24 May 2021

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Bathla Investments Pty Ltd
Universal Property Group P/L
T/as Bathla Investments
PO Box 270
Wentworthville NSW 2145

Attention: Emma Fleming

Dear Emma

230-232 Grange Avenue & 1032 Richmond Road, Marsden Park
Cross Ventilation Assessment - Lot 8 - Letter of Advice

SLR Consulting Pty Ltd (SLR) has been engaged by Bathla Investments Pty Ltd to qualitatively assess the natural ventilation potential of the proposed Lot 8, for the residential development at 230-232 Grange Avenue & 1032 Richmond Road, Marsden Park. This assessment forms part of the Development Application to the City of Blacktown Council.

Specifically, this report is concerned with the potential for units utilising highlight windows and skylights to comply with natural ventilation requirements proposed within the ADG.

Natural Ventilation via Highlight Windows

Upon assessment, SLR is of the opinion that provided slots are appropriately sized to allow natural airflow through apartments without risk of air becoming trapped and not circulating out of designated slots. In addition, SLR is of the opinion that highlight windows are capable of sufficient airflow dependant on the effective open area. In order to meet a suitable minimum air change volume for the proposed apartments, SLR recommends that all highlight windows used for natural ventilation purposes have an effective open area no less than 1 m^2.

Natural Ventilation via Clerestory Windows

SLR is of the opinion that apartments with operable clerestory windows can provide appropriate natural ventilation to living areas. SLR would recommend that any clerestory components used have openings to all four sides, as this would best maximize the negative pressure experienced and aid natural ventilation.

SLR utilised drawing set DA 007 – DA 014 along with elevations and sections DA 015 – DA 016, provided 20 May 2021 to review the proposed site for natural ventilation potential.

Yours sincerely

JAMES CLEARY
Senior Project Consultant

Checked/ Authorised by:
Neihad Al-Khalidy

1 Site and Surrounds

The proposed site is located to the north west of Sydney near the corners of Richmond Road and Grange Avenue. The surrounds of the site are predominantly open currently, with there being some more densely populated residential housing to the north west.

