1095 KINGSTON ROAD

PICKERING, ON

GNOBI CONSULTING INC.

PEDESTRIAN LEVEL WIND CFD ASSESSMENT

GNOBI # 570024

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1.0 INTRODUCTION

This pedestrian-level wind CFD assessment report evaluates wind conditions around the proposed 1095 Kingston Road development in Pickering, ON. The study aims to assess potential wind impacts on pedestrians and outdoor spaces within and around the site, conducted as part of the Zoning By-law Amendment application for the redevelopment.

The analysis considers factors such as wind direction, speed, and the height and configuration of nearby buildings. The findings offer insights into expected wind conditions at the site and assess potential impacts on pedestrian comfort and safety.

The proposed development features four mixed-use residential towers that are 35-storeys (**Image 2**). The surrounding area is primarily characterized by medium- to low-rise commercial and residential buildings. Key areas of pedestrian activity requiring attention include building entrances, outdoor amenities, parking lots, and adjacent sidewalks. Lake Ontario is approximately 2km to the south.

Images 2 and **3** below depict essential visual representations of the proposed project, site plan and ground floor plan. The main entrances to the development are highlighted in **Images 2** and **3**.

Image 1: Aerial View of the Proposed Site, Source: Google Earth™

2.0 PROJECT AND SITE CONTEXT

Image 2: Rendering of the Proposed Project

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Image 3: Proposed Site Plan, Courtesy: BDP Quadrangle Inc.

2.0 PROJECT AND SITE CONTEXT

Image 4: Proposed Ground Floor Plan, Courtesy: BDP Quadrangle Inc.

3.0 METHODOLOGY

3.1 Study Approach

The study approach involves a thorough assessment of the proposed building design in relation to local wind patterns and the surrounding environment. The assessment utilizes advanced computational fluid dynamics (CFD) modelling, supported by engineering expertise and a deep understanding of wind behavior in urban settings. Insights from previous successful projects with similar characteristics also contribute to the analysis.

The CFD analysis simulates the mean wind speed profile of the atmospheric boundary layer approaching the site, incorporating at least 16 wind directions at 22.5° intervals. Mean wind speed ratios at a height of approximately 1.5 meters above local grade are then integrated with hourly wind speed measurements from a reference meteorological station. This process enables the prediction of wind speed conditions throughout the site.

The predicted wind speeds are then compared against established thresholds and frequencies to determine their suitability for various pedestrian activities, including sitting, outdoor dining, standing, and walking.

The study evaluates both existing conditions (**Image 5**) and the proposed design configuration within the context of the surrounding environment (**Image 6**).

The CFD analysis serves as a qualitative assessment of the mean wind speed conditions both on and around the project. It forms the basis for providing preliminary feedback on potential strategies to mitigate wind effects and improve the wind conditions, as necessary.

Overall, the methodology ensures a thorough and informed evaluation of pedestrian wind comfort, utilizing cutting-edge tools and our expertise in urban wind dynamics.

