



CHAPEL DOWNS SCHOOL ACOUSTIC ASSESSMENT

ALTERATION TO SCHOOL DESIGNATION
CHAPEL DOWNS SCHOOL, FLAT BUSH

PREPARED FOR

The Ministry of Education

DATE

26 February 2024

Assessment prepared by Styles Group for The Ministry of Education.

REVISION HISTORY

Rev:	Date:	Comment:	Version:	Prepared by:	Reviewed by:
1	13/12/23	Initial draft	Draft	Jamie Exeter, MASNZ, Assoc. NZPI Principal Styles Group	Jon Styles, MASNZ Director and Principal Styles Group
2	20/02/24	Final draft updated to reflect correspondence with AIAL and assessment of outdoor effects	Draft	Jon Styles, MASNZ Director and Principal Styles Group	Jamie Exeter, MASNZ, Assoc. NZPI Principal Styles Group
3	26/02/24	Final following internal review	Final	Jon Styles, MASNZ Director and Principal Styles Group	Jamie Exeter, MASNZ, Assoc. NZPI Principal Styles Group

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1.0 Introduction

The Ministry of Education (**MOE**) proposes to change the designation of Chapel Downs School at 170S Dawson Road (designation 4912) and enable the education of students in Years 9 – 10 alongside Years 0-8, the education for which is already provided for by the existing designation. The anticipated roll is up to 1250 for primary school age students (Years 0 - 6), and up to 1500 students in Years 7 – 10.

The Site is within the Auckland Airport Moderate Aircraft Noise Area (**MANA**) overlay in the Auckland Unitary Plan (**AUP**).

The MOE has engaged Styles Group to provide advice on acoustics with respect to:

- The existing designation conditions relating to noise emissions and internal ambient noise levels within learning spaces at Chapel Downs School.
- The noise levels at Chapel Downs School from future aircraft operations.
- The efficacy of the existing designation conditions to achieve suitable internal learning environments with respect to future aircraft noise and thereby to avoid reverse sensitive noise effects on Auckland Airport.
- Recommended updates where issues are identified with the standard designation conditions.

The Assessment of Environmental Effects prepared by Forme Planning sets out the details of the application and should be referred to when reading this report.

A glossary of acoustical terms used within this document is attached as Appendix A.

2.0 Designation conditions

This section sets out the existing Chapel Downs School designation conditions with respect to noise limits and examples of noise conditions used for the primary school Te Uho o Te Nikau (designation 5058) that was established in the MANA in 2019. The conditions have been renumbered in this report for ease of reference.

2.1 Chapel Downs School

Noise emissions from the school

1. The noise (rating) levels arising from the operation of the school must comply with the following noise limits when measured within the boundary of any residentially zoned site:

DAY/TIME	NOISE LEVEL
Mon – Sat, 7.00am – 10.00pm (0700–2200)	55 dB LAeq
Sunday 9am to 6pm	
All other times	45 dB LAeq 75 dB LAFmax

These noise limits do not apply to noise from normal school sports and school recreational activities occurring between 8am and 6pm Monday to Saturday.

Noise levels shall be measured and assessed in accordance with NZS 6801: 2008 “Measurement of Environmental Sound” and NZS 6802:2008 “Environmental Noise”.

Noise from construction shall not exceed the limits recommended in, and shall be measured in accordance with, New Zealand Standard NZS 6803:1999 “Acoustics – Construction Noise”.

Internal ambient noise levels in learning spaces

2. The following acoustic and related treatment measures shall be installed in any new or relocated classrooms, libraries or halls or in any classrooms, libraries or halls that are the subject of additions or alterations:
 - a. Acoustic insulation and related ventilation and/or air conditioning systems to achieve indoor an internal acoustic environment in each classroom, library and hall (with all external doors and windows of the classrooms, libraries and halls closed) of Ldn 40dBA;
 - b. In the case of classrooms and libraries, air conditioning and/or mechanical ventilation systems for each classroom and library, that are:
 - i. designed to achieve indoor air temperatures not less than 16 degrees Celsius in winter and not greater than 27 degrees Celsius in summer at 5% ambient design conditions as published by the National Institute of Water and Atmospheric Research (“NIWA”)(NIWA, Design Temperatures for Air Conditioning (degrees Celsius), Data Period 1991-2000); and - capable of providing outdoor air ventilation at the rate of 8 litres of air per second per person for the maximum number of people able to be accommodated in any such room at one time (“the required airflow”);
 - ii. capable of enabling, (in the case of classrooms or libraries in which only mechanical ventilation systems are used to satisfy the above temperature and outdoor air requirements), the outdoor airflow to be controlled across the range, from the maximum airflow capacity down to the required airflow when all external doors and windows of the classroom or library are closed;
 - iii. otherwise complying with the New Zealand Standard NZS 4303:1990 Ventilation for Acceptable Indoor Air; and
 - iv. capable of creating no more than Leq 35dBA in each classroom, no more than Leq 40dBA in each library, and no more than Leq 40dBA in any hallway or corridor. Noise levels from the mechanical

