12 February 2018

610.13932-L02-v0.1 5E S96.docx

Meriton Apartments Pty Ltd
Level 11, Meriton Tower
528 Kent Street
SYDNEY NSW 2000

Attention: Ms Norelle Jones

Dear Norelle

130-150 Bunnerong Road, Pagewood - UB5E
Roof and Podium Terraces - Wind Mitigation

SLR has previously completed qualitative (Desktop) wind reports covering various elements of the UB5E Project located at Bunnerong Road, Pagewood.

- SLR Report 610.13932.00100-R5 dated 14 July 2016

Current design updates propose the addition of private apartment terraces for both the roof area of Buildings A (Refer **Figure 1**) and Building B (Refer **Figure 2**).

SLR has been commissioned by Karimbla Pty Ltd to quantify wind speeds at the roof private terraces of the development and provide detailed advice on specific wind mitigation options for the terraces.

Wind speeds within the areas of interest have now been quantified via Computational Fluid Dynamics (CFD) wind modelling.

Our response is contained herein.

If you have any questions please do not hesitate to contact me on 0401 416 274 / (02) 9427 8100 or via email at nal-khalidy@slrconsulting.com.

Yours sincerely

DR Neihad Al-Khalidy
Technical Director– Specialist Building Services
(Call at any time on 0401 416 274)

Submission Details
Reviewed by: JC

1 BACKGROUND

SLR has previously prepared a qualitative (Desktop) environmental impact of a proposed development at Urban Block 5 East (UB5W), 130-150 Bunnerong Road, Pagewood, with regard to the wind environment in and around the development (SLR Report 610.13932.00100-R5 dated 14 July 2016).

The proposed development is bound by Banks Avenue, Heffron Road, Bunnerong Road and Westfield Drive, with UB5E located on the corner Bunnerong Road and Westfield Drive.

Figure 1 Site Location

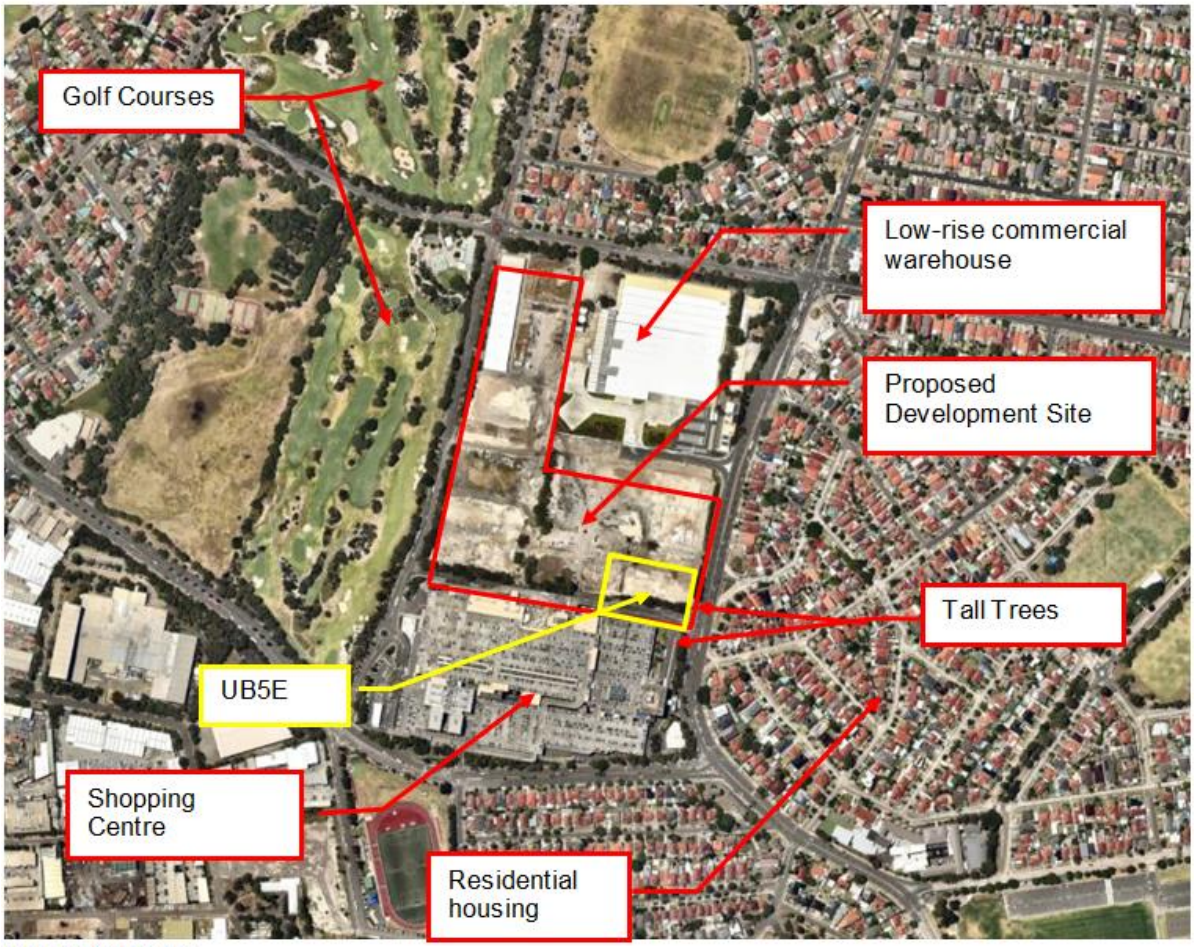
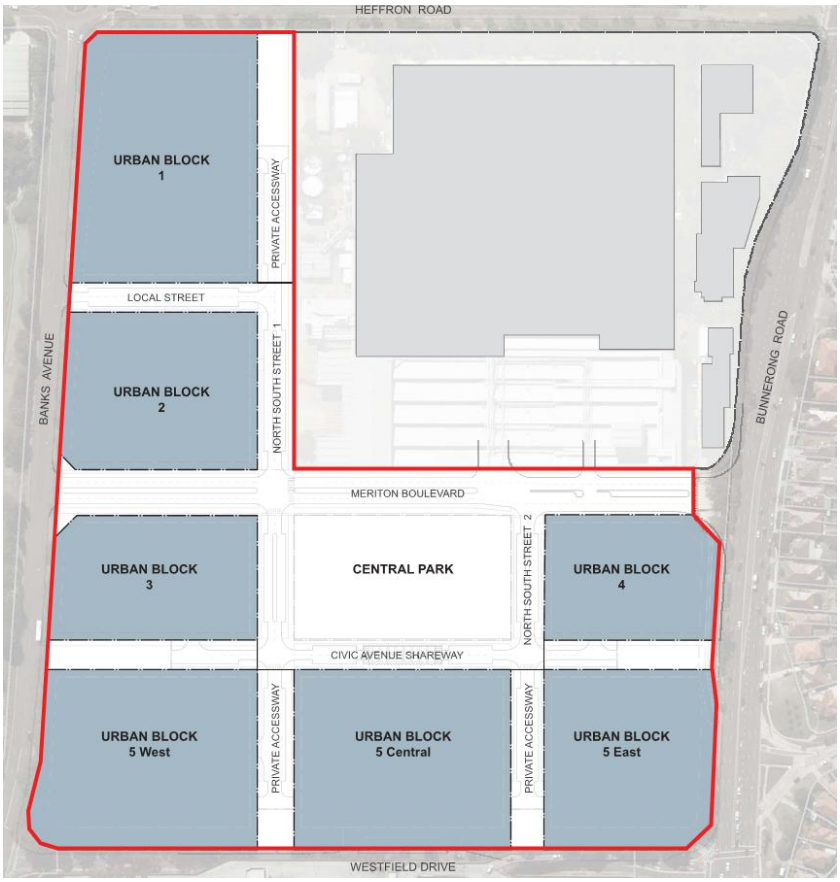


Image: Nearmap

To the west and north-west of the proposed development site are golf courses, while the eastern and northern sides consist mostly of low-level residential housing. To the north of the proposed development site is a low-rise commercial warehouse which will provide moderate shielding while the mid-rise shopping centre to the south will provide more significant shielding.

