WHITTLESEA PLANNING SCHEME AMENDMENT C241WSEA: SHENSTONE PARK PSP

Statement of Evidence - Noise Impacts on Behalf of Submitter 24 - Barro Group Pty Ltd

INSTRUCTED BY PONTE

DOC. REF: V319-01-L STATEMENT OF EVIDENCE (R0)
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1 STATEMENT INTRODUCTION

1. My name is Darren Tardio and I am the Director of Enfield Acoustics Pty Ltd, consultants in acoustics, noise and vibration. My registered business address is 60 Criterion Court, Clunes.

2. I have read the Planning Panels Victoria document *Guide to Expert Evidence* dated April 2019 and confirm that my statement is prepared in accordance with that document.

3. My area of experience includes noise and vibration assessment and expert testimony at planning & advisory panels and VCAT. My evidence is within my area of expertise, except where I state that I am relying upon the evidence of another person. My CV is attached as Appendix A to this Statement which sets out my academic, project and employment experience.

4. I have prepared this statement of evidence for the matter of *Whittlesea Planning Scheme Amendment C241wsea: Shenstone Park PSP* (PSP).

5. My colleague, Mr Mark Chew, provided assistance with measurements and modelling.

2 INSTRUCTIONS AND INFORMATION RELIED ON

6. I have been instructed by Ponte on behalf of Barro Group Pty Ltd (Barro), Submitter 24, to consider the appropriateness and acoustic implications of the noise buffers for the Woody Hill and Phillips Quarries.

7. Barro's land includes Lots 870 Donnybrook Road, Donnybrook, and 430 Summerhill Road, Wollert.

8. Barro currently operates a quarry within 870 Donnybrook Road in accordance with Work Authority 492, hereinafter referred to as 'Woody Hill Quarry'. Woody Hill Quarry operates under existing use rights and does not require a Planning Permit. Woody Hill Quarry operations are intended to be extended south of the existing operating area.

9. Barro also intend to extend the use of 870 Donnybrook Road to the north and east of Woody Hill Quarry, pending approval of Work Authority 6437, hereinafter referred to as 'Woody Hill Extension'.

10. Barro intend to operate an additional quarry site at 430 Summerhill Road, hereinafter referred to as 'Phillips Quarry'. Phillips Quarry is approved under Planning Permit 704901, and pending approval of Work Authority 6852.

11. Barro operate a concrete batching plant on 870 Donnybrook Road (north of Woody Hill Quarry), approved under Planning Permit 710157 (Concrete Plant).

12. Barro intend to operate a trade supplies business on 870 Donnybrook Road (fronting Donnybrook Road), approved under Planning Permit 715902 (Trade Supplies).

13. My assessment considers the approved operating conditions for each respective use on Barro land, both existing and proposed, under the respective Planning Permits and WA's. My assessment does not necessarily indicate limitation to future approvals or amendments to operation conditions, however they are considerations for other Authorities and which I have not deemed relevant to this matter. Of note, the following hours of operation have been assumed when considering cumulative noise impacts in the future:

    a. Woody Hill Quarry currently operates 6am-6pm Monday to Saturday, in accordance with WA492.

    b. The Concrete Plant currently operates 6am-6pm Monday to Saturday, in accordance with the Planning Permit.

    c. The Trade Supplies would operate 7am-5pm Monday to Sunday, in accordance with the Planning Permit.

    d. Woody Hill Extension would operate 6am-6pm Monday to Saturday, in accordance with WA6437.

    e. Phillips Quarry would operate 7am-6pm Monday to Friday, and 7am-1pm Saturday, in accordance with the Planning Permit.

14. In modelling future scenarios, I rely on the site plans and staging plans referred to in the letter from Ponte to the Panel, dated 2 October 2020 (Ref: LWP/JR 940371) and the plans referred to in the 15 October 2020 letter to the Panel (Barro Plans). I have also referred to plans for the Trade Supplies business. I have assumed that there will be no material changes to existing operations on Barro's land when assessing future scenarios.

15. My assessment has been made on estimated peak traffic volumes provided in my instructions, being:

    a. 190 vehicle movements per hour to WA492, WA6437, WA6852, Concrete Plant and Trade Supplies during the Day period.

b. 120 vehicle movements per hour to WA492, WA6437 and Concrete Plant during the Shoulder period.

c. 34 vehicle movements per hour to WA492, WA6437 and Concrete Plant during the Saturday afternoon period.

16. I understand that quarry operations on Barro land are expected to continue for 25+ and 50+ years, and that it is proposed to start operation at both Woody Hill Extension and Phillips Quarries as soon as the relevant permissions are obtained. To that end, it is reasonable to expect that use and operation of the respective sites will overlap and generate cumulative noise emissions, which I have considered in the noise model.

17. I have been instructed that Barro and Donnybrook Joint Venture (DBJV), Submitter 23 of 960 and 1030 Donnybrook Road, have entered into an agreement for an access road between Woody Hill and Phillips Quarries (Agreement). The Agreement also requires Barro to construct an earthen bund between Barro and DBJV lands and for DBJV to not develop residential land use within 500m of WA492, WA6437 and WA6852. I have been instructed to assume for the purposes of my assessment, that the 500m buffer is measured from the extraction boundaries of WA492, WA6437 and WA6852 (Assumed Buffer).

18. I have reviewed the PSP and associated Plans prepared by VPA, including:

    a. Plan 3 - Future Urban Structure Plan (FUSP)

    b. Plan 15 – Buffers, Noise Amenity Area and Measurement Length

19. Additional details on the above are provided in Barro Group's response to Directions 6 & 7 from the Panel and Barro Plans, which I have reviewed in preparation of my evidence.

3 OVERVIEW OF ASSESSMENT

20. My assessment is that Barro will need to comply with State Environment Protection Policy No. N-1 at sensitive land uses within the PSP.

21. I have made recommendations regarding bund heights outlined in the Agreement, as well as plant restrictions during certain periods, and Barro has agreed to this to further mitigate impacts at proposed sensitive uses on DBJV land.

22. I have assessed the exhibited PSP to determine more relevant noise limits that are likely to apply in the future, once land is re-zoned from UGZ.

23. I have visited Barro's existing site and surrounding areas to carry out measurements and make observations in relation to:

    a. Background and ambient noise.

    b. Existing noise emissions from Barro.

24. I have modelled noise emissions from future Barro operations and assessed cumulative noise impacts from all existing and proposed uses on Barro land, to determine if the buffers are satisfactory.

4 SEPP N-1 NOISE LIMITS

25. Noise limits are derived by a prescribed formula in accordance with Schedule B of SEPP N-1, which considers both land zoning and background noise levels.

4.1 Consideration of Land Zoning

26. The calculation of SEPP N-1 noise limits needs to consider future land zoning in this instance, as that will be more relevant to compliance assessments in the future.

27. With respect to land zoning, SEPP N-1 designates particular land uses to determine the noise limits in EPA Publication 316a. Publication 316a does not contemplate the UGZ and I expect there to be a period while developed areas within the PSP are translated into standard zones. For simplicity, I have taken the ordinary meaning of areas identified on the PSP Plans (e.g. 'Light Industry' being equivalent to a Type-2 use under SEPP N-1) when calculating Zoning Levels under SEPP N-1.

4.2 Consideration of Background Noise Levels

28. Background noise is particularly relevant to my instructions and this matter because:

    a. Approved uses include Barro operations during shoulder periods, in particular 6am-7am which is within the SEPP N-1 'Night' period. While the Night period is traditionally the most sensitive under SEPP N-1, it is common to find that shoulder period noise limits are significantly higher than the assumed 'Zoning Level' if calculated in accordance with SEPP N-1 because:

        i. The Zoning Level can be taken to assume operation throughout a night period including the most sensitive hours (e.g. 3am).

ii. The Zoning Level is based on a calculation of surrounding land uses within a 200m radius only, and does not consider background noise that can be emitted from other sources beyond this region, such as distant traffic which is more likely to peak during a shoulder period.

b. The PSP is exposed to appreciable traffic, which includes elevated traffic and truck volumes in the early morning period on Donnybrook Road, and to a lesser extent, Hume Fwy.

c. While not possible to quantify in my evidence, it is reasonable to expect that traffic noise will increase on Donnybrook Road in the future as a result of the PSP being approved and other land currently being subdivided and developed in the area under previously approved PSP's. I note that the PSP proposes that Donnybrook Road will be upgraded to a 6-lane road. To that end, noise limits based on background noise occurring today may be conservative, but are reasonable in my opinion.

29. Reasonable accuracy with regard to SEPP N-1 noise limits is important in this instance as those limits define reasonable distance buffers to proposed sensitive uses within the PSP, and the controls which Barro may need to consider for future operations.

30. Because Barro already operates between 6am and 6pm, background noise cannot be measured at locations where Barro already emits audible noise, such as boundaries on Barro Land, as a background noise measurement should not include any existing industrial or commercial uses. I note that this is not particularly critical, as background noise levels are found to be similar over relatively large areas unless there are particular local noise sources, which might occur near busy roads, such as Donnybrook Road. Quantifying background noise levels at substitute points is also an acceptable method under Clause C1 of SEPP N-1. To that end, I have carried out a number of site visits and measurements at different locations broadly within the PSP and surrounding area to observe and quantify background noise levels during the shoulder period. I have focused on quantifying noise limits during the shoulder period as it follows that compliance is more readily achieved during the other periods with higher Zoning Levels.

31. I have relied on attended measurements during the shoulder period, given it allows the following advantages in this instance:

a. The Shoulder period is relatively short (1-hour) so does not demand long-term monitoring.

b. Direct observation of audible sources, ensuring that only background relevant sources are included and that there is no extraneous industry noise being included.

c. Direct observation of source differences prior to and after 6am, in particular changes in traffic flows.

d. Direct observation of the location and directivity of sources, in particular identification of contributions from both Donnybrook Road and the Hume Fwy as the primary sources of background noise in the area.

e. Ability to observe differences at multiple locations, within relatively short timeframes and under consistent meteorological conditions.

32. Refer to Appendix B for locations where attended noise measurements have been carried out.

33. The following Table summarises noise levels recorded at each location:

Measurement Location	**Date & Time**	**Background Noise Level, L_{90}**
A	7 June 2020 4:15am	38dB(A)
	9 September 2020 5:25am	43dB(A)
	18 September 2020 4pm	43dB(A)
B	9 September 2020 5:40am	44dB(A)
C	9 September 2020 5:50am	49dB(A) 51dB(A)

	6:15am	
E	14 September 2020 5am 5:15am 5:30am 5:45am	 40dB(A) 41dB(A) 42dB(A) 44dB(A)
H	18 September 2020 3:50pm	 53dB(A)
I	18 September 2020 3:40pm	 51dB(A)
J	1 October 2020 5am 5:30am 6am 6:30am	 41dB(A) 43dB(A) 45dB(A) 47dB(A)

34. Measurements I carried out at 'Location J' were undertaken to both ensure a significant distance from:

    a. Barro land so that 6am-7am measurements were not corrupted by existing noise from Barro; and

    b. Donnybrook Road to indicate background noise that would occur at future properties proposed towards the south boundary of DBJV land, which will be setback from direct traffic impacts.

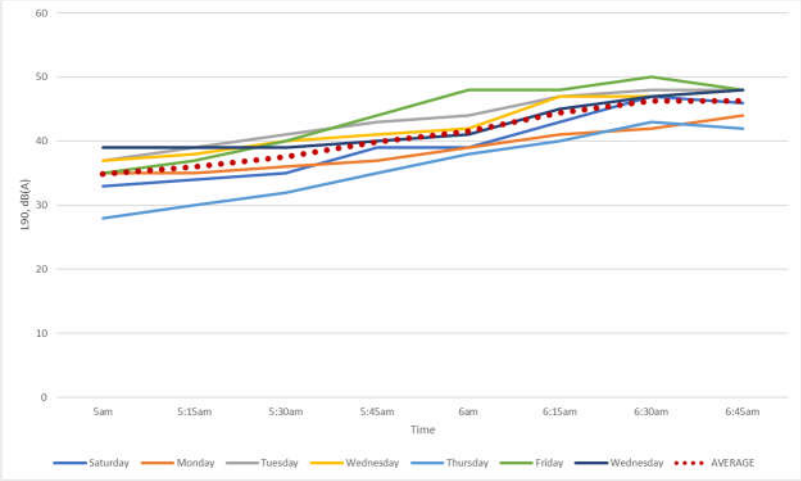
35. To verify that the background noise levels I have derived are reasonable, I have also reviewed the GHD Report, dated December 2017, prepared on behalf of City of Whittlesea and exhibited with the draft PSP. GHD's analysis included two long-term noise monitoring stations that were placed to the east of Barro land. Their monitoring 'Location 2' was sited approximately 1.25km from the east boundary of Woody Hill Quarry, on what appears to be 1030 Donnybrook Road. That monitoring

location can reasonably be expected to be representative of background noise only, and without impact from Barro's existing operations. As described later in my evidence, I observed that noise emissions from Barro were barely audible to inaudible at distances greater than 800m to the east of Woody Hill Quarry. On review of GHD's data (considering only the days which were not affected by adverse meteorological conditions), the following were identified:

a. The average background L_{90} noise level between the 5am-6am period was 39dB(A); and

b. The average background L_{90} noise level between the 6am-7am period was 45dB(A).

36. The increase in background noise between 5am and 7am is shown in the following Figure, using GHD's monitoring data:



37. GHD's data clearly indicates a gradual and linear background noise increase in the area throughout the shoulder period, noting that this is consistent with my measurements and observations. I also note that it is more likely that noise levels would plateau after 6am if they were indeed driven by Barro's existing operations, and not some other source of noise in the environment which ramps up. The same pattern is noted in GHD's monitoring on days which had adverse weather, including Sunday monitoring when Barro does not operate. GHD provide the following commentary in their report regarding Location 2 as being acceptable for the measurement of background noise:

- **Location 2 (1030 Donnybrook Road)** – The monitoring location is located at a distance of approximately 1.25 km from the Woody Hill Quarry eastern boundary. This location was selected to assess the background noise environment within the PSP in the absence of operational noise from the quarry. Prior to selection of this monitoring location, GHD was advised by the tenant that operational noise from the Woody Hill Quarry was not audible at the property site.

38. The measurements I have carried out and GHD's data indicate a similar pattern of:

    a. Material background noise increase of 4-6dB in the 6am-7am period when compared to the 5am-6am period. From my observation, the primary source of background noise was traffic on Donnybrook Road, and the Hume Fwy to a lesser extent.

    b. Background noise levels between the 6am-7am period which are consistently higher than the SEPP N-1 Zoning Level. Therefore, the analysis is not made on the basis of a limited sample, and can be expected to occur on average under varying meteorological conditions.

39. I note that my assessments were also carried out under Covid-19 restrictions. It is generally accepted that background and ambient noise levels have decreased as a result of lower traffic volumes during this period, though this has not been quantified throughout Victoria to my knowledge. This may indicate that my measurements are conservative.

40. The background noise analysis shows that it is inappropriate to apply the SEPP N-1 Zoning Level to the 6am shoulder period. Again, this is not surprising given a shoulder period can often exhibit background noise levels which are higher than the middle of the day, due to peak traffic flows occurring at this time. While the easiest method of assessment would be to simply look at background noise levels prior to 6am to ensure that Barro's existing operations are not included in the measurement data, the analysis also shows that it is inappropriate and results in unnecessarily low noise limits because there is a significant increase in traffic after 6am.

41. On the balance of noise measurements I have carried out and review of the GHD data, the 6am-7am L_{90} background noise levels which I have applied to my assessment are as follows:

    a. 45dB(A) for receptors which are setback from Donnybrook Road.

    b. 51dB(A) for receptors which interface directly with Donnybrook Road.

42. While there is likely to be an iterative change in background noise levels (and SEPP N-1 noise limits) as sensitive receptors get closer to Donnybrook Road or Hume Fwy,

it is unnecessarily complicated when modelling typical worst-case. More specific assessments of background noise and noise limits are better suited to compliance measurements. I have simplified the assessment of noise limits into broader capture areas, as follows:

a. Proposed residential areas within the PSP which will have significant setbacks to Donnybrook Road (generally those properties to the south of DBJV and 1100 Donnybrook Rd lands), with consideration of both:

   i. Those properties which are within 200m of proposed industrial or commercial land use would result in a higher Zoning Level under SEPP N-1.

   ii. Those properties proposed to be greater than 200m from industrial or commercial land use will fall under Type-1 zoning categories only in accordance with SEPP N-1, resulting in lower Zoning Levels. In practice, this is not expected to be material given those properties would inherently be at a greater distance from Barro land and would benefit from additional shielding provided by built form.

b. Proposed residential dwellings which interface with Donnybrook Road.

