240 Lower Styx Road

Bottle Lake, Christchurch

ACOUSTICS

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Prepared for: Sub180 Entertainment Limited

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Document Control

240 Lower Styx Road, Bottle Lake, Christchurch

Assessment of Noise Effects – Festival Activities

J006777

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Table of Contents

1 Introduction

This report has been prepared to assess the noise effects associated with the proposed festival activities at 240 Lower Styx Road, Bottle Lake, Christchurch. The primary intent of this report is to assess proposed activities in context of compliance with regulatory requirements for neighbouring sensitive receivers in the vicinity of the proposed festival area. This report covers:

- Noise Sources: Assessment of the predicted noise levels emanating from potential equipment and activities associated with festival events and crowds.
- Noise Propagation: Modelling of noise propagation from the proposed festival area to receivers in proximity to the development
- Mitigation Options: Consideration of practicable mitigation measures for the control of noise from the event

2 Site

2.1 Identification

The festival is proposed to occur at 240 Lower Styx Road in Bottle Lake, Christchurch.

The events associated with the festival are planned on the north-eastern side of the site, with camping and parking to the south-east and 3 stages distributed throughout the site, as detailed in the following Section – Proposed Activities.

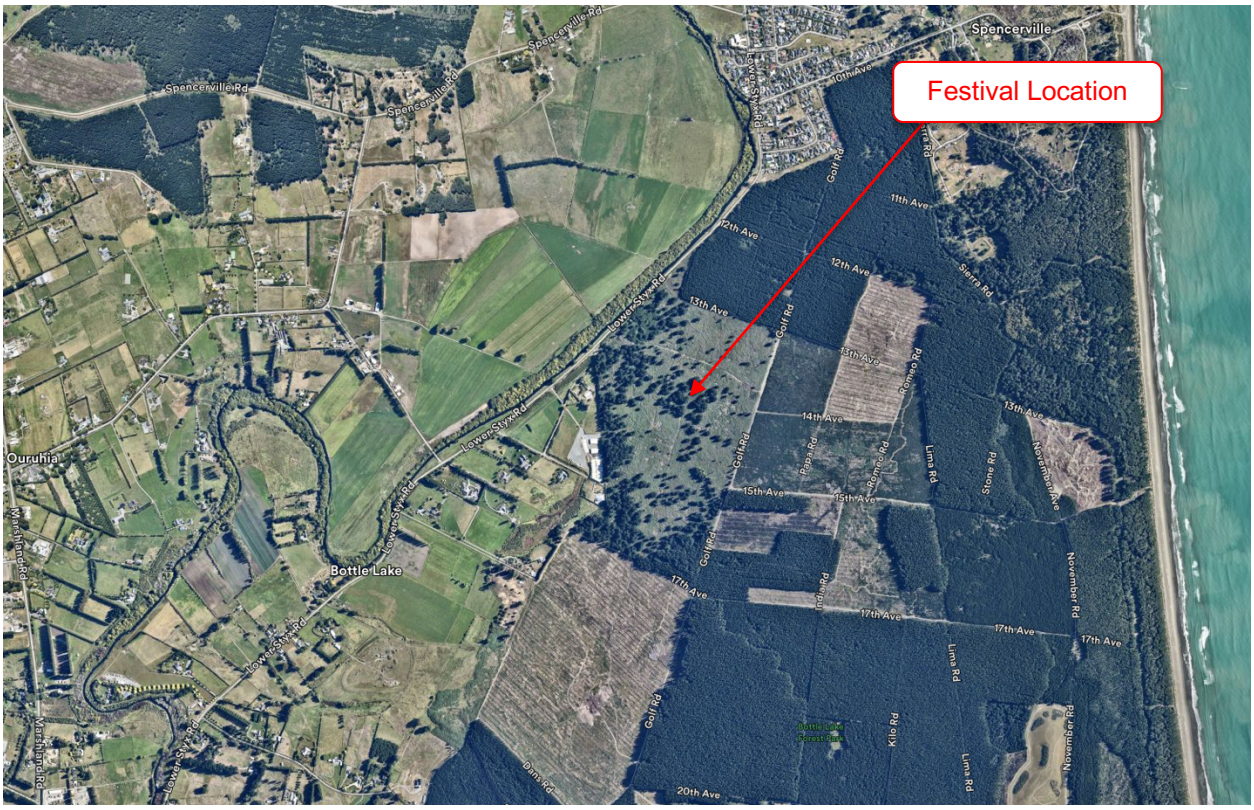

Figure 1 - Site Location

2.2 Zoning

In accordance with the Christchurch District Plan, the zoning of the subject area and areas in the vicinity are *Rural Urban Fringe Zone* with *Open Space Natural Zone* to the east and *Specific Purpose (Gulf Resort) Zone* to the north-west. Further to the north are *Residential Small Settlement Zone* properties.

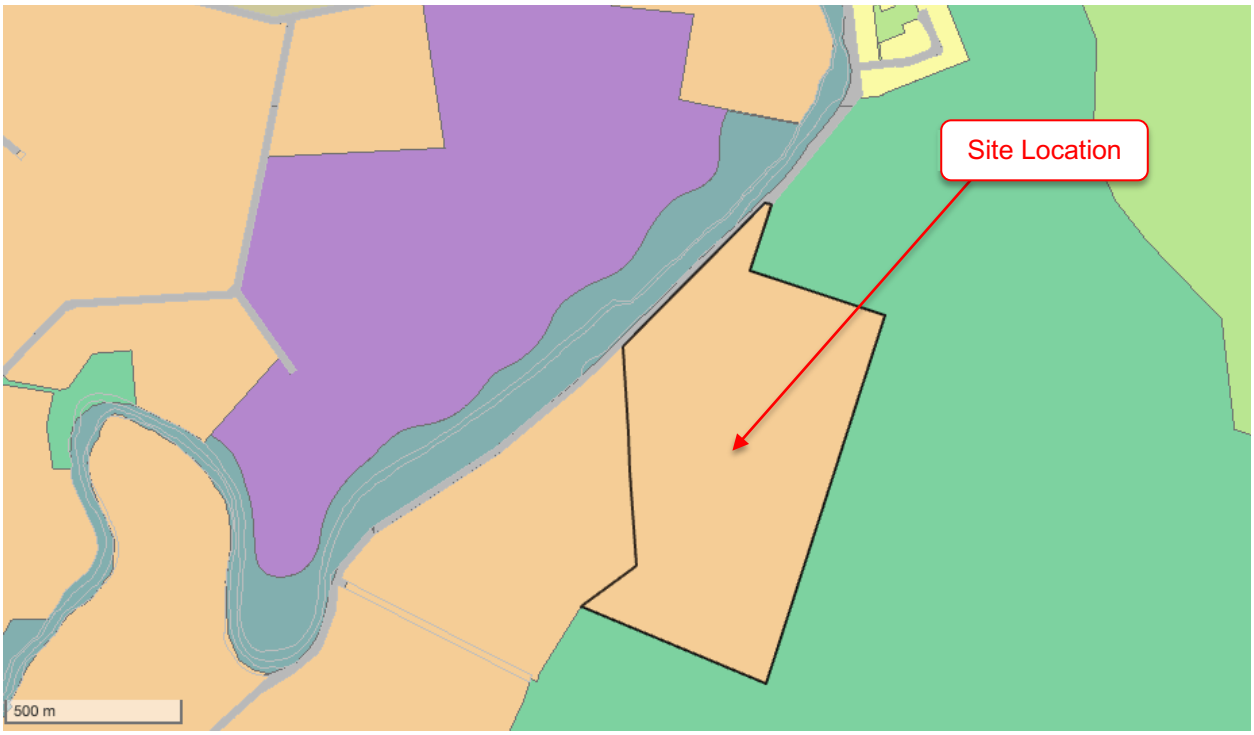

Figure 2 - Site Zoning

2.3 Vicinity and Environment

The proposed festival area is boarded to the west by residential dwelling in close proximity. The stages and speakers will be situated and oriented away from these receivers to reduce noise levels as much as practicably possible. The closest inhabited buildings are identified as being within approximately 350m from the closest Stage, being Stage B.

We do not have ambient noise level measurements in the area, however, can extrapolate based on ambient measurements in generally rural areas. I would estimate that ambient background noise levels in the area could be as low as 35dBA during the daytime, 20dBA or lower during the night-time hours. This would be highly dependent on weather conditions and even the slightest breeze would likely result in significantly higher levels of noise. Additionally, whilst relatively far away, I would expect there to be a relatively notable level of noise from the ocean at some receivers, e.g. the campgrounds, which would be fairly continuous and generally keep the background noise levels elevated.

In context, the background ambient noise levels may be discernibly lower than the noise levels that will be generated, as such the noise from the festival, e.g. where the predicted level is 40dBA or above, would be audible.

3 Assessment Standards

3.1 General Noise Standards

6.1.4.1 Measurement and assessment of noise

a. Unless otherwise specified elsewhere in this District Plan, noise shall be measured in accordance with NZS 6801:2008 "Acoustics – Measurement of environmental sound", and assessed in accordance with NZS 6802:2008 "Acoustics-Environmental noise", except that provisions in NZS 6802 referring to Special Audible Characteristics shall not be applied.

b. The noise standards shall apply at any point within a site receiving noise from an activity, except where:

i. the site boundary is a boundary with a site in the Transport Zone outside the Central City, in which case noise standards shall apply at or beyond the far boundary of the Transport Zone; or
ii. the site boundary is a boundary with a site in the Transport Zone, open space zone or any combination of these zones in the Central City, in which case noise standards shall apply at or beyond the far boundary of the Transport or open space zone; or
iii. the standards specify otherwise.

c. Where a site is divided by a zone boundary then each part of the site divided by the zone boundary shall be treated as a separate site for the purpose of these rules.

3.2 Zone Standards

The following standard applies for noise produced within the subject site and received at the neighbouring Rural Urban Fringe Zoned properties.

6.1.5.2.1 Zone noise limits outside the Central City

a. Outside the Central City, any activity that generates noise shall meet the Zone noise limits in Table 1 below at any site receiving noise from that activity, as relevant to the zone of the site receiveing the noise.