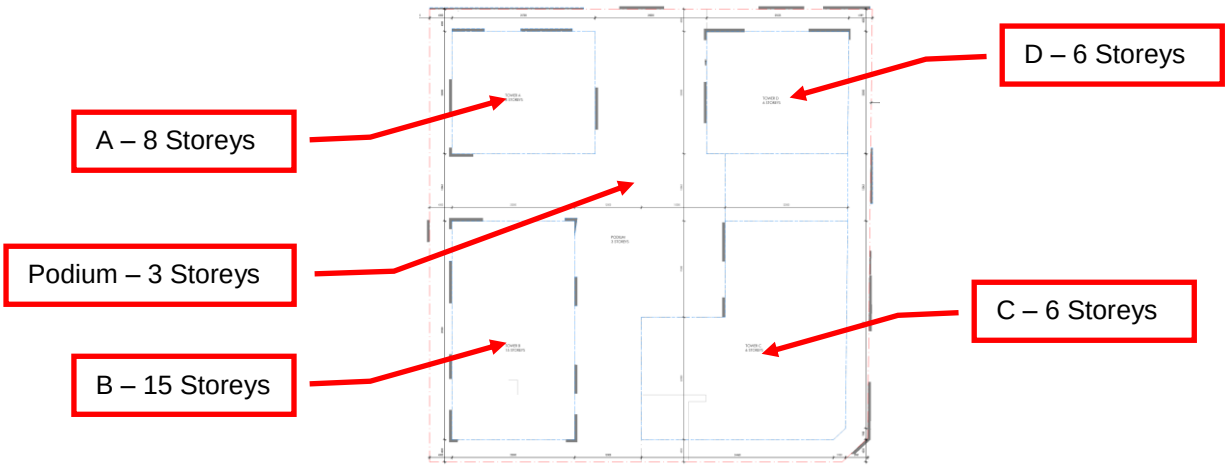
There are seven blocks with a central park as shown in **Figure 2**.

Figure 2 Site layout



UB5E consists of four towers over a common podium as indicated in the Building Key below:

Figure 3 UB5E Building Key



Current design updates propose the addition of private apartment terraces for both the roof area of Buildings A (Refer **Figure 4**) and Building B (Refer **Figure 5**).

SLR has been commissioned by Karimbla Pty Ltd to quantify wind speeds at the roof private terraces of the development and provide detailed advice on specific wind mitigation options for the terraces.

Wind speeds within the areas of interest have now been quantified via Computational Fluid Dynamics (CFD) wind modelling.

Figure 4 Roof Terraces – Level 8

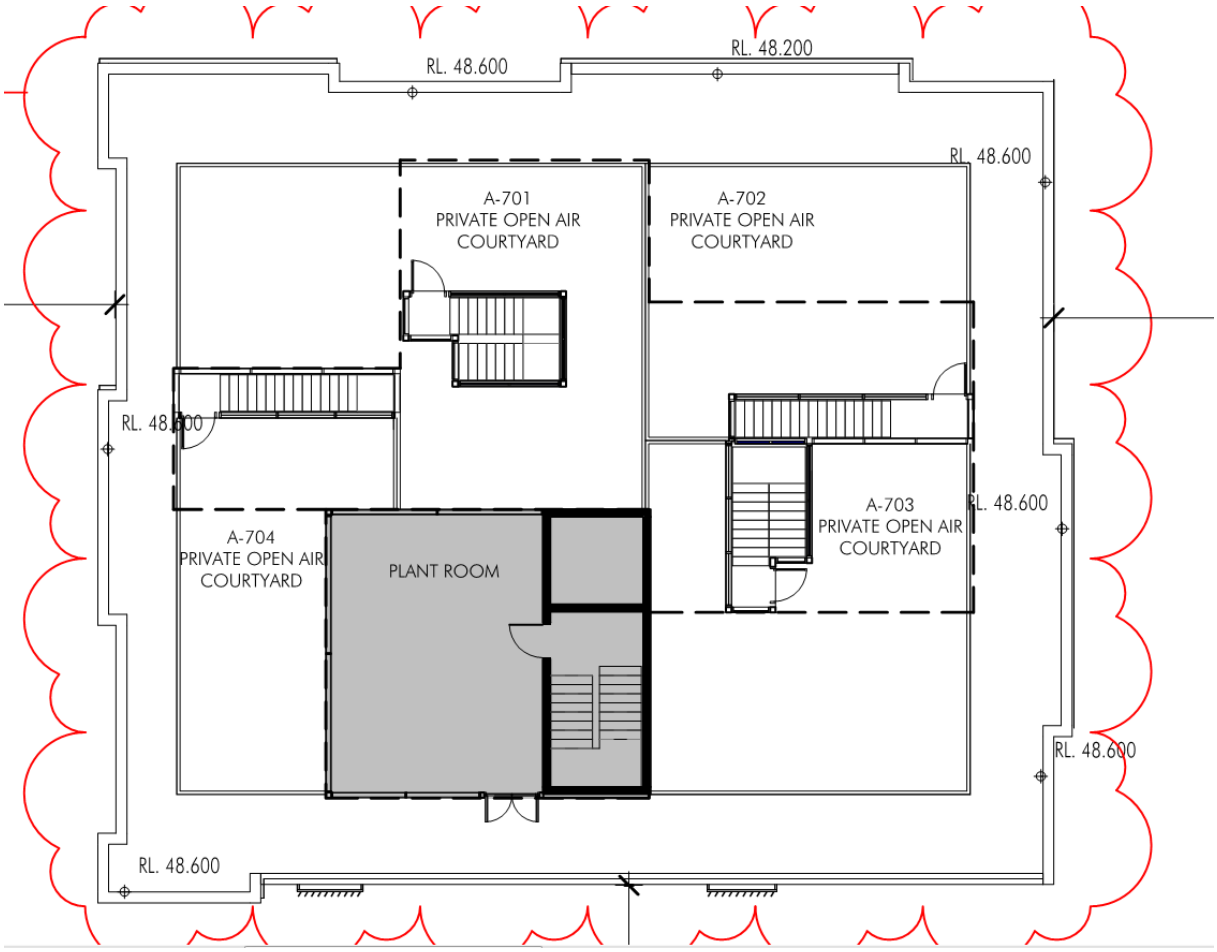
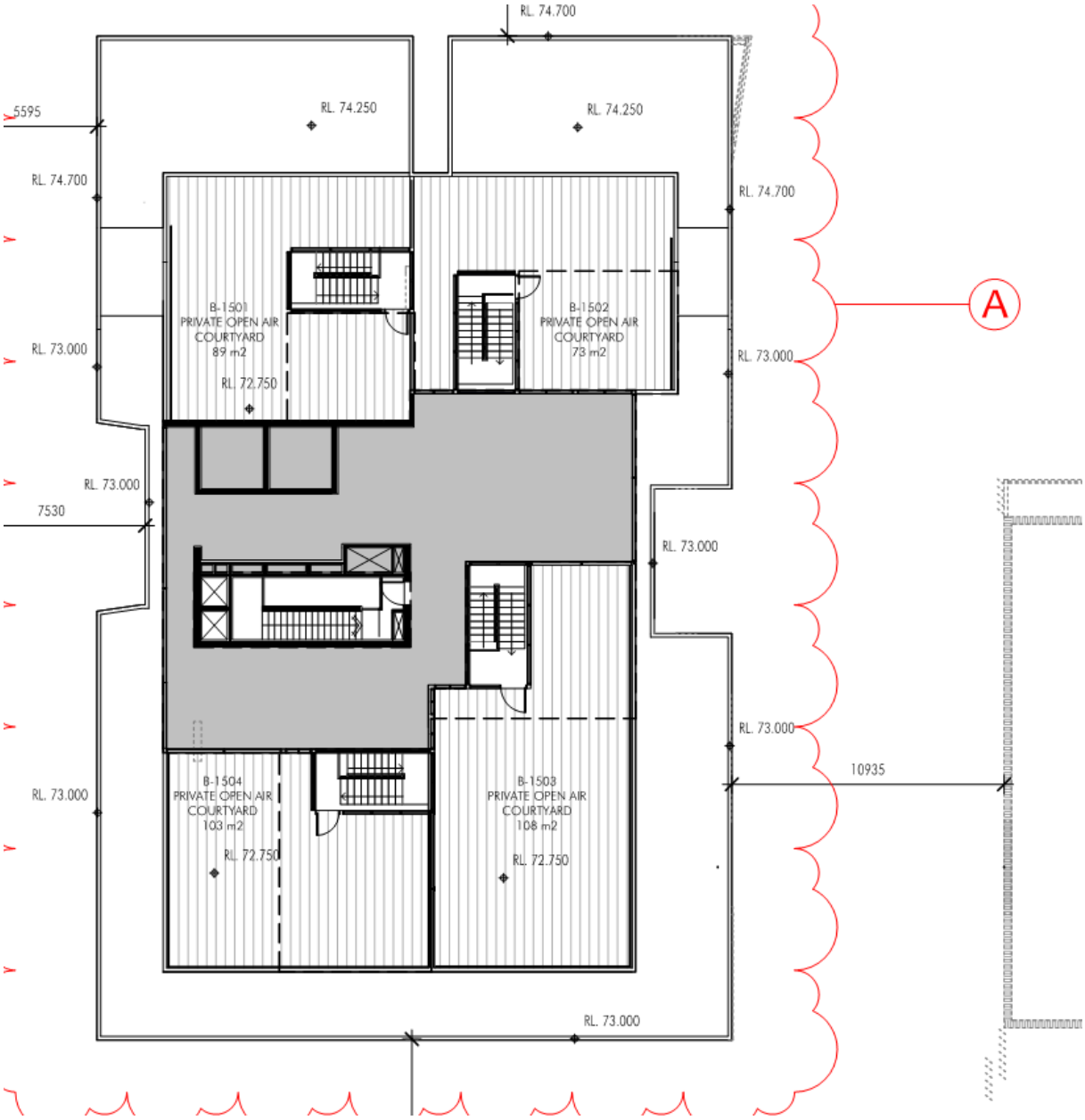