43. The SEPP N-1 noise limits I have applied under the PSP are as follows:

a. For proposed residential use under the PSP towards the south boundary of DBJV land interfacing with proposed light industry:

SEPP N-1 Period	Zoning Level	Background Noise	Noise Limit
Day, 7am-6pm Mon-Fri, 7am-1pm Sat	54	-	54^
Evening, 1pm-6pm Sat	48	-	48^
Night, 6am-7am Mon-Sat	43	45	48
Notes:	^Noise limit taken as the zoning level		

b. For proposed residential use under the PSP towards the south boundary of DBJV and 1100 Donnybrook lands with setbacks from proposed industrial or commercial land by at least 200m:

SEPP N-1 Period	Zoning Level	Background Noise	Noise Limit

Day, 7am-6pm Mon-Fri, 7am-1pm Sat	50	-	50^
Evening, 1pm-6pm Sat	44	-	44^
Night, 6am-7am Mon-Sat	39	45	48
Notes:	^Noise limit taken as the Zoning Level		

c. For proposed residential use under this PSP which interfaces with Donnybrook Road:

SEPP N-1 Period	Zoning Level	Background Noise	Noise Limit
Day, 7am-6pm Mon-Fri, 7am-1pm Sat	58	-	58^
Evening, 1pm-6pm Sat	51	-	51^
Night, 6am-7am Mon-Sat	46	51	54
Notes:	^Noise limit taken as the zoning level		

5 NOISE EMISSIONS FROM BARRO

5.1 Site Inspections & Noise Survey

44. I have carried out an analysis of both existing and future noise emissions from all operations on Barro's land. While the assessment is based on empirical data captured from Barro's existing operations, modelling is required to assess:

    a. Broader impacts from existing operations due to the relatively large area of emission, distances and access to surrounding lands.

    b. Future uses on Barro land which have not commenced operation.

    c. Worst-case cumulative noise impacts, where all existing and proposed uses on Barro land may be operating simultaneously.

45. Sound Power Level data has been obtained by undertaking noise surveys carried out on 23 April 2020 at the following locations:

a. Woody Hill Quarry, to assess existing and future noise emissions.

b. Woody Hill Concrete Batching Plant.

46. I have also undertaken a noise survey at Barro's Wyndham Vale quarry. My instructions are that crushing plant at this site is more likely to reflect the fixed plant intended for Phillips Quarry in the long-term. From my observations at the Wyndham Vale site, crushing plant, while larger, is contained within enclosures and therefore the radiated Sound Power Levels are less than the plant surveyed at Woody Hill, which have been used in the model.

47. Measurement of plant was generally carried out within 5-50m of sources, and included:

- Crushers
- Screens
- Excavators loading material
- Front end loaders loading into trucks
- Sales trucks driving access roads and being loaded
- Haul trucks driving and loading the primary crusher at the Wyndham Vale site
- Rock breaking
- Concrete batching plant

48. All other sources observed in operation were not deemed material with regard to noise emission, such as water carts and passenger vehicles.

49. Sound Power Level information and survey photographs are provided in Appendix C of this statement.

50. Sources could not always be measured in isolation, for instance where an excavator was loading the primary crusher, or where two pieces of plant were in close proximity to one another. To that end, a Validation Model has been prepared to help determine if any inaccuracies in the noise measurement survey are material when compared to observed noise levels at greater distances.

51. Sources which do not otherwise exist on Barro's sites have been taken from other previous projects I have consulted on, including delivery trucks and forklifts I have measured at warehousing trade supply stores.

52. I also carried out measurements proximate to boundaries on Barro's land, as well as adjacent and public land for the purpose of validating the acoustic model. I was granted access to DBJV land by that landowner for the purpose of carrying out observations and noise measurements. I again rely on attended measurements as during my survey, there were other noisy works occurring on Donnybrook Road and adjacent subdivisions.

53. While noise emissions can be measured directly for Barro's existing operations, the Validation Model provides verification that the results are reasonably accurate and therefore future proposals can also be expected to be reasonably accurate. The Validation Model tests that the combined modelling inputs reflect the acoustic parameters on-site, such as Sound Power Levels and ground terrain information. Finally, the noise model allows testing of typical worst-case meteorological conditions which may not occur regularly, or which are difficult to capture in limited noise surveys. Modelling under conditions favourable to noise propagation is best practice, while not necessarily required by SEPP N-1 under a compliance assessment.

54. The noise surveys undertaken on lands surrounding the Barro land, including surveys conducted on DBJV land, resulted in good agreement with the Validation Model, with corrections applied for specific wind conditions at the time of measurement.

55. When I attended DBJV land on 9 September and 18 September 2020, Barro operations were barely audible when observed from the Assumed Buffer, and inaudible when further east. While this provides some confidence that existing operations on Barro land can comply beyond the Assumed Buffer, future operations, cumulative impacts and downwind propagation effects need to be considered in the noise modelling.

56. At other locations, closer to Woody Hill Quarry, noise emissions are audible. From observations, rock breaking is clearly the highest noise emission which occurs from the site, both in level and character. It is reasonable that a +2dB impulsive adjustment could be made in accordance with SEPP N-1 methodologies when the rock breaker is being used.

57. I observed that mobile plant on-site had broadband 'squaker' alarms and off-site sales trucks, while assumed to have beeper alarms installed, where not observed to reverse and use them. To that end, there was no obvious tonal character observed to be emitted from the site. In areas closer to Barro boundaries, a more audible plant 'hum' was observed that could be subject to a +2dB adjustment in accordance with SEPP N-1, however that appeared to diminish at greater distances, generally being

masked, or blending into the prevailing ambient noise once at a distance greater than 400-500m.

5.2 Noise Modelling

5.2.1 Key Parameters

58. Because of the multiple uses on Barro land as well as proposed staging plans, the number of modelling scenarios that need to be considered is relatively complex for future operations. The exact staging overlap is not known at this time, so I have assumed the scenarios which result in worst-case noise impacts.

59. I have received detailed ground elevation data for the existing site on Barro land. I am reliant on data from DELWP's Land Channel for surrounding areas, noting that it is reasonable to expect that some areas of land may be cut or filled as the PSP area is developed. I have not been provided with digital terrain contours for Barro's future operations. Pit levels are based on email instructions I received describing the intended works and staging is generally set out in Barro response to Directions 6 & 7 from the Panel. As described above, it is reasonable to expect that the initial operation after the site has been cleared of topsoil will be indicative of the worst-case scenario, and therefore the ground height at the depth of overburden is the most critical.

60. The purpose of modelling both initial operation and pit construction is to assess noise emissions of plant at different terrain heights. However, any works beyond site preparation or construction need to be considered as operational noise under SEPP N-1, meaning that 'Day 1 operation' for each stage inherently results in the highest noise emissions. To that end, there is minimal benefit assumed in the model due to pit depth given 'Day 1 operation' needs to be considered.

61. My experience is that 'construction' and 'operation' for earth resources sites is not always self-evident, because both works would use similar extraction machinery. Overburden is also expected to be used to construct bunding on the site for shielding and noise control purposes. Development which is considered site preparation, construction or works for the purpose of providing noise attenuation is not subject to compliance with SEPP N-1.

62. EPA Publication 1411 Noise from Industry in Regional Victoria provides further guidance on this matter, as follows:

Process	Variations to recommended levels	Limitations to applying variations
Installation of constructed noise-control works 'Constructed noise-control works' are works specifically targeted to a noise-control purpose. They can include walls or fences; or earth mounds or bunds, constructed in particular circumstances (see 'Limitations to applying variations'). They are not mining or quarrying works carried out during the project that have a coincidental, secondary noise-control benefit (e.g. general overburden stockpiling). 'Constructed noise-control works' does not refer to building construction or demolition. SEPP N-1 and this document do not apply to building construction or demolition (e.g. construction of industrial premises, including ore-processing plants). *Noise control guidelines* (EPA publication 1254) apply.	During installation of constructed noise-control works (in the circumstances described under 'Limitations to applying variations') the noise from the activity may be exempted from recommended levels during the Day period.	• The exemption should only be provided for noise-control works that are necessary for the site to meet the recommended levels.[1] • The exemption is primarily intended for structures such as walls that are specifically for a noise-control purpose. • The exemption might also be applied to construction of earth mounds or bund walls (such as from soil or overburden) at the start of the project, where their primary purpose is noise control to meet the recommended levels. • In limited cases, the approved work plan may provide an exemption for noise control works at a later stage in the project. • Later project exemptions should only be applied to noise-control works that are to prevent new/different noise-sensitive areas from being exposed to noise above the recommended levels (e.g. where extraction works take place in a different part of a large site). • Where noise-control works employ soil or overburden, site operations should give priority to the noise-control benefits, above general stockpiling benefits. • The approved work plan should define the exemptions and constrain the periods to which the exemption applies. See Part 4 introductory notes – do not apply variations where recommended levels can be achieved by best practice.
Site clearing and preparation 'Site clearing and preparation' means vegetation removal, topsoil removal, subsoil removal, road construction and civil works such as site drainage.	During site clearing and preparation, the noise from the activity may be exempted from recommended levels during the Day period.	• The exemption can only be applied where the activity will happen before acoustic mounds can feasibly be constructed. • The exemption does not include overburden removal. See Part 4 introductory notes – do not apply variations where recommended levels can be achieved by best practice.

63. Modelling calculations have been carried out under the standard *ISO 9613: Attenuation of Sound During Propagation Outdoors*. The algorithms of ISO 9613 are widely accepted in that they assume typical worst-case meteorological conditions in all directions of propagation, i.e. all receptors are 'down-wind' of the noise source. To that end, I consider the modelling to be inherently conservative, noting that SEPP N-1 does not explicitly prescribe compliance under conditions most favourable to sound propagation, though it is best practice to model noise under favourable propagation. For the purpose of validation modelling against neutral propagation conditions observed during some measurements (i.e. nil wind), I have also modelled in accordance with a different algorithm known as CONCAWE which allows for wind conditions to be input.

64. Non-sensitive buildings are proposed within the Assumed Buffer to the east of the Woody Hill Quarry. I have not included the built form of this area in the modelling but note that it will likely provide additional attenuation to sensitive use properties most exposed to noise impacts along the Assumed Buffer. I have modelled a single scenario to reflect the likely attenuation that will occur after the industrial area is developed. This is provided at Appendix D – Map 06b. Similarly, the built form of sensitive land uses will also provide inherent shielding to properties further setback from buffers but have not been included in the modelling.

65. For future scenarios, bunding has been included on:

    a. The east boundary of Woody Hill and Woody Hill Extension Quarries. This is required to mitigate noise both from Woody Hill Extension and trucks which are proposed to be routed along that boundary for access to Phillips Quarry, and is part of the Agreement between Barro and DBJV.

    b. The north boundary of Phillips Quarry. This is required to mitigate noise from Phillips Quarry and is part of the Agreement between Barro and DBJV.

5.2.2 Results Summary

66. The following provides a summary of the modelling scenarios I have undertaken to assess the likely impacts at proposed buffers:

    a. Validation Model – good agreement was found between the measurement surveys (refer to Figure at paragraph 32) and model. **Refer to Maps 1 & 2 at Appendix D.**

Measurement Point	Measured Noise Level	Measurement Conditions	Modelled	Difference
A	45dB(A)	Downwind (south easterly) 320m to Barro title boundary	46dB(A) Downwind (ISO9613) Refer to Map 1 at Appendix D.	+1dB
D	49dB(A)	Calm 15m to Barro title boundary	51dB(A) Calm (Concawe) Refer to Map 2 at Appendix D.	+2dB
F	45dB(A)	Calm 300m to Barro title boundary	47dB(A) Calm (Concawe) Refer to Map 2 at Appendix D.	+2dB

G	Barro not clearly audible and not measurable. Ambient noise 44dB(A).	Calm 485m to Barro title boundary	43dB(A) Calm (Concawe) Refer to Map 2 at Appendix D.	-
At all other accessible measurement locations, Barro noise emissions were inaudible or not measurable due to higher ambient noise levels.				

b. Woody Hill Quarry operating under worst-case conditions. Noise emissions are up to 51dB(A) at the Assumed Buffer (inclusive of impulsive adjustment), indicating that the Assumed Buffer is inadequate without the additional mitigation within the Agreement as well as controls I have recommended. **Refer to Map 3 at Appendix D.**

c. Woody Hill Extension operating simultaneously with Woody Hill Quarry, under the following Staging Plans:

Scenario	Modelled Noise Level at Proposed 500m DBJV Buffer (Assumed Buffer)	Modelled Noise Level 200m from proposed Industrial Use on DBJV land	Modelled Noise Level at PSP 300m Noise Buffer (1100 Donnybrook Road)
Woody Hill Extension Operating Simultaneously with Woody Hill Quarry			
Stage 1 – Day Initial Operation Refer **Map 4**	50dB(A)	47dB(A)	34dB(A)
Stage 1 – Day Final Pit Level Refer **Map 5**	49dB(A)	46dB(A)	33dB(A)
Stage 4 – Day Initial Operation Refer **Map 6**	50dB(A)	47dB(A)	35dB(A)
Stage 4 – Night (Shoulder 6am to 7am) Initial Operation Refer **Map 7**	48dB(A)	46B(A)	33dB(A)

Stage 4 – Evening (Saturday 1pm to 6pm) Initial Operation Refer **Map 8**	47dB(A)	44dB(A)	32dB(A)
Stage 4 – Day Final Pit Level Refer **Map 9**	49dB(A)	47dB(A)	34dB(A)
Stage 2/3/5 – Day Initial Operation Refer **Map 10**	50dB(A)	47dB(A)	33dB(A)
Stage 2/3/5 – Day Final Pit Level Refer **Map 11**	49dB(A)	47dB(A)	33dB(A)
Phillips Quarry Operating Simultaneously with Woody Hill Quarry and Woody Hill Extension (Stage 4 – Initial Operation)			
Stage 1A – Day Initial Operation Refer **Map 12**	49dB(A)	47dB(A)	43dB(A)
Stage 1A – Day Final Pit Level Refer **Map 13**	49dB(A)	47dB(A)	43dB(A)
Stage 1B(ii) – Day Initial Operation Refer **Map 14**	49dB(A)	47dB(A)	48dB(A)
Stage 1B(ii) – Day Final Pit Level Refer **Map 15**	49dB(A)	47dB(A)	46dB(A)
Stage 1C – Day Initial Operation Refer **Map 16**	50dB(A)	48dB(A)	44dB(A)
Stage 1C – Day Final Pit Level Refer **Map 17**	49dB(A)	47dB(A)	44dB(A)
Stage 1D – Day Initial Operation Refer **Map 18**	49dB(A)	47dB(A)	44dB(A)
Stage 1D – Day Final Pit Level Refer **Map 19**	49dB(A)	47dB(A)	44dB(A)

67. From the results, I provide the following comments:

a. Barro is currently complying with SEPP N-1 at all existing and approved residential uses surrounding the site, with the exception of existing dwellings to the north of Langley Park Drive, where there may be minor exceedances during the Shoulder period and on Saturdays after 1pm where rock breaking occurs. The potential non-compliance would not occur under the PSP where the land between Barro and Langley Park Drive is rezoned to industrial or commercial use.

b. During approved Day period operations, the highest noise emission at the Assumed Buffer from all possible future scenarios is 50dB(A), occurring during Stage 1C of Phillips Quarry when operating simultaneously with Woody Hill and Woody Hill Extension. Allowing for a +2dB impulsive adjustment when the rock breaker is in use, the effective noise level is not expected to exceed 52dB(A) at the Assumed Buffer. This would comply with the SEPP N-1 Day noise limit.

c. During Shoulder period operations, the highest noise emission at the Assumed Buffer from all possible future scenarios is 48dB(A), when Woody Hill and Woody Hill Extension are operating simultaneously. Allowing for a +2dB impulsive adjustment when the rock breaker is in use, the effective noise level is expected to exceed SEPP N-1 Shoulder noise limit. To that end, I recommend that rock breaking does not occur on Barro's land on any day before 7am where the Assumed Buffer is in place.

d. The above scenario may also marginally exceed the noise limits beyond the Assumed Buffer during the Saturday afternoon period of 1pm-6pm. Modelling of noise levels without the rock breaker operating would reduce the effective noise level and result in SEPP N-1 compliance. To that end, I recommend that rock breaking does not occur on Barro's land on Saturday's between the hours 1pm-6pm.

e. There is only minor attenuation provided by the quarry pits, for the following reasons:

    i. DBJV land is elevated above Barro's land, and in particular above Phillips Quarry. Shielding from the pit faces is less effective because of this.

    ii. The proposed earth bunds on the boundary already provide significant shielding, resulting in diminishing returns from the pit design.

    iii. When Woody Hill Extension and Phillips Quarry are introduced, overall noise emissions are still largely driven by existing Woody Hill operations, which currently has direct line-of-sight to DBJV land.

