



Transport
Roads & Maritime
Services

OPERATIONAL NOISE MANAGEMENT REPORT

Pacific Highway upgrade, Sapphire to
Woolgoolga

FEBRUARY 2014





**COFFS HARBOUR CITY COUNCIL
HW10 PACIFIC HIGHWAY
SAPPHIRE TO WOOLGOOLGA UPGRADE**

**OPERATIONAL NOISE MANAGEMENT
REPORT**

Part 1:

Noise Modelling and Calibration

ZONE 0000

Lot No: Lot S2W-20-0000-EN052E

Doc No: S2W-REP-20-0000-EN052E-FD-14

Phase: Final Design

December 2013

Prepared for
Contractor:



Prepared by
Designer:



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Table of Contents

1. INTRODUCTION.....	5
1.1. General	5
1.2. Description of Package	5
1.3. Design Year	5
2. NOISE CRITERIA	7
2.1. Minister's Conditions of Approval	7
2.2. Statement of Commitments	8
2.3. RMS Scope of Works and Technical Criteria Appendix 4	9
2.4. EPA Environmental Criteria for Road Traffic Noise	11
2.5. RMS Environmental Noise Management Manual	12
3. BACKGROUND NOISE MONITORING.....	14
3.1. Noise Loggers - General	14
3.2. Noise Monitoring Instrumentation	14
3.3. Noise Monitoring Results	14
3.4. Traffic Volume Counting	16
4. NOISE MODELLING.....	17
4.1. Noise Modelling Inputs	17
4.2. Ground Absorption	17
4.3. Traffic Source Strings	17
4.4. Road Surface Corrections	18
4.5. Sensitivity Allowance Correction	18
4.6. Noise Barriers	18
4.7. Headlight Screens	19
4.8. Additional Noise Barriers	24
4.8.1. General	24
4.8.2. Case Study 1: Coachmans Close, Sapphire Beach	25
4.8.3. Case Study 2: Hunter Close, Korora	26
4.8.4. Case Study 3: North of Sugarmill Road, East Side of Highway, Sapphire Beach	27
4.8.5. Case Study 4: 1206 Pacific Highway, Moonee Beach (opposite Maccues Road)	28
4.8.6. Case Study 5: Emerald Heights Drive	28
4.8.7. Case Study 6: Newmans Road	29
4.8.8. Case Study 7: North of Sugarmill Road, West side of Highway	31
4.8.9. Case Study 8: Crystal Drive	31
4.8.10. Case Study 9: Wakelands Road	32
4.8.11. Case Study 10: Heritage Park	33



4.8.12. Case Study 11: Seaview close	33
4.8.13. Case Study 12: Emerald Beach – Fiddaman Road	34
4.9. Traffic Volumes	35
4.10. Noise Modelling Scenarios	37
5. NOISE MODEL CALIBRATION.....	39
6. NOISE MODELLING OUTPUTS.....	41
6.1. Noise Mitigation	41
6.2. Noise Contours	41
6.3. Noise Analysis Results	42

Appendices

Appendix A – Noise Logger Locations and Photographs

Appendix B – Ambient Noise Monitoring Graphs

Appendix C – Noise Contours

Appendix D – Detailed Assessment of Additional Noise Barriers

D1: Coachmans Close

D2: Hunter Close

D3: North of Sugarmill Road, East Side of Highway, Sapphire Beach

D4: 1206 Pacific Highway, Moonee Beach (opposite Maccues Road)

D5: Emerald Heights Drive

D6: Newmans Road

D7: Crystal Drive

Appendix E – Noise Analysis Results

Appendix F – Summary of Treatment Changes

1. INTRODUCTION

1.1. General

The Pacific Highway Upgrade from Sapphire to Woolgoolga includes the following:

- Duplication of the existing highway to a four lane dual carriageway between Sapphire and South Woolgoolga.
- Dual carriageway bypass of Woolgoolga deviating from the existing highway alignment north of Graham Drive North and rejoining the existing highway near Arrawarra Beach Road.
- Grade separated interchanges:
 - Sapphire Interchange at Split Solitary Road
 - Moonee Beach Interchange at Moonee Beach Road
 - Emerald Interchange South
 - Emerald Interchange North
 - South Woolgoolga Interchange at Graham Drive North
 - Arrawarra Interchange at Arrawarra Beach Road
- Approx 16 km of Access Roads and Local Roads
- Access road/local road highway crossings at Headland Road, Killara Avenue, Smiths Road, Diamond Head Drive, Greys Road, Woolgoolga Creek Road, Newmans Road and Bark Hut Road.
- Relocation of various public utilities and services including high and low voltage overhead and underground power lines, telecommunications, network water mains and sewer mains.

1.2. Description of Package

This report forms Part 1 of the Operational Noise Management Report (ONMR). This report outlines the noise criteria, noise model inputs and calibration processes incorporated to develop the noise model and considers the requirements for additional noise mitigation. The structure of the ONMR is set out in the Table 1.1.

1.3. Design Year

The design year for the noise modelling is 2024, 10 years after opening. Refer to Section 4.9 Traffic Volumes and Section 4.10 Noise Modelling Scenarios for further information. Noise contours are also provided for the year 2021 to compare with the Road and Maritime Service's (RMS) $L_{Aeq(9hr)}$ 50 dB(A) Year 2021 noise contours.

Table 1.1 ONMR Report Structure

Lot Title	Lot Number
Operational Noise Management Report <i>Part 1: Noise Modelling and Calibration</i>	S2W-20-0000-EN052E
Operational Noise Management Report <i>Part 2: Properties Eligible for Architectural Treatment Identified in the Environmental Assessment</i>	S2W-20-0000-EN052A
Operational Noise Management Report <i>Part 3: Additional Properties Eligible for Architectural Treatment</i>	S2W-20-0000-EN052B
Operational Noise Management Report <i>Part 4: Property Treatment Plans</i>	S2W-20-0000-EN052G

Table 1.2 ONMR Digital Files

Model Description	File Reference
Façade model DWG ¹	S2W-xrf-00-0000-facade.dwg
Facade model PDF ¹	Architectural Facade Treatments_Nov 2013.pdf

Note 1: The façade model provides the treatment eligibility at each floor and façade. This is recorded on different layers within the model.

2. NOISE CRITERIA

2.1. Minister's Conditions of Approval

The Minister's Conditions of Approval dated 14 November 2009 in regards to operational noise and vibration are presented below. Note that due to changes in government body names, references to "DECC" should now read EPA (Environment Protection Authority).

Operational Noise

2.24 Unless otherwise agreed by the Director-General, the Proponent shall submit for the approval of the Director-General, a review of proposed operational noise mitigation measures identified in the documents nominated in Condition 1.1, within six months of commencing construction. The review shall take into account the detailed design of the project and, where feasible and reasonable, refine the proposed measures with the objective of meeting the criteria outlined in the Environmental Criteria for Road Traffic Noise. The review shall be undertaken in consultation with the DECC.

Noise Auditing

3.2 No later than one year after commencement of operation of the project, or as otherwise agreed by the Director-General, the Proponent shall undertake operational noise monitoring to compare actual noise performance of the project against noise performance predicted in the review of noise mitigation measures required by Condition 2.24 and prepare an Operational Noise Report. The Report shall include, but not necessarily be limited to:

- a) noise monitoring to assess compliance with the operational noise levels predicted in the review of operational noise mitigation measures required under Condition 2.24 and documents specified under Condition 1.1 of this approval;*
- b) a review of the operational noise levels in terms of criteria and noise goals established in the Environmental Criteria for Road Traffic Noise (EPA 1999);*
- c) methodology, location and frequency of noise monitoring undertaken, including monitoring sites at which project noise levels are ascertained, with specific reference to locations indicative of impacts on sensitive receivers;*
- d) details of any complaints and enquiries received in relation to operational noise generated by the project between the date of commencement of operation and the date the report was prepared;*
- e) any required recalibrations of the noise model taking into consideration factors such as noise monitoring undertaken and actual traffic numbers and proportions;*
- f) an assessment of the performance and effectiveness of applied noise mitigation measures together with a review and if necessary, reassessment of all reasonable and feasible mitigation measures; and*
- g) any additional feasible and reasonable measures, as identified in the review of noise mitigation measures required by Condition 2.24, that would be implemented to comply with the criteria outlined in the Environmental Criteria for Road Traffic Noise (NSW EPA, 1999), when these measures would be implemented and how their effectiveness would be measured and reported to the Director-General and the DECC.*

3.3 The Proponent shall provide the Director-General and the DECC with a copy of the Operational Noise Report within 60 days of completing the operational noise monitoring referred to under condition 3.2 of this approval, or as otherwise agreed by the Director-General.

It should be noted that the LFHJV has been unable to meet the above time requirement of Cl. 2.24 as the design has not been sufficiently progressed across all zones within the specified timeframe. A request for extension of time was submitted to Department of Planning, which has been accepted.

2.2. Statement of Commitments

The Sapphire to Woolgoolga approval states:

Terms of Approval

1.1 The Proponent shall carry out the project generally in accordance with the:

- c) *Coffs Harbour Highway Planning – Sapphire to Woolgoolga section – Environmental Assessment Submissions Report*, prepared by Connell Wagner Pty Ltd and dated June 2008, including the revised Statement of Commitments contained therein;

The Statement of Commitments with respect to operational traffic noise are:

Table 2.1: Statement of Commitments (from EA Submissions Report)

Statement of Commitment	Condition
ON1	A reasonable and feasible approach will be adopted to limit operational noise impacts in accordance with the NSW Government's Environmental Criteria for Road Traffic Noise. The approach to operational noise impacts will be developed further during detailed design and in consultation with relevant property owners.
ON2	Low-noise pavement will be utilised from the southern limit of works at Sapphire to approximately 700 metres north of Bark Hut Road, Woolgoolga.
ON3	Other noise mitigation measures (eg. road design, noise mounds or noise barriers) will be installed at the locations and to the specifications identified in the environmental assessment (subject to detailed design).
ON4	Architectural treatments will be provided to properties identified in the environmental assessment as requiring such (subject to further design refinement of the project; and to owner agreement).
ON5	Monitoring of operational noise will be undertaken between six months and one year after opening along the proposed highway upgrade and within Woolgoolga. Should the monitoring indicate traffic noise impacts exceeding the relevant noise level criteria in NSW Government's Environmental Criteria for Road Traffic Noise; the RTA will investigate and implement further "reasonable and feasible" mitigation measures. The selection of these measures will be undertaken in consultation with affected property owners. The mitigation measures will be confirmed against predictions of noise levels 10 years after opening.

2.3. RMS Scope of Works and Technical Criteria Appendix 4

The noise sections of the RMS Scope of Works and Technical Criteria (SWTC) are stated below:

4.6 Noise Mitigation

- (a) *Notwithstanding the requirements of Practice Note ii of RTA Environmental Noise Management Manual, December 2001, noise mitigation measures are not required at commercial or industrial premises.*
- (b) *Further to any other requirements of the Environmental Documents in relation to noise mitigation measures, the Contractor must design and provide at-road operational noise mitigation measures to maintain operational noise levels of 50dB (A) $L_{Aeq(9hr)}$ (night) or less, for the year 2021, at the locations identified by the contour lines described in electronic file App_9 Noisev0.2.txt in Appendix 9 to this Scope of Works and Technical Criteria.*

At-road operational noise mitigation measures must be contained within the Site, Local Road Works Areas and existing road reserves.

At-road noise mitigation barriers must be provided, as a minimum, at the locations, lengths and heights detailed in table 4-10 of working paper No. 2-Noise and Vibration - in Appendix F of the document titled "Coffs Harbour Highway Planning, Sapphire to Woolgoolga Section, Environmental Assessment, November 2007". This document is referred to hereafter in this Appendix as the Environmental Assessment.

The Contractor must undertake noise modelling on the design of the Project Works to predict the 2021 noise contour. The noise modelling must:

- (i) *use a traffic speed of 110km/h for the Main Carriageways and the posted traffic speeds on Ramps and Local Roads identified in Appendix 9 of the Scope of Works and Technical Criteria;*
- (ii) *use the traffic volumes for year 2021 identified in Tables 4-5, 4-6 and 4-7 of working paper No. 2 Noise and Vibration in Appendix F of the Environmental Assessment;*
- (iii) *include a +1dB(A) sensitivity allowance; and*
- (iv) *include a +2.5dB(A) façade reflection.*

The Contractor must comply with the requirements of this sub-section 4.6(b) notwithstanding any financial, costing, feasibility or other constraints on the types of mitigation identified in the Environmental Noise Management Manual (ENMM).

- (c) *Further to the requirements of sub-section 4.6(b), the Contractor must design and provide noise mitigation measures that comply with the NSW Government's Environmental Criteria for Road Traffic Noise (ECRTN) and ENMM for the year 2024. Noise mitigation measures that comply with the ECRTN and ENMM must be provided for the noise sensitive receivers that are identified in the Environmental Documents and any other noise sensitive receivers, including those that have been constructed or have been granted development approval by the relevant Authority under the provisions of the Environmental Planning and Assessment Act 1979 prior to 13 January 2009.*

The Contractor must undertake noise modelling on the design of the Project Works to predict the 2024 noise contour line. The noise modelling must;

- (i) *use the posted traffic speed at each location as identified in Appendix 9 of the Scope of Works and Technical Criteria;*
- (ii) *use the traffic volumes for 2024, calculated by adjusting the traffic volumes for year 2021 identified in Tables 4-5, 4-6 and 4-7 of Working Paper No. 2 Noise and Vibration*

in Appendix F of the Environmental Assessment at a 3% per year traffic growth until 2024;

- (iii) *include a +1dB(A) sensitivity allowance; and*
- (iv) *include a +2.5dB(A) façade reflection.*

The Contractor must comply with the requirements of this sub-section 4.6(c) notwithstanding any financial, costing, feasibility or other constraints on the types of mitigation identified in the ENMM.

- (d) *Noise mitigation measures must be provided to noise-sensitive receiver (where the term “noise-sensitive receiver” is as defined in ENMM) locations that are predicted to have acute noise levels. Acute noise levels are defined as the levels equal to or greater than 65 dB(A) $L_{Aeq(15hr)}$ (day) and 60 dB(A) $L_{Aeq(9hr)}$ (night);*
- (e) *Pavement wearing surfaces must be designed to produce noise levels and tonal characteristics that contribute to achieving compliance with the noise level requirements of the deed. Low noise pavements must be provided on the Main Carriageways and Ramps from the southern extent of the Works to 700 metres north of Bark Hut Road. Low noise pavements must comply with the requirements of Appendix 12 of the Scope of Works and Technical Criteria.*
- (f) *Bridge joints must be designed, selected and installed to reduce vehicle noise impacts.*
- (g) *All at residence treatments identified in Appendix D of Working Paper 2 Noise and Vibration in Appendix F of the Environmental Assessment, excluding Receiver 337 (8 Sapphire Crescent) and Receiver 635 (6 Sapphire Crescent), must be completed within 6 months of the commencement of Construction.*
- (h) *All noise mitigation measures at noise sensitive receivers that are required by section 4.6(c) of this Appendix must be completed, in the case of noise sensitive receivers constructed:*
 - (i) *prior to the commencement of Construction, within 6 months of the commencement of Construction; and*
 - (ii) *after the commencement of Construction, within 6 months of the completion of construction of the noise sensitive receivers and no later than the Date of Construction Completion.*
- (i) *Notwithstanding any other noise mitigation measures provided, the Contractor must also provide architectural treatments in accordance with Practice Note iv of the ENMM.*
- (j) *Where the architectural treatment required by the ENMM is mechanical ventilation, mechanical ventilation must, as a minimum, be air conditioning that complies with the fresh air requirements of the Building Code of Australia.*

4.7 Operational Noise Management Report

Further to the requirements of condition 2.24 of the Planning Minister’s Approvals, the Contractor must prepare an operational noise management report as a part of the Design Documentation for the noise mitigation measures. The Contractor must undertake a noise study on the certified and verified Design Documentation of the Project Works and include a report on this study in the operational noise management report. The operational noise management report must be included as part of the review of proposed operational noise mitigation measures required by condition 2.24 of the Planning Minister’s Approvals. The noise study must use the input variables of traffic speed, volume, composition and growth identified in section 4.6(c) of this Appendix 4.

In addition to the requirements of the other Environmental Documents the noise study and report must address and include:

- (a) *a description of the prevailing ambient noise environment;*
- (b) *the results of noise modelling and proposed mitigations required by section 4.6 of this Appendix 4;*
- (c) *the results of all field survey and noise monitoring required to calibrate the modelling required by section 4.6 of this Appendix. Noise monitoring must include monitoring at 39 Hoys Road, Moonee Beach;*
- (d) *details on the noise-sensitive receivers and noise monitoring locations, including distances to the nearest roads where roads are located close to the noise monitors;*
- (e) *a site plan showing the noise-sensitive receivers and noise monitoring locations;*
- (f) *aerial photographs showing the noise-sensitive receivers and noise monitoring locations;*
- (g) *details on the positioning of noise loggers at each noise monitoring location, including photographs of the noise logger in its monitoring position;*
- (h) *charts and a summary table of measured and/or computed noise modelling parameters, including the L_{Amax} , L_{A10} , L_{Aeq} and L_{A90} , at 15-minute intervals for each 24-hour period of the noise monitoring survey;*
- (i) *a table summarising the noise parameters measured;*
- (j) *tabulations of average annual daily traffic (AADT) predictions for the day and night;*
- (k) *summaries of the computational algorithms used in the noise model and justification for their selection, the location of noise-sensitive receivers and how the modelling parameters were addressed;*
- (l) *a table summarising the relevant noise modelling parameters computed at the monitoring locations and comparisons with the design noise objectives and requirements of the Environmental Documents and section 4.6 of this Appendix 4;*
- (m) *noise contour maps for years 2021 and 2024 detailing the $L_{Aeq(9hr)}$ Night and $L_{Aeq(15hr)}$ Day and identifying all noise-sensitive receiver locations;*
- (n) *details on all noise sensitive receivers that are predicted to exceed the ECRTN (base criteria and allowance criteria) for the year 2024;*
- (o) *identification of noise sensitive receivers predicted to have noise levels, for the year 2024, at an acute noise level or above; and*
- (p) *identification of all at-road and at-resident operational noise mitigation measures.*

2.4. EPA Environmental Criteria for Road Traffic Noise

The criteria for determining whether properties are eligible for noise treatment are set out in the Environment Protection Authority's (EPA) document Environmental Criteria for Road Traffic Noise (ECRTN).

External L_{Aeq} Level Criteria

In accordance with EPA guidelines the redevelopment of the Pacific Highway between Sapphire to Woolgoolga would be regarded as a "redevelopment of an existing arterial road" where the route follows the alignment of the existing Pacific Highway and, where the future Woolgoolga Bypass

alignment differs substantially from the existing Pacific Highway alignment, it is considered to be a 'new arterial road corridor'. Provided in Table 2.1 are the EPA's road traffic noise criteria for new freeway/arterial road corridors and redevelopment of existing freeway/arterial roads. The external noise criteria are applicable 1 metre from the façade that is most exposed to traffic noise and at a height of 1.5 m from the floor level. The criteria include an allowance for noise reflected from the façade.

Table 2.2 New and Redeveloped Road Noise Criteria

Period	Parameter	Criterion dB(A)
New freeway or arterial road corridor¹		
Day (7.00 am – 10.00 pm)	$L_{Aeq(15hr)}$	55
Night (10.00 pm – 7.00 am)	$L_{Aeq(9hr)}$	50
Redevelopment of existing freeway/arterial road²		
Day (7.00 am – 10.00 pm)	$L_{Aeq(15hr)}$	60
Night (10.00 pm – 7.00 am)	$L_{Aeq(9hr)}$	55

Note:

Note 1: In cases where noise from an existing road already exceeds the above criteria, the ECRTN recommends "the new road should be designed so as not to increase existing noise levels by more than 0.5 dB(A). Where reasonable and feasible noise levels from existing roads should be reduced to meet the noise criteria."

Note 2: In cases where noise from an existing road already exceeds the above criteria, the ECRTN recommends "In all cases, the redevelopment should be designed so as not to increase existing noise levels by more than 2 dB(A). Where feasible and reasonable, noise levels from existing roads should be reduced to meet the noise criteria."

2.5. RMS Environmental Noise Management Manual

The RMS's Environmental Noise Management Manual (ENMM) also states what is deemed to be reasonable and feasible in terms of noise mitigation in Practice Note iv.

One of the considerations stipulated in the ECRTN document for assessing "reasonable" noise mitigation is the "existing and future noise levels at affected land uses" and changes in noise levels.

There are two situations in which the RMS believes it is generally not "reasonable" to take action to reduce predicted noise levels through the adoption of measures (such as noise barriers/mounds, architectural treatments, and quieter pavement surfaces) beyond the adoption of all "feasible and reasonable" traffic management and other road design measures.

(1) For proposed “new” roads and road “redevelopments” (see ENMM Practice Note i), the RMS believes it is generally not “reasonable” to take action to reduce predicted noise levels to the target noise levels if the noise levels with the proposal, ten years after project opening, are predicted to be:

- Within 2 dB(A) of “future existing” noise levels (the noise levels from existing sources of road traffic noise predicted for the time of project opening), and

This approach is based on the insignificance of the changes in noise levels involved and the insignificant exceedances of the target noise levels.

It applies only if it can be demonstrated that all “feasible and reasonable” traffic management and other road design opportunities for reducing traffic noise have been exhausted.

(2) For proposed “redevelopments” of roads where existing noise levels already exceed the ECRTN target noise levels, and all “feasible and reasonable” traffic management and noise reducing design opportunities have been incorporated into the road design, the RMS believes it is generally not “reasonable” to apply additional treatments such as noise barriers/mounds, quieter pavement surfaces and architectural treatment of private dwellings if the predicted design year noise levels:

- Do not exceed the ECRTN allowances (in column 4 of Table 1 in the ECRTN) over the “future existing” noise levels (the noise levels from existing sources of road traffic noise predicted for the time of project opening) , and
- Will not be acute (i.e. the noise levels are predicted to be less than 65 dB(A) $L_{Aeq(15hr)}$ (day) and 60 dB(A) $L_{Aeq(9hr)}$ (night)).

Hence premises qualify for assessment of mitigation treatment where noise levels are acute or where there is an increase of more than 2 dB over future existing noise levels.

The ENMM includes another situation where it is not considered reasonable to provide treatment. The relevant point states that design year noise levels are *no more than 2 dB(A) above the target noise levels set out in columns 2 and 3 of Table 1 in the ECRTN*. However the RMS has recently changed its stance on this point and it is no longer considered suitable. As such it has not been considered in this assessment.

3. BACKGROUND NOISE MONITORING

3.1. Noise Loggers - General

Nine noise loggers were used to continuously measure ambient noise levels along the proposed alignment. The selected locations are considered to be representative of the noise sensitive receivers in the area. Locations of noise loggers are illustrated on small scale plans in Appendix A and on detailed aerial plans in Part 4 of the ONMR. Photographs of the noise loggers are provided in Appendix A.

3.2. Noise Monitoring Instrumentation

All noise monitoring equipment used was of at least Type 2 instrumentation standard as described in Australian Standard IEC 61672.1 2004 "Electroacoustics - sound level meters" and calibrated to NATA standards that are traceable to Australian Physical Standards held by the National Measurement Laboratory (CSIRO Division of Applied Physics).

All the long-term unattended noise loggers and short-term attended measurements sound level meters were calibrated before and after noise measurements with no significant drift in calibration.

All microphones were located 1.5 m above ground and had clear line of site to the road (apart from 39 Hoys Road which was required by the SWTC).

3.3. Noise Monitoring Results

A noise logger measures the noise level over the sample period and then determines L_{A1} , L_{A10} , L_{A90} , L_{Amax} and L_{Aeq} levels of the noise environment. The L_{A1} , L_{A10} and L_{A90} levels are the noise levels exceeded for 1%, 10% and 90% of the sample period respectively. The L_{Amax} is indicative of maximum noise levels due to individual noise events. The L_{Aeq} is the A – Weighted sound pressure level energy averaged over the sample period. The L_{A90} is taken as the background noise level.

During site visits (to install and retrieve equipment), short term operator-attended monitoring was also conducted. A description of the acoustical environment was also documented.

A summary of the calculated daytime and night-time L_{Aeq} noise levels is presented in Table 3.1. The results of the noise logging are provided graphically in Appendix B.

Weather and noise data has been processed in accordance with the EPA's Industrial Noise Policy (INP). Weather data has been included on the graphs in Appendix B.

Table 3.1 Noise Logging Results

Location	Chainage (km)	Distance to current alignment (m)	Location Description	L _{Aeq} Sound Level (dBA)	
				Daytime (7am – 10pm)	Night-time (10pm – 7am)
1	8595	11	West of 28 Warrawee St, Sapphire Beach	65	62
2	10670	66	7 Wakelands Rd, Sapphire Beach	54	53
3 ¹	11940	300	18 Woodhouse Rd, Moonee Beach	59	57
4	12510	158	39 Hoys Rd, Moonee Beach	69	65
5	15490	43	1579 Pacific Hwy, Moonee Beach	73	69
6	21720	16	West of Pacific Hwy, Sandy Beach	62	59
7	22475	53	Nth of Cnr of Hearnes Lake Rd, and Pacific Hwy, Woolgoolga	73	71
8	Not for operational noise – for construction noise only				
9	30765	108	2986 Pacific Hwy, Arrawarra	58	58

Note 1: Location 3 was within close proximity to a shopping centre. The controlling noise source at this location was confirmed to be the Pacific Highway. Mechanical services from the shopping centre were not audible at this location. Car park noise was not found to contribute to the L_{Aeq} noise levels.



3.4. Traffic Volume Counting

Traffic volume counting was undertaken simultaneously with the noise logging to assist in verifying and calibrating the noise model. The traffic classification count details provided for each direction of travel are outlined below:

- Hourly traffic volumes for light vehicles for each 24 hour period during the monitoring period
- Hourly traffic volumes for heavy vehicles for each 24 hour period during the monitoring period
- Vehicle speed (total mean and 85 percentile) during the day period (7:00am to 10:00pm) and night (10:00pm to 7:00am)

Six traffic count locations were used to provide sufficient traffic volume data to calibrate the noise model:

- Arrawarra
- Sandy Beach
- Woolgoolga
- Emerald Beach
- Moonee Beach
- Sapphire Beach

Refer to Section 4.9 for further details.

4. NOISE MODELLING

4.1. Noise Modelling Inputs

Noise levels were calculated using SoundPLAN software, incorporating the Calculation of Road Traffic Noise (CoRTN) algorithm. The UK Department of Transport devised the CoRTN algorithm and with suitable corrections, this method has been shown to give accurate predictions of traffic noise levels under Australian conditions. SoundPLAN's Façade Noise Map calculation model was utilised to calculate noise levels at each individual façade of each receiver. Noise levels for almost 5000 individual façades have been calculated. This level of detail facilitated the designation of property treatments at individual façades. This information is provided on the façade model digital drawing.

The noise model for this project incorporated the following features:

- Traffic volume and/or percentage of cars on the roadway
- Traffic volume and/or percentage of medium/heavy trucks on the roadway
- Correction for pavement surface
- Corrections for roadway gradient
- Road chainage and x, y and z coordinates of traffic lanes and topographic features imported from electronic data (DXF format)
- Receiver x, y and z coordinates and heights
- Intervening ground cover absorption
- Roadside or topographic barriers
- A 2.5 dB(A) correction for façade effects
- Minor shielding from existing buildings to neighbouring houses
- Noise barriers and headlight screens as listed in Table 4.2 and 4.4
- A road surface correction factor in accordance with the RMS's ENMM
- A three source correction factor for three individual string inputs (0.0 dB for light vehicles, -0.6 dB for heavy vehicle engine noise and -8.6 dB for heavy vehicle exhaust noise)

4.2. Ground Absorption

The ground absorption was set at 0.6 for the modelled area. This provided the best correlation with measured data and is typical for this area based on the previous experience of AECOM.

4.3. Traffic Source Strings

A three source height model was utilised throughout the modelling with individual source strings for each lane of traffic. The source height was set at 0.5 m for light vehicles and 1.5 m and 3.6 m for heavy vehicle engines and exhausts respectively (including the default 0.5 m height assumed by the implementation of CoRTN within SoundPLAN). The following factors were included to calculate the appropriate noise levels:

- The 15 hour and 9 hour traffic flows were converted to 1 hour traffic flows
- L_{10} to L_{Aeq} correction factor of -3 dB was applied
- A correction was included where appropriate to remove CoRTN's low volume traffic flow correction, which is not valid for L_{Aeq} predictions

- Corrections of -0.6 dB(A) and -8.6 dB(A) were applied to the heavy vehicle engine and exhaust strings respectively to take into account the relative source contributions of the engine and exhaust in the three source height model

These corrections have been applied to CoRTN's $L_{A10(1\text{hour})}$ algorithm to calculate $L_{Aeq(15\text{hr})}$ and $L_{Aeq(9\text{hr})}$ noise levels.

4.4. Road Surface Corrections

The road surface corrections that have been applied to this project are consistent with Table 4.1 of the RMS's ENMM, using the most conservative correction for each surface and vehicle type. These corrections are provided in Table 4.1.

Table 4.1 Road Surface Noise Correction

Surface Type	Northbound Chainages	Southbound Chainage	Car correction dB(A)	Truck correction dB(A)
Stone mastic asphalt	7000 – 28395	6900 - 28354	-2.2	-4.3
Portland Cement Concrete	28395 – 32230	28354 - 32230	+3.5	+1

4.5. Sensitivity Allowance Correction

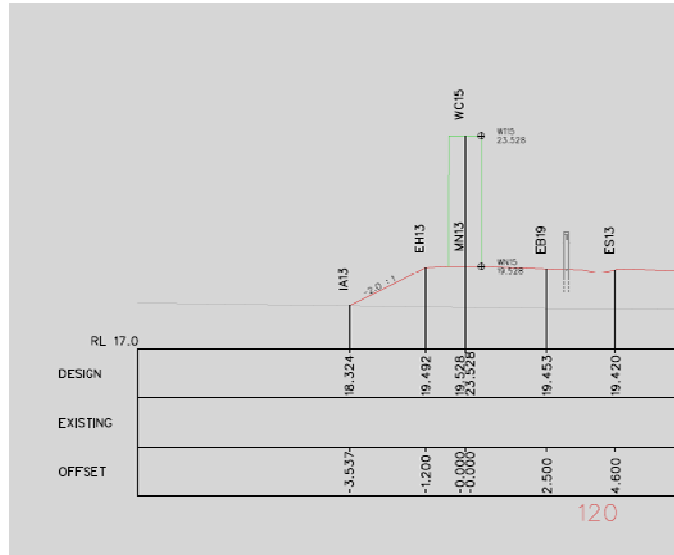
An allowance of +1 dB was included in the model as required by the SWTC Appendix 4.

4.6. Noise Barriers

Design noise barriers based on the EA defined locations and extents were included in the noise model. Details of the noise barriers are provided in the Table 4.2. The noise barrier height has been set above ground level at the location of the noise barrier (apart from where the barrier runs up the edge of a batter). This allows the barrier to be constructed from standard height panels. The top of the noise barrier is at or above the required height above the edge of pavement level as illustrated on the sketch below. The heights of barriers B21b and B21c are set above the edge of service road pavement rather than main carriageway level, as required in the EA/SWTC.

Whilst noise barriers are discussed and documented in this report, consideration may be given to the provision of noise mounds where feasible.

Typical Section through Zone 5000 Noise Barrier



The noise barriers included in the noise modelling are set out in Table 4.2 overleaf. Table 4.2 compares the noise barriers quoted in the EA to the noise barriers adopted in the design. It should be noted that the chainage used to reference the EA noise barriers is different to the design chainage. Nevertheless, the provision of noise barriers is fundamentally the same as the EA noise barriers with some adjustments at the extremities to allow integration with the current design.

Table 4.3 provides information on the noise barrier end transitions. These transitions are not included in the noise barrier lengths in Table 4.2 except where stated otherwise.

The location and height of the noise barriers used in the modelling is illustrated on the drawings in Part 4 of the ONMR.

4.7. Headlight Screens

Headlight screens will be built with the same material and design as noise barriers, generally at a height of 2.5 m. At chainages 7390–7740, 7980-8260 & 8560-9280 the headlight screens will be built at a height of 3.5 m to integrate aesthetically with the 3.5 m high adjacent noise barrier at chainage 8260 – 8560.

The location and height of the headlight screens used in the modelling is illustrated on the drawings in Part 4 of the ONMR.

The headlights screens have been included in the noise model.

Table 4.2 Noise Barriers Provided in the Design Compared to Noise Barriers Stated in the EA

Ref.	EA Ref.	Location	Noise barrier height* (m)	Min height measured above edge of**	EA length (m)	Design Noise Barrier – lengths (m)				Diff. from EA (m)	Comment
						Full height	Combined barrier/batter	Full height batter***	Total Equivalent length		
Zone 2000											
2NW20-SB	B21a	SB	3.5	MC	310	247	60	3	310	0	Effective barrier length maintained by cutting
2NW30-NB	B1a	NB	3	MC	208	181	36	0	217	9	
2CW40-SB	B21b	SB	3.5	SR	240	240	0	0	240	0	
	B21c	SB	3.5	SR	300	308	0	0	308	8	
2NW80-SB	-	-	-	-	0	290	0	52	342	342	Additional noise barrier Nth of Sugarmill Road, east side of highway. Refer Section 4.8.4.
Zone 4000											
4NW90-NB	-	-	-	-	0	906	42	0	948	948	Additional noise barrier stn 18050 – 19020, west side of highway. Refer Section 4.8.6.
4NW60-NB	B6a	NB	4	MC	320	293	32	0	325	5	
4NW65-SB	B15a	SB	4	MC	260	193	42	25	260	0	Effective barrier length maintained by cutting
4NW80-NB	B6b	NB	4	MC	230	169	60	0	229	-1	
4NW85-SB	B15b	SB	4	MC	220	145	60	15	220	0	Effective barrier length maintained by cutting

Continued on next page

Table 4.2 Noise Barriers Provided in the Design Compared to Noise Barriers Stated in the EA...Continued

Ref.	EA Ref.	Location	Noise barrier height* (m)	Min height measured above edge of**	EA length (m)	Design Noise Barrier – lengths (m)				Diff. from EA (m)	Comment
						Full height	Combined barrier/batter	Full height batter***	Total Equivalent length		
Zone 5000											
5NW20-NB	B8a	NB	3.5	MC	135	120	17	0	137	2	
5NW30-NB	B8b	NB	3.5	MC	245	216	34	0	250	5	
5NW40-NB	B8c	NB	4	MC	295	265	24	0	289	-6	Due to termination of barrier at Woolgoolga Creek Bridge transition panels are needed on the approach. These panels form part of the noise barrier length but have been modelled at 0.8 m high to confirm no impact on property
Zone 6000											
6NW10-SB	B11a	SB	3	MC	285	254	31	0	285	0	
	B11b	SB	3	MC	475	443	30	2	475	0	Effective barrier length maintained by cutting
6NW30-SB	B11c	SB	4	MC	225	197	19	9	225	0	Effective barrier length maintained by cutting
	B11d	SB	2.5	MC	145	128	27	0	155	10	

* Noise barrier height meets EA required height at all locations.

** MC = Mainline carriageway. SR = Service Road. Minimum required height is provided above edge of road pavement.

*** Full height batter equivalent barrier measured to limit of EA barrier only. Many batters extend beyond this and provide a noise reducing function. Refer drawings for more details.

Table 4.3 Noise Barriers Transitions

Ref.	EA Ref.	Barrier end	Transition panels	No of panels	Total length	Comments
Zone 2000						
2NW20-SB	B21a	South	Yes	2	12	
		North	No	-	-	
2NW30-NB	B1a	South	No	-	-	Barrier runs into batter and hence transition not needed
		North	Yes	2	12	
2CW40-SB	B21b	North / South	No	-	-	
	B21c					
Zone 4000						
4NW60-NB	B6a	South	Yes	2	12	
		North	No	-	-	Barrier transitions to retaining wall and hence transition not needed
4NW65-SB	B15a	South	Yes	2	12	
		North	No	-	-	Barrier transitions to retaining wall and hence transition not needed
4NW80-NB	B6b	South	No	-	-	Barrier transitions to retaining wall and hence transition not needed
		North	Yes	2	12	
4NW85-SB	B15b	South	No	-	-	Barrier transitions to retaining wall and hence transition not needed
		North	Yes	2	12	

Continued on next page

- Noise end transition panels are for aesthetic purposes in addition to required noise barrier lengths.
- Transitions panels are excluded from noise calculations unless stated otherwise.
- At Woolgoolga Creek Bridge the 4 m high barrier finishes at the bridge in the EA. For aesthetic purposes this barrier is transitioned down over 2 panels. A 0.8 m transition panel height has been included in the noise calculations to ensure any additional at house mitigation measures requirements are highlighted.

Table 4.3 Noise Barriers Transitions...Continued

Ref.	EA Ref.	Barrier end	Transition panels	No of panels	Total length	Comments
Zone 5000						
5NW20-NB	B8a	South	No	-	-	Barrier runs into batter and hence transition not needed
		North	Yes	2	12	
5NW30-NB	B8b	South	No	-	-	Barrier runs into batter and hence transition not needed
		North	No	-	-	Barrier runs into batter and hence transition not needed
5NW40-NB	B8c	South	No	-	-	Barrier runs into batter and hence transition not needed
		North	Yes	2	12	Transition forms part of noise barrier - refer Note 3
Zone 6000						
6NW10-SB	B11a	South	No	-	-	Barrier runs into batter and hence transition not needed
		North	No	-	-	Connects to adjacent headlight screen
	B11b	South	No	-	-	Connects to adjacent headlight screen
		North	No	-	-	Barrier runs into batter and hence transition not needed
6NW30-SB	B11c	South	No	-	-	Barrier runs into batter and hence transition not needed
		North	No	-	-	Connects to adjacent headlight screen
	B11d	South	No	-	-	Connects to adjacent headlight screen
		North	No	-	-	Barrier runs into batter and hence transition not needed

4.8. Additional Noise Barriers

4.8.1. General

The modelling indicated that additional noise mitigation is required at properties over and above that set out in the EA. Noise mitigation in the form of alternative pavement, noise mounds and barriers and architectural treatments has been considered to minimise the potential impact on sensitive receivers. The SWTC requires low noise pavement for over 21 km of the 26 km of the Upgrade and hence further reduction in noise from alternative pavement types is unlikely to have a significant impact. Consideration has been given to the provision of additional noise barriers to reduce the need of implementing architectural treatment to affected residences.

To eliminate the need to provide architectural treatment at a property, the at-source treatment must reduce noise levels below the noise criteria. The RMS's ENMM states that:

“... architectural treatments may be provided, as an *alternative* to a noise barrier ... to all residences where:

- The ECRTN target noise levels or the ECRTN allowances (as applicable) are exceeded
- The community prefer them, *and*
- They cost less than the optimal combined barrier and architectural treatment option.

If the “architectural treatment in lieu of noise barrier” option is *not* largely supported by the community, and/or if architectural treatment of individual dwellings will cost more than a noise barrier, the optimal *combination* of road treatment and architectural treatment options should be applied ...” (*ENMM Practice Note iv, Step 6, page 102*).

The problem with providing noise barriers with much of this project is the fact that the receivers are spaced too far apart to make the noise barriers cost-effective. Additionally, the noise modelling has indicated that the maximum attenuation provided by a noise barrier was typically in the range of 5 dB(A) to 7 dB(A). It has been found that many residences would need further treatment (e.g. architectural) even after a noise barrier has been installed.

Further assessment has been undertaken of affected residences to determine their eligibility for noise barriers.

Consistent with the requirements of the ENMM, for a noise barrier to be considered effective the following conditions must apply:

- More than three houses in close proximity to each other must exceed the ECRTN noise criteria and be eligible for additional mitigation,
- A noise barrier less than 5 m high must provide at least 5 dB(A) attenuation at the most affected residence, and
- A noise barrier 5 m high or higher must provide at least 10 dB(A) attenuation at the most affected residence. Noise barriers greater than 8 m high are generally excluded due to visual impact considerations.

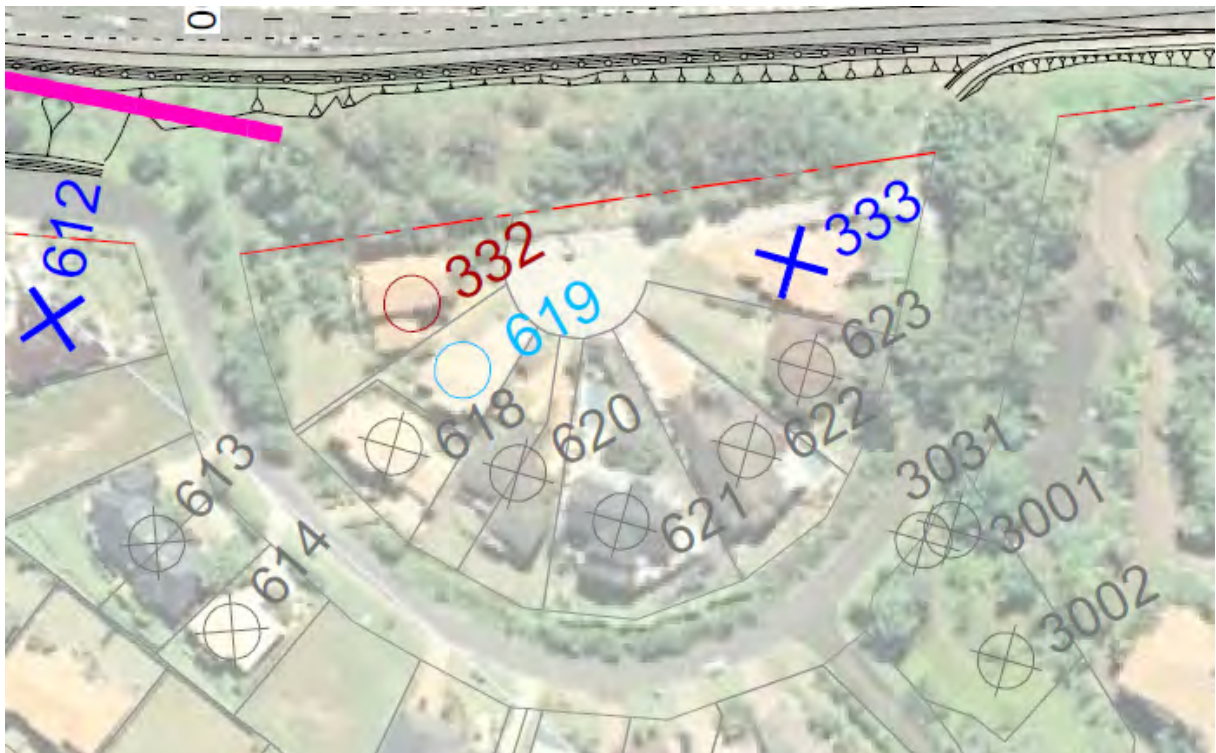
The following cost data has been provided by LFHJV and has been used to consider the cost-effectiveness of various noise barriers:

- Noise barrier: approximately \$595/m² for 3.5 m high barrier, \$828/m² for a 5.5 m high barrier and \$1,060/m² for a 7.5 m high barrier. These costs exclude any additional civil costs for noise barrier installation, such as widening the earthworks to accommodate the barrier and the landscape screening zone.
- Average architectural treatment has been found to cost \$27,500 per residence (note that this can vary considerably between properties).

The RMS has requested that receivers listed in the EA and any receivers pre-insulated under the Noise Abatement Programme be included as noise sensitive receivers (if eligible) for the assessment of noise barriers. Should a noise barrier prove to meet the ENMM requirements, negotiations can be held with EA listed receivers to discuss replacement of at-house treatment with barriers or mounds.

The following case studies review twelve separate locations where an additional noise barrier could be considered. The case studies have been set out in accordance with ENMM Practice Note IV. Where an assessment has been undertaken, the detail of the assessment is contained in Appendix D.

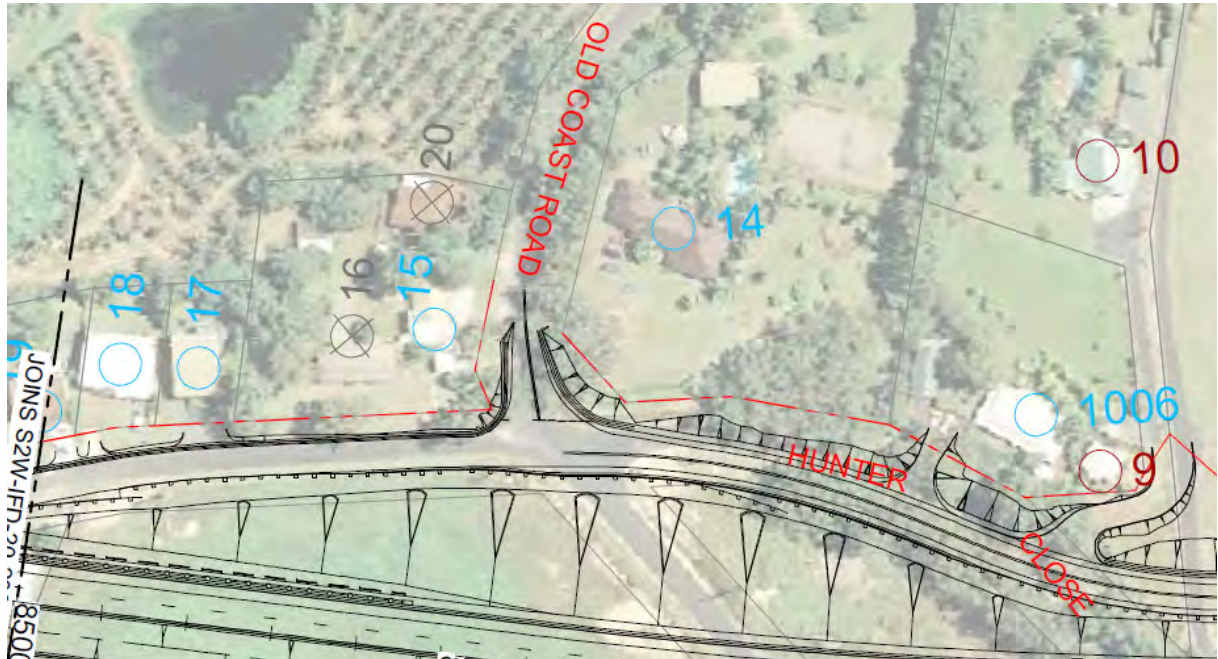
4.8.2. Case Study 1: Coachmans Close, Sapphire Beach



There are noise sensitive receivers located in close proximity where road traffic noise levels are predicted to exceed the ECRTN noise criteria. These properties have been assessed for a noise barrier. The detailed assessment is contained in Appendix D1.

The detailed assessment concludes that as there are not more than three properties located within a group a barrier is not warranted. Architectural treatment is the appropriate noise mitigation measure for properties at this location. It is noted that receiver 333 has already received treatment.

4.8.3. Case Study 2: Hunter Close, Korora

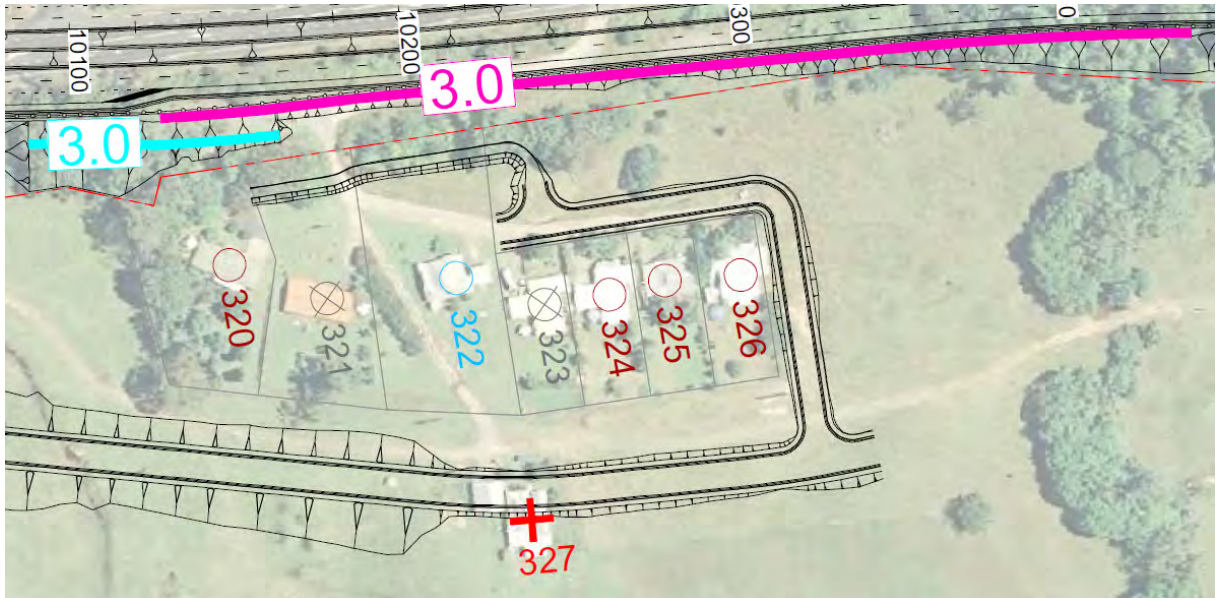


As set out in Appendix D2, a barrier along Hunter Close would meet the minimum insertion loss for a noise barrier less than 5m high.

For a barrier to be effective it would need to be located at the top of the cutting, which would impact on the easterly (ocean) views for the residences in Hunter Close. As there is no available space to the boundary, a retaining wall would be required. In addition careful consideration would need to be given to the planned relocation of the 66kV overhead electrical line in this area.

A lower height barrier could be considered but it would not meet insertion loss requirements and may also have visual issues. Therefore, due to visual and engineering considerations, it is not considered practicable to build a barrier in this location. Architectural treatment is the appropriate noise mitigation measure for properties at this location.

4.8.4. Case Study 3: North of Sugarmill Road, East Side of Highway, Sapphire Beach



There are more than three noise sensitive receivers located in close proximity which are predicted to exceed the ECRTN noise criteria and hence an assessment for eligibility for a noise barrier has been undertaken – refer to Appendix D3.

A barrier less than 5 m high meets the insertion loss requirements of 5 dB(A).

A 3 m noise barrier is justified at this location and would reduce noise levels such that only receiver 322 is eligible for architectural treatment. It is noted that the four receivers 320, 324, 325 and 326 are listed for treatment consistent with the EA assessment.

It is noted that an option to provide a full length noise mound at this location is currently under investigation and may be adopted in lieu of the currently proposed structural barrier. Both options are comparable in terms of acoustic performance and would be appropriate at this location.

4.8.5. Case Study 4: 1206 Pacific Highway, Moonee Beach (opposite Maccues Road)



There are sensitive receivers within close proximity which are predicted to exceed the ECRTN noise criteria and hence these properties have been considered for further noise mitigation measures – refer to Appendix D4.

As there are only three sensitive receivers at this location it is not considered reasonable to provide a noise barrier. Architectural treatments will be provided to receivers 290, 291 and 292.

4.8.6. Case Study 5: Emerald Heights Drive

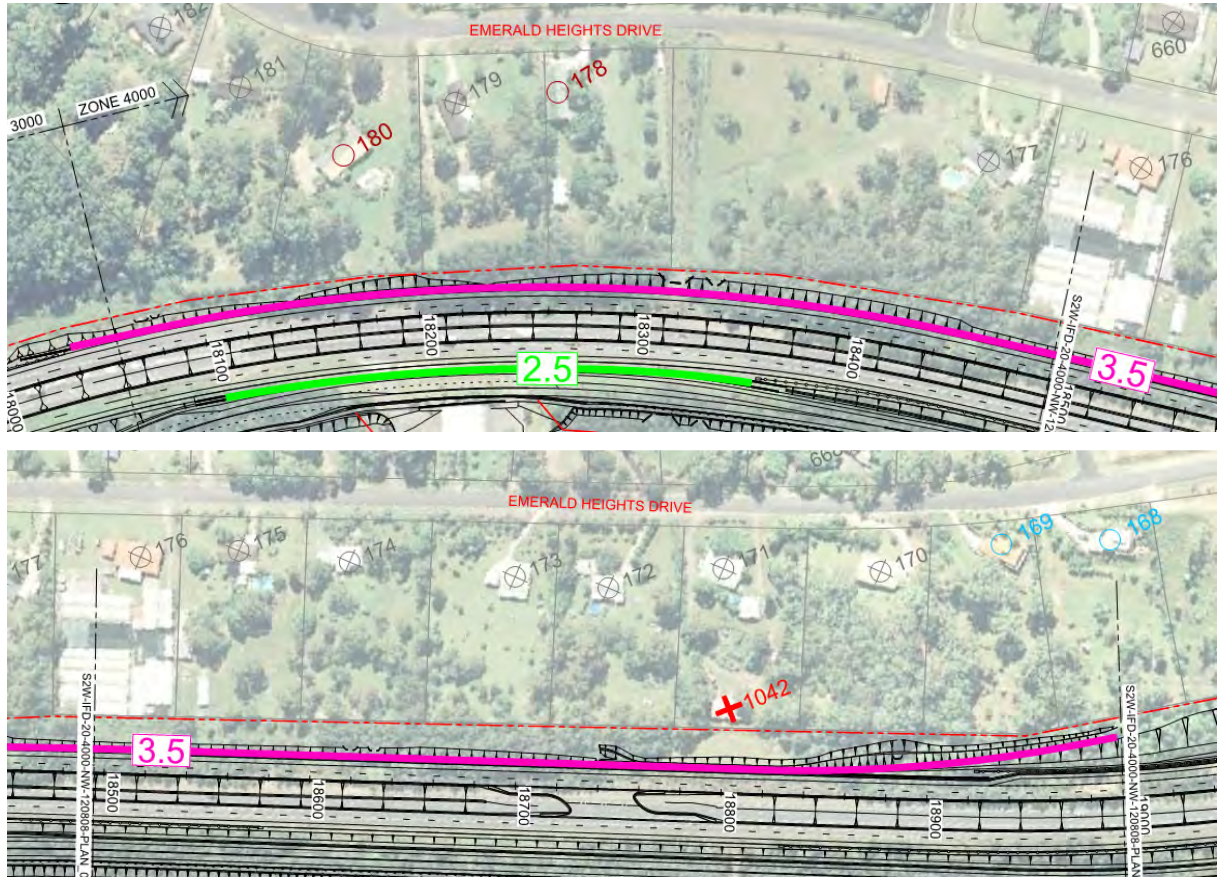
There are a number of noise sensitive receivers along Emerald Heights Drive within close proximity, of the Pacific Highway including two EA listed receivers which are predicted to exceed the ECRTN noise criteria. Consequently this location has been assessed for a noise barrier.