Image 5: Model of the Existing Site and Surrounding Context

3.0 METHODOLOGY

3.1 Study Approach Cont'd

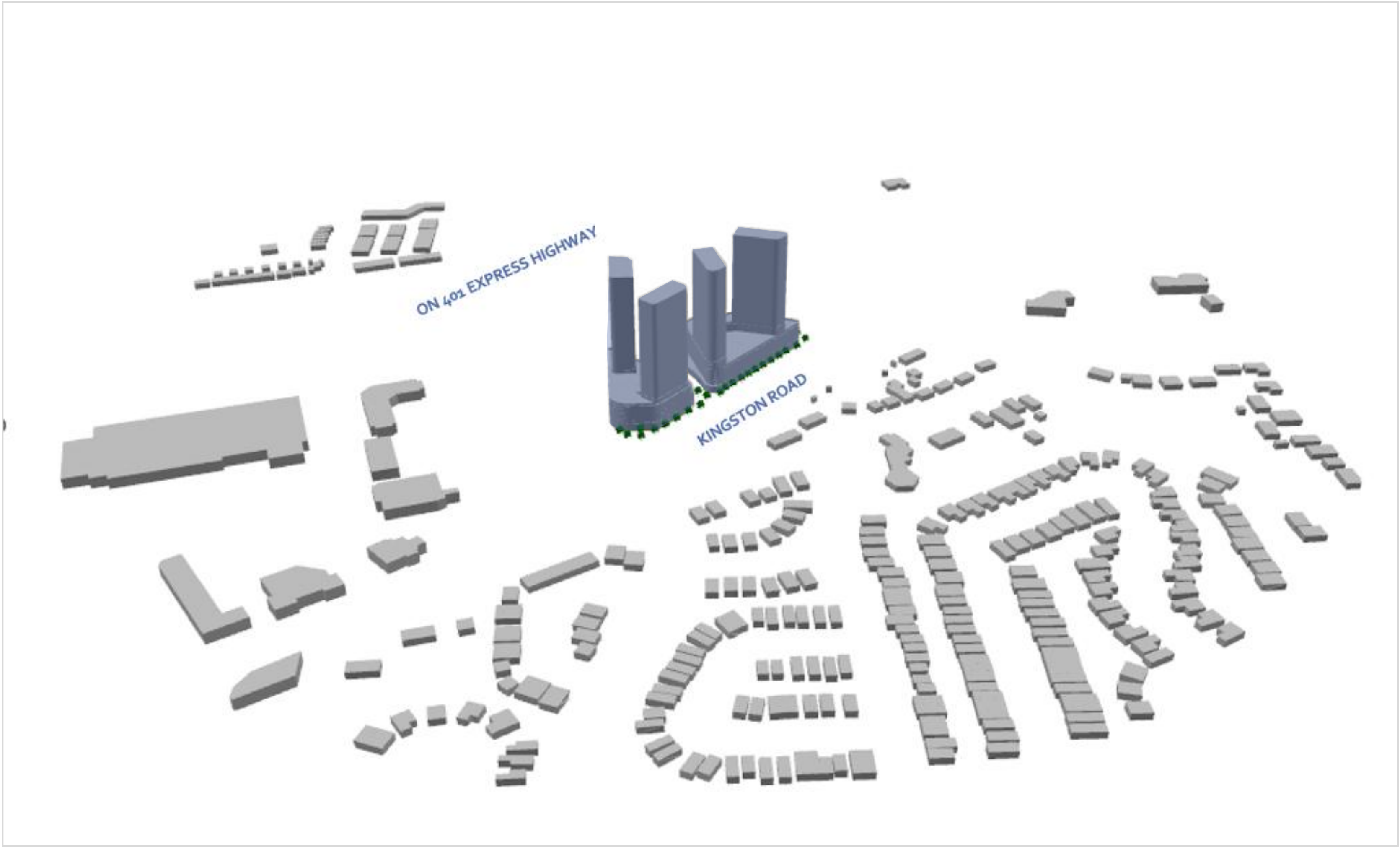


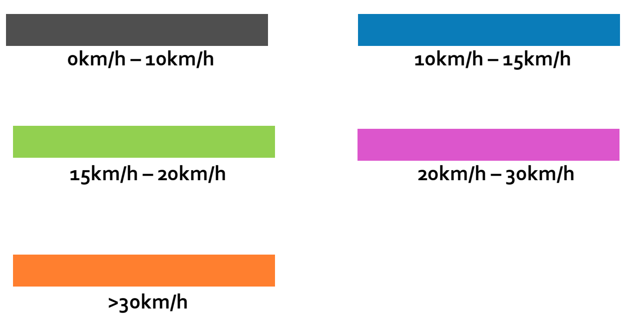
Image 6: Model of the Proposed Project and Surrounding Context

3.0 METHODOLOGY

3.2 Meteorological Data

The local wind climate at the proposed site was evaluated using hourly wind data collected at Toronto Pearson International Airport, situated at a height of 10 meters above ground level, as a point of reference. The wind roses in **Image 7** below presents the cumulative probability distribution of wind speeds for the spring (March to May), summer (June to August), fall (September to November) and winter (December to February) months.

Analysis of the data reveals that spring and winter months are characterized by a higher frequency of strong winds than the summer and fall months and the strong winds occur primarily from the northwest and southwest quadrants.



