Rouse Hill Anglican College Masterplan

Construction Noise and Vibration Management Plan

4 September 2017

SPOKE ACOUSTICS

Rouse Hill Anglican College

Masterplan

Construction Noise and Vibration Management Plan

Prepared for

Anglican Schools Corporation

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1 Introduction

1.1 Purpose of document

This Construction Noise and Vibration Management Plan (CNVMP) was prepared for the Anglican Schools Corporation to address potential noise and vibration impacts during the proposed expansion of the school. It is a sub-plan to the Construction Management Plan.

The CNVMP provides an overview of the site in Section 2 and evaluates the current noise environment in Section 3. Relevant goals and criteria to manage noise are presented in Sections 4 and 5. The project stages and how these relate to potential noise impacts is presented in Section 6. Potential noise and vibration levels are assessed in Sections 7 and 8 and a number of mitigation options identified in Section 9.

1.2 Overview of school expansion

The Junior school area at the north of site will be expanded via relocation and further student growth with 3 new classroom modules, new roadway and carparking and associated landscaped areas. A new library, multi-purpose building and associated landscaped areas will be shared between the junior school and senior school.

The senior school to the south of the school will be expanded with a newly constructed building on the sites of the two existing primary and kindergarten buildings.

The expansion will be completed over three main stages to complete the following:

- on-site traffic generated by the proposed school expansion
- public road traffic on residents
- additional plant items
- kids at play
- multipurpose hall.

2 Site description

The proposed site for the junior school expansion is located on the northern end of the school property (Figure 1 and Figure 2). The proposed senior school expansion will be at the southern boundary on the site of the existing classrooms. A proposed private access road will run along the northern boundary between Worcester Road and Cudgegong Road with a car park midway through the site. The multipurpose hall and library will be in the middle of the existing site. The school has recently purchased the site located to the north-east of the existing school to construct the new classrooms and road.

The existing residential receivers that are potentially the most affected by road traffic noise are located approximately 20m to 40m from the road side on Worcester Road, Rouse Road and Cudgegong Road.

Figure 1 School Location

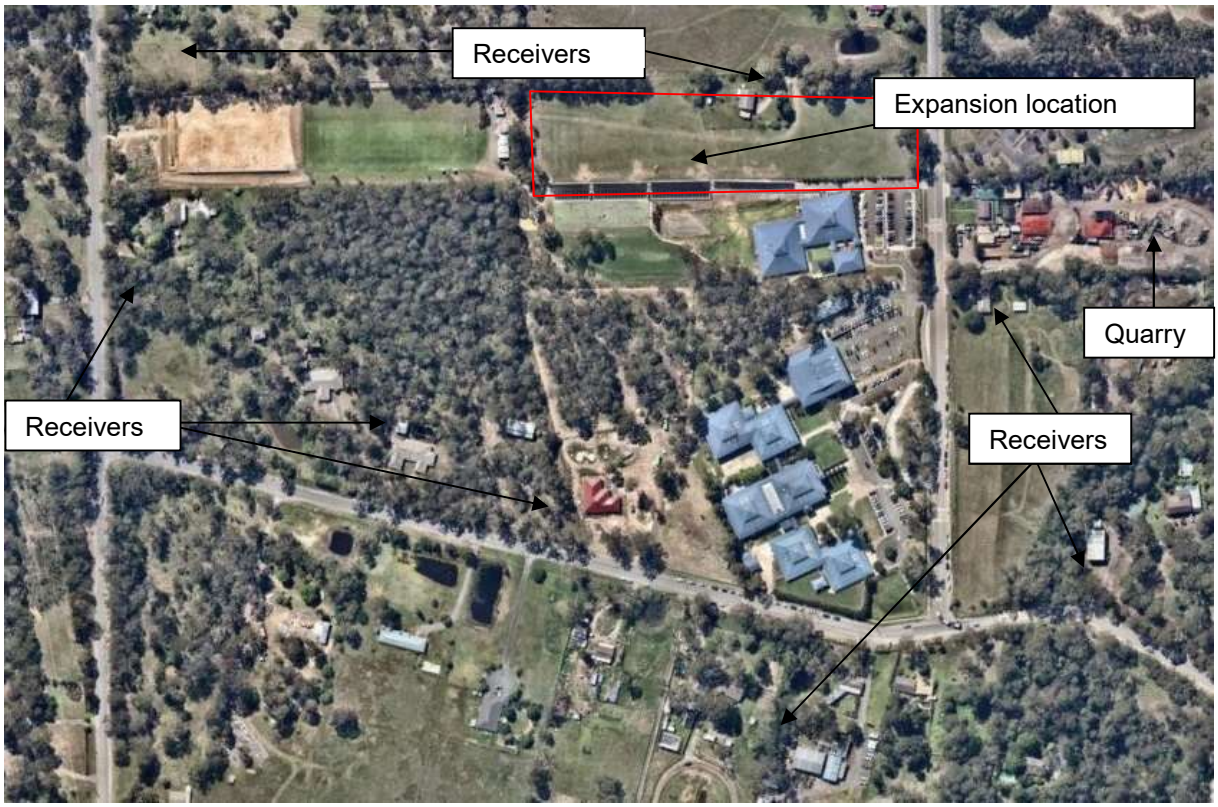
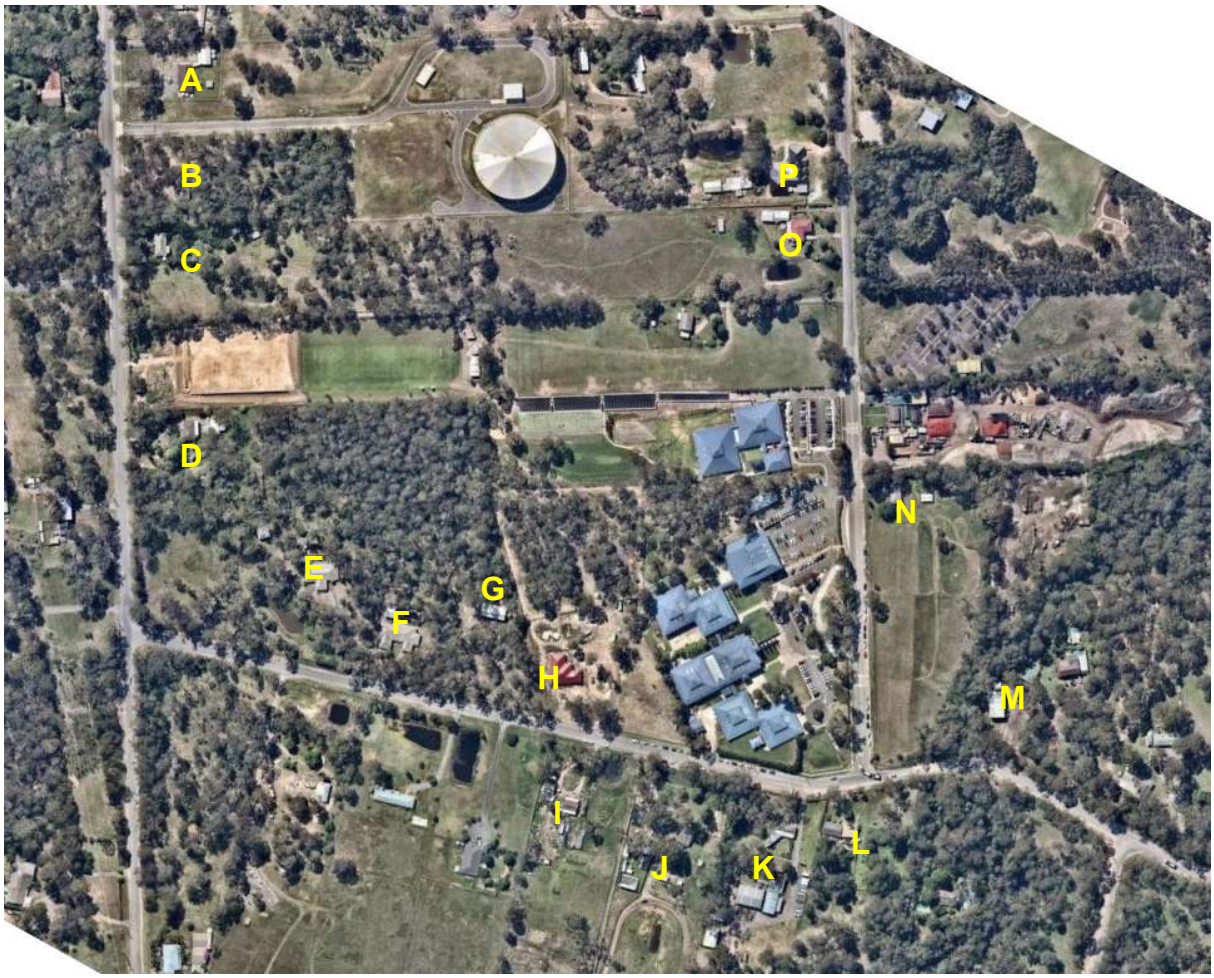


Figure 2 Site layout

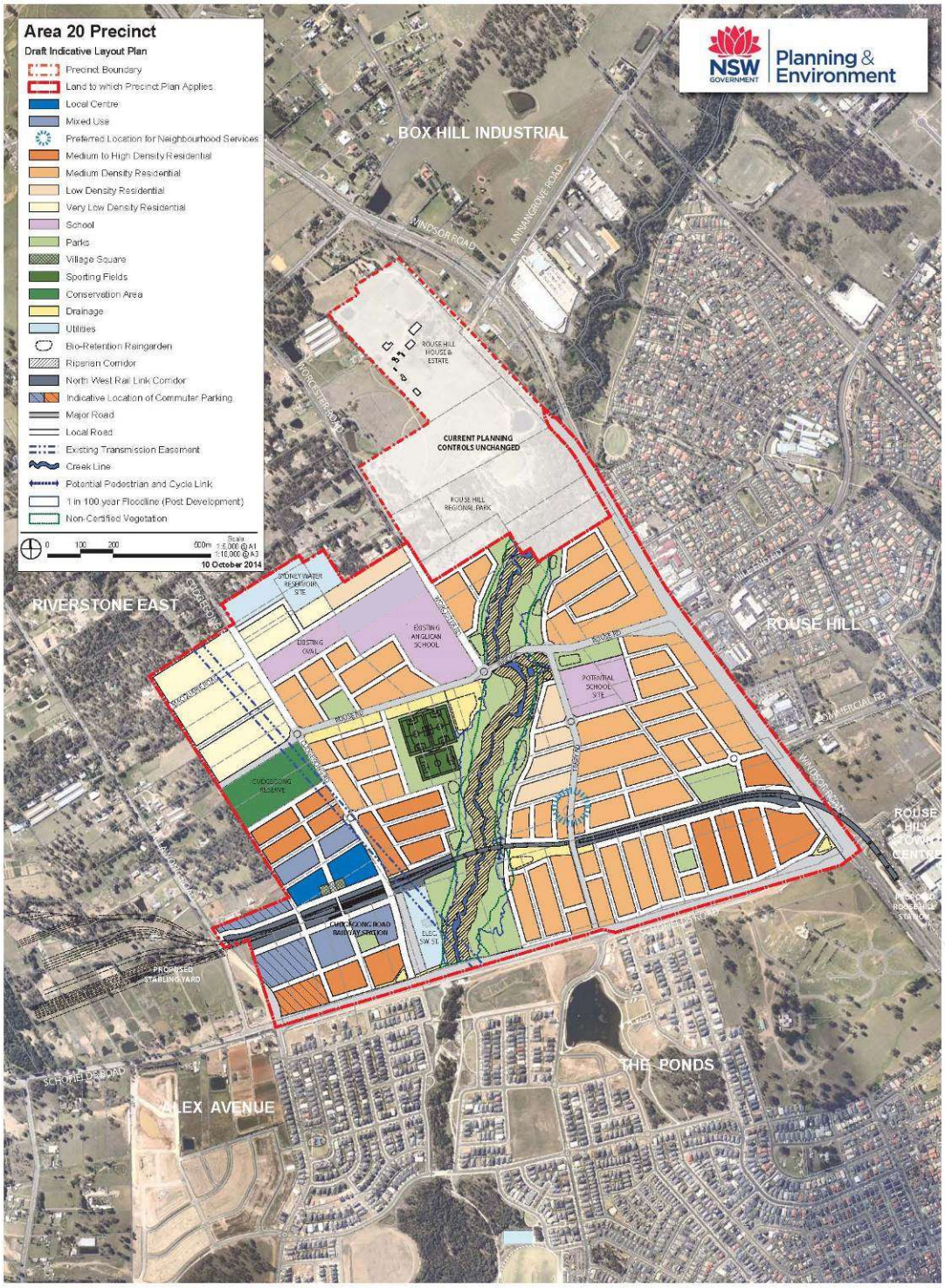
There are a number of existing receivers located near the school. These worst affected receivers are shown below in Figure 3.

Figure 3 Existing residential receivers



Council has also requested the assessment of impacts to future residential development located to the north, west and east of the school as detailed in Figure 4. This will see new low and very low density housing to the schools north. The developer to the north of the school is also proposing an alternative to the Area 20 Indicative Plan in Figure 4 with higher density housing.

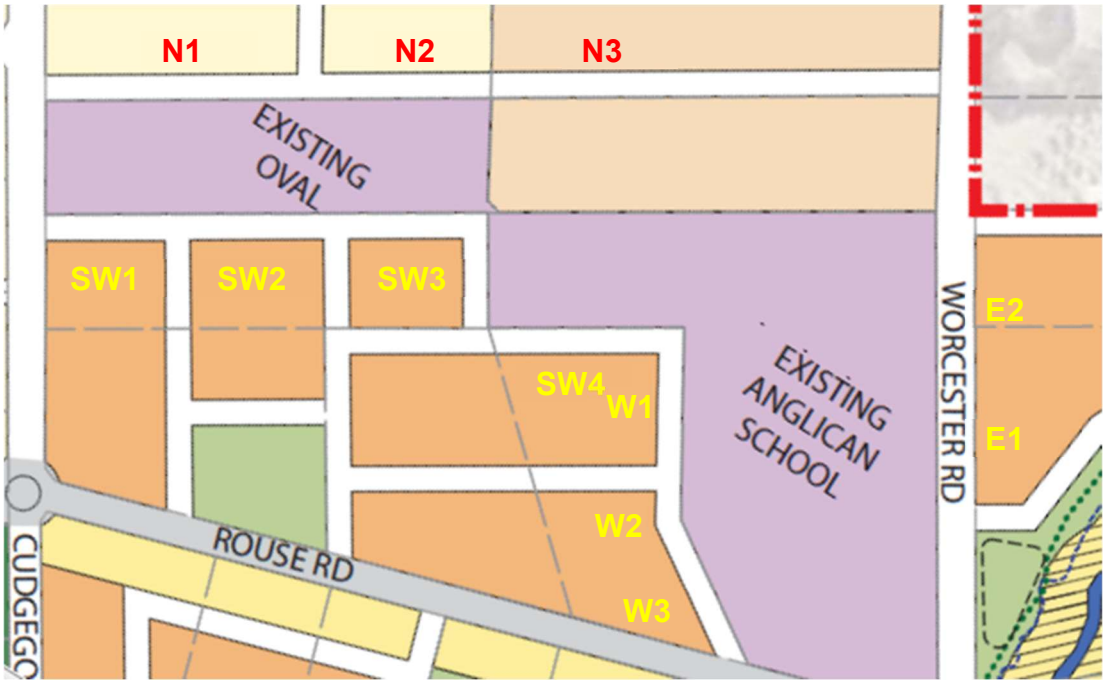
Figure 4 Area 20 Indicative Plan



The future development in the Area 20 Indicative Plan also has the potential to alter the existing acoustic environment through increased local traffic, urban noise and the end of quarry operations.

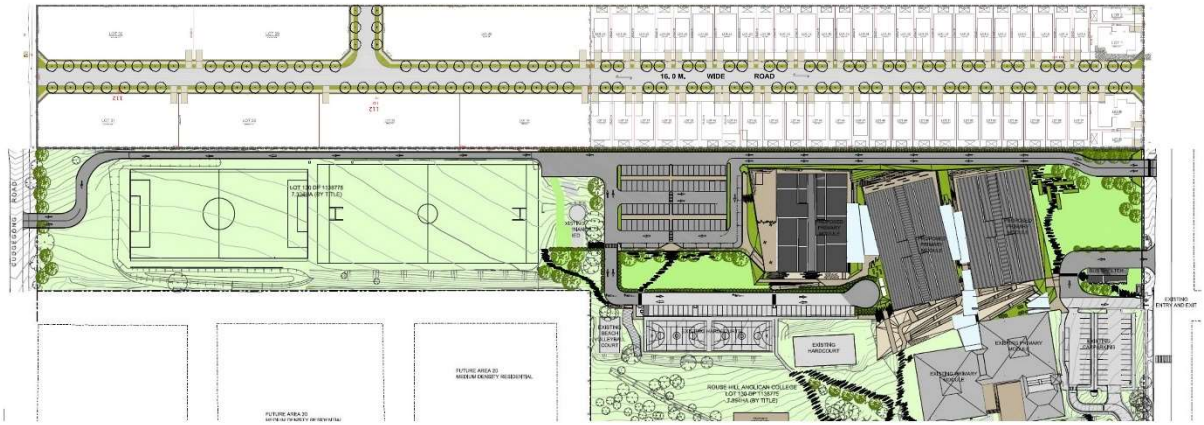
Indicative receiver locations for the future development have been identified in Figure 5.

Figure 5 Indicative receiver locations



There is also an alternative proposal to the north of the school that differs from the Area 20 plan. This is for higher density residential as illustrated in Figure 6.

Figure 6 Alternative higher density residential



This assessment considers the potential impact at all receivers but excludes any building shielding effects from the higher density development to the north of the school. This is conservative and reflects the uncertainty of the relative timing of each stage of school construction relative to the surrounding urban development in the area.

Other sensitive receivers include the existing and future buildings within the school. These have been identified in Figure 7.

Figure 7 Sensitive classrooms and admin offices within the existing school

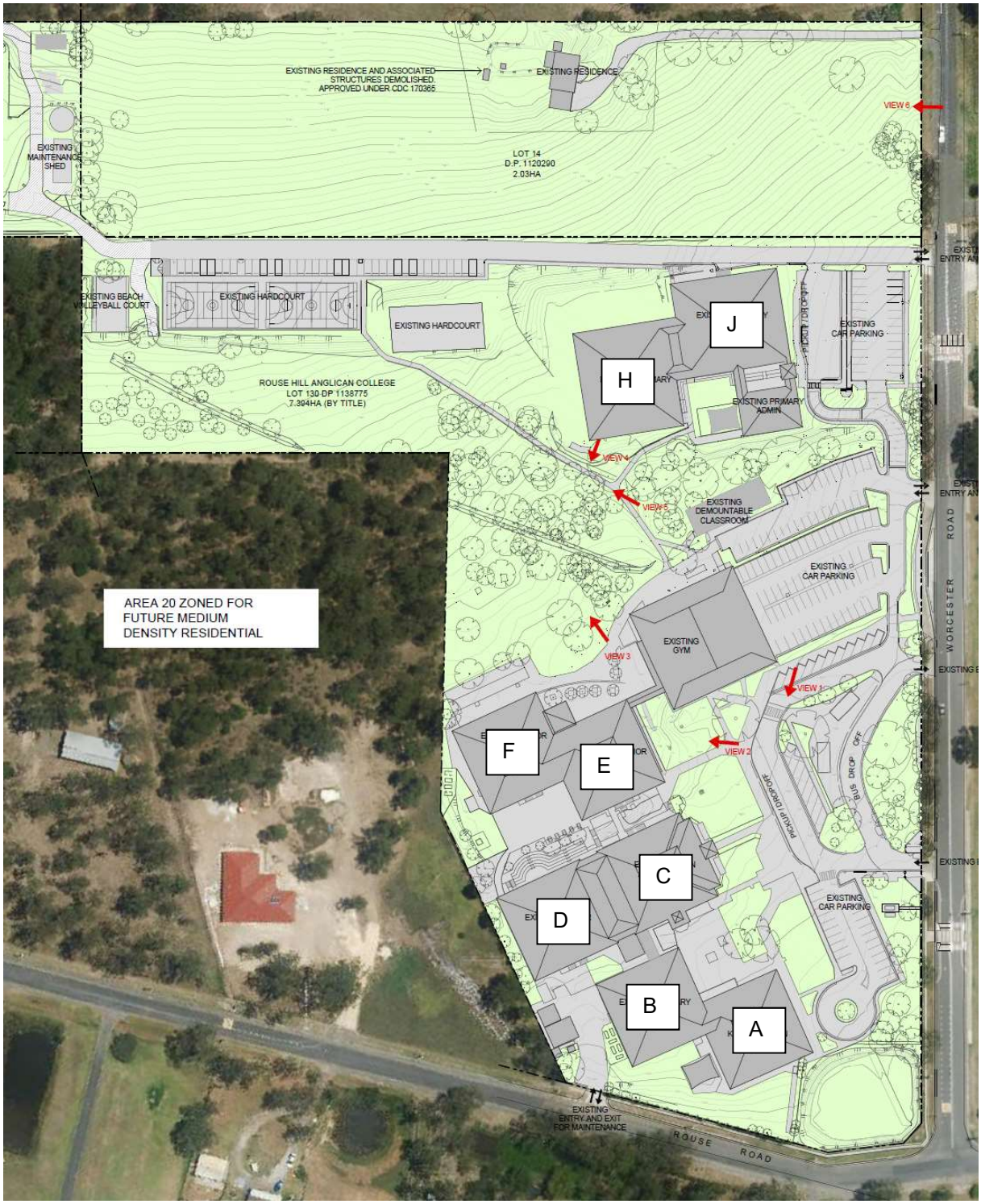


Figure 8 Sensitive classrooms and administration offices within the school following the proposed expansion

3 Ambient noise environment

Existing background noise levels

The existing acoustic environment is highly variable. It is either dominated by natural sounds from birds and insects with intermittent traffic or moderately high industrial noise from significant plant items and machinery at the quarry located on Worcester Road opposite the school. Without the quarry in operation daytime background noise levels are at the highest during peak traffic hours and typically at their lowest around midday. With the quarry in operation the noise levels increase as operations begin and remain relatively high throughout the day. With the quarry in operation the daytime noise levels are at their lowest in the build up to the morning peak traffic hour just before quarry operations begin.

The existing noise environment is likely to change as the Area 20 Indicative Plan is actioned. The change in noise level is difficult to estimate. The future acoustic environment is likely to change and may become increasingly urban with the proposed residential development surrounding the school and the future train station. These changes will result in increased traffic flows and noise from human activity. This will increase background noise levels compared to the existing situation without the quarry in operation.

The Area 20 Plan also shows that the quarry is to be developed. Future noise levels following urbanisation and development of the quarry may be similar to the current noise levels with the quarry in operation.

For the purposes of this assessment the existing background noise levels have been used to set noise goals. This is conservative and may be reviewed if necessary once detailed construction plans have been completed and once construction timing has been finalised.

Baseline noise monitoring was undertaken at the rear of the property at 110 Cudgegong Road. During this time the quarry was not in operation. The location of the logger is shown in Figure 9. This noise survey was carried out between Monday 15 May 2006 and Monday 22 May 2006. Weather during this period was generally calm and fine. The noise environment at this monitoring location was representative of the existing rural setting surrounding the school. Sources of noise identified during the site inspection include mainly natural sounds from birds and insects and leaves rustling in the wind. Noise caused by infrequent traffic along Cudgegong Road (approximately 80 m away) was identified as a minor contributor to overall acoustic environment.

Additional noise monitoring was completed between Thursday 17 and Thursday 24 September 2015 as is shown in Figure 9. During this time the quarry was in operation during most of the day time period with audible machinery noise on weekdays and Saturday. The logger was placed opposite 53 Worcester Road which is closest to the proposed new classrooms.

The noise monitoring was carried out using an Infobyte iM3 (2006) and an ARL Ngara (2015) automated noise logger, a NATA calibrated Type 1 logger. They were programmed to continuously monitor and record various statistical noise descriptors in consecutive 15 minutes intervals throughout the monitoring period. The Ngara also recorded audio files. Calibration was checked prior to and following the noise survey, and any drift was found to be within acceptable limits.

Figure 9 Noise Logging Location

Table 1 presents the summary of Rating Background Levels (RBL's), the noise levels relevant to the assessment of mechanical plant noise in accordance with the NSW's EPA's Industrial Noise Policy (INP). Note the day period is defined as the period between the hours of 7:00 am and 6:00 pm Monday to Saturday, and between 8:00am and 6:00pm Sundays and Public Holidays. The evening is defined as the period between 6:00 pm to 10:00 pm Monday to Sunday and on Public Holidays.

The measured ambient L_{Aeq} noise levels due to road traffic and the quarry on Worcester Road were between 50dBA and 55dBA.

Table 1 Summary of RBL Noise Levels from logging

Receiver Location	Rating Background Levels (RBLs)		
	Day Period, dBA	**Evening Period, dBA**	**Night-time Period, dBA**
Cudgegong Road, Rouse Hill (2006)	34[1]	33	30[2]

1 Background noise level around midday without quarry

2 Night time noise levels regularly drop below 30dBA. Under the EPA's INP the background noise level in these situations is set at 30dBA for assessment purposes.

