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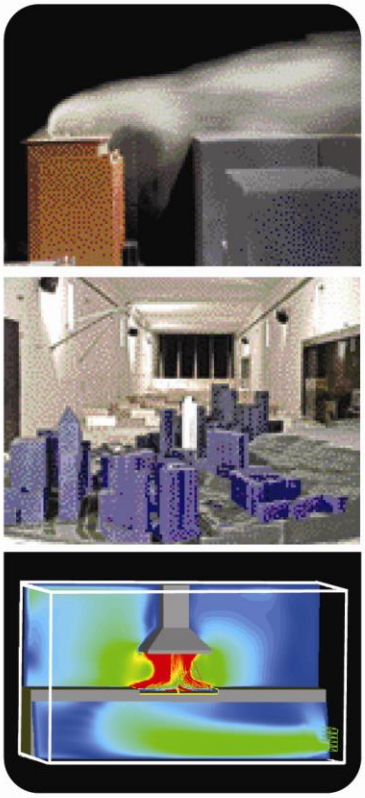
WIND ENGINEERING AND AIR QUALITY CONSULTANTS

FINAL REPORT



Wind Assessment for:

IVANHOE ESTATE

Macquarie Park, NSW, Australia

Frasers Property Ivanhoe

c/o Frasers Property Australia Pty Ltd

1 Homebush Bay Drive

Rhodes

NSW 2138

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CPP Project 11743

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Executive Summary

This report provides an opinion based qualitative assessment of the impact of the proposed Ivanhoe Estate masterplan on the local pedestrian-level wind environment. This assessment is based on knowledge of the local wind climate. The assessment considers the revised masterplan layout as of July 2018 and provides a comparison of the revised and original masterplan layout, which was assessed in a previous CPP report (CPP, 2017).

With reference to the City of Ryde DCP criteria, the environmental wind conditions around the proposed development are expected to be suitable for pedestrian walking from a comfort perspective and pass the safety criterion, which is generally suitable for the intended use of the public outdoor spaces in the precinct. For any areas intended for outdoor seating, local mitigation measures are likely required, which can be developed as part of the further design of the individual buildings in the precinct. The pattern of the proposed buildings is expected to encourage channelling of winds through the main roads throughout the precinct.

DOCUMENT VERIFICATION

Date	Revision	Prepared by	Checked by	Approved by
09/08/2018	Initial release	JP	CR	JP
23/08/2018	Minor amendments	JP	CR	JP
18/09/2018	Updated drawings	JP		JP

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Introduction

Cermak Peterka Petersen Pty. Ltd. has been engaged by Frasers Property Ivanhoe to provide an opinion based assessment of the impact of the proposed Ivanhoe Estate masterplan on the local wind environment. The site of approximately 400 m by 200 m is located in Macquarie Park on the southern side of Herring Road and the eastern side of Epping Road, approximately 400 m south of Macquarie University campus, Figure 1. The surrounding area is dominated by low- to medium-rise buildings, with the towers of Macquarie Park Village directly to the north-west being of similar height to the proposed development. The site is proposed to be developed in 8 stages and to include mixed-use primarily residential buildings 8-24 storeys height, Figure 2 and Figure 3.

The main differences between the original masterplan layout as of December 2017 and the revised layout of July 2018 are the removal of building C2 as well as changes in the massing and heights of the remaining buildings. These changes primarily affect buildings A2, A3, B3, C4, and D4.

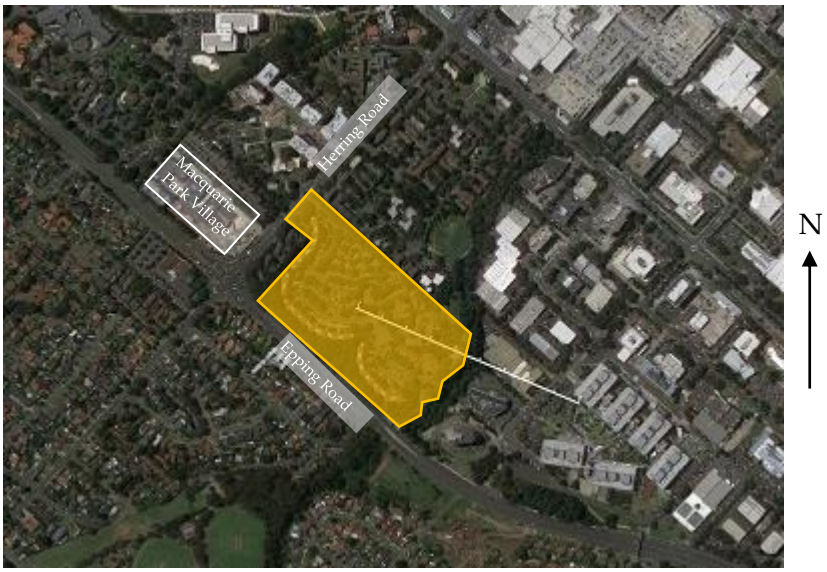

Figure 1: Aerial view with proposed development site highlighted (Google Earth, 2017)