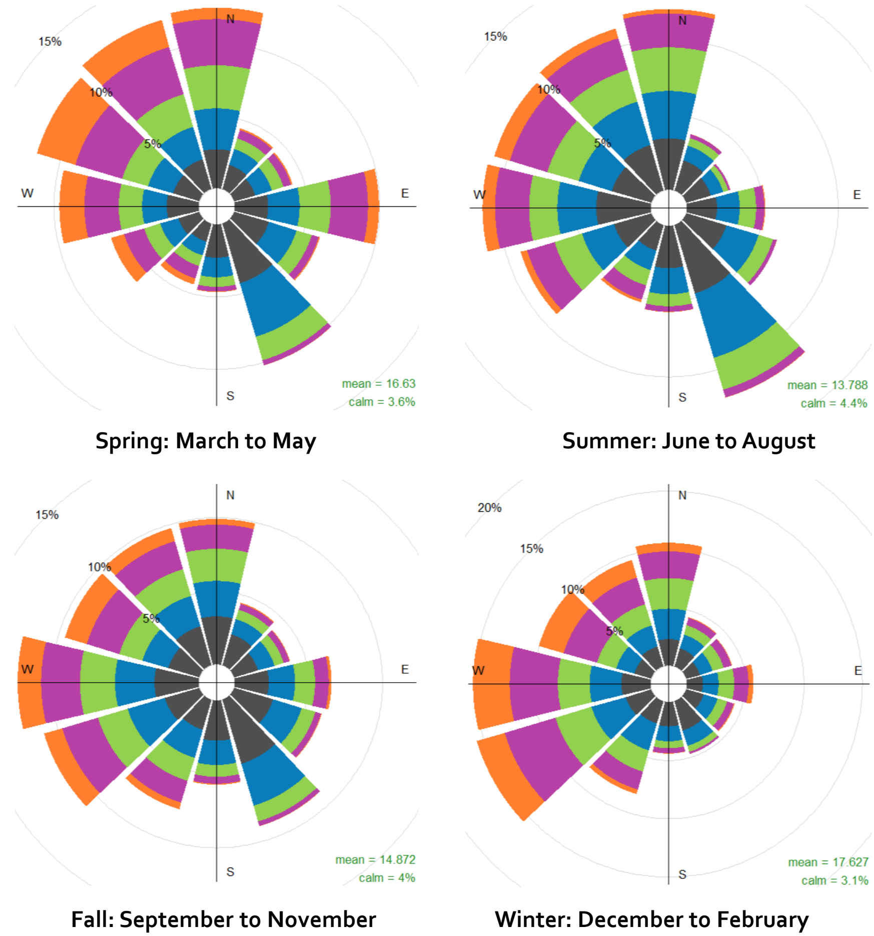


Image 7: Wind Data from Toronto Pearson International Airport (1992 – 2022)

3.3 Wind Criteria

The pedestrian wind criteria used in the current study are specified in the pedestrian level wind Terms of Reference of most cities in southern Ontario and are applicable in the city of Pickering, ON. The wind criteria are an essential component of building design in urban areas. They are established guidelines that determine the maximum allowable wind speed and frequency of occurrence that pedestrians can safely and comfortably tolerate for various passive or active activities such as sitting, standing, strolling or walking. The criteria are generally based on a combination of scientific data, engineering principles, and human experience. They take into consideration factors such as the intended use of the pedestrian spaces on and around the project.

The wind criteria referenced include two primary categories:

1. Pedestrian Wind Safety / Hazard

Pedestrian safety is correlated with gust wind speeds that exceed the threshold (90 km/h) capable of negatively impacting a pedestrian's stability and balance. When wind speeds capable of destabilizing an individual, at around 90 km/h, occur more than 0.1% of the time or for a duration of 9 hours per year, the wind conditions can be classified as hazardous.

Sitting	Standing	Strolling	Walking	Uncomfortable
≤ 10 km/h	≤ 14 km/h	≤ 17	≤ 20 km/h	> 20 km/h

2. Pedestrian Wind Comfort

Sitting (≤ 10 km/h): Tranquil breezes desired for passive pedestrian activities such as outdoor dinning or seating areas.

Standing (≤ 15 km/h): Suitable for areas where pedestrians are apt to linger such as main building entrances, drop-off areas, parks and bus stops.

Walking (≤ 20 km/h): Relatively high speeds but are considered suitable for active pedestrian activities such as walking, running or cycling.

Uncomfortable (>20km/h): wind speeds exceeding 20km/h more than 20% of the time.

To determine suitable wind conditions for pedestrian activities such as sitting, standing, strolling or walking, it is recommended that the associated mean wind speeds be expected for at least 80% of the time (approximately five and half out of seven days). In areas where winds surpass the 20km/h limit for over 20% of the time or surpass the wind safety threshold, wind control measures are typically required to ensure the safety and comfort of individuals.