Figure 1 Site Location

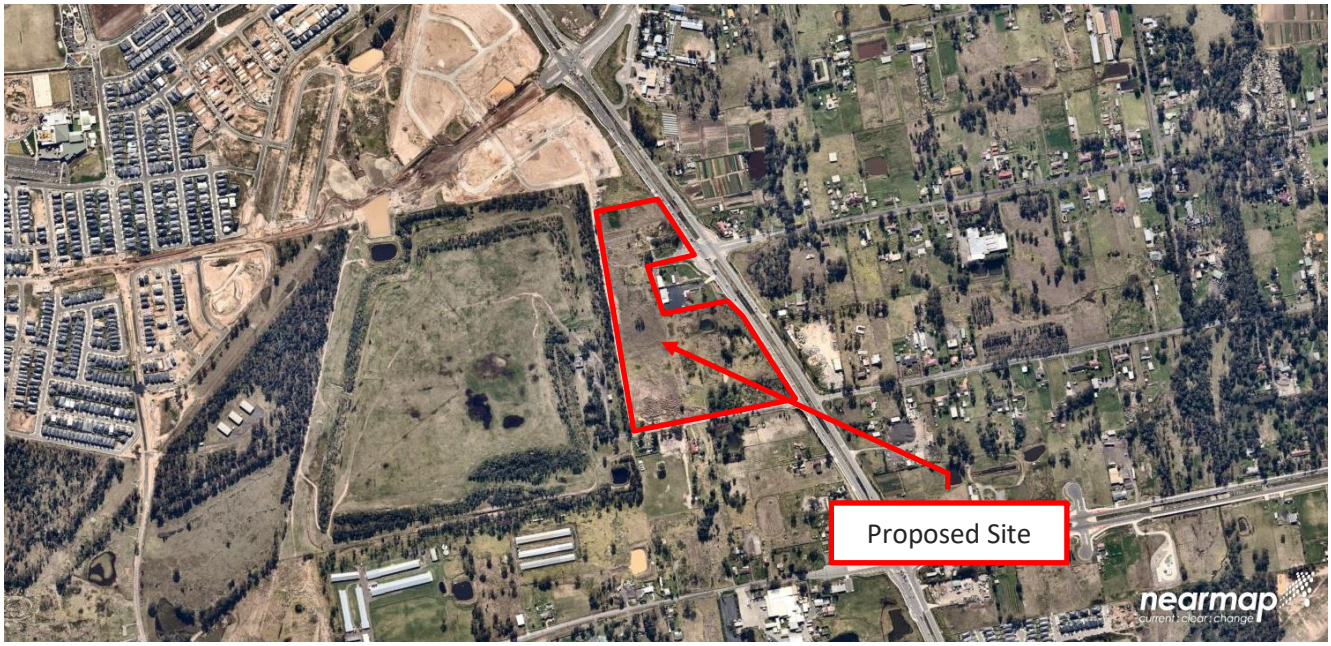
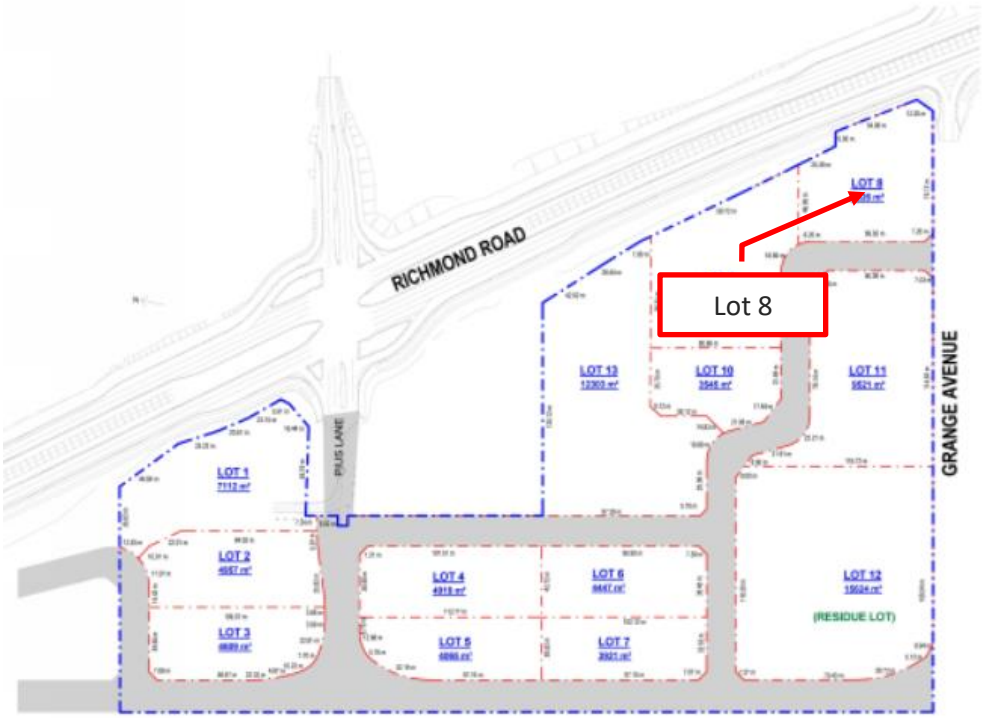


Image: Nearmap, 3 August 2020

Figure 2 Site Subdivision Plan



2 Apartment Design Guide Requirements

The State Environmental Planning Policy (SEPP) 65 supported by the Apartment Design Guide is relevant to the assessment of the natural ventilation through residential components of proposed development. Section 4B-3 of the Apartment Design Guide states that:

At least 60% of apartments are naturally cross ventilated in the first nine storeys of the building. Apartments at ten storeys or greater are deemed to be cross ventilated only if any enclosure of the balconies at these levels allows adequate natural ventilation and cannot be fully enclosed.

