by the range of K_a and MIC values indicates that the residential development is feasible providing the blasts are implemented appropriately at the quarry. It is recommended that site constants are confirmed using small test blasts to further refine the predictions. Historical blast monitoring results may also be useful in providing additional information.

Air blast is a short-lived impact of approximately one second per blast, however even when prepared for the sound, people at sensitive receiver locations are often still startled when it occurs, therefore warnings from the quarry as to an impending blast, such as a warning siren or similar, will be important for notifying the local community.

Over a 12-month period, where blasting occurs one time per month, the total air blast overpressure time would amount to approximately 12 seconds per year.

10. Blast generated vibration

The operation of the Woody Hill Quarry would have the potential to generate environmental blast vibration impacts onto the Shenstone Park PSP site. This section discusses the potential impacts from this type of impact for the possible expansion scenarios.

10.1 Legislation, policy and guidelines

10.1.1 Blast vibration

Guidance on potential blast overpressure (noise) is provided from the Australian and New Zealand Environment Council (ANZEC) *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration (1990)*. This guideline recommends noise and vibration limits for human comfort for residential dwellings as shown in Table 18.

Table 18 Recommended ANZEC 1990 blasting limits for residential dwellings (human comfort)

Parameter	Vibration Criteria
Maximum level	5 mm/s PPV
Allowances	The level of 5 mm/s may be exceeded on up to 5% of the total number of blasts over a period of 12 months, but never over 10 mm/s.
Long term	It is recommended that a level of 2 mm/s (PPV) be considered as the long-term regulatory goal.

AS 2187.2 – 2006 *Explosives – Storage and use, Part 2: Use of explosives* references to British Standard, BS 7385-2 – 1993 *Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration* for guidance values to limit cosmetic and minor building structural damage. These limits are shown in Table 19.

Table 19 Transient vibration guide values for cosmetic damage (BS 7385-2)

Line	Type of building	PPV in frequency of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures. Industry and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structure. Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Requirements for building vibration may not be sufficient to cover high-rise buildings, buildings with long span floors, specialist structures including hospitals or those with sensitive equipment. These cases require special consideration, which may include measurement on the structure itself with particular attention given to suspended floors. Further consideration will also be required in relation to underground services including pipes and cables. For heritage structures this assessment has adopted the DIN 4150-3: 1999 criteria found in Table 13 of this report as 'line 3' structures.

10.1.2 Buried pipework

GHD understand a 35 m wide Gas and Fuel Commission easement exists to the east of the Phillips Quarry. Based on the City of Whittlesea Planning Permit 704901 issued for the quarry, a 300 mm high-pressure gas main is buried within the easement boundary.

DIN 4150-3:1999 – *Structural Vibration Part 3: Effects of vibration on structures* provides guidance on the effect of short-term vibration on buried pipework such as may occur through blasting. Table 20 includes the acceptable values of vibration from DIN 4150-3:1999 in mm/s for short-term vibration on buried pipework. The values provided are based on measurements to be taken on the pipe surface.

The guideline values provided in Table 20 can be reduced by 50% without further analysis when assessing the impact of long-term vibrational impacts on the pipework.

Table 20 Guideline values for short-term vibration on buried pipework

Line	Pipe material	Guideline values for velocity measured on the pipe, v_i , in mm/s
1	Steel (including welded pipes)	100
2	Clay, concrete, reinforced concrete, pre-stressed concrete, metal with or without flange)	80
3	Masonry, plastic	50

10.2 Vibration assessment

Blasting may be required during the quarrying process. Depending on the actual ground conditions encountered, there is the potential that if development is too close to the quarry, vibrations for sensitive receivers may exceed the blasting vibration limits.

Ground vibration was estimated using the distance relationship calculation outlined in AS 2187.2 – 2006.

$$V = K_g \left(\frac{R}{Q^{1/2}} \right)^{-B}$$

Where

V = ground vibration as a vector peak particle velocity in mm/s

R = distance between charge and point of measurement, in metres

Q = maximum instantaneous charge (effective charge mass delay), in kg

K_g = Site constant related to rock properties

B = Site exponent

The standard recommends a site constant of $K_g=1140$ and site exponent of $B=1.6$ for average conditions when blasting is to be carried out in free face conditions, however the resulting vibration predictions are a median value with 50% probability of exceedance and actual vibration levels may vary from 40 percent to 400 percent of the predictions.

For a preliminary assessment scenario for vibration impacts, blasting was considered to occur at the extraction limit boundary. As blast size Maximum Instantaneous Charge (MIC) is unknown at this stage, the equation was used to identify possible MIC values based on the receiver distance and vibration criteria levels. Ground vibration predictions are presented in Table 21, where pink outline values above the long-term regulatory goal of 2 mm/s.

Further assessment comes from Table J7.3.1 of AS 2187.2:2006 which outlines the 2 m/s, 5 m/s, and 10 mm/s criteria outline in the ANZEC guideline as well as a 25 mm/s criteria for occupied non-sensitive sites, such as factories and commercial premises, refer to Table 22.

British Standard BS 6472-2 provides in Table B.1 data from measurements of blast vibrations at three maximum instantaneous charge levels of 75 kg, 100 kg, and 120 kg. The produced charts shows compliance with the ANZEC short-term guideline generally occurs around a distance of 550 m.