system(s) shall be measured at least 1 metre away from any diffuser.

- c. in the case of halls either:
- i. a mechanical ventilation system or mechanical ventilation systems for each hall capable of:
 - providing at least 12 litres of outdoor air per second per square metre with all external doors and windows of the hall closed;
 - enabling the outdoor airflow to be controlled across the range, from the maximum airflow down to the rate of 8 litres of outdoor air per second per person for the maximum number of occupants able to be accommodated in the hall at one time; otherwise complying with the New Zealand Standard NZS 4303: 1990 Ventilation for Acceptable Indoor Air Quality; and
 - creating no more than Leq 35dBA in each hall, and no more than Leq 40dBA in any hallway or corridor. Noise levels from the mechanical system(s) shall be measured at least 1 metre away from any diffuser. Or;
 - ii. air conditioning plus mechanical outdoor air ventilation designed to provide 8 litres per second per person of outdoor air, and internal air temperatures in each hall not greater than 27 degrees Celsius at 5% ambient design conditions as published by the National Institute of Water & Atmospheric Research ("NIWA")(NIWA, Design Temperatures for Air Conditioning (degrees Celsius), Data Period 1991-2000). The mechanical system shall create no more than Leq 35dBA in each hall, and no more than Leq 40dBA in any hallway or corridor. Noise levels from the mechanical system(s) shall be measured at least 1 metre away from the diffuser. These systems shall otherwise comply with the New Zealand Standard NZS 4303: 1990 Ventilation for Acceptable Indoor Air Quality.
3. Where Condition 2 requires the Minister to install acoustic treatment and related ventilation measures the Minister shall obtain a certificate from a suitably qualified independent person (or persons) nominated by the Minister and approved by the Council ("an approved person"), certifying that the proposed acoustic treatment and related ventilation measures are sufficient to achieve the internal acoustic environment and ventilation requirements specified in this condition, and where the Minister installs any acoustic treatment and or ventilation or air conditioning measures, the Minister shall:
- a. provide the Council with a certificate from an approved person that the installation has been properly undertaken in accordance with sound practice; and
 - b. not be in breach of Condition 2 where the internal noise standards and related ventilation requirements are not met in each instance provided the relevant certificate required in subclause (a) of this condition (Condition 2), above, has been provided to the Council.

2.2 Te Uho o Te Nikau

Construction noise

4. The Establishment OPW shall include a Noise Management Plan and be submitted to the Council prior to the commencement of any construction activities. The Noise Management Plan will demonstrate how the construction work will be undertaken to ensure compliance with the requirements of NZS 6803: 1999 Acoustics – Construction Noise.

Communications plan

5. Prior to the opening of the school, the Minister shall, either directly or through the school Board of Trustees, develop a school community Communications Plan in consultation with Auckland International Airport and the Board of Airline Representatives New Zealand, the purpose of which is to ensure that the school community is aware of the noise environment that the school operates within. The Communications Plan shall include:
 - i. a statement that the site is located in proximity to the Airport and the airport operations will necessarily involve aircraft noise;
 - ii. a statement that the Airport is authorised to operate at the noise levels provided for in Designation 1100 to the Unitary Plan and that those noise levels may increase as a result of increased airport operations to support the growth of the Airport; and
 - iii. information regarding the mitigation measures that the Minister has undertaken to mitigate the effects of aircraft noise on the site, including the acoustic insulation of buildings within the MANA.

