28 June 2021

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M Development Group Pty Ltd
c/- Swaab
Level 4, 20 Hunter Street,
Sydney NSW 2000

Attention: Emma Fleming

Dear Emma

205-209 Grange Avenue, Marsden Park
Cross Ventilation Assessment - Letter of Advice

SLR Consulting Pty Ltd (SLR) has been engaged by M Development Group Pty Ltd to qualitatively assess the natural ventilation potential for the proposed residential development at 205-209 Grange Avenue, Marsden Park. This assessment forms part of the Development Application to the City of Blacktown Council.

As specified within the ADG, at least 60% of apartments are required to be 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.

Developments, which seek to vary from the minimum standards, must demonstrate how natural ventilation can be satisfactorily achieved, particularly in relation to habitable rooms.

Qualitative Natural Ventilation Potential

The proposed development has been provided with openings on multiple sides of apartments for the majority of proposed floor plans, allowing it to make use of wind-induced natural ventilation throughout the year and thereby minimising energy costs.

Based off our best engineering judgement the qualitative study concluded that for the development:

- Based on a qualitative study 61.36% (108 of 176) of apartments within the proposed development comply with cross-ventilation requirements of the Australian Design Guide.
- A significant proportion of those deemed to be ADG compliant will also have naturally cross ventilated kitchens.
- Ventilated skylights have been utilised for some Level 3 apartments.

Quantitative Natural Ventilation Potential

Additionally, recesses and articulations proposed for the development 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.

SLR has identified 22 apartments that could reach appropriate levels of natural cross ventilation with further quantitative assessment.

SLR utilised drawing set DA200 – DA239, Rev D, dated 19.04.21, to review the proposed site for natural ventilation potential.

Yours sincerely

JAMES CLEARY
Senior Project Consultant

Checked/ Authorised by:
Neihad Al-Khalidy

1.1 Site and Surrounds

The proposed site is located to the north west of Sydney, sitting south of Grange Avenue, Marsden Park. The surrounds of the site are predominantly open currently, with there being some more densely populated residential housing further afield to the east and west.

Figure 1 Site Location

Image: Nearmap, 5 June 2021

1.2 Development Description

The proposed development will comprise three (3) residential buildings, inclusive of:

- Two (2) levels of basement car parking;
- Ground Level with residential apartments, building lobbies and communal open space;
- Level 1-3 with residential apartments;
- Level 4 Roof with private open space for Buildings A and B; and
- Level 4 Roof with private open space and communal open space for Building C.

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

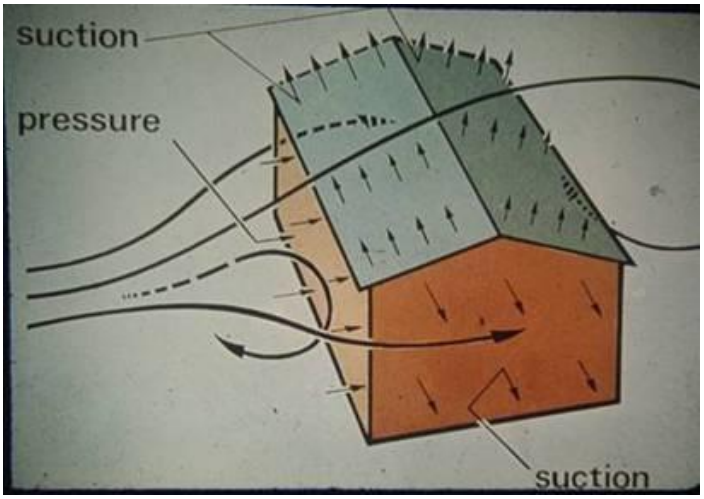
3.1 General Principles

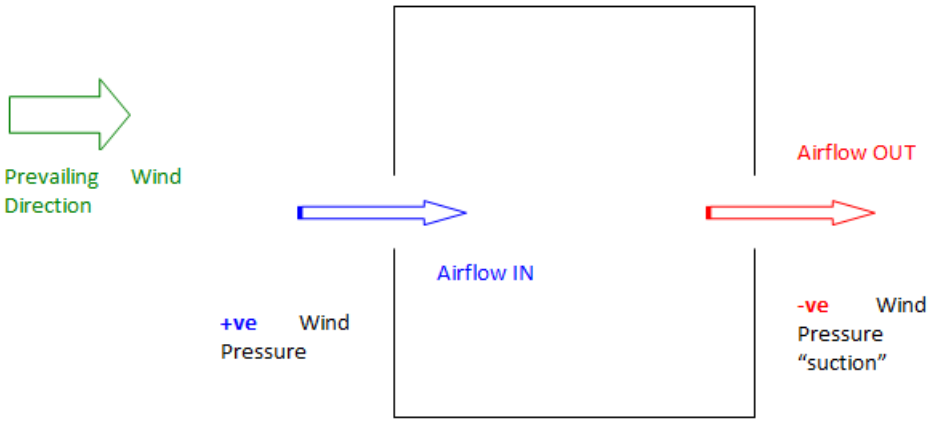
A key feature of the proposed development is the incorporation of façade openings designed to enable various spaces within the development buildings to make use of wind–induced natural ventilation throughout the year thereby minimising energy costs.

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 2**.

Figure 2 Wind-Induced Natural Ventilation via Differential Pressure





4 Qualitative Assessment of Natural Ventilation

The natural ventilation for the proposed residential development has been qualitatively assessed. Ventilation is achieved by the differential pressure between the different building facades. Examples of the natural ventilation principles that apply for the proposed development are shown in **Figure 3**. Full diagrams for natural ventilation can be found in **Appendix A**.

The following comments are made regarding proposed natural ventilation system for the development:

- Operable windows are provided to all façade orientations;
- There are balconies located on all building facades, with openings provided to all aspects. Minimal shielding is expected to upper levels; therefore, the proposed development benefits from all prevailing Sydney winds, creating the potential for cross ventilation.
- Based on a qualitative study 61.36% (108 of 176) of the apartments within the proposed development comply with the cross ventilation requirements of the Australian Design Guide for the first nine stories (Refer **Table 4**)

Table 1 Apartments with Openings to Support Natural Ventilation – Building A

Level	Number of Apartments	Number of Apartments with Openings to Support Cross Ventilation (as per ADG)	Percentage
G	16	10	62.50%
L1	17	9	52.94%
L2	17	9	52.94%
L3	17	11	64.71%
Total	**67**	**39**	**58.21%**

Table 2 Apartments with Openings to Support Natural Ventilation – Building B

Level	Number of Apartments	Number of Apartments with Openings to Support Cross Ventilation (as per ADG)	Percentage
G	16	10	62.50%
L1	17	9	52.94%
L2	17	9	52.94%
L3	17	11	64.71%
Total	**67**	**39**	**58.21%**

Table 3 Apartments with Openings to Support Natural Ventilation – Building C

Level	Number of Apartments	Number of Apartments with Openings to Support Cross Ventilation (as per ADG)	Percentage
G	10	10	100.00%
L1	10	6	60.00%
L2	12	8	66.67%
L3	10	6	60.00%
Total	**42**	**30**	**71.43%**