A noise barrier has been assessed between stn 18050 to 19020. The assessment of the noise barrier is detailed in Appendix D5.

The investigations found a 3.5 m noise barrier would meet the requirements of the ENMM. Architectural treatment will be required at receivers 168,169, 178 and 180. Further details on architectural treatments are provided in Part 2 and Part 3 of this report.

It is noted that civil works required for the noise barrier will be extensive due to the lack of available land. There may also be issues associated with maintenance of the drainage infrastructure and swales behind the barrier.

Plan showing proposed location of Noise Barrier



4.8.7. Case Study 6: Newmans Road

There are a number of sensitive receivers in close proximity to the Pacific Highway, including one EA listed receiver, which are predicted to exceed the ECRTN noise criteria. Given the number of additional receivers not identified in the EA, LFHJV has reviewed the changes in this area to establish the reasons for the increase in the number of property treatments.

The EA noise assessment used 2 m ground contours to determine the ground level at the properties for the calculation of noise levels. LFHJV has used ALS survey data, which is considerably more accurate. The ground levels at the properties used in the noise modelling have increased and the road levels have changed as follows:

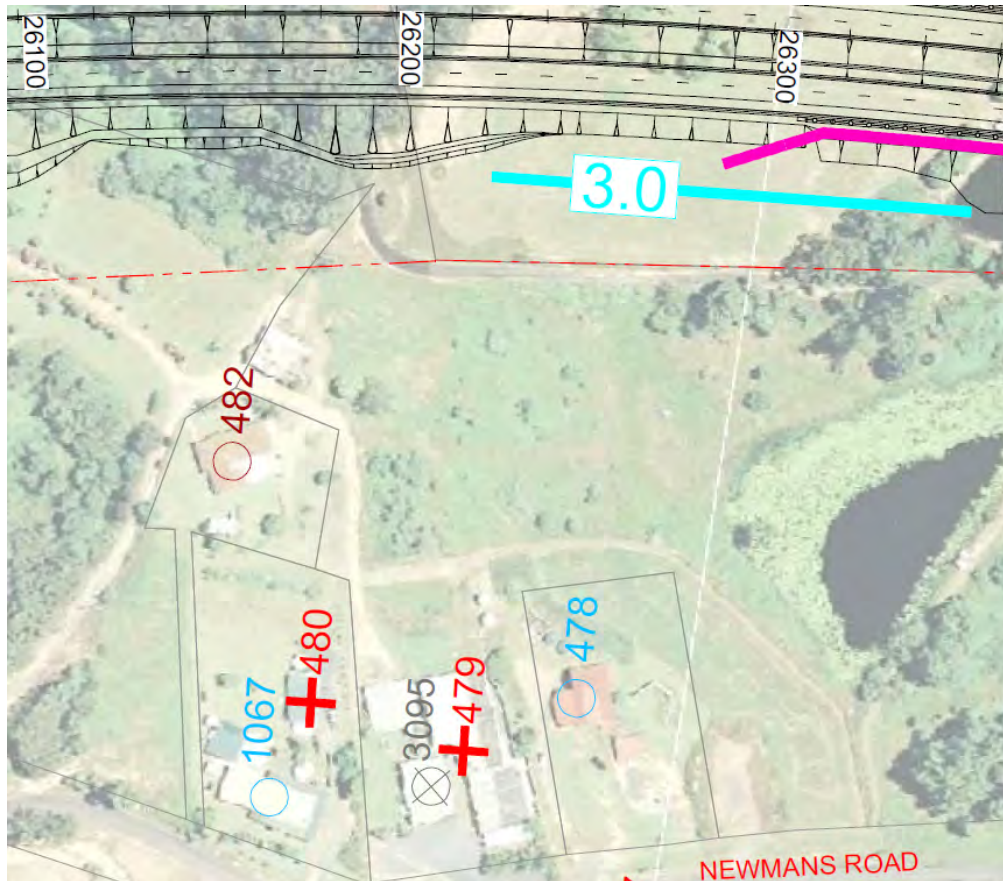
Receiver number	Ground level increase	Station	Design level increase
478	2.5 m	26080	0.6 m
479	2.7 m	26180	1.2 m
482	1.2 m	26180	1.2 m

The higher road levels and the higher ground levels at the properties are very likely to be the cause of the additional requirements for architectural treatment.

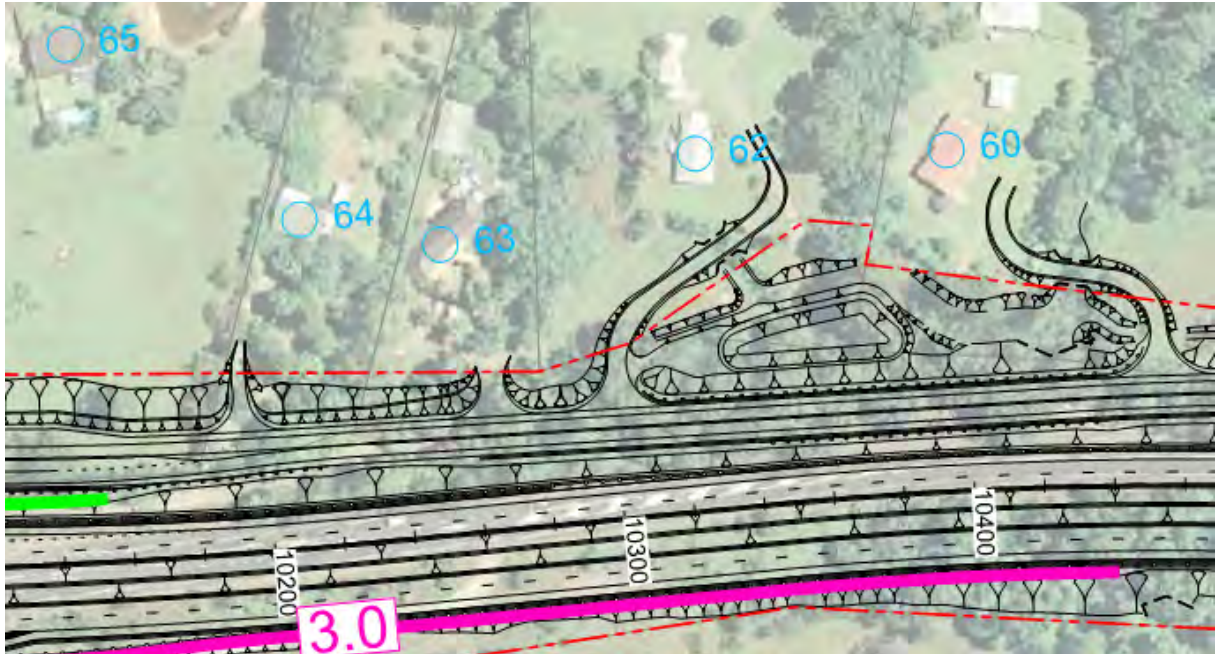
An assessment has been undertaken into the justification for extending the noise barrier that currently ends at Stn 26 300 – refer Appendix D6. The analysis indicates that the provision of a barrier is not reasonable given that there are less than four residences. However given the amount of land available, LFHJV intend to construct a noise mound adjacent to the road and run the end of the noise barrier into the mound. The noise barrier will be approximately 15 m shorter than the EA listed barrier but the noise amelioration function will be provided by the mound.

LFHJV has decided to construct a mound as indicated in the sketch below, as it provides a sustainability benefit for the project in allowing excess material to be utilised effectively on site rather than disposed of offsite. However at house treatments will be undertaken based on the earlier (no mound) analysis.

Plan showing location of proposed noise mound



4.8.8. Case Study 7: North of Sugarmill Road, West side of Highway



There are four noise sensitive receivers north of Sugarmill, on the western side of the highway which are predicted to exceed the ECRTN noise criteria. The four properties are of rural character and reasonably spaced and hence do not constitute a group for the purposes of Practice Note iv.

Therefore architectural treatments are the appropriate noise mitigation measures for properties at this location.

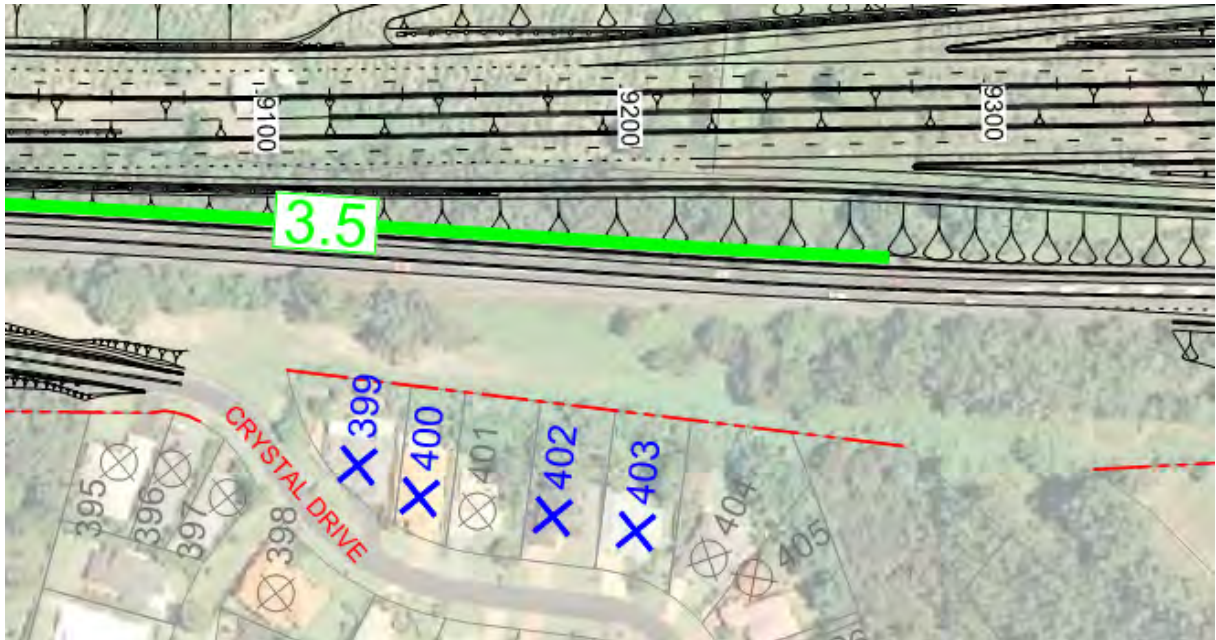
4.8.9. Case Study 8: Crystal Drive

At Crystal Drive there is one new receiver identified for architectural treatment between four pre-treated receivers.

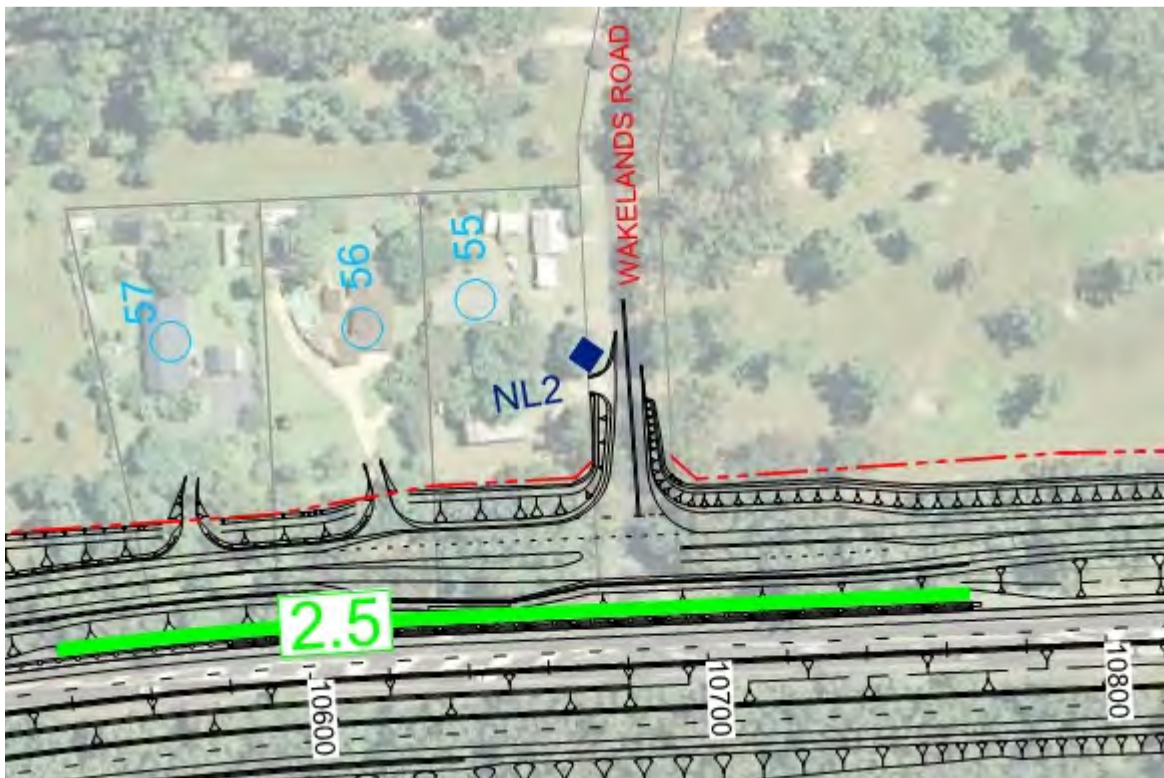
An insertion loss of approximately 5 dB(A) would be achieved for a barrier 4.5 m high. The minimum insertion loss for barrier heights greater than 5 m high of 10 dB(A) is not achieved at this location.

The best option at this location was to extend the adjacent headlight screen by 130 m. With a 3.5 m barrier height, only one receiver would exceed the ECRTN criteria, and this property is already treated. Refer to Appendix D7 for the detailed assessment of this barrier.

Plan showing extension of headlight screen to act as a noise barrier



4.8.10. Case Study 9: Wakelands Road



The sketch above shows that there are three noise sensitive receivers in close proximity which are predicted to exceed the ECRTN noise criteria. However to be assessed for a noise barrier there needs to be a minimum of four properties grouped together.

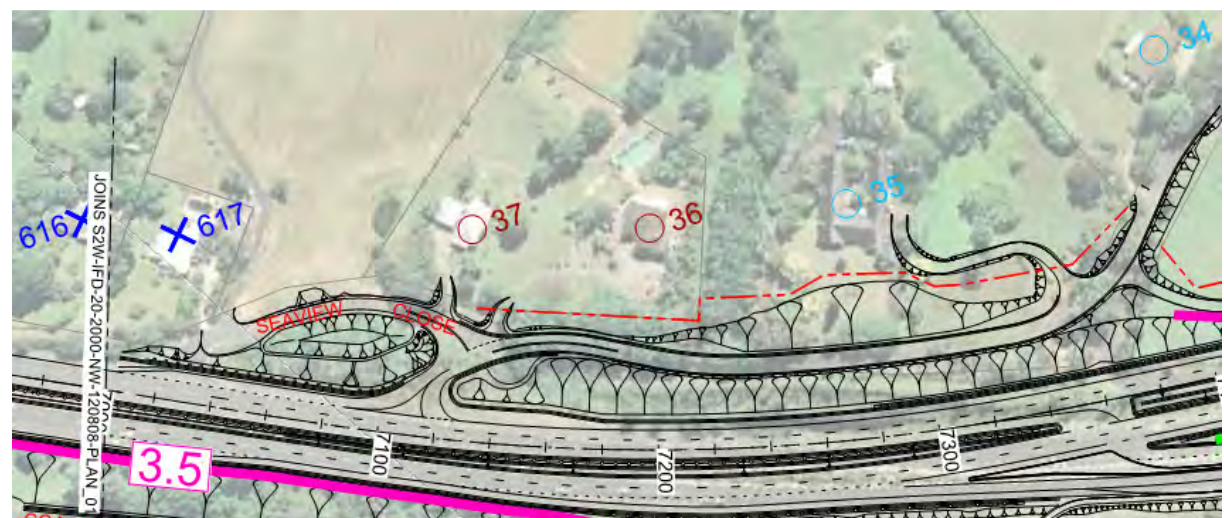
A barrier does not need to be assessed at this location. Architectural treatment is the appropriate noise mitigation measure for the properties that exceed the ECRTN noise criteria at this location.

4.8.11. Case Study 10: Heritage Park



There are only two noise sensitive receivers within close proximity on Heritage Drive/Kumbaingerai which are predicted to exceed the ECRTN criteria (Receivers 3093, 3024). On the basis that there are not more than three receivers eligible for additional noise mitigation, these receivers do not require consideration of a noise barrier. Architectural treatments are the appropriate noise mitigation measures for the properties that exceed the ECRTN noise criteria at this location.

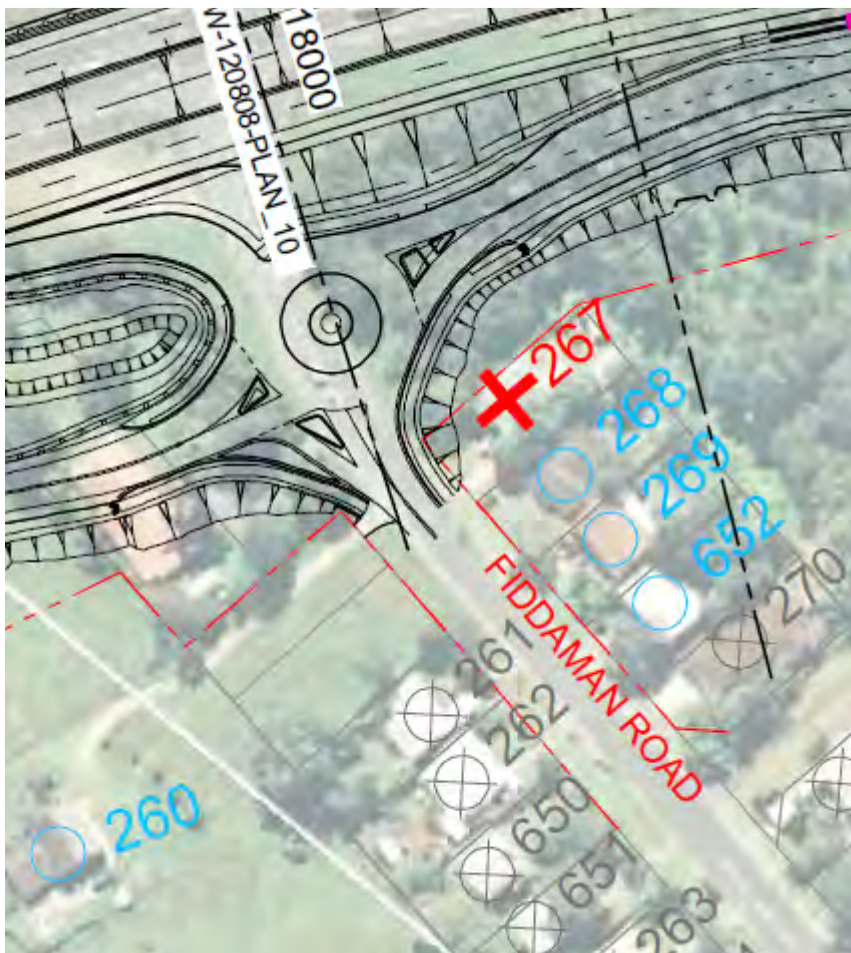
4.8.12. Case Study 11: Seaview close



There are six noise sensitive receivers adjacent to the Seaview/Campbell Close link which are predicted to exceed the ECRTN criteria. These receivers are on rural type blocks and this location does not need to be assessed for a noise barrier. In addition, receivers 616 and 617 would be directly affected by the proposed Coffs Harbour bypass and would be demolished for that project. Receiver 616 has been purchased by the RMS.

No assessment of noise barrier is required. Architectural treatment is the appropriate noise mitigation measure for the properties that exceed the ECRTN noise criteria at this location.

4.8.13. Case Study 12: Emerald Beach – Fiddaman Road



As the upgrade project directly impacts on No. 1 Fiddaman Road, the RMS has purchased the property and will demolish Receiver 267. Receiver 260 cannot be serviced by the same barrier hence is considered a separate catchment area. This effectively reduces the number of noise sensitive receivers which exceed the ECRTN noise criteria to three. Only groups of more than three receivers in close proximity to each other exceeding the ECRTN noise criteria require barrier assessment. Therefore architectural treatment is the appropriate noise mitigation measure for the properties that exceed the ECRTN noise criteria at this location.

4.9. Traffic Volumes

As discussed in Section 3, the noise model was calibrated using measured traffic flows undertaken simultaneously with the noise logging.

The noise modelling has used the traffic volumes for 2024, calculated by adjusting the traffic volumes for year 2021 identified in Tables 4-5, 4-6 and 4-7 of Working Paper No. 2 Noise and Vibration in Appendix F of the Environmental Assessment at a 3% per year traffic growth until 2024.

A summary of the traffic flows is provided below. Source data can be provided upon request.

Table 4.4 2014 Traffic Volumes

Location	Direction	Daytime (7am – 10pm)		Night-time (10pm – 7am)	
		Light	Heavy	Light	Heavy
South of Headlands	NB	8376	918	557	392
	SB	8289	905	769	250
North of Headlands	NB	7877	808	519	389
	SB	7669	846	700	252
North of Gaudrons Road/ Split Solitary Road	NB	7741	782	509	387
	SB	7504	829	682	254
North of Moonee Beach Road	NB	6918	627	448	379
	SB	6547	728	584	247
North of Bucca Road	NB	6930	623	449	375
	SB	6545	735	579	250
North of Killara Ave	NB	6848	623	444	376
	SB	6471	735	567	250
North of Fiddaman Rd	NB	6674	618	434	376
	SB	6302	744	538	252
North of Graham Drive South	NB	5586	599	369	378
	SB	5310	732	393	248
North of Graham Drive North	NB	6815	615	441	370
	SB	6421	750	552	255
North of River St	NB	3915	556	275	374
	SB	3748	687	252	238
North of Pullen St/ Clarence St	NB	6324	605	412	372
	SB	5958	761	475	258
North of Newmans Rd	NB	5732	605	378	380
	SB	5448	732	414	248

Table 4.4 2014 Traffic Volumes

Location	Direction	Daytime (7am – 10pm)		Night-time (10pm – 7am)	
		Light	Heavy	Light	Heavy
North of Safety Beach Road	NB	4827	596	329	389
	SB	4627	711	332	243
North of Mullaway Drive	NB	3897	553	273	370
	SB	3720	691	249	239

Table 4.5 2024 Traffic Volumes

Location	Direction	Daytime (7am – 10pm)		Night-time (10pm – 7am)	
		Light	Heavy	Light	Heavy
South of Headlands	NB	15916	1580	1059	674
	SB	15741	1660	1460	444
North of Headlands	NB	15124	1536	1006	664
	SB	14816	1605	1377	434
North of Gaudrons Road/ Split Solitary Road	NB	13070	1422	873	639
	SB	12763	1482	1193	414
North of Moonee Beach Road	NB	12024	1364	805	627
	SB	10127	1325	969	389
North of Bucca Road	NB	11550	1337	775	621
	SB	10978	1376	1041	397
North of Killara Ave	NB	4660	796	327	534
	SB	4476	994	299	345
North of Fiddaman Rd	NB	8600	326	532	84
	SB	8050	341	777	74
North of Graham Drive South	NB	3287	237	231	81
	SB	3174	247	215	54
North of Graham Drive North	NB	6819	278	422	75
	SB	6376	313	567	71
North of River St	NB	6208	292	390	89
	SB	5880	298	490	63
North of Pullen St/ Clarence St	NB	4530	275	298	97
	SB	4369	270	335	58
North of Newmans Rd	NB	3486	249	245	82
	SB	3347	267	224	57

Table 4.5 2024 Traffic Volumes

Location	Direction	Daytime (7am – 10pm)		Night-time (10pm – 7am)	
		Light	Heavy	Light	Heavy
North of Safety Beach Road	NB	15916	1580	1059	674
	SB	15741	1660	1460	444
North of Mullaway Drive	NB	15124	1536	1006	664
	SB	14816	1605	1377	434

In the development of the project, consideration was given to incorporating traffic information derived from recent modelling in Traffic Report S2W-REP-20-0000-TE189A. A comparison between the EA predictions and the new traffic model is provided below. A positive figure in the disparity column indicates the noise model would under-predict noise in this section. A negative figure indicates the noise model would provide a conservative result.

Table 4.6 2024 EA Model Traffic Comparison

Location	EA Values		Latest Predictions		Difference		Disparity dB(A)
	AADT	Heavy Vehicles	AADT	Heavy Vehicles	AADT	Heavy Vehicles	
South of Headlands	38533	11	34780	12	-3753	1	-0.4
North of Gaudrons Road	36564	12	41500	12	4936	0	0.5
North of Moonee Beach Road	31856	12	29620	13	-2236	1	-0.3
North of Fiddaman Road	27631	13	25480	14	-2151	1	-0.4
North of Graham Drive	28074	13	25990	14	-2084	1	-0.3
Woolgoolga Bypass	12432	21	18890	-	6458	-	1.8

The traffic numbers modelled above indicate that typically the latest traffic numbers are within 0.5 dB(A) of the EA traffic figures. However traffic figures for the Woolgoolga bypass have increased significantly, resulting in an under-prediction of 1.8 dB(A). The RMS has advised that the EA traffic figures should be used in the noise model. Considering the large difference between the predicted traffic flows, traffic counting should be undertaken concurrently with any compliance noise measurements.

4.10. Noise Modelling Scenarios

Four noise models were developed to assess the Sapphire to Woolgoolga Upgrade project. These models are detailed below:

- **Existing Model** – This model incorporated the existing alignment and traffic volumes recorded from the traffic counters. The existing model was used for calibration purposes.



- **Year 2014 'Future Existing' Model** – This model incorporated the existing alignment and 2014 traffic volumes (as provided above in Table 4.4). This model was used to determine the 'Future Existing' case at the year of opening.
- **Year 2021 old Design Year Model** – This model incorporated the future S2W alignment and 2021 traffic volumes (as provided above in the EA).
- **Year 2024 Design Year Model** – This model incorporate the future S2W alignment and 2024 traffic volumes (as provided above in Table 4.5). This model was used to determine the noise levels 10 years after opening and to determine appropriate noise mitigation.

5. NOISE MODEL CALIBRATION

Standard corrections are typically applied when using the Calculation of Road Traffic Noise (CoRTN) in Australia to account for Australian conditions. These correction factors of -1.7 dB(A) ¹ and $+0.5 \text{ dB(A)}$ ² have been applied to the daytime and night-time predicted noise results respectively.

Noise logging was undertaken over a period of one week at nine locations to calibrate the noise model. Traffic flow monitoring was undertaken simultaneously to determine the traffic flows at each location over the same time periods.

Logger Location 1 was deemed too close to the road to provide accurate results so the location has been excluded. CoRTN uses a source model 10 m from the side of the road. Propagation algorithms start from 10 m. If a logger is located within or close to 10 m from the carriageway the CoRTN calculations would not be valid.

The noise logging results and noise model predictions have been provided in Table 5.1. The noise logger locations are provided in Appendix A and are shown on the aerial plans in Part 4 of ONMR. From the aerial photography, the distance to roads can be confirmed.

Table 5.1 Noise Model Calibration

Logger Location	Day Noise Levels dB(A)				Night Noise Levels dB(A)			
	Measured	Predicted	Predicted with Std Correction	Difference	Measured	Predicted	Predicted with Std Correction	Difference
1	64.9	66.5	64.8	-0.1	62	61.9	62.4	0.4
2	53.7	57.6	55.9	2.2	52.9	53	53.5	0.6
3	59.1	60.4	58.7	-0.4	56.8	55.5	56	-0.8
4	68.9	69.1	67.4	-1.5	65.3	64.4	64.9	-0.4
5	72.6	74	72.3	-0.3	68.8	69.3	69.8	1
6	62	65.2	63.5	1.5	58.8	60.4	60.9	2.1
7	73.2	75.5	73.8	0.6	71.3	70.8	71.3	0.0
8	59.9	60.3	58.6	-1.3	57.7	56.7	57.2	-0.5
9	58.2	62.9	61.2	3	57.6	59.2	59.7	2.1
Average				0.4				0.5

Note: The daytime standard correction is -1.7 dB(A) ¹. The night-time correction is $+0.5 \text{ dB(A)}$ ²

The results in Table 5.1 indicate that measured noise levels during the daytime period vary between -1.5 dB(A) to $+3.0 \text{ dB(A)}$ and -0.8 dB(A) to $+2.1 \text{ dB(A)}$ during the night-time period from predicted noise levels. Predicted noise level from a new road surface would generally have reasonably good coherence to the predicted noise levels. However noise levels from a well-worn road such as the Pacific Highway are likely to deviate significantly due to the change in surface texture. The variance

¹ An evaluation of the U.K. DoE traffic noise prediction method: final report of the NAASRA Working Group on Traffic Noise Prediction Evaluation / by R.E. Saunders...[et al.] Vermont South, Vic. : Australian Road Research Board, 1983.

² Based on AECOM experience



found in Table 5.1 is considered typical for this section of the Pacific Highway. Hence the noise model is deemed to be providing reasonable correlation between predicted and measured results.

The average disparity between measured and predicted noise levels, taking into account the standard corrections is 0.4 dB(A) and 0.5 dB(A) during the daytime and night-time scenarios respectively.

6. NOISE MODELLING OUTPUTS

6.1. Noise Mitigation

Sensitive receivers that exceed the relevant noise criteria are discussed in Parts 2 and 3 of the ONMR. The recommended noise mitigation is summarised in Parts 2 and 3 of the ONMR and provided diagrammatically on the aerial plans contained within Part 4 of the ONMR and digitally in the façade model.

6.2. Noise Contours

The SWTC requires that the predicted Year 2021 $L_{Aeq(9hour)}$ 50 dB(A) noise contour falls within the contour line described in electronic file App_9 Noisev0.2.txt in Appendix 9 of the SWTC.

Since the original noise modelling was undertaken at the EA stage there have been numerous changes/adjustments to the alignment. Additionally, further ALS topographical surveys have been undertaken of the area surrounding the future alignment, which have highlighted some considerable changes to the property elevations (more than 10 m in some locations). The significant changes in the ground contours indicate that the propagation path of noise would have also changed. Accordingly, the ground absorption and barrier attenuation would be different resulting in discrepancies between noise predictions undertaken at the EA stage and those undertaken for this report.

The chart provided below illustrates the significant changes in receiver heights between the Department of Lands ground contours and the ALS survey ground contours.





The noise contours are provided in Appendix C. However, it is important to note that even though a receiver falls within a noise contour, the receiver is not necessarily eligible for additional noise mitigation. Even though the receiver exceeds the $L_{Aeq(15\text{hour})}$ or $L_{Aeq(9\text{hour})}$ noise criteria, it may not exceed the increase in noise limit. The noise contours should typically only be used as a guide of future noise levels. Receivers are only eligible for treatment if they have been identified in Parts 2 and 3 of the ONMR.

6.3. Noise Analysis Results

Details of noise levels at individual noise sensitive receivers are provided in Appendix E.

APPENDIX A – NOISE LOGGER LOCATIONS AND PHOTOGRAPHS

Logger 1

No photo available

Logger 2



Logger 3



Logger 4



Logger 5



Logger 6



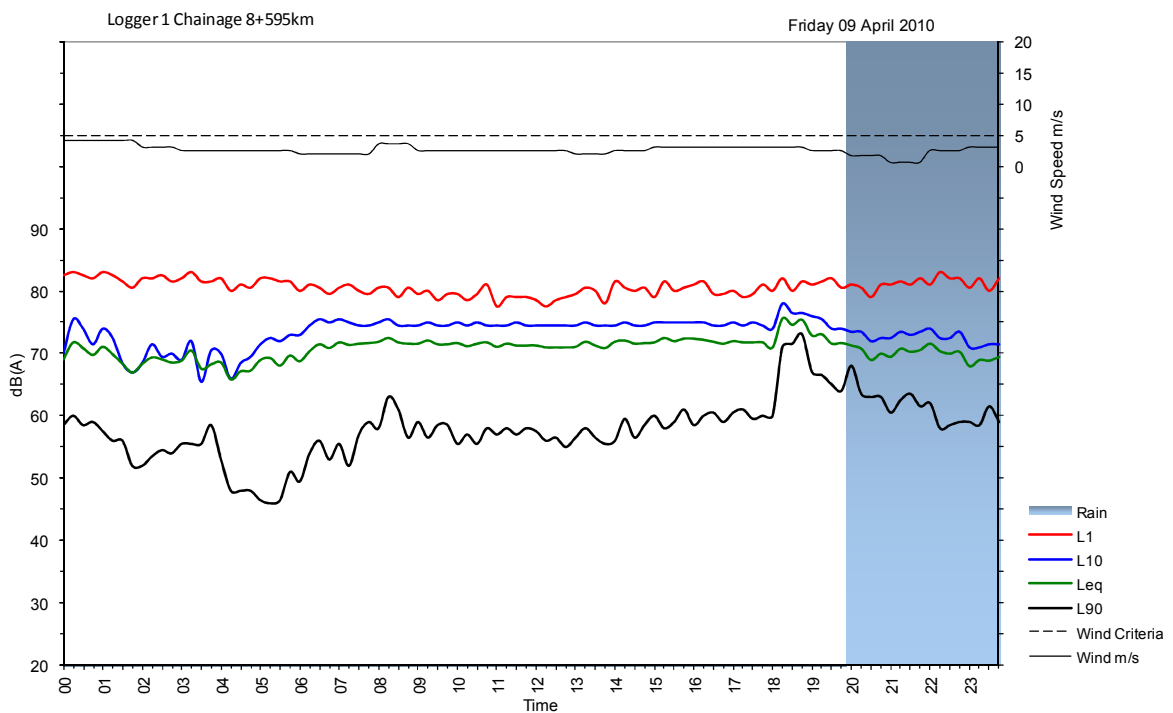
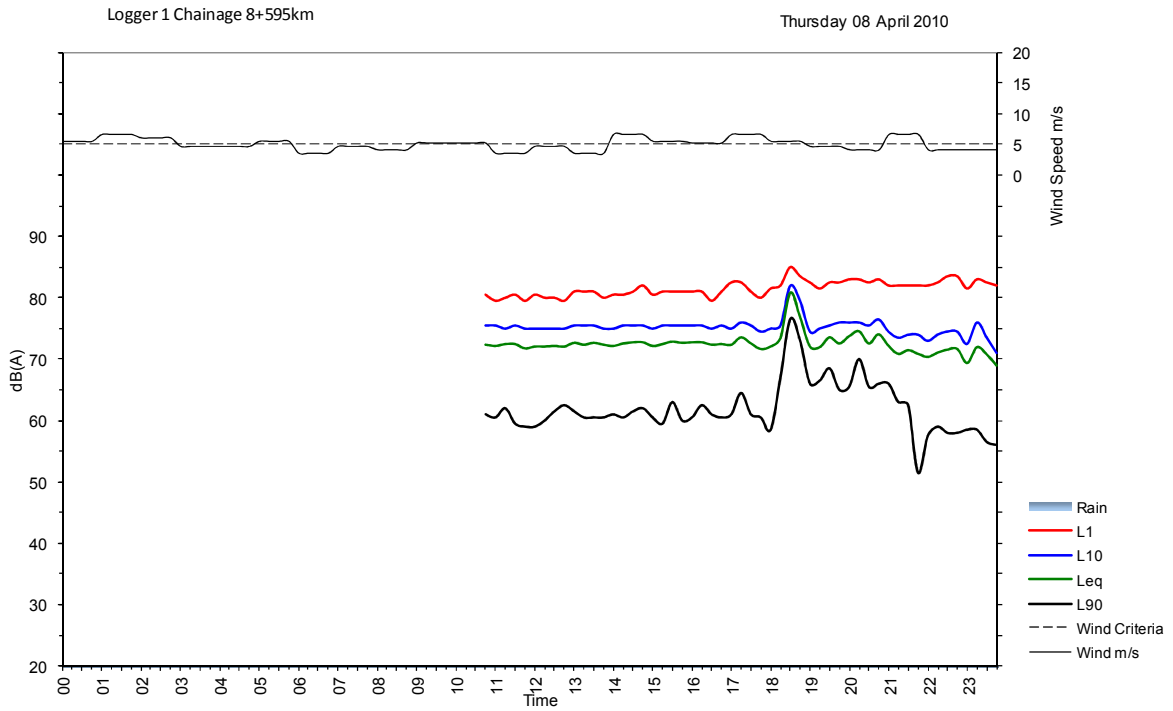
Logger 7
No photo available

Logger 9

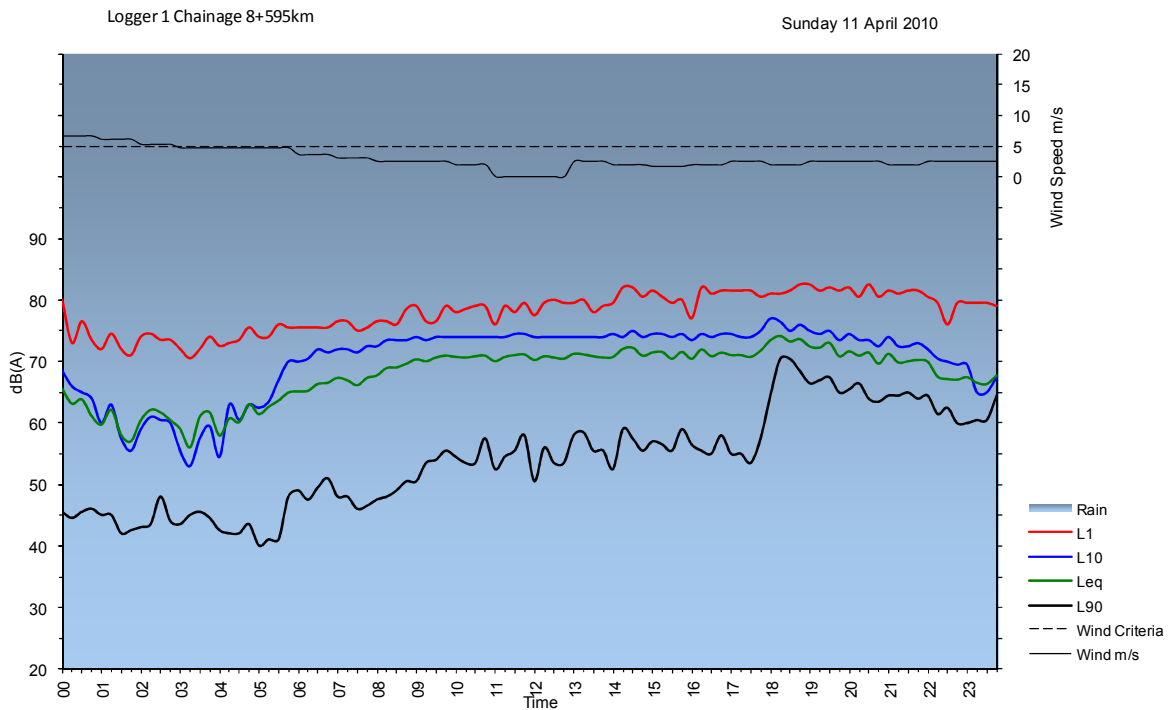
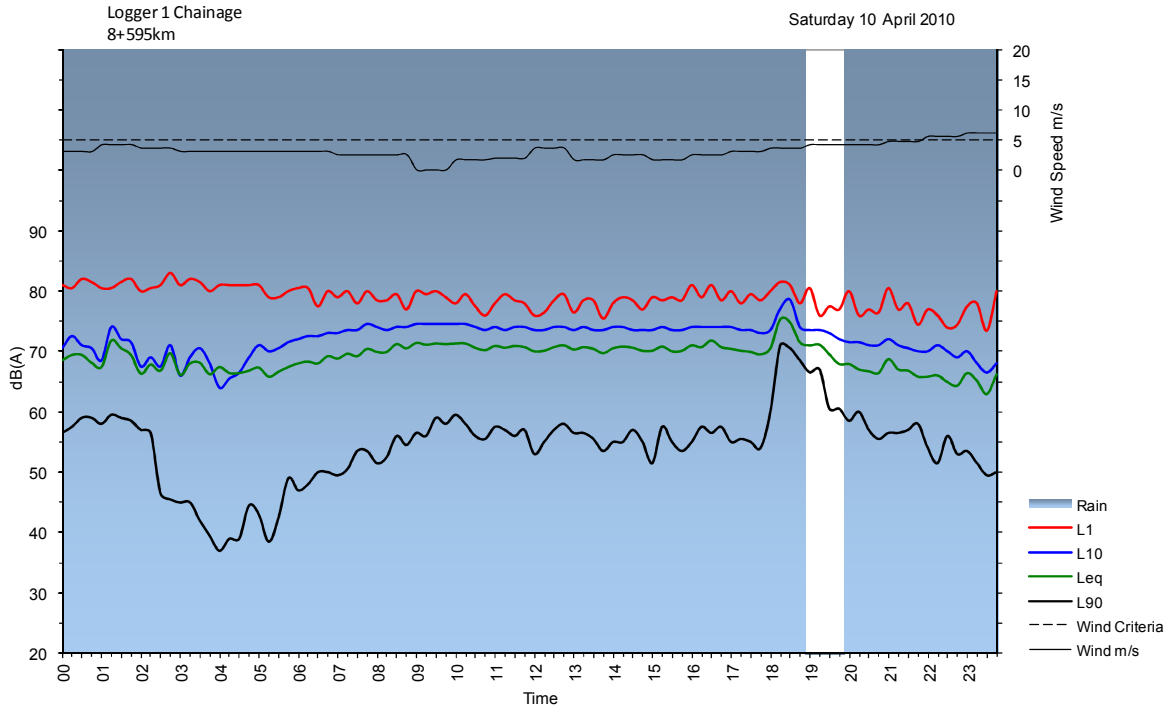


APPENDIX B – AMBIENT NOISE MONITORING GRAPHS

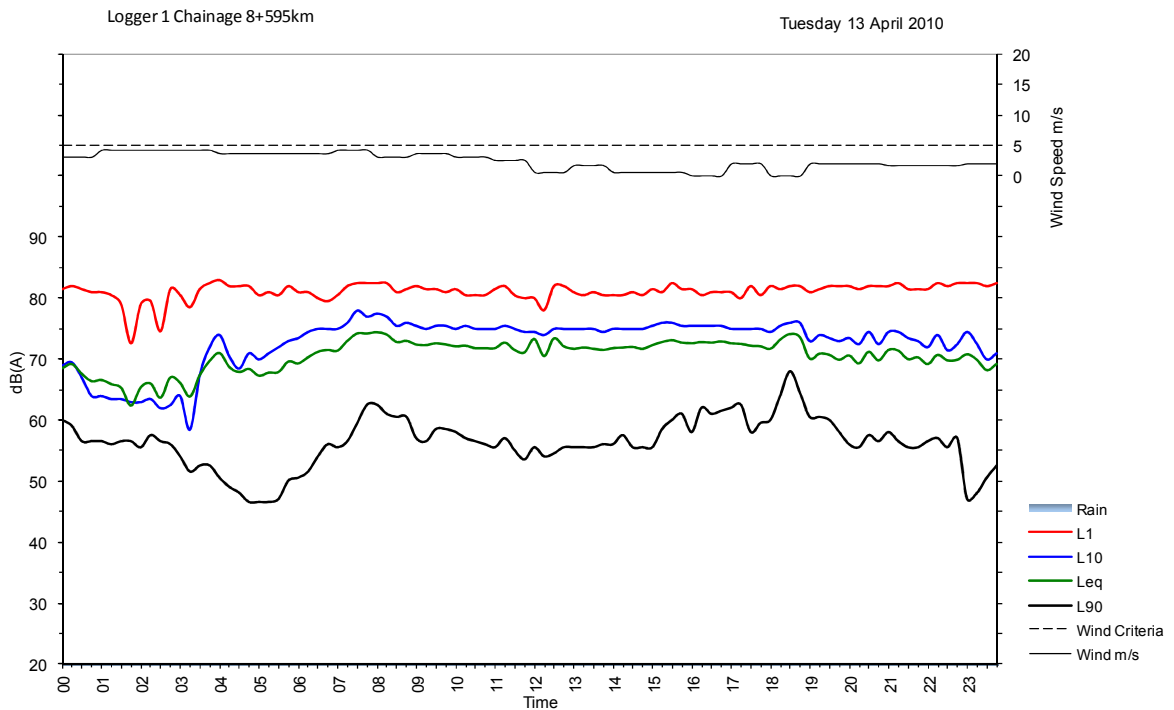
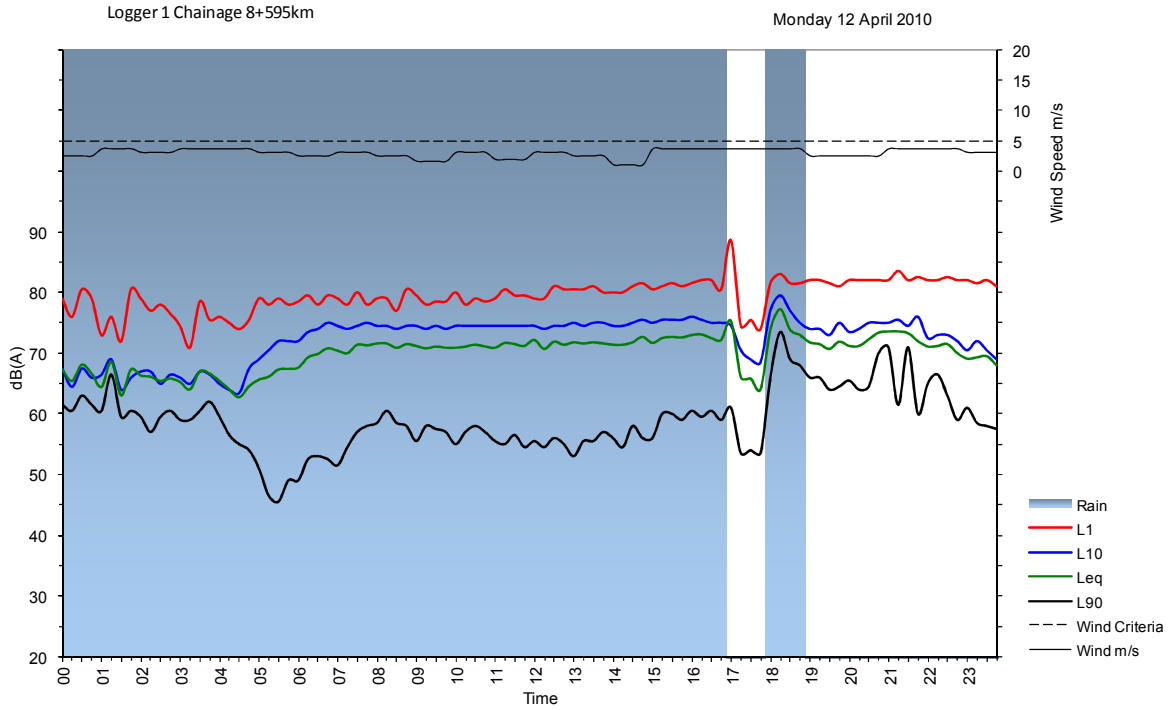
Location 1 –



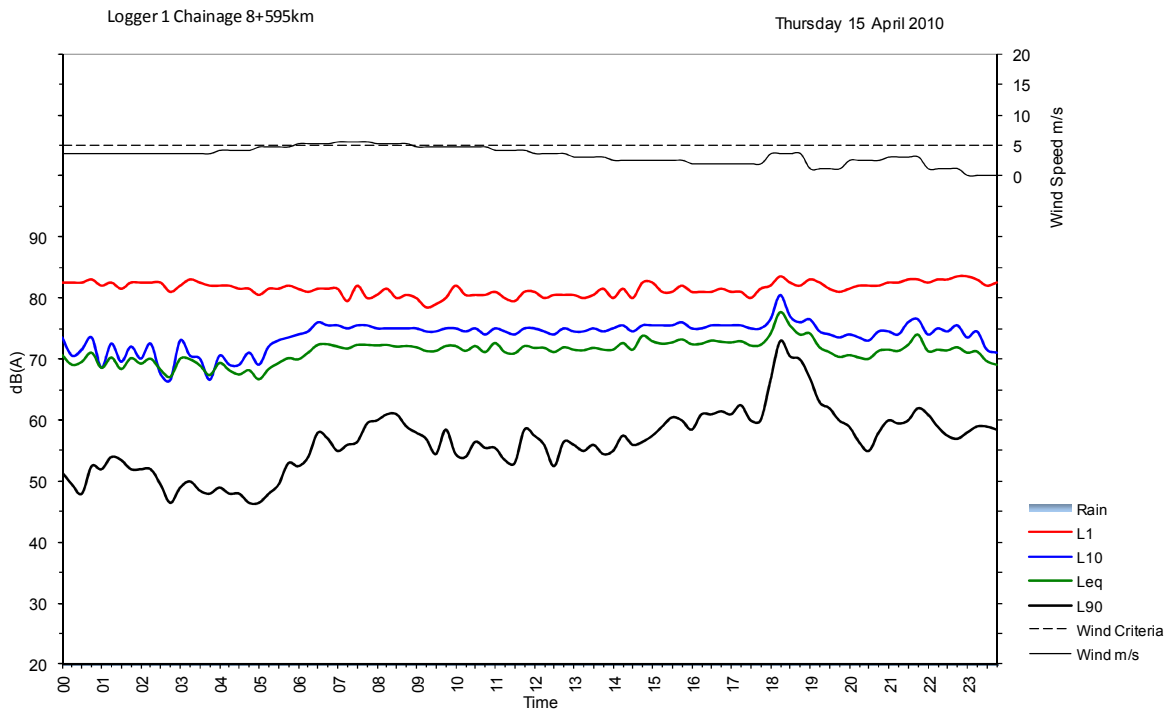
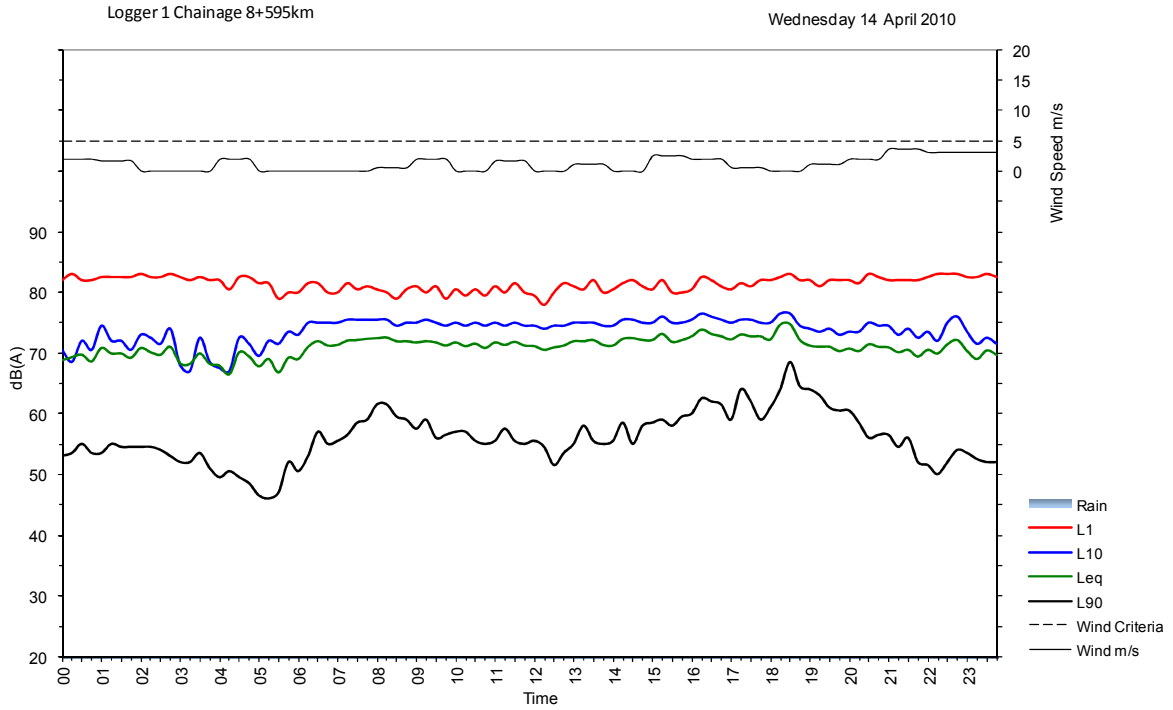
Zone 0000 - Operational Noise Management Report: Part 1