68. The following Table provides an overview of the worst-case modelling results, with controls implemented, for both existing and future sensitive receptors:

Location: Proposed residential use to south of DBJV land interfacing with industry/commercial			
Period	Shoulder, 6am-7am	Day, 7am-6pm (Sat 7am-1pm)	Evening, Sat 1pm-6pm
Noise Limit	48dB(A)	54dB(A)	48dB(A)
Highest Modelled Noise Level	48dB(A)	52dB(A) Inclusive of +2dB penalty	47dB(A)
SEPP N-1 Compliance	Yes	Yes	Yes
Controls Assumed	No rock breaking	-	No rock breaking
Location: Proposed residential use to south of DBJV land at least 200m from industry/commercial use			
Period	Shoulder, 6am-7am	Day, 7am-6pm (Sat 7am-1pm)	Evening, Sat 1pm-6pm
Noise Limit	48dB(A)	50dB(A)	44dB(A)
Highest Modelled Noise Level	46dB(A)	50dB(A) Inclusive of +2dB penalty	44dB(A)
SEPP N-1 Compliance	Yes	Yes	Yes
Controls Assumed	No rock breaking	-	No rock breaking
Location: Proposed residential use interfacing with Donnybrook Road			
Period	Shoulder, 6am-7am	Day, 7am-6pm (Sat 7am-1pm)	Evening, Sat 1pm-6pm

Noise Limit	54dB(A)	58dB(A)	51dB(A)
Highest Modelled Noise Level	45dB(A)	49dB(A) Inclusive of +2dB penalty	43dB(A)
SEPP N-1 Compliance	Yes	Yes	Yes
Controls Assumed	No rock breaking	-	No rock breaking
Location: Proposed residential use on 1100 Donnybrook Road at 300m PSP Buffer			
Period	Shoulder, 6am-7am	Day, 7am-6pm (Sat 7am-1pm)	Evening, Sat 1pm-6pm
Noise Limit	48dB(A)	50dB(A)	44dB(A)
Highest Modelled Noise Level	33dB(A)	50dB(A) Inclusive of +2dB penalty	32dB(A)
SEPP N-1 Compliance	Yes	Yes	Yes
Controls Assumed	No rock breaking	-	No rock breaking

69. Beyond DBJV land, the next adjacent landowner within the PSP with proposed residential use is 1100 Donnybrook Rd (Submitter 20) and Plan 15 indicates a 300m distance to future residential use to Phillips Quarry. The noise model indicates noise levels up to 50dB(A) during the Day period (inclusive of impulsive penalty) when Phillips is operating, and 32dB(A) or less during the shoulder and Saturday afternoon periods when Woody Hill and Woody Hill Extension Quarries are operating without Phillips Quarry. It is arguable that at 300m, penalties under SEPP N-1 could be increased in a compliance assessment. Penalties are normally applied subjectively under SEPP N-1 during measurements, so it is difficult to quantify this precisely in modelling. To that end, it would be prudent to increase the buffer at 1100 Donnybrook Rd, if anything at all, but an increase in SEPP N-1 adjustments would not be required beyond a buffer of 500m based on site observations.

70. 1150 Donnybrook Road also proposes residential use however it follows that the noise impacts will be less than at 1100 Donnybrook Rd given the additional separation distance.

6 SUMMARY OF ANALYSIS & RECOMMENDATIONS TO THE PANEL

71. Noise modelling of both existing and proposed operations on Barro land, including all uses on 870 Donnybrook Road and 430 Summerhill Road, indicates:
    a. Compliance within 500m of extraction boundaries of WA492, WA6437, WA6852.
    b. Buffers proposed to residential use at 1100 Donnybrook Rd land, as exhibited in the PSP, indicates compliance with SEPP N-1 where a consistent adjustment is applied for impulsive noise across the entire PSP area. I note however that there is minimal margin for error at this location where adjustments under SEPP N-1 could potentially be increased due to closer range of rock breaking during Stage Plan 1b(ii). It would be prudent to increase the noise buffer to 500m at 1100 Donnybrook Rd and 1150 Donnybrook Road, to account for subjective character assessments of noise.
    c. There are no other sensitive uses proposed within the exhibited PSP which are relevant to the noise assessment for this hearing.

7 DECLARATION

72. I have made all the inquiries that I believe are desirable and appropriate and that no matters of significance which I regard as relevant have to my knowledge been withheld from the Panel.

Signed and dated this date

Darren Tardio
Director
Enfield Acoustics Pty Ltd

28 October 2020

Appendix A: CV

CURRICULUM VITAE

Darren Tardio

Director of Enfield Acoustics Pty Ltd

Qualifications & Associations

- B Mus (Eng. & Tech.)
- MAAS, Australian Acoustical Society

Summary

Darren is a founding Director and Noise & Vibration Engineer at Enfield Acoustics Pty Ltd. He completed his Bachelor Degree in 2004. His undergraduate thesis researched the inaudible (infrasound and ultrasound) frequency spectrum and its effects on reproduction equipment and the subjective quality of the listener.

With 15 years of professional acoustic consulting experience, Darren has been involved in many key local and overseas projects related to noise and vibration. Darren's professional career has demonstrated the ability to project manage large commercial projects in utilities, buildings and infrastructure as well as carry out complex environmental noise impact assessments. His hands-on approach has required travel to all major cities in Australia as well as the Middle East, including work on the world's tallest building, the Burj Khalifa.

Darren has worked extensively on projects relating to:

- Environmental noise studies for industrial and infrastructure projects
- Expert Witness for VCAT, Legal and Panel Hearings
- Industrial and Environmental Noise Control for Power Stations, Petrochemical, Water Treatment, Mining, Quarries, etc.
- Aero-acoustic (wind noise) testing and mitigation of noisy building facades
- Expert in BCA acoustics issues
- Site inspections of acoustic works and workmanship defects during construction
- Laboratory sample testing for manufacturers
- Community noise disputes
- Building and ground vibration analysis
- Human comfort vibration and structure-borne noise

Recent Experience

Environment, Infrastructure, Planning and Legal

West Gate Tunnel Project, EES Review and Panel Hearing for MCC; Waurn Ponds Stabling Yard, Rail Projects Victoria; Tulla Widening Project, EES Review for MVCC; Kaufland Australia Tranche Panel Hearings; Webb Dock Tender EES for John Holland; Kilmore Bypass Route Selection and EES for VicRoads; Murray River Crossing for VicRoads; Thompsons Road Duplication Project for VicRoads; Western Highway duplication, Burrumbeet to Beaufort; Dingley Bypass; Geelong Ring Road for Fulton Hogan; Calder Freeway for Fulton Hogan; Regional Rail Link Package G for UGL/Manidis Roberts; Melbourne Metro Early Works Package for John Holland; Hobart Airport STARs flight path EES review; VicRoads Land, Pakenham Bypass; Tylden Quarry Expansion for Fulton Hogan; Amendment C109 Panel Hearing, Hobsons Bay; Ballarto Road Concrete Batching Plant, Clyde; Mt Ridley Cleanfill, Yuroke; Boral Clayton Concrete Plant; Boral Quarries, Deer Park; Melbourne Regional Landfill EES Review; Tea Tree Quarry, Tasmania; Fonterra Stanhope; ACM Quarries, Rockbank & Epping; Northeast Link Project, EES Review and Panel.

Building Acoustics, Facades & Mechanical Services

Melbourne Quarter, Lend Lease; Burj Khalifa, Dubai; Nazareth College, Noble Park; Westfield Cinemas, North Lakes; Broadmeadows Childrens Court; Camberwell Kindergarten; GTV9, Richmond; HM@S Apartments, Port Melbourne; Department of Environment and Primary Industries offices, Warrnambool; Hampton on Hampton Apartments, Hampton; La Trobe University, Bundoora; Constance Apartments, Hawthorn; Kew Circle Apartments, Kew; 26-28 Wilson Street, South Yarra; McKinnon Kindergarten, McKinnon; Martha's Point Retirement Village; AFL Victoria offices, Visy Park; 105 Ormond Esplanade; 5-7 Wilson Street, South Yarra; 108 Glen Iris Road apartments; 101 Collins Street offices, Melbourne; 25-29 Wilson Street, South Yarra; 54-56 Chapel Street, St Kilda; V6 Concavo, Docklands; 108 Maribyrnong Road apartments, Moonee Ponds; Docklands Square Library, Docklands; EXO, Docklands; Forte Living, Docklands; Serrata, Docklands

Vibration & Structural Damage

ACU, Watpac; Melbourne Water Sewer Replacement, John Holland; Goodlife, Camberwell; Richmond Terminal Power Station, transmission tower structural damage; Webb Dock, Port Melbourne; Regional Rail Link; Bosch Automotive Shaker Laboratory; 313 Victoria Street Woolworths, Abbotsford

Music Noise

Queenscliff Music Festival; The Pier Hotel, Port Melbourne; Iddy Biddy, St Kilda; Alphington Rehearsal Studios; Mothers Milk, Brighton; The Penny Black, Brunswick; The George Basement, St Kilda; Branch Bar, St Kilda; Purepop, St Kilda; The Mint Bar, Melbourne; City of Port Phillip Noise Management and Application Plans; Tanglewood Festival

Research & Development Studies

Melbourne Zoo, noise & vibration induced animal behaviour; Hollowcore Concrete, impact sound insulation; Rehau wastewater pipe sound insulation; Duratray / AngloAmerican mining, Hunter Valley; Knauf Auralisation study

Professional History

- 2018 – Founder & Director, Enfield Acoustics
- 2016 – Founder & Director, Octave Acoustics
- 2013 – Senior Acoustic Consultant, Renzo Tonin & Associates
- 2011 – Project Engineer, Renzo Tonin & Associates
- 2006 – Project Engineer, VIPAC Engineers & Scientists

Publications & AIA CPD Presentations

Darren has published papers for national and international conferences and journals on the topics of noise.

These include:

- "Plenum Effect of Ceiling Space on the Assessment of Noise Levels", 37th International Congress and Exposition of Noise Control Engineering, Shanghai, China, Oct, 2008, D Tardio and X Li.
- "Investigation into the Airborne Flanking Sound Transmission Paths of Wastewater Pipes and Acoustic Lagging", Acoustics 2012, Australian Acoustical Society Annual Conference, Fremantle, WA, November 2012, D Tardio and P Tommasini
- "Effect of Singing on Respiratory Function, Voice and Mood after Quadriplegia: A Randomized Controlled Trial", The National Center for Biotechnology Information, 2012, J Tamplin et al. (contributor)
- "Sound of Architecture", Architectural CPD 2014, Talking Brand, D Tardio and M Micallef
- "A case study in the isolation of flanking noise in prefabricated timber construction and buildings relying on load bearing internal timber cladding" Acoustics 2018, Australian Acoustical Society Annual Conference, Adelaide, SA, November 2018, T Murray, D Tardio, A Lloyd

Appendix B: Noise Measurement Locations

Scale: 1: 8273 @ A3

ENFIELD ACOUSTICS NOISE VIBRATION

PO Box 920
North Melbourne, VIC 3051
P: 03 9111 0090

BARRO GROUP - WOODY HILL QUARRY

NOISE MONITORING LOCATIONS

Project No: V319-01 Drawing No: APPENDIX B Date: 27.10.2020

Appendix C: Noise Survey and SWL Data

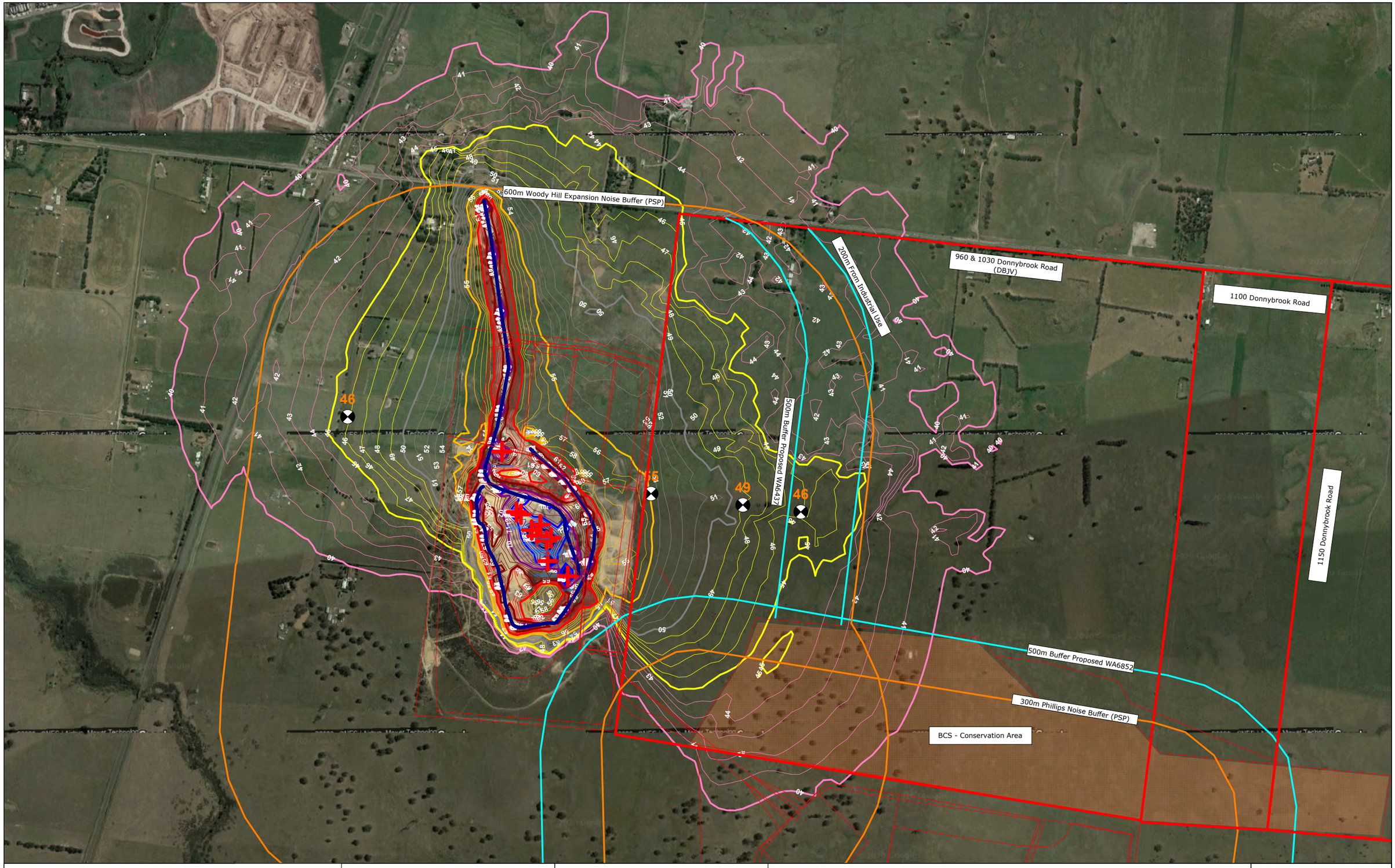
Noise Source	SWL, dB(A)	63Hz dB	125Hz dB	250Hz dB	500Hz dB	1000Hz dB	2000Hz dB	4000Hz dB
Sales and Concrete Trucks	108, $L_{max,\ 10km/hr}$	112	112	105	104	104	100	93
Haul Trucks	113, $L_{max,\ 10km/hr}$	117	117	110	109	109	105	98
Primary Crusher and Excavator	113 $L_{Aeq,\ 30\text{-}min}$	122	115	111	112	108	105	100
Secondary Crusher and Screen	115 $L_{Aeq,\ 30\text{-}min}$	122	108	108	108	108	110	109
Tertiary Crusher	110 $L_{Aeq,\ 30\text{-}min}$	112	112	106	109	104	103	101
Rock Breaker	119 $L_{Aeq,\ 30\text{-}min}$	116	119	117	117	113	112	108
Batching Plant	107 $L_{Aeq,\ 30\text{-}min}$	103	109	101	102	104	99	98
Front End Loader Reversing (Squaker)	103 $L_{Aeq,\ 30\text{-}min}$	99	94	92	89	99	100	85
Loading with Front End Loader	111 $L_{Aeq,\ 30\text{-}min}$	121	114	110	107	107	104	98
Sales Trucks (point source within pits)	103 $L_{Aeq,\ 30\text{-}min}$	107	107	99	99	99	95	88
Trade Supplies Deliveries	85 $L_{Aeq,\ 30\text{-}min}$	83	80	78	79	79	78	78
Trade Supplies Forklift	91 $L_{Aeq,\ 30\text{-}min}$	100	92	91	88	87	82	77

LOCATIONS OF FIXED PLANT ON WOODY HILL SITE


HITACHI
DANGER


CH440

Appendix D: Noise Mapping



Legend:

- Point Source
- Line Source
- Building
- Barrier
- Embankment
- Ground Absorption
- Receiver
- Calculation Area

Noise Level - dB(A)

- >= 40.0
- >= 45.0
- >= 50.0
- >= 55.0
- >= 60.0
- >= 65.0
- >= 70.0
- >= 75.0
- >= 80.0

Scale: 1: 11044 @ A3

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BARRO GROUP - WOODY HILL QUARRY

