ACOUSTIC REVIEW & OPINION

Proposed Boarding House
16 Gladys Avenue Frenchs Forest NSW

Report To:

Mr Michael Williamson

WILLIAMSON BUILDING CORPORATION

Report By:

NG Child & Associates

23 November 2018

DOCUMENT CONTROL REGISTER

Project Reference	CA/18/151-2001
Project Name	Review and Acoustic Opinion of a Proposed Boarding House Development at 16 Gladys Avenue Frenchs Forest NSW
Document Title	Acoustic Review & Opinion: Proposed Boarding House 16 Gladys Avenue Frenchs Forest (Version 1; November 23rd, 2018)
Document Reference	16 Gladys Avenue: Acoustic Review & Opinion (Version 1) – 231118.docx
Issue Type	Electronic
Attention	Ms Michael Williamson

Version	Date	Document Reference	Prepared By	Checked By	Approved By
1	23 November 2018	16 Gladys Avenue: Acoustic Review & Opinion (Version 1) – 231118.docx	NGC	HMC	NGC

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1.1 BACKGROUND

Williamson Building Corporation is involved in the design and prospective construction of a boarding house development at 16 Gladys Avenue Frenchs Forest NSW.

The proposed development will involve the demolition and removal of existing structures at the site, including an existing dwelling, and the construction of a purpose designed boarding house complex.

The proposed boarding house complex is subject to approval by the local government consent authority at interest, which is Northern Beaches Council, and to regulatory control by Council, and relevant NSW Government departments and agencies.

A Development Application (DA) for the project will be lodged with Northern Beaches Council. As part of the DA submission, Williamson Building Corporation wishes to include an appropriate review and opinion of acoustic issues relevant to the proposed development.

NG Child & Associates has been engaged to prepare and provide the acoustic review and opinion required. Noel Child of NG Child & Associates is a suitably qualified and experienced person to undertake the various assessments required. His CV has been included for reference at Appendix B.

This document presents that acoustic review and opinion.

1.2 LOCATION OF PROPOSED DEVELOPMENT

A recent (November 2nd, 2018) aerial view and street map showing the location of the proposed development are provided in Figures 1.1 and 1.2 below and on the following page respectively.

Figure 1.1 – Satellite View of Proposed Development Site (November 2nd, 2018)

The direction of north is towards the top of both diagrams, and the site area is shown shaded in blue.

The proposed development site is bounded by Gladys Avenue to the south, and by existing residential properties and land uses to the east, west and north.

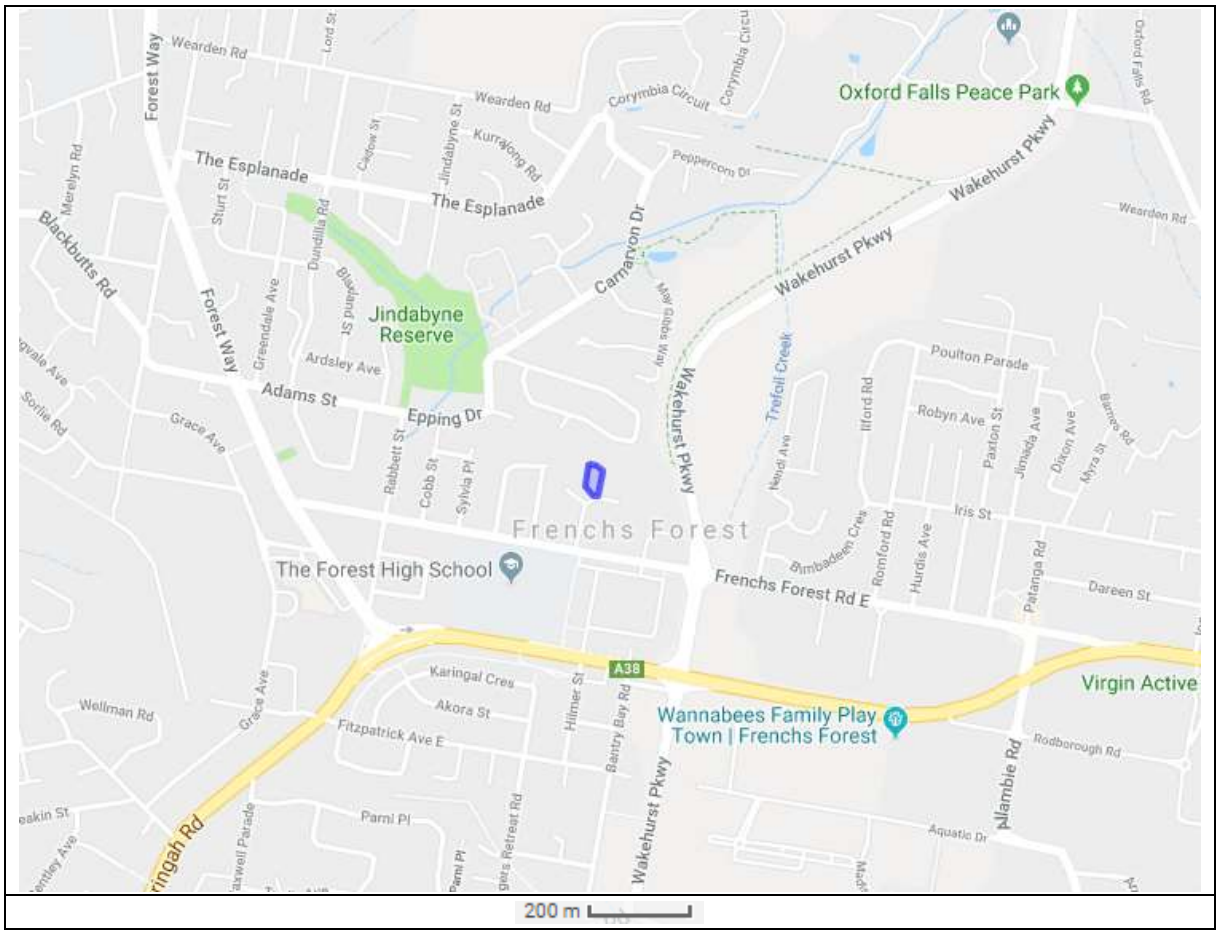

Figure 1.2 – Street Map

2 SITE DETAILS

2.1 SITE DESCRIPTION

The development site comprises an irregular shaped portion of land, with an existing residential dwelling, located at 16 Gladys Street Frenchs Forest NSW.

The land is formally identified as Lot 1 in Deposited Plan (DP) 548605.

The site has an area of 2415 square metres.

“Battle-axe” access driveways provide separation from the adjoining residentials properties to the east and west.

2.2 ZONING

The site and surrounding land are zoned R2 low density residential shown in Figure 2.1, as shown in Figure 2.1 on the following page.

The information [provided in Figure 2.1 is sourced form the current Northern Beaches Council Local Environment Plan (LEP).

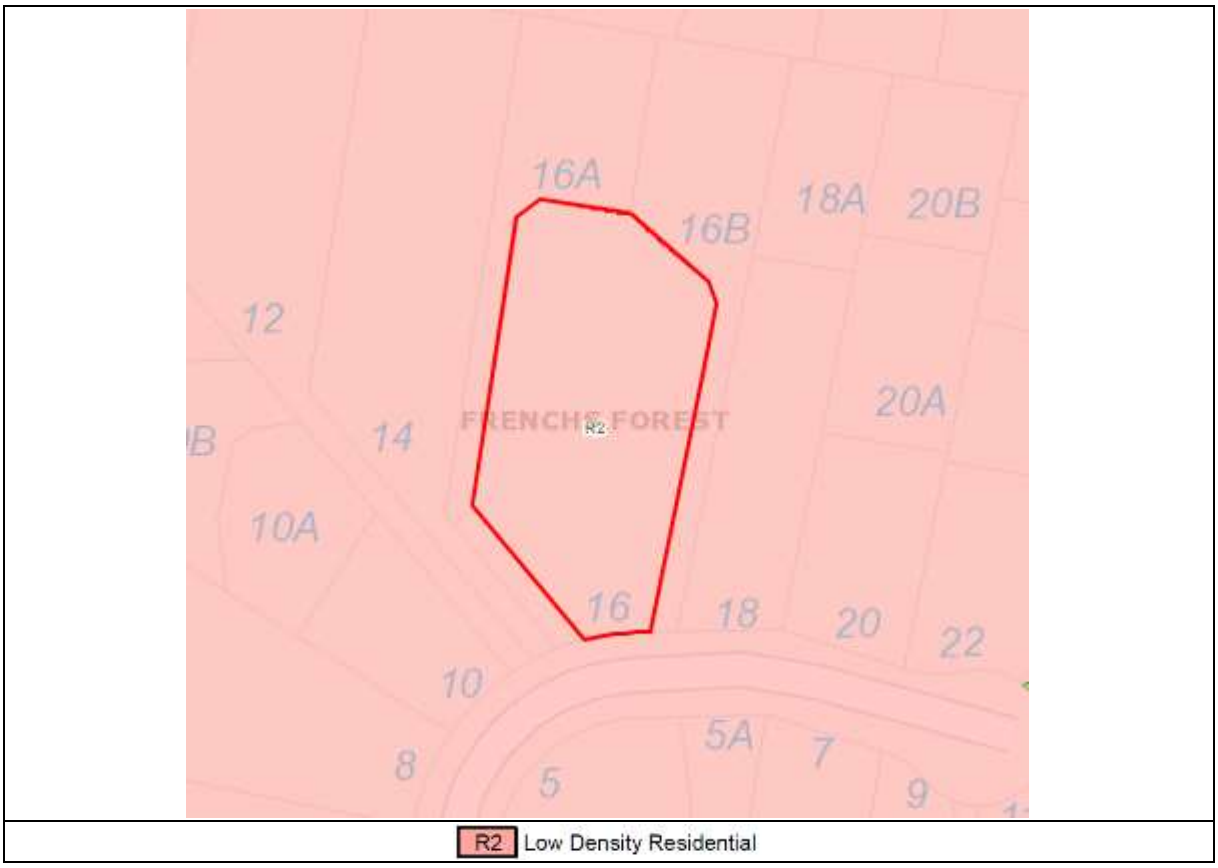

Figure 2.1 – Land Zoning Diagram

3 PROJECT DESCRIPTION & PLANS

As stated in 1.1 above, the proposed development will involve the demolition and removal of existing structures at the site, including an existing dwelling, and the construction of a purpose designed boarding house complex.