The following points from the design guide are also noted.

- Overall depth of a cross-over or cross-through apartment does not exceed 18m, measured glass line to glass line.
- Natural ventilation to single aspect apartments is achieved with a light well or stack effect ventilation (or similar) or courtyards or building indentations have a width to depth ratio of 2:1 or 3:1 to ensure effective air circulation and avoid trapped smells.
- In cross-through apartments external window and door opening sizes/areas on one side of an apartment (inlet side) are approximately equal to the external window and door opening sizes/areas on the other side of the apartment (outlet side).

There are no specific requirements (eg air changes per hour) in the ADG guideline.

AS1668.2-2002 “The use of ventilation and air-conditioning in buildings Part 2: Ventilation design for indoor air contaminant control (excluding requirements for the health aspects of tobacco smoke exposure)” recommends 3 air changes per hour for habitable rooms to satisfy the air quality requirements.

3 Natural Ventilation

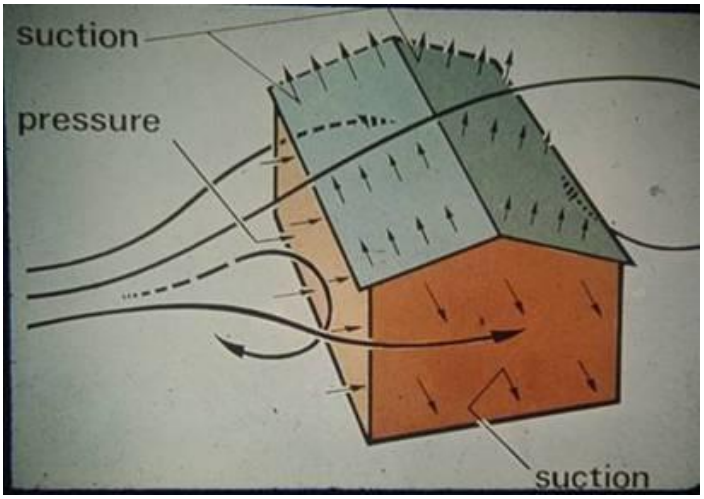
3.1 General Principles

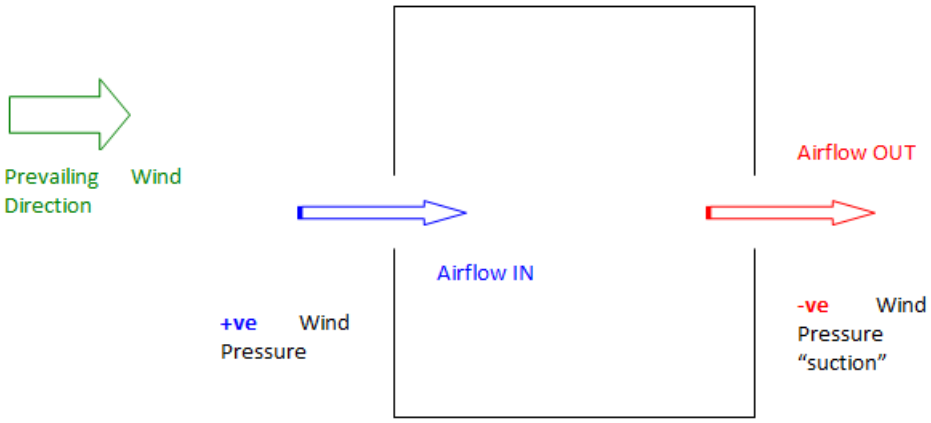
A key feature of the proposed development is the incorporation of façade openings designed to enable various spaces within the development buildings to make use of wind–induced natural ventilation throughout the year thereby minimising energy costs.

Wind-induced natural ventilation works on the straightforward principle of differential pressure. If a building envelope has multiple openings and there exists a pressure difference between those openings, e.g. the wind pressure at one opening is greater than the pressure at the other opening; airflow will be pushed through the building in the direction positive to negative.