Figure 5 Roof Terraces – Level 16



2 CFD WIND MODELLING

The wind acceptability criteria provided in **Table 1** have been used for the CFD study.

It should also be emphasised that the criterion listed in **Table 1** are gust wind speeds as opposed to steady mean wind speeds modelled in the current CFD investigation. For a normally distributed process it is reasonable to assume that the peak 2-3 second mean maximum gust may be up to 3.5 standard deviations above the mean. It is therefore reasonable (and usually conservative) to assume that mean winds could be approximately half the magnitude of gust wind speeds given the level of wind turbulence expected at the proposed site.

Table 1 Standard Local Government Wind Acceptability Criteria

Type of Criteria	Limiting Gust Wind Speed Occurring Once Per Year	Activity Concerned
Safety	24 m/s	Knockdown in Isolated Areas
	23 m/s	**Knockdown in Public Access Areas**
Comfort	**16 m/s**	**Comfortable Walking**
	13 m/s	Standing, Waiting, Window Shopping
	10 m/s	**Dining in Outdoor Restaurant**

2.1 CFD Methodology

The mean wind speed profile used in the CFD Study was determined using the Sydney Region wind rose and the AS 1170.2:2002 wind code. The model was then run with winds from the northwest, south and west wind directions, noting that southerly and westerly winds are worse case scenarios for Sydney.

The geometry for the CFD modelling is shown in **Figure 6**.

The domain for the CFD modelling covers an area of 4 km^2 and extends 450 m above the proposed development.

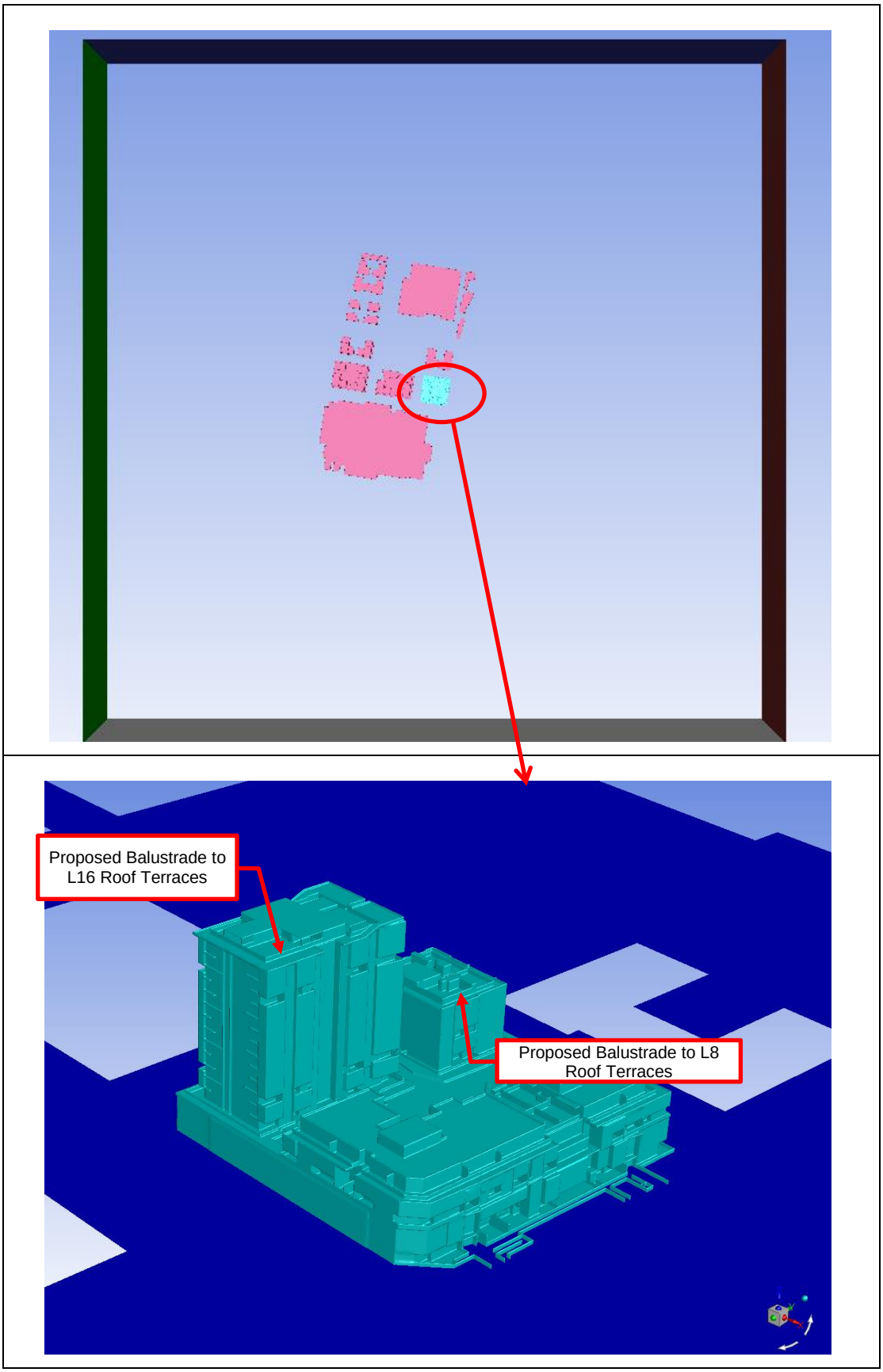
The influence of the immediate surrounding physical environment, all neighbouring buildings and local topography around the proposed development were included in the CFD model as shown in **Figure 6.**

The surrounding buildings and terrain were simplified to reduce computational time. This includes the removal of all trees and vegetation, which means that the model can be considered slightly conservative as the presence of trees and vegetation would typically reduce ground level wind speeds.