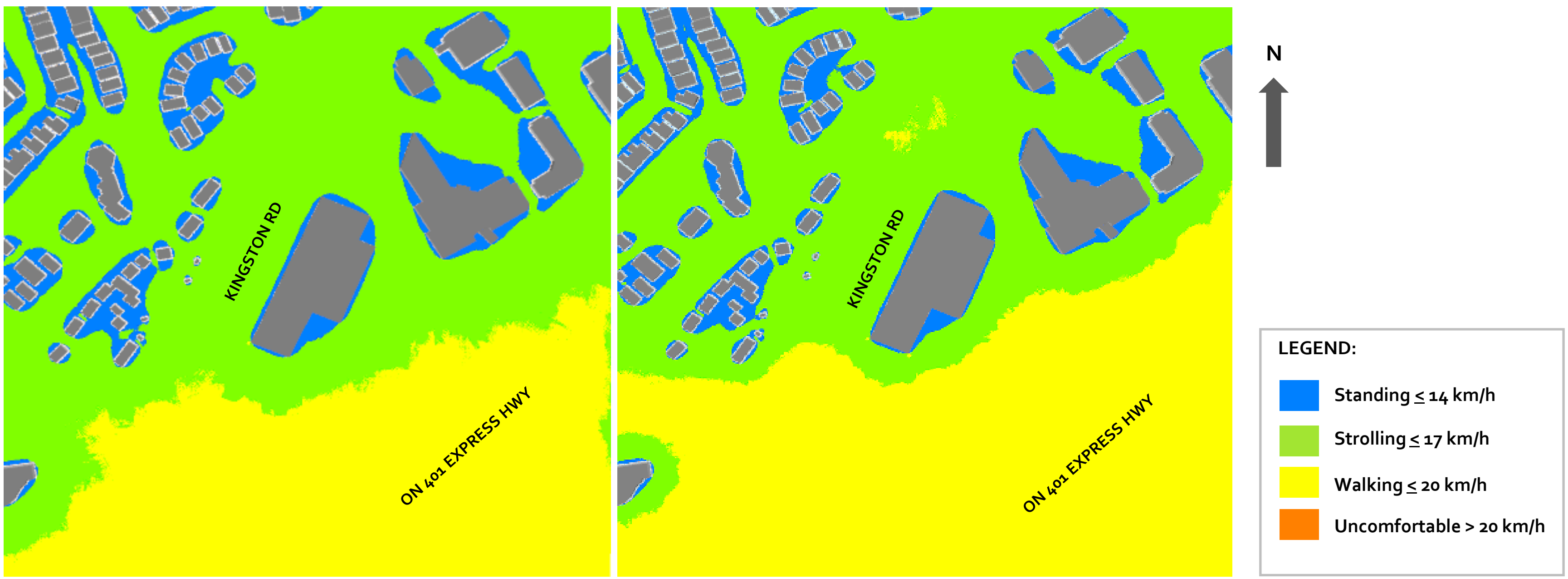
4.0 RESULTS AND DISCUSSION

4.1 Existing Wind Conditions

The proposed site is primarily surrounded by a mix of low-rise residential and commercial buildings. Lake Ontario is approximately 2 km to the south. Given the low-rise nature of the surrounding buildings, the impact of downwashing and subsequent corner-accelerating winds at the site is expected to be minimal.

Images 8A to **8B** visually represent the current wind conditions at the site and surrounding areas, based on the findings of the CFD analysis. As depicted in the images, the existing wind conditions generally provide a comfortable environment for standing, walking or better throughout the year, which is deemed appropriate.

Furthermore, the prediction indicates that the pedestrian wind hazard/safety criterion is met in all areas on and around the existing site. This suggests that wind conditions are unlikely to pose any danger to pedestrians.



8A) Existing Summer: May to October

8B) Existing Winter: November to April

Image 8: Existing Wind Conditions (6am to 11pm, Summer & Winter)

4.2 Proposed Design and Anticipated Wind Flows

The proposed project incorporates several design features intended to mitigate adverse wind impacts, which should be retained in the final design. These features include:

Strategic Entrance Placement: Main residential entrances are positioned away from exposed building corners, which are prone to accelerated wind speeds.