The development will be in accordance with the plans and drawings provided in Figures 3.1 to 3.11 on subsequent pages, as follows:

Figure 3.1 - Architectural Design Statement

Figure 3.2 – Site Plan

Figure 3.3 - Lower 01

Figure 3.4 - Ground Floor Upper

Figure 3.5 - First Floor Upper

Figure 3.6 - Second Floor Upper

Figure 3.7 - Roof Upper

Figure 3.8 - North &South Elevations

Figure 3.9 - Sections

Figure 3.10 - Sections

Figure 3.11 - Sections

Of relevance to this acoustic review and opinion, it is noted that:

- The site is in what appears to be a relatively quiet cul-de-sac street;
- The site is adjoinded to the east and west by battle axe blocks;
- It is proposed that communal open space will be in the centre of the site between the front and rear buildings;
- The communal open space on the building roof area will be screened by landscaping and is more than 9 metres away from any site boundary;
- Balconies facing site boundaries are small and generally a minimum of 6 metres away from boundaries; and
- Rules for use of communal areas will be detailed in the Management Plan to be prepared for the boarding house development and enforced by a care taker who will be living on the site. Rules will include, but not be limited to the following:
    - Noise control
    - Restricted hours of operation (i.e. only to be used between 7am and 10pm)
    - No Alcohol policy

GFA and FSR Controls

Site Area: 2411 sqm

Level	Proposed GFA (sqm)	Control
Lower Floor Plan	293.12	
Ground Floor Plan _ Upper & Lower	849.9	
Level 1 Floor Plan _ Upper & Lower	802.96	
Level 2 Floor Plan _ Upper & Lower	445.48	
Total GFA	**2391.46**	
Total FSR	**0.9919**	**2:01**

Landscape and Deep Soil Controls

Control	Proposed	%
Landscaped Area - 40%	1066.44	44.2
Deep Soil - 40%	986.27	40.9

Parking Controls

Control	Required	Proposed
Parking	41	21
Motorcycle Parking Provided:	16	17
Bicycle Parking Provided:	16	17

Building Inclusions

Area	Quantity	Area
Single Boarding Room	4	>12sqm + Wet Areas
Double Boarding Room	77	>16sqm + Wet Areas
Managers Room	1	>16sqm + Wet Areas + 8sqm POS
Communal Living Area	1	26.88sqm
Communal Open Space	2	120.2sqm
Communal Laundry	1	18.65sqm