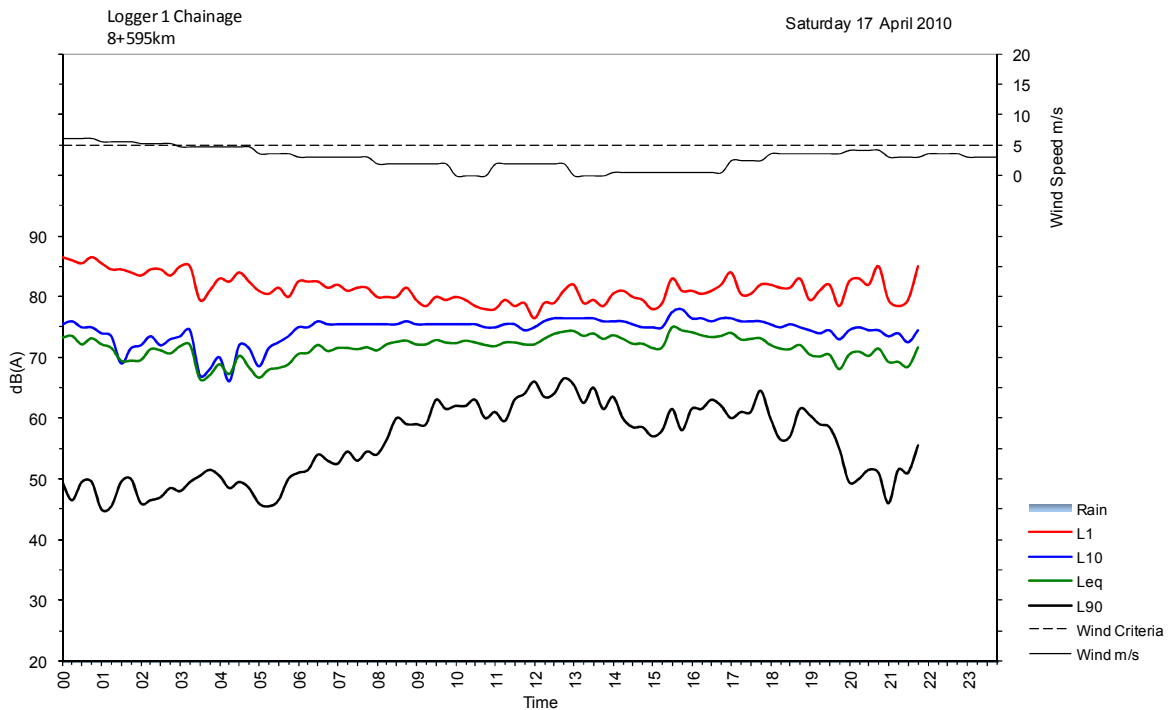
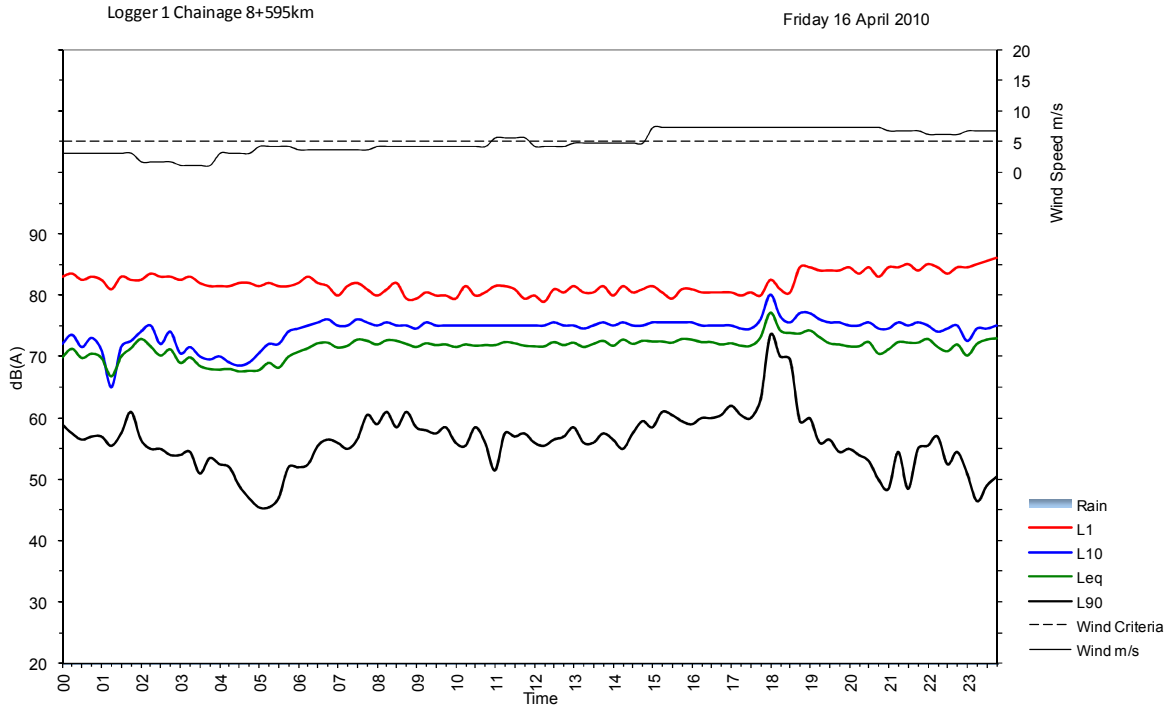
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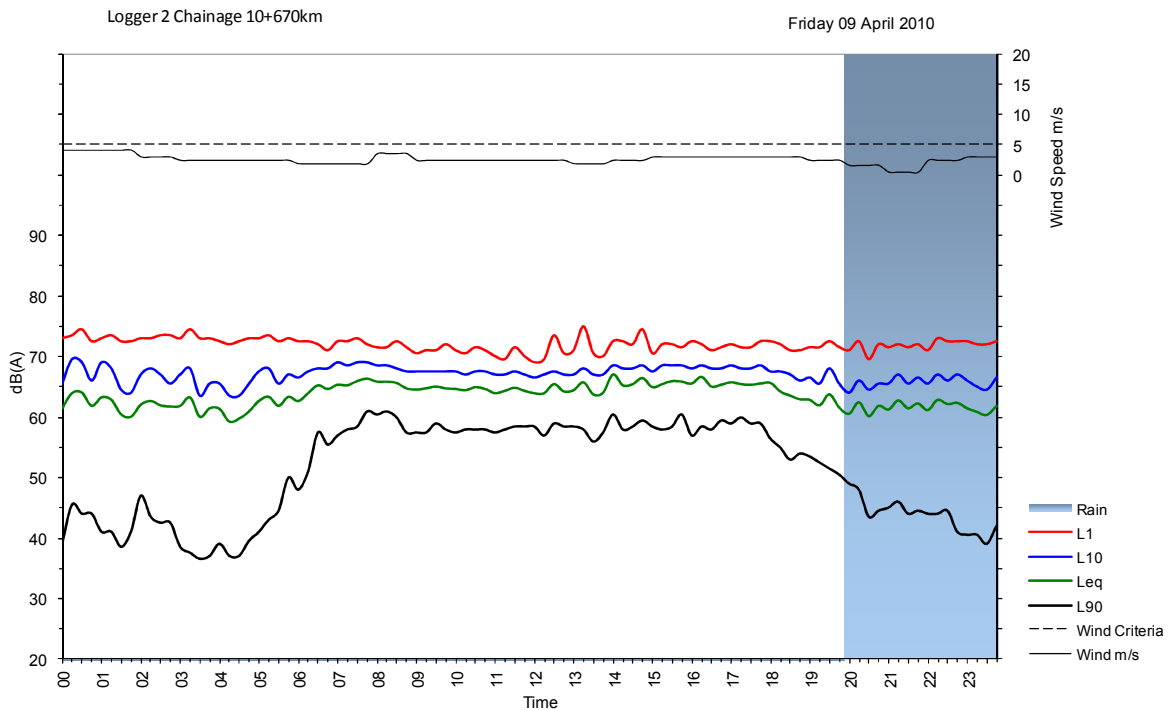
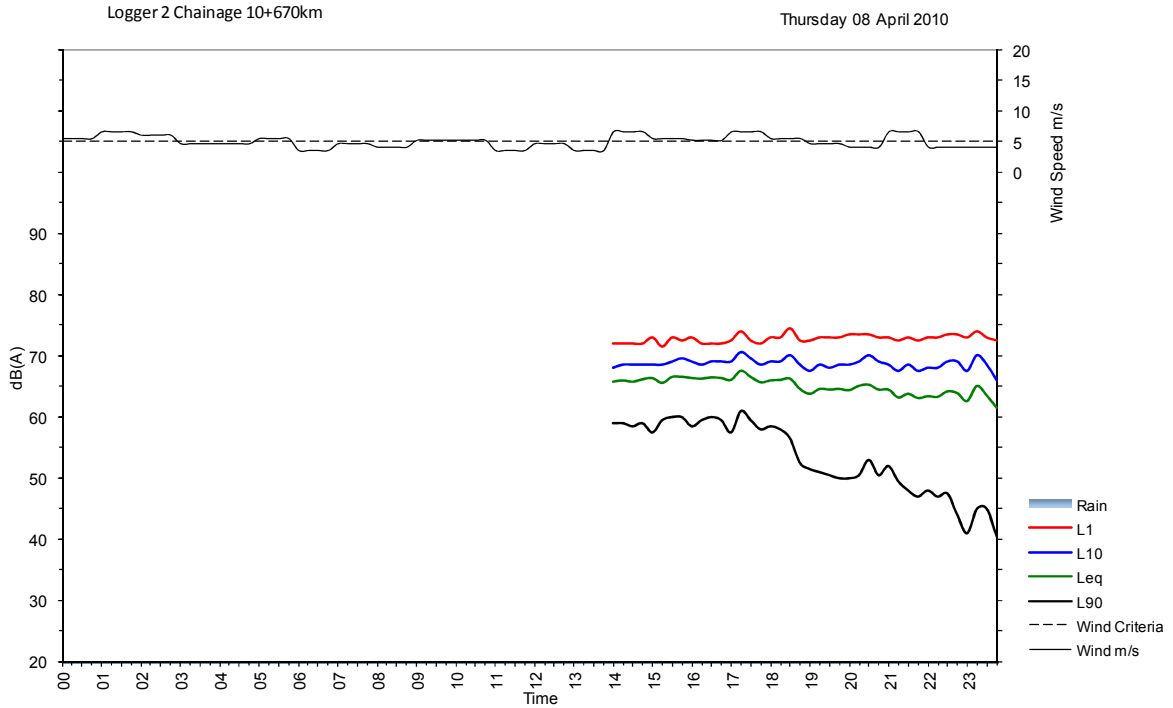
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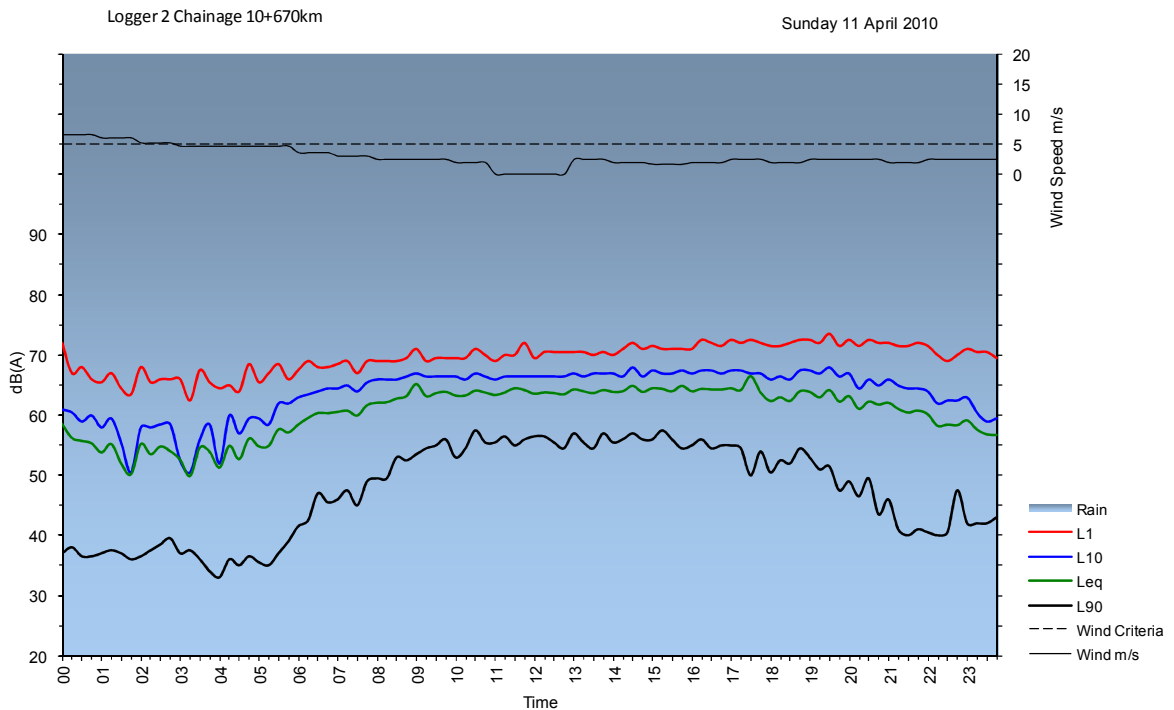
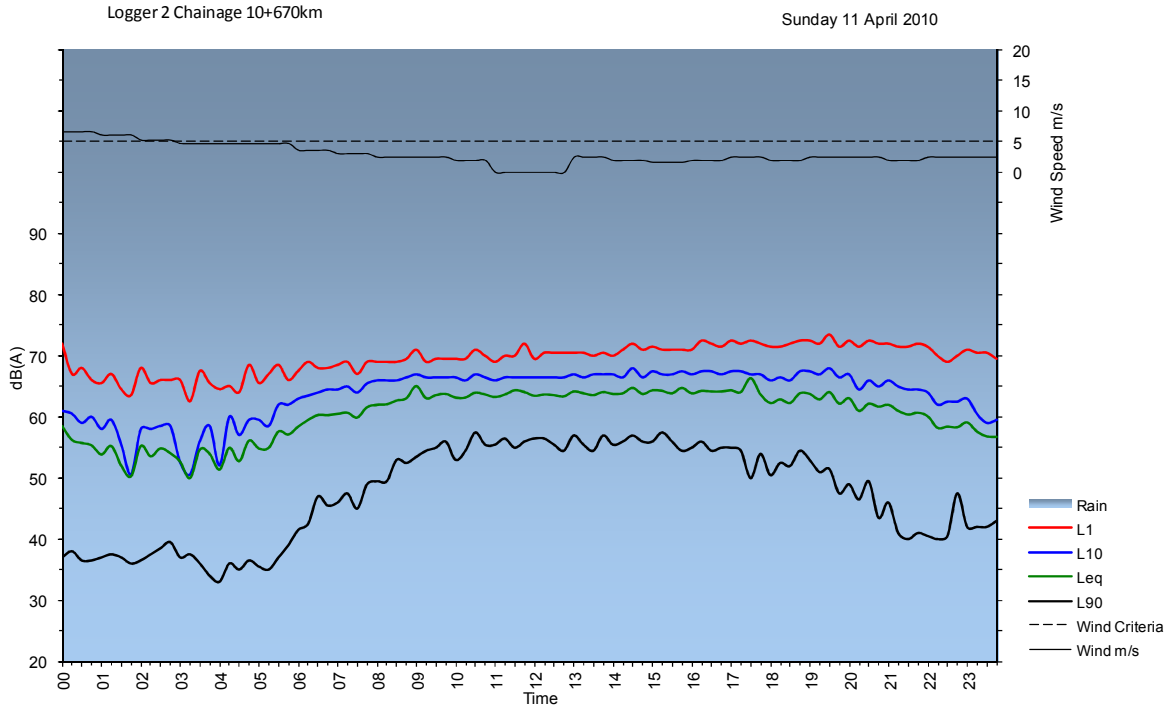
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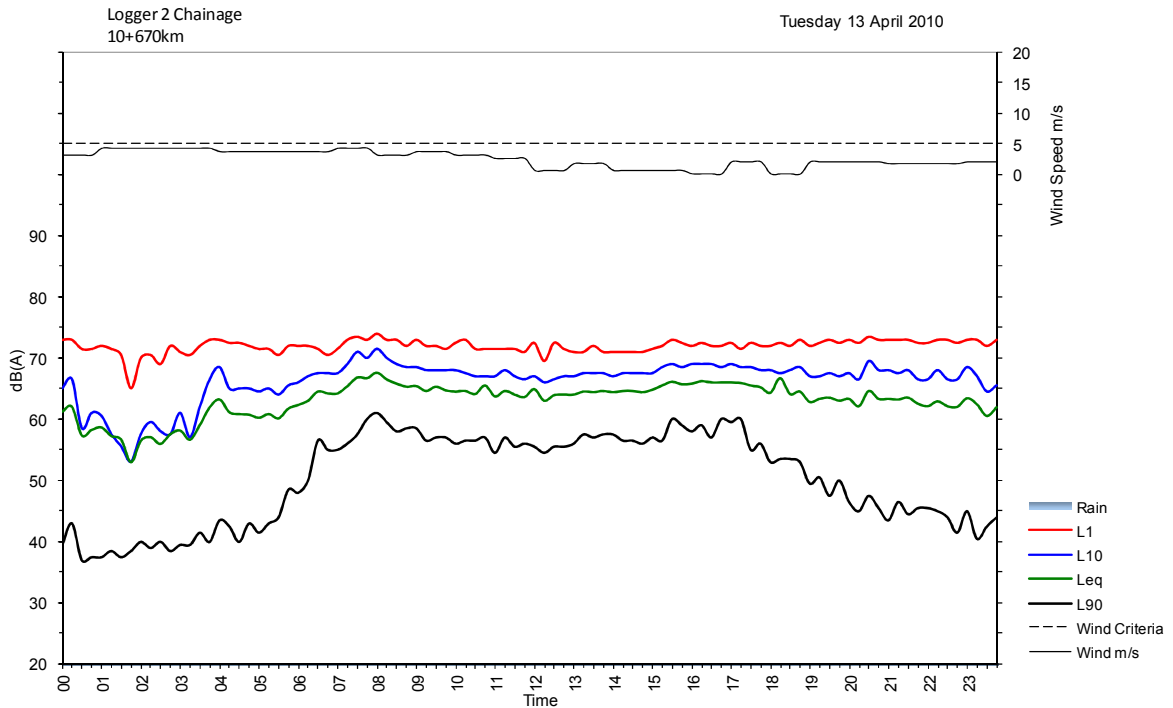
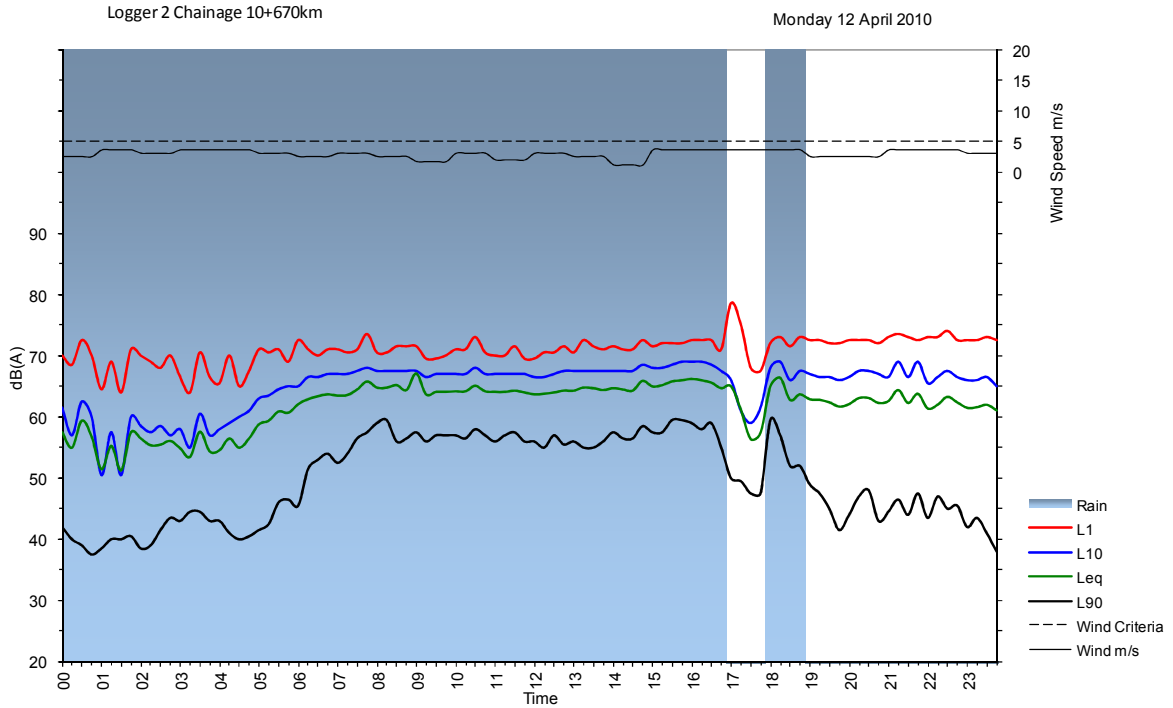
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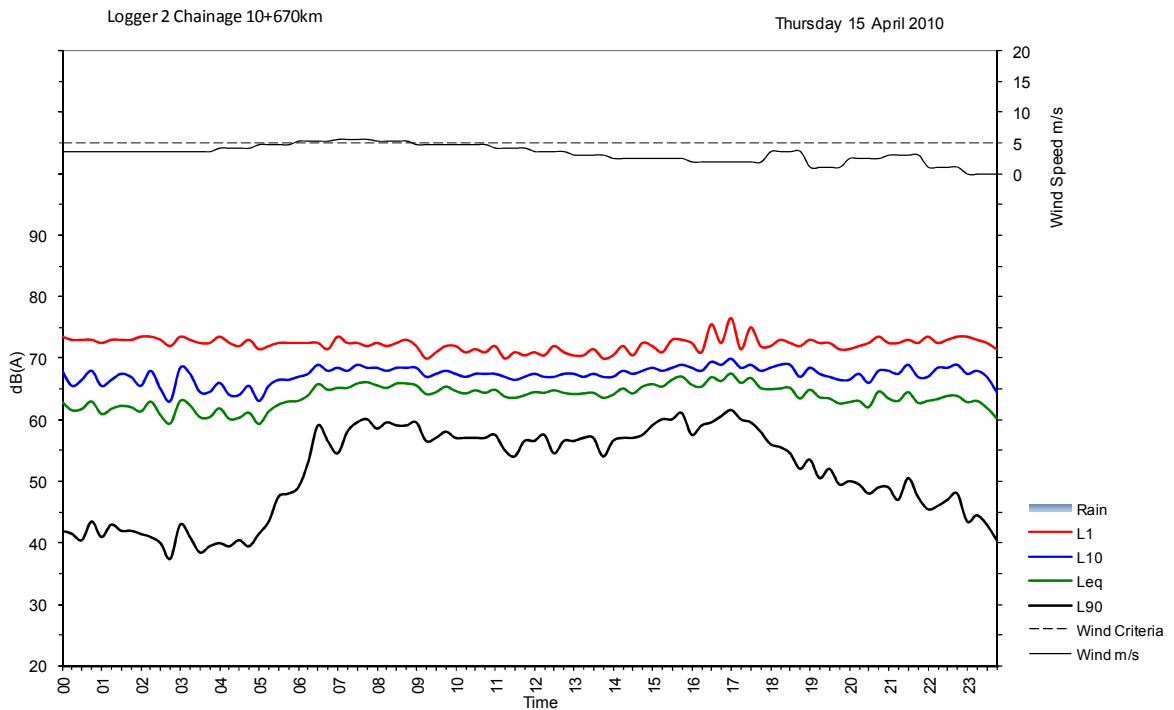
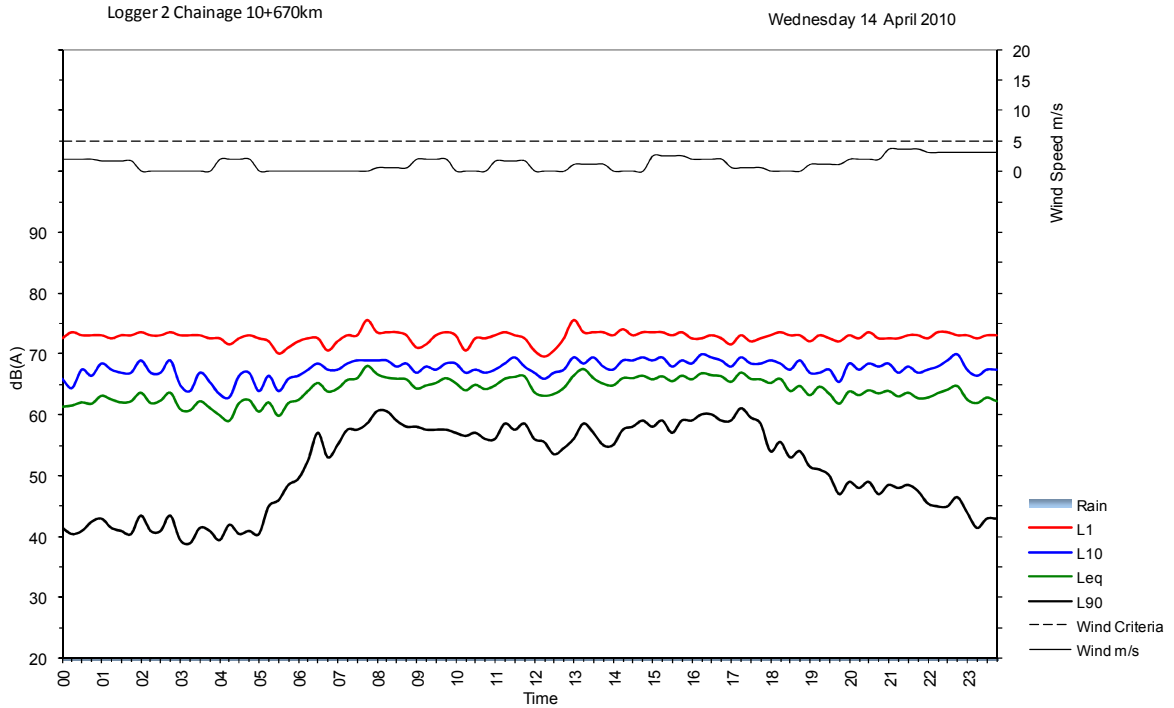
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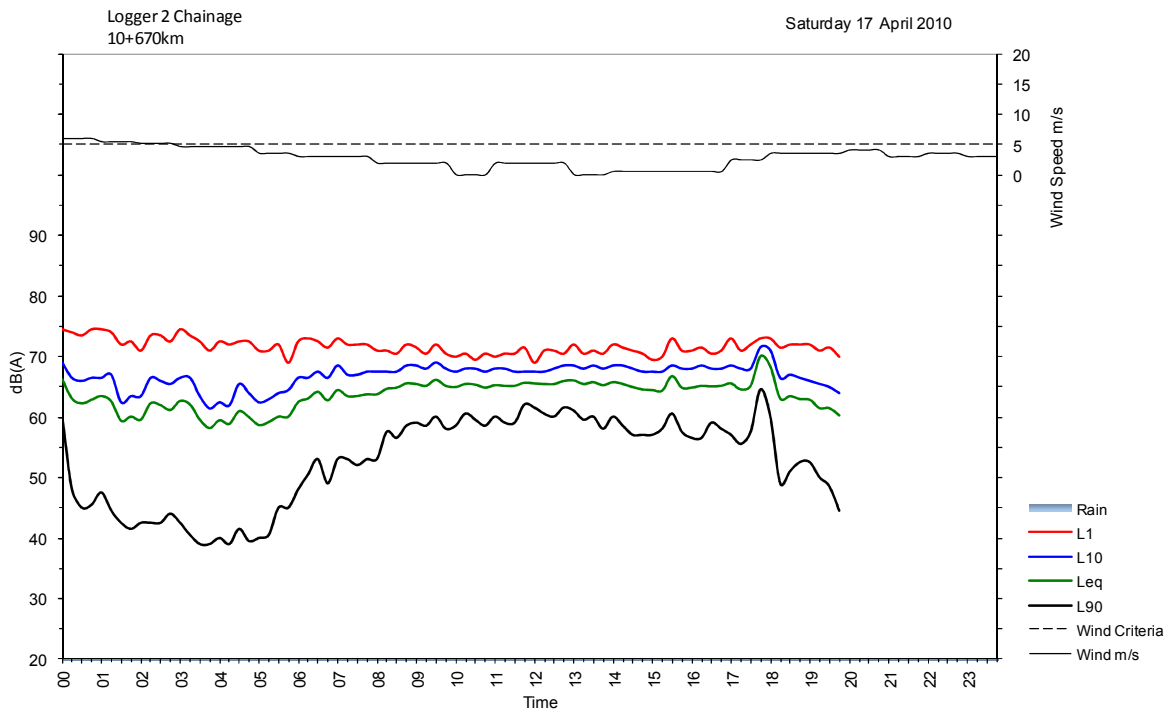
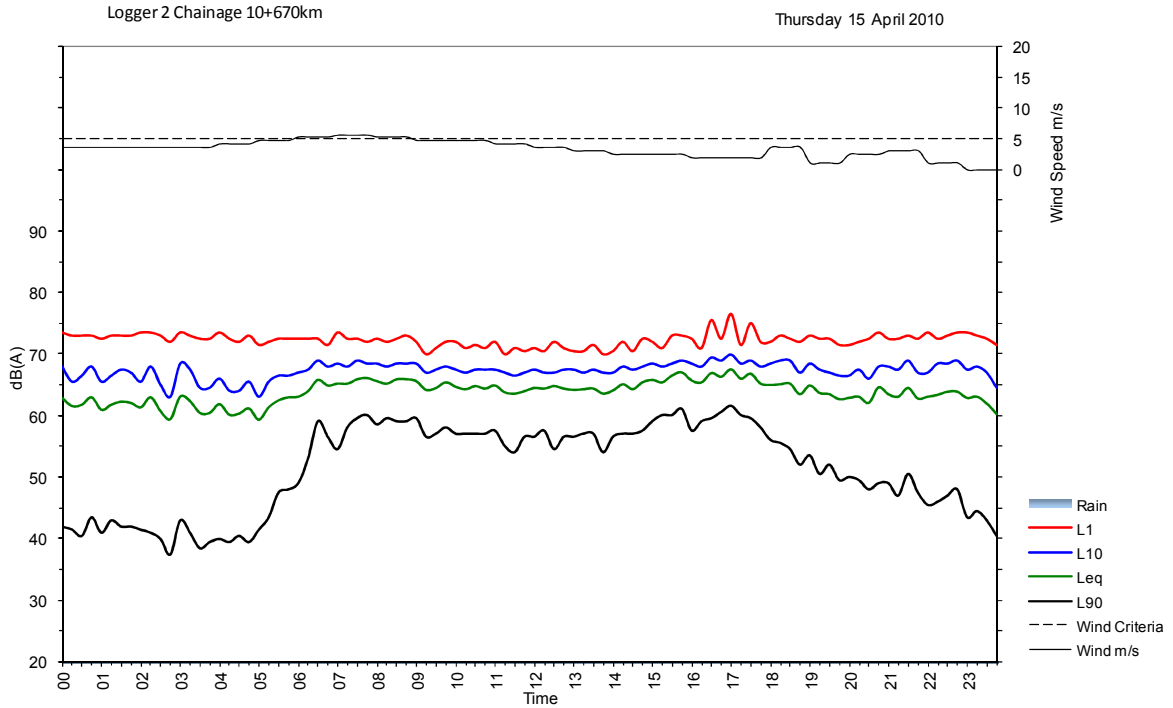
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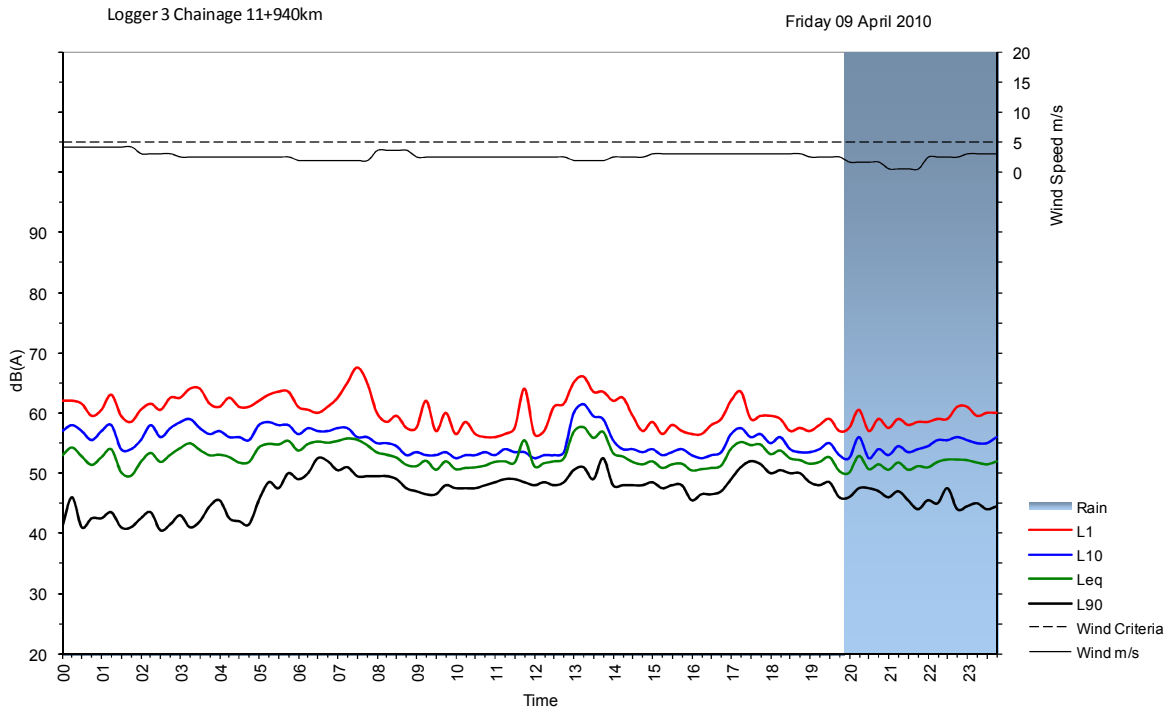
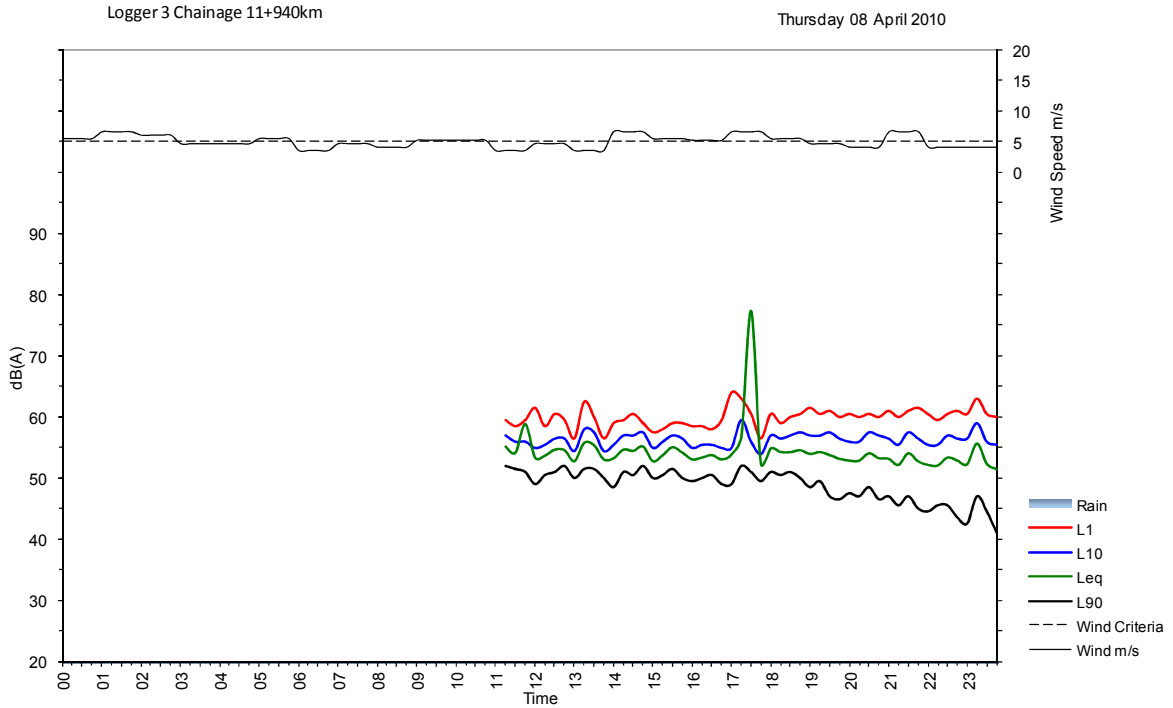
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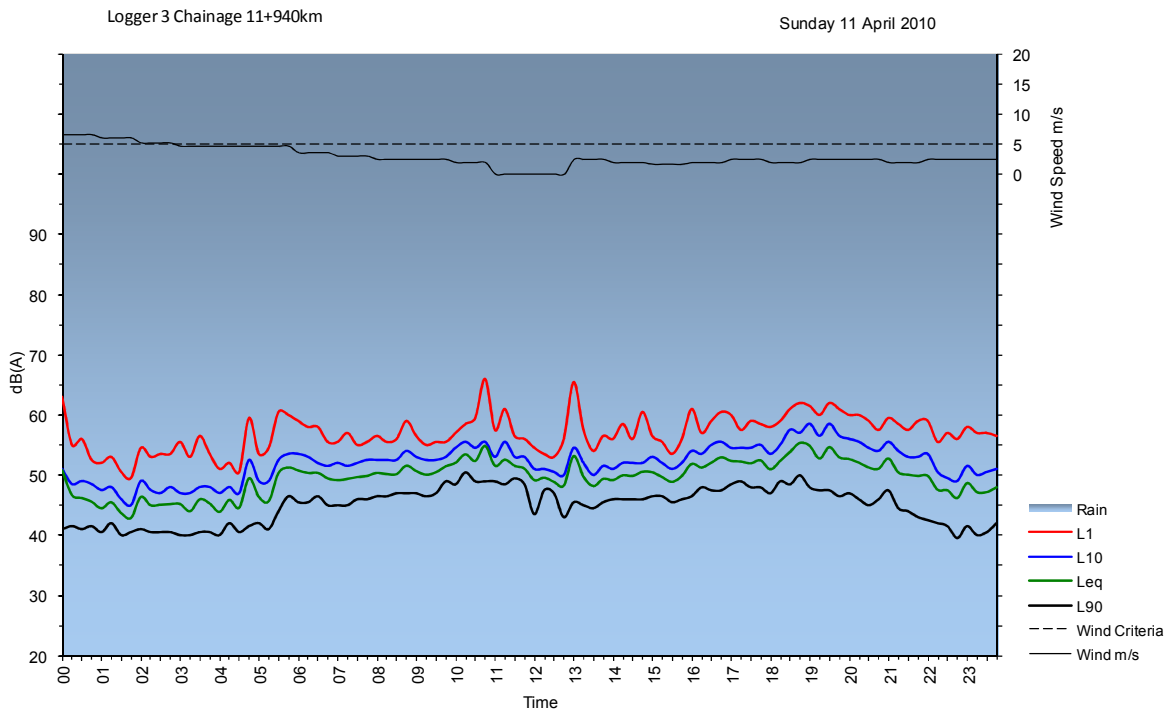
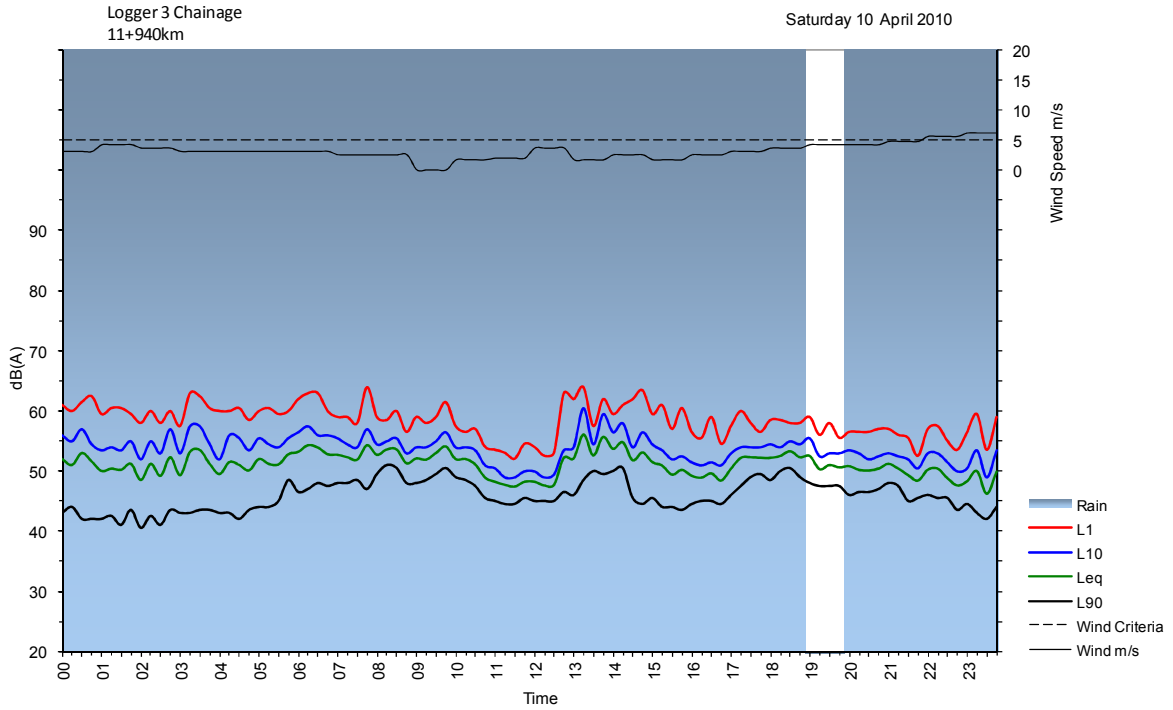
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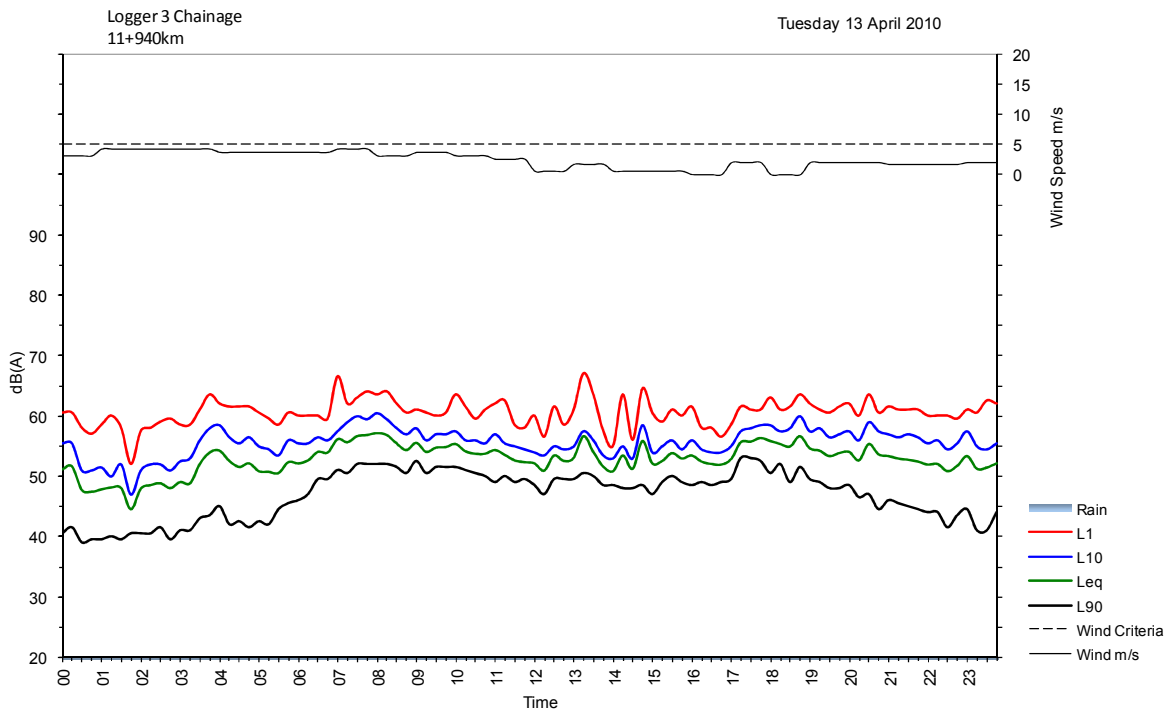
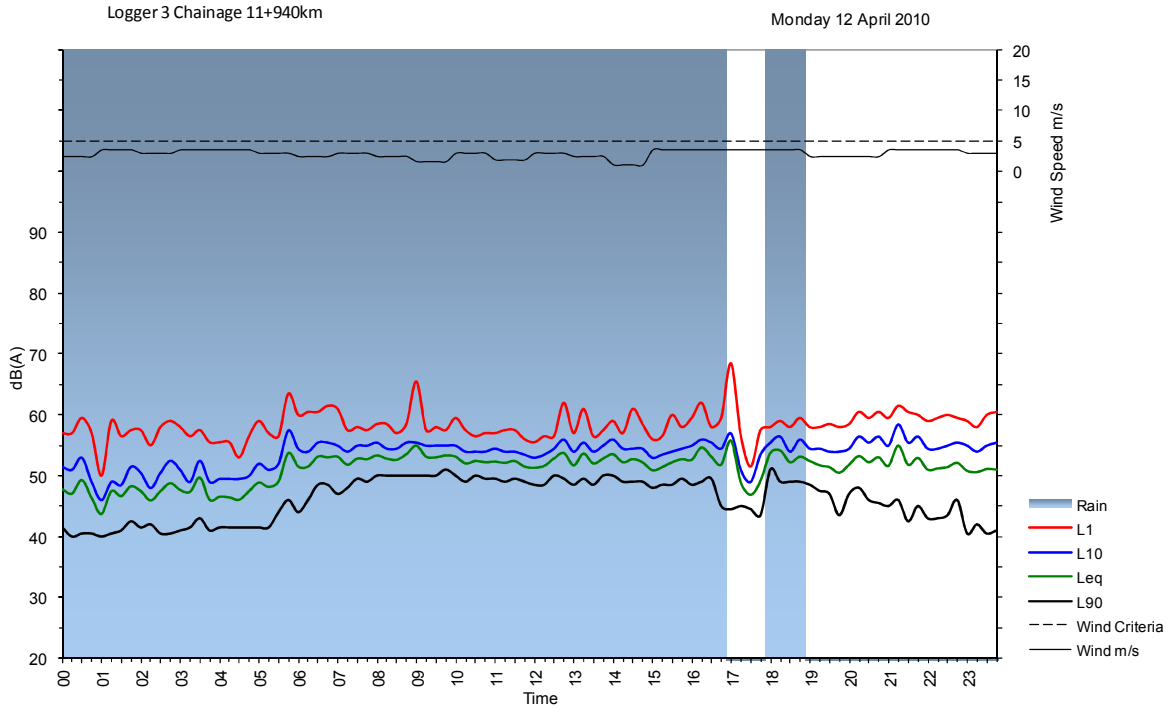
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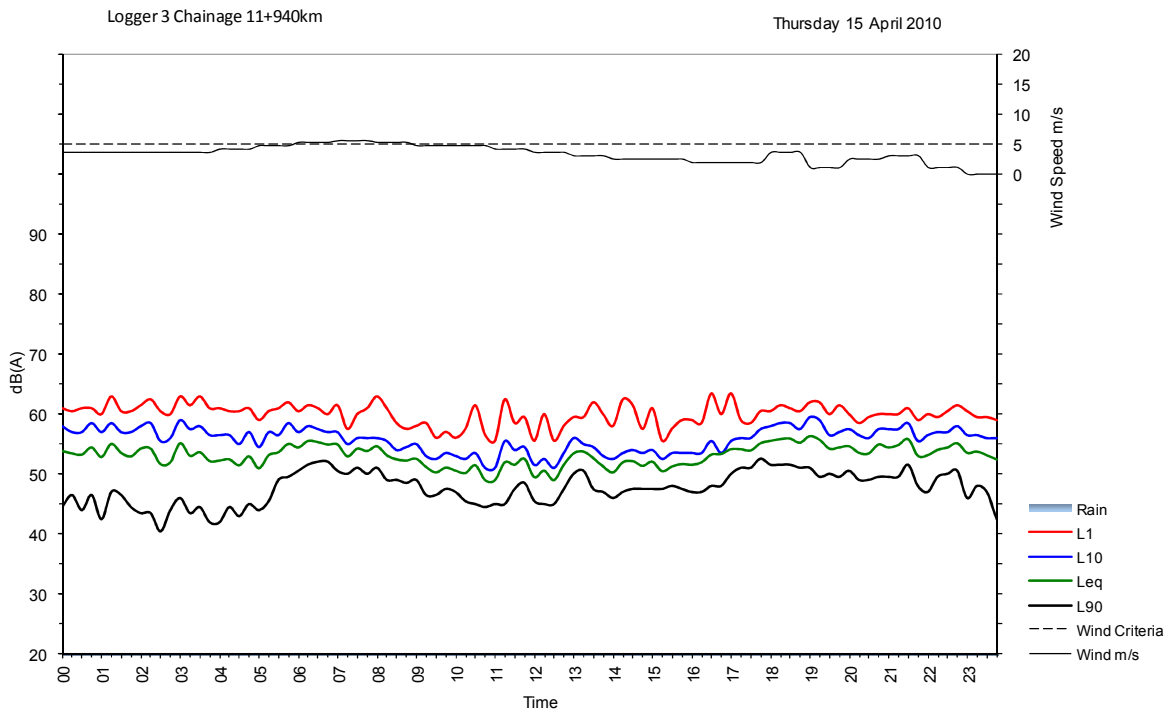
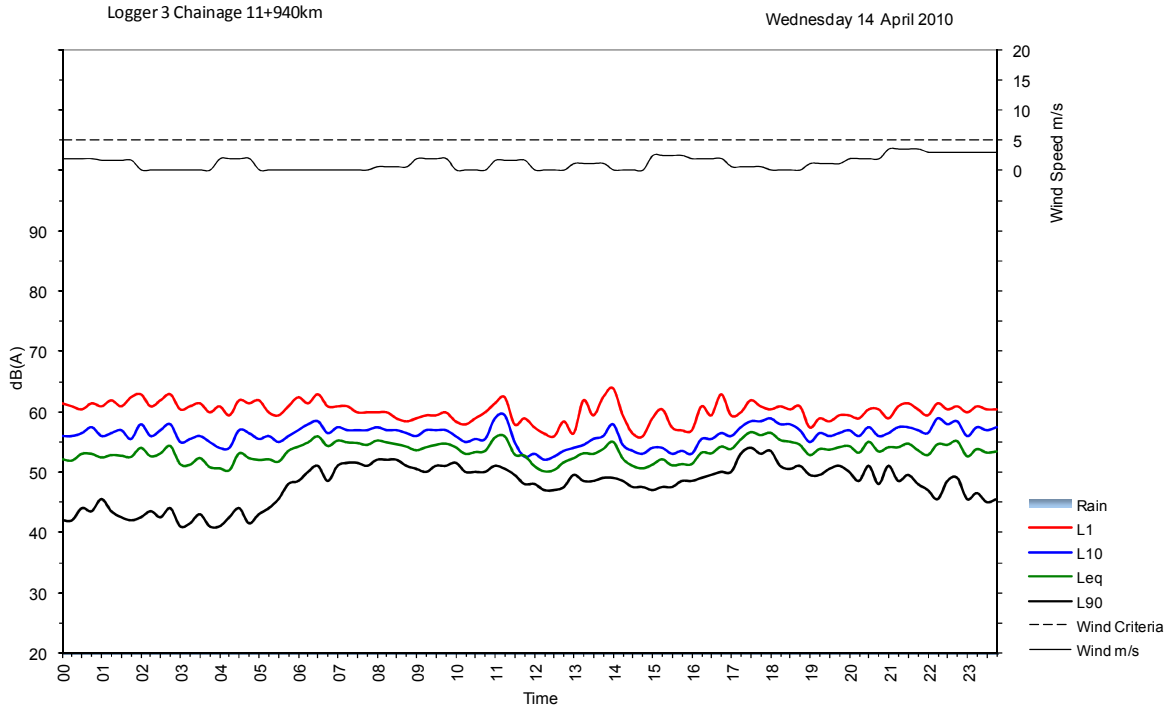
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Zone 0000 - Operational Noise Management Report: Part 1