Table 21 Predicted blast ground vibration PPV, mm/s (AS 2187.2:2006)

Distance to nearest blast location (m)	Predicted Blast Ground Vibration PPV (mm/s)									
	site constant K(ground) = 1140									
	MIC (kg)									
	0.5	1.0	2.0	5.0	10	20	30	40	50	100
50	1.25	2.18	3.80	7.90	13.76	23.95	33.13	41.71	49.86	86.81
100	0.41	0.72	1.25	2.61	4.54	7.90	10.93	13.76	16.45	28.64
150	0.22	0.38	0.65	1.36	2.37	4.13	5.71	7.19	8.60	14.97
200	0.14	0.24	0.41	0.86	1.50	2.61	3.61	4.54	5.43	9.45
250	0.10	0.17	0.29	0.60	1.05	1.82	2.52	3.18	3.80	6.61
300	0.07	0.12	0.22	0.45	0.78	1.36	1.88	2.37	2.84	4.94
350	0.06	0.10	0.17	0.35	0.61	1.06	1.47	1.85	2.22	3.86
400	0.04	0.08	0.14	0.28	0.49	0.86	1.19	1.50	1.79	3.12
450	0.04	0.06	0.11	0.23	0.41	0.71	0.99	1.24	1.48	2.58
500	0.03	0.05	0.10	0.20	0.35	0.60	0.83	1.05	1.25	2.18
550	0.03	0.05	0.08	0.17	0.30	0.52	0.71	0.90	1.08	1.87
600	0.02	0.04	0.07	0.15	0.26	0.45	0.62	0.78	0.94	1.63
650	0.02	0.04	0.06	0.13	0.23	0.40	0.55	0.69	0.82	1.43
700	0.02	0.03	0.06	0.12	0.20	0.35	0.49	0.61	0.73	1.27
750	0.02	0.03	0.05	0.10	0.18	0.31	0.44	0.55	0.65	1.14
800	0.01	0.03	0.04	0.09	0.16	0.28	0.39	0.49	0.59	1.03
850	0.01	0.02	0.04	0.08	0.15	0.26	0.36	0.45	0.54	0.93
900	0.01	0.02	0.04	0.08	0.13	0.23	0.32	0.41	0.49	0.85
950	0.01	0.02	0.03	0.07	0.12	0.22	0.30	0.38	0.45	0.78
1000	0.01	0.02	0.03	0.07	0.11	0.20	0.27	0.35	0.41	0.72
1050	0.01	0.02	0.03	0.06	0.11	0.18	0.25	0.32	0.38	0.67
1100	0.01	0.02	0.03	0.06	0.10	0.17	0.24	0.30	0.35	0.62

Table 22 Free face vibration at distance compared to MEC (AS 2187.2:2006)

Vibration (VPPV) mm/s	Estimated maximum effective charge per delay, kg													
	Distance, m													
	1	5	10	20	30	50	80	100	150	200	300	500	800	1000
2	-	0.010	0.035	0.145	0.3	0.9	2.3	3.6	8	14	32	90	230	360
5	0.001	0.030	0.110	0.450	1.0	2.8	7.2	11.3	25	45	100	280	720	1,130
10	0.003	0.070	0.270	1.050	2.4	6.7	17.2	26.9	60	105	240	670	1,720	2,700
25	0.008	0.210	0.840	3.400	7.6	21.0	54.0	84.2	190	340	760	2,100	5,400	8,400

