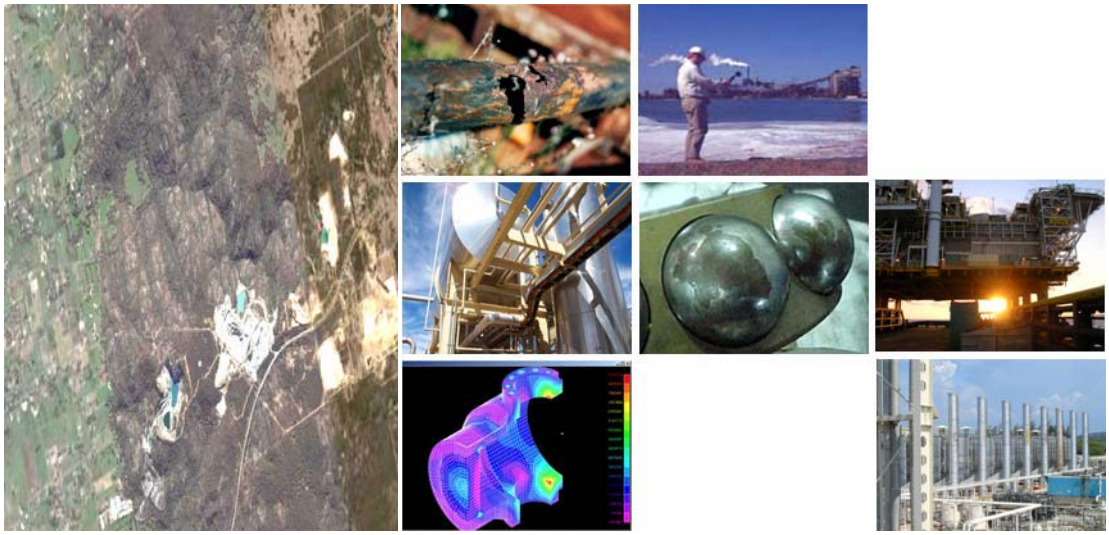
ENVIRONMENTAL NOISE IMPACT ASSESSMENT OF PROPOSED RED HILL QUARRY DEVELOPMENT



HANSON CONSTRUCTION MATERIALS PTY LTD

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SVT ENGINEERING CONSULTANTS

Head Office: Perth, Western Australia
Kuala Lumpur, Malaysia
Melbourne, Australia
www.svt.com.au

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DOCUMENT CONTROL & REVIEW INFORMATION

Client: **Hanson Construction Materials Pty Ltd**

Client Contact: **John Symonds**

SVT Contact: **Paul Keswick**

SVT Office: **Perth**

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0	Issued as draft to clients	Paul Keswick	Jim McLoughlin	30 Jun 07

SVT Engineering Consultants

ABN: 18 122 767 944

SVT Perth (HEAD OFFICE)	SVT Kuala Lumpur Office	SVT Melbourne Office
112 Cambridge Street West Leederville WA 6007 Australia Tel: (61) 8 9489 2000 Fax: (61) 8 9489 2088 Email: mailbox@svt.com.au	SVT-Engineering Malaysia Sdn Bhd (Malaysian Office) No.875, Taman Mewah, 1¼ mile, Jalan Pantai, 71000,Port Dickson.N.S.D.K Tel: +6066 464 035 (h/p 012-6017514) Fax: +6066 464 036 Email: mailbox@svt.com.au	Suite 1 , 20 Cato Street Hawthorn East VIC 3123 Australia Tel: +61 3 9832 4406 Fax: +61 3 03 9917 2204 Email: mailbox@svt.com.au

EXECUTIVE SUMMARY

An environmental noise impact assessment has been undertaken of the Hanson Construction Materials Pty Ltd (Hanson) proposed quarry development at Red Hill in Western Australia. Noise from both the processing plant and quarry operations has been reviewed.

Noise Model

A noise model has been developed for the current quarrying and processing plant and for the proposed quarry development. The noise model has been developed based on noise measurements taken for the existing plant and verified against noise measurements taken around the plant. The noise model has been used to predict worst-case noise levels at noise sensitive locations around the plant for the current quarrying and processing plant and for the proposed quarry development.

To ensure that the worst case noise impact is assessed, all mobile equipment operating in the quarry (haul trucks, excavator, water cart, and drilling rig) have been located on high level benches to ensure that there is minimum shielding from the pit walls, and the crushing and screening plant is assumed to be running. It is unlikely that all of the plant and equipment items will be running at full load or full capacity at the same time, and with all pit equipment located on high level benches, hence the noise impact assessment undertaken is likely to be conservative, ie it will predict higher noise levels than are likely to occur during normal quarrying operations.

The following presents a comparison of worst case predicted noise levels at the closest noise sensitive premises before and after the proposed development. It has been assumed that all new equipment associated with the proposed development (ie relocation of the primary crusher, new quaternary crusher, and conveyors from the primary crusher to the existing secondary crusher), will have sound power levels at least equivalent or less than the existing primary crusher and conveyors.

Table ES- 1 : Worse case LA10 predicted noise levels in dB(A)

Stages	Noise levels at noise sensitive premises in dB(A)				
	P1	P2	P3	P4	P5
Existing Plant	12.7	11.8	6.1	31.3	31.9
Stage 1- 12	12.6 - 15.4	12.6 - 14.5	16.6 - 30.2	30.9 - 34.7	31.8 - 33.5
Maximum increase in noise levels when compared with the Exisitng Plant	2.7	2.7	24.1	3.4	1.6

For all stages of the quarring the highest noise levels are observed at positions P4 and P5. The model predictions shows small increases in noise levels as a result of the upgrade at all positions except at position P3. This increase is observed because the operations remove the ridge between the quarry and position P3 which has the result of increasing noise levels at P3. At all positions the

noise emission is primarily dominated by the fixed plant noise, with noise emission from the mobile plant generally being a secondary contributor.

Assigned Noise Levels

The assigned noise levels as imposed under the Environmental Protection (Noise) Regulations 1997 determine the allowable noise emission from the quarry. The quarry operates between the hours of 0600 to 1900 hours, hence for premises around the quarry the following assigned noise levels apply.

Table ES- 2 : Assigned noise levels

Type of premises receiving noise	Time of day	Assigned Level dB(A)		
		$L_{A\,10}$	$L_{A\,1}$	$L_{A\,max}$
Noise sensitive premises at locations within 15 metres of a building directly associated with a noise sensitive use	0700 to 1900 hours Monday to Saturday	45 + IF	55 + IF	65 + IF
	2200 to 0700 hours	35 + IF	45 + IF	55 + IF
Noise sensitive premises at locations further than 15 metres from a building directly associated with a noise sensitive use	All hours	60	75	80
Notes: IF- Influencing factor (refer to Section 6 for an explanation of the IF)				

Noise measurements recorded at logging positions surrounding the quarry showed no evidence of tonality, modulation or impulsiveness, and therefore no further adjustments to the noise emissions from the existing operations is required.

Since noise emission from the quarrying operations is made up of steady state noise sources like the processing plant, and noise from mobile equipment which can vary with movement through the quarry, the most restrictive assigned noise level for the quarrying operations to be met is the L_{A10}. If the L_{A10} noise levels are met then the L_{A1} and L_{Amax} noise levels will also be met. The following table presents the assigned noise levels to be met at the closest noise sensitive premises, after application of the influencing factor.

Table ES- 3 : L_{A10} assigned noise levels in dB(A)

Time of Day	Assigned noise levels in dB(A)					
	P1	P2	P3	P4	P5	P6
0600 – 0700	35	35	35	38	39	60
0700 – 1900	45	45	45	48	49	60

For the quarry noise emission not to be a significant contributor under the regulations, then noise emission from the quarry must be 5 dB less than the assigned noise levels. Therefore for the quarry to comply with the Environmental Protection (Noise) Regulations 1997 then the noise emission should be 5 dB less than the L_{A10} assigned noise levels given in Table ES-3.

Compliance

The current quarry operations and the proposed Stages 1 - 4 and 9 - 12 of the quarry development are in compliance with the assigned noise levels of the Environmental Protection (Noise) Regulations 1997. However, for Stages 5 - 8 (years 2032 – 2051) the quarry development will be potentially in exceedance of the L_{A10} noise level of 30 dB(A) at position P4 by between 1.3 – 1.7 dB during the hours of 0600 – 0700. To achieve compliance during these times the quarry will need to reduce its noise output by either not operating the crushing plant, or not operating parts of its mobile fleet, or by applying noise control mitigation measures to its various noise sources (all of these options SVT believes are readily achievable).

Noise Logging Results

Noise logging was undertaken at various positions around the site (generally 1.0 km or further from the site). General observations from the noise logging indicates that noise levels for the area can be quite low, less than 30 dB(A) during the night. During the day noise levels generally increases at the logging positions around the quarry, however, the noise logging results do not show a strong pattern of increase.

Blast noise and vibration levels

For all stages of the quarry development the blast noise and ground-borne vibration levels are less than 120 dB(lin), and 5mm/sec peak particle velocity respectively, and hence in compliance with the required noise and vibration levels for blasting.

Construction Noise Management Plan

As part of the requirements of the Environmental Protection (Noise) Regulations 1997 a noise management plan is being developed by Hanson for the proposed quarry development. The noise management plant will cover all activities at the quarry including construction and operational noise.

An outline of a noise management plan has been developed in Appendix D of the report. When a schedule of activities and details of the equipment to be used for construction work has been developed, SVT can undertake a review of the impact of the construction noise on noise sensitive premises around the plant and advise on noise control measures that should be adopted.

TABLE OF CONTENTS

EXECUTIVE SUMMARY II

TABLE OF CONTENTS V

1. INTRODUCTION 1
1.1 Scope of Work 1
1.2 Description of Existing Quarry 1
1.3 Description of Proposed Quarry Development 2

2. METHODOLOGY 3

3. SITE VISIT 4
3.1 Noise Instrumentation 4
3.2 Noise Logging 4
3.2.1 Noise Logging Result L1 5
3.2.2 Noise Logging Result L2 5
3.2.3 Noise Logging Result L3 5
3.2.4 Noise Logging Result L4 6
3.2.5 Noise Logging Result L5 6
3.2.6 Noise Logging Result L6 6
3.2.7 Summary 7
3.3 Quarry & Processing Plant Noise Levels 7

4. NOISE MODELLING – OVERVIEW 9
4.1 Acoustic Model 9
4.2 Input Data 10
4.2.1 Source Sound Power Levels 10
4.2.2 Topography and Ground Types 10
4.2.3 Receiving Locations 10
4.2.4 Meteorology 10

5. NOISE MODELLING 12
5.1 Noise Modelling Results 12
5.2 Verification of Noise Model 12
5.3 Point Calculations 12
5.4 Noise Contours 15

6. COMPLIANCE ASSESSMENT 17
6.1 Summary of Legislation and Noise Limits 17
6.2 Assigned noise levels 19
6.3 Assessment of Compliance for the Existing Quarry 19
6.4 Assessment of Compliance for the Proposed Upgraded Quarry 20

7. BLASTING NOISE AND VIBRATION IMPACT 21

8. NOISE MANAGEMENT PLAN 22

APPENDIX A : PLANT LAYOUT DRAWINGS A-1

APPENDIX B : NOISE LOGGING RESULTS B-1

APPENDIX C : NOISE CONTOURS C-1

APPENDIX D : CONSTRUCTION NOISE MANAGEMENT PLAN OVERVIEW D-1

1. INTRODUCTION

SVT were commissioned by Hanson to undertake an environmental noise impact assessment of the proposed quarry development at Red Hill in Western Australia. The objectives of the study are to determine current noise emission levels, to assess the noise impacts of the proposed development, and where appropriate to suggest methods to mitigate excessive noise emissions to achieve compliance with noise limits imposed under the Environmental Protection (Noise) Regulations 1997.

1.1 Scope of Work

The following list outlines the major activities undertaken during the course of the study:

- Review of documentation provided by Strategen and Hanson including site plans, plant, equipment lists, and topographical data.
- Determination of noise emission levels (sound power levels) for existing high noise equipment items and estimation of sound power levels for equipment associated with the proposed quarry development.
- Development of an acoustic model for the existing and for the various stages of the proposed quarry development. The noise model takes in the closest noise sensitive premises to the north, west and south west of the quarry development.
- Preparation of noise contours for worst case meteorological conditions for the current operations and for the proposed quarry development for the area surrounding the quarry.
- Calculation of noise levels at the closest noise sensitive locations around the quarry for calm and worst case day time meteorological conditions.
- Assessment of noise emissions from the existing operations and from the proposed development for compliance with noise limits imposed under the Environmental Protection (Noise) Regulations 1997.
- Provision of noise mitigation and noise management recommendations if required.
- Review of blast vibration impacts from the proposed development.
- Preparation of an outline of a construction noise management plan.

1.2 Description of Existing Quarry

Hanson quarry blue metal from the Red Hill quarry site. At the quarry site there are facilities for: stockpiling and ore blending, crushing, and loading of road trucks. Figure A1 found in Appendix A shows an outline for the existing quarry and surrounding area. Figure A2 found in Appendix A shows an outline of the existing processing facility.

The primary fixed noise sources are:

- Primary crusher
- Primary crusher to secondary crusher conveyor
- Secondary and tertiary crushing plant

- Secondary and tertiary crushing plant to screening plant conveyors
- Dust collection unit
- Screening plant

Table 1-1 below presents the mobile equipment in operation at the quarry.

Table 1-1 : Mobile equipment in operation

Item	Mobile equipment description	Quantity
1	Tamrock CHA1100 Drilling Rig	1
2	CAT 773B Dump Truck	1
3	KOMATSU HD465 Dump Truck	2
4	CAT 140G Grader	1
5	CAT 245B Excavator	1
6	CAT 990 Loader	1
7	Road Haulage Truck (in operation on site)	2

1.3 Description of Proposed Quarry Development

Hanson proposes to continue to develop the quarry pit to the north and west of the existing pit. The proposed quarry development is to occur over a 100 year period. To aid with the efficiency of the quarrying operations, the primary crusher will be moved into the expanded pits when the quarry expands and a quaternary crusher will be added to the existing plant. All other plant and equipment operating at the quarry remains the same. The number and type of mobile equipment operating at the quarry also remains the same.

Hanson have provided a 12 stage 100 year plan to enable the noise modelling of the proposed quarry development to assess the likely noise impacts as the development progresses. Figure A-3 found in Appendix A presents the quarry development footprints. It is likely that the technologies associated with the quarrying activities will change over this period. However, SVT has assumed that the noise emission from the plant and equipment, and mobile equipment associated with the quarrying operations remains the same.

2. METHODOLOGY

Noise emission from the quarry can be considered as consisting of three components:

1) Noise from fixed plant;

2) Noise from mobile equipment; and,

3) Noise and vibration from blasting

A noise model was developed to assess the noise impacts from the fixed plant and mobile equipment associated with the operations of the quarry, and for the proposed plant for each of the 12 quarry expansion stages.

To verify the noise model for the existing plant noise readings were taken to the east of the plant and compared with predictions produced by the model under similar conditions.

Noise level predictions have been assessed at various noise sensitive locations (residential dwellings) around the quarry, and noise contours have been produced for the area surrounding the quarry . This information was used to determine Hanson's current compliance status with the *Environmental Protection (Noise) Regulation 1997.*

The noise model was then revised to include the expanded pit outline, with the primary crusher being relocated into the pit area. For each expanded quarry plan further noise contours were prepared and noise level predictions undertaken to determine the impact of the proposed development, and to assess compliance with *Environmental Protection (Noise) Regulation 1997.*

Noise and vibration from blasting has been assessed as part of this review to ensure that each blast complies with the requirement of *Environmental Protection (Noise) Regulations 1997* and the recommended maximum ground-borne vibration levels given by the EPA.

3. SITE VISIT

Site visits were undertaken in December 2006, February 2007 and April 2007 to assess current noise emission from the plant. The objectives of the site visits were to record noise levels from equipment operating at the quarry and to obtain typical noise levels at noise sensitive premises surrounding the plant.

3.1 Noise Instrumentation

The following instrumentation has been used for this assessment.

Table 3-1 : Measurement equipment used

Equipment	Make	Model	Serial No
Sound Level Meter	Bruel & Kjaer	Type 2260	2248361
Sound Intensity Probe kit for 2260	Bruel & Kjaer	Type 3595	2075769
Intensity adaptor for Type 4231	Bruel & Kjaer	Type DP 0888	
Noise logger	Bruel & Kjaer	Type 2238	2246519
Noise logger	Bruel & Kjaer	Type 2238	2343825
Noise logger	Bruel & Kjaer	Type 2238	2428867
Sound Calibrator	Bruel & Kjaer	Type 4231	1807308

Both the Bruel & Kjaer Type 2238 sound level meter and the Bruel & Kjaer Type 2260 sound analyser meet the requirements for Type 1 sound level meters as specified in AS 1259. All measuring instruments were calibrated on site before and after measurements were taken using a Bruel & Kjaer type 4231 reference sound source.

All equipment used have current NATA calibration certificates, the calibration certificates are available on request.

3.2 Noise Logging

Continuous noise logging has been undertaken over 14 days at six positions around the quarry (including noise logging undertaken at the residence at 31 Daniel Place Baskerville). Figure B1 found in Appendix B presents the location of noise logging, along with the noise logging results.

Table 3-2 presents the locations of the noise logging along with dates over which the noise logging was undertaken.

Table 3-2 : Noise logging locations and duration

Position	Location	Dates of logging
L1	100m north of quarry	10th to 23rd of November 2006 16th to 30th of March 2007 10th to 17th of April 2007
L2	Loton Road	16th to 28th of March 2007
L3	North east boundary of Hanson lease area	10th to 23rd of November 2006
L4	31 Daniel Place Baskerville	10th to 17th of April 2007
L5	Williams Road	16th to 30th of March 2007
L6	North west boundary of Hanson lease area	10th to 23rd of November 2006

3.2.1 Noise Logging Result L1

Position L1 (close to the quarry) has been used as a reference position to indicate when noise emission from the quarry is high. The noise logging results taken at L1 show significant increase in noise levels when high noise emission activities are occurring at the quarry. An increase in noise levels from the quarry is particularly observable for the noise logging undertaken during the 16th to 30th of March 2007 and during the 10th to 17th of April 2007. The noise logging undertaken during the 10th to 23rd of November 2006 does not show a significant increase in quarry noise emission.

3.2.2 Noise Logging Result L2

Inspection of the noise logging data at this location indicates that noise levels can be quite low, with the L_{A90} noise levels reaching below 30 dB(A) during both the day and night time hours. During installation and collection of the noise loggers the quarrying operations at Red Hill were not audible at this site.

A comparison of the noise logging taken at L1(Quarry) with that taken at L2 does not show any significant correlation when the quarry is operating during the day time periods. A close inspection of the noise logging results show that the L_{A10} noise levels are less than 45 dB(A) when wind speeds are low (less than 4 m/s). When wind speeds increase above 4 m/s, recorded noise levels are influenced by noise from foliage (rustling leaves).

3.2.3 Noise Logging Result L3

As per L2, inspection of the noise logging data at this location indicates that noise levels can be quite low during the night time hours, with the L_{A90} noise levels reaching below 25 dB(A). During installation and collection of the noise loggers the quarrying operations at Red Hill were not audible at this site.

A comparison of the noise logging taken at L1 (Quarry) with that taken at L3 does show a weak correlation during the day time period. A close inspection of the noise logging results show that during day time hours the L_{A10} noise levels varies between 40 dB(A) and 50 dB(A). However, during this period the high noise is likely to be due to wind generated noise rather than the quarrying operations, as the wind was generally greater than 4m/s during the day for the logging

period. When wind speeds increase above 4 m/s, recorded noise levels are influenced by noise from foliage (rustling leaves).

3.2.4 Noise Logging Result L4

Inspection of the noise logging data at this location indicates that noise levels can be quite low, with the L_{A90} noise levels reaching below 30 dB(A) during day time hours. During installation of the noise loggers the SVT operator just heard noise from the quarrying operations at Red Hill when the ambient noise levels fell below 35 dB(A).