Zone of site receiving noise from the activity	*Time (hrs)*	*Noise Limit (dB)*	
		L_{Aeq}	L_{Amax}
All residential zones *All rural zones, except Rural Quarry Zone, assessed at any point within a notional boundary*	*07:00-22:00*	*50*	*n/a*
	22:00-07:00	*40*	*65*
All rural zones, except Rural Quarry Zone, assessed at the site boundary	*07:00-2200*	*55*	*n/a*
Specific Purpose (Golf Resort) Zone	*22:00-07:00*	*45*	*70*
All open space zones	*07:00-2200*	*55*	*n/a*
	22:00-07:00	*45*	*70*

Table 1 – Zone noise limits outside the Central City

Note: there are two applicable noise limits at rural zoned receivers, being 5dB lower at the notional boundary, relative to the site boundary. For the purposes of assessing the noise levels; the predictions and subsequent analysis is made at the relevant location where the noise limit is lower.

3.3 Temporary Activities

Note that the rules above are for general activities and apply for all hours outside those permitted for temporary events noted below. The temporary events noise limits are noted below. These noise levels / criteria may be used as a point of reference to acceptable noise levels from the festival, and may be applied to a portion of the events activities.

Temporary activities are defined as follows under chapter 2 of the Christchurch District Plan as followings:

In relation to Chapter 6 General Rules and Procedures, means activities and their ancillary buildings that are intended to have a limited duration and incidence (one--off, infrequent, transitional or with a defined end date, as opposed to regular and ongoing) and:

a. *are not part of a permanent activity that occurs on the site; and*
b. *create no, or only negligible, lasting alteration or disturbance to any site, building or vegetation.*

It includes:

c. *public artworks, recreation activities and entertainment activities; and*
d. *the provision of car parking areas ancillary to a temporary activity, whether sealed or unsealed, provided in accordance with an approved Traffic Management Plan, except as otherwise specified in Sub-chapter 6.4 Temporary earthquake recovery activities.*

It excludes:

e. *temporary utilities, which must comply with the relevant provisions in Chapter 11 Utilities and Energy.*

Advice note:

1. *Temporary buildings are required to comply with the provisions of the Building Act 2004.*

6.1.6.2.3 Noise – Activity Specific Noise Rules – Activity Standards – Temporary Activities

a. Temporary activities and buildings specified in Rule 6.2, other than temporary military training activities or emergency management activities which are subject to the activity standards in Rule 6.1.6.2..2, shall meet the following activity standards:

i. *Temporary activities and buildings specified in Rule 6.2, and located at a location listed in Table 4 below, shall meet the noise standards set out in Table 4.*
ii. *Any temporary activity and building specified in Rule 6.2, and located at a location not listed in Table 4, shall:*
    a. *Be located no closer than 30m from any residential unit;*
    b. *Undertake sound amplified activities for a total duration not exceeding 4 hours per day on any site, including all sound checks; and*
    c. *Occur only between 09:00 hours and 22:00 hours;*

    And for sound amplified activities, either

    d. *Have a total amplified power not exceeding 500 Watts RMS; or*
    e. *Result in a sound level not exceeding 65dB L_{Aeq} at any residential unit, to be evidenced by a report from a suitably qualified acoustic consultant.*

Additional temporary events noise limits for specific locations (e.g. Lancaster Park, Hagley Park, etc.) are also noted in the District Plan, however, are not applicable to the subject site.

3.4 Construction Activities

6.1.6.1.1 Noise Activities Specific Noise Rules

P2 Construction activities – Construction activities shall meet relevant noise limits in Tables 2 and 3 of NZS 6803:1999 Acoustics – Construction Noise, when measured and assessed in accordance with that standard.

Table 2 – Recommended upper limits for construction noise received in residential zones and dwellings in rural areas

Time of week	Time period	Duration of work					
		Typical duration (dBA)		Short-term duration (dBA)		Long-term duration (dBA)	
		L_{eq}	L_{max}	L_{eq}	L_{max}	L_{eq}	L_{max}
Weekdays	0630-0730	60	75	65	75	55	75
	0730-1800	75	90	80	95	70	85
	1800-2000	70	85	75	90	65	80
	2000-0630	45	75	45	75	45	75
Saturdays	0630-0730	45	75	45	75	45	75
	0730-1800	75	90	80	95	70	85
	1800-2000	45	75	45	75	45	75
	2000-0630	45	75	45	75	45	75
Sundays and public holidays	0630-0730	45	75	45	75	45	75
	0730-1800	55	85	55	85	55	85
	1800-2000	45	75	45	75	45	75
	2000-0630	45	75	45	75	45	75

Table 3 – Recommended upper limits for construction noise received in industrial or commercial areas for all days of the year

Time period	Duration of work		
	Typical duration	Short-term duration	Long-term duration
	L_{eq} (dBA)	L_{eq} (dBA)	L_{eq} (dBA)
0730 – 1800	75	80	70
1800 – 0730	80	85	75

4 Proposed Activities and Noise Sources

The Lower Styx Festival will be held once a year, at 240 Lower Styx Road, over the 29th, 30th and 31st December. The festival will include 3 stages, parking and a camping/glamping area.

The capacity of the festival will accommodate up to 10,000, approximately 4,000 vehicles, and accommodate food trucks and amusement rides.

The events comprising the festival include live music, in addition to sports competitions, etc.

This report is limited to the assessment of noise from the proposed activities. The following sections are a summary of the event types, with an indicative schedule pertaining to noise limits applicable at different days, times and zones.

4.1 Basic Festival Services

A number of services are proposed to be available throughout the festival including food trucks/vendors, an information centre, porta-loos, fridges, and power generation. In context of noise, the main sources over the day would be crowd noise, loud concert music, and equipment such as generators and food trucks. Note that the stages will be oriented towards the east, with the speakers oriented away from the neighbouring receivers. The following figures are indicative of the proposed layout of activities:

Figure 3 - Site Plan

4.2 Crowd Noise

Crowd noise levels are influenced by a number of parameters specific to each scenario and environment, including; age, gender, voice effort, background noise effect (Lombard coefficient), crowd size, synchronization of noise and directivity of noise.

Pertaining to festival and entertainment settings, noise from people would be expected to vary significantly between low noise from conversational dialog, to crowd noise and to shouting or announcements for coordination, and at the extreme; to synchronized directional shouting during live music events. The following are indicative sounds pressure levels at 1m from individual vocal efforts (Source: Lazarus, 1986):

Vocal Effort	Speech Level (dBA @ 1m)
Soft	42
Relaxed, Normal	54
Normal, Raised	60
Raised	66
Loud	72
Shouting	84
Maximal Shout	90

Table 2 – Sound Pressure level at 1m for different vocal efforts (Lazarus, 1986)

Taking into account the multitude of factors including age, gender, loudness, background noise effect (Lombard coefficient), percentage of people talking, and situational context we note the following sound power levels pertaining to people noise for crowd sizes under different situations

Noise Type – Outdoor	Number of people	Sound Power (Lw)
Raised	1	77 dBA
Loud	1	83 dBA
Shouting (Coordination)	1	95 dBA
Small Group – Raised	10	87 dBA
Small Group - Loud	10	93 dBA

Medium Group – Raised	100	97 dBA
Medium Group – Loud	100	103 dBA
Large Group – Raised	250	103 dBA
Large Group – Loud	250	109 dBA

Table 3 – Sound Power Levels for Different Vocal Efforts

With regards to directionality of noise, when a crowd noise is directional (e.g. following sports coverage on a screen) noise levels incident on receivers are lower at angles away from the direction of noise. This ranges from a reduction of 2dB for a receiver at 90˚ from the direction of noise. For a receiver at 130˚-180˚ noise levels would be between 6dB and 7dB lower. (Hayne et al 2006.)

We note that modelling multiple smaller crowds yields more accurate results than modelling one large crowd as it allows for more realistic distribution of noise sources. We would generally recommend noise is modelled for groups of 10-100 people as a localised non directional source for non-crowd-controlled events. Where crowds are managed (i.e. live music event with an allocated area) then directional effects are taken into account.

4.3 Setup

The following table lists relevant noise generating equipment and mechanical plant expected to be used at different stages during the setup works on the subject site for establishment of required areas. Noise data is quoted below in accordance with NZS 6803:1999, and BS 5228: Part 1:1997.

Equipment	Sound Power	Sound Pressure
	L_{WA} [dB]	L_{Aeq} at 10m [dB]
Hammer	107	79
Hand-held electric circular saw	105	77
Circular Saw, bench mounted	106	78
Wheeled Crane (4kW)	103	75
Tracked Crane (22t)	99	71
Loading scaffolding frames and clips	96	68
Loading scaffolding poles	100	72

Table 4 – Construction Equipment noise levels – NZS6803:1999 reproduced from BS5228-1:1997

4.4 Music Activities

The highest levels of noise are expected to be associated with the proposed live shows. These involve amplified sound in addition to crowd noise.

- 29th December:
    - Stage A: 12pm - 12am (midnight)
- 30th December:
    - Stage A: 1pm – 1am
    - Stage B: 10:05am – 10pm
    - Stage C: 10:05am – 10pm
- 31st December (to 1st January)
    - Stage A: 2pm – 2am
    - Stage B: 10:05am – 10pm
    - Stage C: 10:05am – 10pm

Sound checks will be run on stage A, and only for 2 artists per day between 10:05am and 12pm. Sound checks would be carried out at a lower level than those used for performances. The sound checks will not alter the overall predicted noise levels.

The main sources of noise during these events are the amplified sound and crowd noise. In most cases; crowd noise would have varying levels, continuity and directionality.

The highest noise levels anticipated from the overall festival would likely occur during the live music events from amplified music, in the evenings.

We note that after 10pm; music levels will cause an exceedance of the 45dB LAeq night-time limit for Rural and Specific Purpose (Golf Resort) Zones and the 45dB LAeq night-time noise limit for the Open Space Zone. We also note that a 5dB special audible characteristics penalty would typically be applicable to the noise levels regarding music, however, is specifically excluded from assessment in accordance with the District Plan standards (see Rule 6.1.4.1).

For the daytime period (7am–10pm), an adjustment is applied to the predicted noise rating level to account for the variation in sound levels across the day, with quieter periods relative to the peak activity resulting in a small overall reduction in the calculated rating level.

Large crowds of gathered people are assumed to produce a sound power level of 83dB per person.

The event will accommodate up to 10,000 attendees resulting in a total sound power level of L_w = 123dBA. People are assumed to be congregated between the various stages and food court / amusement areas.