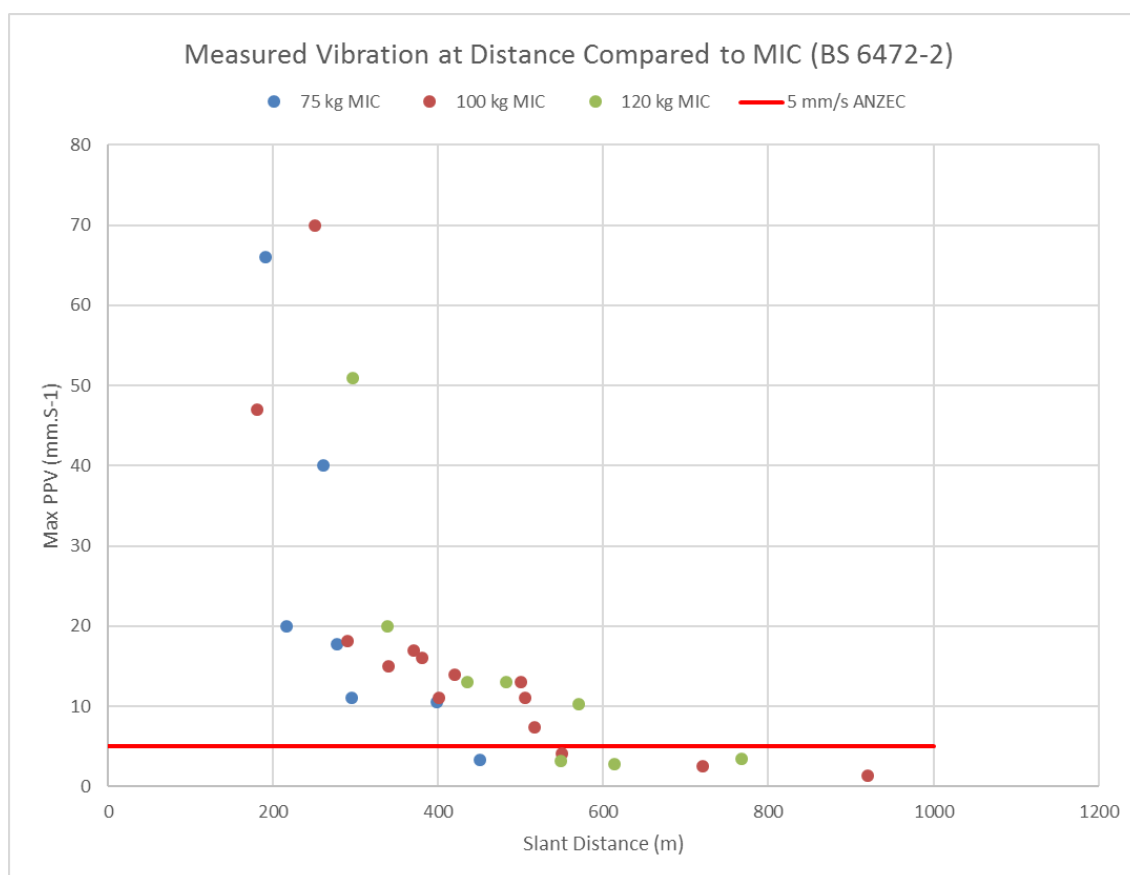


Figure 16 Measured vibration at distance compared to MIC (BS 6472-2)

10.3 Summary

It is expected that any vibrational impact from blasting at the Woody Hill Quarry would require a distance of approximately 550 m from the extraction boundary to provide sufficient attenuation for a blast with MIC of approximately 100 kg to meet the 2 mm/s (PPV) long-term regulatory goal.

11. Future land use planning considerations

11.1 Key findings and development constraints

This report has highlighted that potential amenity impacts from the possible expansions of the Woody Hill Quarry and the encroachment of incompatible land uses, must be managed through the development of the PSP and planning controls for the precinct. Protecting significant assets whilst enabling sustainable development to occur is important, as incompatible land uses may adversely impact the operations and viability of the quarry into the future and in turn impact the amenity and health of the community

Dust

Two possible expansion scenarios were assessed for the Woody Hill Quarry. From the EPA guideline, an active quarry with blasting has a recommended buffer of 500 m. Though not specified in the guideline, the 250 m difference in separation distance applying to blasting activities at 500 m and auxiliary activities appears to account for possible transport of dust particles.

The default 500 m buffer applied to the extraction boundaries for the two scenarios extend onto the PSP area.

The EPA also allow for a site-specific variation to the default buffer distance for a given industry and identifies six criteria to consider in Table 4 of the guideline. It is likely that some of the factors listed in that table could vary the default buffer, if specific operational details about the industry are known.

Two criteria that allow for site specific variations which would have the biggest impact in varying the default buffers are considered to be size of the facility (de-rating a default buffer) and local meteorology (directional buffer).

GHD considers that the relevant buffer for the active quarry area with blasting should be the default 500 m buffer irrespective of the throughput of the quarry.

However, GHD considers that the directional buffer would apply to the default 500 m buffer given that the default buffer accounts for possible transport of dust particles, which would be subject to meteorological influences. The local meteorology would only apply during daytime hours for the quarries as blasting would only occur during the daytime.

DEDJTR's advice¹⁵ indicates that a 200 m radial buffer distance from the extraction boundary of the extraction area is sufficient to mitigate against safety issues from flyrock during blasting, with which GHD agrees. This buffer is to be radial as the flyrock component will be independent of wind speed and direction, as the projectile speed of flyrock is much higher than the wind speed.

The directional buffer assessment shows that the default buffer can be retracted and extended in the directions of good and poor dispersion. A large extension of the default buffer occurs to the east and northeast into the PSP, while the default buffer is retracted in the west due to anticipated meteorology conditions.

Dust dispersion modelling was also undertaken for dust impacts from the northern and southern extraction scenarios. The criterion for PM₁₀ (60 µg/m³) did marginally extend into PSP area. The PM₁₀ 24 hour criterion was predicted to be met at all existing sensitive receptors, and was predicted to be contained within the default and directional separation distances for the various scenarios. For an expansion of 20 m below the ground surface the impacts would be similar in nature to Scenario 1 presented in the earlier GHD Report #51460, albeit a slight 5% reduction for pit emission retention.

¹⁵ Meeting with DEDJTR on 17 October 2017

In order to manage the conflicts between land uses, there must be a balance between selecting measures that sufficiently mitigate amenity impacts and avoiding over regulation, therefore impacting on the ability to achieve other objectives, such as urban growth and environmental sustainability. However, in this instance, due to the adverse amenity impacts anticipated by the operation on the existing quarry, a conservative and cautious approach to any form of urban intensification surrounding the existing and future industries is the preferred approach.

Noise and vibration

Noise from the operation of the Woody Hill Quarry was audible at the noise logger located within the property at 960 Donnybrook Road.

Noise levels noted at this logger location are consistent with those predicted in modelling (Figure 8 and Figure 9), suggesting a good fit of the model to the current existing conditions occurring at the quarry, noting there is some conservatism in the model and also in the noise criteria to ensure adequate protection.

It is expected that the daytime noise levels generated from the two expansion scenarios for the Woody Hill Quarry will require a buffer of approximately 600 m from the extraction area to meet the daytime criteria of 48 dB(A), prior to any noise mitigation measures being implemented.

Modelling of the existing approved extraction area for the Woody Hill Quarry was also undertaken in the GHD report entitled '*City Of Whittlesea Council Impact Assessment Report for the Shenstone Park Precinct Structure Plan – December 2017*¹⁶'. In that report a buffer of 900 m was recommended, which is 300 m greater than that assessed in this report due to the elevated location of existing noise sources combined with the concrete batching plant. However, as the northern and southern extraction scenarios will be at a much lower elevation, this has enabled greater attenuation of the noise impact from each of these two scenarios reducing the buffer size by one third down to 600 m.

