FINAL REPORT

505, 511, 515, & 533 YONGE STREET

BARRIE, ON

PEDESTRIAN WIND ASSESSMENT

PROJECT #2103485

DECEMBER 16, 2021

SUBMITTED TO

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1. INTRODUCTION

Rowan Williams Davies & Irwin Inc. (RWDI) was retained by Innovative Planning Solutions to conduct a qualitative desktop wind assessment for the pedestrian wind conditions at the proposed residential/ commercial development at 505, 511, 515 & 533 Yonge Street in Barrie, Ontario (see **Image 1**). A wind assessment is required by the City of Barrie for the Zoning By-Law Amendment as per their Terms of Reference.

This assessment is based on the following:

- a review of regional long-term wind data;
- design drawings received from Salter Pilon Architecture up to December 8, 2021;
- wind-tunnel studies undertaken by RWDI for similar projects;
- our engineering judgement and knowledge of wind flows around buildings[1-3]; and
- use of 3D software developed by RWDI (*WindEstimator*[2]) for estimating the potential wind conditions around generalized building forms.

This approach provides a screening-level estimation of potential wind comfort conditions. Conceptual wind control measures to improve wind comfort are recommended, where necessary. Wind tunnel testing may be required to quantify these wind conditions and optimize the wind control measures presented herein.

Note that other issues related to wind loads, snow, door operability, stack effect, etc., are not considered within the scope of this assessment.

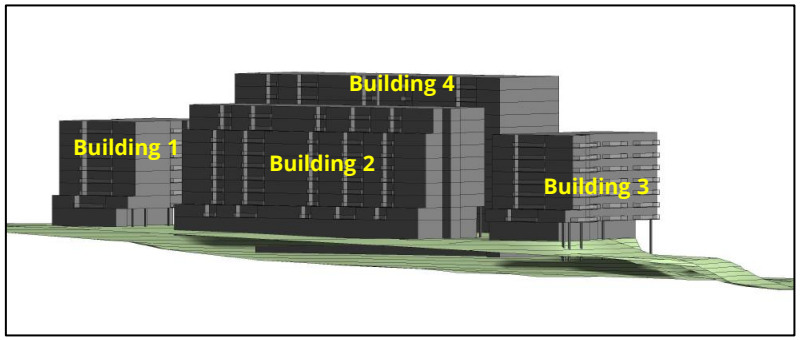


Image 1: Proposed development – 3D view looking north across Yonge St. ***(courtesy of Salter Pilon Architecture)***

1. 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.
2. 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.
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.

2. SITE & BUILDING INFORMATION

The proposed development fronts the east side of Yonge Street opposite the intersection with D'Ambrosio Drive (see **Image 2**).

The site is currently occupied by four low-rise commercial and residential buildings. The area surrounding the site is primarily low-rise residential in all directions. Lake Simcoe is located about 1,500 m to the north and east.

The proposed development project includes four separate market rental buildings, one with commercial space at grade, ranging in height from 8 to 12 storeys.

Pedestrian areas of greatest interest include the main building entrances, public sidewalk, walkways, outdoor amenity spaces and potential roof terraces on Buildings 2 and 4.