A comparison of the noise logging taken at L1 with that taken at L4 does not show any strong pattern of noise levels increasing at L4 when the quarry is operating during the day time periods. The L_{A10} noise levels are less than 45 dB(A) when wind speeds are low (ie noise generated by wind rustling leaves is low). Close inspection of the noise logging data shows that during the logging period, noise levels at Daniel Place starts to increase at 6.30 am in the morning, whilst at the quarry the noise levels do not increase in level until 8.15 am. Similarly the noise levels at Daniel Place did not show a decrease after 5.00pm when the quarry was not emitting high noise levels. These observations could be due to fauna sources of noise (birds chirping, etc) or due to noise emission from local households and traffic movements in the area.

When collecting the noise logger at 31 Daniel Place the owner of the premises indicated that noise from the quarry was not audible during the logging period.

3.2.5 Noise Logging Result L5

Inspection of the noise logging data at this location indicates that noise levels can be quite low, with the L_{A90} noise levels reaching below 25 dB(A) during night and early morning hours. During installation and collection of the noise loggers the quarrying operations at Red Hill were not audible at this site.

A comparison of the noise logging taken at L1(Quarry) with that taken at L5 does not show any strong pattern of noise levels increasing at L5 when the quarry is operating during the day time periods. A close inspection of the noise logging results show that the L_{A10} noise levels are less than 45 dB(A) when wind speeds are low (less than 4m/s). When wind speeds increase above 4 m/s, recorded noise levels are influenced by noise from foliage (rustling leaves).

3.2.6 Noise Logging Result L6

Inspection of the noise logging data at this location indicates that noise levels can be quite low, with the L_{A90} noise levels reaching below 30 dB(A) during day time hours. During installation of the noise loggers the SVT operator just heard noise from the quarrying operations at Red Hill when the ambient noise levels fell below 35 dB(A).

A comparison of the noise logging taken at L1 with that taken at L6 does not show any strong pattern of noise levels increasing at L6 when the quarry is operating during the day time periods. The L_{A10} noise levels when wind speeds are low (ie noise generated by wind rustling leaves is low) is less than 45 dB(A).

3.2.7 Summary

At positions L2, L4, L5 and L6 noise emission from the quarry does not show any strong correlation of noise measured at these sites with activities at the quarry. At these positions the L_{A10} noise levels are less than 45 dB(A). At position L3 there is a weak correlation between noise received at this position and the quarrying activities, however, the L_{A10} noise levels are highly influenced by wind generated noise, and hence do not give a good indication of noise emission from the quarrying activities.

3.3 Quarry & Processing Plant Noise Levels

Noise levels were recorded for the majority of the equipment operating at the quarry including:

- Primary Crusher;
- Secondary and Tertiary Crusher;
- Screening unit;
- Dust collector;
- Conveyors;
- Dump Trucks;
- Drilling Rig;
- Excavators;
- Front end loader; and
- Haulage trucks.

Based on these noise levels the L_{10} sound power for existing equipment was evaluated. Table 3-3 presents the octave band sound power levels used in the noise models.

Table 3-3 : L_{10} sound power levels for both the plant and mobile equipment.

Equipment	Octave Band Sound Power Levels in dB(lin)									O/A dB(A)
	31.5	63	125	250	500	1k	2k	4k	8k	
Fixed Plant										
Primary Crusher	118.3	120.4	117.7	114.6	111.4	108.2	104.4	98.8	91.8	113.7
Secondary and Tertiary Crusher	112.1	111.2	111.8	109.5	107.9	107.7	102.3	95.1	85.9	111.2
Conveyor: Primary to Secondary	115.7	118.0	117.0	114.9	112.9	111.2	108.1	103.7	98.9	116.1
Screening Unit	113.0	112.5	110.0	107.2	104.8	103.5	102.2	98.3	89.9	109.0
Dust Collector (exhaust stack)	102.9	102.5	93.5	93.6	90.2	89.2	92.9	91.8	83.0	98.1
Motor Assembly (adjacent to the dust collector)	107.6	99.4	106.2	102.9	100.6	99.6	96.5	96.9	92.2	105.0

Equipment	Octave Band Sound Power Levels in dB(lin)									O/A dB(A)
	31.5	63	125	250	500	1k	2k	4k	8k	
Mobile Equipment										
TAMROCK CHA1100 Drilling Rig	103.4	104.3	110.1	105.5	108.0	106.7	106.4	101.1	91.1	112.0
CAT 773B Excavator	105.2	104.2	108.9	104.0	107.4	106.5	105.8	99.4	91.0	111.4
KOMATSU HD465 Dump Truck	100.4	109.9	121.1	104.9	103.0	101.1	99.5	94.7	89.4	108.7
CAT 140G Grader	95.1	97.5	104.2	103.3	99.8	99.1	97.5	92.7	86.9	104.2
CAT 245B Excavator	102.2	94.1	109.9	103.2	103.2	100.9	97.7	92.7	86.3	105.8
CAT 990 Loader	102.6	100.7	110.0	103.0	103.2	100.9	100.6	92.3	86.3	106.5
Haulage Truck	95.1	104.6	115.8	99.6	97.7	95.8	94.2	89.4	84.1	103.4

It has been assumed that all new equipment associated with the proposed development (ie relocation of the primary crusher, and conveyors from the primary crusher to the existing secondary crusher), will have sound power levels at least equivalent or less than the existing primary crusher and conveyors. It has been assumed that the quaternary crusher will be located inside the existing secondary crushing building.

4. NOISE MODELLING – OVERVIEW

An acoustic model has been developed for the quarry site to assess the highest noise impact from the quarrying operations on the surrounding areas. The noise impact has been assessed assuming:

- worst case meteorological conditions as given by *Environmental Protection Act 1986)* Guidance note No 8,
- all mobile quarrying equipment is running at high idle,
- the drilling rig is drilling,
- water truck is operating,
- a truck is dumping at the crusher,
- the crusher is operating,
- two haulage trucks moving within the sotockyard, and
- all process plant is operating at full capacity.

Noise modelling of the quarry's L_{A10} noise levels has been undertaken since this will be the most restrictive noise emission parameter to be met by the *Environmental Protection (Noise) Regulations 1997.*

To ensure that the worst case noise impact is assessed in terms of mobile equipment location within the quarrying pit, all mobile equipment operating in the quarry (haul trucks, excavator, water cart, and drilling rig) have been located on high level benches to ensure that there is minimum shielding from the pit walls.

It is unlikely that all of the plant and equipment items will be running at full load or full capacity at the same time, and with all pit equipment located on high level benches, hence the noise impact assessment undertaken is likely to be conservative, ie it will predict higher noise levels than are likely to occur during normal quarrying operations.

The noise modelling was undertaken in accordance with EPA guidance Note No. 8.

4.1 Acoustic Model

An acoustic model has been developed using the SoundPlan 6.3 program developed by SoundPLAN LLC. This program calculates sound pressure levels at nominated receiver locations or produces noise contours over a defined area of interest around the noise sources. SoundPlan can be used to model different types of noises, such as industrial noise, traffic noise and aircraft noise, and it has been recognised internationally including in Australia. The inputs required in SoundPlan are noise source data, ground topographical data, meteorological data and receiver locations.

The model has been used to generate noise contours for the area surrounding the quarry site and also to predict noise levels at the nearby noise sensitive locations.

The acoustical model does not include noise emissions from any source other than the quarrying activities. Therefore, noise emissions from other neighbouring industrial sources, road traffic, animals, domestic sources, etc are excluded from the modelling, as these are not part of the sites noise emission.

The area over which the noise modelling has been undertaken is given in Figure A1 found in Appendix A.

4.2 Input Data

4.2.1 Source Sound Power Levels

For both the existing and proposed quarrying operations the sound power levels determined from noise levels recorded for the existing quarrying operations have been used, as given in Section 3.3 of this report.

4.2.2 Topography and Ground Types

Topographical information for the noise model was obtained from Hanson in electronic format. These contours were converted into DXF file format for direct import into the noise model. Hard ground type has been used for the quarrying area, with a soft ground type for the surrounding area.

4.2.3 Receiving Locations

The noise model has been used to predict noise levels at six locations (P1 to P6) around the perimeter of the quarrying area. These locations are shown in Figure B1 in Appendix B.

Table 4-1 : Receiving locations

Designation	Location	Zoning	Sensitivity
P1	Corner of Stock Rd and Campersic Rd, Baskerville	Rural	Residential dwelling- noise sensitive
P2	Corner of Williams Rd and Campersic Rd, Baskerville	Rural	Residential dwelling- noise sensitive
P3	Loton Rd, Baskerville	Rural	Residential dwelling- noise sensitive
P4	Daniel Place, Baskerville	Rural	Residential dwelling- noise sensitive
P5	Burgess Rd, Baskerville (north of mine)	Rural	Residential dwelling- noise sensitive
P6	Burgess Rd, Baskerville (north east of mine)	Resource	Property owned by Boral- commercial

4.2.4 Meteorology

SoundPlan calculates noise levels for defined meteorological conditions. In particular, temperature, relative humidity, wind speed and direction data are required as input to the model.

For the noise modelling SVT has used the worst case meteorological conditions suggested by the EPA *(Environmental Protection Act 1986)* Guidance note No 8 for assessing noise impact from new

developments as the upper limit of the meteorological conditions investigated. Table 4-2 below presents the worst-case meteorological conditions for noise emission from the quarry site.

Table 4-2 : Worst-case meteorological conditions for noise emission from the transformers

Time of day	Temperature Celsius	Relative Humidity	Wind speed	Pasquill Stability Category
Day (0700 --- 1900)	20º Celsius	50%	4 m/s	D
Evening (1900 --- 2200)	20º Celsius	50%	4 m/s	D
Night (2200 --- 0700)	15º Celsius	50%	3 m/s	F
Notes: The Pasquill Stability Category is a term that describes the atmospheric stability				

5. NOISE MODELLING

5.1 Noise Modelling Results

The noise model developed for the existing and proposed quarry represents a typical worst case noise emission scenario with the following equipment operating:

- Primary Crusher, and Quaternary Crusher;
- Secondary and Tertiary Crusher;
- Screening unit;
- Dust collector;
- Conveyors between primary crusher and secondary crusher, and from the secondary and tertiary crusher to the screening house;
- Dump Trucks (2 off);
- Water Cart;
- Drilling Rig;
- Excavator; and,
- Front end loader.

5.2 Verification of Noise Model

The noise model for the existing quarrying operations was verified using noise level data collected around the plant under known weather and plant operating conditions. The average error margin associated with the modelling predictions is +1.5 dB with a standard deviation of 2.1 dB, hence the modelling is likely to over predict. Typically SVT would expect this type of modelling to have an error of 0 to +5 dB (ie is conservative), therefore, the average error is within the error we would expect.

5.3 Point Calculations

The tables below present the noise levels predicted at each of the six point locations for the existing plant and the various quarrying stages for calm and day time worst case meteorological conditions.

Table 5-1 : Predicted noise levels for calm conditions (L_{A10} dB(A))

Stages of the proposed development (timing)	P1	P2	P3	P4	P5	P6
Existing Plant Operation	7.8	6.9	0.8	26.1	26.8	37.5
Stage 1 (2007-2012)	7.7	7.7	11.7	25.8	26.6	38.9
Stage 2 (2012-2017)	8.2	8.6	19.3	26.1	26.8	38.6
Stage 3 (2017-2028)	8.1	8.4	23.7	26.1	26.8	38.6
Stage 4 (2028-2032)	8.1	8.5	24.0	26.4	26.8	38.7
Stage 5 (2032-2038)	8.0	8.0	24.2	29.2	27.6	38.6
Stage 6 (2038-2044)	8.0	7.9	25.0	29.5	27.9	38.6
Stage 7 (2044-2049)	8.0	7.9	24.2	29.1	27.8	38.6
Stage 8 (2049-2055)	8.0	7.8	24.5	29.3	28.3	38.6
Stage 9 (2055-2061)	8.0	7.8	23.8	26.9	27.3	38.6
Stage 10 (2061-2079)	7.9	7.8	24.1	27.6	26.8	38.6
Stage 11 (2061-2079)	8.0	7.7	24.1	27.6	26.8	38.6
Stage 12 (2079-2103)	10.4	9.5	23.2	25.7	26.9	38.9

Table 5-2 : Predicted noise levels for day time worst case conditions (L_{A10} dB(A))

Stages of the proposed development (timing)	P1	P2	P3	P4	P5	P6
Existing Plant Operation	12.7	11.8	6.1	31.3	31.9	41.6
Stage 1 (2007-2012)	12.6	12.7	16.6	31.0	31.8	43.1
Stage 2 (2012-2017)	13.0	13.6	24.4	31.3	31.9	42.8
Stage 3 (2017-2028)	12.9	13.4	28.9	31.3	31.9	42.8
Stage 4 (2028-2032)	12.9	13.5	29.2	31.5	32.0	42.9
Stage 5 (2032-2038)	12.8	12.9	29.4	34.4	32.8	42.8
Stage 6 (2038-2044)	12.8	12.8	30.2	34.7	33.1	42.8
Stage 7 (2044-2049)	12.8	12.8	29.4	34.3	33.1	42.8
Stage 8 (2049-2055)	12.8	12.8	29.7	34.5	33.5	42.8
Stage 9 (2055-2061)	12.8	12.7	28.9	32.1	32.5	42.8
Stage 10 (2061-2079)	12.7	12.7	29.4	32.8	32.0	42.8
Stage 11 (2061-2079)	12.7	12.6	29.3	32.8	31.9	42.8
Stage 12 (2079-2103)	15.4	14.5	28.4	30.9	32.0	43.1
Maximum increase in noise levels when compared with the Existing Plant	2.7	2.7	24.1	3.4	1.6	1.5

The highest noise levels is observed at position P6 (zoned resource) for all stages of the quarrying, where the worst case noise level is currently predicted to be 41.6 dB(A) and increases to 43.1 dB(A) during the development.

Noise levels at positions P1 and P2 are low (below 16 dB) for all stages of the quarrying, because these locations are shielded from the noise by the presence of a ridge located to the west of the quarrying areas.

Noise levels at P3 progressively increase during the quarry development to a level of 30.2 dB(A) (Stage 6) from a very low level of 1 dB for the existing plant. This increase is observed because the quarrying operations removes the ridge between the quarry and position P3 which has the result of increasing noise levels at P3.

At positions P4 and P5 the noise levels increase by 3.5 dB and 1.6 dB respectively from current levels, and then reduce back to the current noise level during the quarry development. The highest noise levels at P4 and P5 are 34.7 dB(A) (Stage 6) and 33.5 dB(A) (Stage 8) respectively.

Table 5-3 presents the top ten contributors of the various noise sources at Position P4 of the receiver positions for the existing quarry and for stages 5, 11 and 12 of the quarry.

Table 5-3 : Top 10 noise contributors

Ranking	Existing	SPL* dB(A)	Stage 5 (2032-2038)	SPL* dB(A)
1	Conveyor Primary-Secondary	25.9	Drilling Rig	29.4
2	Secondary Crusher	25.3	Conveyor Primary-Secondary	25.9
3	Primary crusher	24.4	CAT 773B Dump Truck	25.6
4	Screening unit	22.6	Secondary Crusher	25.3
5	Watercart	19.6	Primary crusher	24.4
6	D400 Truck #2	16.3	CAT 245B Excavator	22.6
7	CAT 990 Loader	12.1	Screening unit	22.6
8	Dust Collector (exhaust stack)	3.1	KOMATSU HD465 Dump Truck	19.7
9	Drilling Rig	2.2	CAT 990 Loader	14.6
10	Dust Collector Motor assembly	0.7	Motor assembly (dust collector	12.6
	Total	31.3		34.4

* SPL- L_{A10} Sound pressure level

Ranking	Stage 11 (2061-2079)	SPL* dB(A)	Stage 12 (2079-2103)	SPL* dB(A)
1	CAT 773B Dump Truck	27	Conveyor Primary-Secondary	25.9
2	Conveyor Primary-Secondary	25.9	Secondary Crusher	25.3
3	Secondary Crusher	25.3	Primary crusher	24.4
4	Primary crusher	24.4	Screening unit	22.6
5	Screening unit	22.6	Dust Collector Motor assembly	12.6
6	KOMATSU HD465 Dump Truck	19.7	Dust Collector (exhaust stack)	3.1
7	Drilling Rig	18.6	CAT 990 Loader	3.1
8	CAT 990 Loader	14.6	Drilling Rig	2.4
9	Dust Collector Motor assembly	12.6	DD400 Truck #1	1
10	CAT 245B Excavator	8.3	Watercart	0.9
	Total	32.8		30.9

* SPL- L_{A10} Sound pressure level

The model predictions show the noise level contribution at the premises is primarily dominated by the fixed plant noise, with noise emission from the mobile plant generally being a secondary contributor.

5.4 Noise Contours

Noise contours have been produced for day-time worst case conditions for the existing and the proposed quarry operations. The following table presents the figure numbers for the noise contours for each of the various stages of the quarry development, the figures can be found in Appendix C.

Table 5-4 : Noise contours for daytime worst case metrological condition

Stages of the proposed development (timing)	Figure No	Stages	Figure No
Existing Plant	C1	Stage 7 (2044-2049)	C8
Stage 1 (2007-2012)	C2	Stage 8 (2049-2055)	C9
Stage 2 (2012-2017)	C3	Stage 9 (2055-2061)	C10
Stage 3 (2017-2028)	C4	Stage 10 (2061-2079)	C11
Stage 4 (2028-2032)	C5	Stage 11 (2061-2079)	C12
Stage 5 (2032-2038)	C6	Stage 12 (2079-2103)	C13
Stage 6 (2038-2044)	C7		

The noise contours show that as the quarry progresses from stages 1 to 11 the area of impact from the quarry development expands slightly (ie the extent of the noise emission). The major increase in noise is in the area to the west of the quarry as the quarry progresses from stages 1 to 11. This is primarily because the quarry extends westwards and northwards which removes natural barriers (hill ridges) which would otherwise have attenuated noise. When the quarry reaches stage 12 there is a slight increase in noise levels to the south of the quarry, again this is because the quarrying activity at the quarry has removed natural barriers (hill ridges) which would otherwise have attenuated noise.

6. COMPLIANCE ASSESSMENT

This section compares the calculated noise levels at the closest noise sensitive premises with the assigned noise levels of the *Environmental Protection (Noise) Regulations 1997.*

6.1 Summary of Legislation and Noise Limits

Noise management in Western Australia is implemented through the *Environmental Protection (Noise) Regulations 1997* which operate under the *Environmental Protection Act 1986*.

The Regulations specify maximum noise levels (assigned levels) which are the highest noise levels that can be received at noise-sensitive premises, commercial and industrial premises.

Assigned noise levels have been set differently for noise sensitive premises, commercial premises, and industrial premises.

For noise sensitive premises, eg residences, an "influencing factor" is incorporated into the assigned noise levels. The influencing factor depends on land use zonings within circles of 100 m and 450 m radius from the noise receiver, including:

- the proportion of industrial land use zonings;
- the proportion of commercial zonings; and,
- the presence of major roads.

For noise sensitive residences, the time of day also affects the assigned levels.

The regulations define three types of assigned noise level:

- $L_{A\ max}$ assigned noise level means a noise level which is not to be exceeded at any time;
- $L_{A\ 1}$ assigned noise level which is not to be exceeded for more than 1% of the time;
- $L_{A\ 10}$ assigned noise level which is not to be exceeded for more than 10% of the time.

The L_{A10} noise limit is the most significant for this study since this is representative of continuous noise emissions from the quarrying operations.

Noise levels at the receiver are subject to penalty corrections if the noise exhibits intrusive or dominant characteristics, ie if the noise is impulsive, tonal, or modulated. That is, the measured or predicted noise levels are adjusted and the adjusted noise levels must comply with the assigned noise levels.

Regulation 9 sets out objective tests to assess whether the noise is taken to be free of these characteristics.

Table 6-1 presents the assigned noise levels for noise sensitive premises. Table 6-2 presents the adjustment to measured or predicted noise which exhibits intrusive or dominant characteristics.

