88 PARK STREET EAST

MISSISSAUGA, ONTARIO

PEDESTRIAN WIND ASSESSMENT

PROJECT #2200904
JUNE 9, 2023

SUBMITTED TO

Roman Tsap
roman.tsap@edenshaw.com

Edenshaw Queen Developments Limited
129 Lakeshore Road East, Suite 201
Mississauga, ON, L5G 1E5

SUBMITTED BY

Jennifer Shoniker
Technical Coordinator / Associate
Jennifer.Shoniker@rwdi.com

Rose Babaei, Ph.D.
Senior Technical Coordinator
Rose.Babaei@rwdi.com

Scott Bell, GSC
Project Manager
Scott.Bell@rwdi.com

RWDI
600 Southgate Drive
Guelph, Ontario, N1G 4P6
T: 519.823.1311

rwdi.com

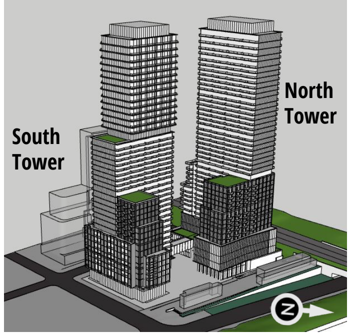
1. INTRODUCTION

Rowan Williams Davies & Irwin Inc. (RWDI) was retained to assess the potential wind conditions at pedestrian levels on and around the proposed 88 Park Street East development in Mississauga, Ontario. The objective of this assessment is to provide an evaluation of the potential wind impact of the proposed development in support of the Zoning Bylaw Application (ZBA).

The development site is located on the west side of Hurontario Street between Park Street East to the south and the Metrolinx rail corridor to the north (**Image 1**). The project site is primarily surrounded by low-rise suburban neighbourhoods, with a cluster of mid to high-rise buildings to the southeast through south to southwest. Lake Ontario is approximately half a kilometer to the southeast of the site.

The proposed development consists of two towers connected through a bridge, the South Tower at 40-storeys and the North Tower at 42-storeys (**image 2**). In addition to sidewalks and properties near the project site, key areas of interest for this assessment include the main entrances to the towers, P.O.P.S. at grade, and above grade amenity spaces (**Image 3**).

Image 1: Aerial view of the existing site and surroundings
Credit: Google Maps



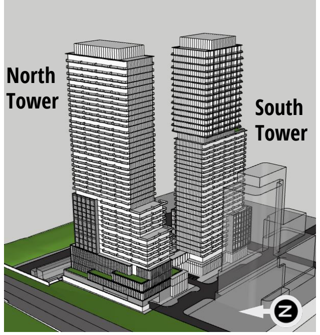


Image 2: 3D model

1. INTRODUCTION

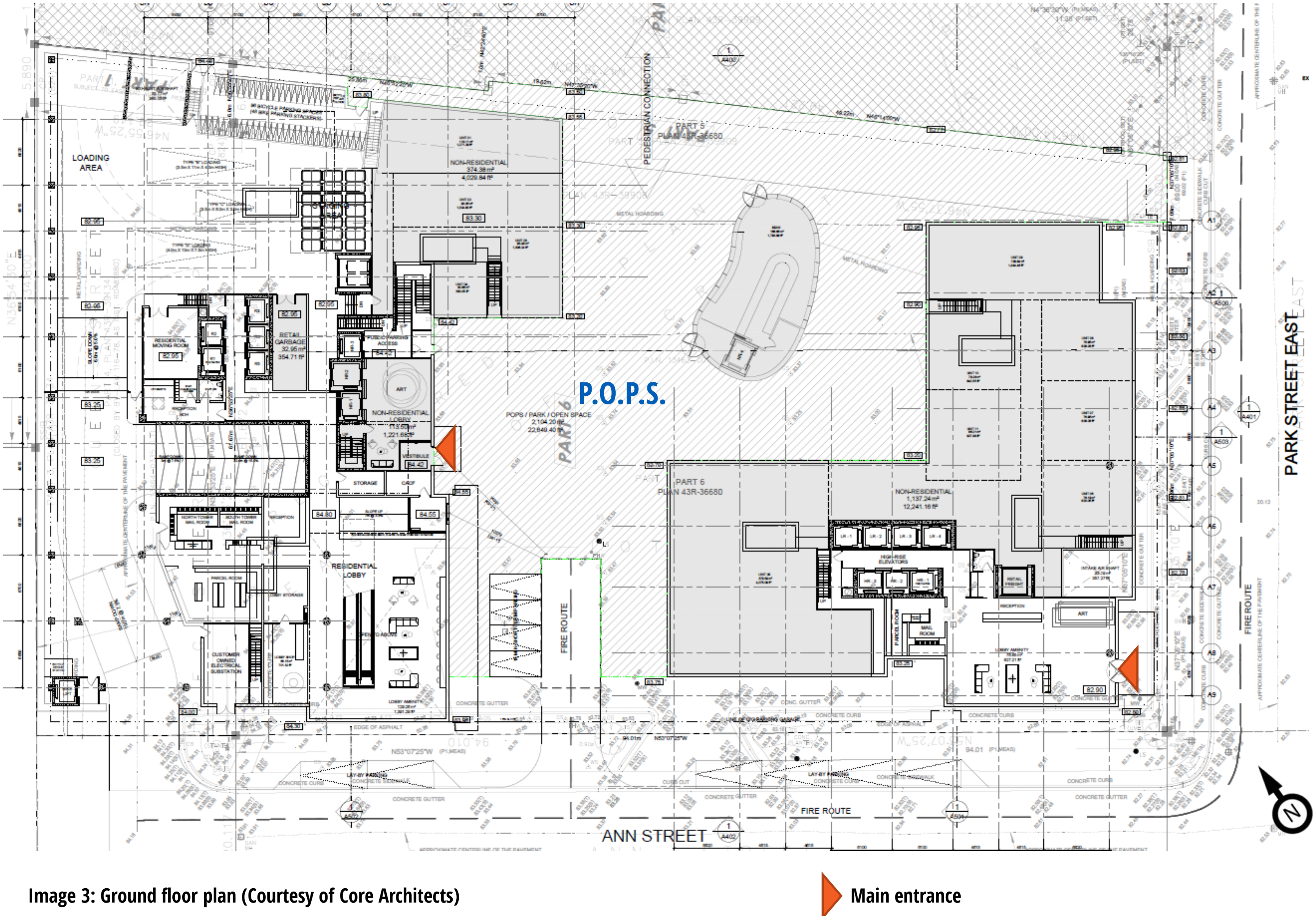


Image 3: Ground floor plan (Courtesy of Core Architects)