Figure 3.1 – Architectural Design Statement

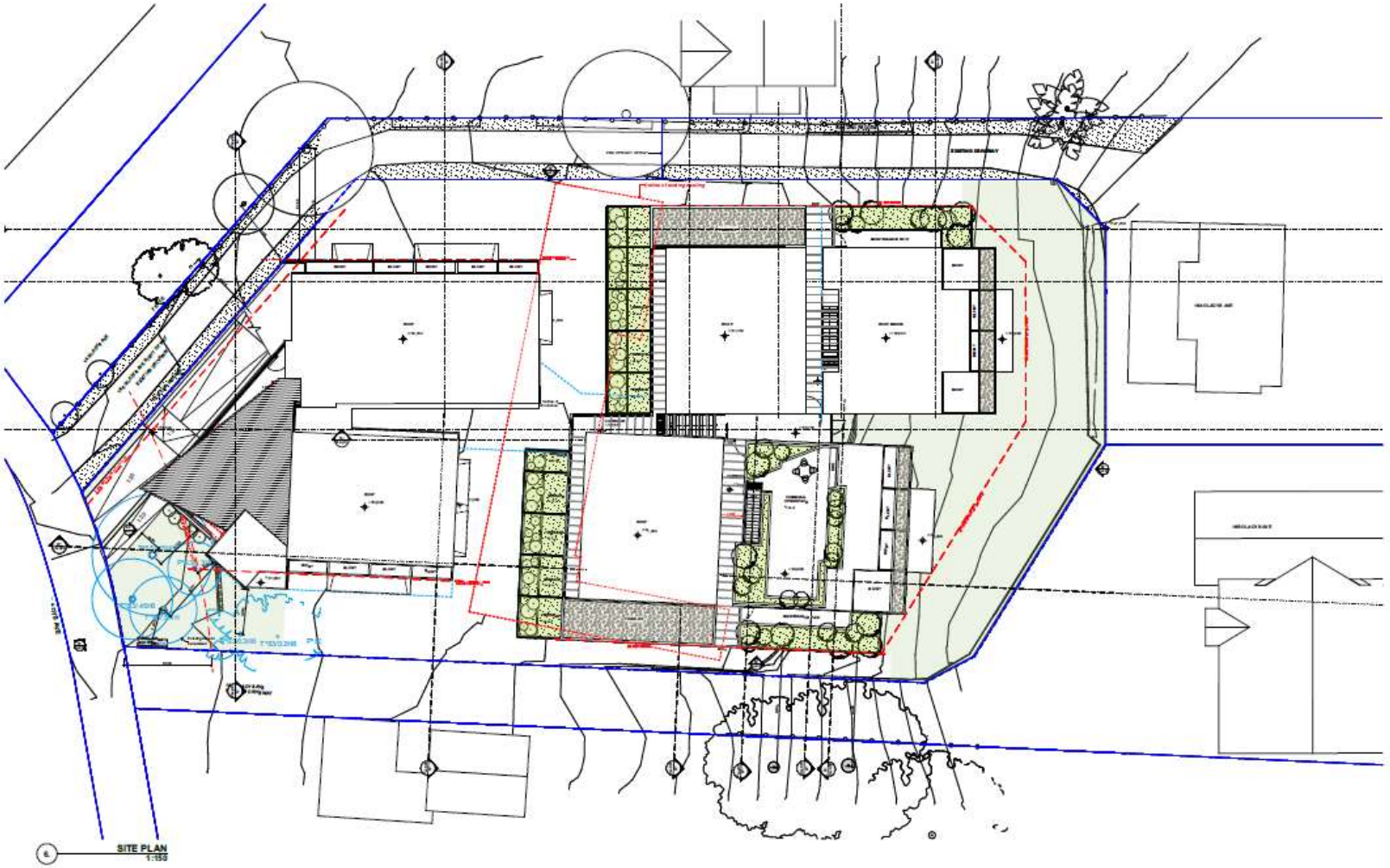

Figure 3.2 – Site Plan

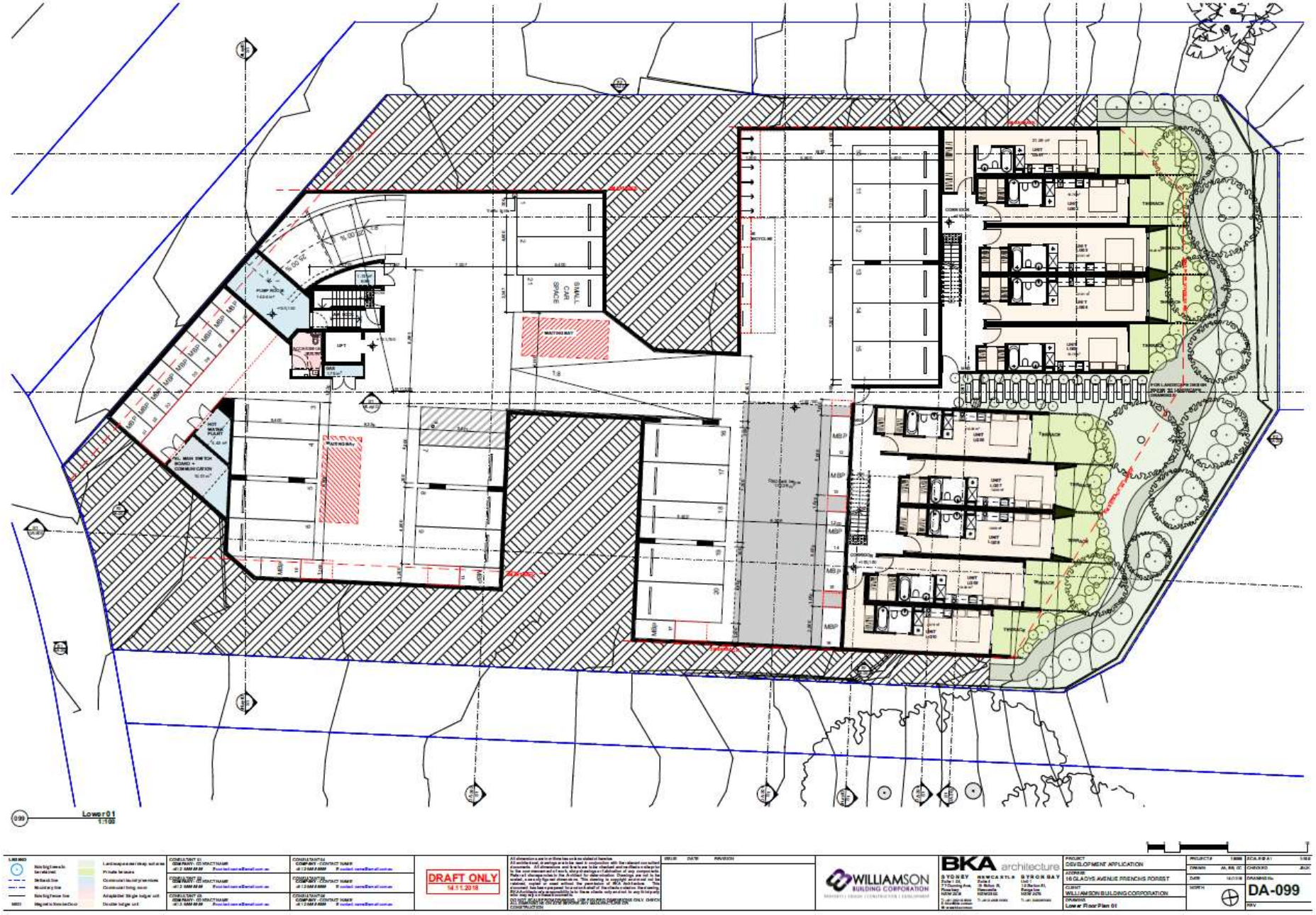

Figure 3.3 – Lower 01

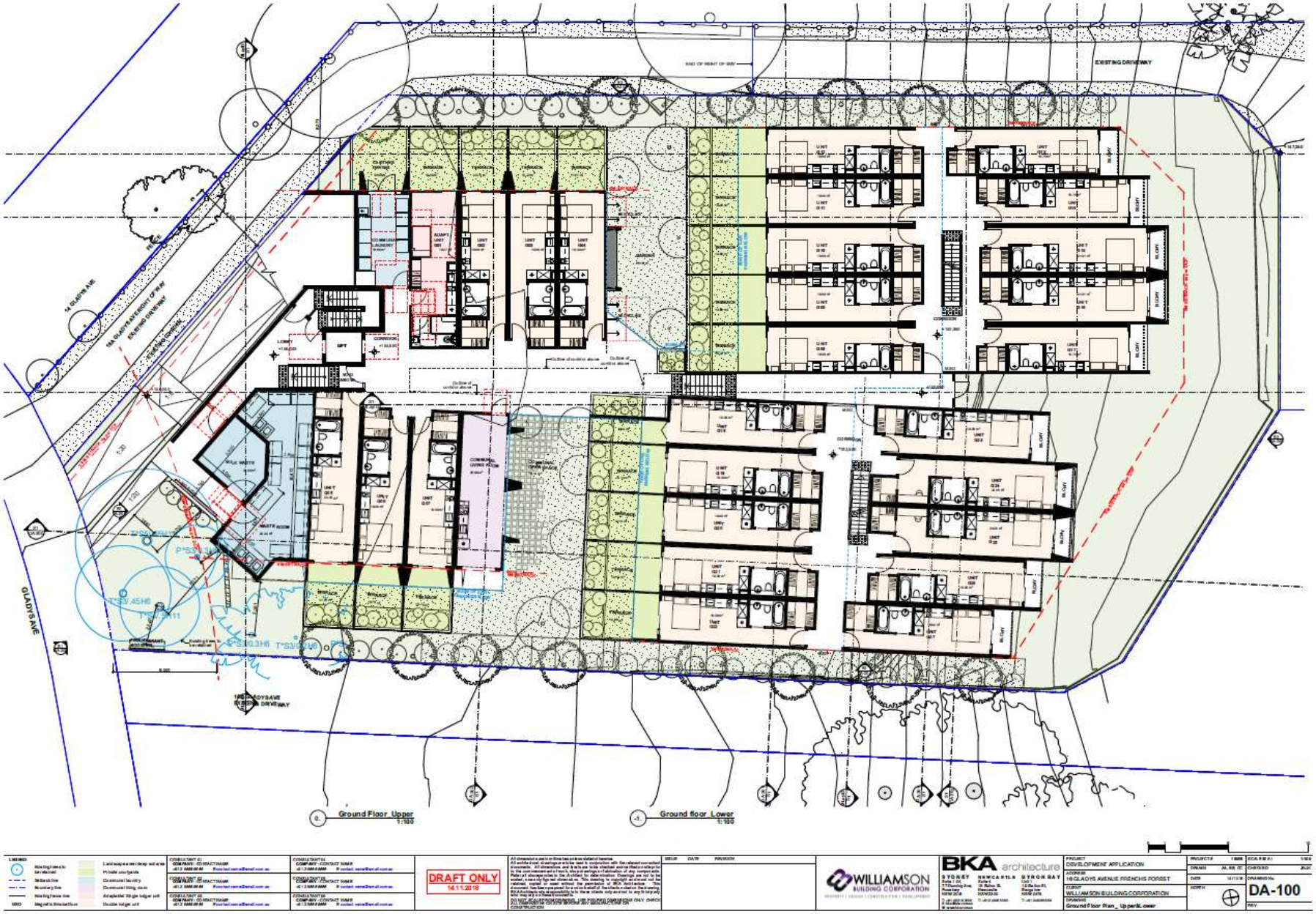

Figure 3.4 – Ground Floor Upper

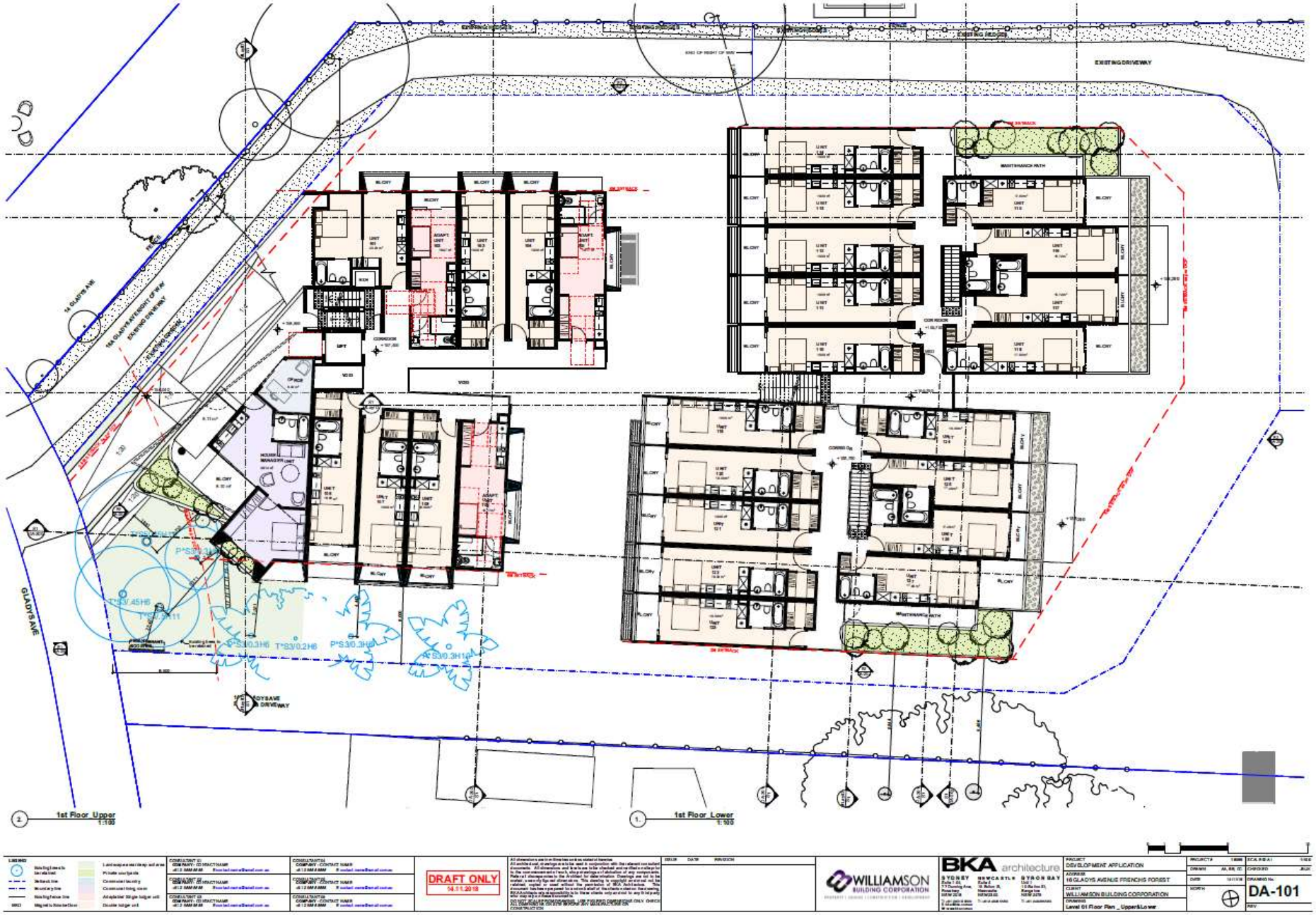

Figure 3.5 – First Floor Upper

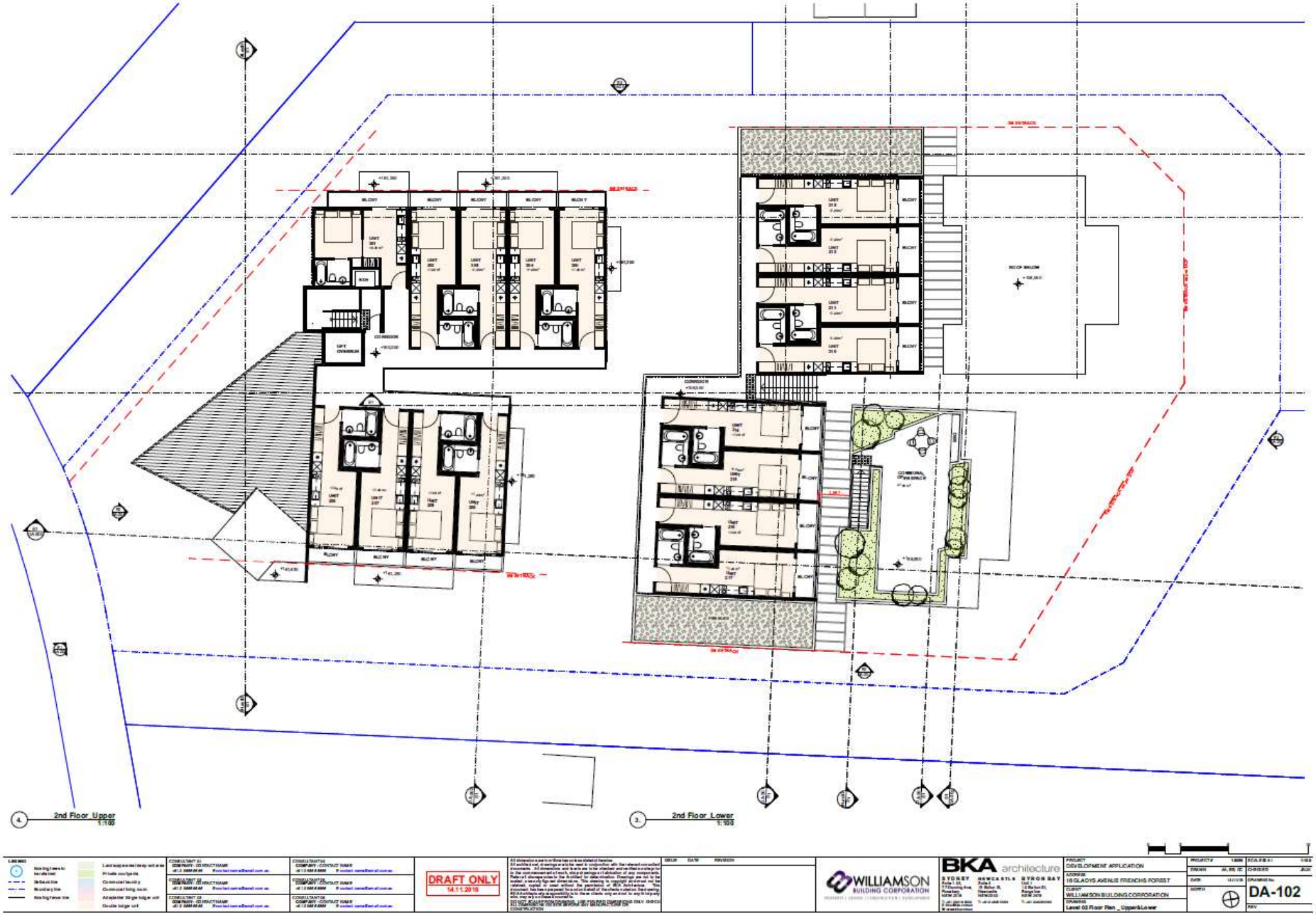

Figure 3.6 – Second Floor Upper

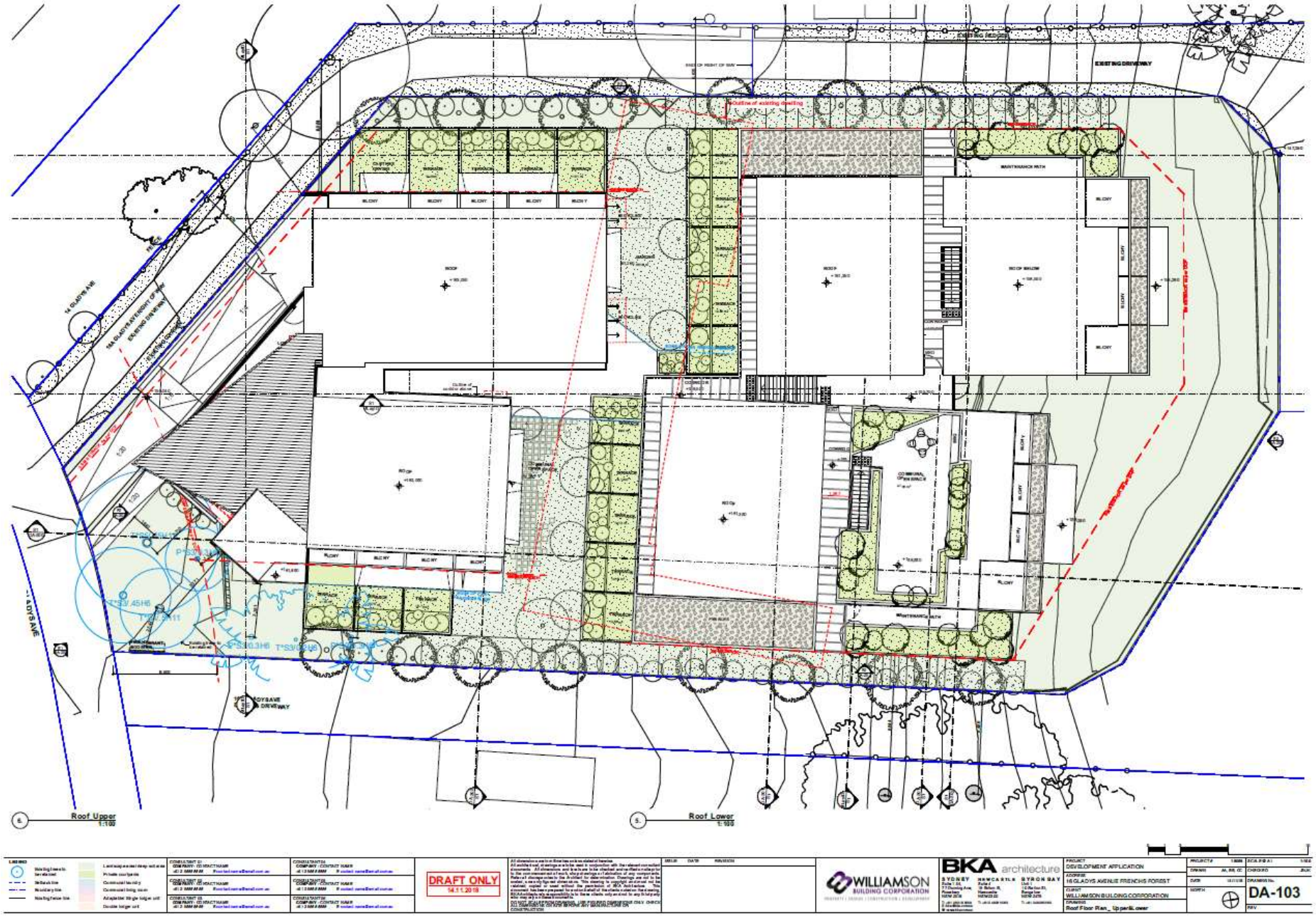

Figure 3.7 – Roof Upper

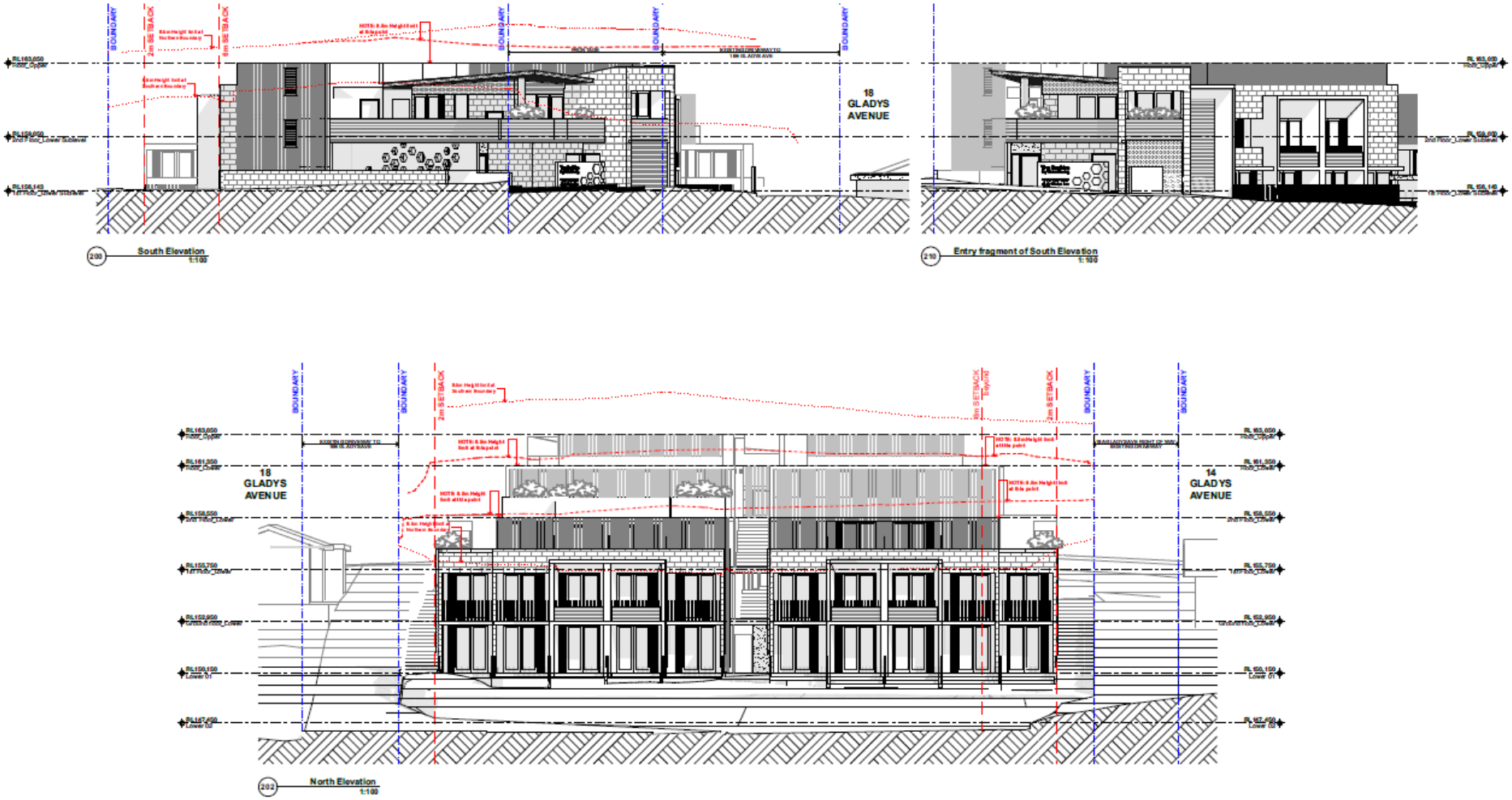

Figure 3.8 – North &South Elevations

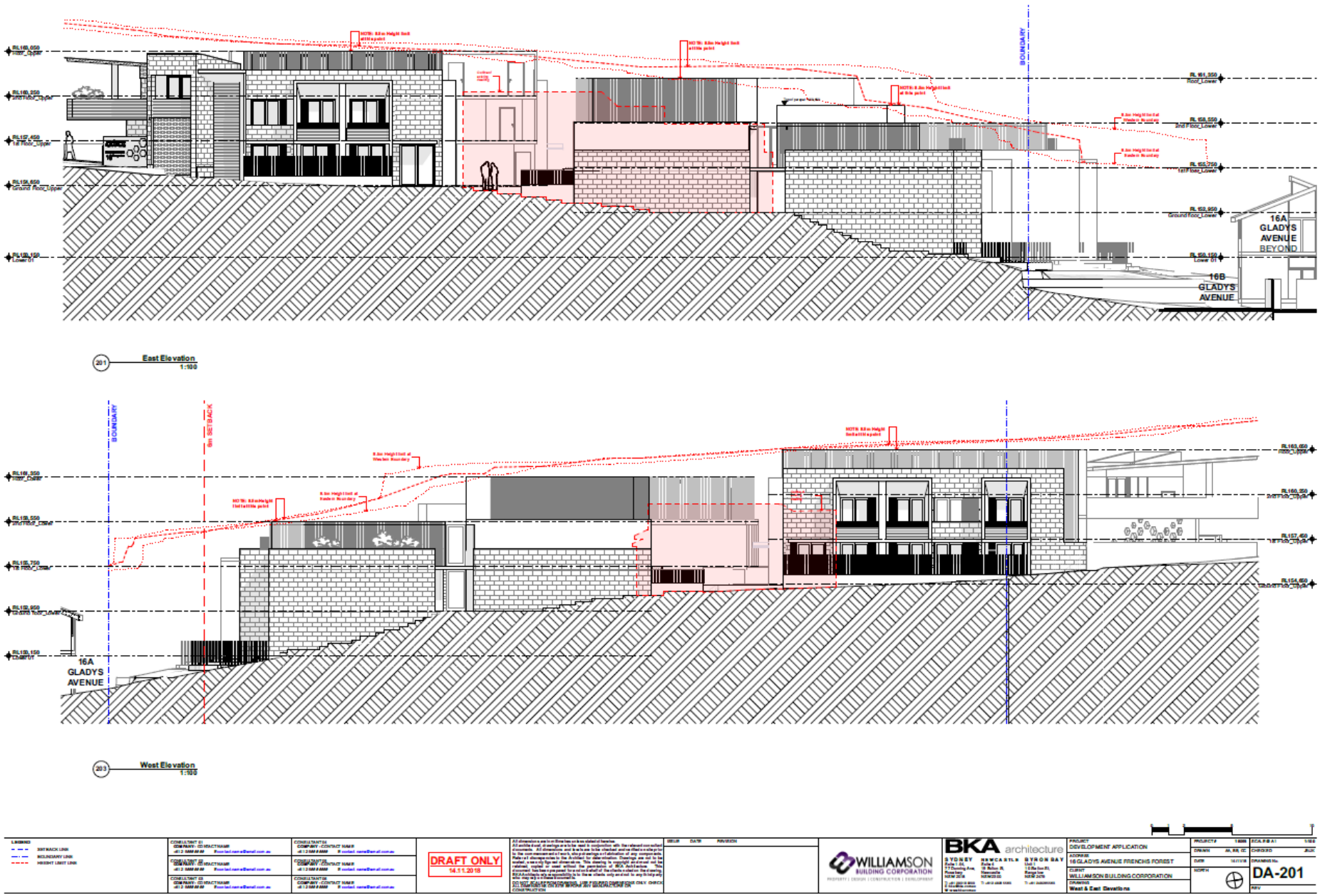

Figure 3.8 – East & West Elevations