Figure 2: Masterplan of the proposed development
(Frasers Property Ivanhoe, 2018)

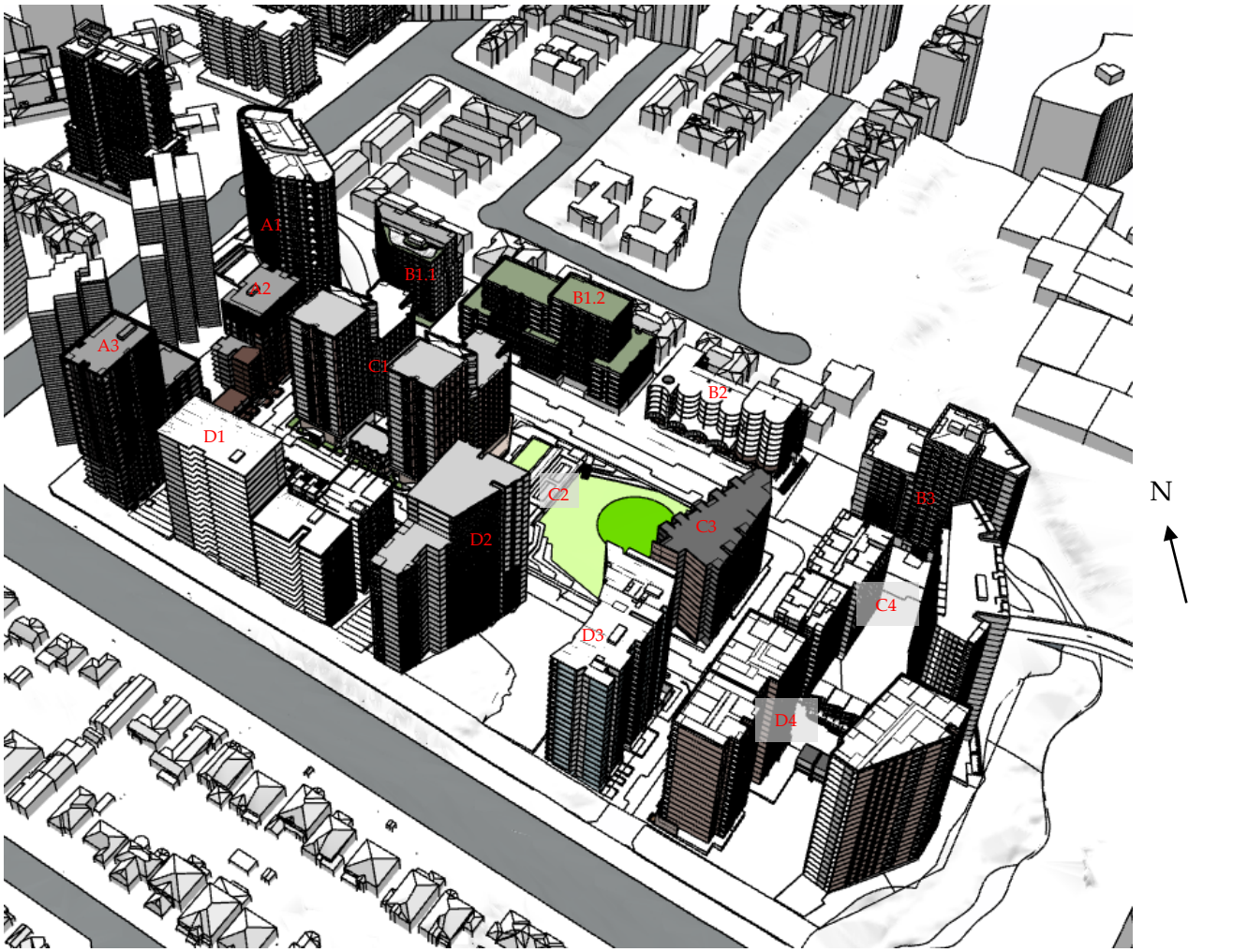

Figure 3: 3d sketch of the masterplan of the proposed development
(Frasers Property Ivanhoe, 2018)

Macquarie Park Wind Climate

The proposed development is located about 19 km to the north of the Bankstown Airport Bureau of Meteorology anemometer and 21 km to the north-west of the Sydney Airport anemometer. The general wind roses for Bankstown and Sydney Airports are presented in Figure 4. In coastal Sydney, winds from the north-east tend to be summer sea breezes and bring welcome relief on summer days, but dissipate with distance from the coast and are significantly diminished at Bankstown. In terms of distance from the coast, the site is located approximately halfway between the two airports. For this development, a superstation has been created by analysing data at both stations from 1995-2017 and performing statistics on the extended dataset. The result of this analysis is indicated in Figure 4.