2. METHODOLOGY

2.1 Objective

The objective of this assessment is to provide an evaluation of the potential wind impact of the proposed development on pedestrian areas around it. The assessment is based on the following:

- A review of regional long-term meteorological data from Toronto City Billy Bishop Airport;
- 3D model of the proposed project received on May 5, 2023, architectural drawings received on May 11, 2023, and Landscape drawings received on May 31, 2023;
- The use of *Orbital Stack*, an in-house (CFD) tool;
- RWDI's engineering judgment, experience, and expert knowledge of wind flows around buildings[1-3]; and,
- A review of RWDI Pedestrian Wind Tunnel Report for the project dated January 19, 2022;
- The City of Mississauga wind comfort and safety criteria;

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

2.2 CFD for Wind Simulation

CFD is a numerical technique that can be used for simulating wind flow in complex environments. For modelling winds around buildings, CFD techniques are used to generate a virtual wind tunnel where flows around the site, surroundings and the study building are simulated at full scale. The computational domain that covers the site and surroundings are divided into millions of small cells where calculations are performed, which allows for the "mapping" of wind conditions across the entire study domain. CFD excels as a tool for wind modelling and presentation for providing early design advice, comparing different design and site scenarios, resolving complex flow physics, and helping diagnose problematic wind conditions.

Gust conditions are infrequent but deserve special attention due to their potential impact on pedestrian safety. The computational modelling method used in the current assessment does not quantify the transient behaviour of the wind, including wind gusts. The effect of gust, i.e., wind safety, is predicted qualitatively in this assessment using analytical methods and wind-tunnel-based empirical models[1]. The assessment has been conducted by experienced microclimate specialists in order to provide an accurate prediction of wind conditions.

In order to quantify the transient behavior of wind and refine any conceptual mitigation measures, physical scale-model tests in a boundary-layer wind tunnel or more detailed transient computational modelling would be required.

2. METHODOLOGY

2.3 Simulation Model

CFD simulations were completed for two scenarios:

- Existing: Existing site and surroundings
- Proposed: Proposed development with the existing surroundings

The computer model of the proposed development is shown in **Image 4** and the Existing and Proposed configurations with the proximity model are shown in **Images 5** and **6**, respectively. The 3D models were simplified to include only the necessary building and terrain details that would affect the local wind flows in the area and around the site. Landscaping and other smaller architectural and accessory features were not included in the computer model in order to provide more conservative wind conditions (as is the norm for this level of assessment).

The wind approaching the modelled area were simulated for 16 directions (starting at 0°, at 22.5° increments around the compass), accounting for the effects of the atmospheric boundary layer and terrain impacts. Wind data were obtained in the form of ratios of wind speeds at approximately 1.5m above concerned levels, to the mean wind speed at a reference height. The data was then combined with meteorological records obtained from Billy Bishop Toronto City Airport to determine the wind speeds and frequencies in the simulated areas.