Generally, through carefully implemented control measures, most flyrock can be contained within the active pit area to approximately 50 m in front of the face. Industry practice is to allow at least a factor of four times this distance as a safety factor, this indicates that a 200 m radial buffer distance from the extraction boundary is sufficient to mitigate against safety issues.

Blast generated noise is very dependent on site specific constants and can vary significantly based on the blast methodology being used. Onsite measurements would be required prior to any future development to understand the air blast overpressure from each quarry's operation and what restrictions this would have on future development.

It is expected that any vibrational impact from blasting at the Woody Hill Quarry would require a distance of approximately 550 m from the extraction boundary to provide sufficient attenuation for a blast with an MIC of approximately 100 kg.

The existing quarry will likely remain throughout the precinct development and the quarry asset owner will remain obligated to comply with the SEPP N-1 noise policy. However, it is expected any sensitive receivers proposed to be built within the PSP, would be required to design and build future structures in a manner so as to minimise any existing noise impacts on persons utilising the proposed building.

Development may still be able to occur within the 600 m buffer following appropriate mitigation either at the quarry or via building acoustic treatments at the sensitive receiver location.

Discussion with the asset owner may need to be undertaken to provide effective as well as agreed noise mitigation measures for the quarry, as necessary.

¹⁶ GHD Report #51460

Should a control at source noise mitigation strategy not be possible or practicable, it is common that the indoor amenity of sensitive receivers subject to operational noise be acoustically treated using a control at receiver strategy, via building acoustic treatment. However, the limitation of this strategy is that it would not preserve the outdoor amenity of the receiver unless a combination of controls such as noise controls at the source of transmission be implemented.

Noise mitigation strategies have been identified into four different areas from the most to the least preferred (NSW INP, 2000):

- *Land-use Controls* (separating the location of noise-producing activities from sensitive areas)
- *Control at Source* (reduce the noise output of the source to provide protection surrounding environment)
- *Control in Transmission* (reduce noise level at the receiver but not necessarily the environment surrounding the source, e.g. noise barrier, etc.)
- *Receiver Control* (localised acoustic treatment at sensitive receiver)

Use of mitigation strategies involving land-use control such as:

- A setback strategy (e.g. Non sensitive uses adjacent to noisy industries, busy road and/or railway corridor to provide noise reduction through setback distances to residential and other sensitive uses).
- Use of acoustic control planning conditions on new developments will enable a blending of light industrial, commercial and residential lands uses to occur along the buffer boundary, allowing staged development to occur.

11.2 Recommended buffers

Figure 17 (aerial base map) provides a visual display of the impact assessments undertaken as part of this report.

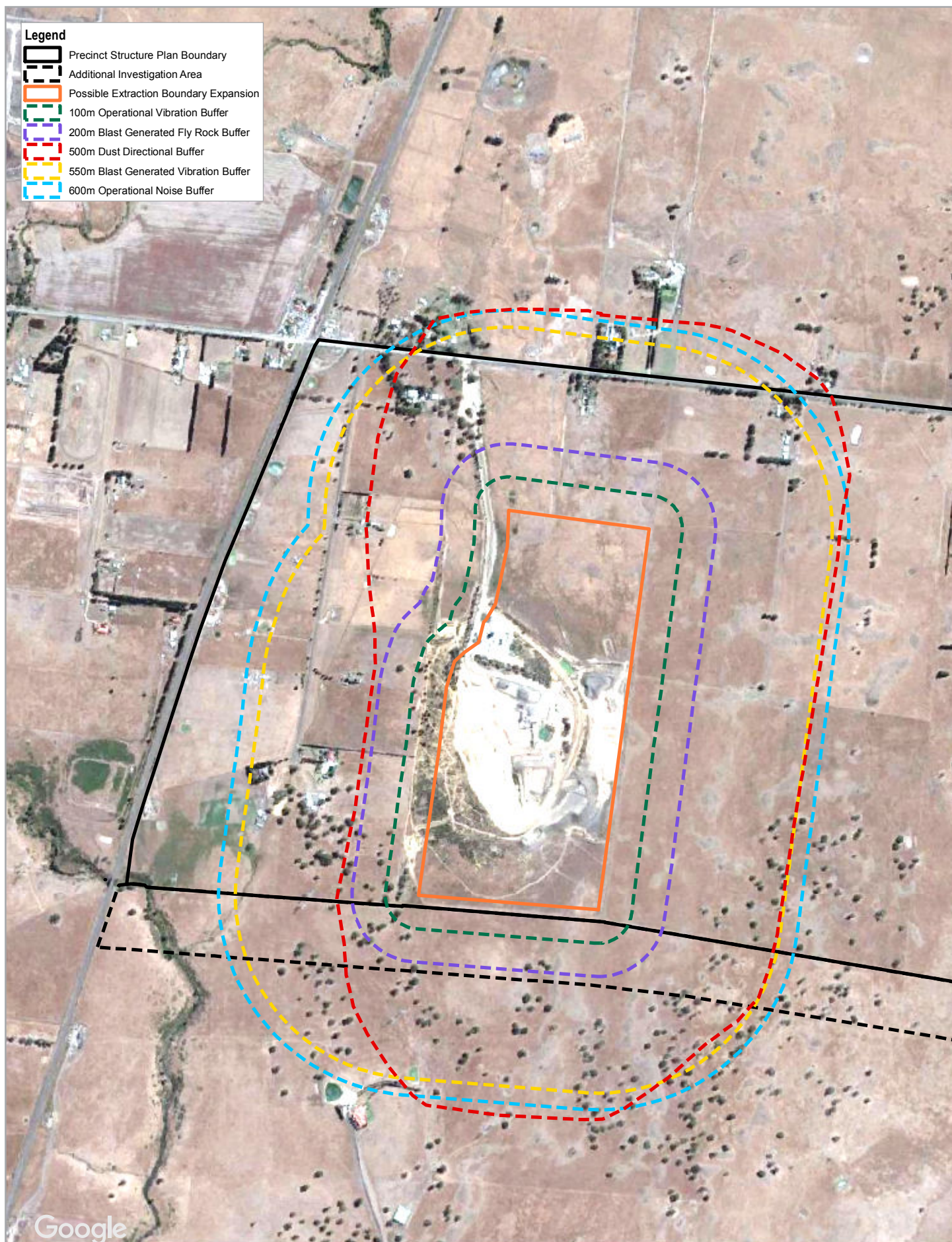
Figure 17 shows the following information:

- 500 m dust directional buffers from the extraction area boundaries for the two expansion scenarios.
- Operational noise buffer for the Woody Hill Quarry of 600 m from the extraction area boundaries for the two expansion scenarios prior to any operational noise mitigation being implemented. Should further work be undertaken to determine the noise controls and operations in place at the quarry, it may be possible to reduce the extent of the noise buffer.
- 100 m operational vibration buffer from the approved extraction area boundaries for the two expansion scenarios.
- Blast generated flyrock buffer of 200 m from the approved extraction area boundaries for the two expansion scenarios.
- Blast generated noise would require empirical measurements prior to any proposed development to assess the site specific conditions experienced during a blast event. Any proposed development would be limited by the requirement to achieve 115 dB (linear) at the proposed development location.
- Blast generated vibration buffer of 550 m for the Woody Hill Quarry from the approved extraction area boundaries for the two expansion scenarios for an MIC of approximately 100 kg to meet the 2 mm/s (PPV) long-term regulatory goal for human comfort.

The intent of the buffers from the quarry would be to restrict additional sensitive land use intensification in these buffer areas (including land inside and outside of the PSP), due to the risks from, dust, operational noise and vibration, blast noise, blast vibration and blast generated flyrock.

The inclusion of buffer controls within the PSP should achieve separation of non-compatible uses and delineate land available for urban development.

The PSP planning process must protect significant assets, whilst enabling sustainable development to occur. Inappropriate planning may adversely impact the operations and viability of the quarry into the future and, in turn, impact the amenity and health of the community.

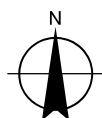


Paper Size ISO A4

0 150 300 450 600

Metres

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



City of Whittlesea
Shenstone Park PSP - Impact Assessment

Project No. 31-35311
Revision No. -
Date 12 Dec 2017

Possible Buffer Areas -
Woody Hill Expansions

FIGURE 17

Appendices

Appendix A – Dust emission factors

Emission factors used for the assessment of PM₁₀;

Activity	Source	Emission Factor	Reference
Winning	Excavator	0.012 kg/t	NPI 2012
	Dump Truck	0.0043 kg/t	NPI 2012
	Grader	0.085 kg/VKT	NPI 2012
	Loading	0.0017 kg/t	NPI 2012
	Wheel Generated Dust	1.25 kg/VKT	NPI 2012
Processing	Conveyor Transfer	0.00015 kg/t	NPI 2012
	Primary Crusher	0.0012 kg/t	AP-42
	Secondary Crusher	0.0012 kg/t	AP-42
	Screening	0.0043 kg/t	AP-42
	Fines Screening	0.036 kg/t	AP-42
Other	Blasting	3.0780 kg/blast	NPI 2012
	Misc. Transfer Points	0.00015 kg/t	NPI 2012
	Wind Blown	0.2 kg/ha/h	NPI 2012
Notes			
* Emission factor for PM ₁₀ primary and secondary crushing from AP42 (tertiary crusher)			

