APPENDIX D – Noise Assessment

North Boambee Valley (West) Release Area

Road Traffic Noise Impact Assessment

Report Number 630.10324-R1

8 October 2012

De Groot & Benson Pty Ltd
PO Box 1908
Coffs Harbour
NSW 2450

Version: Revision 0

North Boambee Valley (West) Release Area

Road Traffic Noise Impact Assessment

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1 INTRODUCTION

SLR Consulting Pty Ltd Australia (SLR Consulting) has been commissioned by De Groot & Benson Pty Ltd to conduct a road traffic noise impact assessment for the North Boambee Valley (west) Release Area. The area is located off the Pacific Highway, west of Coffs Harbour, NSW.

The main objectives of this assessment were as follows:

- To determine the impact of road traffic noise from the Pacific Highway, and proposed RTA preferred Pacific Highway Bypass (Coffs Bypass) on the North Boambee Valley (west) Release Area.
- To establish existing and likely future noise contours across the study area.
- To identify and recommend ameliorative measures to mitigate noise impacts over the study area.

This noise impact assessment has been prepared with reference to the following NSW Environment Protection Authority (EPA) policy documents:

- Road Noise Policy (RNP).
- Environmental Noise Control Manual (ENCM).
- Industrial Noise Policy (INP).

In addition, reference has also been made to relevant Australian Standards (AS 2107-2000 and AS 3671-1989), the Coffs Harbour City Council's *Draft Coffs Harbour Development Control Plan 2012,* Coffs Harbour City Council's *Coffs Harbour City Council North Boambee Valley (west) Structure Plan,* RTA's *Coffs Harbour Highway Planning Southern and Northern Sections – Coffs Harbour City Council Preferred Corridor Feasibility Assessment June 2004,* RTA's *Coffs Harbour Bypass Concept Design Report September 2008* and the NSW Department of Planning's *Development Near Rail Corridors and Busy Roads – Interim Guideline.*

1.1 Acoustic Terminology

The following report uses specialist acoustic terminology. An explanation of common terms is provided in **Appendix A**.

2 SITE DETAILS

The study area is located on the north coast of NSW within the Coffs Harbour Local Government Area. It is on the south-western fringe of Coffs Harbour city centre, in an area identified as North Boambee Valley. The North Boambee Valley (West) study area is west of the RTA preferred Pacific Highway bypass route and has a total area of 585 hectares (refer to **Figure 1**). Furthermore, the development overlay is shown in **Figure 2**.

North Boambee Valley runs in an east west direction, and is bordered by a steep escarpment to the north, which forms part of Roberts Hill Reserve. Boambee State Forest and the North Boambee Valley Quarry bound the investigation area to the west and agricultural activities bound the area to the south.

The majority of the area is currently zoned 1A Rural Agriculture and 7A Environmental Protection – Habitat and Catchment under the *Coffs Harbour Local Environmental Plan 2000*. A proportion of land in the northeast corner of the study area is zoned 2A Residential Low Density, 5A Special Uses – Community Purposes and 6C Open Spaces – Private Recreation

The study area has two main arterial roads including North Boambee Road to the north and Englands Road to the south of the study area. Newport's Creek and its tributaries are located throughout the study area with the largest running in an east west direction sited between North Boambee Road and Englands Road.

The study area is characterised by large areas cleared for agricultural production (mainly bananas and grazing land), and a mosaic of remnant and regenerating vegetation predominantly along drainage lines and on steep areas.

Pacific Highway

The Pacific Highway is a four lane dual carriageway that bounds the North Boambee Valley (west) Release Area to the east.

North Boambee Road

The North Boambee Road is a two lane dual lane arterial road that is north of the North Boambee Valley (west) Release Area.

Englands Road

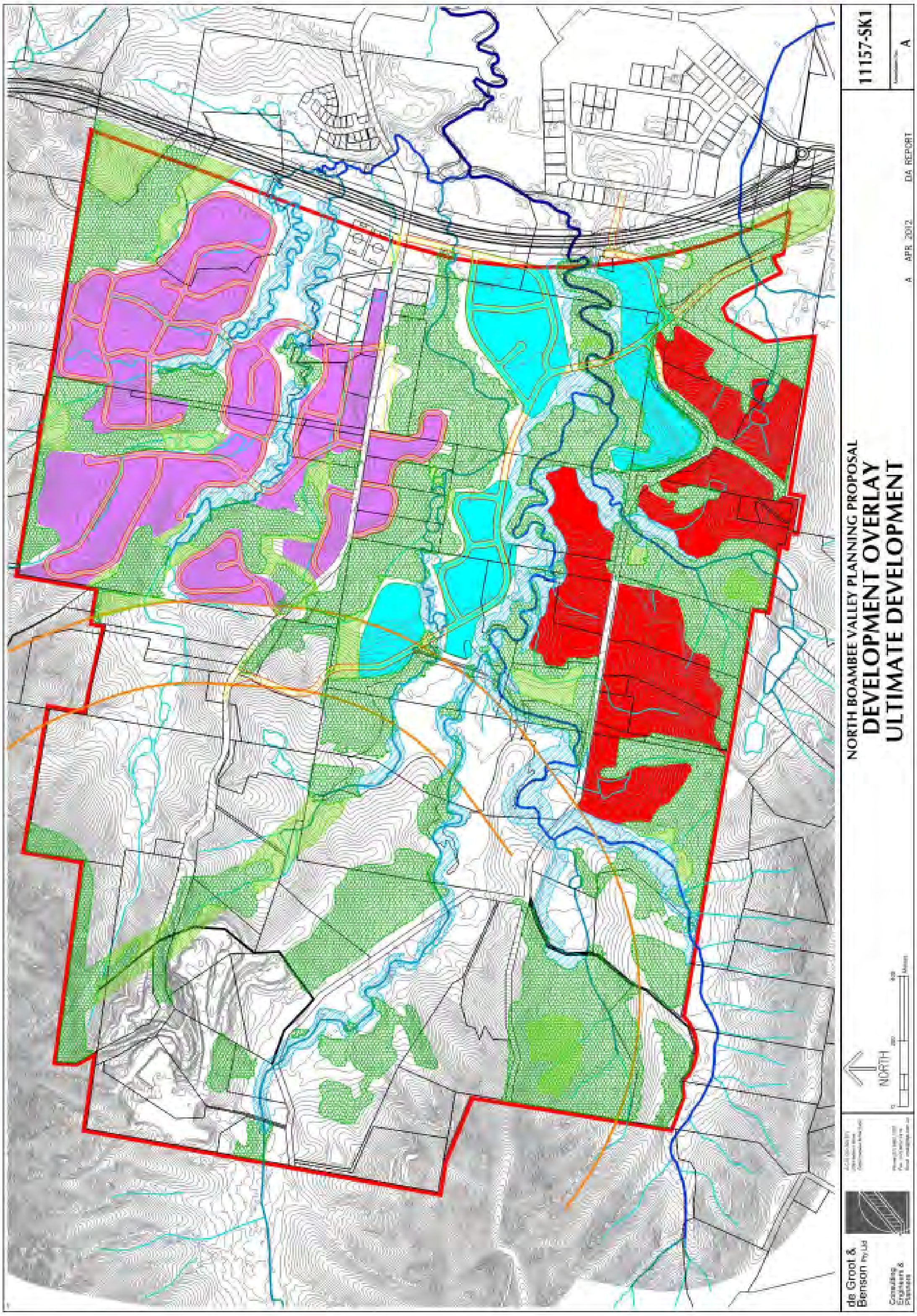
The North Boambee Road is a two lane dual lane arterial road that bounds the North Boambee Valley (west) Release Area to the south.

Proposed Pacific Highway Bypass Corridor (Coffs Bypass)

The RTA has investigated and proposed a new road corridor to replace the existing Pacific Highway bypassing Coffs Harbour to the west. The bypass is proposed as a four lane dual carriageway which will lie west of Coffs Harbour, and run to the north and east of the North Boambee Valley (West) study area. The proposed bypass will reduce Pacific Highway traffic through Coffs Harbour, although the existing highway will still carry significant local traffic.

Figure 1 North Boambee Valley (West) Release Area Site Plan

Figure 2 North Boambee Valley (West) Development Overlay



3 TRAFFIC NOISE IMPACT ASSESSMENT PROCEDURES

3.1 Road Noise Policy

The Road Noise Policy (RNP) presents guidelines for road traffic noise assessment. The policy document provides road traffic noise criteria for proposed road or residential developments as well as criteria for other sensitive land uses.

Table 1 presents the most relevant RNP criteria for residential land uses affected by a freeway, arterial or sub-arterial roads (Pacific Highway and proposed Coffs Bypass) traffic noise. Noise levels provided in **Table 1** are external noise levels and refer only to road traffic noise; they do not include ambient noise from other sources. Furthermore, the RNP provides criteria for non-residential land uses affected by proposed road projects and traffic generating developments and are presented in **Table 2**.

Table 1 Road Traffic Noise Assessment Criteria for Residential Land Uses

Road category	Type of project/land use	Assessment criteria – dB(A)	
		Day (7 a.m.–10 p.m.)	**Night (10 p.m.–7 a.m.)**
Freeway/ arterial/ sub-arterial roads	1. Existing residences affected by noise from new freeway/arterial/sub-arterial road corridors	LAeq, (15 hour) 55 (external)	LAeq, (9 hour) 50 (external)
	2. Existing residences affected by noise from redevelopment of existing freeway/arterial/sub-arterial Roads 3. Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	LAeq, (15 hour) 60 (external)	LAeq, (9 hour) 55 (external)
Local roads	4. Existing residences affected by noise from new local road corridors 5. Existing residences affected by noise from redevelopment of existing local roads 6. Existing residences affected by additional traffic on existing local roads generated by land use developments	LAeq, (1 hour) 55 (external)	LAeq, (1 hour) 50 (external)

Note: Land use developers must meet internal noise goals in the Infrastructure SEPP (Department of Planning NSW 2007) for sensitive developments near busy roads (see **Appendix C10** of the RNP for details).

Table 2 Road Traffic Noise Assessment Criteria for Non-residential Land Uses Affected by Proposed Road Projects and Traffic Generating Developments

Existing sensitive land Use	Assessment criteria – dB(A) Day (7 a.m.–10 p.m.)	Night (10 p.m.–7 a.m.)	Additional considerations
1. School classrooms	LAeq, (1 hour) 40 (internal) when in use	-	In the case of buildings used for education or health care, noise level criteria for spaces other than classrooms and wards may be obtained by interpolation from the 'maximum' levels shown in Australian Standard 2107:2000 (Standards Australia 2000).
2. Hospital wards	LAeq, (1 hour) 35 (internal)	LAeq, (1 hour) 35 (internal)	
3. Places of worship	LAeq, (1 hour) 40 (internal)	LAeq, (1 hour) 40 (internal)	The criteria are internal, i.e. the inside of a church. Areas outside the place of worship, such as a churchyard or cemetery, may also be a place of worship. Therefore, in determining appropriate criteria for such external areas, it should be established what in these areas may be affected by road traffic noise. For example, if there is a church car park between a church and the road, compliance with the internal criteria inside the church may be sufficient. If, however, there are areas between the church and the road where outdoor services may take place such as weddings and funerals, external criteria for these areas are appropriate. As issues such as speech intelligibility may be a consideration in these cases, the passive recreation criteria (see point 5) may be applied.
4. Open space (active use)	LAeq, (15 hour) 60 (external) when in use	-	Active recreation is characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion. Passive recreation is characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, e.g. playing chess, reading. In determining whether areas are used for active or passive recreation, the type of activity that occurs in that area and its sensitivity to noise intrusion should be established. For areas where there may be a mix of passive and active recreation, e.g. school playgrounds, the more stringent criteria apply. Open space may also be used as a buffer zone for more sensitive land uses.
5. Open space (passive use)	LAeq, (15 hour) 55 (external) when in use	-	

Existing sensitive land Use	Assessment criteria – dB(A)		Additional considerations
	Day (7 a.m.–10 p.m.)	**Night (10 p.m.–7 a.m.)**	
6. Isolated residences in commercial or industrial zones	-	-	For isolated residences in industrial or commercial zones, the external ambient noise levels can be higher than those in residential areas. Internal noise levels in such residences are likely to be more appropriate in assessing any road traffic noise impacts, and the proponent should determine suitable internal noise level targets, taking guidance from Australian Standard 2107:2000 (Standards Australia 2000).
7. Mixed use development	-	-	Each component of use in a mixed use development should be considered separately. For example, in a mixed use development containing residences and a childcare facility, the residential component should be assessed against the appropriate criteria for residences in **Table 2**, and the childcare component should be assessed against point 8 below.
8. Childcare facilities	Sleeping rooms LAeq, (1 hour) 35 (internal) Indoor play areas LAeq, (1 hour) 40 (internal) Outdoor play areas LAeq, (1 hour) 55 (external)	-	Multi-purpose spaces, e.g. shared indoor play/sleeping rooms should meet the lower of the respective criteria. Measurements for sleeping rooms should be taken during designated sleeping times for the facility, or if these are not known, during the highest hourly traffic noise level during the opening hours of the facility.
9. Aged care facilities	-	-	Residential land use noise assessment criteria should be applied to these facilities (see **Table 2**).

Note: Land use developers must meet internal noise goals in the Infrastructure SEPP (Department of Planning NSW 2007) for sensitive developments near busy roads. See **Appendix C10** of the RNP for details.

3.2 Development Near Rail Corridors and Busy Roads – Interim Guideline

The NSW Government *Development Near Rail Corridors and Busy Roads – Interim Guideline* provides internal noise guidelines for residential receivers located in the vicinity of a rail corridor or busy roads (as defined in clauses 87 and 102 of the State Environmental Planning Policy (Infrastructure) 2007 (SEPP)). It is recommended that the following L_{Aeq} levels are not exceeded:

Table 3 Development Near Rail Corridors and Busy Roads – Interim Guideline Noise Criteria

Residential Buildings		
Type of Occupancy	**Noise Level dBA**	**Applicable time period**
Sleeping areas (bedroom)	35	Night 10pm to 7am
Other habitable rooms (excl. garages, kitchens, bathrooms and hallways)	40	At any time
Non-Residential Buildings		
Type of Occupancy		**Recommended Max Level dBA**
Educational Institutions including child care centres		40
Places of Worship		40
Hospitals	Wards	35
	Other noise sensitive areas	35

Note: Airborne noise is calculated as Leq (9hour) (night) and Leq (15hour)(Day). Groundborne noise is calculated as Lmax (slow) for 95% of rail pass-by events.

The policy applies to (and is mandatory for) developments located near major roadways where the annual average daily traffic (AADT) volume exceeds 40,000 vehicles and the relevant consent authority considers that the roadway is likely to cause adverse noise impacts.

Although the major roads in the vicinity of this location do not experience 40,000 vehicles per day, these criteria have been utilised for the purpose of assessing potential road traffic noise impacts as they are consistent with other relevant Australian Standards, namely AS2107.

3.3 State Environmental Planning Policy (SEPP)

The NSW State Environmental Planning Policy (Infrastructure) 2007 - REG 102 provides guidelines with regard to impact of road noise or vibration on non-road development and are as follows:

102 Impact of road noise or vibration on non-road development

1 *This clause applies to development for any of the following purposes that is on land in or adjacent to the road corridor for a freeway, a tollway or a transitway or any other road with an annual average daily traffic volume of more than 40,000 vehicles (based on the traffic volume data published on the website of the RTA) and that the consent authority considers is likely to be adversely affected by road noise or vibration:*

- *a building for residential use,*
- *a place of public worship,*
- *a hospital,*
- *an educational establishment or child care centre.*

2 *Before determining a development application for development to which this clause applies, the consent authority must take into consideration any guidelines that are issued by the Director-General for the purposes of this clause and published in the Gazette.*

3 *If the development is for the purposes of a building for residential use, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded:*

- in any bedroom in the building 35 dB(A) at any time between 10 pm and 7 am,
- *anywhere else in the building (other than a garage, kitchen, bathroom or hallway) 40 dB(A) at any time.*

4 In this clause, "freeway", "tollway" and "transitway" have the same meanings as they have in the *Roads Act 1993.*

In other circumstances (eg. Development adjact to a road with an annual average daily traffic volume of 20,000 – 40,000 vehicles) these guidelines provide best practice advice.

3.4 Australian Standards

3.4.1 AS 2107-2000 “Acoustics - Recommended design sound levels and reverberation times for building interiors

Australian Standard AS 2107-2000 *“Acoustics - Recommended design sound levels and reverberation times for building interiors”* recommends suitable internal noise levels for residential habitation and other buildings. The buildings should be constructed to achieve an internal noise level equal to or lower than the levels outlined in **Table 4**. How this is achieved will depend strongly on the location, orientation and type of construction of each building.

Care should be taken in applying the “Satisfactory Design Levels” set out in **Table 4**. Some of these levels are relatively low and, while providing a suitable target for a prestige “up market” development with above-the-norm quality, achievement of these levels might be too onerous for a building of general, but still good, quality standard. The “Maximum Design Levels” are more indicative of the standards applicable for the latter type of development.

Table 4 Recommended Design Sound levels For Different Areas of Occupancy in Buildings

Type of Occupancy/Activity	Recommended design sound level, L_{Aeq} (dBA)	
	Satisfactory	**Maximum**
EDUCATIONAL BUILDINGS		
Teaching spaces-primary schools	35 dBA	45 dBA
HEALTH BUILDINGS		
Consulting rooms	40 dBA	45 dBA
Dental clinics	40 dBA	45 dBA
Pharmacies	45 dBA	50 dBA
INDUSTRIAL BUILDINGS		
Assembly Lines	55 dBA	70 dBA
Control Rooms	50 dBA	60 dBA
Laboratories or test areas	40 dBA	50 dBA
OFFICE BUILDINGS		
General office areas	40 dBA	45 dBA
Private offices	35 dBA	40 dBA
Reception areas	40 dBA	45 dBA
PUBLIC BUILDINGS		
Places of Worship (with a speech amplification system)	35 dBA	40 dBA
Parking stations (carpark areas)	55 dBA	65 dBA
Post offices and general banking areas	45 dBA	50 dBA
Cafeterias and food courts	45 dBA	55 dBA
RESIDENTIAL BUILDINGS		
Houses and Apartments near Major Roads*		
Living Areas	35 dBA	45 dBA
Sleeping Areas	30 dBA	40 dBA
Work Areas	35 dBA	45 dBA
Common Areas	45 dBA	55 dBA
Hotels and Motels		
Foyers and recreation areas	45 dBA	50 dBA
Sleeping areas - near major roads	35 dBA	40 dBA
SHOP BUILDINGS		
Small retail stores (general)	45 dBA	50 dBA
Shopping malls	45 dBA	55 dBA

*These are also suitable criteria for retirement homes/villages.

3.4.2 AS 3671-1989 "Acoustics - Road traffic noise intrusion - Building siting and construction

Australian Standard AS 3671-1989 *"Acoustics - Road traffic noise intrusion - Building siting and construction"* is concerned with the reduction of road traffic noise intrusion in buildings in areas near major roads. This standard provides guidelines for determining the type of building construction necessary to achieve acceptable internal noise levels. **Table 5** summarises the recommended building construction categories outlined in AS 3671-1989.

Table 5 Definition of Construction Categories

Category Type	Definition	Approximate Traffic Noise Reduction
Category 1	Standard construction; openings, including open windows and doors may comprise up to 10% of the exposed facade.	Up to 10 dBA
Category 2	Standard construction, except for light-weight elements such as fibrous cement or metal cladding or all-glass facades. Windows, doors and other openings must be closed.	> 10 dBA ≤ 25 dBA
Category 3	Special construction. Windows, doors and other openings must be closed.	> 25 dBA ≤ 35 dBA
Category 4	Specialist acoustic advice should be sought.	> 35 dBA

4 PROJECT SPECIFIC NOISE CRITERIA

4.1 External Noise Level Criteria

The RNP criteria for residential land uses affected by a freeway, arterial or sub-arterial roads (Pacific Highway and proposed Coffs Bypass) traffic noise have been adopted for the purpose of this assessment and are presented in **Table 1**.

Table 6 Road Traffic Noise Assessment Criteria for Residential Land Uses

Road category	Type of project/land use	Assessment criteria – dB(A)	
		Day (7 a.m.–10 p.m.)	Night (10 p.m.–7 a.m.)
Freeway/ arterial/ sub-arterial roads	1. Existing residences affected by noise from new freeway/arterial/sub-arterial road corridors	LAeq, (15 hour) 55 (external)	LAeq, (9 hour) 50 (external)

Note: Land use developers must meet internal noise goals in the Infrastructure SEPP (Department of Planning NSW 2007) for sensitive developments near busy roads (see **Appendix C10** of the RNP for details).

It is relevant to note that the project specific external road traffic noise level criteria presented in **Table 6** are for existing residences. However, we have used these external noise level criteria as a guideline for future and proposed residences contained within the project site.

Furthermore, the criteria for non-residential land uses affected by proposed road projects and traffic generating developments are to meet the noise level criteria presented in **Table 2**.

4.2 Internal Noise Level Criteria

The criteria supplied in the *Development Near Rail Corridors and Busy Roads – Interim Guideline* have been adopted for the purposes of this noise assessment. The noise criteria for residential buildings for both road and rail are consistent with the relevant Australian Standards. The relevant internal noise criteria for the subject development used for the purpose of this assessment are provided in **Table 7**. Furthermore, refer to **Table 4** for internal noise levels for other building types other than residential.

Table 7 Internal Noise Criteria

Residential Buildings		
Type of Occupancy	**Noise Level (dBA)**	**Applicable time period**
Sleeping areas (bedroom)	35	Night 10 pm – 7 am
Other habitable rooms (excl. garages, kitchens, bathrooms and hallways)	40	At any time

Note: Airborne noise is calculated as LAeq(9hour)(night) and LAeq(15hour)(day).