Based on measurements of similar outdoor live music events and collated with data from published research, the main source of noise from the amplified music from speaker stacks, may reach L_{Amax} 100dBA at 30m from the stage. All stages will be oriented towards the ocean to the east/south-east.

Sound levels from the main sound system are highly directional, with the majority of energy projected towards the audience. Published studies and our own measurements at comparable outdoor events indicate that levels directly behind a properly-oriented concert array are typically 20–25 dB lower than in front of the stage at the same distance. This estimate is consistent with both published guidance on loudspeaker directivity and empirical measurements we have undertaken at similar outdoor concerts and performances. In practice, rearward sound exposure is expected to be further reduced by the predominance of in-ear monitoring, which limits the use of traditional stage monitors.

Additionally the subwoofer system will be deployed in a cardioid configuration, designed to direct low-frequency energy towards the audience and reduce sound spill. This approach significantly reduces low-frequency exposure to sensitive areas.

The stage locations, orientations, and configurations have been carefully optimised to minimise noise levels at neighbouring receivers as far as reasonably practicable, while still meeting the operational requirements of the festival.

We note for reference that for live music events, noise levels averaged over the duration of the events are usually 10dBA lower than the L_{Amax} levels. This is collated by measurements at similar events, in addition to published research on the matter (e.g. T. Tronstad and F. Gelderblom – Sound Exposure During Outdoor Music Festivals – Noise Health – 2016 July -Aug).

The stages will be limited to produce:
Stage A (speaker height 8m):

- 29th December:
    - 12pm – 12am: 90dB LAeq(15min) at 30m from the stage
- 30th December:
    - 1pm – 6pm: 90dB LAeq(15min) at 30m from the stage
    - 6pm – 10pm: 95dB LAeq(15min) at 30m from the stage
    - 10pm-1am: 90dB LAeq(15min) at 30m from the stage
- 31st December:
    - 2pm – 6pm: 90dB LAeq(15min) at 30m from the stage
    - 6pm – 10pm: 95dB LAeq(15min) at 30m from the stage
    - 10pm – 12am: 92dB LAeq(15min) at 30m from the stage
    - 12am – 2am: 90dB LAeq(15min) at 30m from the stage

Stage B (speaker height 7m):

- 30th & 31st December:
    - 10:05am – 10pm: 84dB LAeq(15min) at 30m from the stage
        - measured at FOH (Front of House) at 15m to LAeq 90dB

Stage C (speaker height 4m):

- 30th & 31st December:
    - 10:05am – 10pm: 84dB LAeq(15min) at 30m from the stage
        - measured at FOH at 10m to LAeq 93dB

NZS6802:2008 Duration Adjustment Notes: amplified music will start playing no earlier than 10:05am, this ensures that music is produced for no more than 79% of the daytime period, which would accommodate a 1dB duration adjustment to the overall noise rating level.

However, it is noted that variations in the noise levels over the day can be accounted for in accordance with the NZS 6802, *6.4.6: For situations where the level of the sound reduces significantly for large periods of time but the sound does not switch off completely, some adjustment to account for this relief to persons exposed to the sound is also appropriate. In these cases the energy average of the sound under investigation should be calculated over the entire prescribed time frame. The rating level shall be the greater of this average value for the representative level over the reference time interval -5 dB*.

The adjustment is therefore made over the total daytime period, and accounts for variation in the overall noise levels throughout the day, which equates to a 1 – 2 dB difference relative to the peak levels of noise.

To effectively control noise beyond 10pm, Stage A will operate independently. This approach ensures that night-time noise is managed from a single speaker arrangement, providing greater certainty regarding the source of noise during sensitive hours.

By isolating the source, this method simplifies recalibration of speakers to maintain compliance at surrounding noise receivers. It is a more efficient and reliable strategy compared to managing multiple concurrent noise sources.

Additionally, the realignment of speakers has managed to direct noise toward the East Coast, and reduces potential impact on residents to the North. The noise contours therefore demonstrate a reduction in noise in this area, achieving compliance with night-time noise standards except for a short period on the night of the 31st December (10pm-12pm).

4.5 Camping Activities

Camping activities will generally produce no more than low levels of noise, primarily conversational noise, but may include background levels of instrumental music, etc. during the day. This is anticipated to be a very low level of music.

Calculations for camping activities are based on the following assumptions

- The sound power level used in the calculation is based on a mix of 50% male / female.
- 50% of people are assumed to be talking at any given time.
- We used a conservative level of Lw = 72 dBA per person.

4.6 Traffic

An estimate of 4,000 vehicles per day (two-way) and 500 vehicles per hour at its peak has been made. These vehicle movements have been assumed to be distributed evenly between the two designated parking areas.

At the maximum of 10,000 guests, traffic movements are based on an estimate of 2.5 people per vehicle. This results in a total of 4000 vehicles over the day or 1333 vehicles per hour. Traffic movements are anticipated to occur between 10am and 10pm each day.

In accordance with the guidelines of the British Standard BS 5228:Part 1: 1997 as referenced in the NZ standard NZS6803:1999; noise levels from movement of heavy goods vehicles at low speeds are estimated to have a Sound Power Level L_{WA} of 98dB and result in a Sound Pressure Level of L_{Aeq} 70 dBA at 10m. As a conservative measure, idling heavy goods vehicles with ancillary mechanical equipment (e.g. refrigeration) are assumed to have the same noise levels quoted above.

Frequency distribution of vehicular noise is in accordance with ISO 717, where for example the Sound Pressure level 70dBA would have the following frequency distribution. We also note for reference that the frequency distribution of traffic noise in accordance with ISO717 generally corresponds with the measured distribution of similar activities.

Exterior Sound Pressure Level	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	Overall dBA
Traffic (ISO 717)	77.9	71.8	68.3	65.9	65.7	62.5	47.7	70.0

Table 5 – Example Truck Sound Pressure Level Frequency Distribution

4.7 Power Generation

The following table lists relevant power generation equipment to be assessed for use as part of the operation of the subject event. Noise data is quoted below in accordance with BS 5228: Part 1:1997.

Equipment	Sound Power	Sound Pressure
	L_{WA} [dB]	L_{Aeq} at 10m [dB]
Petrol driven generator – 1.5kVA	95	67
Petrol driven generator – 2.5kVA	98	70
Petrol driven generator – 4kVA	104	76
Diesel driven generator – 5kVA	104	76

Table 6 – Example Power Generation Equipment noise levels – BS5228-1:1997

5 Noise Propagation Modelling

To predict noise propagation at the subject site from the considered noise sources, an environmental model was constructed for the festival using CadnaA version 2025 computer modelling, using the methodology and parameters detailed below.

5.1 Modelling Methodology

The following applies to the modelling software CadnaA:

- CadnaA is an internationally recognised software package designed for the prediction of noise propagation. CadnaA implements numerous national and international standards and guidelines, including the CoRTN standard of the United Kingdom Department of Transport and Welsh Office for the Calculation of Traffic Noise as required in NZS6806:2010.
- The modelling method for noise propagation over distance is based on the international standard ISO 9613: “Acoustics – Attenuation of sound during propagation outdoors” methodology.
- The modelling also takes into account a multitude of additional absorption and reflection effects including ground and façade reflections. The program then calculates the LAeq dB or LAmax dB (depending on the activity), as the metric for the noise levels at the receivers for the purposes of this assessment.

5.2 Modelling Parameters

The following parameters were incorporated into the CadnaA noise propagation models:

Parameter	Value
Ground Attenuation, as per ISO9613.2	Water: G=0, Beach: G=0.5, Open Space: G=1 Roads, Pavements, Parking Lots: G=0, Other: G=0.5
Atmospherics	Temperature: 20˚C Rel. Humidity: 70%
Receiver Heights	Outdoor: 1.5m – Relative AGL
Source Heights	Crowd: 1.5m – Relative AGL Engines: 1m – Relative AGL Speakers: Varies between stages – see section 4.4
Building Facades	Structured Reflecting Facades

Table 7 – Modelling Parameters

5.3 Modelled Scenarios

A number of scenarios were assessed covering the different combinations of noise generating activities and noise sources for events. Modelling was done for the proposed areas as per the festival plan.

We note that modelling and assessment of noise levels was done for the cumulative combinations based planned activities, with power generation and vehicular noises including food trucks included in all scenarios.

5.3.1 Setup days

Assessment is made for construction works across the proposed festival area covering primarily the central and southern areas of the site. This includes the equipment detailed in the Section 4.3, used and operated simultaneously across all festival areas.

5.3.2 Low intensity activity

The low-level activity will be general background activities, conversation, camping, and does not include any music or large crowd noise.

5.3.3 Predicted Noise Levels by Day & Time

Each day is modelled based where each stage is utilized over the day. For modelling purposes, the speaker stack have varying heights noted in section 4 above, with the stage assumed to include two primary sets of speakers, each with a horizontal directional spread of 45˚ vectored towards the crowd.

5.3.4 Mitigation

No physical screening mitigation is proposed, however, stages have been oriented so as to minimise the noise projected towards the residentially zoned neighbours and the campground to the north-east. The speakers for A Stage have been oriented towards the south-east and B & C Stage to the east-south-east.

Over the course of this project, numerous iterations of noise assessment and acoustic reporting have been undertaken. These iterations have reflected a range of factors including:

- the original proposed stage layout;
- the investigation of various mitigation measures;
- multiple changes to stage orientation and speaker height; and
- refinements to speaker directivity and dispersion.

For completeness, the applicant has explored the option of including an acoustic wall around stage A, however this will only result in a small reduction in noise. Significant noise reductions have been found through location and orientation of speaker, as assessed in the original application. The current modelling therefore represents an optimised orientation and configuration that achieves the desired music levels while reducing off-site impacts as far as practicable.

6 Predicted Noise Levels

6.1 Setup/Pack Down

Noise modelling is done for the L_{Aeq} metric as per the associated references in BS5228. Noise levels during the setup and pack down phases are assessed against the construction noise limits of 80 dB L_{Aeq} and 95dB L_{AFmax} for short-term work. Based on the noise propagation models, noise levels are predicted to be:

Receiver	Predicted Noise Level dB L_{Aeq}	Noise Limit dB L_{Aeq}	Comments
176 Lower Styx Road	48	80	Complies
206 Lower Styx Road	48		
212 Lower Styx Road	46		
218 Lower Styx Road	48		
220 Lower Styx Road	48		
222 Lower Styx Road	49		
224 Lower Styx Road	49		
226 Lower Styx Road	52		
228 Lower Styx Road	50		
230 Lower Styx Road	53		
234 Lower Styx Road	56		
Specific Purpose (Golf Resort) Zone	57		
Residential Zone (e.g. 286 Lower Styx Road)	46		

Table 8 – Predicted Setup Noise Levels

6.2 Event Noise Levels

Noise modelling is done for the LAeq metric. Noise levels during this scenario are assessed against the permitted noise levels for the zoning.