The Minister shall provide a copy of the Communications Plan in any enrolment or induction document for any new students or staff upon the commencement of their enrolment or employment and publish the Communications Plan on the school website prior to the opening of the school. The Communications Plan shall be reviewed at the time of submitting each subsequent OPW relating to increased student capacity.

3.0 Aircraft noise at Chapel Downs School

Appendix 19 of the AUP provides Future Aircraft Noise Contours (**FANC**) for the operation of Auckland Airport in 2044.

The FANC represent L_{dn} noise levels that must not be exceeded by aircraft and they inform land-use requirements under the AUP. They have been calculated based on projected flight numbers in 2044 with existing models of aircraft.

The FANC over Chapel Downs School are shown in Figure 1.

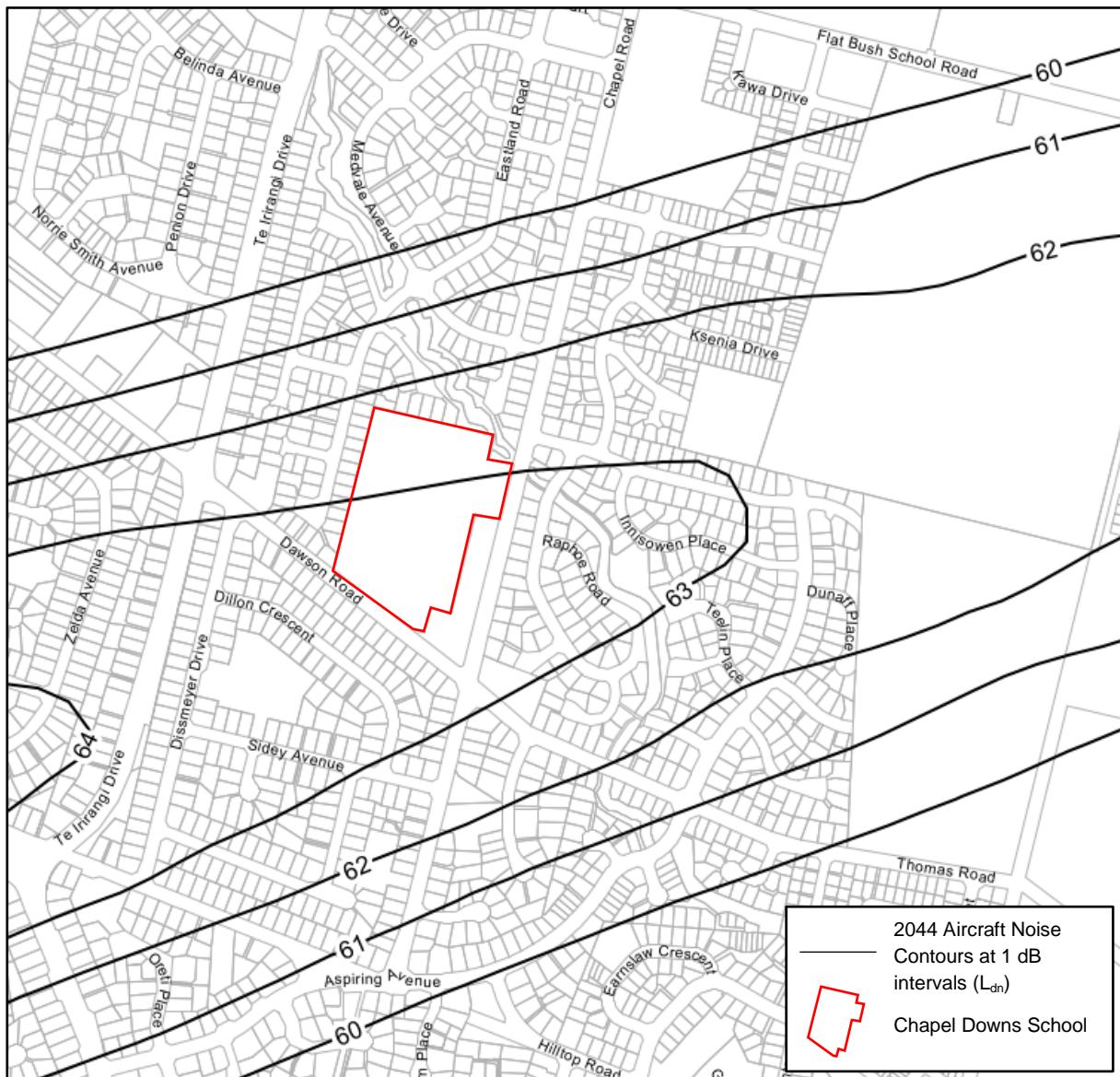


Figure 1: FANC over Chapel Downs School

The FANC show a predicted noise level of 63 dB L_{dn} at the Chapel Downs School site in 2044.

