



MARSHALL DAY
Acoustics 

NEW PUBLIC SCHOOL IN WAGGA WAGGA
ASSESSMENT OF NOISE AND VIBRATION

Rp 001 20191068 | 4 November 2019

Project: **NEW PUBLIC SCHOOL IN WAGGA WAGGA**

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Report No.: **Rp 001 20191068**

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EXECUTIVE SUMMARY

Marshall Day Acoustics (MDA) has conducted an assessment of noise emissions from the construction and operation of the proposed New Public School in Wagga Wagga project. The assessment was originally commissioned by Hayball Architects, with reporting issued as *Rp 004 r01 20180592 NSW Southern Cluster Schools - New Public School in Estella (Wagga Wagga) - Assessment of Noise and Vibration* on 18 December 2018. Since this time, Hansen Yuncken has become the primary building contractor on the Project and has engaged MDA to update the assessment documentation to reflect the revised site plan.

As instructed by Hansen Yuncken, changes to the site plan have not resulted in material changes to the Project construction or operation and no recalculation or reassessment has been requested or conducted. MDA's review of the building mass and location alterations represented in Hansen Yuncken's updated site plan indicates that changes with respect to the acoustic assessment are unlikely, provided the construction and operation parameters remain the same as outlined in the previous report prepared for Hayball Architects.

Updating of this report is limited to:

- Reflecting the changed Project name: ('New Public School in Estella (Wagga Wagga)' changed to New Public School in Wagga Wagga)
- Clarification of lot identification: Lot 1 in DP 1253855
- Updating of site plans
- Clarification of the noise logging position

Assessment of the school has considered the following:

- Planning Secretary's Environmental Assessment Requirements (SEARs) (Application Number: SSD 9494)
- *NSW Noise Policy for Industry 2017, NSW Environment Protection Authority (NPfI)*
- *Interim Construction Noise Guideline, Department of Environment and Climate Change (ICNG)*
- *Assessing Vibration: A Technical Guideline 2006, NSW Environment Protection Authority (AV:ATG)*
- *Development Near Rail Corridors and Busy Roads – Interim Guideline, NSW Department of Planning 2008 (DNRCBR)*
- *State Environmental Planning Policy (Schedule 2: Educational Establishments and Child Care Facilities), NSW Department of Planning and Environment SEPP 2017 (EECF SEPP)*
- *Protection of the Environment Operations Act 1997, NSW Environment Protection Authority (POEO)*
- *Noise Guideline for Local Government, NSW Environment Protection Authority 2013 (NGLG)*
- *Road Noise Policy, NSW Department of Environment, Climate Change and Water 2011 (RNP)*

Noise from construction activities have been assessed based on assumed plant equipment likely to be used during the three stages of construction; Site Preparation, Bulk Excavation and Construction. Noise at two primary receivers has been considered, residents along Estella Rd and the active recreation facility, Peter Hastie Oval.

Noise from construction is below the derived "noise affected" management goals for Peter Hastie Oval for all stages for both "worst case" and "average" scenarios.

For the most noise affected receiver within the Estrella Rd Residences receivers, noise from construction stages is predicted to be up to 24 dB above the "noise affected" management goal for the "worst case" scenario and up to 18 dB "noise affected" management goal for an "average" scenario. Noise levels

throughout the construction works will tend to the “average” predicted noise levels for most of the time. Noise levels from all stages of construction are below the “highly noise affected” management goals for all Estella Rd Residences.

As predicted construction noise levels are expected to be above the “noise affected” management goals, MDA has provided a schedule of appropriate noise control recommendations and an example Construction Noise and Vibration Management Plan, to assist in controlling noise impacts from construction stages. All feasible noise controls and management practises detailed in this report should be adopted as a matter of course.

Vibration levels from construction activities are not expected to give rise to vibration impacts at any nearby receivers with sufficient vibration control provided by the distance between the future work site and receiver locations.

With respect to operational noise, noise emissions from the following sources have been considered:

- Public Address System
- School Bell
- Mechanical Services
- Use of School Hall
- Out of Hours Community Use
- Outdoor Activities
- Traffic Noise

At this early point in the development of the Project design, the specification of the public address system, school bell and mechanical services is not sufficiently progressed such that noise emissions can be evaluated in detail. General comments and derived maximum noise levels have however been provided in order to assist this ongoing design and ensure noise emissions from these sources can be properly controlled.

Noise from use of school internal facilities, during school time and out of hours community use, has been quantitatively evaluated based on assumed maximum internal sound levels for expected activities. This has informed preliminary performance requirements for building enclosure elements including external walls, roofs, glazing and door systems.

Outdoor activity noise has been qualitatively assessed based on the subjective assessment guidance described in the Protection of the Environment Operations Act 1997, and the EPA Noise Guideline for Local Government. Noise from outdoor learning and play/sport activities has been clearly established as **not** qualifying for description as offensive noise.

A quantitative assessment of noise levels from increased road traffic activity related to future operation of the school has established compliance with the requirements of the EPA Road Noise Policy.

On the basis of the above described assessments, the overall noise emissions assessment of the New Public School in Wagga Wagga project has been demonstrated to fulfil the requirements of the Planning Secretary’s Environmental Assessment Requirements (SEARs) (Application Number: SSD 9494).

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1.0 INTRODUCTION

Marshall Day Acoustics (MDA) has been commissioned by Hayball Architects to conduct an assessment of noise and vibration relating to the construction and operation of the proposed New Public School in Wagga Wagga (the Project).

This assessment is to satisfy the requirements of the Planning Secretary's Environmental Assessment Requirements (SEARs) (Application Number: SSD 9494) issued 8 August 2018, with respect to Noise and Vibration.

The extent of our engagement relates to:

- General project and site descriptions including nearby noise sensitive receivers
- Derivation of criteria applicable to the Project based on advice provided in the SEARs documentation with additional reference made to other guidance applied outside of the SEARs requirements
- Qualitative assessment of outdoor play and sporting activities
- Quantitative assessment of noise emissions from internal school activities
- Quantitative assessment of noise generated by additional traffic on public roads
- Quantitative assessment of construction noise with additional comments with respect to construction vibration
- Comments regarding mechanical services noise emissions
- Provision of maximum noise levels from PA and school bell operation
- Provision of measures to mitigate and minimise noise impacts where required

Acoustic advice provided in this report is based on Hayball preliminary issue schematic architectural drawings, received 15 October 2018, operational information provided by Hayball, and existing acoustic advice relating to the current schematic architectural design, summarised in MDA report Rp002 r01 20180592, issued 6 November 2018.

Technical terms used throughout this report are described in Appendix A

2.0 PROJECT AND SITE DESCRIPTION

2.1 Site Location

The Project site is located within an existing greenfield lot (Lot 1 in DP 1253855) currently owned by Charles Sturt University and currently zoned SP2 – Infrastructure – Educational Establishment in the City of Wagga Wagga Local Environment Plan 2010. The Project site is bounded by a car park related to Charles Sturt University to the north, an empty greenfield lot to the west currently zoned SP2 – Infrastructure – Educational Establishment, assorted residential receivers over Estella Rd to the south west, south and south east, and Charles Sturt University's Peter Hastie Oval to the east.

Noise sensitive receivers selected for assessment are described in Table 1 below. 'Worst case distance' represents a distance from the closest point of the project site to the receiver, 'Average distance' is the distance from the middle of the project site to the nearest point of the receiver.

Table 1: Noise sensitive receivers and approximate distances

Receiver	Land Use	Distance to development (Average), m	Distance to development (Worst Case), m
Estella Rd Residences	Residential	100	50
Peter Hastie Oval	Active Recreation	135	70

An aerial view of the site and surrounding area is provided in Figure 1. A site plan is provided in Appendix B.