Figure 3.9 – Sections

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WILLIAMSON BUILDING CORPORATION

BKA architecture

DEVELOPMENT APPLICATION
16 GLADYS AVENUE FRENCHS FOREST
WILLIAMSON BUILDING CORPORATION
Sections 3 & 4
DA-301

Figure 3.10 – Sections

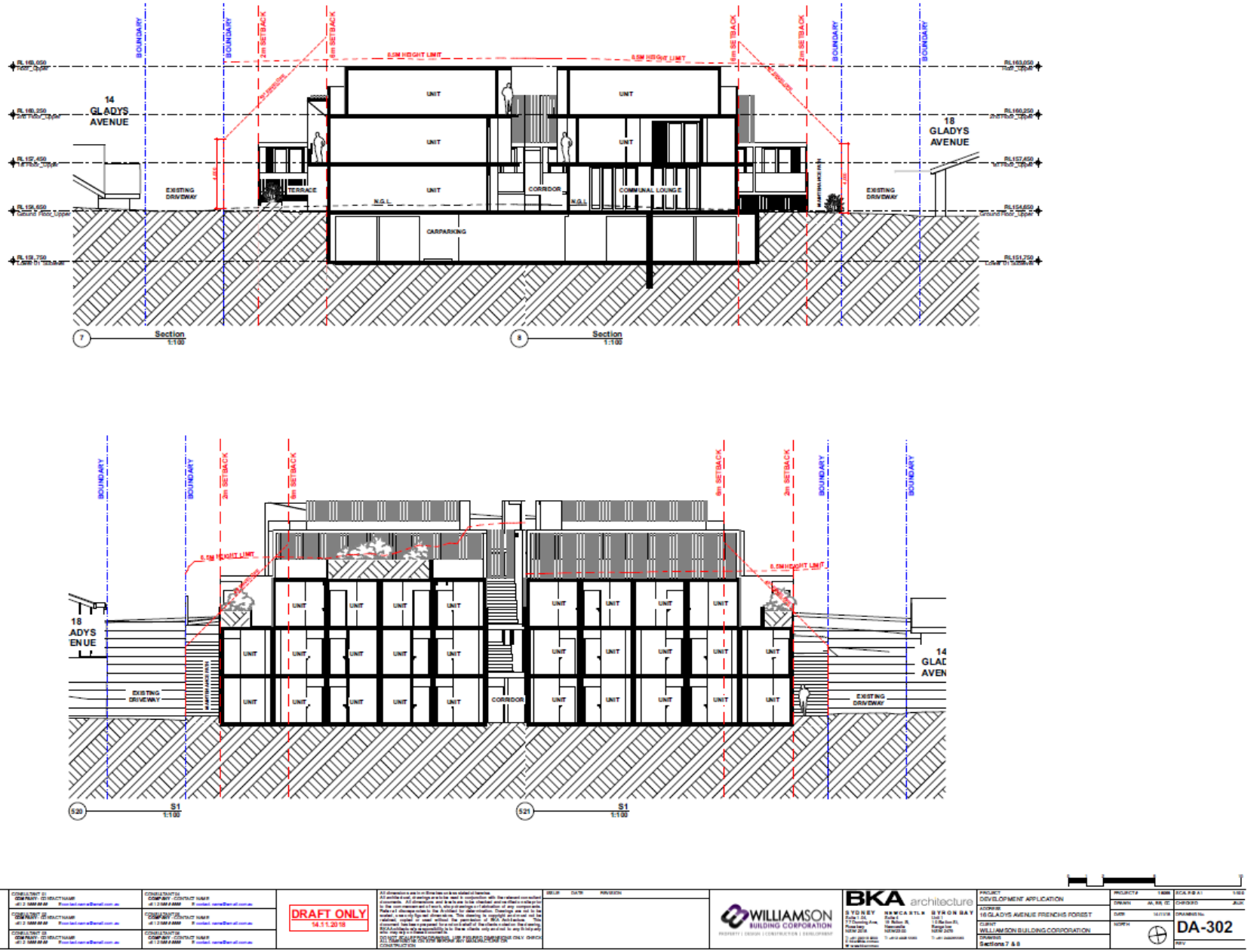

Figure 3.11 – Sections

5 ACOUSTIC ASSESSMENT CONSIDERATIONS

5.1 GENERAL

The review and opinion provided in this report has taken into account all applicable acoustic guidelines and protocols, as detailed below, and has been prepared in accordance with relevant acoustic assessment practices.