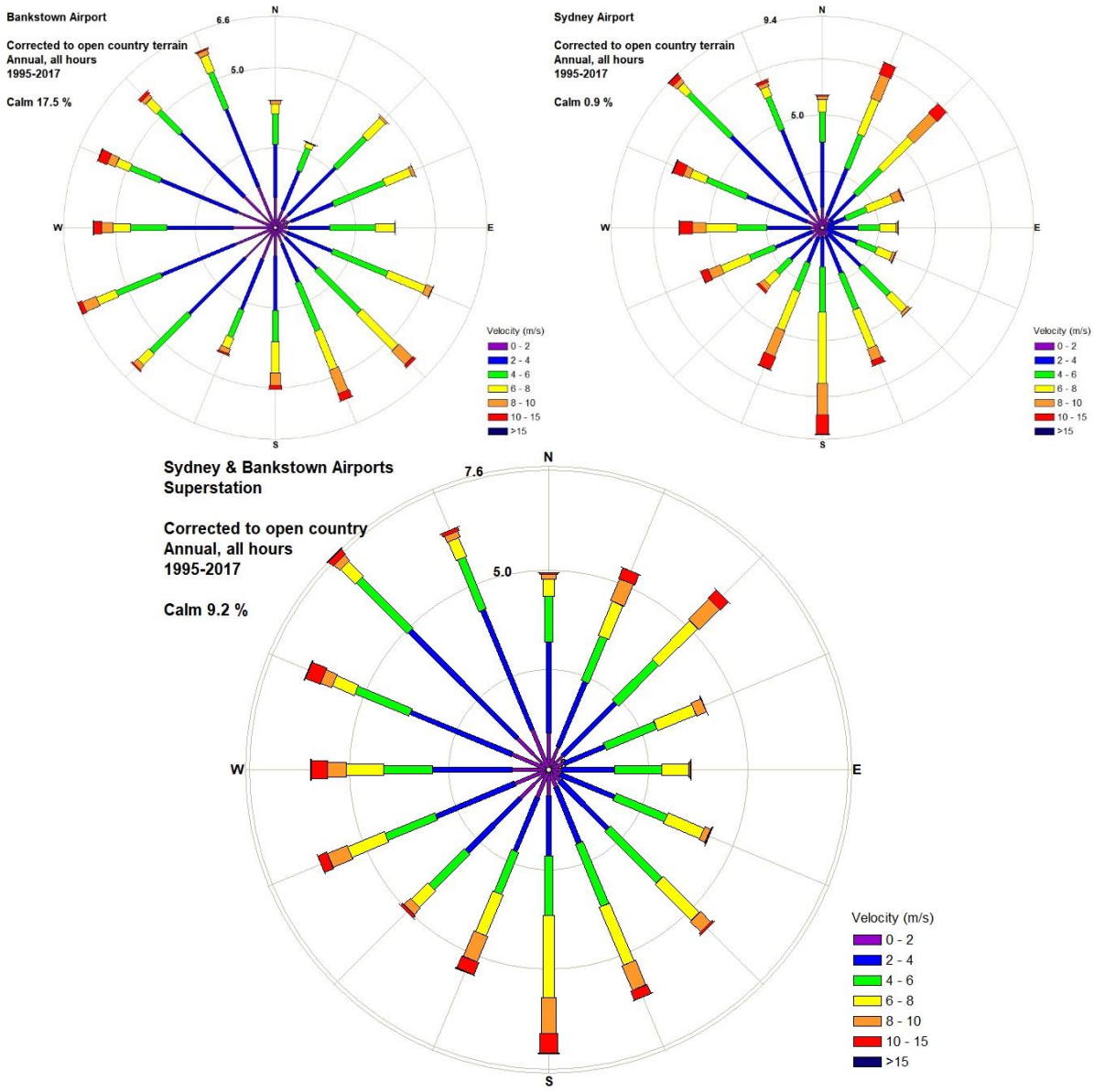

Figure 4: Wind roses for Bankstown and Sydney Airports (top), and superstation (bottom)

Winds from the south-east, which tend to be cold, are often caused by frontal systems that can last several days and occur throughout the year with reduced frequency in winter. Winds from the west tend to be the strongest of the year and are associated with large weather patterns and thunderstorm activity. These winds occur throughout the year, but are reduced in frequency in summer, and can be cold or warm depending on the inland conditions. The prevailing wind directions associated with rain are from the south and west quadrants. This wind assessment is focused on these prevailing wind directions. Seasonal wind roses for the superstation are presented in Appendix 1.

Environmental Wind Speed Criteria

This report refers to the City of Ryde 2014 Development Control Plan wind speed criteria for pedestrian comfort and safety. A detailed discussion of the criteria is provided in the wind assessment report for the original masterplan layout (CPP, 2017).