Figure 1: Aerial view of the Project site



2.2 Project Description

The Project consists of the design and construction of a new primary school, including new pedestrian and vehicular access points from Estella Road.

MDA's understanding of the design intent of the Project is described below and is based on correspondence and discussion with Hayball. If the design intent described below changes, or is not accurate, MDA must be advised immediately so that the acoustic design can be updated.

Capacity: Up to 550 students by completion of all future stages

Description: A new primary school comprising 7 buildings which include Learning Clusters, Library, Special Program and Outdoor Learning spaces, Administration Canteen and Staff facilities, with additional community shared Hall, meeting/community rooms and commercial kitchen.

It is expected the primary use of the Hall will be for sporting activities, with a secondary use for assemblies.

Hours of use: School teaching spaces will predominantly be in use during typical daytime hours, 0700-1800hrs, however use of the Hall and other Community spaces will extend into the evening time, 1800-2200hrs. No use of any facilities is expected in the night-time period, 2200-0700hrs.

Mechanical services: Mechanical services are expected to be included as part of the Project and comprise a fully ducted system. At this early stage, no system information or equipment selections have been provided.

3.0 PLANNING SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

Key Issue requirements applicable to the Project are detailed in the Planning Secretary's Environmental Assessment Requirements (SEARs) (Application Number: SSD 9494) issued 8 August 2018. The SEARs provide the following requirements for Noise and Vibration:

11. Noise and Vibration

- Identify and provide a quantitative assessment of the main noise and vibration generating sources during demolition, site preparation, bulk excavation, construction. Outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land.
- Identify and assess operational noise, including consideration of any public-address system, school bell, mechanical services (e.g. air conditioning plant), use of any school hall for concerts etc. (both during and outside school hours) and any out of hours community use of school facilities, and outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land.

Relevant Policies and Guidelines:

- NSW Noise Policy for Industry 2017, NSW Environment Protection Authority (NPfI)
- Interim Construction Noise Guideline, Department of Environment and Climate Change (ICNG)
- Assessing Vibration: A Technical Guideline 2006, NSW Environment Protection Authority (AV:ATG)
- Development Near Rail Corridors and Busy Roads – Interim Guideline, NSW Department of Planning 2008 (DNRCBR)

In addition to the above, the following documents have also been referred for guidance:

- State Environmental Planning Policy (Schedule 2: Educational Establishments and Child Care Facilities), NSW Department of Planning and Environment SEPP 2017 (EECF SEPP)
- Protection of the Environment Operations Act 1997, NSW Environment Protection Authority (POEO)
- Noise Guideline for Local Government, NSW Environment Protection Authority 2013 (NGLG)
- Road Noise Policy, NSW Department of Environment, Climate Change and Water 2011 (RNP)

3.1 Noise and Vibration Sources

Based on the above, Table 2 shows the noise and vibration sources associated with Project and the documents referred for assessment. Note that vibration has been considered for Construction sources only as no operation sources are expected to give rise to perceptible vibration levels at residential receivers.

Table 2: Project noise and vibration sources and assessment references

Noise/Vibration Source	Assessment Reference
Construction	
Site Preparation	Interim Construction Noise Guideline Assessing Vibration: A Technical Guideline
Bulk Excavation	Interim Construction Noise Guideline Assessing Vibration: A Technical Guideline
Construction	Interim Construction Noise Guideline Assessing Vibration: A Technical Guideline
Operation	
Public Address System	NSW Noise Policy for Industry Educational Establishments and Child Care Facilities SEPP
School Bell	NSW Noise Policy for Industry Educational Establishments and Child Care Facilities SEPP

Noise/Vibration Source	Assessment Reference
Mechanical Services	NSW Noise Policy for Industry
Use of School Hall	NSW Noise Policy for Industry Educational Establishments and Child Care Facilities SEPP
Out of Hours Community Use	NSW Noise Policy for Industry Educational Establishments and Child Care Facilities SEPP
Outdoor Activities	Noise Guideline for Local Government Protection of the Environment Operations Act
Traffic Noise	Road Noise Policy Development Near Rail Corridors and Busy Roads – Interim Guideline

4.0 BACKGROUND NOISE SURVEY

A survey of background noise levels was conducted at a location within the proposed school lot between 26 July 2018 and 6 August 2018 using an ARL EI-316 noise logger (S/N:16-707-018).

Spot measurements conducted during the site visit indicated that the noise environment in the vicinity of the proposed site was similar for all noise sensitive receivers. Traffic volumes along Estella Rd were low with infrequent vehicle trips. As such, the selected logger position provided a representative environment for measurements of background noise at all nearby receivers. This scenario is common at sites in which no localised sources of background noise exist.

The logging position is shown in Figure 1. Measurement equipment was calibrated before and after the survey with no significant drift observed.

Average L_{A90} and L_{Aeq} measured during the survey are shown in Table 3 and have been derived in accordance with the data exclusion rules described in the NPfI.

Table 3: Measured average background noise levels

Period	Time of day	RBL $L_{A90, 15min}$ dB	$L_{Aeq, 15min}$ dB
Day	0700-1800hrs	32	47
Evening	1800-2200hrs	33	43

5.0 CONSTRUCTION NOISE AND VIBRATION

5.1 Construction Noise and Vibration Criteria

Noise and vibration criteria applicable to the project site with respect to construction activities have been derived considering the references detailed in Table 2 and are summarised in the following sections. Full derivation of criteria is provided in Appendix B.

5.1.1 Interim Construction Noise Guideline

Noise criteria applicable to the site derived in accordance with the ICNG are summarised in Table 4. These criteria apply to airborne noise emissions related to construction activity during the recommended standard hours only (see Appendix B for further details).

Table 4: Interim Construction Noise Guideline airborne noise criteria

Receiver Type	Management Level, L_{Aeq} (15 min)	
	Noise Affected	Highly Noise Affected
Residential	42	75

Receiver Type	Management Level, L_{Aeq} (15 min)
Active Recreation	65

The “noise affected” level is the point above which there may be some community reaction to noise. The “highly noise affected” level represents the point above which there may be a strong community reaction to noise. Where the “noise affected” management level is predicted to be exceeded, the ICNG requires that all feasible and reasonable work practices be employed. Where it is predicted that the “highly noise affected” management level will be exceeded, respite periods may need to be considered.

5.1.2 Assessing Vibration: A Technical Guideline

Vibration criteria applicable to the site, derived in accordance with the Technical Guideline are summarised in Table 5. These criteria apply to vibration events at residential receivers related to construction activity. Only Day time criteria is provided as no out of hours construction activities are expected.

Table 5: Assessing Vibration: A Technical Guideline; construction vibration criteria

Daytime (0600-2200hrs)	
Preferred Value, VDV	Maximum Value, VDV
0.20	0.40

5.2 Assumed Construction Plant Items

At this early planning stage, specific details regarding proposed construction processes are not known, with the types of activities, plant and scheduling not yet determined. A general plan of construction staging is understood to be:

- Site Preparation
- Bulk Excavation
- Construction

On this basis, plant equipment used during each stage of construction works have been assumed based on typical work practises. These assumptions must be reviewed by others. If the plant items used differ from that assumed, further assessment of construction activity noise and vibration will be required at a later stage. Assumed plant items are detailed in Table 6. Sound power data for these plant items is provided in Appendix C.