5 EXISTING ACOUSTICAL AND METEOROLOGICAL ENVIRONMENT

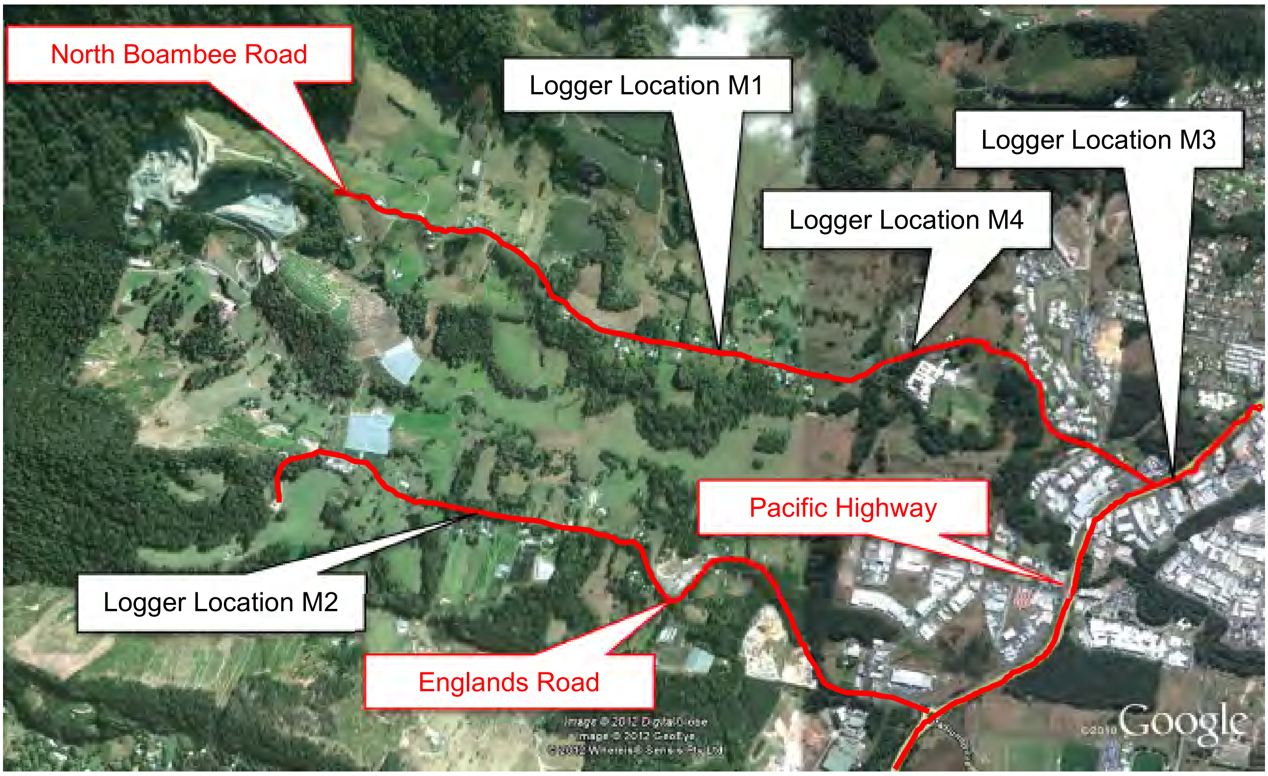
5.1 Methodology

A site inspection was conducted on Thursday 7 June 2012 to gain an appreciation of the study area and to commence the noise monitoring program. Both short-term operator attended noise surveys and long-term unattended noise monitoring was conducted. Three (3) type EL-316 environmental noise loggers were positioned at the subject site to record ambient and traffic noise levels over a period of nine (9) days from Thursday 7 June 2012 and concluded on Friday 15 June 2012. Operator attended noise surveys were conducted during logger deployment and retrieval for a period of 15 minutes at each noise logger location.

All instrumentation used during noise measurements comply with the requirements of AS IEC 61672.1-2004 Electroacoustics – Sound Level meters - Specifications and carry current NATA or manufacturer calibration certificates.

Figure 3 provides a plan showing noise logger locations.

Figure 3 Noise Monitoring Locations



Source: Google Earth

5.2 Unattended Continuous Noise Monitoring

5.2.1 Traffic Noise Monitoring

Noise loggers at location M1, M2 and M3 were installed to determine existing ambient road traffic noise levels surrounding the proposed development (see **Figure 3**).

The noise loggers were set to record statistical indices over 15-minute intervals including L_{Amax}, L_{A1}, L_{A10}, L_{A90} and L_{Aeq} noise levels.

Monitoring commenced on Thursday 7 June 2012 and concluded on Friday 15 June 2012. Measurements were conducted using two (2) ARL Type EL316 and one (1) SVAN 957 environmental noise logger.

Weather data for the survey period was obtained from the nearest Bureau of Meteorology weather station located at Coffs Harbour Airport, approximately 4 km east of the monitoring locations. Unattended noise data corresponding with periods of rainfall and/or wind speeds in excess of 5 m/s (approximately 18km/hr) were discarded in accordance with INP data exclusion methodology.

Results of the unattended noise monitoring program are provided in graphical format in **Appendix B1** to **B4**. A summary of noise levels measured during the unattended noise monitoring program is provided in **Table 8**.

It is relevant to note that for unforeseen circumstances the noise monitor positioned at location M1 only logged data for half a day and therefore has not been used in this assessment. However, SLR Consulting has previously conducted traffic noise monitoring of North Boambee Road in 2006 and the logger location is indicated by location M4 in **Figure 3** and the results are summarised in **Table 8** .

Table 8 Unattended Noise Monitoring Results Summary

Location	Noise Logger type/ Serial Number	Road Traffic Noise			
		LAeq(15 hour) Day	LAeq(1 hour) Day	LAeq(9 hour) night	LAeq(1hour) Night
M1 – 202 North Boambee Road (Rose Cottage Health Centre approx. 2m from road)	SVAN957/20666	N/A	N/A	N/A	N/A
M2 – 231 Englands Road, North Boambee Valley (approx. 4m from road)	ARL316/16-306-039	55 dBA	58 dBA	49 dBA	52 dBA
M3 - 6 North Boambee Road – Jayco Watsons Caravans (approx. 20m from the pacific Highway)	ARL316/16-301-473	70 dBA	72 dBA	67 dBA	69 dBA
M4 – Opposite Bishop Druitt College, North Boambee Road (approx. 44m from road)	ARL316/16-301-473	47 dBA	50 dBA	42 dBA	44 dBA

Note: The LAeq(1hour) descriptor is the noisiest 1 hour of the relevant period; day (7.00 am to 10.00 pm) or night (10.00 pm to 7.00 am).

All noise levels reported here are from free-field measurements, meaning that no noise reflections occurred from building/structure facades near the logging sites.

5.3 Operator Attended Noise Monitoring

An operator attended noise survey was conducted at the noise monitoring location to verify the unattended logging results and to determine the character and contribution of noise sources to the total ambient noise level.

The operator attended noise survey was conducted during logger deployment on Thursday 7 June 2012 for Monitoring locations M1 to M3 using a Bruel & Kjaer 2270 precision integrating sound level meter (Type 1 – Serial Number 2679354) and on Tuesday 24 October and Wednesday 25 October 2006 using a Bruel & Kjaer 2260 precision integrating sound level meter (Type 1 – Serial Number 2487418) at monitoring location M4. Results of these surveys are shown in **Table 9**. Ambient noise levels given in **Table 9** include all noise sources such as traffic and residential activities.

Table 9 Operator Attended Noise Measurements

Location	Date/ Start Time/ Weather	Primary Noise Descriptor (dBA re 20µPa)					Description of Noise Emission and Typical Maximum Levels LAmax (dBA)
		LAmax	LA1	LA10	LA90	LAeq	
M1 – 202 North Boambee Road (Rose Cottage Health Centre approx.. 2m from road)	07/06/12 11:40am Clear Wind SW 4m/s 17°C	85	73	52	37	60	Road Traffic Noise 73 to 85 (Intermittent) Bird song 37 to 52 Trees in wind 42 to 43 Distant Road traffic hum (pacific Highway) 37
M2 – 231 Englands Road, North Boambee Valley (approx. 4m from road)	07/06/12 10:36am Clear Wind SW 4m/s 17°C	80	63	47	36	53	Road Traffic Noise 63 to 80 (Intermittent) Bird song 51 to 56 Dogs barking 48 to 50 Trees in wind 36 to 48 Aircraft Noise 48 (intermittent)
M3 - 6 North Boambee Road – Jayco Watsons Caravans (approx. 20m from the pacific Highway)	07/06/12 12:19pm Clear Wind SW 4m/s 17°C	86	78	72	59	69	Road Traffic Noise 59 to 86 (Constant)
M4 – Opposite Bishop Druitt College, North Boambee Road (approx. 44m from road)	24/10/2006 15:08 Wind: 2-5m/s NE Temp: 22°C	76	61	52	50	43	School Buses 59 to 65 School traffic, typically 46 to 49 Passing cars 43 to 51 Insect & bird noise 40 to 43 Occasional construction site noise (adjacent) – up to 50
	25/10/2006 09:30 Wind: 3-5m/s NNW Temp: 22°C	75	64	51	51	40	Passing Quarry Trucks 53 to 68 Passing cars up to 51 Children 40 to 44 Wind in trees 38 to 50 Aircraft 43 to 47

The ambient noise environment was typical of a suburban location. Noise sources included local intermittent road traffic noise and aircraft flyover by the nearby airport.

6 TRAFFIC NOISE ASSESSMENT

6.1 Methodology and Assumptions

Noise modelling of the project area was carried out using the CORTN algorithms incorporated in the SoundPLAN noise modelling software. The modelling allows for traffic volume and mix, type of road surface, vehicle speed, road gradient, reflections off building surfaces, ground absorption and shielding from ground topography and physical noise barriers.

The algorithm output of CORTN (fundamentally an L_{A10} predictor) has been modified to calculate the relevant L_{Aeq} road traffic noise emission descriptors, as required.

All reported noise levels are "facade-corrected". The predicted noise levels have been adjusted upwards to include a notional 2.5 dBA reflection within the noise model computation.

The predicted levels are for receiver points 1.5 m and 4.5m above the external ground level

In the original United Kingdom version of the CORTN model, all traffic noise "sources" are located 0.5 m above the pavement. This approach is appropriate as a "standard" calculation method and yields reasonable consistency from project to project. The predicted noise levels are considered reasonably accurate for roadway conditions having a clear line of sight from receivers to the traffic.

Where noise barriers (including the edges of cuttings) are present however, the CORTN barrier reduction algorithm would tend to over-predict the reductions for truck engine and exhaust noise components, which have effective source heights above pavement considerably greater than 0.5 m.

For this project therefore, the SoundPLAN traffic noise source "strings" have been modified to incorporate four effective noise sources (and heights) in each carriageway. These comprise a "cars" source with height of 0.5 m above pavement and three "truck" sources at three separate heights representing truck tyres (0.5 m), truck engines (1.5 m) and truck exhausts (3.5 m).

The truck sources have relative sound power emission levels (compared to total truck sound power) of -5.4 dBA, -2.4 dBA and -8.5 dBA for tyres, engines and exhausts, respectively. These modifications ensure that the noise predictions (particularly in the presence of noise barriers) address the significance of the elevated heights of noise emission from truck engines and exhausts.

Two (2) scenarios were modelled in SoundPLAN for the purposes of this traffic noise impact assessment:

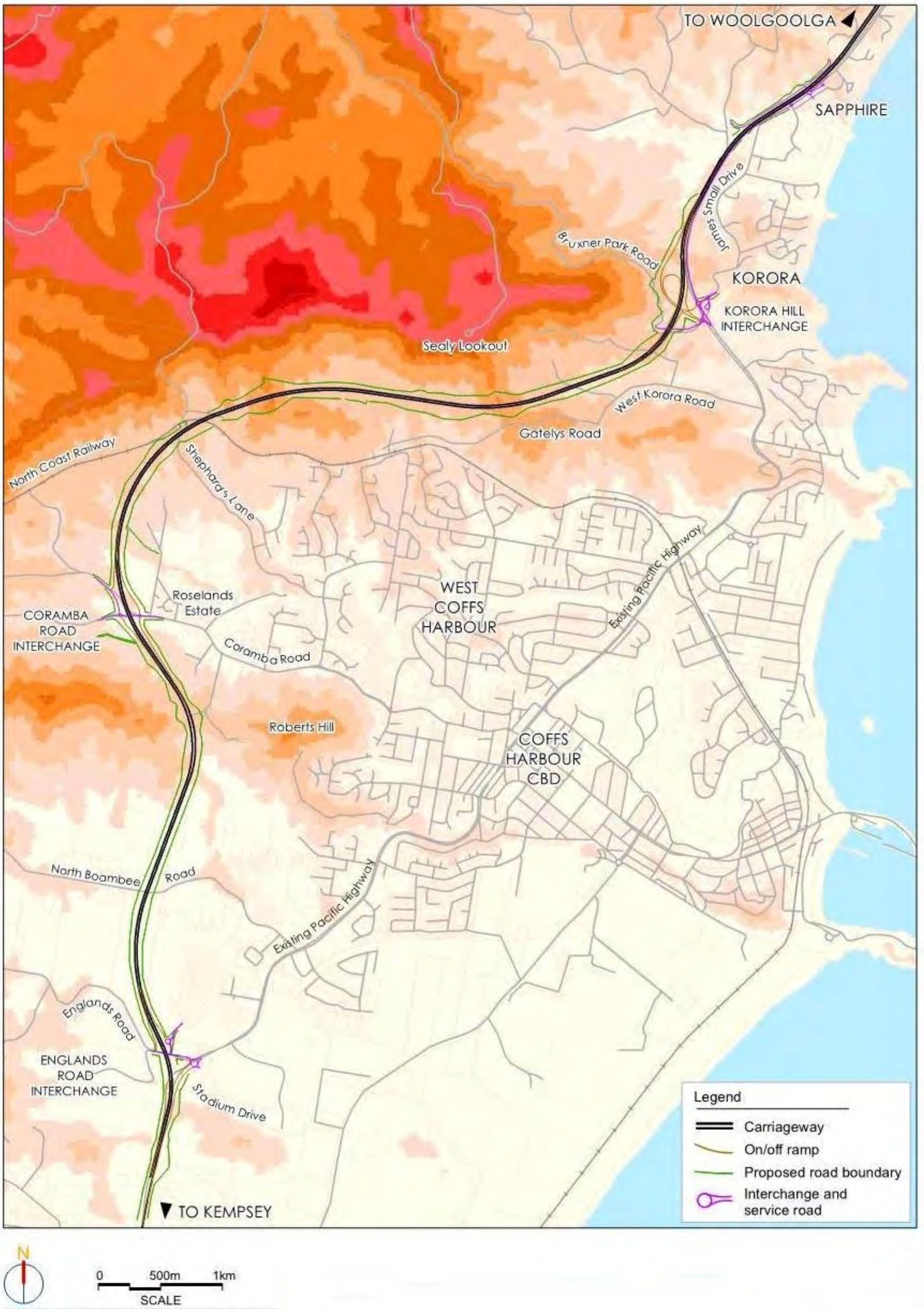
- Scenario 2012 – the baseline scenario which assumes 2012 traffic volumes with the proposed Coffs Harbour Bypass not constructed.
- Scenario 2022 – the 10 year projection scenario assumes 2022 traffic volumes with the proposed Coffs Harbour Bypass are constructed.

6.1.1 Topography and Road Design

Topographic information for the study area was supplied by Coffs Harbour City Council.

The proposed Coffs Harbour Bypass alignment used in the noise model is given in **Figure 4**.

Figure 4 Coffs Harbour Bypass Preferred Road Alignment



6.1.2 Road Traffic Parameters

Road traffic volume information was provided by Coffs Harbour City Council. Reference has also been made to the RTA's *Coffs Harbour Highway Planning Southern and Northern Sections – Coffs Harbour City Council Preferred Corridor Feasibility Assessment June 2004,* RTA's *Coffs Harbour Bypass Concept Design Report September 2008.*

Details of parameters utilised in the noise model are provided in **Table 10**.

Table 10 Road Traffic Volumes Utilised in Noise Model

Description			AADT Both Directions	Average Daily Vehicle Count (Both Directions)		Percentage of Heavy Vehicles	
Year	**Road Traffic Source**	**Road Traffic Speed km/h**	**Total**	**Day (7am-10pm)**	**Night (10pm-7am)**	**Daytime (7am-10pm)**	**Night-Time (10pm-7am)**
2012	Existing Pacific highway south of halls road	70	20316	19096	1220	9%	4%
	Englands road west of tip area	60	482	454	28	6.4%	6.4%
	North Boambee Road east of Bishop Druitt College	60	1815	1706	109	11.1%	11.1%
	North Boambee Road west of Bishop Druitt College	60	526	494	32	20.2%	20.2%
	North Boambee Road no 328	60	133	124	9	33.7%	33.7%
2022	Inner Bypass Corridor (Englands rd to North Boambe rd)	110	14136	12580	1556	9%	4%
	Existing Pacific highway south of halls road	70	23992	22552	1440	9%	52%
	Englands road west of tip area	60	650	610	40	6.4%	6.4%
	North Boambee Road east of Bishop Druitt College	60	2440	2294	146	11.1%	11.1%
	North Boambee Road west of Bishop Druitt College	60	710	668	42	20.2%	20.2%
	North Boambee Road no 328	60	180	170	10	33.7%	33.7%

Note: 50-50 split s for both directions has been assumed for traffic for all roads

6.2 Noise Model Validation

Numerous operator attended and unattended noise surveys have been conducted across the study area. These measurements have been utilised to calibrate and validate the road traffic noise model. Validation of the computer noise model was enabled by carrying out single-point receiver calculations at noise monitoring locations adjacent to the Pacific Highway, North Boambee Road and Englands Road.

Results of modelling indicated that predicted day $L_{Aeq(15hour)}$, night $L_{Aeq(15hour)}$, day $L_{Aeq(1hour)}$, night $L_{Aeq(1hour)}$ noise levels are equal to the measured data. Therefore, the noise model is considered to have excellent correlation with measured results and is therefore deemed suitable for predicting road traffic noise levels at all potentially affected receiver locations for the North Boambee Valley (west) Release Area.

The results of the validation calculations are provided in **Table 11** with a comparison to predicted noise levels.

Table 11 Comparison of Predicted and Measured Road Traffic Noise Levels

Location No.		SoundPLAN Prediction	Measured 2006	Measured 2012	Difference (Prediction-Measured)
Pacific Highway monitoring location	Daytime LAeq(15hour)	70 dBA	N/A	70 dBA	0 dBA
	Night-time LAeq(9hour)	67 dBA	N/A	67 dBA	0 dBA
Englands Road Monitoring location	Daytime LAeq(15hour)	55 dBA	N/A	55 dBA	0 dBA
	Night-time LAeq(9hour)	49 dBA	N/A	49 dBA	0 dBA
North Boambee Road Monitoring location	Daytime LAeq(15hour)	47 dBA	47 dBA	N/A	0 dBA
	Night-time LAeq(9hour)	42 dBA	42 dBA	N/A	0 dBA

*Measured results at all locations don't include a façade correction of +2.5 dBA to account for free-field measurement.

6.3 Road Traffic Noise Predictions

6.3.1 Overview

Noise level predictions are presented as noise contour plots for day and night-time periods for Scenario 2012 and also for Scenario 2022. The noise contour plots are contained in the following appendices:

Appendix C1 - Daytime 2012 (No Coffs Harbour bypass) no mitigation (first storey).
Appendix C2 – Daytime 2012 (No Coffs Harbour bypass) no mitigation (second storey).
Appendix C3 - Night-time 2012 (No Coffs Harbour bypass) no mitigation (first storey).
Appendix C4 – Night-time 2012 (No Coffs Harbour bypass) no mitigation (second storey).

Appendix D1 - Daytime 2022 (with Coffs Harbour bypass) no mitigation (first storey).
Appendix D2 - Daytime 2022 (with Coffs Harbour bypass) no mitigation (second storey).
Appendix D3 – Night-time 2022 (with Coffs Harbour bypass) no mitigation (first storey).
Appendix D4 – Night-time 2022 (with Coffs Harbour bypass) no mitigation (second storey).

The noise contour predictions are *external* noise levels at first and second storey and have been adjusted (increased) by 2.5 dBA to reflect façade noise levels.

At this stage of the project no detailed layout is available for any proposed development within the North Boambee Valley (West) Release Area. Therefore, the noise contours display the likely noise levels across the existing site. It is worth noting that once buildings are constructed adjacent to the roads they will provide some acoustic shielding to other adjacent properties situated further from the road.

The night-time period provides the limiting criteria for residential locations. This means that noise mitigation designed for the night-time noise criteria will also be effective at reducing daytime road traffic noise levels below the relevant noise goals.

6.3.2 Assessment of Impacts

Proposed Coffs Bypass Alignment

A summary of the predicted 2022 night-time road traffic noise levels at the proposed residential areas within North Boambee Valley (west) Release Area with the proposed Coffs Bypass Alignment is provided as follows (refer to **Appendix D3 to D4**):

- Road traffic noise levels are predicted to exceed the relevant external noise criteria of $L_{Aeq(9hour)}$ 50 dBA by up to approximately 15 dBA immediately adjacent to the proposed Coffs Bypass.
- External road traffic noise goals are predicted to be exceeded throughout the northern area designated for residential release.
- External road traffic noise goals are predicted to be exceeded at the majority of areas within approximately 350m of the Coffs Bypass.
- External noise goals are predicted to be achieved at distances greater than approximately 450m from the Coffs Bypass.

Given the predicted noise levels across the North Boambee Valley (West) Release Area site, SLR Consulting has investigated the potential benefits of the construction of noise barriers adjacent to the proposed Coffs Bypass. Road traffic noise levels including the potential noise barriers (all 3m above existing ground level) are provided in **Appendix E1 and E2** for 2022 night-time with proposed bypass traffic volumes.

A summary of the predicted reduction in road traffic noise levels is provided as follows:

- The construction of 3m noise barriers is predicted to reduce road traffic noise level immediately adjacent to the proposed Coffs Bypass in the proposed residential development area by approximately 5 dBA.
- Road traffic noise levels are predicted to exceed the relevant external noise criteria of $L_{Aeq(9hour)}$ 50 dBA by up to approximately 10 dBA immediately adjacent to the proposed Coffs Bypass with the proposed noise wall. Therefore, internal noise level goals need to be meet see **Section 7** for details.

6.3.3 Proposed Noise Barriers

The location of the proposed noise barrier for the proposed Coffs Bypass alignment is provided in **Figure 5**.

The noise barriers could be a wall, an earth bund or a combination of an earth bund and a wall, provided the total height remains at the recommended elevation. The noise wall (and/or bund) should be continuous and contain no gaps. Recommended construction materials for a noise wall include aerated concrete or timber. Due to poor attenuation of noise at low frequencies, sheet-steel fencing material is not recommended.

