17 SOPHIA STREET EAST, 3, 5, 7 & 11 MCDONALD STREET, AND 58 & 60 CLAPPERTON STREET

BARRIE, ON

PEDESTRIAN WIND ASSESSMENT

PROJECT #2104949

APRIL 13, 2022

SUBMITTED TO

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1. INTRODUCTION

Rowan Williams Davies & Irwin Inc. (RWDI) was retained to conduct a qualitative assessment of the pedestrian wind conditions expected around the proposed project at 17 Sophia Street East, 3, 5, 7 & 11 McDonald Street, and 58 & 60 Clapperton Street at Barrie, ON. A wind assessment is required by the City of Barrie for the Zoning By-Law Amendment as per their October 2018 Pedestrian Wind Terms of Reference.

The proposed site is located to the southwest of the intersection of McDonald St and Clapperton St (Image 1). The site is currently occupied by a lawn and two single-family residences. The site is surrounded by low to mid-rise commercial and residential developments, including a 7-storey residential building (11 Sophia St E) to its immediate southwest.

The project consists of a 21-storey mixed-use development with commercial units on the ground floor and residential units above (Image 2). A 3-storey podium is proposed around the west half of the development (see site plan in Image 3). The key areas of interest on the site for this assessment include the residential entrances, the commercial entrances, parking lots, walkways, and the grade-level outdoor amenity area at the northeast side of the site. Outside of the site, the assessed areas include the public sidewalks around the proposed development and the children playground of the adjacent 11 Sophia St E building.

Image 1: Aerial View of the Existing Site and Surroundings (Credit: Google Maps)