Appendix B – AERMOD INPUT file

woody_hill.ADI

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** Lakes Environmental Software Inc.
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AVERTIME 24
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ERRORFIL woody_hill.err
CO FINISHED
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** AERMOD Source Pathway
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				woody_hill.ADI	
SRCPARAM	L0000004	0.0074285714	2.00	9.09	3.16
SRCPARAM	L0000005	0.0074285714	2.00	9.09	3.16
SRCPARAM	L0000006	0.0074285714	2.00	9.09	3.16
SRCPARAM	L0000007	0.0074285714	2.00	9.09	3.16
SRCPARAM	L0000008	0.0074285714	2.00	9.09	3.16
SRCPARAM	L0000009	0.0074285714	2.00	9.09	3.16
SRCPARAM	L0000010	0.0074285714	2.00	9.09	3.16
SRCPARAM	L0000011	0.0074285714	2.00	9.09	3.16
SRCPARAM	L0000012	0.0074285714	2.00	9.09	3.16
SRCPARAM	L0000013	0.0074285714	2.00	9.09	3.16
SRCPARAM	L0000014	0.0074285714	2.00	9.09	3.16
SRCPARAM	L0000015	0.0074285714	2.00	9.09	3.16
SRCPARAM	L0000016	0.0074285714	2.00	9.09	3.16
SRCPARAM	L0000017	0.0074285714	2.00	9.09	3.16
SRCPARAM	L0000018	0.0074285714	2.00	9.09	3.16
SRCPARAM	L0000019	0.0074285714	2.00	9.09	3.16
SRCPARAM	L0000020	0.0074285714	2.00	9.09	3.16
SRCPARAM	L0000021	0.0074285714	2.00	9.09	3.16
SRCPARAM	L0000022	0.0074285714	2.00	9.09	3.16
SRCPARAM	L0000023	0.0074285714	2.00	9.09	3.16
SRCPARAM	L0000024	0.0074285714	2.00	9.09	3.16
SRCPARAM	L0000025	0.0074285714	2.00	9.09	3.16
SRCPARAM	L0000026	0.0074285714	2.00	9.09	3.16
SRCPARAM	L0000027	0.0074285714	2.00	9.09	3.16
SRCPARAM	L0000028	0.0074285714	2.00	9.09	3.16
SRCPARAM	L0000029	0.0074285714	2.00	9.09	3.16
SRCPARAM	L0000030	0.0074285714	2.00	9.09	3.16
SRCPARAM	L0000031	0.0074285714	2.00	9.09	3.16
SRCPARAM	L0000032	0.0074285714	2.00	9.09	3.16
SRCPARAM	L0000033	0.0074285714	2.00	9.09	3.16
SRCPARAM	L0000034	0.0074285714	2.00	9.09	3.16
SRCPARAM	L0000035	0.0074285714	2.00	9.09	3.16

SRCPARAM	WIND	5.6E-06	1.000	8	
AREAVERT	WIND	321210.000	5841993.000	321376.000	5841947.000
AREAVERT	WIND	321363.000	5841906.000	321301.000	5841908.000
AREAVERT	WIND	321306.000	5841781.000	321138.000	5841737.000
AREAVERT	WIND	321125.000	5841904.000	321194.000	5841916.000

LINE	VOLUME	Source	ID	=	ROAD2
SRCPARAM	L0000036	0.0030588235	2.00	4.65	3.16
SRCPARAM	L0000037	0.0030588235	2.00	4.65	3.16
SRCPARAM	L0000038	0.0030588235	2.00	4.65	3.16
SRCPARAM	L0000039	0.0030588235	2.00	4.65	3.16
SRCPARAM	L0000040	0.0030588235	2.00	4.65	3.16
SRCPARAM	L0000041	0.0030588235	2.00	4.65	3.16
SRCPARAM	L0000042	0.0030588235	2.00	4.65	3.16
SRCPARAM	L0000043	0.0030588235	2.00	4.65	3.16
SRCPARAM	L0000044	0.0030588235	2.00	4.65	3.16
SRCPARAM	L0000045	0.0030588235	2.00	4.65	3.16
SRCPARAM	L0000046	0.0030588235	2.00	4.65	3.16
SRCPARAM	L0000047	0.0030588235	2.00	4.65	3.16
SRCPARAM	L0000048	0.0030588235	2.00	4.65	3.16
SRCPARAM	L0000049	0.0030588235	2.00	4.65	3.16
SRCPARAM	L0000050	0.0030588235	2.00	4.65	3.16
SRCPARAM	L0000051	0.0030588235	2.00	4.65	3.16
SRCPARAM	L0000052	0.0030588235	2.00	4.65	3.16
SRCPARAM	L0000053	0.0030588235	2.00	4.65	3.16
SRCPARAM	L0000054	0.0030588235	2.00	4.65	3.16
SRCPARAM	L0000055	0.0030588235	2.00	4.65	3.16
SRCPARAM	L0000056	0.0030588235	2.00	4.65	3.16
SRCPARAM	L0000057	0.0030588235	2.00	4.65	3.16
SRCPARAM					

			woody_hill.ADI	
SRCPARAM	L0000083	0.0030588235	2.00	4.65
SRCPARAM	L0000084	0.0030588235	2.00	4.65
SRCPARAM	L0000085	0.0030588235	2.00	4.65
SRCPARAM	L0000086	0.0030588235	2.00	4.65
SRCPARAM	L0000087	0.0030588235	2.00	4.65
SRCPARAM	L0000088	0.0030588235	2.00	4.65
SRCPARAM	L0000089	0.0030588235	2.00	4.65
SRCPARAM	L0000090	0.0030588235	2.00	4.65
SRCPARAM	L0000091	0.0030588235	2.00	4.65
SRCPARAM	L0000092	0.0030588235	2.00	4.65
SRCPARAM	L0000093	0.0030588235	2.00	4.65
SRCPARAM	L0000094	0.0030588235	2.00	4.65
SRCPARAM	L0000095	0.0030588235	2.00	4.65
SRCPARAM	L0000096	0.0030588235	2.00	4.65
SRCPARAM	L0000097	0.0030588235	2.00	4.65
SRCPARAM	L0000098	0.0030588235	2.00	4.65
SRCPARAM	L0000099	0.0030588235	2.00	4.65
SRCPARAM	L0000100	0.0030588235	2.00	4.65
SRCPARAM	L0000101	0.0030588235	2.00	4.65
SRCPARAM	L0000102	0.0030588235	2.00	4.65
SRCPARAM	L0000103	0.0030588235	2.00	4.65
SRCPARAM	L0000104	0.0030588235	2.00	4.65
SRCPARAM	L0000105	0.0030588235	2.00	4.65
SRCPARAM	L0000106	0.0030588235	2.00	4.65
SRCPARAM	L0000107	0.0030588235	2.00	4.65
SRCPARAM	L0000108	0.0030588235	2.00	4.65
SRCPARAM	L0000109	0.0030588235	2.00	4.65
SRCPARAM	L0000110	0.0030588235	2.00	4.65
SRCPARAM	L0000111	0.0030588235	2.00	4.65
SRCPARAM	L0000112	0.0030588235	2.00	4.65
SRCPARAM	L0000113	0.0030588235	2.00	4.65
SRCPARAM	L0000114	0.0030588235	2.00	4.65
SRCPARAM	L0000115	0.0030588235	2.00	4.65
SRCPARAM	L0000116	0.0030588235	2.00	4.65
SRCPARAM	L0000117	0.0030588235	2.00	4.65
SRCPARAM	L0000118	0.0030588235	2.00	4.65
SRCPARAM	L0000119	0.0030588235	2.00	4.65
SRCPARAM	L0000120	0.0030588235	2.00	4.65