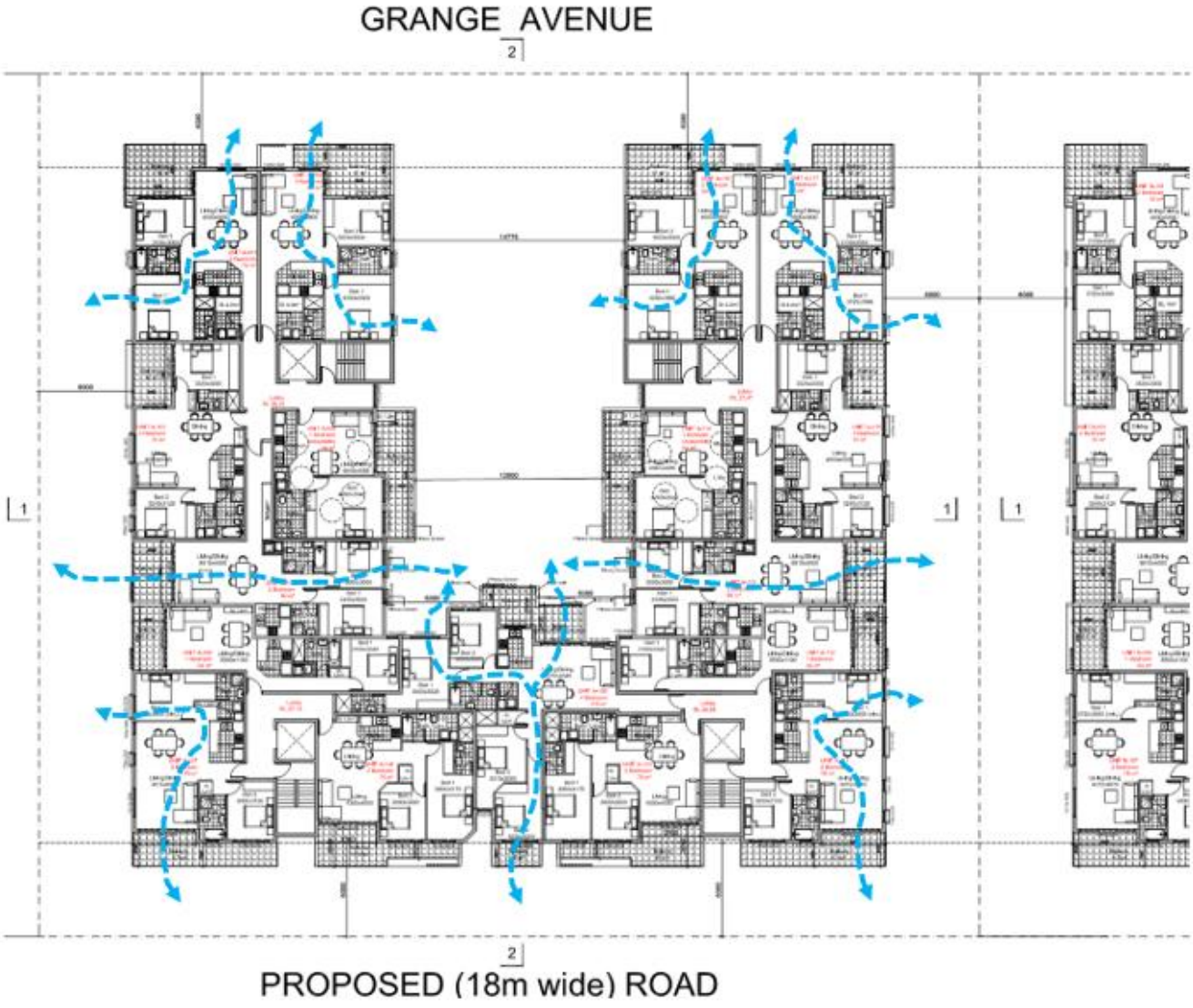
Table 4 Apartments with Openings to Support Natural Ventilation – Building Summary

Level	Number of Apartments	Number of Apartments with Openings to Support Cross Ventilation (as per ADG)	Percentage
A	67	39	58.21%
B	67	39	58.21%
C	42	30	71.43%
Total	**176**	**108**	**61.36%**

4.1 Assessment of Natural Ventilation Through to Central Courtyards

In assessing natural ventilation through to the central courtyards for each building, SLR has assessed that the relative width and building heights for the proposed space ensure that the space will not act as a building slot, as defined within the ADG. Given this, apartments with dual aspects utilising the courtyard space for natural ventilation purposes have been deemed compliant with natural ventilation requirements.

Figure 3 Natural Ventilation Example for the Site – Building A Level 1



5 Assessment of Natural Ventilation Potential

From the provided plans and as shown in **Section 4**, there are a significant number of apartments that will comply with the ADG guidelines.

Additionally, recesses and articulations proposed for the development 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 operable windows connected to building slots.

Appendix A outlines several apartments that SLR anticipates will prove to be adequately cross ventilated, given further analysis.

6 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.

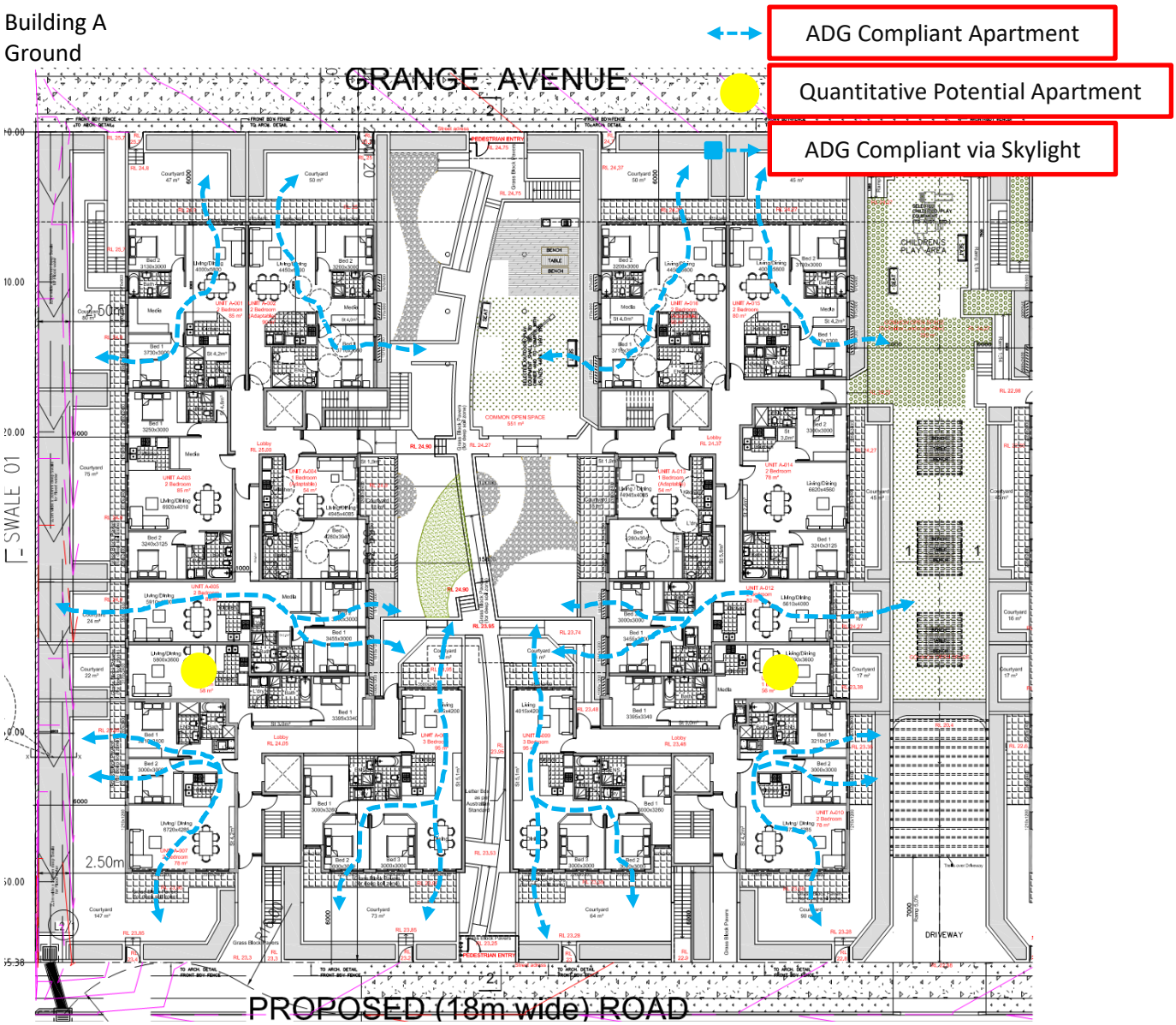
I have recently joined the editorial board of the International Journal of Architectural Engineering Technology and recently published my invited paper entitled "Better Natural Ventilation Design for Single Sided Apartments Utilising Computational Fluid Dynamics".

