REPORT

3275 TRAFALGAR ROAD

OAKVILLE, ONTARIO

PEDESTRIAN WIND COMFORT ASSESSMENT

PROJECT #2205964
September 10, 2024

SUBMITTED TO

3275 Trafalgar Limited Partnership

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1. INTRODUCTION

Rowan Williams Davies & Irwin Inc. (RWDI) was retained to conduct a pedestrian wind assessment for the proposed development at 3275 Trafalgar Road in Oakville, Ontario. The objective of this assessment is to provide an evaluation of the potential wind impact of the proposed development.

The project site is located east of Trafalgar Road north of Threshing Mill Boulevard, surrounded by high-rise residential towers and subdivisions to the south, and open agricultural lands to the north, east, and west (Image 1).

The project is a residential development comprising of two parcels, 1 and 2. Parcel 1 consists of a building with two 30-storey towers (Building A and B) connected by a 6-storey podium (Parcel 1A), and a number of 2-storey townhouses (Parcel 1B). Parcel 2 consists of two 14-storey towers (Building C and D), where Building D includes a 6-storey podium. The buildings will have stepped forms, which is favourable for reducing wind impacts.

In addition to sidewalks and walkways near the project site, key areas of interest for this assessment include main entrances to the buildings, a ground floor outdoor amenity south of Building C, and above-grade outdoor amenities on Level 7 of the Parcel 1A building, and on Building D (Image 3).

Based on a review of the latest architectural design drawings dated August 6th, 2024, these results will remain the same or similar due to the minor changes from the original design drawings which were used for this assessment.

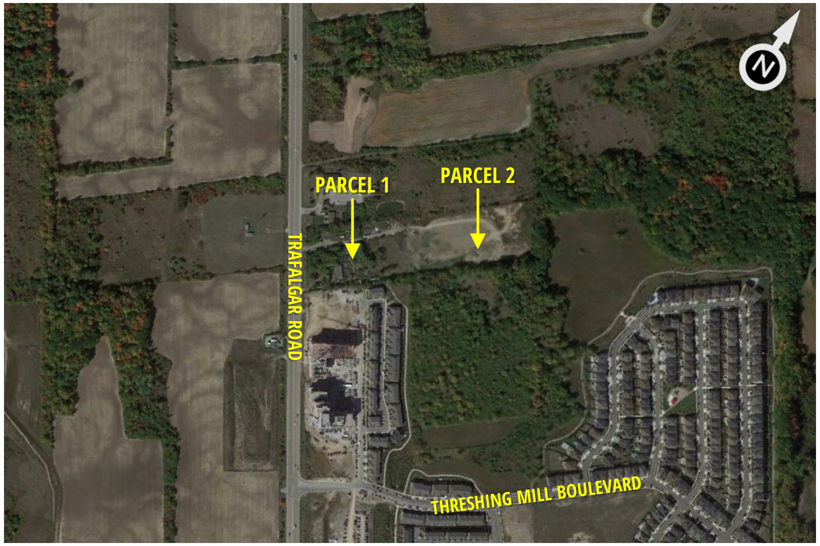


Image 1: Aerial view of the Existing Site and Surroundings
Source: Google Earth

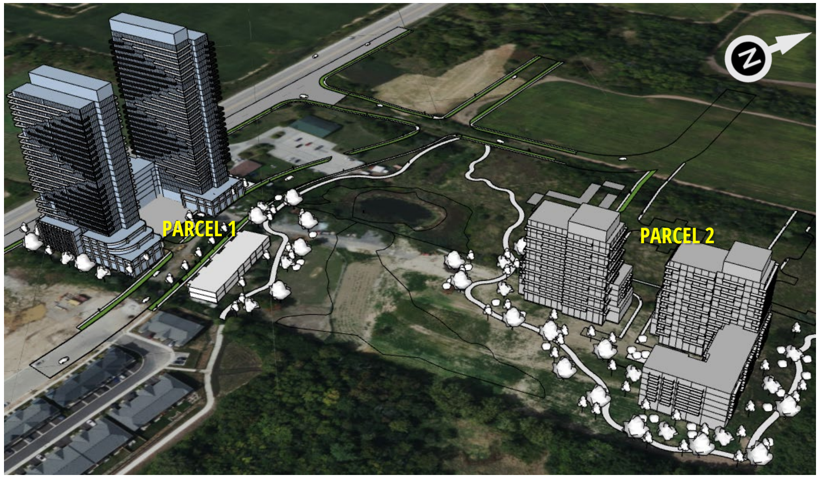


Image 2: Conceptual Massing of the Proposed Parcel 1 (left) and Parcel 2 (right) Buildings