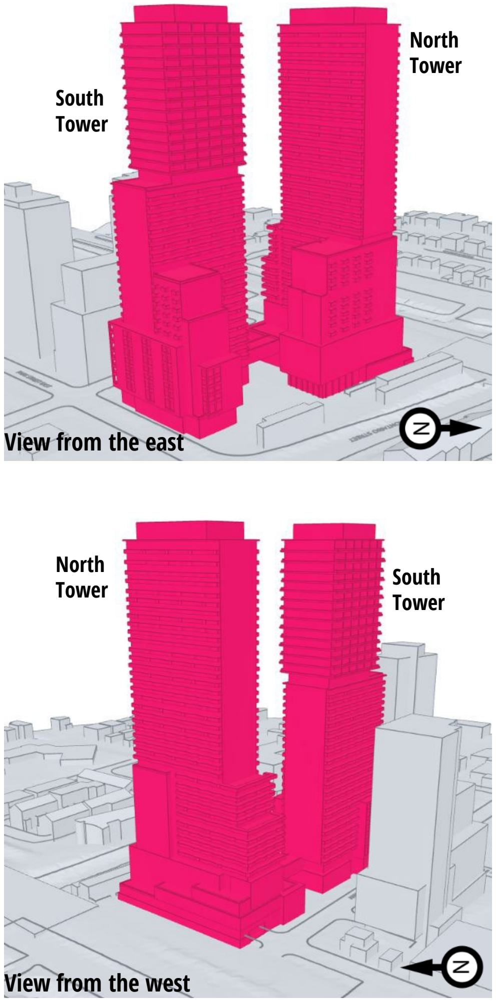


Image 4: Computer model of the proposed project

2. METHODOLOGY

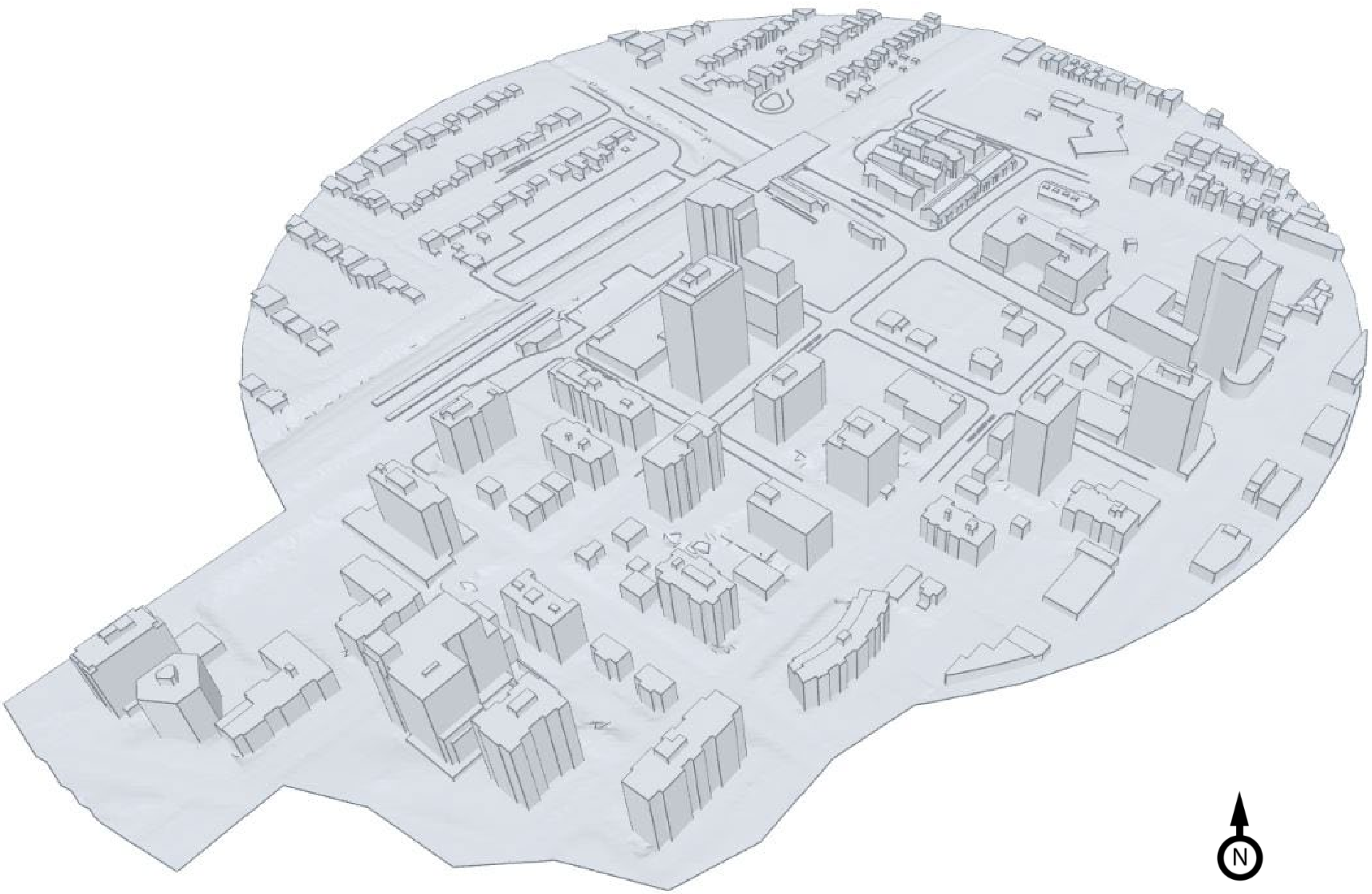


Image 5: Computer model of the existing site and extended surroundings

2. METHODOLOGY

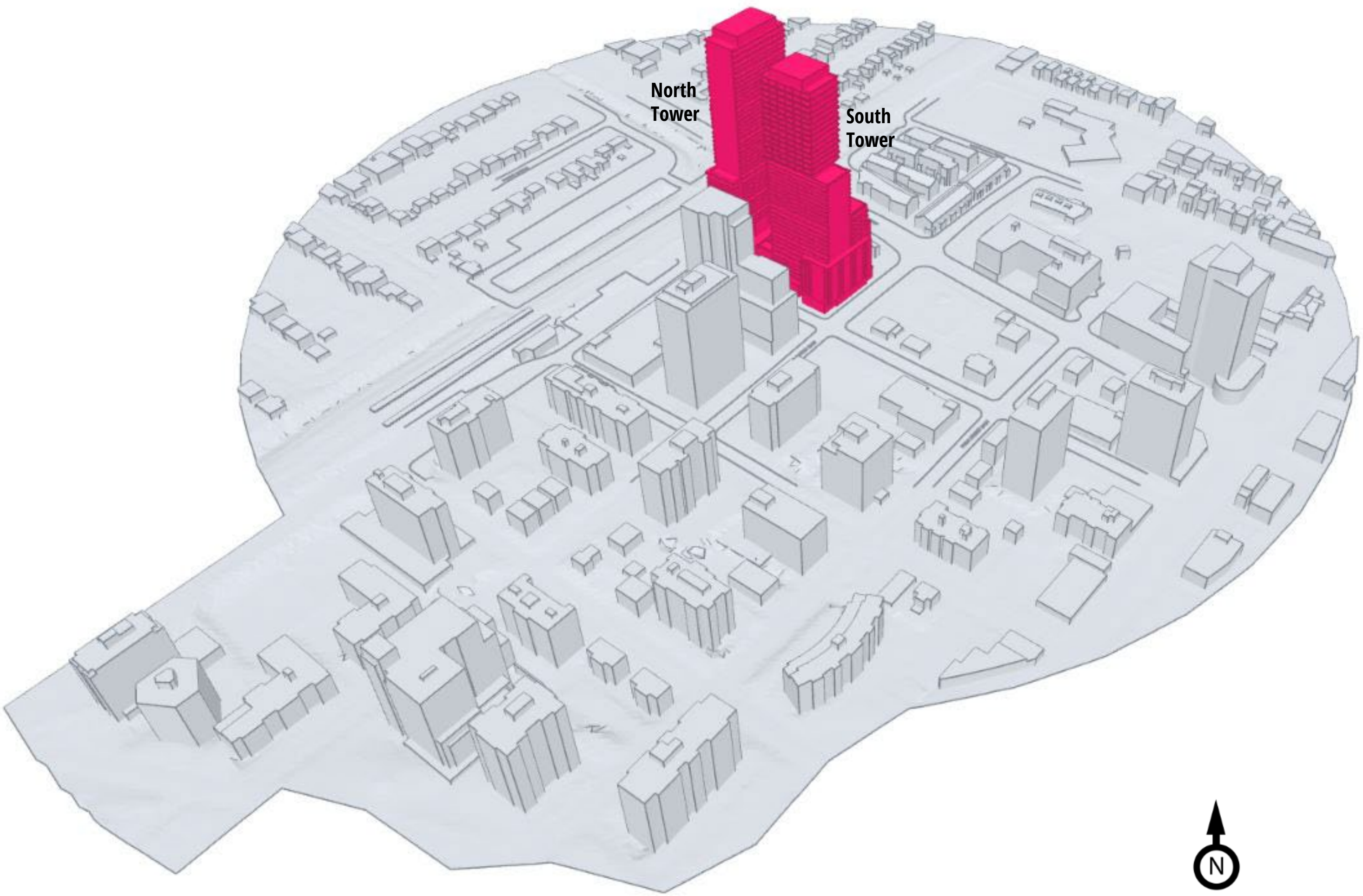


Image 6: Computer model of the proposed development and existing surroundings

2. METHODOLOGY

Long-term wind data recorded at Billy Bishop Toronto City Airport between 1989 and 2019, inclusive, were analyzed for the summer (May to October) and winter (November to April) months. **Image 7** graphically depicts the directional distributions of wind frequencies and speeds for these periods.