The following prevailing wind conditions were modelled:

- West Winds (which provide the strongest winds in the Sydney region)
- Northeast Winds
- South Winds (which also provide strong winds in the Sydney region)

Figure 6 3D Geometry for CFD Modelling



2.2 CFD Results

2.2.1 West Winds

Figure 7 shows mean wind speeds at 1.5 m above the ground for the wind flowing from the west (Wind Angle =270^{o}). Mean velocity magnitudes are plotted on a colour coded scale between 0 and 11.5 m/s. Dark blue represents still conditions at 0 m/s and red representing the strongest wind speed. The following conclusions can be reached:

- The CFD model captures the fluid flow characteristics in significant detail (Refer **Figure 7**). Wind approaching the site from the West channels between buildings, accelerated near the edges and stagnated and recirculated behind the buildings.

Figure 8 and **Figure 9** show the mean wind speeds at 1.5 m above the ground of the private roof terraces. The following conclusions can be reached:

- The roof terraces receive a significant shielding from UB5 Central and UB5 West developments.
- There are no areas predicted to experience winds which may pose an actual hazard to users of the development, ie exceed safety criteria
- There are no areas predicted to experience wind speeds above the comfort criteria for walking.
- There are no areas on L8 terraces predicted to experience wind speeds above the comfort criteria for standing.
- One small area on L16 terrace (Unit 1504 private courtyard) is predicted to experience wind speeds above the comfort criteria for standing. The maximum mean wind speed is 7.4 (m/s). The corresponding gust is 14.8 m/s hence exceeding the comfort criterion at the southwest part of the terrace. Lower wind speeds are predicted below the proposed 1.395 m balustrade.
    - There are no areas on other L18 terraces are predicted to experience wind speeds above the comfort criteria for standing.
- All areas shown in yellow, green and blue are suitable for dining.

2.2.2 North-East Winds

Northeast winds are generally mild and the potential therefore for high wind speeds are likely to be very infrequent.

Figure 10 and **Figure 11** show mean wind speeds at 1.5 m above the ground for the wind flowing from the northeast (Wind Angle =45^{o}). The following conclusions can be reached:

- There are no areas predicted to experience winds which may pose an actual hazard to users of the development, ie exceed safety criteria
- The site has low-level shielding to the north-east from the low-rise residential dwellings and Level 8 terraces will receive shielding from UB4 development.
- There are no areas on L8 terraces predicted to experience wind speeds above the comfort criteria for walking and standing.
- Two L 18 terraces (Private terraces 1501 and 1502) are predicted to experience wind speeds above the comfort criteria for walking.
- All areas shown in yellow, green and blue are suitable for dining.

2.2.3 South Winds

Figure 12 and **Figure 13** shows mean wind speeds at 1.5 m above the ground for the wind flowing from the south (Wind Angle =180^{o}). The following conclusions can be reached:

- There are no areas predicted to experience winds which may pose an actual hazard to pedestrians, ie exceed safety criteria
- There are no areas predicted to experience wind speeds above the comfort criteria for walking.
- There are no areas on L8 terraces are predicted to experience wind speeds above the comfort criteria for standing.
- One small area on L16 terrace (B1504) is predicted to experience wind speeds above the comfort criteria for standing. The maximum mean wind speed is 7.4 (m/s). The corresponding gust is 14.8 m/s hence exceeding the comfort criterion at the southwest part of the terrace
- All areas shown in yellow, green and blue arte suitable for dining.