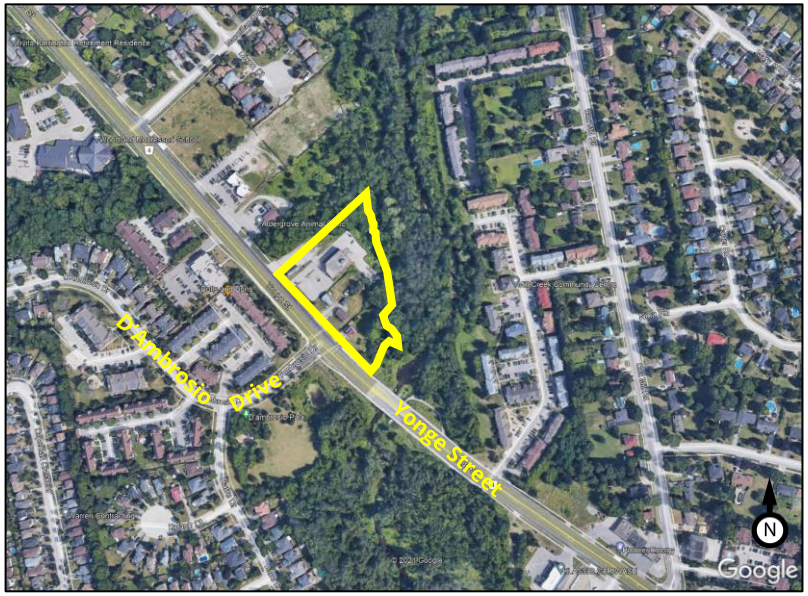


Image 2: Aerial view of existing site and surroundings
(Courtesy of Google™ Earth)

3. WIND CLIMATE

Wind statistic recorded at Lake Simcoe Regional Airport, located approximately 15 km to the northeast, were analyzed for summer and winter seasons to determine the local wind directionality. The results are presented in the form of graphic wind roses in **Image 3**.

The most frequent winds blow from the west through northwest directions in both the summer and winter seasons. The southeast winds are relatively frequent in the summer and east winds in the winter, but they are of lower wind speeds.

It is our opinion that the most significant winds at the project site for comfort would be from the northwest quadrant and easterly directions, although all directions are considered in this assessment.

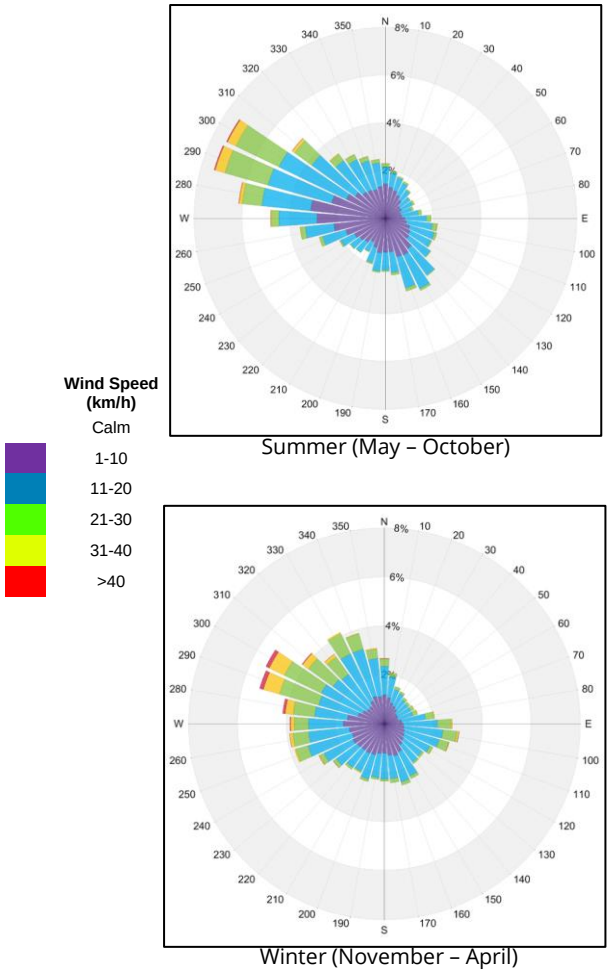


Image 3: Directional distribution of winds recorded at Lake Simcoe Regional Airport 2003 - 2016

4. 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,* they exceed the wind safety criterion, or they are incompatible with the intended pedestrian use.

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).

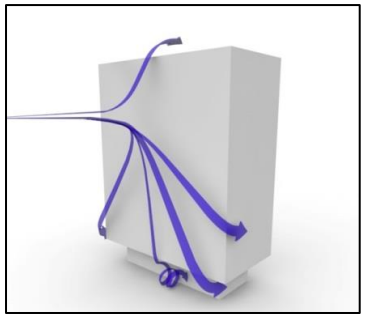
These criteria for wind forces represent average wind tolerance. They are sometimes subjective and regional differences in wind climate and thermal conditions as well as variations in age, health, clothing, etc. can also affect people's perception of the wind climate.