The resulting amount of airflow through the building envelope will be a function of the magnitude of the pressure differential, size of the various building openings and degree of "blockage" in between. These features are illustrated in **Figure 3**.

Figure 3 Wind-Induced Natural Ventilation via Differential Pressure





4 Assessment of Natural Ventilation Potential

From the provided plans there are a significant number of apartments that will comply with the ADG guidelines.

Additionally, Recesses and articulations proposed for the development, while not within the outlined width to depth ratio of the ADG, can provide appropriate conditions for natural ventilation. SLR has found that numerical solutions including Computational Fluid Dynamics (CFD) and wind tunnel studies can prove these apartments to provide appropriate through apartment ventilation and circulation, for natural ventilation requirements. These slots and façade articulations create pressure differences across the various facades and encourage cross ventilation through an increased number of apartments.

SLR has assessed the proposed developments potential to achieve natural ventilation to apartments through highlight windows connected to building slots.

4.1 Natural Ventilation Potential using Highlight Windows

Apartments within common levels of Lot 8 which are designed with highlight windows to slots are identified in **Figure 4**. **Figure 5** shows the typical highlight windows provided to proposed apartments.

Figure 4 Apartments Utilising Highlight Windows – Lot 8 Common Level

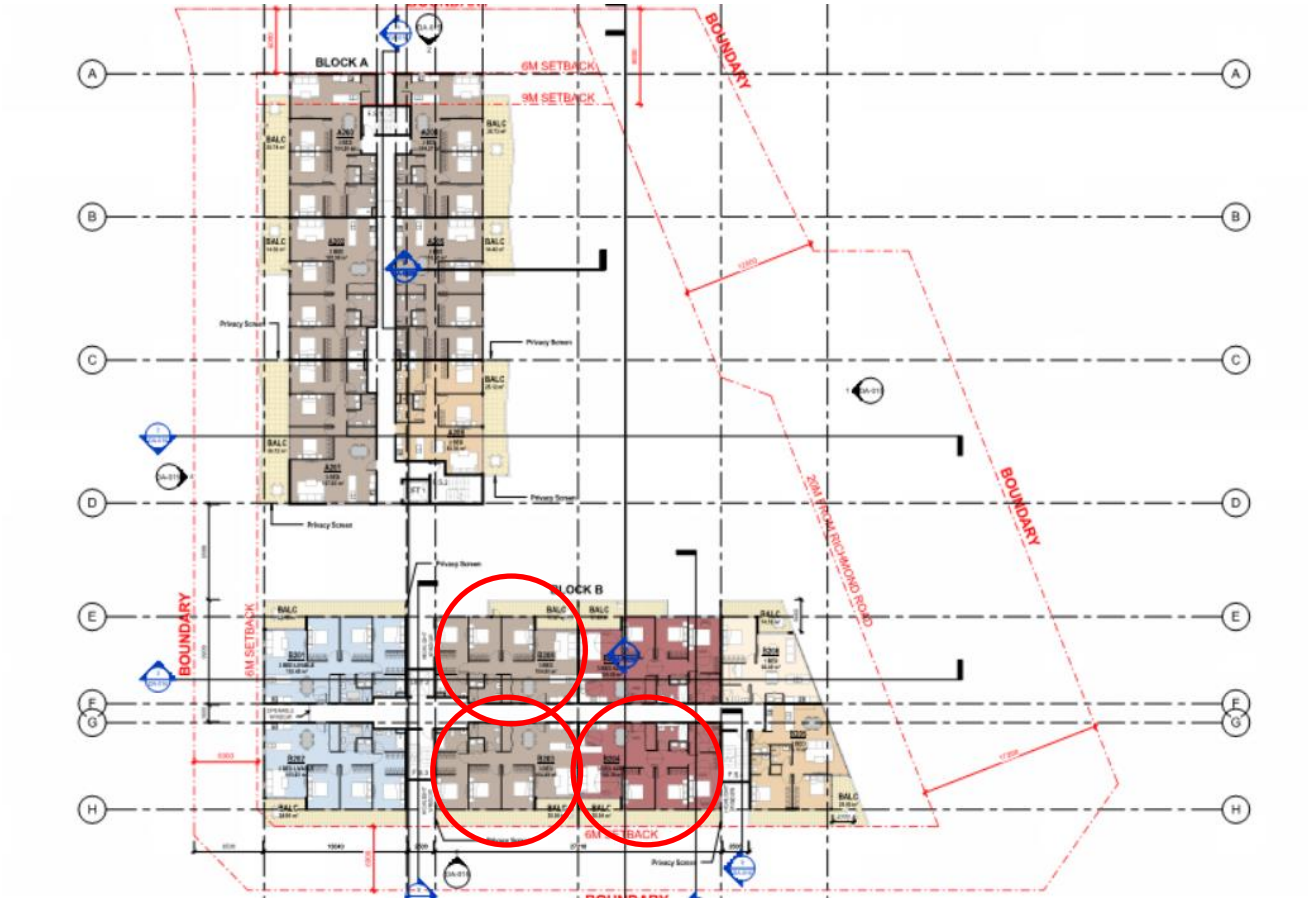
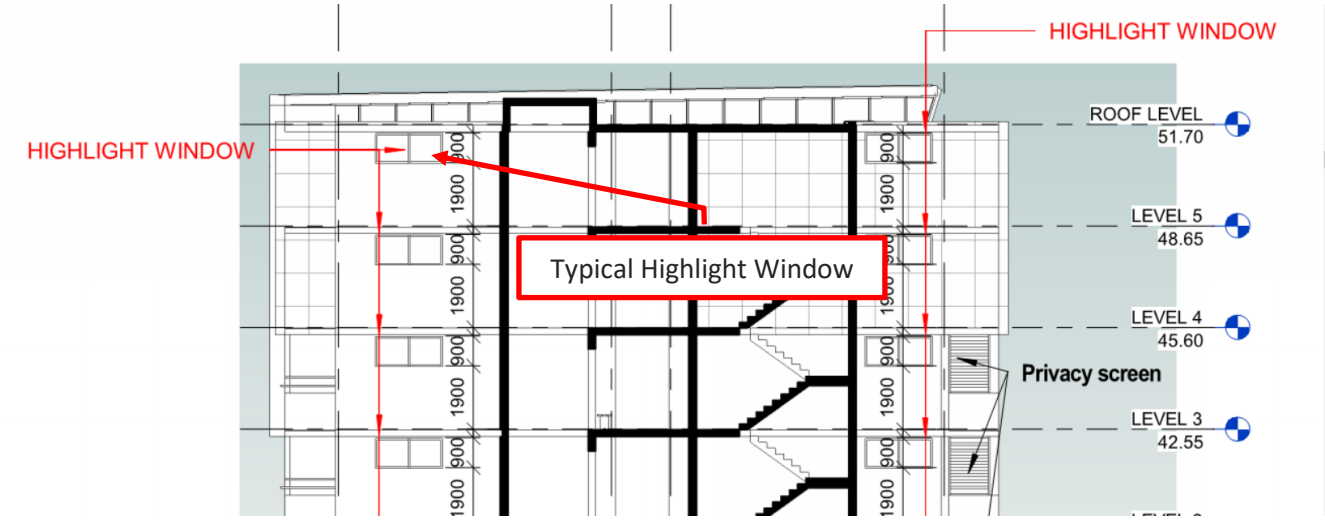


Figure 5 Typical Highlight Window



Through **Figure 4** it can be seen that the provided slots for the highlighted units do not fit within the width to depth ratio specified under the ADG guidelines. However, SLR is of the opinion that the provided slots are appropriately sized to allow for airflow through apartments without the risk of air becoming trapped or not circulating out of the provided slots.

This assessment is based on previous CFD experience modelling natural ventilation for similar developments and building sizes. SLR previously carried out a quantitative assessment on the proposed neighbouring development at 1086 Richmond Road and found the similarly sized slots to be adequate for natural ventilation requirements.