Image 2: Aerial View – Northeast

1. INTRODUCTION

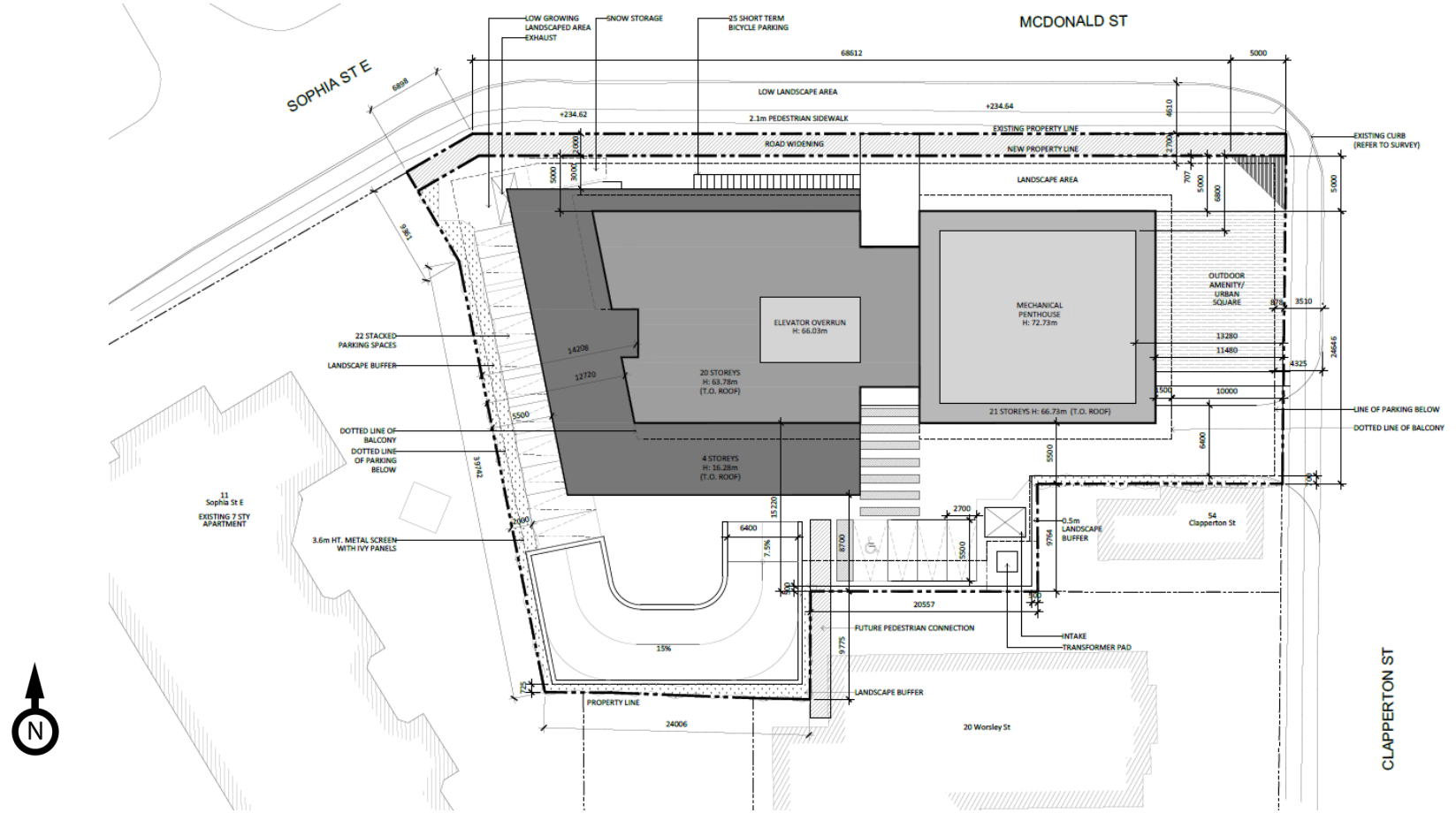


Image 3: Site Plan of the Proposed Development

2. METHODOLOGY

Predicting wind speeds and occurrence frequencies is complex. It involves the combined assessment of building geometry, orientation, position and height of surrounding buildings, upstream terrain and the local wind climate.

Over the years, RWDI has conducted thousands of wind-tunnel model studies on pedestrian wind conditions around buildings, yielding a broad knowledge base. In some situations, this knowledge and experience, together with literature, allow for a reliable, consistent and efficient desktop estimation of pedestrian wind conditions without wind-tunnel testing. This approach provides a screening-level estimation of potential wind conditions and offers conceptual wind control measures for improved wind comfort, where necessary.

In order to quantify and confirm the predicted conditions or refine any of the suggested conceptual wind control measures, physical scale model tests in a boundary-layer wind tunnel would be required.

RWDI's assessment is based on the following:

- Design drawings received on March 7, 2022;
- A review of the regional long-term meteorological data from Egbert Climate Station;
- Use of RWDI's proprietary software (*WindEstimator*[1]) for providing a screening-level numerical estimation of potential wind conditions around generalized building forms;
- Wind-tunnel studies and desktop assessments undertaken by RWDI for projects in the Barrie area;
- RWDI's engineering judgement and knowledge of wind flows around buildings[2, 3]; and,
- City of Barrie's criteria for pedestrian wind comfort and safety.

Note that other microclimate issues such as those relating to cladding and structural wind loads, door operability, building air quality, noise, vibration, etc. are not part of the scope of this assessment.

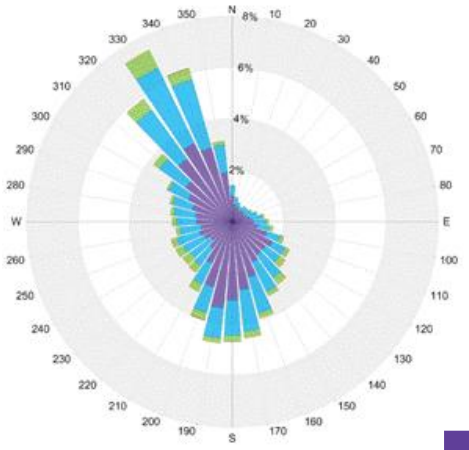
1. H. Wu, C.J. Williams, H.A. Baker and W.F. Waechter (2004), "Knowledge-based Desk-Top Analysis of Pedestrian Wind Conditions", *ASCE Structure Congress 2004,* Nashville, Tennessee.
2. H. Wu and F. Kriksic (2012). "Designing for Pedestrian Comfort in Response to Local Climate", *Journal of Wind Engineering and Industrial Aerodynamics*, vol.104-106, pp.397-407.
3. C.J. Williams, H. Wu, W.F. Waechter and H.A. Baker (1999), "Experience with Remedial Solutions to Control Pedestrian Wind Problems", *10th International Conference on Wind Engineering*, Copenhagen, Denmark.