In the summer, winds from the easterly directions are predominant, with frequent winds from the southwest and northwest quadrants. In the winter, winds from the west, southwest and northwest are significantly more frequent in addition to winds from the easterly directions.

Strong winds of a mean speed greater than 30 km/h measured at the airport (at an anemometer height of 10m) are more frequent in the winter (red and yellow bands in **Image 7**). These winds potentially could be the source of uncomfortable or severe wind conditions, depending on the site exposure and development design.

Wind statistics were combined with the simulated data to predict the wind conditions at the project site and assessed against the wind criteria for pedestrian comfort.

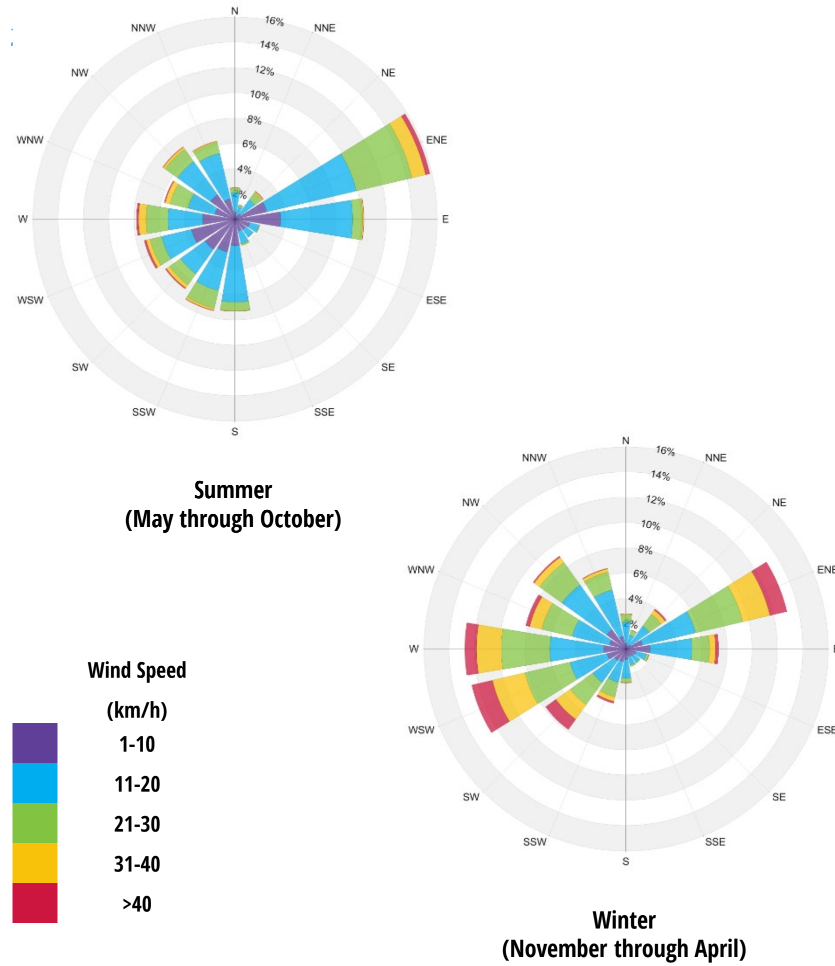


Image 7: Directional distribution of wind approaching Billy Bishop Toronto City Airport (1989 to 2019)

3. WIND CRITERIA

The Mississauga pedestrian wind criteria, developed in June 2014, are specified in the Urban Design Terms of Reference, "Pedestrian Wind Comfort and Safety Studies". The criteria are as follows:

3.1 Pedestrian Safety Criterion

Pedestrian safety is associated with excessive gust 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.

3.2 Pedestrian Comfort Criteria

Wind comfort can be categorized by typical pedestrian activities:

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 above criteria 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., 1.5m above grade or the concerned floor level), typically lower than those recorded in the airport (10m 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 walkways; and lower wind speeds comfortable for standing are required at the main building entrance and drop-off areas. For amenity spaces, calm wind conditions comfortable for sitting or standing are desired in the summer when these areas are typically in use.

4. RESULTS AND DISCUSSION

4.1 Wind Flow Around the Project

Wind generally tends to flow over buildings of uniform height, without disruption. Buildings that are taller than their surroundings tend to intercept and redirect winds around them. The mechanism in which winds are directed down the height of a building is called *Downwashing*. These flows subsequently move around exposed building corners, causing a localized increase in wind activity due to *Corner Acceleration*. When two buildings are situated side by side, wind flow tends to accelerate through the space between the buildings due to *Channelling Effect* caused by the narrow gap. Stepped massing, low roofs and canopies diffuse downwash and reduce the potential wind impact on the ground level. These flow patterns are illustrated in **Image 8**.

The project will be taller than the buildings that exist in the surrounding area. Thus, it is expected to redirect winds to the ground level. The proposed massing designs with multiple steps are favourable toward reducing wind impacts at the grade to some extent.

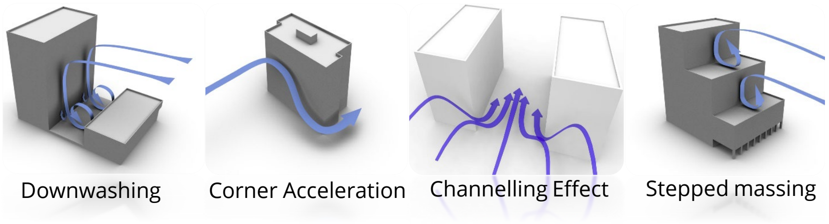


Image 8: General wind flow patterns

4.2 Simulation Results

The predicted wind comfort conditions for the existing and proposed configurations are presented in **Images 9a** through **10b** and **14**. The results are presented as colour contours of wind speeds calculated based on the wind criteria (Section 3.2). The contours represent wind speeds at a horizontal plane approximately 1.5 m above the concerned level.

The assessment against the safety criterion (Section 3.1) was conducted, based on the predicted wind conditions and our wind tunnel experience with similar developments. The areas where the criterion is expected to be exceeded are discussed in the following sections within this report.