5.2 GENERAL ACOUSTIC ASSESSMENT GUIDELINES

The following acoustic assessment and reporting guidelines have been considered:

Noise Guide for Local Government (2009), NSW Office of Environment & Heritage (OEH);

Australian Building Codes Board (ABCB) Regulation Impact Statement (August 2012);

NSW Government Department of Planning Infrastructure SEPP 2007; and

NSW Industrial Noise Policy (1999), NSW Office of Environment & Heritage (OEH).

The requirements of these guidelines have been taken into account in the review and opinion provided.

5.3 NORTHERN BEACHES COUNCIL

Northern Beaches Council's general requirements regarding acoustic privacy in boarding houses in the Frenchs Forest area are set out in the current Warringah Development Control Plan.

Typical requirements include:

i. Locate kitchen, dining room, lounge room and outdoor open space adjacent to or directly accessible from each other;

ii. Locate similar uses (such as bedrooms or bathrooms) back to back, to minimise internal noise transmission;

iii. Provide screen fencing, plantings and acoustic barriers where practicable to screen noise and reduce visual impacts;

iv. Where possible locate the main entry point at the front of the site, away from the side boundary and adjoining properties;

v. Locate communal open space, balconies and windows to bedrooms or communal areas, to minimise overlooking, privacy and acoustic impacts on adjoining properties;
Note: Indicative locational relationships between communal living areas and facilities

5.4 INDUSTRIAL NOISE POLICY

It has been assumed as a basis for this assessment that appropriate noise criteria for the proposed development are specified in the NSW Industrial Noise Policy (INP).

The noise criterion set out in the INP depends on whether existing noise levels in a given area are close to recommended amenity levels for different types of residential receiver, for example whether the receivers in question are urban, rural, near existing roads and so on. In this case, the potential receivers in question appear to be almost exclusively residential in nature.

The requirements of the Industrial Noise Policy have been considered in the preparation of the acoustic review and opinion provided in this document.

5.5 SUMMARY OF TYPICAL ACOUSTIC GUIDELINES & REQUIREMENTS

Taking into account all relevant guidelines, the acoustic conditions that it is considered will be required to be demonstrated in relation to the proposed development are as follows:

The effect of noise from external sources on the boarding house development:

Type of Occupancy	Noise Level	Applicable Time Period
Internal Areas of the Boarding House	Leq, 1hr 40 dBA	Typically
Bedrooms	Leq, 1hr 35 dBA	10:00pm – 7:00am

The effect of noise from the boarding house development on nearby receivers:

Type of Receiver	Noise Level dBA	Applicable Time Period
Site Boundaries	+ 10 dBA (max) versus RBL [1]	During Operating Hours
Nearby Residential Properties	+ 5dBA (max) versus RBL [1]	During Operating Hours

1 RBL = Rated Background Sound Level
2 NSW Industrial Noise Policy

The requirement in relation to the impact of noise associated with the proposed boarding house on nearby residential properties is typically that such noise is not permitted to result in an increase of more than 5 dBA above existing sound levels measured at the boundary between the boarding house development and the nearest residential boundary.

6 ACOUSTIC REVIEW & OPINION

6.1 INTRODUCTION

The acoustic assessment of the proposed development requires consideration of both the impacts that existing environmental sound and noise levels might have on the proposed development and its future residents and occupants, and also the likely acoustic impacts that the development and its associated activities might have on potentially affected individuals, residences and activities.

ACOUSTIC IMPACTS ON THE DEVELOPMENT

Consideration of the impacts of external noise on the proposed development, including actions necessary to ensure that relevant internal sound levels are achieved, is presented in Section 7.3, below.

ACOUSTIC IMPACTS OF THE DEVELOPMENT

Consideration of the acoustic impacts that the proposed development will have on neighbouring premises is presented in Section 7.6, below.

6.2 ESTIMATED BACKGROUND SOUND LEVELS

Rated Background Sound levels (RBL's) provide a very important reference for this acoustic assessment. The significance of RBL's was described in Section 6.2. The adopted RBL's for this assessment, as detailed in Section 6 above, are repeated for convenient reference in Table 6.1, below.

Table 6.1 – Estimated Background Sound Levels

Rated Background Sound Levels for Assessment Purposes	
Daytime:	
LA90	45 – 50 dBA
LAeq	50 – 55 dBA
Night-time:	
LA90	43 – 48 dBA
LAeq	48 – 52 dBA
Night-time:	
LA90	38 – 43 dBA
LAeq	43 – 48 dBA

These rated background levels have been rounded to the first decimal place, and are the highest average parameters recorded during the seven day period of continuous monitoring, on the basis that guideline criteria for sound levels within habitable rooms at the proposed residential development are required to be achieved at all times, and therefore need to take into account the highest background sound levels measured.

6.3 ACOUSTIC IMPACTS ON THE PROPOSED DEVELOPMENT

6.3.1 Indicative Sound Levels

Projected "Internal" Sound Levels – General Indoor Areas

Sound levels within the boarding hose building will be influenced by the ambient external sound levels as indicated by the estimated background sound levels as summarised in Table 6.3, which will be subject to attenuation or reduction by the structural features of the proposed development (refer Figures 3.1 – 3.11).

Acoustic protection to the internal spaces of the proposed centre will be provided by the external masonry structural walls and glazed elements of the building.

Sound Transmission through Structures

The structural elements of buildings (walls, windows, doors etc) reduce the level of sound. The degree of sound reduction varies from material to material.

The weighted sound reduction index (Rw) is the measure used to describe the acoustic performance of the various building elements making up a construction system, as described in 6.1 above.

The Rw rating is measured in decibels (dB) and in effect indicates the reduction that is achieved when noise passes through a given material.

If the noise outside is 70 dB and inside it is 40 dB, the structural element (wall, window, door etc) is said to have an Rw rating of 30.

Structural imperfections mean that this nominal level of noise reduction is not always achieved, and a degree of conservatism is required.

Acoustic Qualities of Solid Walls

Typically, solid form external wall elements have sound reduction (or attenuation) ratings in excess of 35 dBA, and in the case of masonry elements in excess of 45 dBA.

This means that the maximum estimated rated external sound level in this case, which is 55 dBA (refer Table 6.3), can readily be reduced to the desired maximum indoor sound levels of 40 dBA maximum (general areas) and 35 dBA objective maximum (bedrooms) by the effect of external walls, and in the case of internal spaces by the combined effect of external walls and internal structural elements.

A very conservative estimate of 35 dBA for the sound reduction capability of external walls would reduce this maximum daytime estimated external background sound level of 55 dBA to substantially below the required indoor sound levels of 35 dBA (bedrooms) and 40 dBA (other habitable rooms).

External Windows & Doors

The most acoustically “vulnerable” elements of the external building facades are the glazed windows and doors.

Glazed construction elements (windows and doors) provide lower levels of sound attenuation (or reduction) than solid structural elements such as walls.

The indicative acoustic reduction effects provided by various glazing options available for the doors and windows fitted to the facades of the proposed child care centre are shown in Table 6.2, below.

Table 6.2 – Acoustic Attenuation due to Glazing

Glazing Type	Sound Attenuation (Rw) *
10.38 mm laminated	35
6.38 mm laminated	31
10 mm float	33
6 mm float	27
4 mm float	22

* Based on specifications provided by Pilkington Glass

The maximum estimated external background sound level in this case is 55 dBA (refer Table 6.1).

The use of glazing for external windows and doors with minimum acoustic quality equivalent to standard 6 mm float or window glass will readily achieve the level of attenuation or reduction required.

It is assumed that laminated safety glass, which has a higher Rw rating than standard window glass, would be used for safety reasons in any external doors.

To ensure that projected noise reduction or attenuation is achieved by external windows and doors, it is recommended that the window and door frames are sealed into the façade openings using a polyurethane sealant such as "Bostik Fireban One", or equivalent, and that full perimeter acoustic seals equal to Schlegel Q-Lon seals are fitted to all external windows and doors.

6.3.2 Projected Internal Sound Levels

Projected "Internal" Sound Levels – General Areas

On the basis of the external window and door elements described above, sound levels projected to apply in the general indoor areas of the proposed centre, as a consequence of external acoustic influences, are summarised in Table 6.3 below.

Table 6.3 – Forecast Sound Levels: General Internal Areas

Projected Sound Level	Typical Daytime
Rated External Sound Level (RBL)	55 L_{Aeq} (dBA $_{Leq, 1 hour}$)
Less Estimated 20-25 (dBA) Attenuation [1]	-25 (dBA)
Projected Internal Sound Levels	<35 L_{Aeq} (dBA $_{Leq, 1 hour}$)

Note 1: Conservative estimate of sound reduction achieved

Internal sound levels below 35 dBA satisfy relevant acoustic requirements and guidelines.

6.3.3 Road Traffic & Basement Car Park Noise

The maximum estimated external noise level of 55 dBA LAeq (refer Table 6.1) includes the effect of existing environmental noise, including road traffic on Meurants Lane and Wardia Street.

The additional effect of noise generated by vehicles accessing the proposed basement car park areas is considered unlikely to significantly change this measured external noise level, and subject to sensible and normally anticipated driving behavior within the car park, no acoustic impact on the proposed development is anticipated.

6.3.4 Internal Acoustics for Residential Spaces

The following typical considerations are included for reference in relation to internal design and acoustic aspects of the various residential spaces within the proposed development. Construction materials of this type, or equivalent, will achieve the internal acoustic performance required.

WALLS

- All inter-tenancy walls and corridor walls to be constructed to full height to the underside of the floor slab and/or roof.

- Inter-tenancy wall construction to be two rows of 64mm metal studs with a minimum 20mm gap, 2 layers of 75mm thick 11-14kg/m^3 glass wool insulation (or similar), within the cavity, and 1 layer of 13mm thick fire rated plasterboard on the one side and 2 layers of 13mm thick fire rated plasterboard on the other side.

- Corridor wall construction to be staggered 64mm metal studs on a 92mm track with 1 layer of 16mm thick fire rated plasterboard fixed to each side of the track and 110mm thick 11- 14kg/m^3 glass wool insulation (or similar) within the cavity. Internal wall construction around bathrooms to be 13mm fire rated plasterboard on either side of a 64mm stud.

FLOORS

- Floor slab construction (if applicable) to be of minimum 200mm reinforced concrete with density greater than 2200kg/m^3 with suspended plasterboard ceiling below, to achieve an Rw+Ctr in excess of 50.

- The use of resilient hung ceilings (if applicable) is recommended where hard floor finishes are proposed above the slab.

- For carpet floor coverings within all living spaces and bedrooms, the use of standard carpet underlay is expected to meet floor impact isolation requirements.

- Hard floor coverings are proposed for wet areas such as kitchens, bathrooms and laundries. It is recommended that tiles are laid on top of 10mm thick "Embelton ImpactaMat" acoustic underlay (or equivalent).