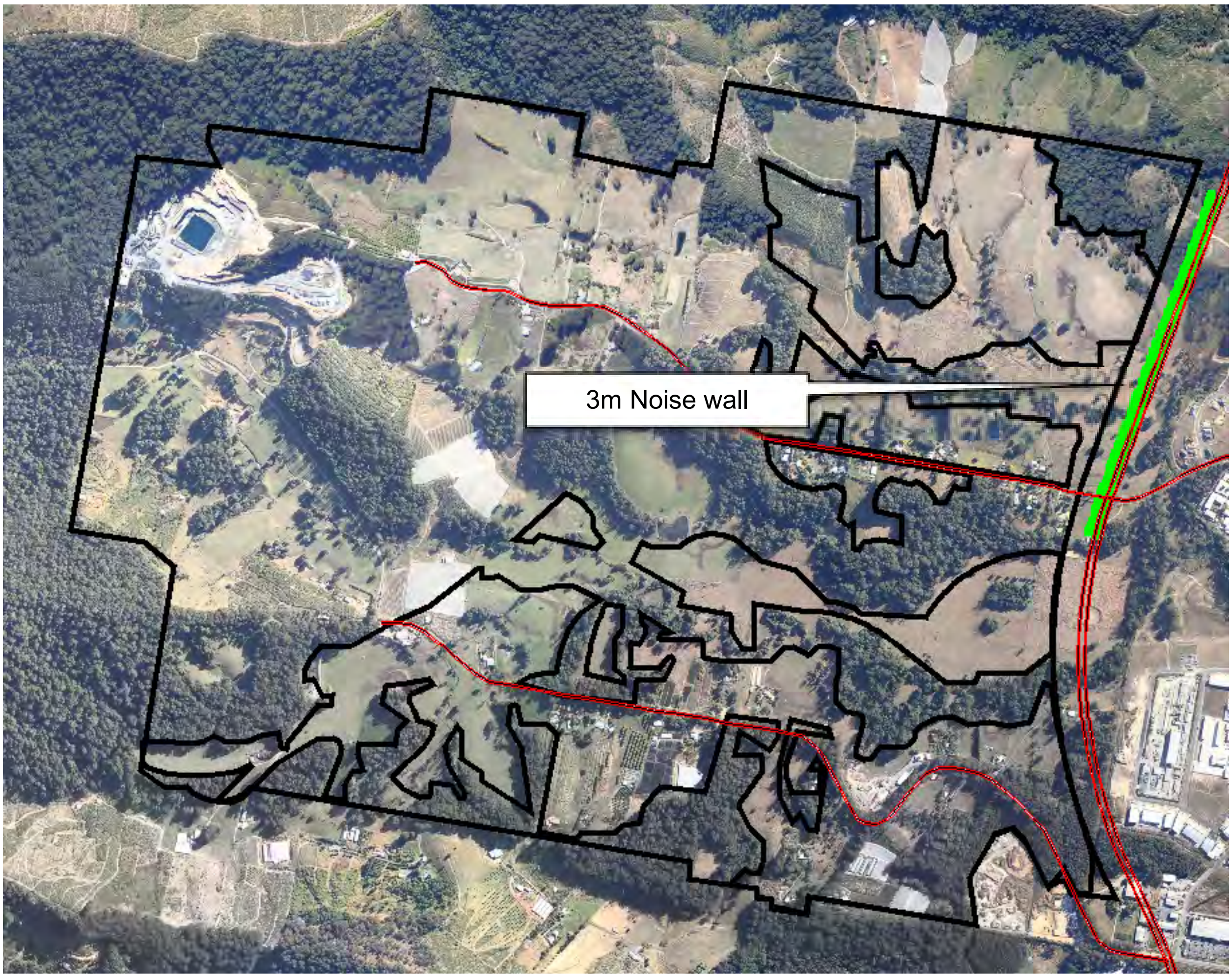
The design of noise mitigation measures must consider many factors including, but not limited to, the following;

- Predicted road traffic noise levels.
- Safety and sight lines.
- Structural feasibility and physical constraints.
- Drainage and access requirements.
- Retention or maximisation of views and outlooks.

- Expectations of affected residences.
- Visual impacts.
- Overshadowing and potential loss of breeze.

Some of these factors cannot be considered at this early stage of the proposed development. Furthermore, it is not appropriate for an acoustic consultant to attempt to consider most of these factors. Therefore, this noise assessment considers noise barriers for the purpose of reducing road traffic noise levels only without regard to other design factors.

Figure 5 Proposed Noise Barriers – Coffs Harbour Bypass



It should also be noted that in order for a noise barrier to be most effective, it should be constructed as close as possible to either the source or receiver. Since no detailed site layout available at this stage of the project site, it has been assumed that maximum benefit will be gained with the wall adjacent to the road. On completion of a detailed site layout, it is recommended that further investigation of noise barrier options be carried out as it may be more effective (and more cost efficient) to consider the construction of noise barriers adjacent to the most noise affected residences (i.e. the use of garden fences during the development as noise barriers).

7 RECOMMENDATIONS TO ACHIEVE INTERNAL NOISE GOALS

Where external noise goals are not achieved, special attention needs to be paid to ensure that internal noise goals can be achieved.

The required road traffic noise reduction has been determined for each residential lot assuming a noise-sensitive area (ie living or sleeping area) is located on the façade where noise predictions have been conducted. Where this reduction is less than 10 dBA Category 1 construction methods (refer to **Table 5**) will likely reduce internal traffic noise levels to below recommended values. Where this reduction is greater than 10 dBA but less than 25 dBA then Category 2 construction methods (refer to **Table 5**) will likely reduce internal traffic noise levels to below recommended values. Where this reduction is greater than 25 dBA but less than 35 dBA then Category 3 construction methods (refer **Table 5**) will likely reduce internal traffic noise levels to below recommended values.

Results of this analysis are provided in **Table 12** and **Table 13**.

Table 12 2022 Daytime Road Traffic Noise Reduction Required to Achieve Recommended Internal Noise Goals

Type of Occupancy	Required Noise Reduction	Relevant Lots	Architectural Treatment
Single Storey (refer to Appendix E1 contour plot results)			
Living Areas	Up to 10 dBA	Lots in the dark green zone (<45dBA) Lots in the light blue zone (45 -50dBA)	Construction Category 1
	10 dBA - 25 dBA	Lots in the dark blue zone (50-55dBA) Lots in the yellow zone (55-60dBA) Lots in the orange zone (60-65dBA)	Construction Category 2
	25 dBA – 35 dBA	Lots in the red zone (65-70dBA)	Construction Category 3
Sleeping Areas		N/A	
Second Storey (refer to Appendix E2 contour plot results)			
Living Areas	Up to 10 dBA	Lots in the dark green zone (<45dBA) Lots in the light blue zone (45 -50dBA)	Construction Category 1
	10 dBA - 25 dBA	Lots in the dark blue zone (50-55dBA) Lots in the yellow zone (55-60dBA) Lots in the orange zone (60-65dBA)	Construction Category 2
	25 dBA – 35 dBA	Lots in the red zone (65-70dBA)	Construction Category 3
Sleeping Areas		N/A	

Table 13 2022 Night-time Road Traffic Noise Reduction Required to Achieve Recommended Internal Noise Goals

Type of Occupancy	Required Noise Reduction	Relevant Lots	Architectural Treatment
Single Storey (refer to Appendix E4 contour plot results)			
Living Areas	Up to 10 dBA	Lots in the dark green zone (<45dBA) Lots in the light blue zone (45-50dBA)	Construction Category 1
	10 dBA - 25 dBA	Lots in the dark blue zone (50-55dBA) Lots in the yellow zone (55-60dBA) Lots in the orange zone (60-65dBA)	Construction Category 2
	25 dBA – 35 dBA	Lots in the red zone (65-70dBA)	Construction Category 3
Sleeping Areas	Up to 10 dBA	Lots in the Green Zone (<45dBA)	Construction Category 1
	10 dBA - 25 dBA	Lots in the light blue zone (45-50dBA) Lots in the dark blue zone (50-55dBA) Lots in the yellow zone (55-60dBA)	Construction Category 2
	25 dBA – 35 dBA	Lots in the orange zone (60-65dBA) Lots in the red zone (65-70dBA)	Construction Category 3
Second Storey (refer to Appendix E5 contour plot results)			
Living Areas	Up to 10 dBA	Lots in the dark green zone (<45dBA) Lots in the light blue zone (45-50dBA)	Construction Category 1
	10 dBA - 25 dBA	Lots in the dark blue zone (50-55dBA) Lots in the yellow zone (55-60dBA) Lots in the orange zone (60-65dBA)	Construction Category 2
	25 dBA – 35 dBA	Lots in the red zone (65-70dBA)	Construction Category 3
Sleeping Areas	Up to 10 dBA	Lots in the Green Zone (<45dBA)	Construction Category 1
	10 dBA - 25 dBA	Lots in the light blue zone (45-50dBA) Lots in the dark blue zone (50-55dBA) Lots in the yellow zone (55-60dBA)	Construction Category 2
	25 dBA – 35 dBA	Lots in the orange zone (60-65dBA) Lots in the red zone (65-70dBA)	Construction Category 3

In all instances where windows are required to be closed (construction category 2) to achieve internal noise levels, alternative means of achieving the requirement for "comfort ventilation" will need to be considered to enable openings in the external facade (i.e. windows and doors) to remain fully closed during noisy periods. However, this doesn't prevent the residential occupants from opening the windows during quieter periods.

Provided the recommendations in this report are implemented, it is expected that this development will be able to satisfy the relevant noise criteria requirements of AS 2107:2000 and the RNP.

Generally, to reduce internal noise levels for future residential dwellings, design and construction suggestions include, but are not limited to, the following:

- Locate dwellings on each allotment as far as possible from the noise source.
- Minimise the size and number of windows facing the noise source.
- Locate noise insensitive areas such as the kitchen, storage areas and laundry toward the noise source.

- Use construction techniques that focus on sealing gaps around windows, doors, ceiling spaces, etc.
- Use thick glass or double glazing.
- Use solid core doors and appropriate door seals.
- Residential boundary fence noise walls

It should be noted that mitigation recommendations apply to two storey dwellings. The upper floors of three storey (or higher) dwellings will need further consideration and possibly additional mitigation. These multiple storey dwellings should be assessed on a case by case basis.

8 CONCLUSION

SLR Consulting has conducted a noise impact assessment for the proposed North Boambee Valley (West) Release Area development west of Coffs Harbour, NSW.

Road traffic noise levels have been assessed across the subject site for the existing road network and proposed Coffs Bypass Alignment. Recommendations have been made with regard to appropriate building construction and/or noise barriers where external road traffic noise levels are predicted to exceed the relevant noise goals.

1 Sound Level or Noise Level

The terms “sound” and “noise” are almost interchangeable, except that in common usage “noise” is often used to refer to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. The human ear responds to changes in sound pressure over a very wide range. The loudest sound pressure to which the human ear responds is ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or L_P are commonly used to represent Sound Pressure Level. The symbol L_A represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2E-5 Pa.

2 “A” Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an “A-weighting” filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People’s hearing is most sensitive to sounds at mid frequencies (500 Hz to 4000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dBA is a good measure of the loudness of that sound. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dBA or 2 dBA in the level of a sound is difficult for most people to detect, whilst a 3 dBA to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels

Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120 110	Heavy rock concert Grinding on steel	Extremely noisy
100 90	Loud car horn at 3 m Construction site with pneumatic hammering	Very noisy
80 70	Kerbside of busy street Loud radio or television	Loud
60 50	Department store General Office	Moderate to quiet
40 30	Inside private office Inside bedroom	Quiet to very quiet
20	Unoccupied recording studio	Almost silent

Other weightings (eg B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as “linear”, and the units are expressed as dB(lin) or dB.

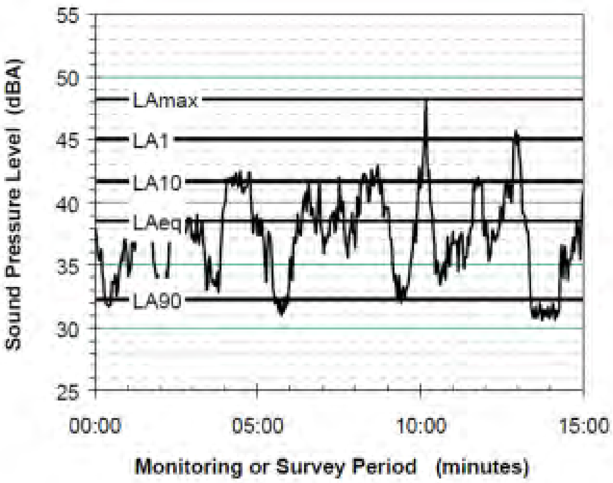
3 Sound Power Level

The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 1E-12 W.
The relationship between Sound Power and Sound Pressure may be likened to an electric radiator, which is characterised by a power rating, but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

4 Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels L_{AN}, where L_{AN} is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the L_{A1} is the noise level exceeded for 1% of the time, L_{A10} the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.



Of particular relevance, are:

- L_{A1} The noise level exceeded for 1% of the 15 minute interval.
- L_{A10} The noise level exceed for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.
- L_{A90} The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of th source under consideration), or simply the background le el.
- L_{Aeq} The A-weighted equivalent noise level (ba cally the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

When dealing with numerous days of statistical noise data, it is sometimes necessary to define the typical noise levels at a given monitoring location for a particular time of day. A standardised method is available for determining these representative levels.

This method produces a level representing the “repeatable minimum” L_{A90} noise level over the daytime and night-time measurement periods, as required by the EPA. In addition the method produces mean or “average” levels representative of the other descriptors (L_{Aeq}, L_{A10}, etc).

5 Tonality

Tonal noise contains one or more prominent tones (ie distinct frequency components), and is normally regarded as more offensive than “broad band” noise.

6 Impulsiveness

An impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.

7 Frequency Analysis

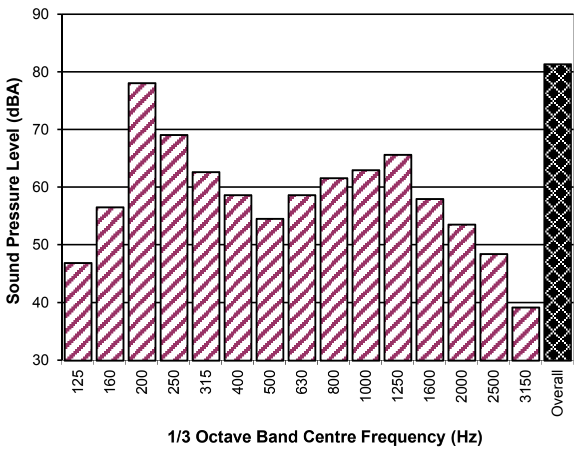
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers.

The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (3 bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.



8 Vibration

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity. These may be expressed in terms of "peak" velocity or "rms" velocity.

The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as "peak particle velocity", or PPV. The latter incorporates "root mean squared" averaging over some defined time period.

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements. Where triaxial measurements are used, the axes are commonly designated vertical, longitudinal (aligned toward the source) and transverse.

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V, expressed in mm/s can be converted to decibels by the formula 20 log (V/V_o), where V_o is the reference level (1E-6 mm/s). Care is required in this regard, as other reference levels are used by some organizations.

9 Human Perception of Vibration

People are able to "feel" vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as "normal" in a car, bus or train is considerably higher than what is perceived as "normal" in a shop, office or dwelling.

10 Over-Pressure

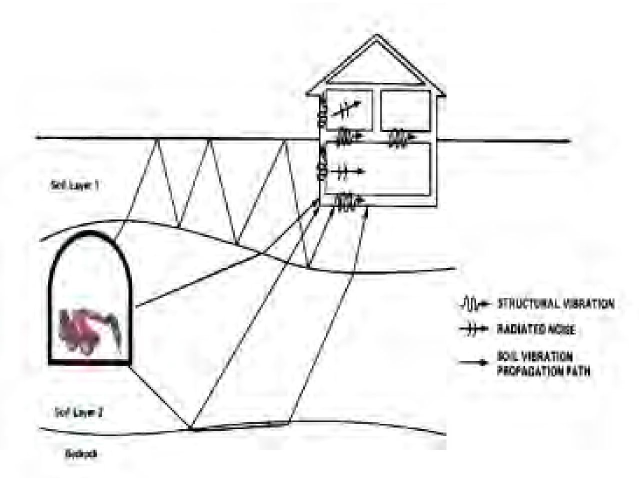
The term "over-pressure" is used to describe the air pressure pulse emitted during blasting or similar events. The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.

11 Regenerated Noise

Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed "regenerated noise", "structure-borne noise", or sometimes "ground-borne noise". Regenerated noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air.

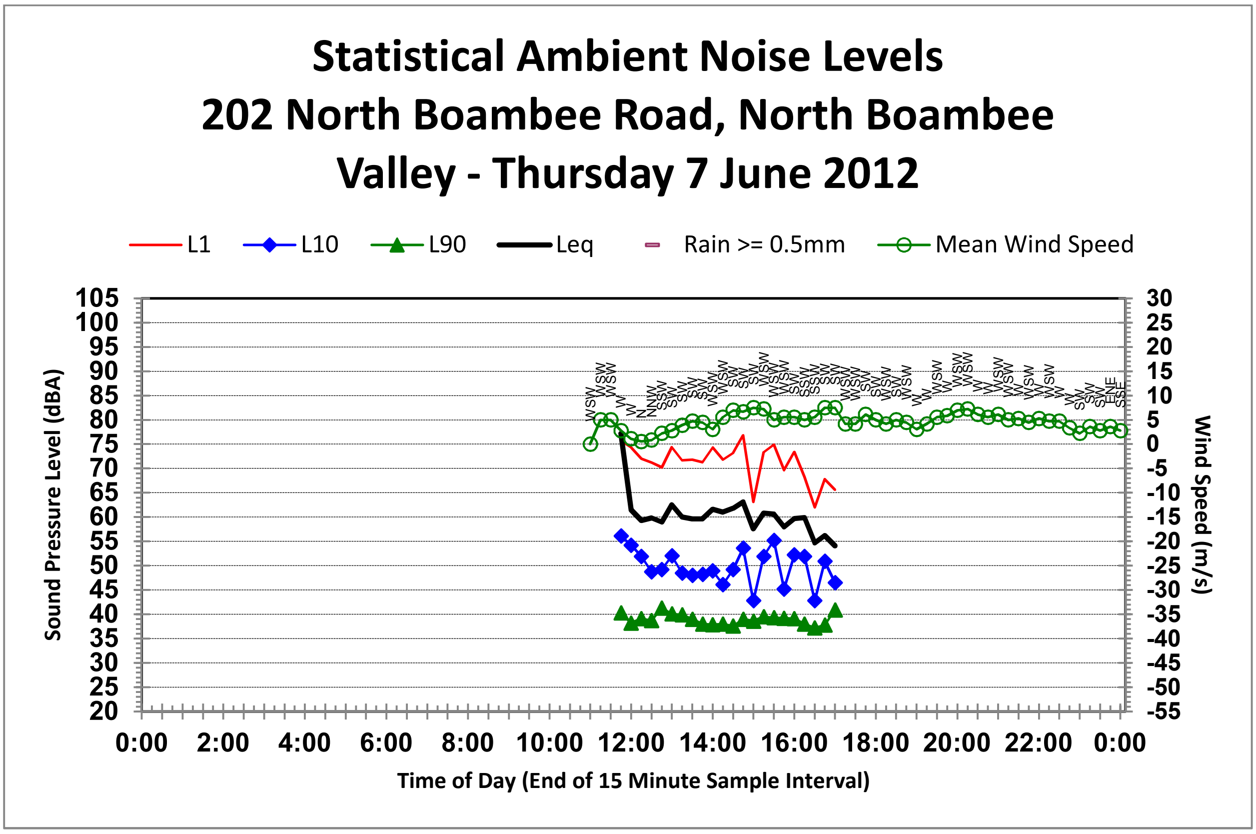
Typical sources of regenerated noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

The following figure presents the various paths by which vibration and regenerated noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.

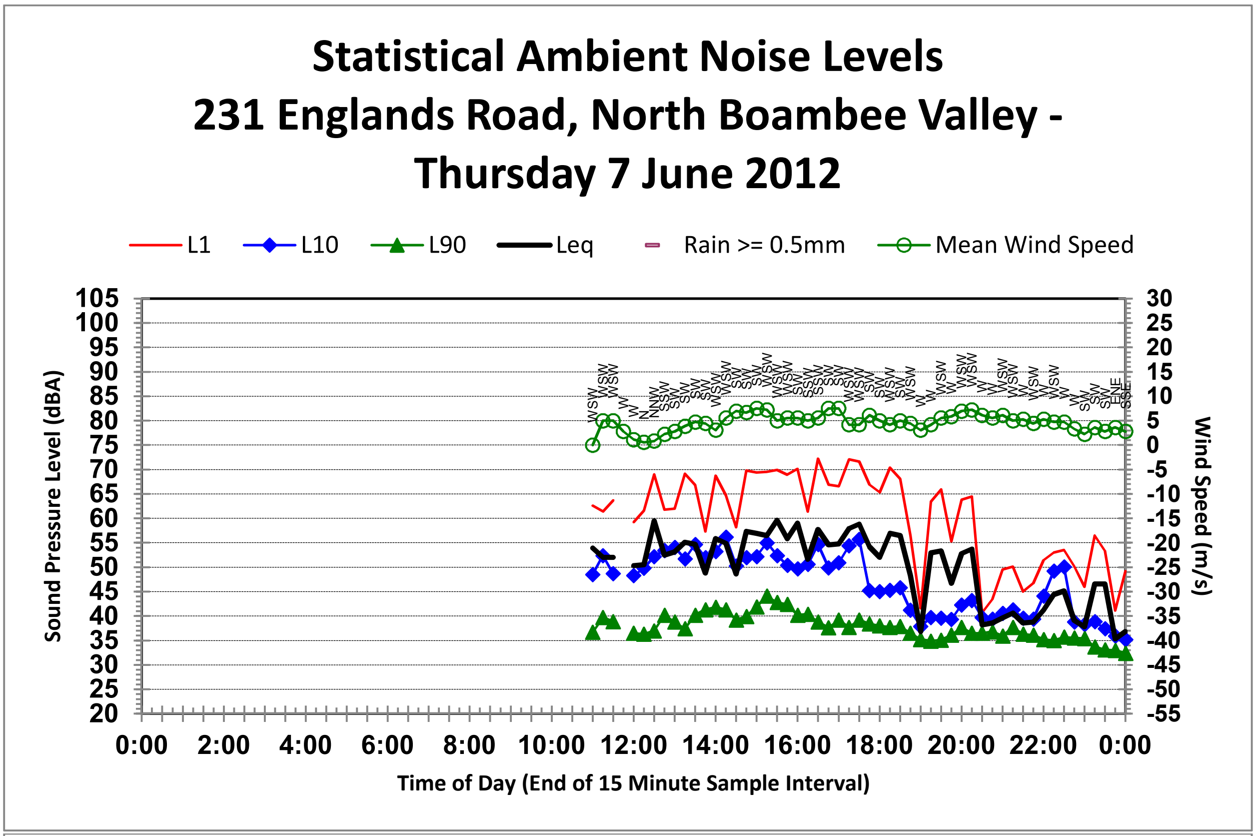


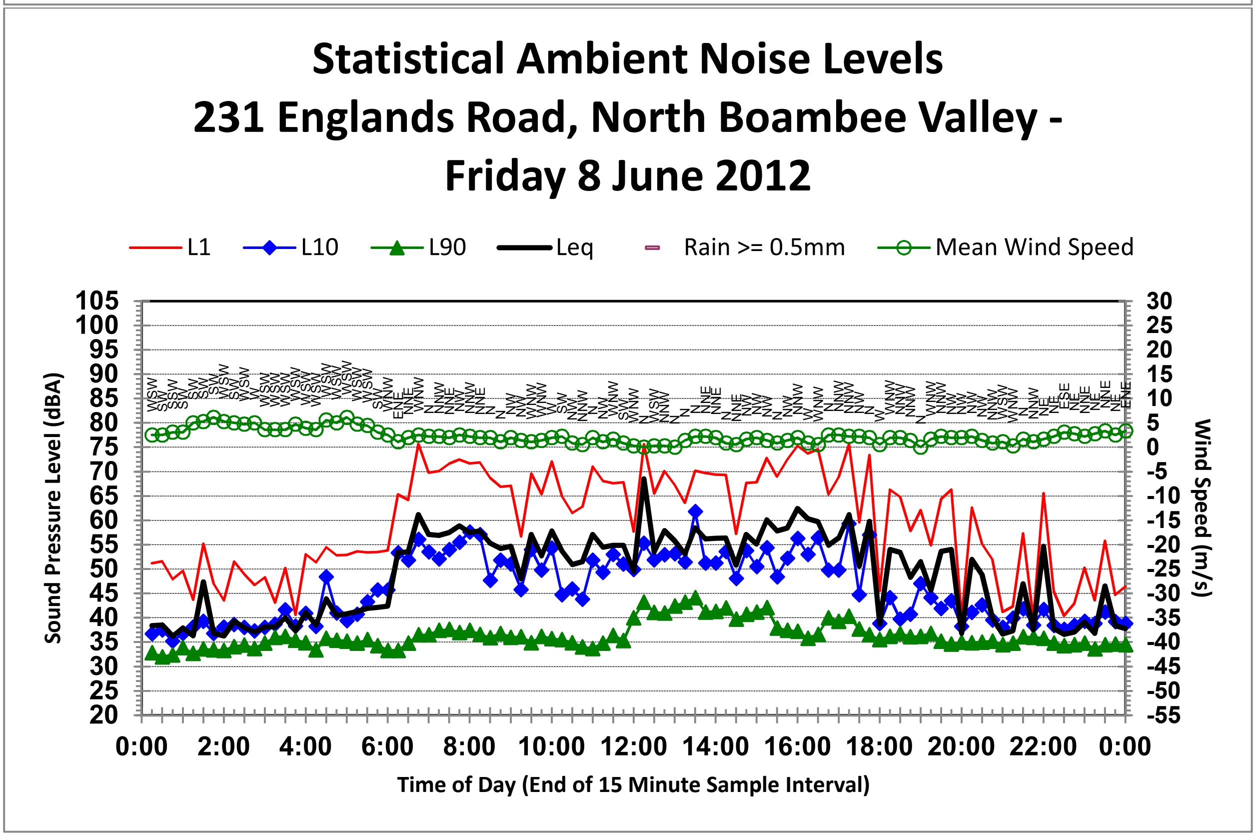
The term "regenerated noise" is also used to describe other types of noise that are emitted from the primary source as a different form of energy. One example would be a fan with a silencer, where the fan is the energy source and primary noise source. The silencer may effectively reduce the fan noise, but some additional noise may be created by the aerodynamic effect of the silencer in the airstream. This "secondary" noise may be referred to as regenerated noise.

