WIND ENVIRONMENT DESKTOP STUDY
538 Karangahape Rd, Auckland

18 December 2023

Prepared for:
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Opinion on the Likely Wind Environment Effects of the Proposed Development at 538 Karangahape Road, Auckland Central

INTRODUCTION

The wind opinion for a proposed development at 538 Karangahape Rd (or K Rd) was requested by the James Kirkpatrick Group Limited (JKGL), who made contact with the writer and UniServices, and provided drawings. The signed contract for the wind opinion was received by UniServices on 7 November 2023. The writer visited the site 27 October 2023.

Online meetings took place between the writer and Mark Benjamin from the Mt Hobson Group (MHG), to clarify some aspects of the proposed development on 15 November 2023. A visual simulation file and a file showing the building outline was received by the writer on 15 November 2023.

Further online meetings took place as the writer sought further clarifications. Additional modifications along the SW face of the proposed building were discussed and agreed upon on 8 December 2023.

The final opinion has thus been formed from an assessment based on:

a) the site, surrounding terrain, topography and built environment –Google maps and site visit.

b) the proposed development plans of 'Fearon Hay' – provided by James Kirkpatrick Group Ltd.

c) the visual simulation and clarification files – provided by the Mt Hobson Group.

d) additional information gathered in online meetings and email exchanges.

e) knowledge of the wind climate of Auckland, and the prevailing and predominant wind conditions – from various sources and in-house knowledge.

f) knowledge of the Auckland Unitary Plan (AUP) pertaining to wind control, and

g) the knowledge, experience and expertise of a qualified wind engineer.

LOCATION AND SURROUNDINGS

The development is proposed on a site that is situated along a ridge line, along Karangahape or K Road, close to the Ponsonby Rd–Newton Rd intersection, at 583 K Rd. The ground slopes downward away from K Road, on either side of K Road.

The block runs approximately half-way along the length of Abbey Street and corresponding locations along K Road, starting from the Gundry Street end, as shown bounded by blue lines in Figure 1. There is a gentle slope downwards from K Road along Gundry Rd towards Abbey St.

The surrounding buildings along K Road, Grundy Street, Abbey Street, and beyond, are of heights of up to only about 15m on average.

Four relatively tall buildings situated on the opposite side of K Road around the NE–N–NW sectors of the site (see Figure 1), which while appearing to be somewhat taller than the proposed building, have significant spacing between them.