The results of the noise survey are presented in Appendix A.

4 Noise goals

4.1 EPA construction noise goals

The noise goals for construction projects in NSW are defined in the EPA's Interim Construction Noise Guideline (ICNG). The noise goals are not mandatory, instead the guideline calls for the feasible and reasonable application of mitigation measures and requires a proactive approach to managing community impacts.

For residential receivers the noise goals are external and set relative to the background noise level for the daytime, evening and night time periods. For sensitive receivers such as schools internal noise goals are defined that are designed to not unduly impact learning. The ICNG noise goals are presented in Table 2.

Table 2 ICNG noise goals for construction – external noise levels

Time of Day	**Noise Management Level $L_{Aeq(15minute)}$**	**How to apply**
Recommended standard hours: Monday to Friday 7.00 am to 6.00 pm Saturday 8.00 am to 1.00 pm No work on Sundays or public holidays	Noise affected RBL + 10 dBA	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq(15minute) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to minimise noise. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details
	Highly noise affected 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the proponent should consider very carefully if there is any other feasible and reasonable way to reduce noise to below this level. If no quieter work method is feasible and reasonable, and the works proceed, the proponent should communicate with the impacted residents by clearly explaining the duration and noise level of the works, and by describing any respite periods that will be provided.

Time of Day	Noise Management Level $L_{Aeq(15minute)}$)	How to apply
Outside recommended standard hours	Noise affected RBL + 5 dBA	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dBA above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see Section 7.2.2 of the Interim Construction Noise Guideline.

Internal noise goals for classrooms and other sensitive receivers are provided below in Table 3.

Table 3 ICNG noise goals for construction – internal noise levels

Land Use	Management Level, $L_{Aeq(15minute)}$ (Applies When Land Use is being Utilised)
Classrooms at schools and other educational institutions	Internal noise level 45 dBA
Hospital wards and operating theatres	Internal noise level 45 dBA
Places of Worship	Internal noise level 45 dBA
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	External noise level 65 dBA
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External noise level 60 dBA
Community Centres	Depends on the intended use of the centre. Refer to the recommended 'maximum' internal levels in AS2107 for specific uses.

Due to the broad range of sensitivities that commercial or industrial land can have to noise from construction, the process of defining management levels is separated into three categories. The external noise levels should be assessed at the most-affected occupied point of the premises:

- industrial premises: external $L_{Aeq(15\ minute)}$ 75 dBA
- offices, retail outlets: external $L_{Aeq(15\ minute)}$ 70 dBA

4.2 Project specific noise goals

The external noise goals for representative residential receivers are presented in Table 4 below.

Table 4 ICNG project specific noise goals – external noise levels

Representative receiver Location	**Construction noise goals, $L_{Aeq\ 15\ minute}$**		
	Day Period, dBA	**Evening Period, dBA**	**Night-time Period, dBA**
Standard hours			
Cudgegong Road, Rouse Hill (2006)	44[1]	-	-
Out of hours works			
Cudgegong Road, Rouse Hill (2006)	39[1]	38	35

The school classrooms are the only other sensitive receiver which has been identified in the area. The internal noise goal for classrooms is 45 dBA. This equates to an external noise goal of 65dBA assuming that closed windows provide 20dBA of noise reduction. This level of noise reduction is typically achieved with standard windows and glazing.

4.3 Road traffic noise

The EPA's Construction Noise Guideline refers to the NSW Road Noise Policy for the assessment of construction traffic on public roads.

For construction traffic an initial screening test shall be applied by evaluating whether noise levels will increase by more than 2dBA due to construction. Where increases are 2dBA or less then no further assessment is required as the effect of construction traffic is barely perceptible.

5 Construction vibration objectives

The effects of vibration in buildings can be divided into three main categories; those in which the occupants or users of the building are inconvenienced or possibly disturbed, those where the building contents may be affected and those in which the integrity of the building or the structure itself may be prejudiced.

5.1 Human perception of vibration

Guidance in relation to acceptable vibration levels for human comfort are provided in OEH's Assessing Vibration: a technical guideline (February 2006). This document is based on the guidelines contained in BS 6472-1992.

The OEH guideline provides thee assessment methods, depending on whether the vibration is continuous, impulsive or intermittent. The preferred and maximum values are provided in Table 5.

- Continuous vibration would normally be generated by fixed plant items such as generators, fans and the like where the vibration emissions continue uninterrupted (usually throughout the daytime or night-time period).

- Impulsive vibration would normally be generated by short duration (ie less than two second) events with no more than three occurrences in an assessment period. A typical example would be ground compaction by dropping a large mass. Higher levels are allowed for impulsive vibration, however if more than three impulsive vibration events occur during the assessment period, the more stringent intermittent objectives are applied.

- Intermittent vibration can be defined as interrupted periods of continuous vibration (eg vibratory rolling, heavy truck passbys or rockbreaking) or continuous periods of impulsive vibration (eg impact pile driving). Higher vibration levels are allowed for intermittent vibration compared with continuous vibration on the basis that the higher levels occur over a shorter time period. Hence, for intermittent vibration, human comfort vibration levels are assessed on the basis of the Vibration Dose Value, based on the level and the duration of the vibration events.

Table 5 Preferred and maximum vibration levels for human comfort

Location	**Assessment period**	**Preferred values**		**Maximum values**	
Continuous vibration		**z axis**	**x and y axes**	**z axis**	**x and y axes**
Critical areas	Day- or night-time	0.005 m/s^2	0.0036 m/s^2	0.010 m/s^2	0.0072 m/s^2
Residences	Daytime	0.010 m/s^2	0.0071 m/s^2	0.020 m/s^2	0.014 m/s^2
	Night-time	0.007 m/s^2	0.005 m/s^2	0.014 m/s^2	0.010 m/s^2
Offices, schools, educational institutions and places of worship	Day- or night-time	0.020 m/s^2	0.014 m/s^2	0.040 m/s^2	0.028 m/s^2
Workshops	Day- or night-time	0.040 m/s^2	0.029 m/s^2	0.080 m/s^2	0.058 m/s^2
Impulsive vibration		**z axis**	**x and y axes**	**z axis**	**x and y axes**
Critical areas	Day- or night-time	0.005 m/s^2	0.0036 m/s^2	0.010 m/s^2	0.0072 m/s^2
Residences	Daytime	0.30 m/s^2	0.21 m/s^2	0.60 m/s^2	0.42 m/s^2
	Night-time	0.10 m/s^2	0.071 m/s^2	0.20 m/s^2	0.14 m/s^2
Offices, schools, educational institutions and places of worship	Day- or night-time	0.64 m/s^2	0.46 m/s^2	1.28 m/s^2	0.92 m/s^2
Workshops	Day- or night-time	0.64 m/s^2	0.46 m/s^2	1.28 m/s^2	0.92 m/s^2
Intermittent vibration		**x, y and z axes**		**x, y and z axes**	
Critical Areas	Day- or night-time	0.10 $m/s^{1.75}$		0.20 $m/s^{1.75}$	
Residences	Daytime	0.20 $m/s^{1.75}$		0.40 $m/s^{1.75}$	
	Night-time	0.13 $m/s^{1.75}$		0.26 $m/s^{1.75}$	
Offices, schools, educational institutions and places of worship	Day- or night-time	0.40 $m/s^{1.75}$		0.80 $m/s^{1.75}$	
Workshops	Day- or night-time	0.80 $m/s^{1.75}$		1.60 $m/s^{1.75}$	

- Notes:
- For continuous and intermittent vibration, the preferred and maximum values are weighted acceleration values (Wg for z axis and Wd for x and y axes).
- For intermittent vibration, the preferred and maximum values are Vibration Dose Values (VDVs), based on the weighted acceleration values.

5.2 Effects on building contents

People can perceive floor vibration at levels well below those likely to cause damage to building contents or affect their operation. For most receivers, the controlling vibration criterion is therefore the human comfort criterion and separate objectives are not normally required in relation to the effect of construction vibration on building contents.

Ground vibration – Minimum working distances from sensitive receivers

As a guide, minimum working distances from sensitive receivers for typical items of vibration intensive plant are listed in Table 6. The minimum distances are quoted for both “cosmetic” damage (refer BS 7385) and human comfort (refer OH&E’s Assessing Vibration - a technical guideline). The minimum working distances for cosmetic damage must be complied with at all times, unless otherwise approved under the environmental license as relevant. DIN 4150 has criteria of particular reference for heritage structures.

Table 6: Recommended minimum working distances for vibration intensive plant from sensitive receiver

Plant item	**Rating / Description**	**Minimum working distance**	
		Cosmetic damage (BS 7385)	**Human response (OH&E Vibration guideline)**
Vibratory Roller	< 50 kN (Typically 1-2 tonnes)	5 m	15 m to 20 m
	< 100 kN (Typically 2-4 tonnes)	6 m	20 m
	< 200 kN (Typically 4-6 tonnes)	12 m	40 m
	< 300 kN (Typically 7-13 tonnes)	15 m	100 m
	> 300 kN (Typically 13-18 tonnes)	20 m	100 m
	> 300 kN (> 18 tonnes)	25 m	100 m
Small Hydraulic Hammer	(300 kg - 5 to 12t excavator)	2 m	7 m
Medium Hydraulic Hammer	(900 kg – 12 to 18t excavator)	7 m	23 m
Large Hydraulic Hammer	(1600 kg – 18 to 34t excavator)	22 m	73 m
Vibratory Pile Driver	Sheet piles	2 m to 20 m	20 m

Plant item	Rating / Description	Minimum working distance	
		Cosmetic damage (BS 7385)	Human response (OH&E Vibration guideline)
Pile Boring	≤ 800 mm	2 m (nominal)	4 m
Jackhammer	Hand held	1 m (nominal)	2 m

Note: More stringent conditions may apply to heritage or other sensitive structures

The minimum working distances are indicative and will vary depending on the particular item of plant and local geotechnical conditions. They apply to cosmetic damage of typical buildings under typical geotechnical conditions. Vibration monitoring is recommended to confirm the minimum working distances at specific sites.

In relation to human comfort (response), the minimum working distances in Table 6 relate to continuous vibration. For most construction activities, vibration emissions are intermittent in nature and for this reason, higher vibration levels, occurring over shorter periods are allowed (see OEH's Assessing Vibration: a technical guideline).

If the predicted ground-bourne vibration levels exceed the cosmetic damage objectives, a different construction method with lower source vibration levels must be used where feasible and reasonable otherwise construction works should not proceed unless attended vibration measurements are undertaken at the commencement of the works. If there is any risk of exceedance of the cosmetic damage objective, a permanent vibration monitoring system should be installed, to warn plant operators (via flashing light, audible alarm, SMS, etc) when vibration levels are approaching the cosmetic damage objective.

Ground-borne noise

Underground vibration intensive works may be transmitted through the ground into a building structure creating noise. This may also occur when works are completed in a different floor or occupancy of a building. Ground-borne noise becomes apparent where typical noise paths through the air are blocked.

These effects are considered unlikely for the proposed works at the school.

Table 7: Ground-bourne noise criteria

Time of day	**Ground-borne noise objectives** $L_{Aeq(15minute)}$
Daytime 7.00 am to 6.00 pm	Human comfort vibration objectives only
Evening 6.00 pm to 10.00 pm	40 dBA - Internal
Night-time 10.00 pm to 7.00 am	35 dBA - Internal

6 Construction noise modelling

The Construction Management Plan provides further detail for each stage of construction for the school expansion. Each stage is summarised in the figures and captions below:

Figure 10 Stage 1: Construction of Junior Classrooms and first stage of car parking

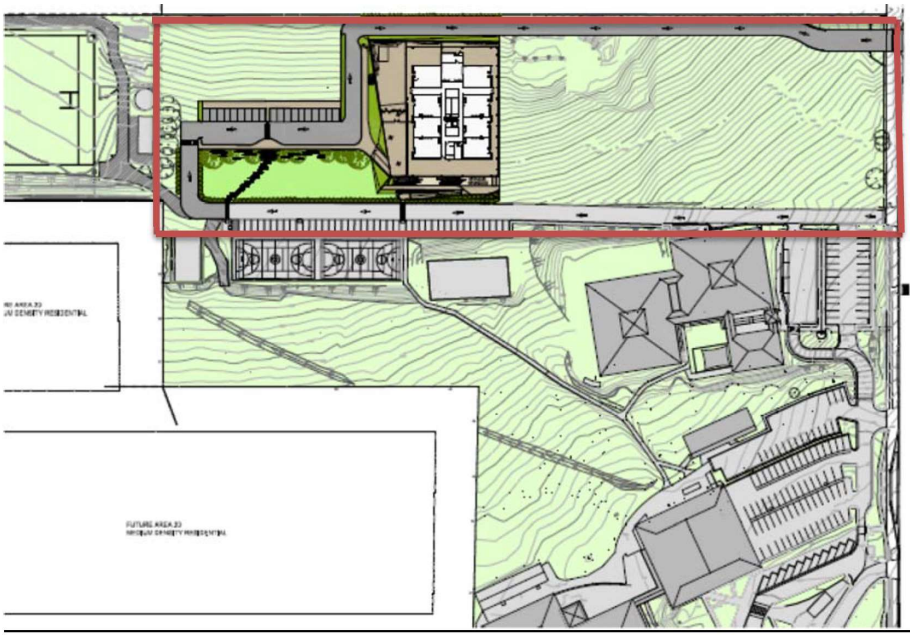


Figure 11 Stage 2: Construction of Junior Classrooms and second stage of car parking internal road network

Figure 12 Stage 3: Construction of Senior Classrooms

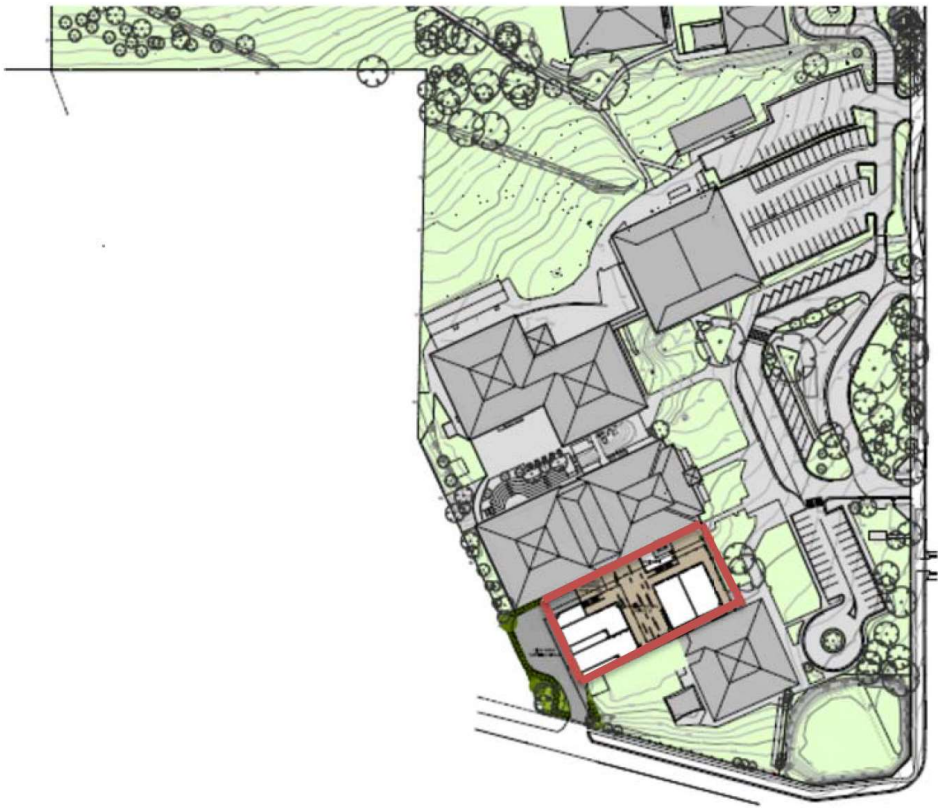


Figure 13 Stage 4: Construction of Library and Outdoor Learning Area

Figure 14 Stage 5: Constructed Senior Classrooms

Figure 15 Stage 6: Constructed Multi-Purpose Centre

Figure 16 Stage7: Construction of Junior Classrooms

From a noise perspective, these stages may be broken down into a number of activities and plant items for assessment. These may be refined following the appointment of a contractor and when the final construction methodology is confirmed. For this assessment, the following scenarios in Table 8 have been considered for each of the construction stages. Please see Table 9 for individual plant source levels.

Table 8 Construction scenarios and overall sound power level

Activity and Plant	**Sound Power Level, dBA**
Construction of the private road and carpark in stages 1 and 2	
Earthworks using a bulldozer and grader with spoil trucks and occasional rock breaking	122 with breaker 116 without breaker
Depositing road base, compacting and vibratory rolling. Using rollers, trucks and a grader	114
Hotmix road surface using trucks and a roller	116
Demolition of some existing junior classrooms and caretaker buildings in Stages 5 and 6	
Rock breaker, onsite crane, front end loader and trucks	123 with breaker 114 without breaker

Activity and Plant	Sound Power Level, dBA
Construction of new buildings in all stages	
Initial earthworks with a digger, trucks, bulldozer/front end load and a rock breaker	122 with breaker 116 without breaker
Slab construction with trucks and a concrete pump etc	111
Then general construction with trucks, onsite crane, basic power tools/hand tools	111

Table 9 Plant items used in scenarios

Plant item	Sound Power Level, dBA
Rock breaker	122
Hotmix truck	114
Bulldozer	112
Front end loader	112
Grader	110
Excavator	110
Truck	110
Digger	110
Roller	107
Hand tools	105
Concrete pump	102
Crane	98

7 Noise assessment

7.1 Overview

This noise assessment presents predicted noise levels at each construction stage for typical activities at the worst affected receivers. The exceedences are discussed qualitatively based on how audible the noise levels will appear relative to the background noise level.

The predicted noise level exceedences are for standard construction hours between 7am and 6pm Monday to Friday and 8am to 1pm Saturday. The same noise levels would also be predicted for out of hours work. Out of hours works has not been assessed.

Out of hours work in the day time would have noise level exceedences 5dBA higher than predicted in the assessment tables. Noise levels from evening works would have noise level exceedences that are 6dBA higher than predicted in the following tables.

The range in noise levels and exceedences are typical for the construction of a new road and buildings near residential receivers. Recommended noise management measures for these noise levels and exceedences are discussed in Section 8 based on industry best practices supported by the NSW EPA.

Noise levels predicted for the private road are the worst case when plant is operating on the section of road closest to the receiver. Most of the time noise levels will be less when plant is working on sections of road further from the receiver. This means that the worst case noise levels for the private road presented in the tables will not all occur at the same time.

7.2 Impacts on residential receivers

Stage 1 and Stage 2 - Road and carpark construction

Discussion of activities and noise levels

The highest noise levels are predicted to occur during initial earthworks where the rock breaker may be used to prepare the site. Noise from the rock breaker is only expected to occur occasionally. Noise levels during the remainder of the earthworks using a bulldozer, grader and spoil trucks are predicted to be up to 6dBA quieter. Noise levels while depositing the road base, compacting and rolling as well as laying the road surface are also predicted to be 6dBA to 7dBA quieter than the rock hammering.

Existing receivers

The noise levels at existing receivers are predicted to range from 52dBA to 61dBA during rock break and from 46dBA to 53dBA for the other works (see Table 10) when the carpark is constructed. The noise level exceedences in Table 11 from these works are typically 5dBA to 15dBA and are expected to be clearly audible to moderately intrusive.

Table 10 Noise level from carpark construction – Stage 1 and 2

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Road base	Road surfacing
A	44	55	49	47	49
B	44	56	50	48	50
C	44	56	50	48	50
D	44	57	51	49	51
E	44	59	53	51	53
F	44	59	53	51	53
G	44	61	55	53	55
H	44	58	52	50	52
I	44	56	50	48	50
J	44	55	49	47	49
K	44	54	48	46	48
L	44	53	47	45	47
M	44	52	46	44	46
N	44	59	53	51	53
O	44	57	51	49	51
P	44	56	50	48	50

Table 11 Exceedence of noise goal by carpark construction – Stage 1 and 2

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Road base	Road surfacing
A	44	11	5	3	5
B	44	12	6	4	6
C	44	12	6	4	6
D	44	13	7	5	7
E	44	15	9	7	9
F	44	15	9	7	9
G	44	17	11	9	11
H	44	14	8	6	8
I	44	12	6	4	6
J	44	11	5	3	5
K	44	10	4	2	4
L	44	9	3	1	3
M	44	8	2	-	2
N	44	15	9	7	9
O	44	13	7	5	7
P	44	12	6	4	6

Noise levels from the construction of the private road are much higher at receivers B, C, D, N, O and P than the carpark construction (see Table 12). This is because the private road passes close to these existing receivers. These noise levels are the expected worst case noise levels that will occur when plant is working at a position on the private road that is closest to the receiver. For much of the time during the private road construction the noise levels at receivers B, C, D, N, O and P will be much lower when the plant is further away on another part of the road. For most of the duration of the works noise levels will by 8dBA to 10dBA quieter than rock breaking and range between 43dBA to 62dBA at different receivers.

Table 12 Noise level from private road construction – Stage 1 and 2

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	**Rock Breaker**	**Earthworks**	**Road base**	**Road surfacing**
A	44	60	52	50	52
B	44	67	59	57	59
C	44	72	64	62	64
D	44	70	62	60	62
E	44	62	54	52	54
F	44	60	52	50	52
G	44	60	52	50	52
H	44	57	49	47	49
I	44	55	47	45	47
J	44	54	46	44	46
K	44	53	45	43	45
L	44	54	46	44	46
M	44	56	48	46	48
N	44	70	62	60	62
O	44	74	66	64	66
P	44	74	66	64	66

The worst noise level exceedences will occur at receivers B, C, D, N, O and P. At receivers B, C, D, N, O and P noise levels will be highly intrusive during rock breaking. Noise levels at receivers O and P are close to the EPA's highly affected noise limit of 75dBA where they recommend the proponent should communicate with the impacted residents by clearly explaining the duration and noise level of the works, and by describing any respite periods that will be provided. During other works noise levels at receivers A and E to M will mostly be clearly audible, moderately intrusive at receivers B, C, D and N and highly intrusive at receivers O to P when plant is located on the section of road closest to the receiver. However, most of the time noise levels and exceedences will be considerably less when plant is on other sections of road rather than on the section of road adjacent to the receiver.

Table 13 Exceedence of noise goal by private road construction – Stage 1 and 2

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Road base	Road surfacing
A	44	16	8	6	8
B	44	23	15	13	15
C	44	28	20	18	20
D	44	26	18	16	18
E	44	18	10	8	10
F	44	16	8	6	8
G	44	16	8	6	8
H	44	13	5	3	5
I	44	11	3	1	3
J	44	10	2	-	2
K	44	9	1	-	1
L	44	10	2	-	2
M	44	12	4	2	4
N	44	26	18	16	18
O	44	30	22	20	22
P	44	30	22	20	22

Future receivers in Area 20 Plan

The Area 20 Plan proposes new receivers that are much closer to the carpark works than existing receivers. The closest indicative future receivers are N1 and N2 where noise levels of 67dBA to 71dBA respectively are predicted during rock breaking (see Table 14). Future indicative receivers SW2, SW3 and SW4 are also close with noise levels ranging between 60dBA and 66dBA during rock breaking. Noise levels at other receivers range between 56dBA and 64dBA during rock breaking. The noise levels at all receivers are expected to be around 6dBA less for construction activities other than rock breaking.

Table 14 Noise level from carpark construction – Stage 1 and 2

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Road base	Road surfacing
E1	44	56	50	48	50
E2	44	58	52	50	52
N1	44	59	53	51	53
N2	44	67	61	59	61
N3	44	71	65	63	65
SW1	44	60	54	52	54
SW2	44	57	51	49	51
SW3	44	66	60	58	60

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Road base	Road surfacing
SW4	44	66	60	58	60
W1	44	64	58	56	58
W2	44	58	52	50	52
W3	44	57	51	49	51

The worst noise level exceedences will occur at receivers N2, N3, SW3 and SW4. The noise levels at all receivers are predicted to be highly intrusive during rock breaking. Noise levels during other activities range may still be highly intrusive at receivers N3 during other earthworks and surfacing. During other earthworks, preparing road base and surfacing the noise levels are expected to range from clearly audible to moderately intrusive at other receivers.

Table 15 Exceedence of noise goal by carpark construction – Stage 1 and 2

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Road base	Road surfacing
E1	44	12	6	4	6
E2	44	14	8	6	8
N1	44	15	9	7	9
N2	44	23	17	15	17
N3	44	27	21	19	21
SW1	44	16	10	8	10
SW2	44	13	7	5	7
SW3	44	22	16	14	16
SW4	44	22	16	14	16
W1	44	20	14	12	14
W2	44	14	8	6	8
W3	44	13	7	5	7

The private road construction (see Table 16), as for the existing receivers, has the potential to cause higher noise levels than the carpark construction when plant equipment is located on the new private road close to the residence. The duration of impact is expected to be less than for the carpark as the plant equipment progresses along the private road. Noise levels at indicate receivers N1, N2 and N3 are predicted to be highly affected as defined by the NSW EPA's construction noise guideline during rock breaking and would require additional communication with the impacted residents including clear explanation of the duration of the works, engaging with the receivers to identify potential for respite and improved scheduling of the works. Noise levels at receiver SW1, SW2 and SW3 are also relatively high ranging from 69dBA to 71dBA during rock breaking. Again, for the overall duration of the works most activities will be around 8dBA to 10dBA quieter than rock breaking.