Validation Model

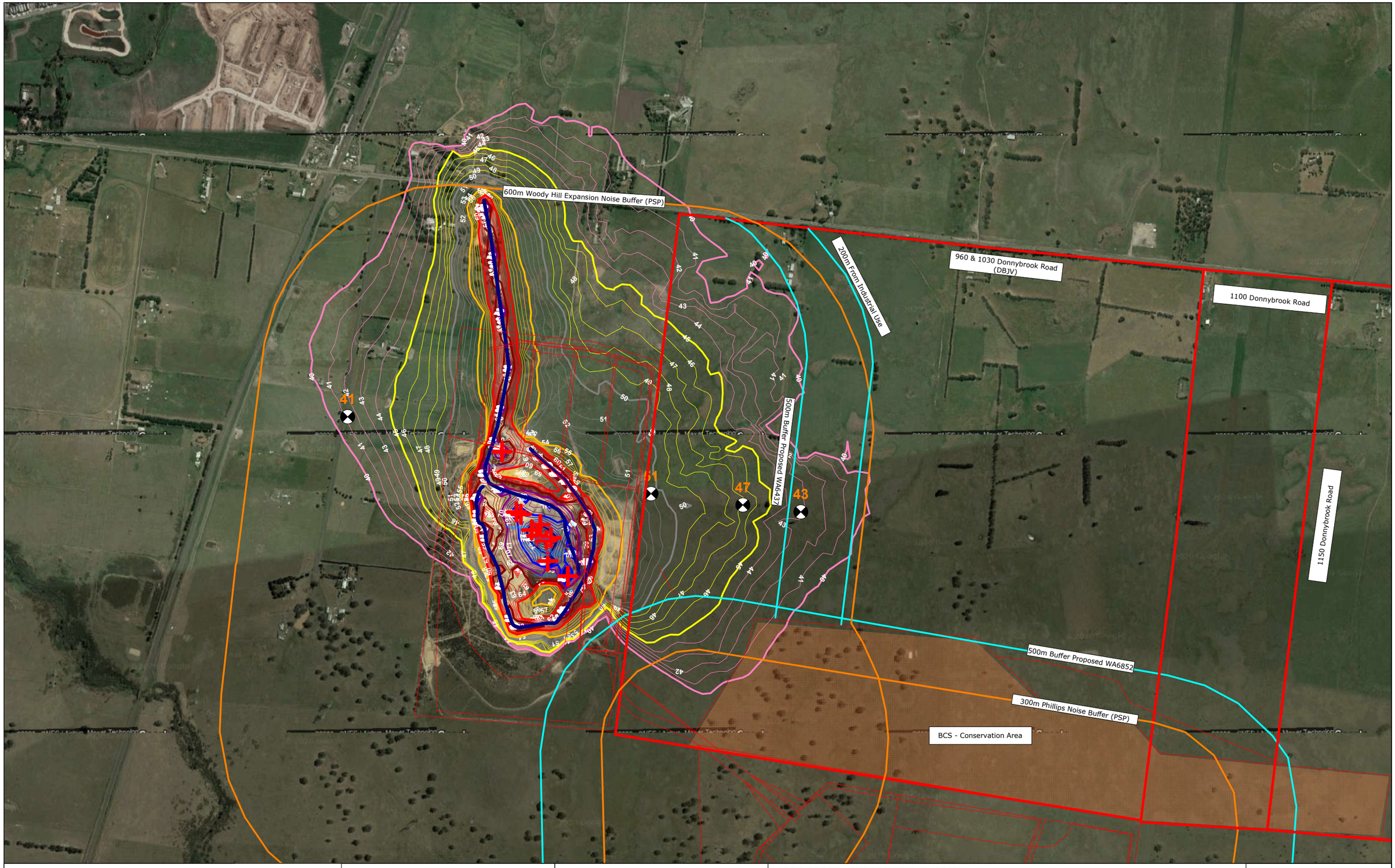
Woody Hill Plant Operating
Batching Plant Operating

LAeq, 30-min noise levels, SEPP N-1 Assessment - Day

Project No: V319-01 Drawing No: MAP-01 (f1) Date: 28.10.2020

NOTES:

*Propagation in accordance with ISO9613
*Model includes land topography
*Refer to report for SWL
*Contours at 1.5m RL



Legend:

- Point Source
- Line Source
- Building
- Barrier
- Embankment
- Ground Absorption
- Contour Line
- Receiver
- Calculation Area

Noise Level - dB(A)

- >= 40.0
- >= 45.0
- >= 50.0
- >= 55.0
- >= 60.0
- >= 65.0
- >= 70.0
- >= 75.0
- >= 80.0

Scale: 1: 11044 @ A3

ENFIELD ACOUSTICS NOISE VIBRATION

PO Box 920
North Melbourne, VIC 3051
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BARRO GROUP - WOODY HILL QUARRY

Validation Model - Concawe (Calm / No Wind)

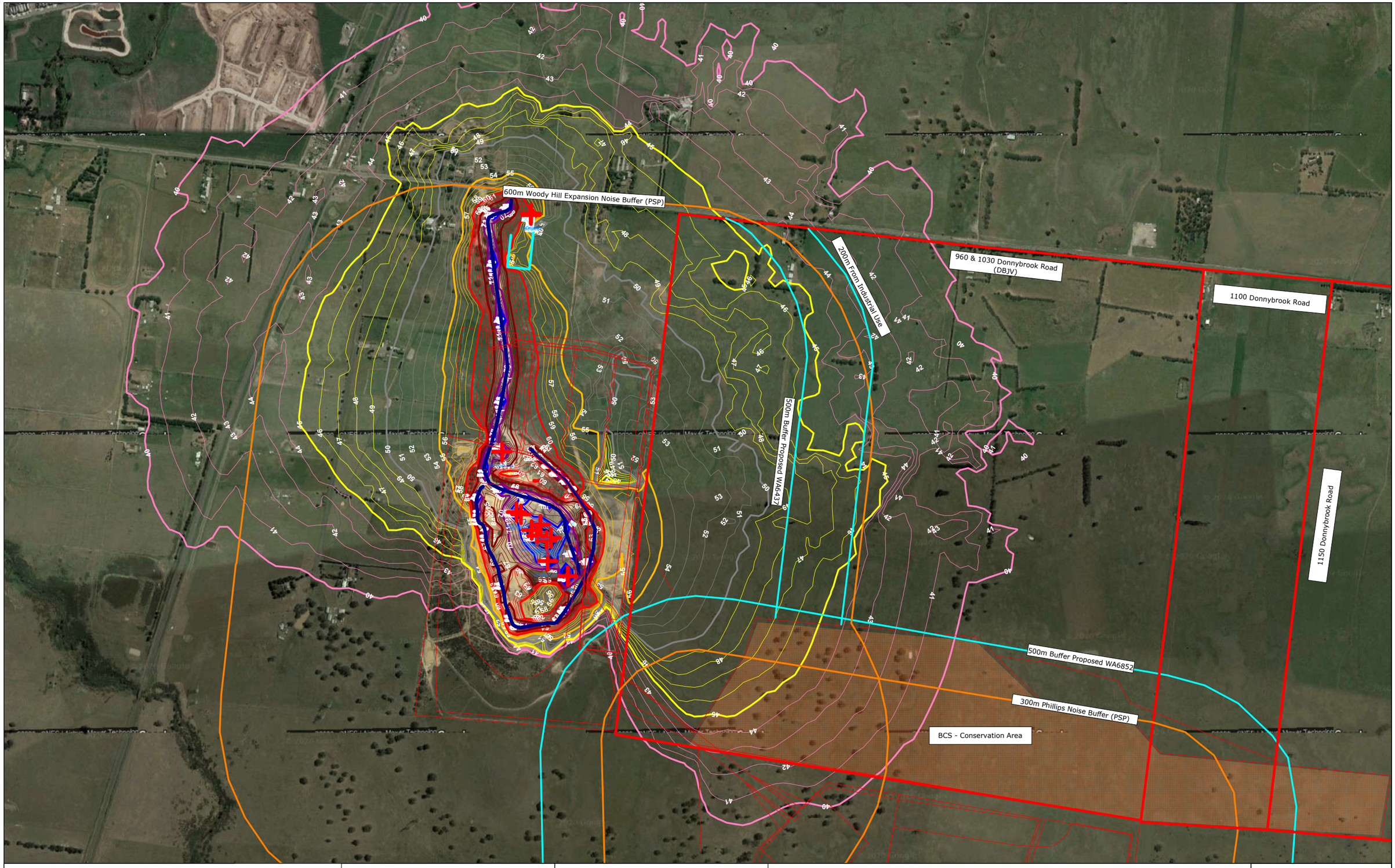
Woody Hill Plant Operating
Batching Plant Operating

LAeq, 30-min noise levels, SEPP N-1 Assessment - Day

Project No: V319-01 Drawing No: MAP-02 (f1) Date: 28.10.2020

NOTES:

*Propagation in accordance with CONCAWE
*Model includes land topography
*Refer to report for SWL
*Contours at 1.5m RL



Legend:

- Point Source
- Line Source
- Building
- Barrier
- Embankment
- Ground Absorption
- Receiver
- Calculation Area

Noise Level - dB(A)

- >= 40.0
- >= 45.0
- >= 50.0
- >= 55.0
- >= 60.0
- >= 65.0
- >= 70.0
- >= 75.0
- >= 80.0

Scale: 1: 11044 @ A3

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BARRO GROUP - WOODY HILL QUARRY

WA492 - Future Scenario

Woody Hill Plant Operating
Batching Plant Operating

LAeq, 30-min noise levels, SEPP N-1 Assessment - Day

Project No: V319-01 Drawing No: MAP-03 (f1) Date: 28.10.2020

NOTES:

*Propagation in accordance with ISO9613
*Model includes land topography
*Refer to report for SWL
*Contours at 1.5m RL

600m Woody Hill Expansion Noise Buffer (PSP)

200m From Industrial Use

960 & 1030 Donnybrook Road (DBJV)

1100 Donnybrook Road

1150 Donnybrook Road

500m Buffer Proposed WA6437

500m Buffer Proposed WA6852

300m Phillips Noise Buffer (PSP)

BCS - Conservation Area

Stage 1

Legend:

- Point Source
- Line Source
- Building
- Barrier
- Embankment
- Ground Absorption
- Receiver
- Calculation Area

Noise Level - dB(A)

- >= 40.0
- >= 45.0
- >= 50.0
- >= 55.0
- >= 60.0
- >= 65.0
- >= 70.0
- >= 75.0
- >= 80.0

Scale: 1: 11044 @ A3

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BARRO GROUP - WOODY HILL QUARRY

WA6437 - Stage 1 - Initial Operation

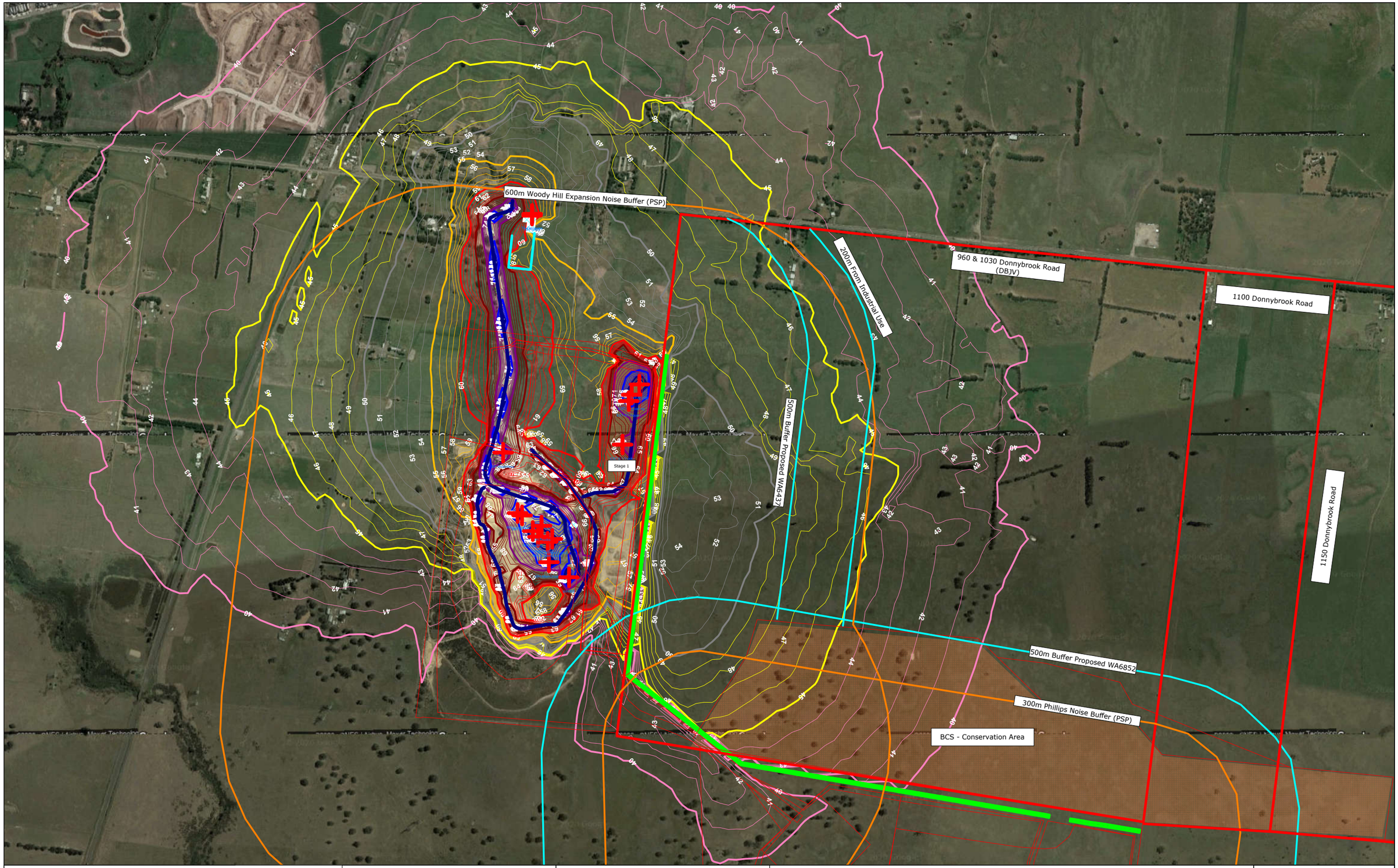
Woody Hill Plant Operating
Batching Plant Operating
WA6437 Stage 1 Plant Operating

LAeq, 30-min noise levels, SEPP N-1 Assessment - Day

Project No: V319-01 Drawing No: MAP-04 (f1) Date: 28.10.2020

NOTES:

*Propagation in accordance with ISO9613
*Model includes land topography
*Refer to report for SWL
*Contours at 1.5m RL



Legend:

- Point Source
- Line Source
- Building
- Barrier
- Embankment
- Ground Absorption
- Receiver
- Calculation Area

Noise Level - dB(A)

- >= 40.0
- >= 45.0
- >= 50.0
- >= 55.0
- >= 60.0
- >= 65.0
- >= 70.0
- >= 75.0
- >= 80.0

Scale: 1: 11044 @ A3

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BARRO GROUP - WOODY HILL QUARRY