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.

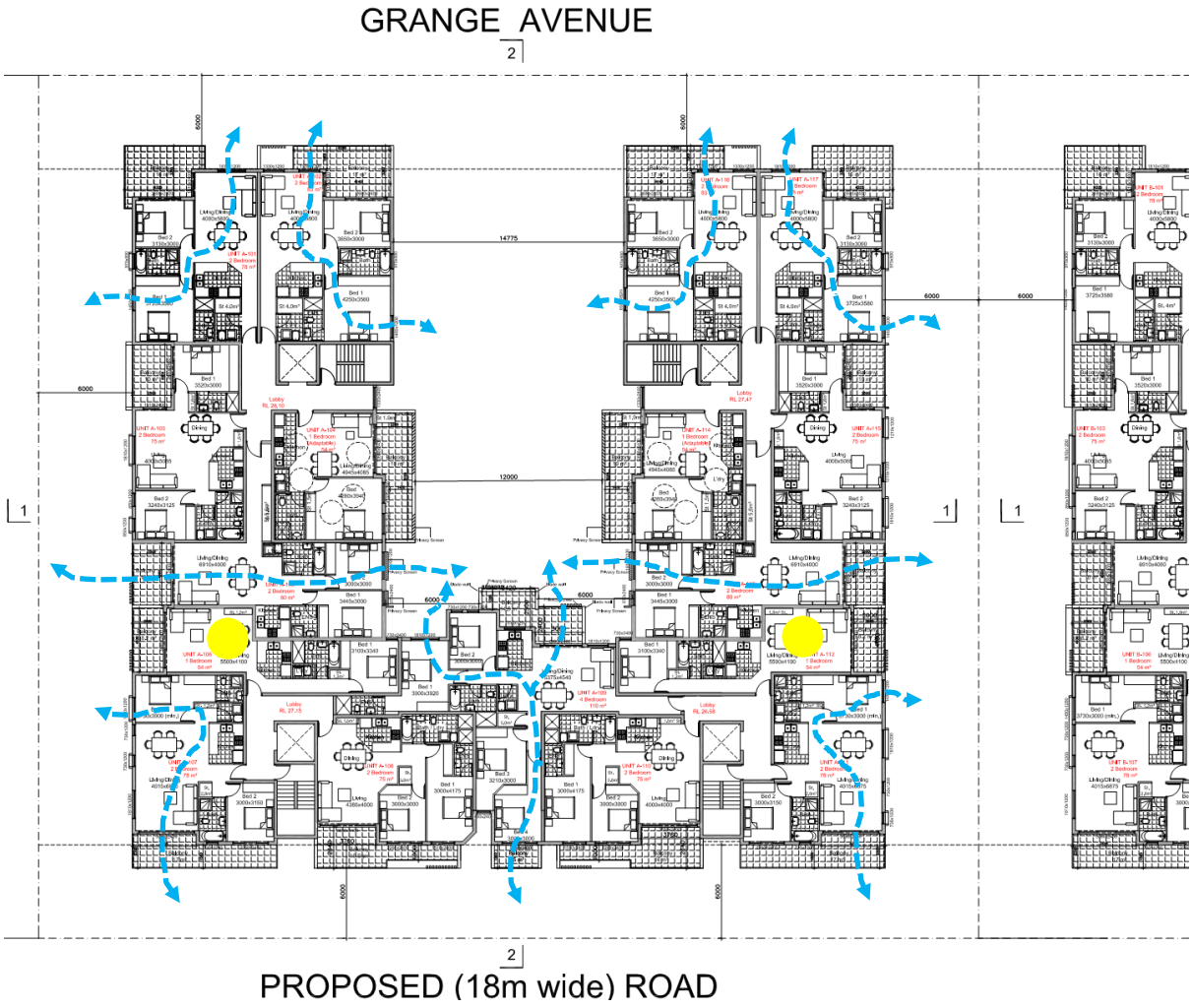
My background combines an extensive academic record including 55 technical papers in prestigious International Journals and conferences plus an international track record in consulting activities ranging across a wide variety of industries. International Publications including CFD approach to enhance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