Recessed Entrances and Colonnade: The recessed design of main entrances, combined with a proposed colonnade at grade, will create sheltered zones for pedestrians.

Aerodynamic Tower Corners: Rounded tower corners enhance aerodynamics, reducing the potential for downwashing winds.

Building Setbacks: Stepped setbacks contribute to wind mitigation by disrupting airflow patterns.

Marcescent Tree Planting: An array of marcescent trees at grade will reduce the impact of downwashing and corner-accelerated winds, particularly from the northwest quadrant.

Wind Screens/Guardrails: Proposed 2.2m-high wind screens on podiums and above-grade amenity areas will reduce wind speeds to more comfortable levels for users.

These elements collectively enhance the project's ability to manage wind speeds effectively.

Generally, winds move smoothly over areas with buildings of uniform height. However, taller structures disrupt this flow by intercepting the wind and redirecting it downward in a process known as downwashing. As the wind moves around the corners of these buildings, it can also create localized speed increases, referred to as corner acceleration. Another common urban wind pattern is wind channeling, which occurs when two tall buildings are positioned close together, accelerating airflow through the space between them. The intensity of this effect depends on factors such as the gap size and the alignment of the buildings with the prevailing wind directions at the site. Narrower gaps tend to create stronger wind tunnel effects, while larger distances reduce the potential for channeling. These wind flow mechanisms are often the main factors contributing to uncomfortable and potentially hazardous wind conditions around buildings.

4.3 Proposed Wind Conditions

The Computational Fluid Dynamics (CFD) assessment for the proposed development evaluates pedestrian-level wind impacts under urban wind phenomena, including wind tunneling/channeling, downwashing, and corner acceleration.

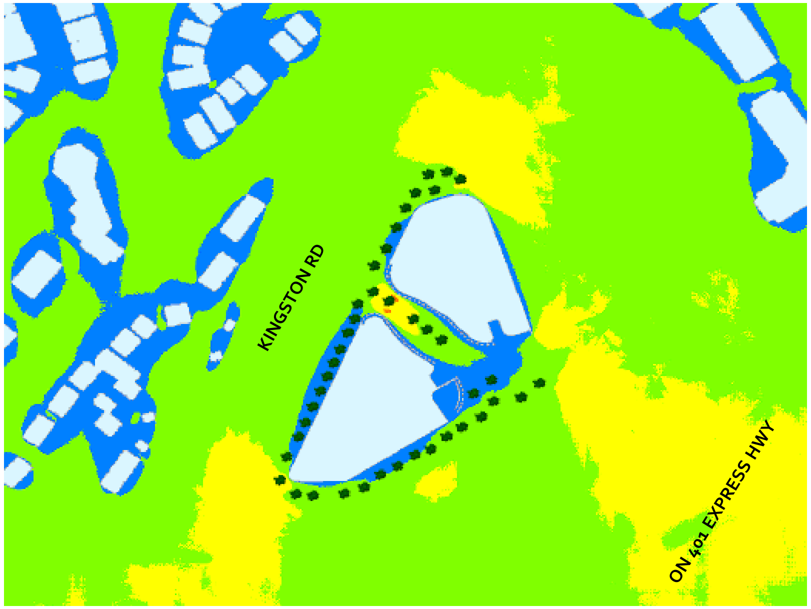
The proposed 35-storey towers significantly exceed the height of adjacent structures, resulting in the redirection of high-altitude winds toward pedestrian zones. The side-by-side configuration of the towers is anticipated to amplify wind channeling effects between Towers 1B and 2A, as described in Section 4.2. Image 9A provides a visual representation of projected summer wind conditions across the site.