**

** Variable Emissions Type: "By Hour-of-Day (HROFDY)"

** Variable Emission Scenario: "Scenario 2"

EMI SFACT	DUMP	HROFDY	0.0	0.0	0.0	0.0	0.0	1.0
EMI SFACT	DUMP	HROFDY	1.0	1.0	1.0	1.0	1.0	1.0
EMI SFACT	DUMP	HROFDY	1.0	1.0	1.0	1.0	1.0	0.0
EMI SFACT	DUMP	HROFDY	0.0	0.0	0.0	0.0	0.0	0.0
EMI SFACT	EXC1	HROFDY	0.0	0.0	0.0	0.0	0.0	1.0
EMI SFACT	EXC1	HROFDY	1.0	1.0	1.0	1.0	1.0	1.0
EMI SFACT	EXC1	HROFDY	1.0	1.0	1.0	1.0	1.0	0.0
EMI SFACT	EXC1	HROFDY	0.0	0.0	0.0	0.0	0.0	0.0
EMI SFACT	EXC2	HROFDY	0.0	0.0	0.0	0.0	0.0	1.0
EMI SFACT	EXC2	HROFDY	1.0	1.0	1.0	1.0	1.0	1.0
EMI SFACT	EXC2	HROFDY	1.0	1.0	1.0	1.0	1.0	0.0
EMI SFACT	EXC2	HROFDY	0.0	0.0	0.0	0.0	0.0	0.0
EMI SFACT	EXC3	HROFDY	0.0	0.0	0.0	0.0	0.0	1.0
EMI SFACT	EXC3	HROFDY	1.0	1.0	1.0	1.0	1.0	1.0
EMI SFACT	EXC3	HROFDY	1.0	1.0	1.0	1.0	1.0	0.0
EMI SFACT	EXC3	HROFDY	0.0	0.0	0.0	0.0	0.0	0.0
EMI SFACT	EXC4	HROFDY	0.0	0.0	0.0	0.0	0.0	1.0
EMI SFACT	EXC4	HROFDY	1.0	1.0	1.0	1.0	1.0	1.0
EMI SFACT	EXC4	HROFDY	1.0	1.0	1.0	1.0	1.0	0.0
EMI SFACT	EXC4	HROFDY	0.0	0.0	0.0	0.0	0.0	0.0
EMI SFACT	EXC5	HROFDY	0.0	0.0	0.0	0.0	0.0	1.0
EMI SFACT	EXC5	HROFDY	1.0	1.0	1.0	1.0	1.0	1.0
EMI SFACT	EXC5	HROFDY	1.0	1.0	1.0	1.0	1.0	0.0
EMI SFACT	EXC5	HROFDY	0.0	0.0	0.0	0.0	0.0	0.0
EMI SFACT	EXC6	HROFDY	0.0	0.0	0.0	0.0	0.0	1.0
EMI SFACT	EXC6	HROFDY	1.0	1.0	1.0	1.0	1.0	1.0
EMI SFACT	EXC6	HROFDY	1.0	1.0	1.0	1.0	1.0	0.0
EMI SFACT	EXC6	HROFDY	0.0	0.0	0.0	0.0	0.0	0.0
EMI SFACT	EXC7	HROFDY	0.0	0.0	0.0	0.0	0.0	1.0
EMI SFACT	EXC7	HROFDY	1.0	1.0	1.0	1.0	1.0	1.0
EMI SFACT	EXC7	HROFDY	1.0	1.0	1.0	1.0	1.0	0.0
EMI SFACT	EXC7	HROFDY	0.0	0.0	0.0	0.0	0.0	0.0
EMI SFACT	FINES	HROFDY	0.0	0.0	0.0	0.0	0.0	1.0
EMI SFACT	FINES	HROFDY	1.0	1.0	1.0	1.0	1.0	1.0
EMI SFACT	FINES	HROFDY	1.0	1.0	1.0	1.0	1.0	0.0
EMI SFACT	FINES	HROFDY	0.0	0.0	0.0	0.0	0.0	0.0
EMI SFACT	GRADE	HROFDY	0.0	0.0	0.0	0.0	0.0	1.0
EMI SFACT	GRADE	HROFDY	1.0	1.0	1.0	1.0	1.0	1.0
EMI SFACT	GRADE	HROFDY	1.0	1.0	1.0	1.0	1.0	0.0
EMI SFACT	GRADE	HROFDY	0.0	0.0	0.0	0.0	0.0	0.0
EMI SFACT	LOAD	HROFDY	0.0	0.0	0.0	0.0	0.0	1.0
EMI SFACT	LOAD	HROFDY	1.0	1.0	1.0	1.0	1.0	1.0
EMI SFACT	LOAD	HROFDY	1.0	1.0	1.0	1.0	1.0	0.0
EMI SFACT	LOAD	HROFDY	0.0	0.0	0.0	0.0	0.0	0.0