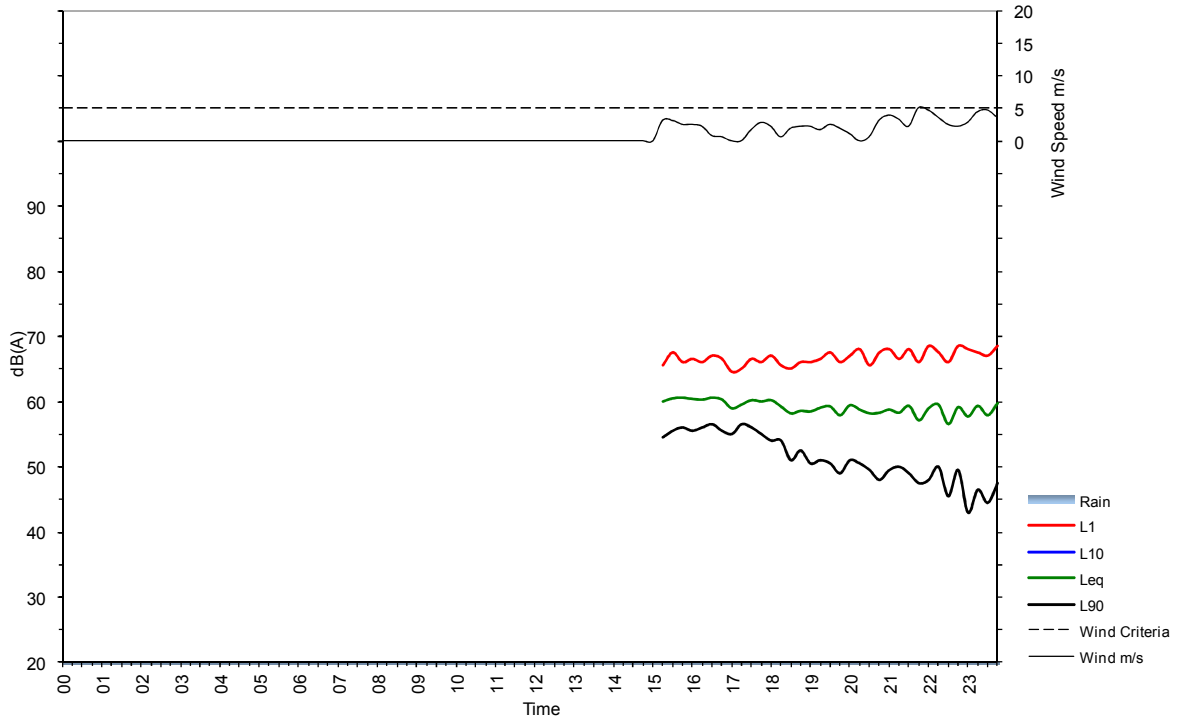


Zone 0000 - Operational Noise Management Report: Part 1



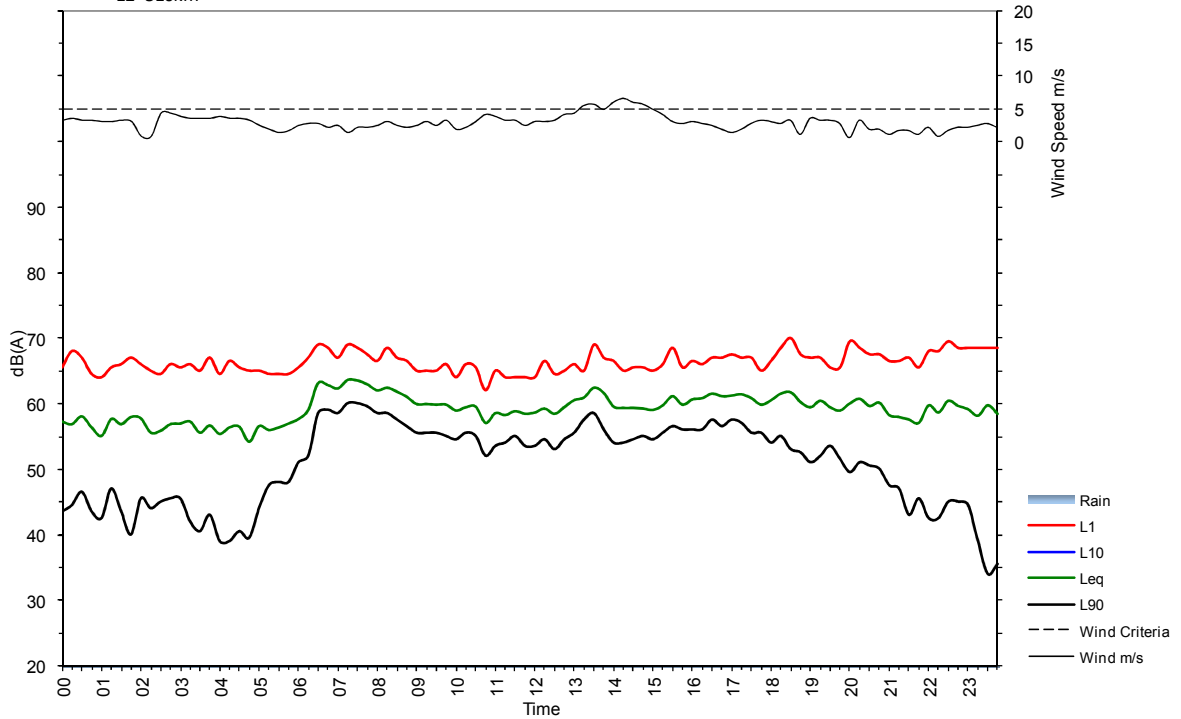
Logger 4 Chainage 12+510km

Tuesday 08 June 2010

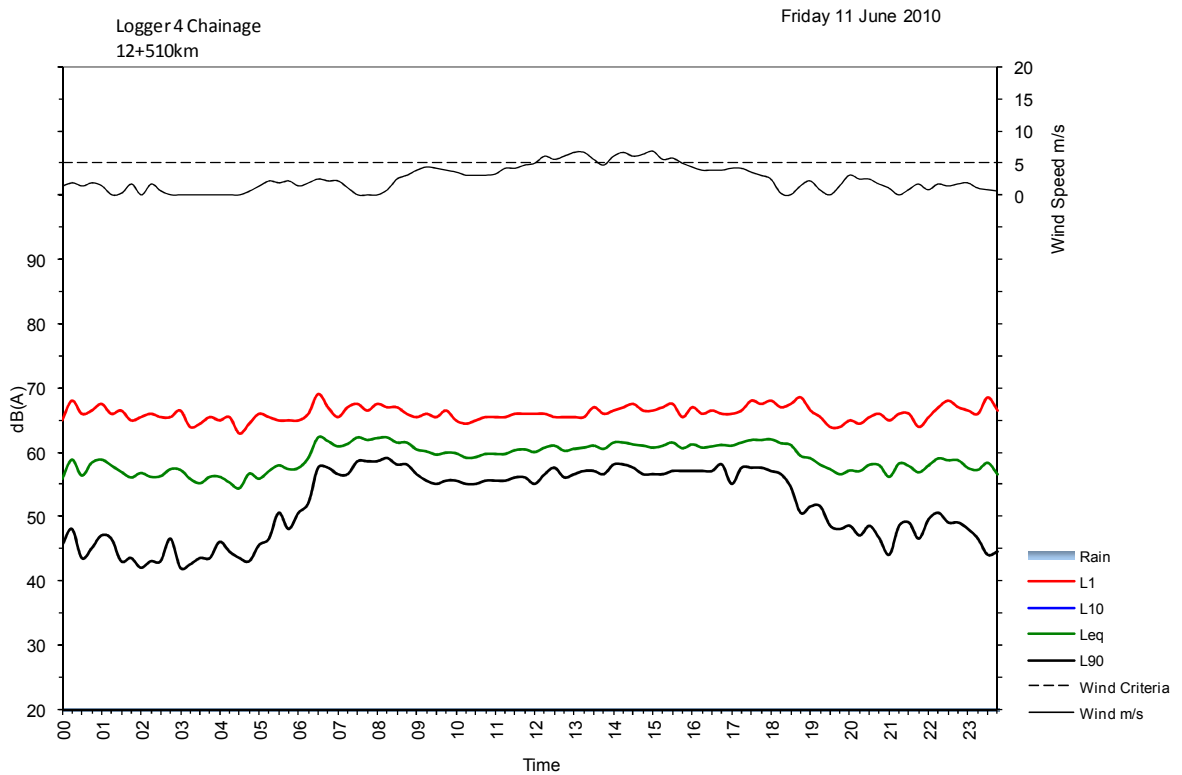
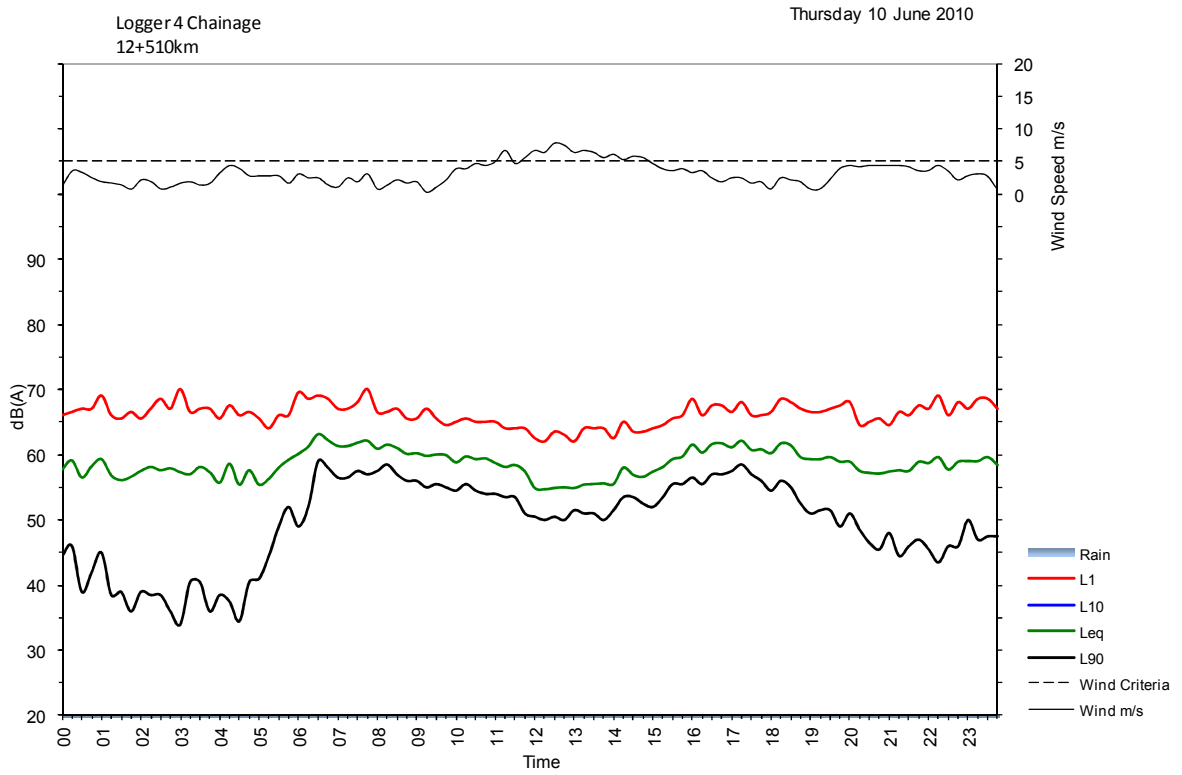


Logger 4 Chainage 12+510km

Wednesday 09 June 2010



Zone 0000 - Operational Noise Management Report: Part 1

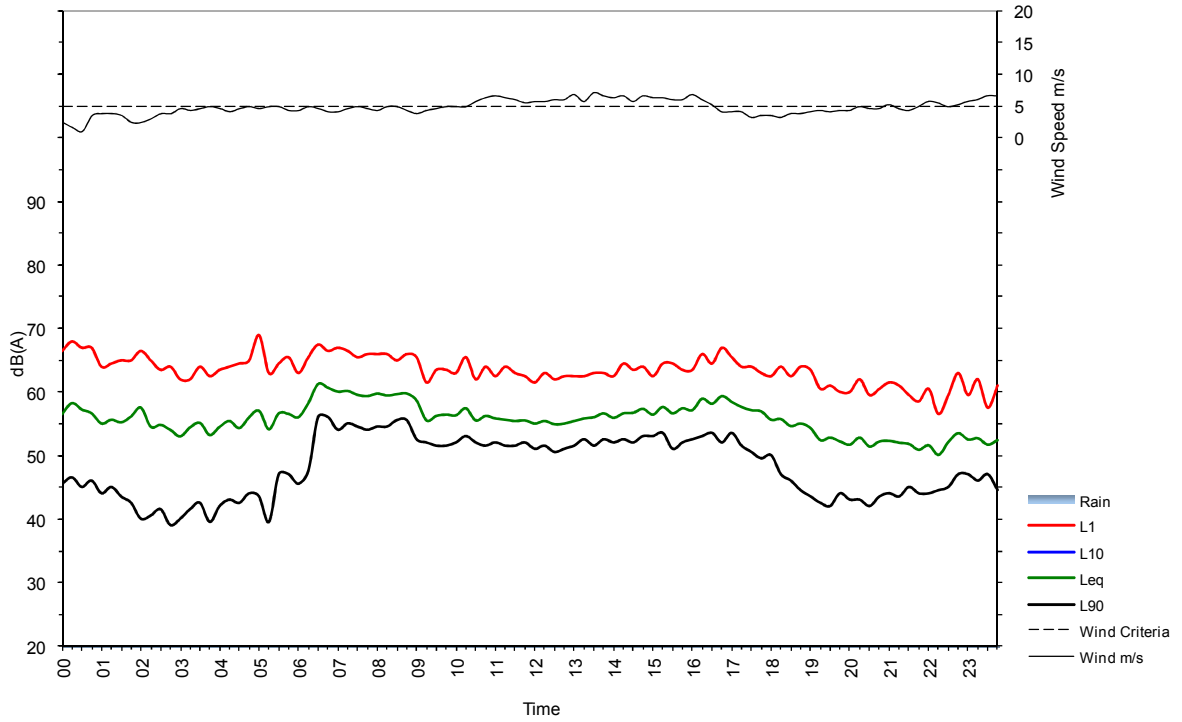


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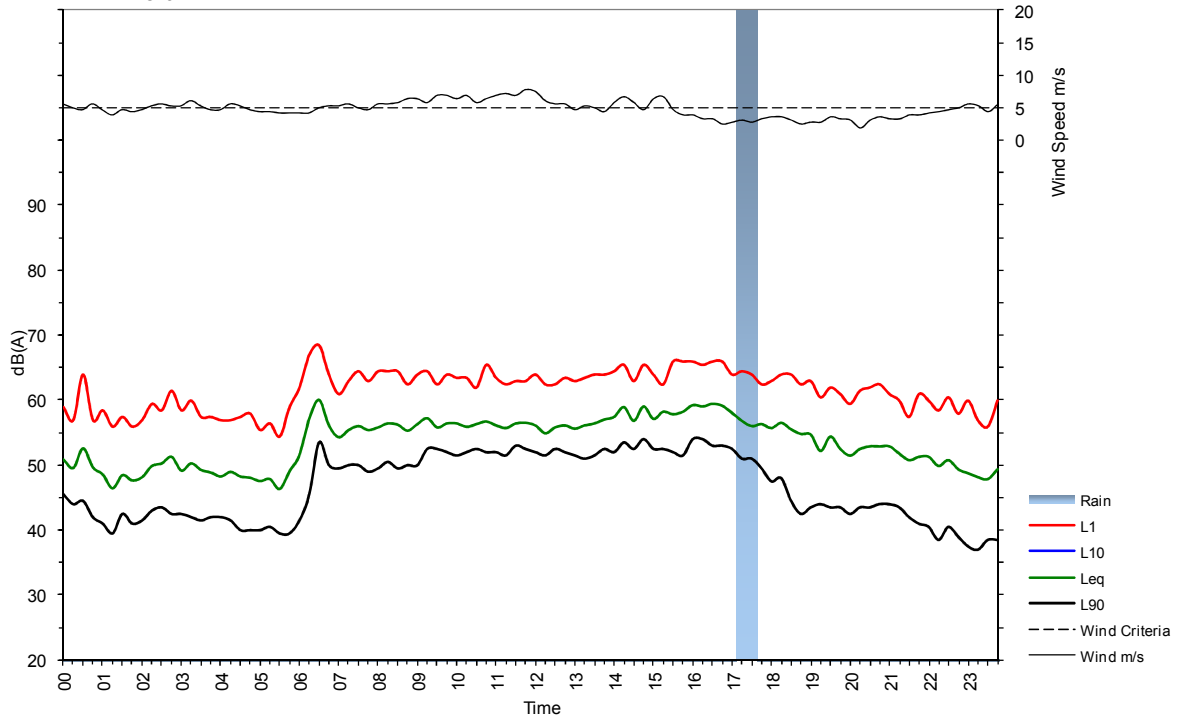
Logger 4 Chainage 12+510km

Saturday 12 June 2010



Logger 4 Chainage 12+510km

Sunday 13 June 2010

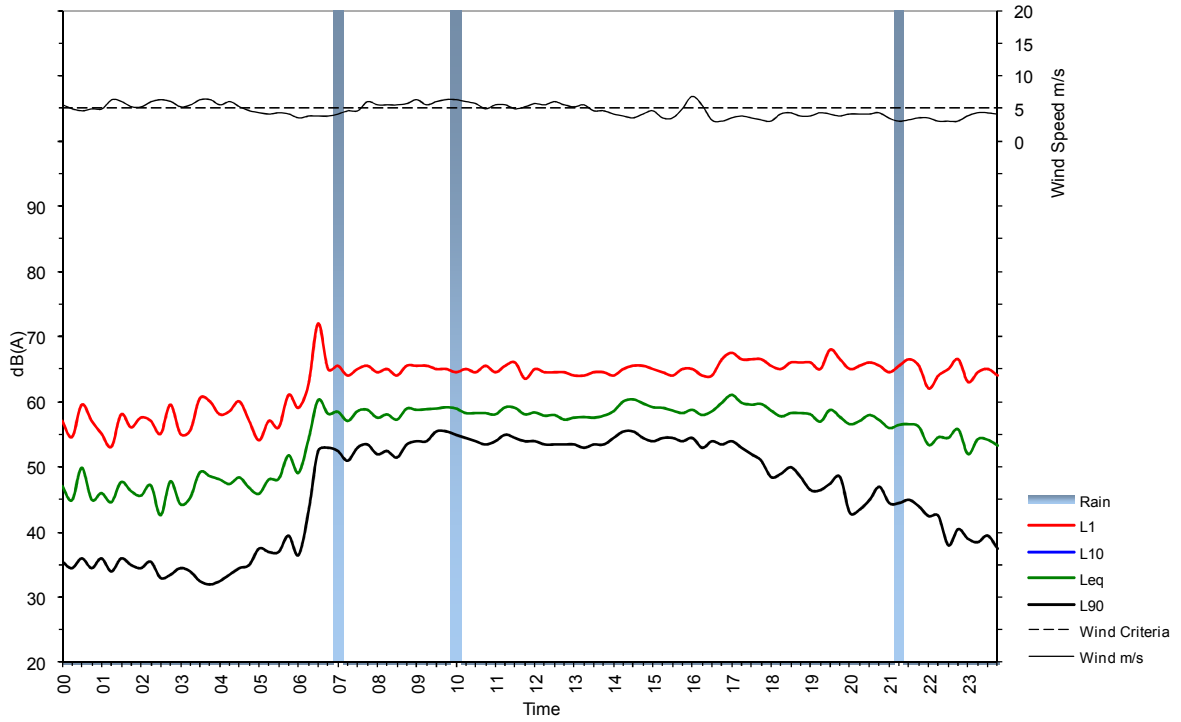


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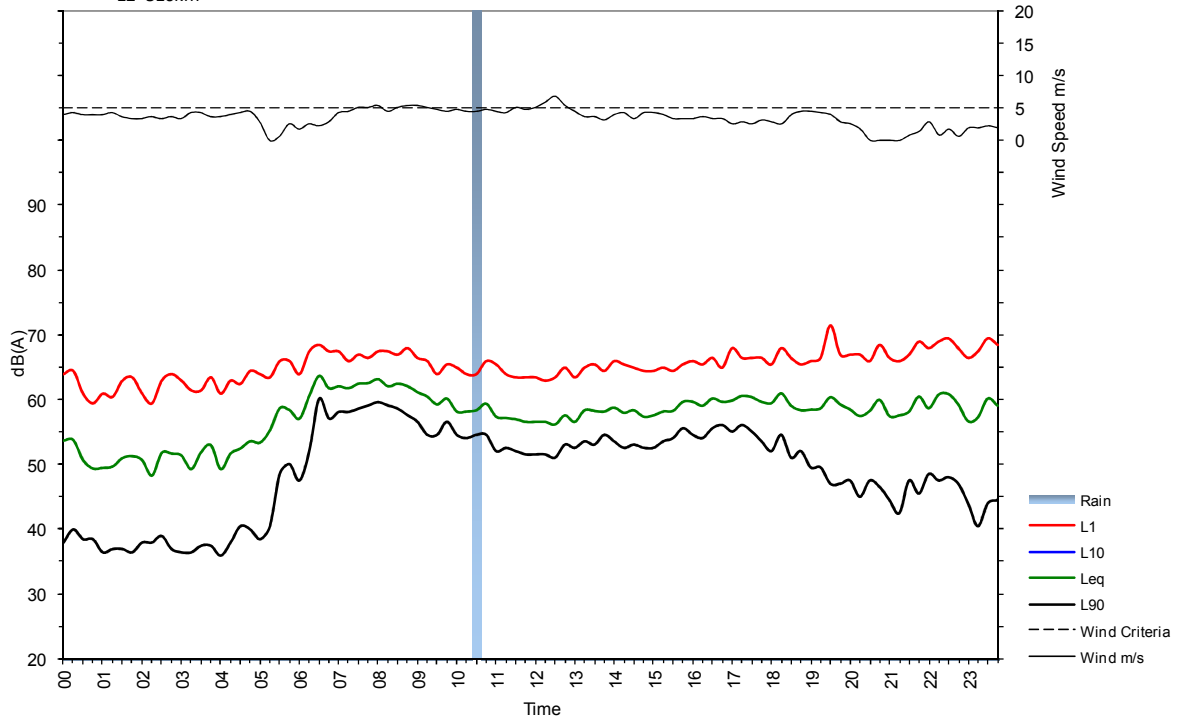
Logger 4 Chainage 12+510km

Monday 14 June 2010



Logger 4 Chainage 12+510km

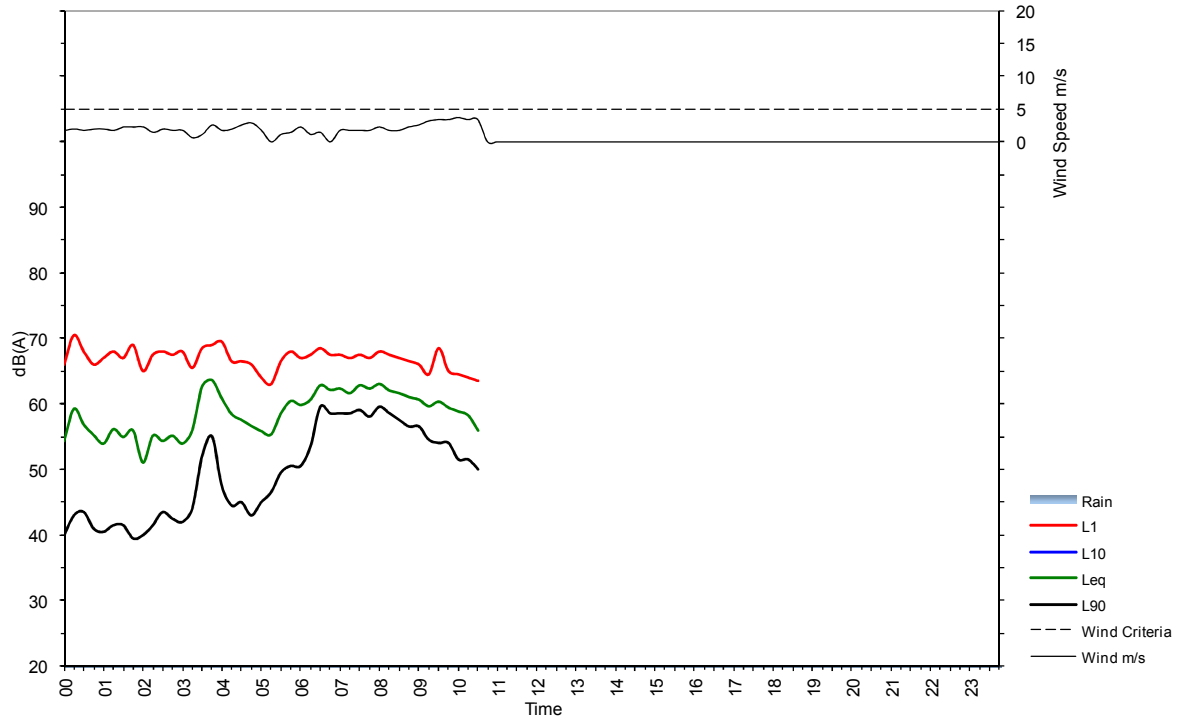
Tuesday 15 June 2010





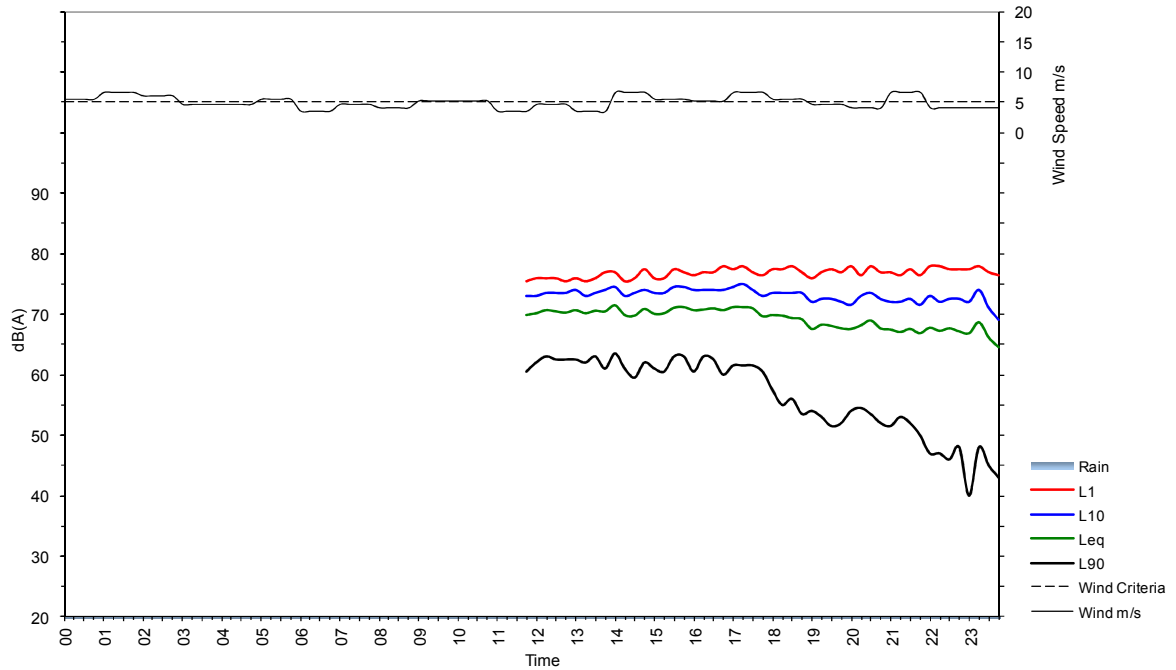
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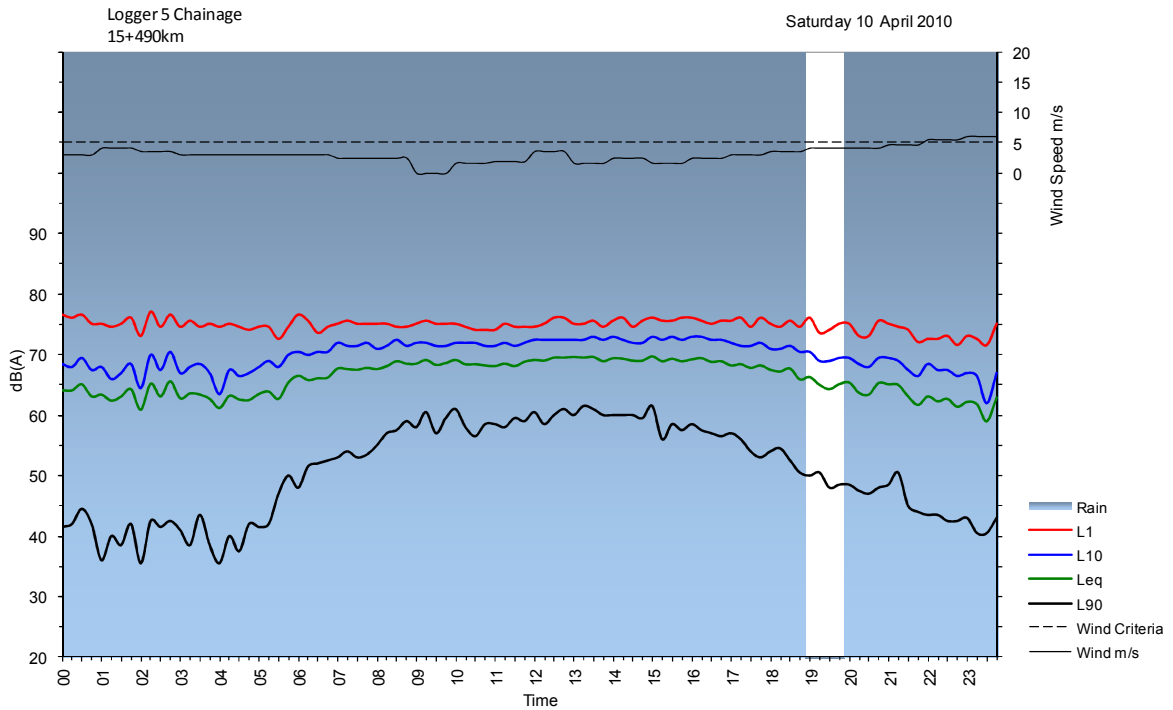
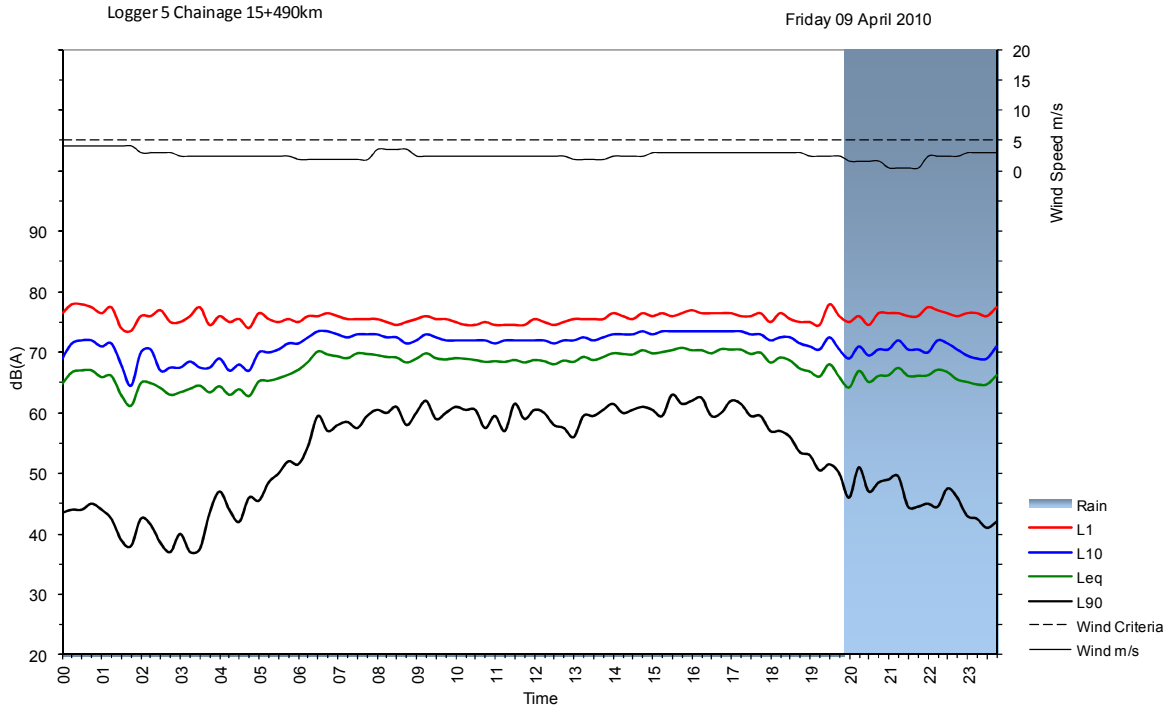


Logger 5 Chainage 15+490km

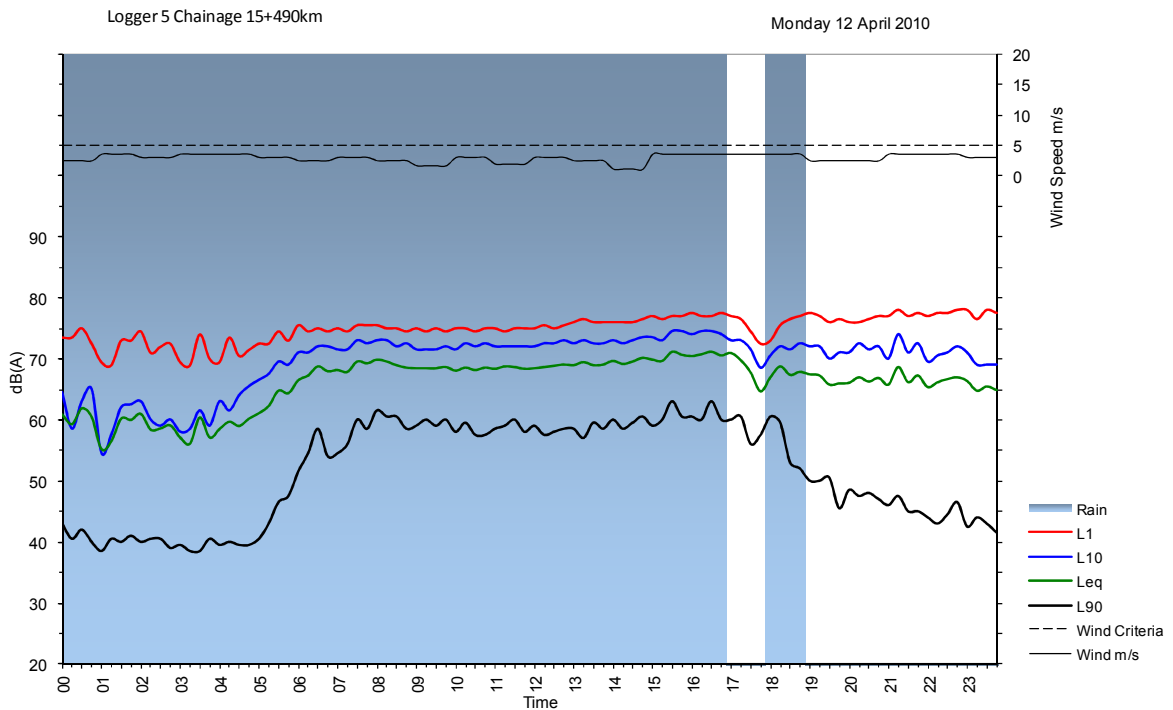
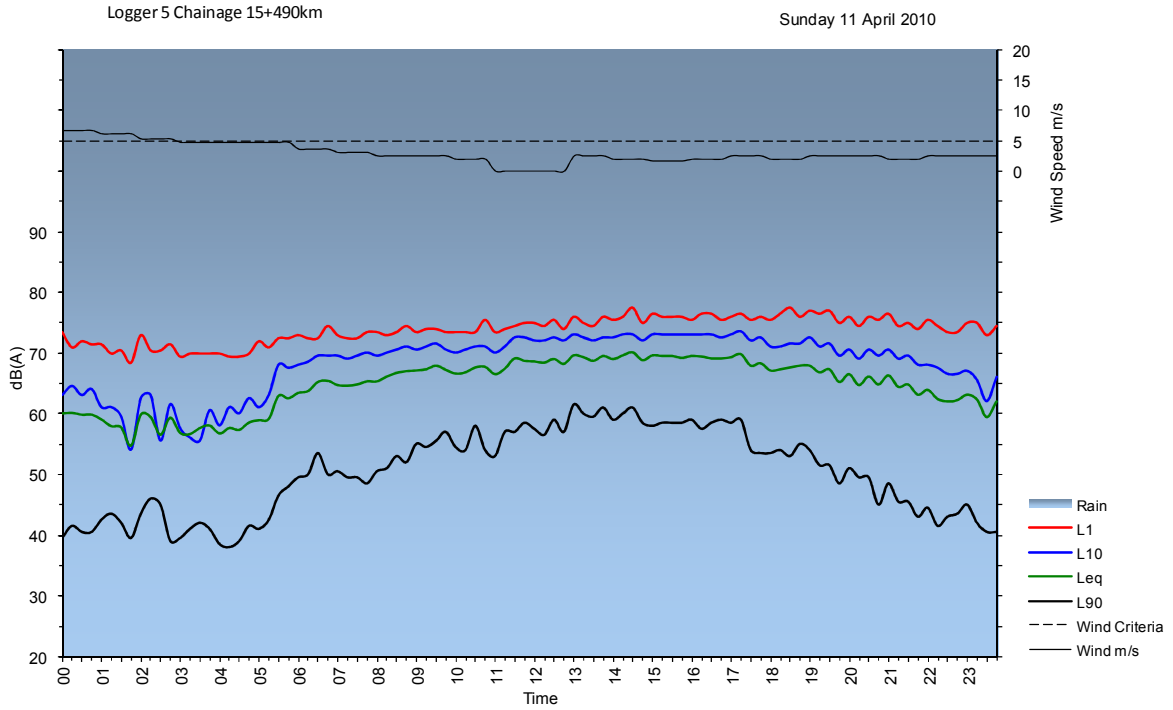
Thursday 08 April 2010