1. INTRODUCTION

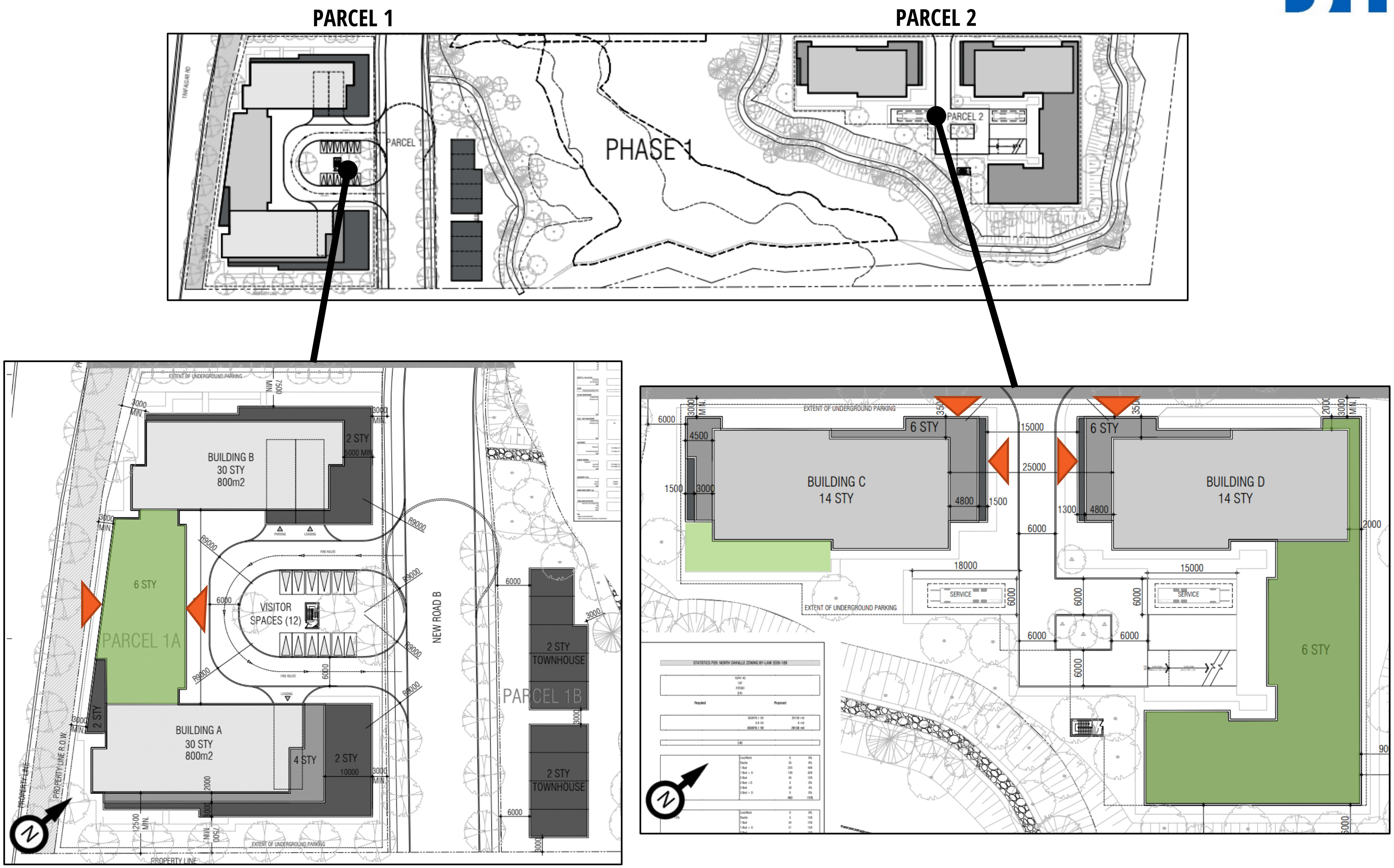


Image 3: Overall Site Plan and Floor Plans Identifying Key Outdoor Areas of Interest

OUTDOOR AMENITY

BUILDING ENTRANCE

2. METHODOLOGY

2.1 Objective

The objective of this assessment is to provide an evaluation of the potential impact of the proposed development on wind conditions in pedestrian areas on and around it based on Computational Fluid Dynamics (CFD) modelling. The assessment is based on the following:

- A review of the regional long-term meteorological data from Toronto Pearson International Airport;
- Architectural drawings and 3D model of the proposed project received on December 22, 2023, and January 8, 2024, respectively;
- 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,
- The RWDI wind comfort and safety criteria.

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

Based on a review of the latest architectural design drawings dated August 6th, 2024, these results will remain the same or similar due to the minor changes from the original design drawings which were used for this assessment.

2.2 CFD for Wind Simulation

CFD is a numerical technique that can be used for simulating wind flows in complex environments. For this analysis, CFD techniques were used to generate a virtual wind tunnel where flows around the site and its surroundings were simulated in full scale. The computational domain that covered the site and its surroundings was divided into millions of small cells where calculations were performed, yielding a prediction of wind conditions across the entire study domain. CFD excels as a tool for wind modelling, presenting early design advice, comparing different design and site scenarios, resolving complex flow physics, and helping diagnose problematic wind conditions.

While the computational modelling method used in the current assessment does not explicitly simulate the transient behaviour of turbulent wind, its effects were estimated based on other calculated quantities. RWDI has found this approach to be appropriate for the assessment of typical wind comfort conditions. Wind safety issues, which relate to transient, higher-speed gusts, are discussed qualitatively, based on the CFD predictions and our extensive wind-tunnel experience for similar projects.

In order to quantify the transient behaviour of wind and refine any conceptual mitigation measures, a more detailed assessment would be required using either boundary-layer wind tunnel or transient computational modelling.

2. METHODOLOGY

2.3 Simulation Model

CFD simulations were completed for two scenarios:

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

The computer model of the proposed buildings is shown in Image 4, and the Existing and Proposed configurations with the proximity model are shown in Images 5a and 5b, 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 Toronto Pearson International Airport to determine the wind speeds and frequencies in the simulated areas.