DOORS

- Entry doors to the apartments shall be a 38-40mm solid core fire rated door with full perimeter acoustic seals, achieving Rw30 and above. Acoustic seals shall be equivalent to "Raven RP10" for the sides and the top and equivalent to "Raven RP38" drop seal at the bottom.

6.3.5 Sound Insulation Rating of Services

Ceilings over wet areas containing hydraulic piping to be constructed from a layer of 13mm thick plasterboard with ceiling cavity filled with 75mm thick 11-14kg/m^3 glass wool insulation.

All penetrations in the ceilings to be acoustically sealed, including any recessed light fittings in the ceiling.

Hydraulic piping contained in ceilings above dry areas to be lagged with "Soundlag 4525C" (or equivalent).

Ceiling to be constructed from a layer of 13mm thick plasterboard with a 75mm thick 11-14kg/m^3 glass wool insulation blanket for 500mm either side of pipe work.

Riser construction within habitable areas to be constructed from 2 layers of 13mm thick fire rated plasterboard on inner layer of a 64mm metal stud and 1 layer of 13mm thick fire rated plasterboard on outer layer, with 75mm thick 11-14kg/m^3 glass wool insulation within riser and wall cavities, with all plasterboard joints to be sealed, and the system to be appropriately reviewed to ensure compliance with fire rating requirements.

Riser construction within wet areas to be constructed from a layer of 13mm thick fire rated plasterboard with 75mm thick 11-14kg/m^3 glass wool insulation within riser cavity.

All plasterboard joints to be sealed and the system reviewed to ensure compliance with fire rating requirements.

6.3.6 Sound Isolation of Pumps

Any point of connection between the service pipes in a building and any pumps (circulation or other) will require a flexible coupling at the point of connection.

6.4 ACOUSTIC IMPACTS OF THE PROPOSED DEVELOPMENT

The proposed development will involve a range of activities that involve the generation of noise, and that therefore have the potential to impact on nearby individuals and activities.

6.4.1 Human Activity

Human activity within the development will result in noise generation, but within normal and reasonable boundaries the magnitude of the resulting sound levels are not considered likely to have a significant impact on neighbouring receivers.

Noise generated by individual residents of the proposed development will be subject to existing regulatory limits and constraints, and any individual issues will be controlled through these mechanisms, as is the case in the community generally.

It is noted that a Management Plan will be prepared and implemented for the boarding house complex, and that Plan will include guidelines for noise minimisation and control.

6.4.2 Mechanical Ventilation or Air Conditioning

Details of the items of mechanical ventilation, air conditioning and other plant and equipment required for the proposed development are not yet available.

It will be a requirement that the acoustic impact (individually and collectively) of plant and equipment installed as part of the development does not exceed 5 dBA above existing background sound levels at any property boundary. It is anticipated that approval of the development will be subject to the appropriate demonstration of such performance at the Construction Certificate and/or Occupation Certificate stage.

Based on the use of plant and equipment items with typical acoustic performance capabilities and considering the proposed layout and structure of the development (refer Figures 3.1 to 3.11), it is our opinion that the requirement for such plant and equipment to have an acoustic impact less than 5 dBA at all property boundaries will be readily achievable.

6.4.3 Mechanical Plant

Mechanical plant associated with the proposed development can have the potential to impact on neighbouring properties.

At this stage of the project, the selection of the type and location of mechanical plant associated with the proposed development has not yet been finalised.

At the detailed design stage of the project the selected plant noise levels will be assessed with respect to established noise criteria.

Should any exceedances of established noise criteria be indicated, it is envisaged that standard noise control measures will be adopted to ensure that the acoustic amenity of nearby residences is maintained.

Indicative engineering treatment methods that can be adopted in such circumstances include:

- Appropriate and judicious positioning of plant and equipment behind built elements to provide acoustic shielding;
- The use of acoustic screens/enclosures if required;
- The use of silencers; and
- The use of acoustically lined ductwork.

The following summary of strategies for the management of noise emissions from typical mechanical plant items associated with a residential boarding house development of the type proposed is provided as a general guideline, based on previous professional experience.

> **Kitchen supply and exhaust fans:** These fans would typically be housed within a mechanical riser or located on the rooftop. These fans typically incorporate acoustic treatment being duct lining to the intake and discharge, use of silencers and/or acoustic louvers. The required treatment will be determined at the detailed design stage.
>
> **Toilet exhaust fans:** These fans would typically be housed within a mechanical riser or located on the rooftop. These fans typically incorporate acoustic treatment being duct lining to the intake and discharge, use of silencers and/or acoustic louvers. The required treatment will be determined at the detailed design stage.

Accordingly, it our conclusion that with appropriate acoustic treatment, if required, items of mechanical plant as detailed above can be designed to comply with relevant mechanical plant noise objectives .

It is noted that the control and management of noise associated with mechanical plant will be required to consider potential impacts on both potential receivers external to the proposed development, and on the of the residential and retail spaces within the proposed development itself.

6.4.4 Balconies

Units throughout the proposed development will include external balconies (refer Figures 3.1 to 3.11).

It is noted that balconies facing site boundaries are small and generally a minimum of 6 metres away from boundaries.

Prospective noise generated by "normal and reasonable" activity on balcony areas is considered very unlikely to impact on nearby receivers.

To further assist in ensuring that noise generated on balcony areas does not unduly impact on neighbouring residents, and on other units within the proposed development, it is recommended that normal and prudent acoustic design and construction practices apply, as indicated in Figures 3.1 to 3.11, including:

1. Glass or other solid form wall structures and solid form balustrades to terraces wherever feasible; and

2. Solid form blades or end walls to balconies.

Appropriate guidelines regarding noise generation on balconies should be provided in the Management Plan for the boarding house complex, to help ensure that any undue acoustic impacts are avoided.

6.4.5 Communal Open Space

It is noted that communal open space will be provided in the centre of the site between the front and rear buildings (refer Figures 3.1 to 3.11).

In acoustic terms, this means that typical noise levels generated in this area and from reasonable communal activities will be effectively contained and attenuated by the bulk of the surrounding building structures, and that the resulting acoustic impact at adjoining residential property boundaries will comply with the requirement that such impact will not exceed prevailing the existing background LA90 sound environment by more than 5 dBA.

6.4.6 Rooftop Communal Area

It is also noted that communal open space will be provided on the building roof area.

This communal space will be screened by landscaping and will be more than 9 metres away from any site boundary. On this basis, sound generated by normal and reasonable interaction and activities within this communal area will comply with the requirement that such impact will not exceed prevailing the existing background LA90 sound environment by more than 5 dBA.

Appropriate guidelines regarding noise generation in this area, as in the case of noise generation from balconies near property boundaries, should be provided in the Management Plan for the boarding house complex, to help ensure that any undue acoustic impacts are avoided.

6.4.7 Impacts at the Nearest Residential Boundaries

The proposed development will be adjoined by residential properties to the east, west and north. As indicated above, it is required that any noise generated by activities within the proposed development will not result in an increase of greater than 5dBA in the existing background LA90 measure (the existing background in the absence of road traffic noise) at the nearest residential receiving boundary.

Adjoining residential receivers will be protected from noise impact by the various measures and consideration detailed in 6.4.1 to 6.4.6 above.

In addition, the measures described in Section 6.3 of this report that are required to ensure that indoor noise levels no greater than 35 dBA in bedroom at night, and no greater than 40dBA in other habitable rooms at any time, will also provide an acoustic environment that will ensure that no adverse or non-compliant acoustic impacts will be imposed on neighbouring residential properties by noise generated by normal and reasonable activities within the proposed boarding house development.

6.5 CONSTRUCTION & DEMOLITION NOISE

This review and opinion addresses the likely acoustic impacts that will be associated with the proposed boarding house development in an ongoing sense.

It deals with the sound levels that are required to be achieved in the bedrooms and other habitable rooms within the development; indicates what measures are required to ensure that these sound levels can be achieved and confirms that these required sound levels can be achieved.

The assessment also considers the noise or acoustic impacts that the development will have on neighboring receivers, and confirms that these impacts will comply with relevant acoustic guidelines.

The proposed development, if approved, will also involve demolition and construction phases, which will be required to comply with appropriate noise control guidelines.

While demolition and construction noise are fall outside the scope of this assessment, appropriate noise management plans and controls, in accordance with guidelines established by Northern Beaches Council and others, will need to be developed and applied, and this requirement can be expected to be a normal condition of the approval of any successful Development Application.

6.6 KEY FINDINGS

The key findings of this acoustic review are that, subject to the implementation of the various recommendations included in this report, and with the plans and drawings provided in Figures 3.1 to 3.11:

- Sound levels within the various residential spaces associated with the proposed development will comply with relevant acoustic requirements, including in particular the requirement that sound levels no greater than 35 dBA will be achieved in all bedrooms during the 10:00pm to 7:00am night-time period, and sound levels no greater than 40 dBA will be achieved in all habitable rooms within the development, at all times; and

- The proposed development will have no unreasonable, adverse or non-compliant acoustic impacts on any nearby residential receivers.

7 OVERALL SUMMARY

This report presents a review and provides a professional opinion regarding acoustic performance and compliance associated with a proposed residential boarding house development at 16 Gladys Avenue Frenchs Forest NSW. The assessment has been undertaken and the resulting opinion provided in accordance with relevant acoustic requirements, standards and guidelines. Based on the review undertaken, the key aspects of my professional opinion are summarised below.

Regarding the Impacts of External Noise on the Development:

1. **General Acoustic Environment:** The general acoustic environment at the proposed development site has been considered, and background sound level ranges estimated based on limited but targeted measurements. The background acoustic environment is relatively quiet, and not unduly impacted by external noise sources such as traffic noise;

2. **Noise Levels within the Boarding House:** Taking into account the range of external LAeq noise levels, which are the noise levels which include environmental impacts such as traffic noise, and carefully considering the acoustic qualities of both the design and construction materials associated with the proposed development, and noting the specific comments and advice provided in Section 6 above, it is my professional opinion that sound levels within the various residential spaces associated with the proposed development will comply with relevant acoustic requirements, including in particular the requirement that sound levels no greater than 35 dBA will be achieved in all bedrooms during the 10:00pm to 7:00am night-time period, and sound levels no greater than 40 dBA will be achieved in all habitable rooms within the development, at all times;

3. **Acoustic Compliance within the Development:** On the above basis, it is concluded that internal acoustic performance associated with the development will comply with relevant acoustic guidelines and requirements.

This Opinion Assumes:

4. **BCA Requirements:** That relevant Building Code of Australia (BCA) and other internal acoustic design and construction considerations, including but not limited to those summarised in Section 6.3.4 and Appendix A of this report, are applied to all aspects of the construction of the various residential spaces within the proposed development;

5. **Plant & Equipment:** That any mechanical plant and equipment required for the development will be specified and/or designed and installed such that acoustic noise emissions are consistent with the internal acoustic environments required, and that any penetrations from ductwork and/or pipework will not reduce the acoustic performance of other building design features;

6. **Management Plan:** hat an appropriate management Plan for the proposed development is prepared and implemented, and that the Plan includes appropriate guidelines for noise management and minimisation on balconies throughout the development, and for the rooftop communal area;

7. **Acoustic Certification:** That appropriate certification and validation of the acoustic performance of plant and equipment associated with the proposed development is provided prior to construction, and prior to occupation, as reasonably required; and

8. **Demolition & Construction Noise Management Plan:** That noise management and control plans will be developed and applied to the demolition and construction phases of the proposed development, in accordance with established procedures and practices.