Table 6-1 : Table of assigned levels

		Assigned Level dB(A)		
Type of premises receiving noise	Time of day	$L_{A\,10}$	$L_{A\,1}$	$L_{A\,max}$
Noise sensitive premises at locations within 15 metres of a building directly associated with a noise sensitive use	0700 to 1900 hours Monday to Saturday	45+ IF	55+ IF	65+ IF
	0900 to 1900 hours Sundays and public holidays	40+ IF	50+ IF	65+ IF
	1900 to 2200 hours all days	40+ IF	50+ IF	55+ IF
	22 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays	35+ IF	45+ IF	55+ IF
Noise sensitive premises at locations further than 15 metres from a building directly associated with a noise sensitive use	All hours	60	75	80
Commercial premises	All hours	60	75	80
Industrial and utility premises	All hours	65	80	90
Note 1: IF - influencing factor				

Table 6-2 : Adjustments to measured or predicted noise due to the characteristics of the noise received

Adjustment where noise emission is not music - these adjustments are cumulative to a maximum of 15 dB		
Where tonality is present	Where modulation is present	Where impulsiveness is present
+5 dB	+5 dB	+10 dB

The quarry currently operates from 6.00 am to 6.00 pm on Mondays to Saturdays, and does not operate on public holidays, therefore the following assigned noise levels (noise limits) apply.

Table 6-3 : Assigned noise levels for noise sensitive premises surrounding the Red Hill quarrying operations

Type of premises receiving noise	Time of day	Assigned Level dB(A)		
		$L_{A\,10}$	$L_{A\,1}$	$L_{A\,max}$
Noise sensitive premises at locations within 15 metres of a building directly associated with a noise sensitive use	0700 to 1900 hours Monday to Saturday	45 + IF	55 + IF	65 + IF
	22 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays	35+ IF	45+ IF	55+ IF

Type of premises receiving noise	Time of day	Assigned Level dB(A)		
		$L_{A\,10}$	$L_{A\,1}$	$L_{A\,max}$
Noise sensitive premises at locations further than 15 metres from a building directly associated with a noise sensitive use	All hours	60	75	80

Noise measurements recorded at the logging positions showed no evidence of tonality, modulation or impulsiveness, and therefore no penalties apply to noise emissions from the existing operation.

Since noise emission from the quarrying operations is made up of steady state noise sources like the processing plant, and noise from mobile equipment which can vary with movement through the quarry, the most restrictive assigned noise level for the quarrying operations to be met is the L_{A10} , hence if the L_{A10} noise levels are met then the L_{A1} and L_{Amax} noise levels will also be met.

6.2 Assigned noise levels

Figure A4 presents the zoning for the area around the quarry. The area immediately surrounding the quarry is zoned resource of extractive industry (ie zoned industrial), otherwise all other areas around the quarry would be considered noise sensitive. For the residents surrounding the quarry there are no roads which would be classified as "major" or "secondary", hence the transport factor for influencing factors of the assigned noise levels is 0. The following table presents the day time and night-time assigned noise levels to be met at premises P1 to P6, after the application of the influencing factor.

Table 6- 4 : L_{A10} assigned noise levels in dB(A)

Time of Day	Assigned noise levels in dB(A)					
	P1	P2	P3	P4	P5	P6
0600 – 0700	35	35	35	38	39	60
0700 – 1900	45	45	45	48	49	60

There is the potential for accumulative noise impacts at noise sensitive premises around the quarry from other extractive industries (Boral) and industries in the area (Delta concrete, vinyards, etc). For the quarry noise emission not to be a significant contributor under the regulations, noise emission from the quarry must be 5 dB less than the assigned noise levels. Therefore for the quarry to comply with the Environmental Protection (Noise) Regulations 1997 then the noise emission should be 5 dB less than the L_{A10} assigned noise levels given in Table 6-4.

6.3 Assessment of Compliance for the Existing Quarry

The current quarry operations are in compliance with the assigned noise levels of the Environmental Protection (Noise) Regulations 1997. The maximum noise levels were at least 5 dB

below the assigned noise levels (Table 6-4) at all sites under calm and worst case conditions (Tables 5-1 and 5-2).

6.4 Assessment of Compliance for the Proposed Upgraded Quarry

The proposed Stages 1 - 4 and 9 - 12 of the quarry development are in compliance with the assigned noise levels of the Environmental Protection (Noise) Regulations 1997. However, for Stages 5 - 8 (years 2032 – 2051) the quarry development will potentially be in exceedance of the L_{A10} noise level of 33 dB(A) at position P4 by between 1.3 – 1.7 dB during the hours of 0600 – 0700.

To achieve compliance during these times the quarry will need to reduce its noise output by either not operating the crushing plant, or not operating parts of its mobile fleet, or by applying noise control mitigation measures to its various noise sources (all of these options SVT believes are readily achievable).

7. BLASTING NOISE AND VIBRATION IMPACT

This section reviews the noise and vibration impact of blasting from the proposed quarry development.

To comply with the blasting noise requirements of the Environmental Protection (Noise) Regulations 1997, 9 out of 10 consecutive blast are to be less than 120 dB(lin) with no blasts exceeding 125 dB(lin). For ground-borne vibration from blasting the EPA recommends that the peak particle vibration levels should be less than 5 mm/sec with none exceeding 10mm/sec.

As part of the quarrying activities Hanson undertakes blasting at the quarry site on a regular basis (typically 2 blasts per month). Each blast is monitored by a blasting consultant, with both blast over pressure and ground-borne vibration monitored. Vibration levels have been monitored at the eastern end of Williams Road (some 2.4 km from the quarry). Monitoring undertaken over the 2006 year indicated that the average peak particle velocity was 0.65 mm/sec (with the maximum level of 1.77 mm/sec), with an average blast over pressure of 94.5 dB(lin) (with a maximum level of 114 dB(lin)).

Table 7-1 presents the estimated peak particle velocity in mm/sec due to blasting at the quarry at the various residential positions around the quarry (P1 to P6 in Figure B1 in Appendix B). The assessment is based on an individual charge per hole of 150 kgs, with the total amount of explosive per blast of 32 tonnes. The maximum peak particle velocity observed at any of the residential position is less than 3.23 mm/s, which complys with the EPA recommended vibration levels of 5mm/sec.

Table 7-1 : Estimated Peak Particle Velocity in mm/sec due to blasting at the quarry

Stages of the proposed development (timing)	Peak Particle Velocity in mm/sec					
	P1	P2	P3	P4	P5	P6
1 to 5 (2001-2038)	0.97	1.52	1.37	1.52	0.72	1.83
6 to 11 (2038-2079)	0.97	1.52	1.52	1.69	0.99	2.70
12 (2079-2103)	1.69	3.23	1.07	0.76	0.57	1.13

The blast overpressure associated with blasting activities with all stages of the proposed development is expected to comply with the average requirement of 120 dB(lin) and the maximum requirement of 125 dB(lin). This is based on results from the blast overpressure monitoring undertaken at the quarry to date, which indicates blast over pressure levels are below 114 dB(lin), and assuming charge sizes and delays are maintained.

8. NOISE MANAGEMENT PLAN

As part of the requirements of the Environmental Protection (Noise) Regulations 1997 a noise management plan is being developed by Hanson for the proposed quarry development. The noise management plant will cover all activities at the quarry including construction and operational noise.

The following works are likely to be undertaken as part of the construction component of the development:

- Relocation of primary crusher
- Extension of conveyor from the secondary crusher to the new primary crusher location
- Construction of new quarrying pit

An outline of the construction noise management plan has been developed in Appendix D of the report. The elements of the noise management plan for the construction and ongoing operational activities will be prepared as part of an Environmental Management Plan for the overall Red Hill quarry operation.

When a schedule of activities and details of the equipment to be used for construction work has been developed, SVT can undertake a review of the impact of the construction noise on noise sensitive premises around the plant and advise on noise control measures that should be adopted.