We note that the 5dB special audible characteristics penalty, which would typically be applied to music noise, is not applicable to assessment under the Christchurch District Plan and is therefore excluded from assessment.

There is a noise limit of 55/45dBA during the day/night at the boundary of the Open Space zone property to the east. However, this property doesn't contain any noise sensitive activities such that the effects may be considered limited, over 4 days.

6.2.1 Low Intensity

Current assessment is based on conversational noise levels throughout the site, with no music. This is considered representative of typical background activities.

Receiver	Predicted Noise Level dB L_{Aeq}	Noise Limit Day / Night dB L_{Aeq}	Comments
176 Lower Styx Road	<30	50dB / 40dB	Complies at all times
206 Lower Styx Road	<30		
212 (216) Lower Styx Road	<30		
218 Lower Styx Road	<35		
220 Lower Styx Road	<30		
222 Lower Styx Road	<35		
224 Lower Styx Road	<30		
226 Lower Styx Road	<35		
228 Lower Styx Road	<35		
230 Lower Styx Road	38		
234 Lower Styx Road	39		
Spencer Beach Top 10 Holiday Park	<30	55dB / 45dB	
Specific Purpose (Golf Resort) Zone	37		
Residential Zone (e.g. 286 Lower Styx Road)	<30	50dB / 40dB	

Table 9 – Low Intensity Activity Predicted Noise Levels

6.2.2 Predicted Noise Levels by Day & Time

The following noise levels are predicted for each day and the varying time periods during which the different stages are operating. Note that the daytime levels represent the duration-adjusted noise rating level over the period 7:00 am to 10:00 pm. Noise levels for the various stage combinations throughout the day are provided in Appendix B for reference and further detail, if required.

6.2.2.1 Predicted Noise Levels 29th December

Receiver	Predicted Noise Rating Level dB L_{Aeq}		L_{Amax}	Noise Limit Day / Night	dB exceedance
	Duration Adjusted Daytime Noise Rating Level	Stage A only After 10pm	Night-time		
176 Lower Styx Road	36	37	47	50dB / 40dB L_{Aeq} & 65dB L_{Amax} at night	N/A
206 Lower Styx Road	35	36	46		N/A
212 Lower Styx Road	36	37	47		N/A
218 Lower Styx Road	36	37	47		N/A
220 Lower Styx Road	36	37	47		N/A
222 Lower Styx Road	37	38	48		N/A
224 Lower Styx Road	37	38	48		N/A
226 Lower Styx Road	39	40	50		N/A
228 Lower Styx Road	38	39	49		N/A
230 Lower Styx Road	40	41	51		1dB 10pm – 12am
234 Lower Styx Road	41	42	52		2dB 10pm – 12am
Residential Zone (e.g. 286 Lower Styx Road)	38	39	49		N/A
Spencer Beach Top 10 Holiday Park	41	42	52	55dB / 45dB L_{Aeq} & 70dB L_{Amax} at night	N/A
Specific Purpose (Golf Resort) Zone	42	43*	53		N/A

Table 10 – High Intensity Activity – Cumulative Predicted Noise Rating Levels

Complies	
1-2dB above the night-time noise limit	

*Assessed at the site boundary and assessed against the boundary noise limit of 45dB. Noise levels at the notional boundary of any of the closest receivers is less than 40dB LAeq at all times.

6.2.2.2 *Predicted Noise Levels 30th December*

Receiver	Predicted Noise Level dB L_{Aeq}		LAmax	Noise Limit Day / Night	dB exceedance
	Duration Adjusted Daytime Noise Rating Level	10pm – 1am Stage A only	Night-time		
176 Lower Styx Road	45	37	47	50dB / 40dB L_{Aeq} & 65dB L_{Amax} at night	N/A
206 Lower Styx Road	42	36	46		N/A
212 Lower Styx Road	46	37	47		N/A
218 Lower Styx Road	44	37	47		N/A
220 Lower Styx Road	44	37	47		N/A
222 Lower Styx Road	45	38	48		N/A
224 Lower Styx Road	45	38	48		N/A
226 Lower Styx Road	48	40	50		N/A
228 Lower Styx Road	46	39	49		N/A
230 Lower Styx Road	52	41	51		2dB 10:05am – 10pm 1dB 10pm – 1am
234 Lower Styx Road	53	42	52		3dB 10:05am – 10pm 2dB 10pm – 1am
Residential Zone (e.g. 286 Lower Styx Road)	46	39	49		N/A
Spencer Beach Top 10 Holiday Park	48	42	52	55dB / 45dB L_{Aeq} & 70dB L_{Amax} at night	N/A
Specific Purpose (Golf Resort) Zone	50	43*	53		N/A

Table 11 – High Intensity Activity – Cumulative Predicted Noise Rating Levels

Complies	
1-3dB above the noise limit	

*Assessed at the site boundary and assessed against the boundary noise limit of 45dB. Noise levels at the notional boundary of any of the closest receivers is less than 40dB LAeq at all times.

6.2.2.3 *Predicted Noise Levels 31st December*

Receiver	Predicted Noise Level dB L_{Aeq}			LAmax	Noise Limit Day / Night	dB exceedance
	Duration Adjusted Daytime Noise Rating Level	10pm – 12am Stage A only	12am – 2am Stage A only	Night-time		
176 Lower Styx Road	45	39	37	52	50dB / 40dB L_{Aeq} & 65dB L_{Amax} at night	N/A
206 Lower Styx Road	42	39	36	52		N/A
212 Lower Styx Road	46	40	37	53		N/A
218 Lower Styx Road	44	39	37	52		N/A
220 Lower Styx Road	44	39	37	52		N/A
222 Lower Styx Road	45	40	38	53		N/A
224 Lower Styx Road	45	40	38	53		N/A
226 Lower Styx Road	48	42	40	55		2dB 10pm – 12am
228 Lower Styx Road	46	41	39	54		1dB 10pm – 12am
230 Lower Styx Road	52	44	41	57		2dB 10:05am – 10pm 4dB 10pm – 12am 1dB 12am – 2am
234 Lower Styx Road	53	44	42	57		3dB 10:05am – 10pm 4dB 10pm – 12am 2dB 12am – 2am
Residential Zone (e.g. 286 Lower Styx Road)	46	41	39	54		1dB 10pm – 12am
Spencer Beach Top 10 Holiday Park	48	44	42	57	55dB / 45dB L_{Aeq} & 70dB L_{Amax} at night	N/A
Specific Purpose (Golf Resort) Zone	50	44*	43*	57		N/A

Table 12 – High Intensity Activity – Cumulative Predicted Noise Rating Levels

Complies	
1-3dB above the night-time noise limit	
4dB above the night-time noise limit	

*Assessed at the site boundary and assessed against the boundary noise limit of 45dB. Noise levels at the notional boundary of any of the closest receivers is less than 40dB LAeq at all times.

Also note that in all instances the noise levels propagating towards Rothesay Road are reduced to less than 35dB L_{Aeq} levels more than 600m away from the closest residence in that areas. The noise received to the south in this area is expected to be effectively inaudible.

7 Analysis and Conclusion

The proposed festival will involve the use of three stages for live music performances, with events scheduled over four consecutive days. Given the various District Plan noise restrictions, it is crucial to assess the impact of amplified sound on the surrounding environment, particularly in relation to the noise limits set for the area.

Festival Operations and Noise Exceedances

Given that the proposed festival is scheduled to operate beyond the standard permitted hours, it will necessarily conflict with the 9:00am to 10:00pm time restriction. The event's requirement to run past 10:00pm each day creates a direct conflict with these time-based noise limitations.

Night-time Noise Limits

The District Plan specifies a night time noise limit of 40dB LAeq, at the notional boundaries of the rural sites, and at the residential boundaries (noting that the special audible characteristics penalty is not applicable in accordance with the District Plan standards). Additionally, a 45dB LAeq night-time noise limit is applicable at the boundaries of the specific purpose (golf resort) zone, and rural properties, this is generally only relevant to any property where the dwelling is located a significant distance from the sites boundary or where there is no dwelling. These are very low thresholds, designed to maintain a quiet environment and minimize noise disturbance from events or activities in the area.

With the exception of 10pm-12am (midnight) on the 31st December, there will be up to a 3dB daytime exceedance and 2dB night-time exceedance with the noise limits at the closest neighbouring receivers, with music output from Stage A controlled as noted in section 4 above. A special allowance is made for higher levels of music between 10pm and midnight on New Years Eve to allow for 2dB higher music levels, to celebrate the new year. This results in exceedances of up to 4dB at the closest neighbouring receivers.

It is noted that a special audible characteristic penalty has not been applied within this assessment. Such penalties are typically included to account for heightened disturbance caused by features of the sound beyond its overall level. In recognition of this, it is recommended that low-frequency content is carefully controlled to minimise potential disturbance. Specifically, we recommend that no individual third octave band noise level exceed L_{Zeq} 85 dB during the day and 80dB at night, at the neighbouring receivers. This generalised restriction provides a clear performance target for managing bass energy, which is commonly the dominant factor influencing community noise disturbance from music events.

The predicted exceedance of 2-3dB is considered to be a negligible exceedance with 2dB being an inaudible subjective perception difference and 3dB only just being audible to human hearing. The effects are therefore considered to be less than minor.

Noise Mitigation/Management Measures

The following noise mitigation/management measures will be implemented to reduce the impact on neighbouring properties:

- Sound System Design: Directing the speakers optimally towards the south-east will help to minimize the spread of noise towards the neighbouring receivers.
    - The stage locations, orientations, and configurations have been carefully optimised to minimise noise levels at neighbouring receivers as far as reasonably practicable, while still meeting the operational requirements of the festival.
    - The stage orientations have been modelled using the following compass bearings. A margin of error of ±10 degrees has been applied, and it is assumed that speakers will be angled slightly off-centre towards the main audience area or front of house:
        - A Stage: 130 degrees
        - B Stage: 115 degrees
        - C Stage: 105 degrees
    - Limit the music levels, and staggering the use of the stages, use of cardioid subwoofers, monitoring the noise with spot measurements.
    - Use of in-ear monitors for as many artists as possible (to limit noise projected behind the stages).
- On-Site Acoustic Support: It is recommended that a qualified acoustician be involved during the stage establishment and initial sound checks. This would allow for real-time verification of music levels, adjustments to speaker configuration, and fine-tuning of the setup.