The L_{dn} is calculated by averaging the L_{Aeq} noise levels over a 24-hour period after an adjustment of +10 dB is applied to the noise levels between 10.00 pm and 7.00 am. The weighting is applied to noise levels at night because residual noise levels are lower at this time and people are generally more sensitive to noise. The L_{dn} noise level is therefore highly dependent on the number of noise events (flights) that occur at night.

The general assessment of aircraft noise in terms of the L_{dn} descriptor is consistent with the provisions of NZS 6805:1992 *Airport noise management and land use planning*. However, the $L_{Aeq(15\text{ min})}$ noise levels during the day are more relevant than the L_{dn} levels for designing school buildings to optimise learning spaces and avoid reverse sensitivity effects because:

- i. The potential noise effects of passing aircraft on speech intelligibility in learning spaces will only occur during school hours. The operation of the school is not affected by noise levels at night.
- ii. The aircraft noise levels that can be generated during the day is dependent on the number of flights at night under the L_{dn} criteria. Designing to an internal L_{dn} limit does not therefore ensure acceptable outcomes for internal learning spaces.

We have calculated the worst-case L_{Aeq} noise levels over any 15-minute sample period during the day at Chapel Downs School. This calculation is based on the flight numbers and other assumptions that were used to calculate the 2044 FANC in the AUP¹. It also includes measurement data for aircraft movements taken at the Manukau Velodrome by Marshall Day Acoustics² (MDA) (who are engaged by Auckland International Airport Limited).

MDA have produced noise monitoring data from the Manukau Velodrome noise monitoring station from 2023. We requested that the data be taken from periods when the airport was busy, during term time and during normal school hours. The analysis produced the following:

- 1) The highest 15 minute L_{Aeq} noise level during the day was 64dB $L_{Aeq(15min)}$
- 2) The average L_{Aeq} noise level for the school day was 62dB $L_{Aeq(9hr)}$
- 3) The L_{DN} level for the days analysed was 64dB

These levels are taken from a position that is closer to the airport than the Chapel Downs School site and therefore require adjustment. The monitoring station is located right on the 65dB L_{DN} FANC, whereas Chapel Downs School is located across the 63dB L_{DN} FANC. Adjusting the velodrome measurement data for the Chapel Downs School site results in the following predicted noise levels in 2044:

- 1) The highest 15 minute L_{Aeq} noise level during the day will be 63dB $L_{Aeq(15min)}$
- 2) The average L_{Aeq} noise level for the school day will be 61dB $L_{Aeq(9hr)}$
- 3) The L_{DN} level will be 63dB

We understand from the MDA advice that it will be reasonable to assume that a busy day will result in an average of four aircraft flyovers in any 15 minute period in 2044. This analysis is valid for days when the wind conditions will result in arrivals over Chapel Downs School and for busy periods. The noise levels will be several decibels lower when aircraft are departing in the direction of Chapel Downs School.

¹ These details are provided in the acoustic assessment that was lodged with the application for the AIAL northern runway *Auckland International Airport Proposed Northern Runway Assessment of Noise Effects*, Marshall Day Acoustics, 24 February 2017.

² Provided in a memo dated 24 January 2024 and as amended by subsequent emails where we sought clarifications and adjustments.

Aircraft noise over the school day will often be quieter than this and there will be periods when it is not audible at all, even on busy days.

4.0 Guidelines on aircraft noise in learning spaces

There are no guideline internal ambient noise limits recommended by New Zealand Standards for aircraft noise within learning spaces. The Standard AS/NZS 2107:2016 *Acoustics – Recommended design sound levels and reverberation times for building interiors* provides recommended internal ambient noise limits and reverberation times for educational buildings. However, this Standard is specifically not intended for either the assessment or prescription of acceptable recommended noise levels from transient or variable noises outside the building, including aircraft noise.