Building A
Ground



Level 1



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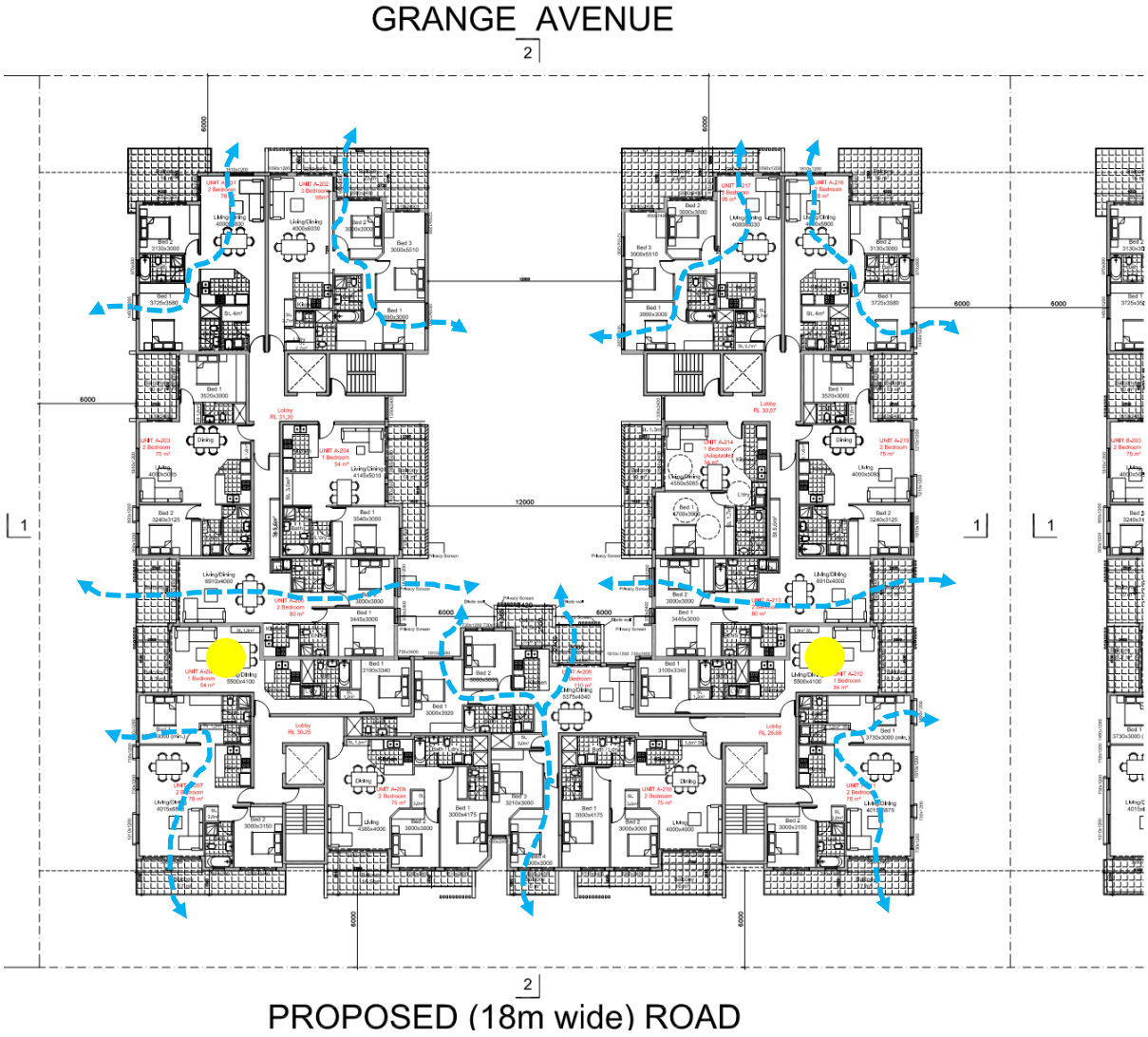