Statistical Ambient Noise Levels - 202 North Boambee Road, North Boambee Valley

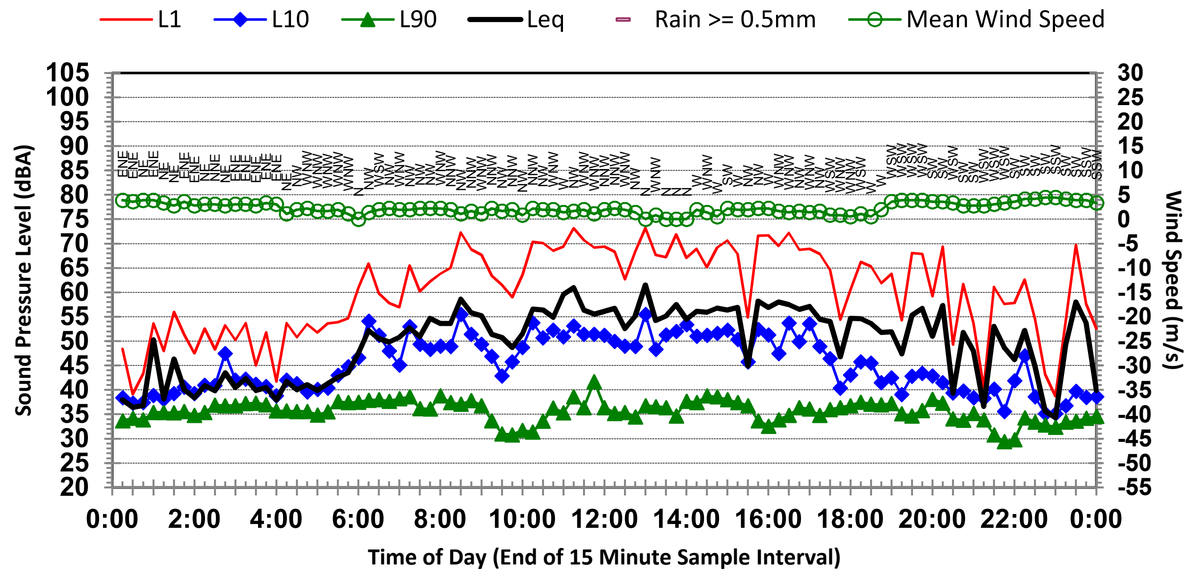


Statistical Ambient Noise Levels - 231 Englands Road, North Boambee Valley

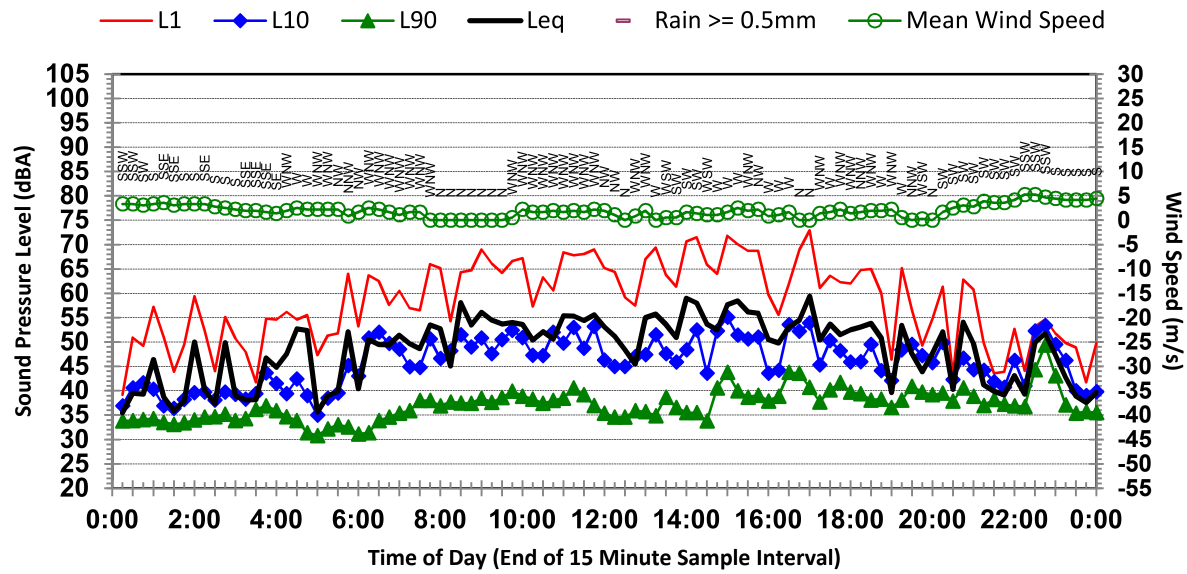


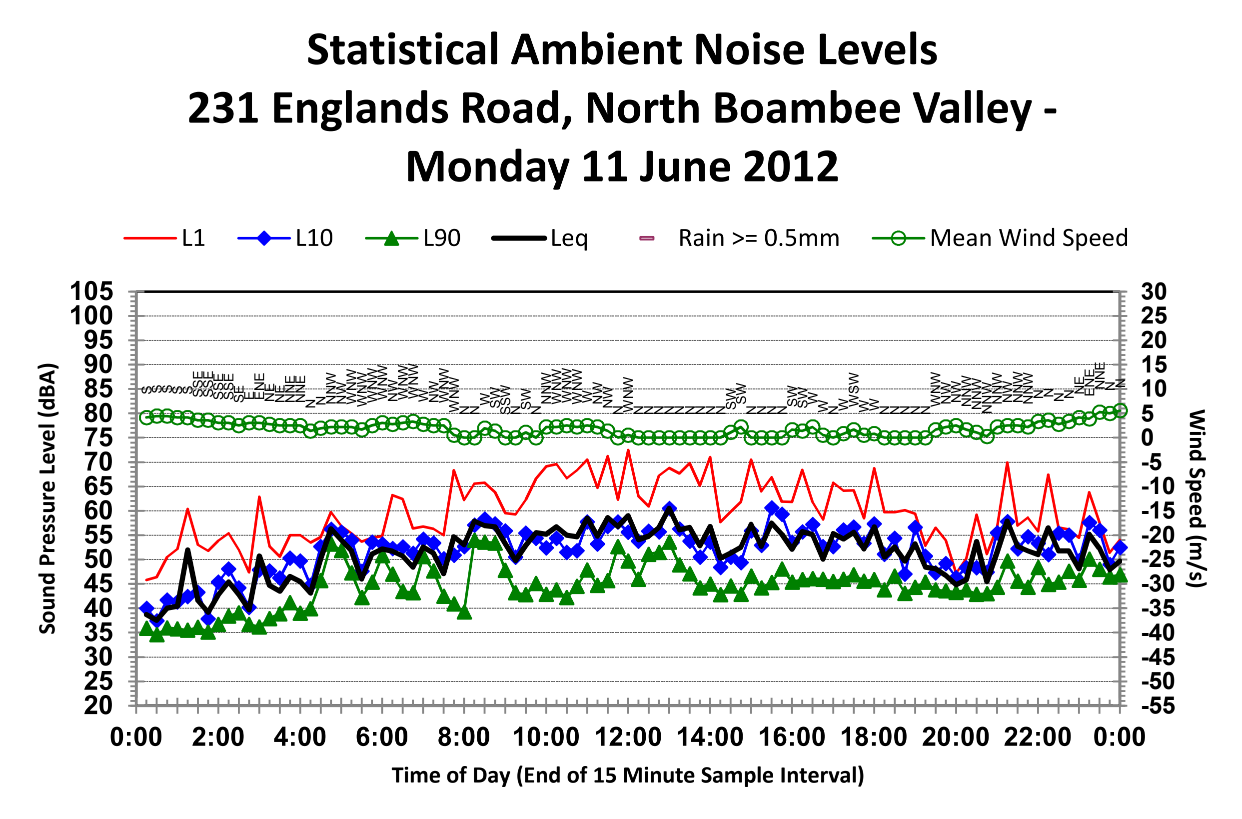


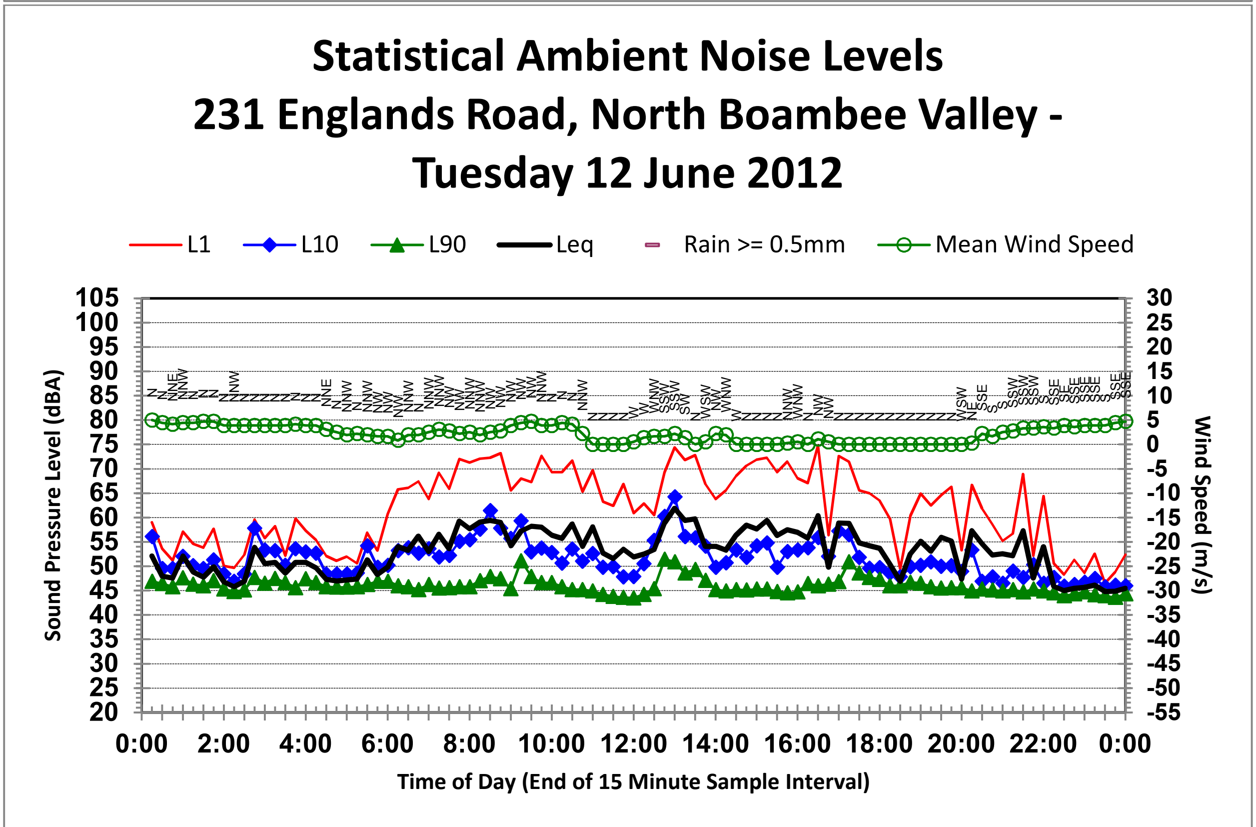
Statistical Ambient Noise Levels
231 Englands Road, North Boambee Valley - Saturday 9 June 2012

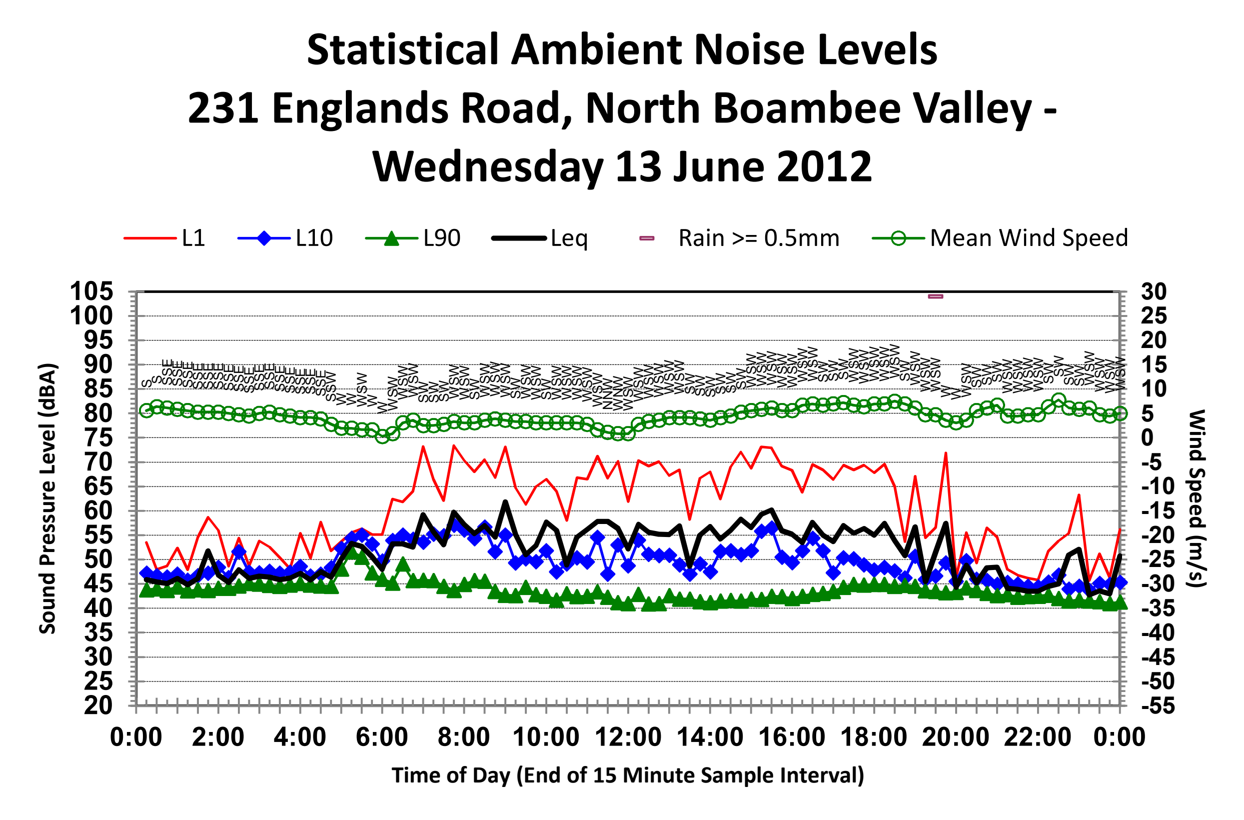


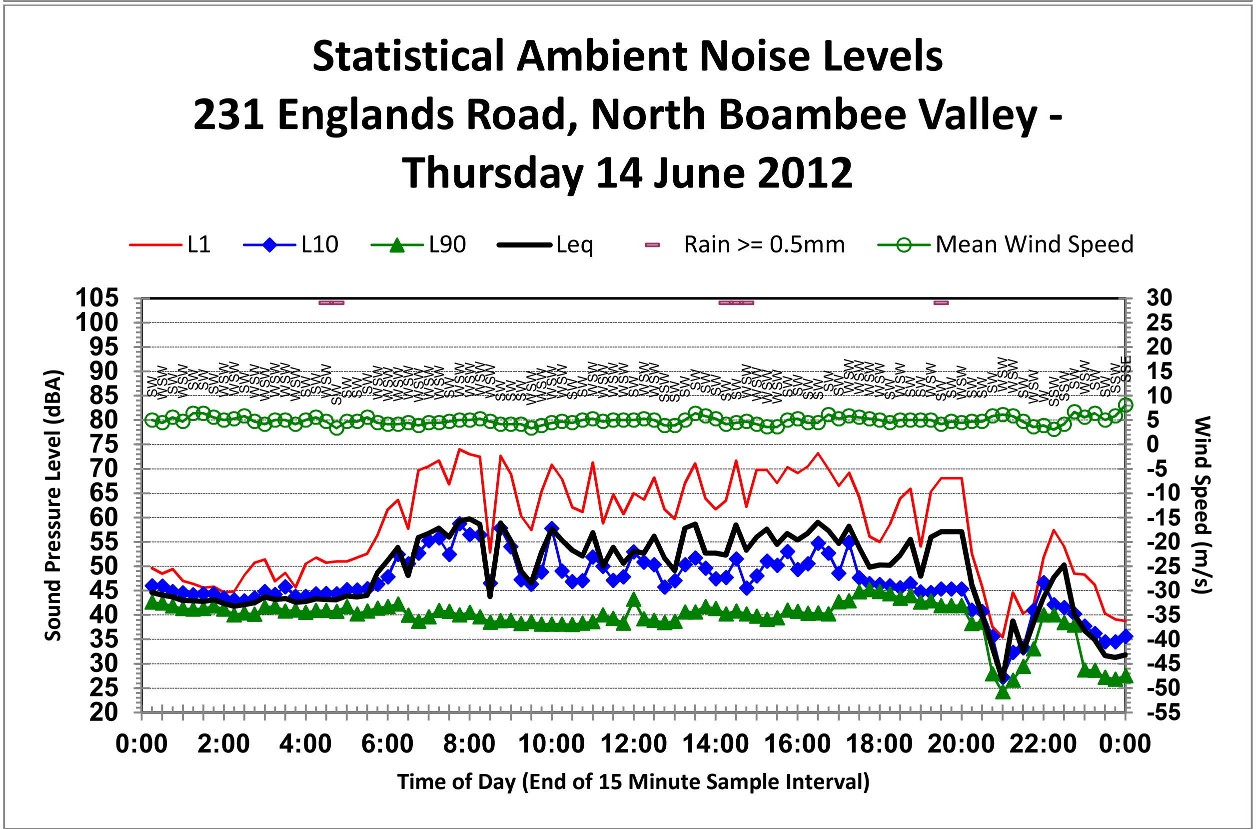
Statistical Ambient Noise Levels
231 Englands Road, North Boambee Valley - Sunday 10 June 2012



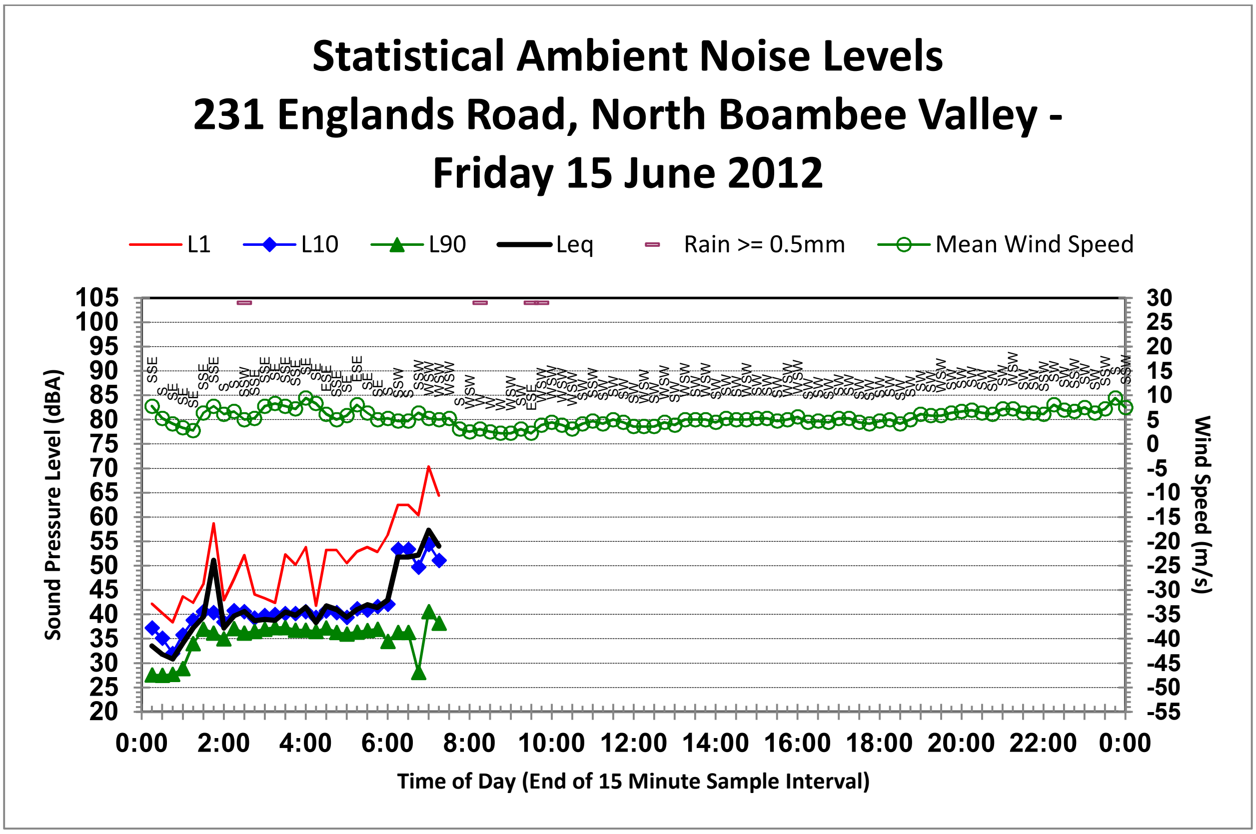

Statistical Ambient Noise Levels
231 Englands Road, North Boambee Valley -
Monday 11 June 2012
L1
L10
L90
Leq
Rain >= 0.5mm
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s)
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
30
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
0:00 2:00 4:00 6:00 8:00 10:00 12:00 14:00 16:00 18:00 20:00 22:00 0:00
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
231 Englands Road, North Boambee Valley -
Tuesday 12 June 2012
L1
L10
L90
Leq
Rain >= 0.5mm
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s)
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
30
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
0:00 2:00 4:00 6:00 8:00 10:00 12:00 14:00 16:00 18:00 20:00 22:00 0:00
Time of Day (End of 15 Minute Sample Interval)