Figure 7 Velocity Vectors (m/s) at 1.5 m above the Ground – West Winds

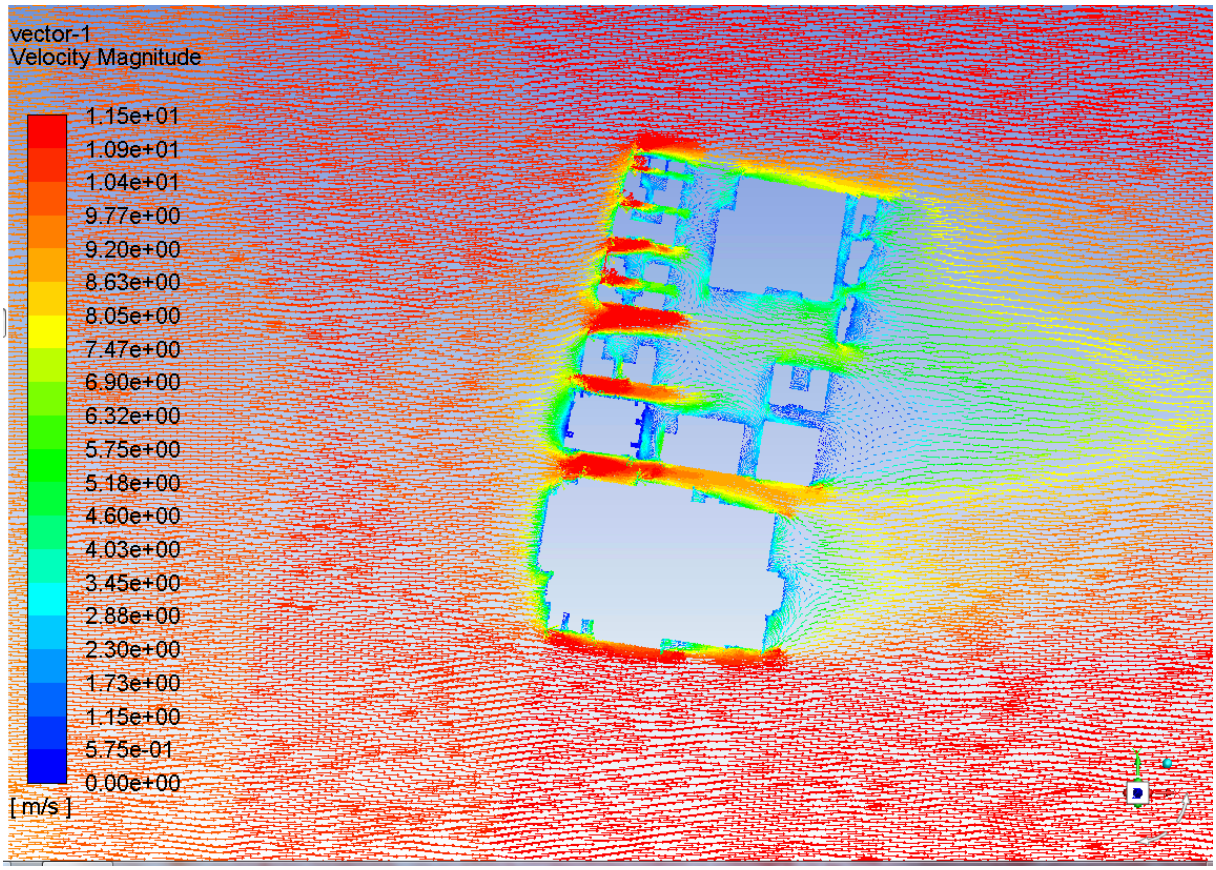
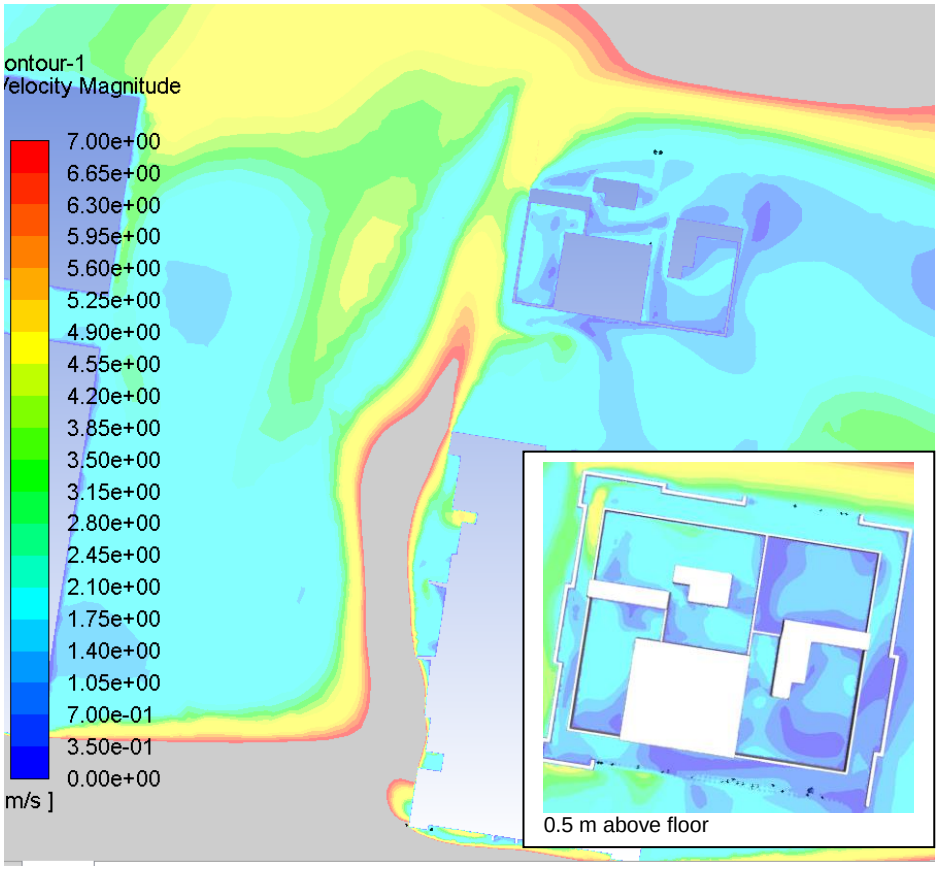
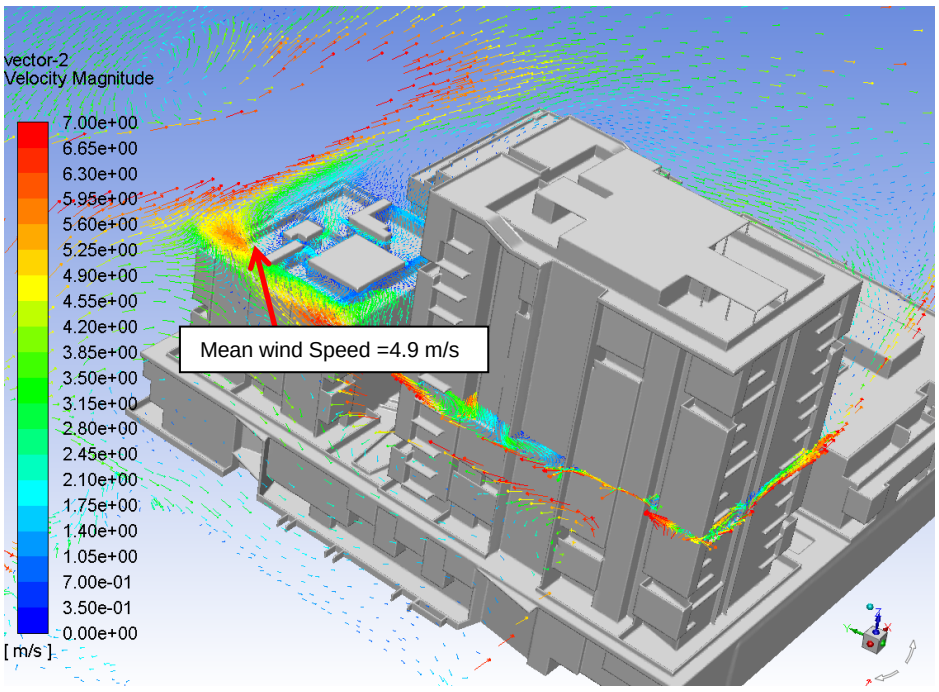


Figure 8 Velocity Magnitudes (m/s) at 1.5 m above floor of L8 Roof Terrace – West Winds