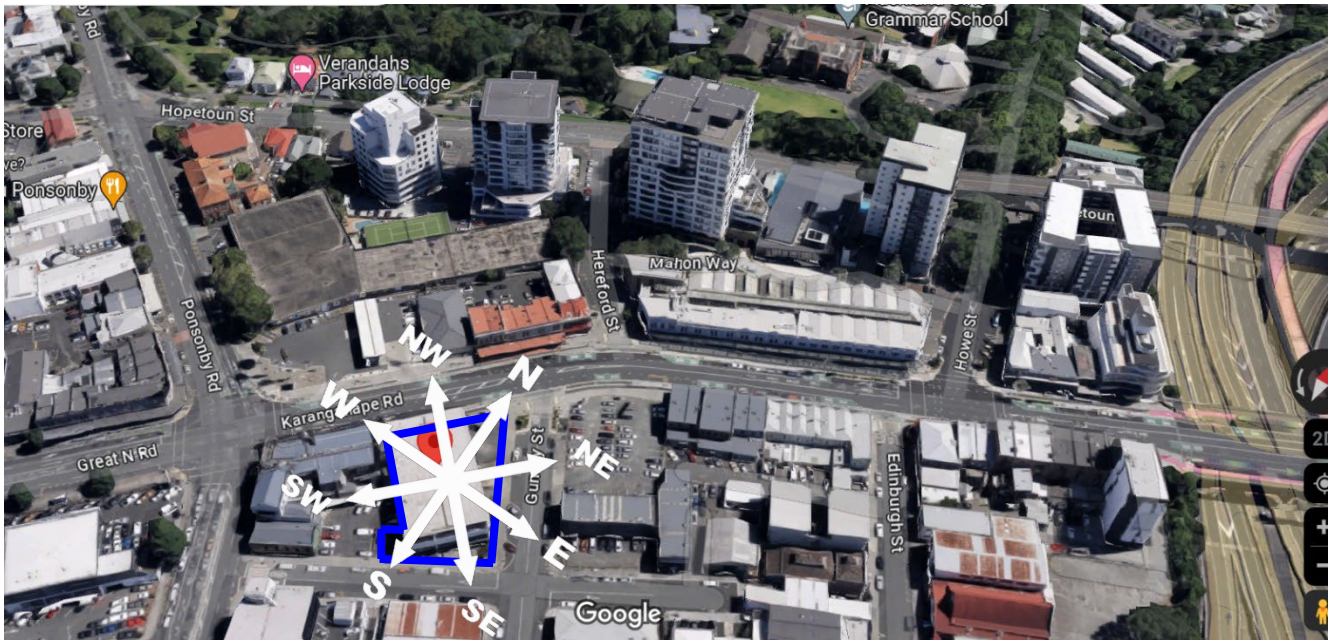


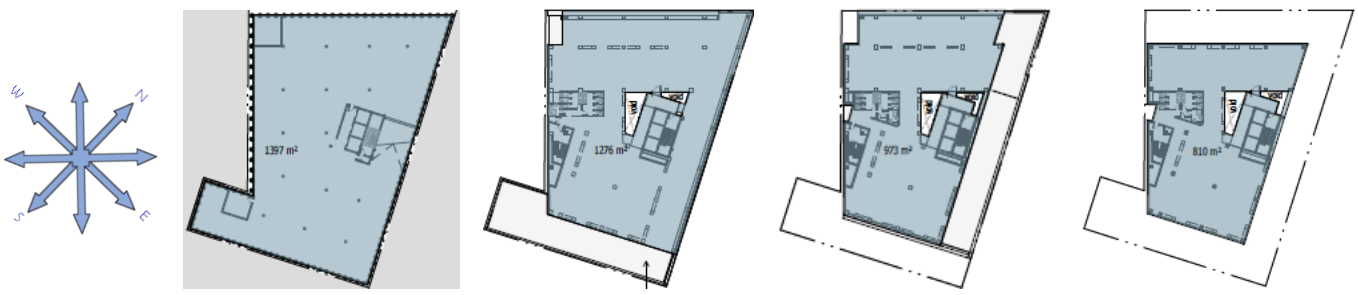
Figure 1 Site location at 583 K Rd, and surroundings

PROPOSED DEVELOPMENT

The proposed development consists of a mixed-use, ten level, approximately 46m high building with approximate extents along K Road [NE – SW] of 38m, along Gundry Street [NNE – SSW] of 52m, and along Abbey Street [ENE – WSW] of 34m.

The proposed building is stepped along its height, as indicated in Figures 2 – 4, with:

- Full extents from the K Road side, along Gundry Street, and to the Abbey Street side, on the Ground Level and on Levels 1 and 2.
- Step in by approximately 6 metres, from Level 3 upwards, on the Abbey Street side, where a top-open terrace is located.
- Step in by approximately 6 metres, from Level 4 upwards, on the Gundry Street side, where an enclosed terrace is located.
- Step in by approximately 6 metres, from Level 6 upwards, on the K Road side, where a top-open terrace is located.



Ground – Level 2 | Level 3 Upwards | Level 4 Upwards | Level 6 Upwards

Figure 2 Proposed building planform variation with height

Figure 3 Proposed building simulation – View from the northern side of K Road (near 501 K Rd) looking southwest towards the site.

Figure 4 Proposed building simulation – View from Great North Road at the intersection with Maidstone St, looking northeast toward the site.

AUCKLAND UNITARY PLAN (AUP) PERTAINING TO WIND CONTROL

A summary of comfort categories and typical activities as stated by Auckland City Council in its Unitary Plan are contained in Table 1, which is a simplification of Table H8.6.28.1, Performance Categories, from the City of Auckland, AUP, Chapter H8.6.28, Wind.

