ARGO NEYAGAWA

OAKVILLE, ON

PEDESTRIAN WIND ASSESSMENT

PROJECT #2403360
MARCH 1, 2024

SUBMITTED TO

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1. INTRODUCTION

Rowan Williams Davies & Irwin Inc. (RWDI) was retained to conduct a qualitative assessment of the pedestrian wind conditions expected around the proposed Argo Neyagawa project in Oakville, Ontario. This effort is intended to inform good design and has been conducted in support of a draft plan application for the project.

The proposed site is open land south of Highway 407, bordered by Neyagawa Boulevard, Burnhamthorpe Road West and Fourth Line. The surrounding is flat, open or treed lands with isolated low buildings.

The preliminary concept plan for the project consists of two 15-storey buildings at the southeast corner of the site, plus a range of low-rise townhomes over the remaining site, as shown in Images 2 and 3. The pedestrian areas of interest of this wind assessment include sidewalks, walkways, green outdoor amenity areas, building entrances and potential terraces at podium and roof levels on the 15-storey buildings.

It should be noted that the building locations and block configurations are preliminary and subject to refinement through future site plan applications.

Image 1: Aerial View of the Existing Site and Surroundings (Credit: Google Maps)

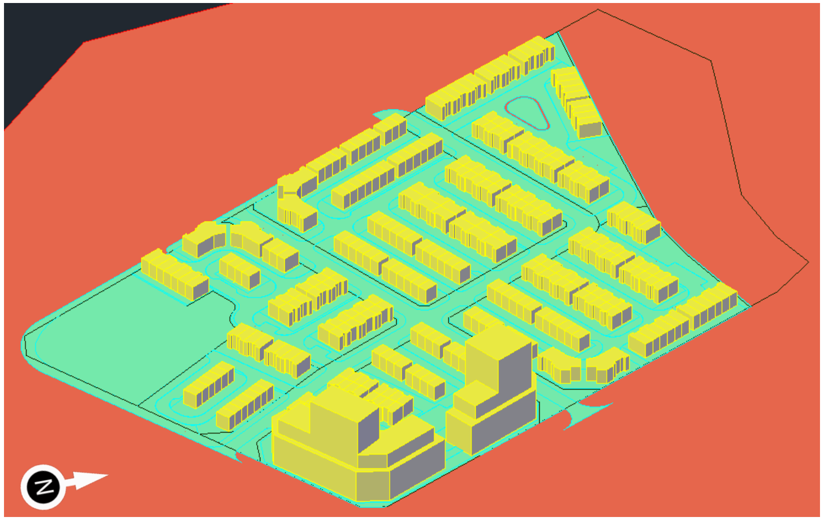

Image 2: Project Rendering

1. INTRODUCTION

Image 3: Preliminary Master Plan

2. METHODOLOGY

Predicting wind speeds and occurrence frequencies is complex. It involves a combined assessment of building geometry, orientation, position and height of surrounding buildings, upstream terrain and the local wind climate.

Over the years, RWDI has conducted thousands of wind-tunnel model studies on pedestrian wind conditions around buildings, yielding a broad knowledge base. In some situations, this knowledge and experience, together with literature, allow for a reliable, consistent and efficient desktop estimation of pedestrian wind conditions without wind-tunnel testing. This approach provides a screening-level estimation of potential wind conditions and offers conceptual wind control measures for improved wind comfort, where necessary.

In order to quantify and confirm the predicted conditions or refine any of the suggested conceptual wind control measures, physical scale model tests in a boundary-layer wind tunnel would be required.

RWDI's wind assessment is based on the following:

- Conceptual design drawings and models received on January 29 and February 14, 2024;
- A review of the regional long-term meteorological data from Toronto Pearson International Airport;
- Use of RWDI's proprietary software (*WindEstimator*[1]) for providing a screening-level numerical estimation of potential wind conditions around generalized building forms;
- Wind-tunnel studies and desktop assessments undertaken by RWDI for projects in Oakville and around the world;
- RWDI's engineering judgement and knowledge of wind flows around buildings[2, 3]; and,
- RWDI Criteria for pedestrian wind comfort and safety.