Table 6: Anticipated construction activities and assumed equipment schedule

Phase	Activities	Equipment
Site Preparation	Concrete removal	1 x 22t excavator
	Removal of waste material from site	Bogie truck, no trailer
	General	Generator Air compressor & lines

Phase	Activities	Equipment
Excavation	Bulk & detailed excavation works	2 x excavators (22 tonne, 27 tonne) with hydraulic hammer, eccentric rock ripper, buckets, rock grinder, demolition grab, rock-saw Compacting plate Jack hammer & breaker Concrete saw - road
	Delivery of materials & removal of waste materials	Flatbed truck Bogie truck
	General	Generator Air compressor & lines De-watering plant
Construction	Concreting	Concrete pump 1 x tower crane Exhaust fans Brick saw Concrete vibrator Concrete floats Concrete saw/ring saw Diamond core drill Nail guns Hydraulic bar cutter
	Delivery of materials	Concrete truck Bogie truck
	General	Generator Air compressor & lines De-watering plant Pressure cleaner Electric winch & materials hoist

5.3 Noise Control Recommendations

MDA recommends that the noise control measures detailed in Table 7 are implemented on-site. Predicted noise levels calculated during the construction noise assessment include the effect of these recommendations.

Table 7: Noise control recommendations for site

Phase	Equipment/Location	Recommendation
Site preparation	Generator	- Localised noise barriers should be utilised when this equipment is in use.

Phase	Equipment/Location	Recommendation
		- Barriers should be mobile and extend to a height 1m above noise source. - Barrier should envelope the work location to ensure no direct line of site to nearby receivers. - Practical and feasible measures should be taken to allow the noise barrier to be located within 4m of the noise source.
	Site boundary	Solid hoarding of minimum 2m height
Bulk Excavation	Jack hammer & breaker	- Localised noise barriers should be utilised when this equipment is in use.
	Concrete saw	- Barriers should be mobile and extend to a height 1m above noise source.
	Generator	- Barrier should envelope the work location to ensure no direct line of site to nearby receivers.
	Compacting Plate	- Practical and feasible measures should be taken to allow the noise barrier to be located within 4m of the noise source.
	Site boundary	Solid hoarding of minimum 2m height
Construction	Concrete saw/ring saw	- Localised noise barriers should be utilised when this equipment is in use.
	Generator	- Barriers should be mobile and extend to a height 1m above noise source.
		- Barrier should envelope the work location to ensure no direct line of site to nearby receivers.
		- Practical and feasible measures should be taken to allow the noise barrier to be located within 4m of the noise source.
	Site boundary	Solid hoarding of minimum 2m height

In addition to the above noise control recommendations, an appropriate construction noise and vibration management plan must be implemented. An example plan is detailed below.

5.4 Construction Noise and Vibration Management Plan

Many complaints about construction noise are due to preventable activities during construction periods. The following should be considered for adoption on site:

- Regularly train workers and contractors (such as at toolbox talks) to use equipment in ways to minimise noise.
- Ensure site managers periodically check the site and nearby residences and other sensitive land uses for noise problems so that solutions can be quickly applied.

- Include in tenders, employment contracts, subcontractor agreements and work method statements clauses that require minimisation of noise and compliance with directions from management to minimise noise.
- Avoid the use of radios or stereos outdoors where neighbours can be affected.
- Avoid the overuse of public address systems.
- Avoid shouting and minimise talking loudly and slamming vehicle doors.
- Keep truck drivers informed of designated vehicle routes, parking locations, acceptable delivery hours or other relevant practices (for example, minimising the use of engine brakes, and no extended periods of engine idling).
- Develop a one-page summary of approval or consent conditions that relate to relevant work practices and pin it to a noticeboard so that all site operators can quickly reference noise information.
- Workers may at times need to discuss or negotiate practices with their managers.

5.4.1 Consultation and Negotiation

The community is more likely to be understanding and accepting of noise if the information provided is frank, does not attempt to understate the likely noise level, and if commitments are firmly adhered to.

Notification Before and During Construction

- Provide, reasonably ahead of time, information such as total building time, what works are expected to be noisy, their duration, what is being done to minimise noise and when respite periods will occur. For works outside standard hours, inform affected residents and other sensitive land use occupants between five and 14 days before commencement.
- Provide information to neighbours before and during construction through media such as letterbox drops, meetings or individual contact. In some areas, the proponent will need to provide notification in languages other than English. A website could also be established for the project to provide information.
- Use a site information board at the front of the site with the name of the organisation responsible for the site and their contact details, hours of operation and regular information updates. This signage should be clearly visible from the outside and include after-hours emergency contact details.
- Maintain good communication between the community and project staff.
- Appoint a community liaison officer where required.
- For larger projects consider a regular newsletter with site news, significant project events and timing of different activities.
- Provide a toll-free contact phone number for enquiries during the works.
- Facilitate contact with people to ensure that everyone can see that the site manager understands potential issues, that a planned approach is in place and that there is an ongoing commitment to minimise noise.

Complaints Handling

- Provide a readily accessible contact point, for example, through a 24-hour toll-free information and complaints line.
- Give complaints a fair hearing.

- Have a documented complaints process, including an escalation procedure so that if a complainant is not satisfied there is a clear path to follow.
- Call back as soon as possible to keep people informed of action to be taken to address noise problems. Call back at night-time only if requested by the complainant to avoid further disturbance.
- Provide a quick response to complaints, with complaint handling staff having both a good knowledge of the project and ready access to information.
- Implement all feasible and reasonable measures to address the source of complaint.
- Keep a register of any complaints, including details of the complaint such as date, time, person receiving complaint, complainant's contact number, person referred to, description of the complaint, work area (for larger projects), time of verbal response and timeframe for written response where appropriate.

5.4.2 Plant and Equipment

In terms of both cost and results, controlling noise at the source is one of the most effective methods of minimising the noise impacts from any construction activities.

Use Quieter Methods

- Examine and implement, where feasible and reasonable, alternatives to rock-breaking work methods, such as hydraulic splitters for rock and concrete, hydraulic jaw crushers, chemical rock and concrete splitting, and controlled blasting such as penetrating cone fracture. The suitability of alternative methods should be considered on a case-by-case basis.
- Use alternatives to diesel and petrol engines and pneumatic units, such as hydraulic or electric controlled units where feasible and reasonable. Where there is no electricity supply, use an electrical generator located away from residences.

Use quieter equipment

- Examine different types of machines that perform the same function and compare the noise level data to select the least noisy machine. For example, rubber wheeled tractors can be less noisy than steel tracked tractors.
- Noise labels are required by NSW legislation for pavement breakers, mobile compressors, chainsaws and mobile garbage compactors. These noise labels can be used to assist in selecting less noisy plant.
- Pneumatic equipment is traditionally a problem – select super silenced compressors, silenced jackhammers and damped bits where possible.
- When renting, select quieter items of plant and equipment where feasible and reasonable.
- When purchasing, select, where feasible and reasonable, the most effective mufflers, enclosures and low-noise tool bits and blades. Always seek the manufacturer's advice before making modifications to plant to reduce noise.

Operate plant in a quiet and efficient manner

- Reduce throttle setting and turn off equipment when not being used.
- Examine and implement, where feasible and reasonable, the option of reducing noise from metal chutes and bins by placing damping material in the bin.

Maintain equipment

- Regularly inspect and maintain equipment to ensure it is in good working order. Also check the condition of mufflers.
- Equipment must not be operated until it is maintained or repaired, where maintenance or repair would address the annoying character of noise identified.
- For machines with enclosures, check that doors and door seals are in good working order and that the doors close properly against the seals.
- Return any hired equipment that is causing noise that is not typical for the equipment – the increased noise may indicate the need for repair.
- Ensure air lines on pneumatic equipment do not leak.