4.3 Proposed Wind Conditions

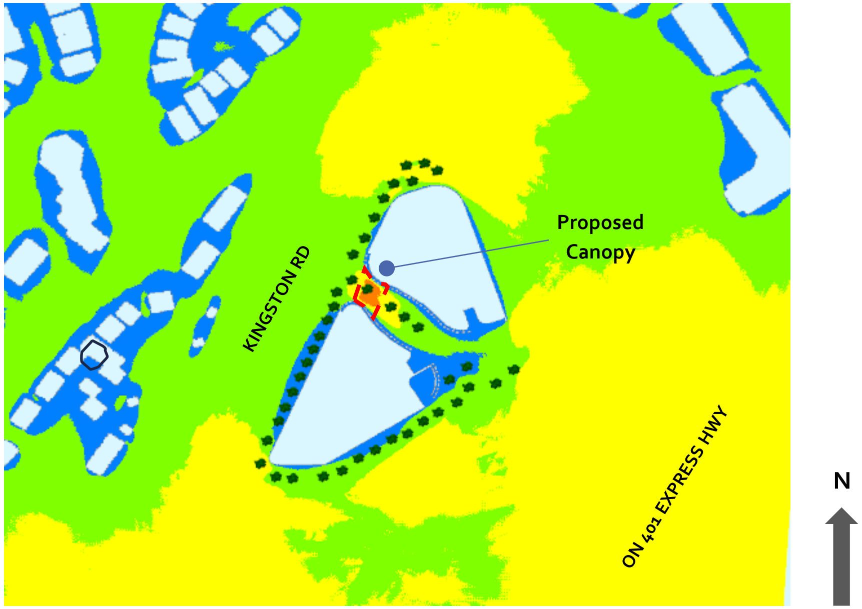
The analysis indicates that wind conditions at all primary entrances are expected to remain comfortable for standing throughout the year. During summer, wind speeds along sidewalks and adjacent areas are projected to align with comfort criteria for sitting, standing, or walking, which is deemed appropriate for pedestrian activity. The highest wind speeds are anticipated in localized areas between Towers 1B and 2A, where marginal discomfort may occur intermittently.

In winter months, wind speeds across most of the site are predicted to remain suitable for the intended use (comfortable for sitting, standing, or walking).

However, localized areas between Towers 1B and 2A may experience marginally uncomfortable wind speeds periodically due to the combined effects of downwashing, corner acceleration, and channeling of prevailing northwesterly winds. Following the initial CFD assessment, the design was updated to incorporate a canopy between Towers 1B and 2A. This modification is expected to reduce wind channeling and downwashing impacts, thereby improving wind comfort levels in the affected area.