Wind Flow Mechanisms

A discussion of generic wind flow mechanisms and wind mitigation strategies applicable for the further design of the masterplan buildings is provided in the original wind assessment report (CPP, 2017).

Environmental Wind Assessment

The proposed developments in the precinct include buildings of up to 24 storeys in height, which are taller than most of the surrounding buildings, Figure 3. The precinct is primarily surrounded by low-rise buildings with the exception of several towers of similar height to the north-west, Figure 1 and Figure 3. The site has significant slope of approximately 23 m rising from the south-east to the north-west side of the site, Figure 5. It is understood that the areas to the north of the site were recently rezoned for increased density and height as part of the Herring Road Priority Precinct. The addition of future medium and high-rise buildings in the area will affect the local wind environment.

The buildings in the precinct are arranged in a relatively regular pattern, Figure 2, and the majority do not present any horizontal articulation with height, such as podia and building setbacks. Some of the buildings show negative setbacks in the revised masterplan, which is understood to be subject to further design and will be addressed in the development application of the respective stages.

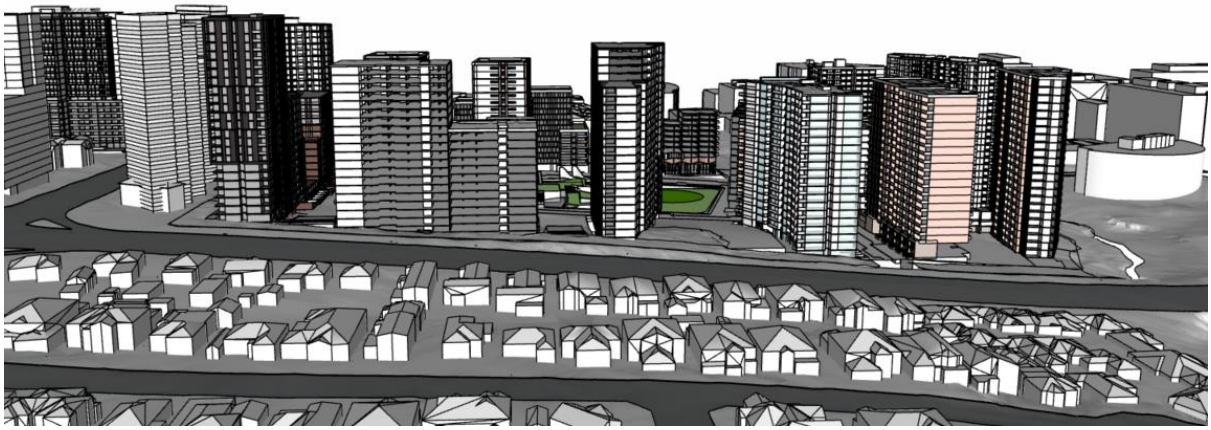

Figure 5: South-west view of the proposed masterplan (Frasers Property Ivanhoe, 2018)

The regular distribution pattern of buildings encourages channelling effects that can cause uncomfortably windy conditions in the streets aligning with the prevailing wind directions. The sheer façade of a tall building, such as those in the precinct, has the potential to produce significant downwash flow, which will accelerate around the windward corners at the base of the towers. The inclusion of a colonnade or reverse podium on the side walls of such buildings has the potential to induce strong winds through these areas. The wind climate is not expected to be strong enough to cause safety issues. Some mitigation measures are expected to be required to achieve a wind environment that would be deemed suitable by patrons in café and recreational areas. It is understood that these measures will be evaluated as part of the wind tunnel and CWE test programme during future detailed design stages. The revised masterplan shows fewer buildings with negative setbacks than the original masterplan, which is beneficial from a wind perspective.

Winds from the west

Winds from the west quadrant reach the site relatively unimpeded, as the upstream buildings are primarily low-rise structures which provide no significant shielding to the site. The buildings in the masterplan mostly do not have major facades facing west, which is expected to reduce the amount of downwash being generated for winds from the north-west to west. The mostly narrow facades of the buildings along Epping Road facing south-west would be expected to generate some downwash for winds from the south-west, which would lead to windy conditions at ground level particularly near the building corners on the south-west, Figure 6. The inclusion of setbacks or awnings on that side could minimise the impact of the downwash at ground level. Due to the setback of the buildings from Epping Road the accelerated flow would primarily affect areas within the site boundary.

The massing changes foreseen in the revised masterplan for the buildings along the south-west of the precinct would only have a minor effect on the downwash, and the wind conditions would be expected to be similar to the original masterplan along Epping Road.