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 outdoor dining terraces and roof terrace during the summer, when these areas will be mainly used.

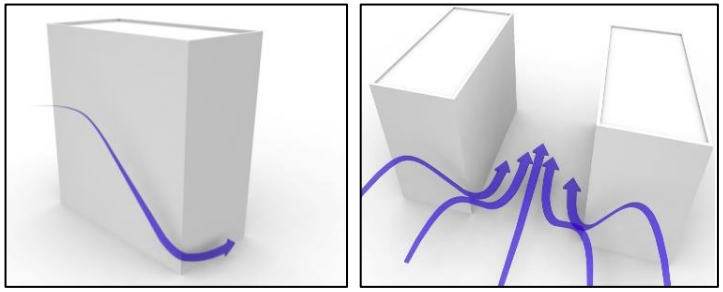
5. PEDESTRIAN WINDS

Predicting wind speeds and occurrence frequencies is complicated. It involves 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 regarding pedestrian wind conditions around buildings, yielding a broad knowledge base. This knowledge has been incorporated into RWDI's proprietary software that allows, in many situations, for a screening-level numerical estimation of pedestrian wind conditions without wind tunnel testing.

Since the surrounding buildings are shorter than the proposed project, the proposed buildings will be fully exposed to winds from all directions. Taller buildings tend to intercept the stronger winds at higher elevations and redirect them to the ground level. Such a *Downwashing Flow* (see **Image 4a**) is the main cause for increased wind activity around taller buildings at the grade level. When oblique winds are deflected down by a building, a localized increase in wind activity or *Corner Acceleration* can be expected around the downwind building corner at pedestrian level (see **Image 4b**). When more than one building are situated in close proximity there is a risk of winds channeling between the buildings (see **Image 4c**). If any of these building/wind combinations occur for prevailing winds, there is a greater potential for increased wind activity.



a) Downwashing flow



b) Corner acceleration **c) Channeling flow**

Image 4: General wind flow patterns around taller buildings

6. ANTICIPATED WIND CONDITIONS

6.1 Existing Wind Conditions

The existing wind conditions on-site are likely comfortable for *sitting* / *standing* during the summer and *walking* during the winter. No wind safety exceedances are likely to occur on or around the existing site.

6.2 Proposed Wind Conditions

Given the height of the proposed buildings and the low height of the immediate surroundings, the project will be quite exposed to the prevailing winds (see **Images 5 and 2**). **Images 6 and 7** present the predicted grade level wind comfort conditions for summer and winter, respectively. No wind safety exceedances are expected around this project.

6.2.1 Main Residential Entrances

All four of the buildings' main residential entrances are all well situated with respect to the prevailing winds and include significant building overhangs / canopies providing overhead protection from the elements. As a result, the main entrances are predicted to have appropriate wind conditions on a year-round basis (i.e., comfortable for *sitting* in summer and *standing* in winter as per **Images 6 and 7**, respectively). The building overhang and canopy features should be preserved to maintain these favourable wind conditions.