WA6437 - Stage 1 - At Final Pit Level

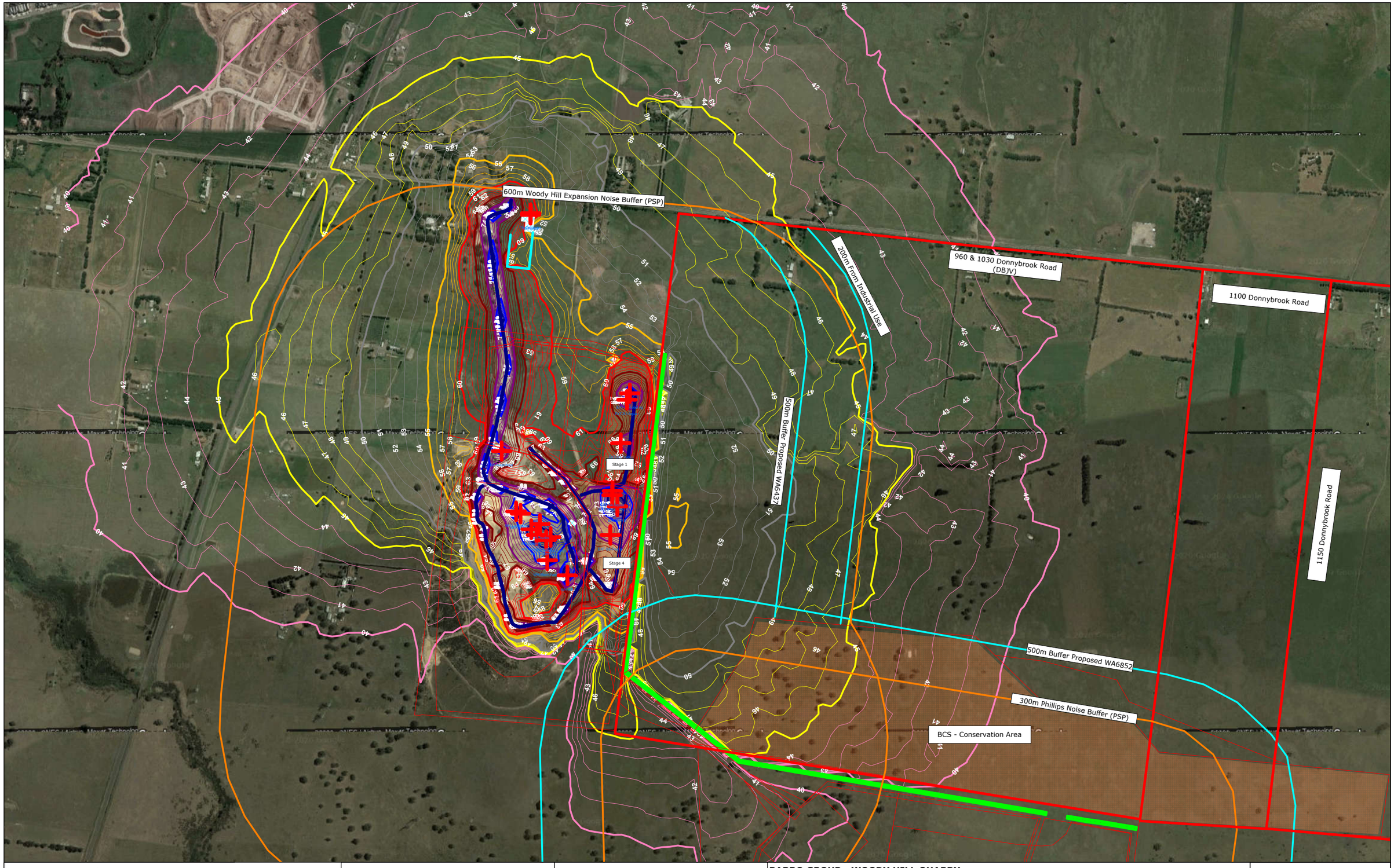
Woody Hill Plant Operating
Batching Plant Operating
WA6437 Stage 1 Plant Operating

LAeq, 30-min noise levels, SEPP N-1 Assessment - Day

Project No: V319-01 Drawing No: MAP-05 (f1) Date: 28.10.2020

NOTES:

*Propagation in accordance with ISO9613
*Model includes land topography
*Refer to report for SWL
*Contours at 1.5m RL



Legend:

- Point Source
- Line Source
- Building
- Barrier
- Embankment
- Ground Absorption
- Receiver
- Calculation Area

Noise Level - dB(A)

- >= 40.0
- >= 45.0
- >= 50.0
- >= 55.0
- >= 60.0
- >= 65.0
- >= 70.0
- >= 75.0
- >= 80.0

Scale: 1: 11044 @ A3

ENFIELD ACOUSTICS NOISE VIBRATION

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North Melbourne, VIC 3051
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BARRO GROUP - WOODY HILL QUARRY

WA6437 - Stage 4 - Initial Operation

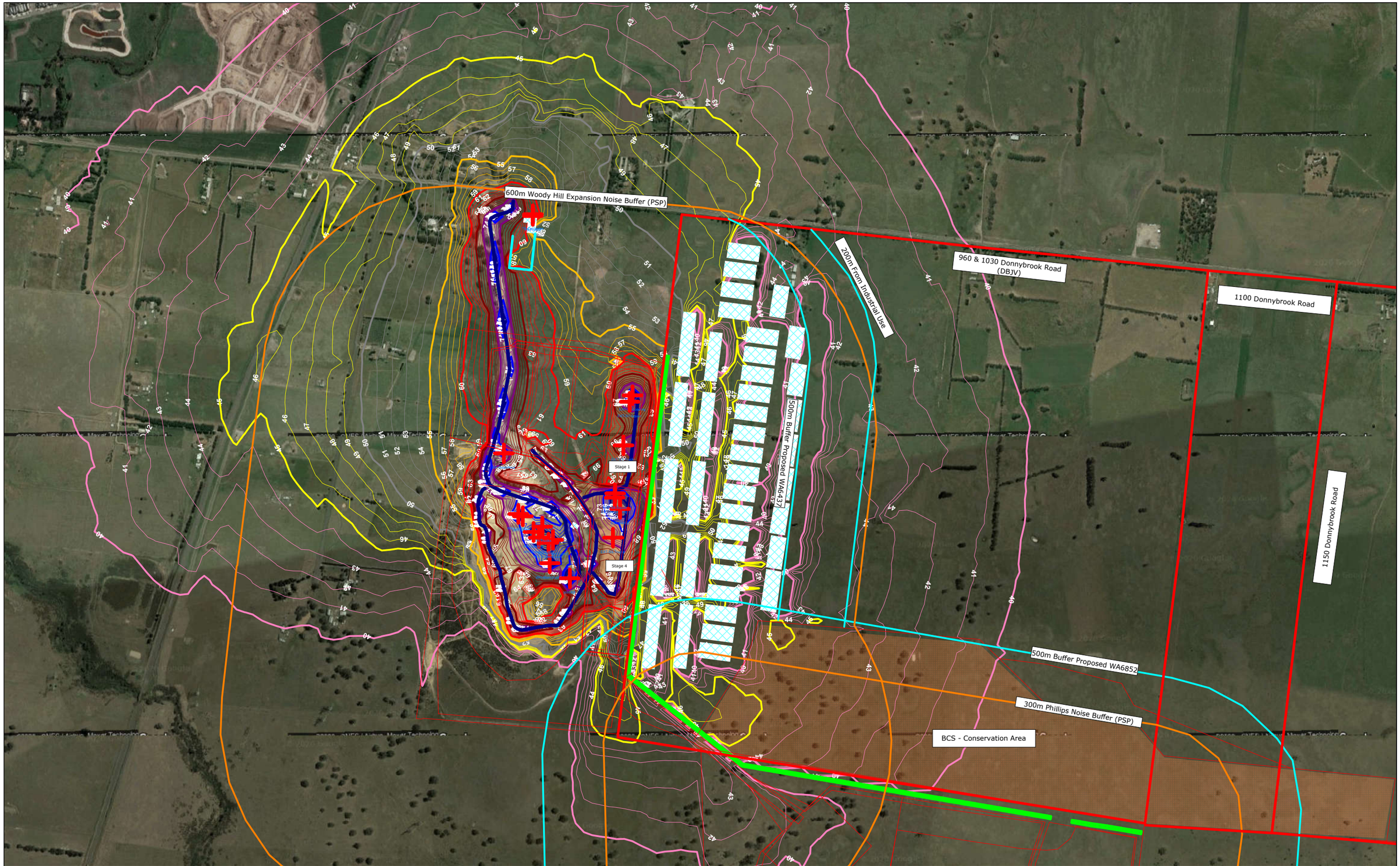
Woody Hill Plant Operating
Batching Plant Operating
WA6437 Stage 1 Operating (No Rock Breaker)
WA6437 Stage 4 Plant Operating

LAeq, 30-min noise levels, SEPP N-1 Assessment - Day

Project No: V319-01 Drawing No: MAP-06 (f1) Date: 28.10.2020

NOTES:

*Propagation in accordance with ISO9613
*Model includes land topography
*Refer to report for SWL
*Contours at 1.5m RL



Legend:

- Point Source
- Line Source
- Building
- Barrier
- Embankment
- Ground Absorption
- Receiver
- Calculation Area

Noise Level - dB(A)

- >= 40.0
- >= 45.0
- >= 50.0
- >= 55.0
- >= 60.0
- >= 65.0
- >= 70.0
- >= 75.0
- >= 80.0

Scale: 1: 11044 @ A3

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North Melbourne, VIC 3051
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BARRO GROUP - WOODY HILL QUARRY

WA6437 - Stage 4 - Initial Operation

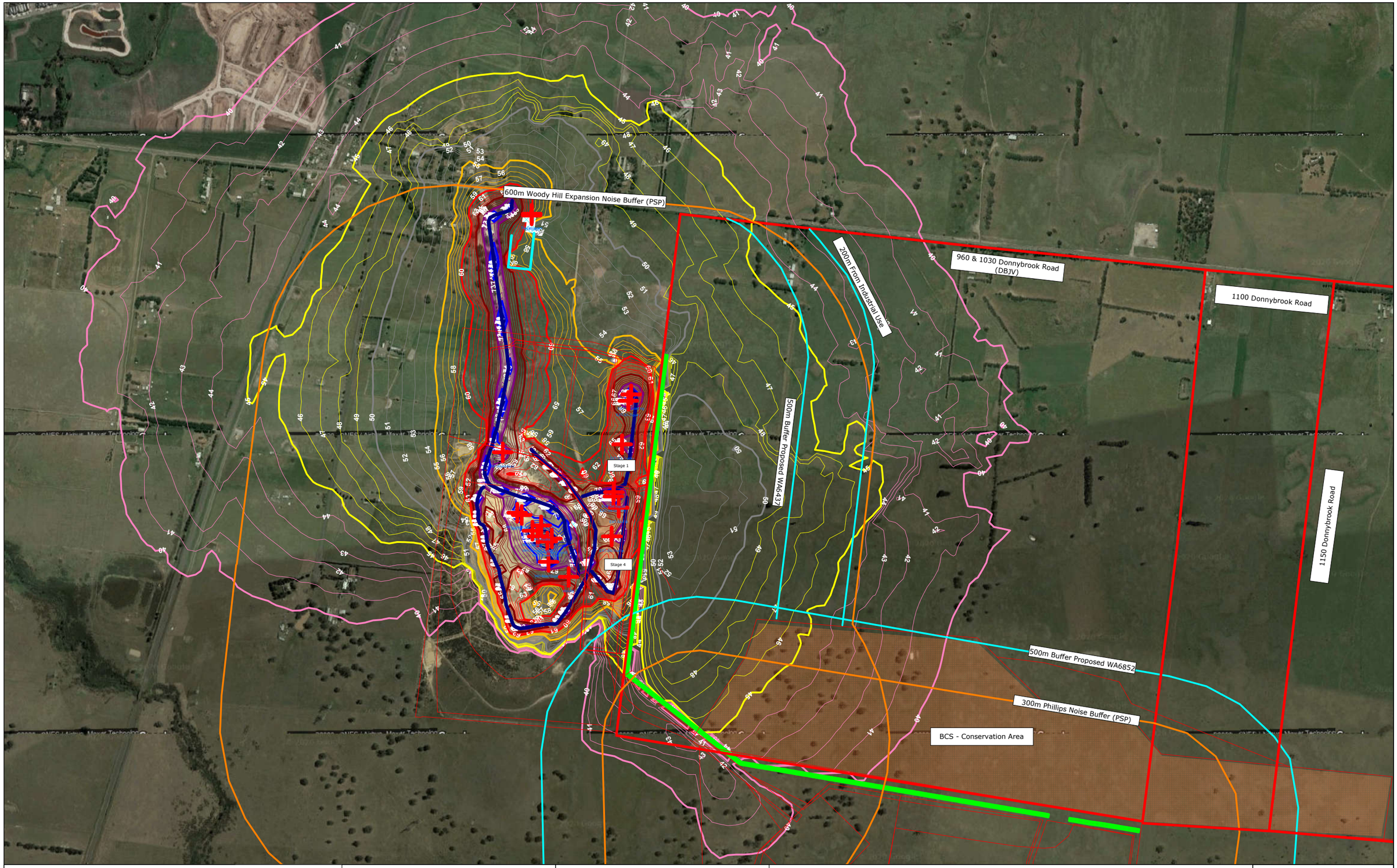
Woody Hill Plant Operating
Batching Plant Operating
WA6437 Stage 1 Operating (No Rock Breaker)
WA6437 Stage 4 Plant Operating
Industrial Buildings @10m RL

LAeq, 30-min noise levels, SEPP N-1 Assessment - Day

Project No: V319-01 Drawing No: MAP-06b (f1) Date: 28.10.2020

NOTES:

*Propagation in accordance with ISO9613
*Model includes land topography
*Refer to report for SWL
*Contours at 1.5m RL



Legend:

- Point Source
- Line Source
- Building
- Barrier
- Embankment
- Ground Absorption
- Receiver
- Calculation Area

Noise Level - dB(A)

- >= 40.0
- >= 45.0
- >= 50.0
- >= 55.0
- >= 60.0
- >= 65.0
- >= 70.0
- >= 75.0
- >= 80.0

Scale: 1: 11044 @ A3

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BARRO GROUP - WOODY HILL QUARRY

WA6437 - Stage 4 - Initial Operation
Worst Case 'Night' Scenario

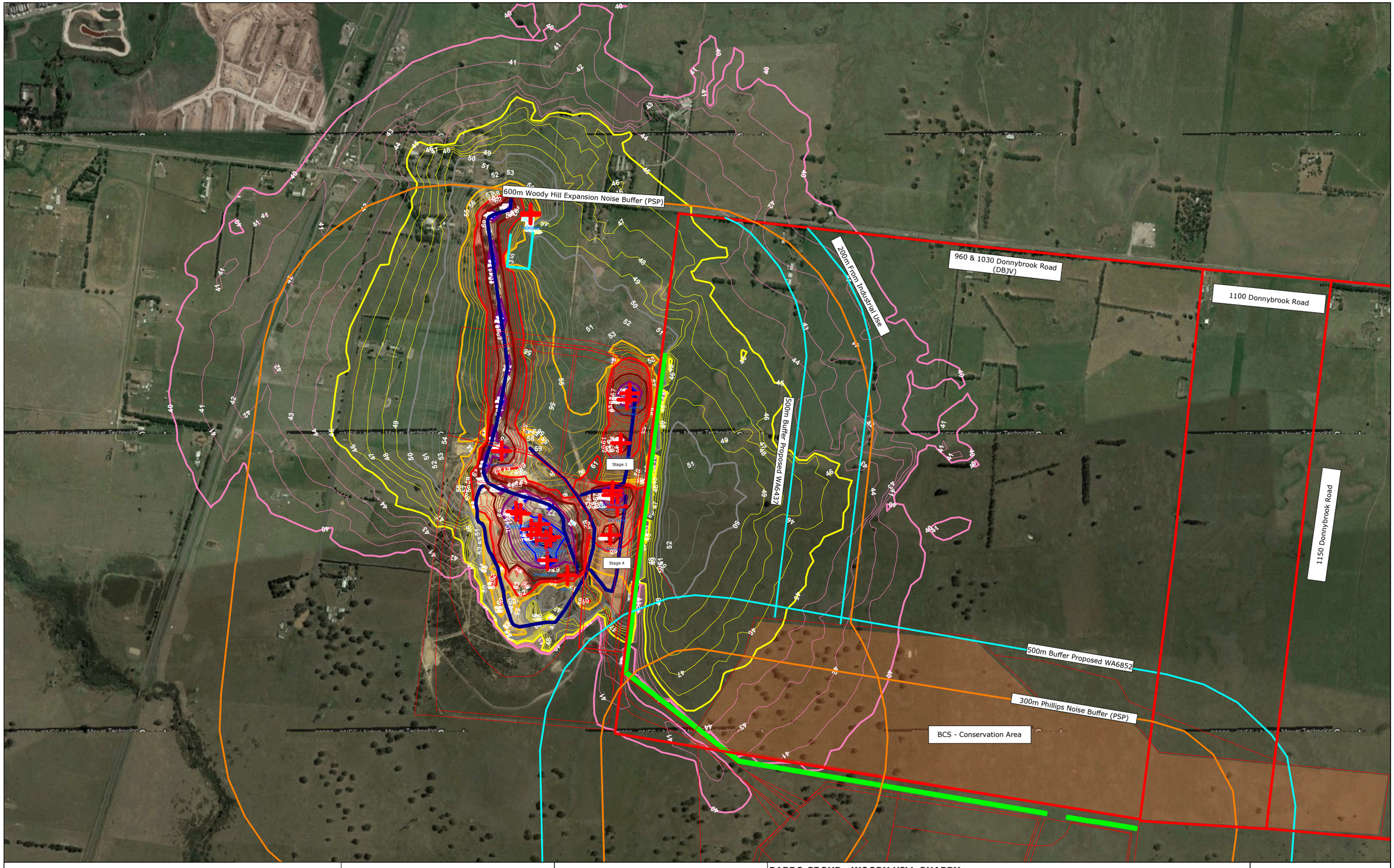
Woody Hill Plant Operating (No Rock Breaker)
Batching Plant Operating
WA6437 Stage 1 Operating (No Rock Breaker)
WA6437 Stage 4 Operating (No Rock Breaker)

LAeq, 30-min noise levels, SEPP N-1 Assessment - 'Night' (Shoulder Period from 6am to 7am)

Project No: V319-01 Drawing No: MAP-07 (f1) Date: 28.10.2020

NOTES:

*Propagation in accordance with ISO9613
*Model includes land topography
*Refer to report for SWL
*Contours at 1.5m RL



Legend:

- Point Source
- Line Source
- Building
- Barrier
- Embankment
- Ground Absorption
- Receiver
- Calculation Area