A detailed discussion of the expected wind conditions with respect to the prescribed criteria and applicability of the results follows in Sections 4.3. and 4.4. The discussion includes recommendations for wind control to reduce the potential for high wind speeds for the design team's consideration.

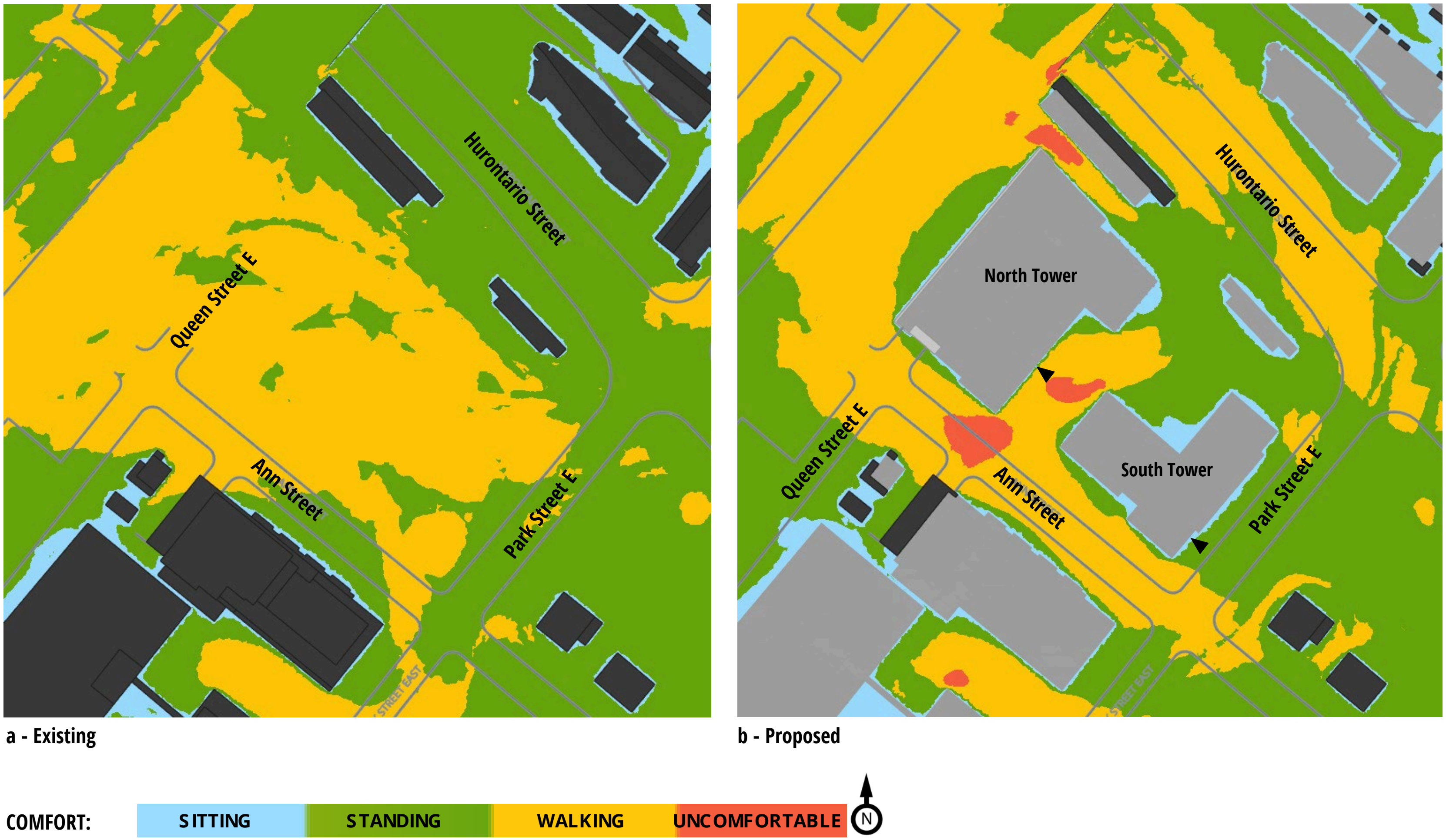
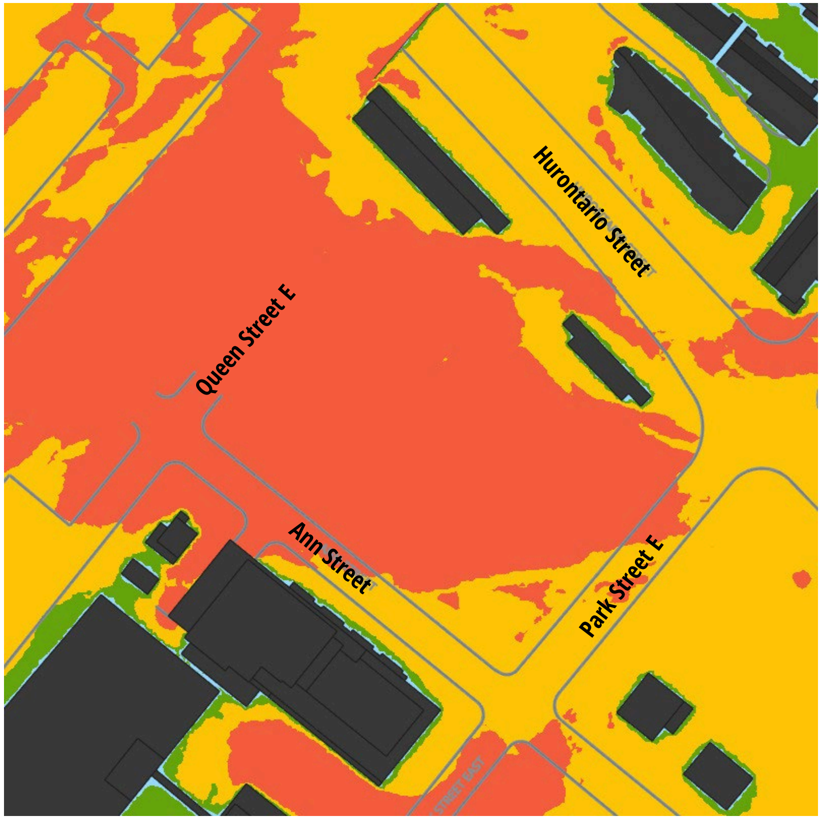


Image 9: Predicted wind conditions – GROUND LEVEL - SUMMER

4. RESULTS AND DISCUSSION



a - Existing

b - Proposed

COMFORT: SITTING | STANDING | WALKING | UNCOMFORTABLE

SAFETY: Areas where the criterion may be exceeded

Image 10: Predicted wind conditions – GROUND LEVEL - WINTER

4.3 Existing Scenario

The existing site is an open parking lot. Wind conditions at most areas in the Existing scenario are considered to be comfortable for standing or walking in the summer (**Image 9a**). Seasonally stronger wind speeds during the winter months result in conditions that are comfortable for walking or uncomfortable - around the site (**Image 10a**).