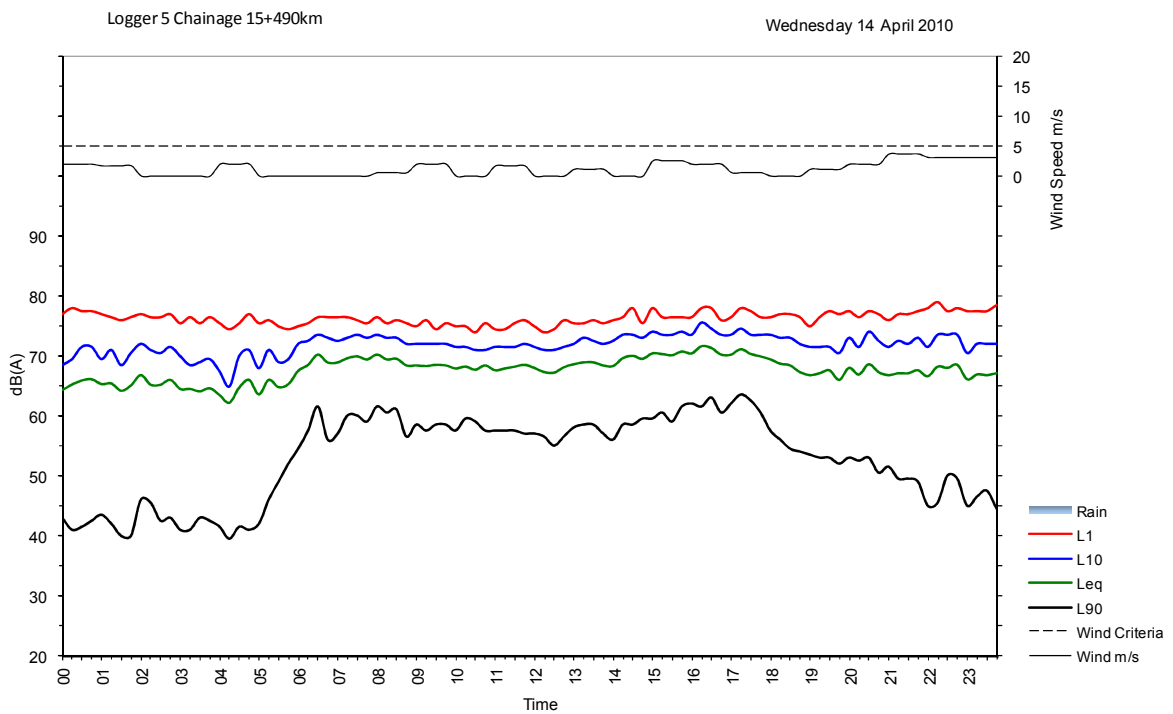
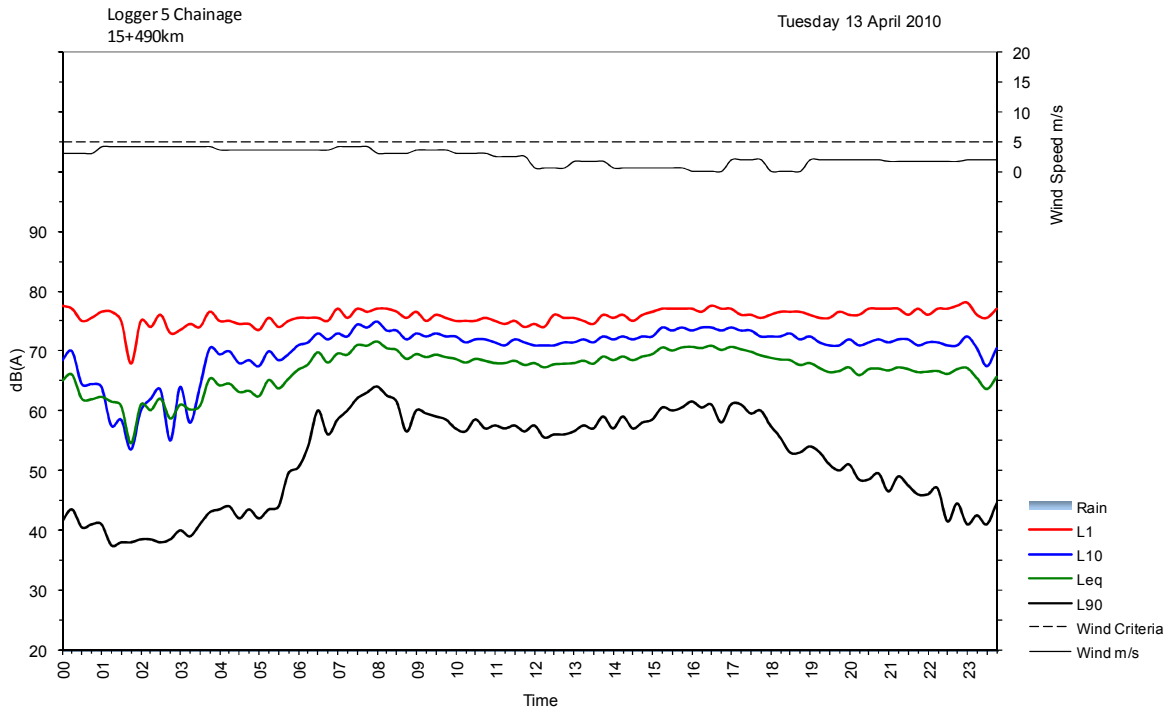
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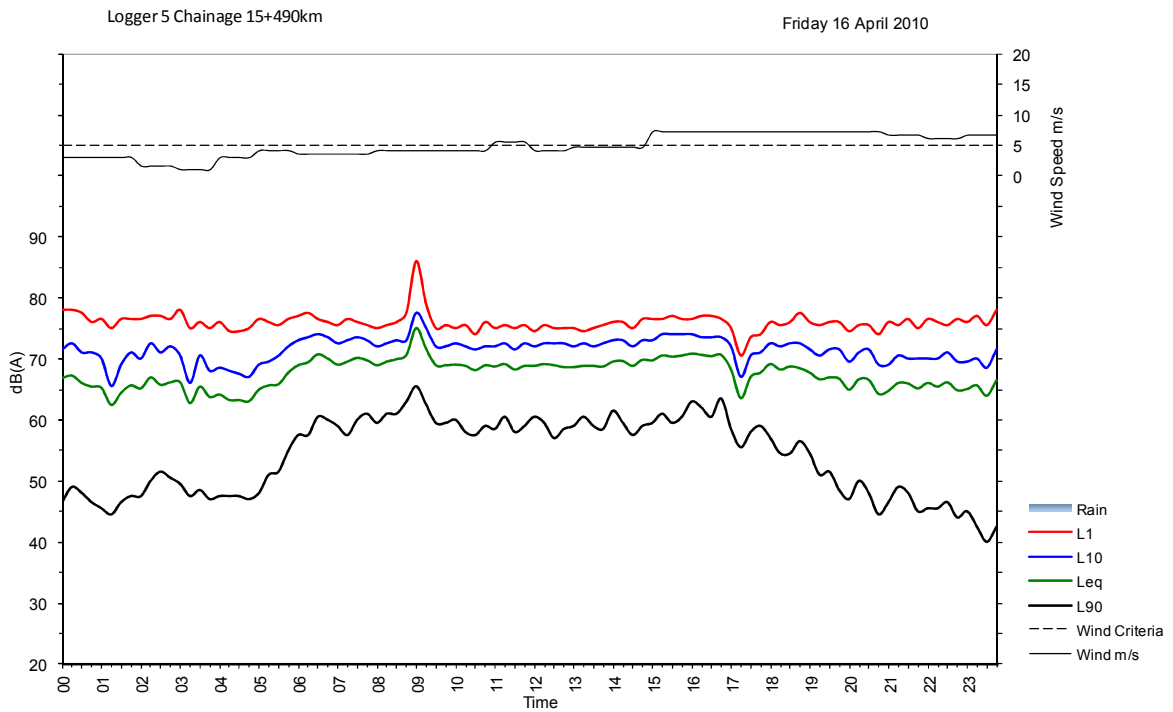
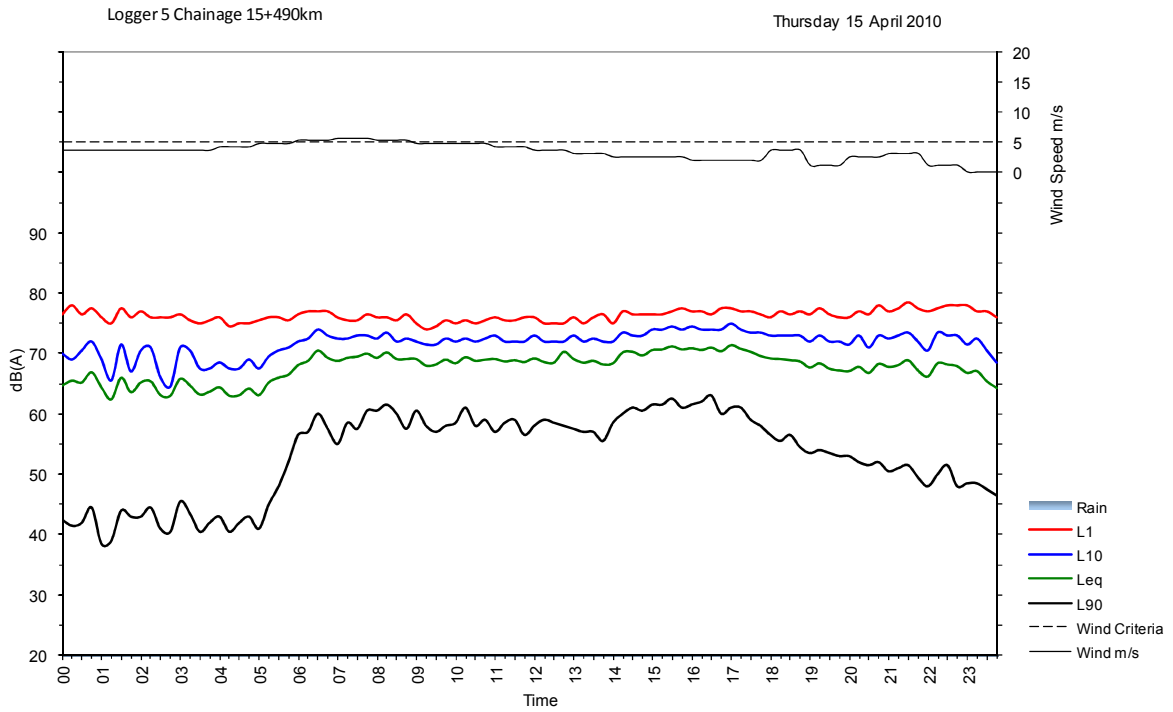
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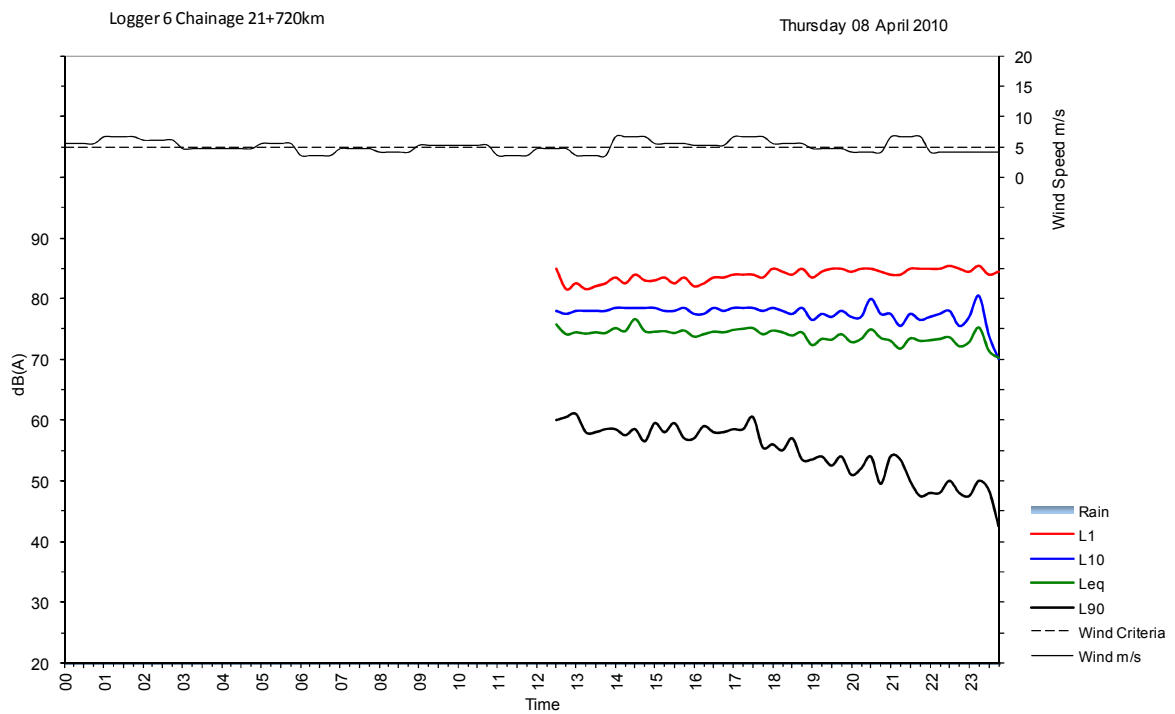
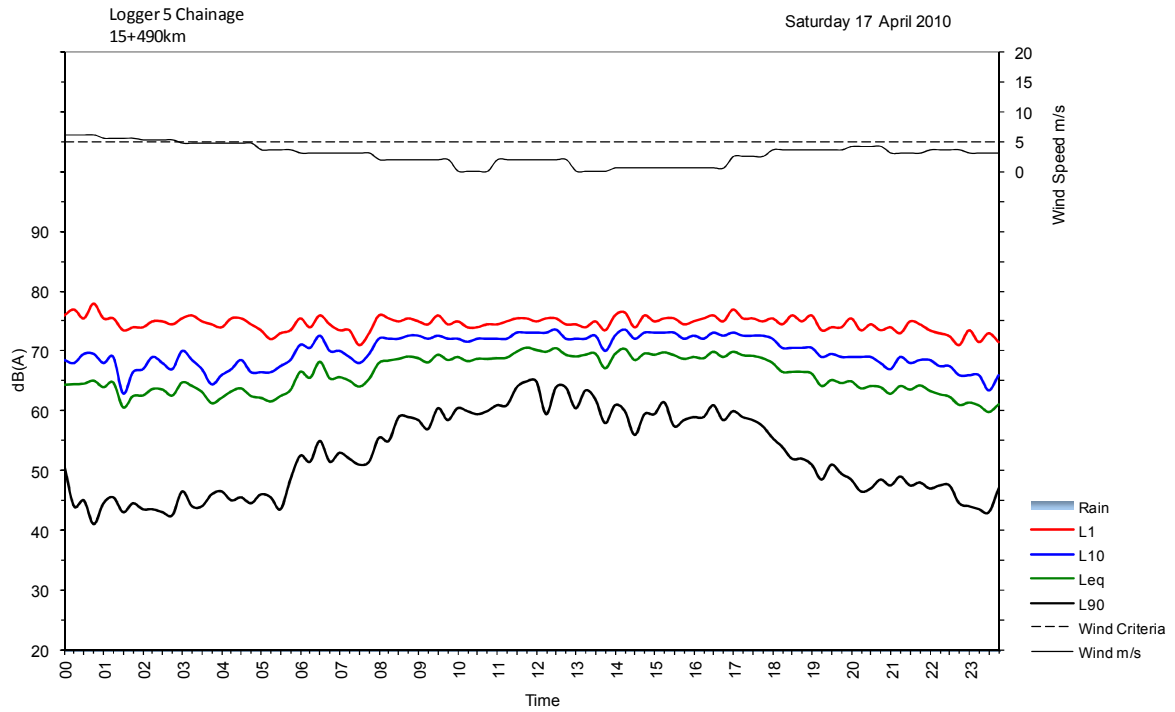
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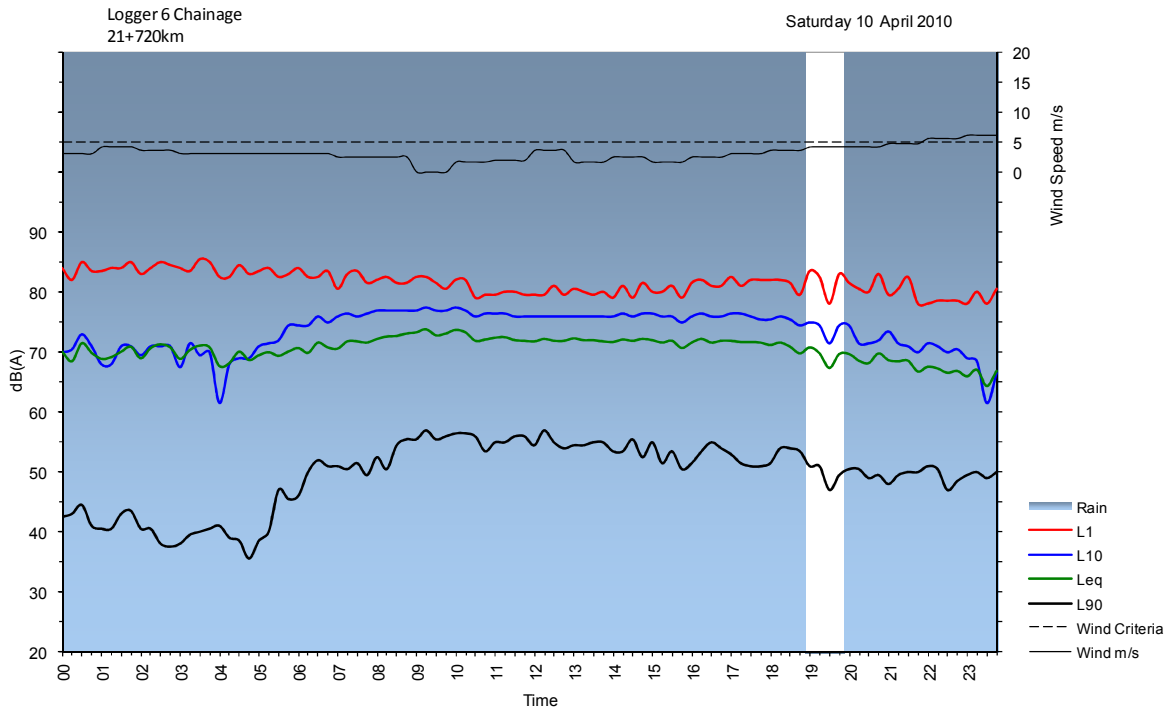
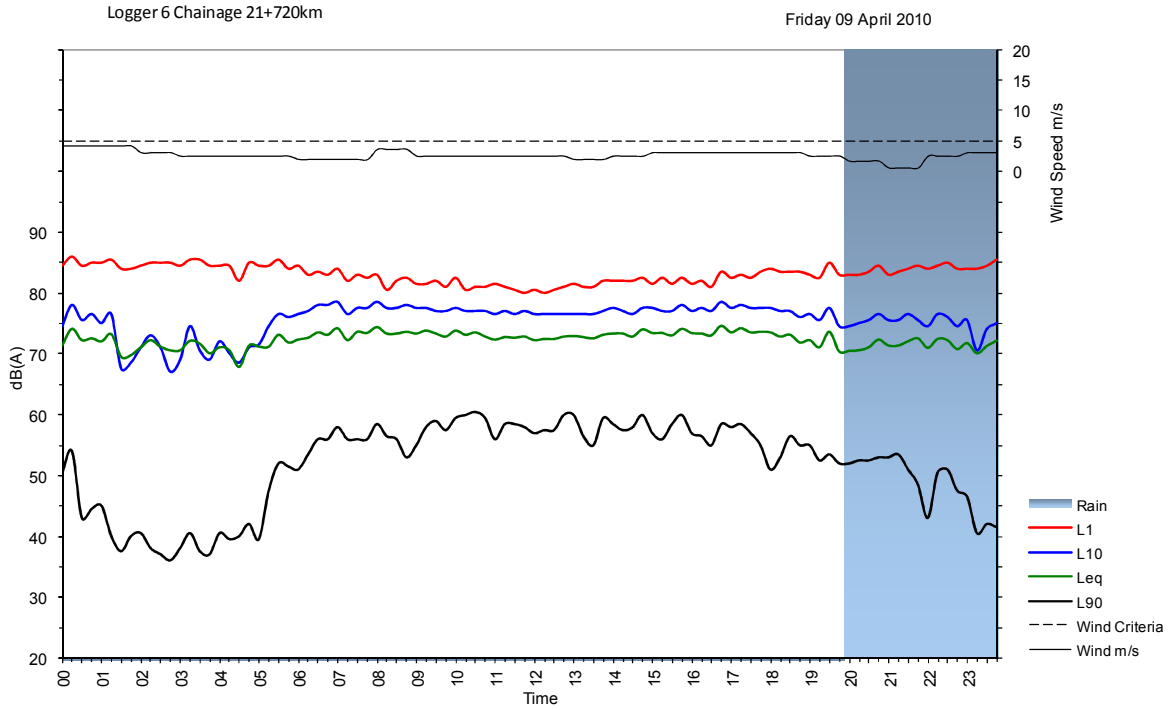
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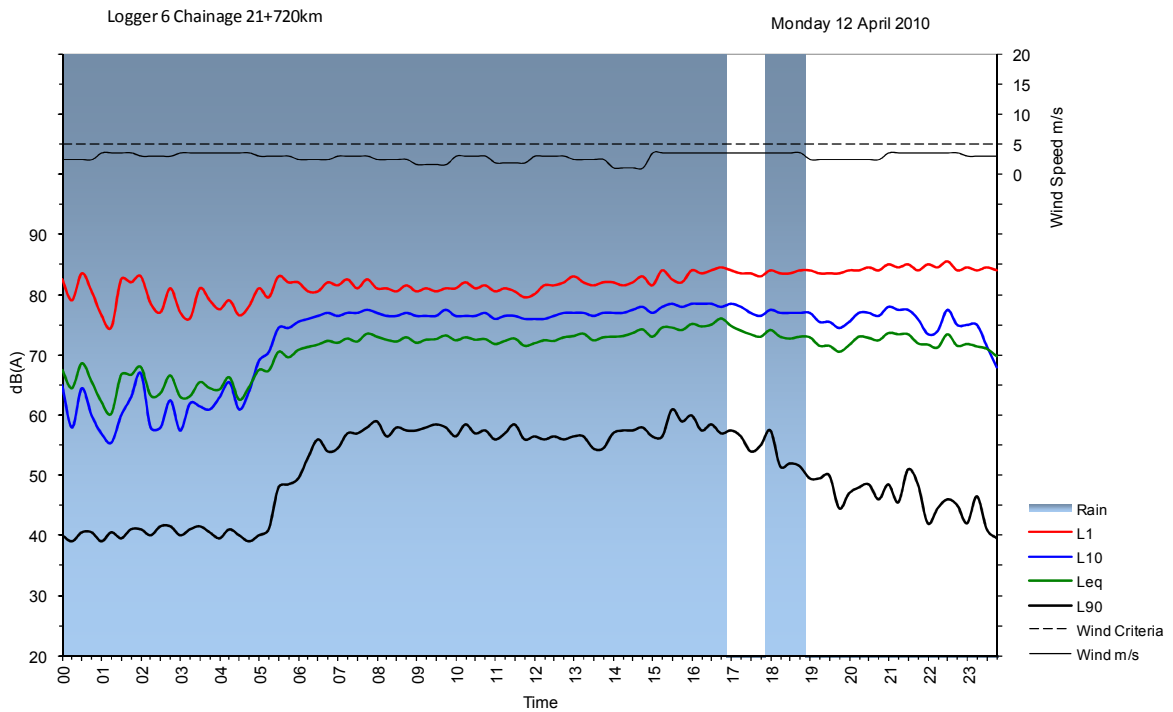
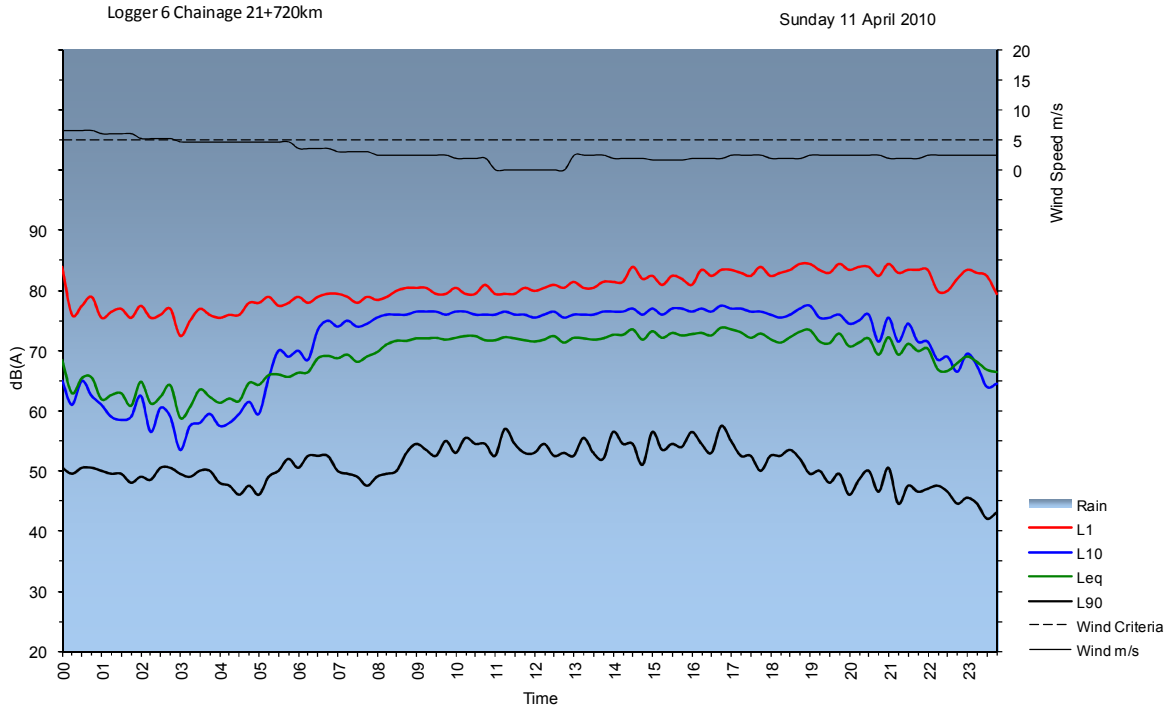
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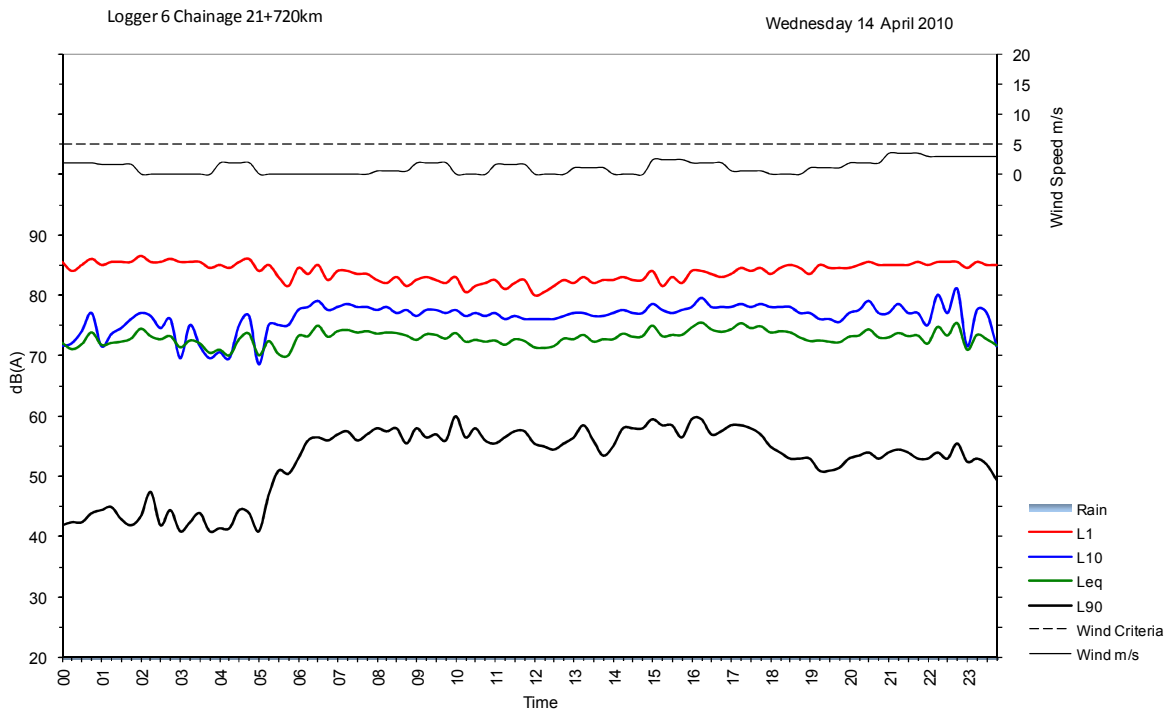
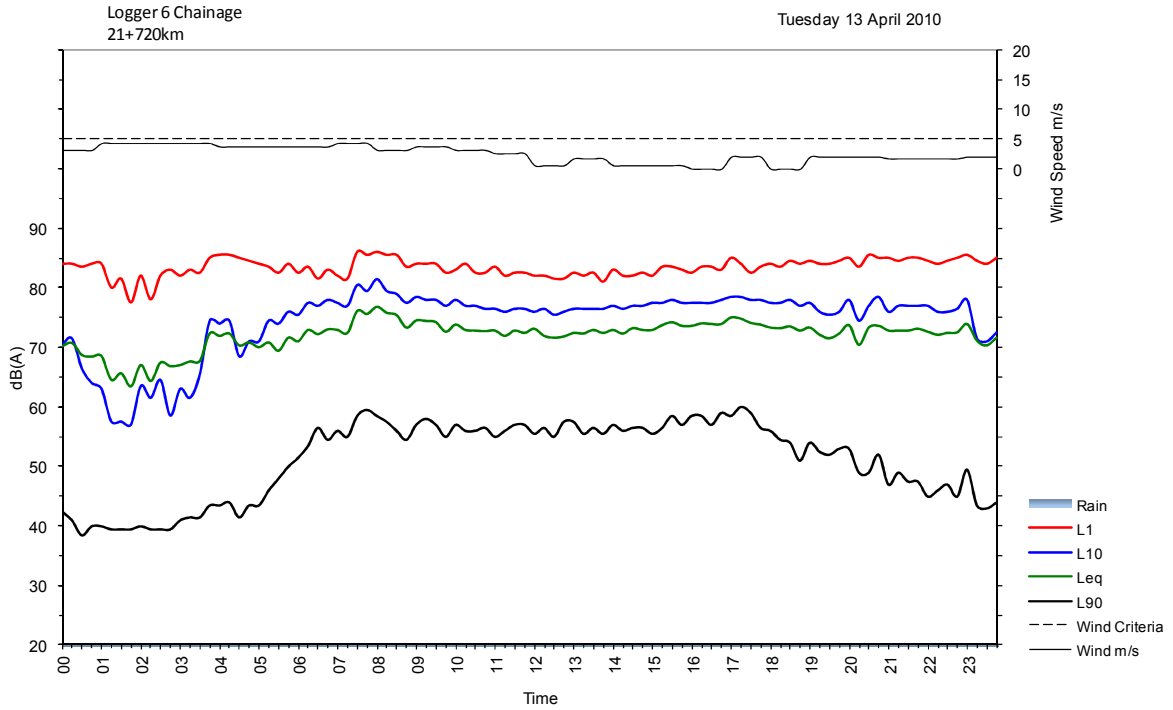
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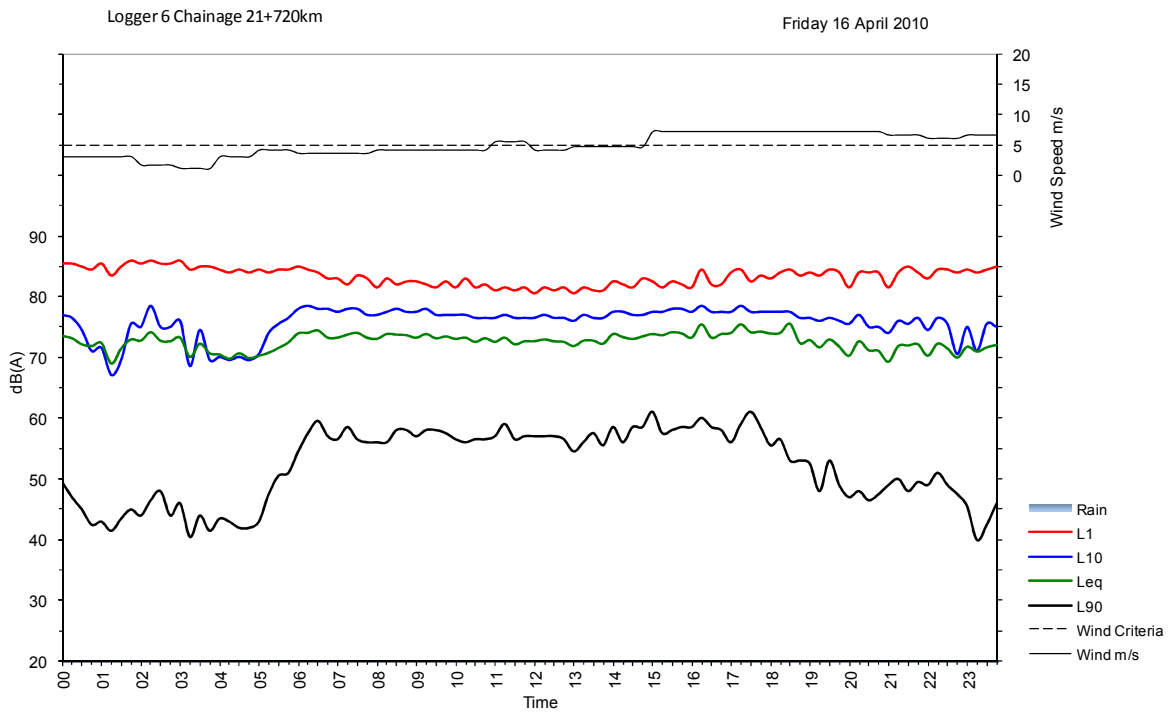
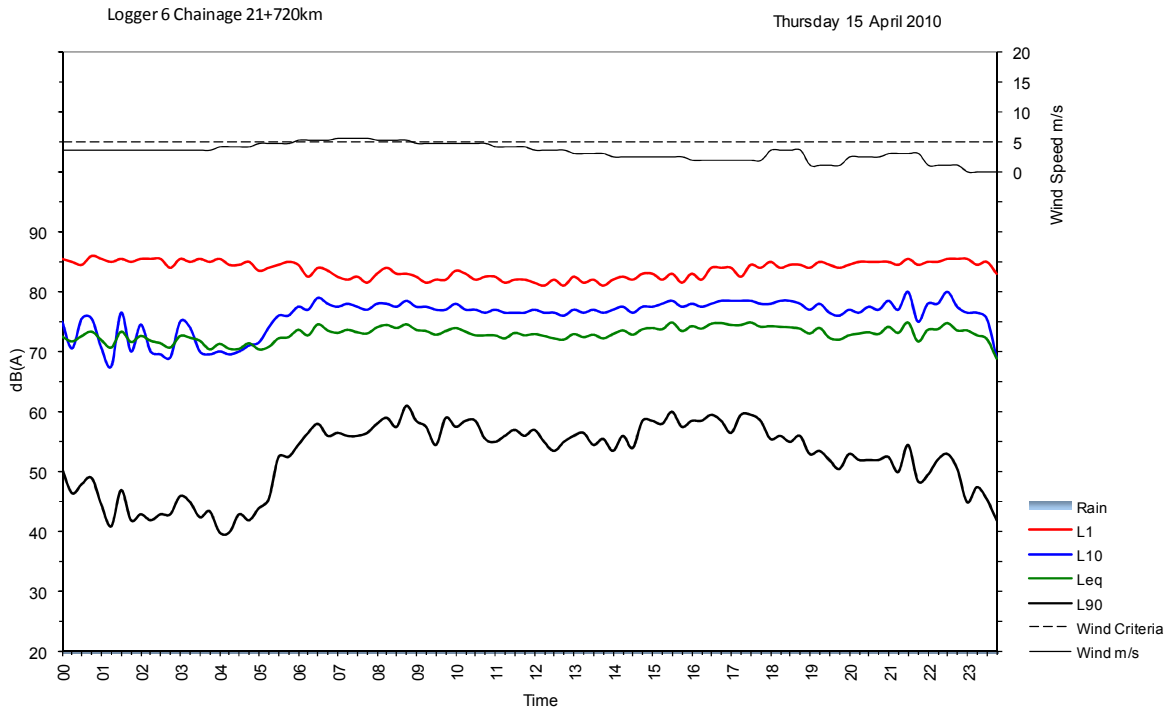
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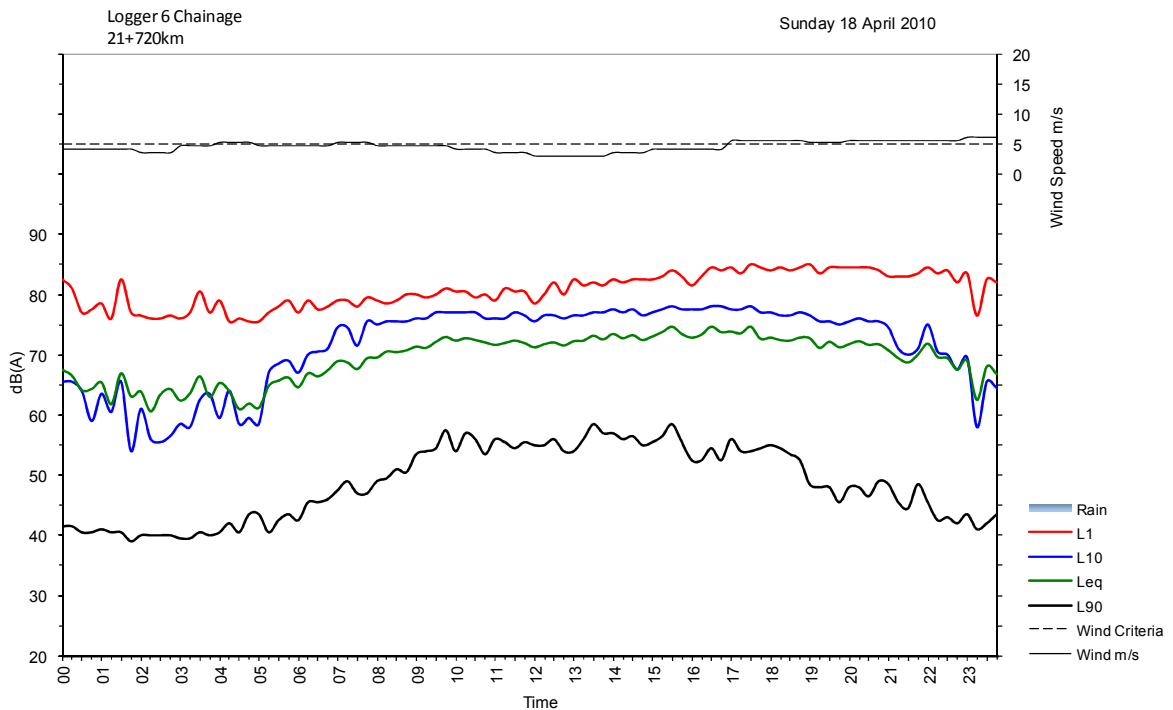
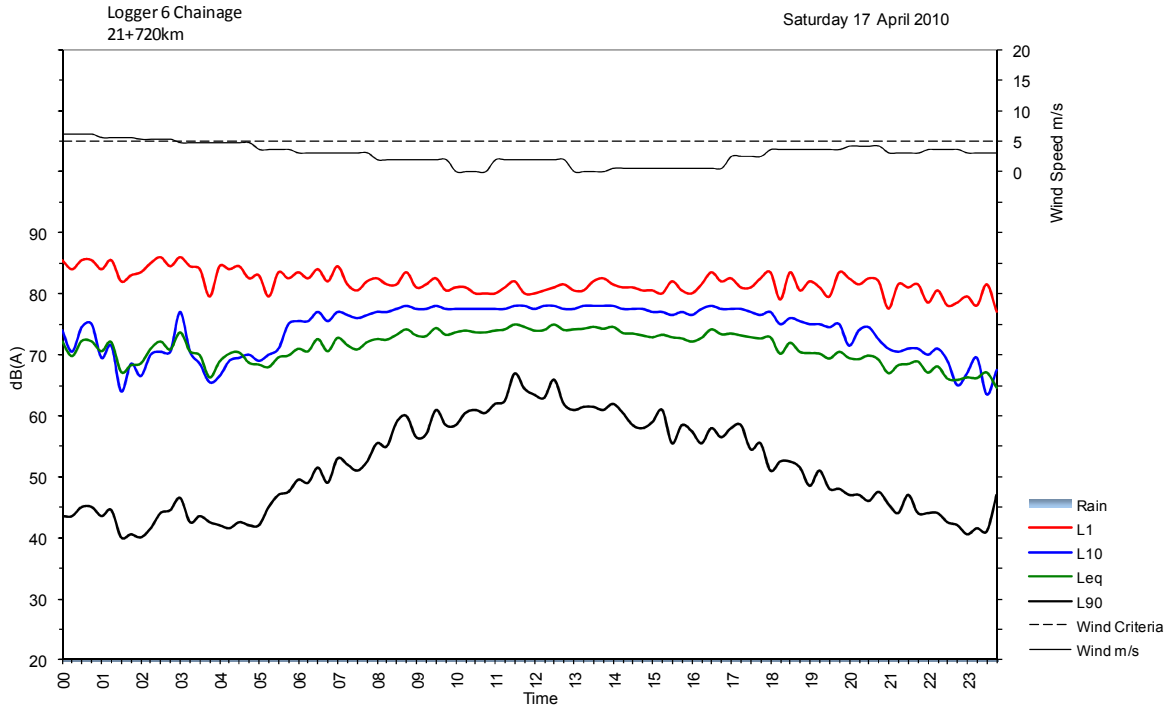
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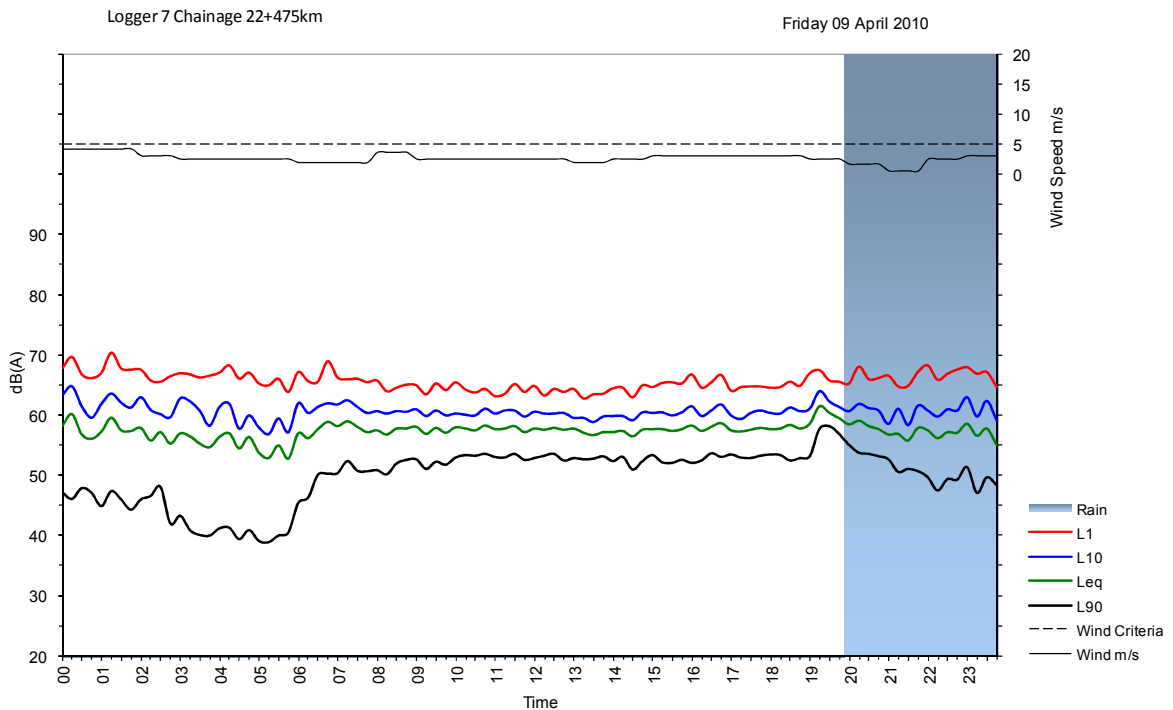
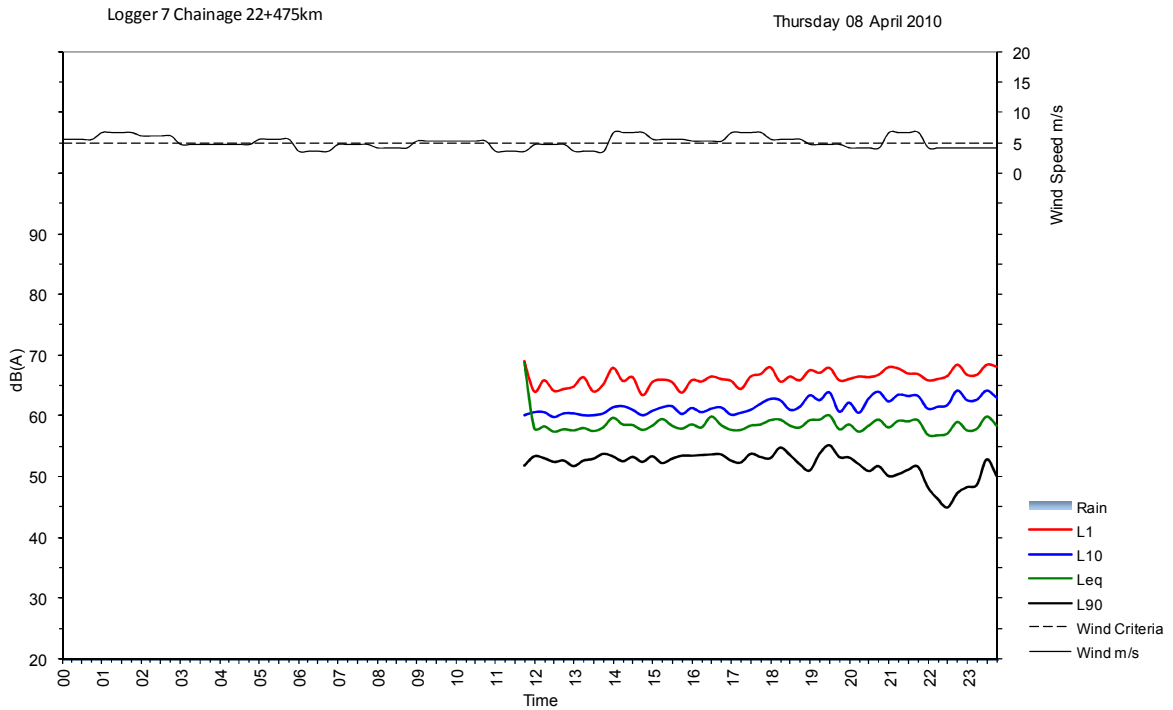
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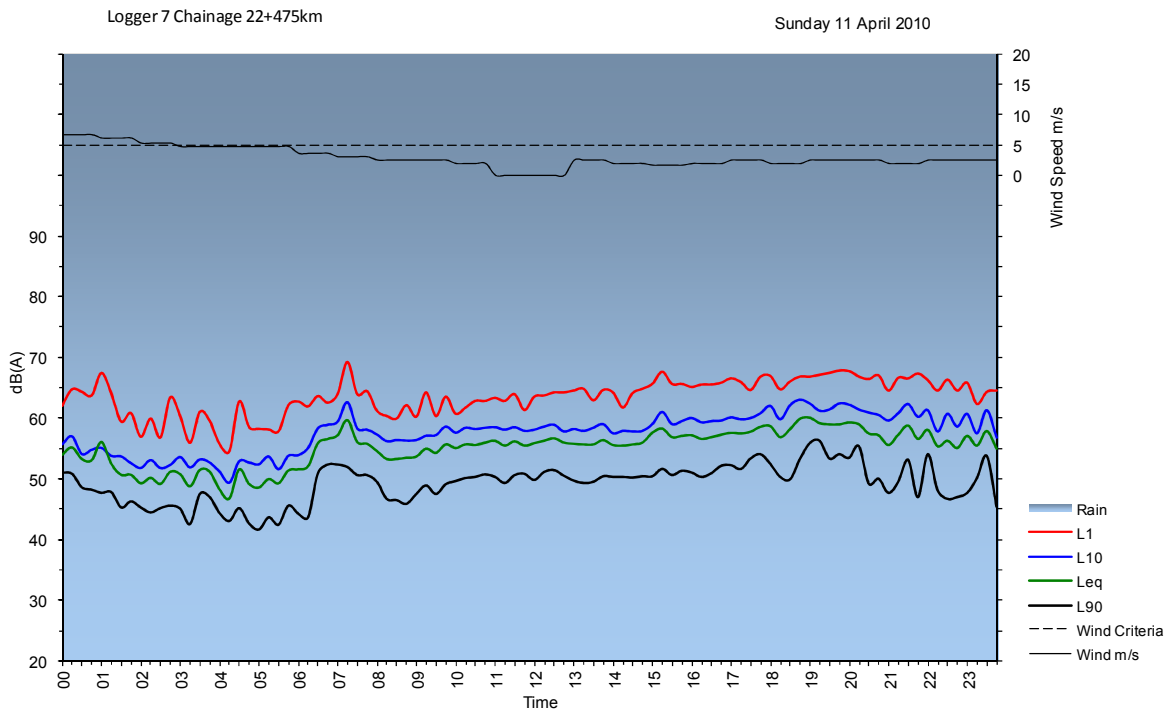
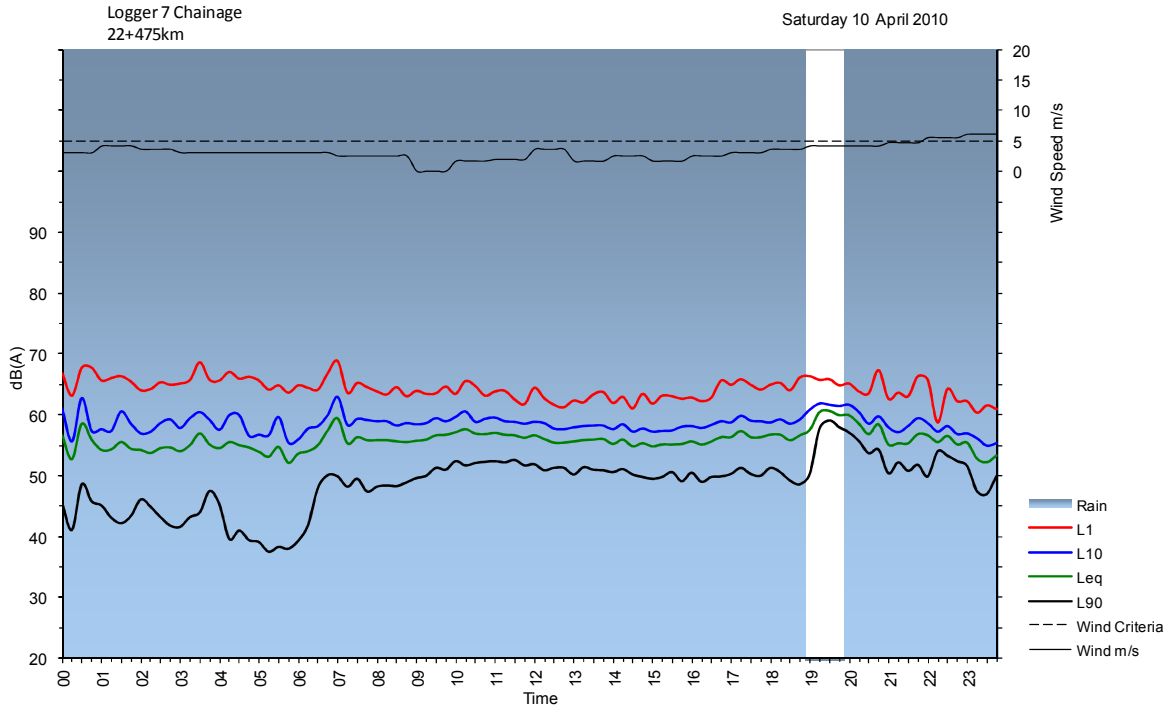
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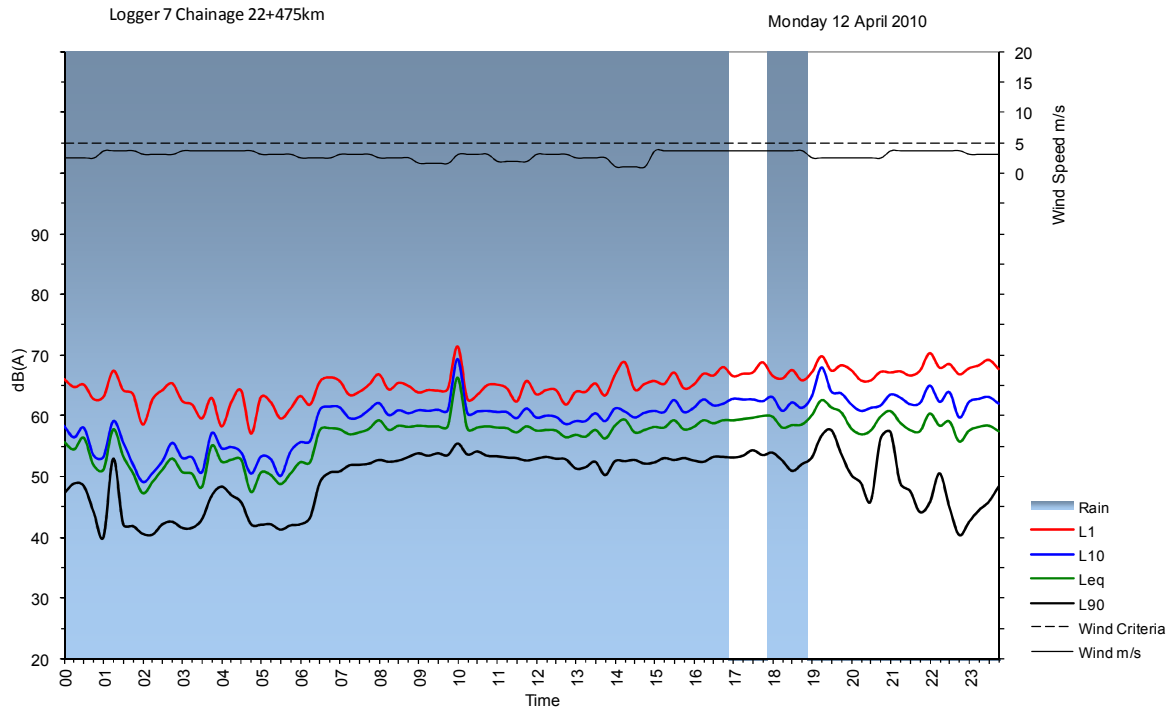
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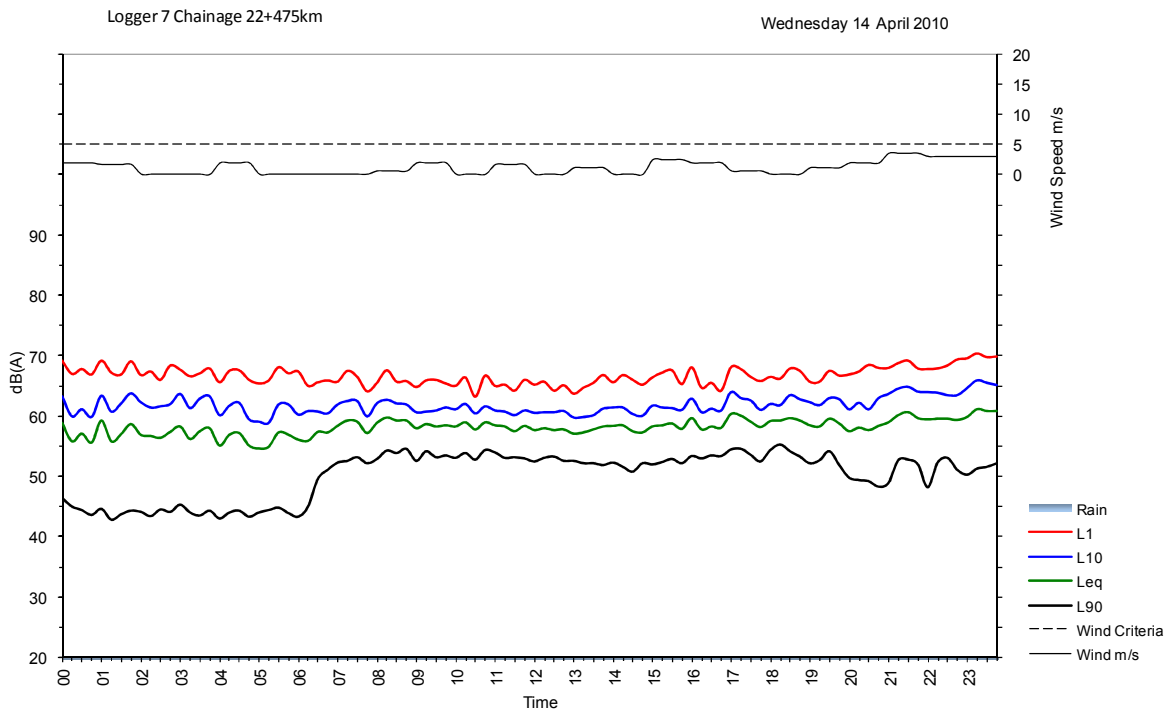
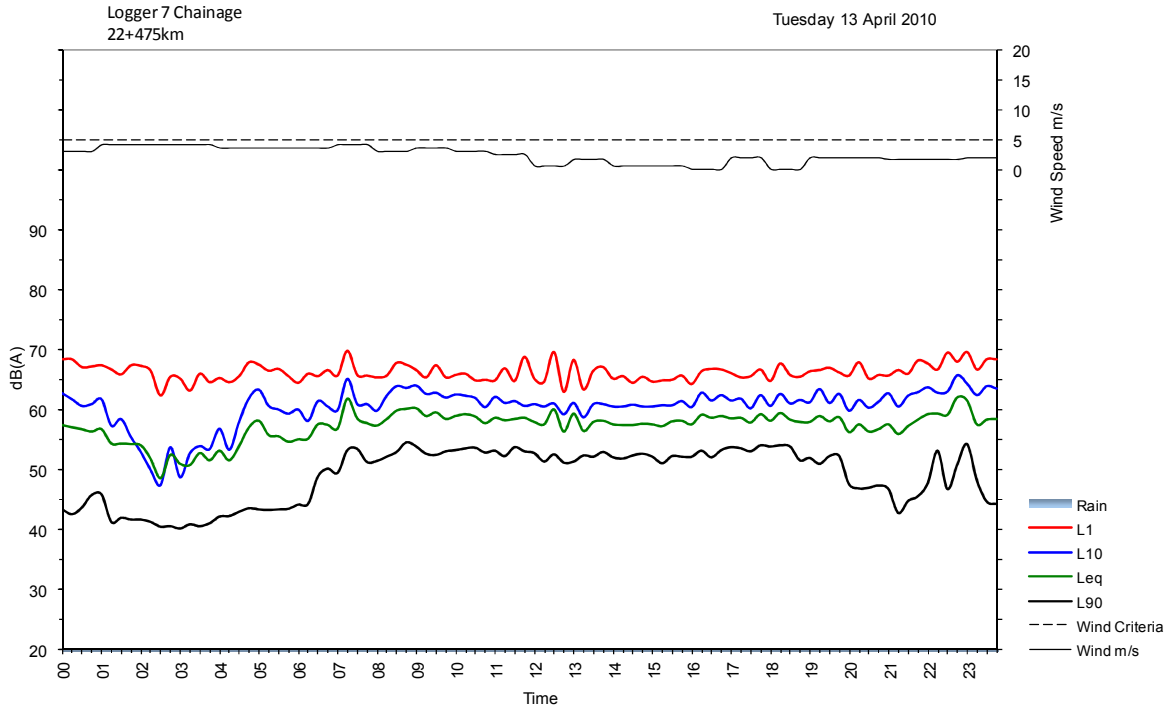
Zone 0000 - Operational Noise Management Report: Part 1



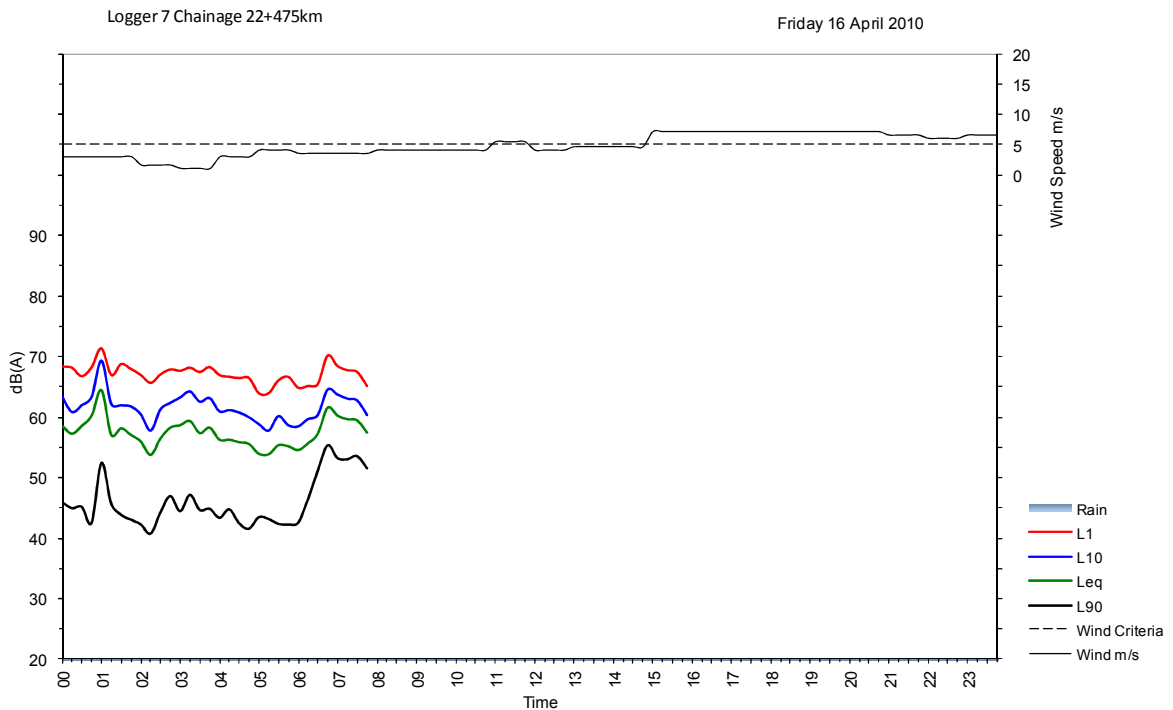
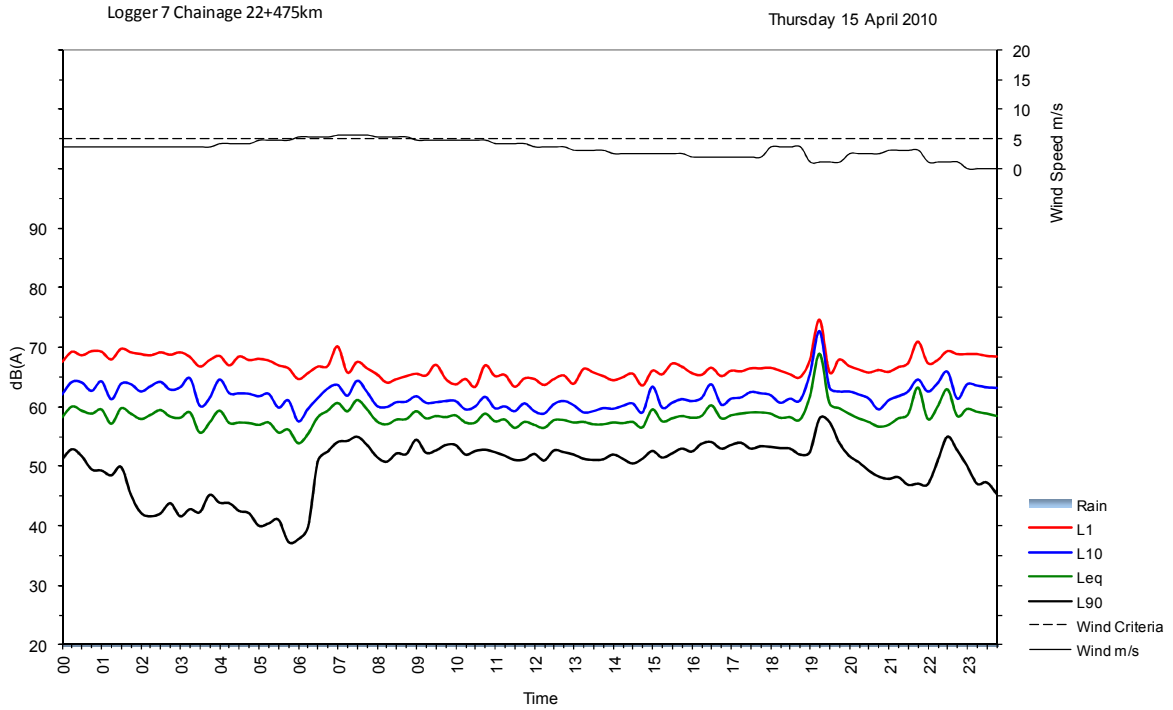
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Zone 0000 - Operational Noise Management Report: Part 1

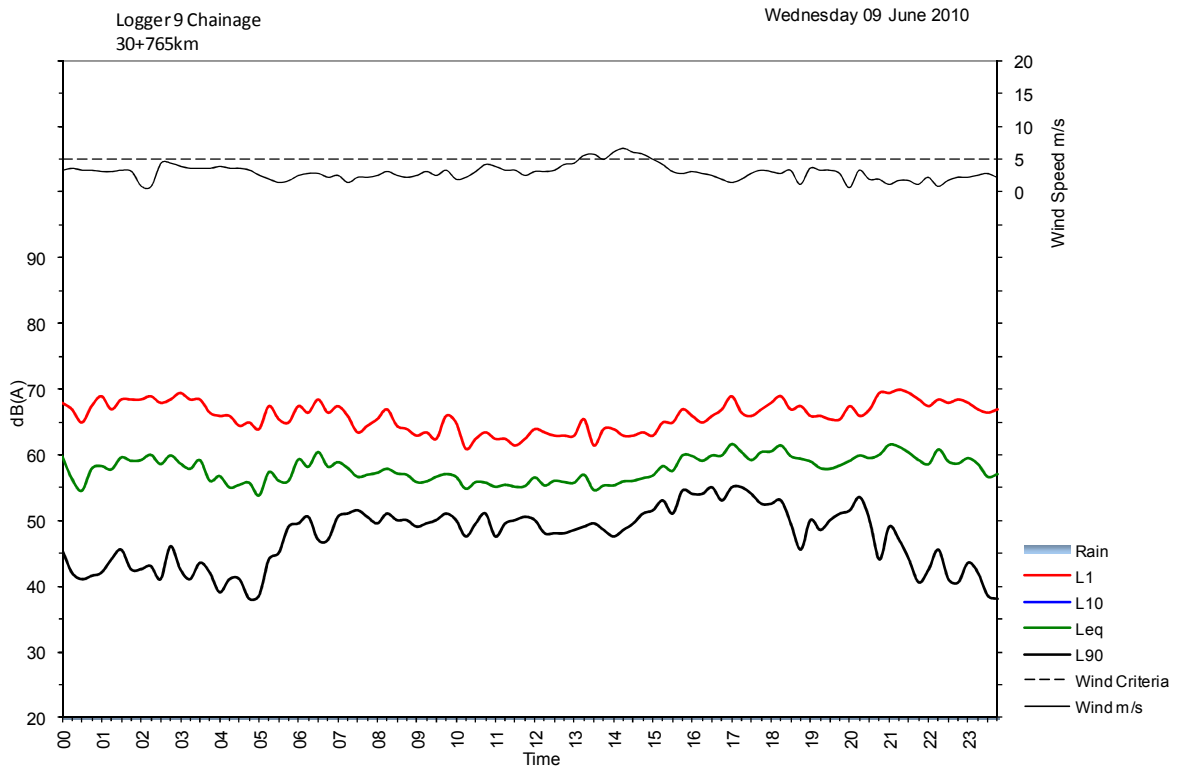
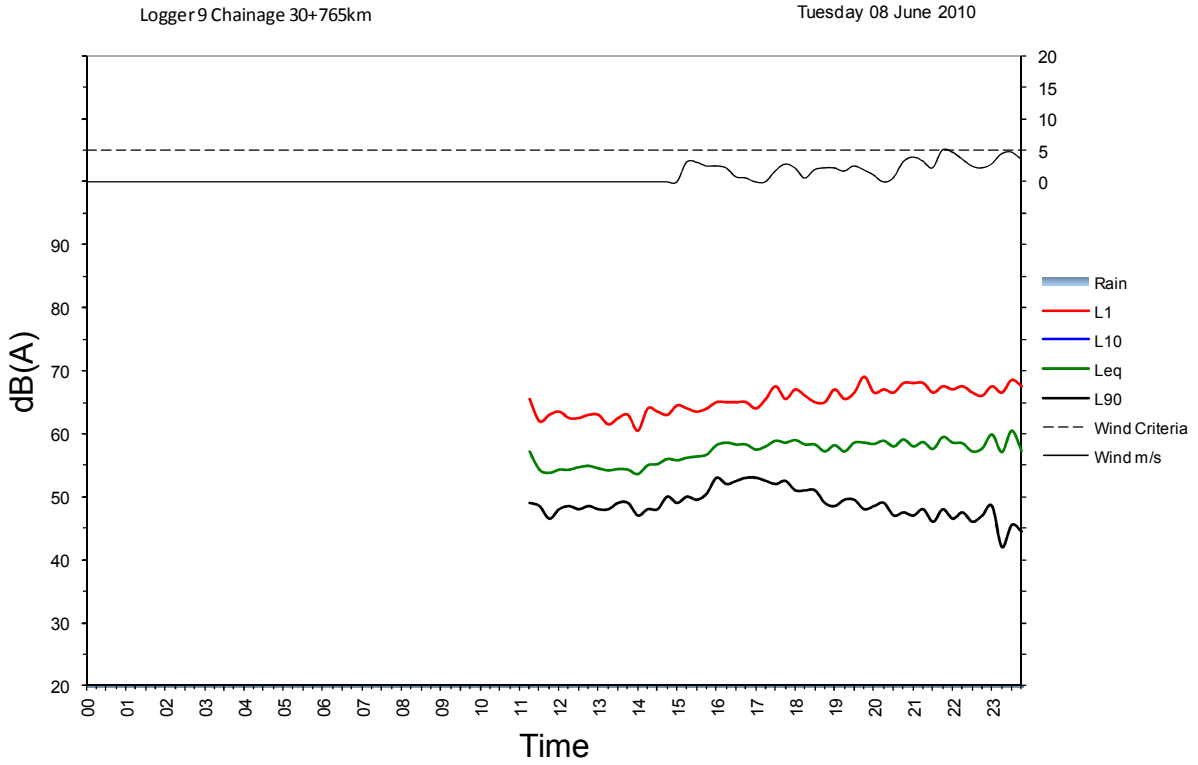


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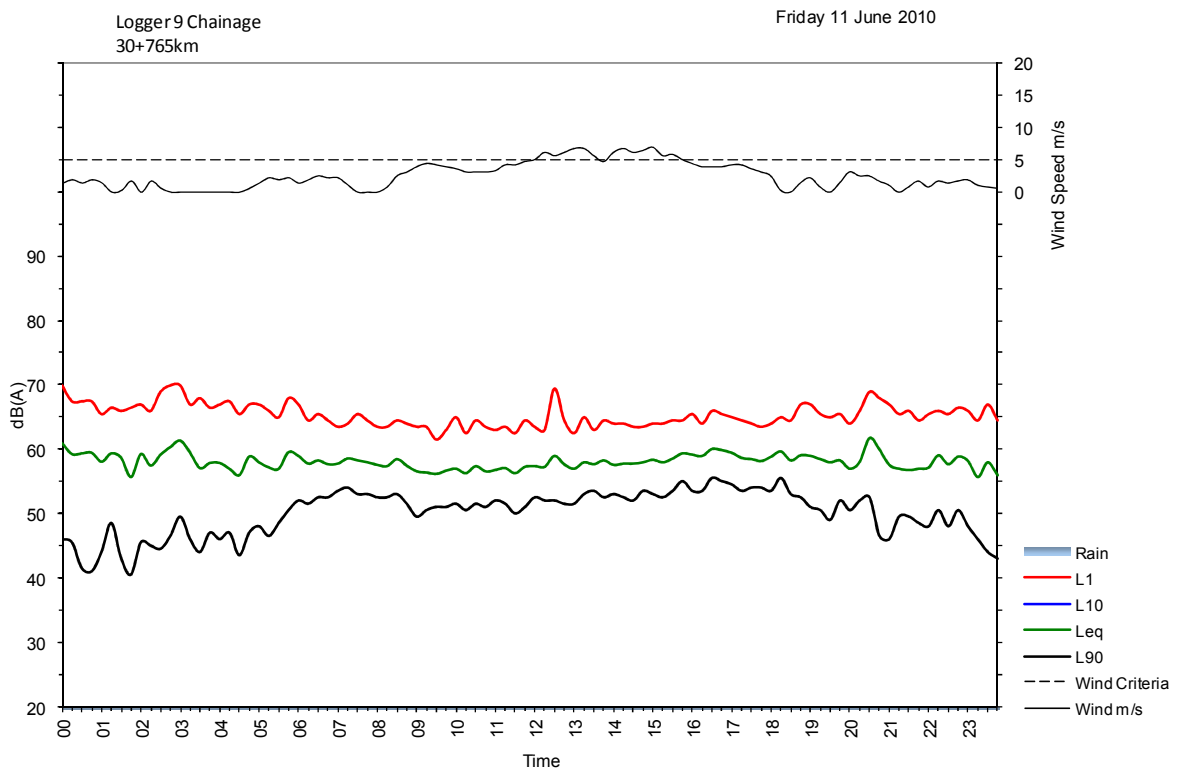
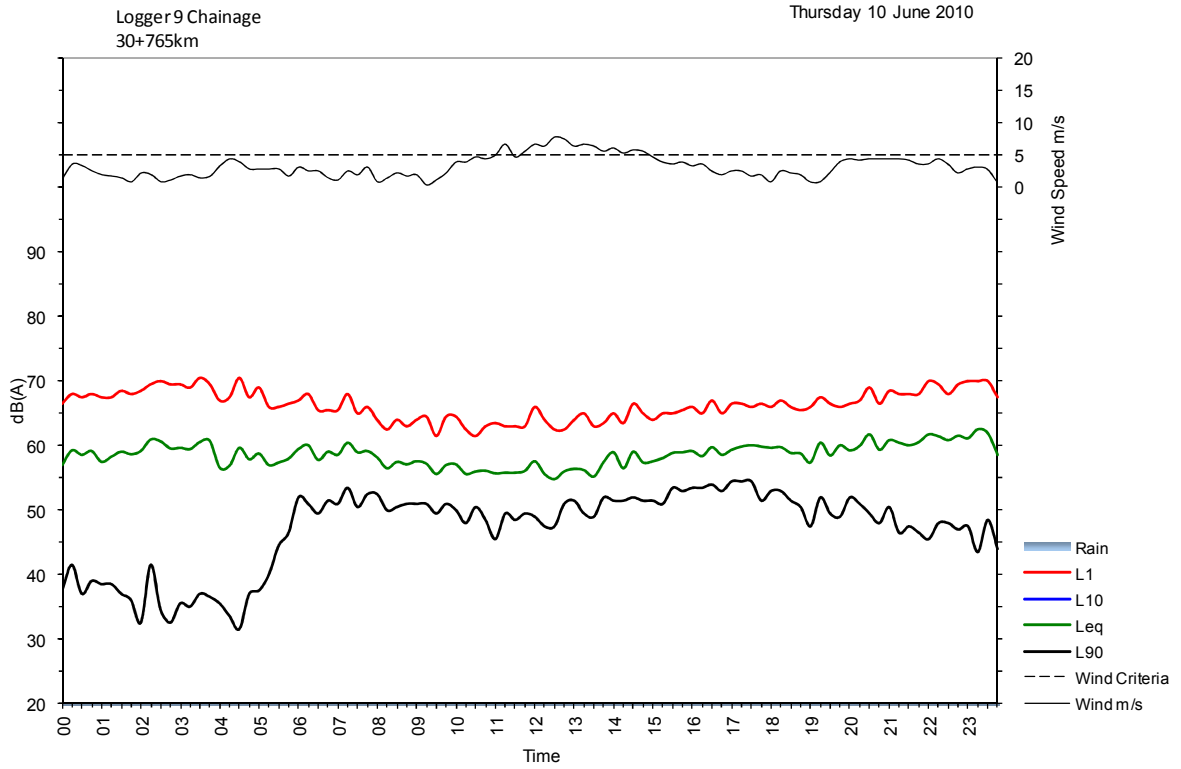


Note: Logger 8 is for construction noise only and hence is omitted from this report.