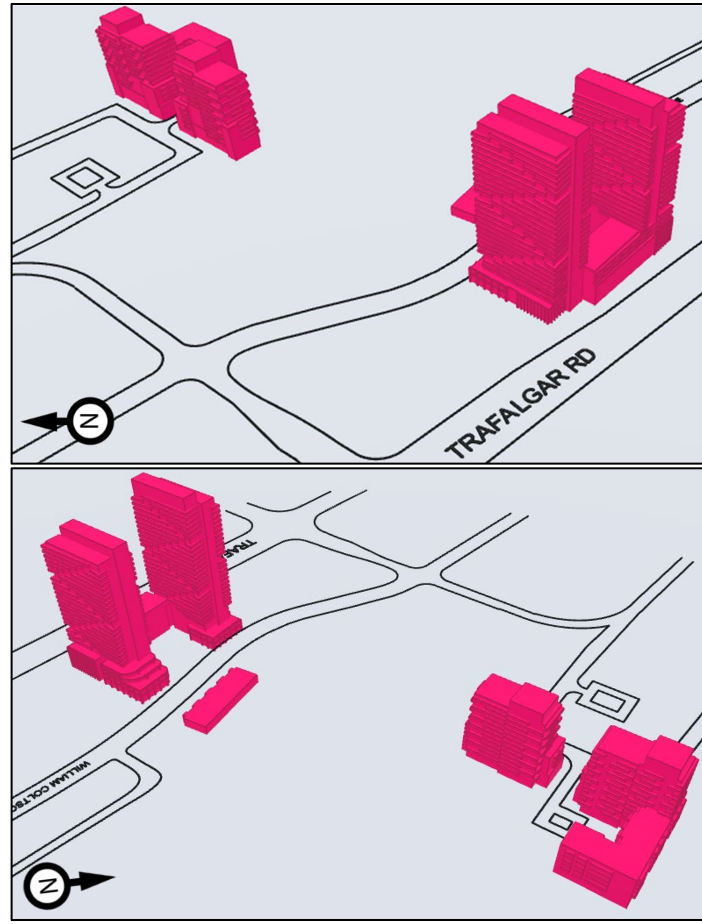


Image 4: Computer Model of the Proposed Project

2. METHODOLOGY

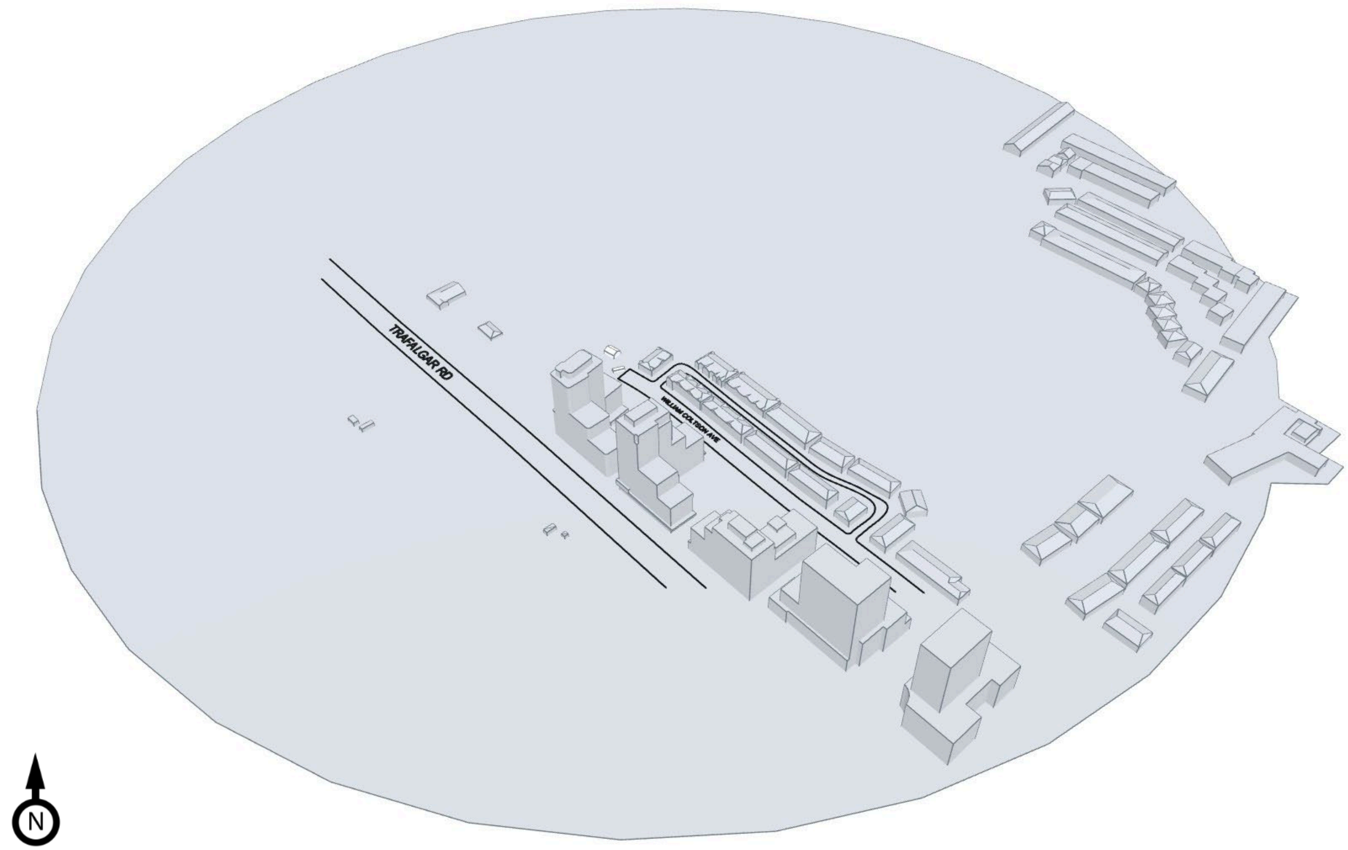


Image 5a: Computer Model of the Existing Site and Extended Surroundings

2. METHODOLOGY

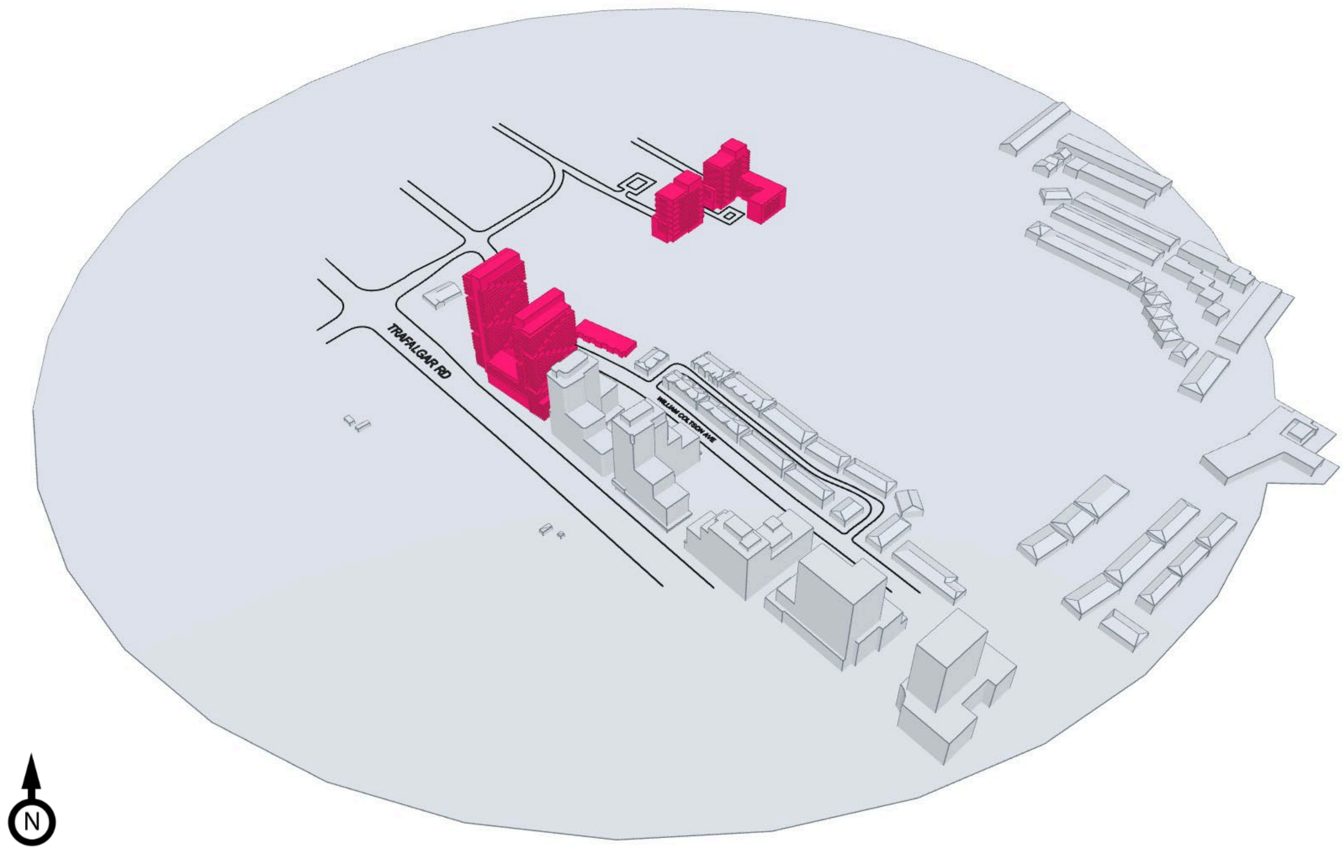


Image 5a: Computer Model of the Proposed Building and Existing Surroundings

2. METHODOLOGY

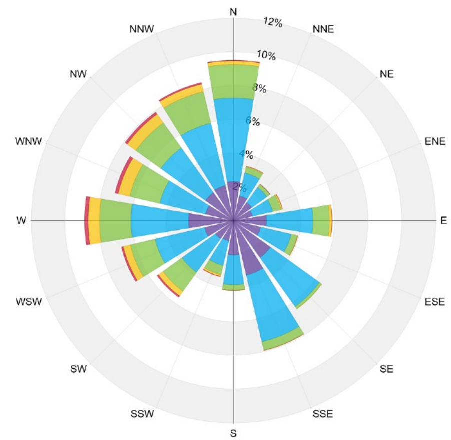
2.4 Meteorological Data

Long-term wind data recorded at Toronto Pearson International Airport between 1992 and 2022, inclusive, were analyzed for the summer (May to October) and winter (November to April) months. Image 6 graphically depicts the directional distributions of wind frequencies and speeds for these periods.

Winds from the southwest through north directions are predominant throughout the year, with the frequency of winds from the west being lower in the summer, and those from the east stronger in the winter.

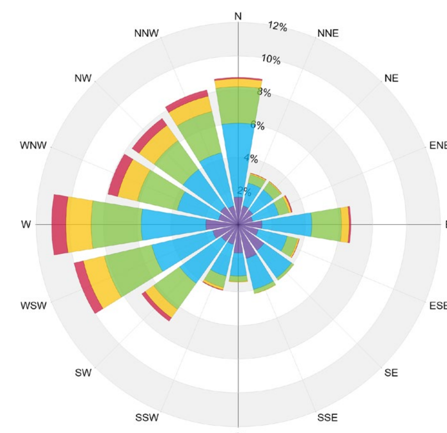
Strong winds of a mean speed greater than 30 km/h measured at the airport (at an anemometer height of 10 m) are more frequent in the winter (red and yellow bands in Image 6). These winds potentially could be the source of uncomfortable or severe wind conditions depending on the site exposure and development 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.



Summer
(May through October)

Wind Speed (km/h)	Probability (%) Summer	Probability (%) Winter
Calm	5.0	3.5
1-10	30.9	22.6
11-20	42.9	39.9
21-30	16.3	22.5
31-40	3.9	8.1
>40	0.9	3.4



Winter
(November through April)

Image 6: Directional distribution of wind approaching Toronto Pearson International Airport (1992 to 2022)

3. WIND CRITERIA

