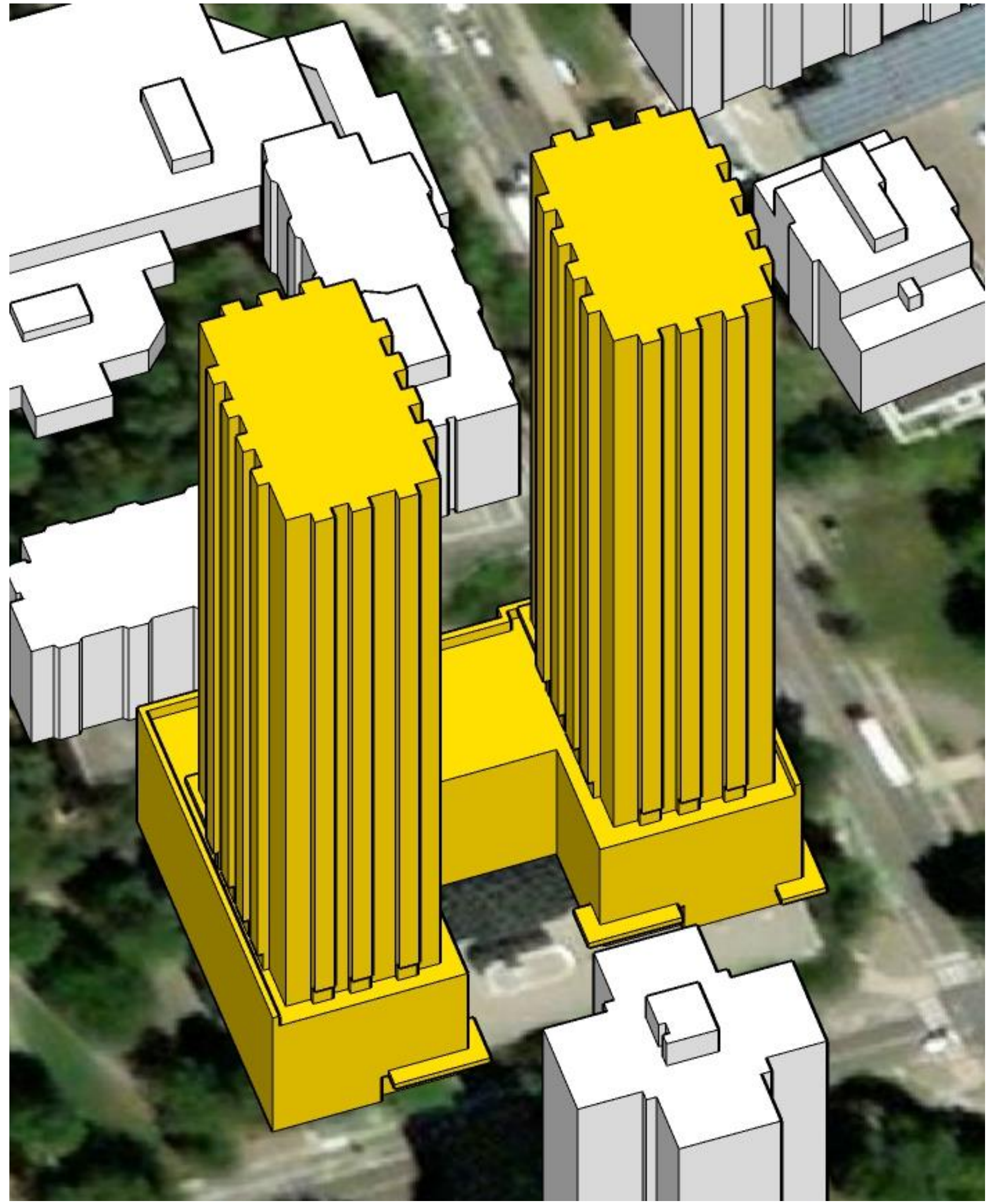
100 Stone Road West, Suite 201
Guelph, Ontario, N1G 5L3
226.706.8080 | www.slrconsulting.com

Date: February 8, 2023

Re: **Pedestrian Wind Assessment**
48 Grenoble Drive
Toronto, ON
SLR Project #241.30416.00000



Prepared by
SLR Consulting (Canada) Ltd.
100 Stone Road West – Suite 201
Guelph, ON   N1G 5L3

For
Tenblock
30 Soudan Ave., Suite 200
Toronto, ON M4S 1V6

LICENSED PROFESSIONAL ENGINEER
2023-02-02
N. NOURIN
100179358
PROVINCE OF ONTARIO

Nishat Nourin, M.Eng., P.Eng. Microclimate Engineer	Tahrana Lovlin, MAES, P.Eng. Principal – Microclimate

VersionFInal	Date
Final	March 18, 2022
Draft 0.1	January 18, 2023
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TABLE OF CONTENTS

1.0 INTRODUCTION

SLR Consulting (Canada) Ltd. (SLR) was retained by Tenblock to conduct a pedestrian wind assessment for the proposed development at 48 Grenoble Drive in Toronto, Ontario. This report is in support resubmission of the combined Zoning Bylaw Amendment (ZBA) and Site Plan Control (SPA) application for the development. SLR previously conducted a pedestrian wind assessment of the proposed development for a different massing in March 2022.

1.1 Existing Site

The proposed development is located at the northwest corner of the intersection of Grenoble Drive and Deauville Lane. The site is currently occupied by a nine-storey residential building, which will be demolished. **Figure 1** provides an aerial view of the immediate study area. A virtual site visit was conducted by SLR using Google Earth images dated October 2020; some of these images are included in **Figures 2a** through **2d**.

Immediately surrounding the site is an apartment building to the northwest, a mid-rise community and residential building to the north through east, a high-rise apartment building to the south and the Grenoble Public School to the southwest. Beyond the immediate surroundings there are primarily high-rise and mid-rise buildings in all directions.

Typically, developments with Site Plan Control approval within a 500 m radius are included as existing surroundings. For this assessment, the following developments were included based on the City's request: 25 St. Dennis Drive (ZBA approved) and 7-11 Rochefort Drive (ZBA submitted).

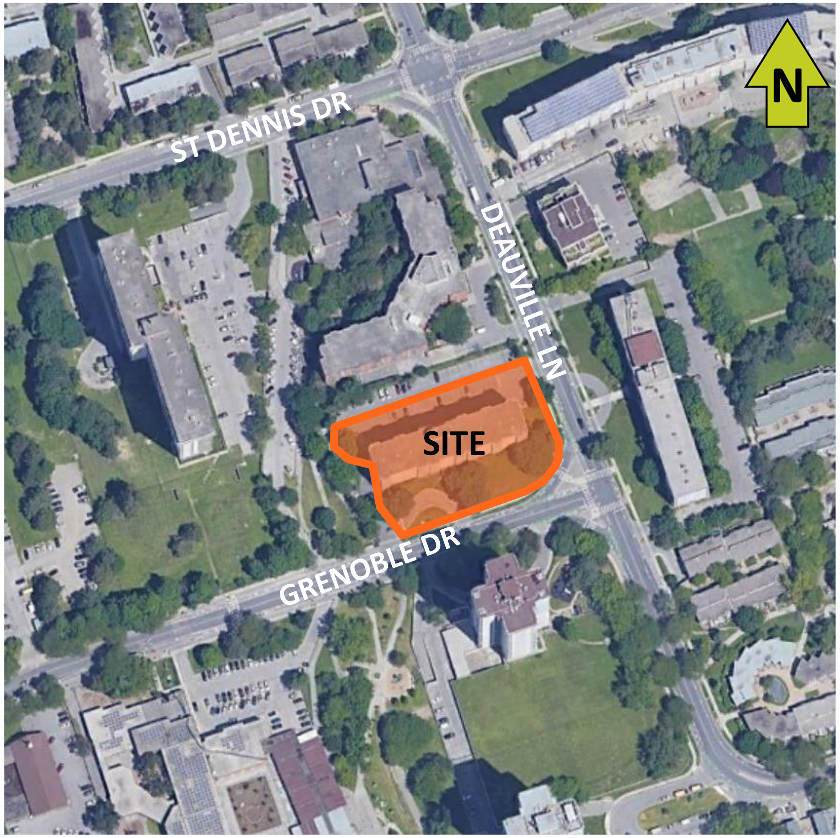


Figure 1: Aerial view of existing site & surroundings
Credit: Google Earth Pro, dated 6/22/2019

Figure 2a: Along Grenoble Drive looking east (site to the left)

Figure 2b: Along Deauville Lane looking southeast (site to the right)

Figure 2c: Along Deauville Lane looking northwest (Site to the left)

Figure 2d: Along St. Dennis Drive looking west

1.2 Proposed Development

The proposed development will require the demolition of the existing nine-storeys residential building, to allow for the construction of two towers atop a six-storey podium. Both towers are 39-storeys tall with a total height of 134 m including the mechanical penthouse. **Figure 3** shows a section of the proposed development.

1.3 Areas of Interest

Areas of interest for pedestrian wind conditions include those areas which pedestrians are expected to use on a frequent basis. Typically, these include sidewalks, main entrances, transit stops, plazas and parks. There are several transit stops along Deauville Lane and St. Dennis Drive, within the project vicinity.

The main residential entrance to the East Tower is located on the south facade, to the east of the central amenity courtyard. Similarly, the main residential entrance to the West Tower is located on the south side of the building, to the west of the central amenity courtyard. There are several secondary entrances and exits located around the perimeter of the building. At grade level, the parkland dedication area is located to the west of the proposed development, and a Privately-Owned Publicly Accessible Space (POPS) is located at the intersection of Grenoble Drive and Deauville Lane. In addition, there are outdoor amenity terraces on the podium roof at Level 7. On-site areas of interest are shown in **Figures 4a** and **4b**.