5.4.3 On Site

Barriers and acoustic sheds are most suited to longer-term fixed works, as in these cases the associated cost is typically outweighed by the overall time savings.

Location of plant

- Place as much distance as possible between the plant or equipment and residences and other sensitive land uses.
- Restrict areas in which mobile plant can operate so that it is away from residences and other sensitive land uses at particular times.
- Locate site vehicle entrances away from residences and other sensitive land uses.
- Carry out noisy fabrication work at another site (for example, within enclosed factory premises) and then transport to site.

Alternatives to reversing alarms

- Avoid use of reversing alarms by designing site layout to avoid reversing, such as by including drive through for parking and deliveries.
- Install where feasible and reasonable less annoying alternatives to the typical ‘beeper’ alarms taking into account the requirements of the Occupational Health and Safety legislation; examples are smart alarms that adjust their volume depending on the ambient level of noise and multifrequency alarms that emit noise over a wide range of frequencies.
- In all circumstances, the requirements of the relevant Occupational Health and Safety legislation must be complied with. For information on replacing audible warning alarms on mobile plant with less annoying alternatives, see Appendix C.

Maximise shielding

- Reuse existing structures rather than demolish and reconstruct.
- Use temporary site buildings and materials stockpiles as noise barriers.
- Schedule construction of any permanent walls so that they can be used as early as possible as noise barriers.
- Use natural landform as a noise barrier – place fixed equipment in cuttings, or behind earth berms.
- Note large reflecting surfaces on and off site that might increase noise levels and avoid placing noise-producing equipment in locations where reflected noise will increase noise exposure or reduce the effectiveness of mitigation measures.

5.4.4 Work Scheduling

Scheduling noisy work during periods when people are least affected is an important way of reducing noise impact.

Provide respite periods

- Consult with affected education facilities to ensure that noise-generating construction works in the vicinity of affected education buildings are not scheduled to occur during examination periods, unless other arrangements (such as relocation to an alternative location) acceptable to the affected parties can be made.
- Where night work near residences cannot be feasibly or reasonably avoided, restrict the number of nights per week and/or the number of nights per calendar month that the works are undertaken, in consultation with residents who will be most affected.

Schedule activities to minimise noise impacts

- Organise work to be undertaken during the recommended standard hours where possible.
- When works outside the recommended standard hours are planned, avoid scheduling on Sundays or public holidays.
- Schedule work when neighbours are not present (for example, commercial neighbours, colleges and schools may not be present outside business hours or on weekends).
- Schedule noisy activities around times of high background noise (local road traffic or when other local noise sources are active) where possible to provide masking or to reduce the amount that the construction noise intrudes above the background.
- Consult with affected neighbours about scheduling activities to minimise noise impacts.

Organise deliveries and access

- Nominate an off-site truck parking area, away from residences, for trucks arriving prior to gates opening.
- Optimise the number of vehicle trips to and from the site – movements can be organised to amalgamate loads rather than using a number of vehicles with smaller loads.
- Designate access routes to the site, through consultation with potentially noise-affected residences and other sensitive land uses and make drivers aware of nominated vehicle routes.
- Provide on-site parking for staff and on-site truck waiting areas away from residences and other sensitive land uses. Truck waiting areas may require bunding or walls to minimise noise.
- Schedule deliveries to nominated hours only.

5.4.5 Transmission Path

Physical methods to reduce the transmission of noise between the construction works and residences or other sensitive land uses are generally suited to works where there is longer-term exposure to the noise.

- Reduce the line-of-sight noise transmission to residences or other sensitive land uses using temporary barriers.
- Temporary noise barriers can be constructed from hoarding (plywood boards, panels of steel sheeting or compressed fibre cement board) with no gaps between the panels at the site boundary. Stockpiles, shipping containers and site office transportables can be effective barriers.
- Erect temporary noise barriers before work commences to reduce noise from works as soon as possible.

- Consult with most affected neighbours about how effective the proposed noise mitigation measures will be in addressing their concerns.

5.5 Summary of Construction Noise Assessment

Predicted noise levels from construction activities have been calculated, a detailed assessment, including predicted noise levels is provided in Appendix D.

Predicted L_{Aeq} levels from the proposed construction equipment indicate that noise from all phases of construction will be below the “noise affected” management levels for Peter Hastie Oval for both “worst case” and “average” scenarios.

For the most noise affected receiver within the Estella Rd Residences, “worst case” noise from typical site preparation, bulk excavation and construction activities may exceed the “noise affected” goals from the EPA criteria at the Estella Rd Residences by up to 24 dB whilst remaining below the “highly noise affected” management levels. It should be noted that for most of the time during construction works, noise levels are likely to be more in line with that predicted by the “average” noise levels.

Within standard ICNG hours (Monday – Friday: 0700-1700hrs, Saturday 0800-1300hrs) the “average” noise levels from typical operations at the most noise affected receiver within the Estrella RD Residences would be;

- Site Preparation activities are calculated to be:
 - o Up to 8 dB above the “noise affected” goals
- Bulk Excavation activities are calculated to be:
 - o Up to 17 dB above the “noise affected” goals
- Construction activities are calculated to be:
 - o Up to 18 dB above the “noise affected” goals

Exceedances of “noise affected” goals are typical of construction sites in suburban areas as background noise levels tend to be relatively low. Further, since all construction work is restricted to take place only during the daytime, noise impacts will not be experienced during the most sensitive time period i.e. night-time.

It is not expected that the “highly noise affected” levels will be exceeded at any receivers during typical operations.

The dominant noise sources for each phase of construction are indicated in Table 8.

Table 8: Dominant noise generating equipment

Phase	Dominant noise generating equipment
Site Preparation	Bogie truck, 22T excavator
Bulk Excavation	Jack hammer
Construction	Tower crane

As construction noise levels are predicted to exceed the “noise affected” goals for the Estella Rd Residences, due diligence by the site operator requires community consultation and negotiation. Notification should be provided of the proposed construction activities to nearby residents and non-residential receivers.

The ICNG recommends that for situations in which the “noise affected” management levels are exceeded; all feasible and reasonable work practises should be adopted. Additionally, all potentially impacted residents should be informed of the nature of the works, expected noise levels and duration, as well as contact details for site representatives. These requirements are described in

detail in the noise control recommendations in Section 5.3 and the Construction Noise and Vibration Management Plan described in Section 5.4.

5.6 Summary of Construction Vibration Assessment

Based on the assumed plant and equipment summarised in Table 6, the distances between the proposed school site and the residential receivers is sufficiently great such that even the most significant vibration generating equipment that may be used on-site is unlikely to give rise to vibration levels exceeding the Assessing Vibration: A Technical Guideline vibration criteria for the Day time period (noting that construction is not expected during the Night-time).

On this basis vibration impacts from construction works related to the Project are not expected to require any specific control beyond the work practises highlighted in Section 5.4.

6.0 OPERATIONAL NOISE AND VIBRATION

6.1 Operational Noise and Vibration Criteria

Noise and vibration criteria applicable to the Project site with respect to operational activities have been derived considering the references detailed in Table 2 and are summarised in the following sections. Full derivation of criteria is provided in Appendix B.

6.1.1 Noise Policy for Industry

Airborne noise criteria applicable to the site derived in accordance with the NPfl are summarised in Table 9. These criteria apply (in accordance with the SEARs) to airborne noise emission related to the PA system, school bell, mechanical services, use of the school hall and out of hours community use.