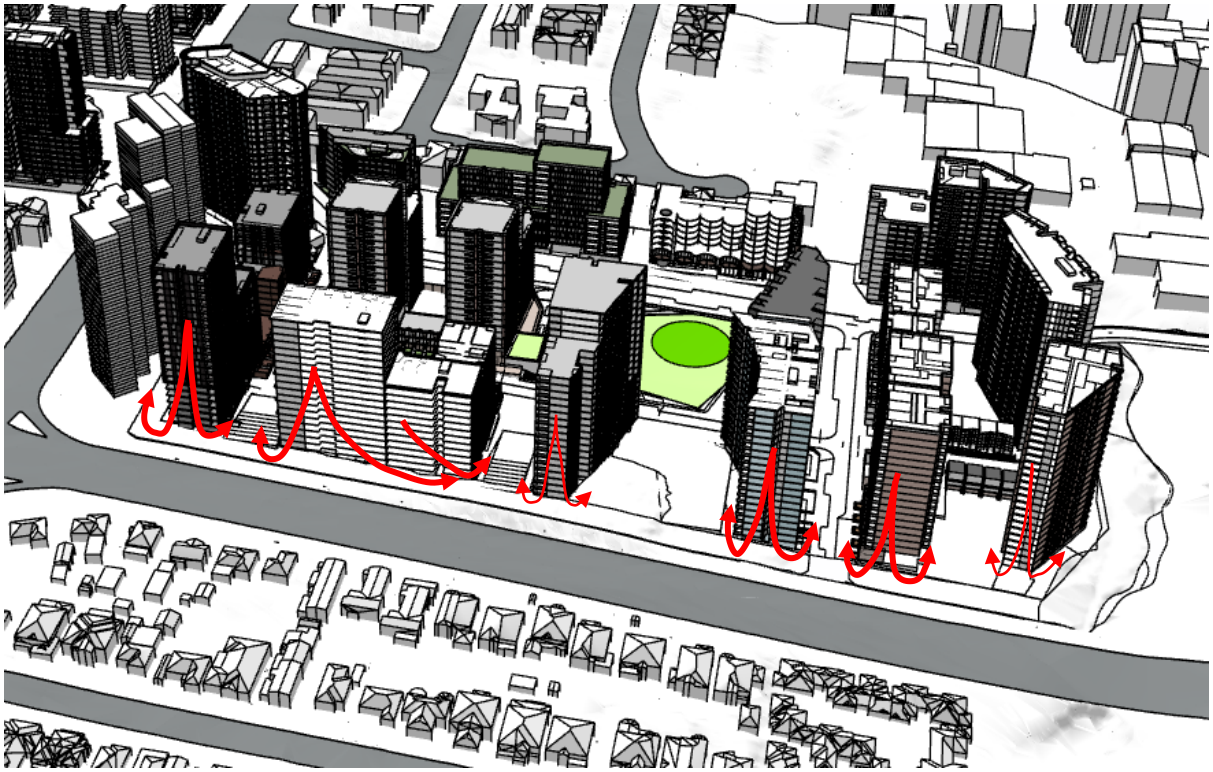

Figure 6: Downwash on south-western facades along Epping Road

Furthermore, several roads in the precinct align with winds from the south-west, and would hence be expected to cause channelling effects along these roads, Figure 7. Any areas along these roads that are intended for stationary use would be expected to require some level of mitigation to improve the wind conditions. Local screening around seating areas particularly in the retail area in the centre of the precinct, or dense evergreen landscaping would be recommended to provide protection for seated

pedestrians in these areas. Details of these mitigation measures are expected to be developed as part of the further design of the individual buildings in the precinct. The articulation of the retail and communal area in the space previously occupied by building C2 to the south-east would provide some local protection from the channelling winds for the different areas of the space, particularly for the lowest level.

The removal of building C2 would allow the channelling winds between building D2 and D3 to expand into the communal open space and hence reduce wind speeds on the western side of the open space compared with the original masterplan layout. As building C2 did also provide some shielding for the area to the east of it, the removal of the building could result in slight increases in the wind speeds in this area for wind from the south-west. Overall, the removal of C2 is expected to be beneficial for the wind conditions in the communal space.