Table 16 Noise level from private road construction – Stage 1 and 2

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Road base	Road surfacing
E1	44	60	52	50	52
E2	44	67	59	57	59
N1	44	79	71	69	71
N2	44	79	71	69	71
N3	44	76	68	66	68
SW1	44	69	61	59	61
SW2	44	71	63	61	63
SW3	44	70	62	60	62
SW4	44	63	55	53	55
W1	44	60	52	50	52
W2	44	67	59	57	59
W3	44	56	48	46	48

Based on the noise level exceedences, noise from the rock breaker is expected to be highly intrusive at most receivers and moderately intrusive at receivers E1, SW4, W1 and W3 when plant is operating on the section of road closest to the receiver. Noise levels are still predicted to be highly intrusive at receivers N1 to N3 during other works. Noise levels at E2, SW1, SW2, SW3 and W2 are predicted to be moderately intrusive and clearly audible at E1, W1 and W3 during the other works. Again it should be noted that the duration of these worst case noise levels is limited to when the receiver is exposed to noise from plant working in the section of road closest to the receiver. At other times noise levels will be lower.

Table 17 Exceedence of noise goal by private road construction – Stage 1 and 2

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Road base	Road surfacing
E1	44	16	8	6	8
E2	44	23	15	13	15
N1	44	35	27	25	27
N2	44	35	27	25	27
N3	44	32	24	22	24
SW1	44	25	17	15	17
SW2	44	27	19	17	19
SW3	44	26	18	16	18
SW4	44	19	11	9	11
W1	44	16	8	6	8
W2	44	23	15	13	15
W3	44	12	4	2	4

Potential high density receivers north of the school

The highest impact from the carpark and private road construction is predicted to occur at the high density receivers north of the school. These receivers are very close to the works with property boundaries within a couple of metres from the new private rod and residences approximately 7m from the works. The noise levels from carpark construction exceed the EPA ICNG's highly noise affected criteria of 75dBA in catchments NCA1 and NCA2 (Table 18).

Table 18 Noise level from carpark construction – Stage 1 and 2

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Road base	Road surfacing
NCA1 GF	44	59-81	53-75	51-73	53-75
NCA2 GF	44	61-80	55-74	53-72	55-74
NCA3 GF	44	56-72	50-66	48-64	50-66
NCA4 GF	44	57-71	51-65	49-63	51-65
NCA5 GF	44	56-68	50-62	48-60	50-62
NCA1 F1	44	73-84	67-78	65-76	67-78
NCA2 F1	44	61-83	55-77	53-75	55-77
NCA3 F1	44	56-72	50-66	48-64	50-66
NCA4 F1	44	61-72	55-66	53-64	55-66
NCA5 F1	44	56-68	50-62	48-60	50-62

The noise levels at most catchments have the potential to be highly intrusive throughout the works at the closest receivers to the works in all catchments except NCA5. In NCA5 the noise levels may be highly intrusive only during the rock breaking.

Table 19 Exceedence of noise goal by carpark construction – Stage 1 and 2

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Road base	Road surfacing
NCA1 GF	44	15-37	9-31	7-29	9-31
NCA2 GF	44	17-36	11-30	9-28	11-30
NCA3 GF	44	12-28	6-22	4-20	6-22
NCA4 GF	44	13-27	7-21	5-19	7-21
NCA5 GF	44	12-24	6-18	4-16	6-18
NCA1 F1	44	29-40	23-34	21-32	23-34
NCA2 F1	44	17-39	11-33	9-31	11-33
NCA3 F1	44	12-28	6-22	4-20	6-22
NCA4 F1	44	17-28	11-22	9-20	11-22
NCA5 F1	44	12-24	6-18	4-16	6-18

Out of all the construction stages the private road construction has the potential to impact on the receivers to the north of the school more greatly than that for any other works and any other receiver. This is because road construction is a relatively noisy activity and the boundary of the receivers is within a few metres of the works and the dwelling approximately 7m from the works.

The noise levels in Table 20 exceed the EPA ICNGS highly affected criteria at all receivers within NCA1 for all works and at some receivers within NCA2 and NCA3 for all of the works. Noise levels in many instances exceed 85dBA which exceeds the noise threshold where hearing protection is required.

Table 20 Noise level from private road construction – Stage 1 and 2

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Road base	Road surfacing
NCA1 GF	44	60-96	52-88	50-86	52-88
NCA2 GF	44	85-96	77-88	75-86	77-88
NCA3 GF	44	80-98	72-90	70-88	72-90
NCA4 GF	44	65-74	57-66	55-64	57-66
NCA5 GF	44	71-75	63-67	61-65	63-67
NCA1 F1	44	90-95	82-87	80-85	82-87
NCA2 F1	44	87-95	79-87	77-85	79-87
NCA3 F1	44	87-96	79-88	77-86	79-88
NCA4 F1	44	67-76	59-68	57-66	59-68
NCA5 F1	44	72-76	64-68	62-66	64-68

The predicted noise level exceedences in Table 21 are highly intrusive at receivers within all catchments for all stages of the works when plant is operating on the section of the road closest to the receiver.

Table 21 Exceedence of noise goal by private road construction – Stage 1 and 2

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Road base	Road surfacing
NCA1 GF	44	16-52	8-44	6-42	8-44
NCA2 GF	44	41-52	33-44	31-42	33-44
NCA3 GF	44	36-54	28-46	26-44	28-46
NCA4 GF	44	21-30	13-22	11-20	13-22
NCA5 GF	44	27-31	19-23	17-21	19-23
NCA1 F1	44	46-51	38-43	36-41	38-43
NCA2 F1	44	43-51	35-43	33-41	35-43
NCA3 F1	44	43-52	35-44	33-42	35-44
NCA4 F1	44	23-32	15-24	13-22	15-24
NCA5 F1	44	28-32	20-24	18-22	20-24

Stage 1 - Classrooms

Existing receivers

During the construction of the new classroom noise levels at existing receivers are low to moderate ranging from 44dBA to 65dBA (see Table 22). Preparation of the site dock breaking and earthworks are the noisiest works and are 11dBA and 5dBA respectively noisier than during the construction of the building.

Table 22 Noise levels during construction of new classroom – Stage 1

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
A	44	56	50	45	45
B	44	57	51	46	46
C	44	57	51	46	46
D	44	57	51	46	46
E	44	60	54	49	49
F	44	61	55	50	50
G	44	63	57	52	52
H	44	61	55	50	50
I	44	58	52	47	47
J	44	57	51	46	46
K	44	57	51	46	46
L	44	56	50	45	45
M	44	55	49	44	44
N	44	64	58	53	53
O	44	63	57	52	52
P	44	65	59	54	54

At most receivers noise levels are predicted to be moderately intrusive during rock breaking at all receivers and at receivers F, G, H, N, O and P during earthworks. At all other locations noise levels will be clearly audible during the earthworks. At all locations, except location N, noise levels are predicted to be clearly audible. Noise levels at location N comply with the noise goal and will be noticeable from time to time.

Table 23 Exceedences during construction of the new classroom – Stage 1

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
A	44	12	6	1	1
B	44	13	7	2	2
C	44	13	7	2	2
D	44	13	7	2	2
E	44	16	10	5	5

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
F	44	17	11	6	6
G	44	19	13	8	8
H	44	17	11	6	6
I	44	14	8	3	3
J	44	13	7	2	2
K	44	13	7	2	2
L	44	12	6	1	1
M	44	11	5	-	-
N	44	20	14	9	9
O	44	19	13	8	8
P	44	20	15	10	10

Future receivers in Area 20 Plan

The noise levels at most future receiver in the Area 20 Plan are moderate for most of the works ranging between 46dBA and 63dBA. Noise levels are highest at receivers N2, N3, SW3, SW4 and W1 ranging between 66dBA and 75dBA. The highest noise level of 75dBA at N3 during use of the rock breaker is at the EPA ICNG's highly affected limit.

Table 24 Noise levels during construction of new classroom – Stage 1

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
E1	44	60	54	49	49
E2	44	63	57	52	52
N1	44	59	53	48	48
N2	44	67	61	56	56
N3	44	75	69	64	64
SW1	44	61	55	50	50
SW2	44	57	51	46	46
SW3	44	66	60	55	55
SW4	44	69	63	58	58
W1	44	68	62	57	57
W2	44	63	57	52	52
W3	44	60	54	49	49

The noise level exceedences (see Table 25) at N3 have the potential to be highly intrusive throughout most of the works and during use of the rock breaker at receivers N2, SW3, SW4 and W1. At other receivers noise levels will mostly be moderately intrusive while the rock breaker is used or earthworks

are being completed. During building construction noise levels are predicted to be clearly audible at receivers E1, E2, N1, SW1, SW2 and moderately intrusive elsewhere.

Table 25 Excedences during construction of new classroom – Stage 1

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
E1	44	16	10	5	5
E2	44	19	13	8	8
N1	44	15	9	4	4
N2	44	23	17	12	12
N3	44	31	25	20	20
SW1	44	17	11	6	6
SW2	44	13	7	2	2
SW3	44	22	16	11	11
SW4	44	25	19	14	14
W1	44	24	18	13	13
W2	44	19	13	8	8
W3	44	16	10	5	5

Potential high density receivers north of the school

The noise levels at future high density receivers north of the school are relatively high at some receivers within most noise catchments. Noise levels exceed the EPA's ICNG highly affected criteria in catchments NCA1, NCA2 and NCA3 while the rock break is in use and during earthworks in NCA2.

Table 26 Noise during classroom construction – Stage 1

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
NCA1 GF	44	61-78	55-72	50-67	50-67
NCA2 GF	44	66-82	60-76	55-71	55-71
NCA3 GF	44	56-70	50-64	45-59	45-59
NCA4 GF	44	65-74	59-68	54-63	54-63
NCA5 GF	44	56-68	50-62	45-57	45-57
NCA1 F1	44	72-78	66-72	61-67	61-67
NCA2 F1	44	68-82	62-76	57-71	57-71
NCA3 F1	44	57-77	51-71	46-66	46-66
NCA4 F1	44	67-75	61-69	56-64	56-64
NCA5 F1	44	57-69	51-63	46-58	46-58

Noise level exceedences in Table 27 indicate that noise levels are expected to be highly intrusive within all catchments when the rock breaker is in use and at some receivers during earthworks within most catchments. During slab and general construction noise are predicted to be up to 11dBA quieter and range from clearly audible to moderately intrusive at receivers in NCA3, NCA4 and NCA 5. Some receivers in NCA1 and NCA2 may still have noise levels that are highly intrusive during slab and general construction.

Table 27 Exceedence of noise goals during classroom construction – Stage 1

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
NCA1 GF	44	17-34	11-28	6-23	6-23
NCA2 GF	44	22-38	16-32	11-27	11-27
NCA3 GF	44	12-26	6-20	1-15	1-15
NCA4 GF	44	21-30	15-24	10-19	10-19
NCA5 GF	44	12-24	6-18	1-13	1-13
NCA1 F1	44	28-34	22-28	17-23	17-23
NCA2 F1	44	24-38	18-32	13-27	13-27
NCA3 F1	44	13-33	7-27	2-22	2-22
NCA4 F1	44	23-31	17-25	12-20	12-20
NCA5 F1	44	13-25	7-19	2-14	2-14

Stage 2 - Classrooms

Existing receivers

During the construction of the new classroom noise levels at existing receivers are low to moderate ranging from 32dBA to 65dBA (see Table 28). Preparation of the site dock breaking and earthworks are the noisiest works and are 11dBA and 5dBA respectively noisier than during the construction of the building. Noise levels to the west at receivers A, B and C are partially shielded from the works by the classroom constructed in Stage 1.

Table 28 Noise levels during classroom construction – Stage 1

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
A	44	44	38	33	33
B	44	44	38	33	33
C	44	43	37	32	32
D	44	52	46	41	41
E	44	54	48	43	43
F	44	55	49	44	44
G	44	57	51	46	46
H	44	58	52	47	47

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
I	44	56	50	45	45
J	44	56	50	45	45
K	44	53	47	42	42
L	44	55	49	44	44
M	44	54	48	43	43
N	44	63	57	52	52
O	44	64	58	53	53
P	44	65	59	54	54

At most receivers noise levels (Table 29) are predicted to be moderately intrusive during rock breaking at all receivers and at receivers N, O and P during earthworks. At all other locations noise levels will either comply with noise goal or be clearly audible during the earthworks.

Table 29 Exceedences during classroom construction – Stage 1

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
A	44	-	-	-	-
B	44	-	-	-	-
C	44	-	-	-	-
D	44	8	2	-	-
E	44	10	4	-	-
F	44	11	5	-	-
G	44	13	7	2	2
H	44	14	8	3	3
I	44	12	6	1	1
J	44	12	6	1	1
K	44	9	3	-	-
L	44	11	5	-	-
M	44	10	4	-	-
N	44	19	13	8	8
O	44	20	14	9	9
P	44	21	15	10	10

Future receivers in Area 20 Plan

The noise levels at most future receiver in the Area 20 Plan range from low to moderate for most of the works ranging between 33dBA and 62dBA. Noise levels are highest at receivers N3, SW4 and W1 ranging between 64dBA and 68dBA.

Table 30 Noise levels during classroom construction – Stage 1

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
E1	44	60	54	49	49
E2	44	62	56	51	51
N1	44	44	38	33	33
N2	44	51	45	40	40
N3	44	68	62	57	57
SW1	44	54	48	43	43
SW2	44	51	45	40	40
SW3	44	58	52	47	47
SW4	44	65	59	54	54
W1	44	64	58	53	53
W2	44	62	56	51	51
W3	44	58	52	47	47

The noise level exceedences (see Table 31) are greatest at receivers N3, SW4 and W1 where they have the potential to be highly intrusive during use of the rock breaker. During all other works noise levels are predicted to either comply with the noise goal or range from clearly audible to moderately intrusive.

Table 31 Exceedences during classroom construction – Stage 1

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
E1	44	16	10	5	5
E2	44	18	12	7	7
N1	44	-	-	-	-
N2	44	7	1	-	-
N3	44	24	18	13	13
SW1	44	10	4	-	-
SW2	44	7	1	-	-
SW3	44	14	8	3	3
SW4	44	21	15	10	10
W1	44	20	14	9	9
W2	44	18	12	7	7
W3	44	14	8	3	3

Potential high density receivers north of the school

The noise levels at future high density receivers north of the school are relatively high at some receivers within most noise catchments, especially at the first floor. Noise levels exceed the EPA's ICNG highly affected noise goal in catchments NCA2 and NCA3 while the rock break is in use and during earthworks in NCA2 and NCA3.

Table 32 Noise levels during classroom construction – Stage 1

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
NCA1 GF	44	54-62	48-56	43-51	43-51
NCA2 GF	44	64-79	58-73	53-68	53-68
NCA3 GF	44	44-53	38-47	33-42	33-42
NCA4 GF	44	55-68	49-62	44-57	44-57
NCA5 GF	44	43-54	37-48	32-43	32-43
NCA1 F1	44	55-66	49-60	44-55	44-55
NCA2 F1	44	58-81	52-75	47-70	47-70
NCA3 F1	44	44-81	38-75	33-70	33-70
NCA4 F1	44	58-72	52-66	47-61	47-61
NCA5 F1	44	44-56	38-50	33-45	33-45

Noise level exceedences in Table 33 indicate that noise levels are expected to be highly intrusive within all catchments when the rock breaker is in use and at some receivers during earthworks within most catchments. During slab and general construction noise are predicted to be up to 11dBA quieter and range from clearly audible to moderately intrusive at receivers in NCA4 and NCA 5. Some receivers in NCA2 and NCA3 may still have noise levels that are highly intrusive during slab and general construction.

Table 33 Exceedences during classroom construction – Stage 1

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
NCA1 GF	44	10-18	4-12	0-7	0-7
NCA2 GF	44	20-35	14-29	9-24	9-24
NCA3 GF	44	0-9	0-3	-	-
NCA4 GF	44	11-24	5-18	0-13	0-13
NCA5 GF	44	0-10	0-4	-	-
NCA1 F1	44	11-22	5-16	0-11	0-11
NCA2 F1	44	14-37	8-31	3-26	3-26
NCA3 F1	44	0-37	0-31	0-26	0-26
NCA4 F1	44	14-28	8-22	3-17	3-17
NCA5 F1	44	0-12	0-6	0-1	0-1

Stage 3 - Senior classrooms

Existing receivers

During the construction of the new classroom noise levels at most existing receivers are low to moderate ranging from 30dBA to 65dBA (see Table 34). Noise levels at receivers I, J, K and L are significantly higher, ranging up to 66dBA to 71dBA, as they are closest to the works which occur at the southern side of the school.

Preparation of the site dock breaking and earthworks are the noisiest works and are 11dBA and 5dBA respectively noisier than during the construction of the building.

Table 34 Noise levels during classroom construction – Stage 3

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
A	44	41	35	30	30
B	44	43	37	32	32
C	44	43	37	32	32
D	44	47	41	36	36
E	44	49	43	38	38
F	44	51	45	40	40
G	44	54	48	43	43
H	44	65	59	54	54
I	44	66	60	55	55
J	44	71	65	60	60
K	44	70	64	59	59
L	44	67	61	56	56
M	44	59	53	48	48
N	44	57	51	46	46
O	44	50	44	39	39
P	44	54	48	43	43

At most receivers noise levels (Table 35) are predicted to be moderately intrusive or comply with the noise goal. The most affected receivers are H, I, J, K and L where noise levels may be highly intrusive when the rock breaker is in use and moderately intrusive during other works.

Table 35 Exceedence of noise goal during classroom construction – Stage 3

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
A	44	-	-	-	-
B	44	-	-	-	-
C	44	-	-	-	-
D	44	3	-	-	-
E	44	5	-	-	-
F	44	7	1	-	-
G	44	10	4	-	-
H	44	21	15	10	10
I	44	22	16	11	11
J	44	27	21	16	16
K	44	26	20	15	15
L	44	23	17	12	12
M	44	15	9	4	4
N	44	13	7	2	2
O	44	6	0	-	-
P	44	10	4	-	-

Future receivers in Area 20 Plan

The noise levels at most future receiver in the Area 20 Plan range from low to moderate for most of the works ranging between 33dBA and 64dBA (see Table 36). The most affected location is at receiver W3 which is closest to the works where noise levels of up to 70dBA have been predicted when the rock breaker is in use.

Table 36 Noise levels during classroom construction – Stage 3

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
E1	44	64	58	53	53
E2	44	58	52	47	47
N1	44	44	38	33	33
N2	44	47	41	36	36
N3	44	49	43	38	38
SW1	44	46	40	35	35
SW2	44	46	40	35	35
SW3	44	49	43	38	38
SW4	44	53	47	42	42
W1	44	53	47	42	42
W2	44	58	52	47	47
W3	44	70	64	59	59

The noise level exceedences (see Table 37) are greatest at receivers E1 and W3 where they have the potential to be highly intrusive during use of the rock breaker. Noise levels at all other locations either comply with the noise goals are or range from clearly audible to moderately intrusive.

Table 37 Exceedence of noise goals during classroom construction – Stage 3

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	**Rock Breaker**	**Earthworks**	**Slab construction**	**General construction**
E1	44	20	14	9	9
E2	44	14	8	3	3
N1	44	-	-	-	-
N2	44	3	-	-	-
N3	44	5	-	-	-
SW1	44	2	-	-	-
SW2	44	2	-	-	-
SW3	44	5	-	-	-
SW4	44	9	3	-	-
W1	44	9	3	-	-
W2	44	14	8	3	3
W3	44	26	20	15	15

Potential high density receivers north of the school

The noise levels (see Table 38) are low to moderate at future high density receivers north of the school. These receivers are more than 350m from the works and are mostly shielded by other school buildings.

Table 38 Noise levels during classroom construction – Stage 3

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	**Rock Breaker**	**Earthworks**	**Slab construction**	**General construction**
NCA1 GF	44	48-51	42-45	37-40	37-40
NCA2 GF	44	49-56	43-50	38-45	38-45
NCA3 GF	44	42-48	36-42	31-37	31-37
NCA4 GF	44	47-55	41-49	36-44	36-44
NCA5 GF	44	43-47	37-41	32-36	32-36
NCA1 F1	44	49-50	43-44	38-39	38-39
NCA2 F1	44	49-56	43-50	38-45	38-45
NCA3 F1	44	44-51	38-45	33-40	33-40
NCA4 F1	44	48-55	42-49	37-44	37-44
NCA5 F1	44	43-47	37-41	32-36	32-36

Noise levels comply with the noise goal at most receivers and have the potential to be clearly audible to moderately intrusive for short periods when the rock breaker is used.

Table 39 Exceedence of noise goals – Stage 3

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
NCA1 GF	44	4-7	0-1	-	-
NCA2 GF	44	5-12	0-6	0-1	0-1
NCA3 GF	44	0-4	-	-	-
NCA4 GF	44	3-11	0-5	-	-
NCA5 GF	44	0-3	-	-	-
NCA1 F1	44	5-6	-	-	-
NCA2 F1	44	5-12	0-6	0-1	0-1
NCA3 F1	44	0-7	0-1	-	-
NCA4 F1	44	4-11	0-5	-	-
NCA5 F1	44	0-3	-	-	-

Stage 3 and 5 – Demolition for new senior classrooms

Existing receivers

To prepare the site for the new senior school classrooms some junior school buildings will be demolished at the south of the school. At most receivers noise levels will be low to moderate ranging from 33dBA to 59dBA. Noise levels at receivers H, I, J, K and L will be higher as they are closer to the works. Noise levels will range from 66dBA to 71dBA between these receivers during the use of a rock breaker. Without the rock breaker the noise levels at the worst affected receivers will range between 57dBA to 62dBA.

Table 40 Noise levels during demolition – Stage 3 and 5

Location	Noise level, dBA $L_{Aeq\ 15min}$		
	Noise goal	Rock Breaker	Without Rock Breaker
A	44	41	33
B	44	43	35
C	44	43	35
D	44	47	39
E	44	49	41
F	44	51	43
G	44	54	46
H	44	65	57
I	44	66	58
J	44	71	63
K	44	70	62

Location	Noise level, dBA $L_{Aeq\ 15min}$		
	Noise goal	Rock Breaker	Without Rock Breaker
L	44	67	59
M	44	59	51
N	44	57	49
O	44	50	42
P	44	54	46

Noise levels (Table 41) are expected comply at receivers A, B. C, D, E, F and O for most of the duration of the works and range from moderately intrusive when the rock breaker is in use to clearly audible at receivers G, M, N and P. Noise levels at receivers H, I, J, K and L are predicted to be highly intrusive when the rock breaker is in use and moderately intrusive at other times.

Table 41 Exceedences during demolition – Stage 3 and 5

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$		
	Noise goal	Rock Breaker	Without Rock Breaker
A	44	-	-
B	44	-	-
C	44	-	-
D	44	3	-
E	44	5	-
F	44	7	-
G	44	10	2
H	44	21	13
I	44	22	14
J	44	27	19
K	44	26	18
L	44	23	15
M	44	15	7
N	44	13	5
O	44	6	-
P	44	10	2

Future receivers in Area 20 Plan

At most receivers noise levels will be low to moderate ranging from 36dBA to 64dBA. Noise levels at receiver W3 are as this location is closer to the works. Noise levels at W3 will range from 70dBA to when the rock breaker is in use down to 62dBA at other times.

Table 42 Noise levels during demolition – Stage 3 and 5

Location	Noise level, dBA $L_{Aeq\ 15min}$		
	Noise goal	Rock Breaker	Without Rock Breaker
E1	44	64	56
E2	44	58	50
N1	44	44	36
N2	44	47	39
N3	44	49	41
SW1	44	46	38
SW2	44	46	38
SW3	44	49	41
SW4	44	53	45
W1	44	53	45
W2	44	58	50
W3	44	70	62

Noise levels (Table 43) are expected comply at most receivers during most of the works and range with some exceedences of up to 9dBA during the use of the rock breaker. Noise levels will be clearly audible at these receivers when the rock breaker is in use.

from moderately intrusive when the rock breaker is in use to clearly audible at receivers G, M, N and P. Noise levels at receivers H, I, J, K and L are predicted to be highly intrusive when the rock breaker is in use and moderately intrusive at other times. Noise levels at locations E1 and W3 may be highly intrusive when the rock breaker is in use with excedences of 20dBA to 26dBA and moderately intrusive at other times.