[illegible]

woody_hill.ADI

[illegible]

[illegible]

woody_hill.ADI

[illegible]

[illegible]

[illegible]

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** Variable Emission Scenario: "Scenario 3"
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month: January, day of week: Monday

[illegible]


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                                woody_hill.ADI
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SRCGROUP SRCGP2 L0000049 L0000050 L0000051 L0000052 L0000053 L0000054
SRCGROUP SRCGP2 L0000055 L0000056 L0000057 L0000058 L0000059 L0000060
SRCGROUP SRCGP2 L0000061 L0000062 L0000063 L0000064 L0000065 L0000066
SRCGROUP SRCGP2 L0000067 L0000068 L0000069 L0000070 L0000071 L0000072
SRCGROUP SRCGP2 L0000073 L0000074 L0000075 L0000076 L0000077 L0000078
SRCGROUP SRCGP2 L0000079 L0000080 L0000081 L0000082 L0000083 L0000084
SRCGROUP SRCGP2 L0000085 L0000086 L0000087 L0000088 L0000089 L0000090
SRCGROUP SRCGP2 L0000091 L0000092 L0000093 L0000094 L0000095 L0000096
SRCGROUP SRCGP2 L0000097 L0000098 L0000099 L0000100 L0000101 L0000102
SRCGROUP SRCGP2 L0000103 L0000104 L0000105 L0000106 L0000107 L0000108
SRCGROUP SRCGP2 L0000109 L0000110 L0000111 L0000112 L0000113 L0000114
SRCGROUP SRCGP2 L0000115 L0000116 L0000117 L0000118 L0000119 L0000120
SRCGROUP SRCGP3 WIND
SRCGROUP SRCGP4 PRIMC SCREEN SECC FINES
SRCGROUP ALL BACKGROUND
SO FINI SHED
**
*****
** AERMOD Receptor Pathway
*****
**
**
RE STARTING
GRIDCART UCART1 STA
                        XYINC 318950.00 91 50.00 5839500.00 91 50.00
GRIDCART UCART1 END
RE FINI SHED
**
*****
** AERMOD Meteorology Pathway
*****
**
**
ME STARTING
SURFFILE "...\\...\\Meteorology\\Melbourne Airport\\SITE outputs\\3135311.SFC"
PROFFILE "...\\...\\Meteorology\\Melbourne Airport\\SITE outputs\\3135311.PFL"
SURFDATA 0 2012
UAIRDATA 11111111 2012
SITEDATA 11111111 2012
PROFBASE 10.0 METERS
ME FINI SHED
**
*****
** AERMOD Output Pathway
*****
**
**
OU STARTING
RECTABLE ALLAVE 1ST 3RD 5TH
RECTABLE 24 1ST 3RD 5TH
** Auto-Generated Plotfiles
PLOTFILE 24 ALL 1ST woody_hill.AD\\24H1GALL.PLT 31
PLOTFILE 24 SRCGP1 1ST woody_hill.AD\\24H1G001.PLT 32
PLOTFILE 24 SRCGP2 1ST woody_hill.AD\\24H1G002.PLT 33
PLOTFILE 24 SRCGP3 1ST woody_hill.AD\\24H1G003.PLT 34
PLOTFILE 24 SRCGP4 1ST woody_hill.AD\\24H1G004.PLT 35
PLOTFILE 24 ALL 3RD woody_hill.AD\\24H3GALL.PLT 36
PLOTFILE 24 SRCGP1 3RD woody_hill.AD\\24H3G001.PLT 37
PLOTFILE 24 SRCGP2 3RD woody_hill.AD\\24H3G002.PLT 38
PLOTFILE 24 SRCGP3 3RD woody_hill.AD\\24H3G003.PLT 39
PLOTFILE 24 SRCGP4 3RD woody_hill.AD\\24H3G004.PLT 40
PLOTFILE 24 ALL 5TH woody_hill.AD\\24H5GALL.PLT 41
PLOTFILE 24 SRCGP1 5TH woody_hill.AD\\24H5G001.PLT 42
PLOTFILE 24 SRCGP2 5TH woody_hill.AD\\24H5G002.PLT 43
PLOTFILE 24 SRCGP3 5TH woody_hill.AD\\24H5G003.PLT 44
PLOTFILE 24 SRCGP4 5TH woody_hill.AD\\24H5G004.PLT 45
SUMMFILE woody_hill.sum
OU FINI SHED
**
*****
** Project Parameters
*****
** PROJCTN CoordinateSystemUTM
** DESCPTN UTM: Universal Transverse Mercator
** DATUM World Geodetic System 1984
** DTMRGN Global Definition
** UNITS m
** ZONE -55
** ZONEINX 0
**

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GHD

180 Lonsdale Street
Melbourne Victoria 3000

T: (03) 8687 8000 F: (03) 8687 8111 E: melmail@ghd.com

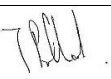

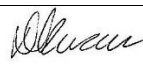
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70468/<https://projects.ghd.com/oc/Victoria/shenstoneparkimpacta/Delivery/Documents/3135311-REP-Addendum-Rev0.docx>

Document Status

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		Name	Signature	Name	Signature	Date
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