Table 9: NPfl airborne noise criteria

Receiver	Period	Project Noise Trigger Level, $L_{Aeq, 15min}$ dB
Residential	Day	37
	Evening	37*
Active recreation	When in use	53

* Section 2.3 of the NPfl advises that due to typical community expectations of greater control of noise during the evening period, derived Evening and Night-time Intrusiveness noise levels must be set to be no greater than the Day-time Intrusiveness noise level.

6.1.2 EECF SEPP

The EECF SEPP provides the following:

A new building or (if the development is an alteration or addition to an existing building for the purpose of changing its use) an existing building that is to be used for the purpose of a school or school-based child care must be designed so as not to emit noise exceeding an L_{Aeq} of 5 dB(A) above background noise when measured at any lot boundary.

Based on the measured background noise level of L_{A90} 32 dB and L_{A90} 33 dB for Day and Evening periods, as detailed in Table 3, EECF SEPP noise emissions targets of $L_{Aeq, 15mins}$ 37 dB (Day) and $L_{Aeq, 15mins}$ 37dB (Evening) have been developed. Similar to the NPfl, the derived Evening criterion has been set to be no greater than the Day criterion.

6.1.3 Noise Guideline for Local Government

The NGLG is designed to assist local government officers in assessing noise impacts and associated decision making. In determining whether a source of noise may be offensive, the following checklist is considered:

Q1: Is the noise loud in an absolute sense? Is it loud relative to other noise in the area?

Q2: Does the noise include characteristics that make it particularly irritating?

Q3: Does the noise occur at times when people expect to enjoy peace and quiet?

Q4: Is the noise atypical for the area?

Q5: Does the noise occur often?

Q6: Are a number of people affected by the noise?

This assessment checklist has been considered in assessing noise from outdoor learning and play activities.

6.1.4 Protection of the Environment Operations Act 1997

The PoEO provides a qualitative basis on which to assess impacts from noise sources and outlines assessment considerations designed to establish whether a noise can be objectively considered offensive. Offensive noise is defined in the PoEO act as being noise:

(a) that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances:

(i) is harmful to (or is likely to be harmful to) a person who is outside the premises from which it is emitted, or

(ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or

(b) that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances, prescribed by the regulations.

The PoEO subjective assessment has been considered in evaluating noise from outdoor learning and play.

6.1.5 Road Noise Policy

The Road Noise Policy provides a noise criterion for existing residences affected by additional traffic on existing sub-arterial roads generated by land use developments. This is specified as $L_{Aeq(15hr)} 60$ dBA assessed at the boundary of a residence.

Additionally, for areas with low background noise, an additional relative increase criterion aimed at protecting existing quiet areas from excessive change in amenity. For existing residents similarly affected by traffic increase along a sub-arterial road, this criterion is defined as Existing Traffic $L_{Aeq(15hr)} + 12$ dB. This is also assessed externally at the residence boundary.

6.1.6 Development Near Rail Corridors and Busy Roads – Interim Guideline

The Project is not located near a rail corridor, and roads in the vicinity of the school site are classed as local roads, with significantly less than 20,000 AADT volumes. On this basis the Development Near Rail Corridors and Busy Roads – Interim Guideline sets out that no assessment of operational road noise or vibration under the guideline is required.

7.0 OPERATIONAL NOISE EMISSIONS

7.1 PA System and School Bell

At this early stage, no detailed information has been provided with respect to the PA system or school bell however general comments can be provided. Noise emissions from these sources will need to be reviewed in more detail at a later stage once the number and location of bells and speakers is known. Any future PA or school bell design must comply with the criteria shown in Table 9 when assessed cumulatively with all site related operational noise emissions

Assuming a maximum number of 10 PA speakers installed on the external façades of the building, each speaker should not exceed a maximum sound pressure level of approximately 75dBA when measured at 1m from the speaker. We note that this is a relatively conservative level to account for the unknown positions of the speakers. Once speaker positions are known, this level can be recalculated with more accuracy.

Additionally;

- Speakers should be positioned to minimise noise spill.
- Consider the use of highly directional speaker units
- A limiter should be incorporated into the PA system to level output
- The finalised speaker system and limiter should be calibrated with measurements conducted at noise sensitive receivers to ensure compliance with applicable noise criteria
- Distributed system of smaller, lower output speakers rather than system of fewer, higher output speakers allows better control of noise spill and lower noise levels

7.2 Mechanical Services

The mechanical services design is currently at schematic stage and finalised equipment selections have not yet been made. As such, the quantitative assessment of mechanical services noise emissions cannot be conducted. Generally speaking, the mechanical services is expected to comprise a fully ducted system with various external plant items likely to give rise to noise emissions from the school.

Any noise emissions related to the Project from external mechanical services items must be designed and selected such that the applicable NPfI noise criteria is achieved at the residential receivers **when assessed cumulatively** with all other project noise emissions.

Noise control measures that may be required to control noise emissions from external plant could include:

- Noise control barriers
- Selection of low noise equipment
- Vibration isolation of items
- Attenuators to exhaust and outside air pathways

It is expected that noise emissions from plant will be reviewed in detail as part of the ongoing mechanical services design.

7.3 Noise Emissions from Use of the School Hall and Out of Hours Community Use

Noise generated within the school's internal spaces will typically be low, with noise within the Communal Hall expected to be higher than other spaces. Noise emissions from the hall have been assessed based on the assumed internal reverberant sound levels shown in Table 10. These activities are expected to occur anytime during the Day time period for school-based activities, or the Evening period for community-based activities.

Any assumptions regarding frequency of these activities should be verified by others.

Table 10: Assumed internal reverberant sound pressure levels, dB

Use	Internal reverberant sound pressure level, L_{Aeq} dB	Comments
Assemblies and drama (with amplified speech)	75	To occur on a weekly or daily basis

Use	Internal reverberant sound pressure level, L_{Aeq} dB	Comments
Sports (e.g. basketball)	75	To occur on a weekly or daily basis

Based on noise emissions from the above activities, in addition to other considerations such as rain noise control, the external wall, roof, glazing and door acoustic performance requirements detailed in Table 11 have been derived. These details have been previously presented as part of the MDA Concept Design report Rp002 r01 0180592.

Table 11: Performance requirements for external building elements, R_w

Building Element/Applicable Block	Performance requirement, R_w
Roof/ceiling	48
External walls	40
Glazing	25
Doors and sliding glazed partitions	30

Predicted noise levels at both the active recreation receiver, Peter Hastie Oval, and the nearest residential receiver have been calculated and are presented in Table 12.

Table 12: Predicted noise levels from School Hall and Community Use

Receiver/Period	NPfI Criteria, L _{Aeq} (15 min), dB	Façade Elements Closed		Façade Elements Open	
		Predicted Level L _{Aeq} (15 min), dB	Compliance?	Predicted Level L _{Aeq} (15 min), dB	Compliance?
Estella Rd Residences - Residential					
Day ¹	37	<30	✓	35	✓
Evening ¹	37	<30	✓	35	✓
Peter Hastie Oval - Active Recreation					
When In Use	53	<30	✓	37	✓

¹ Day: 0700-1800hrs, Evening: 1800-2200hrs

The proposed acoustic performance of the façade elements is predicted to allow sufficient noise control of school and community use activities such that NPfI (and EECF SEPP) noise criteria can be achieved at the residential receivers during both Day and Evening time periods. With façade elements open, noise levels at receivers would increase but would still be compliant with criteria for the Day and Evening periods.

Noise emissions from other sources must be designed such that cumulative noise levels at nearby noise sensitive receivers are capable of complying with the derived NPfI criteria when assessed cumulatively with noise from School Hall and Community use.