Table 43 Exceedence of noise goals – Stage 3 and 5

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$		
	Noise goal	Rock Breaker	Without Rock Breaker
E1	44	20	12
E2	44	14	6
N1	44	-	-
N2	44	3	-
N3	44	5	-
SW1	44	2	-
SW2	44	2	-
SW3	44	5	-
SW4	44	9	1
W1	44	9	1
W2	44	14	6
W3	44	26	18

Potential high density receivers north of the school

Noise levels at the higher density receivers north of the school are low to moderate during the demolition as they are at least 350m from the works and are mostly shielded from noise by school buildings.

Table 44 Noise levels during demolition – Stage 3 and 5

Location	Noise level, dBA $L_{Aeq\ 15min}$		
	Noise goal	**Rock Breaker**	**Without Rock Breaker**
NCA1 GF	44	48-51	40-43
NCA2 GF	44	49-56	41-48
NCA3 GF	44	42-48	34-40
NCA4 GF	44	47-55	39-47
NCA5 GF	44	43-47	35-39
NCA1 F1	44	49-50	41-42
NCA2 F1	44	49-56	41-48
NCA3 F1	44	44-51	36-43
NCA4 F1	44	48-55	40-47
NCA5 F1	44	43-47	35-39

Noise level exceedences (Table 45) are minor or comply with the noise goal through most of the works. Noise levels may be moderately intrusive at some locations within each noise catchment when the rock breaker is in use.

Table 45 Exceedences during demolition – Stage 3 and 5

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$		
	Noise goal	**Rock Breaker**	**Without Rock Breaker**
NCA1 GF	44	4-7	-
NCA2 GF	44	5-12	0-4
NCA3 GF	44	0-4	-
NCA4 GF	44	3-11	0-3
NCA5 GF	44	0-3	-
NCA1 F1	44	5-6	-
NCA2 F1	44	5-12	0-4
NCA3 F1	44	0-7	-
NCA4 F1	44	4-11	0-3
NCA5 F1	44	0-3	-

Stage 4 – Library

Existing receivers

Noise levels are moderate at most receivers (Table 46) during construction of the library ranging from 41dBA to 63dBA. Noise levels at receivers G, H, and I are higher and between 63dBA and 68dBA when the rock breaker is in use and between 53dBA and 62dBA at other times. Of the existing receivers G, H and I are the most exposed to the works and are not shielded by any other buildings.

Table 46 Noise levels during construction of the library – Stage 4

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	**Rock Breaker**	**Earthworks**	**Slab construction**	**General construction**
A	44	52	46	41	41
B	44	53	47	42	42
C	44	54	48	43	43
D	44	56	50	45	45
E	44	60	54	49	49
F	44	63	57	52	52
G	44	68	62	57	57
H	44	68	62	57	57
I	44	64	58	53	53
J	44	59	53	48	48
K	44	58	52	47	47
L	44	55	49	44	44
M	44	55	49	44	44
N	44	58	52	47	47
O	44	47	41	36	36
P	44	59	53	48	48

Based on the exceedances in Table 47 noise levels may be highly intrusive at receivers G, H and I when the rock breaker is in use and moderately intrusive at other times. At other locations noise levels will be clearly audible during the works but only moderately intrusive when the rock breaker is in use.

Table 47 Exceedences during construction of the library – Stage 4

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	**Rock Breaker**	**Earthworks**	**Slab construction**	**General construction**
A	44	8	2	-	-
B	44	9	3	-	-
C	44	10	4	-	-
D	44	12	6	1	1
E	44	16	10	5	5
F	44	19	13	8	8
G	44	24	18	13	13

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
H	44	24	18	13	13
I	44	20	14	9	9
J	44	15	9	4	4
K	44	14	8	3	3
L	44	11	5	-	-
M	44	11	5	0	0
N	44	14	8	3	3
O	44	3	-	-	-
P	44	15	9	4	4

Future receivers in Area 20 Plan

Noise levels are the highest for future receivers in locations SW4 and W1 (Table 48). These locations are closest to the works and are not shielded by any school buildings. Noise levels at location SW4 range from 74dBA when the rock breaker is in use down to 68dBA and 63dBA during other activities. Noise levels at location W1 are classed as highly noise affected as they reach and exceed the 75dBA criteria in EPA's ICNG, see discussion in Section 8 for highly noise affected receivers. Noise levels at other locations are low to moderate ranging from 43dBA to 64dBA.

Table 48 Noise levels during construction of the library – Stage 4

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
E1	44	58	52	47	47
E2	44	62	56	51	51
N1	44	54	48	43	43
N2	44	59	53	48	48
N3	44	58	52	47	47
SW1	44	58	52	47	47
SW2	44	55	49	44	44
SW3	44	62	56	51	51
SW4	44	74	68	63	63
W1	44	81	75	70	70
W2	44	62	56	51	51
W3	44	64	58	53	53

Based on the noise level exceedences in Table 49 noise levels are expected to be moderately intrusive for receivers in most locations when the rock breaker is in use and clearly audible at other times. Noise levels at SW4 are predicted to be highly intrusive during the earthworks and use of the rock breaker and moderately intrusive at other times. Noise levels at W1 have the potential to be highly intrusive during the works.

Table 49 Exceedences during construction of the library – Stage 4

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
E1	44	14	8	3	3
E2	44	18	12	7	7
N1	44	10	4	-	-
N2	44	15	9	4	4
N3	44	14	8	3	3
SW1	44	14	8	3	3
SW2	44	11	5	0	0
SW3	44	18	12	7	7
SW4	44	30	24	19	19
W1	44	37	31	26	26
W2	44	18	12	7	7
W3	44	20	14	9	9

Potential high density receivers north of the school

Noise levels are low to moderate at receivers to the north of the school during construction of the library.

Table 50 Noise levels during construction of the library – Stage 4

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
NCA1 GF	44	61-63	55-57	50-52	50-52
NCA2 GF	44	52-63	46-57	41-52	41-52
NCA3 GF	44	52-61	46-55	41-50	41-50
NCA4 GF	44	50-60	44-54	39-49	39-49
NCA5 GF	44	53-59	47-53	42-48	42-48
NCA1 F1	44	62-63	56-57	51-52	51-52
NCA2 F1	44	57-64	51-58	46-53	46-53
NCA3 F1	44	54-63	48-57	43-52	43-52
NCA4 F1	44	56-62	50-56	45-51	45-51
NCA5 F1	44	54-60	48-54	43-49	43-49

Based on the exceedences in Table 51 noise levels will range from clearly audible to moderately intrusive during earth works including rock breaking and clearly audible for other activities.

Table 51 Exceedences during construction of the library – Stage 4

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
NCA1 GF	44	17-19	11-13	6-8	6-8
NCA2 GF	44	8-19	2-13	0-8	0-8
NCA3 GF	44	8-17	2-11	0-6	0-6
NCA4 GF	44	6-16	0-10	0-5	0-5
NCA5 GF	44	9-15	3-9	0-4	0-4
NCA1 F1	44	18-19	12-13	7-8	7-8
NCA2 F1	44	13-20	7-14	2-9	2-9
NCA3 F1	44	10-19	4-13	0-8	0-8
NCA4 F1	44	12-18	6-12	1-7	1-7
NCA5 F1	44	10-16	4-10	0-5	0-5

Stage 5 - Senior classrooms

During the construction of the new classroom noise levels at most existing receivers are low to moderate ranging from 30dBA to 65dBA (see Table 52). Noise levels at receivers I, J, K and L are significantly higher, ranging up to 68dBA to 75dBA, as they are closest to the works which occur at the southern side of the school. The noise level from the rock breaker is predicted to be at the highly noise affected criteria in EPA's ICNG.

Preparation of the site dock breaking and earthworks are the noisiest works and are 11dBA and 5dBA respectively noisier than during the construction of the building.

Table 52 Noise levels during construction of the classroom – Stage 5

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
A	44	49	43	38	38
B	44	50	44	39	39
C	44	50	44	39	39
D	44	52	46	41	41
E	44	55	49	44	44
F	44	58	52	47	47
G	44	60	54	49	49
H	44	64	58	53	53
I	44	68	62	57	57
J	44	74	68	63	63
K	44	75	69	64	64
L	44	70	64	59	59

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
M	44	59	53	48	48
N	44	58	52	47	47
O	44	51	45	40	40
P	44	54	48	43	43

At most receivers noise levels (Table 53) are predicted to be moderately intrusive or comply with the noise goal. The most affected receivers are H, I, and L where noise levels may be highly intrusive when the rock breaker is in use and moderately intrusive during other works. Noise levels at J and K may be highly intrusive when the rock breaker is in use and during earthworks, then moderately intrusive at other times.

Table 53 Exceedence of noise goal during classroom construction – Stage 5

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
A	44	5	-	-	-
B	44	6	-	-	-
C	44	6	0	-	-
D	44	8	2	-	-
E	44	11	5	0	0
F	44	14	8	3	3
G	44	16	10	5	5
H	44	20	14	9	9
I	44	24	18	13	13
J	44	30	24	19	19
K	44	31	25	20	20
L	44	26	20	15	15
M	44	15	9	4	4
N	44	14	8	3	3
O	44	7	1	-	-
P	44	10	4	-	-

Future receivers in Area 20 Plan

The noise levels at most future receiver in the Area 20 Plan range from low to moderate for most of the works ranging between 33dBA and 64dBA (see Table 54). The most affected location is at receiver W3 which is closest to the works where noise levels of up to 70dBA have been predicted when the rock breaker is in use.

Table 54 Noise levels during construction of senior classroom – Stage 5

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
E1	44	63	57	52	52
E2	44	59	53	48	48
N1	44	51	45	40	40
N2	44	53	47	42	42
N3	44	54	48	43	43
SW1	44	54	48	43	43
SW2	44	52	46	41	41
SW3	44	55	49	44	44
SW4	44	59	53	48	48
W1	44	57	51	46	46
W2	44	59	53	48	48
W3	44	70	64	59	59

The noise level exceedences (see Table 55) are greatest at receiver W3 where they have the potential to be highly intrusive during use of the rock breaker. Noise levels at all other locations either comply with the noise goals are or range from clearly audible to moderately intrusive.

Table 55 Excceedence of noise goal during classroom construction – Stage 5

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
E1	44	19	13	8	8
E2	44	15	9	4	4
N1	44	7	1	-	-
N2	44	9	3	-	-
N3	44	10	4	-	-
SW1	44	10	4	-	-
SW2	44	8	2	-	-
SW3	44	11	5	0	0
SW4	44	15	9	4	4
W1	44	13	7	2	2
W2	44	15	9	4	4
W3	44	26	20	15	15

Potential high density receivers north of the school

The noise levels (see Table 56) are low to moderate at future high density receivers north of the school. These receivers are more than 350m from the works and are mostly shielded by other school buildings.

Table 56 Noise levels during classroom construction – Stage 5

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	**Rock Breaker**	**Earthworks**	**Slab construction**	**General construction**
NCA1 GF	44	54-58	48-52	43-47	43-47
NCA2 GF	44	55-56	49-50	44-45	44-45
NCA3 GF	44	46-54	40-48	35-43	35-43
NCA4 GF	44	53-54	47-48	42-43	42-43
NCA5 GF	44	50-53	44-47	39-42	39-42
NCA1 F1	44	54-55	48-49	43-44	43-44
NCA2 F1	44	54-56	48-50	43-45	43-45
NCA3 F1	44	50-55	44-49	39-44	39-44
NCA4 F1	44	53-54	47-48	42-43	42-43
NCA5 F1	44	50-53	44-47	39-42	39-42

Noise levels comply with the noise goal at most receivers and have the potential to be clearly audible to moderately intrusive for short periods when the rock breaker is used.

Table 57 Exceedence of noise goal during classroom construction – Stage 5

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	**Rock Breaker**	**Earthworks**	**Slab construction**	**General construction**
NCA1 GF	44	10-14	4-8	0-3	0-3
NCA2 GF	44	11-12	5-6	0-1	0-1
NCA3 GF	44	2-10	0-4	-	-
NCA4 GF	44	9-10	3-4	-	-
NCA5 GF	44	6-9	0-3	-	-
NCA1 F1	44	10-11	4-5	-	-
NCA2 F1	44	10-12	4-6	0-1	0-1
NCA3 F1	44	6-11	0-5	-	-
NCA4 F1	44	9-10	3-4	-	-
NCA5 F1	44	6-9	0-3	-	-

Stage 6 - Multi-purpose centre

Existing receivers

During the construction of the multi-purpose centre noise levels are moderate at most receivers (Table 58) ranging from 40dBA to 62dBA. The existing school buildings provide some shielding which reduces noise levels at residential receivers.

Table 58 Noise levels during construction of the multi-purpose centre – Stage 6

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
A	44	51	45	40	40
B	44	52	46	41	41
C	44	52	46	41	41
D	44	54	48	43	43
E	44	56	50	45	45
F	44	57	51	46	46
G	44	59	53	48	48
H	44	57	51	46	46
I	44	59	53	48	48
J	44	55	49	44	44
K	44	43	37	32	32
L	44	56	50	45	45
M	44	55	49	44	44
N	44	62	56	51	51
O	44	53	47	42	42
P	44	53	47	42	42

Based on the exceedances in Table 59 noise levels may moderately intrusive at some receivers when the rock break is in use and during earthworks at receiver N. For other activities noise levels are much lower and are expected to be clearly audible.

Table 59 Exceedence during construction of the multi-purpose centre – Stage 6

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
A	44	7	1	-	-
B	44	8	2	-	-
C	44	8	2	-	-
D	44	10	4	-	-
E	44	12	6	1	1
F	44	13	7	2	2
G	44	15	9	4	4

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
H	44	13	7	2	2
I	44	15	9	4	4
J	44	11	5	-	-
K	44	-	-	-	-
L	44	12	6	1	1
M	44	11	5	-	-
N	44	18	12	7	7
O	44	9	3	-	-
P	44	9	3	-	-

Future receivers in Area 20 Plan

Noise levels are the highest for future receivers in locations E2, SW4, W1 and W2 (Table 60). These locations are closest to the works and are not shielded by any school buildings. Noise levels between these locations range from 68dBA to 65dBA when the rock breaker is in use down to 68dBA and 55dBA during other activities.

Table 60 Noise levels during construction of the multi-purpose centre – Stage 6

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
E1	44	62	56	51	51
E2	44	65	59	54	54
N1	44	53	47	42	42
N2	44	57	51	46	46
N3	44	54	48	43	43
SW1	44	56	50	45	45
SW2	44	53	47	42	42
SW3	44	59	53	48	48
SW4	44	66	60	55	55
W1	44	68	62	57	57
W2	44	65	59	54	54
W3	44	56	50	45	45

Based on the noise level exceedences in Table 61 noise levels are expected to be moderately intrusive for receivers in most locations when the rock breaker is in use and clearly audible at other times. Noise levels at E2, SW4, W1 and W2 are predicted to be highly intrusive when the rock breaker is in use and moderately intrusive at other times.

Table 61 Exceedences during construction of the multi-purpose centre – Stage 6

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
E1	44	18	12	7	7
E2	44	21	15	10	10
N1	44	9	3	-	-
N2	44	13	7	2	2
N3	44	10	4	-	-
SW1	44	12	6	1	1
SW2	44	9	3	-	-
SW3	44	15	9	4	4
SW4	44	22	16	11	11
W1	44	24	18	13	13
W2	44	21	15	10	10
W3	44	12	6	1	1

Potential high density receivers north of the school

Noise levels are low to moderate at receivers to the north of the school during construction of the library.

Table 62 Noise levels during construction of the multi-purpose centre – Stage 6

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
NCA1 GF	44	54-60	48-54	43-49	43-49
NCA2 GF	44	48-58	42-52	37-47	37-47
NCA3 GF	44	51-59	45-53	40-48	40-48
NCA4 GF	44	46-56	40-50	35-45	35-45
NCA5 GF	44	52-58	46-52	41-47	41-47
NCA1 F1	44	59-61	53-55	48-50	48-50
NCA2 F1	44	55-60	49-54	44-49	44-49
NCA3 F1	44	52-59	46-53	41-48	41-48
NCA4 F1	44	52-58	46-52	41-47	41-47
NCA5 F1	44	52-57	46-51	41-46	41-46

Based on the exceedences in Table 63 noise levels will range from clearly audible to moderately intrusive during earth works including rock breaking and clearly audible for other activities.

Table 63 Exceedences during construction of the multi-purpose centre – Stage 6

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
NCA1 GF	44	10-16	4-10	0-5	0-5
NCA2 GF	44	4-14	0-8	0-3	0-3
NCA3 GF	44	7-15	1-9	0-4	0-4
NCA4 GF	44	2-12	0-6	0-1	0-1
NCA5 GF	44	8-14	2-8	0-3	0-3
NCA1 F1	44	15-17	9-11	4-6	4-6
NCA2 F1	44	11-16	5-10	0-5	0-5
NCA3 F1	44	8-15	2-9	0-4	0-4
NCA4 F1	44	8-14	2-8	0-3	0-3
NCA5 F1	44	8-13	2-7	0-2	0-2

Stage 7 - Junior classrooms

Existing receivers

During the construction of the new classroom noise levels at most existing receivers are low to moderate ranging from 31dBA to 57dBA (see Table 64). Preparation of the site dock breaking and earthworks are the noisiest works and are 11dBA and 5dBA respectively noisier than during the construction of the building.

Noise levels receivers N, O and P are much higher than the other receivers as they are within 40m to 70m of the works. During the most intensive activities noise levels at these receivers are between 68dBA and 70dBA when the rock breaker is in use and 62dBA to 64dBA during other earthworks. Noise levels range from 57dBA to 59dBA during the main construction activities.

Table 64 Noise levels from classroom construction – Stage 7

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
A	44	47	41	36	36
B	44	49	43	38	38
C	44	45	39	34	34
D	44	43	37	32	32
E	44	44	38	33	33
F	44	53	47	42	42
G	44	55	49	44	44
H	44	57	51	46	46
I	44	55	49	44	44

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
J	44	55	49	44	44
K	44	42	36	31	31
L	44	55	49	44	44
M	44	55	49	44	44
N	44	68	62	57	57
O	44	70	64	59	59
P	44	70	64	59	59

At most receivers noise levels (Table 65) are predicted to be comply with the noise goal or be clearly audible with minor exceedences. Noise levels are predicted to be moderately intrusive at receivers G, H, I, J, L and M during the use of the rock breaker. Noise levels at N, O and P have the potential to be highly intrusive during rock breaking.

Table 65 Exceedences during classroom construction – Stage 7

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
A	44	3	-	-	-
B	44	5	-	-	-
C	44	1	-	-	-
D	44	-	-	-	-
E	44	-	-	-	-
F	44	9	3	-	-
G	44	11	5	0	0
H	44	13	7	2	2
I	44	11	5	0	0
J	44	11	5	0	0
K	44	-	-	-	-
L	44	11	5	-	-
M	44	11	5	0	0
N	44	24	18	13	13
O	44	26	20	15	15
P	44	26	20	15	15

Future receivers in Area 20 Plan

The noise levels at most future receiver in the Area 20 Plan range from low to moderate for most of the works ranging between 32dBA and 60dBA. Noise levels are highest at receivers E2, N3, and W2 ranging between 63dBA and 66dBA.

Table 66 Noise levels during construction of the classroom – Stage 7

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
E1	44	61	55	50	50
E2	44	66	60	55	55
N1	44	46	40	35	35
N2	44	56	50	45	45
N3	44	63	57	52	52
SW1	44	45	39	34	34
SW2	44	43	37	32	32
SW3	44	48	42	37	37
SW4	44	59	53	48	48
W1	44	60	54	49	49
W2	44	66	60	55	55
W3	44	57	51	46	46

The noise level exceedences (see Table 67) are greatest at receivers E2 and W2 where they have the potential to be highly intrusive during use of the rock breaker. During all other works noise levels are predicted to either comply with the noise goal or range from clearly audible to moderately intrusive.

Table 67 Exceedences during construction of the classroom – Stage 7

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
E1	44	17	11	6	6
E2	44	22	16	11	11
N1	44	2	-	-	-
N2	44	12	6	1	1
N3	44	19	13	8	8
SW1	44	1	-	-	-
SW2	44	-	-	-	-
SW3	44	4	-	-	-
SW4	44	15	9	4	4
W1	44	16	10	5	5
W2	44	22	16	11	11
W3	44	13	7	2	2

Potential high density receivers north of the school

The noise levels at future high density receivers north of the school are relatively high at some receivers within most noise catchments, especially at the first floor. Noise levels exceed the EPA's ICNG highly affected criteria in catchment NCA2 while the rock break is in use and during earthworks.

Table 68 Noise levels during construction of the classroom – Stage 7

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
NCA1 GF	44	53-63	47-57	42-52	42-52
NCA2 GF	44	64-83	58-77	53-72	53-72
NCA3 GF	44	44-55	38-49	33-44	33-44
NCA4 GF	44	58-71	52-65	47-60	47-60
NCA5 GF	44	45-56	39-50	34-45	34-45
NCA1 F1	44	57-64	51-58	46-53	46-53
NCA2 F1	44	60-83	54-77	49-72	49-72
NCA3 F1	44	45-74	39-68	34-63	34-63
NCA4 F1	44	60-71	54-65	49-60	49-60
NCA5 F1	44	46-59	40-53	35-48	35-48

Noise level exceedences in Table 69 indicate that noise levels are expected to be highly intrusive within all catchments when the rock breaker is in use and at some receivers during earthworks within most catchments. Noise levels are also predicted to be highly intrusive at NCA2 throughout the duration of construction as the receivers are located very close to the works (within 25m).

During slab and general construction noise are predicted to be up to 11dBA quieter and range from clearly audible to moderately intrusive at receivers in NCA4 and NCA 5. Some receivers in NCA2 may still have noise levels that are highly intrusive during slab and general construction.

Table 69 Exceedence during construction of the classroom – Stage 7

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
NCA1 GF	44	9-19	3-13	0-8	0-8
NCA2 GF	44	20-39	14-33	9-28	9-28
NCA3 GF	44	0-11	0-5	-	-
NCA4 GF	44	14-27	8-21	3-16	3-16
NCA5 GF	44	1-12	0-6	0-1	0-1
NCA1 F1	44	13-20	7-14	2-9	2-9
NCA2 F1	44	16-39	10-33	5-28	5-28
NCA3 F1	44	1-30	0-24	0-19	0-19
NCA4 F1	44	16-27	10-21	5-16	5-16
NCA5 F1	44	2-15	0-9	0-4	0-4

Stage7 - Construction of car park access

Existing receivers

During the construction of the new classroom Table 70 shows the noise levels at most existing receivers are low to moderate ranging from 34dBA to 58dBA Preparation of the site dock breaking and earthworks are the noisiest works and are 11dBA and 5dBA respectively noisier than during the construction of the building.

Noise levels receivers N, O and P are much higher than the other receivers as they are within 80m to 100m of the works. During the most intensive activities noise levels at these receivers are between 67dBA and 77dBA when the rock breaker is in use and 64dBA to 71dBA during other earthworks. Noise levels range from 61dBA to 71dBA during the main construction activities. At receiver N noise levels are classed as highly affected under EPA's ICNG, see further discussion in Section 8.

Table 70 Noise levels during construction of the carpark access – Stage 7

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Road Base	Road Surfacing
A	44	43	37	35	37
B	44	42	36	34	36
C	44	41	35	33	35
D	44	40	34	32	34
E	44	50	44	42	44
F	44	57	51	49	51
G	44	56	50	48	50
H	44	52	46	44	46
I	44	50	44	42	44
J	44	51	45	43	45
K	44	44	38	36	38
L	44	57	51	49	51
M	44	58	52	50	52
N	44	77	71	69	71
O	44	67	61	59	61
P	44	70	64	62	64

At most receivers noise levels are predicted to be comply with the noise goal or be clearly audible with minor exceedences. Noise levels are predicted to be moderately intrusive at receivers F, G, L and M during the use of the rock breaker. Noise levels at N have the potential to be highly intrusive during all works. Noise levels at O and P have the potential to be highly intrusive during earthworks.

Table 71 Exceedences during construction of the carpark access – Stage 7

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Road Base	Road Surfacing
A	44	-	-	-	-
B	44	-	-	-	-
C	44	-	-	-	-
D	44	-	-	-	-
E	44	6	-	-	-
F	44	13	7	5	7
G	44	12	6	4	6
H	44	8	2	-	2
I	44	6	0	-	0
J	44	7	1	-	1
K	44	-	-	-	-
L	44	13	7	5	7
M	44	14	8	6	8
N	44	33	27	25	27
O	44	23	17	15	17
P	44	26	21	18	20

Future receivers in Area 20 Plan

The noise levels at most future receiver in the Area 20 Plan range from low to moderate for most of the works ranging between 32dBA and 60dBA. Noise levels are highest at receivers E1, E2, N3, and W2 ranging between 62dBA and 73dBA.

Table 72 Noise levels during construction of the carpark access – Stage 7

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Road Base	Road Surfacing
E1	44	65	59	57	59
E2	44	73	67	65	67
N1	44	42	36	34	36
N2	44	49	43	41	43
N3	44	62	56	54	56
SW1	44	42	36	34	36
SW2	44	39	33	31	33
SW3	44	45	39	37	39
SW4	44	63	57	55	57
W1	44	59	53	51	53
W2	44	73	67	65	67
W3	44	50	44	42	44

The noise level exceedences (see Table 73) are greatest at receivers E1, E2 and W2 where they have the potential to be highly intrusive during use of the rock breaker. During all other works noise levels are predicted to either comply with the noise goal or range from clearly audible to moderately intrusive.