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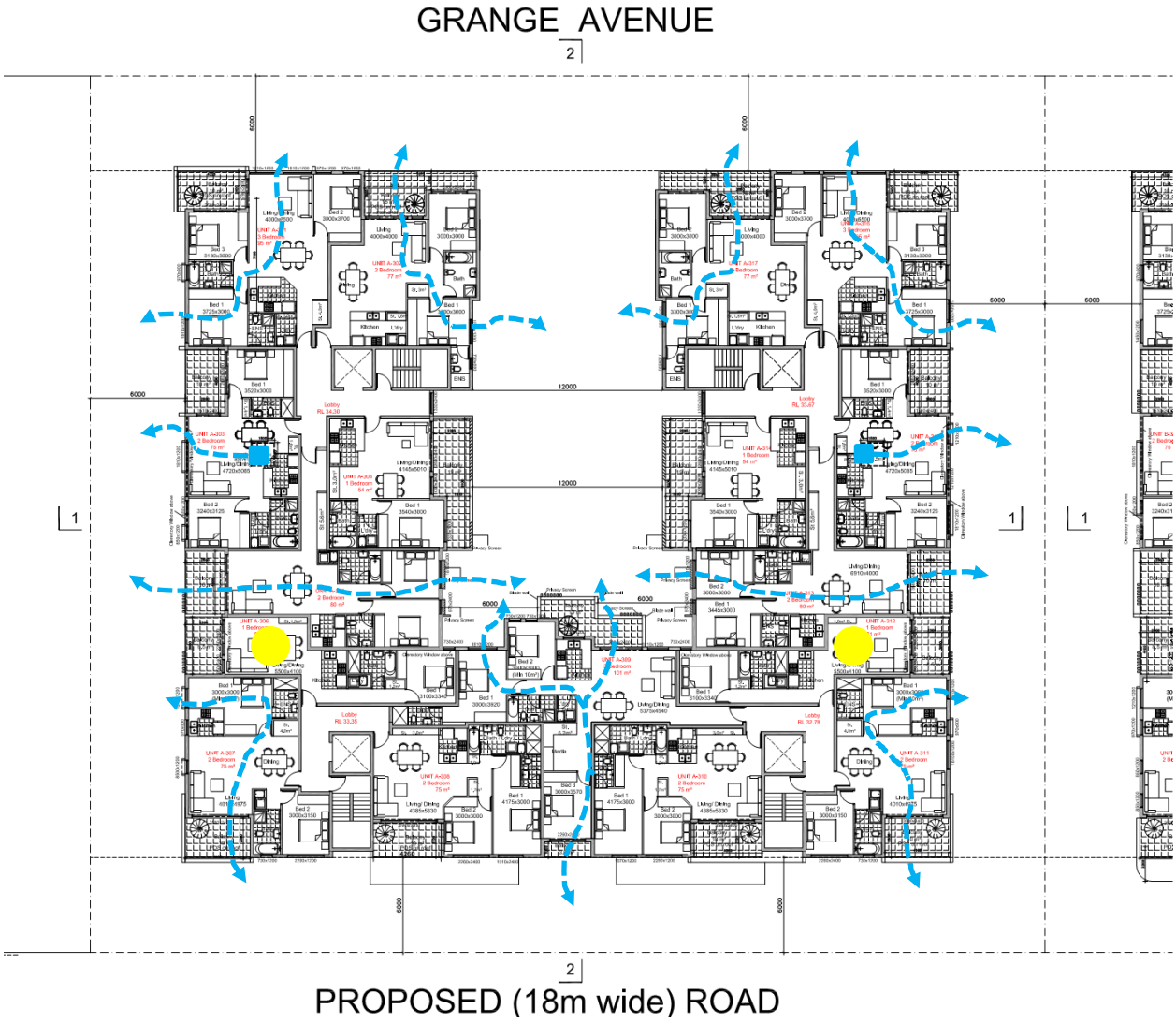
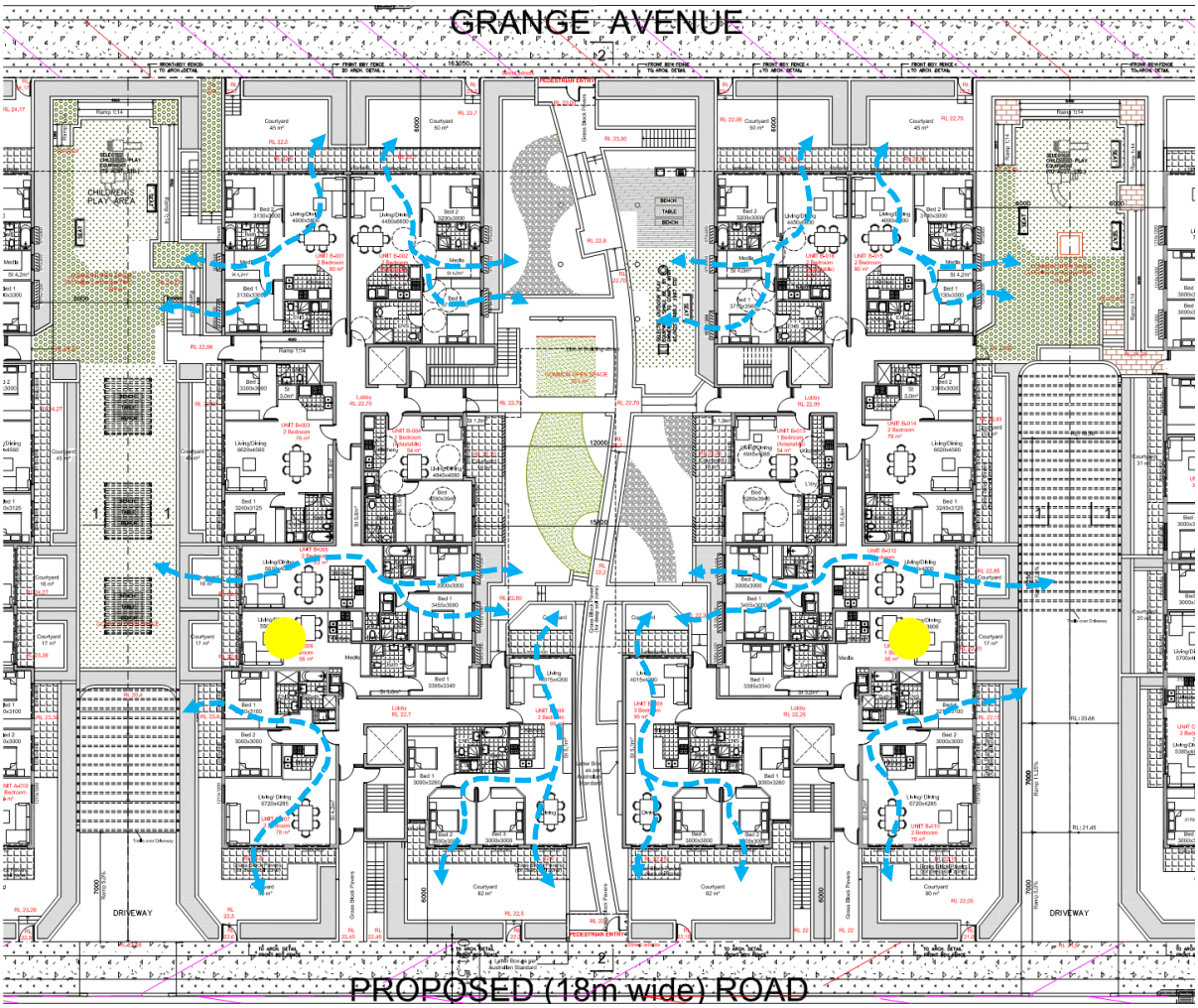