The RWDI pedestrian wind criteria are used in the current study; the criteria presented in the table below, addresses pedestrian safety and comfort. These criteria have been developed by RWDI through research and consulting practice since 1974. They have also been widely accepted by municipal authorities, building designers and the city planning community.

3.1 Pedestrian Comfort

Pedestrian comfort is associated with common wind speeds conducive to different levels of human activity. Wind conditions are considered suitable for sitting, standing, strolling or walking if the associated mean wind speeds (see table) are expected for at least four out of five days (80% of the time). The assessment considers winds occurring between 6 AM and midnight. Limited usage of outdoor spaces is anticipated in the excluded period. Speeds that exceed the criterion for Walking are categorized Uncomfortable. 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.

Comfort Category	GEM Speed (km/h)	Description (Based on seasonal compliance of 80%)
Sitting	≤ 10	Calm or light breezes desired for outdoor seating areas where one can read a paper without having it blown away
Standing	≤ 14	Gentle breezes suitable for main building entrances, bus stops, and other places where pedestrians may linger
Strolling	≤ 17	Moderate winds appropriate for window shopping and strolling along a downtown street, plaza or park
Walking	≤ 20	Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering
Uncomfortable	> 20	Strong winds considered a nuisance for all pedestrian activities. Wind mitigation is typically recommended

3.2 Pedestrian Safety

Pedestrian safety is associated with excessive Gust Speeds that can adversely affect a person's balance and footing. These are usually infrequent events but deserve special attention due to the potential impact on pedestrian safety.