Table 73 Exceedences during construction of the carpark access – Stage 7

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Road Base	Road Surfacing
E1	44	21	15	13	15
E2	44	29	23	21	23
N1	44	-	-	-	-
N2	44	5	-	-	-
N3	44	18	12	10	12
SW1	44	-	-	-	-
SW2	44	-	-	-	-
SW3	44	1	-	-	-
SW4	44	19	13	11	13
W1	44	15	9	7	9
W2	44	29	23	21	23
W3	44	6	-	-	-

Potential high density receivers north of the school

The noise levels at future high density receivers north of the school are relatively high at some receivers within most noise catchments, especially at the first floor. Noise levels exceed the EPA's ICNG highly affected criteria in catchment NCA2 while the rock break is in use.

Table 74 Noise levels during construction of the carpark access – Stage 7

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Road Base	Road Surfacing
NCA1 GF	44	51-58	45-52	43-50	45-52
NCA2 GF	44	59-78	53-72	51-70	53-72
NCA3 GF	44	40-50	34-44	32-42	34-44
NCA4 GF	44	54-72	48-66	46-64	48-66
NCA5 GF	44	41-52	35-46	33-44	35-46
NCA1 F1	44	54-63	48-57	46-55	48-57
NCA2 F1	44	57-78	51-72	49-70	51-72
NCA3 F1	44	42-73	36-67	34-65	36-67
NCA4 F1	44	58-73	52-67	50-65	52-67
NCA5 F1	44	42-56	36-50	34-48	36-50

Noise level exceedences in Table 75 indicate that noise levels are expected to be highly intrusive within all catchments when the rock breaker is in use and at some receivers during earthworks within most catchments. Noise levels are also predicted to be highly intrusive at NCA2 and NCA 4 throughout the duration of construction as the receivers are located very close to the works (within 25m).

During slab and general construction noise are predicted to be up to 11dBA quieter and range from clearly audible to moderately intrusive at receivers in NCA1, NCA3 and NCA 5.

Table 75 Exceedences during construction of the carpark access – Stage 7

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	**Rock Breaker**	**Earthworks**	**Road Base**	**Road Surfacing**
NCA1 GF	44	7-14	1-8	0-6	1-8
NCA2 GF	44	15-34	9-28	7-26	9-28
NCA3 GF	44	0-6	-	-	-
NCA4 GF	44	10-28	4-22	2-20	4-22
NCA5 GF	44	0-8	0-2	-	0-2
NCA1 F1	44	10-19	4-13	2-11	4-13
NCA2 F1	44	13-34	7-28	5-26	7-28
NCA3 F1	44	0-29	0-23	0-21	0-23
NCA4 F1	44	14-29	8-23	6-21	8-23
NCA5 F1	44	0-12	0-6	0-4	0-6

7.3 Impacts on the school

Stage 1 and Stage 2 - Road and carpark construction

Noise levels (Table 76) during the construction of the Stage 1 and 2 carpark are predicted to comply with the noise goal (Table 77) at most building facades. Noise levels at Block K may exceed noise goals by up to 21 dBA during Stage 2 if the car parking areas closest to the building are not completed at Stage 1. Stage 1 noise levels are not expected to impact Block K as this building is also constructed as part of Stage 1.

Table 76 Noise levels during carpark construction – Stage 1 and 2

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	**Rock Breaker**	**Earthworks**	**Road Base**	**Road Surfacing**
J GF	65	48-60	42-54	40-52	42-54
H GF	65	50-67	44-61	42-59	44-61
F GF	65	43-63	37-57	35-55	37-57
E GF	65	43-62	37-56	35-54	37-56
D GF	65	40-55	34-49	32-47	34-49
C GF	65	40-51	34-45	32-43	34-45

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Road Base	Road Surfacing
B GF	65	44-48	38-42	36-40	38-42
A GF	65	56-57	50-51	48-49	50-51
K GF	65	70-86	64-80	62-78	64-80
J F1	65	60-65	54-59	52-57	54-59
H F1	65	60-65	54-59	52-57	54-59
F F1	65	59-61	53-55	51-53	53-55
E F1	65	59-60	53-54	51-52	53-54
D F1	65	55-59	49-53	47-51	49-53
C F1	65	49-57	43-51	41-49	43-51
B F1	65	53-57	47-51	45-49	47-51
A F1	65	53-56	47-50	45-48	47-50
K F1	65	56-86	50-80	48-78	50-80

Table 77 Exceedences during carpark construction – Stage 1 and 2

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Road Base	Road Surfacing
J GF	65	-	-	-	-
H GF	65	0-2	-	-	-
F GF	65	-	-	-	-
E GF	65	-	-	-	-
D GF	65	-	-	-	-
C GF	65	-	-	-	-
B GF	65	-	-	-	-
A GF	65	-	-	-	-
K GF	65	5-21	0-15	0-13	0-15
J F1	65	-	-	-	-
H F1	65	-	-	-	-
F F1	65	-	-	-	-
E F1	65	-	-	-	-
D F1	65	-	-	-	-
C F1	65	-	-	-	-
B F1	65	-	-	-	-
A F1	65	-	-	-	-
K F1	65	0-21	0-15	0-13	0-15

Table 78 shows that the noise levels during the construction of the Stage 1 and 2 private road are predicted to comply with the noise goal (Table 79) at most building facades. Noise levels at Block K may exceed noise goals by up to 48 dBA during Stage 2 if the private road sections closest to the building are not completed at Stage 1. Stage 1 noise levels are not expected to impact Block K as this building is also constructed as part of Stage 1.

Table 78 Noise levels during private road construction – Stage 1 and 2

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	**Rock Breaker**	**Earthworks**	**Road Base**	**Road Surfacing**
J GF	65	54-71	46-63	44-61	46-63
H GF	65	51-65	43-57	41-55	43-57
F GF	65	43-62	35-54	33-52	35-54
E GF	65	44-61	36-53	34-51	36-53
D GF	65	50-57	42-49	40-47	42-49
C GF	65	40-56	32-48	30-46	32-48
B GF	65	48-49	40-41	38-39	40-41
A GF	65	58-59	50-51	48-49	50-51
K GF	65	71-113	63-105	61-103	63-105
J F1	65	66-70	58-62	56-60	58-62
H F1	65	62-67	54-59	52-57	54-59
F F1	65	57-62	49-54	47-52	49-54
E F1	65	57-59	49-51	47-49	49-51
D F1	65	55-58	47-50	45-48	47-50
C F1	65	55-58	47-50	45-48	47-50
B F1	65	55-57	47-49	45-47	47-49
A F1	65	55-58	47-50	45-48	47-50
K F1	65	58-102	50-94	48-92	50-94

Table 79 Exceedences during private road construction – Stage 1 and 2

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	**Rock Breaker**	**Earthworks**	**Road Base**	**Road Surfacing**
J GF	65	0-6	-	-	-
H GF	65	-	-	-	-
F GF	65	-	-	-	-
E GF	65	-	-	-	-
D GF	65	-	-	-	-
C GF	65	-	-	-	-
B GF	65	-	-	-	-
A GF	65	-	-	-	-
K GF	65	6-48	0-40	0-38	0-40
J F1	65	1-5	-	-	-
H F1	65	0-2	-	-	-
F F1	65	-	-	-	-
E F1	65	-	-	-	-
D F1	65	-	-	-	-
C F1	65	-	-	-	-
B F1	65	-	-	-	-
A F1	65	-	-	-	-
K F1	65	0-37	0-29	0-27	0-29

Stage 1 – Classrooms

Noise levels (Table 80) during the construction of Block K are predicted to comply with the noise goal (Table 81) at most building facades during most of the works. During the use of the rock breaker noise levels will exceed the noise goal by 9dBA to 10dBA at Blocks H and J. All other exceedences of noise goals are minor.

Table 80 Noise levels during classroom construction – Stage 1

	Noise level, dBA $L_{Aeq\ 15min}$				
Location	**Noise goal**	**Rock Breaker**	**Earthworks**	**Slab construction**	**General construction**
J GF	65	54-74	48-68	43-63	43-63
H GF	65	55-72	49-66	44-61	44-61
F GF	65	46-67	40-61	35-56	35-56
E GF	65	47-66	41-60	36-55	36-55
D GF	65	50-53	44-47	39-42	39-42
C GF	65	43-61	37-55	32-50	32-50
B GF	65	47-50	41-44	36-39	36-39
A GF	65	59-62	53-56	48-51	48-51
J F1	65	69-74	63-68	58-63	58-63
H F1	65	67-75	61-69	56-64	56-64
F F1	65	64-67	58-61	53-56	53-56
E F1	65	64-66	58-60	53-55	53-55
D F1	65	60-64	54-58	49-53	49-53
C F1	65	55-62	49-56	44-51	44-51
B F1	65	57-62	51-56	46-51	46-51
A F1	65	57-61	51-55	46-50	46-50

Table 81 Exceedences during classroom construction – Stage 1

	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
Location	**Noise goal**	**Rock Breaker**	**Earthworks**	**Slab construction**	**General construction**
J GF	65	0-9	0-3	-	-
H GF	65	0-7	0-1	-	-
F GF	65	0-2	-	-	-
E GF	65	0-1	-	-	-
D GF	65	-	-	-	-
C GF	65	-	-	-	-
B GF	65	-	-	-	-
A GF	65	-	-	-	-
J F1	65	4-9	0-3	-	-
H F1	65	2-10	0-4	-	-
F F1	65	0-2	-	-	-

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
E F1	65	0-1	-	-	-
D F1	65	-	-	-	-
C F1	65	-	-	-	-
B F1	65	-	-	-	-
A F1	65	-	-	-	-

Stage 2 – Classrooms

Noise levels (Table 82) during the construction of Block L will have the biggest impact on Block M which is immediately adjacent to the works. Noise levels at the worst affected façade by up to 20dBA during earthworks and when the rock breaker is in use. This may produce noise levels of up to 70dBA in the classroom which will make study and potentially communication difficult. During construction of the building noise levels still exceed the noise goal by up to 10dBA. The external noise levels will also be in access of 85dBA which may require play areas to be restricted.

During the use of the rock breaker noise levels will exceed the noise goal by 11dBA to 12dBA at Blocks H and J. This is expected to produce noise levels in the classroom of around 65dBA which is similar to noise levels for a conversation.

At other locations the noise levels are predicted to comply with the noise goal (Table 83) at most building facades during most of the works. All other exceedences of noise goals are minor.

Table 82 Noise levels during classroom construction – Stage 2

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
J GF	65	57-77	51-71	46-66	46-66
H GF	65	56-76	50-70	45-65	45-65
F GF	65	45-65	39-59	34-54	34-54
E GF	65	45-65	39-59	34-54	34-54
D GF	65	46-52	40-46	35-41	35-41
C GF	65	42-60	36-54	31-49	31-49
B GF	65	45-49	39-43	34-38	34-38
A GF	65	58-61	52-55	47-50	47-50
K GF	65	48-85	42-79	37-74	37-74
J F1	65	70-80	64-74	59-69	59-69
H F1	65	66-80	60-74	55-69	55-69
F F1	65	61-66	55-60	50-55	50-55
E F1	65	61-63	55-57	50-52	50-52

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
D F1	65	57-61	51-55	46-50	46-50
C F1	65	52-60	46-54	41-49	41-49
B F1	65	55-59	49-53	44-48	44-48
A F1	65	55-58	49-52	44-47	44-47
K F1	65	58-86	52-80	47-75	47-75

Table 83 Exceedences during classroom construction – Stage 2

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
J GF	65	0-12	0-6	0-1	0-1
H GF	65	0-11	0-5	-	-
F GF	65	-	-	-	-
E GF	65	-	-	-	-
D GF	65	-	-	-	-
C GF	65	-	-	-	-
B GF	65	-	-	-	-
A GF	65	-	-	-	-
K GF	65	0-20	0-14	0-9	0-9
J F1	65	5-15	0-9	0-4	0-4
H F1	65	1-15	0-9	0-4	0-4
F F1	65	0-1	-	-	-
E F1	65	-	-	-	-
D F1	65	-	-	-	-
C F1	65	-	-	-	-
B F1	65	-	-	-	-
A F1	65	-	-	-	-
K F1	65	0-21	0-15	0-10	0-10

Stage 3 and 5 – Demolition of junior classrooms for senior classrooms

Demolition of Blocks A and B has the potential to significantly impact Blocks A, B C and D with exceedences of up to 25dBA. This may produce noise levels of up to 70dBA in the classroom (90dBA externally) which will make study and potentially communication difficult. The external noise levels will also be in access of 85dBA near the works and these Blocks which may require play area access to be restricted.

Table 84 Noise levels during demolition – Stage 3 and 5

Location	Noise level, dBA $L_{Aeq\ 15min}$		
	Noise goal	Rock Breaker	Without Rock Breaker
J GF	65	42-63	34-55
H GF	65	37-57	29-49
F GF	65	43-66	35-58
E GF	65	44-68	36-60
D GF	65	51-90	43-82
C GF	65	56-87	48-79
K GF	65	37-52	29-44
L GF	65	38-53	30-45
J F1	65	53-61	45-53
H F1	65	53-58	45-50
F F1	65	58-66	50-58
E F1	65	59-71	51-63
D F1	65	71-90	63-82
C F1	65	73-90	65-82
B F1	65	81-91	73-83
A F1	65	80-88	72-80
K F1	65	50-80	42-72
L F1	65	50-55	42-47

Table 85 Exceedences during demolition – Stage 3 and 5

Location	Noise level, dBA $L_{Aeq\ 15min}$		
	Noise goal	Rock Breaker	Without Rock Breaker
J GF	65	-	-
H GF	65	-	-
F GF	65	0-1	-
E GF	65	0-3	-
D GF	65	0-25	0-17
C GF	65	0-22	0-14
K GF	65	-	-
L GF	65	-	-
J F1	65	-	-
H F1	65	-	-
F F1	65	0-1	-
E F1	65	0-6	-
D F1	65	6-25	0-17
C F1	65	8-21	0-13
B F1	65	16-26	8-18

Location	Noise level, dBA $L_{Aeq\ 15min}$		
	Noise goal	Rock Breaker	Without Rock Breaker
A F1	65	15-23	7-15
K F1	65	-	-
L F1	65	-	-

Stage 3 - Senior classrooms

Construction of a new senior classroom block in location B has the potential to significantly impact Blocks C and D with exceedences of up to 26dBA. This may produce noise levels of up to 70dBA in the classroom (90dBA externally) which will make study and potentially communication difficult. The external noise levels will also be in access of 85dBA near the works and these Blocks which may require play area access to be restricted.

Table 86 Noise levels during classroom construction – Stage 3

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
J GF	65	42-63	36-57	31-52	31-52
H GF	65	37-57	31-51	26-46	26-46
F GF	65	43-66	37-60	32-55	32-55
E GF	65	44-68	38-62	33-57	33-57
D GF	65	51-90	45-84	40-79	40-79
C GF	65	56-87	50-81	45-76	45-76
K GF	65	37-52	31-46	26-41	26-41
L GF	65	38-53	32-47	27-42	27-42
J F1	65	53-61	47-55	42-50	42-50
H F1	65	53-58	47-52	42-47	42-47
F F1	65	58-66	52-60	47-55	47-55
E F1	65	59-71	53-65	48-60	48-60
D F1	65	71-90	65-84	60-79	60-79
C F1	65	73-90	67-84	62-79	62-79
K F1	65	50-80	44-74	39-69	39-69
L F1	65	50-55	44-49	39-44	39-44

Table 87 Exceedences during classroom construction – Stage 3

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
J GF	65	-	-	-	-
H GF	65	-	-	-	-
F GF	65	0-1	-	-	-

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
E GF	65	0-3	-	-	-
D GF	65	0-25	0-19	0-14	0-14
C GF	65	0-22	0-16	0-11	0-11
K GF	65	-	-	-	-
L GF	65	-	-	-	-
J F1	65	-	-	-	-
H F1	65	-	-	-	-
F F1	65	0-1	-	-	-
E F1	65	0-6	-	-	-
D F1	65	6-25	0-19	0-14	0-14
C F1	65	8-21	2-15	0-14	0-14
K F1	65	-	-	-	-
L F1	65	-	-	-	-

Stage 4 - Construction of library and outdoor learning area

Construction of a new library has the potential to significantly impact Blocks E and F which are adjacent to the site with exceedences of up to 25dBA. This may produce noise levels of up to 70dBA in the classroom (90dBA externally) which will make study and potentially communication difficult. The external noise levels will also be in access of 85dBA near the works and these Blocks which may require play area access to be restricted.

Table 88 Noise levels during library construction – Stage 4

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
J GF	65	46-72	40-66	35-61	35-61
H GF	65	59-77	53-71	48-66	48-66
F GF	65	54-90	48-84	43-79	43-79
E GF	65	52-81	46-75	41-70	41-70
D GF	65	51-57	45-51	40-46	40-46
C GF	65	44-55	38-49	33-44	33-44
B GF	65	49-52	43-46	38-41	38-41
K GF	65	50-69	44-63	39-58	39-58
L GF	65	38-69	32-63	27-58	27-58
J F1	65	63-71	57-65	52-60	52-60
H F1	65	69-78	63-72	58-67	58-67
F F1	65	75-88	69-82	64-77	64-77

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
E F1	65	71-80	65-74	60-69	60-69
D F1	65	66-73	60-67	55-62	55-62
C F1	65	61-66	55-60	50-55	50-55
B F1	65	62-66	56-60	51-55	51-55
K F1	65	60-71	54-65	49-60	49-60
L F1	65	56-71	50-65	45-60	45-60

Table 89 Exceedences during library construction – Stage 4

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
J GF	65	0-7	0-1	-	-
H GF	65	0-12	0-6	0-1	0-1
F GF	65	0-25	0-19	0-14	0-14
E GF	65	0-16	0-10	0-5	0-5
D GF	65	-	-	-	-
C GF	65	-	-	-	-
B GF	65	-	-	-	-
K GF	65	0-4	-	-	-
L GF	65	0-4	-	-	-
J F1	65	0-6	-	-	-
H F1	65	4-13	0-7	0-2	0-2
F F1	65	10-23	4-17	0-12	0-12
E F1	65	6-15	0-9	0-4	0-4
D F1	65	1-3	-	-	-
C F1	65	-	-	-	-
B F1	65	0-1	-	-	-
K F1	65	0-6	-	-	-
L F1	65	0-6	-	-	-

Stage 5 - Senior classrooms

The noise levels (see Table 90) from the construction of a new senior block in location A has the potential to significantly impact Block B with exceedences of up to 24dBA (see Table 91). This may produce noise levels of up to 70dBA in the classroom (90dBA externally) which will make study and potentially communication difficult. The external noise levels will also be in access of 85dBA near the works and these Blocks which may require play area access to be restricted.

Noise levels will also exceed the noise goal by up to 15dBA at blocks C and D with internal noise levels of up to 65dBA. This noise level is similar to that of conversations.

Table 90 Noise levels during classroom construction – Stage 5

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
J GF	65	44-64	38-58	33-53	33-53
H GF	65	44-62	38-56	33-51	33-51
F GF	65	55-67	49-61	44-56	44-56
E GF	65	47-69	41-63	36-58	36-58
D GF	65	46-79	40-73	35-68	35-68
C GF	65	60-77	54-71	49-66	49-66
B GF	65	84-88	78-82	73-77	73-77
K GF	65	43-58	37-52	32-47	32-47
L GF	65	40-57	34-51	29-46	29-46
J F1	65	56-61	50-55	45-50	45-50
H F1	65	59-63	53-57	46-52	46-52
F F1	65	66-68	60-62	52-57	52-57
E F1	65	64-70	58-64	53-59	53-59
D F1	65	67-80	61-74	56-69	56-69
C F1	65	70-75	64-69	59-69	59-69
B F1	65	84-89	78-83	64-78	64-78
K F1	65	81-82	75-76	70-78	70-78
L F1	65	53-60	47-54	42-49	42-49

Table 91 Exceedences during classroom construction – Stage 5

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
J GF	65	-	-	-	-
H GF	65	-	-	-	-
F GF	65	0-2	-	-	-
E GF	65	0-4	-	-	-
D GF	65	0-14	0-8	0-3	0-3
C GF	65	0-12	0-6	0-1	0-1
B GF	65	19-23	13-17	8-12	8-12
K GF	65	-	-	-	-
L GF	65	-	-	-	-
J F1	65	-	-	-	-
H F1	65	-	-	-	-
F F1	65	1-3	-	-	-
E F1	65	0-5	-	-	-

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
D F1	65	2-15	0-9	0-4	0-4
C F1	65	5-10	0-4	0-4	0-4
B F1	65	19-24	13-18	0-13	0-13
K F1	65	-	-	-	-
L F1	65	-	-	-	-

Stage 6 - Multi-purpose centre

Construction of the multi-purpose centre has the potential to significantly impact Blocks E, F, H and J which are closest to the site (see Table 92). An exceedence 22dBA (see Table 93) is predicted at Block H. The external noise levels at J and H and near the works may be in access of 85dBA which may require play area access to be restricted.

Noise levels at Blocks E, F and H may exceed the noise goal by up to 15dBA. Internal noise levels may be similar to conversations.

Table 92 Noise levels during construction of the multi-purpose centre – Stage 6

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
J GF	65	46-80	40-74	35-69	35-69
H GF	65	49-87	43-81	38-76	38-76
F GF	65	50-73	44-67	39-62	39-62
E GF	65	49-75	43-69	38-64	38-64
D GF	65	47-56	41-50	36-45	36-45
C GF	65	50-57	44-51	39-46	39-46
B GF	65	40-41	34-35	29-30	29-30
A GF	65	58-61	52-55	47-50	47-50
K GF	65	48-67	42-61	37-56	37-56
L GF	65	39-59	33-53	28-48	28-48
J F1	65	62-82	56-76	51-71	51-71
H F1	65	64-88	58-82	52-77	52-77
F F1	65	66-68	60-62	55-77	55-77
E F1	65	67-73	61-67	55-62	55-62
D F1	65	58-64	52-58	47-56	47-56
C F1	65	61-66	55-60	50-55	50-55
B F1	65	41-44	35-38	30-55	30-55
A F1	65	61-65	55-59	30-54	30-54
K F1	65	56-69	50-63	45-58	45-58
L F1	65	48-65	42-59	37-54	37-54

Table 93 Exceedences during construction of the multi-purpose centre – Stage 6

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
J GF	65	0-15	0-9	0-4	0-4
H GF	65	0-22	0-16	0-11	0-11
F GF	65	0-8	0-2	-	-
E GF	65	0-10	0-4	-	-
D GF	65	-	-	-	-
C GF	65	-	-	-	-
B GF	65	-	-	-	-
A GF	65	-	-	-	-
K GF	65	0-2	-	-	-
L GF	65	-	-	-	-
J F1	65	0-17	0-11	0-6	0-6
H F1	65	0-23	0-17	0-12	0-12
F F1	65	1-3	-	0-12	0-12
E F1	65	2-8	0-2	-	-
D F1	65	-	-	-	-
C F1	65	0-1	-	-	-
B F1	65	-	-	-	-
A F1	65	-	-	-	-
K F1	65	0-4	-	-	-
L F1	65	-	-	-	-

Stage 7 - Junior classrooms

Noise levels (Table 94) during the construction of Block M will have the biggest impact on Block L and J which are immediately adjacent to the works. Noise levels at the worst affected façade exceed by up to 20dBA during earthworks and when the rock breaker is in use at Block L and J. This may produce noise levels of up to 70dBA in the classroom which will make study and potentially communication difficult. During construction of the building noise levels still exceed the noise goal by up to 10dBA. The external noise levels will also be in access of 85dBA which may require play areas to be restricted.

During the use of the rock breaker noise levels will exceed the noise goal by up to 10dBA at Block H. This is expected to produce noise levels in the classroom of around 55dBA which is similar to noise levels for a quiet conversation.

At other locations the noise levels are predicted to comply with the noise goal (Table 95) at most building facades during most of the works. All other exceedences of noise goals are minor.

Noise levels near the works may be in excess of 85dBA which may require access to play areas to be restricted.