The AUP Figure H8.6.28.1 Wind Environment Control is included below in Figure 5.

Table 1 is used to identify relevant comfort categories around the development site. Figure 5 is used to assess their performance in conjunction with climate data that exists for Auckland city (presented next).

Table 1 Auckland City Wind Comfort Categories, Activities and Typical Locations (Summary version of AUP Table H8.6.28.1 Categories)

Performance Category	Pedestrian activity	Typical location
A	Sitting for long periods, reading, eating	Plazas, Mall, Open-air restaurant areas
B	Sitting for short periods	Streets with minor pleasance areas
C	Walking slowly	General footpaths and areas around buildings
D	Walking faster	Carriageways, car parks
E	Dangerous to pedestrians	

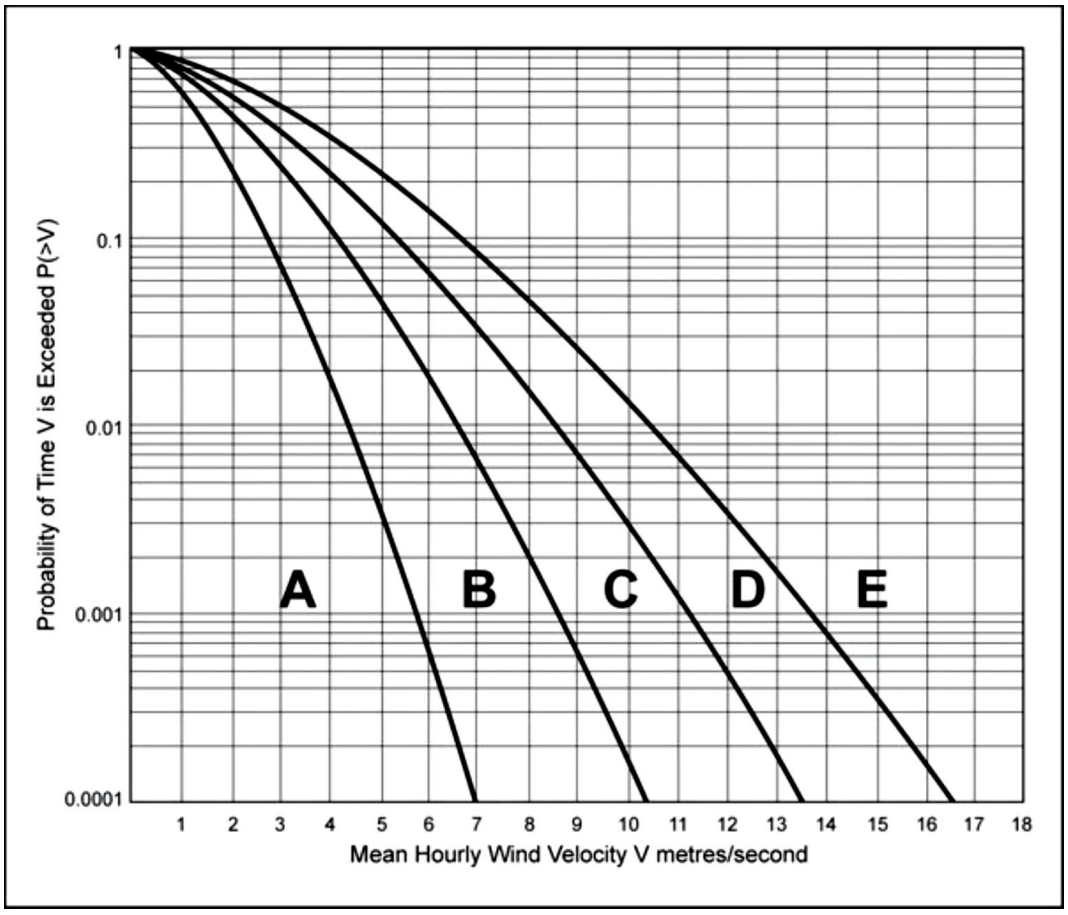


Figure 5 Auckland City Wind Environmental Control (AUP Figure H8.6.28.1 Wind Environment Control).