APPENDIX A : PLANT LAYOUT DRAWINGS

Figure A1 Location map of quarry and surrounding area

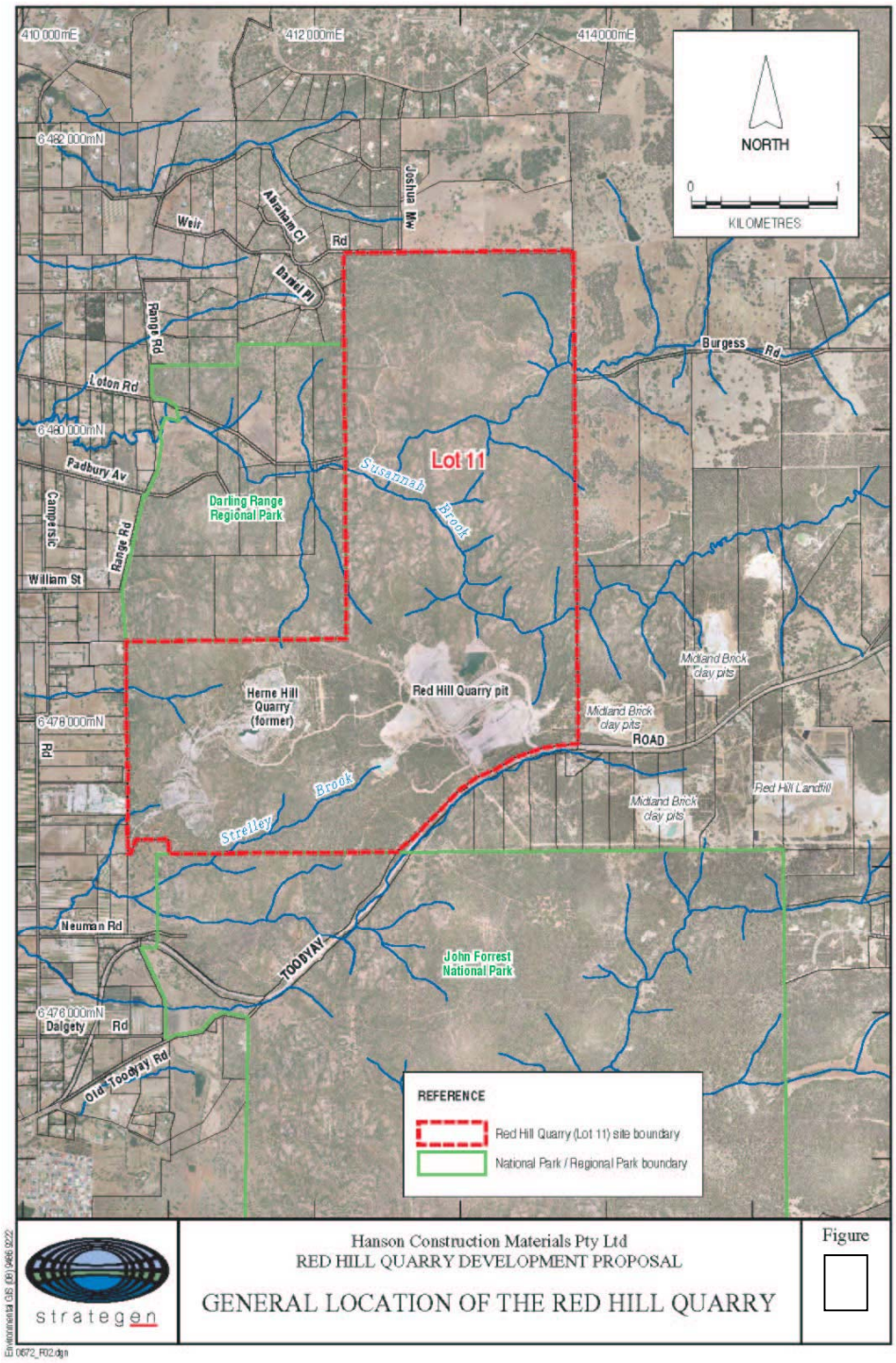


Figure A2 Outline of the existing processing facility

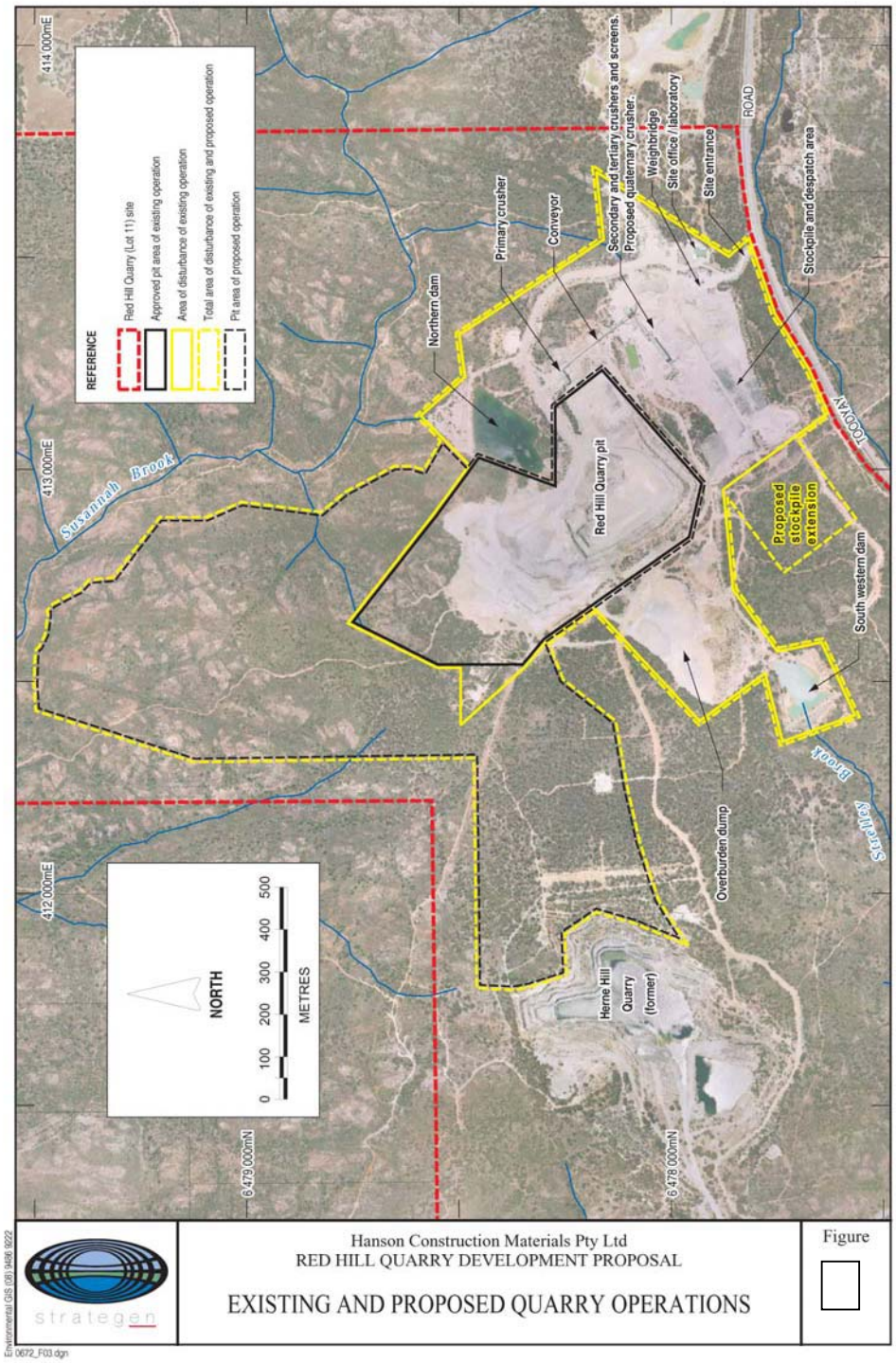


Figure A3 Quarry development footprint

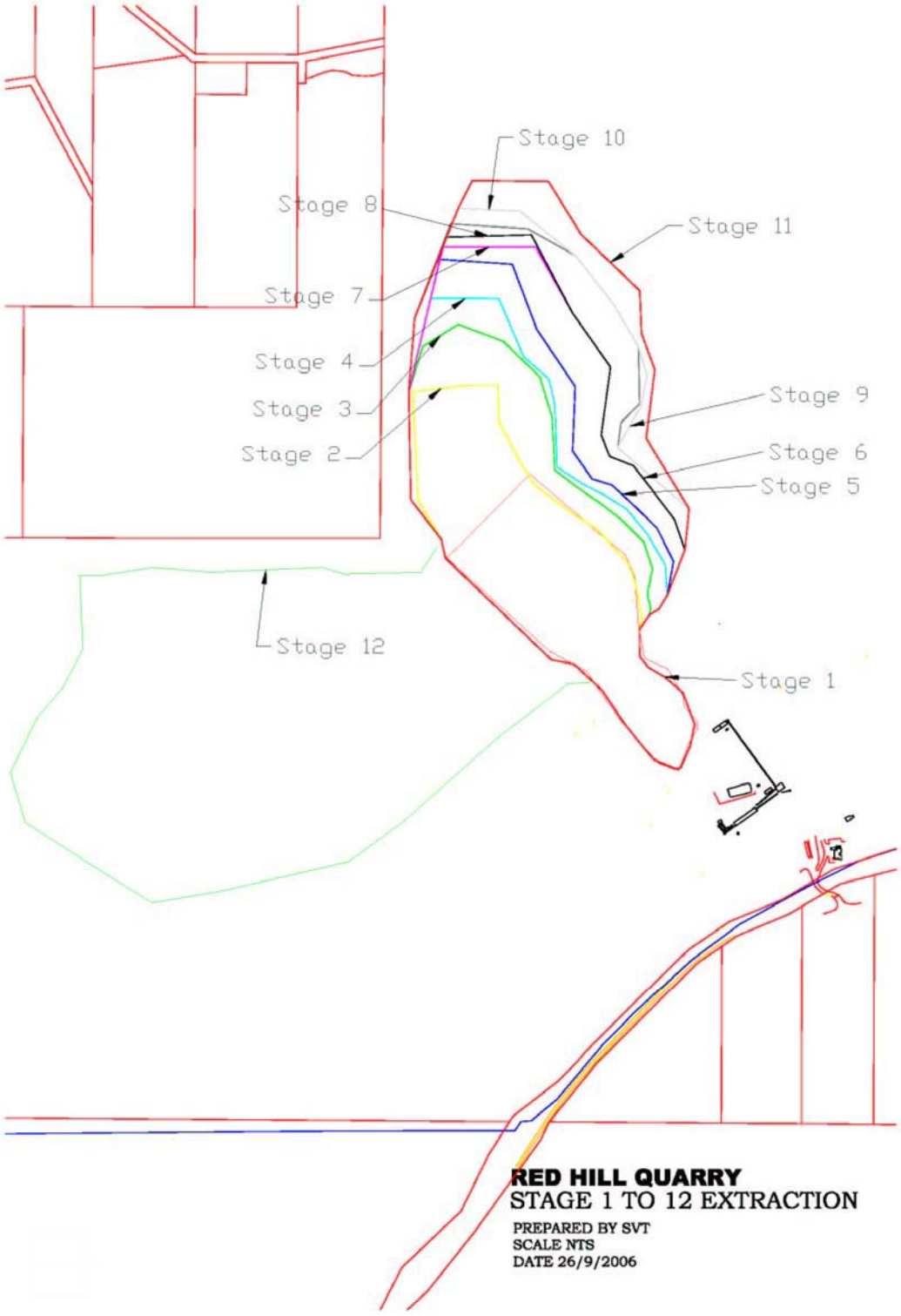
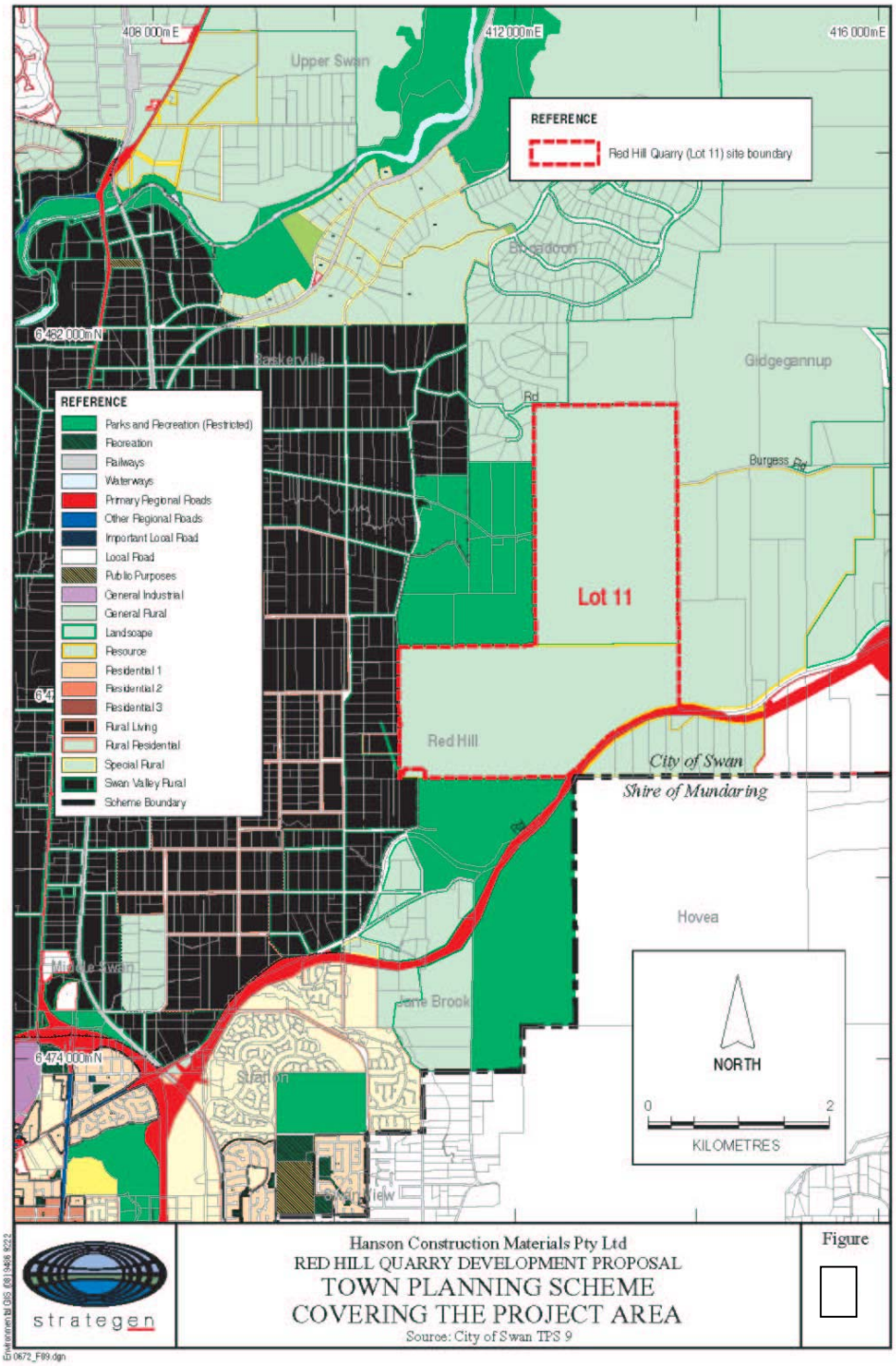
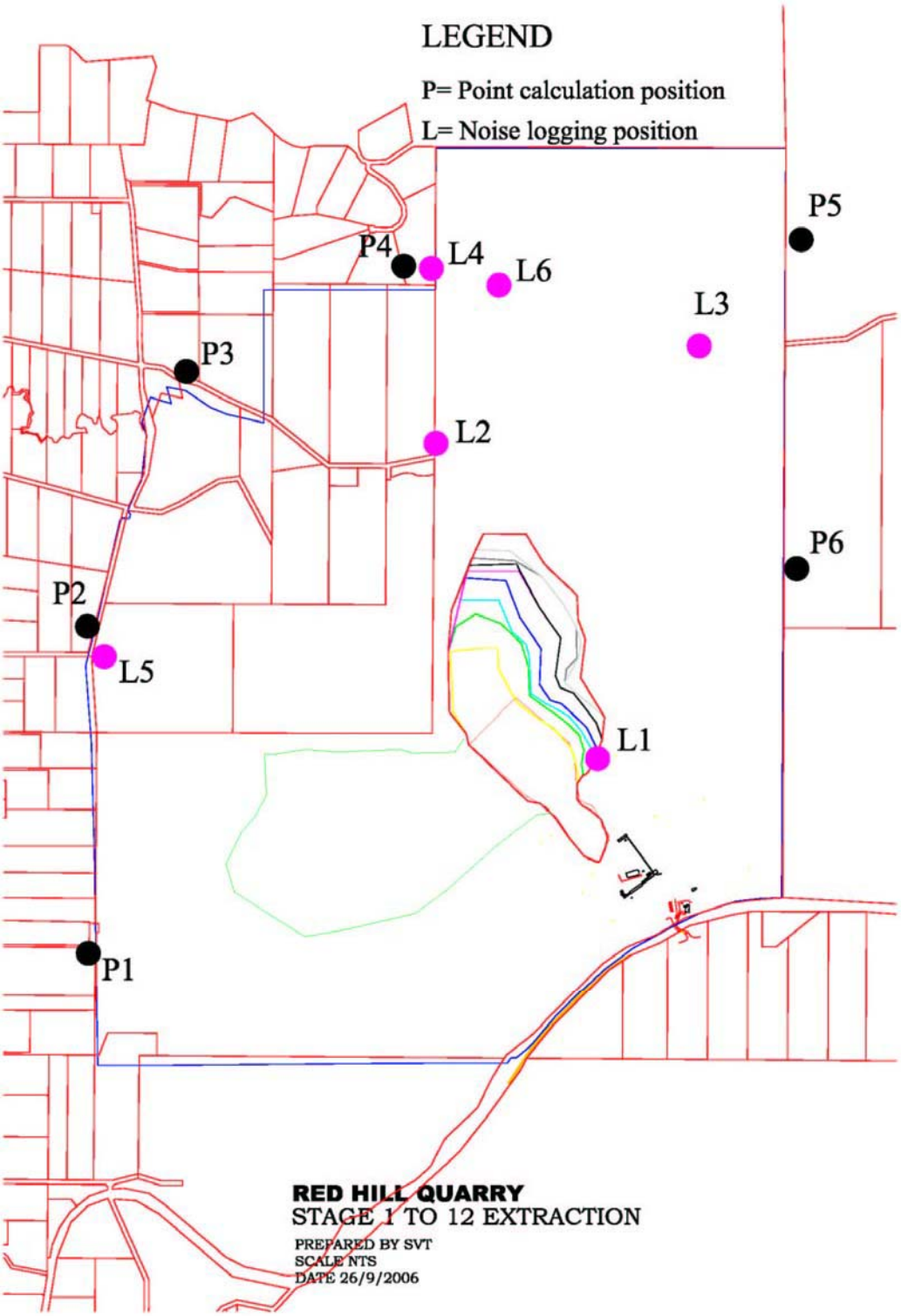


Figure A4 Zoning

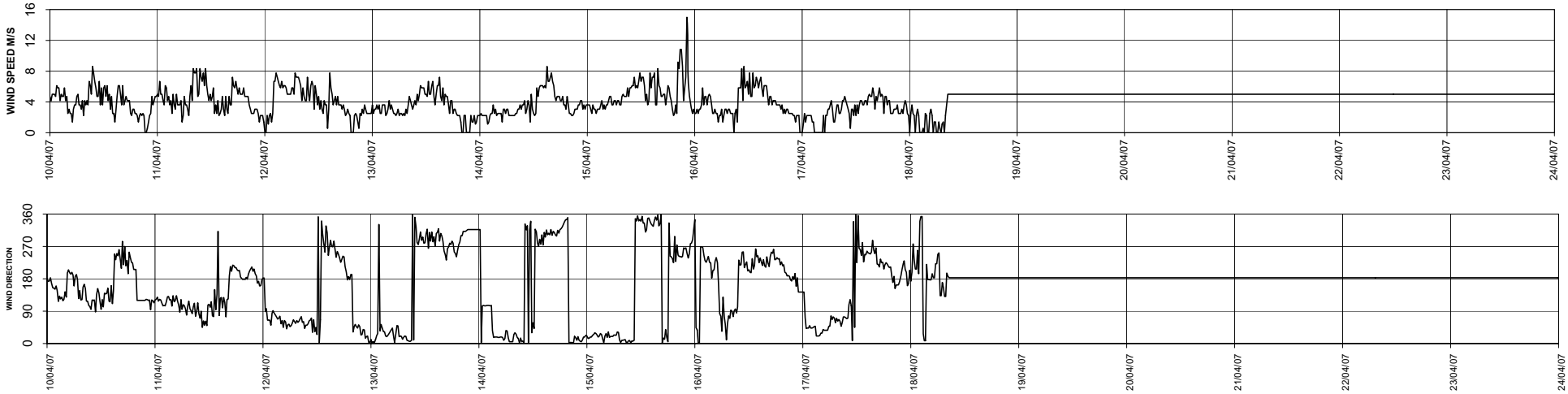


APPENDIX B : NOISE LOGGING RESULTS

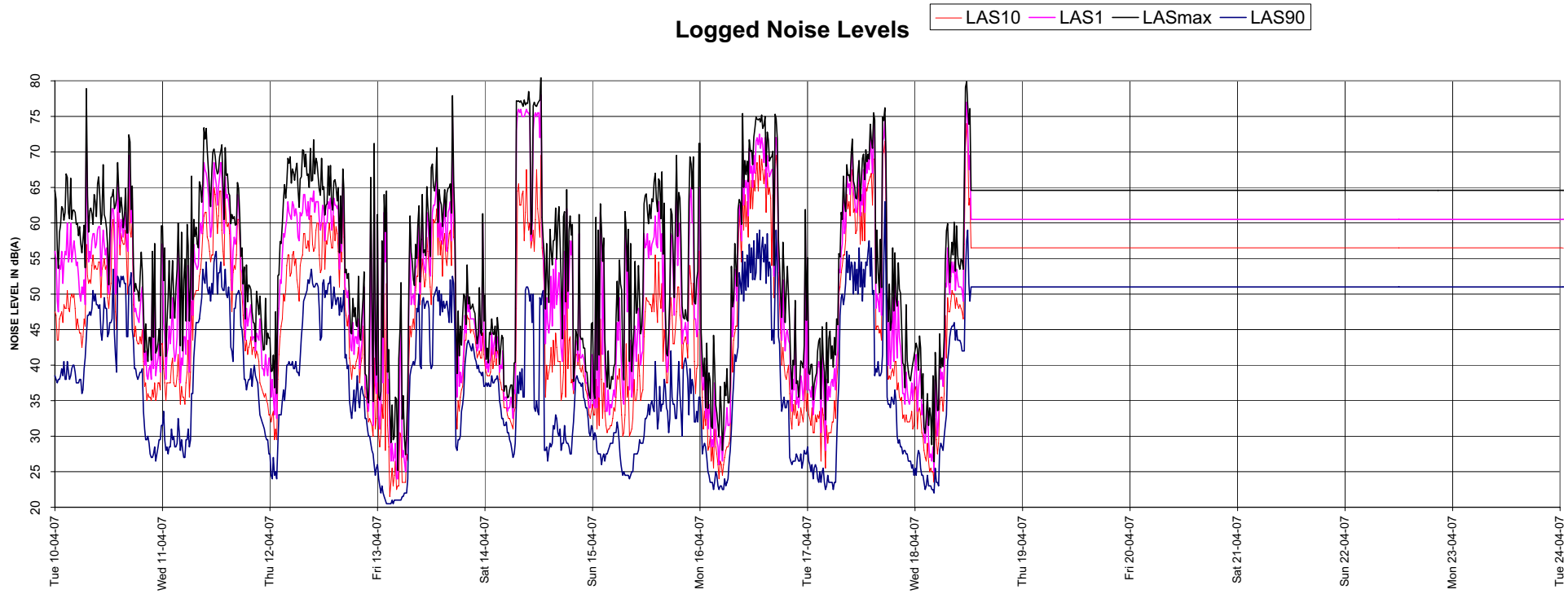
Figure B1 Logging positions and plant expansion for the various stages