3. METEOROLOGICAL DATA

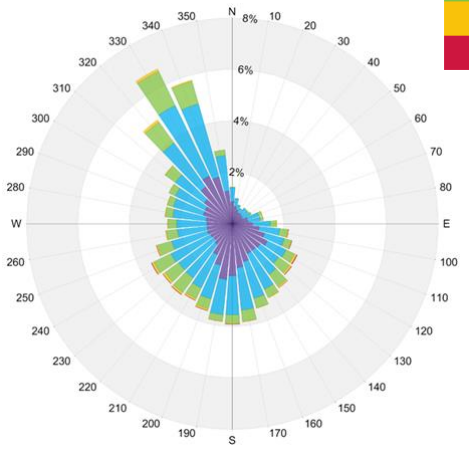
Meteorological data from Egbert Climate Station for the period from 2004 to 2020 was used as a reference for wind conditions in the area as this is the nearest station to the site with long-term, hourly wind data. The distributions of wind frequency and directionality for the summer (May through October) and winter (November through April) seasons are shown in the wind roses in Image 4.

Winds from the northwest and south are predominant throughout the year while winds from the southwest and southeast quadrants are additionally prevalent during the winter, as indicated by the wind roses.

Moderate winds of a speed greater than 20 km/h measured at the met station (green, yellow and red bands) occur more often in the winter than in the summer. Winds from the northwest and southwest potentially could be the source of uncomfortable wind conditions, depending upon the site exposure and development design.



Summer (May through October)



Winter (November through April)

Wind Speed (km/h)	Probability (%) Summer	Winter
Calm	1.7	1.0
1-10	57.4	41.9
11-20	33.8	42.0
21-30	6.7	13.7
31-40	0.3	1.2
>40	0.0	0.1

Image 4: Directional Distribution of Winds Approaching Egbert Climate Station (2004 to 2020)

4. WIND CRITERIA

The pedestrian wind criteria used in the current study are based on those referenced in the City of Barrie's Terms of Reference. The criteria are outlined below.

4.1 Pedestrian Safety

Pedestrian safety is associated with excessive gust wind speeds that can adversely affect a pedestrian's balance and footing. If strong winds that can affect a person's balance (90 km/h) occur more than 0.1% of the time or 9 hours per year, the wind conditions are considered severe.

4.2 Pedestrian Comfort

Sitting (≤ 10 km/h): Calm or light breezes desired for outdoor seating areas where one can read a paper without having it blown away.

Standing (≤ 15 km/h): Gentle breezes suitable for main building entrances and bus stops.

Walking (≤ 20 km/h): Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering.

Uncomfortable: None of the comfort categories are met.

Wind conditions are considered suitable for *sitting, standing* or *walking* if the associated mean wind speeds are expected for at least four out of five days (80% of the time). Wind control measures are typically required at locations where winds are rated as *uncomfortable,* or they exceed the wind safety criterion.

Note that these wind speeds are assessed at the pedestrian height (i.e., 1.5 m above grade or the concerned floor level), typically lower than those recorded in the airport (10 m height and open terrain).

These criteria for wind forces represent average wind tolerance. They are sometimes subjective and regional differences in wind climate and thermal conditions as well as variations in age, health, clothing, etc. can also affect people's perception of the wind climate.

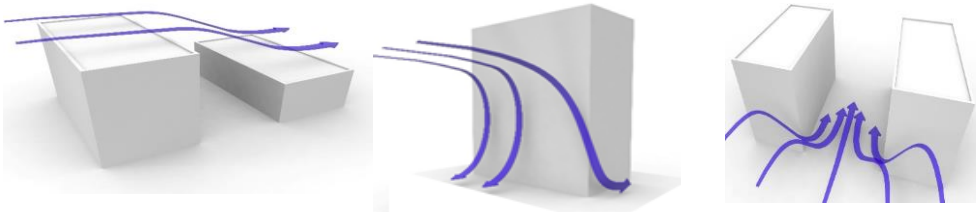
For the current development, wind speeds comfortable for *walking* are appropriate for sidewalks and lower wind speeds comfortable for *standing* are required for building entrances where pedestrians may linger. Wind speeds comfortable for *sitting* are appropriate for the designated seating spaces at the grade-level outdoor amenity area during the summer, when these areas will be mainly used.