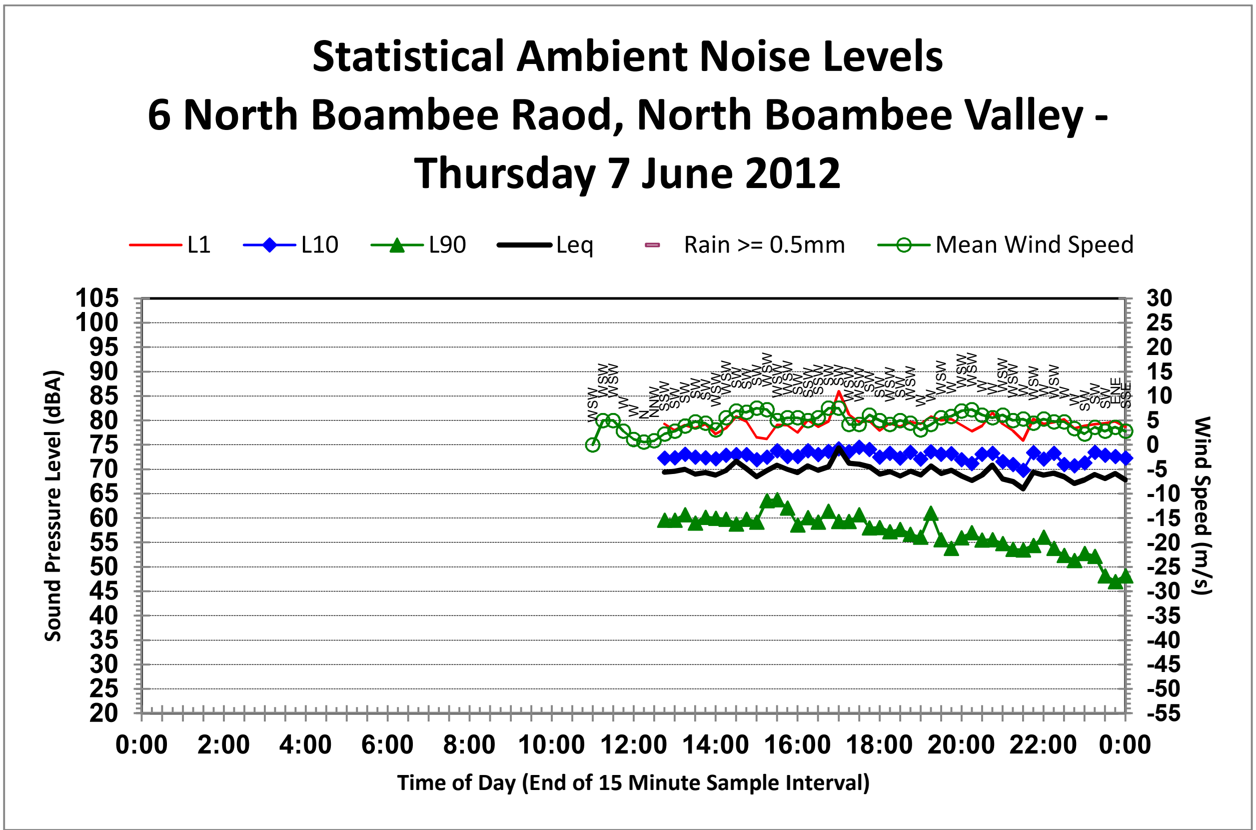

Statistical Ambient Noise Levels
231 Englands Road, North Boambee Valley -
Wednesday 13 June 2012
L1
L10
L90
Leq
Rain >= 0.5mm
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sample Interval)

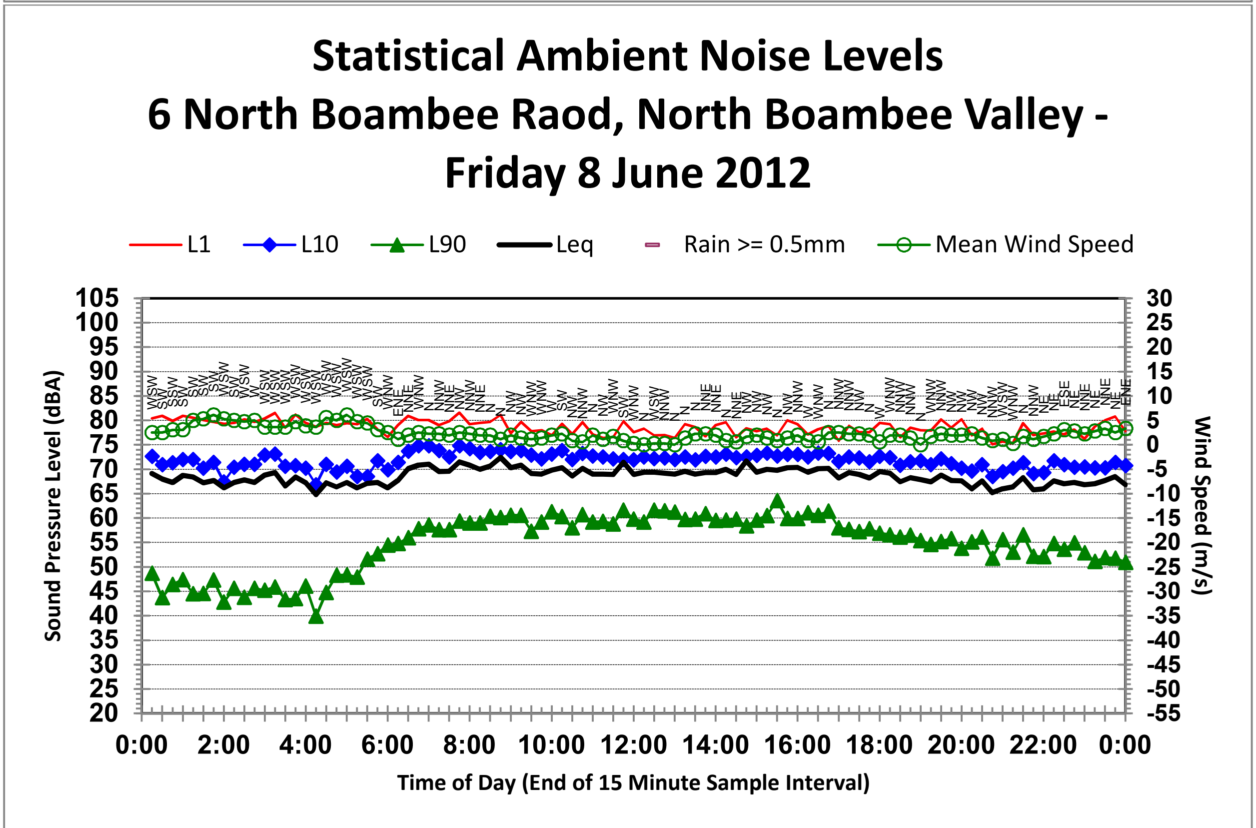

Statistical Ambient Noise Levels
231 Englands Road, North Boambee Valley -
Thursday 14 June 2012
L1
L10
L90
Leq
Rain >= 0.5mm
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sample Interval)

Statistical Ambient Noise Levels - 231 Englands Road, North Boambee Valley

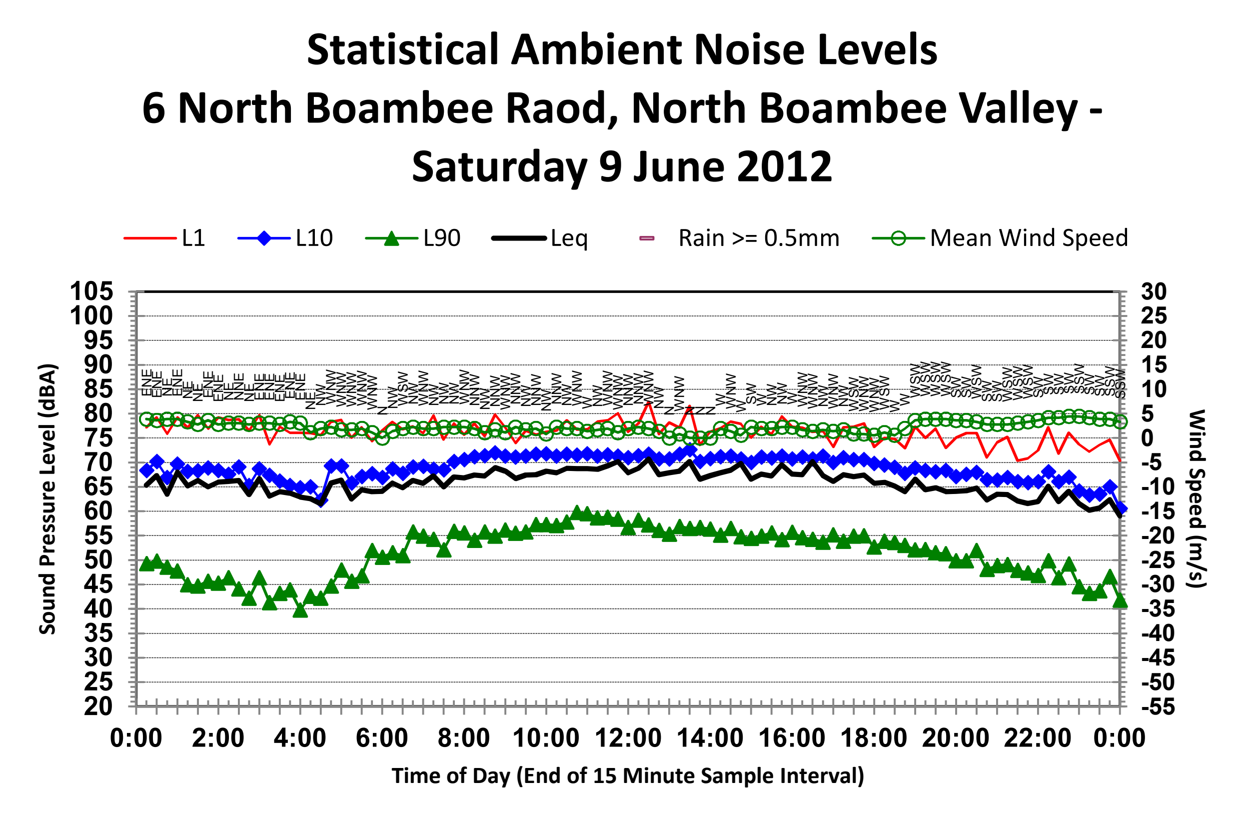


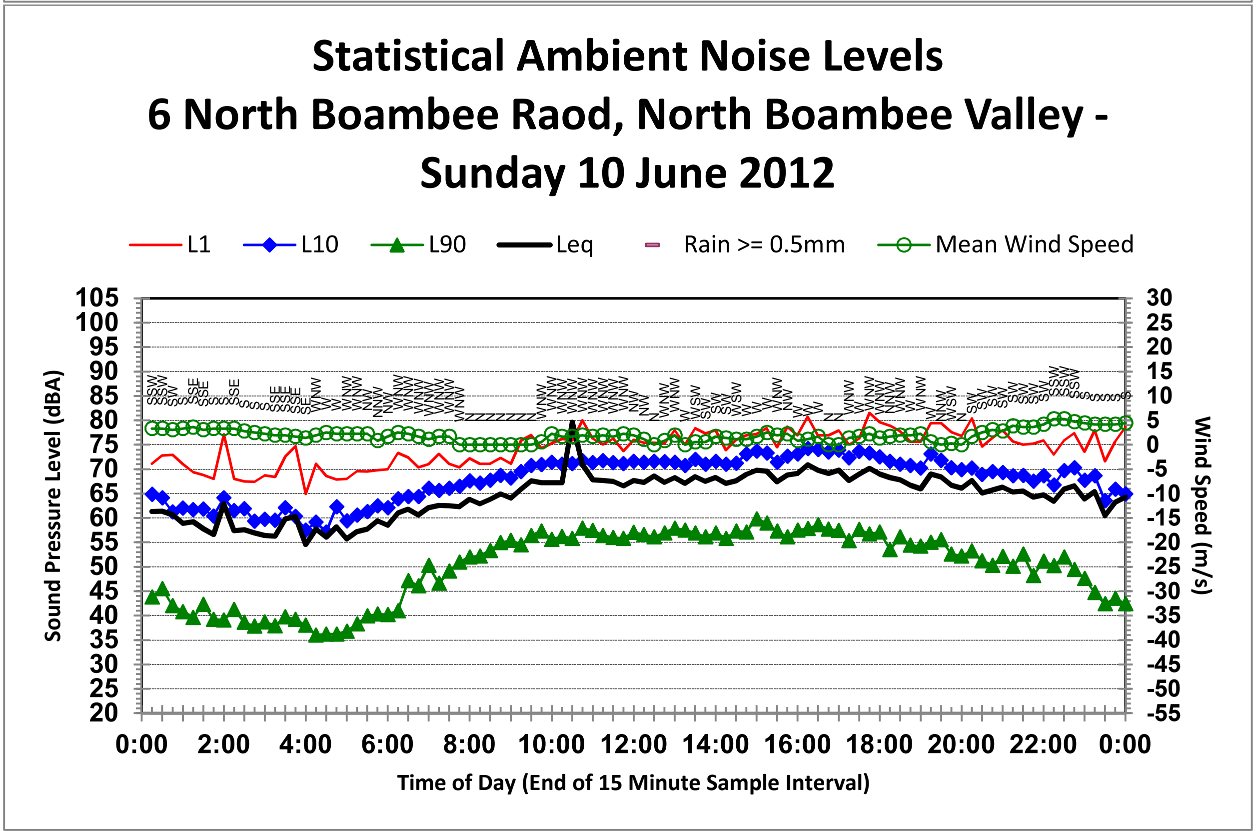
Statistical Ambient Noise Levels - 6 North Boambee Road, North Boambee Valley

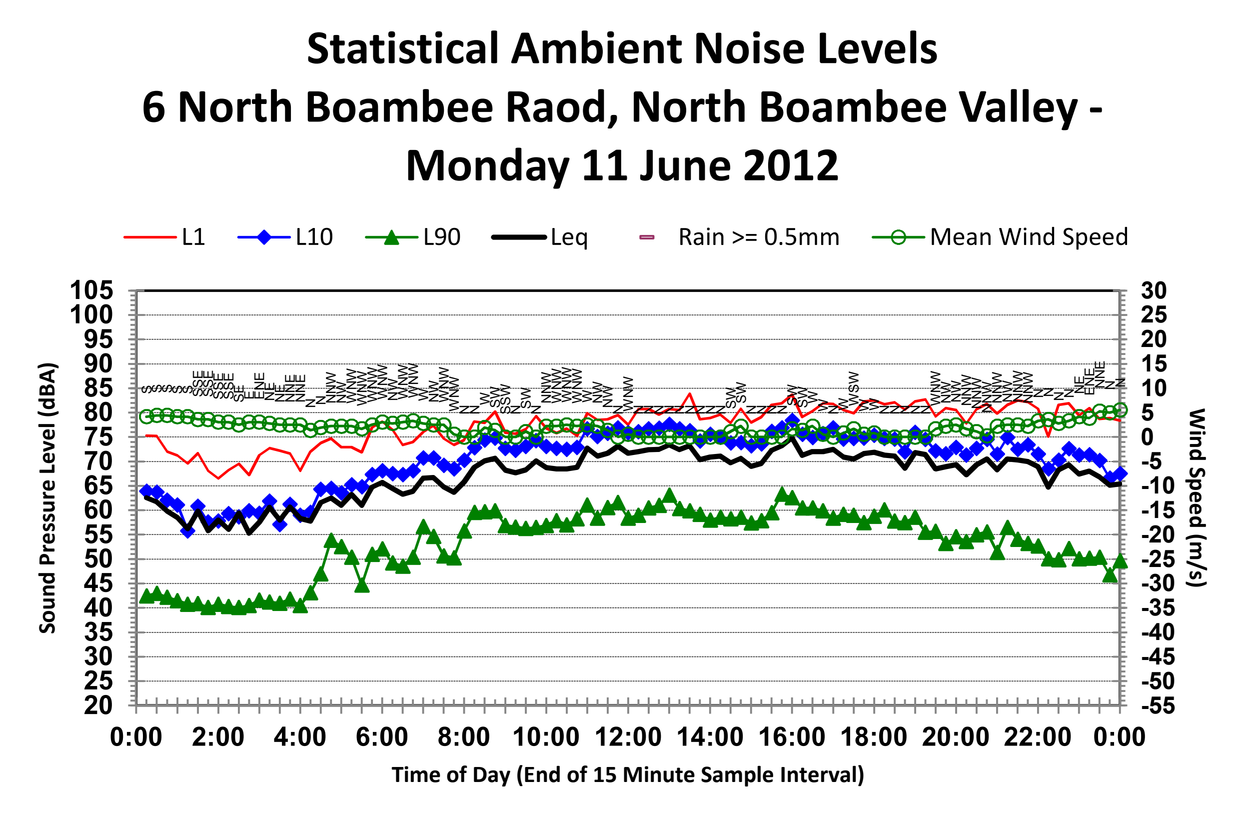


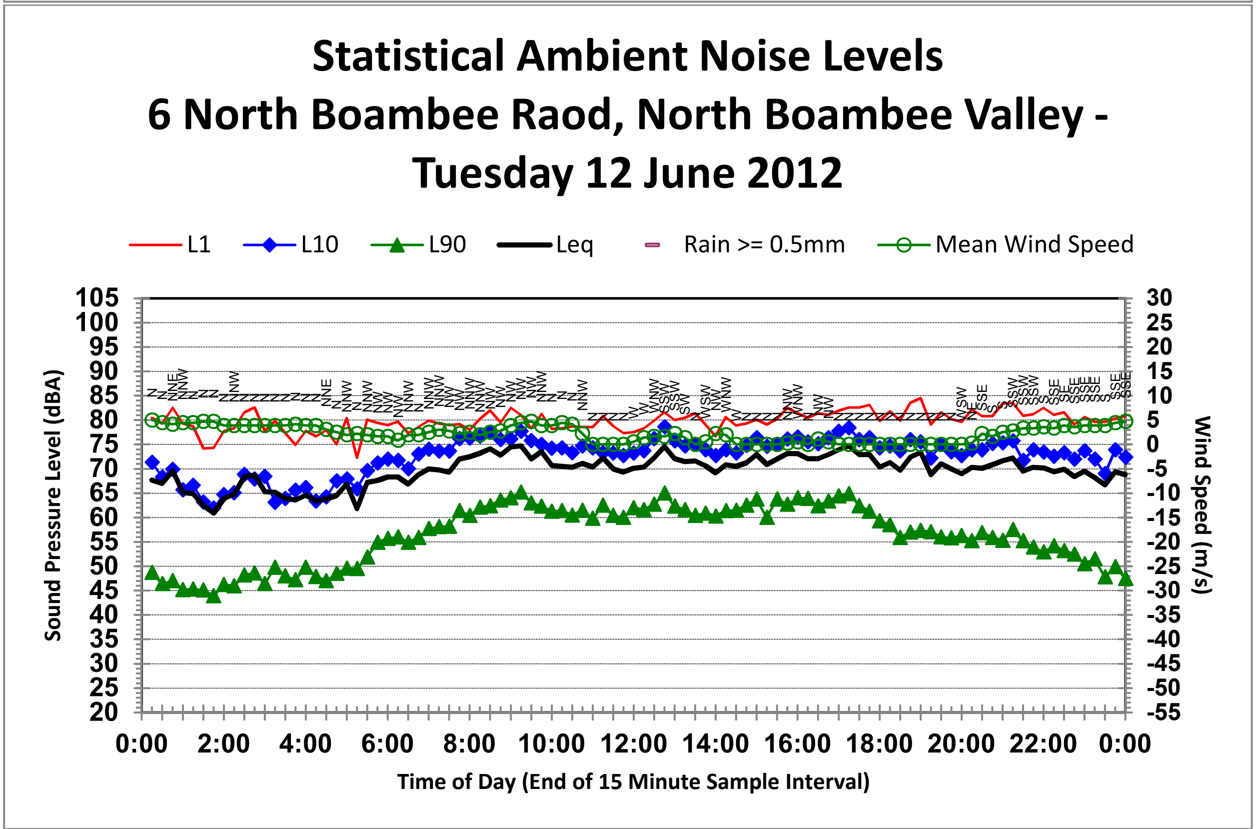


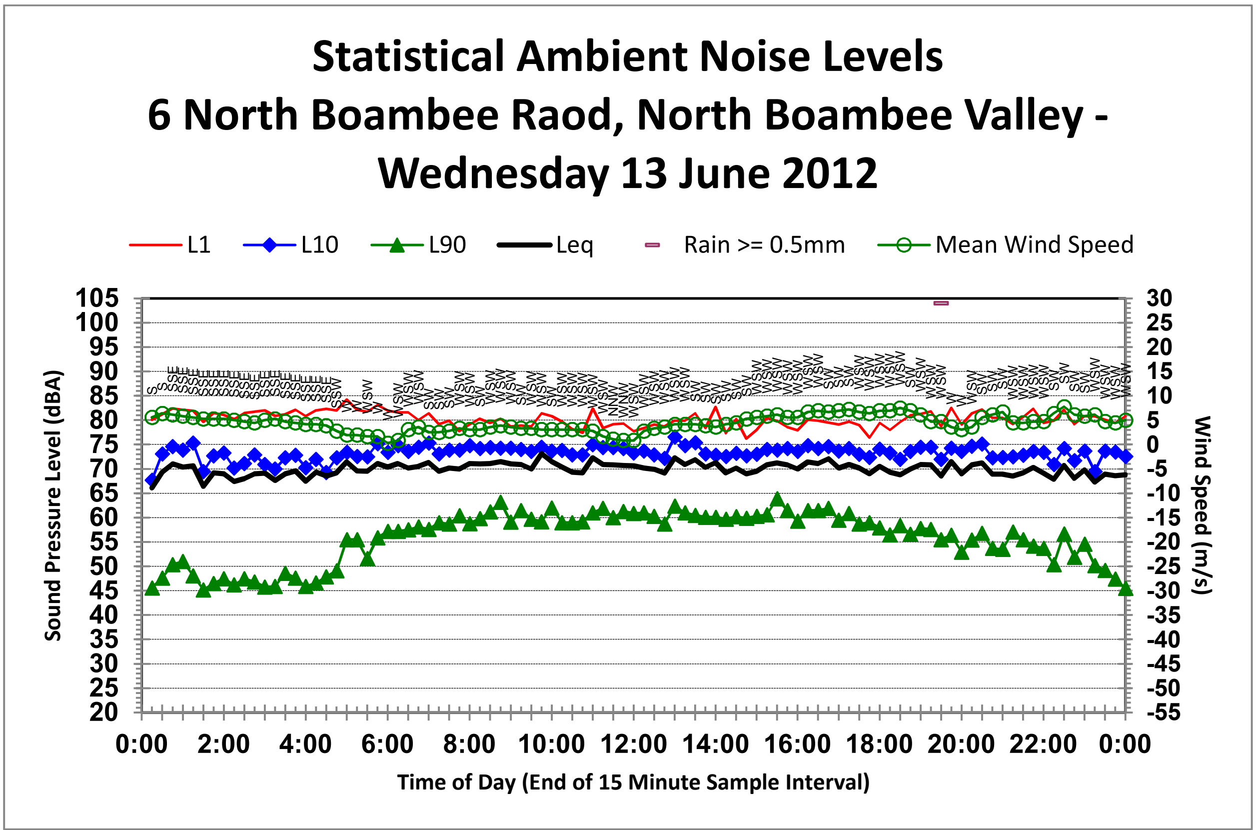
Statistical Ambient Noise Levels - 6 North Boambee Road, North Boambee Valley