Wind Speed



Logged Noise Levels



Noise Logging

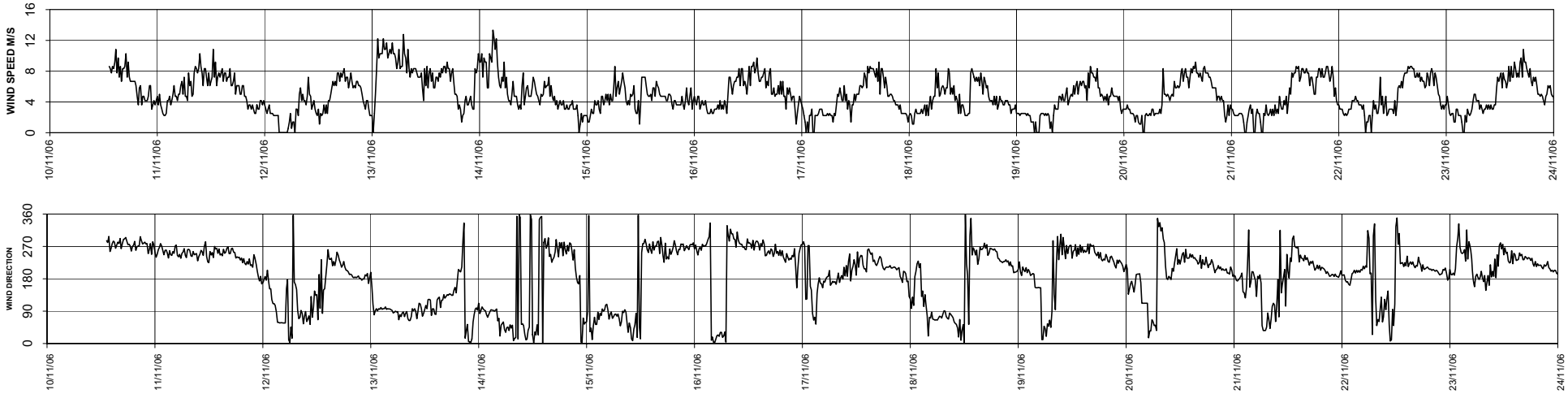
Client: Hanson Construction

SVT-Engineering Consultants

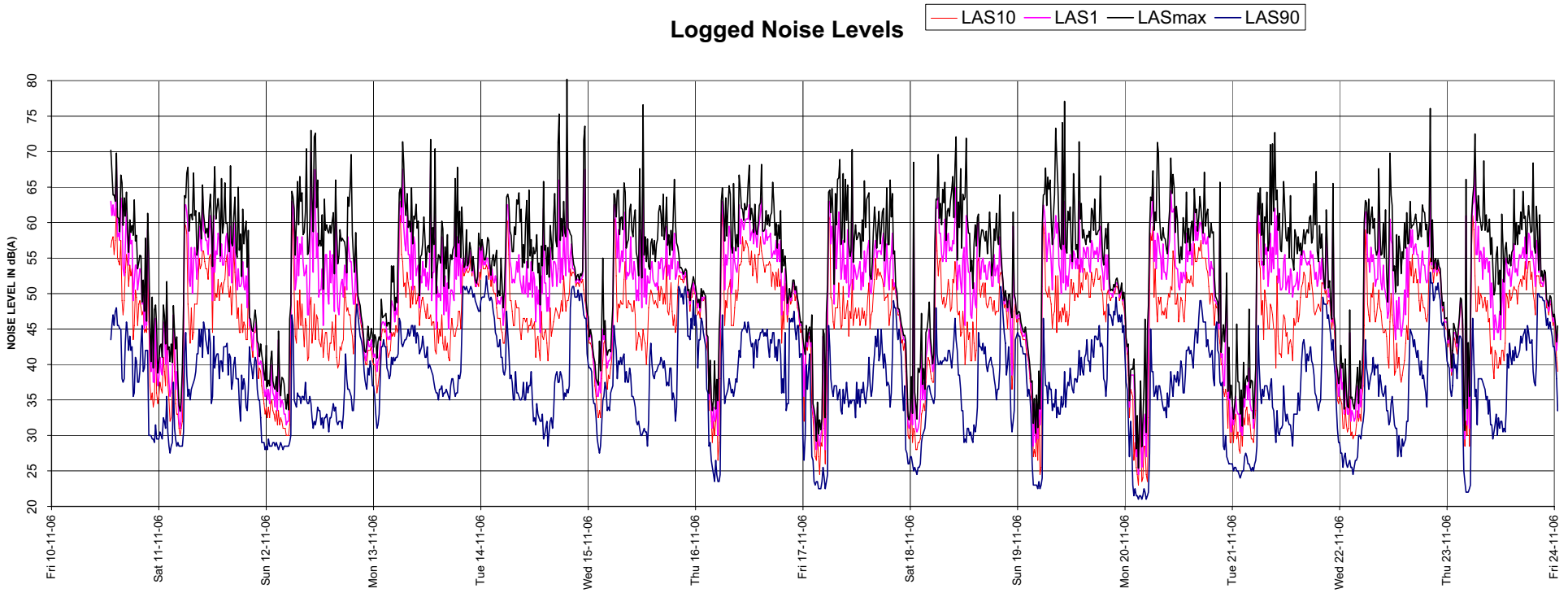
Red Hill Mine Logging

File: L1- Mine 10th to 17th of Apr 07

Wind Speed



Logged Noise Levels



Noise Logging

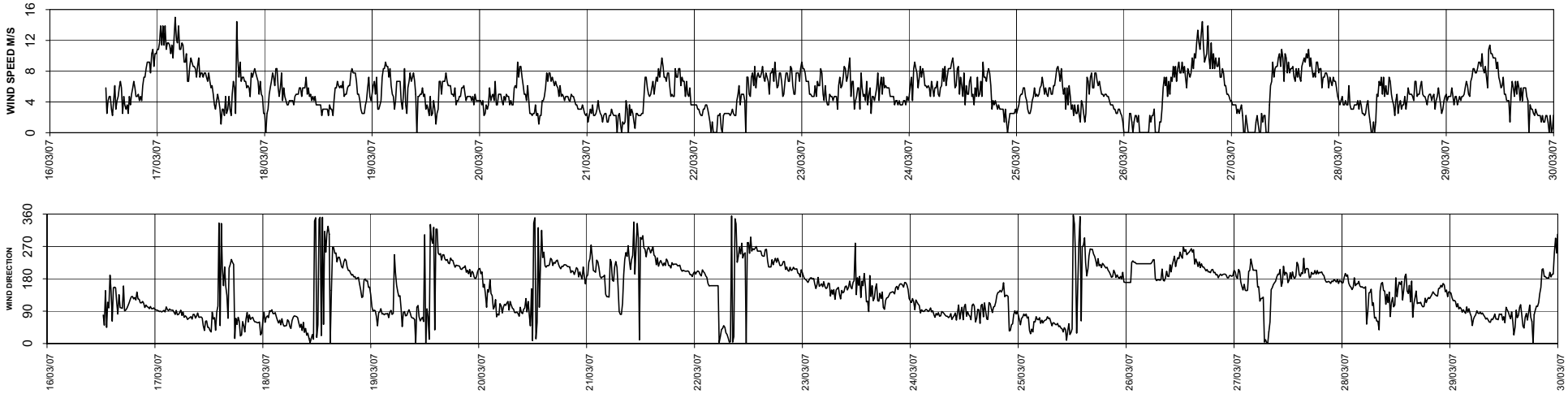
Client: Hanson Construction

SVT-Engineering Consultants

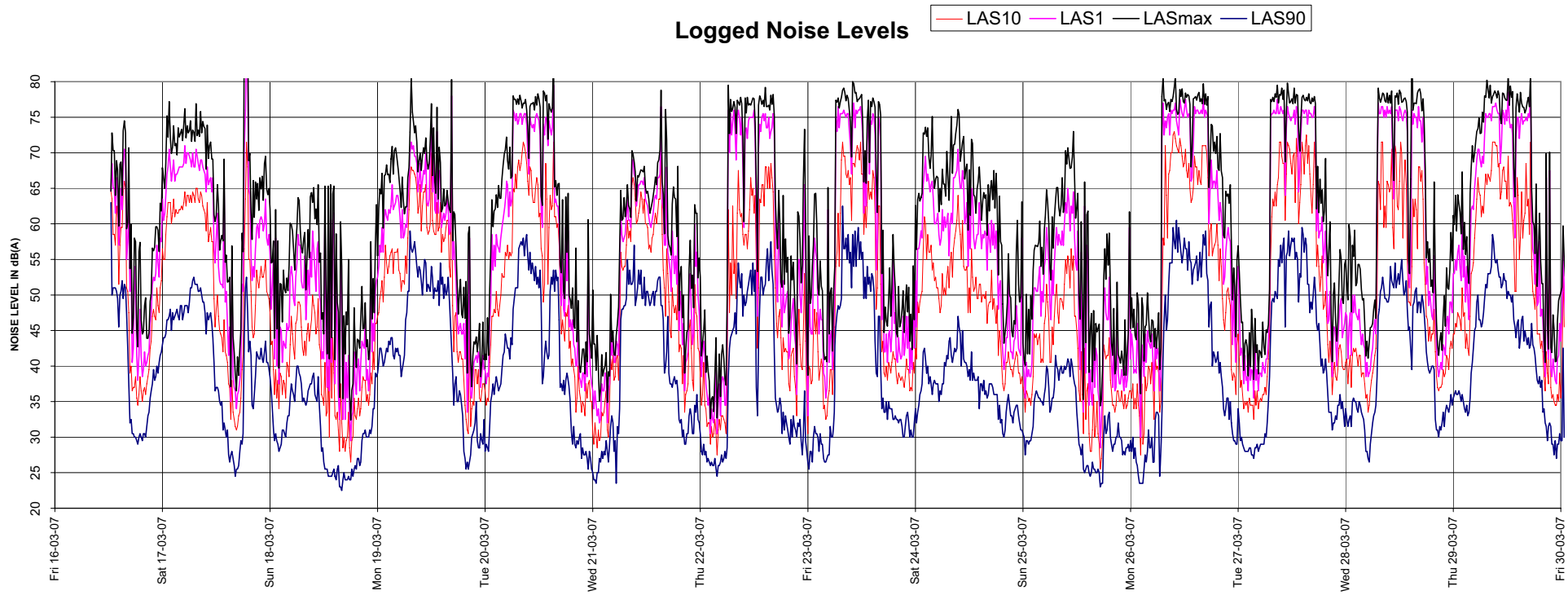
Red Hill Mine Logging

File: L1- Mine 10th to 23rd of Nov 06

Wind Speed



Logged Noise Levels



Noise Logging

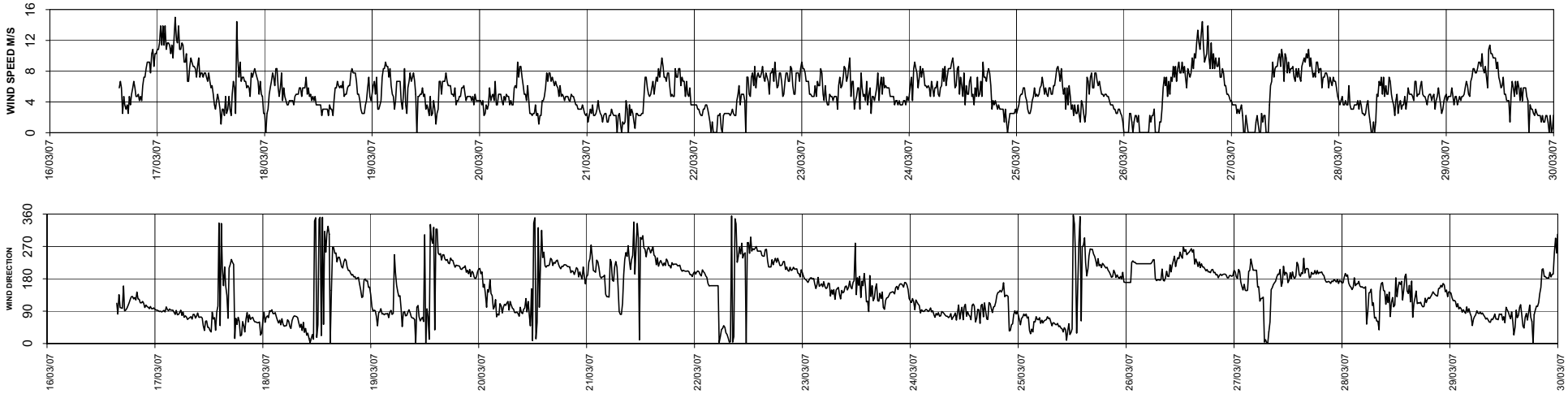
Client: Hanson Construction

SVT-Engineering Consultants

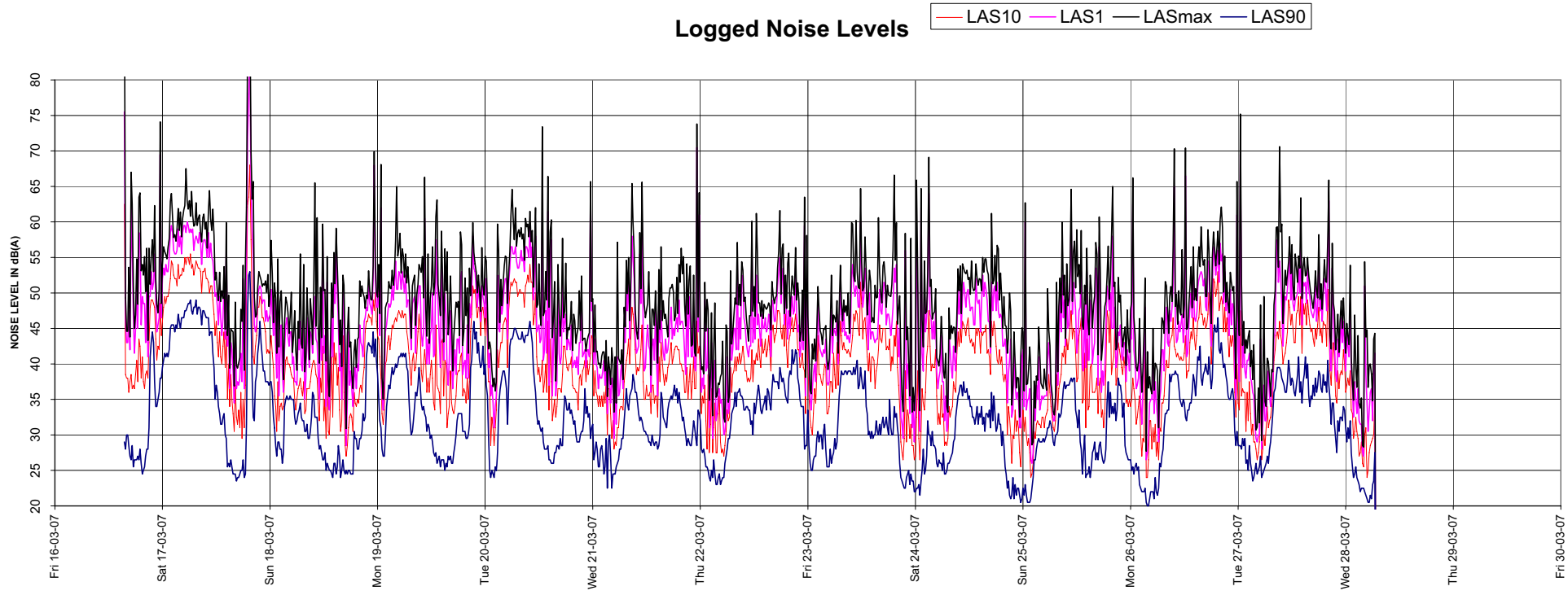
Red Hill Mine Logging

File: L1- Mine 16th to 30th of Mar 07

Wind Speed



Logged Noise Levels



Noise Logging

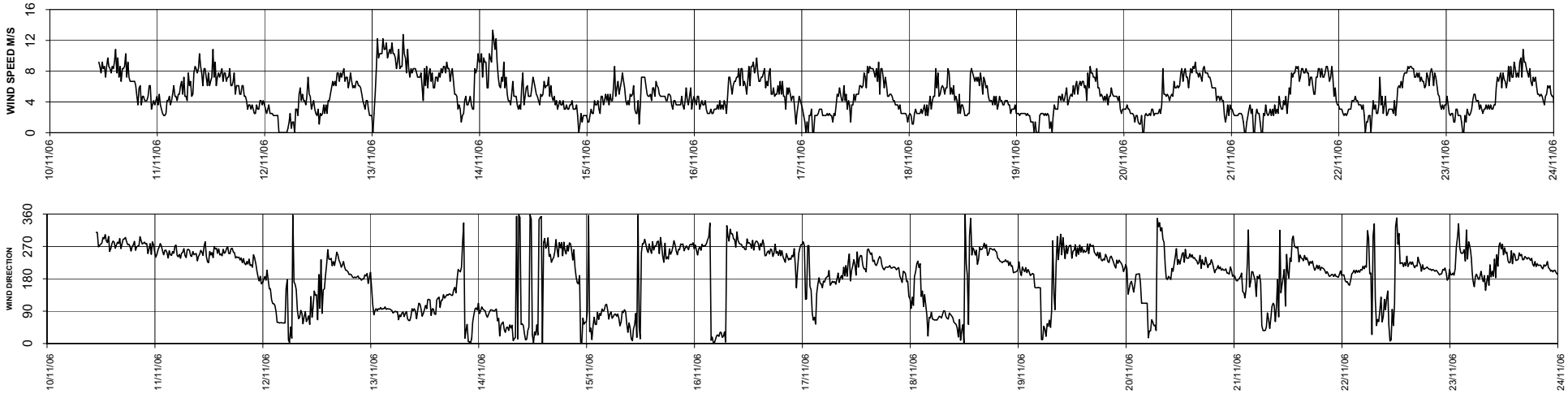
Client: Hanson Construction

SVT-Engineering Consultants

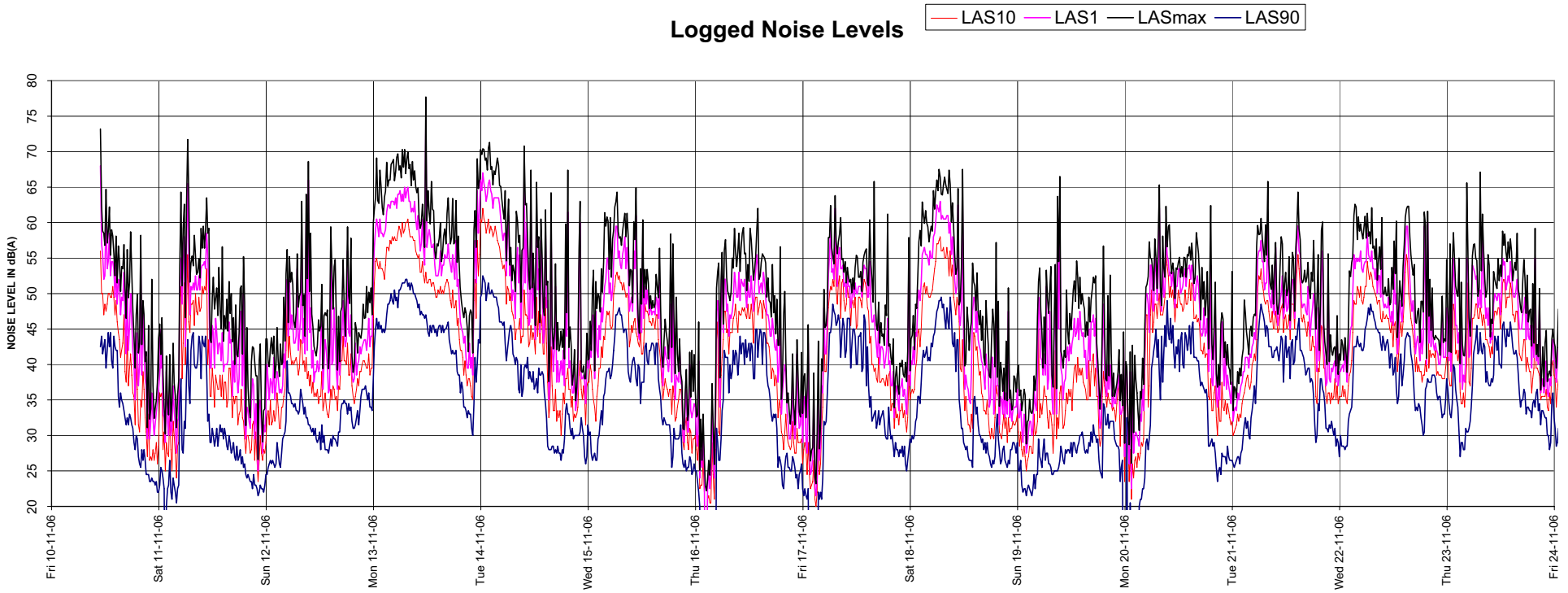
Red Hill Mine Logging

File: L2- Loton Rd 16th to 28th of Mar 07

Wind Speed



Logged Noise Levels



Noise Logging

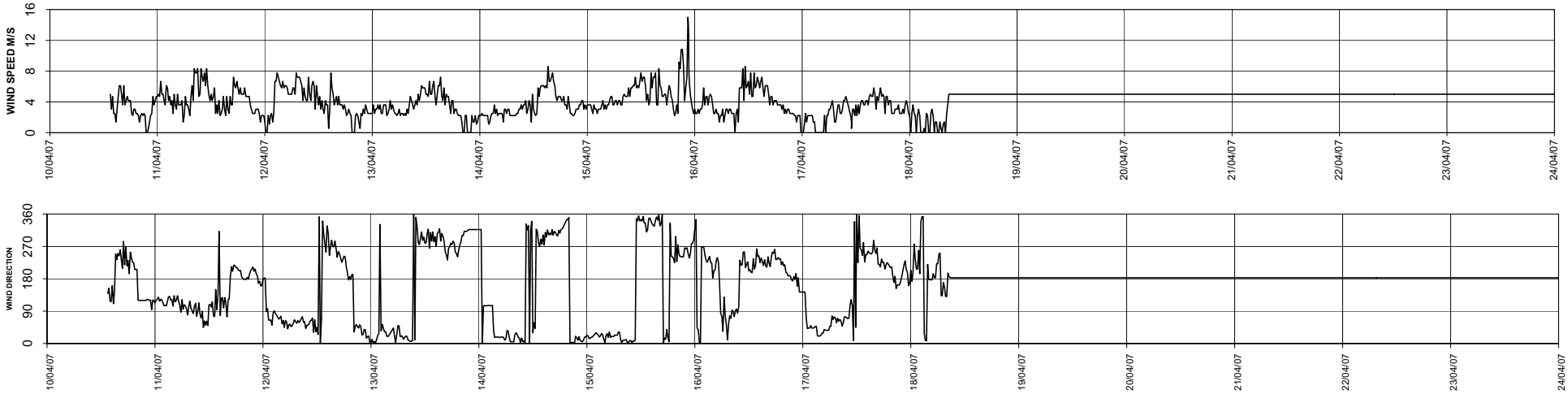
Client: Hanson Construction

SVT-Engineering Consultants

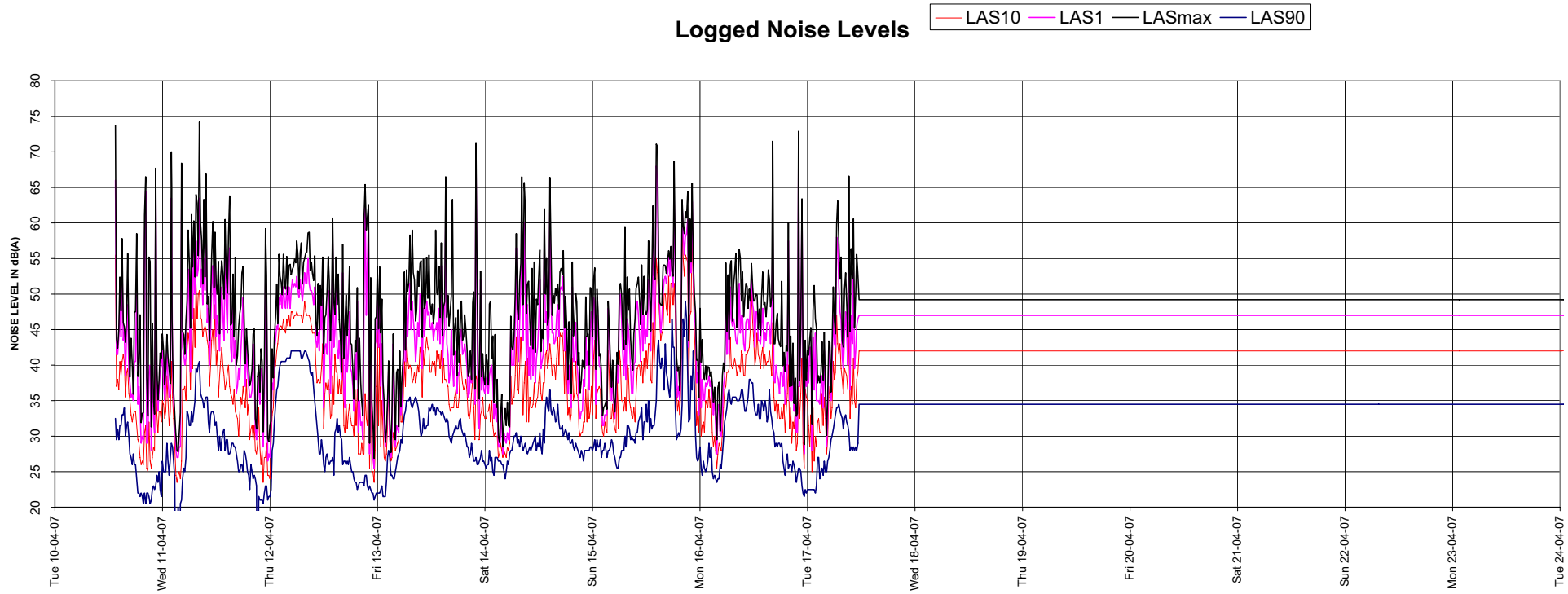