5. RESULTS AND DISCUSSION

5.1 Wind Flow Around Buildings

Short buildings do not redirect winds significantly to cause adverse wind conditions at pedestrian areas (Image 5a). Tall buildings tend to intercept the stronger winds at higher elevations and redirect them to the ground level (downwashing), which subsequently move around exposed building corners, causing a localized increase in wind activity due to Corner Acceleration (Image 5b). When two buildings are situated side by side, wind tends to accelerate through the space between the buildings due to the channeling effect caused by the narrow gap (Image 5c). If these building / wind combinations occur for prevailing winds, there is a greater potential for increased wind activity and *uncomfortable* conditions.

Design details such as stepped massing, tower step-back from a podium edge, deep canopies close to ground level, wind screens / tall trees with dense underplanting, etc. (Image 6) can help reduce wind speeds. The choice and effectiveness of these measures would depend on the exposure and orientation of the site with respect to the prevailing wind directions and the size and massing of the proposed buildings.

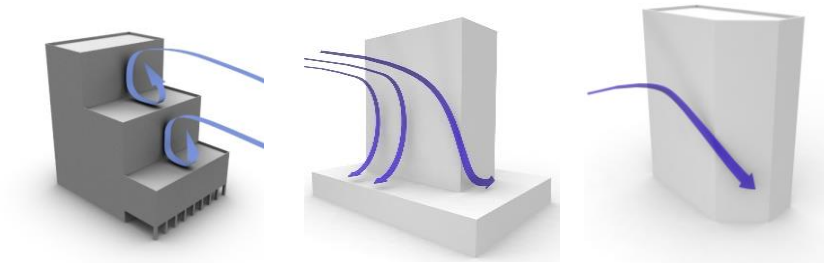


a) Wind flow over built terrain of uniform height

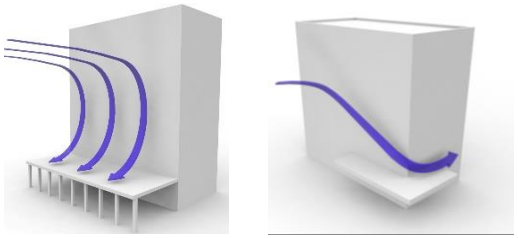
b) Downwashing and Corner Acceleration

c) Channeling Effect

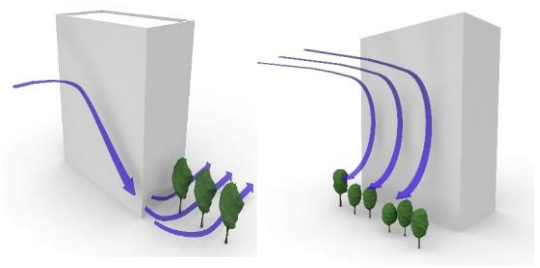
Image 5: Generalized Wind Flows



Stepped Massing ***Podium*** ***Chamfered Corner***



Canopy



Trees help reduce wind impact at ground level

Image 6: Examples of Common Wind Control Measures

5. RESULTS AND DISCUSSION

5.2 Existing Wind Conditions

The existing wind conditions on and around the site are likely to be comfortable for sitting/standing during the summer and walking during the winter. No wind safety exceedances are expected on and around the site in the existing configuration.

5.3 Proposed Wind Conditions

The proposed building at 21-storeys, is taller than the buildings in the surrounding area and, therefore, will be exposed to the prevailing northwesterly and southerly winds. Winds are anticipated to downwash off the north and south facades of the building and accelerate around the western and southern corners. The predicted wind flow patterns relative to the key areas of interest on and around the site is shown in Image 7.