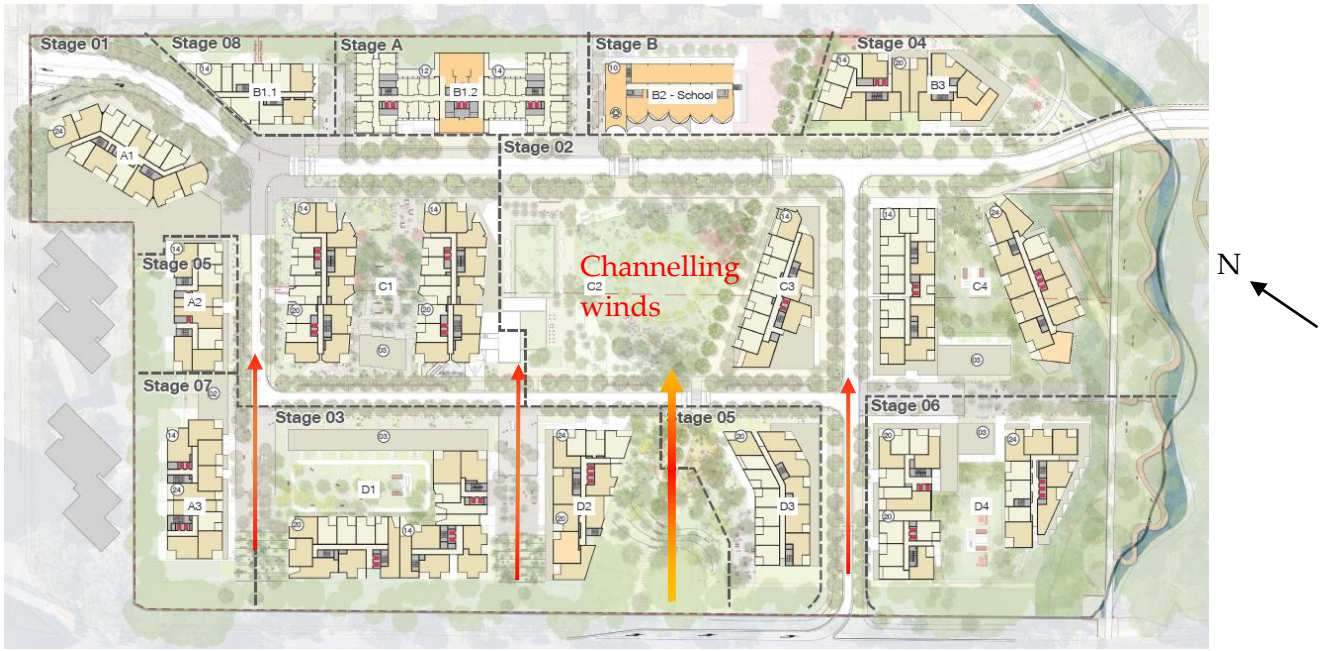

Figure 7: Channelling winds from the south-west

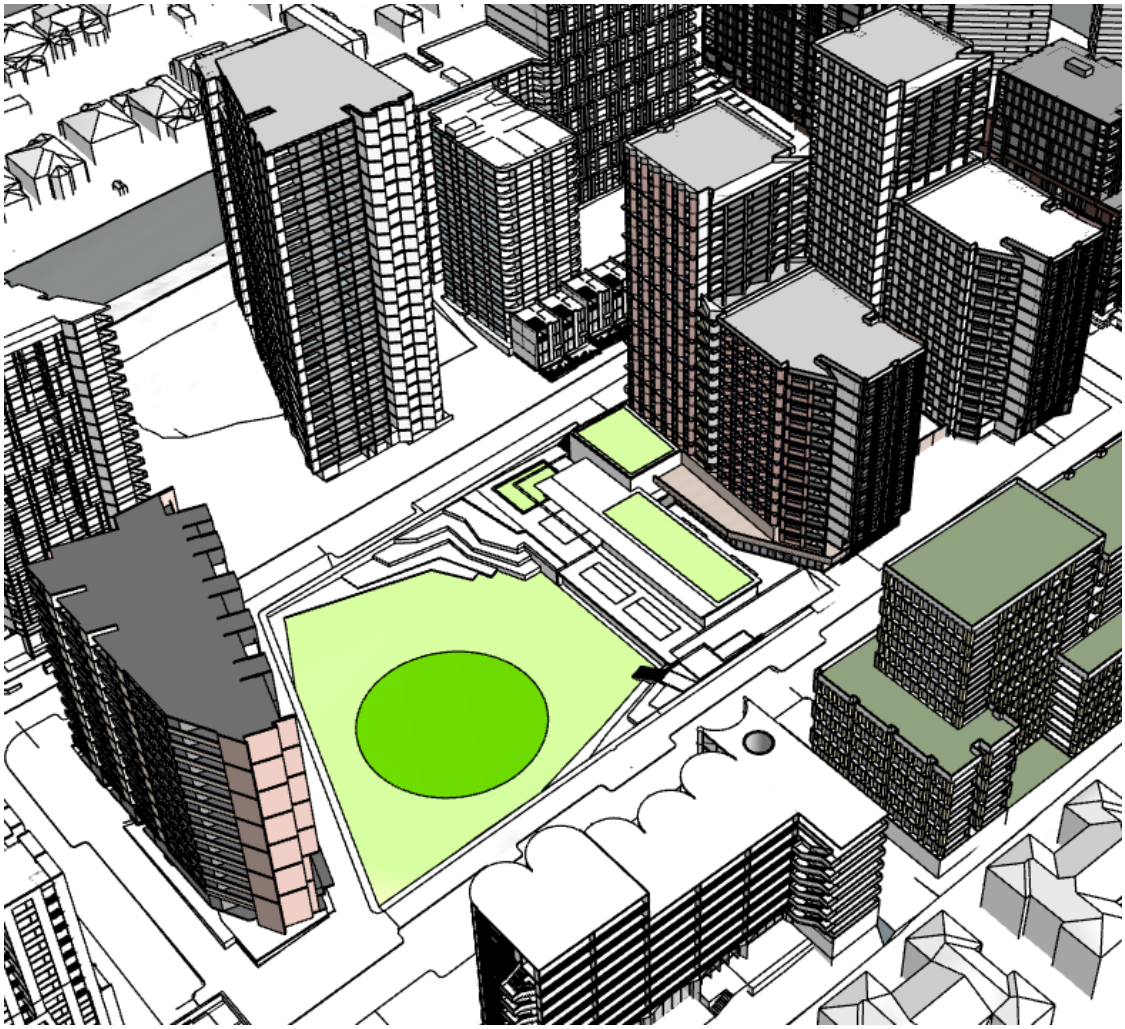

Figure 8: View of the retail area from the east.

Winds from the south-east

The significant slope of the terrain is expected to accelerate winds from the south-east quadrant into the site. Channelling can be expected around the precinct, especially between the buildings located along the two main roads running through the precinct parallel to Epping Road.

It is understood that these roads are primarily intended for use as an accessway and would not generally be used for outdoor seating. If any long term stationary outdoor activities are intended for the areas along these main roads, wind mitigation in the form of local screens or dense landscaping would be recommended.