Table 94 Noise levels during classroom construction – Stage 7

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
J GF	65	59-75	53-69	48-64	48-64
H GF	65	54-72	48-66	43-61	43-61
F GF	65	44-56	38-50	33-45	33-45
E GF	65	45-64	39-58	34-53	34-53
D GF	65	46-56	40-50	35-45	35-45
C GF	65	44-59	38-53	33-48	33-48
B GF	65	37-37	31-31	26-26	26-26
A GF	65	60-61	54-55	49-50	49-50
K GF	65	41-64	35-58	30-53	30-53
L GF	65	52-80	46-74	41-69	41-69
J F1	65	71-82	65-76	60-71	60-71
H F1	65	65-75	59-69	54-64	54-64
F F1	65	56-65	50-59	45-54	45-54
E F1	65	59-62	53-56	48-51	48-51
D F1	65	57-60	51-54	46-49	46-49
C F1	65	51-61	45-55	40-50	40-50
B F1	65	38-61	32-55	27-50	27-50
A F1	65	38-61	32-55	27-50	27-50
K F1	65	59-68	53-62	48-57	48-57
L F1	65	66-85	60-79	55-74	55-74

Table 95 Exceedences during classroom construction – Stage 7

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
J GF	65	0-10	0-4	-	-
H GF	65	0-7	0-1	-	-
F GF	65	-	-	-	-
E GF	65	-	-	-	-
D GF	65	-	-	-	-
C GF	65	-	-	-	-
B GF	65	-	-	-	-
A GF	65	-	-	-	-
K GF	65	-	-	-	-
L GF	65	0-15	0-9	0-4	0-4
J F1	65	6-17	0-11	0-6	0-6

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Slab construction	General construction
H F1	65	0-10	0-4	-	-
F F1	65	-	-	-	-
E F1	65	-	-	-	-
D F1	65	-	-	-	-
C F1	65	-	-	-	-
B F1	65	-	-	-	-
A F1	65	-	-	-	-
K F1	65	0-3	-	-	-
L F1	65	1-20	0-14	0-9	0-9

Stage 7 - Construction of car park access

The construction of new car park access will have the biggest impact on Block H and J which are closest to the works. Noise levels at the worst affected façade exceed by up to 19dBA (see Table 97) during earthworks and when the rock breaker is in use at Block J. This may produce noise levels of up to 65dBA in the classroom which is similar to noise levels for a conversation.

During the use of the rock breaker noise levels will exceed the noise goal by up to 10dBA at Block H. This is expected to produce noise levels in the classroom of around 55dBA which is similar to noise levels for a quiet conversation.

At other locations the noise levels are predicted to comply with the noise goal (Table 95) at most building facades during most of the works. All other exceedences of noise goals are minor.

Noise levels near the works may be in excess of 85dBA which may require access to play areas to be restricted.

Table 96 Noise levels during carpark access construction – Stage 7

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Road Base	Road Surfacing
J GF	65	55-84	49-78	47-76	49-78
H GF	65	51-69	45-63	43-61	45-63
F GF	65	40-54	34-48	32-46	34-48
E GF	65	42-60	36-54	34-52	36-54
D GF	65	41-52	35-46	33-44	35-46
C GF	65	44-57	38-51	36-49	38-51
B GF	65	35-39	29-33	27-31	29-33
A GF	65	63-63	57-57	55-55	57-57
K GF	65	41-55	35-49	33-47	35-49

Location	Noise level, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Road Base	Road Surfacing
L GF	65	49-71	43-65	41-63	43-65
J F1	65	74-84	68-78	66-76	68-78
H F1	65	69-77	63-71	61-69	63-71
F F1	65	54-69	48-63	46-61	48-63
E F1	65	59-61	53-55	51-53	53-55
D F1	65	52-61	46-55	44-53	46-55
C F1	65	56-61	50-55	48-53	50-55
B F1	65	38-61	32-55	30-53	32-55
A F1	65	41-65	35-59	33-57	35-59
K F1	65	55-67	49-61	47-59	49-61
L F1	65	64-77	58-71	56-69	58-71

Table 97 Exceedences during carpark access construction – Stage 7

Location	Exceedence of noise goal, dBA $L_{Aeq\ 15min}$				
	Noise goal	Rock Breaker	Earthworks	Road Base	Road Surfacing
J GF	65	0-19	0-13	0-11	0-13
H GF	65	0-4	-	-	-
F GF	65	-	-	-	-
E GF	65	-	-	-	-
D GF	65	-	-	-	-
C GF	65	-	-	-	-
B GF	65	-	-	-	-
A GF	65	-	-	-	-
K GF	65	-	-	-	-
L GF	65	0-6	-	-	-
J F1	65	9-19	3-13	1-11	3-13
H F1	65	4-12	0-6	0-4	0-6
F F1	65	0-4	-	-	-
E F1	65	-	-	-	-
D F1	65	-	-	-	-
C F1	65	-	-	-	-
B F1	65	-	-	-	-
A F1	65	-	-	-	-
K F1	65	0-2	-	-	-
L F1	65	0-12	0-6	0-4	0-6

7.4 Construction traffic noise

Traffic noise on public roads has not been assessed as detailed scheduling of truck movements has not been completed for each construction stage.

The EPA's Construction Noise Guideline refers to the NSW Road Noise Policy (RNP) for the assessment of construction traffic on public roads.

For construction traffic an initial screening test shall be applied by evaluating whether noise levels will increase by more than 2dBA due to construction. Where increases are 2dBA or less then no further assessment is required as the effect of construction traffic is barely perceptible.

The following criteria apply where construction traffic increases noise levels by more than 2dBA.

Worcester Road, Cudgegong and Rouse Road currently function as local roads in the Rouse Hill area as they are used predominantly access houses with driveway access on these roads. The noise criteria in the RNP appropriate for dwellings adjacent to local roads affected by a land use development are summarised below in Table 98. Local road noise levels are assessed using the worst case 1 hour noise level.

Table 98 Recommended local road traffic noise criteria in RNP and NCG

Type of Development	**Criteria**	
	Day 7am - 10pm (dBA)	**Night 10pm - 7am (dBA)**
Land use developments with potential to create additional traffic on local roads	$L_{Aeq(1hour)}$ 55 dBA	$L_{Aeq(1hour)}$ 50 dBA

Following future residential development a number of much smaller local roads will be created within the blocks currently defined by Worcester Road, Cudgegong Road, Guntawong Road and Rouse Road. These roads will then carry additional through traffic rather than predominantly providing local access to residences on the existing roads. Under the RNP and Roads and Maritimes Noise Criteria Guideline these existing roads will change functional category to collector roads which are assigned the same criteria as sub-arterial roads as summarised below. The main difference compared to local roads is that the noise level and any noise increase is averaged over 15 hours during the daytime and 9 hours during the night time.

Table 99 Recommended collector road traffic noise criteria in the RNP and NCG

Type of Development	**Criteria**	
	Day **7am - 10pm** **(dBA)**	**Night** **10pm - 7am** **(dBA)**
Land use developments with potential to create additional traffic on local roads	$L_{Aeq(15\ hour)}$ 60 dBA	$L_{Aeq(9hour)}$ 55 dBA

Where criteria have been exceeded due to construction traffic then feasible and reasonable measures should be considered. Roads and Maritimes Construction Noise and Vibration Guideline provides guidance on feasible and reasonable management measures for construction traffic which is summarised below.

Management measures

Management of construction related traffic or traffic reroutes noise should as a minimum include the following controls:

- Scheduling and routing of vehicle movements
- Speed of vehicles
- Driver behaviour and avoidance of the use of engine compression brakes
- Ensuring vehicles are adequately silenced before allowing them to access the site

Mitigation controls

Additional feasible and reasonable considerations for noise mitigation given that construction traffic noise is temporary:

- time of day of the noise increase and how far above the criteria the noise is expected to be
- time of use of affected receivers
- how many decibels the noise levels are expected to increase above the existing traffic noise
- how long the mitigation will provide benefit to the receiver during the project

8 Construction vibration

There are a number of small risks with respect to vibration. The construction of the private road and carpark and number of buildings are close to existing structures.

The private road is within 7m of future high density receivers to the north of the school based on current drawings. This is within the minimum recommended working distances for some plant items used in road construction.

The demolition of Blocks A and B and their reconstruction as senior classrooms is within 8m of existing structures. The construction of the library, multi-purpose hall and classrooms L and M are also within 1m to 10m from existing structures. This is also within the minimum recommended distances for some equipment.

For the plant and distances repeated below in Table 6 it is considered unlikely that with appropriate selection of plant that vibration levels will cause cosmetic damage. There is a chance that they may be felt and exceed comfort levels.

Table 6: Recommended minimum working distances for vibration intensive plant from sensitive receiver

Plant item	**Rating / Description**	**Minimum working distance**	
		Cosmetic damage (BS 7385)	**Human response (OH&E Vibration guideline)**
Vibratory Roller	< 50 kN (Typically 1-2 tonnes)	5 m	15 m to 20 m
	< 100 kN (Typically 2-4 tonnes)	6 m	20 m
	< 200 kN (Typically 4-6 tonnes)	12 m	40 m
Small Hydraulic Hammer	(300 kg - 5 to 12t excavator)	2 m	7 m
Medium Hydraulic Hammer	(900 kg – 12 to 18t excavator)	7 m	23 m
Vibratory Pile Driver	Sheet piles	2 m to 20 m	20 m
Pile Boring	≤ 800 mm	2 m (nominal)	4 m
Jackhammer	Hand held	1 m (nominal)	2 m

Note: More stringent conditions may apply to heritage or other sensitive structures

9 Noise mitigation

9.1 Management of noise

The EPA's ICNG calls for the proactive management of construction noise to minimise impacts at sensitive receivers. To ensure this outcome the construction manager or developer should appoint a staff member with appropriate delegation to implement and actively manage the noise mitigation measures in this document.

9.2 Overview

The noise levels and exceedences are typical for construction works in a relatively quiet location with low background noise levels. These exceedences can be managed using industry best practice approaches that have been developed in response to the EPA's Interim Construction Noise Guideline.

9.3 Noise controls

Where feasible and reasonable the best approach to manage noise is to reduce it at source using the following approaches:

- Scheduling of works to standard construction hours where possible.
- Providing a respite period to manage high noise levels at affected receivers during normal hours and out-of-hours work
- Selection of equipment with the lowest noise rating
- Siting of plant of plant within the work area to minimise.
- Plan worksites and activities to minimise noise and vibration.
- Reduced equipment power
- Non-tonal and ambient sensitive reversing alarms
- Minimise disturbance arising from delivery of goods to construction sites
- Shield stationary noise sources such as pumps, compressors, fans etc with noise barriers (Appendix D of AS 2436:2010 lists materials suitable for shielding)
- Shield sensitive receivers from noisy activities with barriers (Appendix D of AS 2436:2010 lists materials suitable for shielding).

Opportunities to provide shielding for the worksites may be limited for these works due to the size of the site and the relative elevation of the site compared to receivers. Receivers to the north of the site are elevated on higher ground and the future higher density receivers are also two storey. Due to topography mobile construction plant is also elevated relative to other sensitive receivers limiting the benefits of shielding.

9.4 Timing of works

Impact at residential receivers

Where practicable consideration should be given to undertaking works:

- in standard hours or in the daytime out of hours periods to minimise noise impact.
- for the private road before higher density receivers on the northern boundary are constructed.

Impact on school classrooms and administration offices

Where practicable consideration should be given to:

- completing carparks, the private road and carpark access before additional classrooms are constructed near these items.
- completing higher impact works such as demolition, use of rock breakers and earthworks during holiday periods if they have the potential to significantly impact school operations.
- as a minimum restricting access to play areas where noise levels exceed 85dBA to meet health and safety requirements (not fully assessed in this report), restrictions to a lower noise level of 70dBA should also be considered.

9.5 Highly affected receivers

The EPA's ICNG classifies receivers with noise levels in excess of 75dBA to be highly affected. The highly noise affected level represents the point above which there may be strong community reaction to noise. In this situation:

- the proponent should carefully consider if there is any other feasible and reasonable way to reduce noise to below this level.
- Where no quieter work method is feasible and reasonable, and the works proceed, the proponent should communicate with the impacted residents by clearly explaining the duration and noise level of the works, and by describing any respite periods that will be provided.
- The relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account:
    - 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences.

- 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

9.6 Additional management measures

Where noise controls have been unable to reduce noise levels to the goals the following approaches have been developed as industry best practice. These outline for a range of noise level exceedences, a subjective description of the noise level exceedance and recommended management measures.

Table 100 Industry best practice management measures

Subjective description of exceedence	Additional mitigation measure	Exceedance above noise goal, dBA
All hours		
Highly noise affected	N, V, PC, RO	75dBA or greater
Standard Hours: Mon - Fri (7am – 6pm), Sat (8am – 1pm), Sun/Pub Hol (Nil)		
Noticeable	-	0
Clearly Audible	-	< 10
Moderately intrusive	N, V	10 to 20
Highly intrusive	N, V	> 20
OOHW Period 1: Mon – Fri (6pm – 10pm), Sat (7am – 8am & 1pm – 10pm), Sun/Pub Hol (8am – 6pm)		
Noticeable	-	< 5
Clearly Audible	N, RO	5 to 15
Moderately intrusive	V, RO	15 to 25
Highly intrusive	V, N, RO, PC	> 25

N - Advanced notification to the community about upcoming works and at least 1 calendar week prior to the initiation of each stage of work
V - Verifying for high impact activities that noise levels are no noisier than predicted. Where noise levels are noisier then a review of mitigation measures should be completed.
PC – Public consultation and engagement with the highly affected receivers
RO – Offers of respite to provide a quiet period during the works

During daytime works the noise level exceedences identified in this assessment at residential may be managed through community notification and verifying that noise levels are no higher than predicted during normal construction hours. Where noise levels are 75dBA and over then additional public consultation and engagement is required and offers of respite.

Similar approaches may be undertaken for out of hours works during the daytime. The additional management measures may be identified from Table 100. The exceedance of the noise goal may be identified by adding 5dBA to the exceedences reported in Section 7 of this document.

9.7 Vibration

With appropriate selection of plant it is unlikely that cosmetic damage will occur due to vibration. Where there is a risk of exceeding comfort levels then notification should be made to building occupants.

10 Conclusions

An assessment of potential noise construction noise impacts for the proposed school expansion of the school has been completed for each of the seven construction stages at the worst affected receivers. These impacts have been considered for existing receivers, the future receivers indicated in the Area 20 Indicative Plan and an alternative higher density development to the north of the school.

The noise levels and exceedences of noise goals are typical for construction works. These exceedences can be managed using industry best practice approaches that have been developed in response to the EPA's Interim Construction Noise Guideline.

Where practicable timing of the construction works may be scheduled to reduce impact at the residential receivers and the school. Where possible this may be achieved by the following.

Undertaking works:

- in standard hours or in the daytime out of hours periods to minimise noise impact.
- for the private road before receivers on the northern boundary are constructed.

Giving consideration to:

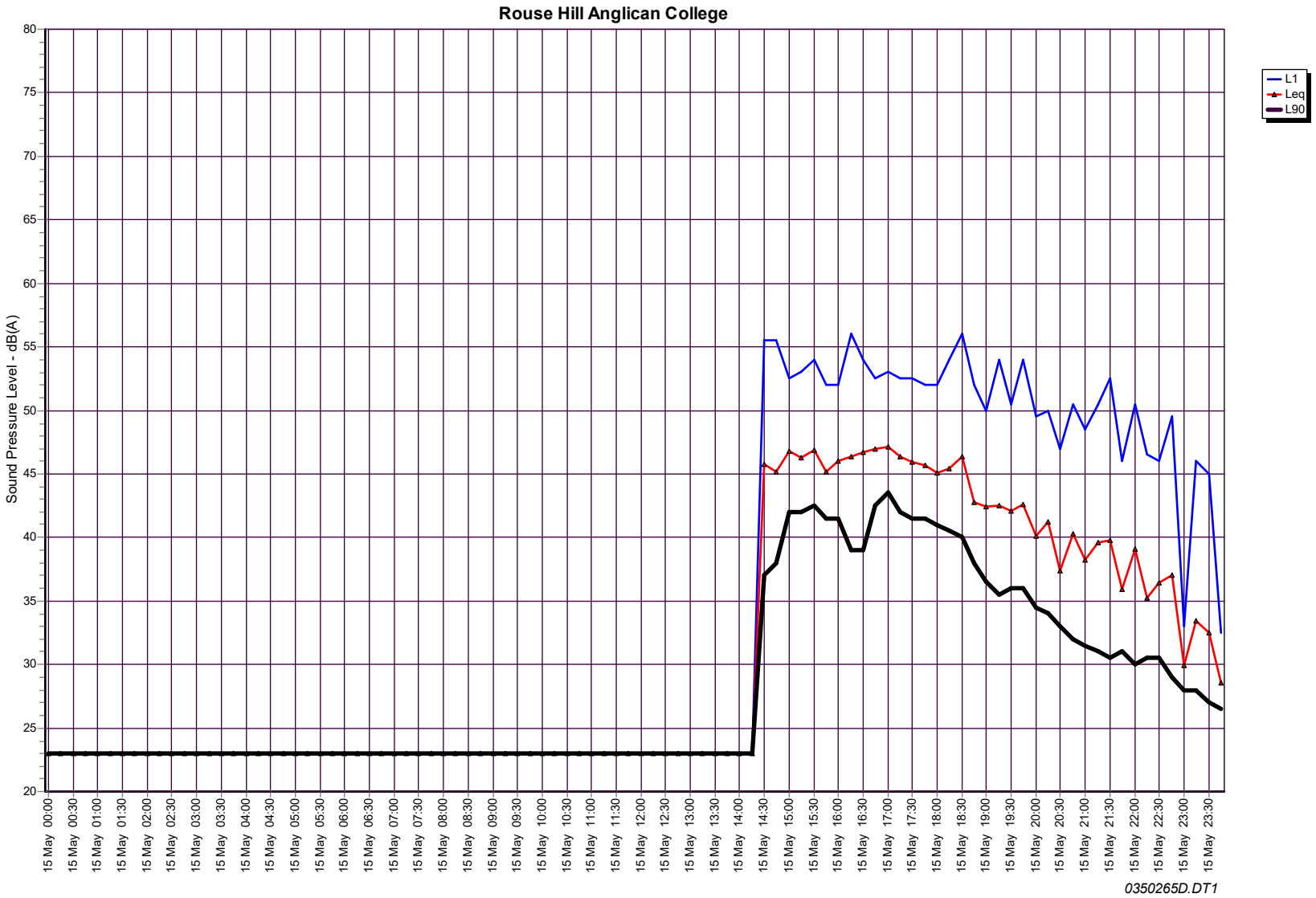
- completing carparks, the private road and carpark access before additional classrooms are constructed near these items
- completing higher impact works such as demolition, use of rock breakers and earthworks during holiday periods if they have the potential to significantly impact school operations.
- as a minimum restricting access to play areas where noise levels exceed 85dBA to meet health and safety requirements (not fully assessed in this report), restrictions to a lower noise level of 70dBA should also be considered.

Noise from construction traffic has not been assessed as details of truck movements for each stage are not yet available. The following management measures may be used to minimise truck noise:

- Scheduling and routing of vehicle movements
- Speed of vehicles
- Driver behaviour and avoidance of the use of engine compression brakes
- Ensuring vehicles are adequately silenced before allowing them to access the site