The 1999 World Health Organisation (**WHO**) guidelines for community noise recommend that internal ambient noise level do not exceed 35 dB L_{Aeq} within classrooms during class to avoid effects on speech intelligibility, disturbance of information extraction, and message communication. The WHO guideline levels are provided as targets for reducing noise in areas that are already affected. They are based on maintaining speech intelligibility when listening to complicated messages by ensuring that normal vocal efforts (at 50 dB L_{Aeq}) remain at least 15 dB louder than the ambient internal noise level. The guideline level is broadly applied to all school classrooms indoors and does not consider the varying requirements between different learning spaces.

The document *Designing Quality Learning Spaces, Acoustics (DQLS)* was prepared by the MOE in collaboration with the Building Research Association of New Zealand and a panel of acoustics experts. It outlines mandatory internal ambient noise and reverberation requirements for a range of learning spaces in new and refurbished educational facilities. The primary goal of the document is to create high-quality learning environments that support teaching, learning, and the well-being of the occupants. The latest version of the DQLS is based on aligning with industry best practice, feedback, and updated research.

The Association of Australasian Acoustical Consultants³ (**AAAC**) have published the document *Guideline for Educational Facilities* to present the views of the AAAC and its members in regard to the design of educational facilities. The focus of the document is Australian schools. It notes that it may be of some use in New Zealand, but states that the requirements and recommendations of the DQLS should generally take precedence over the AAAC guidance for schools in New Zealand.

The American National Standards Institute (**ANSI**) Standard ANSI S12.60-2010 *American National Standard Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools* recommends maximum noise levels in learning spaces where they are dominated by unsteady background noise from sources such as aircraft. The recommendations include maximum levels of 40 dB L_{Aeq} (1 hour) within core learning spaces smaller than 566 m³ and

³ Styles Group are a Member Firm of the Association of Australasian Acoustical Consultants

45 dB L_{Aeq} (1 hour) within larger core learning spaces. The recommendations are referenced in the AAAC guidelines, and they are similar to the requirements of the DQLS document.

We have summarised the recommended internal ambient noise levels published by the WHO, the MOE, and the AAAC in Table 1 for comparison. The AAAC guidelines cover a wide range of spaces. We have consolidated these in terms of the internal spaces described by the DQLS guidelines.

Table 1: Internal ambient noise references

Internal learning space	WHO guidelines	DQLS requirements	AAAC guidelines
Gyms Circulation spaces	35 dB L_{Aeq}	50 dB L_{Aeq}	45-50 dB L_{Aeq}
Learning spaces > 300 m ³ Technology Spaces Laboratories Libraries	35 dB L_{Aeq}	45 dB L_{Aeq}	30-50 dB L_{Aeq}
Learning spaces < 300 m ³ Breakout spaces Music teaching rooms Music practice rooms Teacher workspaces Staff rooms Meeting rooms Offices Whare	35 dB L_{Aeq}	40 dB L_{Aeq} for new builds 45 dB L_{Aeq} for refurbishments	30-45 dB L_{Aeq}
Auditoria Assembly Halls	35 dB L_{Aeq}	35 dB L_{Aeq}	30-40 dB L_{Aeq}
Multimedia rooms Recording rooms	35 dB L_{Aeq}	30 dB L_{Aeq}	35-45 dB L_{Aeq}

5.0 Efficacy of existing designation conditions

This section sets out our comments on the efficacy of the designation conditions with respect to designing suitable learning spaces in accordance with the guidance outlined in Section 4.0, avoiding reverse sensitivity noise effects on Auckland Airport, and managing noise emissions from the school. References to condition numbers are with respect to Section 2.0 of this report.

5.1 Internal ambient noise levels from aircraft

Compliance with the internal L_{dn} limits prescribed by the existing designation conditions (Condition 2) will not necessarily deliver the internal noise environments required by the DQLS. The effectiveness of the L_{dn} noise levels for the school would depend on the noise levels generated by jet flights at night. The distribution of aircraft over the day and night-time periods is outside the control of the MOE and it is not practicable to design the school buildings based on absolute worst-case scenarios for noise that occurs at times when the school is unoccupied.