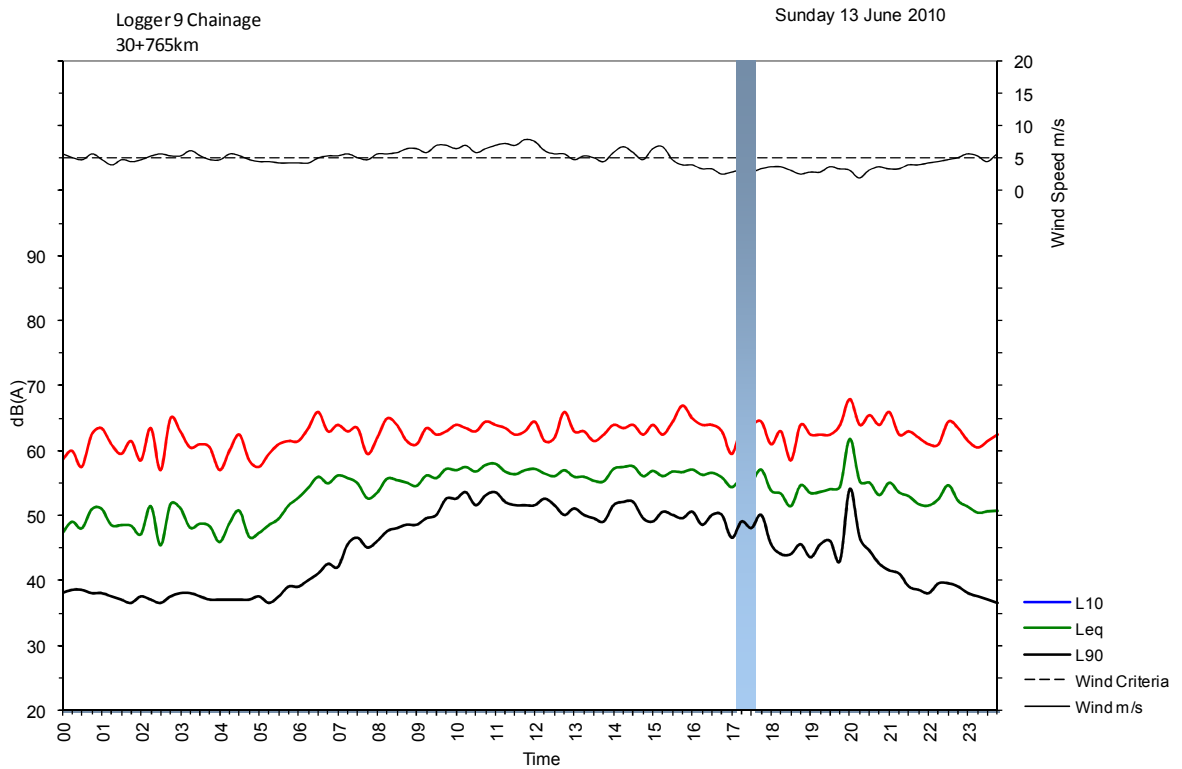
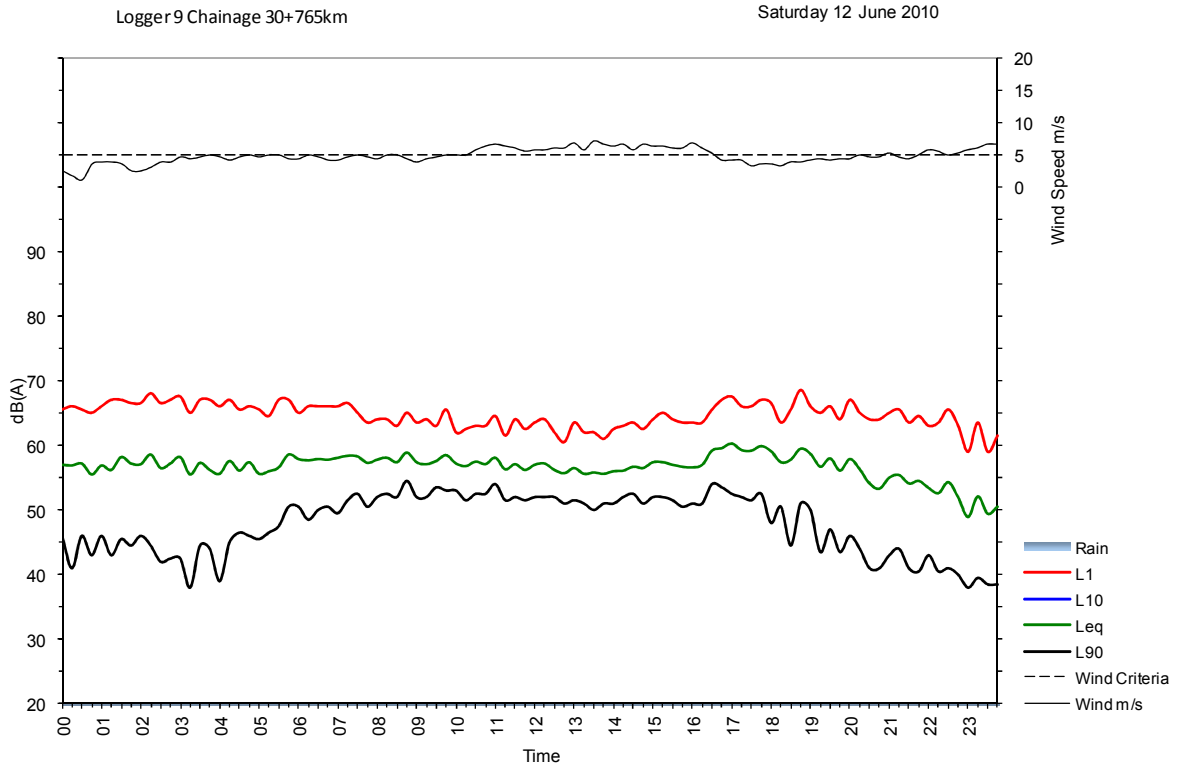
Zone 0000 - Operational Noise Management Report: Part 1



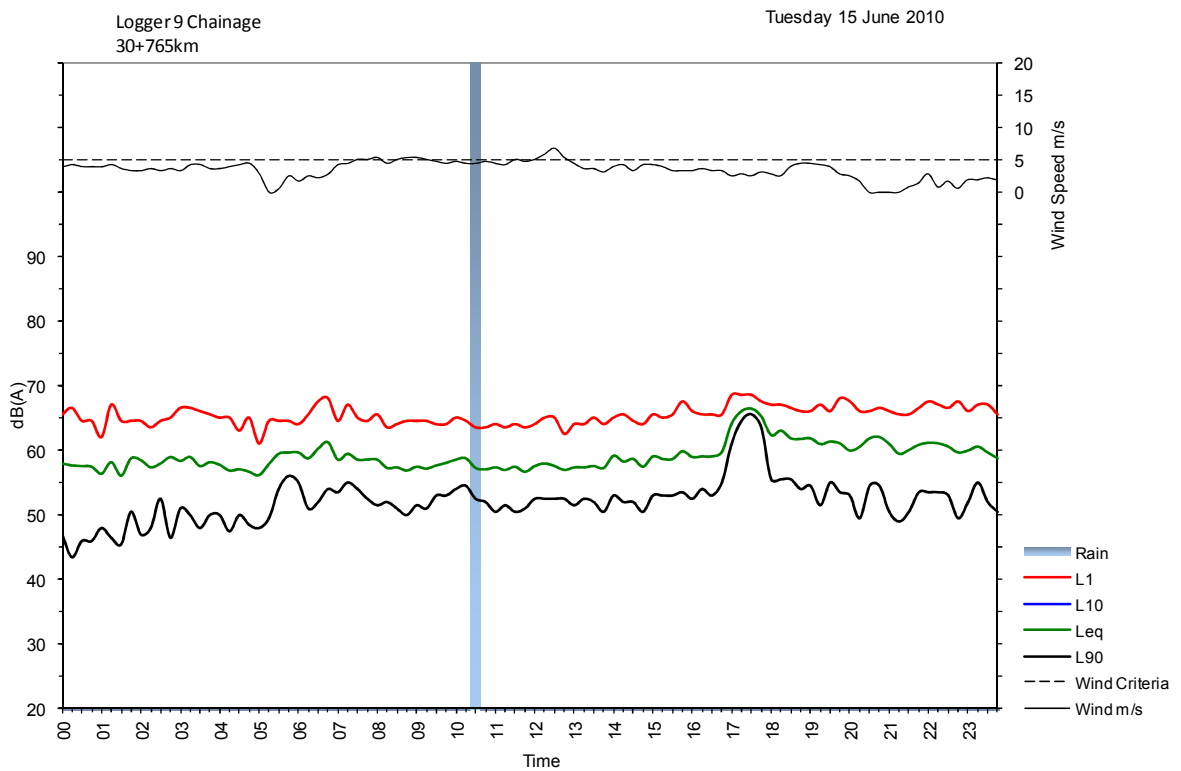
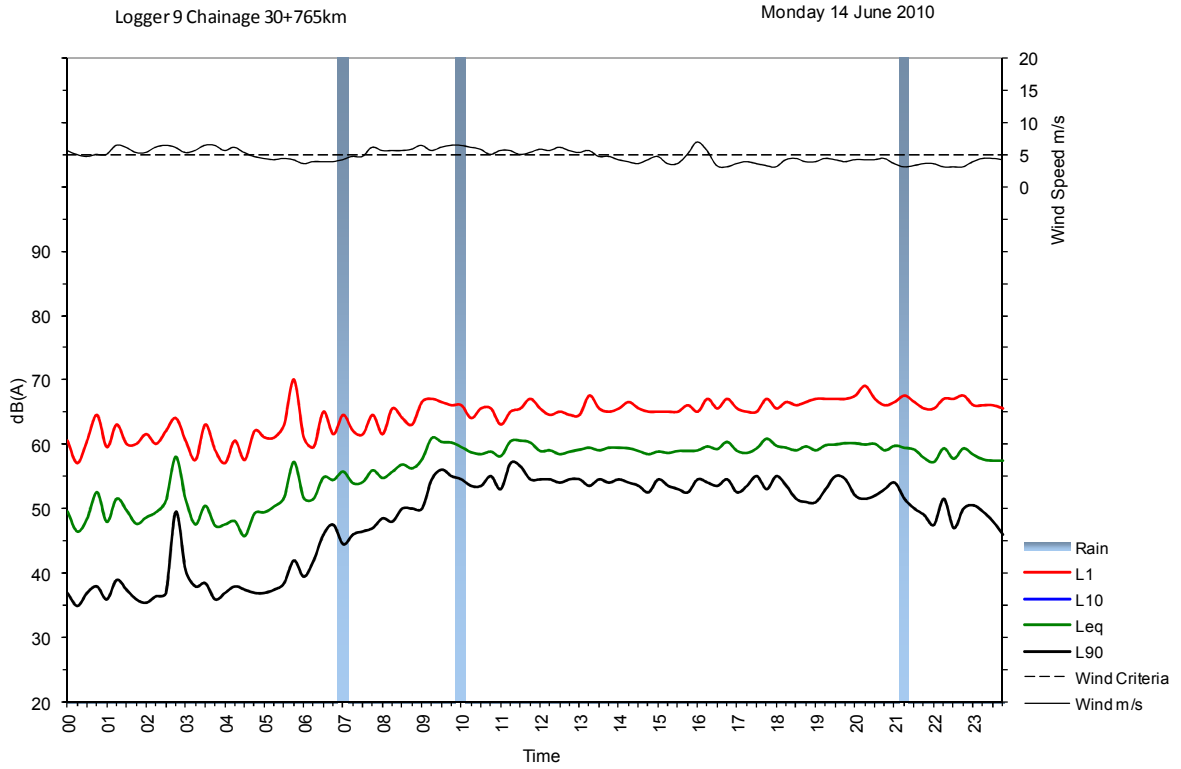
Zone 0000 - Operational Noise Management Report: Part 1



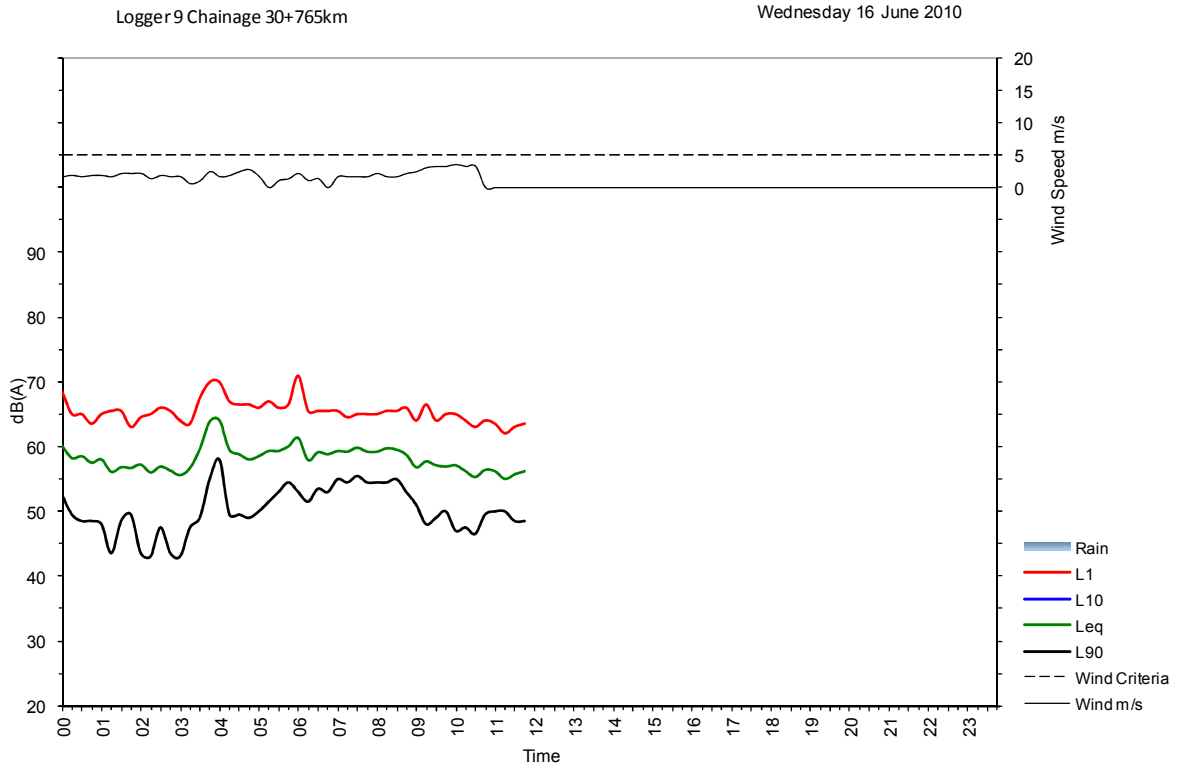
Zone 0000 - Operational Noise Management Report: Part 1



Zone 0000 - Operational Noise Management Report: Part 1

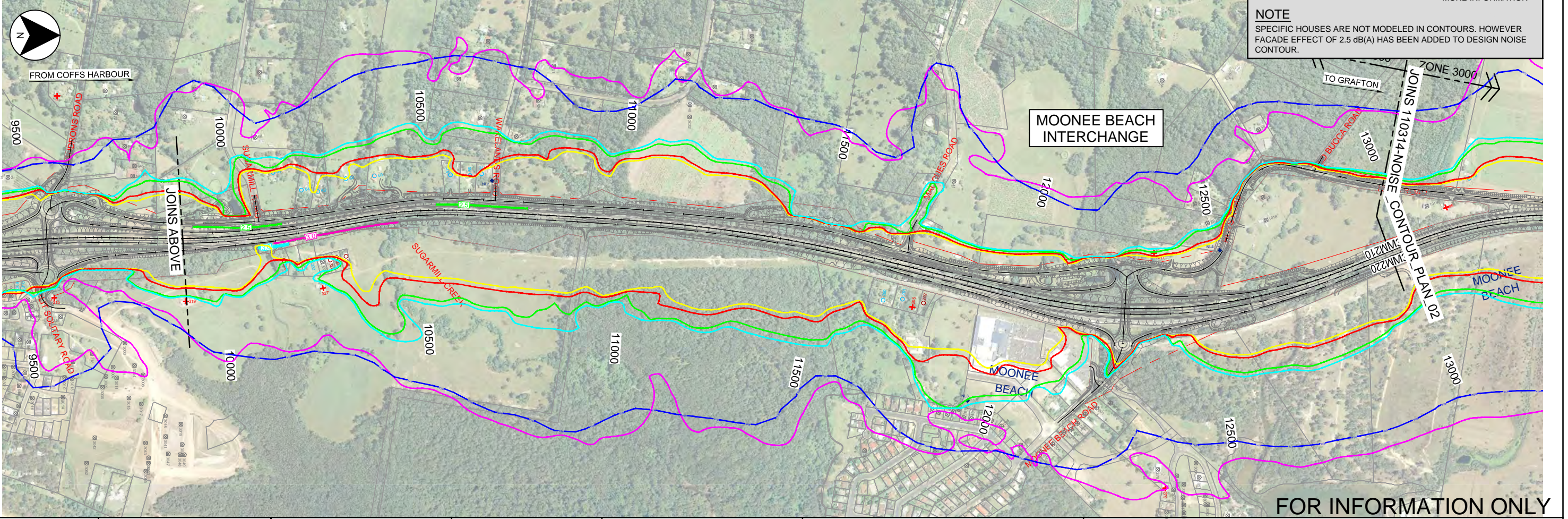
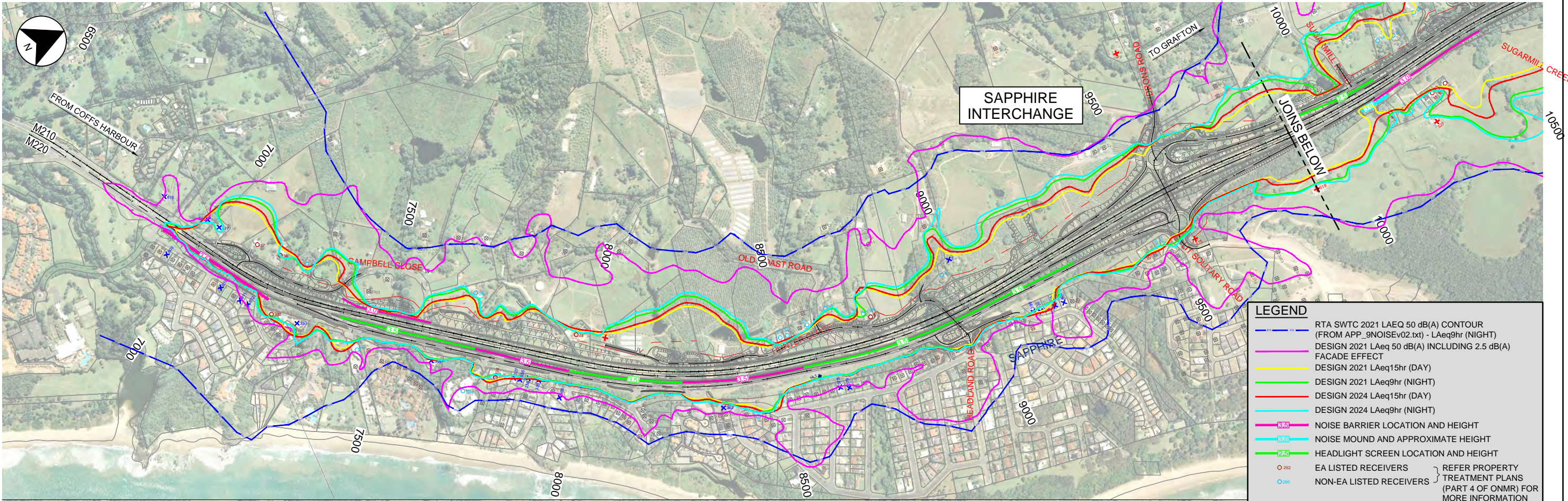


Zone 0000 - Operational Noise Management Report: Part 1





APPENDIX C – NOISE CONTOURS



LEGEND

- RTA SWTC 2021 LAeq 50 dB(A) CONTOUR (FROM APP_9NOISEv02.txt) - LAeq9hr (NIGHT)
- DESIGN 2021 LAeq 50 dB(A) INCLUDING 2.5 dB(A) FACADE EFFECT
- DESIGN 2021 LAeq15hr (DAY)
- DESIGN 2021 LAeq9hr (NIGHT)
- DESIGN 2024 LAeq15hr (DAY)
- DESIGN 2024 LAeq9hr (NIGHT)
- NOISE BARRIER LOCATION AND HEIGHT
- NOISE MOUND AND APPROXIMATE HEIGHT
- HEADLIGHT SCREEN LOCATION AND HEIGHT
- EA LISTED RECEIVERS } REFER PROPERTY TREATMENT PLANS (PART 4 OF ONMR) FOR MORE INFORMATION
- NON-EA LISTED RECEIVERS }

NOTE
 SPECIFIC HOUSES ARE NOT MODELED IN CONTOURS. HOWEVER FACADE EFFECT OF 2.5 dB(A) HAS BEEN ADDED TO DESIGN NOISE CONTOUR.

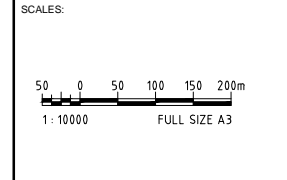
FOR INFORMATION ONLY

CONSORTIUM:

CONTRACTOR:

DESIGNER:

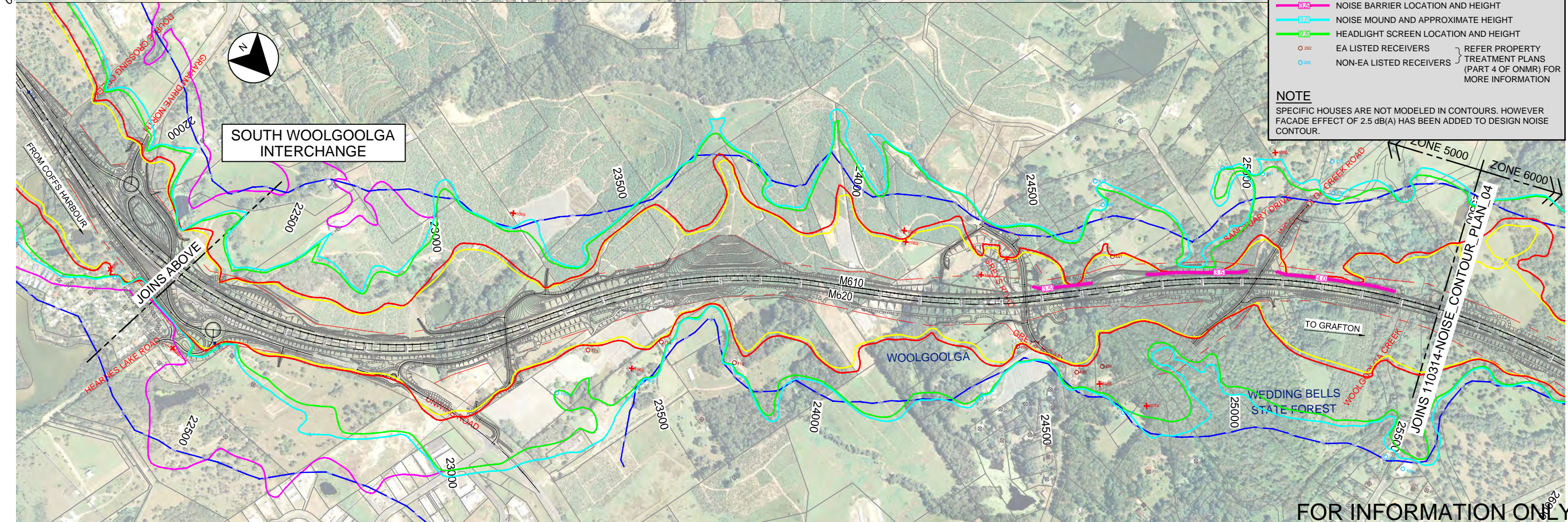
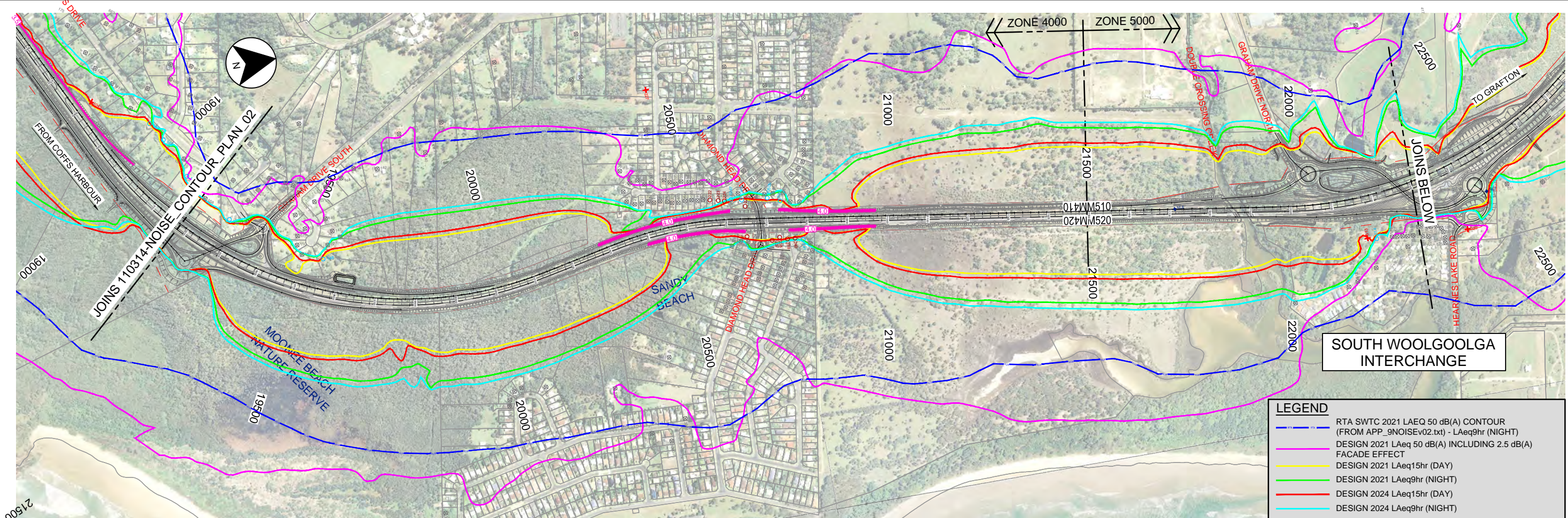
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SAPPHIRE TO WOOLGOOLGA UPGRADE

ZONE 0000
 NOISE CONTOUR
 PLAN
 SHEET 1

INFORMATION DOCUMENT
 DOCUMENT NO.
 PROJECT NO - DOC. TYPE - PROJECT PHASE - ZONE - DISCIPLINE - DATE (YYYYMMDD) - DESCRIPTION:
 S2W-IFD-20-0000-NW-130815-NOISE_CONTOUR_PLAN_01



LEGEND

- RTA SWTC 2021 LAeq 50 dB(A) CONTOUR (FROM APP_9NOISEv02.txt) - LAeq9hr (NIGHT)
- DESIGN 2021 LAeq 50 dB(A) INCLUDING 2.5 dB(A) FACADE EFFECT
- DESIGN 2021 LAeq15hr (DAY)
- DESIGN 2021 LAeq9hr (NIGHT)
- DESIGN 2024 LAeq15hr (DAY)
- DESIGN 2024 LAeq9hr (NIGHT)
- NOISE BARRIER LOCATION AND HEIGHT
- NOISE MOUND AND APPROXIMATE HEIGHT
- HEADLIGHT SCREEN LOCATION AND HEIGHT
- EA LISTED RECEIVERS
- NON-EA LISTED RECEIVERS

} REFER PROPERTY TREATMENT PLANS (PART 4 OF ONMR) FOR MORE INFORMATION

NOTE
 SPECIFIC HOUSES ARE NOT MODELED IN CONTOURS. HOWEVER FACADE EFFECT OF 2.5 dB(A) HAS BEEN ADDED TO DESIGN NOISE CONTOUR.

FOR INFORMATION ONLY



APPENDIX D – DETAILED ASSESSMENT OF ADDITIONAL NOISE BARRIERS



This Appendix presents the detailed assessment of additional noise barriers in accordance with Practice Note iv of the ENMM and includes the following steps:

- Define the road traffic noise catchment area
- Identify all noise sensitive receivers within the noise catchment area
- Calculate existing and future noise levels, including changes in noise levels
- Identify all the options
- Analyse the barrier height and other road treatment options
 - Design a range of barrier options
 - Calculate the total and marginal noise benefits for different barrier heights
 - Plot and evaluate the marginal and total noise benefits and the highest noise levels for different barrier heights.

D1: COACHMANS CLOSE

Detailed noise modelling has been undertaken at 10 years after opening (the design year), taking into account the attenuation provided by the shielding associated with any intervening buildings. A review of the noise model has indicated that the night-time ($L_{Aeq(9hr)}$) period results in a higher exceedance of the noise criteria than the daytime ($L_{Aeq(15hr)}$) period. Therefore, the night-time criterion is the governing criterion and compliance with the night-time criterion will ensure compliance with the daytime requirements.

The noise catchment area is considered to be the residences located on Coachman's Close. Noise modelling for the design year indicated that the road traffic noise levels at Residences 619, 332 and 333 exceed the appropriate noise criterion and hence require evaluation of additional acoustic treatment.

All alternative feasible and reasonable traffic management and other road design opportunities for reducing traffic noise have been exhausted. At this particular chainage of the upgrade, the designated road surface is Stone Mastic Asphalt (SMA) for tyre noise reduction. A realignment of the roadway and more stringent limits on traffic flow speeds would have minimal effectiveness and cannot be considered either feasible or reasonable for this catchment area.

As there are not more than three affected residences grouped together at this location a noise barrier is not considered reasonable and architectural treatments should be implemented. Receiver 333 has already been provided treatment so would not be eligible for additional mitigation.

D2: HUNTER CLOSE

Detailed noise modelling has been undertaken at 10 years after opening (the design year), taking into account the attenuation provided by the shielding associated with any intervening buildings. A review of the noise model has indicated that the night-time ($L_{Aeq(9hr)}$) period results in a higher exceedance of the noise criteria than the daytime ($L_{Aeq(15hr)}$) period. Therefore, the night-time criterion is the governing criterion, compliance with the night-time criterion will ensure compliance with the daytime requirements.

The predicted noise level for the design year is $L_{Aeq(9hr)}$ 53 dB(A) at residence 20. The noise catchment area is therefore defined as the area bounded by the freeway upgrade and residence 20. The noise catchment area includes receivers 9, 10, 14, 15, 17, 18, 19 and 1006 which are eligible for consideration of further mitigation.

All alternative feasible and reasonable traffic management and other road design opportunities for reducing traffic noise have been exhausted. At this particular chainage of the upgrade, the designated road surface is Stone Mastic Asphalt (SMA) for tyre noise reduction. A realignment of the roadway and more stringent limits on traffic flow speeds would have minimal effectiveness and cannot be considered either as feasible or reasonable for this catchment area. Therefore the remaining acoustic treatment options consist of a noise barrier, as there are more than three affected residences grouped together, and architectural treatment.

For a barrier to be effective, it would need to be located at the top of the cutting. A comparison of noise reductions for a range of barrier heights has been carried out for the most affected residences and shows the relationship between barrier height and resulting noise levels for the design year. The graph in Figure D1 indicates that the minimum insertion loss of 5 dB(A) is achieved for barrier heights of 3 m to 4.5 m. The minimum insertion loss for barrier heights above 5 m of 10 dB(A) is met for barrier heights of 7 m to 8 m.

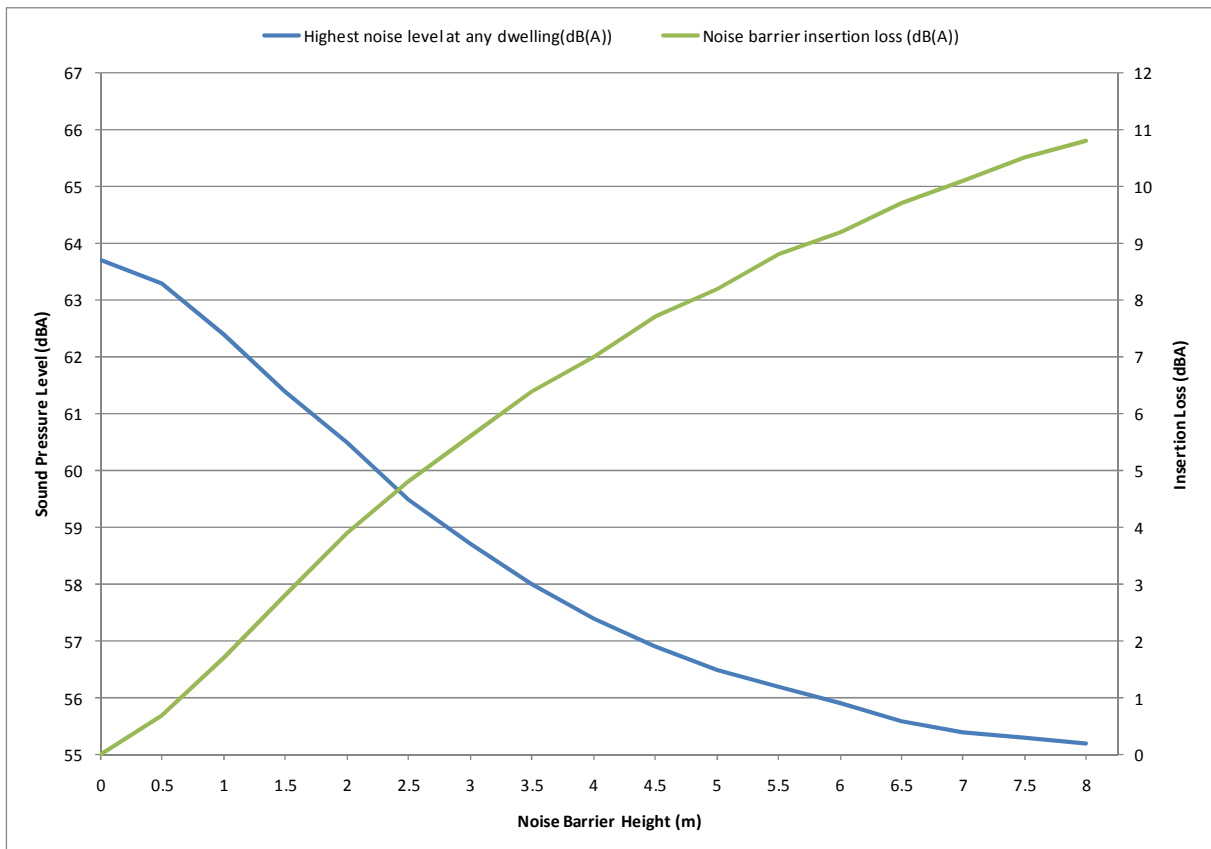


Figure D1 Maximum Insertion Loss and Noise Levels

Figure D2 below illustrates the Total Noise Benefit (TNB), the Marginal Benefit Value (MBV) and the Total Noise Benefit Per Unit Area (TNBA). The TNB is the sum of the noise reduction provided by the barrier. The MBV is the increase in TNB, divided by the increase in barrier height. The TNBA is the TNB divided by the total area of the barrier.

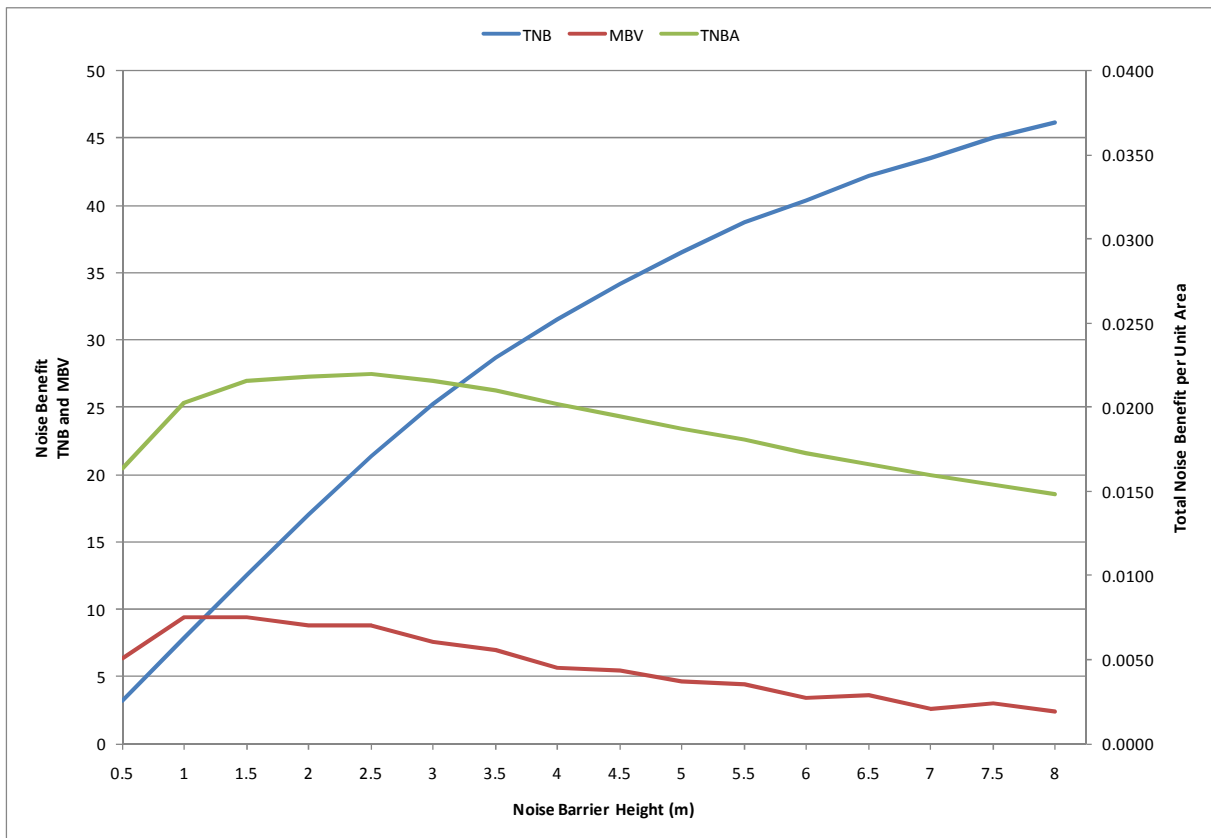


Figure D2 TNB, MBV and TNBA

The ‘target barrier’ is the barrier that achieves compliance with the appropriate noise criteria at all sensitive receivers. This is identified in Figure D1 as a 7 m barrier.

The graph provided in Figure D2 illustrates the Total Noise Benefit (TNB), the Marginal Benefit Value (MBV) and the Total Noise Benefit per Unit Area (TNBA). The TNB is the sum of the noise reduction achieved at all receivers by the barrier. The MBV is the increase in TNB, divided by the increase in barrier height. The TNBA is the TNB divided by the total area of the barrier.

The ‘assessed barrier’ is the barrier option selected after considering the TNB, MBV and TNBA. In this instance with respect to the MBV, a 1 m noise barrier would be the most cost effective. With respect to the TNBA, a 2.5 m noise barrier would be considered the most cost-effective. However neither of these barriers meet the minimum insertion loss of 5 dB(A). A noise barrier of 3 m or greater is required to meet the minimum insertion loss. On this basis a 3 m noise barrier is considered to be the ‘assessed’ barrier.

A barrier located at the top of the cutting would impact the easterly (ocean) views from the residents in Hunter Close. There is no space at the boundary hence a retaining wall would be required to provide space for the noise barrier (due to additional footprint required by the wall and landscaping). Additionally a 66kV overhead electrical line is being relocated along Hunter Close and hence there are likely to be technical issues with the 7 m or 3 m barrier at this location. Hence architectural treatments are recommended in lieu of a barrier for sensitive receivers.

D3: NORTH OF SUGARMILL ROAD, EAST SIDE OF HIGHWAY, SAPPHIRE BEACH

Detailed noise modelling has been undertaken for the period of 10 years after opening (the design year), taking into account the attenuation provided by the shielding associated with any intervening buildings. A review of the noise model has indicated that the night-time ($L_{Aeq(9hr)}$) period results in a higher exceedance of the noise criteria than the daytime ($L_{Aeq(15hr)}$) period. Therefore, the night-time criterion is the governing criterion, compliance with the night-time criterion will ensure compliance with the daytime requirements.

The noise catchment area includes receivers 320 -326. Receivers 320, 322, 324, 325 and 326 have all been identified as eligible for consideration of further mitigation. Receiver 327 will be demolished so has not been considered in this assessment.

A noise-reducing road surface is already incorporated into the design at this location of the upgrade. Remaining acoustic treatment options consist of a noise barrier, as there are more than three affected residences grouped together, and architectural treatment.

A comparison of noise reductions for a range of barrier heights has been carried out for the most affected residences and Figure D3 shows the relationship between barrier height and resulting noise levels for the design year.

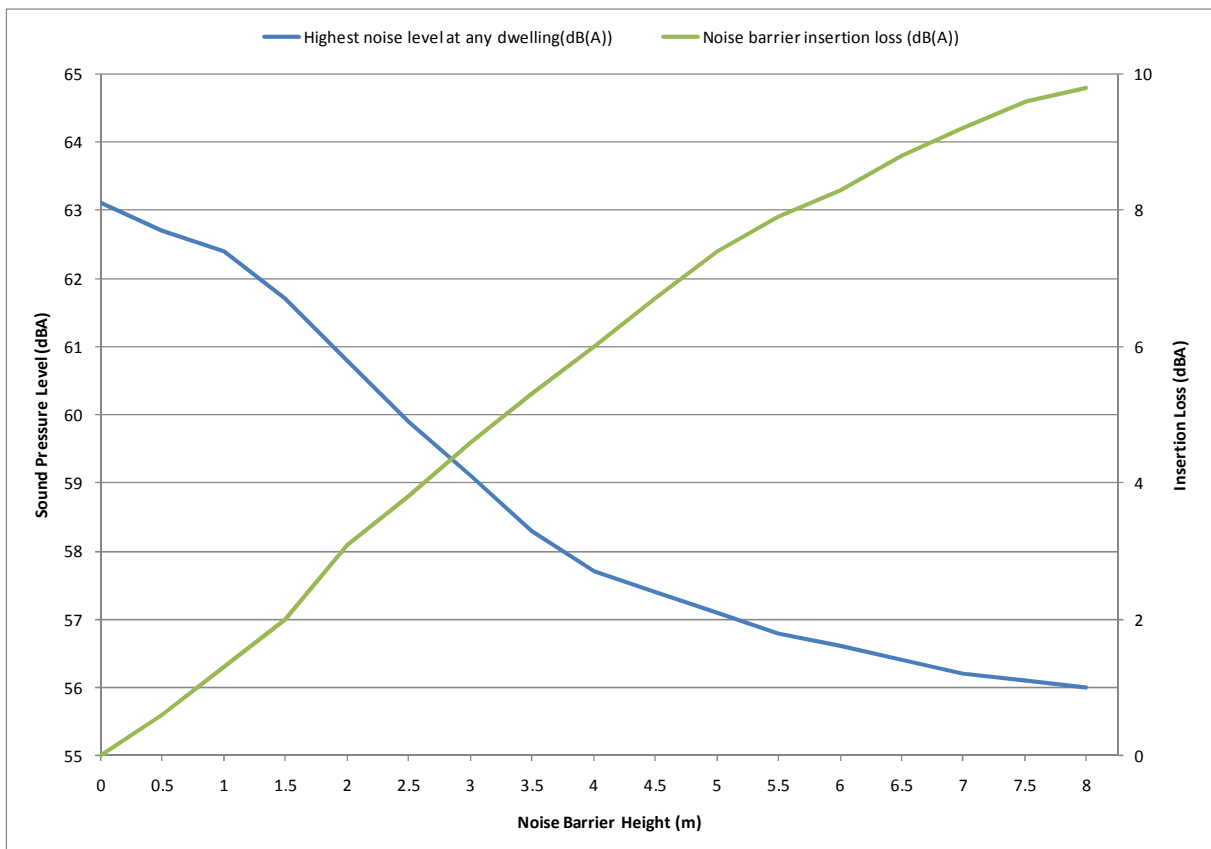


Figure D3 Maximum Insertion Loss and Noise Levels Case Study 3

The graph in Figure D3 indicates that the minimum insertion loss of 5 dB(A) is achieved for barrier heights of 3.5 m and greater. The minimum insertion loss for barrier heights 5 m and greater of 10 dB(A) is not achieved.

Provided below in Figure D4 are the Total Noise Benefit (TNB), the Marginal Benefit Value (MBV) and the Total Noise Benefit Per Unit Area (TNBA). The TNB is the sum of the noise reduction provided by the barrier. The MBV is the increase in TNB, divided by the increase in barrier height. The TNBA is the TNB divided by the total area of the barrier.

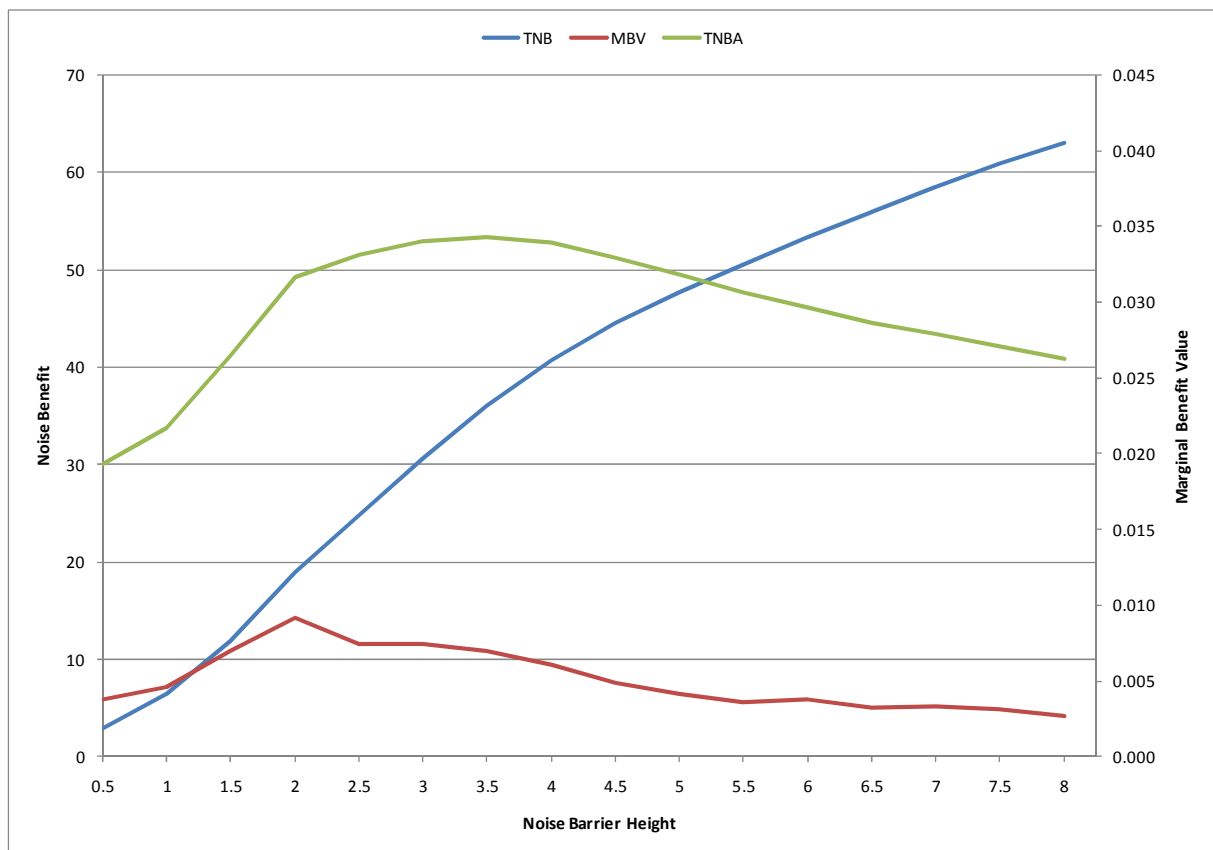


Figure D4 TNB, MBV and TNBA

The ‘target barrier’ is the barrier that achieves compliance with the appropriate noise criteria at all sensitive receivers. As illustrated in Figure D4 a barrier of 8 m in height cannot achieve this. As such there is no ‘target barrier’ for this assessment.