Red Hill Mine Logging

File: L3- NE boundary 10th to 23rd of Nov 06

Wind Speed



Logged Noise Levels



Noise Logging

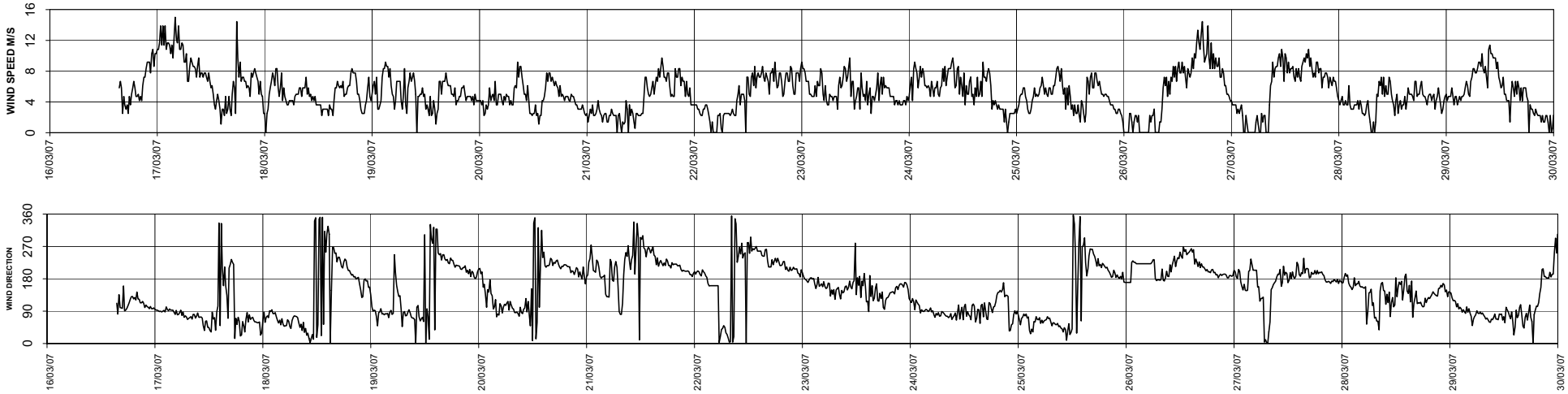
Client: Hanson Construction

SVT-Engineering Consultants

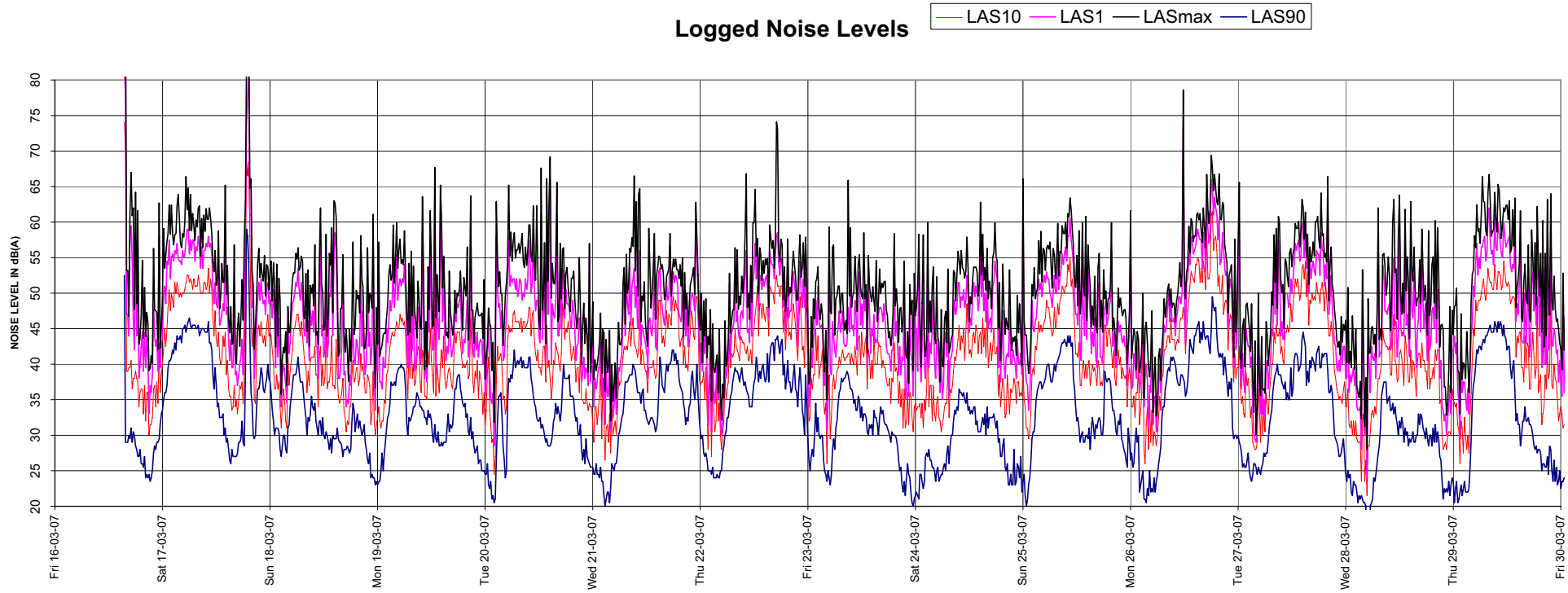
Red Hill Mine Logging

File: L4- Daniel Place 10th to 17th of Apr 07

Wind Speed



Logged Noise Levels



Noise Logging

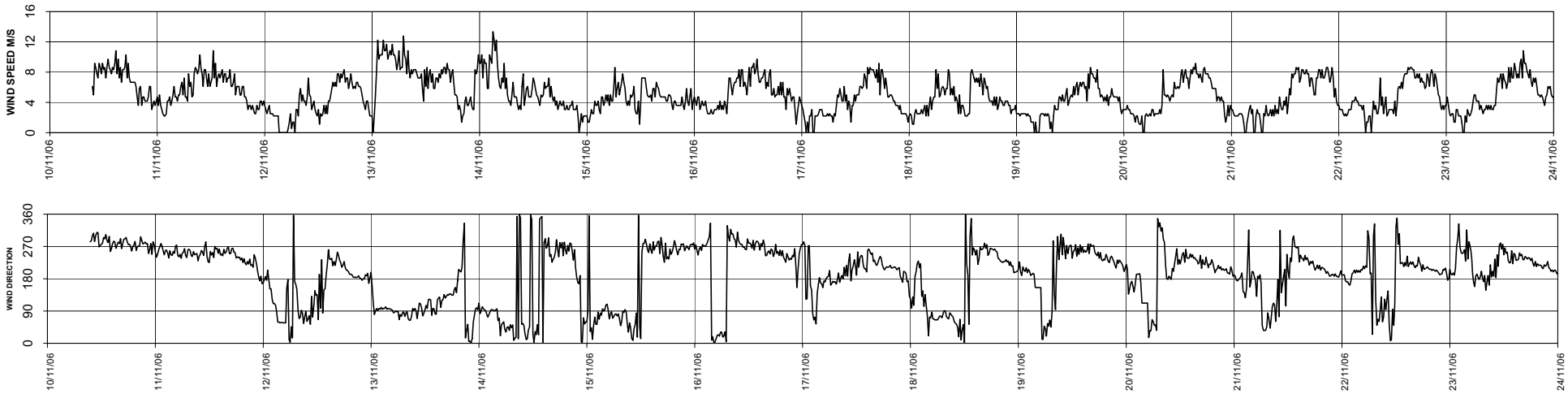
Client: Hanson Construction

SVT-Engineering Consultants

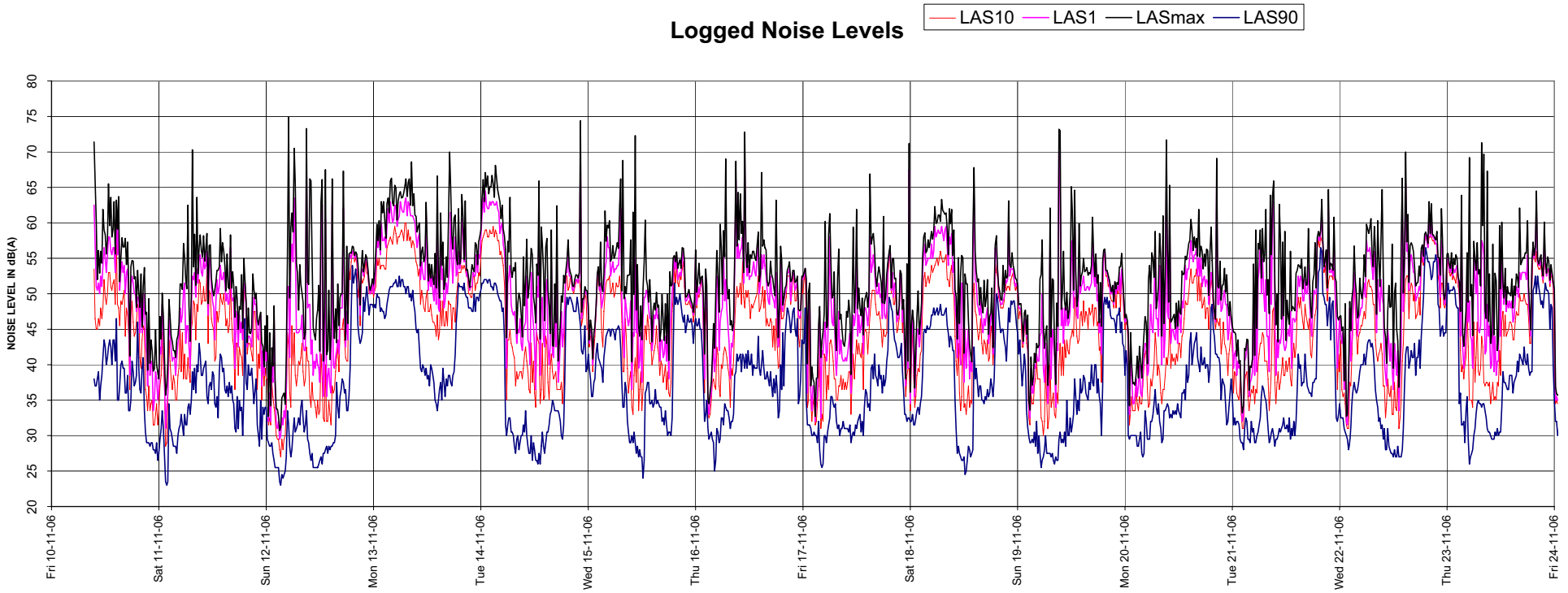
Red Hill Mine Logging

File: L5- Williams Rd 16th to 30th of Mar 07

Wind Speed



Logged Noise Levels



Noise Logging

Client: Hanson Construction

SVT-Engineering Consultants

Red Hill Mine Logging

File: L6 NW boundary 10th to 23rd of Nov 06

APPENDIX C : NOISE CONTOURS

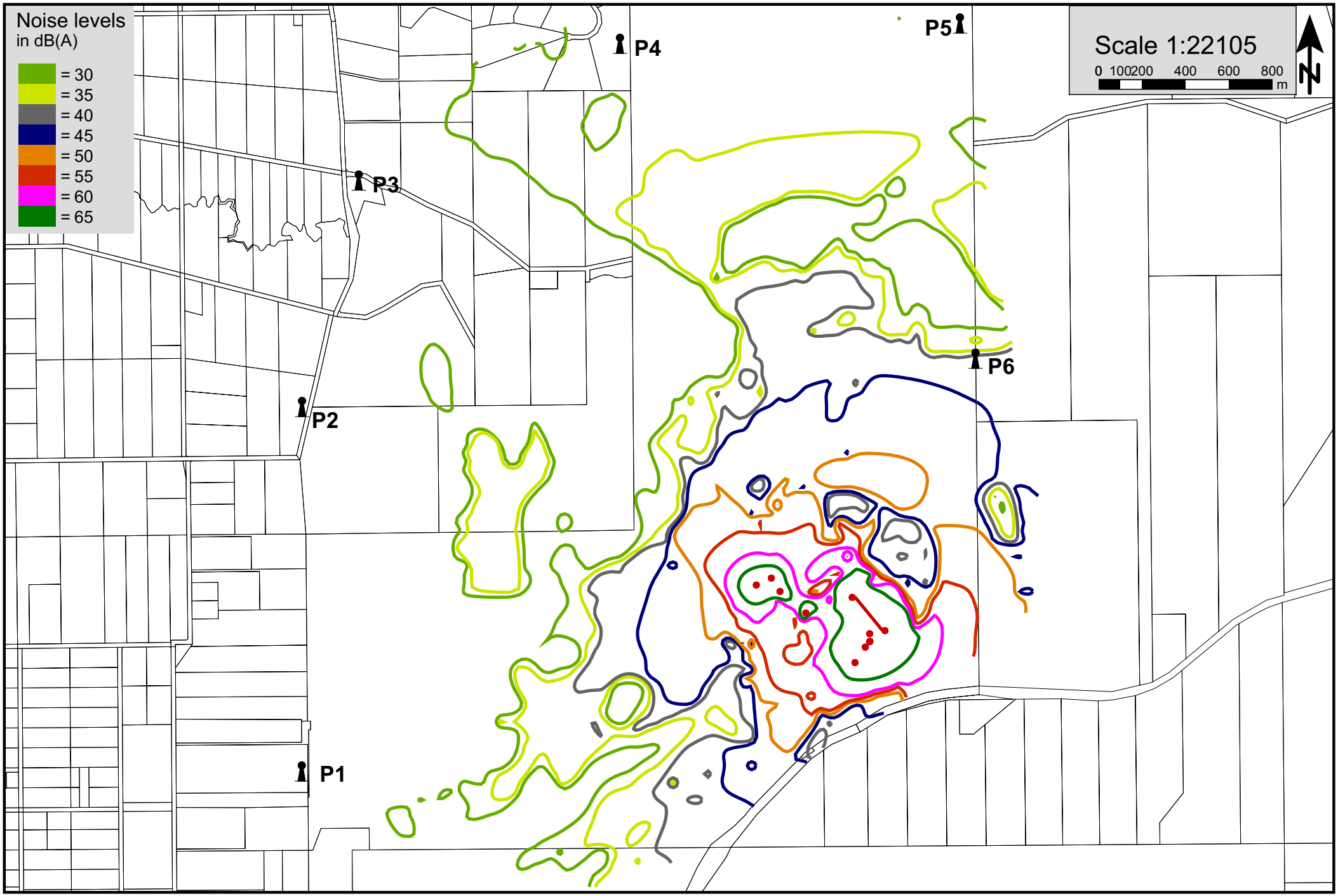


Figure C1. Worst-case day-time noise level contours for the existing operations.

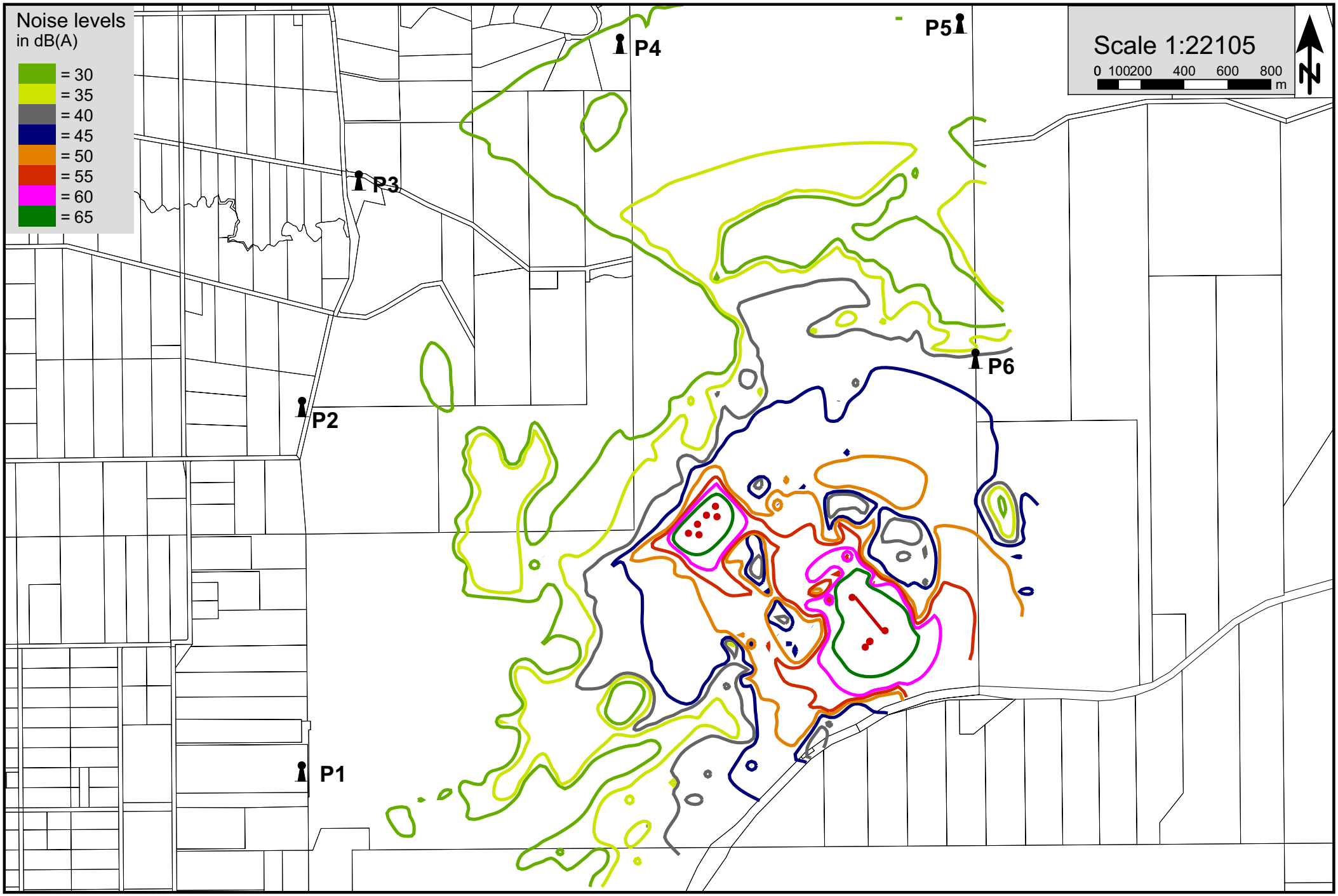


Figure C2. Worst-case day-time noise level contours for the proposed stage 1 quarry development (2007-2012).

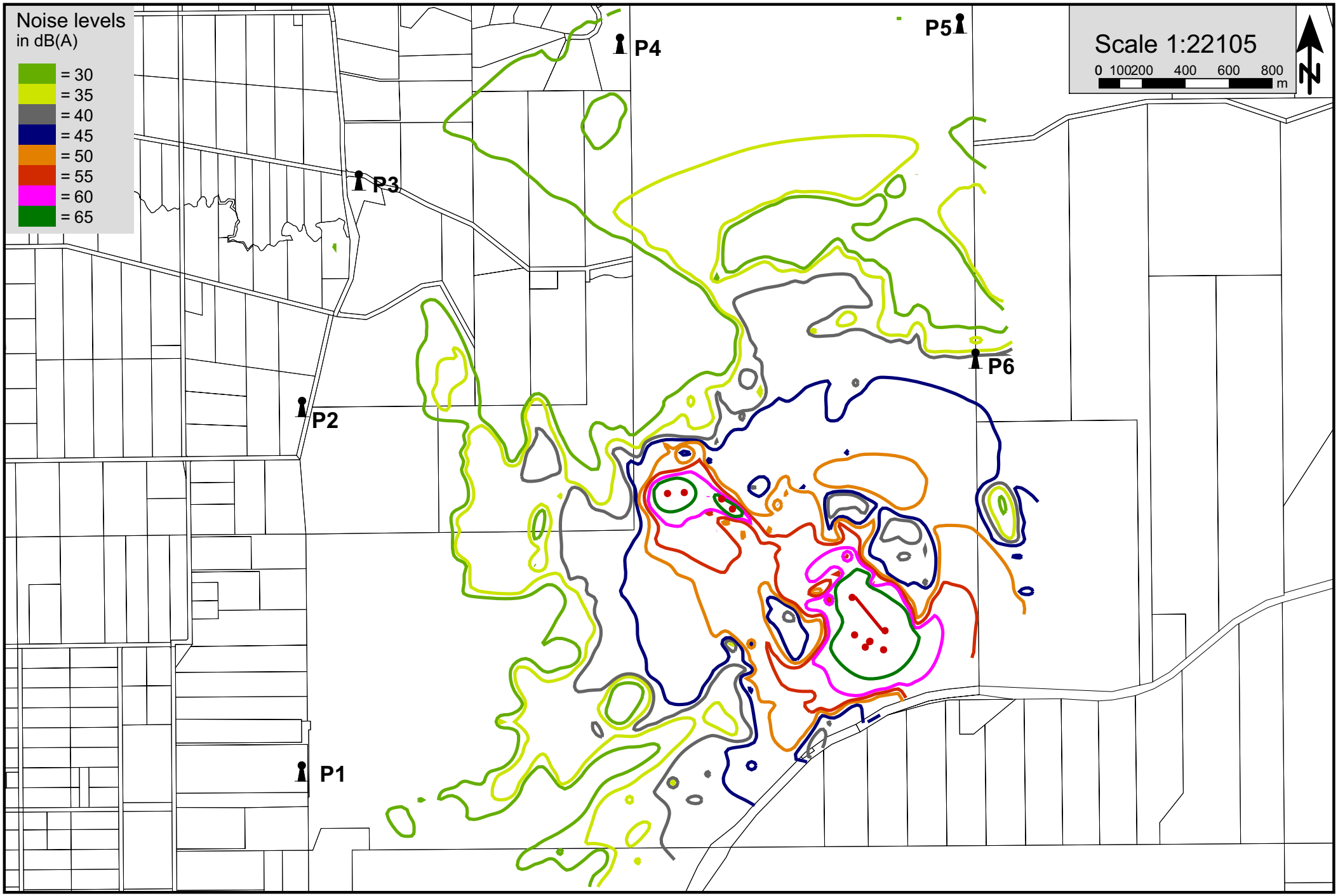


Figure C3. Worst-case day-time noise level contours for the proposed stage 2 quarry development (2012-2017).