AUCKLAND WIND CLIMATE

The prevailing wind directions for Auckland are the NE and SW quarters. It is most common for winds to come from the SW, and this direction also brings many of the strongest winds, but the NE direction is also important and has strong winds, particularly from the tail ends of Tropical Cyclones that sometimes stray south to New Zealand.

The proportion of time that the wind blows from various directions (per 10° interval) is shown in Fig. 6. This has been developed using data from meteorological stations for a height of 200m, for which a = 5m/s and b = 10m/s. The outer rose or plot corresponds to all winds, i.e., it is the time that the wind blows from the indicated direction at any time the speed is greater than zero. The next (middle) rose or plot corresponds to the percent time that the wind speed is greater than 5 m/s (about 10 knots), and the inner rose corresponds to the percent time that the wind blows from the indicated direction with a wind speed greater than 10 m/s (about 20 knots). The graph peaks at 240 degrees, but it is high from 210 to 250 degrees. For winds from the NE, it peaks at 30 degrees.

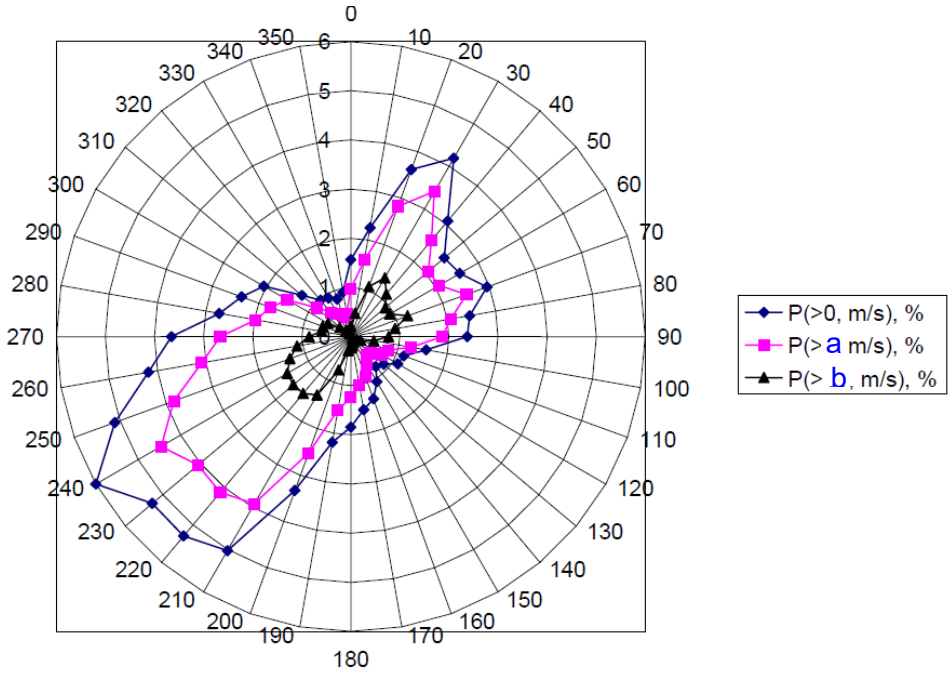


Figure 6 Composite wind rose developed for Auckland at a height of 200m for which a = 5m/s and b = 10m/s (The University of Auckland)

ESTIMATED WIND CLIMATE AT THE PROPOSED BUILDING SITE

The mean wind speeds at 200m height are adjusted to those at a typical elevation along the height of the proposed building from which downwash is created, using the procedure in the wind loading code, the AS/NZS1170.2:2011.

In arriving at these site relevant wind speeds, consideration has been made of: the predominant wind directions of SW and NE; the terrain categories for the different wind directions relative to the site; and the fact that the site lies approximately along the ridge line (along SW–NE), with very minimal topographical speed up to the site, or sheltering, for winds from the SW and NE directions.