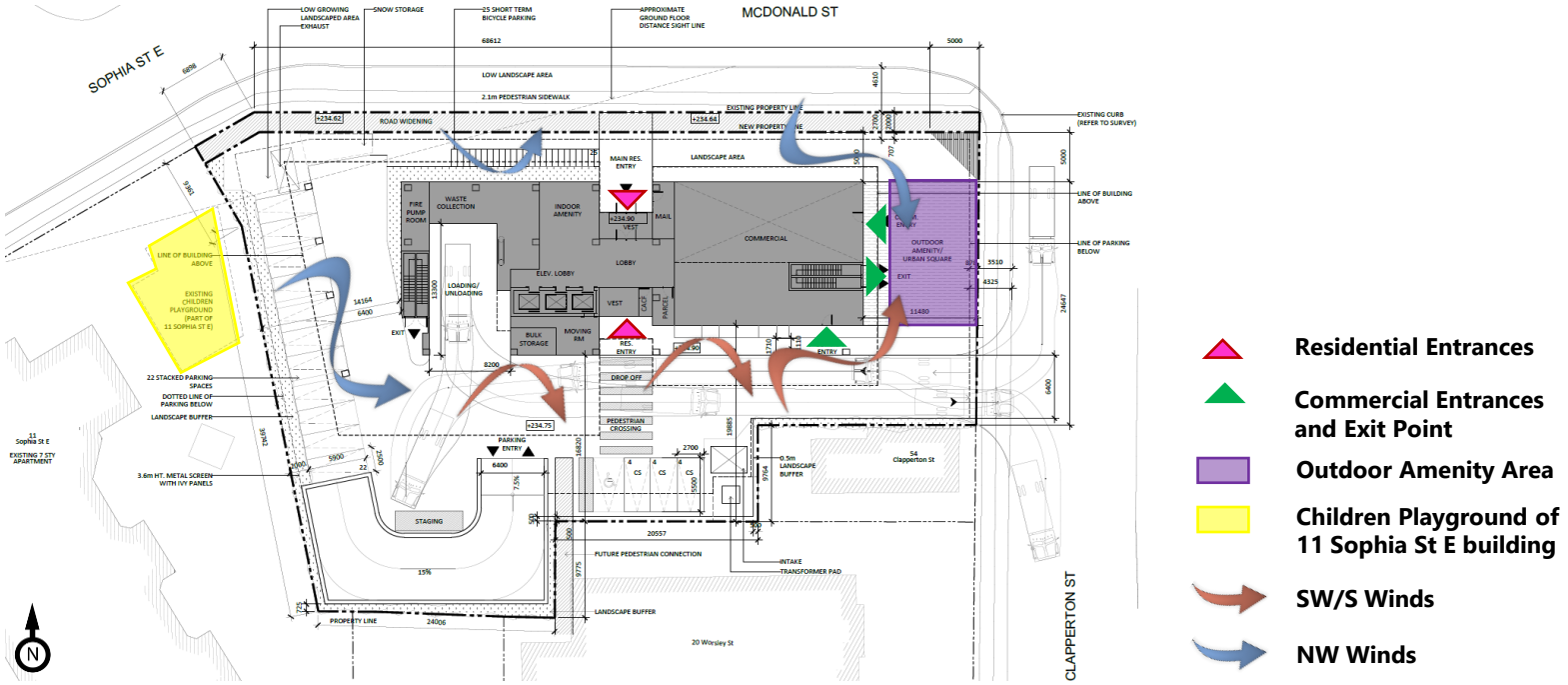


Image 7: Key Areas of Interest and Predicted Flow Pattern around the Site

5.3 Proposed Wind Conditions

Although the project will increase wind speeds in the immediate surroundings, several features of the building massing are favorable towards reducing the potential for severe wind impacts. These features are:

- The tower setback on Level 5 on the west half of the site will reduce the impact of winds redirected by the massing towards the grade at these areas.
- The setback of the development from the sidewalks along McDonald St and Clapperton St will reduce the impact of winds redirected by the development towards these sidewalks.
- The tower setback on the west half of the development and the spacing between the proposed building and the existing 11 Sophia St E building will limit the impact of winds channeling between these buildings.
- The recessed nature of the residential entrances is a positive design feature that will shelter them from the prevailing winds.

The following sections provide a discussion of the potential wind comfort conditions at the different areas of interest on and around the site, taking the aforementioned features into account. The expected wind comfort conditions during the summer and winter seasons are shown in Images 8 and 9, respectively. Wind speeds on and around the proposed project site are not expected to exceed the pedestrian wind safety criterion due to the moderate local wind climate and positive building design features.