Regarding the Impacts of the Development on Others:

9. **Noise Impacts on Adjoining residential Premises:** Potential impacts from noise associated with a wide range of potential sources associated with the proposed development have been carefully considered. Subject to the comments and advice contained in Section 6 above, it is my opinion that such impacts will not be undue, unreasonable or offensive, and will comply with the requirements of all relevant acoustic guidelines and protocols;

8 AUTHORISATION & LIMITATIONS

NG Child & Associates has based this report on the data, methods and sources described herein.

It should be noted that all materials or material types mentioned in this report have been suggested solely based on acoustic performance. Any other properties of these materials, including fire rating and chemical properties should be checked with the suppliers or other specialised bodies to ensure fitness for non-acoustic purposes.

Specific structural requirements should be subject to specialist structural engineering advice.

Subject to the limitations described within the report, it is the view of NG Child & Associates that this report presents an accurate and reliable assessment of the acoustic environment applicable at and in the immediate vicinity of the residential boarding house development proposed for 16 Gladys Avenue Frenchs Forest, NSW.

The information presented in this document has been prepared by NG Child & Associates exclusively for the use of the Williamson Building Corporation, and for submission to Northern Beaches Council and others as required in relation to the proposed development.

This document should not be used for any purposes other than those of Williamson Building Corporation in relation to the development described in this report.

Noel Child BSc (Hons), PhD, MIEA, MRACI
Visiting Fellow, Engineering
University of Technology, Sydney
Principal, NG Child & Associates

23 November 2018

9 CONTACT DETAILS

We would be pleased to provide any further information required, or to answer any questions regarding any of the matters raised in this preliminary advice.

Contact details for NG Child & Associates are as follows.

NG Child & Associates:

Principal:	Noel Child
Address:	22 Britannia Road, Castle Hill NSW, 2154
Telephone:	61-2-9899-1968
Facsimile:	61-2-9899-1797
Mobile:	0409-393-024
E-mail:	ngchild@canda.com.au

APPENDIX A

Building Code of Australia (BCA)
Summary of Internal Acoustic Requirements

Building Code of Australia (BCA)
Summary of Internal Acoustic Requirements

The Building Code of Australia (BCA) nominates various ratings for airborne noise isolation and impact noise isolation. The ratings and abbreviations used are as follows:

Rw – Weighted sound reduction index. The Rw is a typical measure for the sound insulation performance for a wall or floor system in a laboratory. The Rw in the BCA is used for the selection of appropriate construction systems.

Rw+Ctr – Weighted sound reduction index with spectrum adaptation term. The Rw+Ctr is the weighted sound reduction index with a correction factor Ctr added that helps to quantify the low frequency performance. The Rw+Ctr in the BCA is used for the selection of appropriate construction systems.

DnT,w – Weighted standardised level difference. The DnT,w is a typical measure for the sound insulation performance for a wall or floor system in a laboratory. The DnT,w in the BCA is used for the determination of airborne noise in the field.

DnT,w+Ctr – Weighted standardised level difference with spectrum adaptation term. The DnT,w+Ctr is the weighted standardised level difference with a correction factor Ctr added that helps to quantify the low frequency performance. The DnT,w+Ctr in the BCA is used for the determination of airborne noise in the field.

Ln,w+CI – Weighted normalised impact sound pressure level with spectrum adaptation term. The Ln,w+CI is a typical measure of the impact/structure borne noise between two spaces in a laboratory. A reduction in the Ln,w+CI corresponds to an improvement in impact isolation. The Ln,w+CI in the BCA is used for the selection of appropriate impact isolation systems.

LnT,w+CI – Weighted standardised impact sound pressure level with spectrum adaptation term. The LnT,w+CI is a typical measure of the impact/structure borne noise between two spaces in the field. A reduction in the LnT,w+CI corresponds to an improvement in impact isolation. The LnT,w+CI in the BCA is used for the determination of impact noise in the field.

The ratings used for airborne noise isolation and impact noise isolation are here defined:

FSTC – Field sound transmission class. The FSTC is a typical measure for the sound insulation performance for a wall or floor system in a building.

IIC – Impact isolation class. The IIC is a typical measure of the impact/structure borne noise between two spaces in a laboratory.

BCA sound insulation ratings applicable to this project are listed in Tables A-1 and A-2 below.

Table A-1 Sound Insulation Ratings of Walls and Floors – Class 2 or 3

Situation	Lab	Field	Impact
Apartment wall separating different sole occupancies (Same room-type each side, e.g. habitable adjoin habitable)	50 RW +Ctr	45 DnT,w+Ctr	No
Apartment wall separating a habitable room (not a kitchen) from a bathroom, sanitary compartment, laundry or kitchen in another sole occupancy	50 RW +Ctr	45 DnT,w+Ctr	Yes
Apartment wall separating a stairway, public corridor, public lobby or the like; or part of a different classification	50 RW	45 DnT,w	No
Apartment wall separating a plant room or lift shaft	50 RW	45 DnT,w	Yes
Apartment door to a stairway, public corridor, public lobby or the like	30 RW	25 DnT,w	NA
Apartment floor separating different sole occupancies or a plant room, lift shaft, stairway, public corridor, public lobby or the like; or parts of a different classification	50 RW + Ctr	45 DnT,w+Ctr	-
	62 Ln,w+C1	62 LnT,w+CI	-

Table A-2 Sound Insulation Ratings of Walls Services: Class 1, 2, 3 & 9c

Situation	Lab	Field	Impact
Duct, soil, waste or water supply pipe serving or passing through more than one sole occupancy to a habitable room (not a kitchen)	40 Rw+Ctr	NA	NA
Duct, soil, waste or water supply pipe serving or passing through more than one sole occupancy to a kitchen or non-habitable room	25 Rw+Ctr	NA	NA
Storm water pipe passing through a sole occupancy to a habitable room (not a kitchen)	40 Rw+Ctr	NA	NA
Storm water pipe passing through a sole occupancy to a kitchen or non-habitable room	25 Rw+Ctr	NA	NA

Note: Part F5.6 of the BCA requires a flexible coupling to be used at the point of connection between the service pipes in a building and any pump (not applicable to Class 1 buildings).

The City of Sydney DCP sound insulation ratings applicable to this project are listed in Table A-3 below.

Table A-3 Sound Insulation Ratings of Walls and Floors

Situation	Lab	Field	Impact
Apartment wall separating different sole occupancies (Same room-type each side, e.g. habitable adjoin habitable)	NA	50 FSTC	No
Apartment wall separating a habitable room (not a kitchen) from a bathroom, sanitary compartment, laundry or kitchen in another sole occupancy	NA	55 FSTC	Yes
Apartment wall separating a stairway, public corridor, public lobby or the like; or part of a different classification	NA	50 FSTC	No
Apartment floor separating different sole occupancies (Same room-type each side, e.g. habitable adjoin habitable)	NA	50 IIC	
	NA	50 FSTC	
Apartment floor separating a habitable room (not a kitchen) from a bathroom, sanitary compartment, laundry or kitchen in another sole occupancy	NA	55 FSTC	NA
Apartment floor separating different sole occupancies or a plant room, stairway, public corridor, hall way or the like	NA	50IIC	-

APPENDIX E

Noel Child
Summary of Qualifications, Capability & Experience

1 PERSONAL DETAILS

Full Name: Noel George CHILD
Profession: Consultant in Environmental Assessment and Management
Date of Birth: 6th December 1946
Nationality: Australian
Experience: > 30 Years
Address: 22 Britannia Road, Castle Hill, NSW, 2154
Contact: **Phone**: 61 2 9899 1968 **Fax**: 61 2 9899 1797 **Mobile:** 0409 393024

2 CAPABILITY AND EXPERIENCE - SHORT SUMMARY

Noel Child is a successful and experienced commercial and technical professional with over 30 years' experience in a variety of senior level appointments and assignments, within both the corporate and private sectors, with a particular focus on strategic, infrastructure and environmental applications.

Noel's experience includes senior management at both the State and National levels in the Australian petroleum industry, and a number of senior consultancies for both government and corporate clients. His record reflects the ability to develop and achieve positive commercial outcomes through effective planning and communication; critical and objective analysis; and quality task completion and delivery at both the personal and team level.

His management responsibilities have included transport, environmental, safety, and general operational activities at a national level, while his formal professional training includes strategic management, environmental, engineering and business disciplines. He has undertaken a number of senior corporate appointments with distinction and been successfully involved in the ownership and operation of a major petroleum distribution and marketing company in regional Australia. More recently, working through his own businesses Environment Australia and NG Child & Associates, he has applied his knowledge and experience in the areas of strategic management, infrastructure development, energy and the environment on a consultancy and contractual basis to a number of private and public-sector clients, both nationally and internationally.

Noel has had post-graduate training in several technical and commercial disciplines, and provides specialised teaching input, by invitation, to post graduate engineering and business management courses conducted by the Faculties of Business and Engineering at Sydney's University of Technology. He has strong affiliations with a number of international corporations and agencies and has worked closely with both the regulators and the regulated in a number of aspects of environmental management, assessment and performance. He has also been recognised as an independent expert on engineering, and environmental issues by the Land and Environment Court of NSW.

Noel has a detailed understanding of environmental engineering and associated processes and has specific experience and expertise in the fields of acoustics, air quality, electromagnetic field assessment, electrolysis and stray current assessment, contaminated site assessment, and liquid and solid waste management. He also provides post graduate teaching input on environmental engineering issues to post graduate courses at the University of Technology, Sydney, and La Trobe and Monash Universities in Melbourne.

3 EDUCATION, QUALIFICATIONS AND AFFILIATIONS

BE, PhD (Chemical Engineering), UNSW, Sydney
Master of Business Studies, University of New South Wales, Sydney
B.Sc. (Hons) Applied Chemistry (Environmental), University of Technology, Sydney
Graduate Diploma (Environmental Engineering and Management), UNSW, Sydney
Qualified Environmental Auditor, Standards Australia
Member, Royal Australian Chemical Institute, 1972/2018
Member, Institution of Engineers, Australia, 1972/2018
Member, Clean Air Society of Australia and New Zealand, 1992/2018
Member, Australian Natural Gas Vehicle Council, 1996/2004
Executive Director, Australasian Natural Gas Vehicles Council, 2003/2004
Visiting Fellow, Institute for Sustainable Futures, UTS, 1995/2002
Research Fellow, Faculty of Civil & Environmental Engineering, UTS, 1996/2018
Research Associate, New York Academy of Sciences, 2000/2018

4 RECENT ASSIGNMENTS & EXPERIENCE

Mostyn Copper Group & Australian Turf Club (Current) – Site assessment and validation; Coopers Paddock, Warwick Farm NSW.

Mostyn Copper Group & Lodestone HQ (Current) – Site investigation, acoustic, air quality and electromagnetic field assessments for a child care centre development, Princes Highway and Oak Road, Kirrawee NSW, including work required to achieve a Site Audit Statement conforming the suitability of the site for the proposed child care centre use.

Mostyn Copper Group & Lodestone HQ (Current) – Preparation of Remedial Action Plan and Site Validation Report for a child care centre development in College Street Gladesville NSW.

Kaunitz Yeung Architecture (2016) – Electromagnetic field and air quality assessments of a child care centre development project at 60 Dickson Avenue Artarmon NSW.

Australian Consulting Architects (Current) – Electromagnetic, stray current and electrolysis assessments of development projects a Field Place Telopea; Windsor Road Vineyard; Camden Valley way Horningsea Park and others.

Futurespace/Renascent (Current) – Environmental assessment of proposed child care centre development at Waterloo Road Macquarie park and Cleveland Street Strawberry Hills, including general environmental, acoustic assessment, air quality and electromagnetic field assessment.

Thyssen Transrapid Australia (Current) – Adviser on technical and operational issues associated with the development and construction of a high-speed magnetic levitation train systems within the People's Republic of China, and elsewhere, including electrolysis, electromagnetic and stray field effects.