Wind speeds at all areas near the project site are expected to meet the pedestrian safety criterion.

4.4 Proposed Scenario

The addition of the proposed project to the site is generally expected to cause higher wind speeds, compared to the Existing configuration, which is primarily due to the height of the proposed towers and the low surroundings in the predominant wind directions. Downwashing of the prevailing winds off the tall building façades will redirect them to the ground level; these redirected winds can be relatively strong and turbulent, especially around exposed building corners and in areas between buildings where winds accelerate due to the channelling effect. The proposed buildings have stepped massings, which are positive for reducing wind speeds. Also, the protection from the prevailing westerly winds, provided by the proposed buildings, is expected to improve conditions at the southeast part of the site, compared to the Existing scenario.

4.4.1 Sidewalks and Neighbouring Properties

Wind speeds at most sidewalks and areas on and around the proposed development are expected to continue to be comfortable for standing or walking in the summer. Higher wind speeds, becoming uncomfortable, are expected around the southwest and northeast corners of the North Tower and under the bridge in the gap between buildings **(Image 9b)**.

During the winter, higher wind speeds that are uncomfortable for pedestrian use are expected at areas around the western corners of both towers, at the northeast corner of the North Tower, through the gap between the towers and along the sidewalks of Ann Street between the proposed project and the neighbouring mid-rise building to the west **(Image 10b)**. Also, during the winter season due to seasonally stronger winds, uncomfortable conditions are predicted along Hurontario Street. Wind speeds comfortable for standing or walking are predicted on the southeast part of the site and to the south of the South Tower.

Wind conditions at most areas near the project site are expected to meet the safety criterion except for areas near the exposed tower corners and between the towers – see the identified areas in **Image 10b**.

4. RESULTS AND DISCUSSION

To help improve the wind conditions, wide canopies along the west, north and east sides of the North Tower and the north and west sides of the South Tower and wrapped around the corners can be considered to divert the wind downdrafts and moderate the wind impact of the towers. Any massing articulations and façade details at the building corners can also help disorganize the wind flows, hence diffuse their energy.

For areas between the towers, where the wind flow channelling occurs, strategic use of vertical wind control elements in the form of porous screens, art features and evergreen/marcescent landscaping can be explored. Such features can also be implemented near the exposed building corners to diffuse the energy of accelerating winds. Wind control examples are shown in **Image11**.

RWDI will work with the design team to confirm the placement of the recommended wind control measures which will be implemented into the design at a later stage and will be confirmed through wind tunnel testing during the Site Plan Application stage.

Image 11: Design strategies for wind control at grade level

4.4.2 Building Entrances

The main entrances to the proposed towers are identified in **Image 3**. Wind conditions at the main entrance to the South Tower are predicted to be comfortable for standing throughout the year which is suitable for the intended use. Slightly elevated wind speeds may occur at this location from time to time in the winter.

Higher than desired wind speeds, comfortable for walking in the summer and potentially uncomfortable in the winter, are predicted at the main entrance to the North Tower. This is due to prevailing winds downwashing off the tall façade and channelling between the towers **(Images 9b** and **10b)**. To create a more sheltered entrance we recommend the use of canopies overhead and windscreens or landscaping/planters placed on both sides of the doors to reduce wind speeds (See examples in **Image 12**).

Image 12: Design strategies for wind control at Entrances

4.4.3 Grade-Level P.O.P.S. Area

The outdoor P.O.P.S. area between the towers **(Image 3)** is predicted to be comfortable for walking or better at most areas during the summer season when this area will be used more frequently by pedestrians. Conditions comfortable for walking are windier than desired for prolonged use for passive activities (dining, sitting, etc.). Increased wind activity and potentially uncomfortable conditions are expected at some parts of the P.O.P.S in the winter. These higher wind speeds during the winter may be acceptable as outdoor areas would not be frequently used during the colder times of the year.

The recommended massing changes, canopies and landscaping with tall trees/shrubs/screens will lower wind speeds in the P.O.P.S. If the landscaping is mostly deciduous, their wind control benefits will not extend beyond the warmer months. Additionally, trellises, wind screens and planters at least 1.5 m tall around seating areas will locally improve wind conditions **(**See examples in **Image 13).**