It is noted also that, there are no nearby 'tall' buildings in the general upstream directions for the SW and NE winds, therefore sheltering effects are minimal, if any, and the site winds are not likely to be characterised by strong wake mixing flows along the height.

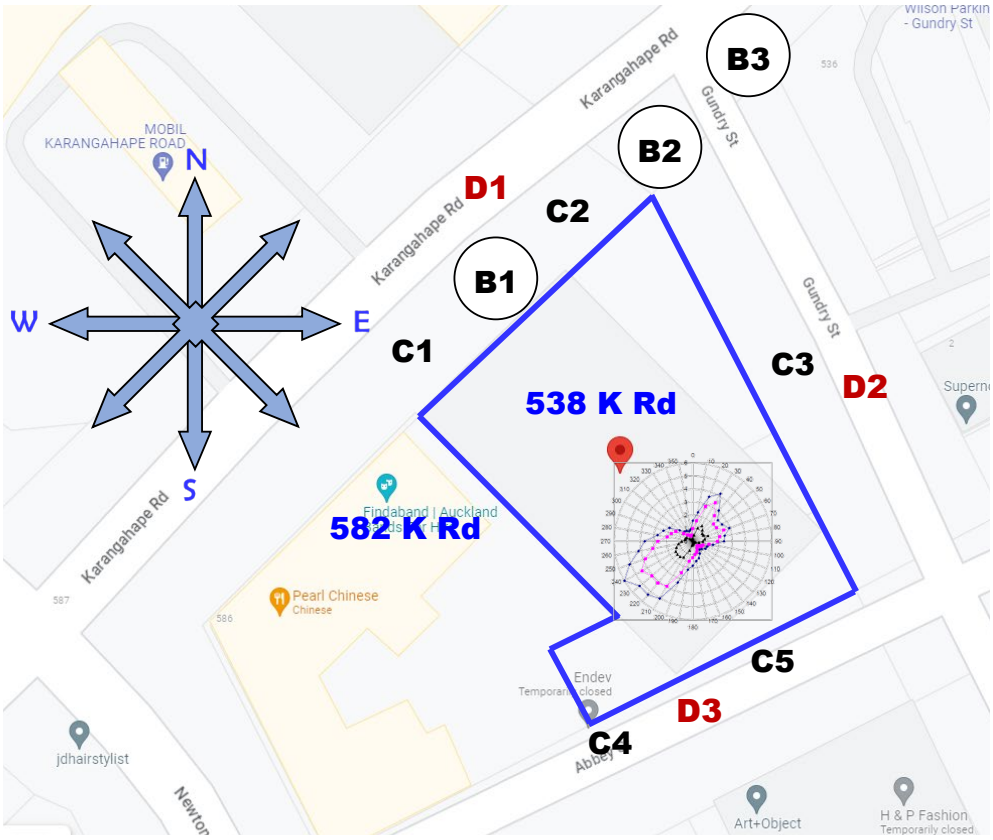
ESTIMATED PEDESTRIAN LEVEL WIND CONDITIONS

WIND PERFORMANCE CATEGORIES AROUND THE PROPOSED DEVELOPMENT SITE

Figure 7 identifies key wind performance category areas around the proposed development site, for which assessment is carried out. These areas include:

- Category B areas: B1, B2, B3 where small seating areas exist along K Rd.
- Category C areas: C1, C2, C3, C4, C5 where general footpaths exist around the building.
- Category D areas: D1, D2, D3 are the road carriageways surrounding the building.

(a)



(b)

Figure 7 Key wind performance categories around the proposed building site. Locations identified as B are existing small seating areas, those identified as C are pedestrian walkways, and D represents the carriageways.

EFFECT OF SOUTH-WESTERLY WINDS

The south-westerly winds are approximately perpendicular to the south-westerly slab-like face of the proposed building, and a strong downwash (downward flow of the in-flowing winds from approximately two-thirds the building height) is expected here. Absence of tall upstream buildings mean the proposed building is neither sheltered nor immersed in any strong vertically mixed wake flow.