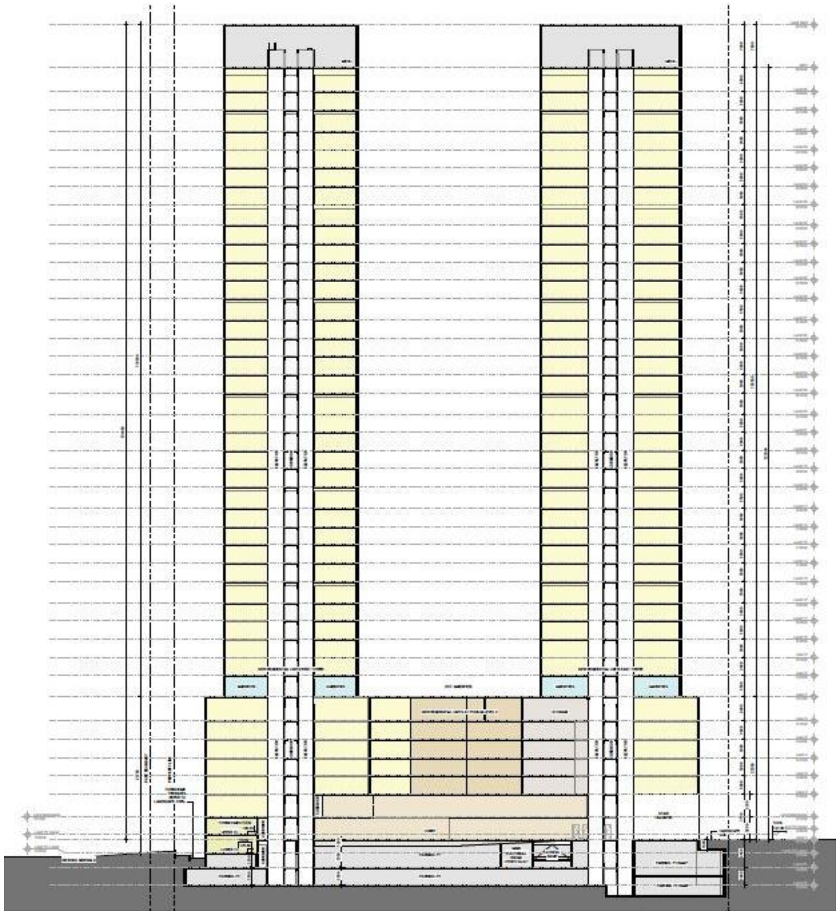


Figure 3: Building Section of proposed development
Credit: Diamond Schmitt

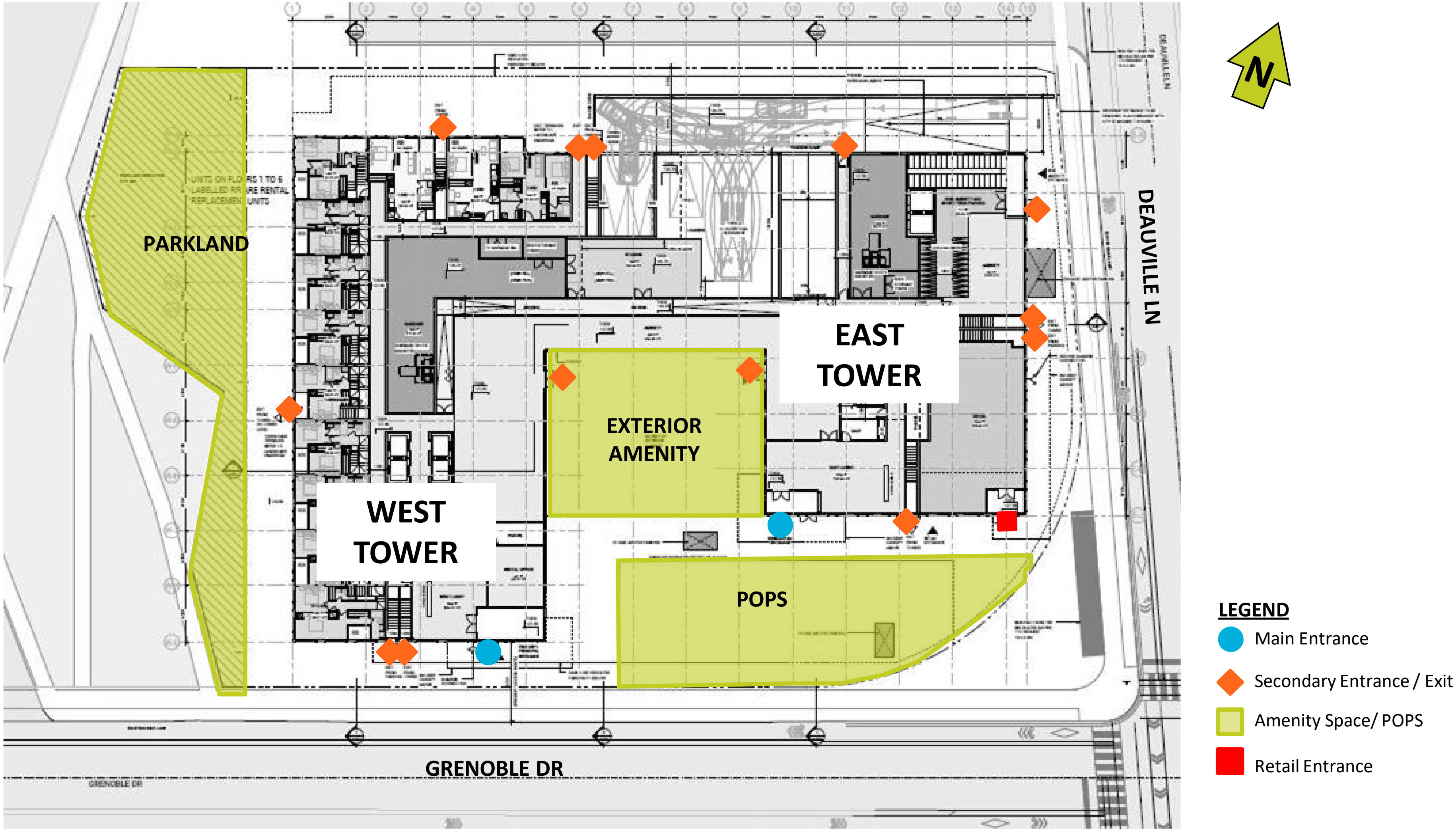


Figure 4a: Areas of Interest – Grade

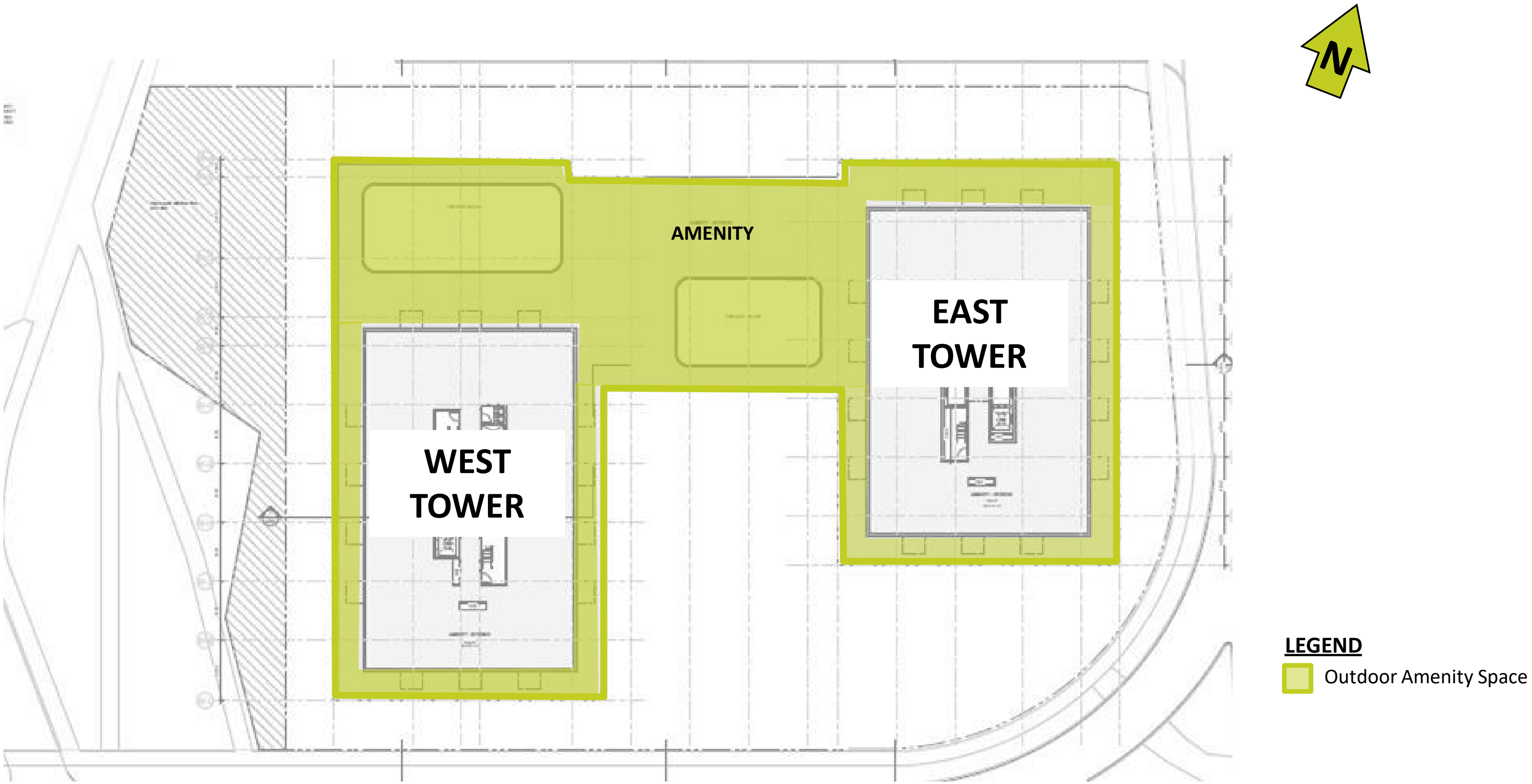


Figure 4b: Areas of Interest – Level 7

2.0 APPROACH

A screening-level assessment was conducted using computational fluid dynamics (CFD). As with any simulation, there are some limitations with this modeling technique, specifically in the ability to simulate the turbulence, or gustiness, of the wind. Nonetheless, CFD analysis remains a useful tool to identify potential wind issues, especially when assessing mean wind speeds. This CFD-based mean wind speed assessment employs a comparable analysis methodology to that used in wind tunnel testing. The results of CFD modeling are also an excellent means of readily identifying relative changes in wind conditions associated with different site configurations or with alternative built forms.

2.1 Methodology

Wind comfort conditions for areas of interest were predicted on and around the development site to identify potentially problematic windy areas. A 3D model of the proposed development, as well as floor plans and elevations, were provided by Diamond Schmitt January 9 and January 17, 2023. The model used for the assessment included surrounding buildings within 500 m from the study site centre. The simulations were performed using CFD software by Meteodyn Inc.

The entire 3D space throughout the modeled area is filled with a three-dimensional grid. The CFD virtual wind tunnel calculates wind speed at each one of the 3D grid points. The upstream "roughness" for each test direction is adjusted to reflect the various upwind conditions and wind characteristics encountered around the actual site. Wind flows for a total of 16 compass directions were simulated. Although wind speeds are calculated throughout the entire modeled area, wind comfort conditions were only plotted for a smaller area immediately surrounding the proposed development. SLR assessed two configurations for comparison purposes. The descriptions are as follows:

- **Existing Configuration:** Existing site with existing and City-approved surroundings.
- **Proposed Configuration:** Proposed development with existing and City-approved surroundings.

A view of two configurations are shown in **Figures 5a** and **5b**.

Wind flows were predicted for both the existing site, as well as with the proposed development for comparison purposes. The CFD-predicted wind speeds for all test directions and grid points were then combined with historical wind climate data for the region to predict the occurrence of wind speeds in the pedestrian realm, and to compare against wind criteria for comfort and safety; these results are shown in the various wind flow images. The analysis of wind conditions is undertaken for four seasons: Winter (January to March), Spring (April to June), Summer (July to September), and Autumn (October to December). However, only the seasonal extremes of summer and winter are discussed within the report. The results of the analysis for spring and autumn can be found in **Appendix A**.