There is a risk of students being affected by aircraft noise if the design criteria do not ensure that the MOE's own minimum noise requirements for providing quality learning spaces will be achieved.

We consider that the internal L_{dn} noise criteria prescribed by the designation conditions cannot be relied upon for the design of the school buildings to ensure acceptable outcomes for occupants of the buildings. Noise monitoring to determine compliance with the L_{dn} noise criteria would require measurements over the night-time period when the school is not occupied. It is not an appropriate control for avoiding effects on students, or for managing potential reverse sensitivity effects on Auckland Airport.

We have made recommendations for updated conditions in terms of the $L_{Aeq(15 \text{ min})}$ noise descriptor that we consider will be more effective. We understand these have been adopted by the Minister and included in the NOR (and accompanying Form 18) prepared by Forme Planning.

5.2 Noise emissions from the school

We generally support the existing operational noise limit condition (Condition 1) except where noise from construction works is required to comply with the noise limits of NZS 6803:1999 *Acoustics – Construction noise* (the **Standard**). Consistent compliance with the guideline upper limits of the Standard is not always practicable. This is acknowledged by the Standard and it is common for construction projects to exceed the Standards' guideline limits by 5-10 dB for short durations without unreasonable noise effects being generated. The potential noise effects of construction projects involving higher noise levels are typically managed through a Construction Noise and Vibration Management Plan (**CNVMP**) which will require communication with the neighbours and the adoption of the best practicable options for noise mitigation.

The Te Uho o Te Nikau construction noise condition (Condition 4) requires a CNVMP to be submitted to Council before any construction activities begin to demonstrate how the requirements of NZS 6803:1999 will be complied with. The definition of construction work under the Standard includes repair, cleaning, and maintenance of buildings. A CNVMP is not necessary for all construction projects. Particularly if the works can comply with the upper limits specified in NZS 6803:1999 without physical mitigation or restrictions being required.

It would be best practice to allow small maintenance and construction work to be undertaken without a CNVMP being required. This does not apply to larger projects that have the potential to exceed the guideline limits of the Standard.

We consider that the existing designation construction noise conditions require updating to align with industry best practice. We have recommended an alternative condition for the updated designation of Chapel Downs School. We understand these have been adopted by the Minister and included in the NOR (and accompanying Form 18) prepared by Forme Planning.

6.0 Assessment of noise effects

The effects of aircraft noise on children in learning environments is relatively complex and influenced heavily by the dynamic nature of the learning environments, time spent outside and the nature and extent of disruption from aircraft noise. It is well accepted internationally that exposing children to high levels of transport noise on a chronic basis can have adverse effects on their ability to communicate and in the very worst cases, impacts on cognitive development. These effects can occur where there is little or no mitigation of external noise intrusion and where exposure is high and consistent over a long period of time, and in situations where the external noise source is constant, such as near to major roads.

We consider that the adoption of the DQLS will result in the noise effects indoors being mitigated to a level that will avoid adverse effects arising from exposure to aircraft noise. We expect that although aircraft noise may at times be audible inside the spaces, the levels will be low enough to prevent disruption to learning and communication.

The aircraft noise levels cannot be physically reduced by structures when the students are in open outdoor learning situations. On days when the airport is relatively busy, students outdoors may be exposed to up to four flyovers (on average) in any 15-minute period. Aircraft noise will control the noise environment for up to around 20-30 seconds during each flyover. There may be some disruption to verbal communication over more than a few metres, and raised voices may be necessary for these short periods.

We understand that some level of outdoor learning is mandatory and that it cannot be entirely avoided. Further, we understand that there is often some discretion available when choosing an outdoor learning space and in some cases the activity could be done inside or outside. This can be done using a hybrid approach where instructions are given inside, and students are then able to complete tasks outdoors without unreasonable disruption from aircraft noise.

We suggest that students' time in outdoor learning situations should be minimised as far as practicable, or managed to ensure the learning can take place around the disruption. We understand that the school itself will be best-placed to manage the potential effects by defining and implementing the most practicable mitigation and management measures as the school and its curriculum evolve, and as aircraft movements increase over time.

We understand that in any event, formal outdoor learning situations are only likely to comprise a few hours each week per student. This is a relatively short period of time that students will be exposed to moderate levels of aircraft noise, and only for an average of 5-8 minutes every hour. We consider that this level of effect is low, and unlikely to result in more than an intermittent and minor disruption to communication between students and teachers.