Part of this side of the building, on the K Rd end, is adjacent to the 2to3-level building at 582 K Rd – the writer has been advised there will be no gap between the two buildings. A part on the Abbey St side has a 3-level extension to the proposed building. These leave a middle part that runs all the way down to the carpark at 582 K Rd – however modifications are proposed, including a 6–9m deep canopy and / or 300mm deep ribs (or fins) along here, as shown in Figure 8.

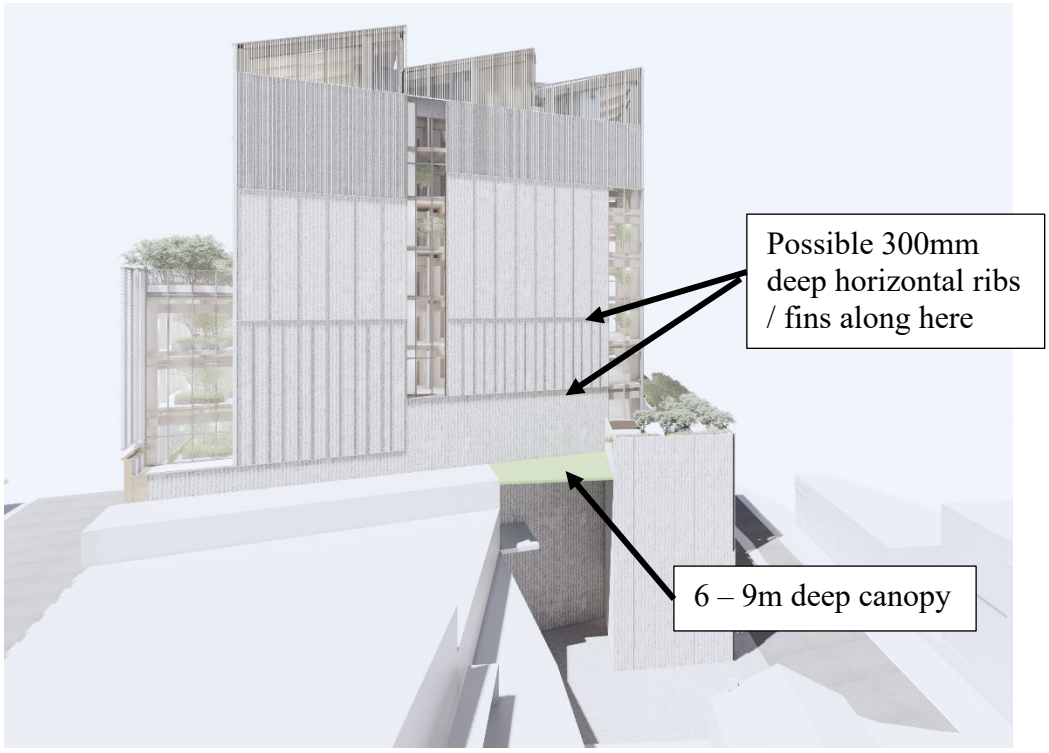


Figure 8 Canopy shown in light green on the SW face of the building.

As such, the downwash is expected to be divided up along three pathways, as follows (see Fig. 7):

- DW1 – On the K Rd end:
    - With no gap existing between the proposed building and that at 582 K Rd, this down-flow will strike the roof of the building at 582 K Rd and likely flow around until it meets the wind flows along K Rd at that height. (a) This is expected to be diffused away from the proposed building, above the pedestrian walkway canopy, and not impact on the pedestrian level wind speeds along the K Rd side of the proposed building. By the time there is any spill over of these winds onto street level on the Grundy Rd side, the writer is of the opinion that mixing in the lee-flow region will help mitigate any potential wind speed up effects at B2 or B3. (b) Any spill over from this height onto the K Rd carriageway, D1, will probably not have any serious impact there due to mixing and diffusion.