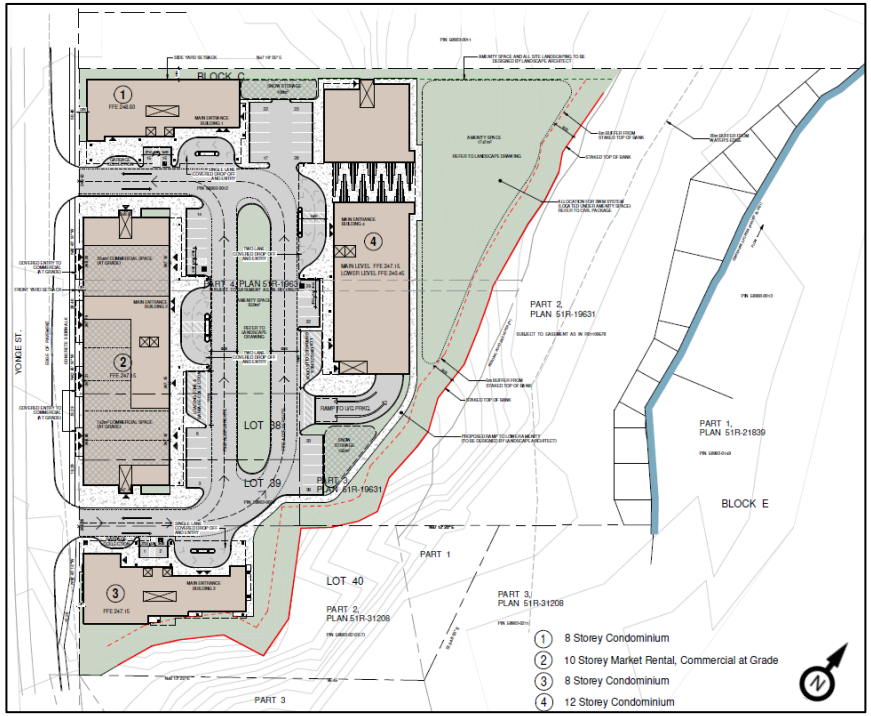


Image 5: Site plan

6. ANTICIPATED WIND CONDITIONS

Predicted
SUMMER
Wind Comfort Conditions

- Sitting / Standing
- Walking
- Uncomfortable / Unsafe

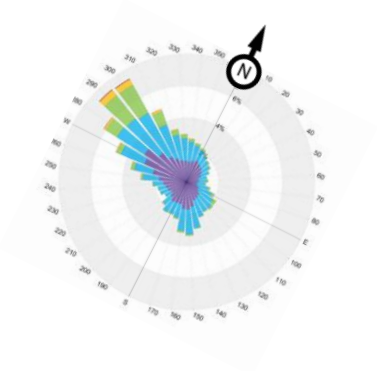


Image 6: Predicted *SUMMER* wind comfort conditions

6. ANTICIPATED WIND CONDITIONS

Predicted
WINTER
Wind Comfort Conditions

- Sitting / Standing
- Walking
- Uncomfortable / Unsafe

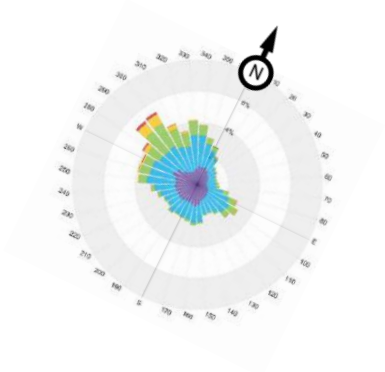


Image 7: Predicted *WINTER* wind comfort conditions

6.2.2 Commercial Entrances

The commercial entrances on the east side of Building 2 are also well situated and predicted to have appropriate wind conditions. Those on the west side of the building will be exposed to westerly winds downwashing and accelerating along that façade creating *walking* conditions which are less than desirable for entrances. The design already includes overhangs above these entrances however, we recommend that they also be either recessed into the façade to protect the doors or that wind screens / planters be added on the north side of each of the four entrances (see **Image 9**).

6.2.3 Public Sidewalk

The public sidewalk along Yonge Street is expected to experience in an increase in wind speeds relative to existing but conditions should, for the most part, remain appropriate (i.e., comfortable for *walking* on a year-round basis) as indicated in **Images 6 and 7**. One exception could be near the southwest corner of Building 2 where *uncomfortable* conditions are likely. To mitigate this location would require either a corner canopy on the building or the planting of winter trees as per **Image 9**).

6.2.4 On-Site Walkways / Parking Lots

During the winter (see **Image 7**) there are a few locations that are predicted to be *uncomfortable*. Typically, these locations would be susceptible to building corner accelerations (as per **Image 4b**). To improve these conditions would require a corner canopy on the building or winter trees planted in the vicinity as per **Image 9**.