Noise Level - dB(A)

- >= 40.0
- >= 45.0
- >= 50.0
- >= 55.0
- >= 60.0
- >= 65.0
- >= 70.0
- >= 75.0
- >= 80.0

Scale: 1: 11044 @ A3

ENFIELD ACOUSTICS NOISE VIBRATION

PO Box 920
North Melbourne, VIC 3051
P: 03 9111 0090

BARRO GROUP - WOODY HILL QUARRY

WA6437 - Stage 4 - Initial Operation
Worst Case 'Evening' Scenario

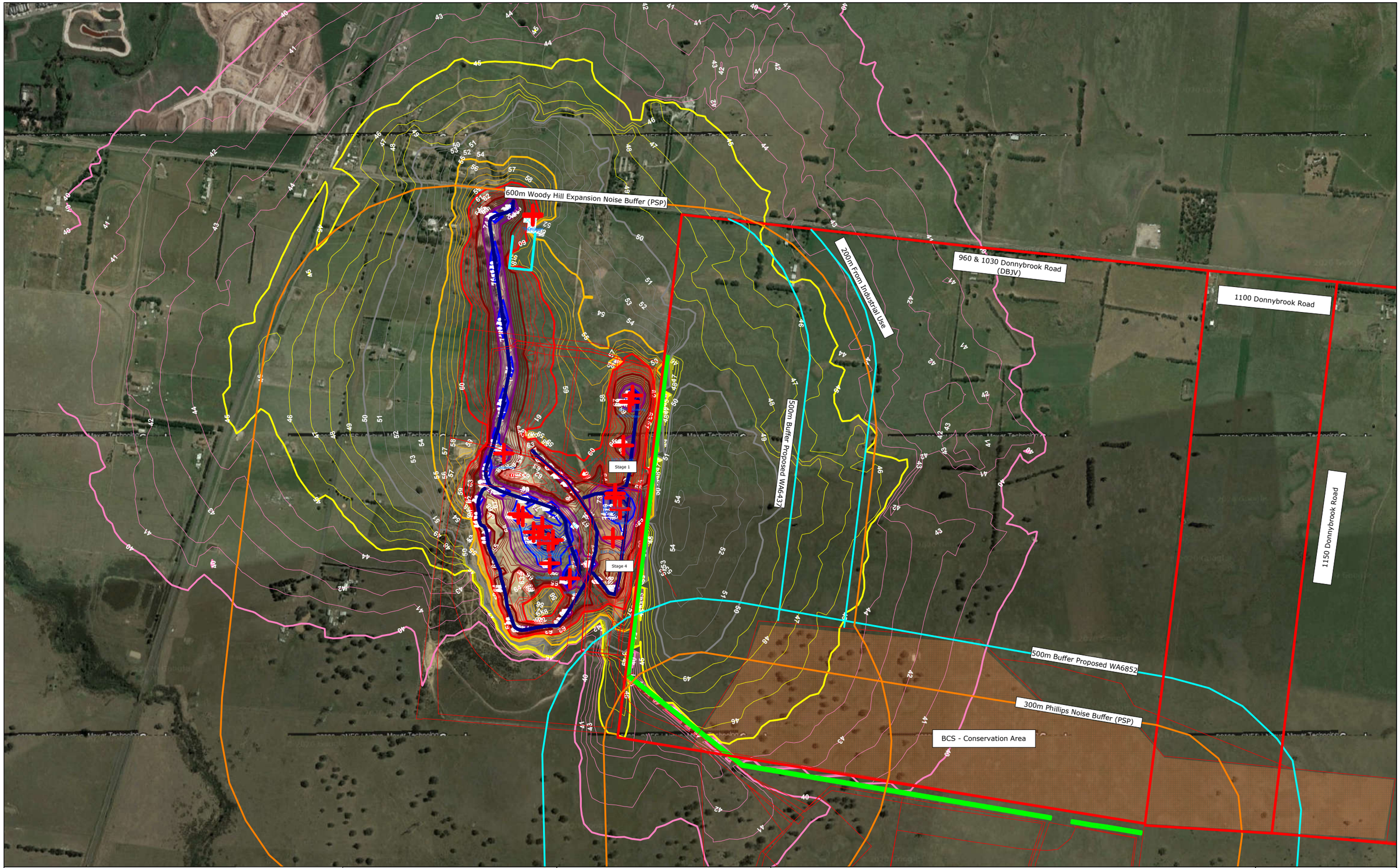
Woody Hill Plant Operating (No Rock Breaker)
Batching Plant Operating
WA6437 Stage 1 Operating (No Rock Breaker)
WA6437 Stage 4 Operating (No Rock Breaker and Reduced Truck Volumes)

LAeq, 30-min noise levels, SEPP N-1 Assessment - 'Evening' (Saturday Afternoon from 1pm to 6pm)

Project No: V319-01 Drawing No: MAP-08 (f1) Date: 28.10.2020

NOTES:

*Propagation in accordance with ISO9613
*Model includes land topography
*Refer to report for SWL
*Contours at 1.5m RL



Legend:

- Point Source
- Line Source
- Building
- Barrier
- Embankment
- Ground Absorption
- Receiver
- Calculation Area

Noise Level - dB(A)

- >= 40.0
- >= 45.0
- >= 50.0
- >= 55.0
- >= 60.0
- >= 65.0
- >= 70.0
- >= 75.0
- >= 80.0

Scale: 1: 11044 @ A3

ENFIELD ACOUSTICS NOISE VIBRATION

PO Box 920
North Melbourne, VIC 3051
P: 03 9111 0090

BARRO GROUP - WOODY HILL QUARRY

WA6437 - Stage 4 - At Final Pit Level

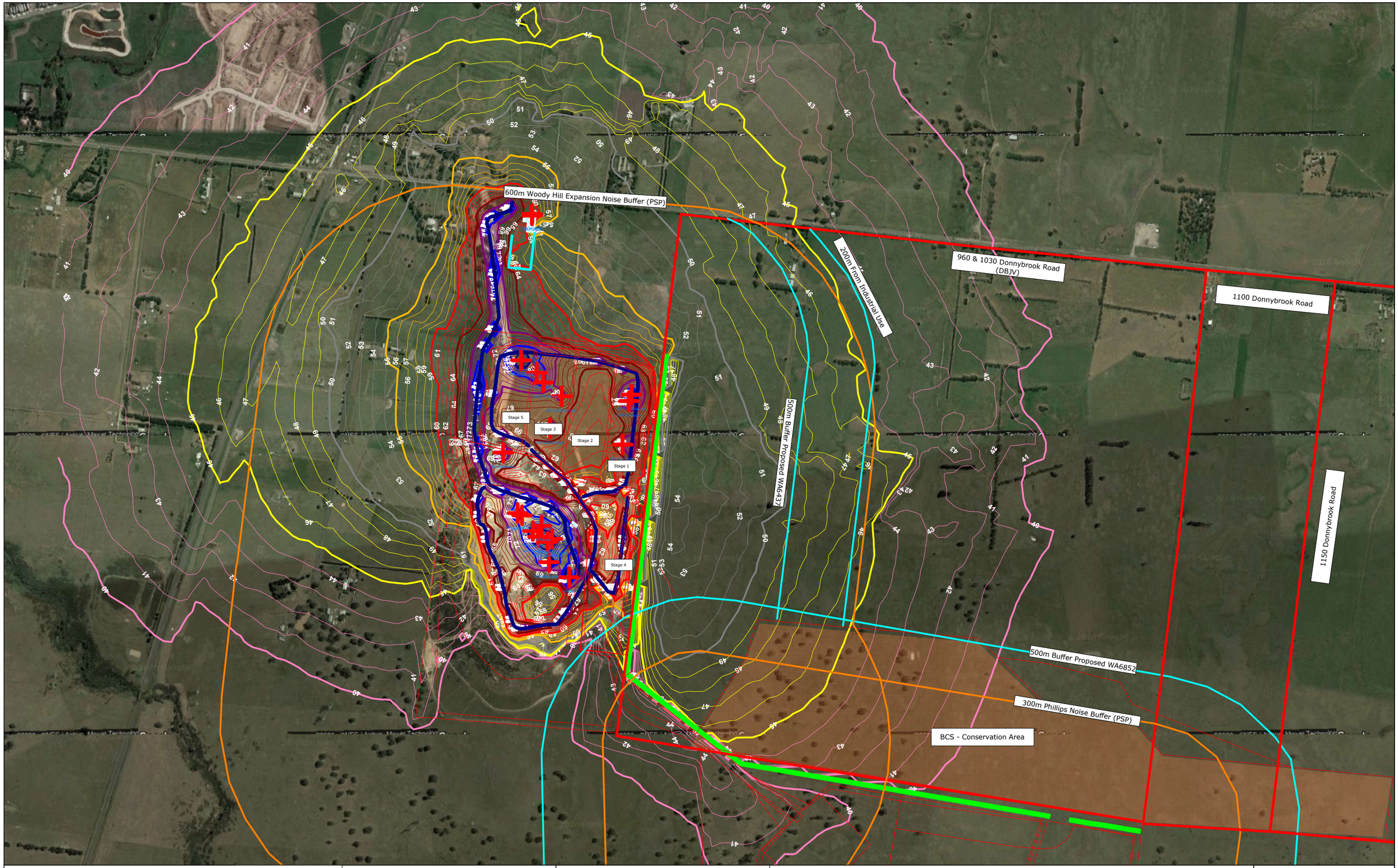
Woody Hill Plant Operating
Batching Plant Operating
WA6437 Stage 1 Operating (No Rock Breaker)
WA6437 Stage 4 Operating

LAeq, 30-min noise levels, SEPP N-1 Assessment - Day

Project No: V319-01 Drawing No: MAP-09 (f1) Date: 28.10.2020

NOTES:

*Propagation in accordance with ISO9613
*Model includes land topography
*Refer to report for SWL
*Contours at 1.5m RL



Legend:

- Point Source
- Line Source
- Building
- Barrier
- Embankment
- Ground Absorption
- Receiver
- Calculation Area

Noise Level - dB(A)

- >= 40.0
- >= 45.0
- >= 50.0
- >= 55.0
- >= 60.0
- >= 65.0
- >= 70.0
- >= 75.0
- >= 80.0

Scale: 1: 11044 @ A3

ENFIELD ACOUSTICS NOISE VIBRATION

PO Box 920
North Melbourne, VIC 3051
P: 03 9111 0090

BARRO GROUP - WOODY HILL QUARRY

WA6437 - Stage 2/3/5 - Initial Operation

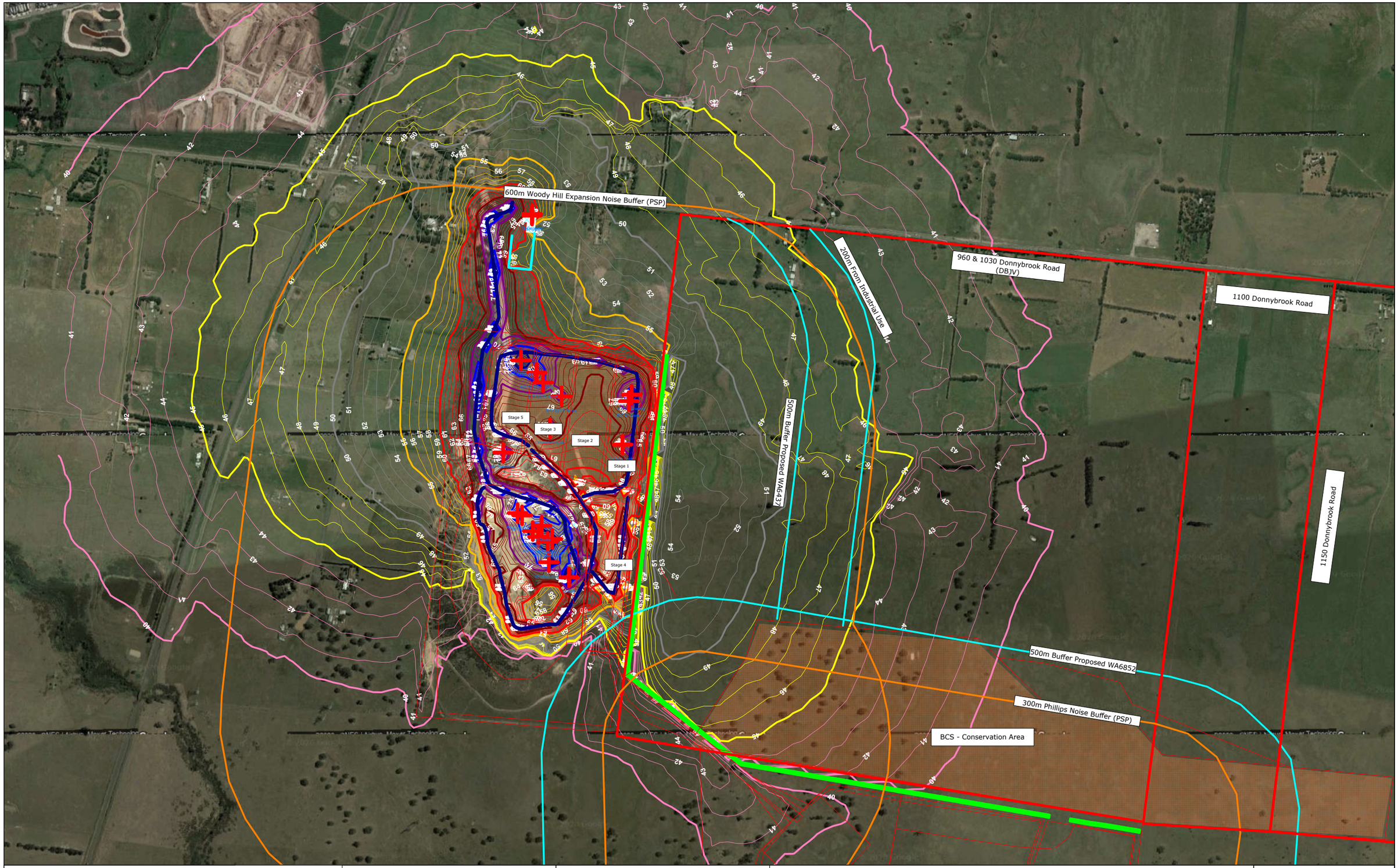
Woody Hill Plant Operating
Batching Plant Operating
WA6437 Stage 1 Operating (No Rock Breaker)
WA6437 Stage 2/3/5 Operating

LAeq, 30-min noise levels, SEPP N-1 Assessment - Day

Project No: V319-01 Drawing No: MAP-10 (f1) Date: 28.10.2020

NOTES:

*Propagation in accordance with ISO9613
*Model includes land topography
*Refer to report for SWL
*Contours at 1.5m RL



Legend:

- Point Source
- Line Source
- Building
- Barrier
- Embankment
- Ground Absorption
- Receiver
- Calculation Area

Noise Level - dB(A)

- >= 40.0
- >= 45.0
- >= 50.0
- >= 55.0
- >= 60.0
- >= 65.0
- >= 70.0
- >= 75.0
- >= 80.0

Scale: 1: 11044 @ A3

ENFIELD ACOUSTICS NOISE VIBRATION

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BARRO GROUP - WOODY HILL QUARRY