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

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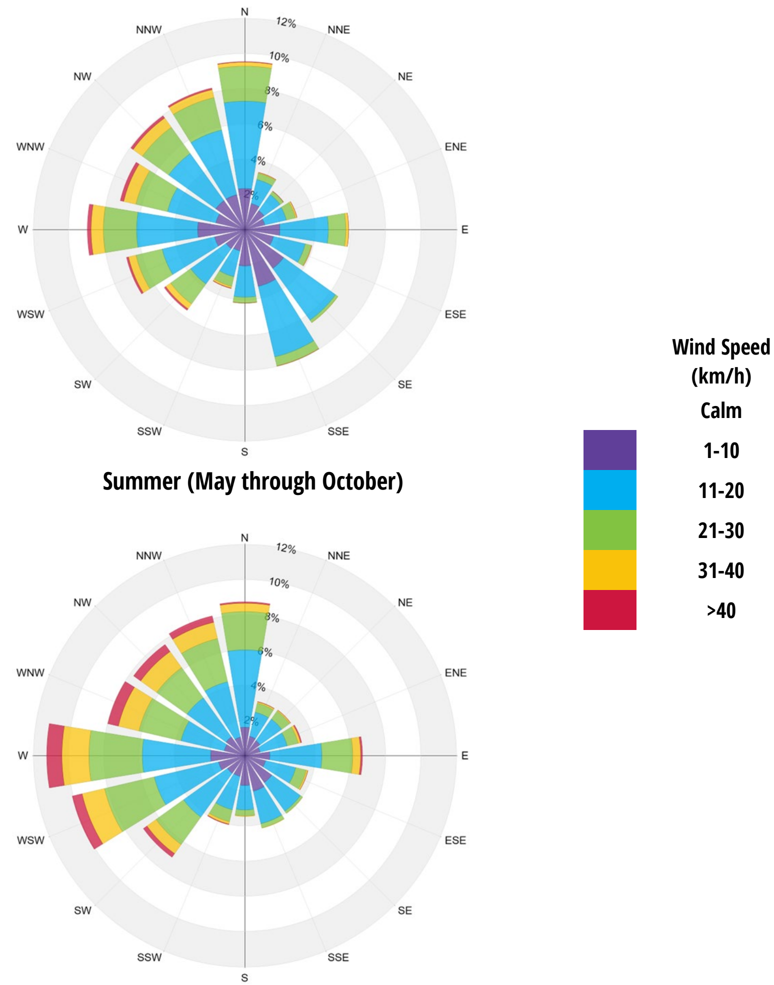
1. H. Wu, C.J. Williams, H.A. Baker and W.F. Waechter (2004), "Knowledge-based Desk-Top Analysis of Pedestrian Wind Conditions", *ASCE Structure Congress 2004,* Nashville, Tennessee.
2. H. Wu and F. Kriksic (2012). "Designing for Pedestrian Comfort in Response to Local Climate", *Journal of Wind Engineering 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.

3. METEOROLOGICAL DATA

Meteorological data from Toronto Pearson International Airport for the period from 1993 to 2022 were used as a reference for wind conditions in the area as this is the nearest station to the site with long-term, hourly wind data. The distributions of wind frequency and directionality for the summer (May through October) and winter (November through April) seasons are shown in the wind roses in Image 4.

When all winds are considered, winds from the southwest through north directions are predominant throughout the year, with secondary winds from south-southeast in the summer, and from east in the winter.

Strong winds of a speed greater than 30 km/h measured at the airport (red and yellow bands) occur more often in the winter than in the summer season. Winds from the west-southwest through north-northwest and east directions potentially could be the source of uncomfortable or severe wind conditions, depending upon the site exposure and development design.



Winter (November through April)

Image 4: Directional Distribution of Winds Approaching Toronto Pearson International Airport (1993 to 2022)

4. WIND CRITERIA

The RWDI pedestrian wind criteria are used in the current study. 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. The criteria are as follows:

4.1 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.

4.2 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 (≤ 14 km/h): Gentle breezes suitable for main building entrances and bus stops.

Strolling (≤ 17 km/h): Moderate winds that would be appropriate for window shopping and strolling along a downtown street, plaza or park.

Walking (≤ 20 km/h): Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering.

Uncomfortable: The comfort category for walking is not met.

Wind conditions are considered suitable for sitting, standing, strolling 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., 1.5 m above grade or the concerned floor level), typically lower than those recorded in the airport (10 m height and open terrain).

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

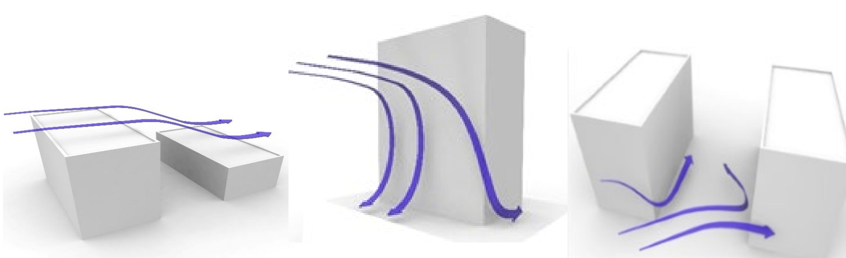
For the current development, wind speeds comfortable for walking or strolling are appropriate for sidewalks and walkways; lower wind speeds comfortable for standing are required for building entrances where pedestrians may linger; and calm wind speeds suitable for sitting or standing are desired in areas where passive activities are anticipated, such as the outdoor amenity areas at and above grade.