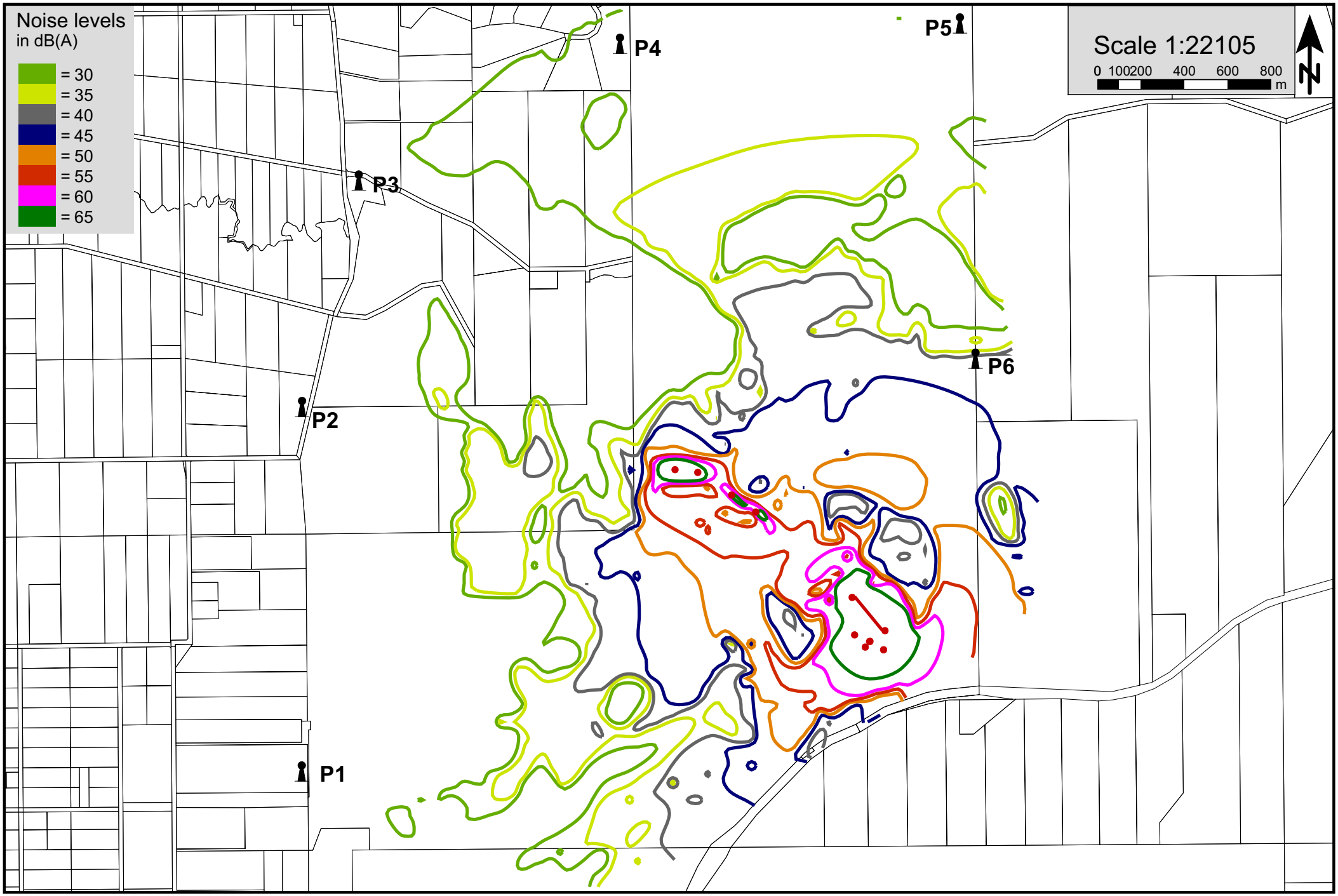


Figure C4. Worst-case day-time noise level contours for the proposed stage 3 quarry development (2017-2028).

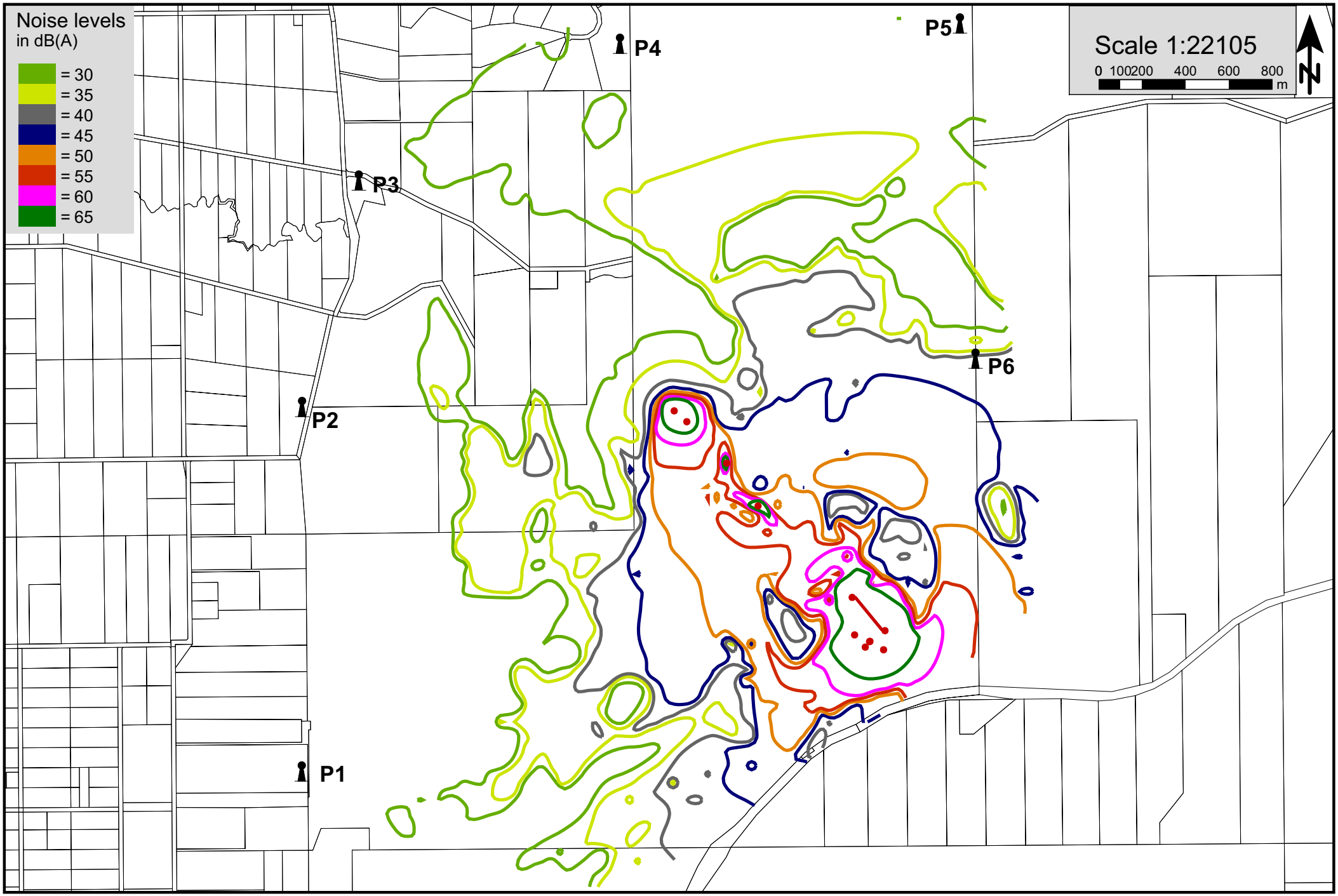


Figure C5. Worst-case day-time noise level contours for the proposed stage 4 quarry development (2028-2032).

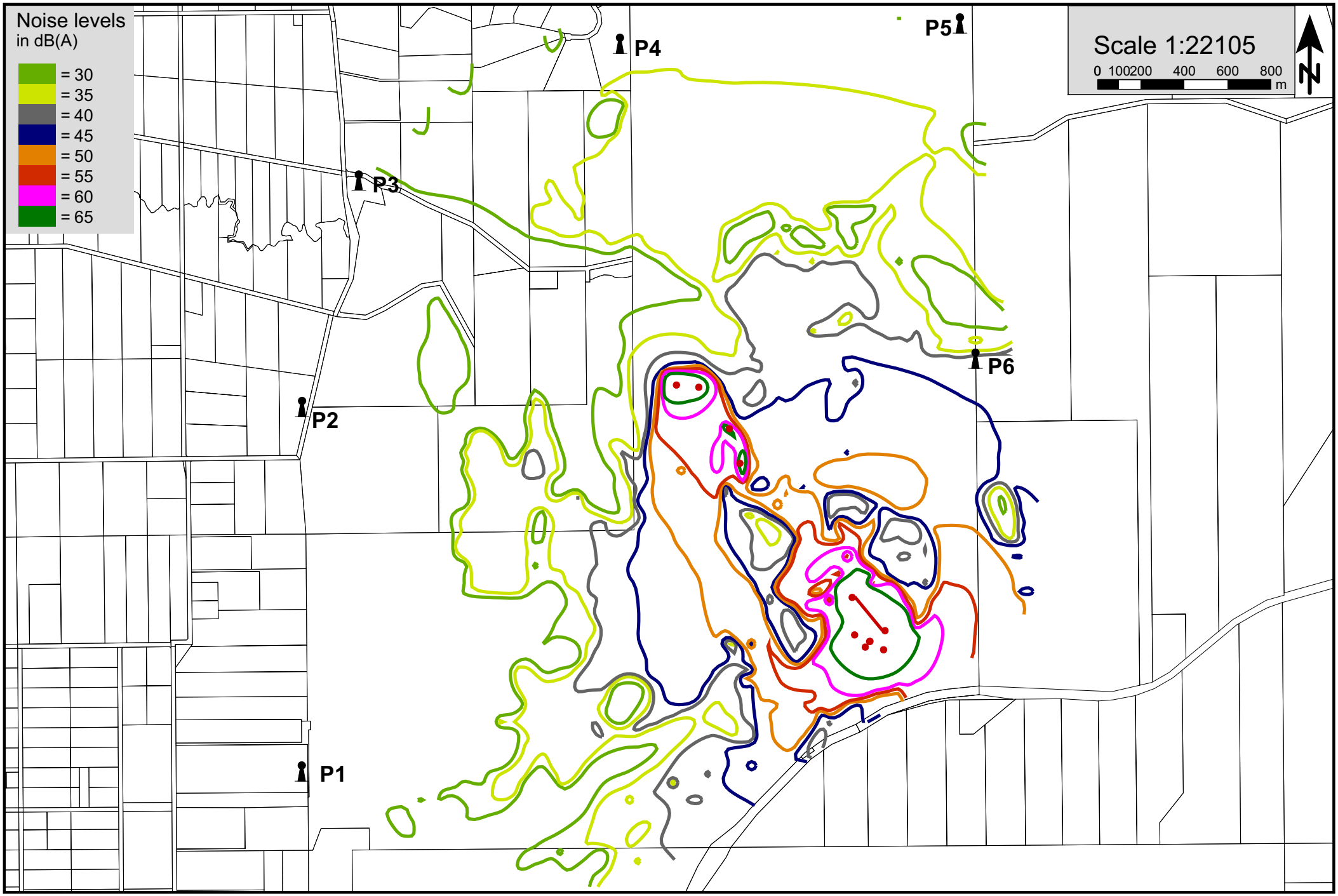


Figure C6. Worst-case day-time noise level contours for the proposed stage 5 quarry development (2032-2038).

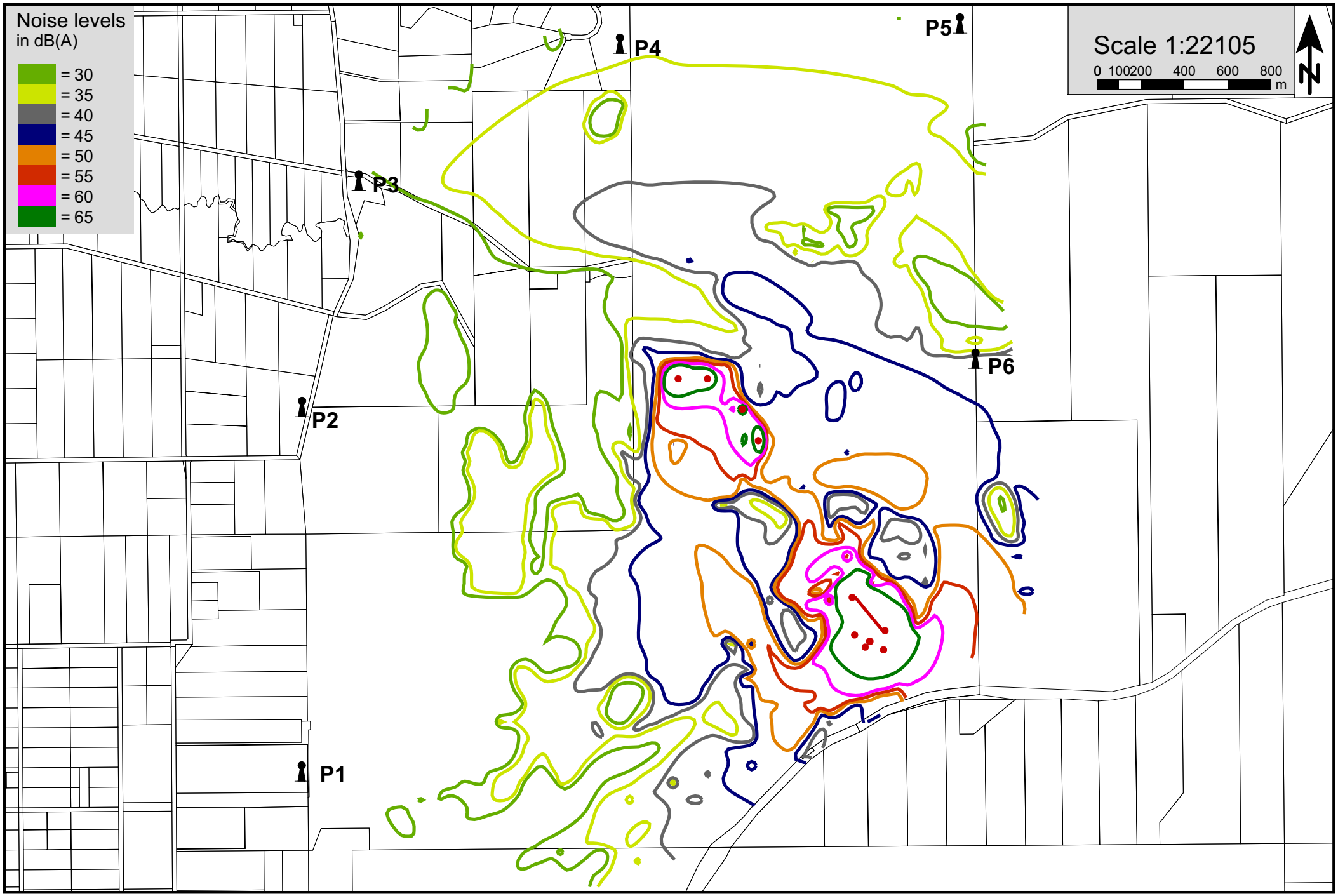


Figure C7. Worst-case day-time noise level contours for the proposed stage 6 quarry development (2038-2044).

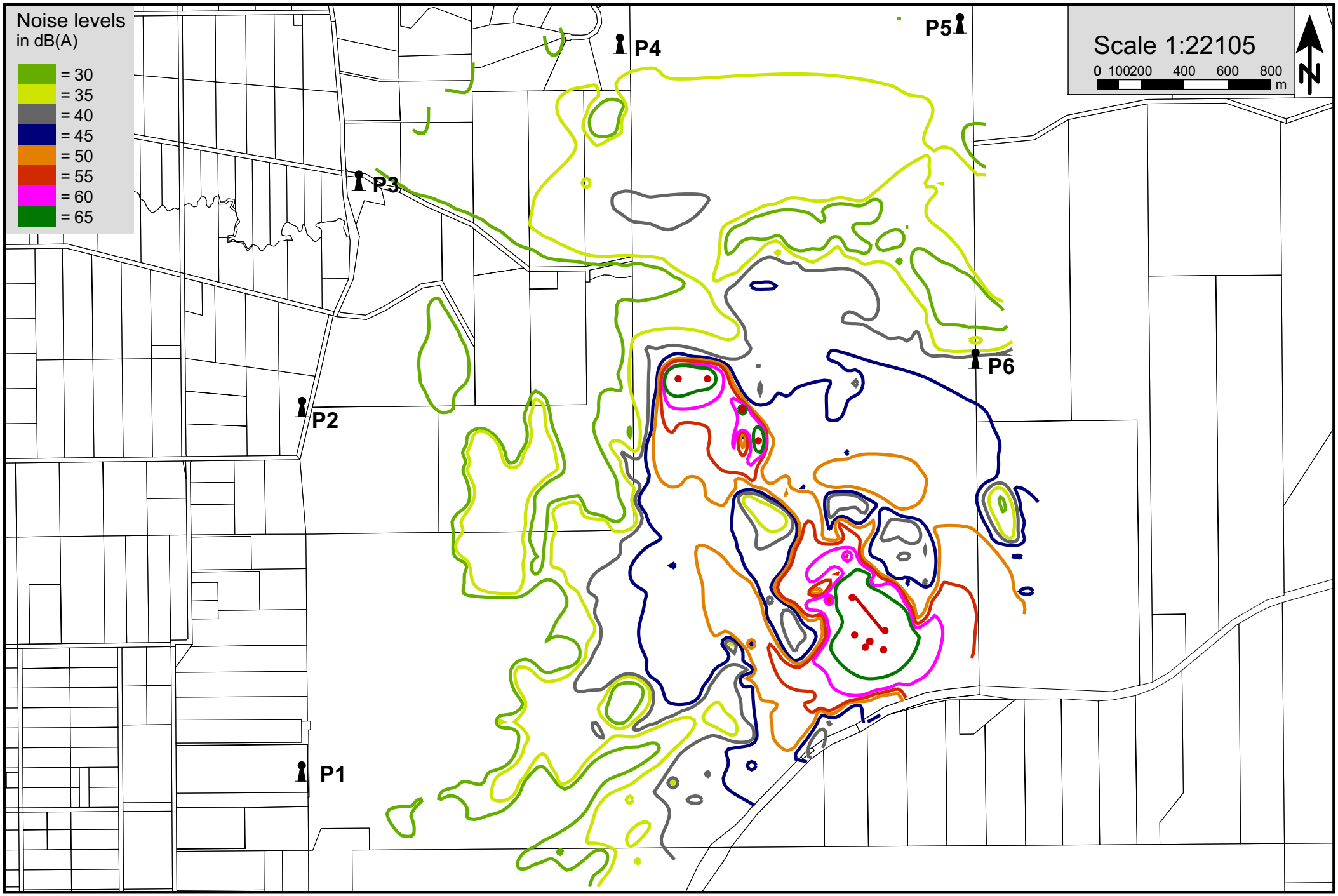


Figure C8. Worst-case day-time noise level contours for the proposed stage 7 quarry development (2044-2049).