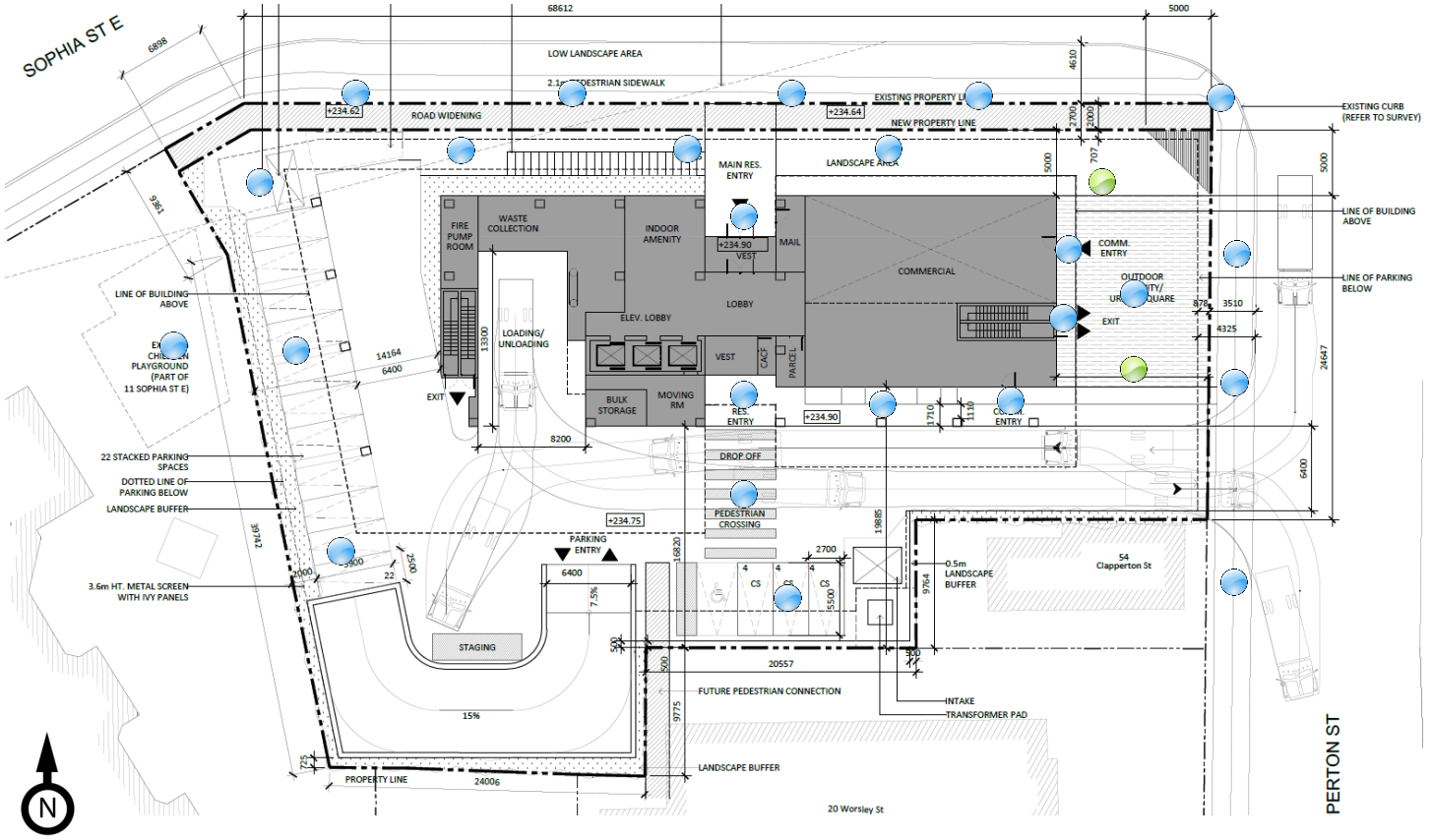
5.3.1 Entrances

Wind speeds are anticipated to be comfortable for sitting/standing throughout the year at all residential and commercial entrances, which is suitable for the intended use. The calm conditions at the entrances are due to their recessed nature and/or their location away from building corners where wind speeds are typically higher.