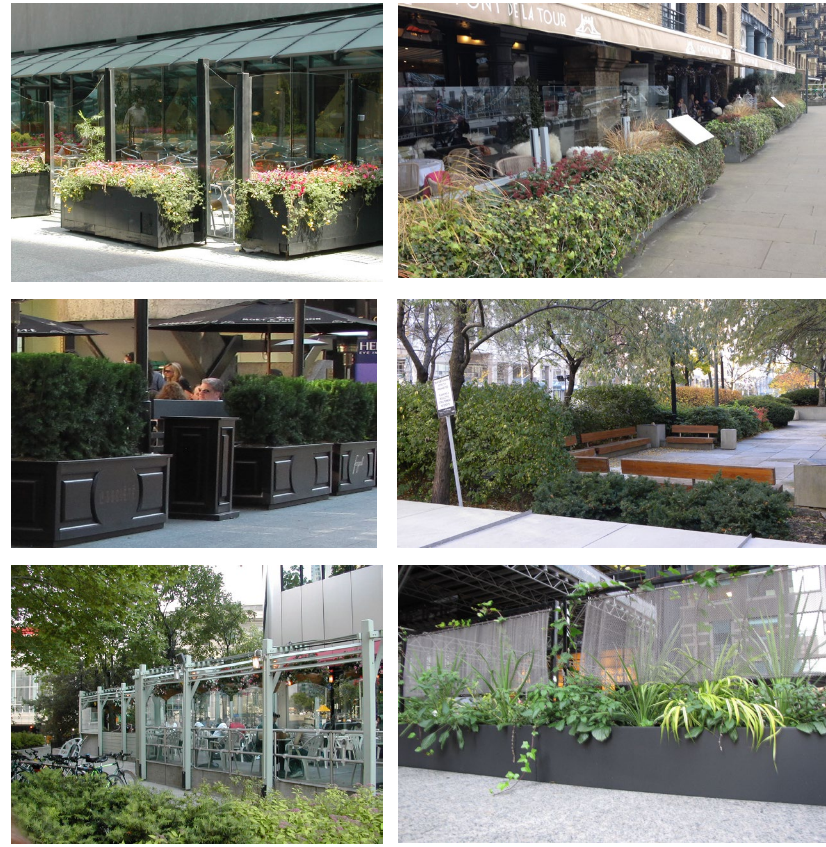


Image 13: Design strategies for wind control at P.O.P.S. areas

4. RESULTS AND DISCUSSION

4.4.4 Above Grade Amenity Terraces

Wind speed increases with elevation; the terrace levels are exposed to the stronger winds at higher elevations as well as winds that are redirected by the tall tower components. As such, conditions on the terraces throughout the year are expected to be higher-than-desired for passive use **(Image 14)**. During the winter, uncomfortable wind speeds that exceed the pedestrian safety criterion are expected at some areas on these terraces, especially near the exposed corners and along the edges. Higher than desired wind speeds in the winter may be acceptable as these areas will likely not be occupied frequently in the cold months.

We encourage the design team to consider minimum 2 m tall guardrails around the terrace perimeters as well as overhead features like canopies and trellises at the tower bases to deflect the wind downdrafts away from the terraces. Wind screens, partitions and planters may be interspersed throughout the terrace or used to surround designated gathering or seating areas. Some examples of these wind control features are shown in **Image 15**. RWDI can guide the selection and placement of such features for wind control as the design advances.