5. RESULTS AND DISCUSSION

5.1 Wind Flow Around Buildings

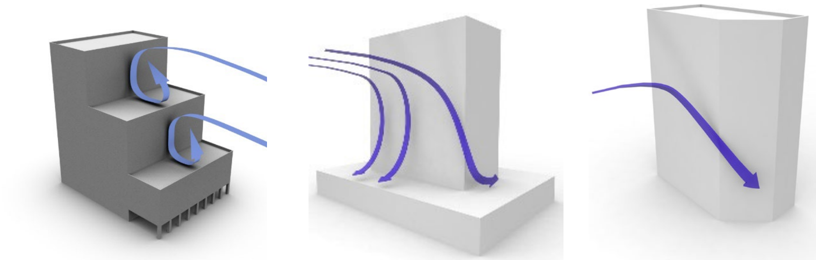
Short buildings do not redirect winds significantly to cause adverse wind conditions at pedestrian areas (Image 5a). Tall buildings tend to intercept the stronger winds at higher elevations and redirect them to the ground level (Downwashing). These winds subsequently move around exposed building corners, causing a localized increase in wind activity due to Corner Acceleration and Channeling Effect (Images 5b and 5c, respectively). If these building / wind combinations occur for prevailing winds, there is a greater potential for increased wind activity and *uncomfortable* conditions.

Design details such as stepped massing, tower setback from a podium edge, deep canopies close to ground level, wind screens / tall trees with dense underplanting, etc. (Image 6) can help reduce wind speeds. The choice and effectiveness of these measures would depend on the exposure and orientation of the site with respect to the prevailing wind directions and the size and massing of the proposed buildings.

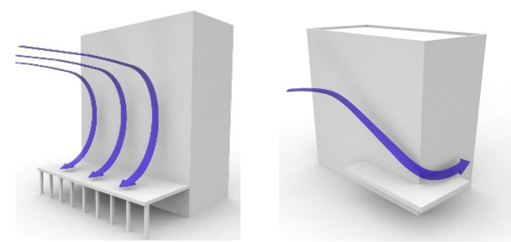


a) Wind over Low Buildings **b) Downwashing & Corner Acceleration** **c) Channeling Effect**

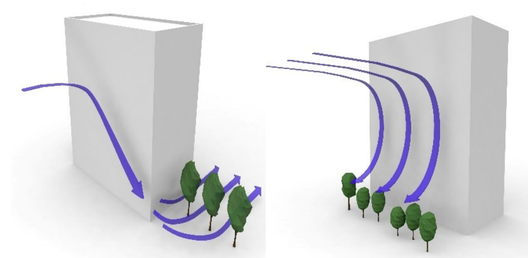
Image 5: Generalized Wind Flows



Stepped Massing ***Podium*** ***Chamfered Corner***



Canopy



Trees help reduce wind impact at ground level

Image 6: Examples of Common Wind Control Measures

5. RESULTS AND DISCUSSION

5.2 Existing Scenario

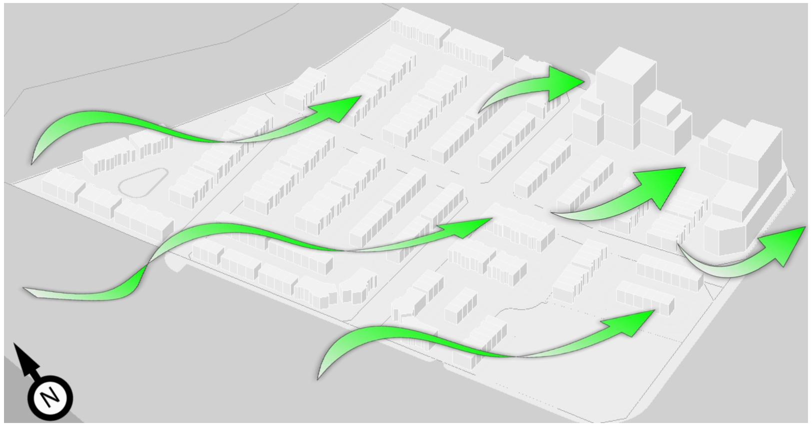
The existing site is largely unoccupied and exposed to winds from all directions. As such, there are no significant structures that would deflect ambient winds to ground to cause adverse wind impacts, but the site exposure allows winds to flow over the site without any disruption.