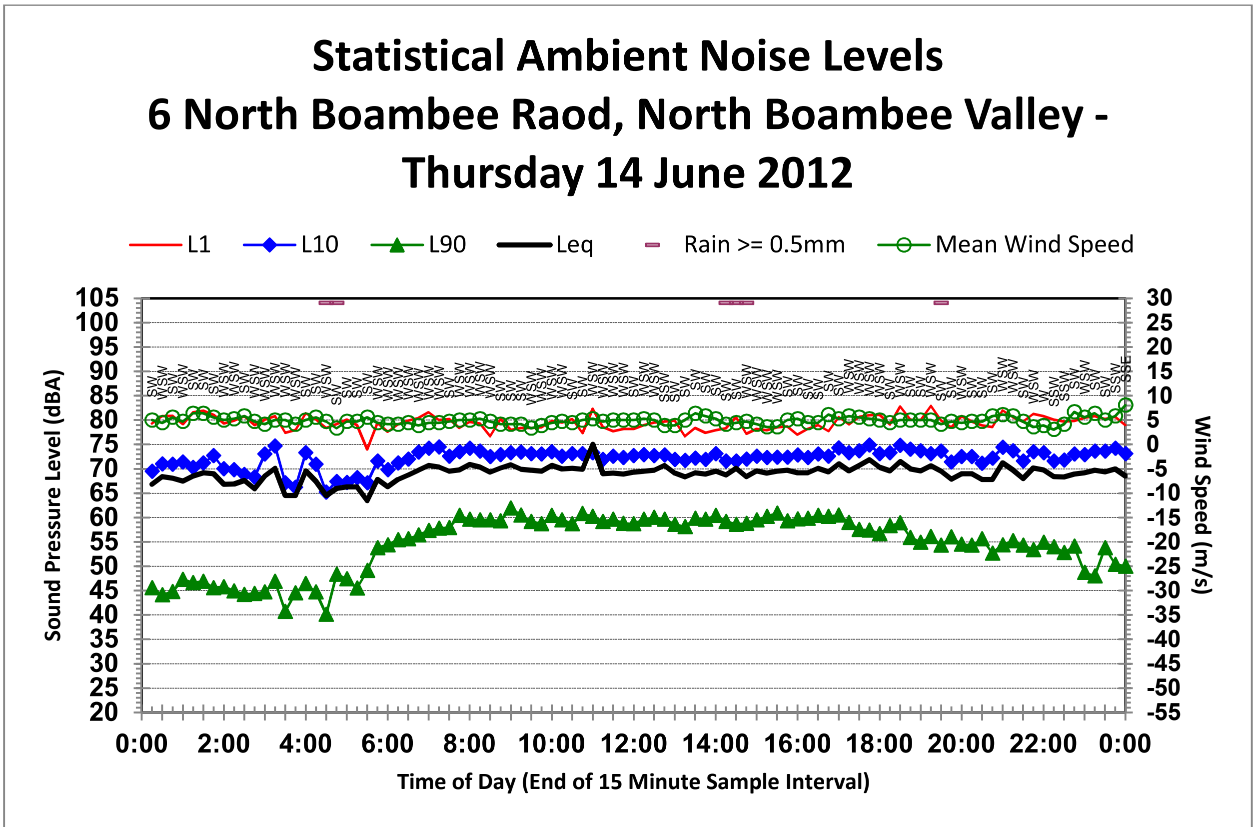




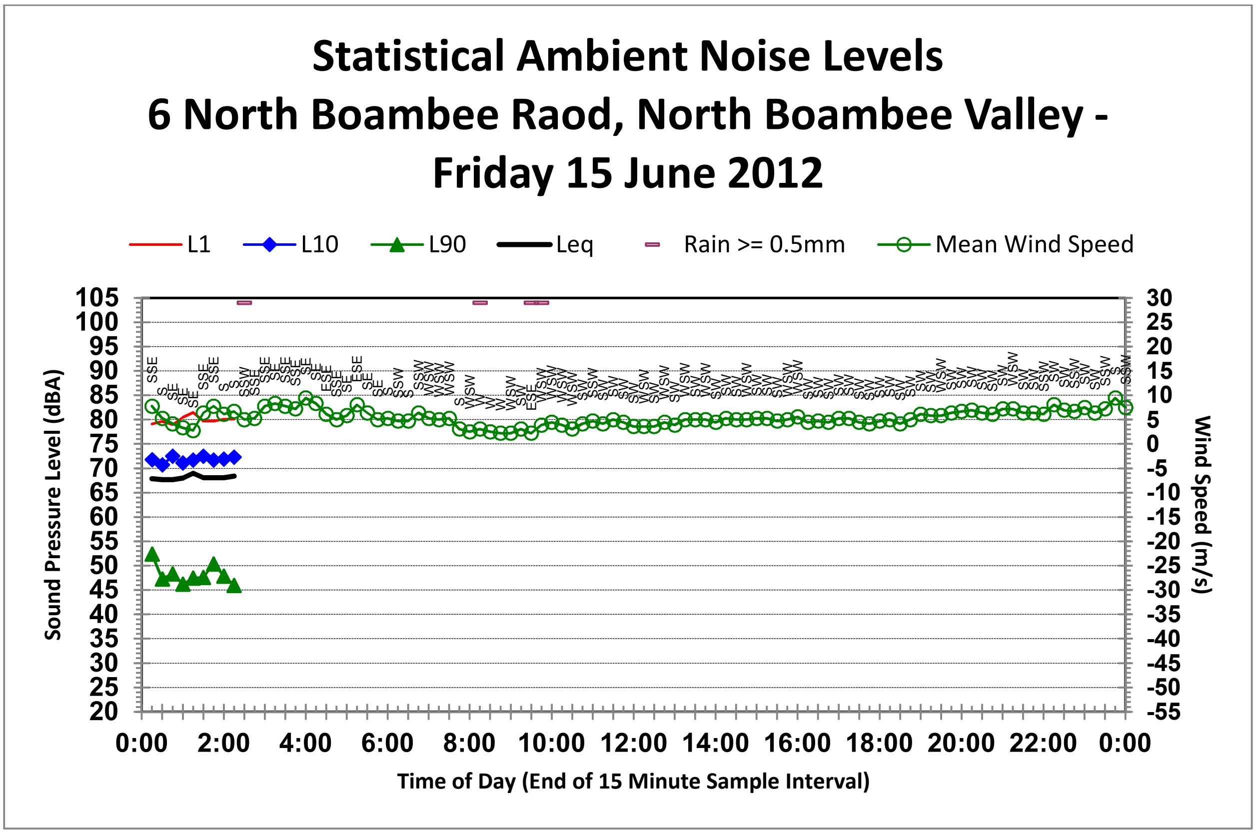

Statistical Ambient Noise Levels
6 North Boambee Raod, North Boambee Valley -
Monday 11 June 2012
L1
L10
L90
Leq
Rain >= 0.5mm
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
6 North Boambee Raod, North Boambee Valley -
Tuesday 12 June 2012
L1
L10
L90
Leq
Rain >= 0.5mm
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sample Interval)

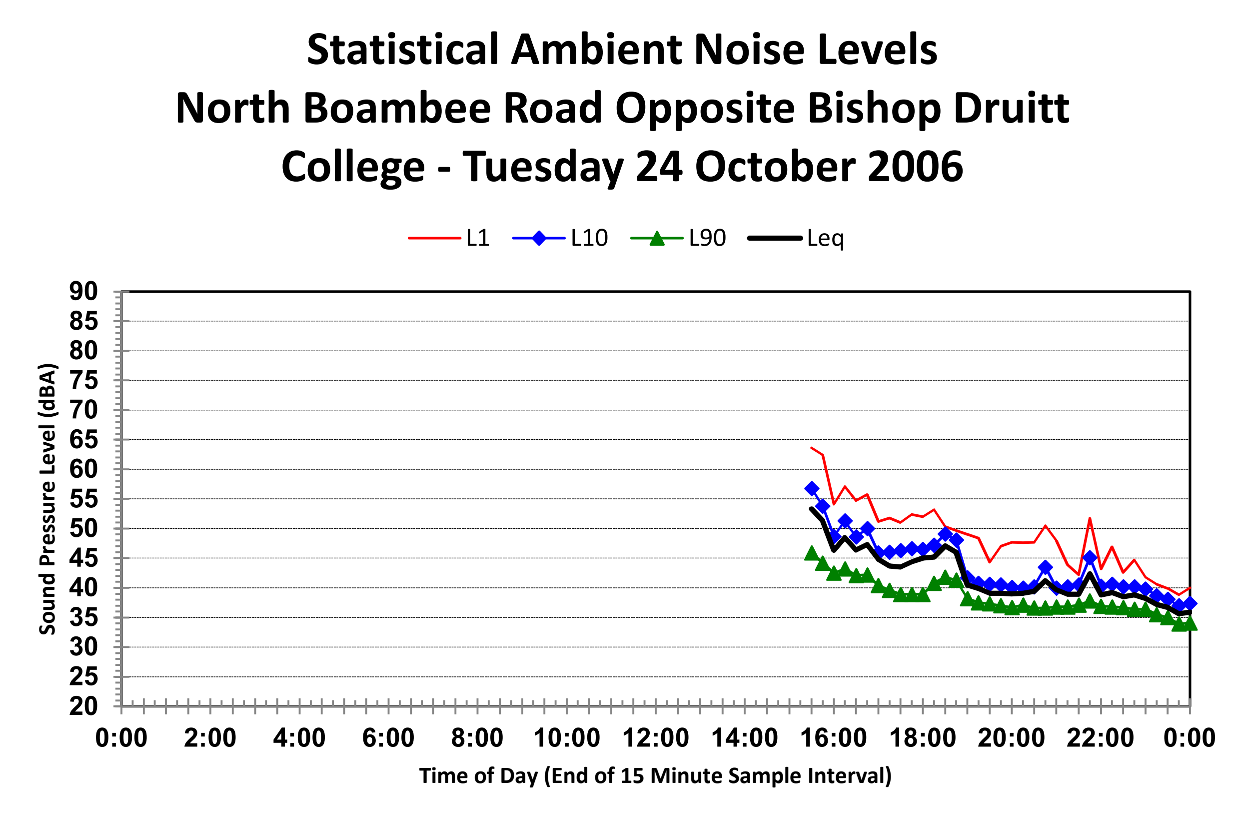

Statistical Ambient Noise Levels
6 North Boambee Raod, North Boambee Valley -
Wednesday 13 June 2012
L1
L10
L90
Leq
Rain >= 0.5mm
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s)
0:00 2:00 4:00 6:00 8:00 10:00 12:00 14:00 16:00 18:00 20:00 22:00 0:00
Time of Day (End of 15 Minute Sample Interval)

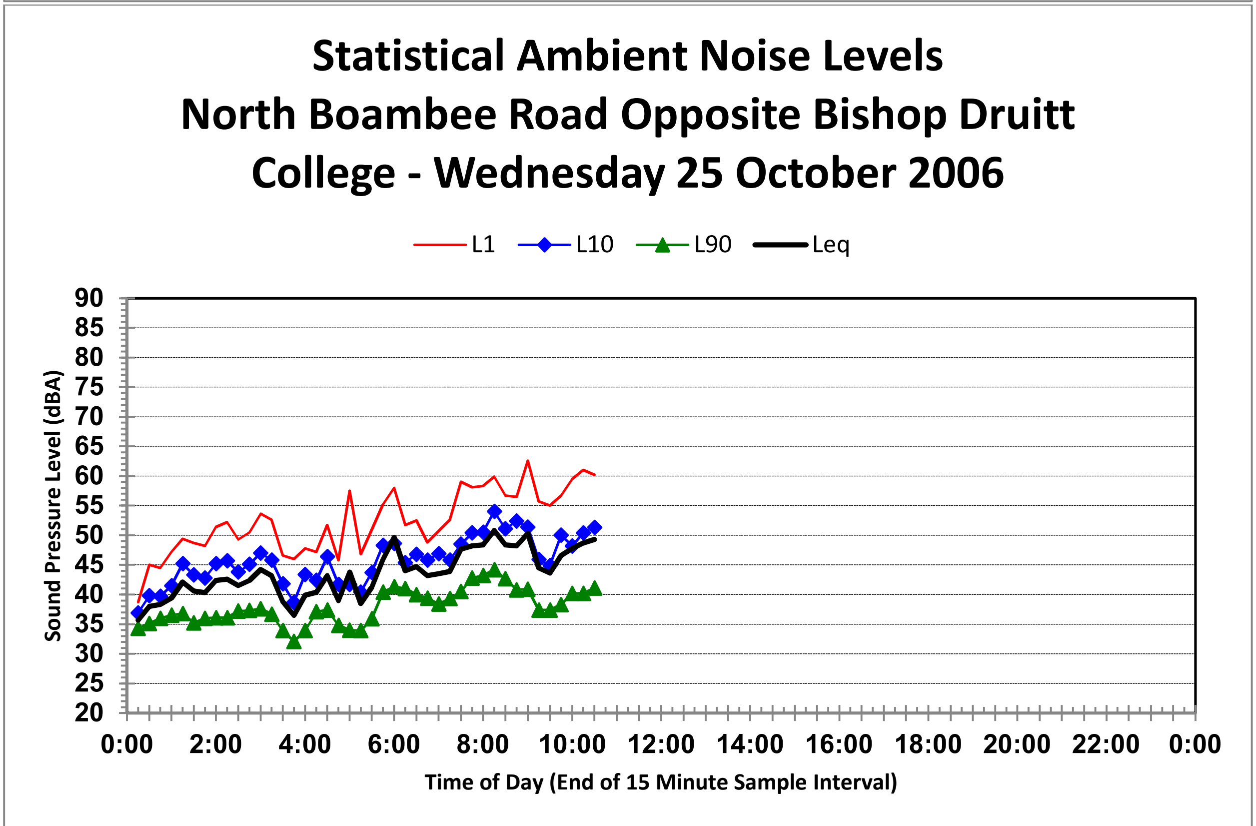

Statistical Ambient Noise Levels
6 North Boambee Raod, North Boambee Valley -
Thursday 14 June 2012
L1
L10
L90
Leq
Rain >= 0.5mm
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s)
0:00 2:00 4:00 6:00 8:00 10:00 12:00 14:00 16:00 18:00 20:00 22:00 0:00
Time of Day (End of 15 Minute Sample Interval)

Statistical Ambient Noise Levels - 6 North Boambee Road, North Boambee Valley

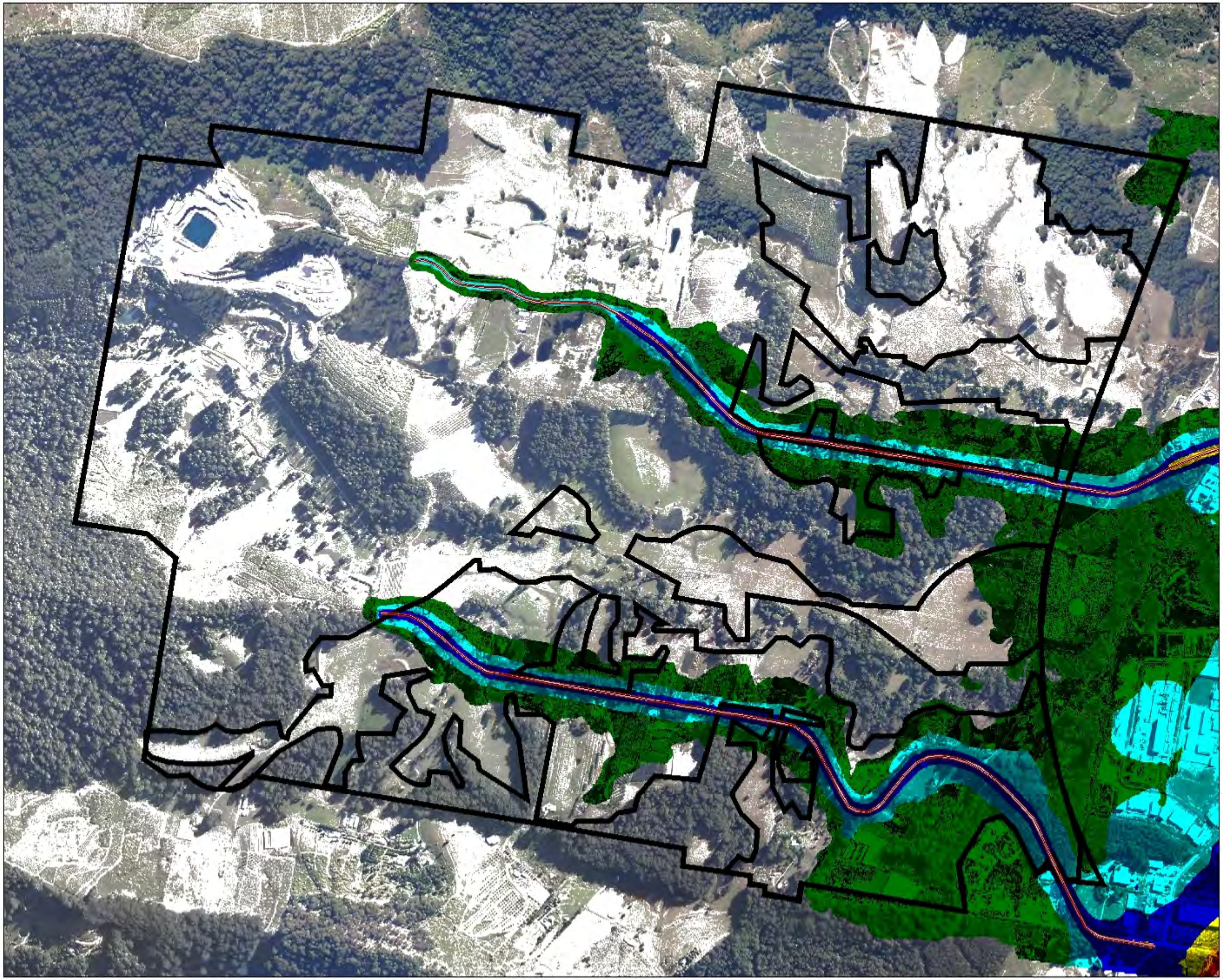


Statistical Ambient Noise Levels - North Boambee Road Opposite Bishop Druitt College





Appendix C1 - Day time 2012 noise contour LAeq (15 hour)



LEGEND

Legend

Study Area

Road Emission line

LAeq dBA Noise Level

= 45.0
= 50.0
= 55.0
= 60.0
= 65.0
= 70.0

0 50 100 200 300 400 m

N

NOTES

NOTES:
Calculation Parameters
1. Calculation Height 1.5m
2. 2.5dBA Facade Correction

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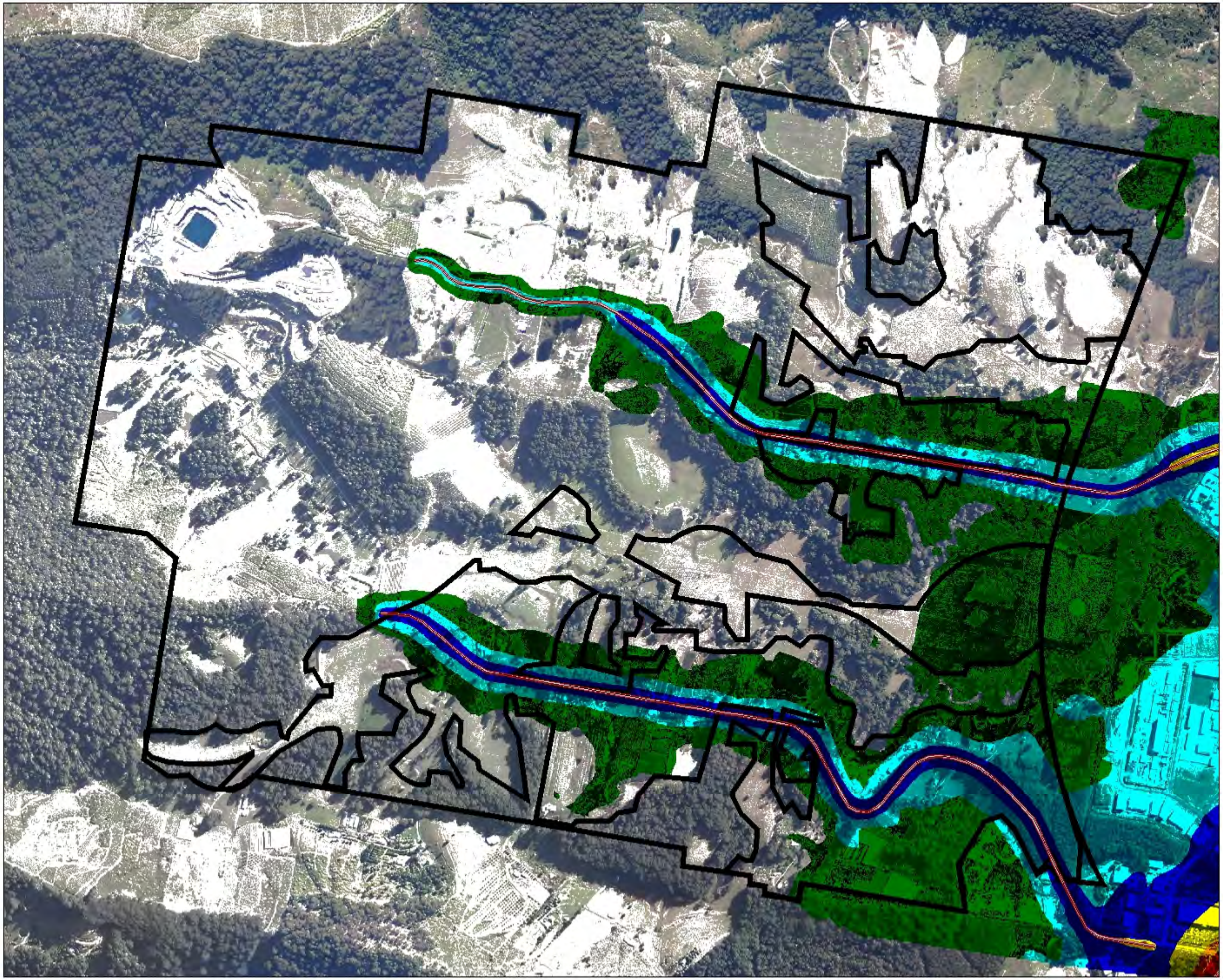
North Boambee Valley (West) Release Area