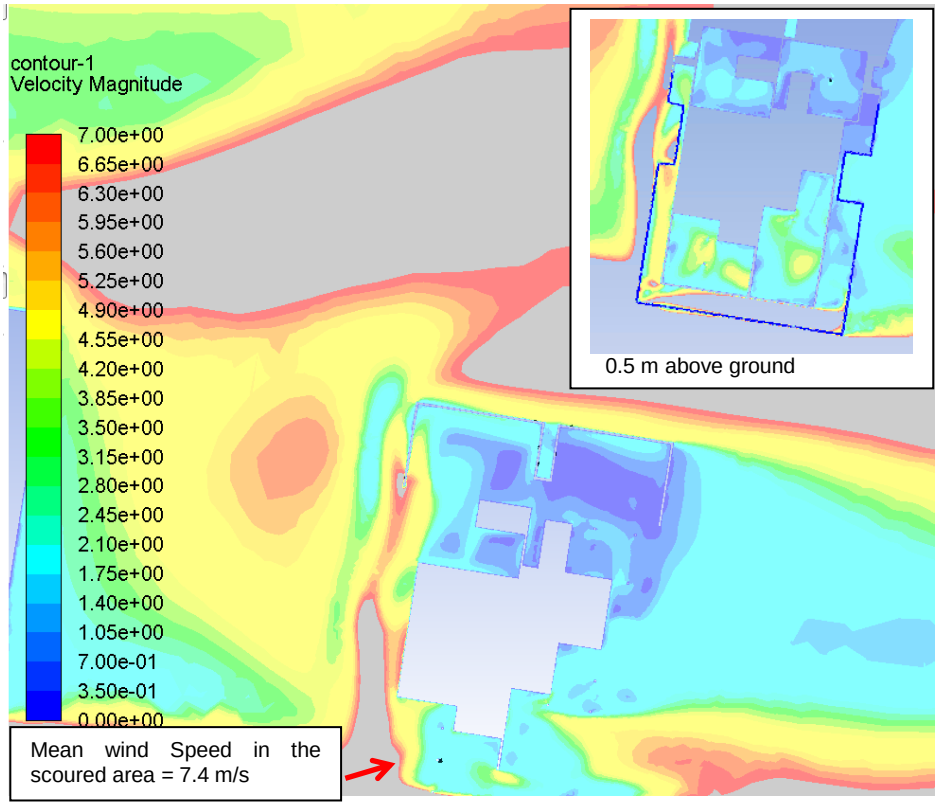


A – Velocity Contours

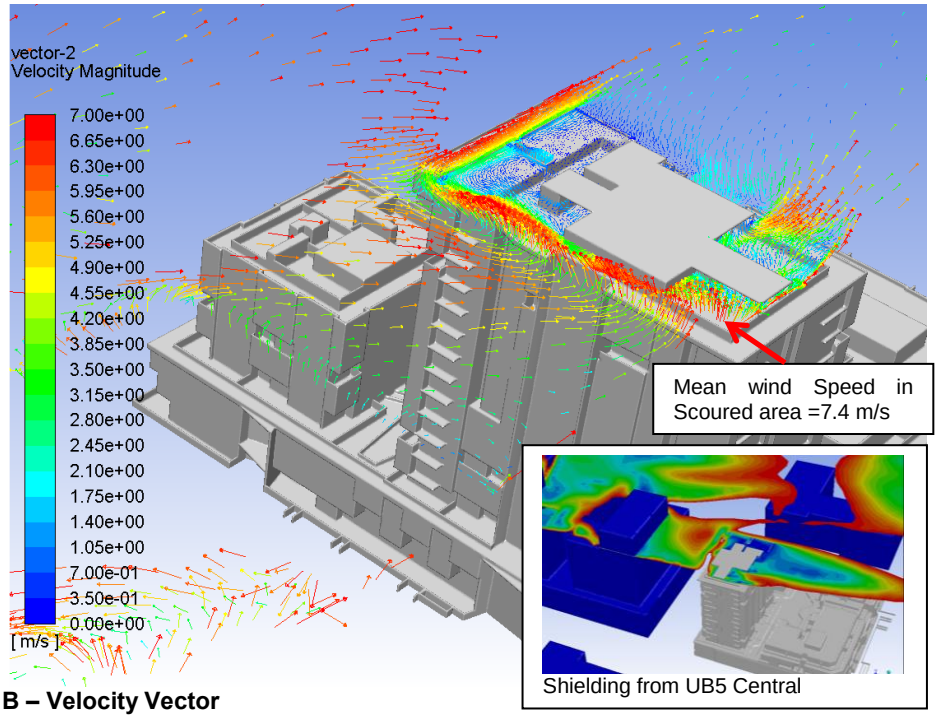


B – Velocity Vectors

Figure 9 Velocity Magnitudes (m/s) at 1.5 m above floor of L16 Roof Terrace – West Winds

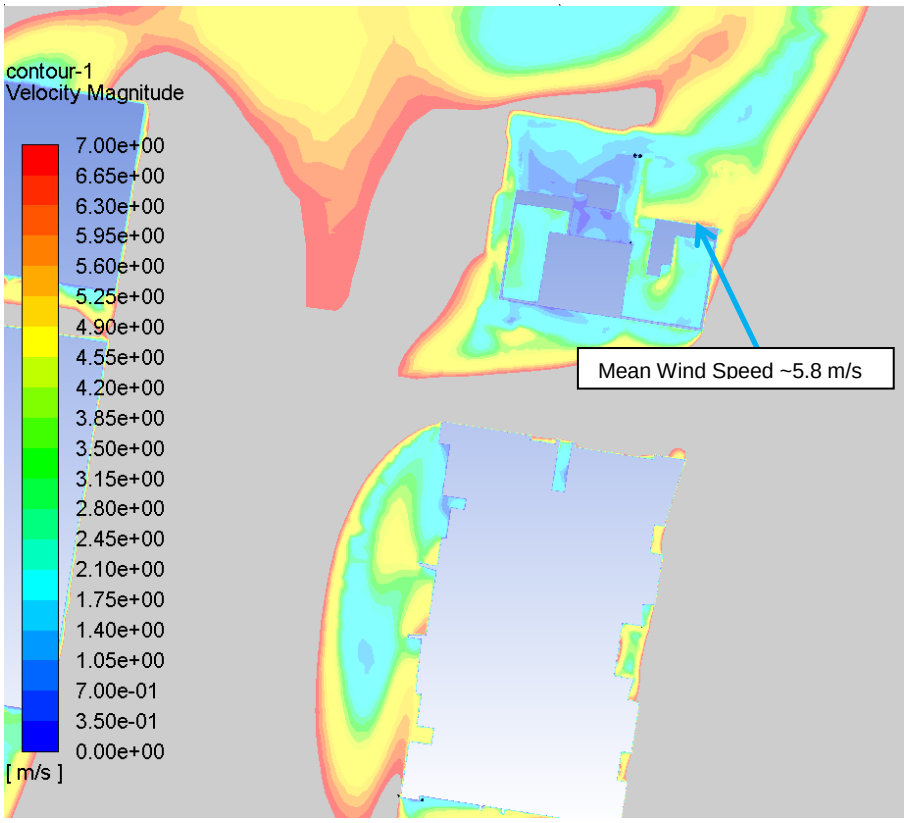


A – Velocity Contours

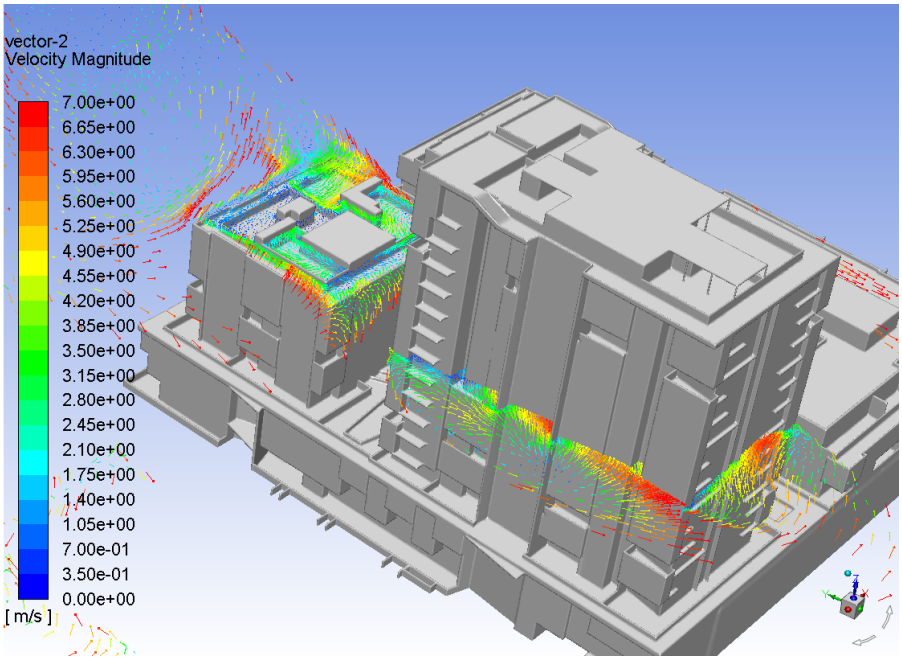


B – Velocity Vector

Figure 10 Velocity Magnitudes (m/s) at 1.5 m above floor of L8 Roof Terrace – North East Winds