9A) Proposed Summer: May to October



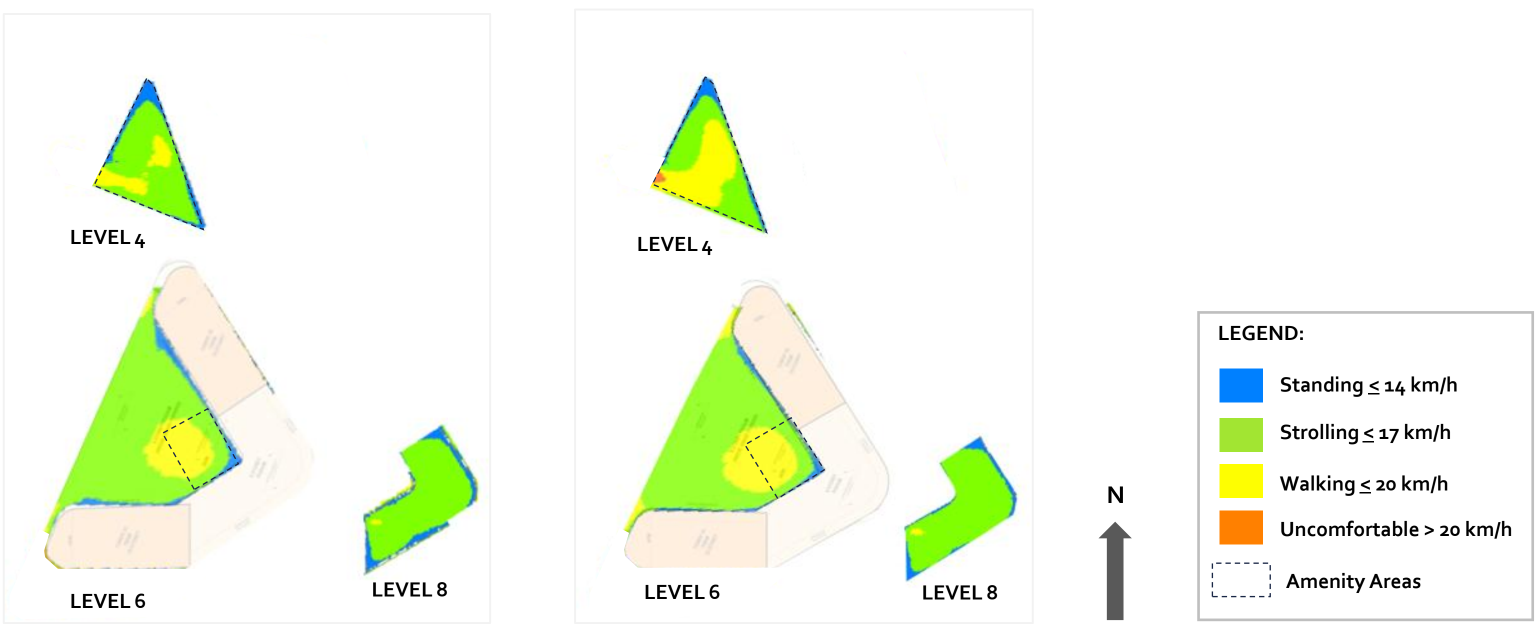
9B) Proposed Winter: November to April

Image 9: Proposed Grade Level Wind Conditions (6am to 11pm, Summer & Winter)

4.3 Proposed Wind Conditions

Several above-grade amenity spaces are proposed within the development, as depicted in Images 10A and 10B (Levels 4, 6, and 8). Wind conditions on the podium and amenity areas are generally projected to be comfortable for standing during summer, consistent with the intended use of these spaces for passive pedestrian activities. Localized areas on Levels 4 and 6 may experience wind speeds conducive to walking intermittently. If desired, localized mitigation measures such as wind screens, landscaping, or trellises can be strategically implemented to further reduce wind speeds and enhance comfort in these zones.

During winter, wind speeds on the above-grade amenity areas are anticipated to remain within comfort thresholds for sitting or standing across most zones. The spatial extent of areas suitable for walking is projected to increase, particularly on Level 4, due to the occurrence of seasonally stronger prevailing winds. A localized area near the southeast corner of Tower 2A may experience marginally uncomfortable wind speeds; however, this is not considered a critical concern, as utilization of these spaces is expected to decline during the colder winter months.



10A) Summer: May to October

10B) Winter: November to April

Image 10: Proposed Wind Conditions – Above Grade Level (6am to 11pm, Summer & Winter)

5.0 CONCLUSION

Gnobi Consulting Inc. was contracted to conduct a pedestrian-level wind CFD assessment for the proposed development at 1095 Kingston Road in Pickering, ON. The assessment utilized advanced CFD modeling techniques, an in-depth analysis of the local wind climate, and consideration of the proposed design and surrounding buildings, combined with our expertise in wind tunnel testing and engineering judgment.

The analysis indicates that existing wind conditions at the site are generally comfortable for standing or walking throughout the year, with wind safety criteria met across all areas. With the introduction of the proposed development, wind conditions at key pedestrian areas, including main residential entrances, are expected to remain suitable for their intended use.

Strategic design features such as recessed entrances, aerodynamic tower corners, and stepped building setbacks contribute to maintaining pedestrian comfort. During summer, wind conditions along sidewalks and adjacent areas are projected to align with comfort criteria for sitting, standing, or walking, which is appropriate for pedestrian activity. Localized areas, particularly between Towers 1B and 2A, may experience slightly elevated wind speeds due to channeling effects.

In winter, seasonally stronger prevailing winds are anticipated to result in marginally higher wind speeds across the site. While most areas will remain comfortable for standing or walking, localized areas—particularly between Towers 1B and 2A—may periodically experience wind speeds exceeding comfort thresholds due to downwashing and channeling effects. The introduction of a canopy between these towers is expected to mitigate these conditions by reducing wind acceleration in this area.

Wind conditions on the above-grade amenity areas are expected to be generally suitable for standing during summer, with localized areas experiencing slightly higher wind speeds. In winter, increased wind activity may lead to conditions suitable for walking in some areas, particularly on Level 4. However, as these spaces are expected to see reduced usage during colder months, this is not anticipated to be a significant concern. Overall, the proposed design incorporates effective wind mitigation strategies, including wind screens, landscaping, and a canopy between towers, to enhance pedestrian comfort.

If calmer wind speeds are desired, particularly in the above-grade amenity areas, localized wind control measures such as wind screens, landscaping, or trellises can be considered for specific locations.

The results of the study indicate that wind conditions at the site will largely remain suitable for the intended use, with no significant pedestrian safety concerns.

As the design progresses toward site plan approval, wind tunnel testing is recommended and can be conducted to confirm the predicted wind conditions and validate the effectiveness of the implemented wind mitigation strategies.

6.0 REFERENCES

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