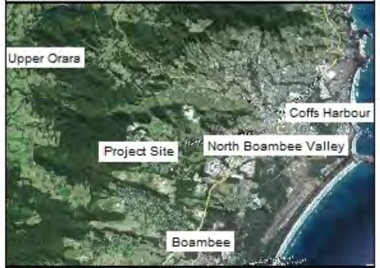
Prepared For:
de Groot & Benson Pty Ltd

Project No:
630.10324.00000

Scale 1:15000	Date: 20/07/2012
Drafted: Tristan Robertson	Approved: John Cotterill

Appendix C2 - Day time 2012 noise contour LAeq (15 hour)





LEGEND

Legend

Study Area

Road Emission line

LAeq dBA Noise Level

= 45.0
= 50.0
= 55.0
= 60.0
= 65.0
= 70.0

0 50 100 200 300 400 m

N

NOTES

NOTES:
Calculation Parameters
1. Calculation Height 4.5m
2. 2.5dBA Facade Correction

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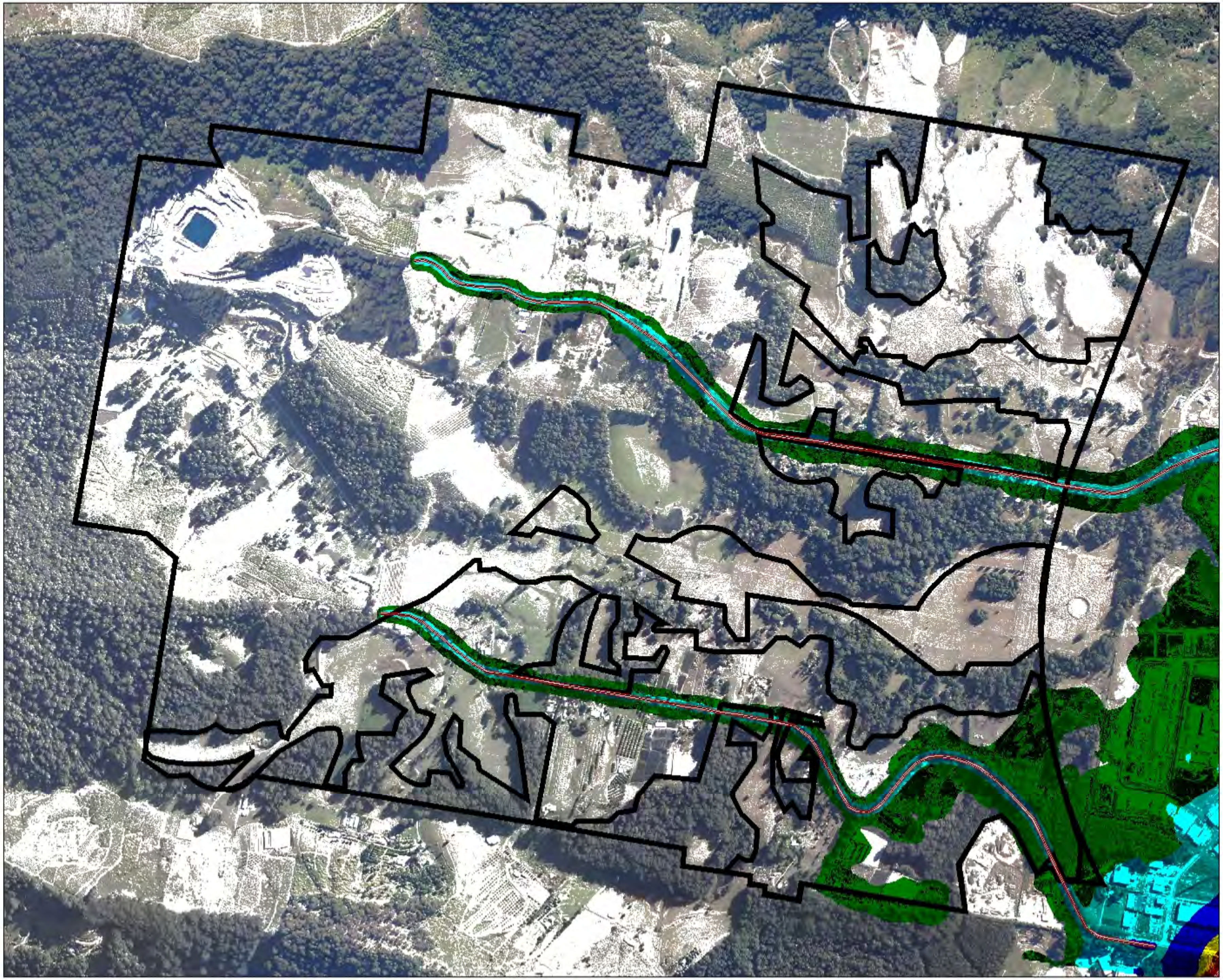
Appendix C3 - Night time 2012 noise contour LAeq (9 hour)



LEGEND

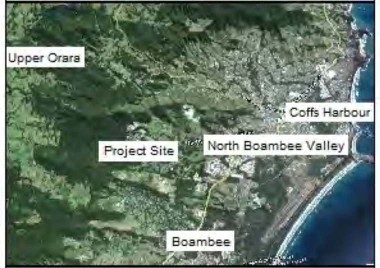
Legend

Study Area

Road Emission line

LAeq dBA Noise Level

- = 45.0
- = 50.0
- = 55.0
- = 60.0
- = 65.0
- = 70.0



0 50 100 200 300 400 m

N

NOTES

NOTES:
Calculation Parameters
1. Calculation Height 1.5m
2. 2.5dBA Facade Correction

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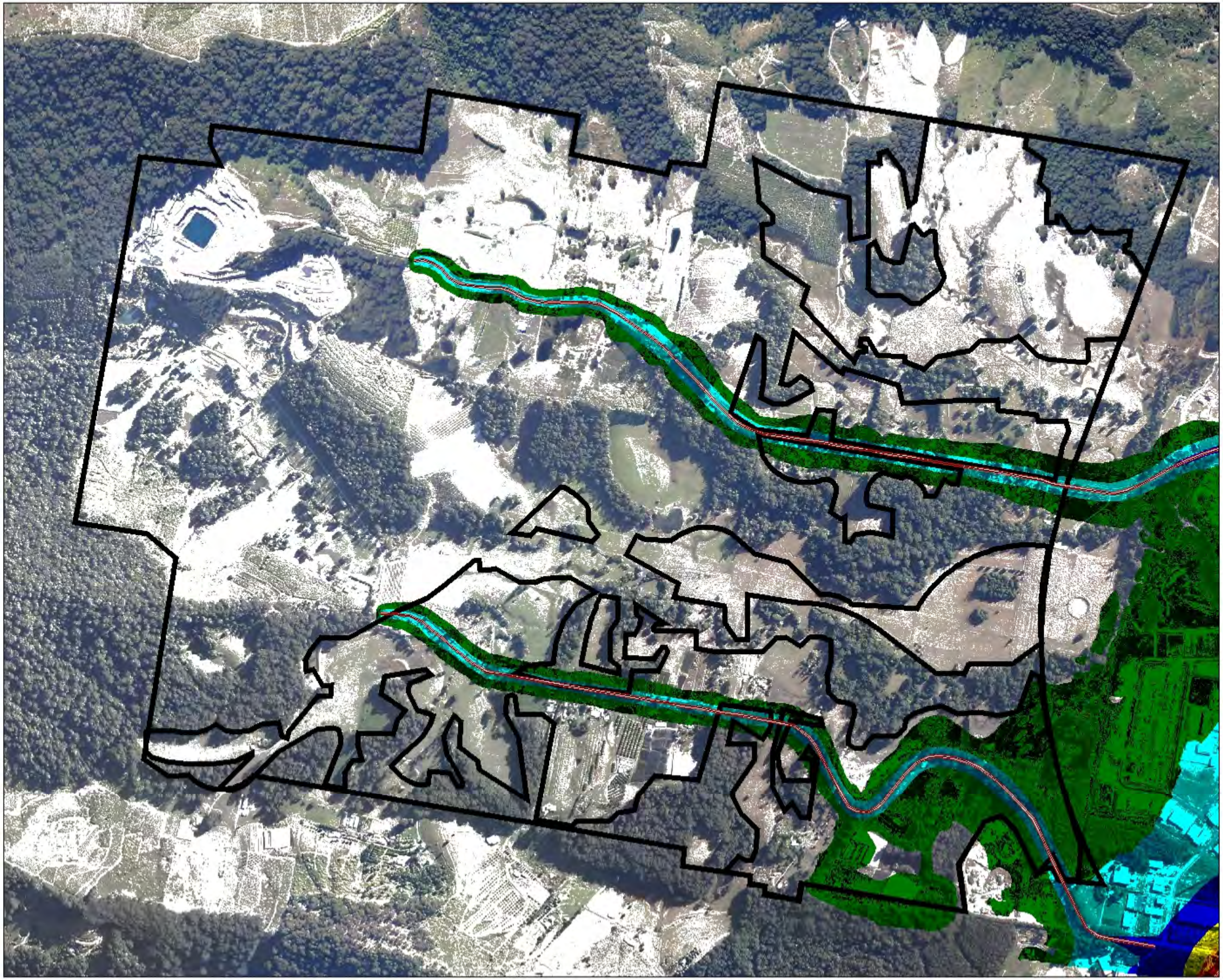
Appendix C4 - Night time 2012 noise contour LAeq (9 hour)



LEGEND

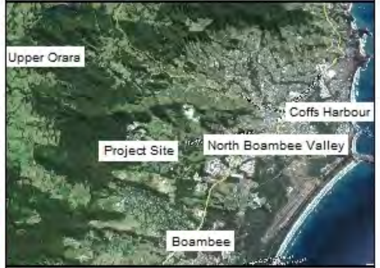
Legend

Study Area

Road Emission line

LAeq dBA Noise Level

- = 45.0
- = 50.0
- = 55.0
- = 60.0
- = 65.0
- = 70.0



0 50 100 200 300 400 m

N

NOTES

NOTES:

Calculation Parameters

1. Calculation Height 4.5m
2. 2.5dBA Facade Correction

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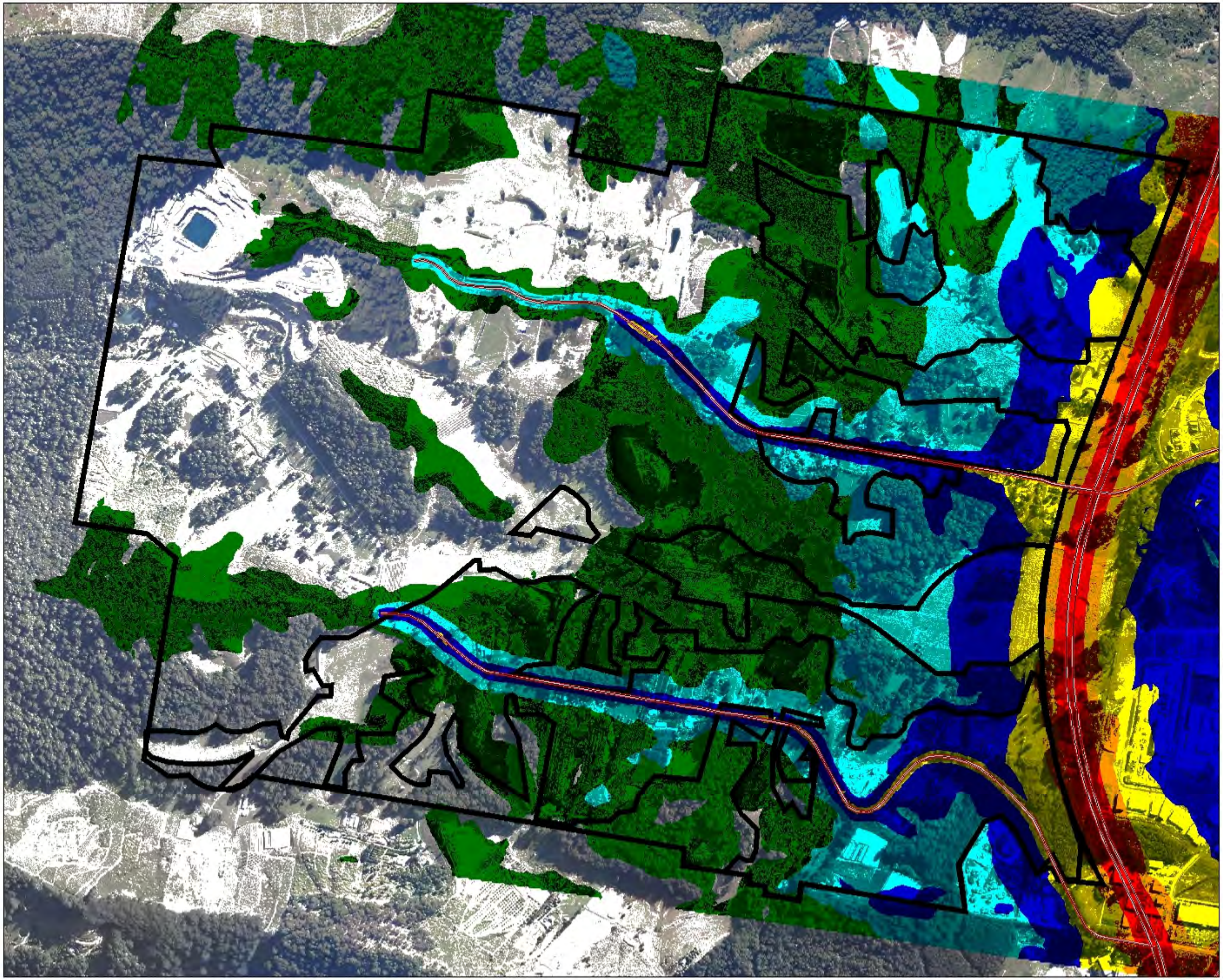
Scale 1:15000	Date: 20/07/2012
Drafted: Tristan Robertson	Approved: John Cotterill

Appendix D1 - Day time 2022 noise contour LAeq (15 hour)



LEGEND

Legend

Study Area

Road Emission line

LAeq dBA Noise Level

= 45.0

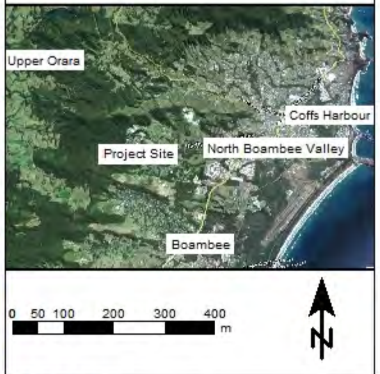
= 50.0

= 55.0

= 60.0

= 65.0

= 70.0



NOTES

NOTES:

Calculation Parameters

1. Calculation Height 1.5m
2. 2.5dBA Facade Correction

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Scale 1:15000	Date: 20/07/2012
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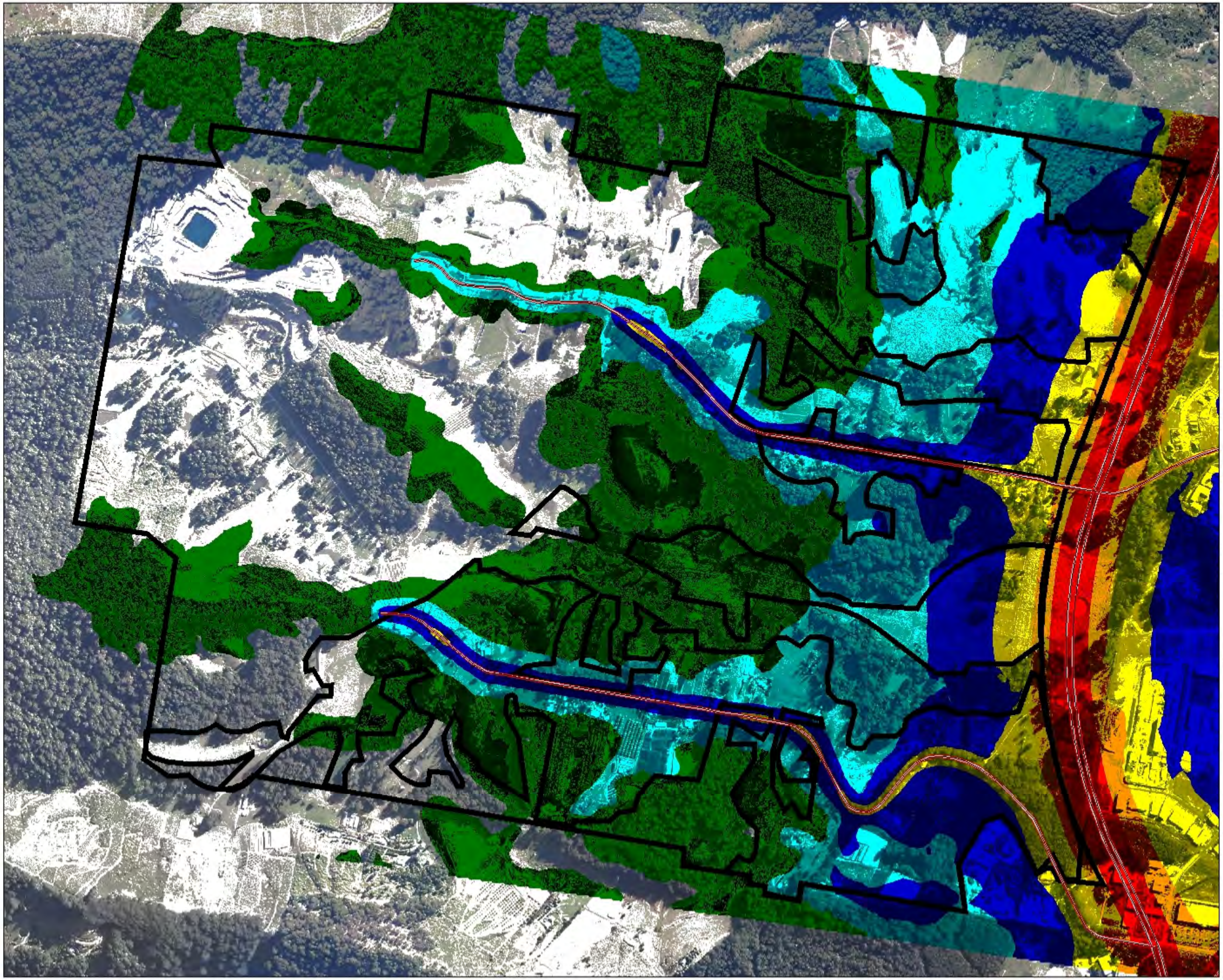
Appendix D2 - Day time 2022 noise contour LAeq (15 hour)



LEGEND

Legend

Study Area

Road Emission line

LAeq dBA Noise Level

= 45.0

= 50.0

= 55.0

= 60.0

= 65.0

= 70.0

0 50 100 200 300 400 m

N

NOTES

NOTES:
Calculation Parameters
1. Calculation Height 4.5m
2. 2.5dBA Facade Correction

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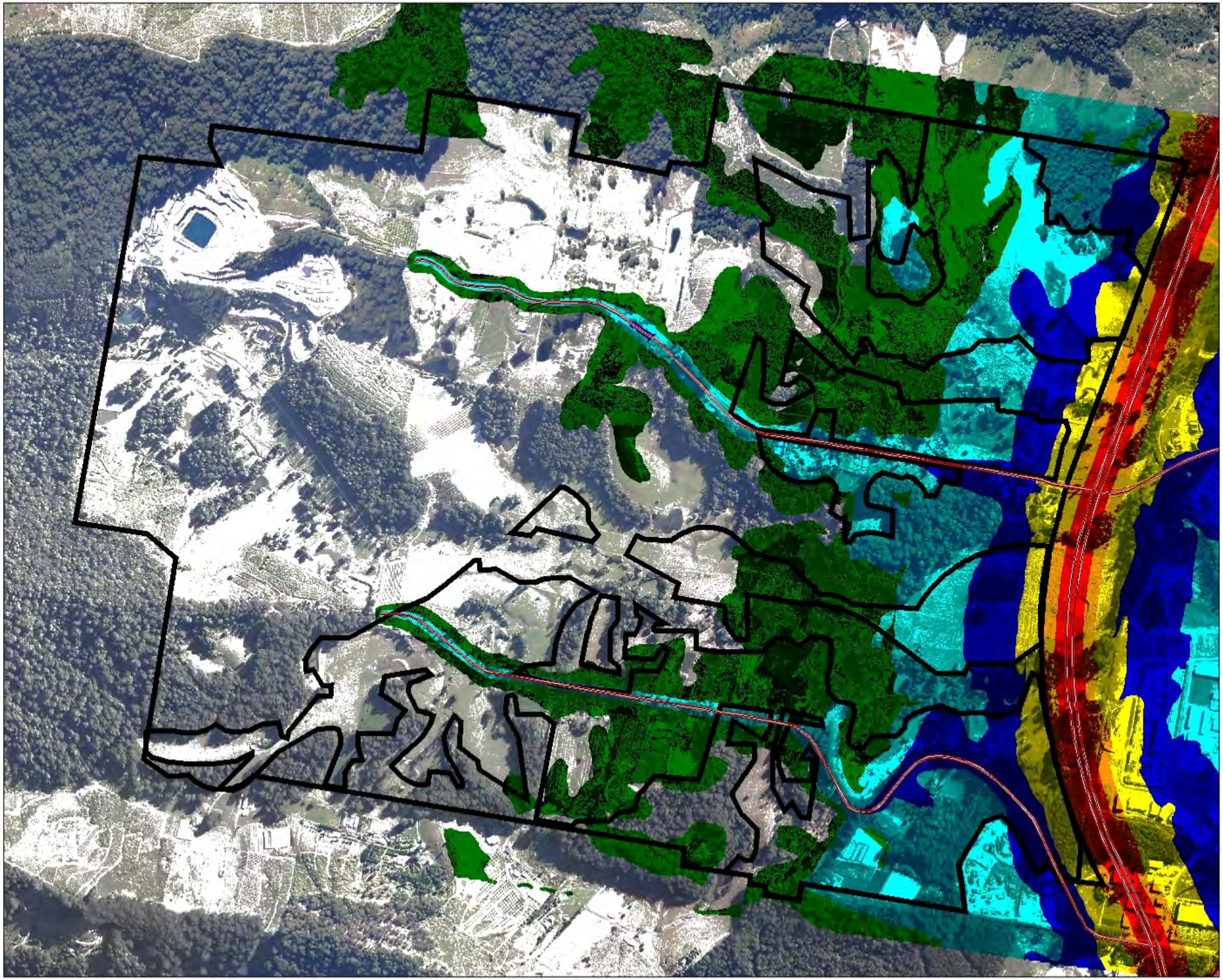
Appendix D3 - Night time 2022 noise contour LAeq (9 hour)