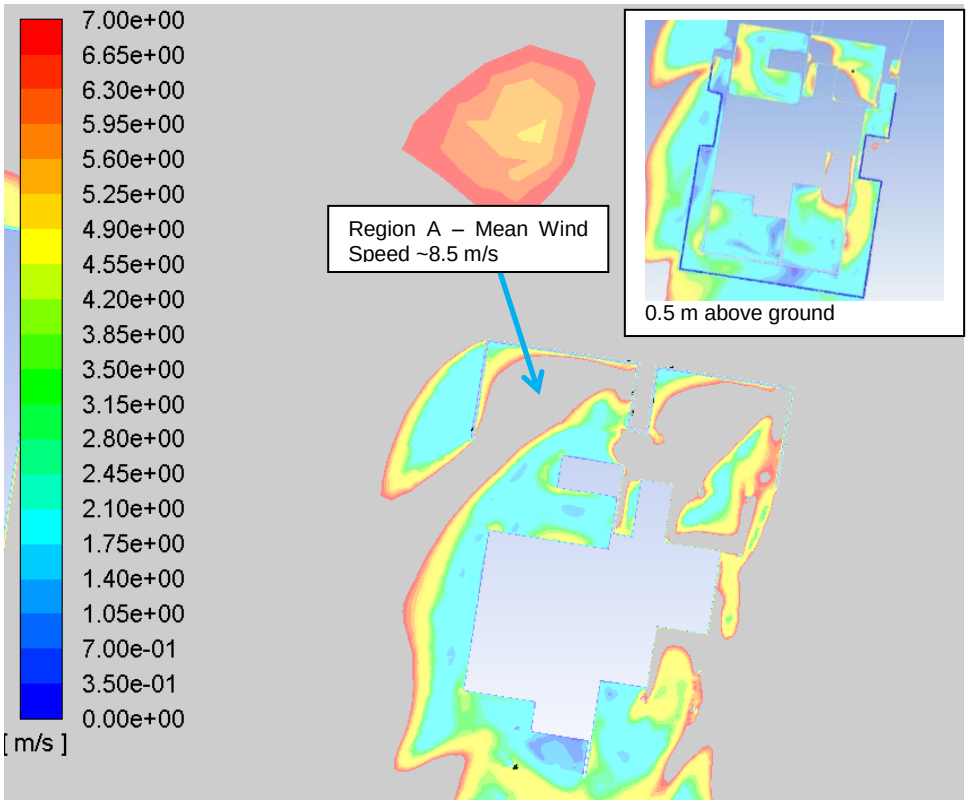


B – Velocity Contours

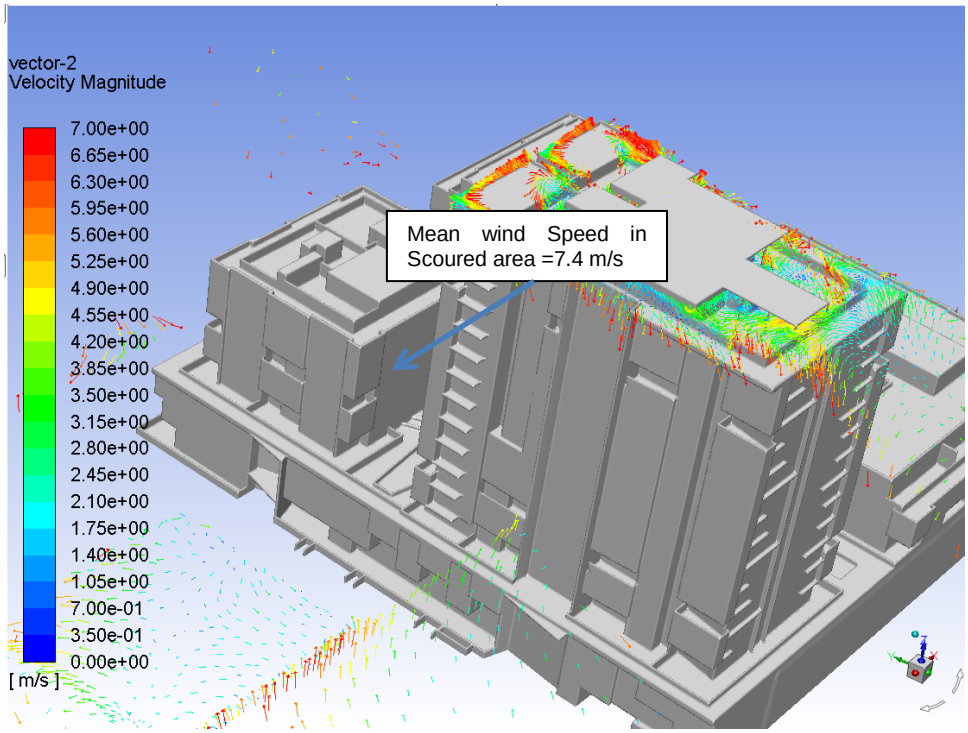


B – Velocity Vector

Figure 11 Velocity Magnitudes (m/s) at 1.5 m above floor of Level 15 Roof Terrace – North East Winds