5.3.2 Outdoor Amenity Area

Wind speeds at the outdoor amenity area are anticipated to be suitable for standing or walking during the summer, when this area is expected to be used the most. These wind speeds, which are higher than desired for passive usage, is due to the acceleration of southerly and southwesterly winds around the southeast corner of the proposed building and the northwesterly winds around the northeast corner. Lower wind speeds suitable for the intended usage can be achieved at this area by using wind control features such as landscaping, wind screens and overhead trellises. Example images of such features are shown in Image 10. RWDI can recommend specific mitigation strategies as the programming of this area evolves.

5. RESULTS AND DISCUSSION

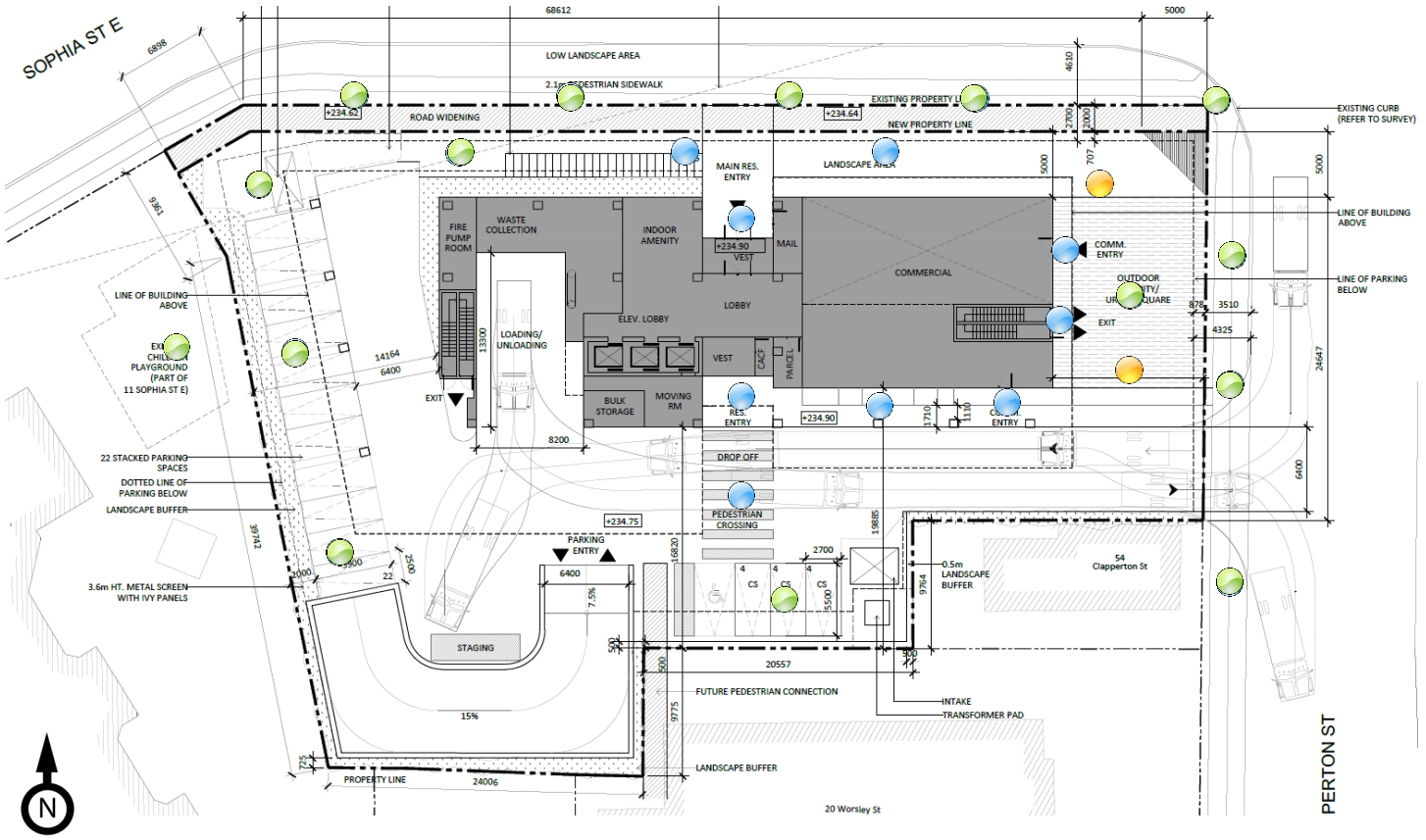


WIND CATEGORIES

- Sitting / Standing
- Walking
- Potentially Uncomfortable

Image 8: Predicted Wind Comfort Conditions – Summer

5. RESULTS AND DISCUSSION



WIND CATEGORIES

- Sitting / Standing
- Walking
- Potentially Uncomfortable

Image 9: Predicted Wind Comfort Conditions – Winter

5.3 Proposed Wind Conditions

5.3.3 Parking Lots and Walkways

Wind speeds at the parking lots and walkways on the site are generally anticipated to be comfortable for walking or better throughout the year, which is suitable for the intended usage. During the winter, potentially uncomfortable wind speeds are anticipated on the walkway at the northeast building corner. This is due to the acceleration of northwesterly winds around the northeast building corner. If feasible, it is recommended to add coniferous trees around this building corner (example in Image 10).

5.3.4 Public Sidewalks

Wind speeds at the sidewalks along Sophia Street E. and Clapperton Street are anticipated to be comfortable for sitting/standing during the summer and walking during the winter, which is suitable for the intended usage.

5.3.5 Children Playground of 11 Sophia St E

Wind speeds at the existing Children Playground of the 11 Sophia St E residential building are anticipated to be suitable for sitting/standing during the summer, which is comfortable for the intended usage. During the winter, higher wind speeds suitable for standing or walking are anticipated, which can be considered acceptable due to the infrequent usage of this area. As noted earlier, the tower setback on the west half of the development and the spacing between the proposed building and the existing 11 Sophia St E building will limit the impact of winds channeling between these buildings. Potentially higher wind speeds is anticipated to be restricted to the immediate vicinity of the proposed development, and the impact on the children playground is expected to be minimal.