LEGEND

Legend
- Study Area
- Road Emission line

LAeq dBA Noise Level

- = 45.0
- = 50.0
- = 55.0
- = 60.0
- = 65.0
- = 70.0

0 50 100 200 300 400 m

N

NOTES

NOTES:
Calculation Parameters
1. Calculation Height 1.5m
2. 2.5dBA Facade Correction

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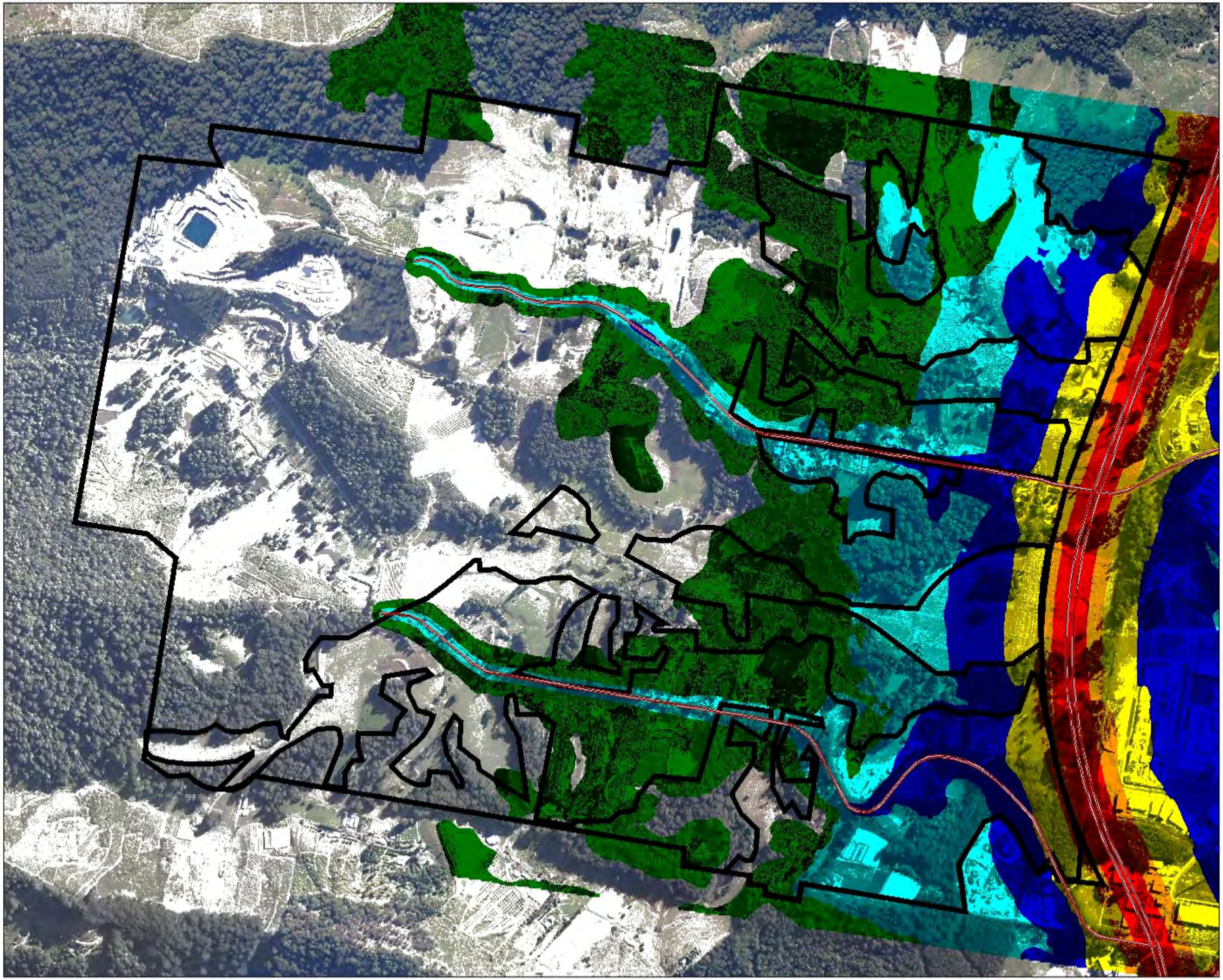
Appendix D4 - Night time 2022 noise contour LAeq (9 hour)



LEGEND

Legend

Study Area

Road Emission line

LAeq dBA Noise Level

= 45.0
= 50.0
= 55.0
= 60.0
= 65.0
= 70.0

NOTES

NOTES:
Calculation Parameters
1. Calculation Height 4.5m
2. 2.5dBA Facade Correction

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Project No:
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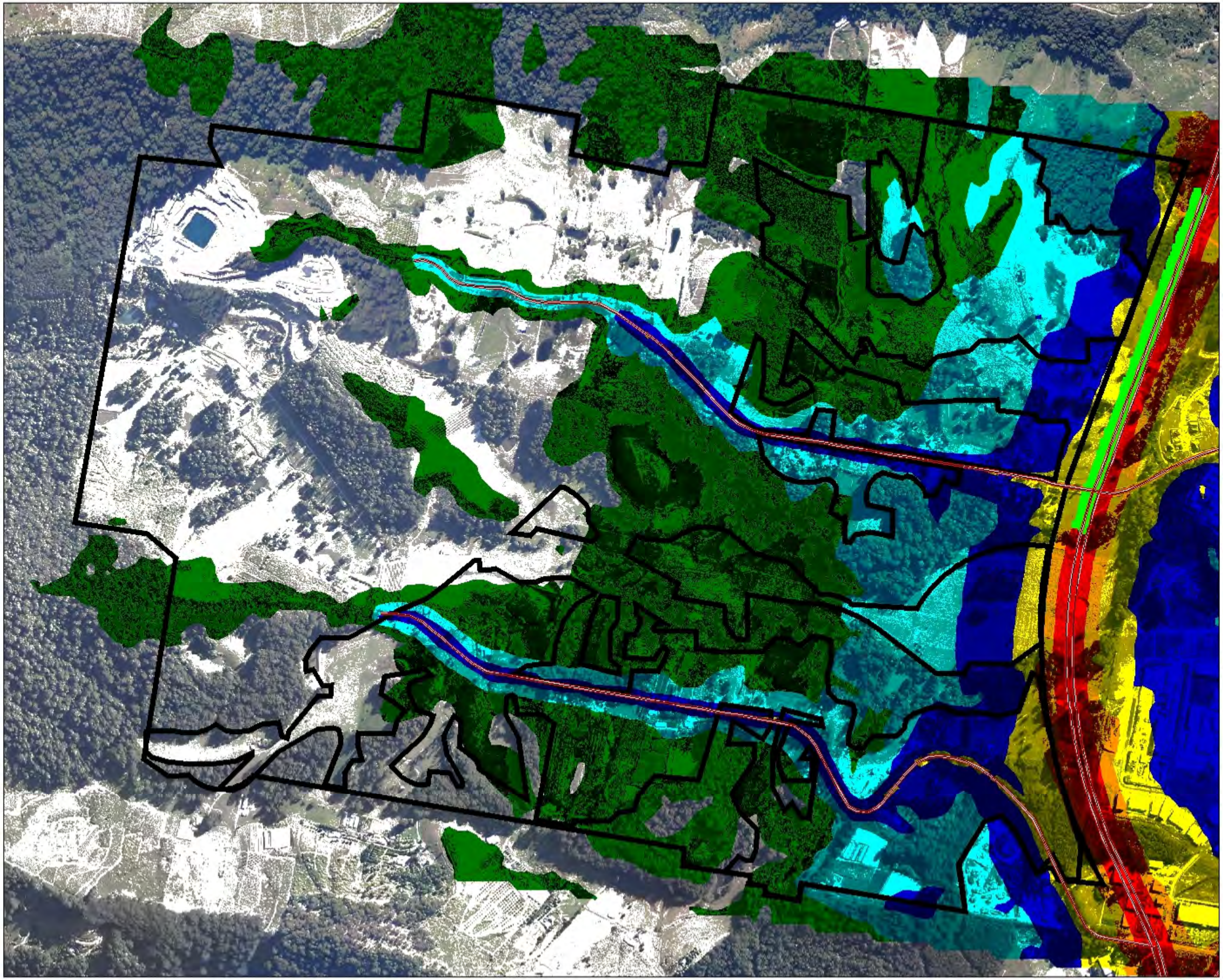
Scale 1:15000	Date: 20/07/2012
Drafted: Tristan Robertson	Approved: John Cotterill

Appendix E1 - Night time 2022 noise contour LAeq (9 hour) - With Mitigation



LEGEND

Legend

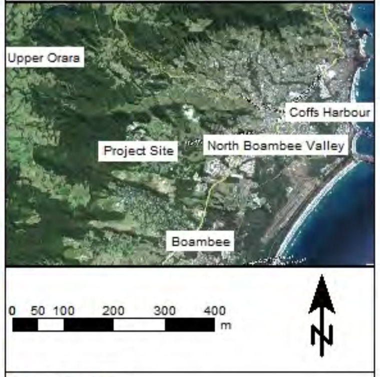
Study Area

Road Emission line

3m Noise Wall

LAeq dBA Noise Level

= 45.0
= 50.0
= 55.0
= 60.0
= 65.0
= 70.0



NOTES

NOTES:
Calculation Parameters
1. Calculation Height 1.5m
2. 2.5dBA Facade Correction
3. 3m high noise wall

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Project No:
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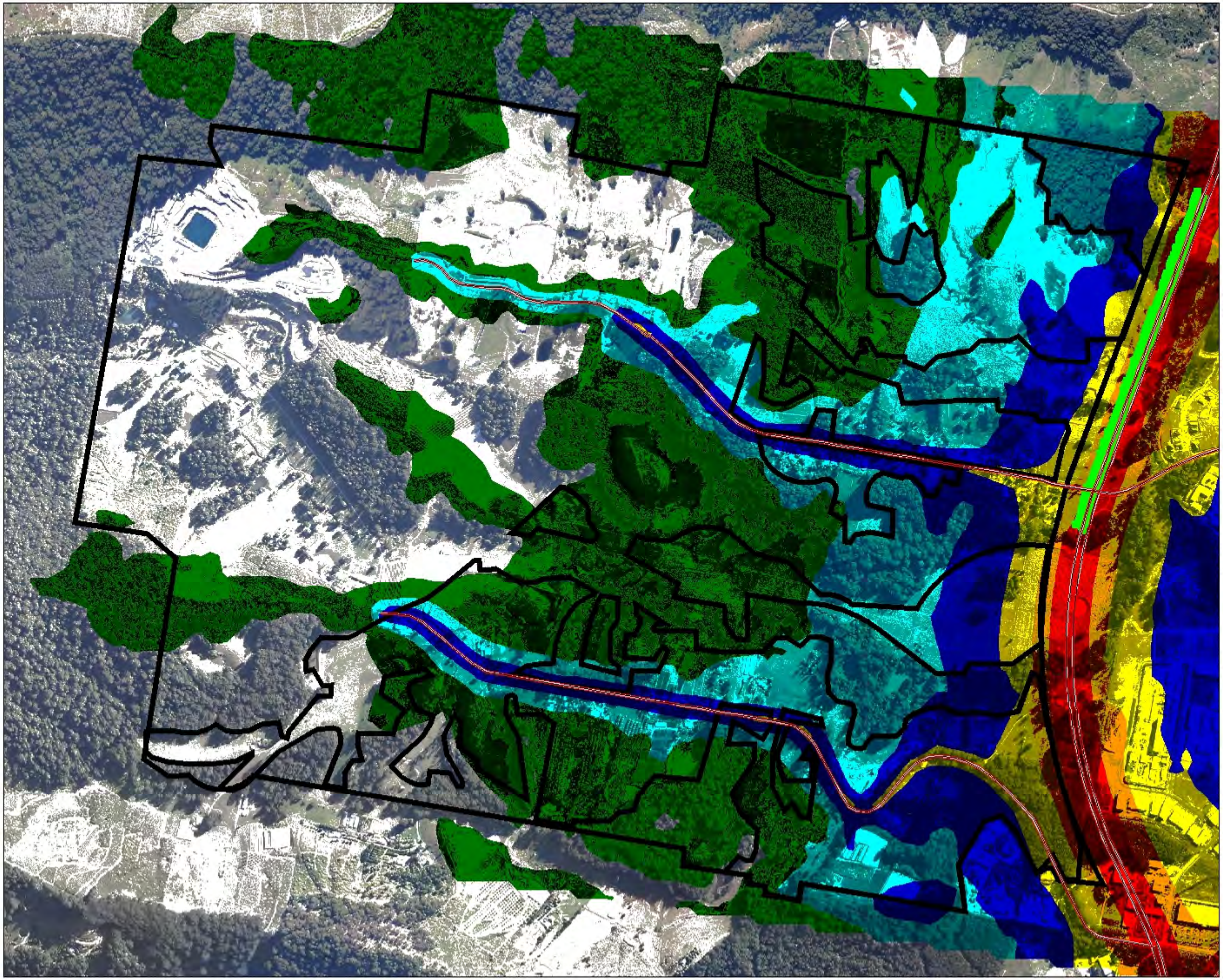
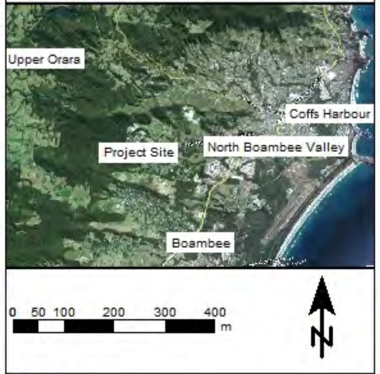
Scale 1:15000	Date: 20/07/2012
Drafted: Tristan Robertson	Approved: John Cotterill

Appendix E2 - Day time 2022 noise contour LAeq (15 hour) - With Mitigation





LEGEND

Legend

- Study Area
- Road Emission line
- 3m Noise Wall

LAeq dBA Noise Level

- = 45.0
- = 50.0
- = 55.0
- = 60.0
- = 65.0
- = 70.0

NOTES

NOTES:
Calculation Parameters
1. Calculation Height 4.5m
2. 2.5dBA Facade Correction
3. 3m high noise wall

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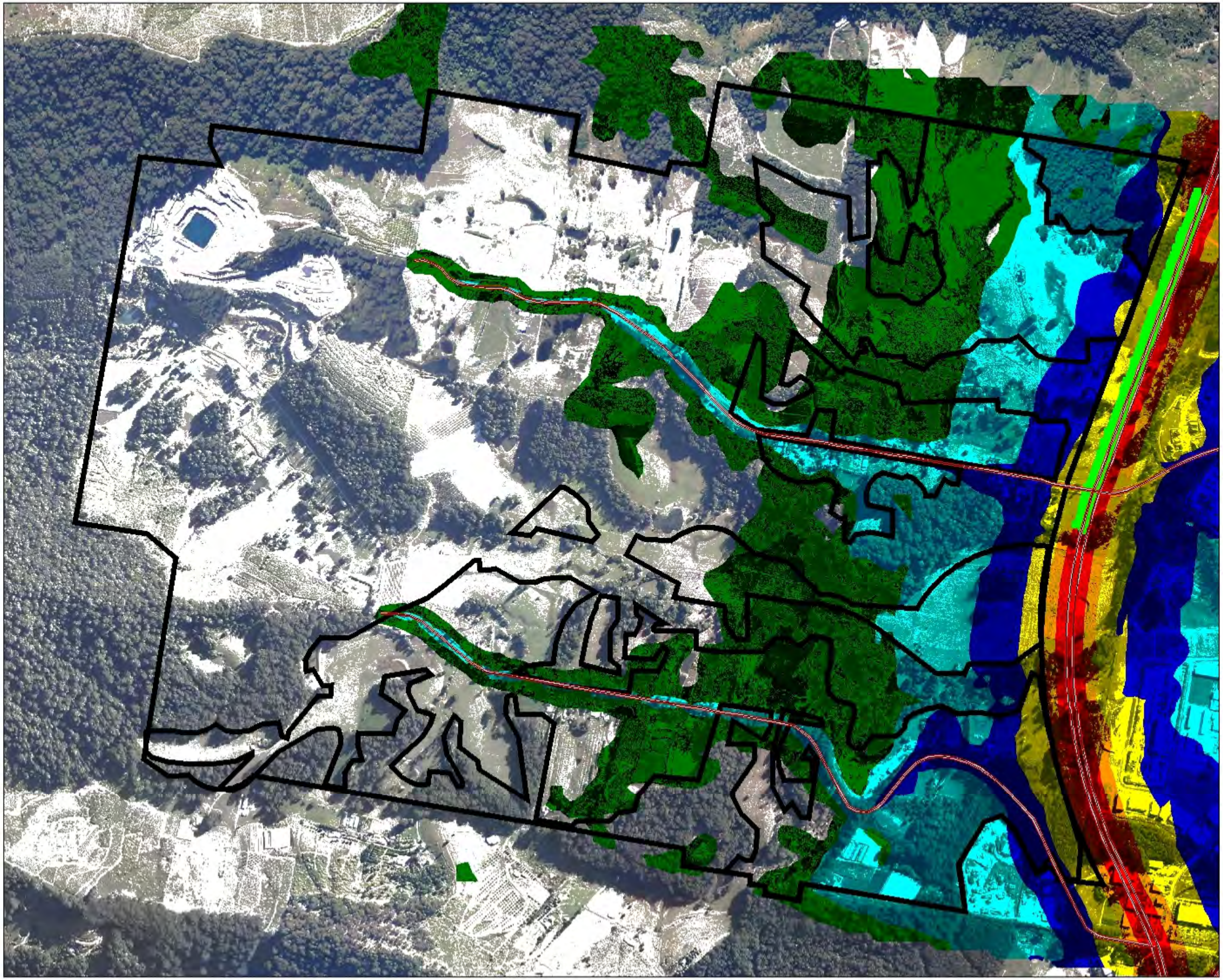
Project No:
630.10324.00000

Scale 1:15000	Date: 20/07/2012
Drafted: Tristan Robertson	Approved: John Cotterill

Appendix E3 - Night time 2022 noise contour LAeq (9 hour) - With Mitigation



LEGEND

Legend

- Study Area
- Road Emission line
- 3m Noise Wall

LAeq dBA Noise Level

- = 45.0
- = 50.0
- = 55.0
- = 60.0
- = 65.0
- = 70.0

0 50 100 200 300 400 m

N

NOTES

NOTES:
Calculation Parameters
1. Calculation Height 1.5m
2. 2.5dBA Facade Correction
3. 3m high noise wall

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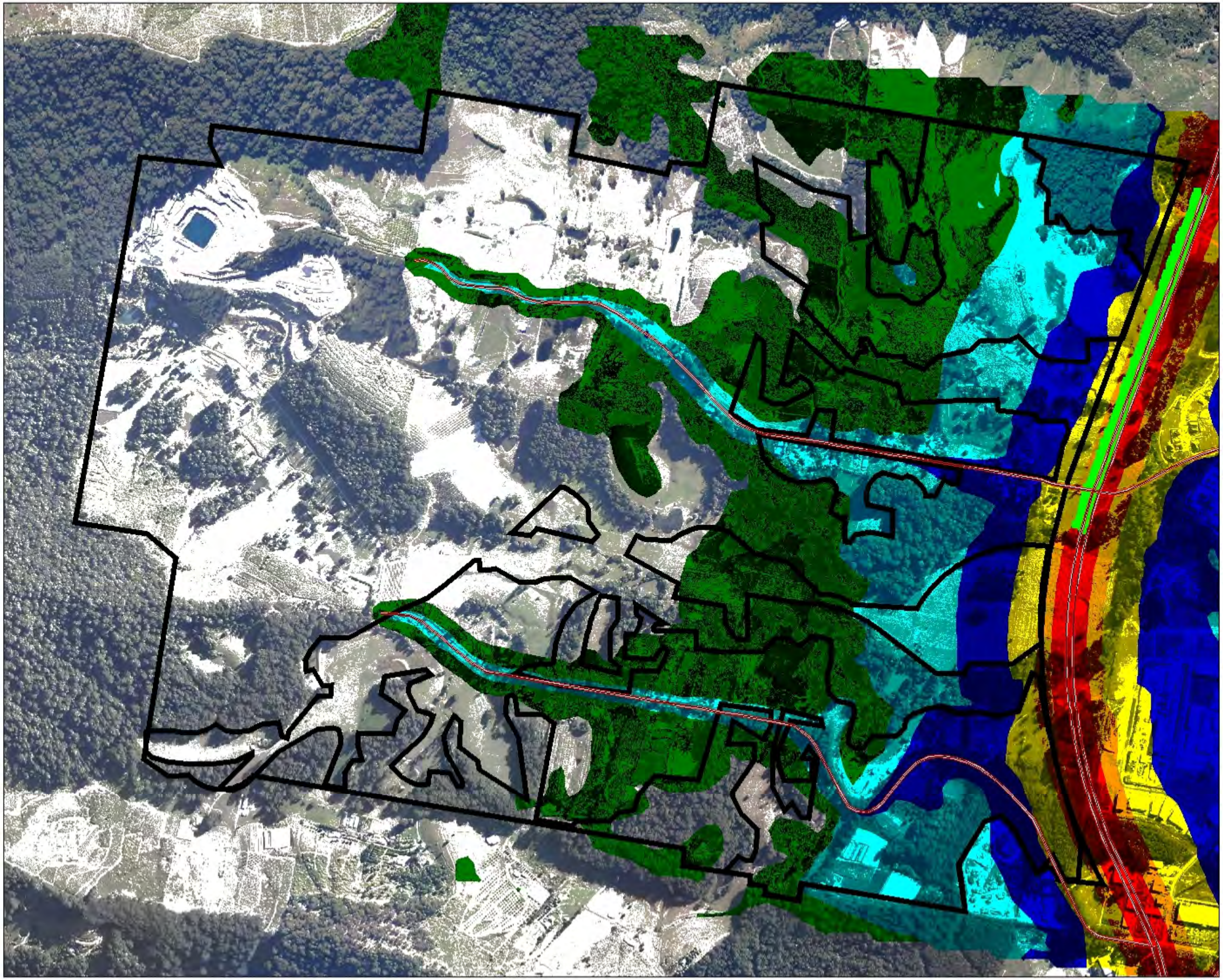
Drafted: Tristan Robertson	Approved: John Cotterill

Appendix E4 - Night time 2022 noise contour LAeq (9 hour) - With Mitigation



LEGEND

Legend

- Study Area
- Road Emission line
- 3m Noise Wall

LAeq dBA Noise Level

- = 45.0
- = 50.0
- = 55.0
- = 60.0
- = 65.0
- = 70.0

0 50 100 200 300 400 m

NOTES

NOTES:

Calculation Parameters

1. Calculation Height 4.5m
2. 2.5dBA Facade Correction
3. 3m high noise wall

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