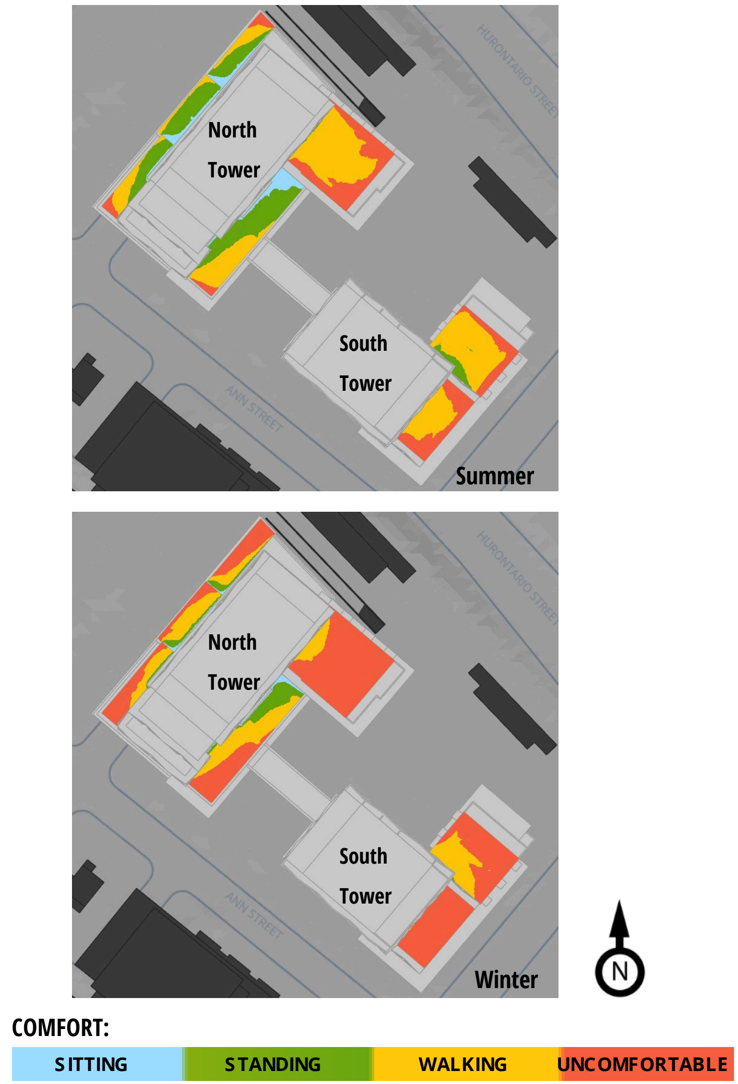


Image 14: Predicted wind conditions – ABOVE GRADE

4. RESULTS AND DISCUSSION

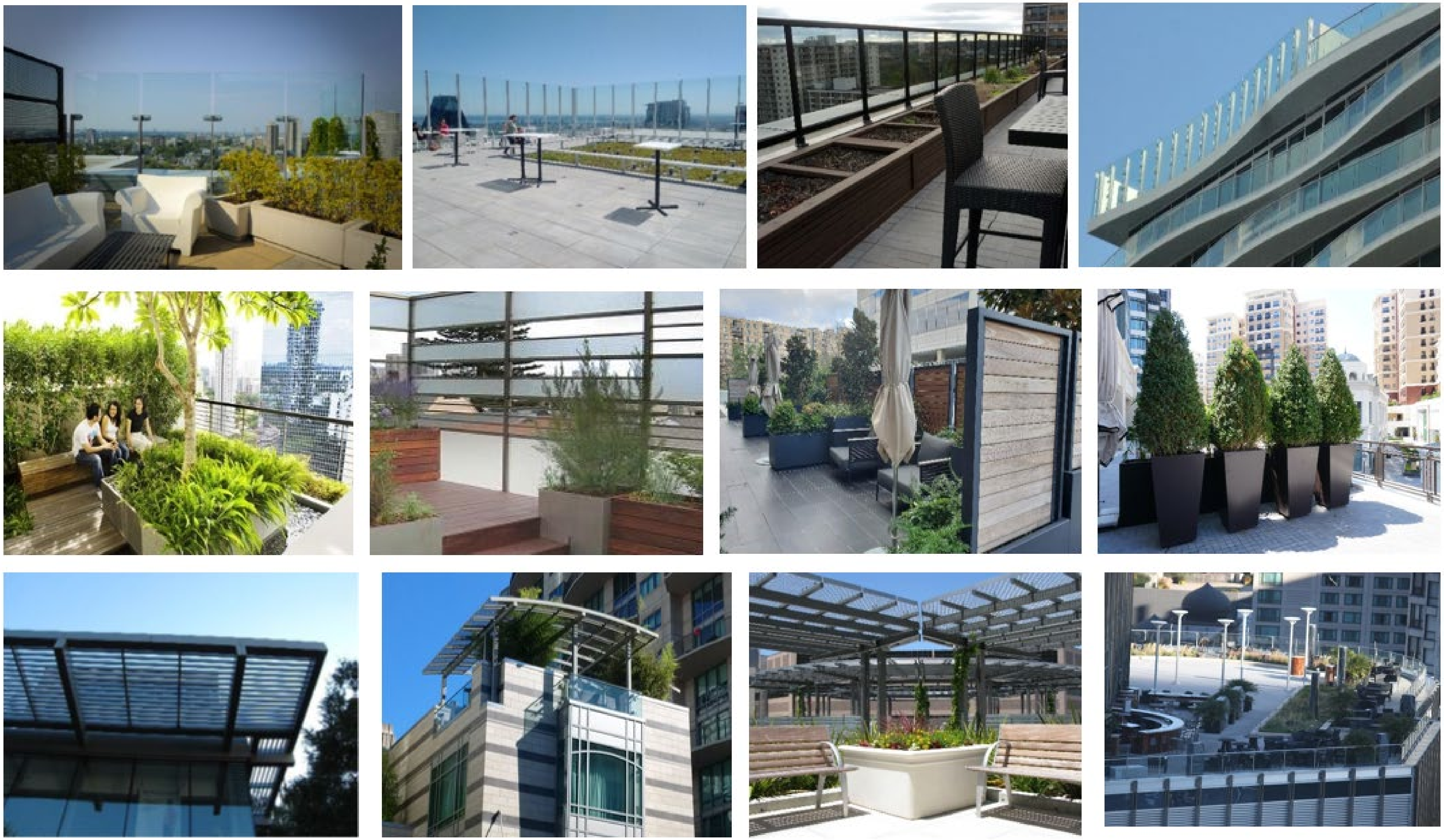


Image 15: Design strategies for wind control on terraces

5. SUMMARY

RWDI was retained to provide an assessment of the potential pedestrian level wind impact of the proposed 88 Park Street East development in Mississauga, Ontario. Our assessment was based on the local wind climate, the current design of the proposed development, the existing surrounding buildings, and computational modelling and simulation of wind conditions. Our findings are summarized as follows:

- Wind conditions on and around the existing site are suitable for the intended pedestrian use during the summer. In the winter, higher-than-desired wind activity is predicted at some areas on the site. The pedestrian wind safety criterion is anticipated to be met at all pedestrian areas on and immediately around the project site.
- The proposed project is taller than its surroundings, and therefore will redirect wind to ground level. However, several positive features are included within the design such as the stepped massing design which will help moderate wind impacts to some extent.
- Wind conditions at most ground level areas, including the South Tower main entrance, are expected to be appropriate for the intended usage during the summer season. Higher wind speeds are predicted around the exposed corners of the North Tower, under the bridge between the towers and at the main entrance of the North Tower.
- In the winter, due to the seasonally stronger winds, higher wind speeds and uncomfortable conditions are predicted at multiple areas on site.
- Wind conditions at most areas in the P.O.P.S. are comfortable for active use during the summer, and uncomfortable in the winter.
- Wind speeds on the terrace levels are predicted to be higher than desired for passive use throughout the year.
- The pedestrian wind safety criterion is expected to be met at all grade level locations in the proposed scenario. However, the criterion may be exceeded around the exposed building corners, along the gap between the buildings and on the elevated terraces, primarily during the winter season.
- The predicted wind conditions can be improved with the use of appropriate large-scale and small-scale wind mitigation measures. Conceptual wind control strategies are provided in the report.

RWDI can help develop the mitigation solutions and guide the placement of wind control features, including landscaping, to achieve appropriate levels of wind comfort. Detailed study of the mitigation measures and the quantitative assessment of their effectiveness will be conducted during the Site Plan Application stage.

6. DESIGN ASSUMPTIONS

The findings/recommendations in this report are based on the geometry and architectural drawings of the proposed project communicated to RWDI in May 2023, listed below. Should the details of the proposed design and/or geometry of the building change significantly, results may vary.

File Name	File Type	Date Received (mm/dd/yyyy)
2023-05-04_Massing	SketchUp	05/05/2023
2023-05-11_88PSE-DraftZBA	PDF	05/11/2023
512 2023-05-31 (Landscape Plans)	PDF	05/31/2023

Changes to the Design or Environment

It should be noted that wind comfort is subjective and can be sensitive to changes in building design and operation that are possible during the life of a building. These could be, for example: outdoor programming, operation of doors, elevators, and shafts pressurizing the tower, changes in furniture layout, etc.. In the event of changes to the design, construction, or operation of the building in the future, RWDI could provide an assessment of their impact on the discussions included in this report. It is the responsibility of others to contact RWDI to initiate this process.

7. STATEMENT OF LIMITATIONS

This report was prepared by Rowan Williams Davies & Irwin Inc. for Edenshaw Queen Developments Limited ("Client"). The findings and conclusions presented in this report have been prepared for the Client and are specific to the project described herein and authorized scope. The conclusions and recommendations contained in this report are based on the information available to RWDI when this report was prepared. Because the contents of this report may not reflect the final design of the Project or subsequent changes made after the date of this report, RWDI recommends that it be retained by Client to verify that the results and recommendations provided in this report have been correctly interpreted in the final design of the Project.

The conclusions and recommendations contained in this report have also been made for the specific purpose(s) set out herein. Should the Client or any other third party utilize the report and/or implement the conclusions and recommendations contained therein for any other purpose or project without the involvement of RWDI, the Client or such third party assumes any and all risk of any and all consequences arising from such use and RWDI accepts no responsibility for any liability, loss, or damage of any kind suffered by Client or any other third party arising therefrom.

Finally, it is imperative that the Client and/or any party relying on the conclusions and recommendations in this report carefully review the stated assumptions contained herein and to understand the different factors which may impact the conclusions and recommendations provided.

8. REFERENCES

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.