WA6437 - Stage 2/3/5 - At Final Pit Level

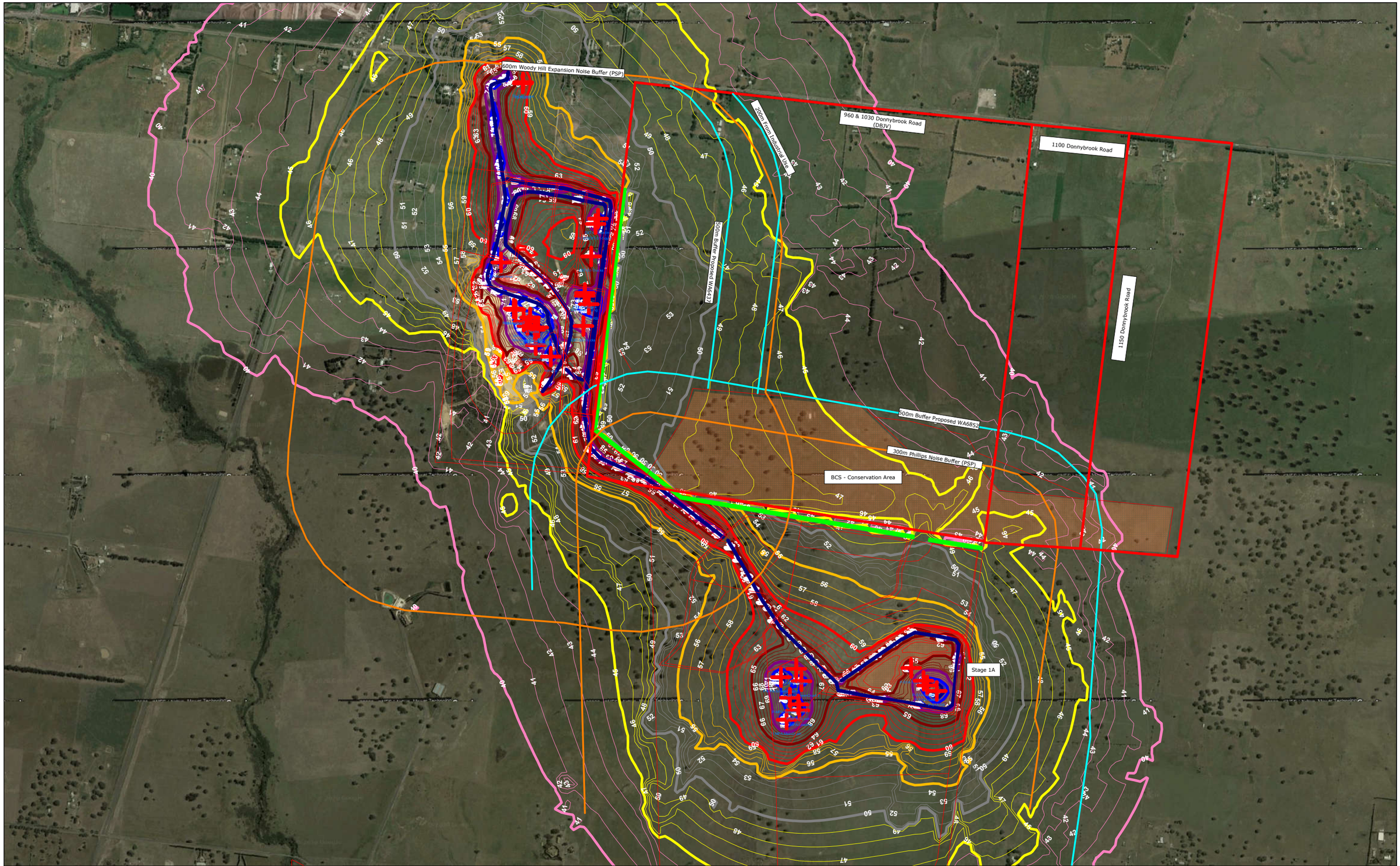
Woody Hill Plant Operating
Batching Plant Operating
WA6437 Stage 1 Operating (No Rock Breaker)
WA6437 Stage 2/3/5 Operating

LAeq, 30-min noise levels, SEPP N-1 Assessment - Day

Project No: V319-01 Drawing No: MAP-11 (f1) Date: 28.10.2020

NOTES:

*Propagation in accordance with ISO9613
*Model includes land topography
*Refer to report for SWL
*Contours at 1.5m RL



Legend:

- Point Source
- Line Source
- Building
- Embankment
- Ground Absorption
- Receiver
- Calculation Area

Noise Level - dB(A)

- >= 40.0
- >= 45.0
- >= 50.0
- >= 55.0
- >= 60.0
- >= 65.0
- >= 70.0
- >= 75.0
- >= 80.0

Scale: 1: 14645 @ A3

ENFIELD ACOUSTICS NOISE VIBRATION

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North Melbourne, VIC 3051
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BARRO GROUP - WOODY HILL & PHILLIPS QUARRY

WA6852 - Stage 1A - Initial Operation

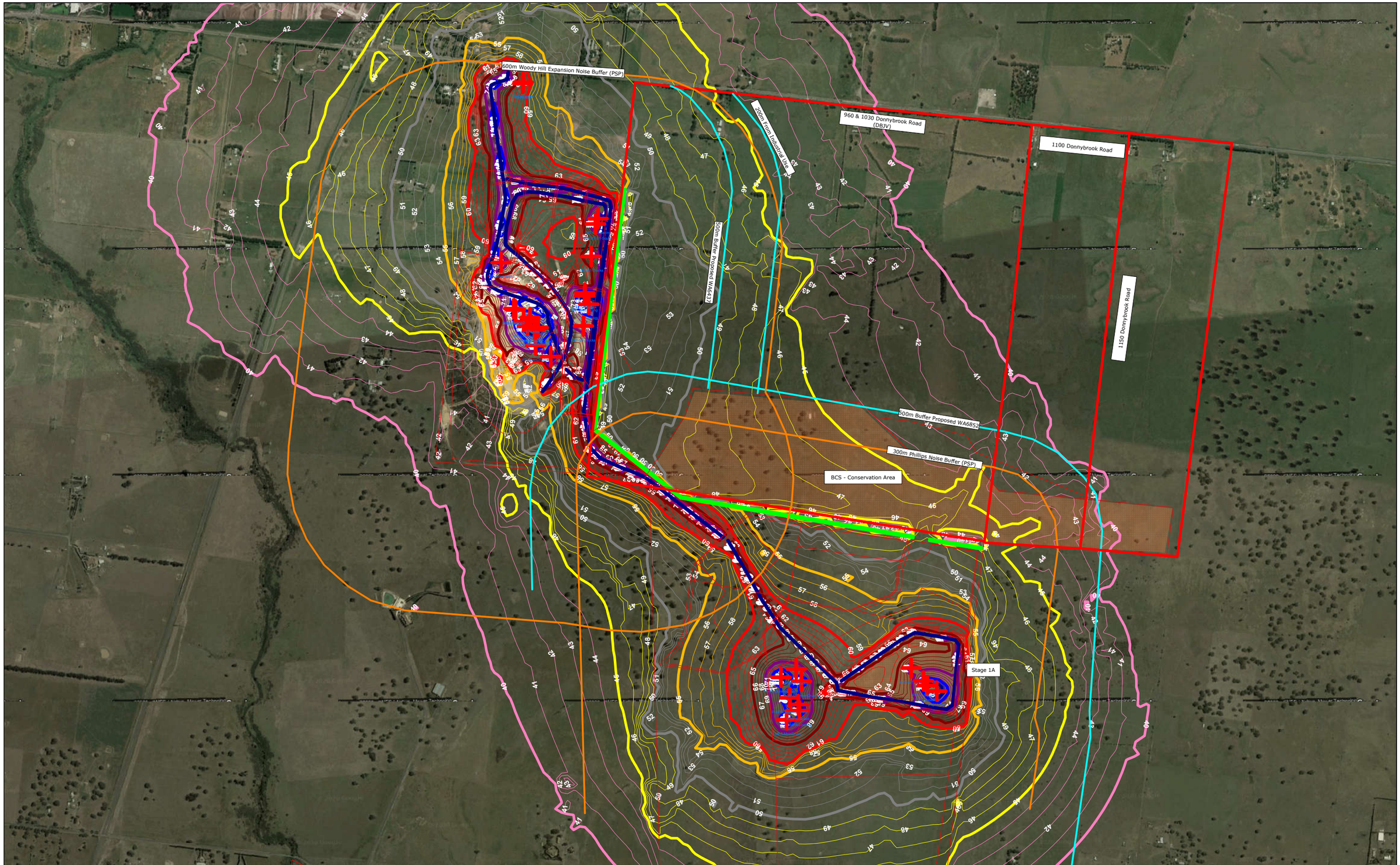
Woody Hill Plant Operating
Batching Plant Operating
WA6437 Stage 1 Operating (No Rock Breaker)
WA6437 Stage 4 Operating

LAeq, 30-min noise levels, SEPP N-1 Assessment - Day

Project No: V319-01 Drawing No: MAP-12 (f1) Date: 28.10.2020

NOTES:

*Propagation in accordance with ISO9613
*Model includes land topography
*Refer to report for SWL
*Contours at 1.5m RL



Legend:

- Point Source
- Line Source
- Building
- Embankment
- Ground Absorption
- Receiver
- Calculation Area

Noise Level - dB(A)

- >= 40.0
- >= 45.0
- >= 50.0
- >= 55.0
- >= 60.0
- >= 65.0
- >= 70.0
- >= 75.0
- >= 80.0

Scale: 1: 14645 @ A3

ENFIELD ACOUSTICS NOISE VIBRATION

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North Melbourne, VIC 3051
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BARRO GROUP - WOODY HILL & PHILLIPS QUARRY

WA6852 - Stage 1A - At Final Pit Level

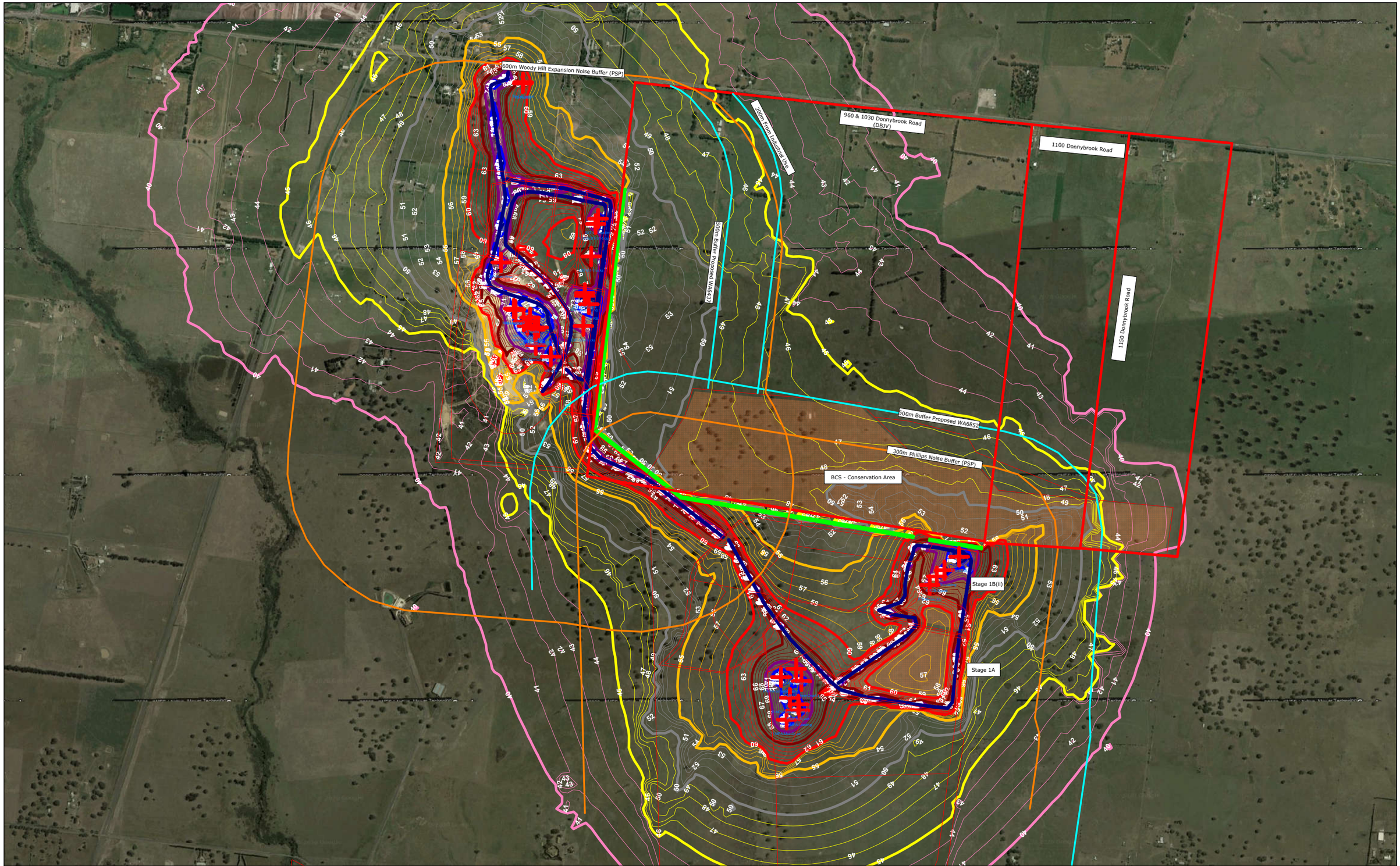
Woody Hill Plant Operating
Batching Plant Operating
WA6437 Stage 1 Operating (No Rock Breaker)
WA6437 Stage 4 Operating

LAeq, 30-min noise levels, SEPP N-1 Assessment - Day

Project No: V319-01 Drawing No: MAP-13 (f1) Date: 28.10.2020

NOTES:

*Propagation in accordance with ISO9613
*Model includes land topography
*Refer to report for SWL
*Contours at 1.5m RL



Legend:

- Point Source
- Line Source
- Building
- Embankment
- Ground Absorption
- Receiver
- Calculation Area

Noise Level - dB(A)

- >= 40.0
- >= 45.0
- >= 50.0
- >= 55.0
- >= 60.0
- >= 65.0
- >= 70.0
- >= 75.0
- >= 80.0

Scale: 1: 14645 @ A3

ENFIELD ACOUSTICS NOISE VIBRATION

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BARRO GROUP - WOODY HILL & PHILLIPS QUARRY

WA6852 - Stage 1B(ii) - Initial Operation

Woody Hill Plant Operating
Batching Plant Operating
WA6437 Stage 1 Operating (No Rock Breaker)
WA6437 Stage 4 Operating

LAeq, 30-min noise levels, SEPP N-1 Assessment - Day

Project No: V319-01 Drawing No: MAP-14 (f1) Date: 28.10.2020

NOTES:

*Propagation in accordance with ISO9613
*Model includes land topography
*Refer to report for SWL
*Contours at 1.5m RL

500m Woody Hill Expansion Noise Buffer (PSP)

300m from Industrial Use

960 & 1030 Donnybrook Road (DBJV)

1100 Donnybrook Road

1150 Donnybrook Road

500m Buffer Proposed WA6437

500m Buffer Proposed WA6852

300m Phillips Noise Buffer (PSP)

BCS - Conservation Area

Stage 1B(ii)

Stage 1A

Legend:

- Point Source
- Line Source
- Building
- Embankment
- Ground Absorption
- Receiver
- Calculation Area

Noise Level - dB(A)

- >= 40.0
- >= 45.0
- >= 50.0
- >= 55.0
- >= 60.0
- >= 65.0
- >= 70.0
- >= 75.0
- >= 80.0

Scale: 1: 14645 @ A3

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BARRO GROUP - WOODY HILL & PHILLIPS QUARRY

WA6852 - Stage 1B(ii) - At Final Pit Level

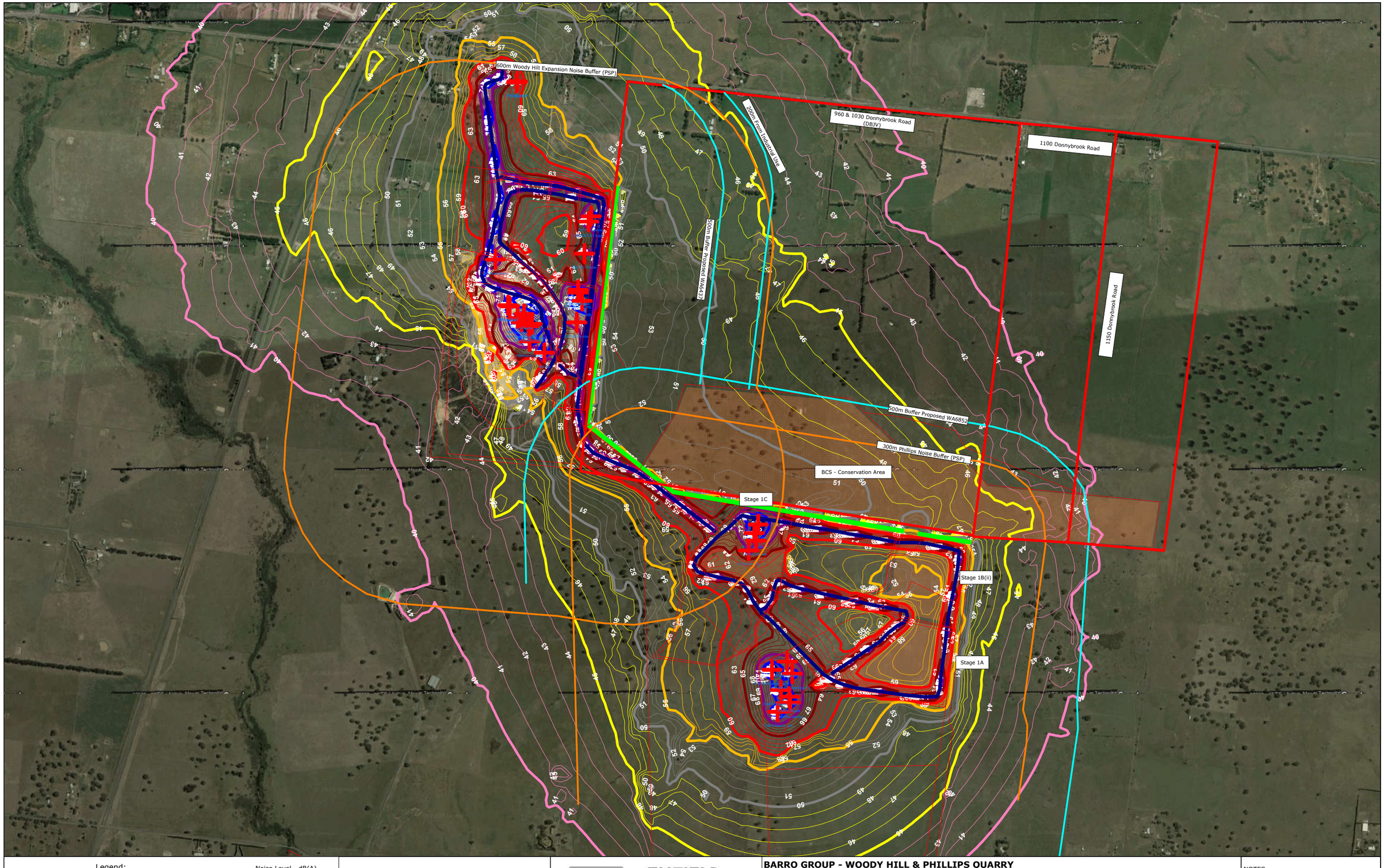
Woody Hill Plant Operating
Batching Plant Operating
WA6437 Stage 1 Operating (No Rock Breaker)
WA6437 Stage 4 Operating