Safety Criterion	Gust Speed (km/h)	Description (Based on annual exceedance of 9 hrs or 0.1% of time)
Exceeded	> 90	Excessive gusts that can adversely affect one's balance and footing. Wind mitigation is typically required

4. RESULTS AND DISCUSSION

4.1 Wind Flow around Buildings

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 towers or buildings are situated side by side, wind flow tends to accelerate through the space due to channelling. Podium massing, low roofs and canopies deflect downwash and reduce the potential wind impact on the ground level. These flow patterns are illustrated in Image 7.

The project, at up to 30 storeys, will be taller than most buildings that exist to the south, and fully exposed to winds from other directions. The project is expected to redirect winds around it; however, potential wind impacts would be moderated by the stepped podium massing of the buildings disrupting downwashing flow.

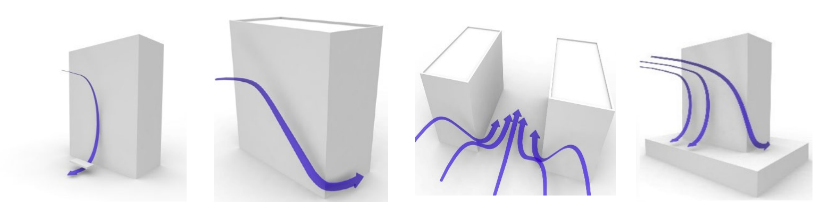


Image 7: General wind flow patterns

4.2 Presentation of Results

The results of the assessment are presented and discussed in detail in Sections 4.3 and 4.4. Images 8 and 9 are the predicted seasonal wind conditions at grade for the Existing and Proposed configurations, respectively, while Image 12 shows the predicted wind conditions on above grade amenities. The graphical presentation is in the form of colour contours of wind speeds calculated based on the wind comfort criteria (Section 3.1), approximately 1.5 m above the concerned levels. The assessment against the safety criterion (Section 3.2) was conducted qualitatively based on the predicted wind conditions and our extensive experience with wind tunnel assessments. The discussion also includes recommendations for wind control, where necessary, to reduce the potential for high wind speeds for the design team's consideration.

Target Conditions

For the current development, wind speeds comfortable for walking or strolling are appropriate for sidewalks and walkways where pedestrians are likely to be active and moving intentionally. Lower wind speeds comfortable for standing are required for entrances and areas where people are expected to be engaged in passive activities. Calm wind speeds suitable for sitting are desired in areas where prolonged periods of passive activities are anticipated, such as above-grade outdoor amenity areas, seating areas etc., especially during the summer when these areas are typically in use.