Results are presented through discussion of the wind conditions along major streets and the areas of interest. The comfort criteria are based on predictions of localized wind forces combined with frequency of occurrence. Climate issues that influence a person's overall "thermal" comfort, (e.g., temperature, humidity, wind chill, exposure to sun or shade, etc.) are not considered in the comfort rating.

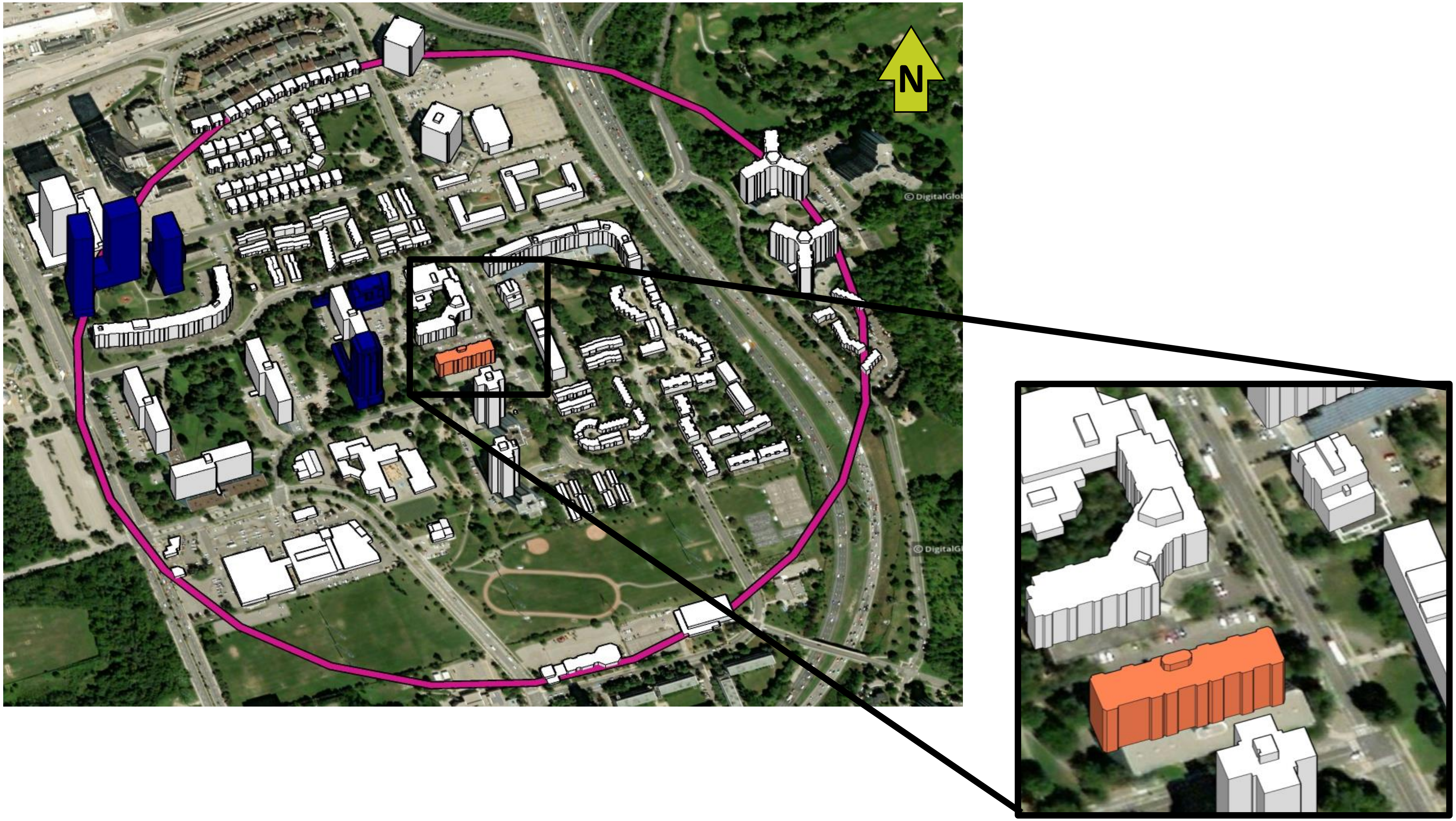


Figure 5a: Massing Model – Existing Configuration

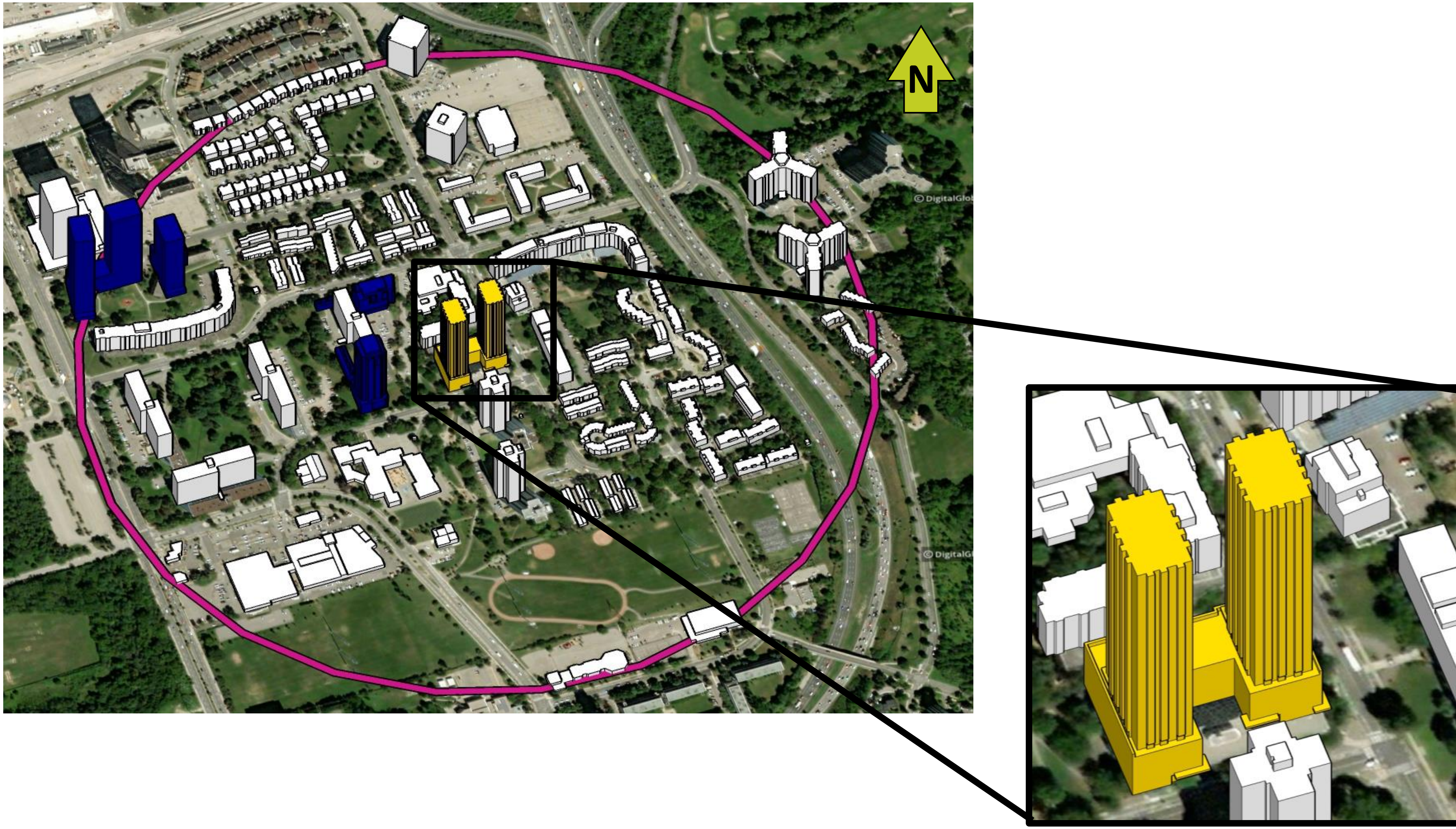


Figure 5b: Massing Model – Proposed Configuration

2.2 Wind Climate

Wind data recorded at Toronto Pearson International Airport for the period of 1991 to 2020 were obtained and analysed to create a wind climate model for the region. Annual and seasonal wind distribution diagrams ("wind roses") are shown in Figure 6. These diagrams illustrate the percentage of time wind blows from the 16 main compass directions. Of main interest are the longest peaks that identify the most frequently occurring wind directions. The annual wind rose indicates that wind approaching from the northerly through westerly directions are most prevalent. The seasonal wind roses readily show how the prevalent winds shift throughout the year.

The directions from which stronger winds (e.g., > 30 km/h) approach are also of interest as they have the highest potential of creating problematic wind conditions, depending upon site exposure and the building configurations. The wind roses in Figure 6 also identify the directional frequency of these stronger winds, as indicated in the figure's legend colour key. On an annual basis, strong winds occur from the northwesterly and westerly sectors. All wind speeds and directions were included in the wind climate model.