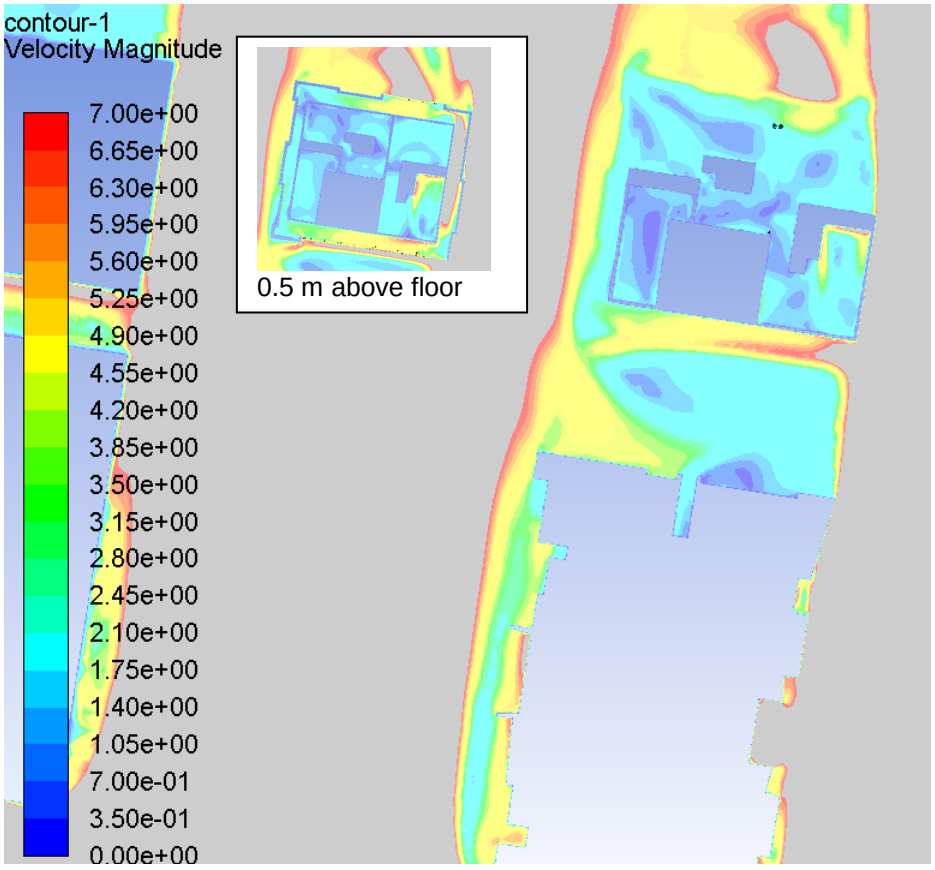


A – Velocity Contours

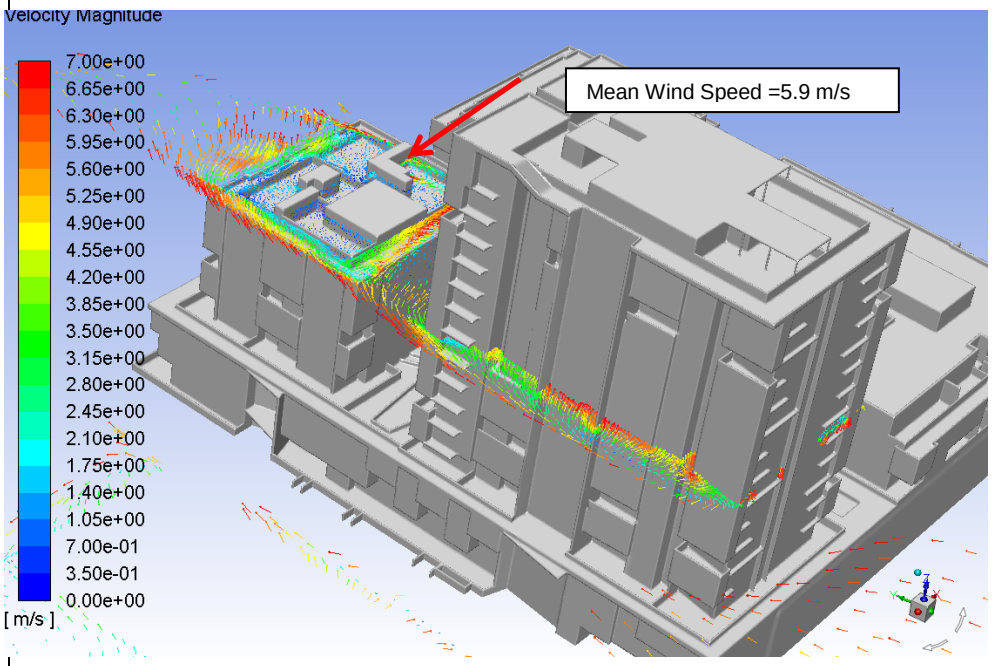


B – Velocity Vector

Figure 12 Velocity Magnitudes (m/s) at 1.5 m above floor of L8 Roof Terrace – South Winds

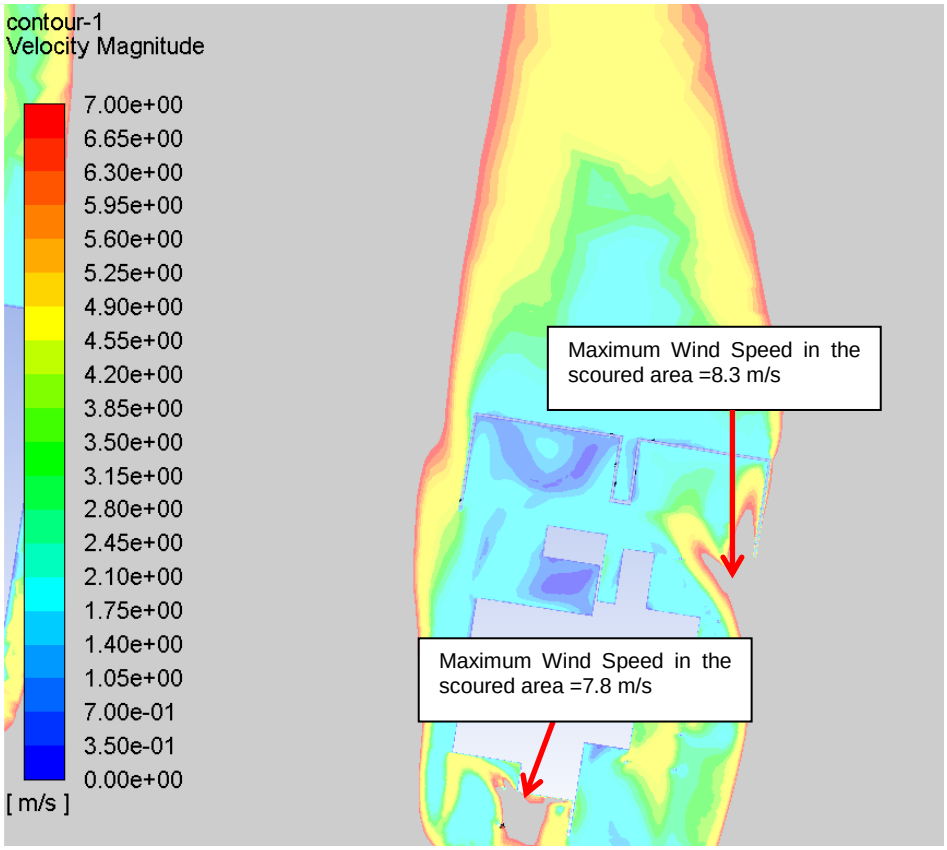


A – Velocity Contours

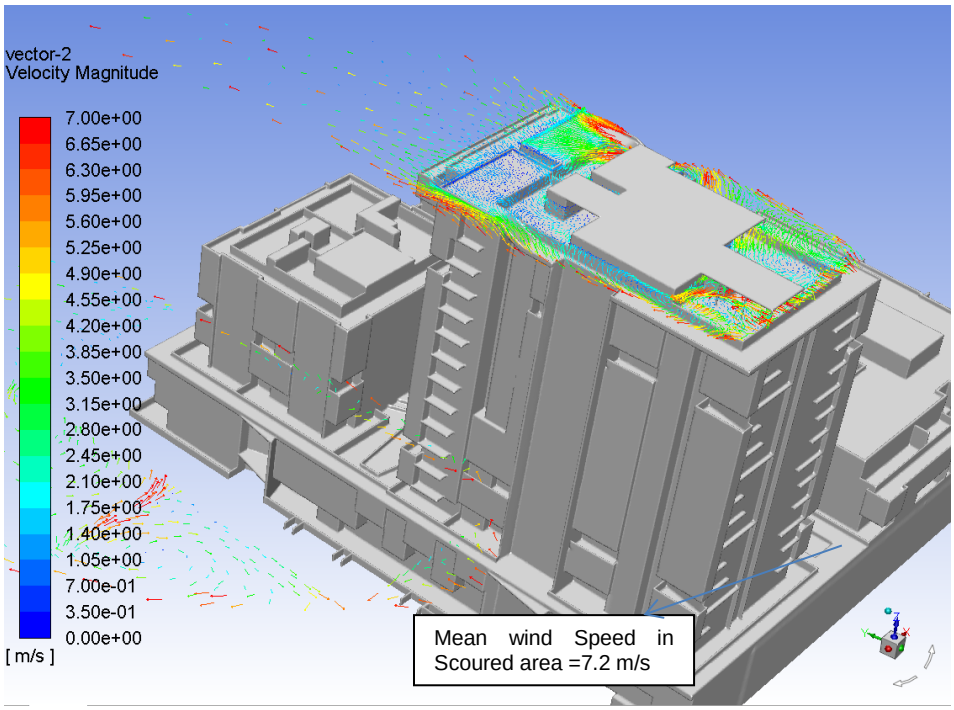


B – Velocity Vector

Figure 13 Velocity Magnitudes (m/s) at 1.5 m above floor of L16 Roof Terrace – South Winds



A – Velocity Contours



B – Velocity Vector

3 RECOMMENDATIONS

On the basis of the CFD modelling described in this study, there are no areas predicted to experience winds which may pose an actual hazard to users of the development, ie exceed safety criteria. The following recommendations are made to improve the dining comfort condition for the private terraces:

1. Retain the proposed vertical windbreak of 1.395 m (ie balustrade) surrounding the open spaces of the Level 8 terraces areas.

2. Increase the height of the vertical wind screen to 1.8 m (1.395 m balustrade + 0.405 m planter) where specified on the Level 16 terraces (Refer **Figure 9**), remaining balustrade to be set at proposed 1.395m.

3. Use Pergolas or similar over seating areas to further improve environment winds especially, for the Level 8 open terraces are recommended.

Alternatively, no additional recommendation is required if the seating areas are limited to areas with low wind speed as detailed in the body of the report, ie the areas shaded in yellow, green and blue in **Figure 8** to **Figure14**.

Figure 14 Mitigation Recommendations – Level 16