The ‘assessed barrier’ is the barrier option selected after considering the TNB, MBV and TNBA. The MBV peaks at 2 m however a 2 m noise barrier does not meet the required minimum insertion loss. The TNBA peaks between 3 m and 3.5 m. Considering the 3 m barrier has the higher MBV, a 3 m barrier has been considered to be the ‘assessed barrier’.

On the basis that there is no ‘target barrier’ for this assessment, the ‘assessed barrier’ has been selected as the optimum barrier. As such a 3 m noise barrier is recommended to attenuate noise levels for receivers in this catchment area.

D4: 1206 PACIFIC HIGHWAY, MOONEE BEACH (OPPOSITE MACCUES ROAD)

Detailed noise modelling has been undertaken for the period of 10 years after opening (the design year), taking into account the attenuation provided by the shielding associated with any intervening buildings. A review of the noise model has indicated that the night-time ($L_{Aeq(9hr)}$) period results in a higher exceedance level than the daytime ($L_{Aeq(15hr)}$) period. Therefore, the night-time criterion is the governing criterion, compliance with the night-time criterion will ensure compliance with the daytime requirements.

The predicted noise level for the design year is 61 dB(A) at residence 290. The noise catchment area is therefore defined as the area bounded by the freeway upgrade and residence 290. The noise catchment area includes receivers 290, 291, 292 based on similar noise exposure, with $L_{Aeq(9hr)}$ noise levels between 61 and 63 dB(A)

All alternative feasible and reasonable traffic management and other road design opportunities for reducing traffic noise have been exhausted. At this particular chainage of the upgrade, the designated road surface is Stone Mastic Asphalt (SMA) for tyre noise reduction. A realignment of the roadway and more stringent limits on traffic flow speeds would have minimal effectiveness and cannot be considered either feasible or reasonable for this catchment area.

As there are only three receivers at this location, it is not considered reasonable to provide a noise barrier. Resident 292 has been identified at the EA stage as requiring architectural treatment and will receive treatment regardless of the predicted noise levels.

D5: EMERALD HEIGHTS DRIVE

Detailed noise modelling has been undertaken for the period of 10 years after opening (the design year), taking into account the attenuation provided by the shielding associated with any intervening buildings. A review of the noise model has indicated that the night-time ($L_{Aeq(9hr)}$) period results in a higher exceedance of the noise criteria than the daytime ($L_{Aeq(15hr)}$) period. Therefore, the night-time criterion is the governing criterion, compliance with the night-time criterion will ensure compliance with the daytime requirements.

The noise catchment area includes receivers 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180 and 181 which are all eligible for consideration of further mitigation and is defined as the area bounded by the two locations of cutting.

All alternative feasible and reasonable traffic management and other road design opportunities for reducing traffic noise have been exhausted. At this particular chainage of the upgrade, the designated road surface is Stone Mastic Asphalt (SMA) for tyre noise reduction. A realignment of the roadway and more stringent limits on traffic flow speeds would have minimal effectiveness and cannot be considered either feasible or reasonable for this catchment area.

Remaining acoustic treatment options consist of a noise barrier, given that there are more than three affected residences grouped together, and architectural treatments.

A comparison of noise reductions for a range of barrier heights has been carried out for the most affected residences and Figure D5 shows the relationship between barrier height and resulting noise levels for the design year. The graph indicates that the minimum insertion loss of 5 dB(A) is achieved for barrier heights of 2.5 m to 4.5 m. The minimum insertion loss for barrier heights 5 m and greater of 10 dB(A) is met for barrier heights of 5 m to 8 m.

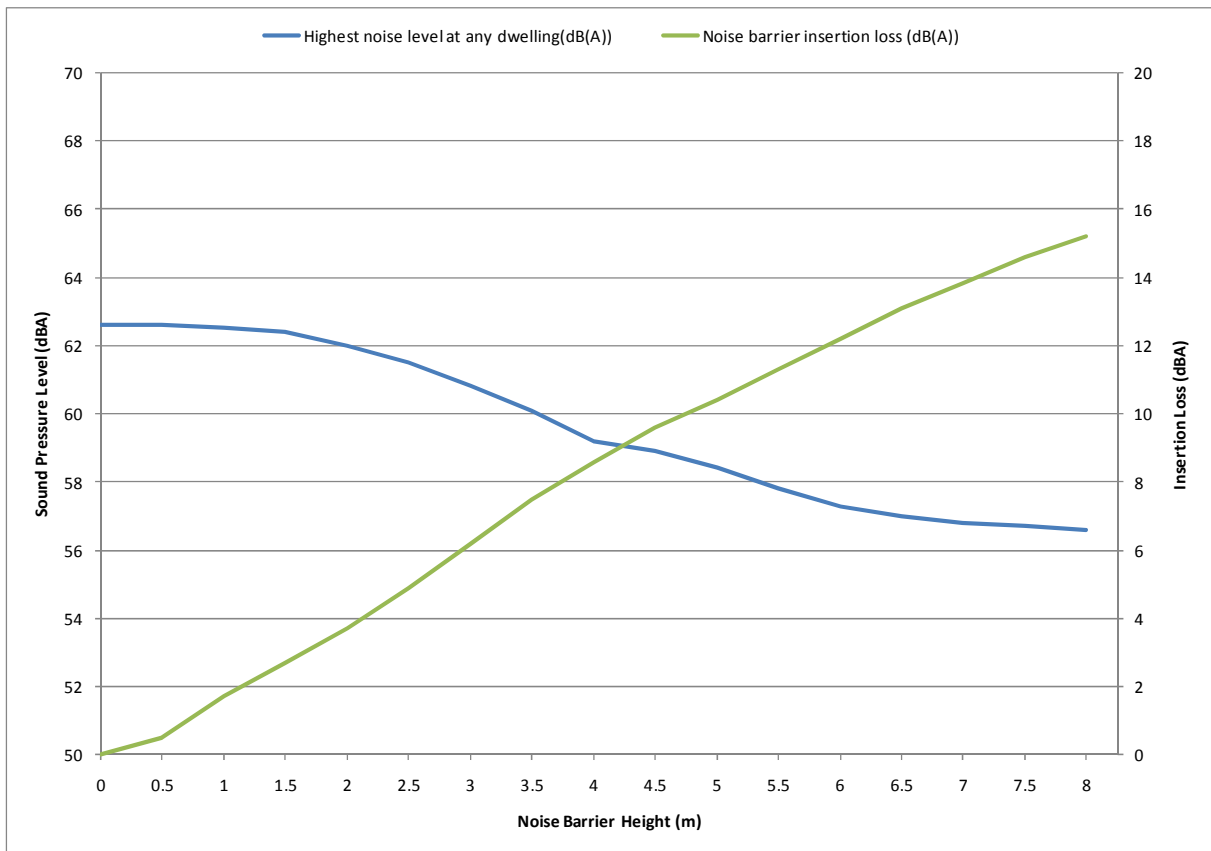


Figure D5 Maximum Insertion Loss and Noise Levels

Figure D6 below illustrates the Total Noise Benefit (TNB), the Marginal Benefit Value (MBV) and the Total Noise Benefit Per Unit Area (TNBA). The TNB is the sum of the noise reduction provided by the barrier. The MBV is the increase in TNB, divided by the increase in barrier height. The TNBA is the TNB divided by the total area of the barrier.

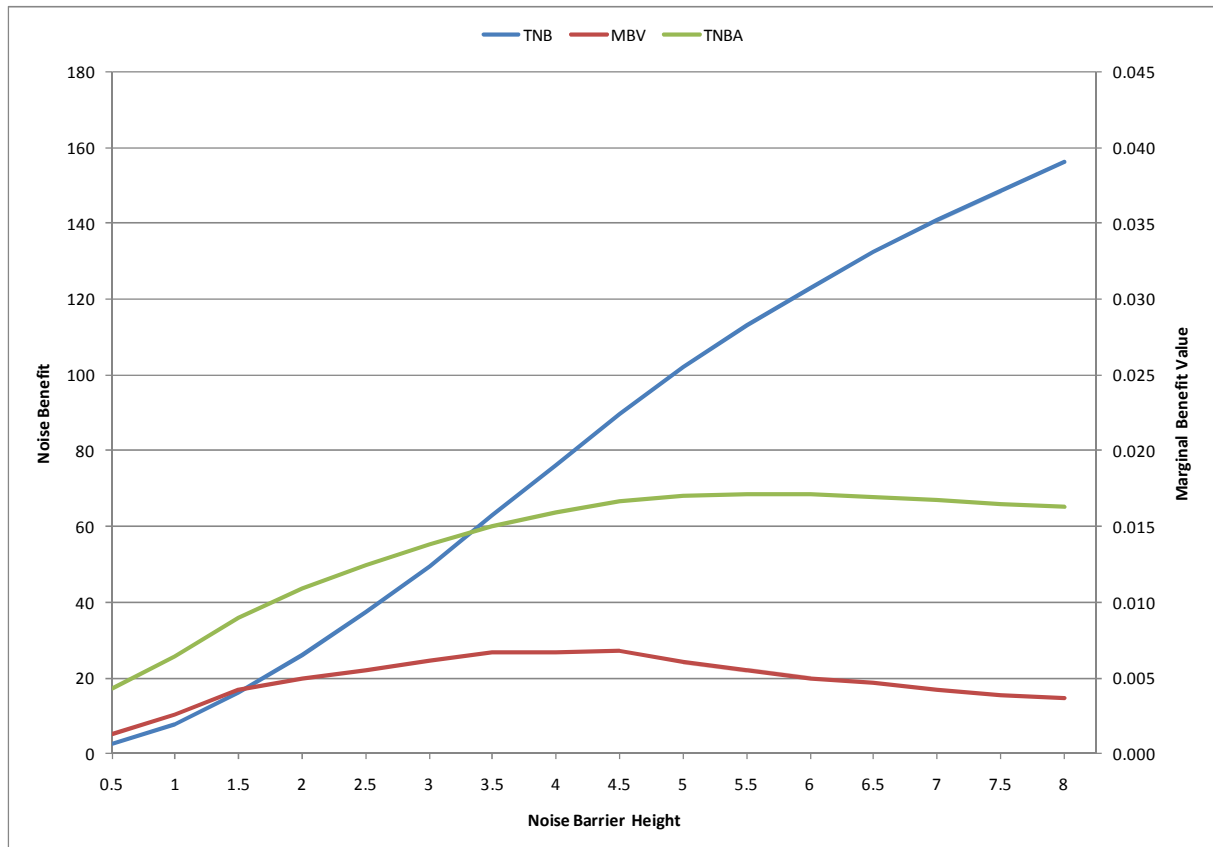


Figure D6 TNB, MBV and TNBA

The ‘target barrier’ is the barrier that achieves compliance with the appropriate noise criteria at all sensitive receivers. As illustrated in Figure D5 a barrier greater than 8 m would be required to achieve this. As such a ‘target barrier’ is not applicable for this location.

The ‘assessed barrier’ is the barrier option selected after considering the TNB, MBV and TNBA. A noise barrier between 3.5 m and 4.5 m height provides a peak in the MBV and is only marginally lower than the peak in the TNBA. On the basis that a 4.5 m barrier does not have a significantly higher MBV, a 3.5 m noise barrier has been considered to be the ‘assessed’ barrier.

As there is no target noise barrier the assessed barrier will be constructed at this location.

D6: NEWMANS ROAD

Detailed noise modelling has been undertaken for the period of 10 years after opening (the design year). A review of the noise model has indicated that the night-time ($L_{Aeq(9hr)}$) period results in a higher exceedance of the noise criteria than the daytime ($L_{Aeq(15hr)}$) period. Therefore, the night-time criterion is the governing criterion, compliance with the night-time criterion will ensure compliance with the daytime requirements.

The predicted noise level for the design year is 52 dB(A) at receiver residence 1067. The noise catchment area is therefore defined as the area bounded by the freeway upgrade and resident 1067. The noise catchment area includes receivers 478, 482 and 1067, based on similar noise exposure with $L_{Aeq(9hr)}$ noise levels between 52 and 56 dB(A).

All alternative feasible and reasonable traffic management and other road design opportunities for reducing traffic noise have been exhausted. At this particular chainage of the upgrade, the designated road surface is Stone Mastic Asphalt (SMA) for tyre noise reduction. A realignment of the roadway and more stringent limits on traffic flow speeds would have minimal effectiveness and cannot be considered either feasible or reasonable for this catchment area.

As there are less than four affected residences grouped together a noise barrier does not need to be considered at this location. Receivers 478, 482 and 1067 will require architectural treatment.

D7: CRYSTAL DRIVE

Detailed noise modelling has been undertaken for the period of 10 years after opening (the design year), taking into account the attenuation provided by the shielding associated with any intervening buildings. A review of the noise model has indicated that the night-time ($L_{Aeq(9hr)}$) period results in a higher exceedance of the noise criteria than the daytime ($L_{Aeq(15hr)}$) period. Therefore, the night-time criterion is the governing criterion, compliance with the night-time criterion will ensure compliance with the daytime requirements.

The noise catchment area includes receivers 399, 400, 401, 402 and 403 which are all eligible for consideration of further mitigation.

All alternative feasible and reasonable traffic management and other road design opportunities for reducing traffic noise have been exhausted. At this particular chainage of the upgrade, the designated road surface is Stone Mastic Asphalt (SMA) for tyre noise reduction. A realignment of the roadway and more stringent limits on traffic flow speeds would have minimal effectiveness and cannot be considered either feasible or reasonable for this catchment area.

Remaining acoustic treatment options consist of a noise barrier, as there are more than three affected residences grouped together, and architectural treatment.

A comparison of noise reductions for a range of barrier heights has been carried out for the most affected residences and Figure D7 shows the relationship between barrier height and resulting noise levels for the design year. The graph indicates that an insertion loss of approximately 5 dB(A) is achieved for a 4.5 m high barrier. The minimum insertion loss for barrier heights 5 m and greater of 10 dB(A) is not achieved at this location.

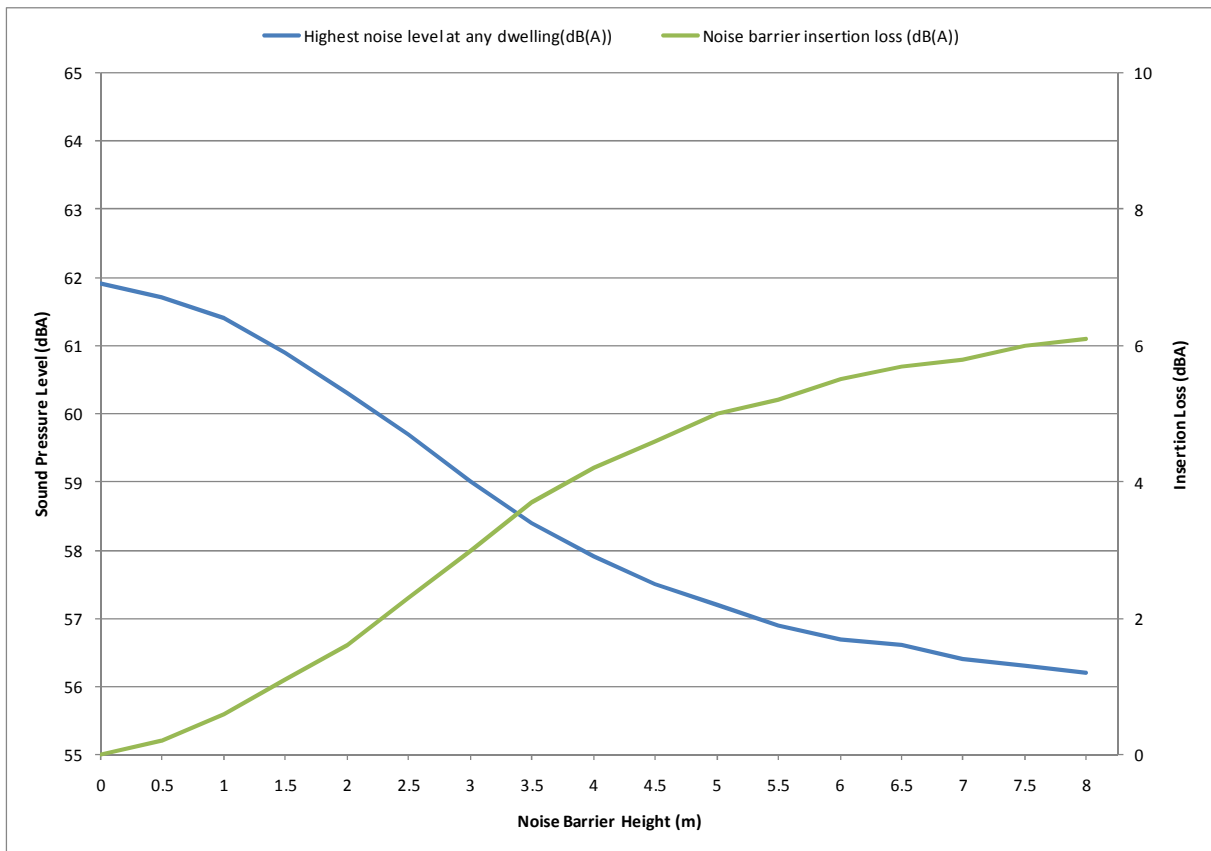


Figure D7 Maximum Insertion Loss and Noise Levels

Figure D8 below illustrates the Total Noise Benefit (TNB), the Marginal Benefit Value (MBV) and the Total Noise Benefit per Unit Area (TNBA). The TNB is the sum of the noise reduction provided by the barrier. The MBV is the increase in TNB, divided by the increase in barrier height. The TNBA is the TNB divided by the total area of the barrier.

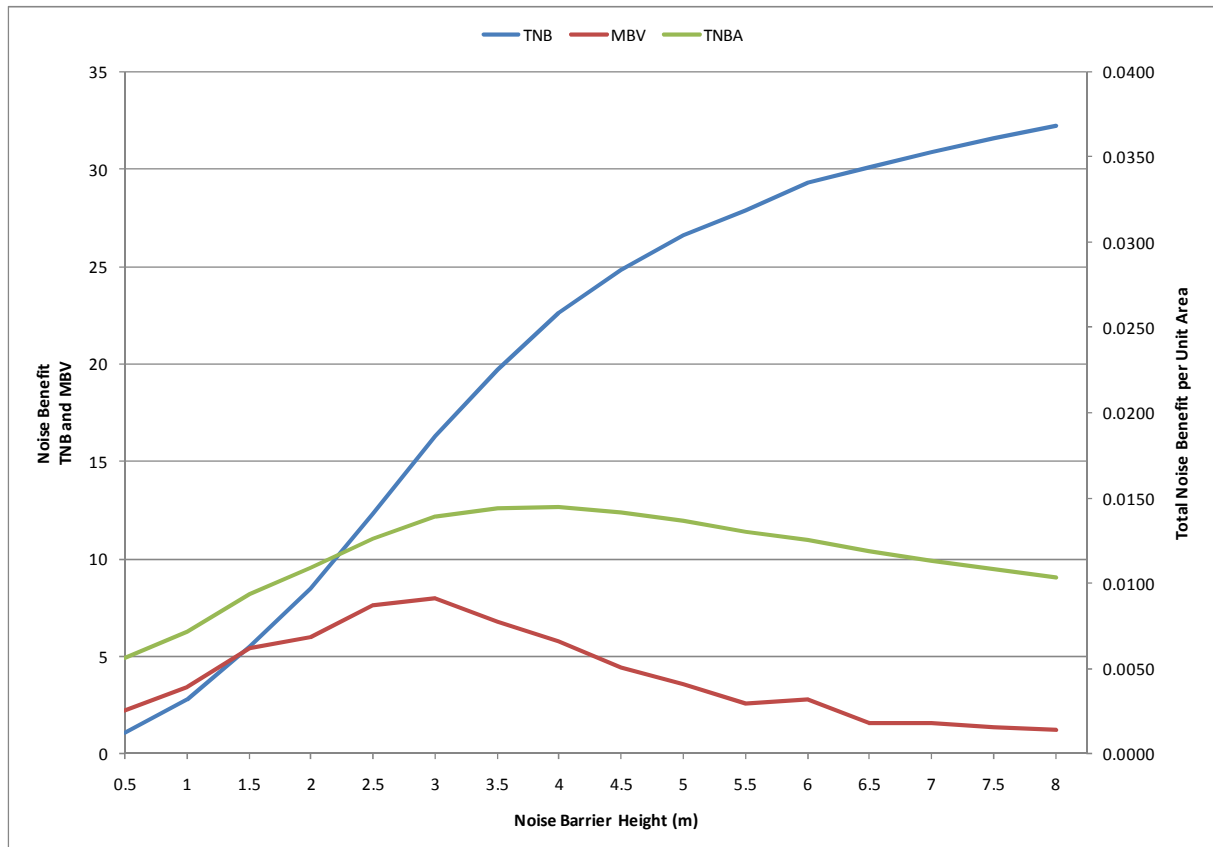


Figure D8 TNB, MBV and TNBA

The ‘target barrier’ is the barrier that achieves compliance with the appropriate noise criteria at all sensitive receivers. As illustrated in Figure D7 the criteria is not met at the most affected receiver, hence there is no target barrier for this noise barrier.

The ‘assessed barrier’ is the barrier option selected after considering the TNB, MBV and TNBA. A noise barrier of 3 m height provides a peak in the MBV and is only marginally lower than the peak in the TNBA. However a noise barrier of 2.5 m height is only slightly less than the 3 m barrier and the height would remain consistent with the headlight screen that is to be built to the south of this area. On this basis a 2.5 m noise barrier is recommended at this location. It should be noted that the extension of the 2.5 m high noise barrier removes the need for architectural treatment at Receiver 401.



APPENDIX E – NOISE ANALYSIS RESULTS

Appendix E - Noise Analysis Results

Receiver	Address	# Floors	Future Existing dB(A)	Design Year dB(A)	Increase	Design Year Criteria	Design Year Criteria Exceedance	Increase Criteria Exceedance ²	Acute?	EA Listed	Treatment ³	
2	9-9A GAUDRONS ROAD~SAPPHIRE BEACH NSW 2450	1	54	53	-1.3	55	-2	-	-	N	-	
3	9-9A GAUDRONS ROAD~SAPPHIRE BEACH NSW 2450	1	55	53	-1.5	55	-2	-	-	N	-	
6	19 THE MOUNTAIN WAY (ROW)~SAPPHIRE BEACH NSW 2450	1	55	56	0.6	55	1	-	-	N	-	
7	18C THE MOUNTAIN WAY (ROW)~SAPPHIRE BEACH NSW 2450	Pre-treated									N	-
8	18 THE MOUNTAIN WAY (ROW)~SAPPHIRE BEACH NSW 2450	2	60	61	1.9	55	6	-	Y	N	1	
9	33 HUNTER CLOSE~KORORA NSW 2450	1	58	64	5.2	55	9	3.2	Y	Y	1	
10	35 HUNTER CLOSE~KORORA NSW 2450	1	55	58	3.7	55	3	1.7	-	Y	1	
11	49 HUNTER CLOSE~KORORA NSW 2450	2	51	54	3.0	55	-1	1	-	N	-	
14	361-371 OLD COAST ROAD~KORORA NSW 2450	1	54	58	3.3	55	3	1.3	-	N	1	
15	369 OLD COAST RD AND~19-21 HUNTER CLOSE~KORORA NSW 2450	1	54	57	2.2	55	2	0.2	-	N	1	
16	369 OLD COAST RD AND~19-21 HUNTER CLOSE~KORORA NSW 2450	1	53	55	1.9	55	0	-	-	N	-	
17	17 HUNTER CLOSE~KORORA NSW 2450	2	55	58	2.9	55	3	0.9	-	N	1	
18	13 HUNTER CLOSE~KORORA NSW 2450	2	51	56	5.3	55	1	3.3	-	N	1	
19	11 HUNTER CLOSE~KORORA NSW 2450	2	55	61	5.7	55	6	3.7	Y	N	1	
20	369 OLD COAST RD AND~19-21 HUNTER CLOSE~KORORA NSW 2450	1	48	53	4.8	55	-2	2.8	-	N	-	
21	817-817A PACIFIC HIGHWAY~KORORA NSW 2450	Ineligible									Y	-
22	300 OLD COAST ROAD~KORORA NSW 2450	2	47	51	3.9	55	-4	1.9	-	N	-	
23	290 OLD COAST ROAD~KORORA NSW 2450	2	48	52	3.9	55	-3	1.9	-	N	-	
24	815 PACIFIC HIGHWAY~KORORA NSW 2450	2	58	66	8.2	55	11	6.2	Y	Y	2	
25	275 OLD COAST ROAD~KORORA NSW 2450	2	48	52	3.6	55	-3	1.6	-	N	-	
26	245 OLD COAST ROAD~KORORA NSW 2450	1	48	52	3.8	55	-3	1.8	-	N	-	
29	39 CAMPBELL CLOSE~KORORA NSW 2450	1	54	59	4.9	55	4	2.9	-	N	1	
30	33-35 CAMPBELL CLOSE~KORORA NSW 2450	1	53	53	0.5	55	-2	-	-	N	-	
31	29-29A CAMPBELL CLOSE~KORORA NSW 2450	2	51	52	0.6	55	-3	-	-	N	-	
32	29-29A CAMPBELL CLOSE~KORORA NSW 2450	2	49	50	1.3	55	-5	-	-	N	-	
33	18-20 CAMPBELL CLOSE~KORORA NSW 2450	1	55	54	-1.3	55	-1	-	-	N	-	
34	15-15A CAMPBELL CLOSE~KORORA NSW 2450	2	54	58	3.3	55	3	1.3	-	N	1	
35	11 CAMPBELL CLOSE~KORORA NSW 2450	1	54	57	2.9	55	2	0.9	-	N	1	
36	9-11 SEAVIEW CLOSE~KORORA NSW 2450	2	58	62	3.7	55	7	1.7	Y	Y	1	
37	9-11 SEAVIEW CLOSE~KORORA NSW 2450	1	58	61	2.8	55	6	0.8	Y	Y	1	
38	15-15A CAMPBELL CLOSE~KORORA NSW 2450	1	50	54	3.6	55	-1	1.6	-	N	-	
40	18 MACCUES ROAD~MOONEE BEACH NSW 2450	1	61	57	-3.7	55	2	-	-	N	-	
43	9 MACCUES ROAD~MOONEE BEACH NSW 2450	1	64	59	-4.6	55	4	-	-	N	-	
53	16 WAKELANDS ROAD~SAPPHIRE BEACH NSW 2450	1	59	56	-2.6	55	1	-	-	N	-	
55	7 WAKELANDS ROAD~SAPPHIRE BEACH NSW 2450	1	65	60	-4.5	55	5	-	Y	N	1	
56	1 WAKELANDS ROAD~SAPPHIRE BEACH NSW 2450	1	65	61	-4.7	55	6	-	Y	N	1	
57	1A WAKELANDS ROAD~SAPPHIRE BEACH NSW 2450	1	66	61	-4.5	55	6	-	Y	N	1	
58	15 WAKELANDS ROAD~SAPPHIRE BEACH NSW 2450	1	58	56	-2.2	55	1	-	-	N	-	
60	1059 PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	1	65	62	-2.5	55	7	-	Y	N	1	
62	1049 PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	1	64	61	-2.8	55	6	-	Y	N	1	
63	2 SUGARMILL ROAD~SAPPHIRE BEACH NSW 2450	1	65	63	-2.0	55	8	-	Y	N	1	
64	2A SUGARMILL ROAD~SAPPHIRE BEACH NSW 2450	2	65	63	-2.0	55	8	-	Y	N	1	

Appendix E - Noise Analysis Results

Receiver	Address	# Floors	Future Existing dB(A)	Design Year dB(A)	Increase	Design Year Criteria	Design Year Criteria Exceedance	Increase Criteria Exceedance ₂	Acute?	EA Listed	Treatment ³
65	16 SUGARMILL ROAD~SAPPHIRE BEACH NSW 2450	2	63	60	-2.2	55	5	-	Y	N	1
66	28 SUGARMILL ROAD~SAPPHIRE BEACH NSW 2450	1	54	52	-1.9	55	-3	-	-	N	-
70	23 SUGARMILL ROAD~SAPPHIRE BEACH NSW 2450	1	57	57	-0.2	55	2	-	-	N	-
73	1469 PACIFIC HIGHWAY~MOONEE BEACH NSW 2450	1	63	60	-2.4	55	5	-	Y	N	1
76	105 HOYS ROAD~MOONEE BEACH NSW 2450	1	61	60	-0.4	55	5	-	Y	N	1
78	55 HOYS ROAD~MOONEE BEACH NSW 2450	1	53	52	-0.4	55	-3	-	-	N	-
79	39 HOYS ROAD~MOONEE BEACH NSW 2450	1	56	56	0.5	55	1	-	-	N	-
80	41 HOYS ROAD~MOONEE BEACH NSW 2450	1	53	53	-0.5	55	-2	-	-	N	-
81	45 HOYS ROAD~MOONEE BEACH NSW 2450	1	52	52	-0.2	55	-3	-	-	N	-
82	49 HOYS ROAD~MOONEE BEACH NSW 2450	1	53	53	0.2	55	-2	-	-	N	-
83	38-48 HOYS ROAD~MOONEE BEACH NSW 2450	1	56	54	-1.5	55	-1	-	-	N	-
85	104 HOYS ROAD~MOONEE BEACH NSW 2450									Y	-
86	38-48 HOYS ROAD~MOONEE BEACH NSW 2450	1	61	59	-2.2	55	4	-	-	N	-
88	1721 PACIFIC HIGHWAY~EMERALD BEACH NSW 2456	1	58	55	-2.4	55	0	-	-	N	-
93	12 SMITHS ROAD~EMERALD BEACH NSW 2456	1	58	55	-3.2	55	0	-	-	N	-
95	14-22 SMITHS ROAD~EMERALD BEACH NSW 2456	1	57	55	-2.7	55	0	-	-	N	-
96	14-22 SMITHS ROAD~EMERALD BEACH NSW 2456	1	60	57	-3.0	55	2	-	-	N	-
97	9 SMITHS ROAD~EMERALD BEACH NSW 2456	2	62	59	-2.7	55	4	-	-	N	-
98	15E SMITHS ROAD~EMERALD BEACH NSW 2456	1	65	63	-2.9	55	8	-	Y	Y	1
99	15 SMITHS ROAD~EMERALD BEACH NSW 2456	1	56	53	-3.1	55	-2	-	-	N	-
100	19 SMITHS ROAD~EMERALD BEACH NSW 2456	1	56	54	-2.7	55	-1	-	-	N	-
101	33 SMITHS ROAD~EMERALD BEACH NSW 2456	1	55	52	-2.7	55	-3	-	-	N	-
106	15A SMITHS ROAD~EMERALD BEACH NSW 2456	1	57	53	-3.7	55	-2	-	-	N	-
107	15B SMITHS ROAD~EMERALD BEACH NSW 2456	1	59	56	-2.8	55	1	-	-	N	-
108	15C SMITHS ROAD~EMERALD BEACH NSW 2456	1	60	57	-3.1	55	2	-	-	N	-
109	15F SMITHS ROAD~EMERALD BEACH NSW 2456	1	58	55	-3.0	55	0	-	-	N	-
110	1637 PACIFIC HIGHWAY~EMERALD BEACH NSW 2456	1	68	64	-4.2	55	9	-	Y	Y	1
111	1635-1635A PACIFIC HIGHWAY~EMERALD BEACH NSW 2456	1	62	58	-4.3	55	3	-	-	N	-
112	1635-1635A PACIFIC HIGHWAY~EMERALD BEACH NSW 2456	2	61	57	-3.8	55	2	-	-	N	-
116	41 KUMBAINGERI CLOSE~MOONEE BEACH NSW 2450	1	60	57	-3.0	55	2	-	-	N	-
119	62 HERITAGE DRIVE~MOONEE BEACH NSW 2450	1	58	56	-2.7	55	1	-	-	N	-
121	1579 PACIFIC HIGHWAY~MOONEE BEACH NSW 2450									Y	-
122	1579 PACIFIC HIGHWAY~MOONEE BEACH NSW 2450	1	64	61	-2.6	55	6	-	Y	N	1
123	46 HERITAGE DRIVE~MOONEE BEACH NSW 2450	1	65	61	-3.7	55	6	-	Y	N	1
125	40 HERITAGE DRIVE~MOONEE BEACH NSW 2450	1	65	62	-3.8	55	7	-	Y	N	1
126	22 HERITAGE DRIVE~MOONEE BEACH NSW 2450	1	61	58	-3.5	55	3	-	-	N	-
127	16 HERITAGE DRIVE~MOONEE BEACH NSW 2450	1	59	55	-3.7	55	0	-	-	N	-
128	6 HERITAGE DRIVE~MOONEE BEACH NSW 2450	1	60	56	-3.9	55	1	-	-	N	-
130	2 SHARPE CLOSE~MOONEE BEACH NSW 2450	1	59	56	-2.9	55	1	-	-	N	-
131	2 SHARPE CLOSE~MOONEE BEACH NSW 2450	1	57	54	-3.2	55	-1	-	-	N	-
144	123 GRAHAM DRIVE~SANDY BEACH NSW 2456	1	55	53	-2.4	55	-2	-	-	N	-
145	125 GRAHAM DRIVE~SANDY BEACH NSW 2456	1	55	52	-2.4	55	-3	-	-	N	-

Appendix E - Noise Analysis Results

Receiver	Address	# Floors	Future Existing dB(A)	Design Year dB(A)	Increase	Design Year Criteria	Design Year Criteria Exceedance	Increase Criteria Exceedance ₂	Acute?	EA Listed	Treatment ³
146	3 CASUARINA COURT~SANDY BEACH NSW 2456	1	54	52	-2.2	55	-3	-	-	N	-
147	5 CASUARINA COURT~SANDY BEACH NSW 2456	1	57	55	-2.2	55	0	-	-	N	-
148	9 CASUARINA COURT~SANDY BEACH NSW 2456	1	63	61	-1.5	55	6	-	Y	N	1
149	8 CASUARINA COURT~SANDY BEACH NSW 2456	1	63	59	-3.8	55	4	-	-	N	-
150	6 CASUARINA COURT~SANDY BEACH NSW 2456	1	60	57	-2.6	55	2	-	-	N	-
151	2 CASUARINA COURT~SANDY BEACH NSW 2456	1	55	53	-2.4	55	-2	-	-	N	-
152	2A CASUARINA COURT~SANDY BEACH NSW 2456	1	54	51	-2.8	55	-4	-	-	N	-
153	127 GRAHAM DRIVE~SANDY BEACH NSW 2456	1	54	52	-2.4	55	-3	-	-	N	-
154	4 ANSELMO CLOSE~EMERALD BEACH NSW 2456	1	55	53	-2.0	55	-2	-	-	N	-
155	2 ANSELMO CLOSE~EMERALD BEACH NSW 2456	2	58	56	-1.9	55	1	-	-	N	-
156	1 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	2	62	61	-0.8	55	6	-	Y	N	1
158	5 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	1	61	59	-1.9	55	4	-	-	N	-
159	9 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	2	64	61	-2.6	55	6	-	Y	N	1
160	1 ANSELMO CLOSE~EMERALD BEACH NSW 2456	1	51	49	-2.4	55	-6	-	-	N	-
161	5 ANSELMO CLOSE~EMERALD BEACH NSW 2456	1	49	46	-3.2	55	-9	-	-	N	-
162	10 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	1	53	50	-2.7	55	-5	-	-	N	-
163	2 STEFAN CLOSE~EMERALD BEACH NSW 2456	1	52	49	-2.5	55	-6	-	-	N	-
164	4 STEFAN CLOSE~EMERALD BEACH NSW 2456	2	56	52	-3.1	55	-3	-	-	N	-
165	6 STEFAN CLOSE~EMERALD BEACH NSW 2456	1	50	48	-2.4	55	-7	-	-	N	-
166	8 STEFAN CLOSE~EMERALD BEACH NSW 2456	2	52	50	-2.9	55	-5	-	-	N	-
167	10 STEFAN CLOSE~EMERALD BEACH NSW 2456	1	50	48	-2.7	55	-7	-	-	N	-
168	17 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	2	63	60	-3.4	55	5	-	Y	N	1
169	21 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	2	64	60	-3.7	55	5	-	Y	N	1
170	25 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	1	63	58	-5.2	55	3	-	-	N	-
171	29 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	1	63	57	-6.2	55	2	-	-	N	-
172	33 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	1	63	56	-7.0	55	1	-	-	N	-
173	37 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	1	63	56	-7.4	55	1	-	-	N	-
174	41 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	1	63	56	-7.6	55	1	-	-	N	-
175	45 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	1	63	56	-7.4	55	1	-	-	N	-
176	NURSERY~49 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	1	63	55	-7.9	55	0	-	-	N	-
177	53 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	1	63	53	-9.3	55	-2	-	-	N	-
178	61 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	2	63	55	-8.2	55	0	-	-	Y	1
179	65 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	1	62	56	-6.5	55	1	-	-	N	-
180	69 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	1	65	60	-4.3	55	5	-	Y	Y	1
181	73 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	1	62	59	-3.7	55	4	-	-	N	-
182	77 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	2	62	58	-3.7	55	3	-	-	N	-
183	34 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	1	58	52	-6.3	55	-3	-	-	N	-
184	1 STEFAN CLOSE~EMERALD BEACH NSW 2456	1	60	56	-3.6	55	1	-	-	N	-
185	44 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	1	56	50	-5.7	55	-5	-	-	N	-
186	81 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	2	61	57	-3.7	55	2	-	-	N	-
187	46 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	1	58	55	-3.9	55	0	-	-	N	-
194	42 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	1	57	50	-7.0	55	-5	-	-	N	-

Appendix E - Noise Analysis Results

Receiver	Address	# Floors	Future Existing dB(A)	Design Year dB(A)	Increase	Design Year Criteria	Design Year Criteria Exceedance	Increase Criteria Exceedance ₂	Acute?	EA Listed	Treatment ³
195	1789 PACIFIC HIGHWAY~EMERALD BEACH NSW 2456	1	66	63	-3.4	55	8	-	Y	Y	1
196	6 OAK CLOSE~SANDY BEACH NSW 2456	1	66	59	-6.7	55	4	-	-	N	-
197	8 OAK CLOSE~SANDY BEACH NSW 2456	1	67	58	-9.0	55	3	-	-	N	-
198	7 OAK CLOSE~SANDY BEACH NSW 2456	1	65	57	-8.1	55	2	-	-	N	-
199	5 OAK CLOSE~SANDY BEACH NSW 2456	1	62	56	-6.2	55	1	-	-	N	-
200	3 OAK CLOSE~SANDY BEACH NSW 2456	1	55	53	-1.5	55	-2	-	-	N	-
201	1 OAK CLOSE~SANDY BEACH NSW 2456	1	56	54	-2.2	55	-1	-	-	N	-
202	79 BLACKBUTT AVENUE~SANDY BEACH NSW 2456	1	59	55	-3.9	55	0	-	-	N	-
203	77 BLACKBUTT AVENUE~SANDY BEACH NSW 2456	1	59	55	-4.3	55	0	-	-	N	-
204	75 BLACKBUTT AVENUE~SANDY BEACH NSW 2456	1	58	54	-4.3	55	-1	-	-	N	-
205	73 BLACKBUTT AVENUE~SANDY BEACH NSW 2456	2	59	55	-4.2	55	0	-	-	N	-
206	71 BLACKBUTT AVENUE~SANDY BEACH NSW 2456	1	58	53	-4.1	55	-2	-	-	N	-
207	50 BLACKBUTT AVENUE~SANDY BEACH NSW 2456	1	57	54	-3.5	55	-1	-	-	N	-
209	47 DIAMOND HEAD DRIVE~SANDY BEACH NSW 2456	1	56	53	-3.0	55	-2	-	-	N	-
213	58 TURPENTINE AVENUE~SANDY BEACH NSW 2456	2	58	54	-3.2	55	-1	-	-	N	-
214	30 MAHOGANY AVENUE~SANDY BEACH NSW 2456	1	59	55	-3.8	55	0	-	-	N	-
215	35 MAHOGANY AVENUE~SANDY BEACH NSW 2456	1	62	56	-6.5	55	1	-	-	N	-
216	33 MAHOGANY AVENUE~SANDY BEACH NSW 2456	1	65	57	-7.9	55	2	-	-	N	-
217	31 MAHOGANY AVENUE~SANDY BEACH NSW 2456	1	65	57	-8.3	55	2	-	-	N	-
218	29 MAHOGANY AVENUE~SANDY BEACH NSW 2456	1	65	56	-8.9	55	1	-	-	N	-
219	27 MAHOGANY AVENUE~SANDY BEACH NSW 2456	1	65	56	-8.9	55	1	-	-	N	-
220	21 MAHOGANY AVENUE~SANDY BEACH NSW 2456	1	66	55	-10.9	55	0	-	-	N	-
221	13 MAHOGANY AVENUE~SANDY BEACH NSW 2456	1	66	55	-11.3	55	0	-	-	N	-
222	9 MAHOGANY AVENUE~SANDY BEACH NSW 2456	2	67	61	-6.5	55	6	-	Y	Y	1
223	7 MAHOGANY AVENUE~SANDY BEACH NSW 2456	2	68	65	-2.6	55	10	-	Y	Y	1
224	5 MAHOGANY AVENUE~SANDY BEACH NSW 2456	2	67	66	-1.7	55	11	-	Y	Y	2
225	52 DIAMOND HEAD DRIVE~SANDY BEACH NSW 2456	2	69	70	0.7	55	15	-	Y	Y	2
233	60 DIAMOND HEAD DRIVE~SANDY BEACH NSW 2456	1	60	55	-5.3	55	0	-	-	N	-
234	1/56 DIAMOND HEAD DRIVE~SANDY BEACH NSW 2456	1	61	55	-6.0	55	0	-	-	N	-
235	54 DIAMOND HEAD DRIVE~SANDY BEACH NSW 2456	1	72	67	-4.5	55	12	-	Y	Y	2
236	62 DIAMOND HEAD DRIVE~SANDY BEACH NSW 2456	1	66	56	-9.8	55	1	-	-	N	-
237	3 PINE CRESCENT~SANDY BEACH NSW 2456	1	65	60	-5.0	55	5	-	Y	Y	1
238	5 PINE CRESCENT~SANDY BEACH NSW 2456	1	68	64	-4.1	55	9	-	Y	Y	1
239	7 PINE CRESCENT~SANDY BEACH NSW 2456	1	68	62	-5.8	55	7	-	Y	Y	1
240	9 PINE CRESCENT~SANDY BEACH NSW 2456	2	71	66	-5.0	55	11	-	Y	Y	2
241	11 PINE CRESCENT~SANDY BEACH NSW 2456	1	69	60	-9.4	55	5	-	Y	N	1
242	13 PINE CRESCENT~SANDY BEACH NSW 2456	1	67	58	-9.6	55	3	-	-	N	-
243	15 PINE CRESCENT~SANDY BEACH NSW 2456	1	58	54	-4.1	55	-1	-	-	N	-
244	17 PINE CRESCENT~SANDY BEACH NSW 2456	1	59	54	-5.1	55	-1	-	-	N	-
246	21 PINE CRESCENT~SANDY BEACH NSW 2456	1	57	53	-3.2	55	-2	-	-	N	-
247	25 PINE CRESCENT~SANDY BEACH NSW 2456	1	58	54	-4.3	55	-1	-	-	N	-
248	23 PINE CRESCENT~SANDY BEACH NSW 2456	1	57	53	-3.9	55	-2	-	-	N	-

Appendix E - Noise Analysis Results

Receiver	Address	# Floors	Future Existing dB(A)	Design Year dB(A)	Increase	Design Year Criteria	Design Year Criteria Exceedance	Increase Criteria Exceedance ₂	Acute?	EA Listed	Treatment ³	
249	12 PINE CRESCENT~SANDY BEACH NSW 2456	1	52	48	-3.6	55	-7	-	-	N	-	
250	10 PINE CRESCENT~SANDY BEACH NSW 2456	1	52	48	-3.7	55	-7	-	-	N	-	
251	8 PINE CRESCENT~SANDY BEACH NSW 2456	2	56	53	-3.3	55	-2	-	-	N	-	
252	6 PINE CRESCENT~SANDY BEACH NSW 2456	2	58	54	-3.6	55	-1	-	-	N	-	
253	4 PINE CRESCENT~SANDY BEACH NSW 2456	1	55	52	-3.2	55	-3	-	-	N	-	
255	61 DIAMOND HEAD DRIVE~SANDY BEACH NSW 2456	1	57	54	-3.3	55	-1	-	-	N	-	
256	65 DIAMOND HEAD DRIVE~SANDY BEACH NSW 2456	1	57	52	-4.3	55	-3	-	-	N	-	
257	67 DIAMOND HEAD DRIVE~SANDY BEACH NSW 2456	1	57	52	-5.2	55	-3	-	-	N	-	
258	69 DIAMOND HEAD DRIVE~SANDY BEACH NSW 2456	1	56	51	-4.8	55	-4	-	-	N	-	
259	14 PINE CRESCENT~SANDY BEACH NSW 2456	1	52	49	-3.1	55	-6	-	-	N	-	
260	1800 PACIFIC HIGHWAY~EMERALD BEACH NSW 2456	2	62	61	-0.9	55	6	-	Y	N	1	
261	6 FIDDAMAN ROAD~EMERALD BEACH NSW 2456	1	60	59	-1.1	55	4	-	-	N	-	
262	8 FIDDAMAN ROAD~EMERALD BEACH NSW 2456	1	56	54	-1.7	55	-1	-	-	N	-	
263	14 FIDDAMAN ROAD~EMERALD BEACH NSW 2456	1	56	54	-2.1	55	-1	-	-	N	-	
264	16 FIDDAMAN ROAD~EMERALD BEACH NSW 2456	1	56	54	-1.9	55	-1	-	-	N	-	
265	18 FIDDAMAN ROAD~EMERALD BEACH NSW 2456	2	58	55	-2.4	55	0	-	-	N	-	
266	20 FIDDAMAN ROAD~EMERALD BEACH NSW 2456	1	53	51	-2.4	55	-4	-	-	N	-	
267	1 FIDDAMAN ROAD~EMERALD BEACH NSW 2456									Demolish	Y	-
268	3 FIDDAMAN ROAD~EMERALD BEACH NSW 2456	1	64	63	-0.7	55	8	-	Y	N	1	
269	5 FIDDAMAN ROAD~EMERALD BEACH NSW 2456	2	63	61	-1.5	55	6	-	Y	N	1	
270	9 FIDDAMAN ROAD~EMERALD BEACH NSW 2456	1	61	59	-2.3	55	4	-	-	N	-	
271	13 FIDDAMAN ROAD~EMERALD BEACH NSW 2456	1	60	57	-2.6	55	2	-	-	N	-	
272	15 FIDDAMAN ROAD~EMERALD BEACH NSW 2456	1	58	56	-2.7	55	1	-	-	N	-	
273	17 FIDDAMAN ROAD~EMERALD BEACH NSW 2456	1	58	56	-2.5	55	1	-	-	N	-	
274	19 FIDDAMAN ROAD~EMERALD BEACH NSW 2456	1	58	56	-2.4	55	1	-	-	N	-	
275	1720 PACIFIC HIGHWAY~MOONEE BEACH NSW 2450									Ineligible	N	-
283	2 TIKI ROAD (ROW)~MOONEE BEACH NSW 2450	1	63	64	0.2	55	9	-	Y	Y	1	
284	10 TIKI ROAD (ROW)~MOONEE BEACH NSW 2450	1	60	59	-1.1	55	4	-	-	N	-	
285	10 TIKI ROAD (ROW)~MOONEE BEACH NSW 2450	2	61	60	-1.7	55	5	-	Y	N	1	
286	16 TIKI ROAD (ROW)~MOONEE BEACH NSW 2450	1	57	56	-1.8	55	1	-	-	N	-	
290	1206A PACIFIC HIGHWAY~MOONEE BEACH NSW 2450	1	62	61	-1.4	55	6	-	Y	N	1	
291	1206B PACIFIC HIGHWAY~MOONEE BEACH NSW 2450	1	62	62	-0.4	55	7	-	Y	N	1	
292	1206C PACIFIC HIGHWAY~MOONEE BEACH NSW 2450	1	63	63	-0.2	55	8	-	Y	Y	1	
295	1206B PACIFIC HIGHWAY~MOONEE BEACH NSW 2450									Ineligible	N	-
297	22-24 WOODHOUSE ROAD~MOONEE BEACH NSW 2450	2	57	57	-0.3	55	2	-	-	N	-	
298	6 WOODHOUSE ROAD~MOONEE BEACH NSW 2450	1	54	54	0.2	55	-1	-	-	N	-	
301	7 MOONEE BEACH ROAD~MOONEE BEACH NSW 2450	1	55	54	-1.1	55	-1	-	-	N	-	
302	9 MOONEE BEACH ROAD~MOONEE BEACH NSW 2450	1	54	54	-0.5	55	-1	-	-	N	-	
303	11 MOONEE BEACH ROAD~MOONEE BEACH NSW 2450	1	54	54	0.1	55	-1	-	-	N	-	
304	13 MOONEE BEACH ROAD~MOONEE BEACH NSW 2450	1	52	53	0.7	55	-2	-	-	N	-	
307	12 ALPINI PLACE~SAPPHIRE BEACH NSW 2450	1	61	57	-3.9	55	2	-	-	N	-	
308	10 ALPINI PLACE~SAPPHIRE BEACH NSW 2450	1	63	58	-5.0	55	3	-	-	N	-	

Appendix E - Noise Analysis Results

Receiver	Address	# Floors	Future Existing dB(A)	Design Year dB(A)	Increase	Design Year Criteria	Design Year Criteria Exceedance	Increase Criteria Exceedance ₂	Acute?	EA Listed	Treatment ³	
309	8 ALPINI PLACE~SAPPHIRE BEACH NSW 2450	2	60	61	1.0	55	6	-	Y	N	1	
310	8 ALPINI PLACE~SAPPHIRE BEACH NSW 2450	2	66	61	-5.1	55	6	-	Y	N	1	
311	6 ALPINI PLACE~SAPPHIRE BEACH NSW 2450	1	63	56	-7.4	55	1	-	-	N	-	
312	4 ALPINI PLACE~SAPPHIRE BEACH NSW 2450	1	63	55	-7.4	55	0	-	-	N	-	
313	2 ALPINI PLACE~SAPPHIRE BEACH NSW 2450	2	61	55	-5.6	55	0	-	-	N	-	
315	5 SPLIT SOLITARY ROAD~SAPPHIRE BEACH NSW 2450	Demolish									N	-
316	11 SPLIT SOLITARY ROAD~SAPPHIRE BEACH NSW 2450	1	61	55	-6.9	55	0	-	-	N	-	
319	1026 PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	1	60	56	-3.7	55	1	-	-	N	-	
320	1026F PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	1	64	59	-5.3	55	4	-	-	Y	1	
321	1026E PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	1	62	58	-3.5	55	3	-	-	N	-	
322	1026G PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	1	64	60	-3.6	55	5	-	Y	N	1	
323	1026A PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	1	63	59	-3.9	55	4	-	-	N	-	
324	1/1026B PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	1	63	59	-4.1	55	4	-	-	Y	1	
325	1026C PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	1	64	59	-4.3	55	4	-	-	Y	1	
326	1026D PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	1	64	59	-4.4	55	4	-	-	Y	1	
327	1026 PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	Demolish									N	-
328	7 ALPINI PLACE~SAPPHIRE BEACH NSW 2450	1	60	56	-4.3	55	1	-	-	N	-	
329	5 ALPINI PLACE~SAPPHIRE BEACH NSW 2450	1	56	52	-4.0	55	-3	-	-	N	-	
330	3 ALPINI PLACE~SAPPHIRE BEACH NSW 2450	1	53	50	-2.9	55	-5	-	-	N	-	
331	26 COACHMANS CLOSE~KORORA NSW 2450	2	60	53	-7.6	55	-2	-	-	N	-	
332	1 COACHMANS CLOSE~SAPPHIRE BEACH NSW 2450	2	62	65	2.8	55	10	0.8	Y	Y	1	
333	13 COACHMANS CLOSE~SAPPHIRE BEACH NSW 2450	Pre-treated									N	-
334	NSW 2450	1	58	52	-5.8	55	-3	-	-	N	-	
335	BEN NEVIS~770 PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	Pre-treated									N	-
336	786 PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	2	63	63	0.4	55	8	-	Y	Y	1	
337	8 SAPPHIRE PLACE~SAPPHIRE BEACH NSW 2450	Pre-treated									Y	-
338	4 SAPPHIRE PLACE~SAPPHIRE BEACH NSW 2450	Pre-treated									N	-
339	2 SAPPHIRE PLACE~SAPPHIRE BEACH NSW 2450	Pre-treated									N	-
340	21 SAPPHIRE CRESCENT~SAPPHIRE BEACH NSW 2450	2	61	54	-6.9	55	-1	-	-	N	-	
341	19 SAPPHIRE CRESCENT~SAPPHIRE BEACH NSW 2450	1	56	51	-5.2	55	-4	-	-	N	-	
342	17 SAPPHIRE CRESCENT~SAPPHIRE BEACH NSW 2450	2	59	53	-5.9	55	-2	-	-	N	-	
343	15 SAPPHIRE CRESCENT~SAPPHIRE BEACH NSW 2450	2	58	53	-4.8	55	-2	-	-	N	-	
344	13 SAPPHIRE CRESCENT~SAPPHIRE BEACH NSW 2450	1	52	50	-1.7	55	-5	-	-	N	-	
345	11 SAPPHIRE CRESCENT~SAPPHIRE BEACH NSW 2450	2	57	53	-4.2	55	-2	-	-	N	-	
347	9 SAPPHIRE CRESCENT~SAPPHIRE BEACH NSW 2450	2	53	51	-1.6	55	-4	-	-	N	-	
348	3 SAPPHIRE CRESCENT~SAPPHIRE BEACH NSW 2450	2	54	51	-2.3	55	-4	-	-	N	-	
349	1 SAPPHIRE CRESCENT~SAPPHIRE BEACH NSW 2450	1	50	49	-1.2	55	-6	-	-	N	-	
350	4 SAPPHIRE CRESCENT~SAPPHIRE BEACH NSW 2450	2	55	51	-3.8	55	-4	-	-	N	-	
351	6 SAPPHIRE CRESCENT~SAPPHIRE BEACH NSW 2450	1	56	51	-5.2	55	-4	-	-	N	-	
352	8 SAPPHIRE CRESCENT~SAPPHIRE BEACH NSW 2450	1	58	52	-5.6	55	-3	-	-	N	-	
353	10 SAPPHIRE CRESCENT~SAPPHIRE BEACH NSW 2450	2	62	56	-5.6	55	1	-	-	N	-	
354	11 SAPPHIRE PLACE~SAPPHIRE BEACH NSW 2450	1	50	51	0.9	55	-4	-	-	N	-	