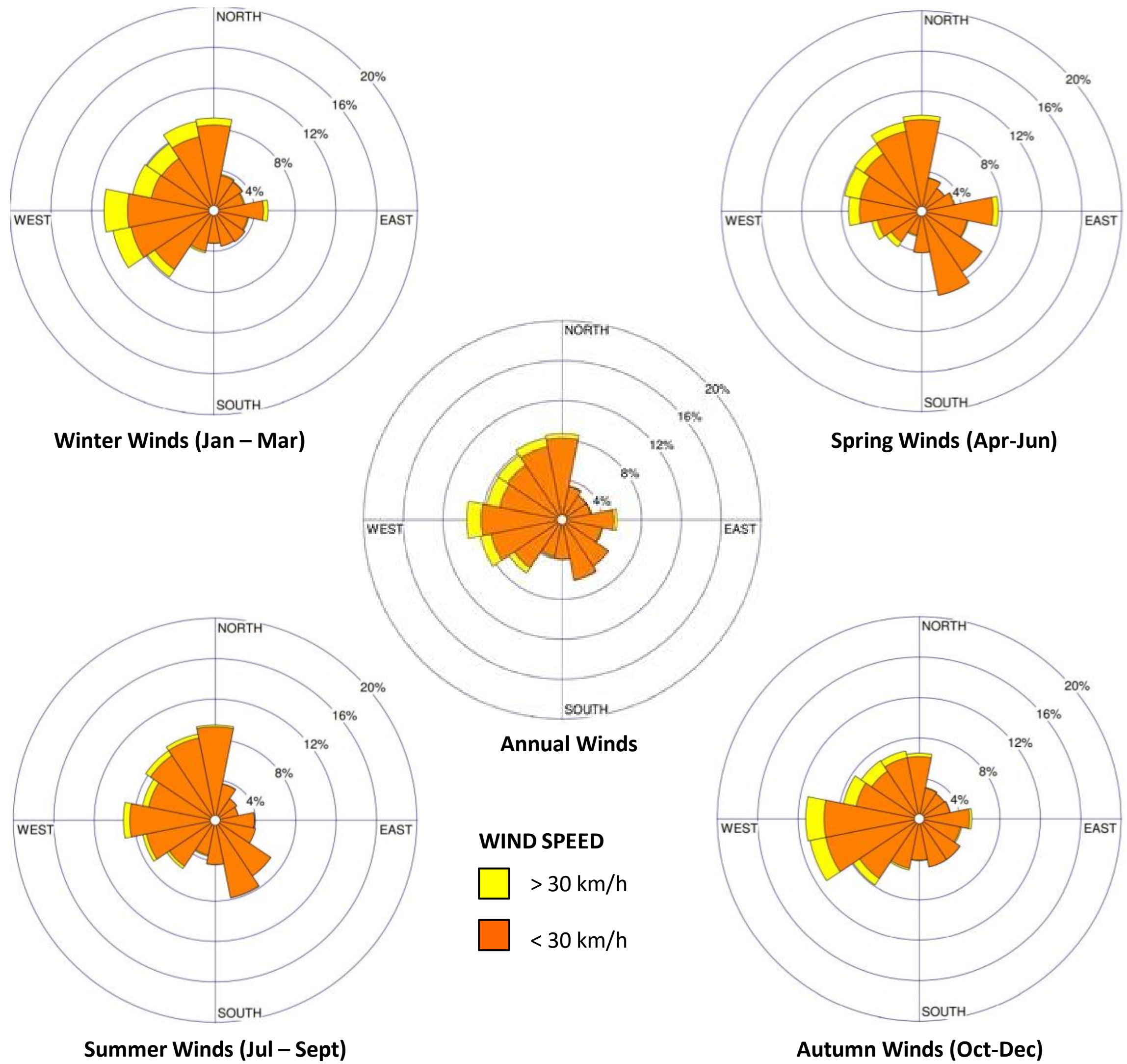


Figure 6: Wind Roses for Toronto Pearson International Airport (1991-2020)

3.0 PEDESTRIAN WIND CRITERIA

Wind comfort conditions are discussed in terms of being acceptable for certain pedestrian activities and are based on predicted wind force and the expected frequency of occurrence. Wind chill, clothing, humidity and exposure to direct sun, for example, all affect a person's thermal comfort; however, these influences are not considered in the wind comfort criteria.

The comfort criteria, which are based on certain predicted hourly mean wind speeds being exceeded 5% of the time, are summarized in **Table 1**. Generally, this is equivalent to a wind event of several hours duration occurring about once per week.

The criterion for wind safety in the table is based on hourly mean wind speeds that are exceeded once per year (approximately 0.01% of the time). When more than one event is predicted annually, wind mitigation measures are then advised. The wind safety criterion is shown in **Table 2**.

The criteria for wind comfort and safety used in this assessment are similar to those developed at the Boundary Layer Wind Tunnel Lab of Western University, together with building officials in London, England. They are broadly based on the Beaufort Scale and on previous criteria that were originally developed by Davenport. Similar criteria are used by the Alan G. Davenport Wind Engineering Group Boundary-Layer Wind Tunnel Laboratory for pedestrian wind study projects located around the globe. For a list of references, describing the criteria and history of its development see **Section 7.0**.

Table 1: Wind Comfort Criteria

Activity	Comfort Ranges for Mean Wind Speed Exceeded 5% of the Time		Description of Wind Comfort
Sitting	0 to 14 km/h	0 to 4 m/s	Calm or light breezes desired for outdoor restaurants and seating areas where one can read a paper comfortably.
Standing	0 to 22 km/h	0 to 6 m/s	Gentle breezes suitable for main building entrances and transit stops.
Leisurely Walking	0 to 29 km/h	0 to 8 m/s	Moderate breezes suitable for walking along pedestrian thorough fares.
Fast Walking	0 to 36 km/h	0 to 10 m/s	Strong breezes that can be tolerated if one's objective is to walk, run or cycle without lingering.
Uncomfortable	> 36 km/h	> 10 m/s	Strong winds of this magnitude are considered a nuisance for most activities, and wind mitigation is typically recommended.

Table 2: Wind Safety Criterion

Activity	Safety Criterion Mean Wind Speed Exceeded Once Per Year (0.01%)		Description of Wind Effects
Any	72 km/h	20 m/s	Excessive gust speeds that can adversely affect a pedestrian's balance and footing. Wind mitigation is typically required.

4.0 RESULTS

Figures 7a through **10b** present graphical images of the wind comfort conditions for the summer and winter months around the proposed development. These represent the seasonal extremes of best and worst case. **Appendix A** presents the wind comfort conditions for spring and autumn. The “comfort zones” shown are based on an integration of wind speed and frequency for all 16 wind directions tested with the seasonal wind climate model. The presence of mature trees can lead to wind comfort levels that are marginally more comfortable than shown, during seasons when foliage is present. **Appendix B** presents the wind safety conditions on an annual basis.

There are generally accepted wind comfort levels that are desired for various pedestrian uses. However, in some climates these may be difficult to achieve in the winter due to the overall climate. For sidewalks, walkways and pathways, wind comfort suitable for leisurely walking are desirable year-round but may not be feasible in the winter. Wind conditions of fast walking are satisfactory for loading areas, laneways, and a limited portion of a sidewalk, considering exposure is brief for pedestrians. For main entrances, transit stops, and public amenity spaces such as parks and playgrounds, wind conditions conducive to standing are preferred throughout the year. For on-site amenity areas, wind conditions suitable for sitting or standing are desirable during the summer, with stronger wind flows, conducive to leisurely walking, tolerated in the winter. The most stringent category of sitting is desirable during the summer for dedicated seating areas, such as patios, where calmer wind is expected for the comfort of patrons.

4.1 Building Entrances & Walkways

Existing wind conditions on the site are expected to be comfortable for sitting or standing year-round (**Figures 7a** and **8a**).

In the Proposed Configuration, wind conditions on-site are predicted to be comfortable for sitting or standing in the summer (**Figure 7b**). During the winter months, similar wind conditions are predicted, with the exception of three corners, where wind conditions conducive to leisurely walking are expected (**Figure 8b**). These wind conditions are considered suitable for the intended use.

Wind conditions at the main residential entrances and all other secondary entrances and exits are generally predicted to be comfortable for sitting or standing throughout the year, which is considered suitable for the intended use (**Figures 9a** and **9b**). If feasible, we recommend moving the East Tower residential entrance a minimum of 5 m away from the building corner, to reduce the impact of stronger wind flows, conducive to leisurely walking (**Figure 9b**).

4.2 Open Space At-Grade

In the parkland, on the west side of the proposed development, wind conditions are anticipated to be comfortable for sitting or standing throughout the year, which is considered suitable for the intended use (**Figure 9a**). The exceptions are small areas near the east edge of the parkland, where wind conditions are conducive to leisurely in the winter, which is windier than desired for passive activities (**Figure 9b**). We suggest including marcescent landscaping and/or vertical wind screens (i.e., fences) near the north and west edges of the parkland.

Wind conditions in the proposed exterior amenity space and in the POPS are predicted to be comfortable for sitting or standing year-round, which is considered suitable for the intended use (**Figures 9a** and **9b**).

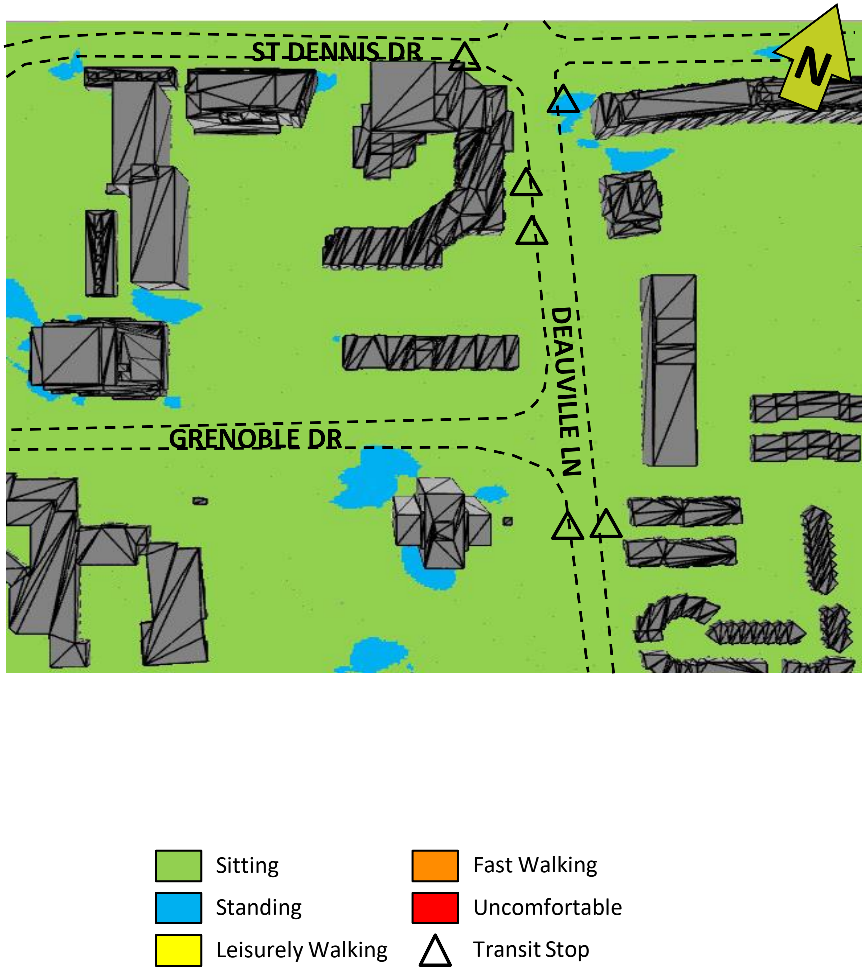


Figure 7a: Existing Configuration – Pedestrian Wind Comfort Summer – On-site & Surrounding Areas