When considering the allocated highlight windows identified in **Figure 5**, SLR is of the opinion they are sufficiently sized dependant on the effective open area. In order to meet a suitable minimum air change volume for the proposed apartments, SLR recommends that all highlight windows used for natural ventilation purposes have an effective open area no less than 1 m^2.

4.2 Natural Ventilation Potential using Clerestory Windows

The development design has proposed the use of operable clerestory windows to the Level 5 for natural ventilation purposes. This provision could be used to provide cross ventilation to habitable areas of apartments which do not achieve dual aspects via their facades. Apartments which have been provided clerestory windows for natural ventilation purposes have been identified in **Figure 6**.

The utilisation of clerestory components could allow for pressure induced air flow through the allocated apartments, with the negative pressure experienced at the roof promoting natural ventilation currents through the apartment.

From experience gained through previous quantitative CFD assessments, SLR is of the opinion that apartments with operable clerestory windows could provide appropriate natural ventilation to the identified apartments. SLR would recommend that any clerestory components used have openings to all four sides, as this would best maximize the negative pressure experienced and aid natural ventilation.

Figure 6 Proposed Apartments to be Naturally Ventilated via Clerestory Window – Level 5

5 Expert Details and Qualifications

James Cleary, Senior Project Consultant – CFD, Wind and Energy

I, James Cleary, am a Senior Project Consultant for CFD, Wind and Energy at SLR Consulting. A copy of my CV is attached.

I have produced this report and have read and agree to be bound by the Expert Witness Code of Conduct set out in schedule 7 of the Uniform Civil Procedure Rules 2005 (NSW) and Part 31, Division 2 of the UCPR.

I declare that I have made all the inquiries which I believe are desirable and appropriate, and that no matters of significance which I regard as relevant have, to my knowledge, been withheld.

I am a Senior Consultant with an Honours Degree in Mechanical Engineering.

My background in aerodynamics and computational fluid dynamics has allowed me to tackle a wide range of fluid flow problems across wind engineering and industrial processes.

Neihad Al-Khalidy, Technical Discipline Manager and Supervisor

I, Dr Neihad Al-Khalidy, am a Technical Discipline Manager for CFD, Wind and Energy at SLR Consulting. A copy of my CV is at attached.

I have supervised this report and have read and agree to be bound by the Expert Witness Code of Conduct set out in schedule 7 of the *Uniform Civil Procedure Rules 2005* (NSW) and Part 31, Division 2 of the UCPR.

I declare that I have made all the inquiries which I believe are desirable and appropriate, and that no matters of significance which I regard as relevant have, to my knowledge, been withheld.

I am a Technical Director with a Mechanical Engineering Bachelors' Degree, Masters in Air Conditioning and Refrigeration Engineering and a Doctorate in the field of Numerical Techniques.

I am a Chartered Professional Engineer MIEAust CPEng, Australian Institute of Engineers, Member of Australian Wind Engineering Society and Member of Council on Tall Buildings.

I have recently joined the editorial board of the International Journal of Architectural Engineering Technology and recently published my invited paper entitled "Better Natural Ventilation Design for Single Sided Apartments Utilising Computational Fluid Dynamics".

I have managed many industrial and commercial projects throughout Australia, UK, SE Asia and the Middle East in the fields of CFD, Natural Ventilation Design, ADG Compliance and Expert Witness Reports. Analytical Calculation (Building Facades, Condensation and Insulation Assessment), Wind, Ecologically Sustainable Development, Building Energy Rating, Exterior Lighting, Solar, Reflectivity and Overshadowing.

My background combines an extensive academic record including 55 technical papers in prestigious International Journals and conferences plus an international track record in consulting activities ranging across a wide variety of industries. International Publications including CFD approach to enhance natural ventilation in residential and industrial buildings.

The opinions expressed in the report and letters are based on our own review of the development's drawings and previous computer simulations of similar developments and I do not rely on the opinions of others.