Appendix A

Ambient Noise Monitoring Data 2006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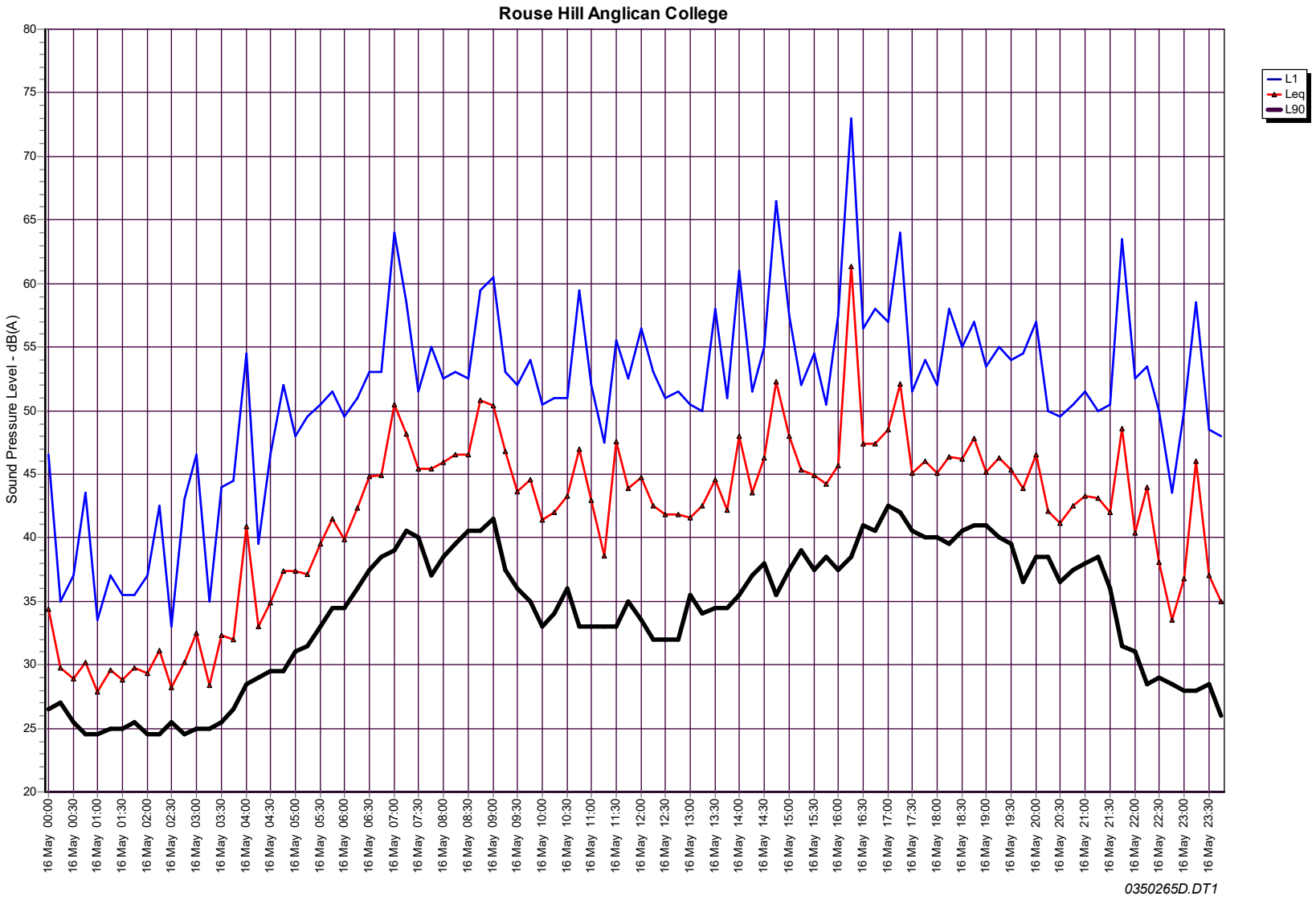
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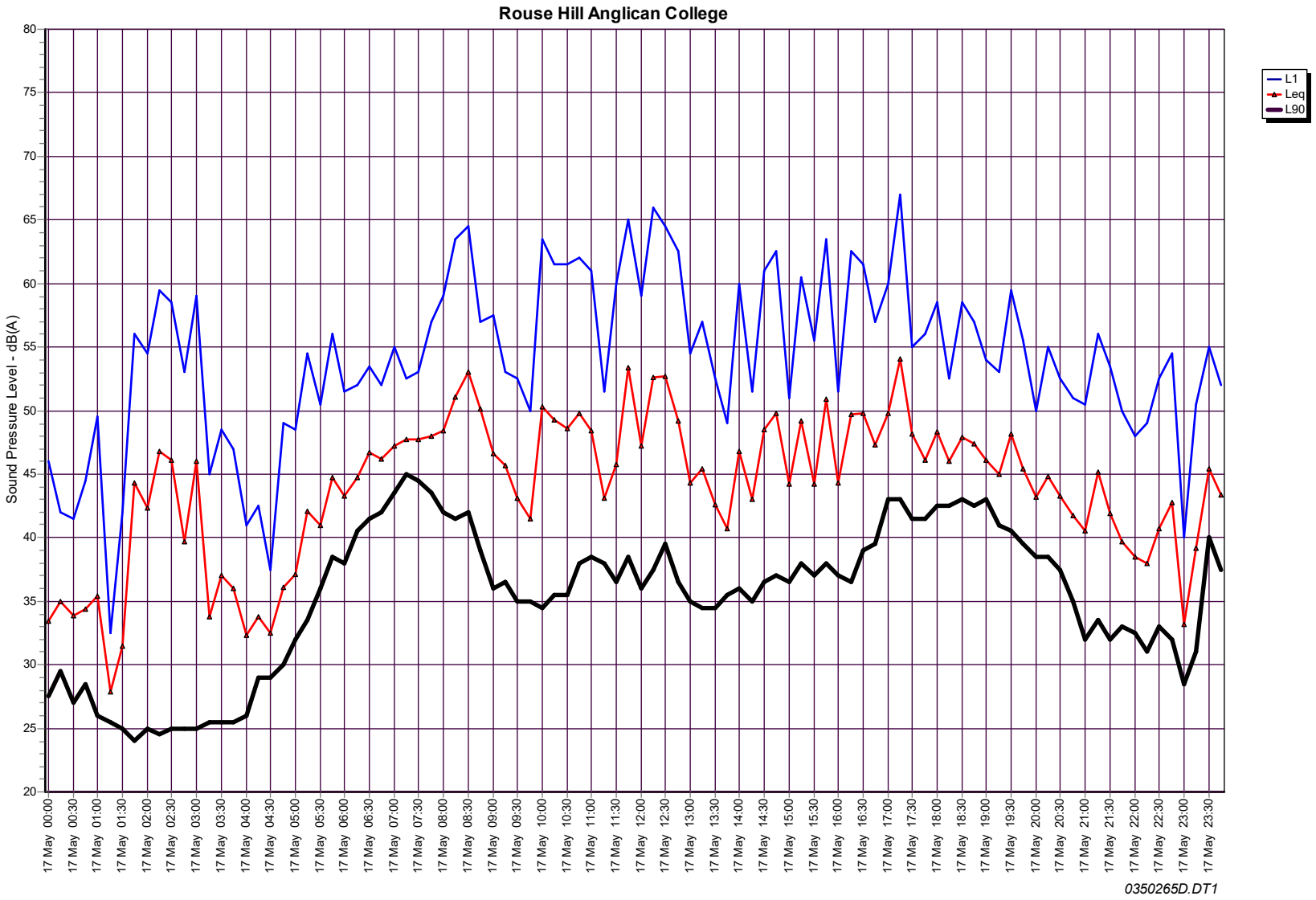
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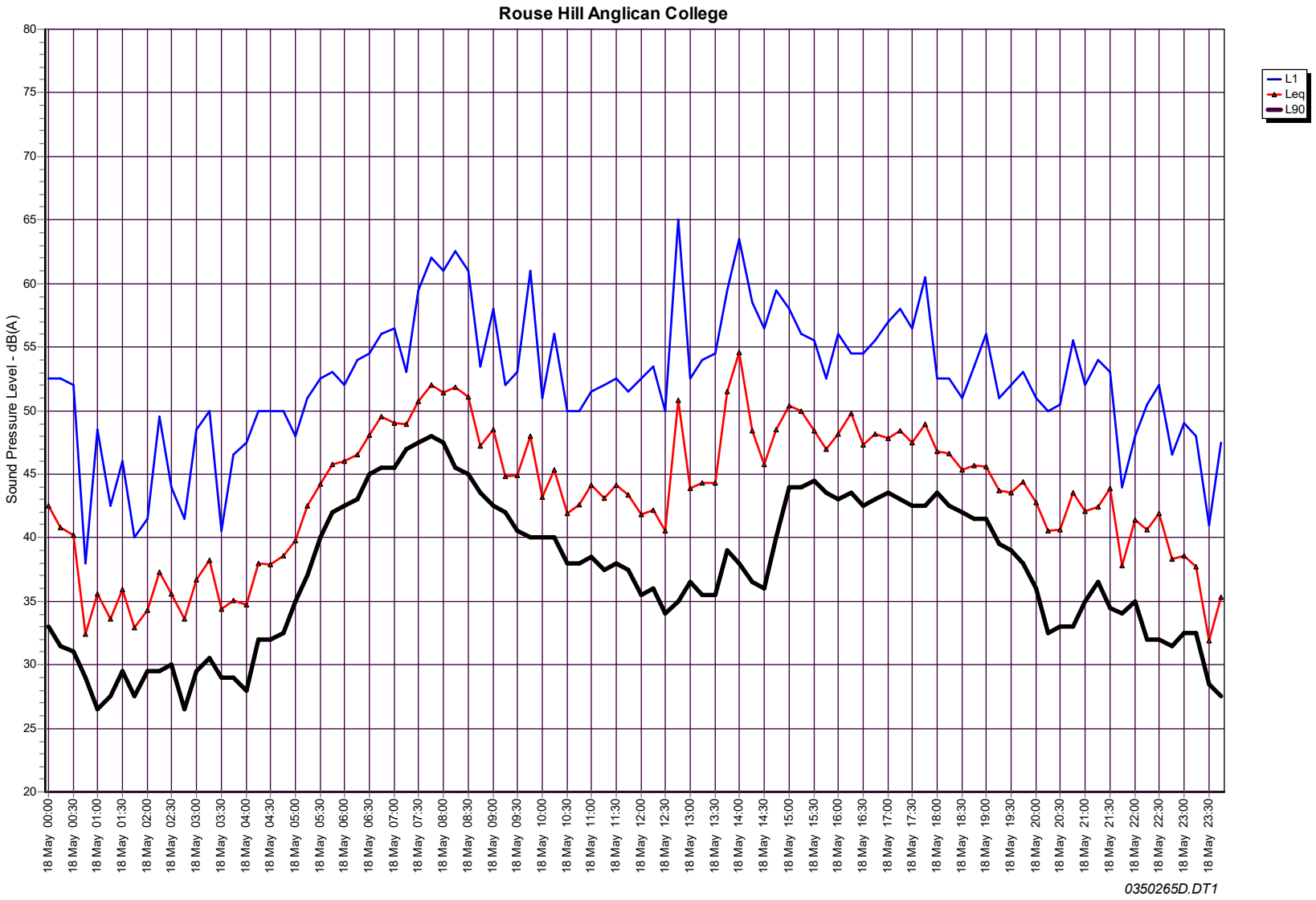
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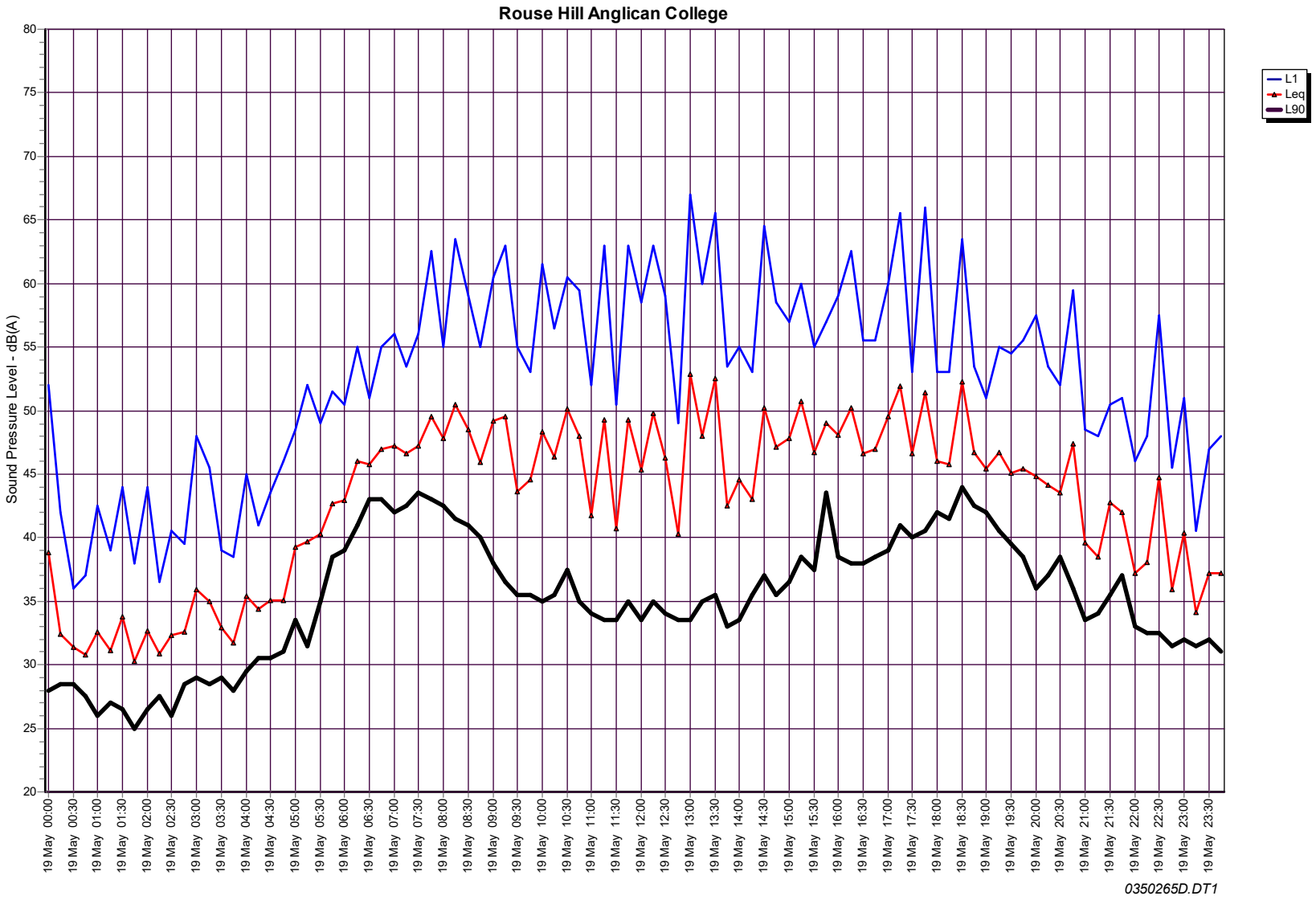
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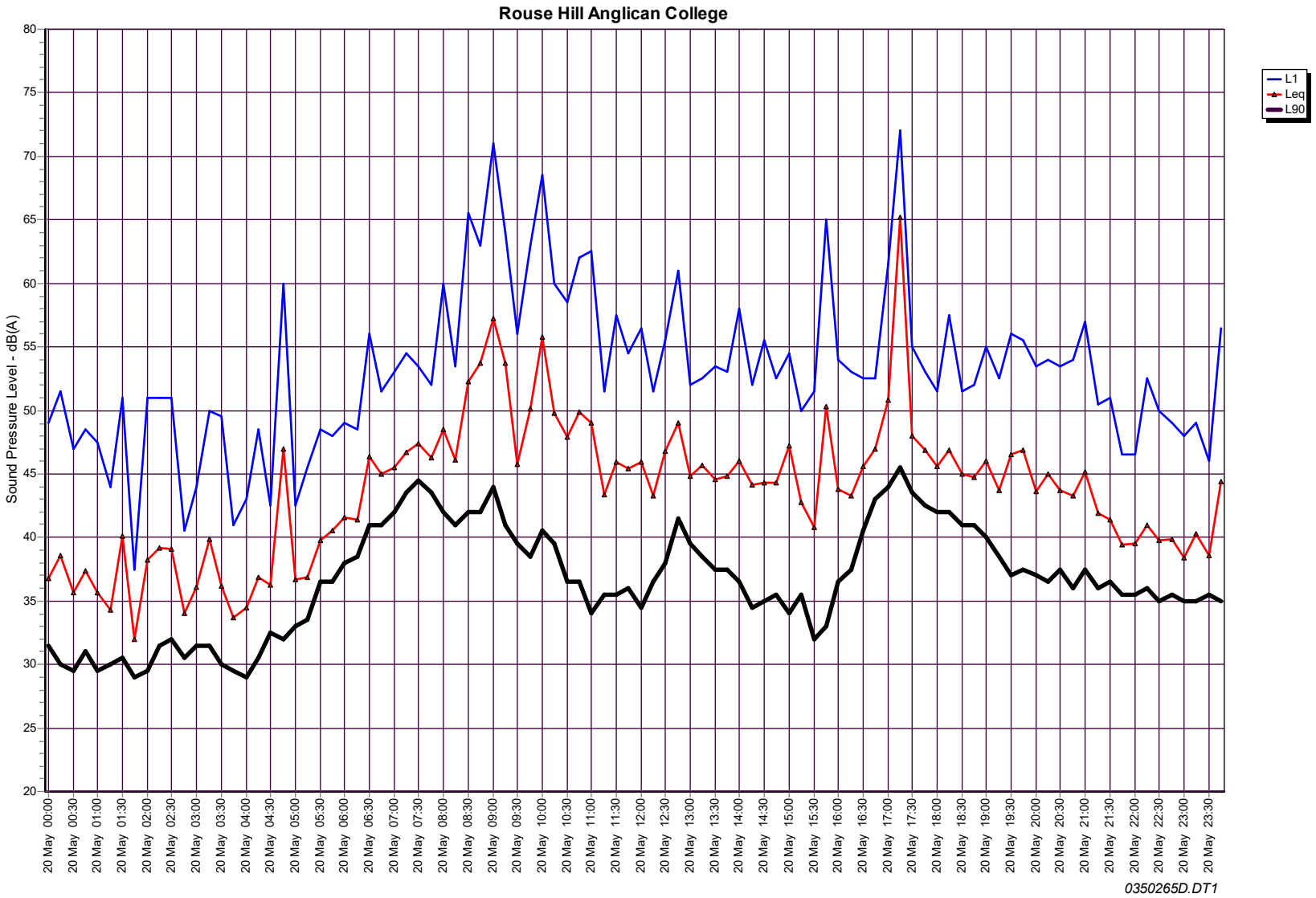
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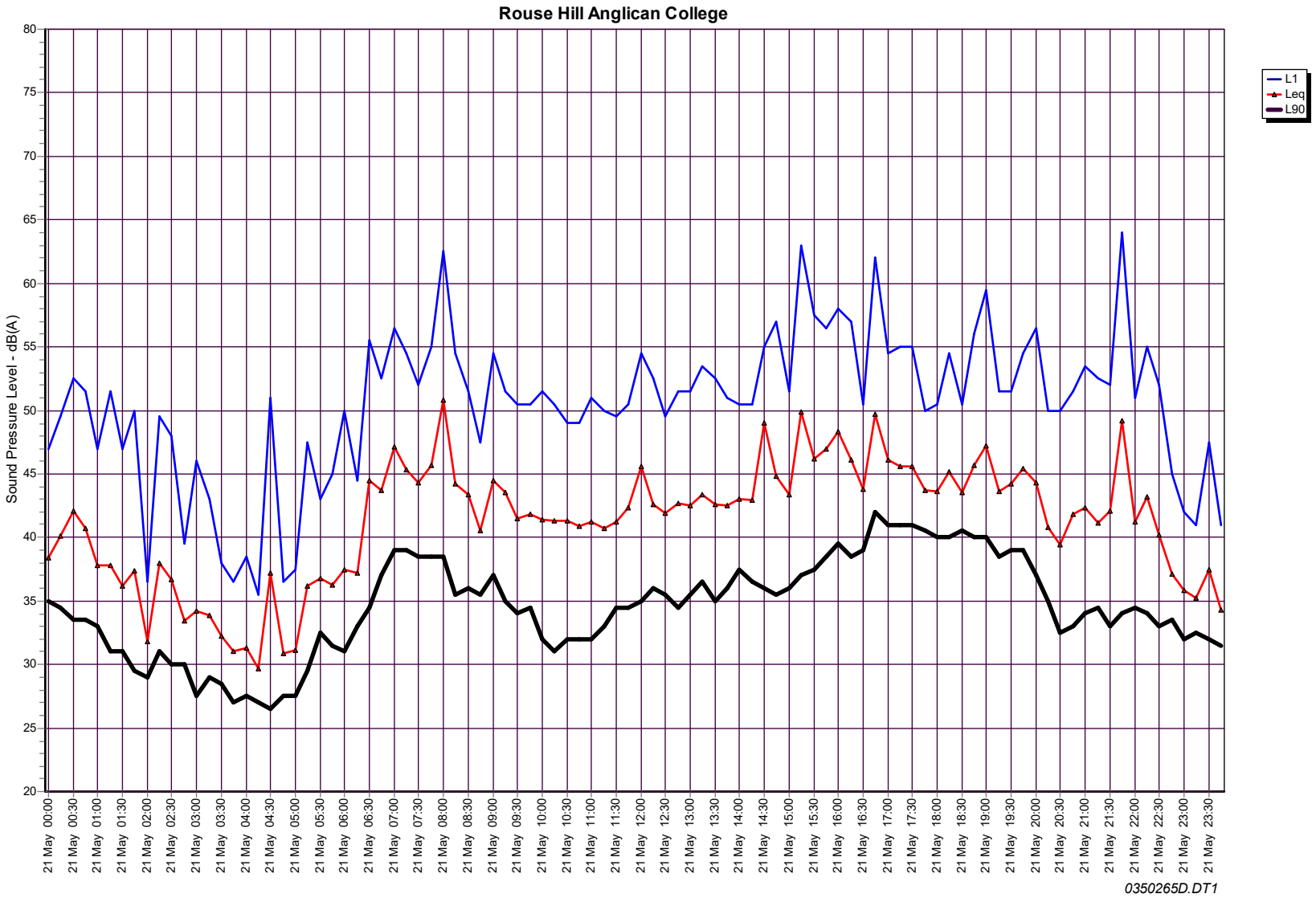
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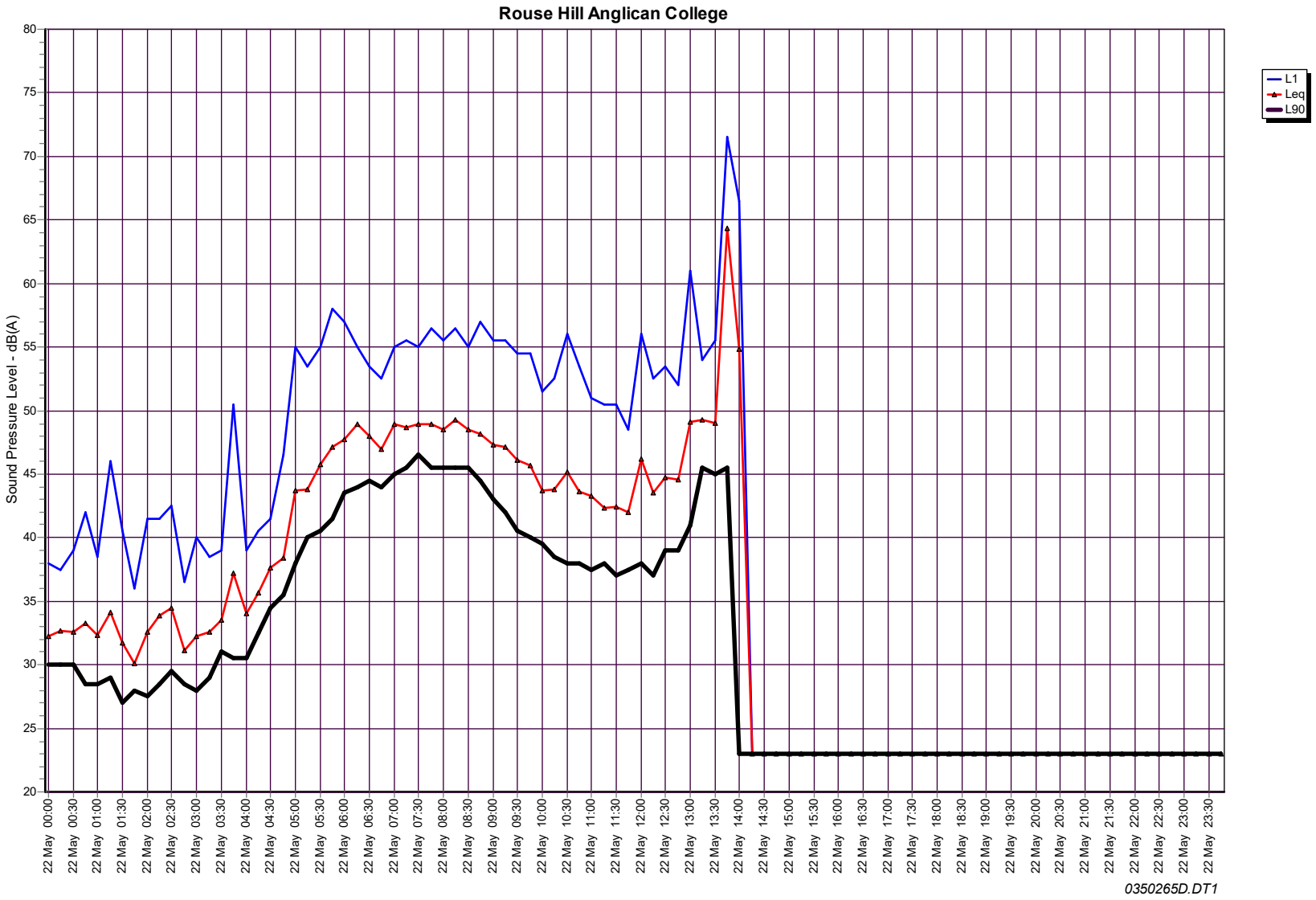
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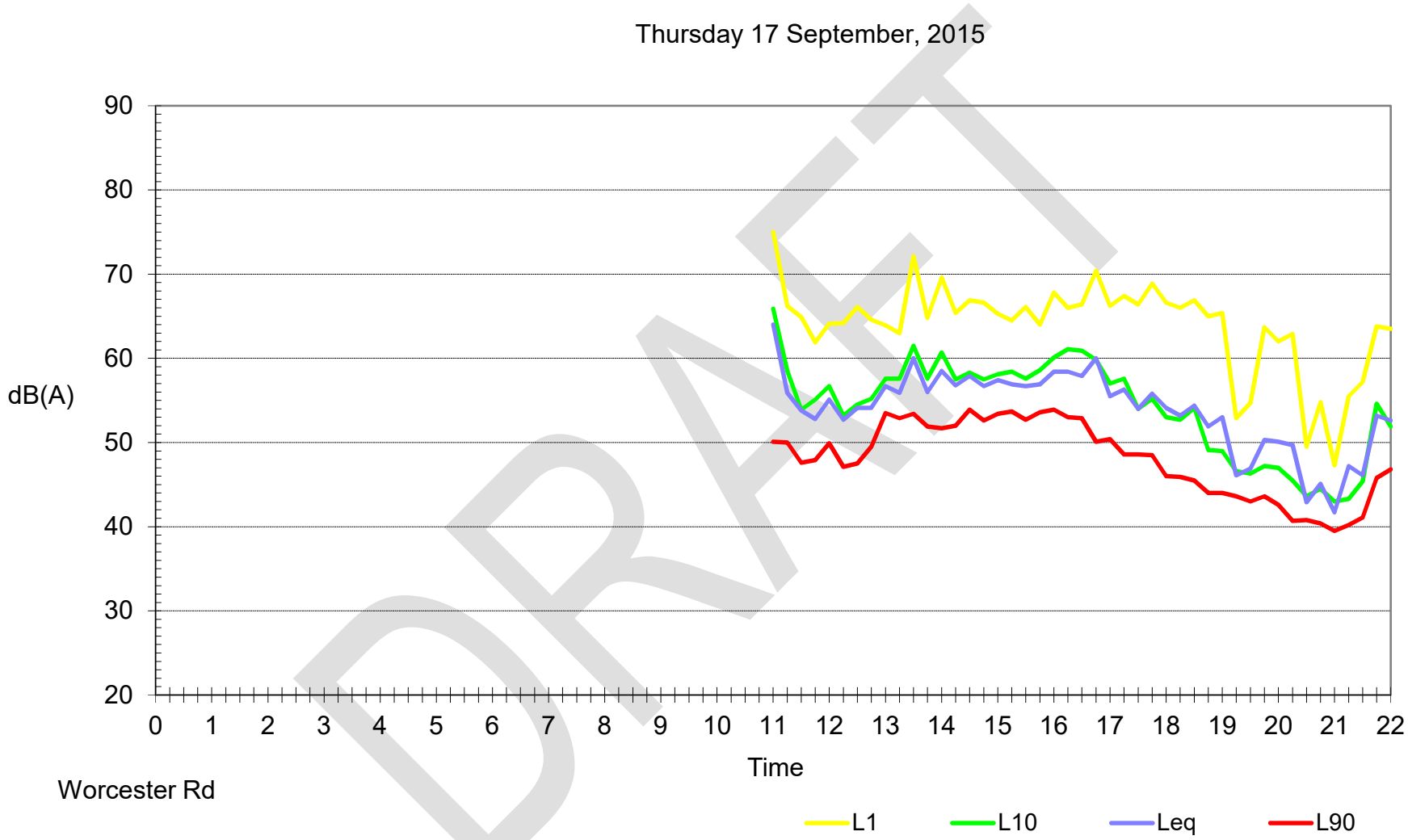
Appendix A