4. RESULTS AND DISCUSSION

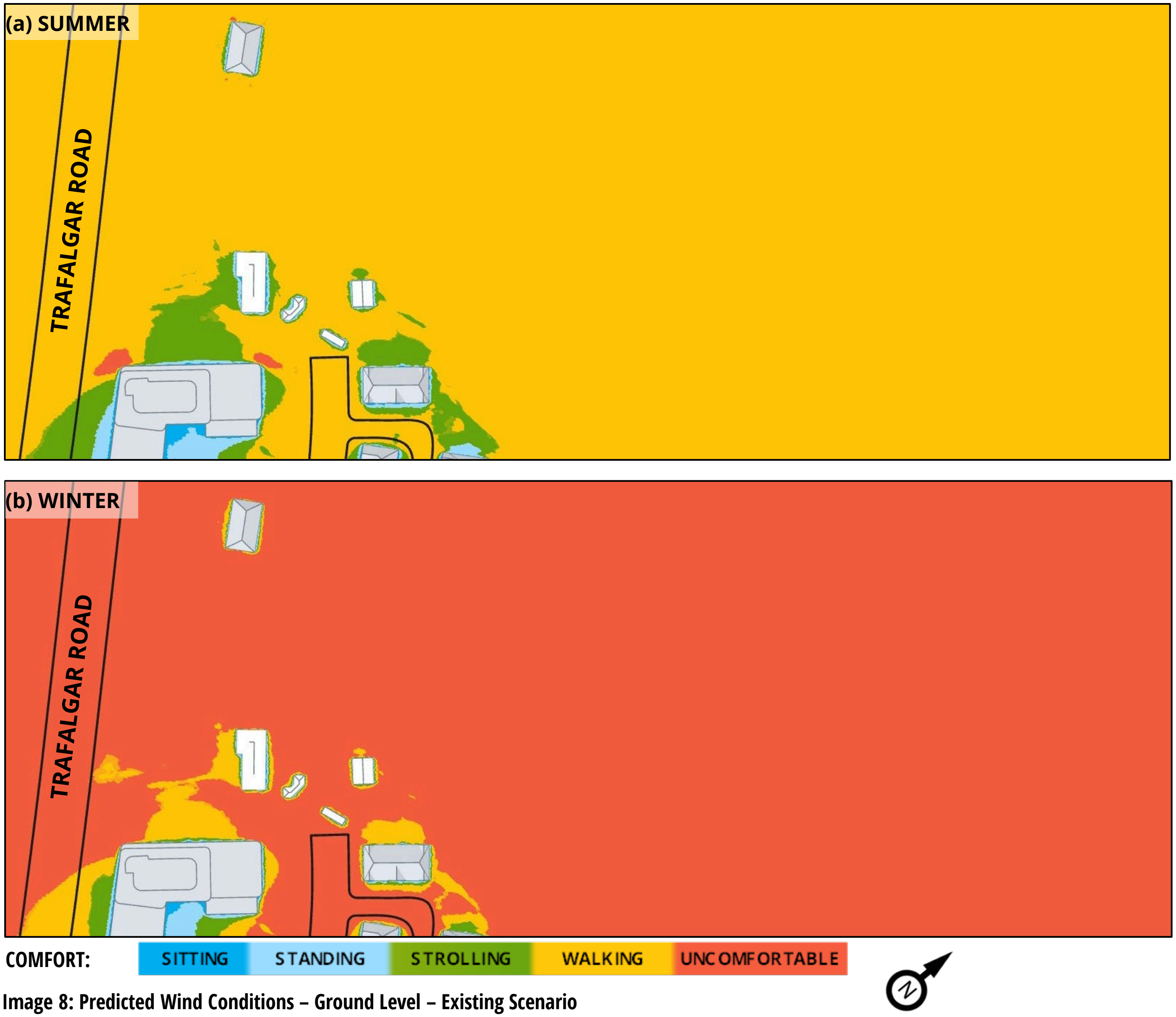


Image 8: Predicted Wind Conditions – Ground Level – Existing Scenario

4. RESULTS AND DISCUSSION

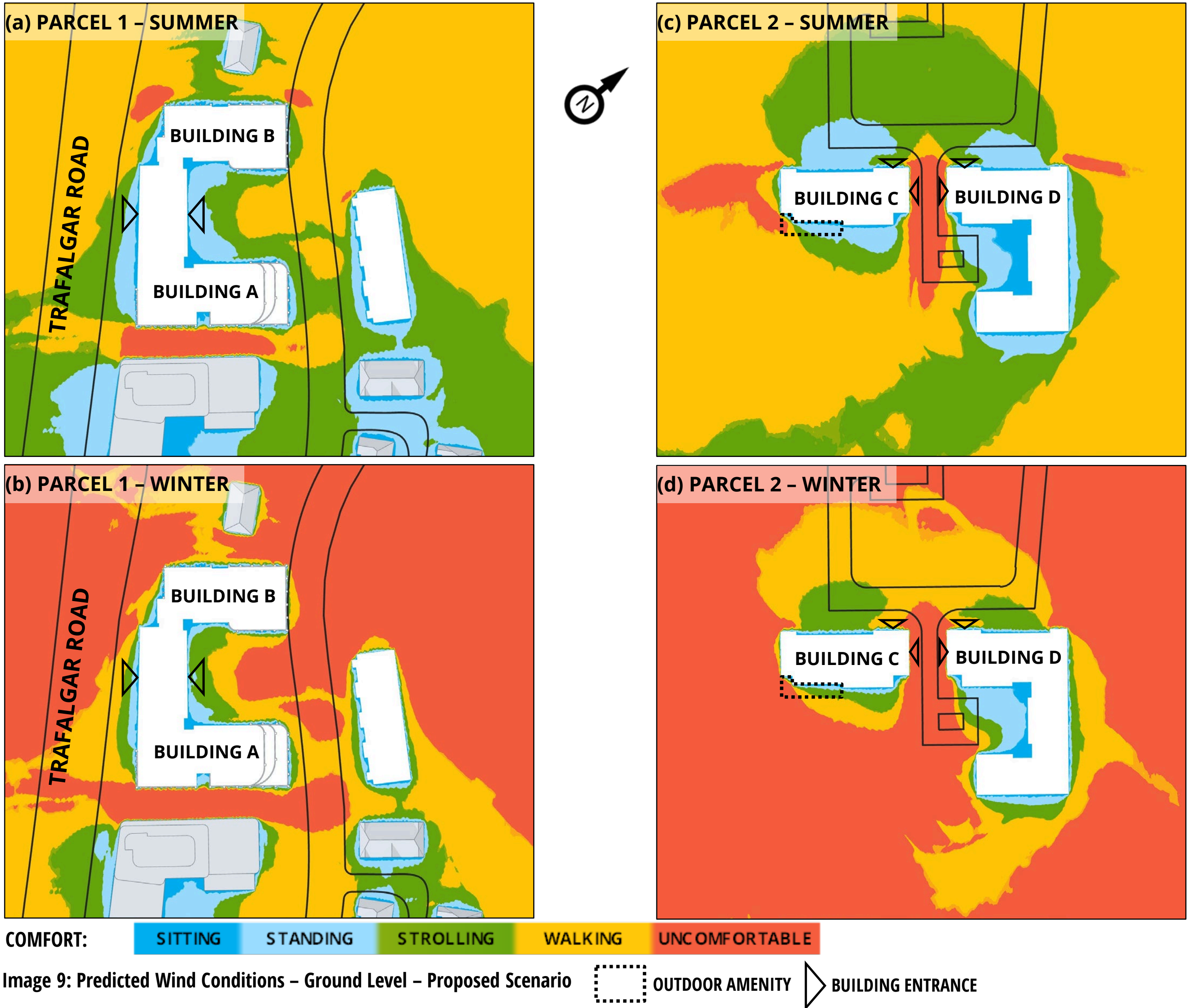


Image 9: Predicted Wind Conditions – Ground Level – Proposed Scenario

4. RESULTS AND DISCUSSION

4.3 Existing Scenario

The project site is largely unoccupied with a few low-rise buildings. Wind conditions at most areas in the existing scenario are considered comfortable for walking in the summer and uncomfortable in the winter due to the open surrounding terrain allowing winds to freely approach the area (Image 8). Closer to the existing buildings, conditions are considered comfortable for strolling in the summer and for walking in the winter. Elevated wind speeds are expected at the northeast and northwest corners of the neighbouring tower to the south, where downwash and corner-accelerated flows may result in uncomfortable and potentially unsafe conditions throughout the year (Image 8). Note that landscaping or local topography was not included in the computer simulation. The predicted wind conditions, for both the Existing and Proposed scenarios, are expected to be slightly conservative.

4.4 Proposed Scenario

4.4.1 Immediate Surroundings

The proposed buildings are taller than most buildings that currently exist to the south and fully exposed to winds from other directions. Therefore, winds are anticipated to be redirected, accelerated, and channelled around and between sections of the proposed development. Positively, wind speeds are expected to decrease around neighbouring buildings to the south, where the massing of the Parcel 1 buildings is anticipated to provide shelter from the prevailing winds from the west through north (Image 9).

In Parcel 1, the resulting wind speeds at most areas on and around Buildings A and B and the townhouses are expected to be comfortable for standing, strolling, or walking in the summer, which is an improvement to conditions observed in the existing scenario (Image 9a). These conditions are appropriate for sidewalk use. Elevated wind speeds that are associated with uncomfortable wind conditions are anticipated in the corridor between Building A and the neighbouring building to the south, and at the northeast and northwest corners of Building B as a result of building-induced wind flow accelerations and exposure to prevailing winds from the west through north.