7.4 Outdoor Activities

Noise from children outside, either undertaking learning activities or engaging in sports has been assessed. No information has been provided with respect to proposed numbers, positioning or scheduling of outdoor teaching or play activities. In order to conduct an assessment of noise impacts MDA has made assumptions regarding the nature of the outdoor activities and provides comments below.

It should be noted that no specific quantitative criteria for the assessment of outdoor play associated with schools is available. NSW EPA indicates consideration of the Noise Guideline for Local Government and the Protection of the Environment Operations Act for the assessment of such sources. These sources provide qualitative guidance for assessment only, however approximate predicted noise levels have been developed to aid in understanding the nature of any noise impacts on nearby receivers.

Outdoor Learning

For learning activities, up to 4 groups of 30 children in positions around the school buildings have been assumed. Noise levels from a student undertaking study are typically low with 1 in 2 children speaking at normal conversation level at any one time.

Noise levels from this activity are predicted to be in the order of 25 dBA at the Estella Rd Residences and in the order of 30 dBA at Peter Hastie Oval. These predicted levels are below measured background noise levels for the area.

Outdoor Play/Sport

For sport activities it is assumed that up to 550 children may be engaging in active play within the playing fields to the North of the school buildings. It is assumed that children will be dispersed over the entire playing field area. It is assumed that children may be vocalising on a 1 in 2 basis.

Noise levels from play activities of this nature are predicted to be in the order of 48 dBA at the most noise affected Estella Rd Residences and in the order of 56 dBA at Peter Hastie Oval.

Based on a subjective assessment under the NGLG our assessment has established that noise from outdoor activities at the school is unlikely to be considered offensive on the basis shown in Table 13.

Table 13: NGLG Subjective Assessment

NGLG Subjective Assessment of Outdoor Activity Noise

Q1: Is the noise loud in an absolute sense? Is it loud relative to other noise in the area?

Predicted noise levels from outdoor learning are expected to be below measured background noise levels and are unlikely to be considered loud relative to other noise in the area.

For play/sporting activities, noise levels are predicted to be above background noise levels however unlikely to be significantly above noise from typical vehicle activity along Estella Rd when the absolute level is considered.

Q2: Does the noise include characteristics that make it particularly irritating?

Court judgements about intrusive noise from schools have indicated that noise from children playing may be considered more acceptable and less irritating than noise of an equivalent level from industrial, commercial or other noise sources

Q3: Does the noise occur at times when people expect to enjoy peace and quiet?

Outdoor learning and play is expected to occur during the Day time period 0700-1800hrs during which residents are generally expecting to be impacted by noise sources.

Q4: Is the noise atypical for the area?

As the proposed school site is currently zoned SP2 – Infrastructure – Educational Establishment, noise from children outdoors or at play is not out of character for the intended land use and is a typical noise source for a school.

Q5: Does the noise occur often?

Noise from students utilising the outdoor areas of the school is expected to occur in varying numbers throughout the day. The worst-case scenario of all students outside simultaneously playing is likely to occur for one of two periods of less than an hour on weekday only.

Q6: Are a number of people affected by the noise?

The number of receivers affected by the noise is likely to be in the order of 20-30 residences within closest proximity to the school site.

With regards assessment under the PoEO Act, noise from outdoor activities is not considered to be offensive. A summary of our subjective assessment is described in Table 14.

Table 14: PoEO Act Subjective Assessment

PoEO Act Subjective Assessment of Outdoor Activity Noise

(a) that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances:

(i) is harmful to (or is likely to be harmful to) a person who is outside the premises from which it is emitted,

Noise from outdoor play is not excessive in level, has acceptable character and occurs during the Day time period. On this basis outdoor activity noise is unlikely to give rise to harm to a receiver outside of the school.

(ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or

Outdoor play will occur during the Daytime period (0700-1800hrs). Receivers are generally less noise sensitive during this period due to increase in other noise generating activities not related to the school, reduced likelihood of residents sleeping, increased likelihood of residents being away from the premises and increase in general activities in the community.

(b) that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances, prescribed by the regulations.

As the proposed school site is currently zoned SP2 – Infrastructure – Educational Establishment, noise from children outdoors or at play is not out of character for the intended land use and is a typical noise source for a school.

7.5 Traffic Noise

Based on information provided in the draft Traffic Impact Report prepared by Peter Meredith Consulting and issued on 12 December 2018, traffic levels associated with both the current and future use of Estella Road are summarised in Table 15 and Table 16.

Table 15: Existing traffic volumes for Estella Rd

	AM peak (vph)	PM peak (vph)	Average Daily Traffic (vpd)
Estella Road	121	134	1232

Table 16: Future traffic volumes with school use for Estella Rd

	Peak hour Trips (vph)	Average Daily Traffic (vpd)
Stage 1 2020 Operation	326 ¹	1746
Future Full Operation 2030	421 ¹	1999

¹ As peak hour trip data for current Estella Rd use is not provided in the report the higher PM peak flow has been used to derive an overall Peak Hour Trip value for future use

Based on the above traffic volumes, noise levels from additional traffic due to the use of the Project are expected to be in the order of $L_{Aeq(15\text{ hr})}$ 48 dB at the most noise affected Estella Rd resident. This complies with the Road Noise Policy criteria of $L_{Aeq(15\text{ hr})}$ 60 dB.

Additionally, a relative increase of 2 dB is predicted. This is significantly lower than the 12 dB increase criteria outlined by the Road Noise Policy.

On this basis, noise generated by additional traffic related to the Project is unlikely to give rise to noise impacts on nearby receivers.

APPENDIX A GLOSSARY OF TERMINOLOGY

Noise	A sound that is unwanted by, or distracting to, the receiver.
Ambient	The ambient noise level is the noise level measured in the absence of the intrusive noise or the noise requiring control. Ambient noise levels are frequently measured to determine the situation prior to the addition of a new noise source.
SPL or L_p	<u>Sound Pressure Level</u> A logarithmic ratio of a sound pressure measured at distance, relative to the threshold of hearing (20 μ Pa RMS) and expressed in decibels.
SWL or L_w	<u>Sound Power Level</u> A logarithmic ratio of the acoustic power output of a source relative to 10^{-12} watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.
dB	<u>Decibel</u> The unit of sound level. Expressed as a logarithmic ratio of sound pressure P relative to a reference pressure of $P_r=20 \mu\text{Pa}$ i.e. $\text{dB} = 20 \times \log(P/P_r)$
dBA	The unit of sound level which has its frequency characteristics modified by a filter (A-weighted) so as to more closely approximate the frequency bias of the human ear.
A-weighting	The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.
$L_{Aeq}(t)$	The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
$L_{A90}(t)$	The A-weighted noise level equalled or exceeded for 90% of the measurement period. This is commonly referred to as the background noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
$L_{A10}(t)$	The A-weighted noise level equalled or exceeded for 10% of the measurement period. This is commonly referred to as the average maximum noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.

APPENDIX A SITE PLAN



APPENDIX B PROJECT SPECIFIC CRITERIA

B1 Interim Construction Noise Guideline

The Interim Construction Noise Guideline (ICNG) aims to provide a clear understanding of ways to identify and minimise noise from construction works through applying all 'feasible' and 'reasonable' work practises to control noise impacts. The guideline identifies sensitive land uses and recommends construction hours, provides quantitative and qualitative assessment methods and subsequently advises on appropriate work practises.

For the Project site, nearby residential receivers have been identified as sensitive land uses for consideration. It is understood that construction activities on-site are unlikely to extend outside of the recommended standard hours detailed in Table B 1.