Trumen Corporation (Current) – Environmental assessment, including acoustic and contamination assessment and certification, of mixed use and child care centre development projects at Waine Street Freshwater, Fitzroy Street Marrickville, and at Huntley Street Alexandria, NSW.

Commonwealth Bank (Current) – Environmental assessment, including general, acoustic, air quality, electromagnetic field and wind impact assessment, of a new child care centre development to be located on Level 2 of Darling Park Power 2, Sussex Street, Sydney.

First Impressions Property – Environmental assessment of a proposed child care centre at Ralph Street Alexandria NSW, including Preliminary (Stage 1) Site Contamination Assessment, and Electromagnetic Field Assessment.

LEDA Holdings – Environmental Assessment of a proposed child care centre at 32 Cawarra Road Caringbah NSW, including general environmental, acoustic, air quality and electromagnetic field assessments.

Universal Property Group (Current) – Environmental assessment of a proposed multi building, multi-level residential development at Garfield Street, Wentworthville NSW, including general environmental, site and soil contamination and preliminary geotechnical assessments.

Gundagai Meat Processors (Current) – Review and enhancement of solid and liquid waste processing and management systems at GMP's Gundagai abattoir, including the on-site treatment of waste streams from meat processing and other operations.

Campbelltown City Council (Current) – Peer review of acoustic assessments submitted to Campbelltown City Council regarding assessment of the acoustic impacts of proposed developments including a major truck maintenance facility and the expansion of Macarthur Square shopping centre, including the conduct of noise measurements.

Brenchley Architects (2009 - Current) – Acoustic assessments of proposed residential and commercial developments at Elizabeth Street Sydney; Spit Road Mosman, Botany Road Waterloo, Cranbrook Street, Botany and Bellevue Hill Road, Bellevue Hill NSW.

BJB Design (2009 - Current) – Acoustic, air quality and odour assessments of residential and commercial developments at Botany Road, Botany and Cranbrook Street Botany.

Bovis Lend Lease (Current) – Environmental assessment of a major development site at Darling Walk, Darling Harbour NSW, including a detailed review of air quality, electromagnetic field and acoustic issues for review by the NSW Department of Planning.

Penrith City Council (2012/13) – Preparation of the Penrith City Council response to the NSW Government Long Term Transport Plan, including consideration of transport and associated environmental issues affecting the Penrith Local Government Area.

Harry Azoulay & Michael Bell Architects (2012) – Assessment of the environmental impacts on and from a proposed child care and early learning centre at Chatswood, NSW. Assessments lodged with and adopted by Willoughby City Council.

Wollondilly Shire Council (2012) – Preliminary environmental assessment and review of the proposed development of a second Sydney airport at Wilton, including a preliminary assessment of acoustic impacts.

White Horse Coffee (2011) – Air quality and odour assessment regarding a boutique coffee roasting and drying operation at 7/3-11 Flora Street, Kirrawee, and NSW.

Sydney Skips & Galaxy Waste (Current) – Environmental assessment of a proposed waste recycling facility to be located on a potentially contaminated site at Stephen Road, Botany, NSW, including a detailed review of all relevant engineering and environmental issues, and the preparation of relevant documentation including assessment reports for review by Botany City Council.

Michael Bell Architects & Clients (2004 to Current) – Assessment of the environmental impacts, including acoustic impacts, associated with various child care centre applications in suburban Sydney, and the Sydney CBD, including the development of plans for the management and control of such impacts.

NSW Roads & Traffic Authority (2004 to Current) – Review of international technologies, systems & applications in relation to the treatment of motor vehicle exhaust emissions and associated air pollution within and discharged from road tunnels, in accordance with the conditions of approval for the M5 East Motorway

Federal Airports Corporation (1995/1996) – Preliminary environmental and ground transport studies for the proposed Sydney West Airport, including consideration of all relevant environmental issues.

Isuzu-GM (2003 to Current) – Representations to Environment Australia and the Department of Transport and regional Services regarding the emission performance standards of Japanese sourced medium and heavy natural gas trucks, with the aim of having the current Japanese emission standard accepted within the Australian design Rule 80 series of vehicle emission standards.

City of Sydney (2005 - 2007) – Assessment of air quality and odour issues associated with a proposed redevelopment of craft studios and associated facilities at Fox Studios, Moore Park, Sydney, and review of air quality monitoring stations in the Sydney CBD area, in part as a basis for monitoring the air quality and potential health cost impacts of transport congestion and modes.

Warren Centre for Advanced Engineering, University of Sydney (2000 to 2003) – Contribution to the report "Sustainable Transport for Sustainable Cities", a major government and private enterprise funded study into the future sustainability of transport in Sydney and adjoining regions, including in particular a review of associated environmental issues. Study received the 2003 Bradfield Award for Engineering Excellence from the Australian Institute of Engineers.

United Kingdom Department of the Environment (1994) – Contribution to the development of revised environmental guidelines for air, soil and groundwater water quality.

United States Environmental Protection Agency (1994) - Contribution to an international team developing strategies for the control and management of air pollution in seven major US cities.

5 CORPORATE EXPERIENCE

NG Child & Associates

- **1992--Present**, Managing Principal - Responsible for all aspects of the conduct of a private engineering and environmental consultancy, including administration, marketing, team coordination and technical and professional delivery.

Western Fuel Distributions Pty Limited, Australia

- **1984-92** Managing Principal. - Responsible for all aspects of the management and development of one of the largest private petroleum distributorships then operating in Australia, with a peak annual sales volume of 70 million litres, turnover of $30 million per annum, a direct staff of thirty, and a network of some 40 retail and wholesale agency outlets. This position included direct personal accountability for all aspects of storage, distribution and environmental performance.

Caltex Oil Australia Limited

- **1982-84** General Manager, Marketing and Operations. Responsible for the management and operation of Caltex Australia's marketing, storage, warehousing, distribution, environmental and safety functions, including seaboard terminal and marine operations.
- **1980-82** National Consumer Marketing Manager. Responsible for Caltex Australia's national consumer, industrial and distributor marketing activities.

Golden Fleece Petroleum Limited

- **1977 - 1980** Manager Operations, NSW. Responsible for the overall management of the distribution, warehousing, seaboard terminal and lubricant production activities of Golden Fleece Petroleum in New South Wales, including environmental, occupational health and safety matters.

Esso Australia Limited

- **1976-77** SA Manager, Marketing and Operations. Responsible for all aspects of the management of Esso's petroleum, lubricant and LPG storage, distribution and marketing throughout South Australia.
- **1975-76** Refinery Manager. Responsible for all engineering, operational and environmental aspects of the joint Esso/Mobil refinery at Port Stanvac in South Australia.
- **1975** Manager, Process Operations, Port Dixon Refinery, Malaysia. Six-month special assignment at the Esso Petroleum Refinery, Port Dixon, Malaysia.
- **1971-75** Senior Analyst, Logistics and Corporate Strategy Departments, Esso Sydney Head office.

6 SOME REPORTS & PUBLICATIONS

- **High Speed Rail – Benefits for the Nation,** Keynote address at the UNSW Institute of Environmental and Urban Studies International High-Speed Rail Seminar, August 2013.
- **High Speed Trains in Australia: Connecting Cities and Energising Regions**; with the Hon Peter Nixon AO, October 2010.
- **Sydney's High Residential Growth Areas: Averting the Risk of a Transportation Underclass**, World Transport & Environmental Forum, Reims France, June 2006.
- **The M5 East Road Tunnel: Implications for Ventilation, Air Quality and Emission Treatment Systems**, International Road Transport and Tunneling Forum, Graz Austria, May 2006.
- **Transport Fuels in Australia: The Folly of Australia's Increasing Reliance on Imported Crude Oil**, Submission to the Australian Senate Rural and Regional Affairs and Transport Committee Inquiry into Australia's Future Oil Supply and Alternative Transport Fuels, February 2006.
- **The Japan 2003 CNG Emission Standard & the Emission Performance of the Isuzu 4HF-1-CNG: The Case for Acceptance under ADR80**. Submission on behalf of Isuzu GM Australia to the Commonwealth Department of Transport and Regional Services, June 2004.
- **M5 East Freeway: A Review of Emission Treatment Technologies, Systems and Applications**, NSW RTA and NSW Department of Planning, April 2004.
- **Future Directions: Challenges & Opportunities in the Australian CNG Vehicle Industry**, ANGVC, December 2002
- **High Speed Rail in Australia: Beyond 2000** (with the Hon Peter Nixon), November 2000
- **Review of Options for the Treatment or "Filtration" of Tunnel Gases and Stack Emissions**, City of Sydney. January 2003
- **A Comparative Analysis of Energy and Greenhouse Performance: Austrans Ultras Light Rail System**, Bishop Austrans Limited, January 2003
- **Engineering and Environmental Aspects of Enclosing the Cahill Expressway Cutting**, City of Sydney, May 2001.
- **M5 East Motorway: Proposed Single Emission Stack at Turrella – Review of Air Quality Impacts and Consideration of Alternative Strategies**, Canterbury City Council, February 1999

7 PERSONAL & PROFESSIONAL REFERENCES

- The Hon Peter Nixon AO, Former Federal Transport Minister
- John Black, Professor Emeritus of Civil & Transport Engineering, University of NSW
- Mr Stephen Lye, Development Manager, Trumen Corporation, Sydney.
- Mr Peter Han, Project Director, Commonwealth Bank, Sydney
- Mr Michael Bell, Principal, Michael Bell Architects, Sydney.
- Mr Barry Babikian, Brenchley Architects
- Mr Luke Johnson, Assistant General Manager, Wollondilly Shire Council
- Mr Bernie Clark, Chief Executive, Thyssen Australia
- Mr Alan Ezzy, Former Chairperson, NSW Flood Mitigation Authority.
- Professor Vigid Vigneswaran, Faculty of Civil & Environmental Engineering, University of Technology, Sydney.
- Mr Merv Ismay, General Manager, Holroyd City Council, Sydney NSW
- Dr Jack Mundey, Past Chairman Historic Houses Trust, Environmentalist
- Alex Mitchell, Journalist

Noel G Child
23 November 2018

ATTACHMENT A
Client Reference List

Acre Woods Childcare Pty Ltd
Australian Commonwealth Environmental Protection Agency
Australian Consulting Architects
Australian Federal Airports Corporation
Australian Federal Department of Transport and Regional Development
Bovis Lend Lease
Brenchley Architects
Campbelltown City Council
Canterbury City Council, Sydney, NSW
Commonwealth Banking Corporation
Environment Protection Authority of NSW
Exxon Chemical
Fairfield City Council, Sydney, NSW
First Impressions Property
FreightCorp, Sydney, NSW
Futurespace
GM - Isuzu
Guangxi Environment Protection Bureau
Gundagai Meat Processors
Hong Kong Department of the Environment
Hornsby and Ku-ring-gai Councils, Sydney, NSW
Kaunitz Yeung Architecture
LEDA Holdings
Lodestone HQ
Michael Bell Architects
Minter Ellison
Mobil Oil Australia Associated
Mostyn Copper Group
NSW Roads & Traffic Authority
Ove Arup & Partners
Qantas Airways
Queensland Ports Corporation
Renascent
Salibeau Pty Ltd
Shell Australia
Sinclair Knight Merz
Skouras and Mabrokardatos
Southern Sydney Regional Organisation of Councils (SSROC)
State Rail Authority of NSW
Stephen Davidson Property Investments
Sydney Skips & Galaxy Waste
The City of Sydney
The Western Sydney Alliance of Mayors
Thyssen Krup Transrapid Australia
Tom Howard QC
Trumen Corporation
UK Department of the Environment
United States Environment Protection Agency
University of Technology, Sydney
Warren Centre for Advanced Engineering, University of Sydney
Waverley Council, Sydney, NSW
Western Sydney Parklands Trust
Wollondilly Shire Council