LAeq, 30-min noise levels, SEPP N-1 Assessment - Day

Project No: V319-01 Drawing No: MAP-15 (f1) Date: 28.10.2020

NOTES:

*Propagation in accordance with ISO9613
*Model includes land topography
*Refer to report for SWL
*Contours at 1.5m RL



Legend:

- Point Source
- Line Source
- Building
- Embankment
- Ground Absorption
- Receiver
- Calculation Area

Noise Level - dB(A)

- >= 40.0
- >= 45.0
- >= 50.0
- >= 55.0
- >= 60.0
- >= 65.0
- >= 70.0
- >= 75.0
- >= 80.0

Scale: 1: 14645 @ A3

ENFIELD ACOUSTICS NOISE VIBRATION

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North Melbourne, VIC 3051
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BARRO GROUP - WOODY HILL & PHILLIPS QUARRY

WA6852 - Stage 1C - Initial Operation
Worst Case 'Day' Scenario

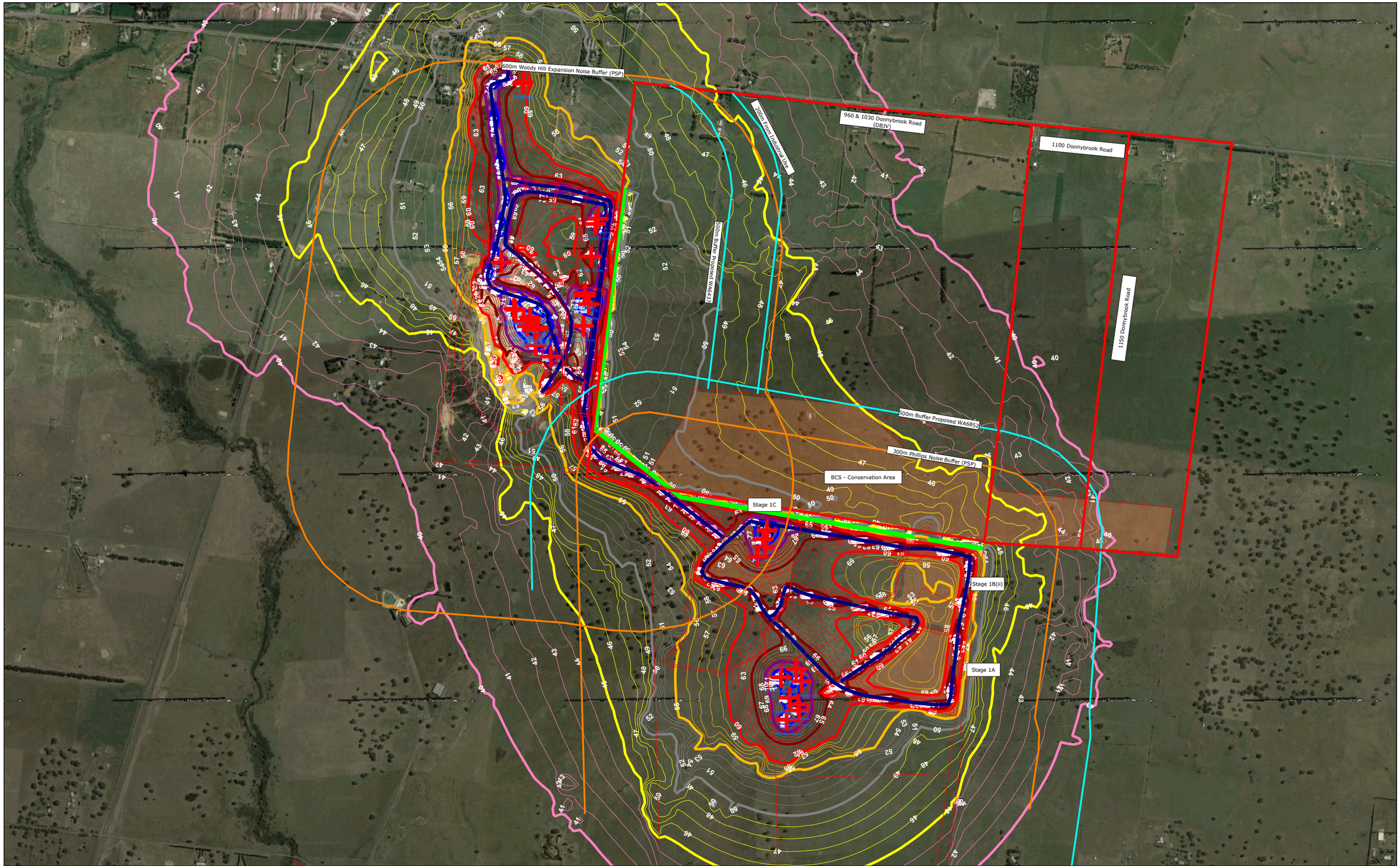
Woody Hill Plant Operating
Batching Plant Operating
WA6437 Stage 1 Operating (No Rock Breaker)
WA6437 Stage 4 Operating

LAeq, 30-min noise levels, SEPP N-1 Assessment - Day

Project No: V319-01 Drawing No: MAP-16 (f1) Date: 28.10.2020

NOTES:

*Propagation in accordance with ISO9613
*Model includes land topography
*Refer to report for SWL
*Contours at 1.5m RL



Legend:

- Point Source
- Line Source
- Building
- Embankment
- Ground Absorption
- Receiver
- Calculation Area

Noise Level - dB(A)

- >= 40.0
- >= 45.0
- >= 50.0
- >= 55.0
- >= 60.0
- >= 65.0
- >= 70.0
- >= 75.0
- >= 80.0

Scale: 1: 14645 @ A3

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North Melbourne, VIC 3051
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BARRO GROUP - WOODY HILL & PHILLIPS QUARRY

WA6852 - Stage 1C - At Final Pit Level

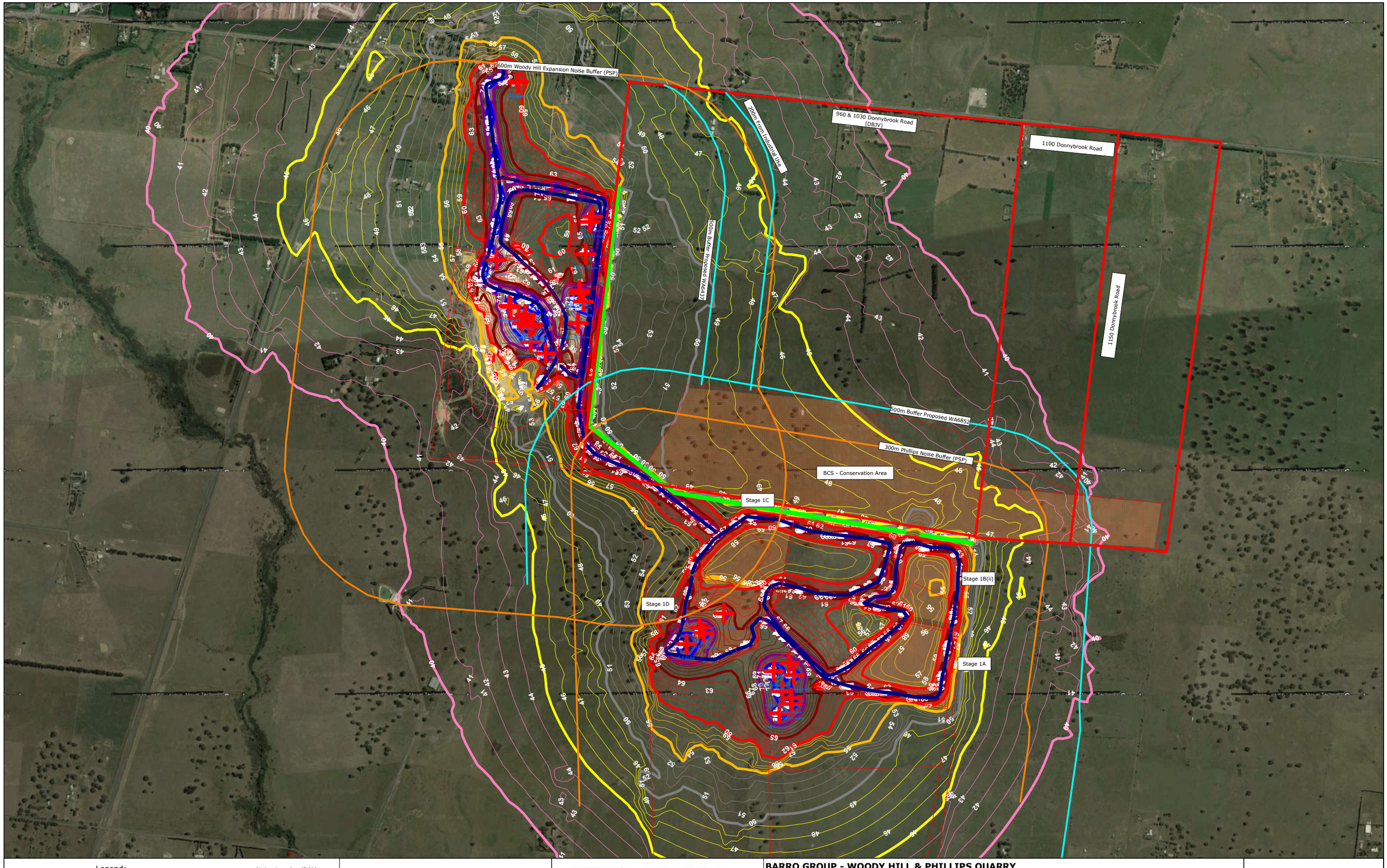
Woody Hill Plant Operating
Batching Plant Operating
WA6437 Stage 1 Operating (No Rock Breaker)
WA6437 Stage 4 Operating

LAeq, 30-min noise levels, SEPP N-1 Assessment - Day

Project No: V319-01 Drawing No: MAP-17 (f1) Date: 28.10.2020

NOTES:

*Propagation in accordance with ISO9613
*Model includes land topography
*Refer to report for SWL
*Contours at 1.5m RL



Legend:

- Point Source
- Line Source
- Building
- Embankment
- Ground Absorption
- Receiver
- Calculation Area

Noise Level - dB(A)

- >= 40.0
- >= 45.0
- >= 50.0
- >= 55.0
- >= 60.0
- >= 65.0
- >= 70.0
- >= 75.0
- >= 80.0

Scale: 1: 14645 @ A3

ENFIELD ACOUSTICS NOISE VIBRATION

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North Melbourne, VIC 3051
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BARRO GROUP - WOODY HILL & PHILLIPS QUARRY

WA6852 - Stage 1D - Initial Operation

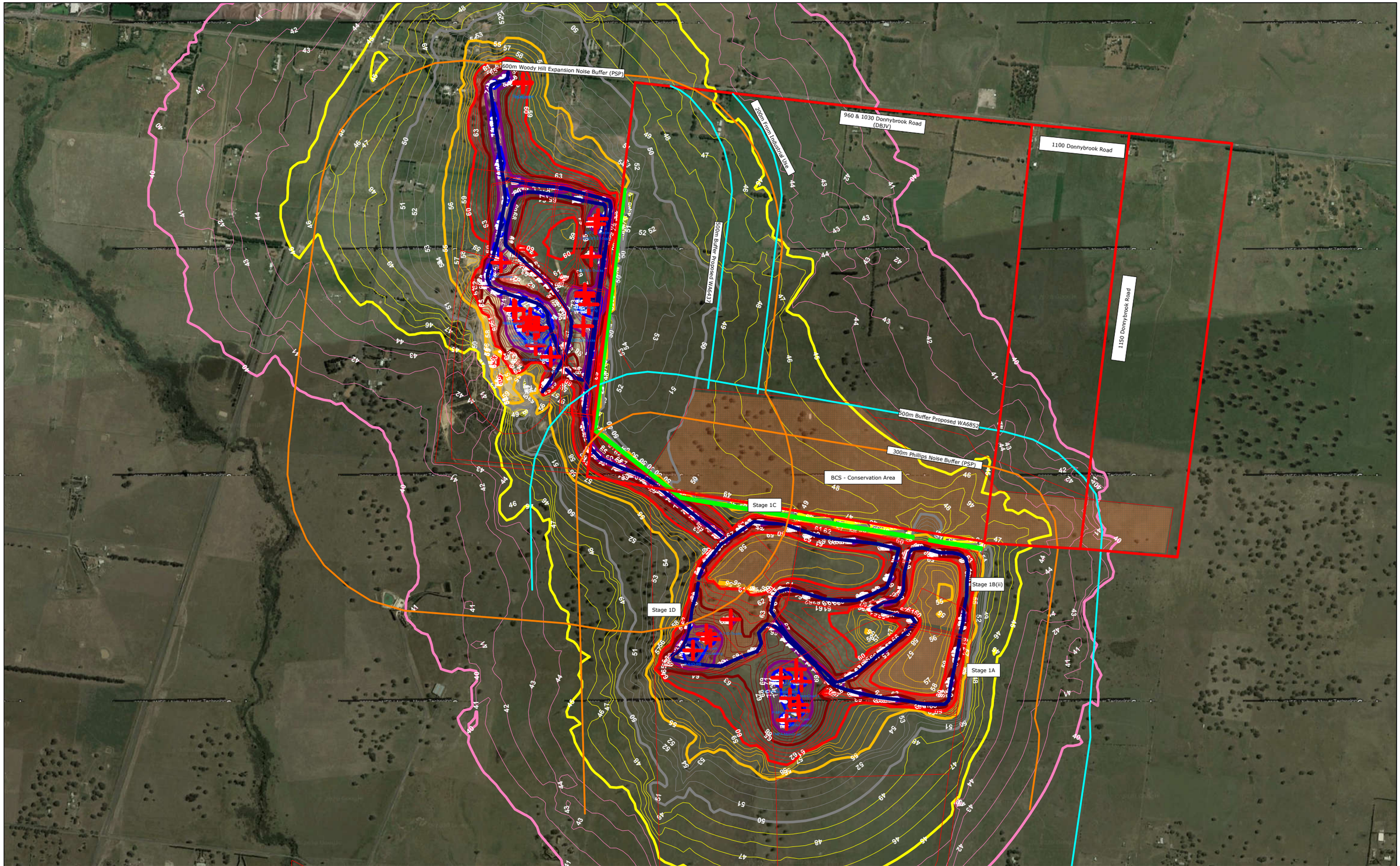
Woody Hill Plant Operating
Batching Plant Operating
WA6437 Stage 1 Operating (No Rock Breaker)
WA6437 Stage 4 Operating

LAeq, 30-min noise levels, SEPP N-1 Assessment - Day

Project No: V319-01 Drawing No: MAP-18 (f1) Date: 28.10.2020

NOTES:

*Propagation in accordance with ISO9613
*Model includes land topography
*Refer to report for SWL
*Contours at 1.5m RL



Legend:

- Point Source
- Line Source
- Building
- Embankment
- Ground Absorption
- Receiver
- Calculation Area

Noise Level - dB(A)

- >= 40.0
- >= 45.0
- >= 50.0
- >= 55.0
- >= 60.0
- >= 65.0
- >= 70.0
- >= 75.0
- >= 80.0

Scale: 1: 14645 @ A3

ENFIELD ACOUSTICS NOISE VIBRATION

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North Melbourne, VIC 3051
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BARRO GROUP - WOODY HILL & PHILLIPS QUARRY

WA6852 - Stage 1D - At Final Pit Level

Woody Hill Plant Operating
Batching Plant Operating
WA6437 Stage 1 Operating (No Rock Breaker)
WA6437 Stage 4 Operating

LAeq, 30-min noise levels, SEPP N-1 Assessment - Day

Project No: V319-01 Drawing No: MAP-19 (f1) Date: 28.10.2020

NOTES:

*Propagation in accordance with ISO9613
*Model includes land topography
*Refer to report for SWL
*Contours at 1.5m RL