The building shape and orientation on the south-eastern side of the precinct aids in reducing the amount of downwash generated for winds from the south-east. The increased height of these buildings in the revised masterplan is therefore expected to have only a minor effect on the wind conditions.

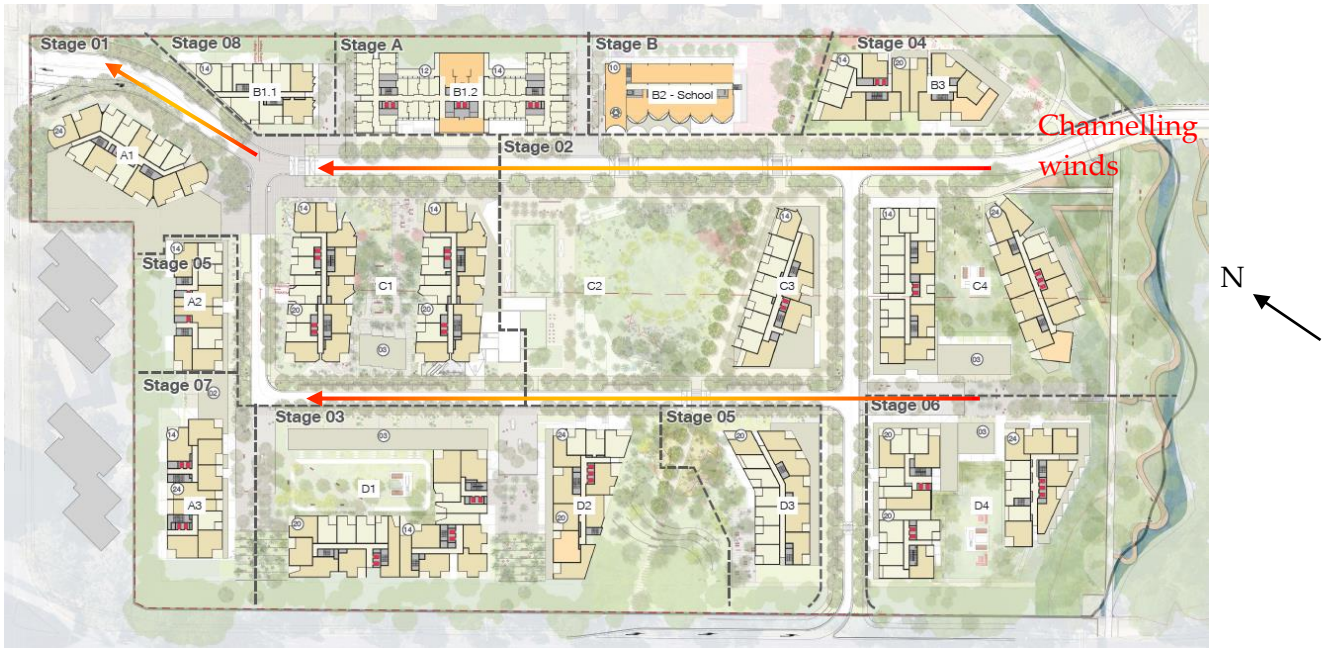

Figure 9: Channelling winds from the south-east

Winds from the east-south-east have potential to generate downwash from the wide exposed façade of the tallest tower in the precinct at the Herring Road entrance causing windy conditions around the base of the tower particularly near the corners. The rounded shape of the tower is beneficial to reduce the amount of downwash, however the wide east façade is still expected to generate downwash for winds impacting that side, Figure 10. Mitigation measures are recommended to be developed as part of the further design of this building.