Appendix E - Noise Analysis Results

Receiver	Address	# Floors	Future Existing dB(A)	Design Year dB(A)	Increase	Design Year Criteria	Design Year Criteria Exceedance	Increase Criteria Exceedance ₂	Acute?	EA Listed	Treatment ³
355	5 SAPPHIRE PLACE~SAPPHIRE BEACH NSW 2450	1	49	48	-1.4	55	-7	-	-	N	-
356	1 SAPPHIRE PLACE~SAPPHIRE BEACH NSW 2450	2	55	51	-4.5	55	-4	-	-	N	-
357	27A SAPPHIRE CRESCENT~SAPPHIRE BEACH NSW 2450	2	63	56	-6.6	55	1	-	-	N	-
359	840 PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	3	63	58	-5.2	55	3	-	-	N	-
360	29/840 PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	2	58	54	-4.0	55	-1	-	-	N	-
361	46A WARRAWEE STREET~SAPPHIRE BEACH NSW 2450	1	57	53	-4.0	55	-2	-	-	N	-
362	44 WARRAWEE STREET~SAPPHIRE BEACH NSW 2450									N	-
363	46 WARRAWEE STREET~SAPPHIRE BEACH NSW 2450	2	57	55	-2.6	55	0	-	-	N	-
364	48 WARRAWEE STREET~SAPPHIRE BEACH NSW 2450	1	46	47	1.4	55	-8	-	-	N	-
365	29 WARRAWEE STREET~SAPPHIRE BEACH NSW 2450	2	57	57	0.8	55	2	-	-	N	-
366	27 WARRAWEE STREET~SAPPHIRE BEACH NSW 2450	2	55	58	2.4	55	3	0.4	-	N	1
367	25 WARRAWEE STREET~SAPPHIRE BEACH NSW 2450	1	52	52	-0.1	55	-3	-	-	N	-
368	23 WARRAWEE STREET~SAPPHIRE BEACH NSW 2450	2	56	55	-0.6	55	0	-	-	N	-
369	2 ELOUERA DRIVE~SAPPHIRE BEACH NSW 2450	1	56	55	-0.6	55	0	-	-	N	-
370	42 WARRAWEE STREET~SAPPHIRE BEACH NSW 2450	2	59	60	1.1	55	5	-	Y	N	1
371	40 WARRAWEE STREET~SAPPHIRE BEACH NSW 2450	2	59	58	-1.0	55	3	-	-	N	-
372	38 WARRAWEE STREET~SAPPHIRE BEACH NSW 2450	2	59	55	-3.4	55	0	-	-	N	-
373	36 WARRAWEE STREET~SAPPHIRE BEACH NSW 2450	1	57	53	-4.1	55	-2	-	-	N	-
374	1 ELOUERA DRIVE~SAPPHIRE BEACH NSW 2450	1	56	52	-3.9	55	-3	-	-	N	-
375	34 WARRAWEE STREET~SAPPHIRE BEACH NSW 2450	2	59	54	-5.4	55	-1	-	-	N	-
376	32 WARRAWEE STREET~SAPPHIRE BEACH NSW 2450	2	59	54	-5.7	55	-1	-	-	N	-
377	30 WARRAWEE STREET~SAPPHIRE BEACH NSW 2450	1	56	51	-4.8	55	-4	-	-	N	-
378	1/28 WARRAWEE STREET~SAPPHIRE BEACH NSW 2450									N	-
379	26 WARRAWEE STREET~SAPPHIRE BEACH NSW 2450									N	-
380	24 WARRAWEE STREET~SAPPHIRE BEACH NSW 2450	2	60	54	-6.2	55	-1	-	-	N	-
381	22 WARRAWEE STREET~SAPPHIRE BEACH NSW 2450	1	57	51	-6.1	55	-4	-	-	N	-
382	18 WARRAWEE STREET~SAPPHIRE BEACH NSW 2450	1	58	51	-6.7	55	-4	-	-	N	-
383	16 WARRAWEE STREET~SAPPHIRE BEACH NSW 2450	1	59	52	-6.9	55	-3	-	-	N	-
384	14 WARRAWEE STREET~SAPPHIRE BEACH NSW 2450	1	59	52	-6.4	55	-3	-	-	N	-
385	12 WARRAWEE STREET~SAPPHIRE BEACH NSW 2450	1	61	53	-7.8	55	-2	-	-	N	-
386	10 WARRAWEE STREET~SAPPHIRE BEACH NSW 2450	1	61	53	-7.7	55	-2	-	-	N	-
387	8 WARRAWEE STREET~SAPPHIRE BEACH NSW 2450	2	62	56	-6.2	55	1	-	-	N	-
388	6 WARRAWEE STREET~SAPPHIRE BEACH NSW 2450	1	65	55	-9.4	55	0	-	-	N	-
389	THE CORNER STORE~4 HEADLAND ROAD~SAPPHIRE BEACH NSW 2450	2	66	59	-7.3	55	4	-	-	N	-
390	6 HEADLAND ROAD~SAPPHIRE BEACH NSW 2450	1	58	54	-4.0	55	-1	-	-	N	-
392	9 HEADLAND ROAD~SAPPHIRE BEACH NSW 2450	1	57	53	-3.3	55	-2	-	-	N	-
393	1 BEACH ROAD~SAPPHIRE BEACH NSW 2450	1	61	54	-6.9	55	-1	-	-	N	-
394	3 BEACH ROAD~SAPPHIRE BEACH NSW 2450	2	62	56	-6.5	55	1	-	-	N	-
395	2 CRYSTAL DRIVE~SAPPHIRE BEACH NSW 2450	1	60	54	-5.6	55	-1	-	-	N	-
396	4 CRYSTAL DRIVE~SAPPHIRE BEACH NSW 2450	1	62	56	-6.3	55	1	-	-	N	-
397	4A CRYSTAL DRIVE~SAPPHIRE BEACH NSW 2450	1	60	55	-5.5	55	0	-	-	N	-
398	6 CRYSTAL DRIVE~SAPPHIRE BEACH NSW 2450	1	55	50	-4.7	55	-5	-	-	N	-

Appendix E - Noise Analysis Results

Receiver	Address	# Floors	Future Existing dB(A)	Design Year dB(A)	Increase	Design Year Criteria	Design Year Criteria Exceedance	Increase Criteria Exceedance ₂	Acute?	EA Listed	Treatment ³
399	1 CRYSTAL DRIVE~SAPPHIRE BEACH NSW 2450									N	-
400	3 CRYSTAL DRIVE~SAPPHIRE BEACH NSW 2450									N	-
401	5 CRYSTAL DRIVE~SAPPHIRE BEACH NSW 2450	1	67	59	-7.8	55	4	-	-	N	-
402	7 CRYSTAL DRIVE~SAPPHIRE BEACH NSW 2450									N	-
403	9 CRYSTAL DRIVE~SAPPHIRE BEACH NSW 2450									N	-
404	11 CRYSTAL DRIVE~SAPPHIRE BEACH NSW 2450	1	66	55	-10.4	55	0	-	-	N	-
405	13 CRYSTAL DRIVE~SAPPHIRE BEACH NSW 2450	1	63	53	-9.7	55	-2	-	-	N	-
406	15 CRYSTAL DRIVE~SAPPHIRE BEACH NSW 2450	1	62	53	-8.7	55	-2	-	-	N	-
407	17 CRYSTAL DRIVE~SAPPHIRE BEACH NSW 2450	1	60	52	-7.8	55	-3	-	-	N	-
408	19 CRYSTAL DRIVE~SAPPHIRE BEACH NSW 2450	1	59	51	-7.8	55	-4	-	-	N	-
409	21 CRYSTAL DRIVE~SAPPHIRE BEACH NSW 2450	1	58	51	-7.4	55	-4	-	-	N	-
410	23 CRYSTAL DRIVE~SAPPHIRE BEACH NSW 2450	1	57	50	-7.1	55	-5	-	-	N	-
411	25 CRYSTAL DRIVE~SAPPHIRE BEACH NSW 2450	1	57	50	-6.6	55	-5	-	-	N	-
425	227 NEWMANS ROAD~WOOLGOOLGA NSW 2456	2	NA	57	NA	50	7	-	-	Y	1
430	200 Woolgoolga Creek Road, Woolgoolga	1	NA	52	NA	50	2	-	-	N	1
431	14 SANCTUARY DRIVE~WOOLGOOLGA NSW 2456	2	NA	53	NA	50	3	-	-	N	1
432	6 FREEMANS ROAD~WOOLGOOLGA NSW 2456	1	NA	51	NA	50	1	-	-	N	1
439	25 PARK AVENUE~WOOLGOOLGA NSW 2456	2	NA	52	NA	50	2	-	-	N	1
440	17 PARK AVENUE~WOOLGOOLGA NSW 2456	1	NA	53	NA	50	3	-	-	N	1
441	15 PARK AVENUE~WOOLGOOLGA NSW 2456	1	NA	58	NA	50	8	-	-	Y	1
442	42 GREYS ROAD~WOOLGOOLGA NSW 2456									Y	-
443	18 SANCTUARY DRIVE~WOOLGOOLGA NSW 2456	1	NA	51	NA	50	1	-	-	N	1
444	244 BARK HUT ROAD~WOOLGOOLGA NSW 2456	3	NA	56	NA	50	6	-	-	Y	1
445	235-235A BARK HUT ROAD~WOOLGOOLGA NSW 2456	1	NA	54	NA	50	4	-	-	Y	1
446	234 BARK HUT ROAD~WOOLGOOLGA NSW 2456	1	NA	57	NA	50	7	-	-	Y	1
447	226 BARK HUT ROAD~WOOLGOOLGA NSW 2456	1	NA	58	NA	50	8	-	-	Y	1
454a	115 WEDDING BELLS WAY (ROW)~WOOLGOOLGA NSW 2456									Y	-
454b	115 WEDDING BELLS WAY (ROW)~WOOLGOOLGA NSW 2456	1	NA	55	NA	50	5	-	-	N	1
455	85 WEDDING BELLS WAY (ROW)~WOOLGOOLGA NSW 2456	2	NA	54	NA	50	4	-	-	N	1
456	210 BARK HUT ROAD~WOOLGOOLGA NSW 2456									N	-
457	199 BARK HUT ROAD~WOOLGOOLGA NSW 2456	1	NA	49	NA	50	-1	-	-	N	-
458	185 BARK HUT ROAD~WOOLGOOLGA NSW 2456	1	NA	46	NA	50	-4	-	-	N	-
459	181 BARK HUT ROAD~WOOLGOOLGA NSW 2456	2	NA	44	NA	50	-6	-	-	N	-
460	215 BARK HUT ROAD~WOOLGOOLGA NSW 2456	1	NA	50	NA	50	0	-	-	N	-
461	169 BARK HUT ROAD~WOOLGOOLGA NSW 2456	1	NA	44	NA	50	-6	-	-	N	-
463	49 PALMER ROAD~WOOLGOOLGA NSW 2456	1	NA	45	NA	50	-5	-	-	N	-
464	181 BARK HUT ROAD~WOOLGOOLGA NSW 2456	1	NA	43	NA	50	-7	-	-	N	-
468	46 PALMER ROAD~WOOLGOOLGA NSW 2456	2	NA	51	NA	50	1	-	-	N	1
469	52 PALMER ROAD~WOOLGOOLGA NSW 2456	2	NA	52	NA	50	2	-	-	N	1
470	56 PALMER ROAD~WOOLGOOLGA NSW 2456	2	NA	55	NA	50	5	-	-	Y	1
472	66 PALMER ROAD~WOOLGOOLGA NSW 2456	1	NA	52	NA	50	2	-	-	N	1
473	254 NEWMANS ROAD~WOOLGOOLGA NSW 2456									N	-

Appendix E - Noise Analysis Results

Receiver	Address	# Floors	Future Existing dB(A)	Design Year dB(A)	Increase	Design Year Criteria	Design Year Criteria Exceedance	Increase Criteria Exceedance ₂	Acute?	EA Listed	Treatment ³	
474	254 NEWMANS ROAD~WOOLGOOLGA NSW 2456	1	NA	48	NA	50	-2	-	-	N	-	
475	240 NEWMANS ROAD~WOOLGOOLGA NSW 2456	1	NA	49	NA	50	-1	-	-	N	-	
477	210 NEWMANS ROAD~WOOLGOOLGA NSW 2456	Ineligible									N	-
478	NEWMANS ROAD~WOOLGOOLGA NSW 2456	1	NA	51	NA	50	1	-	-	N	1	
479	207-209 NEWMANS ROAD~WOOLGOOLGA NSW 2456	Ineligible									N	-
480	201 NEWMANS ROAD~WOOLGOOLGA NSW 2456	Ineligible									N	-
482	187 NEWMANS ROAD~WOOLGOOLGA NSW 2456	1	NA	55	NA	50	5	-	-	Y	1	
483	4 WOLSTENHOLME COURT~WOOLGOOLGA NSW 2456	2	NA	48	NA	50	-2	-	-	N	-	
484	1/19 GRESHAM DRIVE~WOOLGOOLGA NSW 2456	2	NA	48	NA	50	-2	-	-	N	-	
485	21 GRESHAM DRIVE~WOOLGOOLGA NSW 2456	2	NA	51	NA	50	1	-	-	N	1	
491	26 GRESHAM DRIVE~WOOLGOOLGA NSW 2456	2	NA	51	NA	50	1	-	-	N	1	
492	11 STANNER CLOSE~WOOLGOOLGA NSW 2456	1	NA	49	NA	50	-1	-	-	N	-	
493	10 STANNER CLOSE~WOOLGOOLGA NSW 2456	1	NA	48	NA	50	-2	-	-	N	-	
495	12-12A GREYS ROAD~WOOLGOOLGA NSW 2456	1	NA	55	NA	50	5	-	-	Y	1	
496	25 GREYS ROAD~WOOLGOOLGA NSW 2456	1	NA	57	NA	50	7	-	-	Y	1	
497	9 GREYS ROAD~WOOLGOOLGA NSW 2456	1	NA	47	NA	50	-3	-	-	N	-	
498	127 WOOLGOOLGA CREEK ROAD~WOOLGOOLGA NSW 2456	1	NA	55	NA	50	5	-	-	Y	1	
499	111E WOOLGOOLGA CREEK ROAD~WOOLGOOLGA NSW 2456	1	NA	43	NA	50	-7	-	-	N	-	
500	109 WOOLGOOLGA CREEK ROAD~WOOLGOOLGA NSW 2456	1	NA	46	NA	50	-4	-	-	N	-	
504	21 GREYS ROAD~WOOLGOOLGA NSW 2456	1	NA	52	NA	50	2	-	-	N	1	
505	111 WOOLGOOLGA CREEK ROAD~WOOLGOOLGA NSW 2456	2	NA	50	NA	50	0	-	-	N	-	
506	111A WOOLGOOLGA CREEK ROAD~WOOLGOOLGA NSW 2456	1	NA	42	NA	50	-8	-	-	N	-	
507	2377C PACIFIC HIGHWAY~WOOLGOOLGA NSW 2456	1	NA	52	NA	50	2	-	-	N	1	
510	THE PINES LIVE SMART~8 HEARNES LAKE ROAD~WOOLGOOLGA NSW 2456	1	57	56	-0.9	55	1	-	-	N	-	
511	THE PINES LIVE SMART~8 HEARNES LAKE ROAD~WOOLGOOLGA NSW 2456	1	56	55	-0.7	55	0	-	-	N	-	
512	THE PINES LIVE SMART~8 HEARNES LAKE ROAD~WOOLGOOLGA NSW 2456	1	55	54	-1.0	55	-1	-	-	N	-	
513	THE PINES LIVE SMART~8 HEARNES LAKE ROAD~WOOLGOOLGA NSW 2456	Ineligible									N	-
514	THE PINES LIVE SMART~8 HEARNES LAKE ROAD~WOOLGOOLGA NSW 2456	2	62	60	-1.6	55	5	-	Y	N	1	
515	THE PINES LIVE SMART~8 HEARNES LAKE ROAD~WOOLGOOLGA NSW 2456	1	50	50	-0.2	55	-5	-	-	N	-	
516	THE PINES LIVE SMART~8 HEARNES LAKE ROAD~WOOLGOOLGA NSW 2456	1	57	54	-3.2	55	-1	-	-	N	-	
517	THE PINES LIVE SMART~8 HEARNES LAKE ROAD~WOOLGOOLGA NSW 2456	1	57	53	-4.4	55	-2	-	-	N	-	
518	THE PINES LIVE SMART~8 HEARNES LAKE ROAD~WOOLGOOLGA NSW 2456	1	56	51	-4.8	55	-4	-	-	N	-	
519	THE PINES LIVE SMART~8 HEARNES LAKE ROAD~WOOLGOOLGA NSW 2456	1	56	48	-8.0	55	-7	-	-	N	-	
520	THE PINES LIVE SMART~8 HEARNES LAKE ROAD~WOOLGOOLGA NSW 2456	1	57	49	-8.1	55	-6	-	-	N	-	
521	THE PINES LIVE SMART~8 HEARNES LAKE ROAD~WOOLGOOLGA NSW 2456	1	57	49	-7.1	55	-6	-	-	N	-	
522	THE PINES LIVE SMART~8 HEARNES LAKE ROAD~WOOLGOOLGA NSW 2456	1	53	48	-5.4	55	-7	-	-	N	-	
523	THE PINES LIVE SMART~8 HEARNES LAKE ROAD~WOOLGOOLGA NSW 2456	1	53	49	-4.8	55	-6	-	-	N	-	
525	THE PINES LIVE SMART~8 HEARNES LAKE ROAD~WOOLGOOLGA NSW 2456	1	53	48	-4.3	55	-7	-	-	N	-	
526	THE PINES LIVE SMART~8 HEARNES LAKE ROAD~WOOLGOOLGA NSW 2456	1	49	48	-0.7	55	-7	-	-	N	-	
527	THE PINES LIVE SMART~8 HEARNES LAKE ROAD~WOOLGOOLGA NSW 2456	1	49	49	-0.2	55	-6	-	-	N	-	
528	THE PINES LIVE SMART~8 HEARNES LAKE ROAD~WOOLGOOLGA NSW 2456	1	50	48	-2.0	55	-7	-	-	N	-	
529	11 HEARNES LAKE ROAD~WOOLGOOLGA NSW 2456	Ineligible									N	-

Appendix E - Noise Analysis Results

Receiver	Address	# Floors	Future Existing dB(A)	Design Year dB(A)	Increase	Design Year Criteria	Design Year Criteria Exceedance	Increase Criteria Exceedance ₂	Acute?	EA Listed	Treatment ³
530	11A HEARNES LAKE ROAD~WOOLGOOLGA NSW 2456	2	54	53	-0.9	55	-2	-	-	N	-
531	1 HEARNES LAKE ROAD~WOOLGOOLGA NSW 2456	1	60	56	-4.5	55	1	-	-	N	-
532	1 HEARNES LAKE ROAD~WOOLGOOLGA NSW 2456	1	58	56	-2.0	55	1	-	-	N	-
546	2986 PACIFIC HIGHWAY~ARRAWARRA HEADLAND NSW 2456	2	65	59	-5.1	55	4	-	-	N	-
547	2921 PACIFIC HIGHWAY~WOOLGOOLGA NSW 2456	1	NA	52	NA	50	2	-	-	N	1
600	8 PINE BRUSH CRESCENT~KORORA NSW 2450	2	54	46	-7.8	55	-9	-	-	N	-
601	4 COACHMANS CLOSE~KORORA NSW 2450	1	60	45	-14.2	55	-10	-	-	N	-
602	6 COACHMANS CLOSE~KORORA NSW 2450	1	60	46	-13.7	55	-9	-	-	N	-
603	8 COACHMANS CLOSE~KORORA NSW 2450									N	-
604	10 COACHMANS CLOSE~KORORA NSW 2450	1	57	48	-9.1	55	-7	-	-	N	-
605	12 COACHMANS CLOSE~KORORA NSW 2450	1	59	48	-10.5	55	-7	-	-	N	-
606	14 COACHMANS CLOSE~KORORA NSW 2450	1	56	49	-7.2	55	-6	-	-	N	-
607	16 COACHMANS CLOSE~KORORA NSW 2450	1.0	55	49	-5.8	55	-6	-	-	N	-
608	4 FERNLEIGH AVENUE~KORORA NSW 2450	1	54	48	-5.4	55	-7	-	-	N	-
609	1 FERNLEIGH AVENUE~KORORA NSW 2450	2	59	52	-7.6	55	-3	-	-	N	-
610	22 COACHMANS CLOSE~KORORA NSW 2450									N	-
611	28 COACHMANS CLOSE~KORORA NSW 2450									N	-
612	30 COACHMANS CLOSE~KORORA NSW 2450									N	-
613	34 COACHMANS CLOSE~SAPPHIRE BEACH NSW 2450	2	56	53	-3.1	55	-2	-	-	N	-
614	36 COACHMANS CLOSE~SAPPHIRE BEACH NSW 2450	1	51	45	-6.2	55	-10	-	-	N	-
615	BELLEVUE~689 PACIFIC HIGHWAY~KORORA NSW 2450									N	-
616	701 PACIFIC HIGHWAY~KORORA NSW 2450									N	-
617	1 SEAVIEW CLOSE~KORORA NSW 2450									N	-
618	3A COACHMANS CLOSE~SAPPHIRE BEACH NSW 2450	2	58	58	0.0	55	3	-	-	N	-
619	3 COACHMANS CLOSE~SAPPHIRE BEACH NSW 2450	2	55	58	3.8	55	3	1.8	-	N	1
620	5A COACHMANS CLOSE~SAPPHIRE BEACH NSW 2450	2	49	53	3.9	55	-2	1.9	-	N	-
621	7 COACHMANS CLOSE~SAPPHIRE BEACH NSW 2450	2	47	50	3.1	55	-5	1.1	-	N	-
622	9 COACHMANS CLOSE~SAPPHIRE BEACH NSW 2450	2	55	57	1.6	55	2	-	-	N	-
623	11 COACHMANS CLOSE~SAPPHIRE BEACH NSW 2450	2	58	59	1.6	55	4	-	-	N	-
624	7/744 PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	3	63	60	-3.1	55	5	-	Y	N	1
625	7/744 PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	3	57	54	-3.7	55	-1	-	-	N	-
626	NAUTILUS BEACHFRONT VILLAS~746 PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	1	54	49	-5.4	55	-6	-	-	N	-
627	NAUTILUS BEACHFRONT VILLAS~746 PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	1	54	48	-5.7	55	-7	-	-	N	-
628	NAUTILUS BEACHFRONT VILLAS~746 PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	1	54	48	-5.9	55	-7	-	-	N	-
629	NAUTILUS BEACHFRONT VILLAS~746 PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	1	53	48	-5.2	55	-7	-	-	N	-
630	NAUTILUS BEACHFRONT VILLAS~746 PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	1	52	47	-4.3	55	-8	-	-	N	-

Appendix E - Noise Analysis Results

Receiver	Address	# Floors	Future Existing dB(A)	Design Year dB(A)	Increase	Design Year Criteria	Design Year Criteria Exceedance	Increase Criteria Exceedance ²	Acute?	EA Listed	Treatment ³	
631	NAUTILUS BEACHFRONT VILLAS~746 PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	1	51	47	-4.0	55	-8	-	-	N	-	
632	NAUTILUS BEACHFRONT VILLAS~746 PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	1	50	47	-3.4	55	-8	-	-	N	-	
634	SAPPHIRE PINES~29/784 PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	5	62	61	-0.8	55	6	-	Y	N	1	
635	6 SAPPHIRE PLACE~SAPPHIRE BEACH NSW 2450	Pre-treated									Y	-
636	27 SAPPHIRE CRESCENT~SAPPHIRE BEACH NSW 2450	Pre-treated									N	-
637	23 SAPPHIRE CRESCENT~SAPPHIRE BEACH NSW 2450	2	60	53	-6.9	55	-2	-	-	N	-	
640	1 ALPINI PLACE~SAPPHIRE BEACH NSW 2450	1	53	51	-2.5	55	-4	-	-	N	-	
642	7 GUMTREE GLEN~SAPPHIRE BEACH NSW 2450	1	55	50	-5.4	55	-5	-	-	N	-	
645	18 GAUDRONS ROAD~SAPPHIRE BEACH NSW 2450	2	58	57	-0.4	55	2	-	-	N	-	
646	26 GAUDRONS ROAD~SAPPHIRE BEACH NSW 2450	1	53	52	-0.7	55	-3	-	-	N	-	
647	1510 PACIFIC HIGHWAY~MOONEE BEACH NSW 2450	1	60	59	-1.3	55	4	-	-	N	-	
649	1768 PACIFIC HIGHWAY~MOONEE BEACH NSW 2450	Demolish									N	-
650	10 FIDDAMAN ROAD~EMERALD BEACH NSW 2456	2	59	57	-1.5	55	2	-	-	N	-	
651	12 FIDDAMAN ROAD~EMERALD BEACH NSW 2456	1	56	54	-2.3	55	-1	-	-	N	-	
652	7 FIDDAMAN ROAD~EMERALD BEACH NSW 2456	2	62	60	-2.3	55	5	-	Y	N	1	
653	21 FIDDAMAN ROAD~EMERALD BEACH NSW 2456	2	59	56	-2.6	55	1	-	-	N	-	
654	SHELL SERVICE STN~1850-1850A PACIFIC HIGHWAY~EMERALD BEACH NSW 2456	Ineligible									N	-
656	48 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	1	56	54	-2.7	55	-1	-	-	N	-	
659	2 TOPAZ DRIVE~EMERALD BEACH NSW 2456	1	58	52	-6.3	55	-3	-	-	N	-	
660	32 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	1	59	53	-5.4	55	-2	-	-	N	-	
661	30 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	2	60	55	-5.7	55	0	-	-	N	-	
662	28 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	2	61	56	-5.8	55	1	-	-	N	-	
663	26 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	2	60	55	-5.1	55	0	-	-	N	-	
664	1/24 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	2	62	56	-5.3	55	1	-	-	N	-	
665	22 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	2	61	56	-4.3	55	1	-	-	N	-	
666	20 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	2	60	56	-4.2	55	1	-	-	N	-	
667	18 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	2	61	56	-4.7	55	1	-	-	N	-	
668	16 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	1	60	55	-4.7	55	0	-	-	N	-	
669	3 STEFAN CLOSE~EMERALD BEACH NSW 2456	2	60	56	-3.8	55	1	-	-	N	-	
670	5 STEFAN CLOSE~EMERALD BEACH NSW 2456	2	59	55	-4.0	55	0	-	-	N	-	
671	3 ANSELMO CLOSE~EMERALD BEACH NSW 2456	1	48	45	-2.2	55	-10	-	-	N	-	
672	6 ANSELMO CLOSE~EMERALD BEACH NSW 2456	2	55	53	-2.2	55	-2	-	-	N	-	
673	8 ANSELMO CLOSE~EMERALD BEACH NSW 2456	1	53	51	-2.5	55	-4	-	-	N	-	
676	4 CASUARINA COURT~SANDY BEACH NSW 2456	1	56	55	-1.1	55	0	-	-	N	-	
677	7 CASUARINA COURT~SANDY BEACH NSW 2456	1	60	58	-1.8	55	3	-	-	N	-	
683	19 MAHOGANY AVENUE~SANDY BEACH NSW 2456	1	66	55	-11.3	55	0	-	-	N	-	
684	17 MAHOGANY AVENUE~SANDY BEACH NSW 2456	1	65	53	-12.1	55	-2	-	-	N	-	
685	15 MAHOGANY AVENUE~SANDY BEACH NSW 2456	1	66	55	-11.5	55	0	-	-	N	-	
686	25 MAHOGANY AVENUE~SANDY BEACH NSW 2456	1	66	56	-9.5	55	1	-	-	N	-	

Appendix E - Noise Analysis Results

Receiver	Address	# Floors	Future Existing dB(A)	Design Year dB(A)	Increase	Design Year Criteria	Design Year Criteria Exceedance	Increase Criteria Exceedance ₂	Acute?	EA Listed	Treatment ³
687	28 MAHOGANY AVENUE~SANDY BEACH NSW 2456	1	54	51	-3.3	55	-4	-	-	N	-
688	26 MAHOGANY AVENUE~SANDY BEACH NSW 2456	1	56	53	-3.5	55	-2	-	-	N	-
689	24 MAHOGANY AVENUE~SANDY BEACH NSW 2456	1	55	52	-2.9	55	-3	-	-	N	-
690	60 TURPENTINE AVENUE~SANDY BEACH NSW 2456	1	55	52	-3.1	55	-3	-	-	N	-
691	37 TURPENTINE AVENUE~SANDY BEACH NSW 2456	1	56	52	-4.0	55	-3	-	-	N	-
692	18 MAHOGANY AVENUE~SANDY BEACH NSW 2456	1	57	52	-4.8	55	-3	-	-	N	-
693	16 MAHOGANY AVENUE~SANDY BEACH NSW 2456	1	58	53	-5.7	55	-2	-	-	N	-
694	14 MAHOGANY AVENUE~SANDY BEACH NSW 2456	1	59	53	-6.0	55	-2	-	-	N	-
695	12 MAHOGANY AVENUE~SANDY BEACH NSW 2456	1	60	54	-5.9	55	-1	-	-	N	-
696	10 MAHOGANY AVENUE~SANDY BEACH NSW 2456	1	60	54	-6.1	55	-1	-	-	N	-
697	8 MAHOGANY AVENUE~SANDY BEACH NSW 2456	1	61	55	-6.4	55	0	-	-	N	-
698	6 MAHOGANY AVENUE~SANDY BEACH NSW 2456	2	62	57	-5.6	55	2	-	-	N	-
699	4 MAHOGANY AVENUE~SANDY BEACH NSW 2456	2	62	57	-4.5	55	2	-	-	N	-
700	46 DIAMOND HEAD DRIVE~SANDY BEACH NSW 2456	2	61	58	-3.1	55	3	-	-	N	-
702	85 BLACKBUTT AVENUE~SANDY BEACH NSW 2456	1	58	57	-1.2	55	2	-	-	N	-
703	4 OAK CLOSE~SANDY BEACH NSW 2456	1	63	61	-2.1	55	6	-	Y	N	1
704	53 DIAMOND HEAD DRIVE~SANDY BEACH NSW 2456	1	58	56	-2.1	55	1	-	-	N	-
705	51 DIAMOND HEAD DRIVE~SANDY BEACH NSW 2456	1	58	55	-3.4	55	0	-	-	N	-
706	54 BLACKBUTT AVENUE~SANDY BEACH NSW 2456	1	59	55	-3.5	55	0	-	-	N	-
707	66 DIAMOND HEAD DRIVE~SANDY BEACH NSW 2456	1	61	54	-6.6	55	-1	-	-	N	-
708	68 DIAMOND HEAD DRIVE~SANDY BEACH NSW 2456	1	59	53	-5.7	55	-2	-	-	N	-
709	70 DIAMOND HEAD DRIVE~SANDY BEACH NSW 2456	1	59	54	-5.7	55	-1	-	-	N	-
710	74 DIAMOND HEAD DRIVE~SANDY BEACH NSW 2456	1	58	53	-5.1	55	-2	-	-	N	-
711	76 DIAMOND HEAD DRIVE~SANDY BEACH NSW 2456	1	58	53	-5.1	55	-2	-	-	N	-
712	78 DIAMOND HEAD DRIVE~SANDY BEACH NSW 2456	1	58	53	-4.6	55	-2	-	-	N	-
713	34-40 UNWINS ROAD~WOOLGOOLGA NSW 2456	1	NA	55	NA	50	5	-	-	Y	1
714	2377B PACIFIC HIGHWAY~WOOLGOOLGA NSW 2456	1	NA	56	NA	50	6	-	-	Y	1
715	2377A PACIFIC HIGHWAY~WOOLGOOLGA NSW 2456	1	NA	53	NA	50	3	-	-	Y	1
716	124 WOOLGOOLGA CREEK ROAD~WOOLGOOLGA NSW 2456	1	NA	51	NA	50	1	-	-	N	1
717	105 WOOLGOOLGA CREEK ROAD~WOOLGOOLGA NSW 2456	1	NA	46	NA	50	-4	-	-	N	-
718	101 WOOLGOOLGA CREEK ROAD~WOOLGOOLGA NSW 2456	1	NA	46	NA	50	-4	-	-	N	-
776	74 EGGINS DRIVE~ARRAWARRA NSW 2456	1	56	55	-1.5	55	0	-	-	N	-
1003	18-20 CAMPBELL CLOSE~KORORA NSW 2450	1	57	55	-2.5	55	0	-	-	N	-
1006	33 HUNTER CLOSE~KORORA NSW 2450	1	57	61	3.5	55	6	1.5	Y	N	1
1007	18 GAUDRONS ROAD~SAPPHIRE BEACH NSW 2450	1	56	56	0.3	55	1	-	-	N	-
1008	20 WOODHOUSE ROAD~MOONEE BEACH NSW 2450	2	56	56	-0.1	55	1	-	-	N	-
1009	18 WOODHOUSE ROAD~MOONEE BEACH NSW 2450	1	56	56	0.2	55	1	-	-	N	-
1010	16 WOODHOUSE ROAD~MOONEE BEACH NSW 2450	2	57	57	0.0	55	2	-	-	N	-
1011	16 WOODHOUSE ROAD~MOONEE BEACH NSW 2450	1	56	56	0.0	55	1	-	-	N	-
1012	14 WOODHOUSE ROAD~MOONEE BEACH NSW 2450	1	55	55	0.5	55	0	-	-	N	-
1013	12 WOODHOUSE ROAD~MOONEE BEACH NSW 2450	1	55	55	0.4	55	0	-	-	N	-
1014	10 WOODHOUSE ROAD~MOONEE BEACH NSW 2450	2	56	56	0.3	55	1	-	-	N	-

Appendix E - Noise Analysis Results

Receiver	Address	# Floors	Future Existing dB(A)	Design Year dB(A)	Increase	Design Year Criteria	Design Year Criteria Exceedance	Increase Criteria Exceedance ²	Acute?	EA Listed	Treatment ³	
1015	8 WOODHOUSE ROAD~MOONEE BEACH NSW 2450	1	54	55	0.7	55	0	-	-	N	-	
1016	5 MOONEE BEACH ROAD~MOONEE BEACH NSW 2450	1	56	53	-2.1	55	-2	-	-	N	-	
1017	5 HOYS ROAD~MOONEE BEACH NSW 2450	Ineligible									N	-
1018	38-48 HOYS ROAD~MOONEE BEACH NSW 2450	1	58	56	-1.4	55	1	-	-	N	-	
1019	104 HOYS ROAD~MOONEE BEACH NSW 2450	1	61	59	-1.9	55	4	-	-	N	-	
1020	54 HERITAGE DRIVE~MOONEE BEACH NSW 2450	1	61	58	-3.2	55	3	-	-	N	-	
1024	KUMBAINGERI CLOSE~MOONEE BEACH NSW 2450	1	63	60	-3.1	55	5	-	Y	N	1	
1027	12 SMITHS ROAD~EMERALD BEACH NSW 2456	1	59	56	-3.1	55	1	-	-	N	-	
1028	12 SMITHS ROAD~EMERALD BEACH NSW 2456	1	59	56	-3.0	55	1	-	-	N	-	
1033	8 LIGHTS STREET~EMERALD BEACH NSW 2456	2	57	55	-2.2	55	0	-	-	N	-	
1034	6 LIGHTS STREET~EMERALD BEACH NSW 2456	2	56	54	-2.3	55	-1	-	-	N	-	
1039	4 LIGHTS STREET~EMERALD BEACH NSW 2456	2	57	55	-2.0	55	0	-	-	N	-	
1042	29 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	Ineligible									N	-
1043	6 ANSELMO CLOSE~EMERALD BEACH NSW 2456	1	54	52	-2.0	55	-3	-	-	N	-	
1044	5 CASUARINA COURT~SANDY BEACH NSW 2456	1	59	57	-1.9	55	2	-	-	N	-	
1045	23 MAHOGANY AVENUE~SANDY BEACH NSW 2456	1	64	54	-9.8	55	-1	-	-	N	-	
1046	11 MAHOGANY AVENUE~SANDY BEACH NSW 2456	1	66	55	-10.7	55	0	-	-	N	-	
1047	3 MAHOGANY AVENUE~SANDY BEACH NSW 2456	2	66	65	-1.6	55	10	-	Y	N	2	
1048	50 DIAMOND HEAD DRIVE~SANDY BEACH NSW 2456	2	66	64	-1.2	55	9	-	Y	N	1	
1049	48 DIAMOND HEAD DRIVE~SANDY BEACH NSW 2456	1	57	56	-0.6	55	1	-	-	N	-	
1050a	55 DIAMOND HEAD DRIVE~SANDY BEACH NSW 2456	1	54	55	1.0	55	0	-	-	N	-	
1050b	55 DIAMOND HEAD DRIVE~SANDY BEACH NSW 2456	1	60	61	1.0	55	6	-	Y	N	1	
1051	4 OAK CLOSE~SANDY BEACH NSW 2456	1	60	57	-3.0	55	2	-	-	N	-	
1052	13 PINE CRESCENT~SANDY BEACH NSW 2456	1	64	56	-7.8	55	1	-	-	N	-	
1053	1/56 DIAMOND HEAD DRIVE~SANDY BEACH NSW 2456	1	67	58	-8.2	55	3	-	-	N	-	
1054	THE PINES LIVE SMART~8 HEARNES LAKE ROAD~WOOLGOOLGA NSW 2456	1	55	51	-4.1	55	-4	-	-	N	-	
1055	THE PINES LIVE SMART~8 HEARNES LAKE ROAD~WOOLGOOLGA NSW 2456	1	53	50	-3.5	55	-5	-	-	N	-	
1056	THE PINES LIVE SMART~8 HEARNES LAKE ROAD~WOOLGOOLGA NSW 2456	1	57	49	-8.1	55	-6	-	-	N	-	
1057	THE PINES LIVE SMART~8 HEARNES LAKE ROAD~WOOLGOOLGA NSW 2456	1	57	49	-8.1	55	-6	-	-	N	-	
1058	THE PINES LIVE SMART~8 HEARNES LAKE ROAD~WOOLGOOLGA NSW 2456	1	54	49	-4.3	55	-6	-	-	N	-	
1059	UNWINS ROAD~WOOLGOOLGA NSW 2456	Ineligible									N	-
1060	34-40 UNWINS ROAD~WOOLGOOLGA NSW 2456	1	NA	53	NA	50	3	-	-	N	1	
1061	2377C PACIFIC HIGHWAY~WOOLGOOLGA NSW 2456	Ineligible									N	-
1062	GREYS ROAD~WOOLGOOLGA NSW 2456	Ineligible									N	-
1063	GREYS ROAD~WOOLGOOLGA NSW 2456	Ineligible									N	-
1064	37 GREYS ROAD~WOOLGOOLGA NSW 2456	Demolish									N	-
1065	127 WOOLGOOLGA CREEK ROAD~WOOLGOOLGA NSW 2456	Ineligible									N	-
1066	11 FREEMANS ROAD~WOOLGOOLGA NSW 2456	Ineligible									N	-
1067	201 NEWMANS ROAD~WOOLGOOLGA NSW 2456	1	NA	51	NA	50	1	-	-	N	1	
1068	240 NEWMANS ROAD~WOOLGOOLGA NSW 2456	Ineligible									N	-
1072	3006 PACIFIC HIGHWAY~ARRAWARRA HEADLAND NSW 2456	2	61	59	-1.7	55	4	-	-	N	-	
1074	13 Emerald Heights Dr, Emerald Beach NSW 2456, Australia	2	61	58	-3.0	55	3	-	-	N	-	

Appendix E - Noise Analysis Results

Receiver	Address	# Floors	Future Existing dB(A)	Design Year dB(A)	Increase	Design Year Criteria	Design Year Criteria Exceedance	Increase Criteria Exceedance ²	Acute?	EA Listed	Treatment ³	
1080	229 NEWMANS ROAD~WOOLGOOLGA NSW 2456	1	NA	53	NA	50	3	-	-	N	1	
3001	11 Coachmans Close, Sapphire Beach NSW 2450, Australia	1	54	56	1.8	55	1	-	-	N	-	
3002	54 Coachmans Close, Sapphire Beach NSW 2450, Australia	1	51	52	1.1	55	-3	-	-	N	-	
3020	LOT 34 Kumbaingeri Close, Moonee Beach NSW 2450, Australia	1	61	58	-3.0	55	3	-	-	N	-	
3021	34 Kumbaingeri Close, Moonee Beach NSW 2450, Australia	1	62	59	-3.0	55	4	-	-	N	-	
3023	45 Kumbaingeri Close, Moonee Beach NSW 2450, Australia	1	59	56	-3.2	55	1	-	-	N	-	
3024	48 KUMBAINGERI CLOSE~MOONEE BEACH NSW 2450	1	64	60	-3.3	55	5	-	Y	N	1	
3025	LOT 31 Kumbaingeri Close, Moonee Beach NSW 2450, Australia	Ineligible									N	-
3026	LOT 40 Kumbaingeri Close, Moonee Beach NSW 2450, Australia	1	59	56	-3.6	55	1	-	-	N	-	
3027	235 Bark Hut Rd, Woolgoolga NSW 2456, Australia	1	63	59	-4.7	55	4	-	-	N	-	
3028	11 STANNER CLOSE~WOOLGOOLGA NSW 2456	1	NA	50	NA	50	0	-	-	N	-	
3029	180 Bark Hut Road, Woolgoolga, NSW, 1456	Ineligible									N	-
3031	11 Coachmans Close, Sapphire Beach NSW 2450, Australia	1	54	55	0.8	55	0	-	-	N	-	
3033	LOT 2 Pacific Hwy, Sapphire Beach NSW 2450, Australia	1	43	45	2.7	55	-10	0.7	-	N	-	
3034	10 Emerald Ave, Sapphire Beach NSW 2450, Australia	1	40	42	1.8	55	-13	-	-	N	-	
3073	1 Pacific Hwy, Woolgoolga NSW 2456, Australia	1	NA	49	NA	50	-1	-	-	N	-	
3074	10 STANNER CLOSE~WOOLGOOLGA NSW 2456	Ineligible									N	-
3076	124A Woolgoolga Creek Rd, Woolgoolga NSW 2456, Australia	1	NA	43	NA	50	-7	-	-	N	-	
3083	130 Graham Dr, Sandy Beach NSW 2456, Australia	1	54	53	-1.8	55	-2	-	-	N	-	
3084	52 Blackbutt Ave, Sandy Beach NSW 2456, Australia	1	58	55	-3.7	55	0	-	-	N	-	
3087	80 Diamond Head Dr, Sandy Beach NSW 2456, Australia	1	57	53	-4.1	55	-2	-	-	N	-	
3093	42 KUMBAINGERI CLOSE~MOONEE BEACH NSW 2450	1	63	60	-2.8	55	5	-	Y	N	1	
3095	207-209 NEWMANS ROAD~WOOLGOOLGA NSW 2456	1	NA	47	NA	50	-3	-	-	N	-	
3096	180 Bark Hut Road, Woolgoolga, NSW, 1456	1	NA	46	NA	50	-4	-	-	N	-	

Notes:

- The noise levels presented are those calculated at the most affected facade. Refer to the digital facade model for detailed eligibility of each facade and floor.
- Increase criteria = 2.0 dB(A).
- Treatment Type 0: No proposed noise treatment
Treatment Type 1: Air conditioning, sealing of wall vents and upgraded window and door seals.
Treatment Type 2: In addition to Treatment Type 1, upgraded windows, glazing and doors (for masonry structures and colorbond/timber structures where walls include insulation materials).



APPENDIX F – SUMMARY OF TREATMENT CHANGES



This appendix is provided to summarise changes to the specified at-house noise treatments made since the previous published revision of the ONMR report issued December 2011. A total of 41 treatment changes have occurred mainly as a result of further ground truthing that has been undertaken or minor changes to the design, some of which were still under development and not formally issued 'for construction' in December 2011.

The changes fall into four basic categories and include the following:

- Three receivers have been added since the December 2011 report of which one (receiver 309) is eligible for treatment.
- Five receivers previously shown as eligible for treatment have been confirmed as ineligible (not noise sensitive) buildings.
- Twenty-eight receivers have received a treatment level upgrade.
- Five receivers have received a treatment level downgrade.

Each individual change is summarised in the following table including any change to the modelled number of storeys and treatment, whether it is EA listed, the respective Part 4 drawing number and a short description of the predominant reason for the change.


Noise Analysis Results - Treatment Changes From Dec 2011 Revision

Receiver	Address	# Floors (Current)	# Floors (2011)	Treatment (Current)	Treatment (2011)	EA Listed	Drawing No.	Predominant Reason For Change
18	13 HUNTER CLOSE~KORORA NSW 2450	2	1	1	-		2000-05	The modelled number of storeys increased as a result of ground truthing.
21	817-817A PACIFIC HIGHWAY~KORORA NSW 2450	Ineligible	1	-	1	Y	2000-04	Confirmed as an ineligible (non-noise sensitive) receiver.
24	815 PACIFIC HIGHWAY~KORORA NSW 2450	2	3	2	1	Y	2000-03	The modelled noise level increased approximately 1 dB(A) largely due to minor design changes
65	16 SUGARMILL ROAD~SAPPHIRE BEACH NSW 2450	2	1	1	-		2000-08	The modelled number of storeys increased as a result of ground truthing.
156	1 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	2	1	1	-		4000-03	The modelled number of storeys increased as a result of ground truthing.
158	5 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	1	1	-	1		4000-03	Noise levels decreased marginally (<0.5 dB(A)) likely due to minor changes in the design and is no longer acute.
159	9 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	2	1	1	-		4000-03	The modelled number of storeys increased as a result of ground truthing.
168	17 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	2	1	1	-		4000-02	The modelled number of storeys increased as a result of ground truthing.
169	21 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	2	1	1	-		4000-02	The modelled number of storeys increased as a result of ground truthing.
178	61 EMERALD HEIGHTS DRIVE~EMERALD BEACH NSW 2456	2	2	1	-	Y	4000-01	This receiver is not eligible for treatment based on noise criteria however is nominated for treatment based on the EA assessment.
222	9 MAHOGANY AVENUE~SANDY BEACH NSW 2456	2	2	1	-	Y	4000-06	The modelled noise level increased approximately 4 dB(A) largely due to changes in the noise barrier design.
224	5 MAHOGANY AVENUE~SANDY BEACH NSW 2456	2	2	2	1	Y	4000-06	The modelled noise level increased approximately 3 dB(A) largely due to changes in the noise barrier design
237	3 PINE CRESCENT~SANDY BEACH NSW 2456	1	1	1	-	Y	4000-06	The modelled noise level increased approximately 1 dB(A) largely due to changes in the noise barrier design
240	9 PINE CRESCENT~SANDY BEACH NSW 2456	2	2	2	1	Y	4000-06	The modelled noise level increased approximately 5 dB(A) largely due to changes in the noise barrier design.
241	11 PINE CRESCENT~SANDY BEACH NSW 2456	1	1	1	-		4000-06	The modelled noise level increased approximately 1 dB(A) largely due to changes in the noise barrier design.
275	1720 PACIFIC HIGHWAY~MOONEE BEACH NSW 2450	Ineligible	1	-	1		3000-08	Confirmed as an ineligible (non-noise sensitive) receiver.
285	10 TIKI ROAD (ROW)~MOONEE BEACH NSW 2450	2	1	1	-		3000-03	The modelled number of storeys increased as a result of ground truthing.
309	8 ALPINI PLACE~SAPPHIRE BEACH NSW 2450	2	Not listed	1	Not listed		2000-06	A receiver at this location was previously missing and has now been added to the report.
310	8 ALPINI PLACE~SAPPHIRE BEACH NSW 2450	2	1	1	-		2000-06	The modelled number of storeys increased as a result of ground truthing.
320	1026F PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	1	1	1	-	Y	2000-08	This receiver is not eligible for treatment based on noise criteria however is nominated for treatment based on the EA assessment.
322	1026G PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	1	1	1	-		2000-08	The modelled noise level increased approximately 1 dB(A) largely due to changes in the noise barrier/noise mound designs.
324	1/1026B PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	1	1	1	-	Y	2000-08	This receiver is not eligible for treatment based on noise criteria however is nominated for treatment based on the EA assessment.
325	1026C PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	1	1	1	-	Y	2000-08	This receiver is not eligible for treatment based on noise criteria however is nominated for treatment based on the EA assessment.
326	1026D PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	1	1	1	-	Y	2000-08	This receiver is not eligible for treatment based on noise criteria however is nominated for treatment based on the EA assessment.

Noise Analysis Results - Treatment Changes From Dec 2011 Revision

Receiver	Address	# Floors (Current)	# Floors (2011)	Treatment (Current)	Treatment (2011)	EA Listed	Drawing No.	Predominant Reason For Change
370	42 WARRAWEE STREET~SAPPHIRE BEACH NSW 2450	2	1	1	-		2000-04	The modelled number of storeys increased as a result of ground truthing.
460	215 BARK HUT ROAD~WOOLGOOLGA NSW 2456	1	1	-	1		6000-05	Noise levels decreased marginally (<0.5 dB(A)) likely due to minor changes in the design and is no longer eligible.
469	52 PALMER ROAD~WOOLGOOLGA NSW 2456	2	1	1	-		6000-04	The modelled number of storeys increased as a result of ground truthing.
475	240 NEWMANS ROAD~WOOLGOOLGA NSW 2456	1	1	-	1		6000-03	Noise levels decreased (<2.0 dB(A)) likely due to minor changes in the design and is no longer eligible.
479	207-209 NEWMANS ROAD~WOOLGOOLGA NSW 2456	Ineligible	1	-	1		6000-02	This receiver was previously shown over an incorrect building (now 3095). It is now shown over the correct building which is not a noise sensitive
547	2921 PACIFIC HIGHWAY~WOOLGOOLGA NSW 2456	1	1	1	-		6000-10*	The specified treatment for this receiver was incorrect in the previous report. The correct treatment is now shown.
623	11 COACHMANS CLOSE~SAPPHIRE BEACH NSW 2450	2	2	-	1		2000-02	Noise levels decreased marginally (<1.0 dB(A)) due to changes in the headlight screen height and is no longer eligible.
624	7/744 PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	3	2	1	-		2000-02	The modelled number of storeys increased as a result of ground truthing.
634	SAPPHIRE PINES~29/784 PACIFIC HIGHWAY~SAPPHIRE BEACH NSW 2450	5	1	1	-		2000-03	The modelled number of storeys increased as a result of ground truthing.
652	7 FIDDAMAN ROAD~EMERALD BEACH NSW 2456	2	1	1	-		4000-01	The modelled number of storeys increased as a result of ground truthing.
1047	3 MAHOGANY AVENUE~SANDY BEACH NSW 2456	2	1	2	1		4000-06	The modelled number of storeys increased as a result of ground truthing.
3021	34 Kumbaingeri Close, Moonee Beach NSW 2450, Australia	1	1	-	1		3000-06	Noise levels decreased marginally (<0.5 dB(A)) likely due to minor changes in the design and is no longer acute.
3029	180 Bark Hut Road, Woolgoolga, NSW, 1456	Ineligible	1	-	1		6000-18	Previously place holder for a yet to be constructed dwelling. Actual dwelling location now confirmed at receiver 3096. There is no building at this
3074	10 STANNER CLOSE~WOOLGOOLGA NSW 2456	Ineligible	1	-	1		5000-10	There is no dwelling / noise sensitive receiver to be treated at this location.
3093	42 KUMBAINGERI CLOSE~MOONEE BEACH NSW 2450	1	1	1	-		3000-06	The modelled noise level increased approximately 1 dB(A) largely due to confirmation of exact façade location as a result of ground truthing.
3095	207-209 NEWMANS ROAD~WOOLGOOLGA NSW 2456	1	Not listed	-	Not listed		6000-02	New receiver added to cover a noise sensitive receiver that was previously incorrectly labelled as receiver 479.
3096	180 Bark Hut Road, Woolgoolga, NSW, 1456	1	Not listed	-	Not listed		6000-18	New receiver added to cover recently constructed dwelling. Receiver 3029 previously used as a place holder for a future dwelling on this property.

LEGEND

 Ground truthing change

 Treatment type change