Within Parcel 2 during the summer, wind speeds are expected to be comfortable for sitting or standing nearest to the façades of Buildings C and D, and comfortable for strolling or walking in the extended surroundings (Image 9c). High wind speeds that are uncomfortable for pedestrians are anticipated between Buildings C and D, at the western corners of Building C, and at the northeast corner of Building D, where prevailing winds are expected to undergo channelling and corner-accelerated flows, respectively, after being intercepted by the massing of the proposed buildings.

During the winter months, higher wind speeds that are uncomfortable for pedestrian use and potentially exceed the wind safety limit are expected more regularly around the proposed Parcel 1 and 2 buildings, similar to wind conditions observed around the existing tower to the south in the existing scenario (Images 9b and 9d).

4. RESULTS AND DISCUSSION

4.4.1 Immediate Surroundings (Continued)

If reduced wind speeds are desired in the above-mentioned areas, alterations to the building massing, such as additional podiums or tower setbacks, and/or tower corner articulations typically provide the greatest reductions in wind speeds at ground level. Secondary measures, including screen walls, canopies, and/or landscaping may be considered to locally address problematic downwashing, corner-accelerations, and channelling wind flows. Note that street trees generally will lower wind speeds around them, where tall coniferous/marcescent species are recommended to provide wind control benefit in the winter months. See Image 10 for examples of these mitigation measures.

We recommend wind tunnel modelling and testing to refine and quantify the potential wind conditions and to determine any exceedances of the wind safety criterion. RWDI can work with the design team to develop wind control solutions as the design progresses.

4.4.2 Building Entrances

Main entrances to Building A and B are expected to be located facing Trafalgar Road, and in the drop off area between the two buildings (Images 3 and 9). Wind conditions are anticipated to be comfortable for standing throughout the year, which is suitable for the intended pedestrian use of entrances (Images 9a and 9b).

In Parcel 2, entrance locations are assumed to be situated on the north facade of Buildings C and D, and/or on the facades facing the corridor between each building based on the location of lobbies in the provided floorplans. Wind conditions near these areas are expected to be comfortable for strolling or walking on the north facade of each building, and uncomfortable within the corridor throughout the year (Images 9c and 9d). These conditions are higher than desired for pedestrian use of building entrances. Generally, it is recommended that building entrances are positioned away from building corners or enclosed corridors. Physical mitigation measures, such as vertical screens (2 m tall; max. 30% open porosity) and overhead canopies, are recommended to diffuse and redirect building-induced wind flows expected to impact the usability of these areas. Examples of these measures are shown in Image 11).

4.4.3 Ground Level Outdoor Amenity

An outdoor amenity is proposed at ground level near the southwest corner of Building C (Images 3 and 9). Wind speeds are anticipated to primarily be comfortable for standing or strolling during the summer, which would be suitable for active patron use (Image 9c). The western portion of the outdoor amenity may experience stronger winds (comfortable for walking or uncomfortable) as a result of corner-accelerated wind flows. During the winter, elevated wind speeds, resulting in higher than desired conditions are anticipated. However, stronger winds may be considered appropriate in the winter, depending on the proposed programming of the amenity space (Image 9d).

If lower wind speeds suitable for passive patron use are desired in the ground level outdoor amenity (i.e., comfortable for sitting or standing in the summer), vertical screens and/or landscaping may be considered to be placed on the western edge of the amenity to diffuse corner-accelerated wind flows. See Image 12 for examples of vertical features.

4. RESULTS AND DISCUSSION

Image 10: Suggestions for Wind Control at Building Corners and in Corridors

Image 11: Suggestions for Wind Control at Entrances for the Parcel 2 Buildings

Image 12: Suggestions for Wind Control at the Ground Level Outdoor Amenity

4.4.4 Level 7 Outdoor Amenities

Wind speed increases with elevation. The Level 7 outdoor amenities are expected to be exposed to the prevailing winds due to their elevation above the low-rise surroundings, and as a result of building-induced wind flows (i.e., channelling and corner acceleration), particularly for the Level 7 amenity between Buildings A and B. As such, conditions on the amenities are expected to be too windy for passive use in the summer without the use of wind control measures (Image 13).

Note that wind speeds are expected to be lowest, comfortable for standing on the Building D outdoor amenity in areas sheltered by the massing of the Building D tower. We encourage the design team to consider including mitigation features to reduce wind speeds in the summer, including tall parapets and/or wind screens (min. 2.5 m tall; max. 30% open porosity), planters, and trees with underplanting. These features, when placed along the perimeter of the amenities, will help reduce exposure to prevailing winds. In addition, these features may be interspersed throughout the terrace or used to surround designated gathering or seating areas. Some examples of wind control features are shown in Image 14. RWDI can guide the selection and placement of such features for wind control as the design advances.