Limiting the stages used will provide a reduction in the overall noise levels received at the neighbouring properties.

Sound checks will be run on stage A, and only for 2 artists per day between 10am and 12pm. Sound checks would be carried out at a lower level than those used for performances. The sound checks will not alter the overall noise levels predicted.

Effects of Surrounding Forestry on Noise Propagation

Although the surrounding forestry presents a substantial visual barrier, its influence on noise propagation is limited. The primary attenuation effect occurs within the forested area itself (and can be seen in the noise contours), where ground absorption and scattering reduce local noise

levels. However, at the more distant receiver locations, the sound energy largely propagates above and over the treetops. As a result, the reduction in predicted noise levels at the receivers beyond the forestry is relatively small, typically in the order of 1 dB, and not greater than 2 dB.

The difference in predicted levels between a forested landscape and a cleared (logged) landscape is therefore negligible, with changes considered less than minor. Current predictions are based on the existing conditions, which include areas of established and regenerating forestry.

Noise Levels Received Inside Dwellings

As a worst case, assuming that there are bedrooms on the side of the dwellings facing the festival, and windows are open, the noise levels inside would be no more than 40dB. With windows closed and assuming relatively standard building construction details, e.g. non-acoustic standard double glazing, the internal noise levels inside would be below 30dB. Generally speaking, this would be barely audible, with the potential exception of the noise level at and below 125Hz.

It is acknowledged that minor non-compliances are identified at 230 and 234 Lower Styx Road in Tables 10–12. These dwellings are the most proximate to the festival site. Based on typical building construction, internal noise levels with windows closed are expected to fall below the generally accepted night-time criterion of 30 dB LAeq. While low-frequency components may remain faintly audible to sensitive individuals, the overall internal levels are not expected to result in significant or widespread sleep disturbance. The events design and use of directional low-frequency control (cardioid subs) are expected to minimise effects on sleep inside nearby dwellings.

Noise Levels Received by Campers

The predicted noise levels at the most affected areas of the campground are in the order of 42–48 dB LAeq. These levels are comparable to a quiet conversation at a distance of several metres, or to typical ambient noise in suburban outdoor environments during the evening.

For campers in tents, there is little acoustic attenuation provided by the tent material, and as such the internal levels experienced would be similar to the external environment. Noise will therefore remain audible within the tents, particularly the low-frequency components of music. For occupants of campervans or caravans, some degree of noise reduction can be expected through vehicle construction, with internal levels likely to be 5–10 dB lower than outside, depending on the windows and ventilation arrangements.

It is important to note that music of this nature contains a strong low-frequency beat, often perceived as a “thumping” sound. Low-frequency energy travels efficiently and is less reduced by distance or lightweight structures such as tents/caravans. As such, while the overall noise levels are relatively modest, the bass beat is likely to remain clearly perceptible and may be the most noticeable feature for campers. This type of sound is also commonly identified as a cause of disturbance, particularly at night, even when the overall noise level is not considered excessive.

The bass noise effects will be managed through a recommended condition of consent, which restricts third-octave band levels to no more than 85 dB LZeq during the daytime and 80 dB LZeq during the night-time at the receiving environments.

Although the noise is audible and may result in some disturbance for sensitive individuals, the exposure is temporary and associated with a limited time occurring each year, and therefore the overall effect on the campground environment is expected to be limited in extent and duration. I consider compliance with the District Plan noise rules (except for a short period on new year's night), in combination with the proposed conditions restricting third-octave band levels, will result in the effect on the campground being less than minor.

Conclusion

In summary, the proposed festival presents several challenges in terms of compliance with the District Plan's noise restrictions. These challenges have been largely overcome with the final layout of the festival to minimise the noise effects on the neighbouring receivers.

The only notable exception to compliance is the period between 10 pm and midnight on 31 December, where slightly higher noise levels are proposed to accommodate New Year's Eve celebrations.

Outside of this period, the festival is predicted to comply during the day and at night for residentially zoned receivers, with only small exceedances at rural sites:

- 230 Lower Styx Road – with a minor exceedance of 1 & 2 dB above the rural night-time and daytime limits respectively.
- 234 Lower Styx Road – with a minor exceedance of 2 & 3 dB above the rural night-time and daytime limits respectively.

In general, the festival is expected to produce no more than a 3 dB exceedance of the night-time limit. This classifies the activity as a restricted discretionary activity under Rule 6.1.5.1.3 of the District Plan.

It is noted that a 3dB exceedance is considered to be negligible being a barely audible difference, with 2dB being an inaudible difference. The effects of the most exposed neighbouring receivers is therefore considered to be less than minor.

The exceedance will only occur for a limited duration, being restricted to a few hours on a few nights each year. The festival is a New Year's celebration, during which some elevated noise levels are generally anticipated and are often more readily accepted by the community, particularly around and slightly beyond midnight.

During the period between 10pm and 12am on December 31st a slightly higher exceedance is predicted to accommodate the new year's celebration. With the appropriate control of the

music levels the exceedance is predicted as being no more than 4dB, however, it is noted that higher exceedances around the transition into the new year may be considered acceptable for the short period around midnight.

As a temporary event, it does not represent an ongoing source of noise, and the impact on neighbouring receivers is therefore intermittent and short-term. In this context, the predicted exceedance can be regarded as acceptable, and the associated noise effects are considered to be less than minor.

The proposed festival would comply with the temporary events noise limit of 65dB at all neighbouring receivers. However, is anticipated to produce such noise levels exceeding the duration limitation of the District Plan standards. Nevertheless, this may allow for elevated levels of noise for a restricted period of times over the event and gives context to acceptable levels of noise from temporary events.

In terms of noise management, the festival operators have expressed a clear commitment to remaining within compliance with the specified limits, or within the very small exceedances identified in this assessment (generally not more than 3dB, and limited to no more than 4dB around the midnight period on New Year's Eve). Whilst compliance monitoring is referenced to measurements taken at the front-of-house (FOH) mixing position, in practice the management of sound levels will place greater emphasis on measurements undertaken at neighbouring receiver locations. This approach ensures that any necessary adjustments to music levels are made with respect to the actual environmental impact on surrounding residents, rather than solely in relation to FOH reference levels.

This receiver-focused monitoring and adjustment process provides additional confidence that any exceedances are minimised in both magnitude and duration. It also reflects good practice by ensuring that management decisions are based on how sound is experienced at sensitive locations, rather than only at the source. This commitment demonstrates a proactive approach to environmental noise management and helps to balance the needs of the festival with the reasonable expectations of the community.

Appendix A – Noise Contours

Interpretation of Noise Contour Modelling

The noise contour plots prepared for the proposed music festival illustrate a distinct directionality to the predicted noise levels, reflecting the orientation and layout of the stage and sound system. The patterns shown are broadly consistent with expectations for amplified music sources of this type, with higher levels extending in the main direction of the loudspeakers and reduced levels behind the stage area.

In the modelling outputs, some relatively sharp transitions and distinct contour boundaries are visible. These are not considered to represent sudden real-world changes in noise level, but rather a combination of factors inherent to the modelling process. The large geographical area modelled requires calculations to be performed at a slightly reduced spatial resolution for efficiency, which can result in contour lines appearing more angular or stepped.

Some of the contour boundaries in the images appear as distinct lines or sharper transitions than might occur in real-world conditions. This is a recognised characteristic of predictive noise modelling, influenced by several factors:

Directional modelling constraints: The software allows directional patterns to be incorporated, but only within certain parameters. Where the physical sound system has a more complex or refined directional profile, the model may use simplified approximations.

Calculation artefacts: Complex sound fields can produce constructive and destructive interference patterns between multiple sources, and the modelling algorithms can depict these in a stylised manner.

The contours are presented as areas at 5dB increments, this also contributes to relatively harsh lines in the imagery but ultimately makes the image easier to read. These effects are largely cosmetic in nature, relating to how the results are displayed rather than to the accuracy of the underlying predictions. The modelling inputs and methodology remain robust, and the results presented in this report are considered reliable for the purposes of assessing compliance and potential impacts.