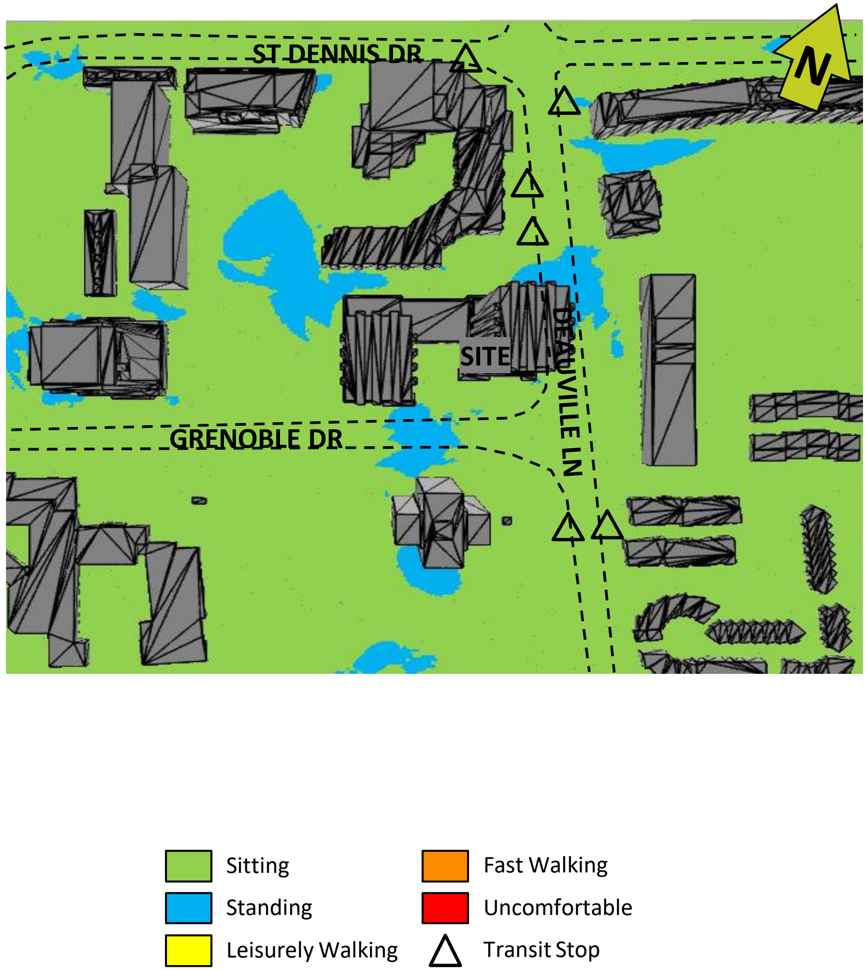


Figure 7b: Proposed Configuration – Pedestrian Wind Comfort Summer – On-site & Surrounding Areas

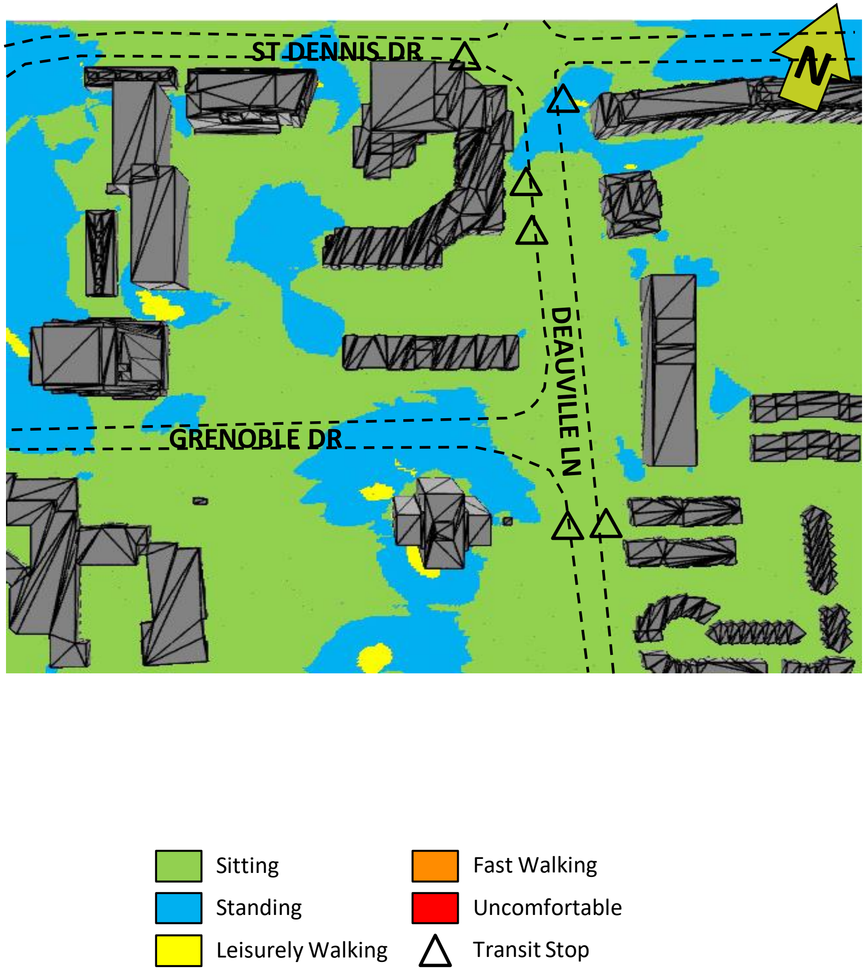


Figure 8a: **Existing Configuration – Pedestrian Wind Comfort Winter – On-site & Surrounding Areas**

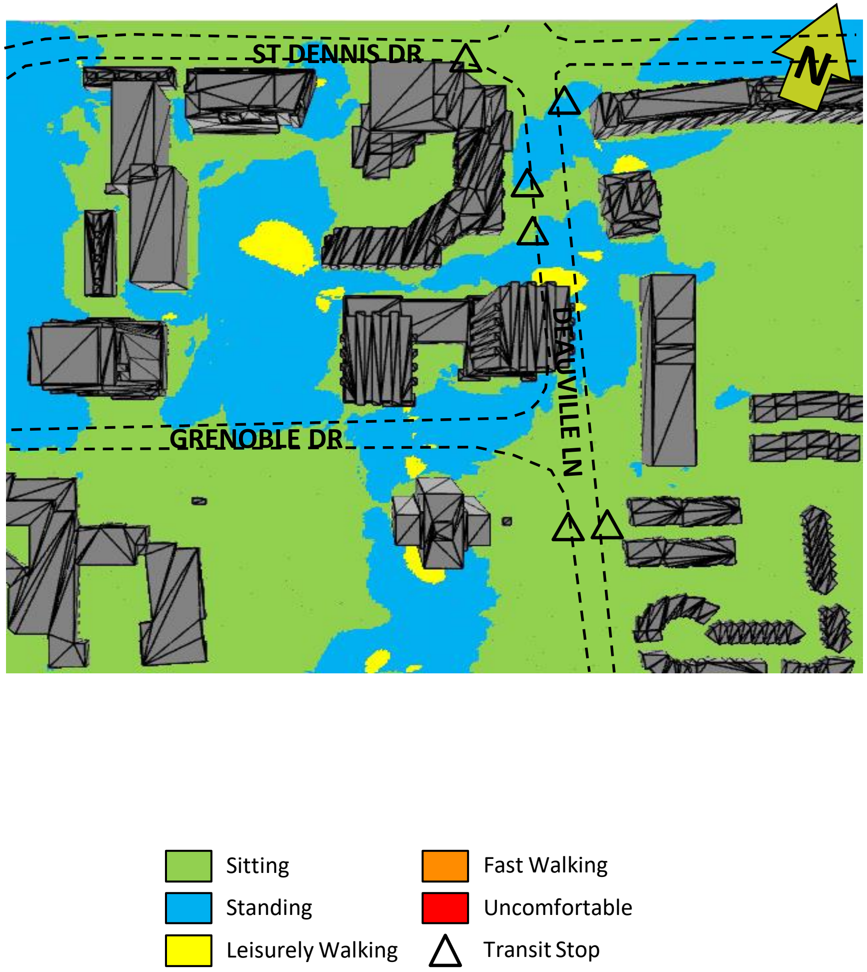


Figure 8b: **Proposed Configuration – Pedestrian Wind Comfort Winter – On-site & Surrounding Areas**

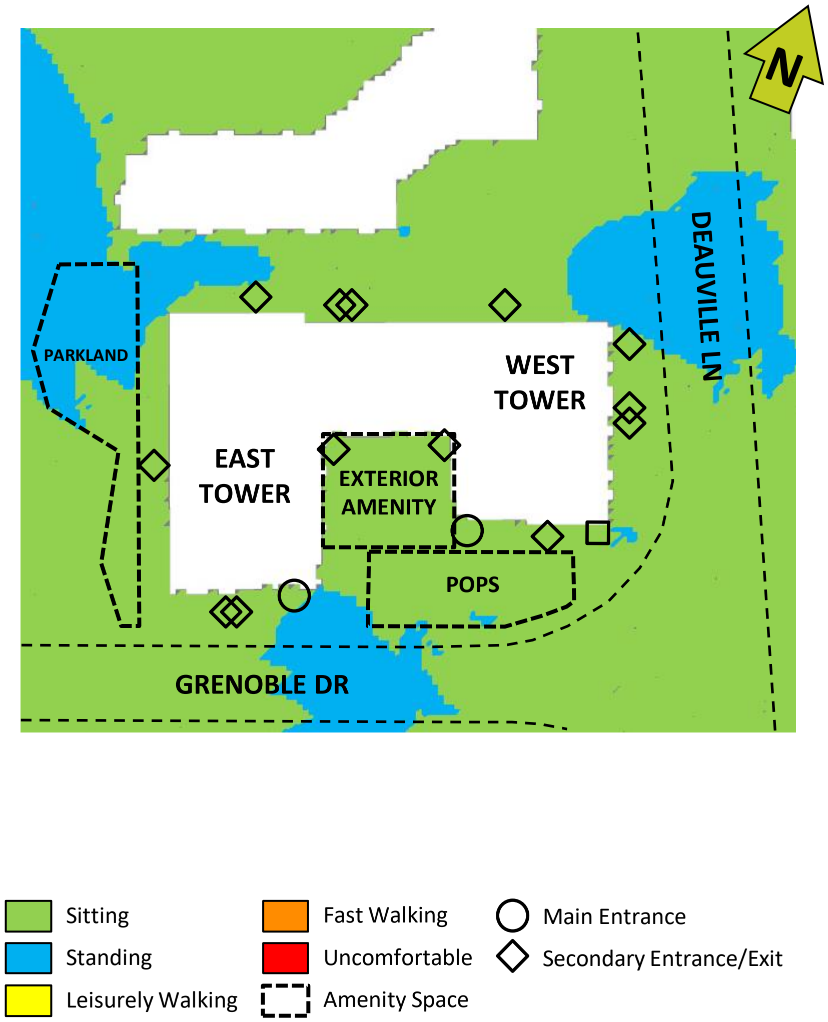


Figure 9a: **Proposed Configuration – Pedestrian Wind Comfort Summer – Building Entrances & Walkways**