We consider that the implementation of acoustic treatment of buildings to achieve the DQLS criteria and the management of outdoor learning activities to minimise disruption will result in only a very small potential residual adverse effect of aircraft noise on the operation of the school that may arise for a limited time when students are outdoors.

It is our experience that the potential reverse sensitivity effects on AIAL will be avoided or adequately mitigated if the effects on students can be avoided or adequately mitigated.

7.0 Recommendations

This section sets out our recommendations on conditions for the altered designation for Chapel Downs School. Our recommendations have been incorporated into the conditions set prepared by Forme Planning.

7.1 Internal noise level conditions

We consider that the existing designation conditions with respect to internal noise could be improved because:

- They are in terms of a descriptor that is heavily weighted to consider noise effects at night which is not relevant to schools.
- Compliance with the existing designation conditions will not necessarily provide a quality learning environment with respect to internal ambient noise levels.
- The existing designation conditions therefore cannot ensure that reverse sensitivity noise effects on Auckland Airport will be avoided.

The DQLS mandatory requirements for indoor ambient levels were developed by the MOE to create quality physical learning environments that are fit for purpose. They are based on expert advice and the guidance of International Standards. They are also consistent with the acoustical performance criteria for internal ambient noise levels provided by the AAAC. Compliance with the DQLS limits will avoid adverse noise effects on the occupants of the buildings, and thereby avoid complaints regarding aircraft noise levels.

We therefore recommend that the designation conditions require new or altered buildings at Chapel Downs School to be designed to comply with the DQLS maximum indoor ambient levels. The designs must be based on external noise levels that are consistent with the 2044 future noise levels contours for the operation of Auckland Airport.

The reductions through the buildings at Chapel Downs School for compliance with the DQLS internal noise criteria are displayed in Table 2. These reductions are achievable for educational facilities in the MANA by following the design guidelines set out in the DQLS and seeking the advice of a suitably qualified acoustics consultant (e.g., MASNZ) at the detailed design stage. The most stringent requirements for multimedia and recording rooms can be achieved through careful design and location of these spaces e.g., minimal external windows and being located at the ground floor.

Table 2: Reduction required for compliance with DQLS

Internal learning space	Proposed internal noise limit (DQLS)	Minimum reduction required through building
Gyms Circulation spaces	50 dB L _{Aeq}	13 dB
Learning spaces > 300 m ³ Technology Spaces Laboratories Libraries	45 dB L _{Aeq}	18 dB
Learning spaces < 300 m ³ Breakout spaces Music teaching rooms Music practice rooms Teacher workspaces Staff rooms Meeting rooms Offices Whare	40 dB L _{Aeq} for new builds 45 dB L _{Aeq} for refurbishments	18-23 dB
Auditoria Assembly Halls	35 dB L _{Aeq}	28 dB
Multimedia rooms Recording rooms	30 dB L _{Aeq}	33 dB

We expect that auditoria and multimedia / recording rooms will be best located on the ground floor of multi-storey buildings to ensure that the internal design levels are practicably achievable and to avoid the otherwise high potential cost of heavyweight roof and ceiling constructions.

7.2 Outdoor learning

We understand that the MOE has no direct control over the curriculum and that designation conditions that control the curriculum to minimise outdoor time are not workable. We have worked with the project team to develop proposed designation conditions to manage potential effects. The objective of the conditions is to identify ways to manage noise exposure during outdoor educational activities through site design, creation of flexible spaces, physical design responses or by school management or any other practicable methods.

7.3 Other noise related conditions

We recommend an alternative construction noise condition that enables the guideline upper limits of NZS 6803:1999 to be exceeded by up to 10 dB where compliance is not practicable, subject to a verified CNVMP being in place for the works. This is a similar approach to the permitted standards for construction works within the road reserve under the AUP.

We also recommend minor updates to the designation noise conditions for clarity and consistency with relevant Standards and industry best practice, including:

- i. Updating notation to be in accordance with NZS 6802:2008.
- ii. Updating Condition 2 to specify time periods for L_{Aeq} samples when measuring noise from mechanical ventilation.
- iii. Updating Condition 5 (if adopted) to clarify that aircraft noise may increase from the current levels but it will not exceed the designation limits.