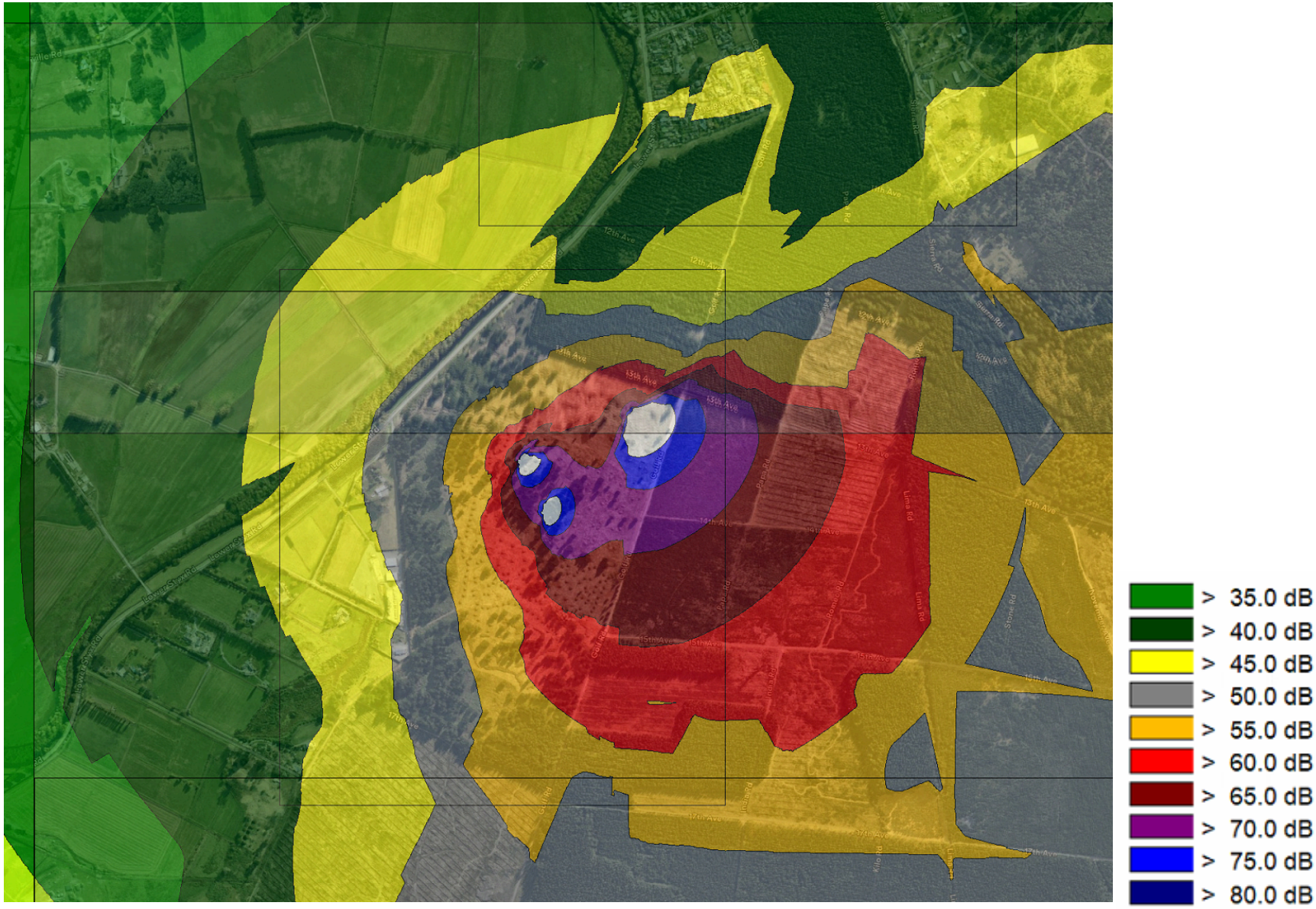

Figure A1 – All 3 Stages – Daytime Duration Adjusted Noise Rating Level

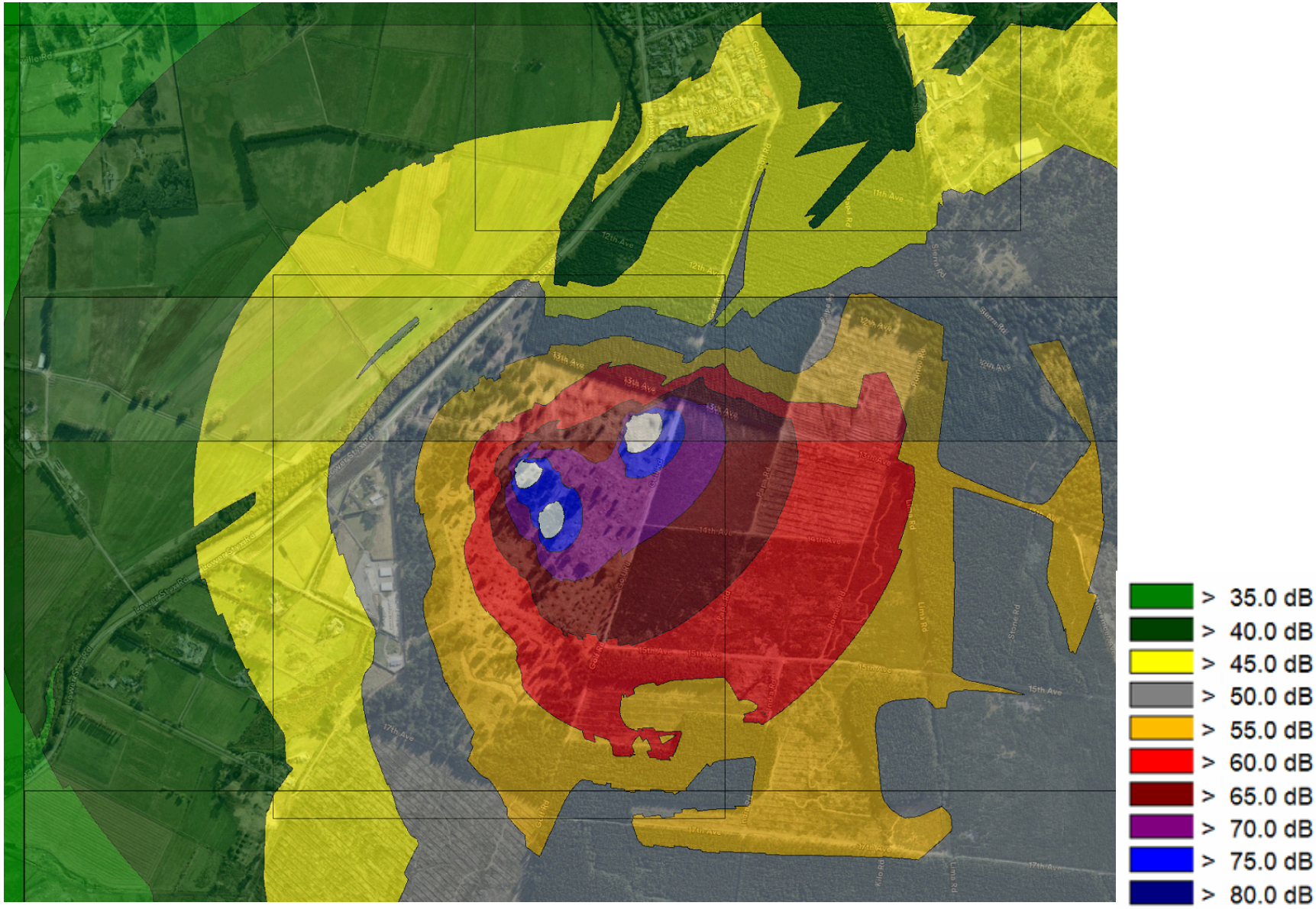

Figure A2 – Daytime – All 3 Stages – A Stage @ 90dBA at 30m; Stages B & C @84dB at 30m

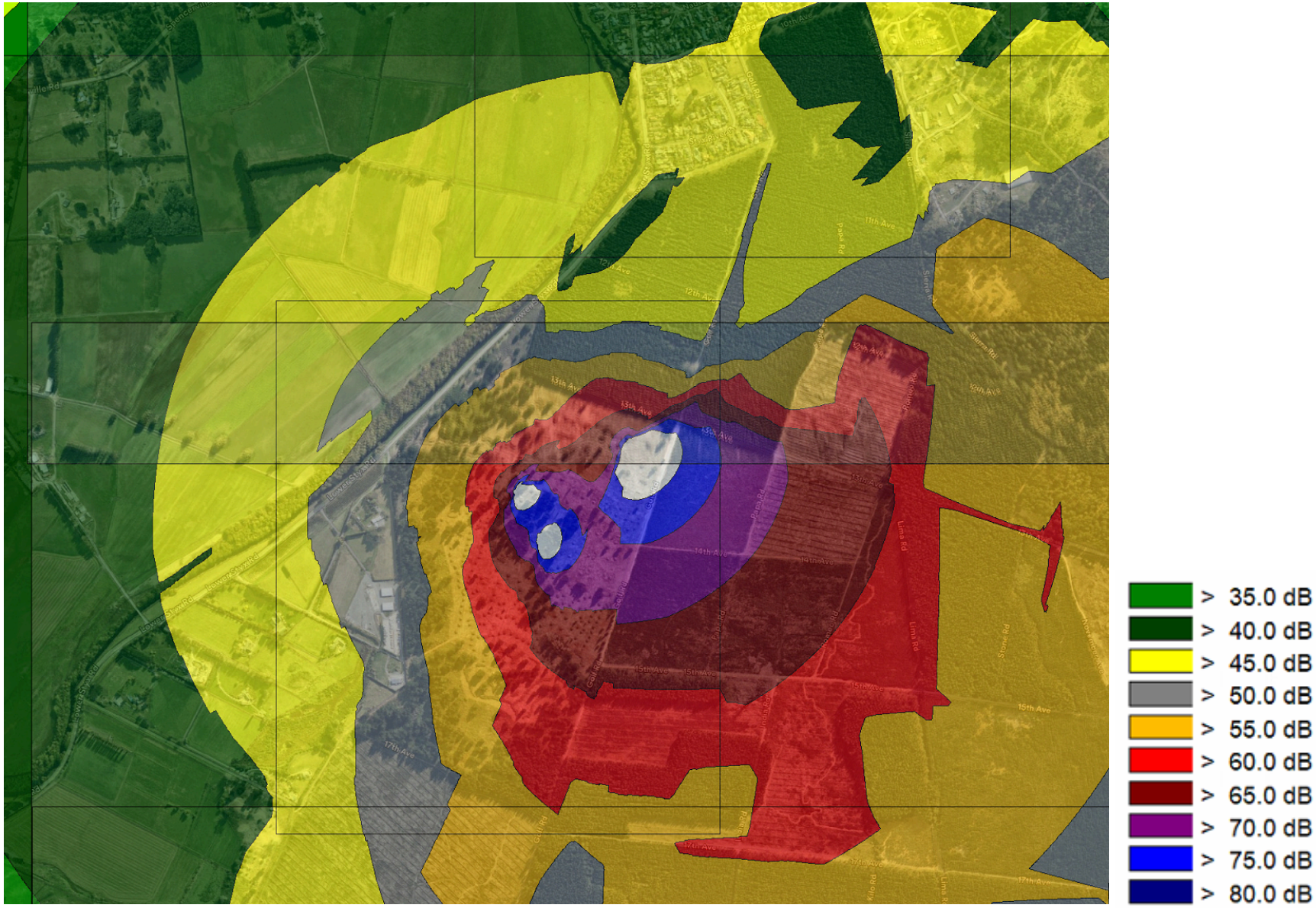

Figure A3 – Daytime – All 3 Stages – A Stage @ 95dB at 30m; Stages B & C @84dB at 30m