Ambient Noise Monitoring Data 2015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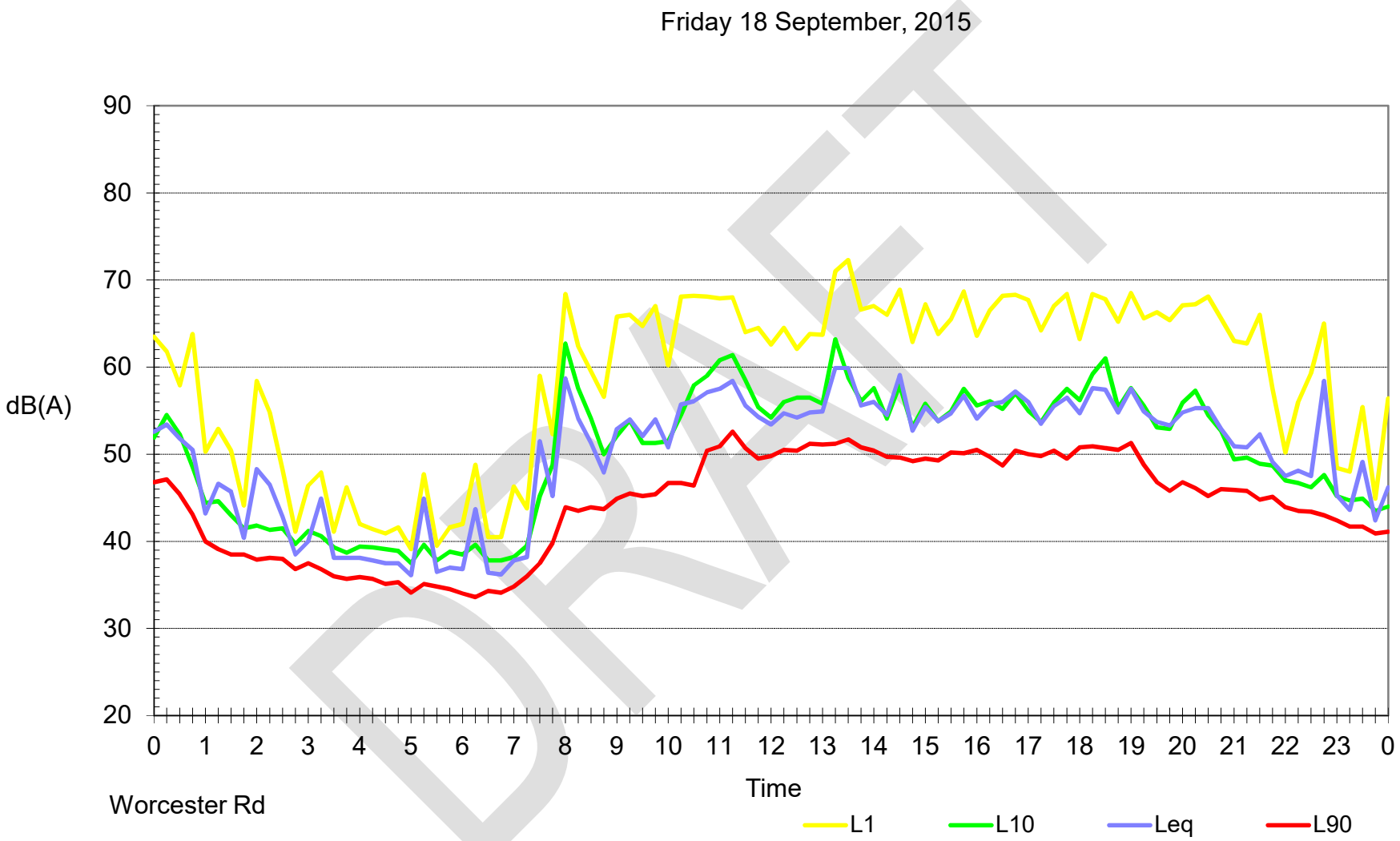
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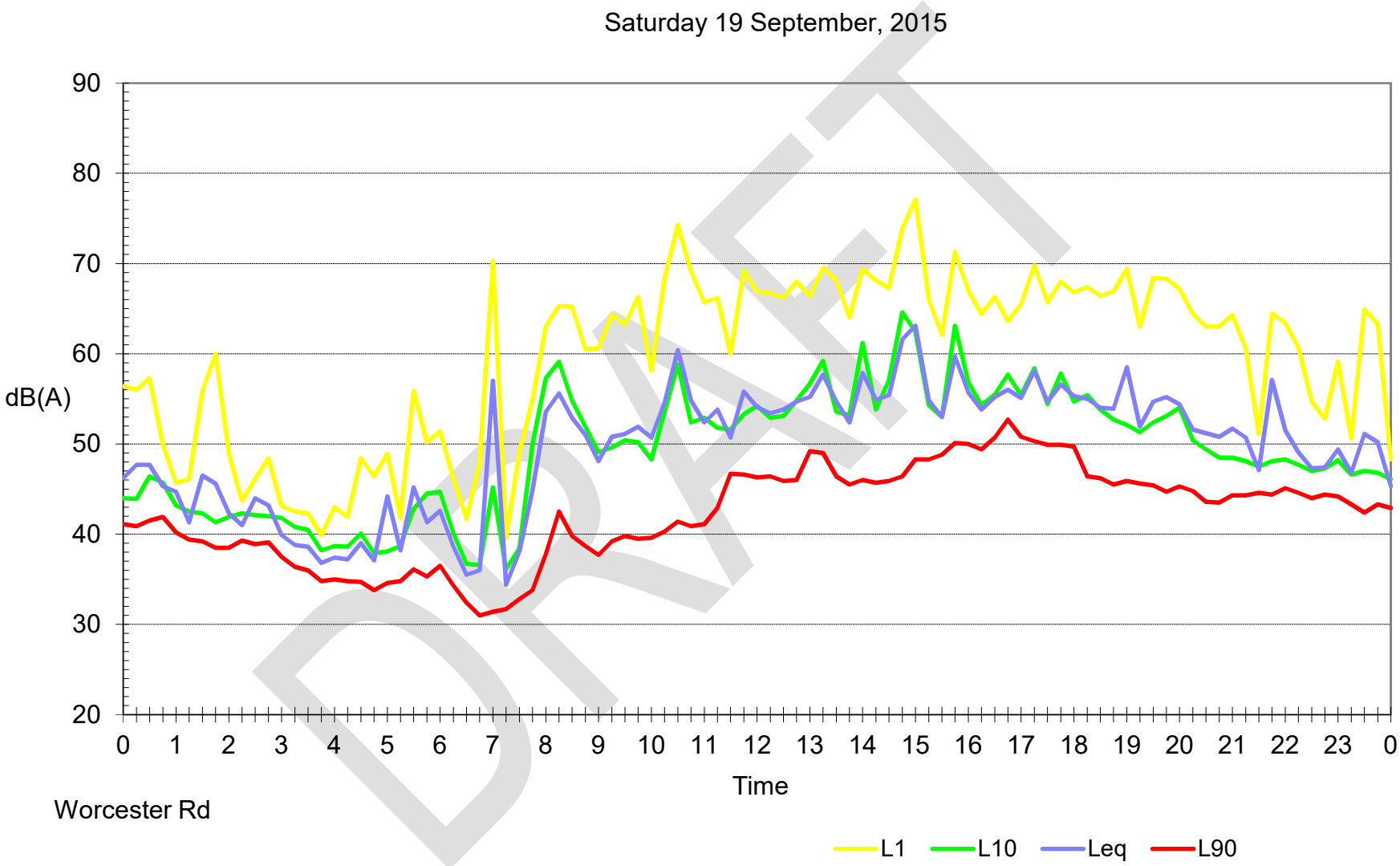
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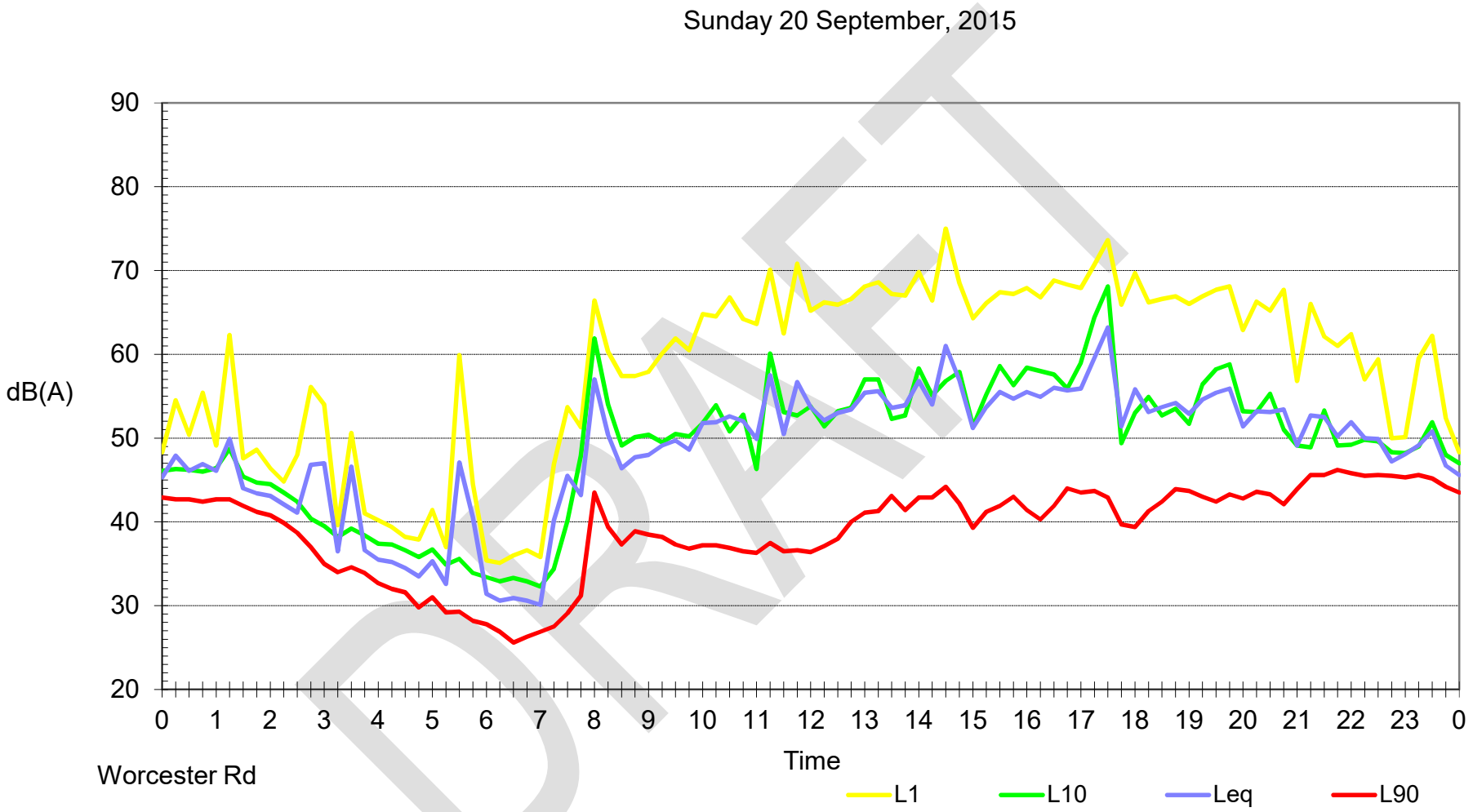
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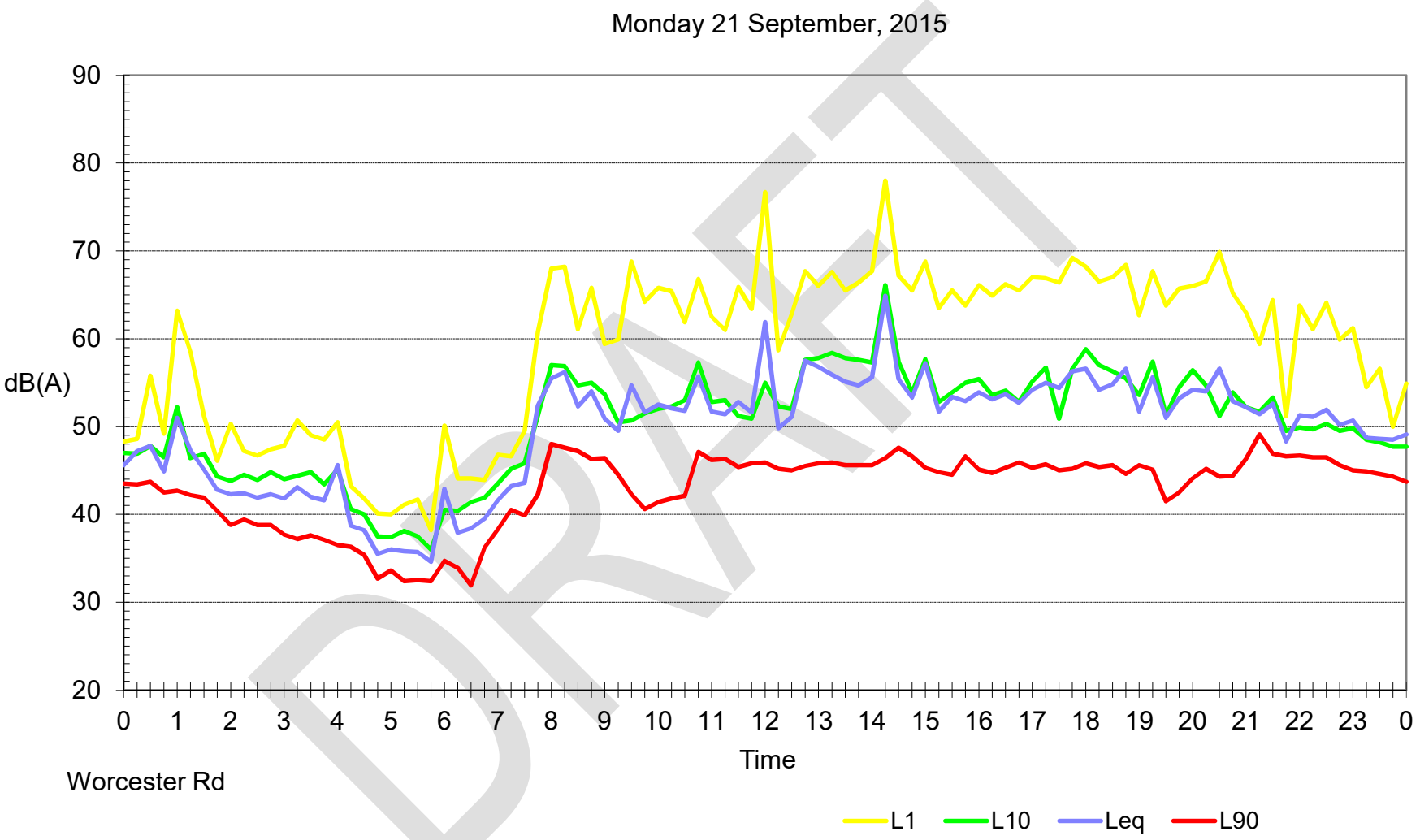
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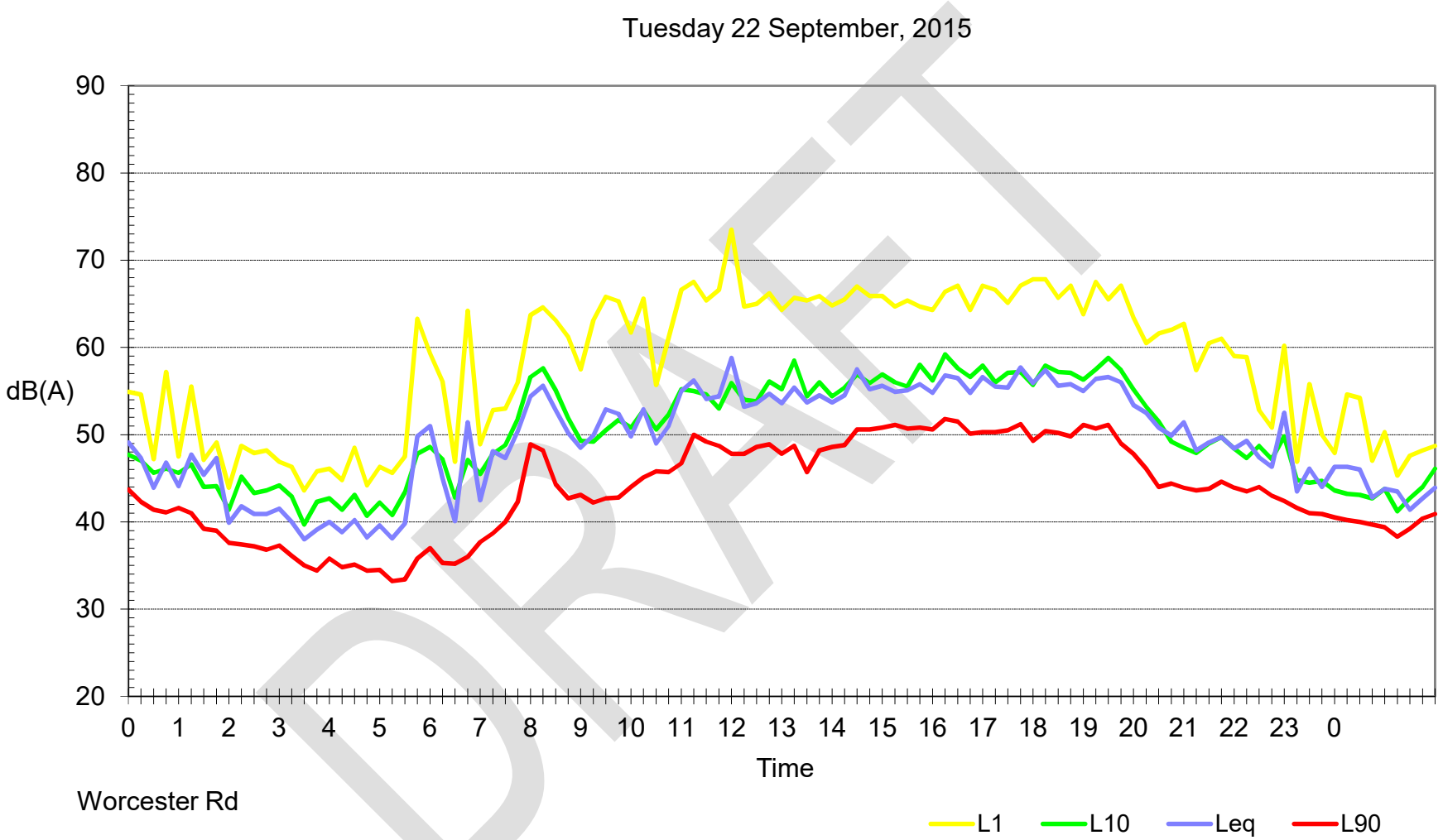
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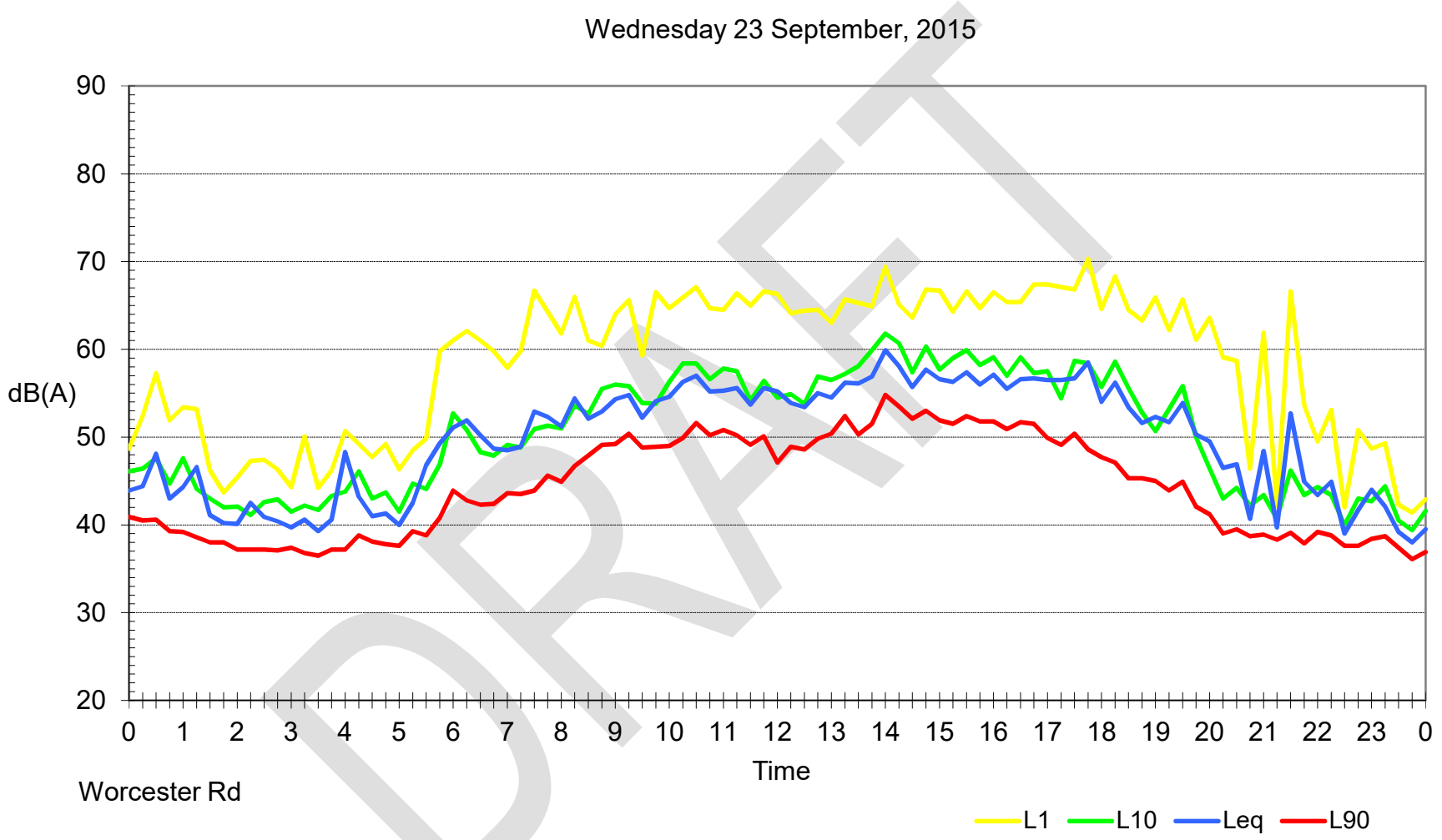
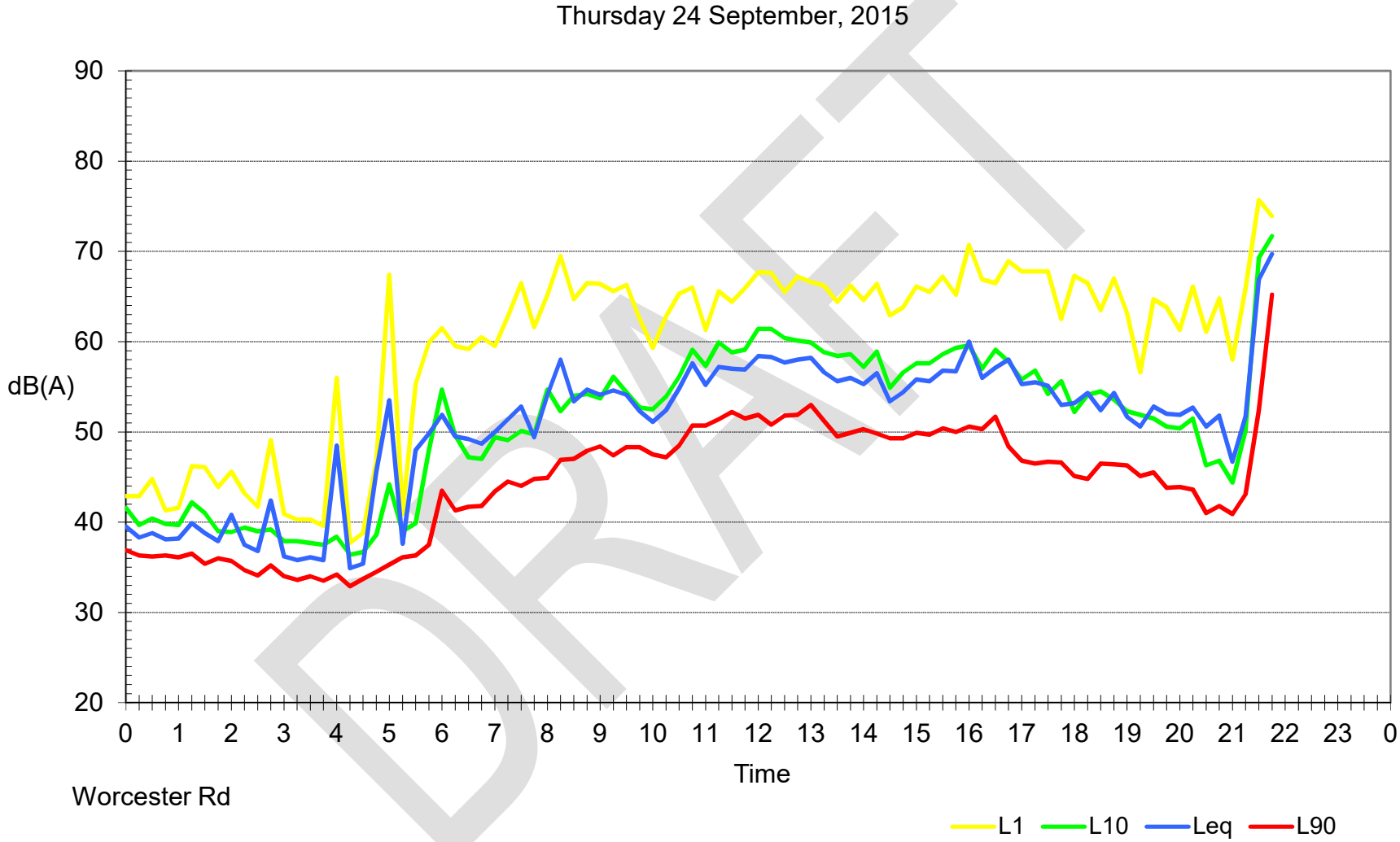
L90


Wednesday 23 September, 2015
90
80
70
60
50
40
30
20
dB(A)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 0
Time
Worcester Rd
L1
L10
Leq
L90


Thursday 24 September, 2015
90
80
70
60
50
40
30
20
dB(A)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 0
Time
Worcester Rd
L1
L10
Leq
L90