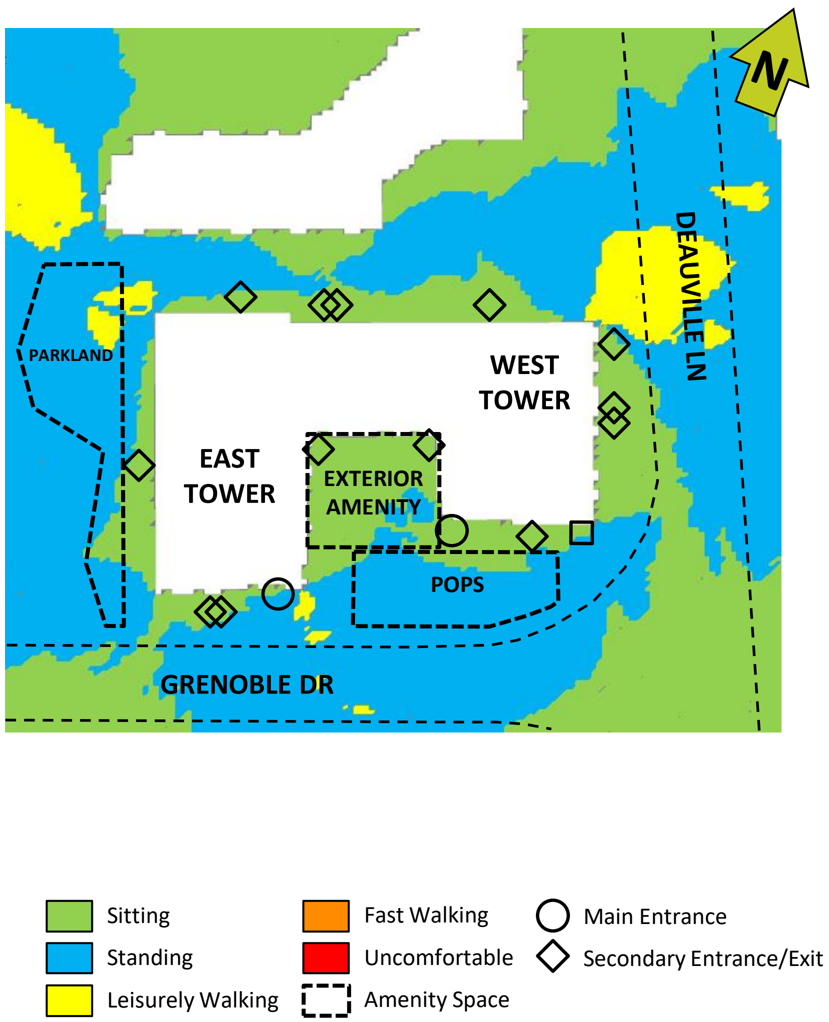


Figure 9b: **Proposed Configuration – Pedestrian Wind Comfort Winter – Building Entrances & Walkways**

Figure 10a: Proposed Configuration – Pedestrian Wind Comfort Summer – Amenity Terraces – Level 7

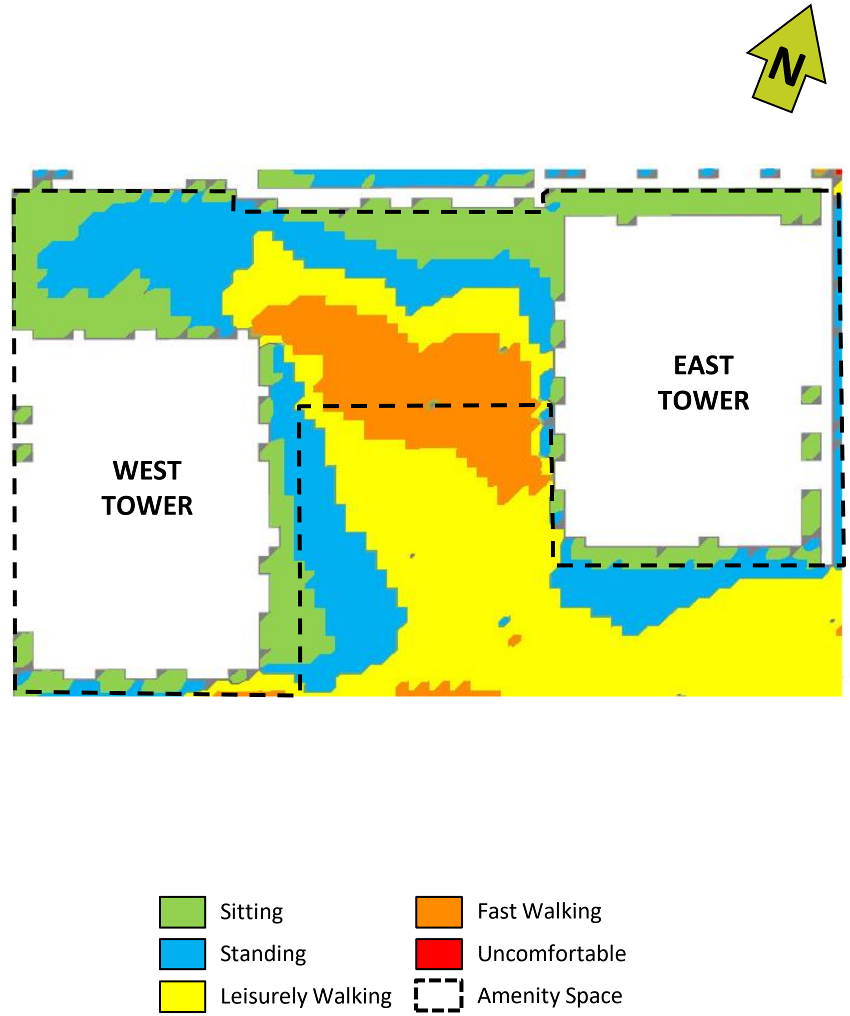
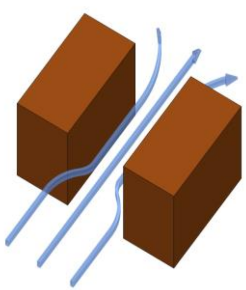


Figure 10b: Proposed Configuration – Pedestrian Wind Comfort Winter – Amenity Terraces – Level 7

4.3 Amenity Terrace

At Level 7, wind conditions in the amenity terrace are generally predicted to be comfortable sitting or standing throughout the year (**Figures 10a** and **10b**). The exception is in the area between the East and West Towers, where wind conditions conducive to leisurely walking and/or fast walking are predicted throughout the year (**Figures 10a** and **10b**). These conditions are considered windier than desired for passive activities.

Strong wind flows on the amenity terrace are due to overall exposure of the development to the northwesterly winds that channel through the gap between the towers, creating local wind accelerations (see image below). We recommend planning passive activities to the north of West Tower and to the north and west of the East Tower (green and blue regions in **Figures 10a** and **10b**). The proposed 2.2 m tall perimeter screens along the north and west edges of the terrace, as well as the canopies along the north facades of each tower, are all positive design features that should be retained in the final design. We recommend additional wind control features, in the form of vertical screens in the area between the towers (yellow and orange areas in **Figures 10a** and **10b**).



Channeling Flow

4.4 Surrounding Sidewalks

Existing wind conditions along the sidewalks of Grenoble Drive, Deauville Lane and St. Dennis Drive are expected to be comfortable for leisurely walking or better year-round. Wind conditions at the transit stops along Deauville Lane and St. Dennis Drive are expected to be comfortable for sitting or standing throughout the year (**Figures 7a** and **8a**).

With the proposed development in place, wind conditions are predicted to remain suitable for leisurely walking or better throughout the year on the surrounding sidewalks. Wind conditions at the nearby transit stops are expected to remain similar to the existing wind conditions (**Figures 7b** and **8b**).

These wind conditions are satisfactory for the anticipated use.

4.5 Wind Safety

The wind safety criterion is predicted to be met at all areas at grade on an annual basis for both the Existing and Proposed Configurations (**Appendix B**).

On the proposed terrace at Level 7, the wind safety criterion is met at all areas on an annual basis except a small area near the southeast corner of the East Tower (**Appendix B**). We recommend extending the 2.2 m tall vertical screen along the south edge of the terrace to eliminate the safety concern.

5.0 CONCLUSIONS & RECOMMENDATIONS

The pedestrian wind conditions predicted for the proposed development at 48 Grenoble Drive in Toronto have been assessed through computational fluid dynamics modeling techniques. Based on the results of our assessment, the following conclusions have been reached:

- The wind safety criterion is met at all areas at grade on-site and surrounding the development in both the Existing and Proposed Configurations. The safety criterion is exceeded on the south edge of Level 7 terrace, near the southeast corner of the West Tower. This can be addressed by extending the 2.2m tall vertical screen along the south edge of the terrace.
- At grade, wind conditions on most of the site, including entrances, are generally expected to be suitable for the intended use year-round. Wind control measures are suggested for the potential parkland area to the west to address windier than desired conditions in the winter months.
- The central portion of the amenity terrace at Level 7 are predicted to be windier than desired for passive activities. Wind control measures are recommended on the terraces.
- On the sidewalks surrounding the proposed development, wind conditions are suitable for the intended use.

6.0 LIMITATIONS OF LIABILITY

This report has been prepared and the work referred to in this report has been undertaken by SLR Consulting (Canada) Ltd. (SLR) for Tenblock, hereafter referred to as the “Client”. It is intended for the sole and exclusive use of the Client. The report has been prepared in accordance with the Scope of Work and agreement between SLR and the Client. Other than by the Client and by the City of Toronto in their role as land use planning approval authorities, copying or distribution of this report or use of or reliance on the information contained herein, in whole or in part, is not permitted unless payment for the work has been made in full and express written permission has been obtained from SLR.

This report has been prepared in a manner generally accepted by professional consulting principles and practices for the same locality and under similar conditions. No other representations or warranties, expressed or implied, are made.

Opinions and recommendations contained in this report are based on conditions that existed at the time the services were performed and are intended only for the client, purposes, locations, time frames and project parameters as outlined in the Scope or Work and agreement between SLR and the Client. The data reported, findings, observations and conclusions expressed are limited by the Scope of Work. SLR is not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. SLR does not warranty the accuracy of information provided by third party sources.

7.0 REFERENCES

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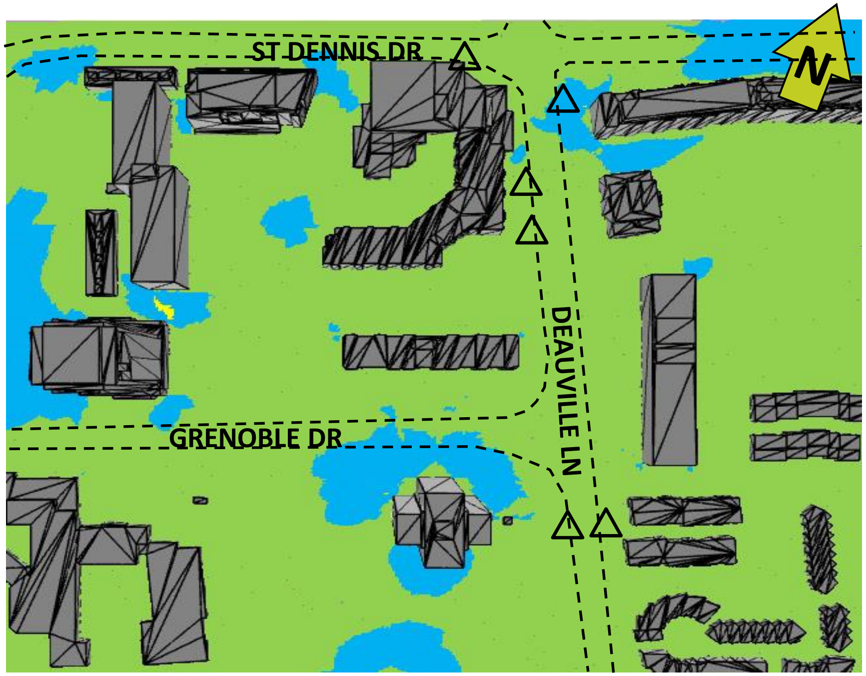
Appendix A