Building B
Ground



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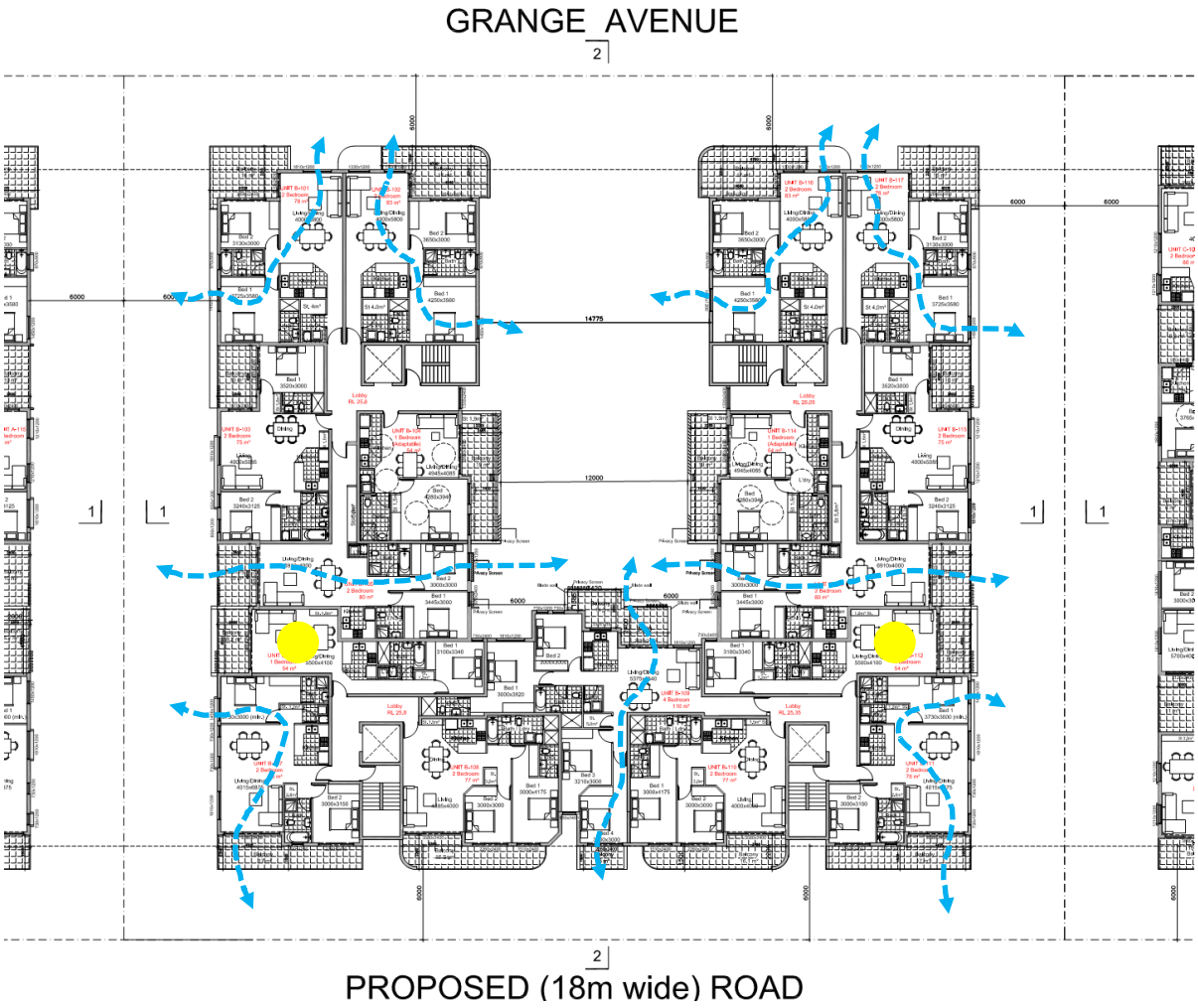
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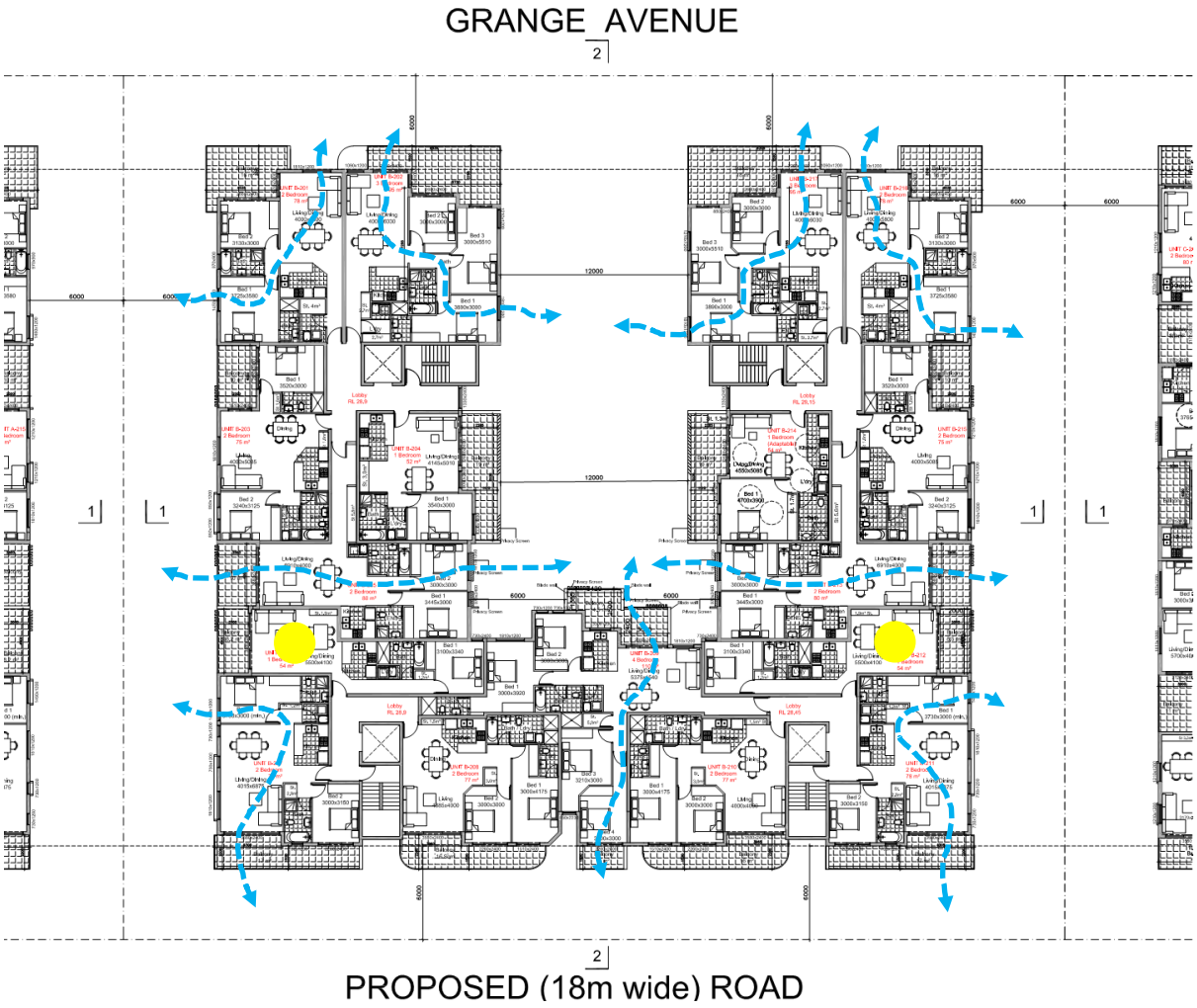