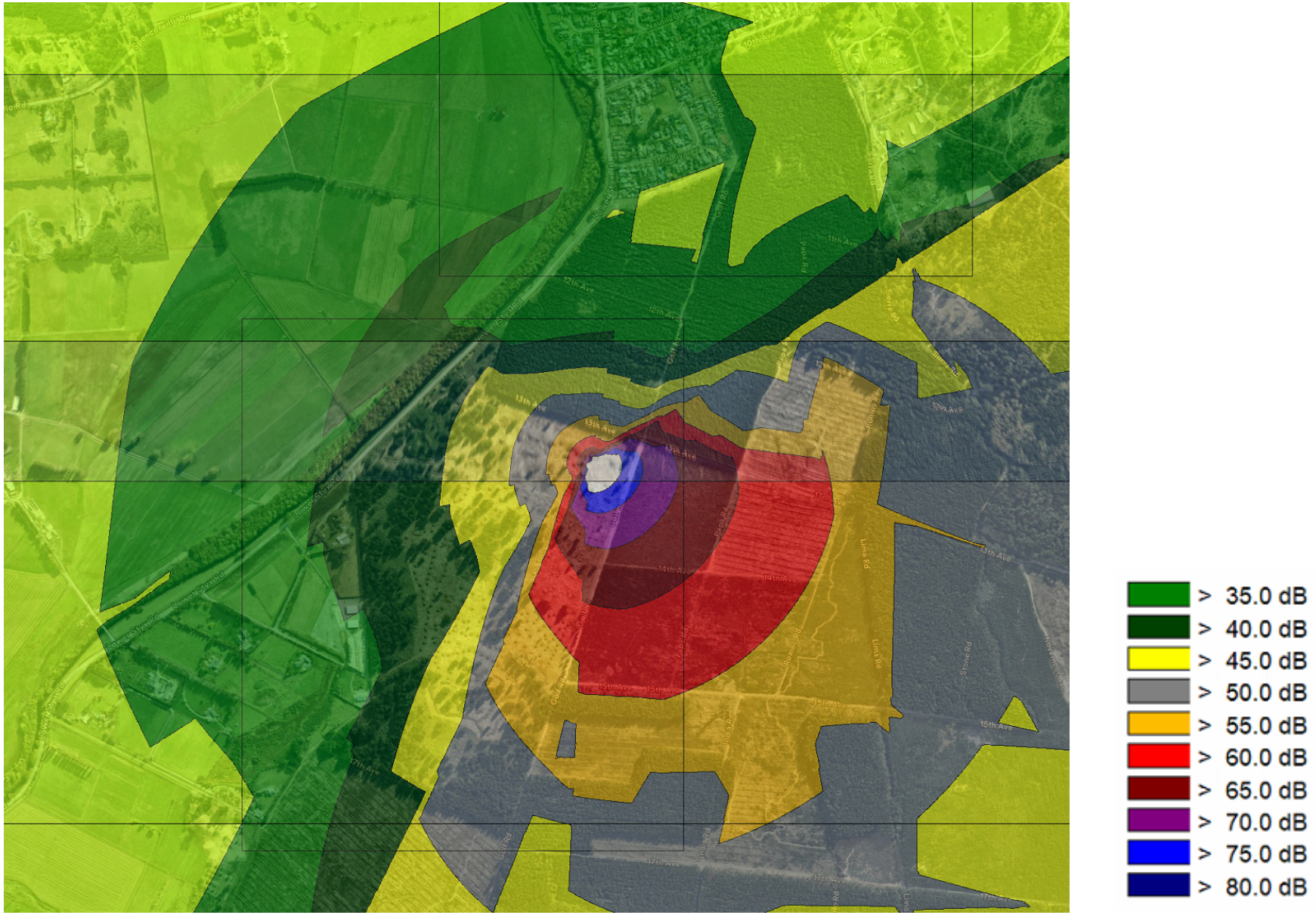

Figure A4 – Stage A Only @ 90dB at 30m

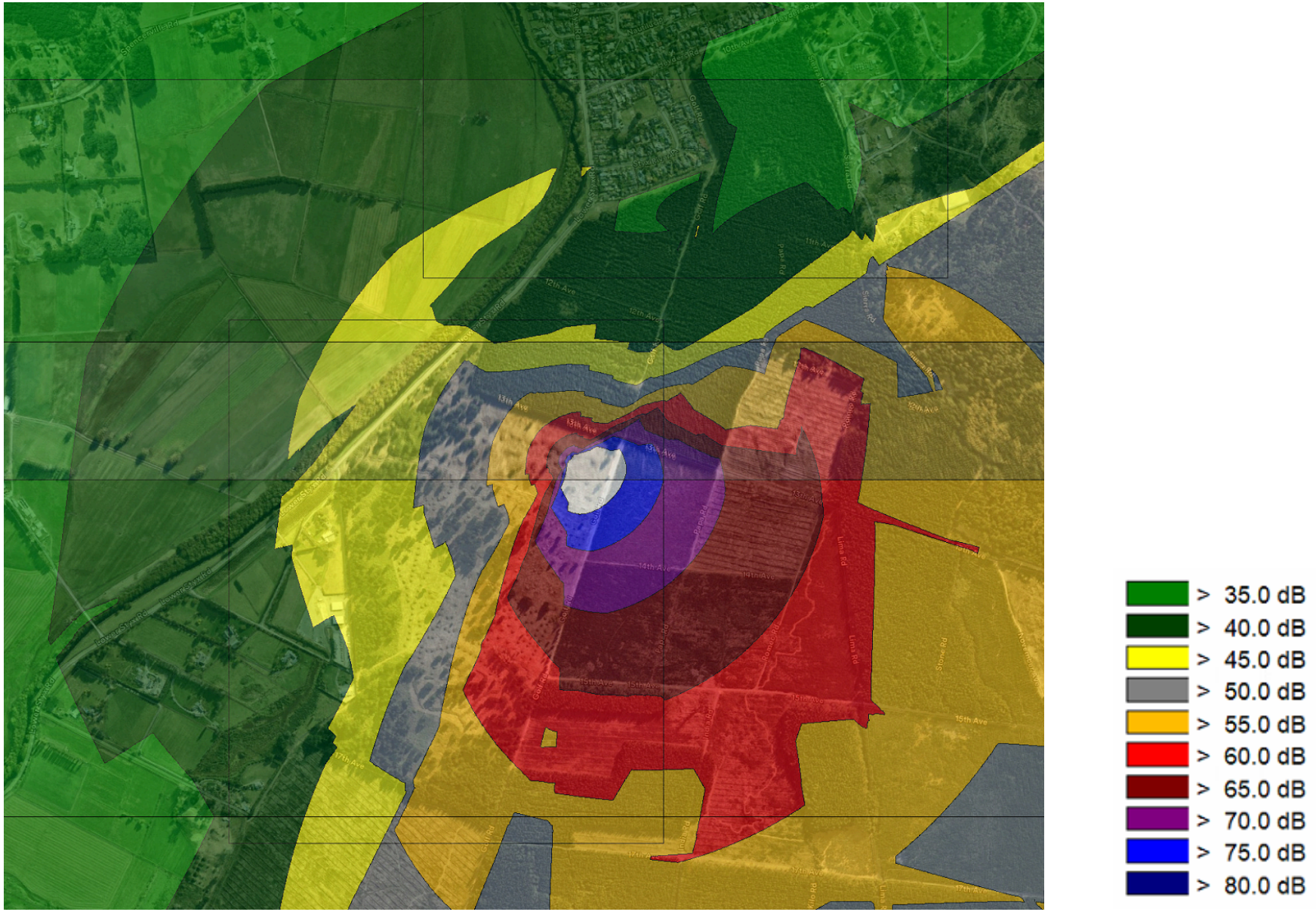

Figure A5 – Stage A Only @ 95dB at 30m

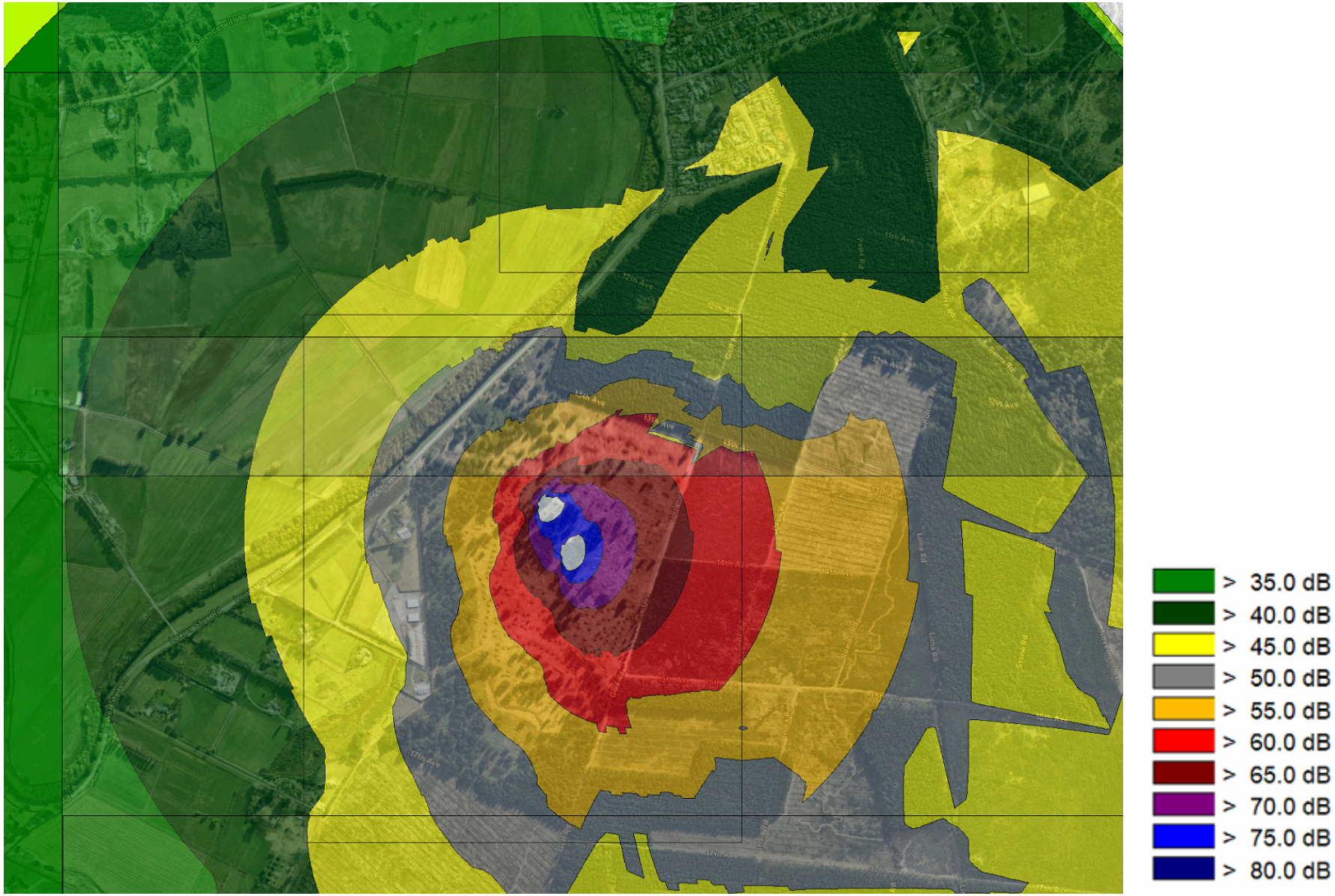

Figure A6 – Stages B & C Only @84dB at 30m

Appendix B – Daytime Noise Levels

The following noise levels are provided to illustrate the predicted sound levels from the stage combinations (and noise level variations) at the reference receiver locations.