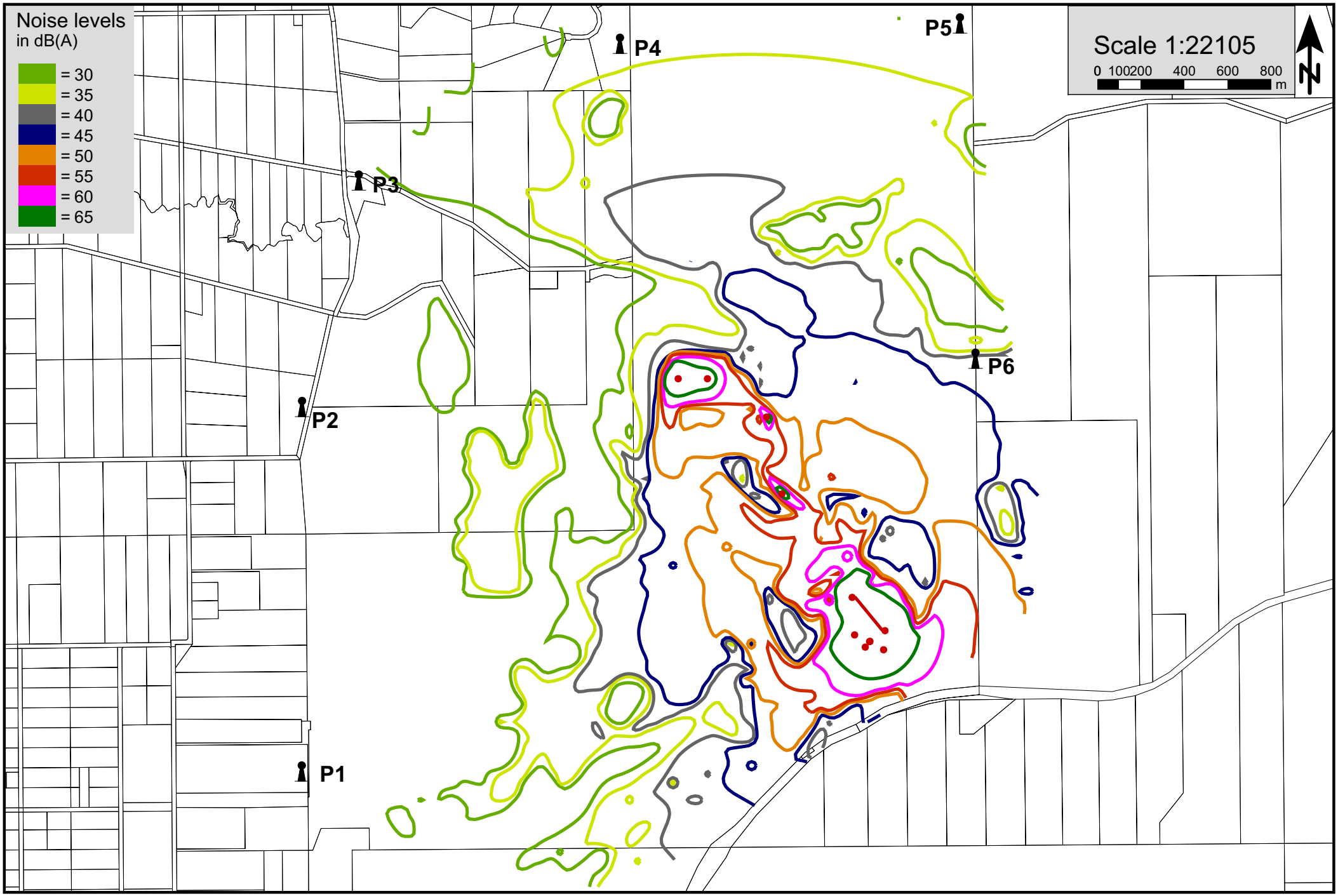


Figure C9. Worst-case day-time noise level contours for the proposed stage 8 quarry development (2049-2055).

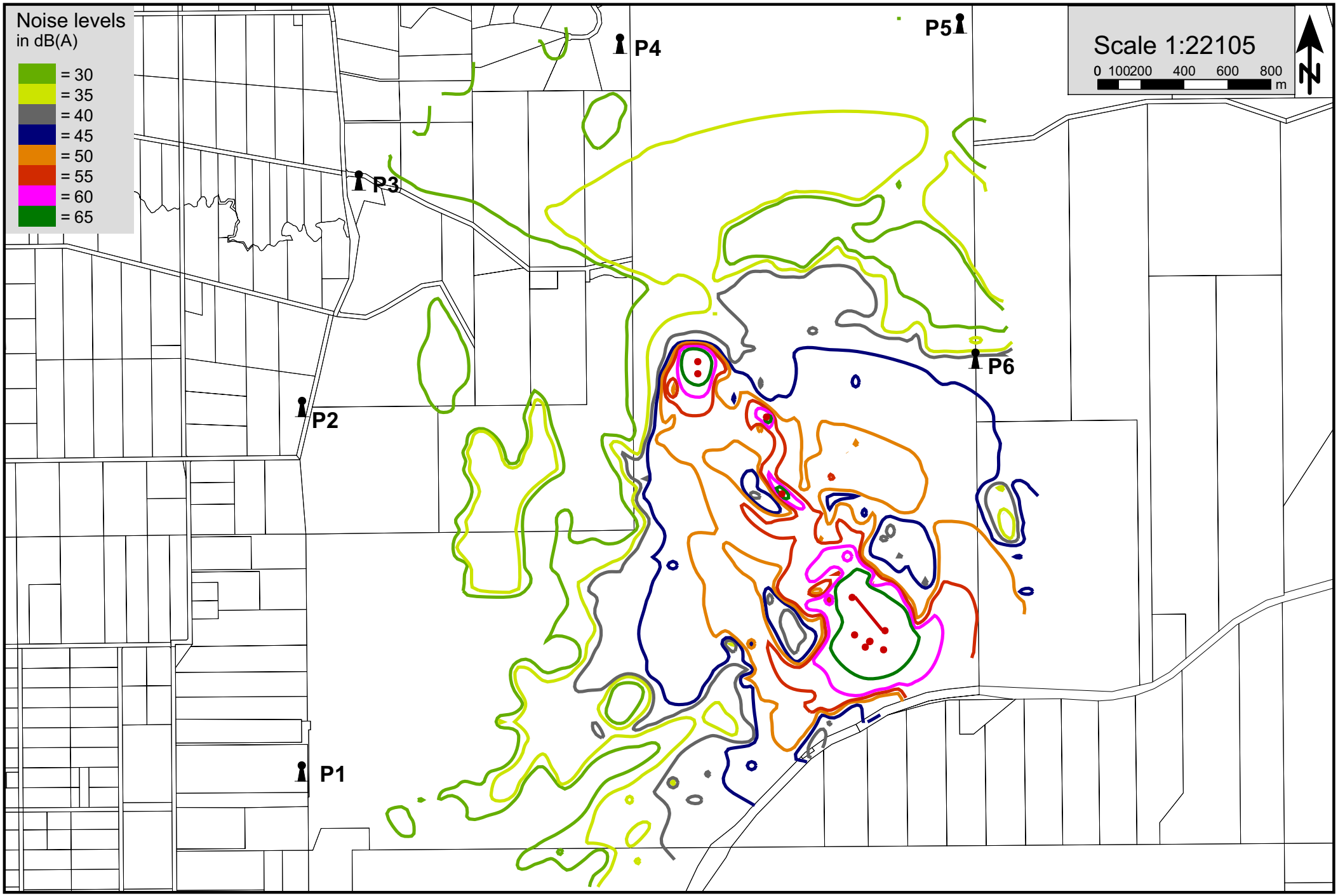


Figure C10. Worst-case day-time noise level contours for the proposed stage 9 quarry development (2055-2061).

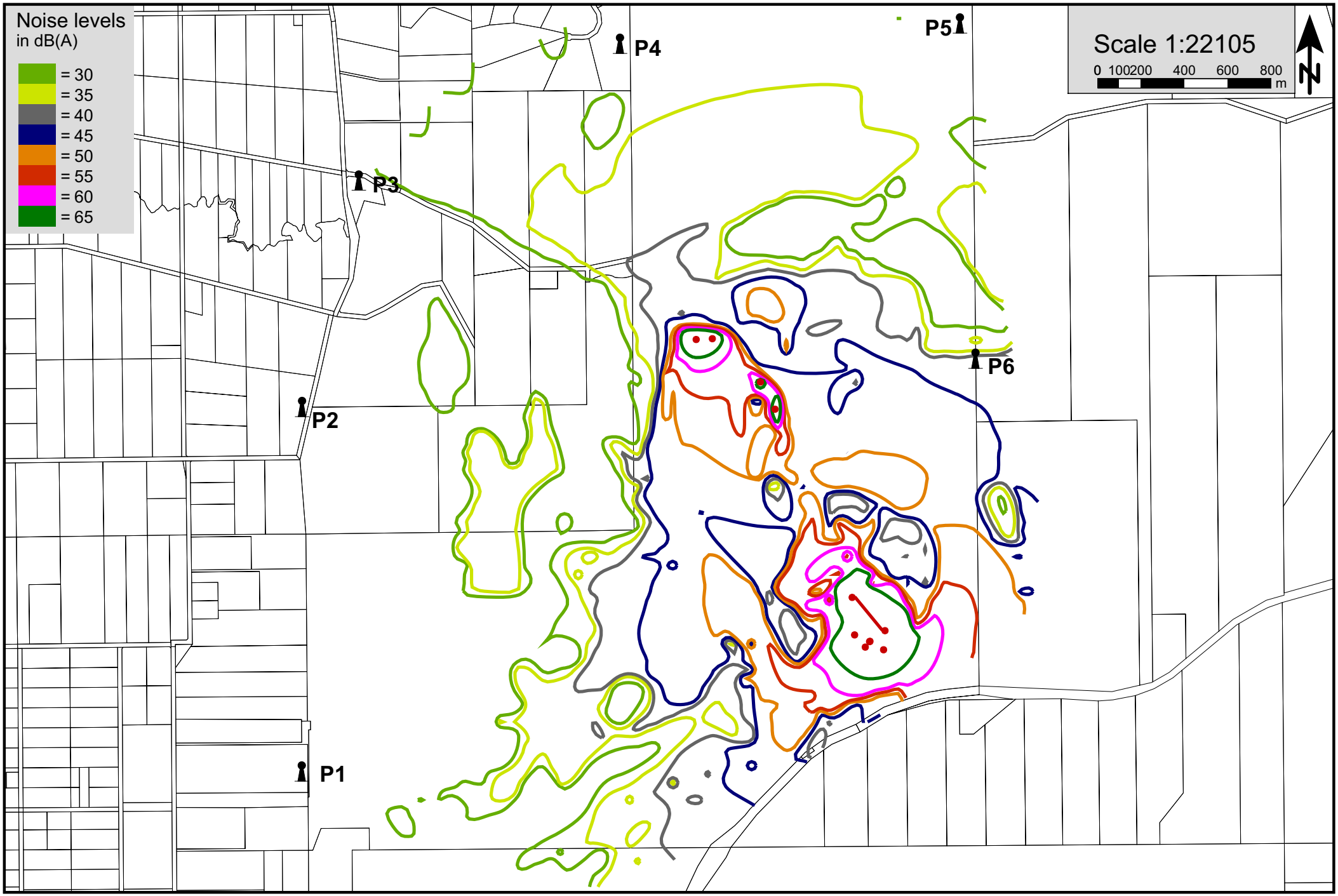


Figure C11. Worst-case day-time noise level contours for the proposed stage 10 quarry development (2061-2079).

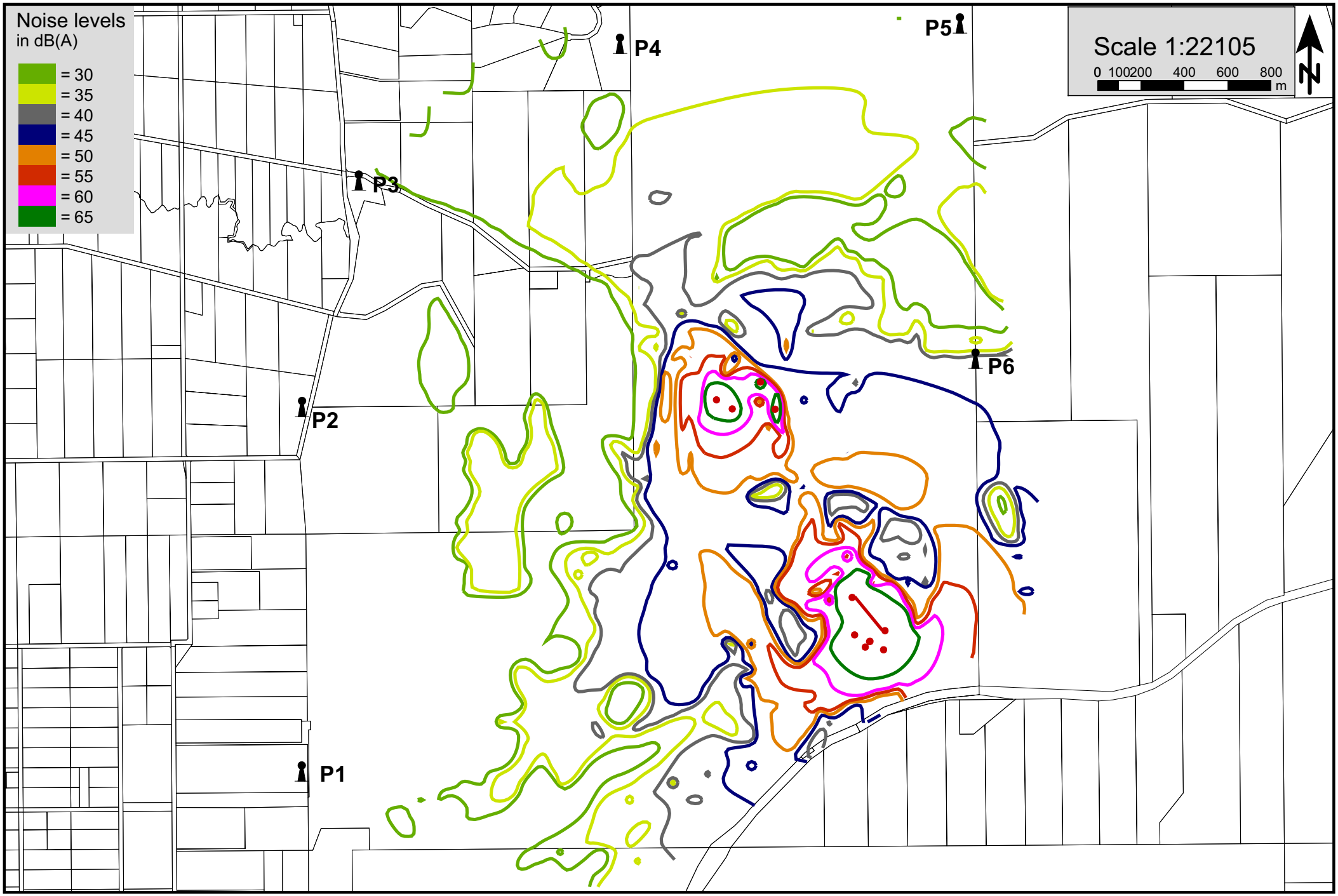


Figure C12. Worst-case day-time noise level contours for the proposed stage 11 quarry development (2061-2079).

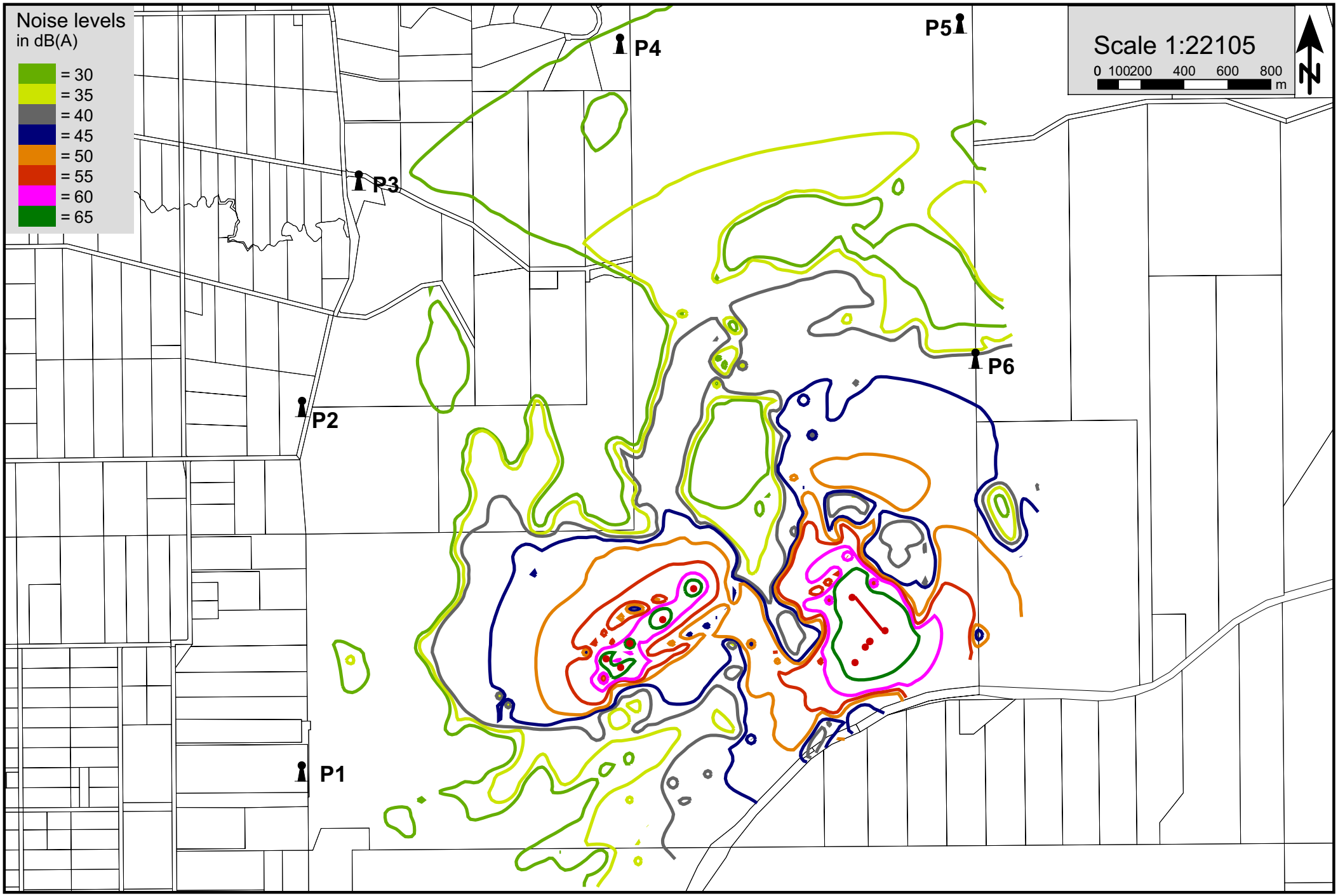


Figure C13. Worst-case day-time noise level contours for the proposed stage 12 quarry development (2079-2103).

APPENDIX D : CONSTRUCTION NOISE MANAGEMENT PLAN OVERVIEW

The following outlines the noise management plan component for construction noise of the proposed development. The elements of the noise management plan for the construction and ongoing operational activities will be prepared as part of an Environmental Management Plan for the overall Red Hill quarry operation.

Environmental Protection Noise Regulations 1997 state that for construction work carried out between 7am and 7pm on any day, which is not a Sunday or public holiday:

- The construction work must be carried out in accordance with control of noise practices set out in Section 6 of Australian Standard 2436-1981 *"Guide to Noise Control on Construction, Maintenance and Demolition Sites"*;
- The equipment used for the construction must be the quietest reasonably available; and
- The Chief Executive Officer (CEO) may request that a noise management plan be submitted for the construction work at any time.

For construction work done outside these hours:

- The construction work must be carried out in accordance with control of noise practices set out in Section 6 of Australian Standard 2436-1981 *"Guide to Noise Control on Construction, Maintenance and Demolition Sites";*
- The equipment used for the construction must be the quietest reasonably available;
- The contractor must advise all nearby occupants or other sensitive receptors who are likely to receive noise levels which fail to comply with the standard under Regulation 7, of the work to be done at least 24 hours before it commences;
- The contractor must show that it was reasonably necessary for the work to be done out of hours; and
- The contractor must submit to the CEO a Noise Management Plan at least seven days before the work starts, and the plan must be approved by the CEO. The plan must include details of:

    1) Need for the work to be done out of hours;
    2) Types of activities which could be noisy;
    3) Predictions of the noise levels;
    4) Control measures for noise and vibration;
    5) Procedures to be adopted for monitoring noise emissions; and
    6) Complaint response procedures to be adopted.