Table B 1: Interim Construction Noise Guideline recommended standard hours of work

Work Type	Recommended standard hours of work
Normal Construction	Monday to Friday 0700 to 1800hrs Saturdays 0800 to 1300hrs No work on Sundays or public holidays

Based on the recommended standard hours, the guideline provides airborne noise criteria for residences and active recreation areas (Peter Hastie Oval) as detailed in Table B 2. The Noise Affected management level is derived on a Rating Background Level (RBL) + 10 dB basis, with RBL values taken from the measured average background noise levels shown in Table 3. The Highly Noise Affected management level is prescriptively set at $L_{Aeq(15\text{ min})}$ 75 dB. The management level for active recreation receivers is not distinguished as either Noise Affected or Highly Noise Affected but is set as a single criterion of $L_{Aeq(15\text{ min})}$ 65 dB.

Table B 2: Interim Construction Noise Guideline airborne noise criteria

Receiver Type	Management Level, $L_{Aeq(15\text{ min})}$	
	Noise Affected	Highly Noise Affected
Residential	42	75
Active Recreation	65	

Where noise from construction works is above the Noise Affected level, all feasible and reasonable work practises should be applied. Where the noise from construction works is above Highly Affected management level, restrictions to the hours of construction may be required.

Additional criteria are provided for ground borne noise from construction vibration, applicable during the Evening and Night periods only. As construction is not expected to occur during these periods, ground borne noise has not been assessed.

B2 Assessing Vibration: A Technical Guideline

The Technical Guideline is designed to assist in evaluating and assessing the effects on amenity of vibration emissions from industry, transportation and machinery, and provides a useful reference in assessing the vibration impacts caused by the construction or operation of new developments.

Construction activities typically give rise to vibration events defined in the Guideline as Intermittent, with interrupted periods of continuous or repeated periods of impulsive vibration that varies significantly in magnitude.

The Guideline provides acceptable values for intermittent vibration based on Vibration Dose Values. These criteria, applicable to residential receivers, are summarised in Table B 3. The Guideline also allows for

assessment for other receiver types such as offices, schools and places of worship however none of these types are located close to the Project site and have been omitted.

Table B 3: Assessing Vibration: A Technical Guideline; construction vibration criteria

Daytime (0700-200hrs)		Night-time (2200-0700hrs)	
Preferred Value, VDV	Maximum Value, VDV	Preferred Value, VDV	Maximum Value, VDV
0.20	0.40	0.13	0.26

B3 Noise Policy for Industry

In NSW, the NPfI is the guideline for assessing noise emissions from industrial facilities and other developments with noise sources that may be considered to be industrial in nature. Whilst the EPA has indicated that the NPfI is inappropriate for the assessment of educational facilities, specifically with regard to noise from children, the NPfI can be used as guidance to inform project specific criteria that may be developed for a school development from industrial type noise sources such as mechanical plant. The SEARs document also indicates that NPfI criteria should be considered in the assessment of the public address system, school bell, use of the school hall and out of hours community use of school facilities.

The NPfI sets out a procedure where a noise source can be evaluated against a series of noise assessment levels. In the NPfI, these project specific noise levels are derived from an analysis of the ambient noise environment and zoning information.

The ambient noise levels for this project are summarised in Table B 4. In the NPfI, the background noise level is called the Rating Background Level (RBL). As the primary use of the school will only occur during the Daytime and Evening periods, the Night-time period is not required for assessment and has been omitted.

Table B 4: NPfI time periods and measured background noise levels

Period	Time of day	RBL $L_{A90, 15min}$ dB	$L_{Aeq, 15min}$ dB
Day	0700-1800hrs	32	47
Evening	1800-2200hrs	33	43

Intrusiveness noise levels

The intrusiveness noise assessment is applicable to residential receivers and is based on knowledge of the background noise level at the receiver location. The intrusiveness level is the background noise level at the nearest noise sensitive location plus 5dB. Therefore, the noise emissions from the premises are considered to be intrusive if the A-weighted source noise level ($L_{Aeq, 15min}$) is greater than the background noise level (L_{A90}) plus 5dB.

Based on the background noise data summarised in Table B 4, noise limits for Intrusiveness have been calculated in accordance with the NPfI and are presented in Table B 5.

Table B 5: NPfI derived Intrusiveness noise levels

Period	Rating Background Level, $L_{A90, 15min}$ dB	Intrusiveness Noise Level (RBL + 5 dB), $L_{Aeq, 15min}$ dB
Day	32	37
Evening	33	37*

* Section 2.3 of the NPfI advises that due to typical community expectations of greater control of noise during the evening period, derived Evening and Night-time Intrusiveness noise levels must be set to be no greater than the Day-time Intrusiveness noise level.

Amenity noise levels

The project amenity noise levels are designed to prevent industrial noise continually increasing above an acceptable level. The initial stage in determining the project amenity level is to determine the recommended amenity noise levels for the appropriate amenity area and time of day.

A review of the noise levels measured indicates that the residential noise environment is typical of a Suburban area with intermittent traffic related noise source during the day and evening ambient noise levels defined by the natural environment and human activity. As such, the recommended amenity noise levels for a Suburban residential receiver as described in Table 2.2 of the NPfI have been selected. The appropriate recommended amenity noise levels are then modified to convert an $L_{Aeq, period}$ time descriptor to an $L_{Aeq, 15 min}$ descriptor (as detailed in Section 2.2 of the NPfI).

The NPfI project amenity noise levels applicable to the development are detailed in Table B 6.

Table B 6: NPfI derived project amenity noise levels

Receiver	Period	Recommended Amenity Noise Level $L_{Aeq, period}$ dB	Project Amenity Noise Level $L_{Aeq, 15min}$ dB
Residential (Suburban)	Day	55	53
	Evening	45	43
Active recreation	When in use	---	53

Source: Table 2.2 NSW Noise Policy for Industry

Determination of Project Noise Trigger Levels

The final process in determining the operational noise limits according to the NPfI is to derive the Project Noise Trigger Levels. The Project Noise Trigger Levels are levels that, if exceeded, would indicate a potential noise impact on the community, and so 'trigger' a management response; for example, further investigation of mitigation measures.

The Project Noise Trigger Levels are derived by selecting the more stringent of either the intrusiveness or project amenity noise levels. For residential receivers each assessment time period is evaluated individually. For non -residential receivers, only the Amenity noise level applies. The NPfI Project Noise Trigger Levels applicable to the site are shown in Table B 7.

Table B 7: NPfI Project Noise Trigger Levels

Receiver	Period	Project Noise Trigger Level, $L_{Aeq, 15min}$ dB
Residential	Day	37
	Evening	37
Active recreation	When in use	53

APPENDIX C CONSTRUCTION NOISE SOURCES

A variety of excavation and construction equipment will be used for this project. At this early stage a comprehensive plan of staging and equipment selection is not known. Table C 1 provides a schedule of construction equipment that is anticipated to be used on this site and their noise levels as taken from:

- AS2436-2010: *Guide to noise and vibration control on construction, demolition and maintenance sites*
- BS5228-1-2009: *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise*

Table C 1: Construction noise source sound power levels , dB L_{Aeq}

Noise source	A-weighted sound power level, L _{Aeq} dB SWL	Source
22 tonne excavator	99	AS2436-2010
27 tonne excavator	103	BS5228-1-2009
Jack hammer & breaker	121	AS2436-2010
Compacting plate	117	BS5228-1-2009
Concrete saw	117	BS5228-1-2009
Concrete truck & pump	108	AS2436-2010
Tower crane	105	AS2436-2010
Brick saw	107	BS5228-1-2009
Concrete vibrator	103	AS2436-2010
Concrete floats	100	BS5228-1-2009
Nail gun	101	BS5228-1-2009
Hydraulic bar cutter	107	BS5228-1-2009
Bogie truck	107	AS2436-2010
Flatbed truck	107	AS2436-2010
Generator	99	AS2436-2010
Air compressor	101	AS2436-2010
Electric winch & materials hoist	96	BS5228-1-2009
De-watering plant (water pumps)	99	BS5228-1-2009

APPENDIX D CONSTRUCTION NOISE IMPACT ASSESSMENT

Noise levels during the Site Preparation , Bulk Excavation and Construction phases have been calculated at the nominated receivers. These noise levels have been predicted under guidance from *AS2436-2010 Guide to noise control on construction, maintenance and demolition sites* and utilising the information provided in *BS 5228-1-2009 Code of practise for noise and vibration control on construction and open sites*.