Level 2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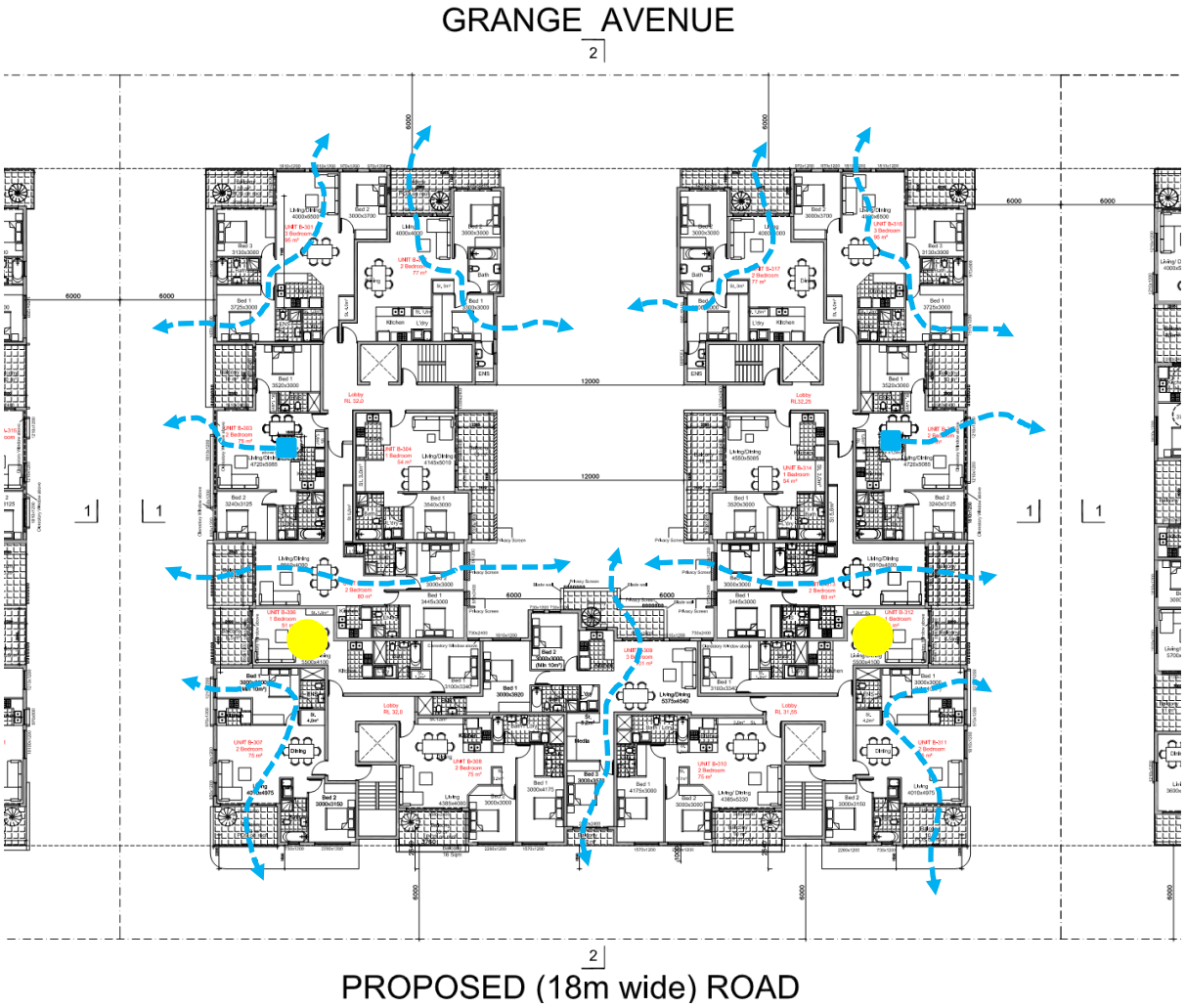
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Building C
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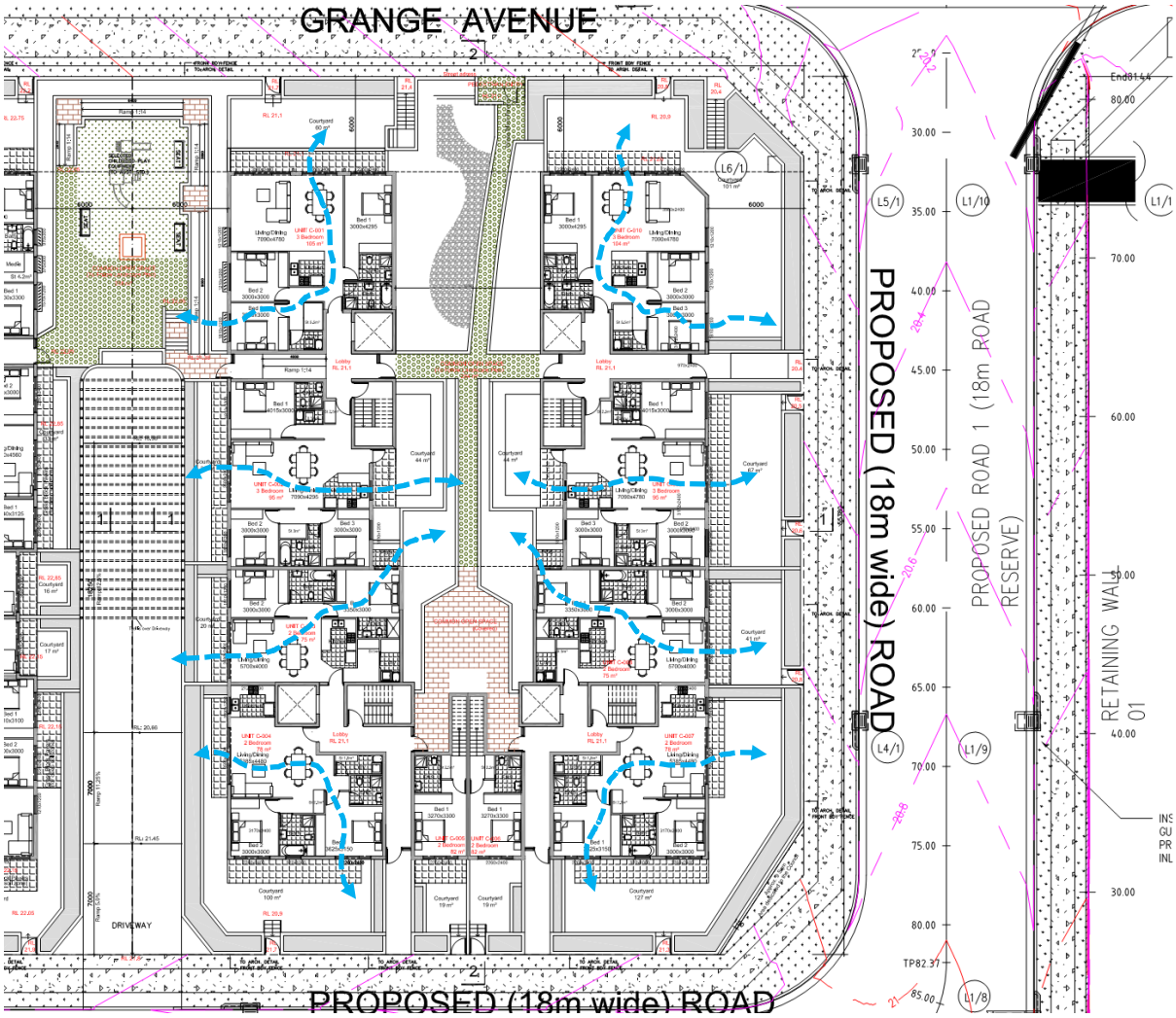