A duration adjustment over the full daytime period (7am–10pm) may be applied when assessing the overall rating level; however, this adjustment cannot be applied on a stage-by-stage basis. This is because the duration correction must account for the cumulative effect of all sources over the entire operating period, including quieter intervals and overlapping contributions, which cannot be readily represented by considering each stage in isolation.

Note that the predicted noise rating levels are based on a energy average of the overall sound over the daytime in accordance with the NZS 6802, *6.4.6: For situations where the level of the sound reduces significantly for large periods of time but the sound does not switch off completely, some adjustment to account for this relief to persons exposed to the sound is also appropriate. In these cases the energy average of the sound under investigation should be calculated over the entire prescribed time frame. The rating level shall be the greater of this average value for the representative level over the reference time interval -5 dB*.

The adjustment is therefore made over the total daytime period, and accounts for variation in the noise levels between the 3 scenarios present below.

The overall noise rating level for the daytime period is presented in Section 6 of the report above.

Receiver	Predicted Noise Level dB L_{Aeq}		
	Stages B & C @84dB at 30m	All Stages A Stage @ 90dBA at 30m B & C Stage @ 84dB at 30m	All Stages A Stage @ 95 dBA at 30m B & C Stage @ 84dB at 30m
176 Lower Styx Road	45	46	47
206 Lower Styx Road	42	42	44
212 Lower Styx Road	46	47	48
218 Lower Styx Road	44	44	46
220 Lower Styx Road	45	45	46
222 Lower Styx Road	45	46	47
224 Lower Styx Road	45	46	47
226 Lower Styx Road	49	49	50
228 Lower Styx Road	46	47	48
230 Lower Styx Road	52	53	54
234 Lower Styx Road	52	54	55
Spencer Beach Top 10 Holiday Park	49	50	50
Specific Purpose (Golf Resort) Zone	52	51	52
Residential Zone (e.g. 286 Lower Styx Road)	46	47	48

Table B1 – Predicted Noise Levels

Glossary of Terms- Acoustics

Ambient Noise: the total noise, at a given place, a composite of sounds from many sources near and far.

Asymmetric: a waveform not identical on both sides of the mean or zero line, lacks symmetry.

Average: in acoustics where dB levels are extensively used, average may not mean adding up the values and then dividing by the number of samples.

Octave: a range of frequencies whose upper frequency limit is twice that of its lower frequency limit. For example, the 1000 Hertz octave band contains noise energy at all frequencies from 707 to 1414 Hertz.

In acoustical measurements, Sound Pressure Level is often measured in octave bands, and the centre frequencies of these bands are defined by ISO - 31.5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 8 kHz, 16 kHz to divide the audio spectrum into 10 equal parts.

The sound pressure level of sound that has been passed through an octave band pass filter is termed the octave band sound pressure level.

One-third Octave Bands, there are three similar bands in each octave band.

1/1, 1/3, 1/6, 1/12, and 1/24 octaves are all used in acoustics.

Background Noise: the noise at a given location and time, measured in the absence of any alleged noise nuisance sources, also known as Residual Noise.

Broadband Noise: also called wideband noise - noise whose energy is distributed over a wide section of the audible range as opposed to Narrowband Noise.

Class 1: precision grade sound level meters for laboratory and field use - also known as Type 1.

Continuous Spectrum: sound spectrum whose components are continuously distributed over a given frequency range.

Frequency Weighted Sound Levels: Frequency weightings correlate objective sound measurements with the subjective human response. The human ear is frequency selective; between 500 Hz and 6 kHz our ears are very sensitive compared with lower and higher frequencies.

A-weighting: the A-weighting filter covers the full audio range - 20 Hz to 20 kHz and the shape is similar to the response of the human ear at the lower levels

C-weighting: a standard frequency weighting for sound level meters, commonly used for higher level measurements and Peak - Sound Pressure Levels.

Z-weighting: Z for 'Zero' frequency weighting, which implies no frequency weighting. In reality the range is 10 Hz to 20 kHz ±1.5 dB.

dB Level: is the Logarithm of the ratio of a given acoustic quantity to a reference quantity of the same kind. The base of the logarithm, the reference quantity, and the kind of level must be indicated.

decibel: dB : a relative unit of measurement widely used in acoustics, electronics and communications. The dB is a Logarithmic unit used to describe a ratio between the measured level and a reference or threshold level of 0dB. The ratio may be Sound Power, Sound Pressure, voltage or Sound Intensity, etc.

Deltatron ®: trade name for IEPE - Integrated Electronics Piezoelectric.

FFT: Fast Fourier Transform : a digital signal processing technique that converts a time record into a narrow band constant bandwidth filtered spectrum. Measurements are defined by specifying the frequency span and a number of lines (or filters).

Frequency: f : the number of times that a Periodic function or vibration occurs or repeats itself in a specified time, often 1 second - cycles per second. It is usually measured in Hertz (Hz).

Frequency Analysis: analysing an overall broadband noise to identify the different contributions in different parts of the audio spectrum. Typically, the analysis in made using 1/1-Octave, 1/3-Octave or narrow band (FFT) Analysis.

Frequency Band: a continuous range of frequencies between two limiting frequencies.

Hertz: Hz : the unit of Frequency or Pitch of a sound. One hertz equals one cycle per second.

Impact Sound: the sound produced by the collision of two solid objects. Typical sources are footsteps, dropped objects, etc., on an interior surface (wall, floor, or ceiling) of a building.

Infrasound: sound whose frequency is below the low-frequency limit of audible sound (about 16 Hz).

Integrating (of an instrument): indicating the mean value or total sum of a measured quantity.

kHz: kilohertz : 1 kHz = 1000 Hz = 1000 Hertz.

LA: A-weighted, Sound Level.

LA10: is the noise level just exceeded for 10% of the measurement period, A-weighted and calculated by Statistical Analysis.

LA90: is the noise level exceeded for 90% of the measurement period, A-weighted and calculated by Statistical Analysis.

LAn: noise level exceeded for n% of the measurement period with A-weighted , calculated by Statistical Analysis - where n is between 0.01% and 99.99%.

LAeq: A-weighted, equivalent sound level. A widely used noise parameter describing a sound level with the same Energy content as the varying acoustic signal measured - also written as dBA Leq

LAF: A-weighted, Fast, Sound Level.

LAFmax: A-weighted, Fast, Maximum, Sound Level.

LAFmin: A-weighted, Fast, Minimum, Sound Level.

LAIeq: A-weighted, Impulse, Leq, Sound Level.

LAmax: A-weighted, Maximum, Sound Level

LAS: A-weighted, Slow, Sound Level.

LASmax: A-weighted, Slow, Maximum, Sound Level.

LASmin: A-weighted, Slow, Minimum, Sound Level.

LC: C-weighted, Sound Level.

LCE: C-weighted, Sound Exposure Level

LCeq: C-weighted, Leq, Sound Level

LCF: C-weighted, Fast, Sound Level.

LCFmax: C-weighted, Fast, Maximum, Sound Level.

LCpeak: C-weighted, Peak, Sound Level.

Leq: Equivalent Sound Level

Lpeak: Peak Sound Level

LZ: Z weighted, Sound Level.

LZE: Z-weighted, Sound Exposure Level

LZeq: Z-weighted, Leq, Sound Level.

LZF: Z-weighted, Fast, Sound Level.

LZFmax: Z-weighted, Fast, Maximum, Sound Level.

LZFmin: Z-weighted, Fast, Minimum, Sound Level.

Multi-spectrum: a one or two-dimensional array of spectra, consisting of two or more spectra that were recorded during the same measurement

Narrowband Noise: noise which has its energy distributed over a relatively small section of the audible range.

Natural Frequency: the frequency at which a resiliently mounted mass will vibrate when set into free vibration. The frequency of oscillation of the free vibration of a system if no Damping were present.

Noise: any sound that is undesired by the recipient. Any sound not occurring in the natural environment, such as sounds emanating from aircraft, highways, industrial, commercial and residential sources. Interference of an electrical or acoustical nature.

Octave: a range of frequencies whose upper frequency limit is twice that of its lower frequency limit. For example, the 1000 Hertz octave band contains noise energy at all frequencies from 707 to 1414 Hertz.

Octave Band analyser: an instrument that measures Sound Levels in octave bands.

Peak-to-Peak: the amplitude difference between the most positive and most negative value in a time waveform, that is, the total Amplitude.

Piezoelectric: PE : any material which provides a conversion between mechanical and electrical energy. Piezo is a Greek term which means 'to squeeze'. If mechanical stresses are applied to a piezoelectric crystal, then an electrical charge results. Conversely, when an electrical voltage is applied across a piezoelectric material, the material deforms.

Pitch: is a subjective auditory sensation and depends on the frequency, the harmonic content, and to a lesser extent on the loudness of a sound.

Spectrum: the description of a sound wave's resolution into its components of frequency and amplitude.

Third Octave Band: Octave bands sub-divided into three parts, equal to 23% of the centre frequency. Used when octave analysis is not discrete enough. Divides the audio spectrum into 33 or more equal parts with Constant Percentage Bandwidth filter.

Tone: sound or noise recognisable by its regularity. A simple or Pure Tone has one frequency. Complex tones have two or more simple tones, the lowest tone frequency is called the Fundamental, the others are Overtones.

Vibration: mechanical oscillations occur about an equilibrium point. The oscillations may be periodic such as the motion of a pendulum or random.