- DW2 – On the Abbey St end:
    - The down-flow will strike the step at level 3 of the proposed building there, and likely flow around and over until it meets the wind flows along Abbey St at that height, assisted by the step along Abbey St (over the terrace). This flow is therefore expected to be diffused away from the proposed building, above level 3, and not impact on the pedestrian level wind speeds along Abbey St in area C4 or Grundy Rd along C3 and D2.
- DW3 – In the central region:
    - Downwash will bring winds from upper heights right down to the car park area of 582 K Rd, and flow out the Abbey St driveway (to 582 K Rd), onto Abbey St, and likely turn around the proposed building at pedestrian level and join the wind flow along Abbey St, creating wind speed up around area C4 (also C5) and D3.
    - The probability of exceedance of winds at angles of 210, 220, 230, 240, 250, 260 and 270 degrees (representing the SW sector), result in a total probability of exceedance of 8 – 9 m/s winds (downwash joining existing low level flow) increase the flows and that will not meet the Wind environment control requirements of AUP (H8.6.28.1).
    - To reduce street level wind speeds and mitigate potential effects, it is proposed to install a 6 – 9m deep canopy on the southwestern elevation of the building (at approximately L3 floor level) and to also add a number of 300mm deep ribs / fins on this elevation (as shown in Figure 8. These elements will disperse the downwash around the building at height and ensure that the building will not bring about any significant enhancement of the winds at pedestrian level or the road carriageways.
    - Based on the assessment undertaken it is the opinion of the writer that the requirements of the AUP Standard H8.6.28.1 will therefore be met.

Effect of north-easterly winds

For the north-easterly winds, the writer is of the opinion that the presence of the 6m wide steps / terraces at levels 3 or 6 on the K Rd, Gundry Rd, and Abbey St sides of the proposed building, will arrest and diffuse downwash generated on the NW and N faces. It is therefore expected that there will be no speed-up of low level winds from the north-easterly flows, and the Wind environment control requirements of AUP (H8.6.28.1) for Performance Category C and D are very likely to be met.

Effect on gust wind speeds

Based on a desktop analysis, the writer is of the opinion that the average annual maximum peak 3-second gust will not exceed the dangerous level of 25m/second in any of the relevant areas in the vicinity and beyond the proposed building, thus will meet the Wind environment control requirements of AUP (H8.6.28.1(b)) for gust wind speeds.

OVERALL ASSESSMENT – CONCLUSIONS

The following conclusions are drawn from the desktop study of the pedestrian level wind conditions in public areas around the site (538 K Rd):

1. The proposed building, with a height of approximately 46m, at this site is exposed to the prevailing winds in Auckland, for the fact that it lies along a ridge line, and has minimal sheltering if any, for the lack of tall buildings in the upstream directions for the SW and NE sectors.

2. For the south-westerly winds,
   a) The presence the adjacent building roof at 582 K Rd on the K Rd side, with the assumption that no gap exists between the buildings at 538 and 582 K Rd, will mitigate the effects of downwash from the SW face of the building, on the pedestrian level wind conditions along and beyond the K Rd side of the site.
   b) The presence of a step at Level 3 of the proposed building on the Abbey St side, will help any downwash from the SW face of the building reaching there, be re-directed around and over the Abbey St side terrace, and is not likely to cause any speed-up of pedestrian level winds around and beyond the site.
   c) The downwash from the SW face of the building in the central region of the SW face has the potential to reach the ground level carpark area at 582 K Rd, and flow out and into Abbey St at pedestrian level, to create 'wind problems' in areas on the Abbey St side of the building. However, this can be mitigated by the use of a 6 – 9m canopy and a number of 300mm deep ribs / fins above this, as in Figure 8. The writer is of the opinion that this will be sufficient to disperse the downwash down the SW face of the building, and direct this flow around the building at height, therefore unlikely to create wind speed up issues at ground level.

3. No speed-up of pedestrian level winds are expected from the north-easterly flows, and the Wind environment control requirements of AUP (H8.6.28.1) are very likely to be met.

4. The average annual maximum peak 3-second gust will not exceed the dangerous level of 25m/s in any of the relevant areas in the vicinity and beyond the proposed building, thus meeting the Wind environment control requirements of AUP (H8.6.28.1(b)) for gust wind speeds.

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