6.2.5 Outdoor Amenity Space

The amenity space located between Buildings 2 and 4 will be exposed to winds making it comfortable for *standing / walking* in summer and *walking / uncomfortable* in winter. To improve these conditions would require the planting of trees and/or wind screens as illustrated in **Image 9**.

The west-east passageway at the ground floor in Building 4 will be vulnerable to channeling of winds (as per **Image 4c**) causing conditions to be *walking* in summer and *uncomfortable* in winter. The summer conditions are less than ideal and would require the elimination of this passageway or the addition of significant wind screens / landscaping to improve conditions (**see Image 9**).

As per **Image 6** the outdoor amenity space near the northeast corner of Building 4 is predicted to be comfortable for *standing* or *walking* in the summer. These conditions are less than ideal for passive uses where *sitting* conditions would be desired. Summer landscaping (i.e., 3m tall trees with under-plantings or shrubs) and/or wind screens installed to protect from winds accelerating around the northeast corner of Building 4 are recommended (see **Image 9**). Winter conditions are not discussed as the space is unlikely to be used during the cold weather.

6.2.6 Rooftop Amenity Spaces

As wind speeds naturally increase with height above grade, the potential amenity spaces at roof level of Buildings 2 and 4 would be exposed to significantly stronger winds than will exist at grade level. As a result, we expect conditions at exposed locations there to be comfortable for *walking* in summer. These conditions would be less than ideal for passive pedestrian uses where *sitting* or *standing* conditions will be desired.

To provide appropriate wind conditions supplementary wind control would be required to protect the most important passive use (i.e., seating) areas from the prevailing westerly winds. Vertical wind screens are recommended to be installed as per the guidelines in **Image 8** and examples in **Image 10**.

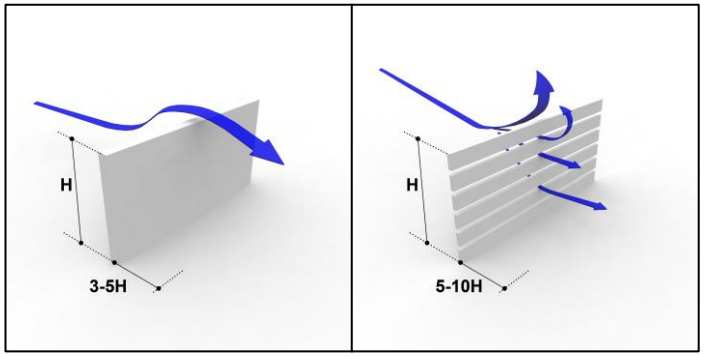


Image 8: Guidelines for installing vertical wind screens (solid on left and porous on right)