8.0 Conclusion

Styles Group has reviewed the existing designation conditions relating to noise and the designation conditions used for other schools in the MANA. We have considered the efficacy of these conditions to achieve acceptable internal ambient noise levels within learning spaces and control noise emissions at the proposed Chapel Downs School designation.

We have provided our advice on the understanding that designing the new school buildings to achieve suitable internal learning environments with respect to future aircraft noise will avoid reverse sensitive noise effects on Auckland Airport.

We consider that the existing designation conditions with respect to internal noise could be improved because they are in terms of a descriptor that is heavily weighted to consider factors that are not relevant to schools, including noise effects at night. Compliance with the existing designation conditions will not necessarily provide quality learning environments and cannot therefore ensure that reverse sensitivity noise effects on Auckland Airport will be avoided.

We generally support the existing operational noise limit conditions except where noise from construction works is required to consistently comply with the guideline noise limits of NZS 6803:1999. It is common for construction projects to exceed these limits by 5-10 dB for

short durations without unreasonable noise effects being generated. The potential noise effects of such projects are typically managed through a CNVMP that requires communication with the neighbours and the adoption of the best practicable options for noise mitigation. CNVMPs are not typically necessary for construction projects that can comply without physical mitigation or restrictions being required.

We consider that the future students will be exposed to moderate levels of aircraft noise for the relatively short durations of outdoor learning that might occur each week. We consider that the exposure times will be low and that the effects will be limited to intermittent and minor disruption to communication between students and teachers. We have recommended updated conditions for the proposed Chapel Downs School designation based on our findings.

We consider that the proposed measures will avoid or adequately mitigate the potential adverse effects of aircraft noise on the school. Accordingly, it is our experience that this will avoid or adequately mitigate the potential reverse sensitivity effects on AIAL.

9.0 References

- NZS 6805:1992 *Airport noise management and land use planning*.
- AS/NZS 2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors, Standards New Zealand, 2016.
- Guidelines for Community Noise, World Health Organisation, 1999.
- Designing Quality Learning Spaces, Acoustics Version 3.0, Ministry of Education, 2020.
- Guideline for Educational Facilities Version 2.0, Association of Australasian Acoustical Consultants, 2018.
- ANSI S12.60-2010 *American National Standard Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools*, Acoustical Society of American, 2010.

Appendix A Glossary of terms

Ambient internal noise level	The sound level in an unoccupied space controlled by internal sources such as air conditioning and ventilation systems, and external sources such as road traffic and aircraft.
A-weighting	A frequency filter applied to the full audio range (20 Hz to 20 kHz) to approximate the response of the human ear at lower sound pressure levels.
dB (decibel)	The basic measurement unit of sound. The logarithmic unit used to describe the ratio between the measured sound pressure level and a reference level of 20 micropascals (0 dB). Typically, time averaged and A-weighted to match the frequency response of average human hearing e.g., dB $L_{Aeq(15 \text{ min})}$.
FANC	Future Aircraft Noise Contour means the long-term (2044) predicted L_{dn} noise contours shown in Appendix 19 of the Auckland Unitary Plan.
$L_{Aeq(t)}$ (dB)	The A-weighted equivalent sound pressure level with the same energy content as the measured varying acoustic signal over a sample period (t). The preferred metric for sound levels that vary over time because it considers the total sound energy over the time period of interest.
L_{dn} (dB)	The L_{Aeq} noise level over a 24-hour period with an adjustment of +10 dB applied to noise levels measured during the night-time period (10.00 pm to 7.00 am).
L_{dn} noise contour	A line connecting points of equal dB L_{dn} sound level.
MANA	Moderate Aircraft Noise Area is the area generally between the 60 dB L_{dn} and 65 dB L_{dn} future aircraft noise contours as shown on the Aircraft Noise Overlay map for Auckland International Airport.
Noise	<p>A sound which serves little or no purpose for the exposed persons and is commonly described as 'unwanted sound'.</p> <p>The definition of noise includes vibration under the Resource Management Act.</p>
Reverberation time (RT)	The time (in seconds) that it takes for a sound to decrease by 60 dB within an enclosed space as a result of reflections. RT is controlled by factors such as the volume and the reflective/absorptive surfaces of the space.