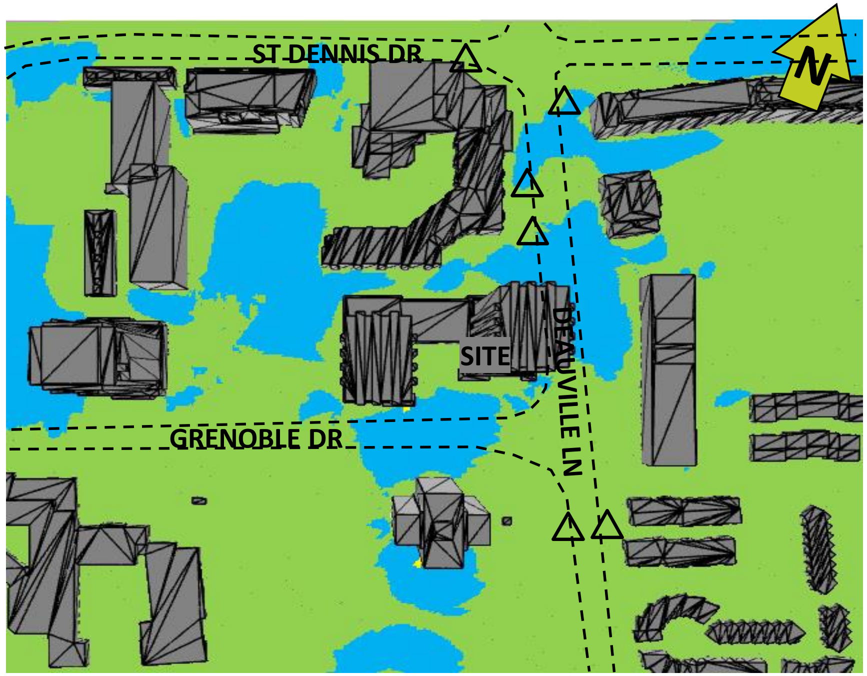
Pedestrian Wind Comfort Analysis

Spring (April – June) and Autumn (October – December)



Sitting | Fast Walking
Standing | Uncomfortable
Leisurely Walking | Transit Stop

Figure A1a: Existing Configuration – Pedestrian Wind Comfort Spring – On-site & Surrounding Areas



Sitting | Fast Walking
Standing | Uncomfortable
Leisurely Walking | Transit Stop

Figure A1b: Proposed Configuration – Pedestrian Wind Comfort Spring – On-site & Surrounding Areas

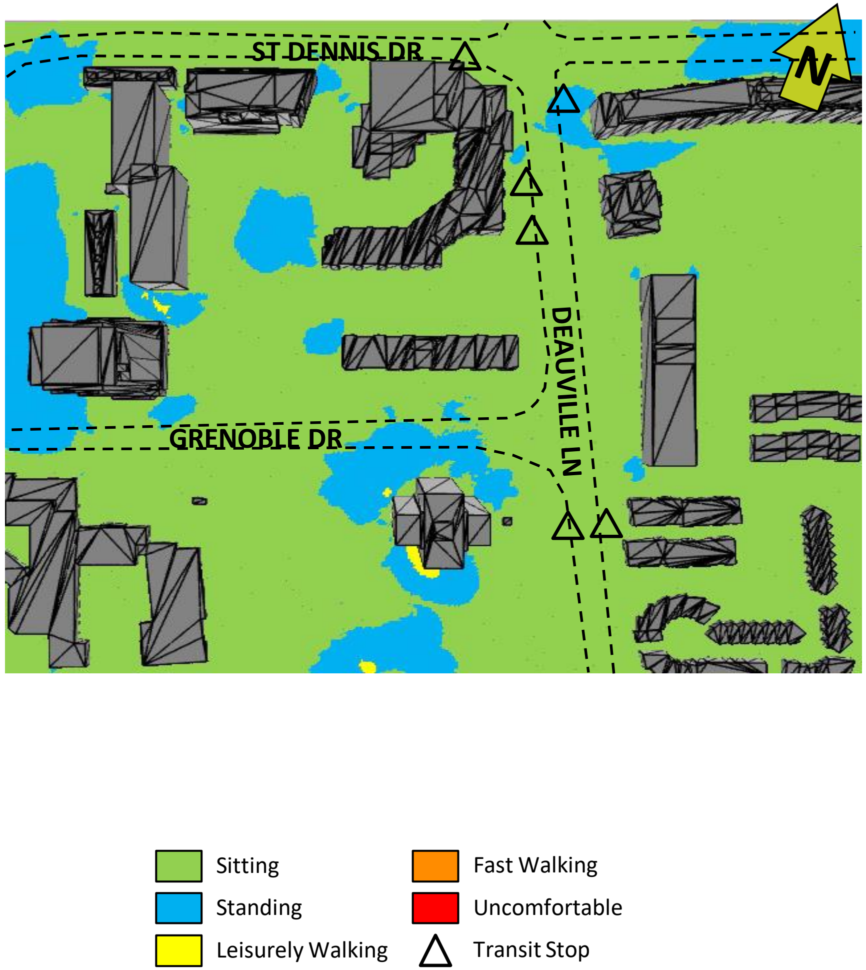


Figure A2a: Existing Configuration – Pedestrian Wind Comfort Autumn – On-site & Surrounding Areas

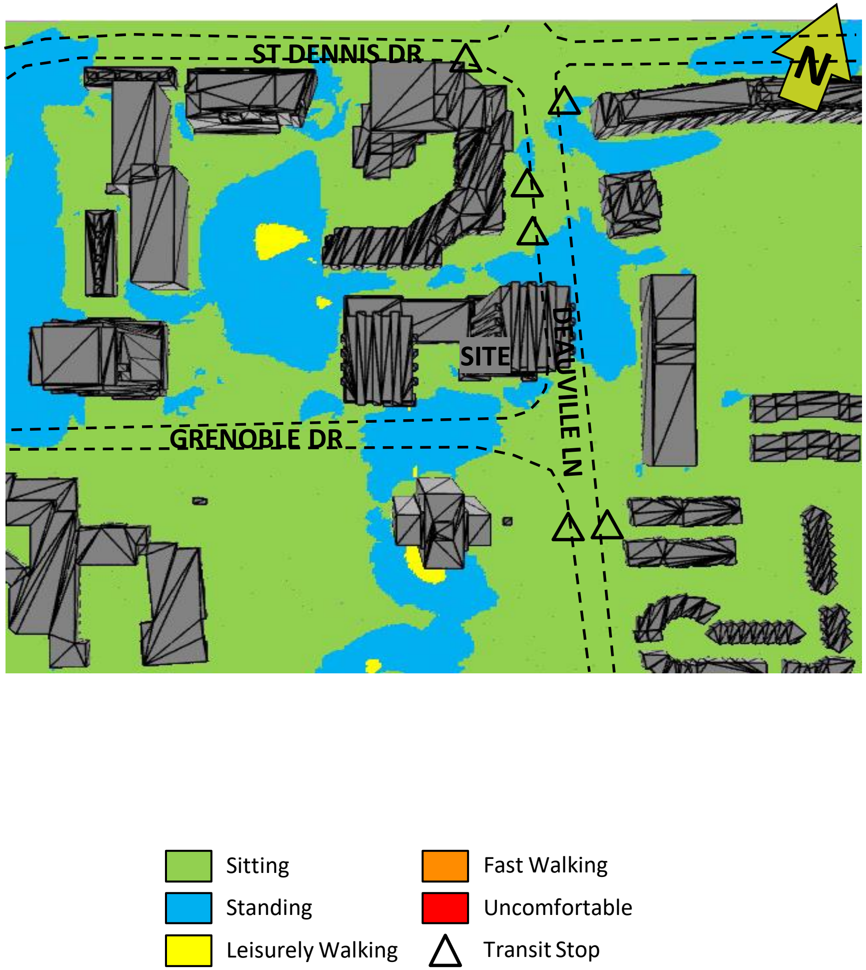


Figure A2b: Proposed Configuration – Pedestrian Wind Comfort Autumn – On-site & Surrounding Areas

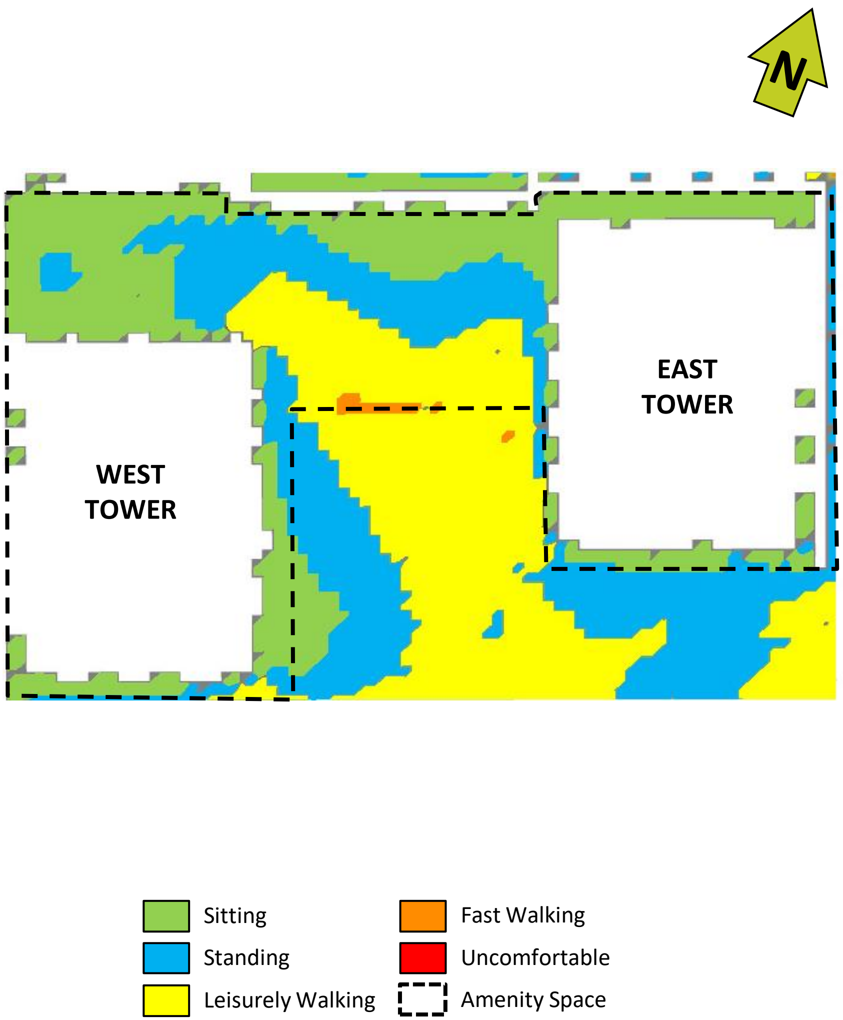


Figure A3a: Proposed Configuration – Pedestrian Wind Comfort Spring – Amenity Terraces – Level 7