7. RECOMMENDATIONS

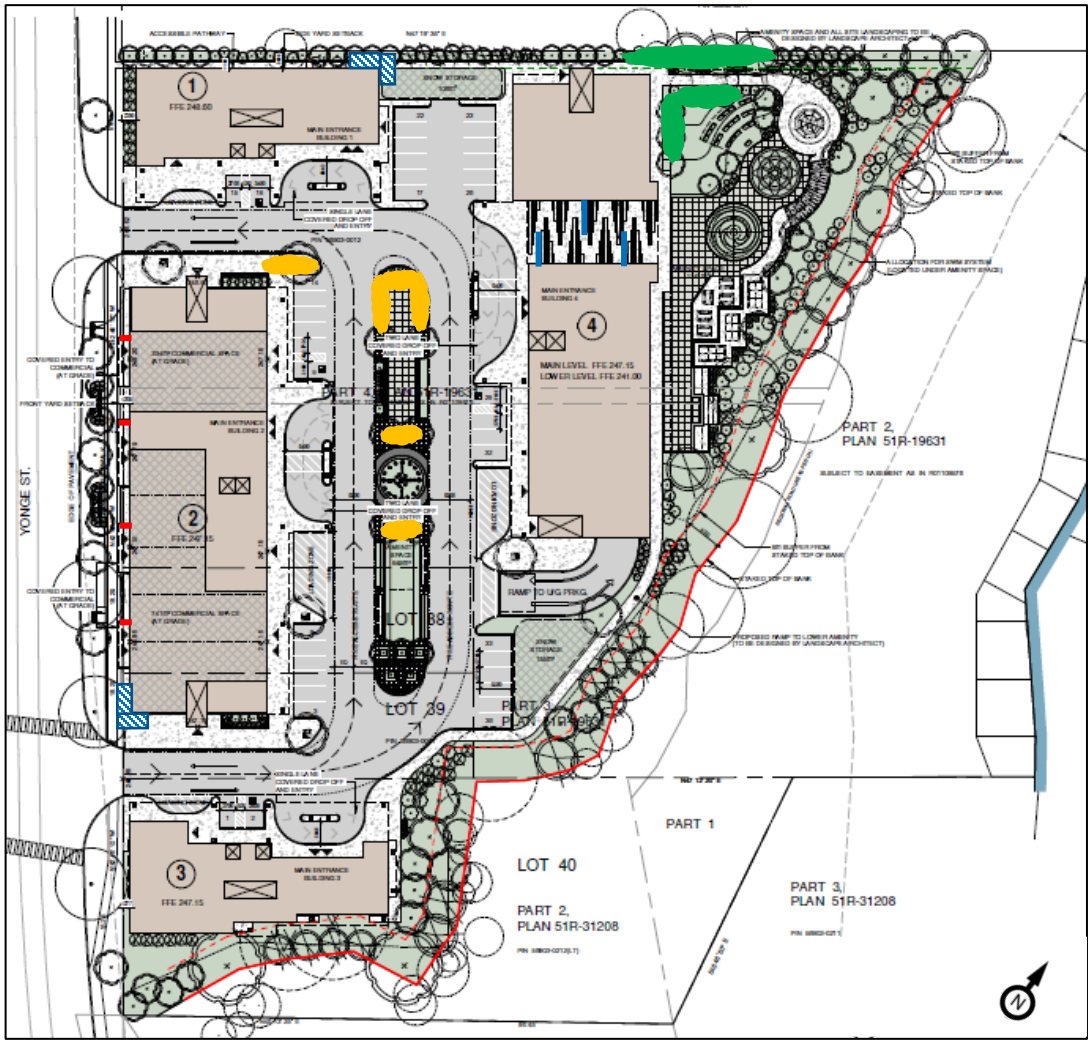


Image 9: Wind control concepts

LEGEND:

- 3m tall coniferous trees OR vertical wind screen (see **Image 10**).
- 2m tall vertical wind screen or planters with coniferous landscaping >60% solid AND/OR recess entrance into the building façade (see **Image 10**).
- 3m tall summer landscaping (i.e., trees with shrub under-plantings AND/OR vertical porous wind screens (see **Image 10**).
- Eliminate the passageway OR add 3m tall vertical wind screens / planters >60% solid (see **Image 10**).
- Overhead canopy OR coniferous trees (see **Image 10**).

8. EXAMPLES OF WIND CONTROL

Image 10: Examples of wind control features discussed

9. SUMMARY

Wind conditions on and around the proposed mixed-use development at 505, 511, 515 & 533 Yonge Street in Barrie, Ontario are discussed in this report and our assessment is based on the local wind climate, surrounding buildings and our past experience with wind tunnel testing of similar buildings. No wind tunnel testing was undertaken for the current assessment.

The proposed development has several positive design features such as well-situated main residential entrances with respect to prevailing winds. Suggestions for improving wind conditions at the commercial entrances along Yonge Street, walkways near building corners, surface parking area and outdoor amenity spaces are provided in the report.

Wind tunnel testing of a scale model may be required at a later design stage, as per the City's Terms of Reference, to quantify the predicted wind conditions and refine the wind control measures presented herein.

10. APPLICABILITY OF RESULTS

The assessment presented in this report for the 505, 511, 515 & 533 Yonge Street residential / commercial building development are based on the design drawings received by RWDI on December 8, 2021.

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.