5. RESULTS AND DISCUSSION

Image 10: Examples of Wind Control Measures at Building Corners and Amenity Areas

6. SUMMARY

RWDI was retained to provide an assessment of the potential pedestrian level wind impact of the proposed project at 17 Sophia Street East, 3, 5, 7 & 11 McDonald Street, and 58 & 60 Clapperton Street. Our assessment was based on the local wind climate, the current design of the proposed development, the existing surrounding buildings, our experience with wind tunnel testing of similar buildings, and screening-level modelling of wind flows around buildings.

Our findings are summarized as follows:

- The proposed building is taller than buildings in the existing surroundings, and therefore will cause an increase in wind speeds around it.
- The building design incorporated several wind-responsive features which will moderate the potential wind impacts on the surroundings.
- Wind conditions on and around the proposed project site are not expected to exceed the pedestrian safety criterion due to local wind climate and positive building design features.
- Wind speeds on sidewalks and other public areas around the proposed development, including the children playground of the existing 11 Sophia St E building, are expected to be comfortable for the intended use throughout the year.
- On the project site, suitable wind conditions are expected at all residential and commercial entrances, as well as at the parking lots.
- Higher-than-desired wind speeds, including potentially uncomfortable conditions during the winter, are anticipated around the eastern corners of the proposed development, including at the outdoor amenity area and the walkway at the northeast corner. Wind control measures to achieve lower wind speeds at these areas have been suggested. A wind tunnel test is recommended at a later design stage to quantify the level and frequency of high wind activity, confirm the need for wind control features and to optimize mitigation efforts.

7. APPLICABILITY OF RESULTS

The assessment presented in this report are for the proposed project at 17 Sophia Street East, 3, 5, 7 & 11 McDonald Street, and 58 & 60 Clapperton Street based on the information listed in the table below. In the event of any significant changes to the design, construction or operation of the building or addition of surroundings in the future, RWDI could provide an assessment of their impact on the pedestrian wind conditions discussed in this report. It is the responsibility of others to contact RWDI to initiate this process.

File Name	File Type	Date Received (dd/mm/yyyy)
17 Sophia ARCH_OPA-ZBA submission	PDF	11/04/2022