Levels have been calculated for “worst-case” situations where noise sources will either be closest to the noise sensitive receiver and/or not screened by existing site structures. Noise levels have also been calculated for the “average” situation, with noise sources located towards the centre of the site. The latter is likely to be representative of the long-term noise emissions.

For the purpose of our calculation, we have assumed that the following plant items will be working together simultaneously for between 25 to 100% of the time over a 15-minute period for the demolition, excavation and construction phases.

Table D 1: Equipment assumed to be operating simultaneously in a 15-minute period

Construction Equipment	Site Preparation	Bulk Excavation	Construction
22 tonne excavator	✓		
27 tonne excavator		✓	
Jack hammer & breaker		✓	✓
Compacting plate		✓	✓
Concrete saw		✓	✓
Concrete truck & pump			✓
Tower crane			✓
Brick saw			✓
Concrete vibrator			✓
Concrete floats			✓
Nail gun			✓
Hydraulic bar cutter			✓
Bogie truck	✓	✓	✓
Flatbed truck		✓	
Generator	✓	✓	✓
Air compressor	✓	✓	✓
Electric winch & materials hoist			✓
De-watering plant (water pumps)		✓	✓

D1 Site Preparation Phase

Table D 2 details the predicted noise levels at the nominated receivers’ occupancies during the Site Preparation phase. Noise levels have been calculated at a position within the receiver that is most exposed to noise from Site Preparation activities. Calculated noise levels include the effects of the noise control recommendations detailed in Section 5.3.

The calculated levels indicate that noise from Site Preparation activities is below the “noise affected” goals for the “worst-case” and “average” assessment position for Peter Hastie Oval. For the Estella Rd Residences, predicted noise levels are expected to be 15 dB above the “noise affected” goals for the “worst case” position and up to 9 dB above the “noise affected” goal for the “average” position.

During the Site Preparation phase, the use of bogie trucks and excavator has the highest potential to impact on the noise receivers at the Estella Rd Residences.

D2 Bulk Excavation Phase

Table D 3 details the predicted noise levels at the nominated receivers during the Bulk Excavation phase. Noise levels have been calculated at position within the receiver that is most exposed to noise from Bulk Excavation activities. Calculated noise levels include the effects of the noise control recommendations detailed in Section 5.3.

The calculated levels indicate that noise from Bulk Excavation activities is below the “noise affected” goals for the “worst-case” and “average” assessment position for Peter Hastie Oval. For the Estella Rd Residences, predicted noise levels are expected to be 23 dB above the “noise affected” goals for the “worst case” position and up to 17 dB above the “noise affected” goal for the “average” position.

During the Bulk Excavation phase, the use of jack hammers has the highest potential to impact on the noise receivers at the Estella Rd Residences.

D3 Construction Phase

Table D 4 details the predicted noise levels at the nominated receivers during the Construction phase. Noise levels have been calculated at position within the receiver that is most exposed to noise from Construction activities. Calculated noise levels include the effects of the noise control recommendations detailed in Section 5.3.

The calculated levels indicate that noise from Construction activities is below the “noise affected” goals for the “worst-case” and “average” assessment position for Peter Hastie Oval. For the Estella Rd Residences, predicted noise levels are expected to be 24 dB above the “noise affected” goals for the “worst case” position and up to 18 dB above the “noise affected” goal for the “average” position.

During the Construction phase, the use of the tower crane has the highest potential to impact on the noise receivers at the Estella Rd Residences.

D4 Comments

Background levels in the vicinity of the residential receivers are low. Whilst noise levels associated with each stage of the Construction works are typically at the lower end of that emitted by such activities, the emergence above the ambient noise level means that some community reaction may occur. The ICNG recommends that for situations in which the “noise affected” management levels are exceeded; all feasible and reasonable work practises should be adopted. Additionally, all potentially impacted residents should be informed of the nature of the works, expected noise levels and duration, as well as contact details for site representatives. These requirements are described in detail in the noise control recommendations in Section 5.3 and the Construction Noise and Vibration Management Plan described in Section 5.4.

Table D 2: Predicted noise levels during Site Preparation works

Receiver	Period	Assessment	Calculated noise level ² , dB L _{Aeq, 15min} ³	“Noise affected”		“Highly noise affected”	
				Management level, dB L _{Aeq, 15min}	Exceedance, dB	Management level, dB L _{Aeq, 15mins}	Exceedance, dB
Estella Rd Residences	Within guideline hours ¹	Worst-case	56	42	14	75	--
		Average	50		8		--
Peter Hastie Oval	Within guideline hours ¹	Worst-case	54	65	--	N/A	N/A
		Average	48		--		

¹ Monday – Friday: 0700-1700hrs, Saturday 0800-1300hrs

² Calculations included the recommended noise controls detailed in Section 5.3

³ Unless noted otherwise, noise level calculated at 1.5m above ground level at the property boundary most exposed to construction noise in accordance with the requirements of the ICNG. Noise levels at upper floors without shielding are likely to be higher.

Table D 3: Predicted noise levels during Bulk Excavation works

Receiver	Period	Assessment	Calculated noise level ² , dB L _{Aeq, 15min} ³	“Noise affected”		“Highly noise affected”	
				Management level, dB L _{Aeq, 15min}	Exceedance, dB	Management level, dB L _{Aeq, 15mins}	Exceedance, dB
Estella Rd Residences	Within guideline hours ¹	Worst-case	65	42	23	75	--
		Average	59		17		--
Peter Hastie Oval	Within guideline hours ¹	Worst-case	63	65	--	N/A	N/A
		Average	57		--		

¹ Monday – Friday: 0700-1700hrs, Saturday 0800-1300hrs

² Calculations included the recommended noise controls detailed in Section 5.3

³ Unless noted otherwise, noise level calculated at 1.5m above ground level at the property boundary most exposed to construction noise in accordance with the requirements of the ICNG. Noise levels at upper floors without shielding are likely to be higher.

Table D 4: Predicted noise levels during Construction works

Receiver	Period	Assessment	Calculated noise level ² , dB L _{Aeq, 15min} ³	“Noise affected”		“Highly noise affected”	
				Management level, dB L _{Aeq, 15min}	Exceedance, dB	Management level, dB L _{Aeq, 15mins}	Exceedance, dB
Estella Rd Residences	Within guideline hours ¹	Worst-case	66	42	24	75	--
		Average	60		18		--
Peter Hastie Oval	Within guideline hours ¹	Worst-case	63	65	--	N/A	N/A
		Average	57		--		

¹ Monday – Friday: 0700-1700hrs, Saturday 0800-1300hrs

² Calculations included the recommended noise controls detailed in Section 5.3

³ Unless noted otherwise, noise level calculated at 1.5m above ground level at the property boundary most exposed to construction noise in accordance with the requirements of the CNG. Noise levels at upper floors without shielding are likely to be higher.