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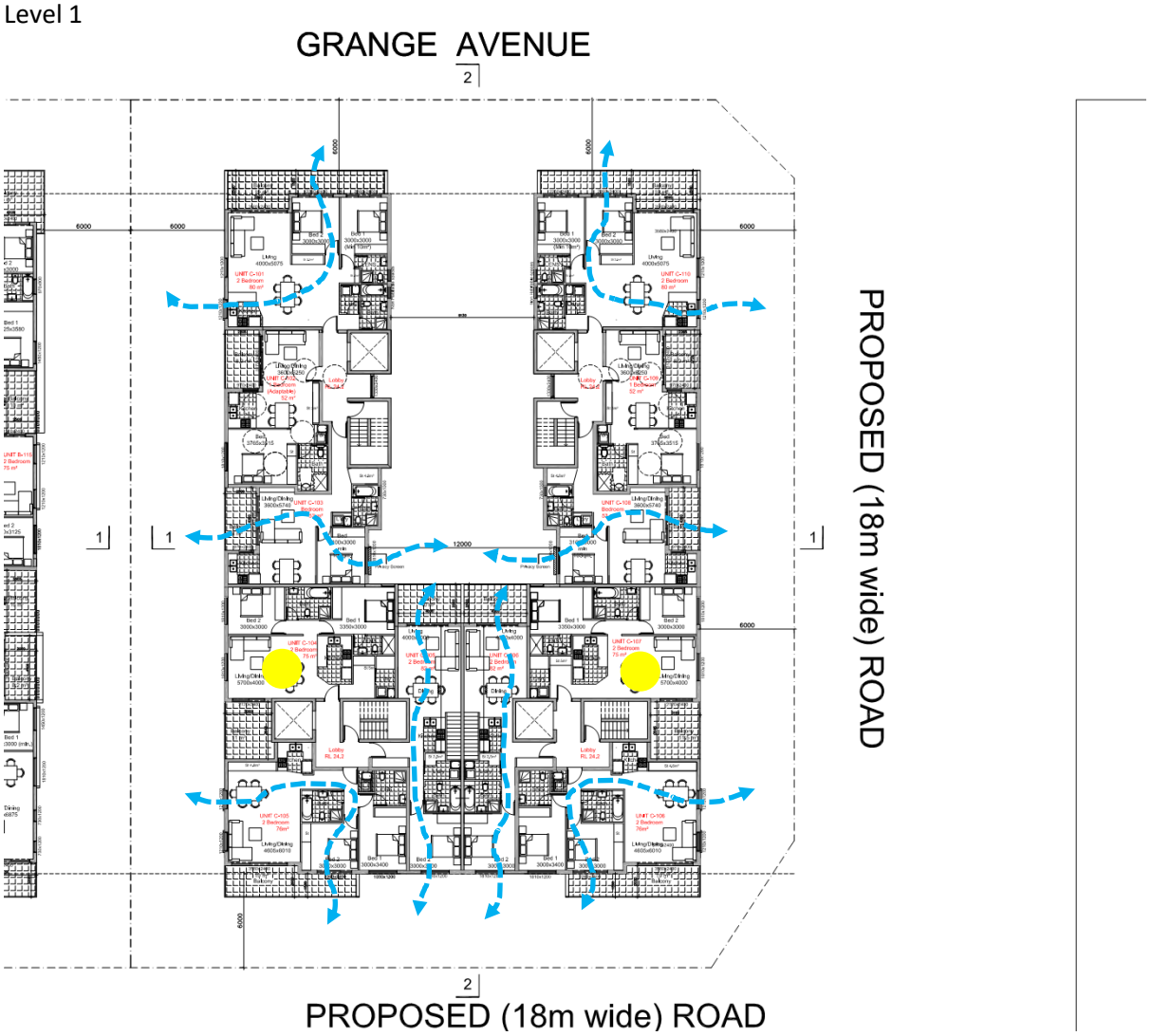
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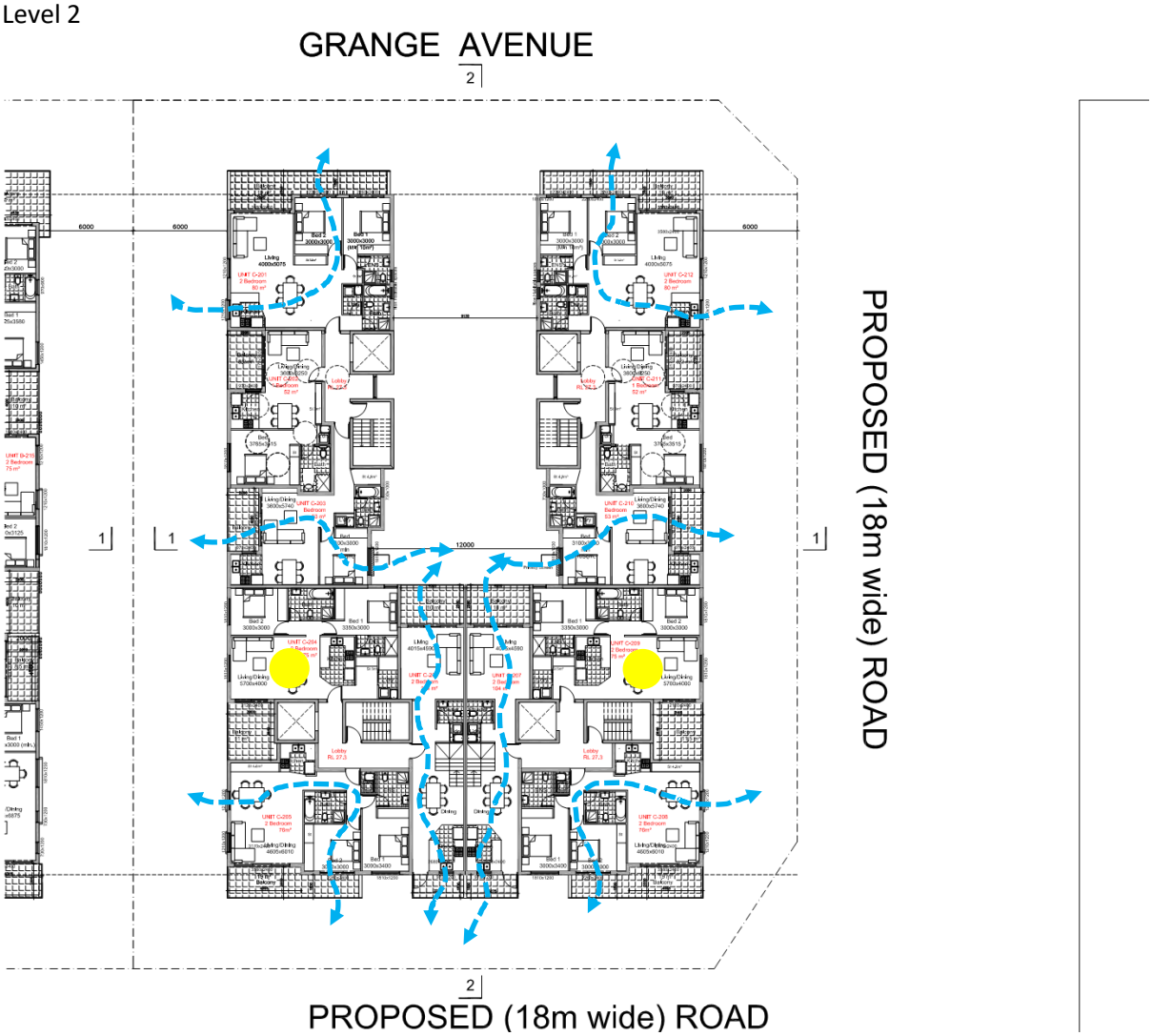
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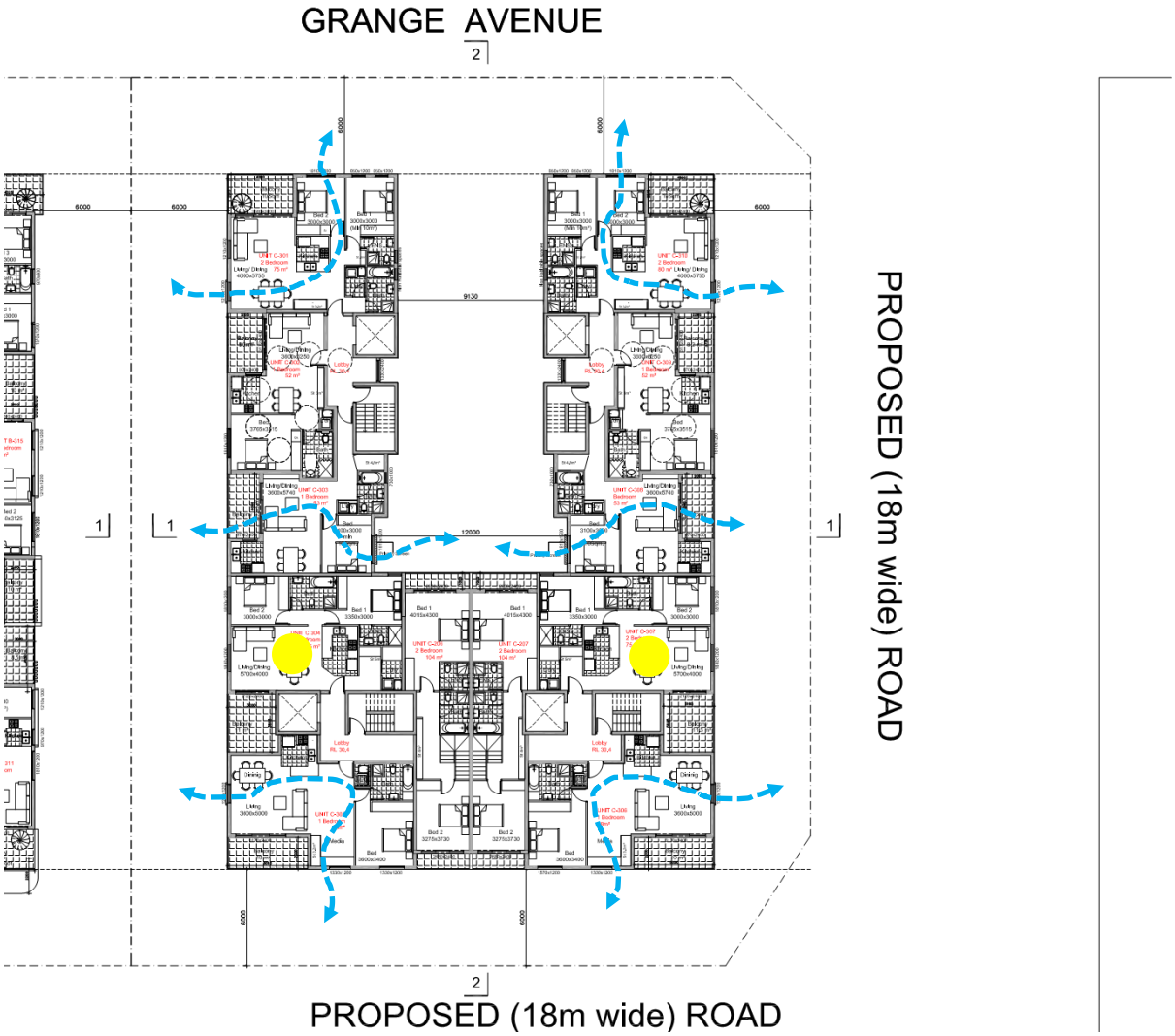
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