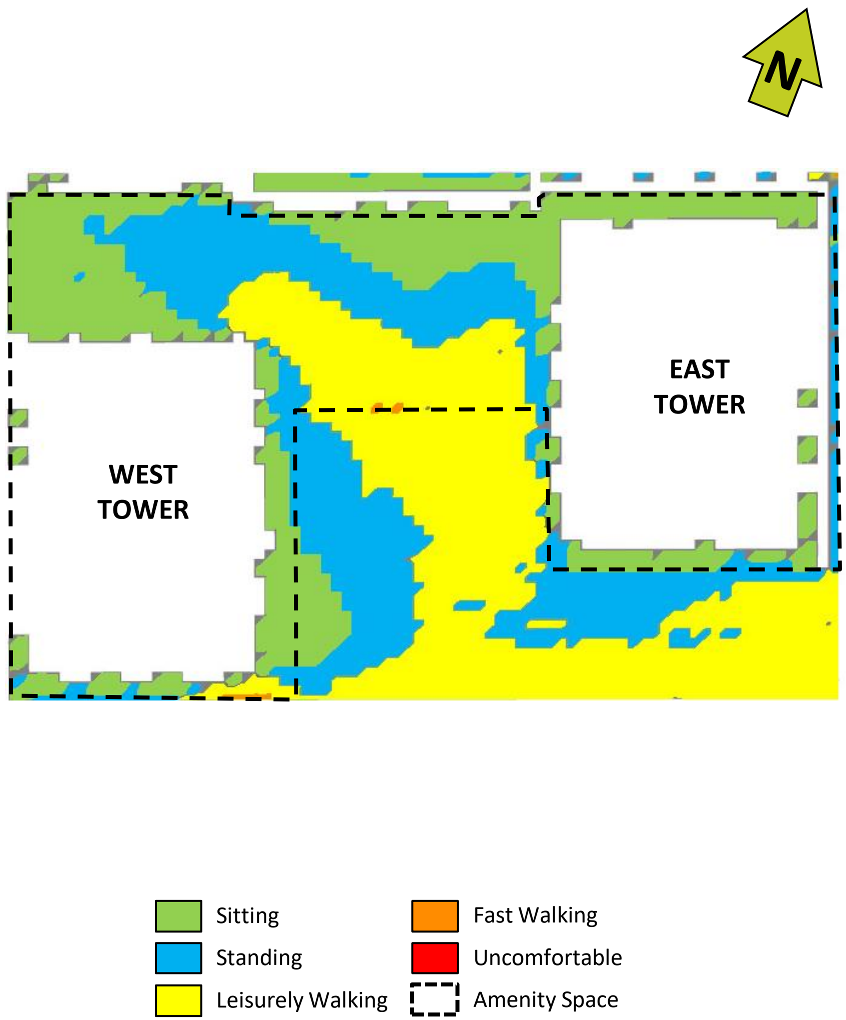


Figure A3b: Proposed Configuration – Pedestrian Wind Comfort Autumn – Amenity Terraces – Level 7

Appendix B

Pedestrian Wind Safety Analysis

Annual

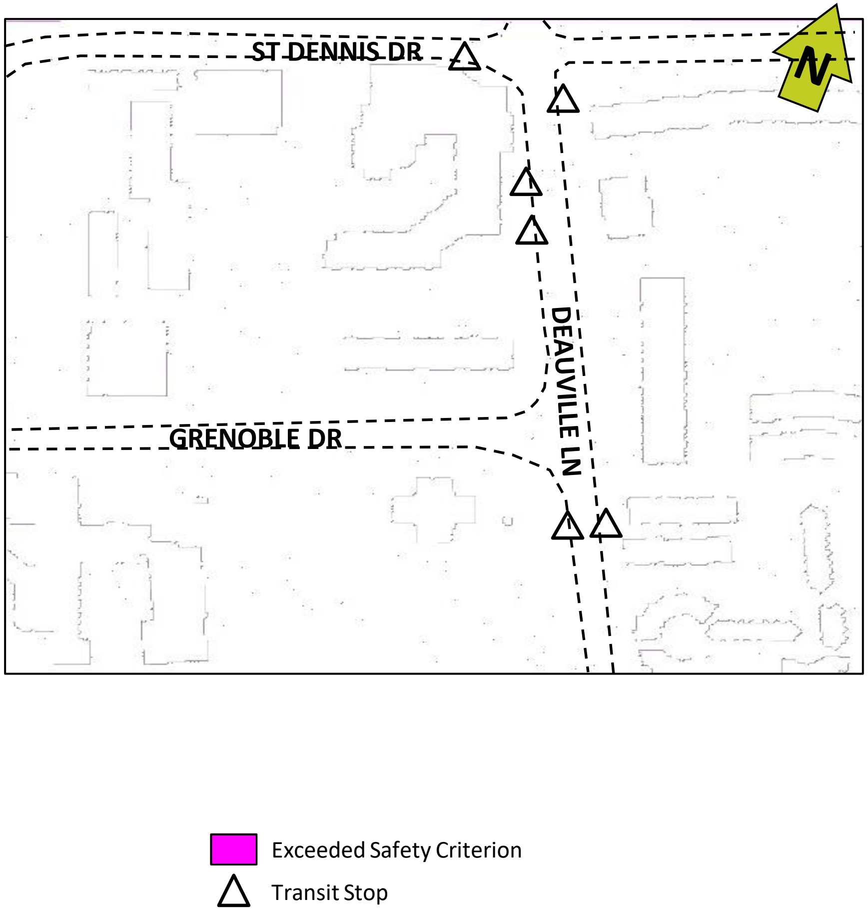


Figure B1a: Existing Configuration – Wind Safety Annual – On-site & Surrounding Areas

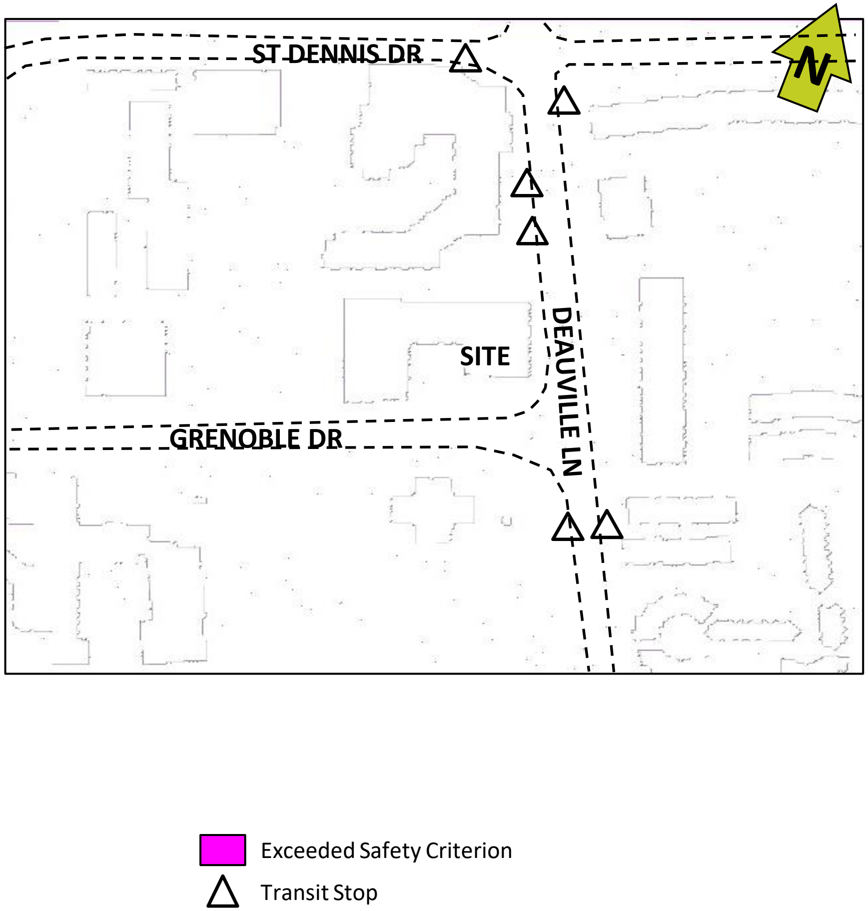


Figure B1b: Proposed Configuration – Wind Safety Annual – On-site & Surrounding Areas

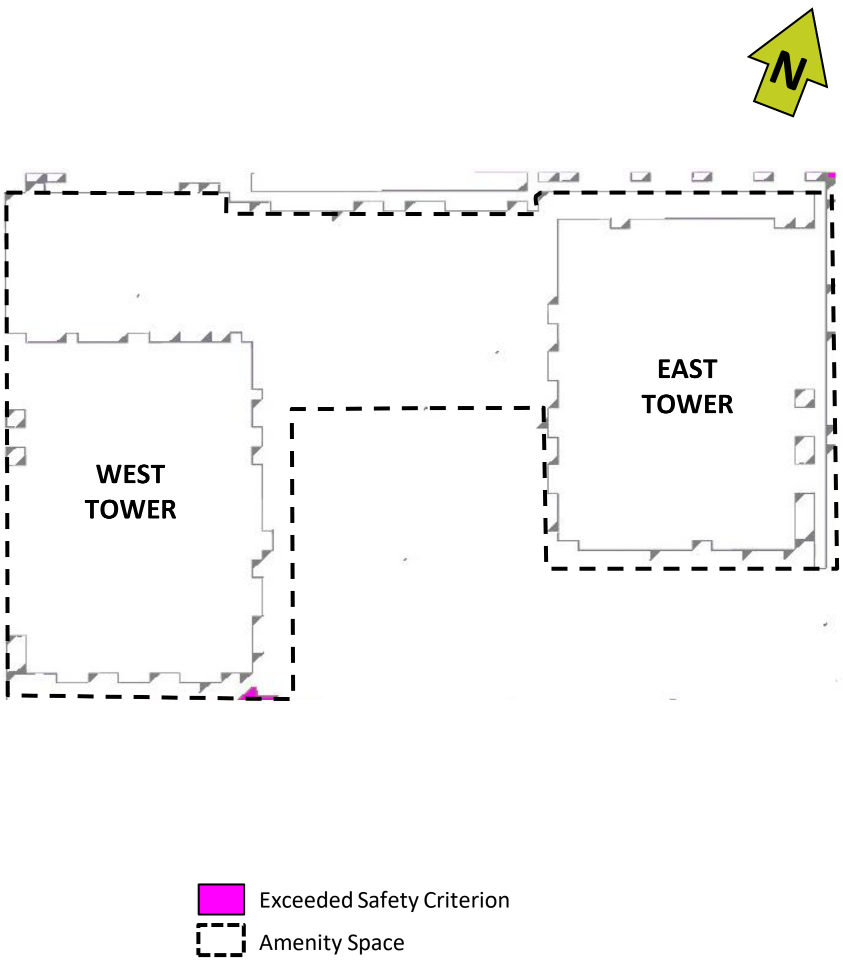


Figure B2: **Proposed Configuration – Pedestrian Wind Comfort Summer – Amenity Terraces – Level 7**