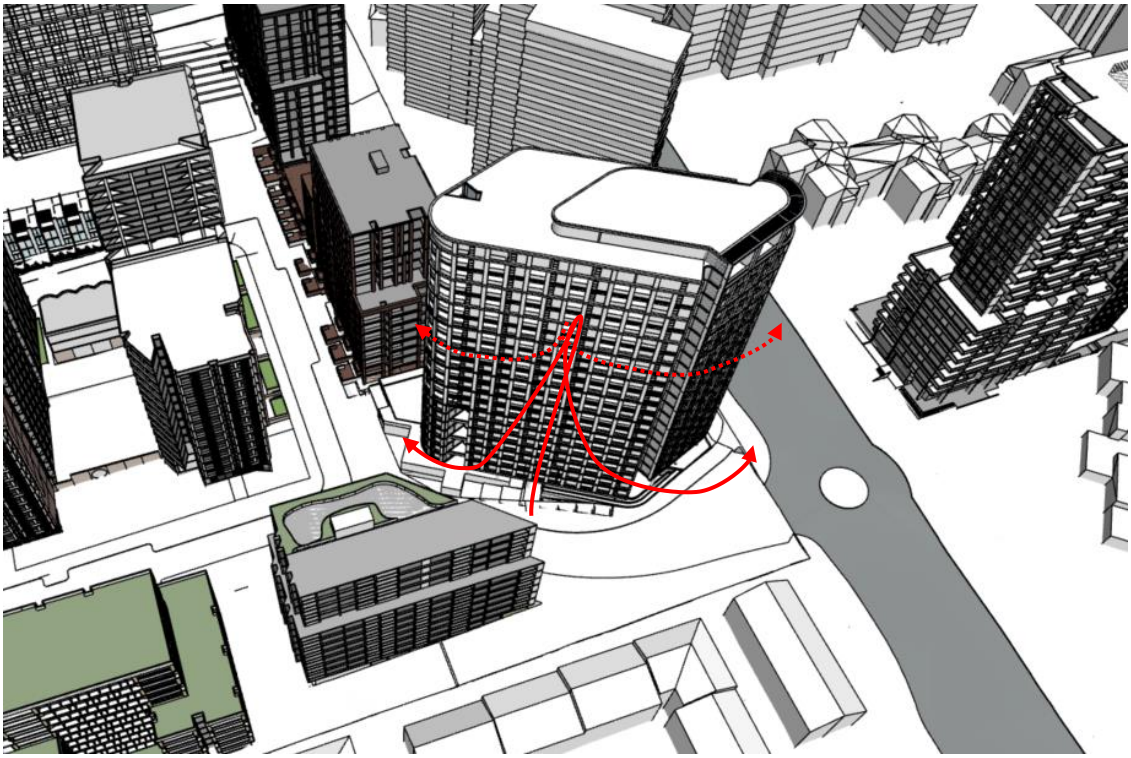

Figure 10: Downwash on the east façade on Herring Road

Summary

In general, wind conditions in and around the proposed masterplan site are expected to be suitable for use as a main public accessway. In relation to the DCP criteria, the wind conditions around the precinct are expected to be classified as suitable for pedestrian standing and walking from a comfort perspective with the exception of some localised hotspots, and to pass the distress criterion. It is recommended that any hotspots are treated with mitigation measures to be developed during further design of the buildings, if required for the intended use of the affected areas.

The impact of the massing and height changes in the revised masterplan on the wind conditions are expected to be relatively minor. The removal of building C2 would be expected to be overall beneficial for the wind conditions in the communal open area in the centre of the precinct.

Mitigation measures, e.g. in the form of local treatment through screens or dense landscaping, would be required in most areas if comfortable wind conditions for outdoor seating are required. In the absence of tower setbacks, it is expected that horizontal awnings will be required in many locations to help mitigate downwash and wind driven rain. Further assessments of the wind conditions in the various areas of the precinct are recommended at the time of the detailed development applications for each stage of the development.

Conclusion

Cermak Peterka Petersen Pty. Ltd. has provided an opinion based assessment of the impact on the local wind environment of the proposed Ivanhoe Estate masterplan.

The proposed development includes buildings that are taller than most surrounding buildings. Areas to the north of the precinct may be subject to future development of similar size due to recent changes in height and density restrictions in the area. The environmental wind conditions at ground level around the proposed development are expected to meet the comfort criteria for pedestrian standing and walking and to pass the safety criterion. The regular distribution pattern of the buildings would be expected to cause channelling effects particularly for winds from the south-west and south-east quadrant.

Mitigation measures would be expected to be required for intended seating areas to protect from downwash and channelled winds. In the absence of tower setbacks, horizontal awnings would be recommended to deflect downwash above ground level.

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Appendix 1: Wind Climate Analysis - Seasonal