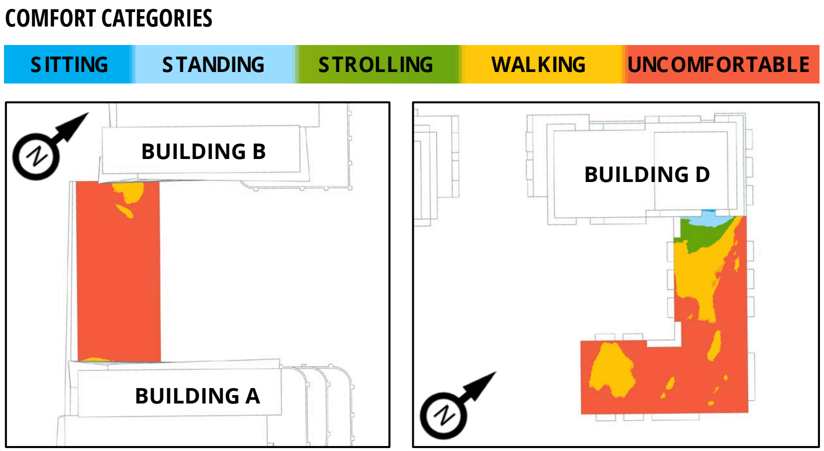


Image 13: Predicted Summer Wind Conditions – Level 7 Outdoor Amenities

4. RESULTS AND DISCUSSION

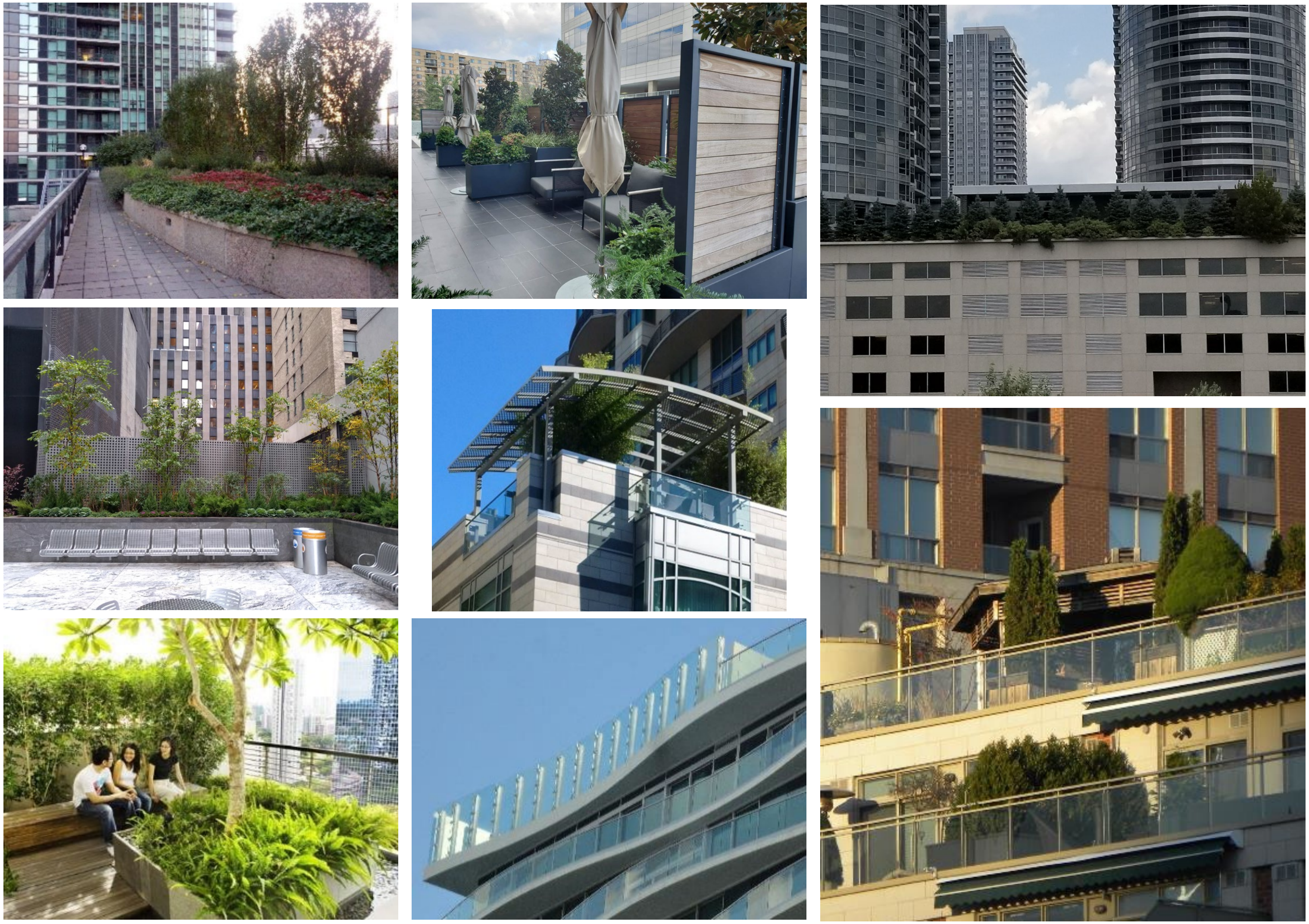


Image 14: Design Strategies for Wind Control on Outdoor Amenities

5. SUMMARY

RWDI was retained to provide an assessment of the potential pedestrian level wind impact of the proposed project at 3275 Trafalgar Road in Oakville, Ontario. Our assessment was based on computational modelling, simulation, and analysis of wind conditions for the proposed development design, in conjunction with the local wind climate data and the RWDI wind criteria for pedestrian comfort and safety. Our findings are summarized as follows:

- The existing wind conditions on and around the site are generally expected to be suitable for transient pedestrian use during the summer. During the winter, as a result of seasonally stronger winds and site exposure, uncomfortable wind conditions are expected.
- The proposed buildings are taller than its surroundings to the south and fully exposed to winds from other directions, and therefore will redirect wind to ground level.
- Wind conditions at ground level, including the main entrances on Parcel 1 and the ground level outdoor amenity on Parcel 2, are expected to be generally be suitable for the intended pedestrian use. Recommendations are provided for the Parcel 2 entrances regarding their position and potential wind control solutions.
- Potentially uncomfortable wind speeds are expected at the northeast and northwest corners of the Parcel 1 and 2 buildings, and in the corridors between Building A and the neighbouring building to the south, and between Buildings C and D throughout the year, the north and south of the site near the building corners in the winter. These wind speeds may potentially exceed the wind safety limit.
- Wind speeds on the Level 7 outdoor amenities are expected to be higher than desirable for passive use during the year.
- Wind control strategies have been provided in the report. Wind tunnel testing is recommended to be conducted at later design stages to quantify the anticipated wind comfort and safety conditions, and to refine any proposed mitigation strategies.
- **Based on a review of the latest architectural design drawings dated August 6th, 2024, these results will remain the same or similar due to the minor changes from the original design drawings which were used for this assessment.**

RWDI can help guide the placement of wind control features, including landscaping, to achieve appropriate levels of wind comfort based on the programming of the various outdoor spaces.

6. DESIGN ASSUMPTIONS

The findings/recommendations in this report are based on the building geometry and architectural drawings communicated to RWDI in December 2023 and January 2024 as well the revised plans issued in August 2024, 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 (dd/mm/yyyy)
02_ArchPlans_v1_2023-10-27	PDF	22/12/2023
1975.22 - 3275 Trafalgar	SKP	08/01/2024
1975.22 – Trafalgar – Arch Set – Aug.06.2024	PDF	12/08/2024

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 3275 Trafalgar Limited Partnership ("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.