Currently, wind conditions on the site are considered comfortable for standing or strolling in the summer and for strolling or walking in the winter due to seasonal climate variations.

Wind conditions exceeding the safety criterion are not expected.

5.3 Proposed Scenario: Wind Flow

Most proposed buildings are low rise, as shown in Images 2 and 3. They tend to cause slight increases in wind speeds around their exposed corners and gaps and provide sheltering for the downwind areas. The two preliminary 15-storey buildings, on the other hand, are taller than the surroundings and therefore, will be exposed to winds from all directions. Downwashing, corner acceleration and channelling flows are predicted to result in increased wind activity around the buildings with the highest speeds expected between the buildings and around the northeast and southwest building corners. These flows are illustrated in Image 7 for the prevailing west and northwest winds.



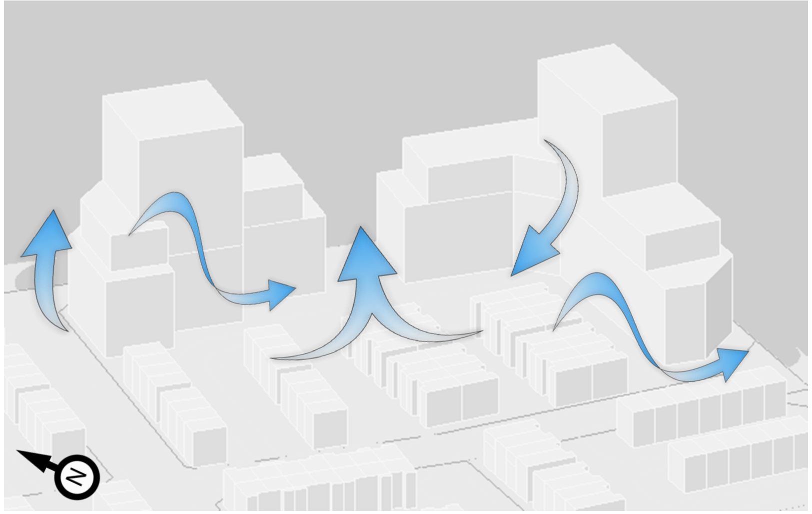


Image 7: Predicted Flow Patterns of the Prevailing West and Northwest Winds

5.3 Proposed Scenario: Wind Flow

Several features of the conceptual masterplan are favourable towards reducing the potential for severe wind impacts. These features include:

- The uniform height of the low townhouses;
- The downwind location of the 15-storey buildings;
- Stepped elevations or tower setbacks on the tall buildings; and
- Chamfered northeast and southwest building corners.

The following sections provide a discussion of the potential wind conditions on and around the project, taking these features into account. The expected wind conditions are shown in Images 8a and 8b for the summer and winter seasons, respectively.

5.4 Proposed Scenario: Wind Safety

Given the local climate and the proposed building height, wind conditions are expected to meet the wind safety criterion in most pedestrian areas on and around the project site.

The only exception may occur around the proposed 15-storey buildings, including the northeast and southwest building corners, the gap between the buildings and potential amenity areas at the podium and roof levels. Additional wind studies are recommended at a later design stage to quantify these wind conditions and to develop wind control solutions.

5.5 Proposed Scenario: Wind Comfort

5.5.1 Low-rise Areas

Wind conditions around the low-rise townhouses are generally expected to be comfortable for sitting or standing in the summer and for standing or strolling in the winter, as shown in Images 8a and 8b. Slightly higher wind speeds comfortable for strolling or walking are predicted between the buildings along the west and north site perimeters due to their exposure. These wind conditions are similar to the existing wind conditions and are suitable for the planed sidewalks and walkways throughout the year and for green outdoor areas in the summer.

5.5.2 Tall Buildings

Higher wind speeds are predicted around the conceptual 15-storey buildings, with conditions typically comfortable for strolling or walking. Uncomfortable wind conditions may occur in the winter along the space between the buildings and around the northeast and southwest building corners (red dots in Image 8b).

If frequent use of these areas is anticipated in the winter, wind mitigation measures are recommended. They could include massing changes such as additional tower setbacks, corner articulations and arcades. Other options include architectural and landscaping features such as canopies or trellises, wind screens and coniferous trees – see Image 9 for examples. Further wind studies can be used to refine these wind mitigation concepts.

5.4 Proposed Scenario: Predicted Wind Conditions

Image 8a: Predicted Wind Conditions - Summer

5. RESULTS AND DISCUSSION

5.4 Proposed Scenario: Predicted Wind Conditions

WIND CATEGORIES

- Sitting / Standing
- Strolling
- Walking
- Uncomfortable

Image 8b: Predicted Wind Conditions - Winter

5. RESULTS AND DISCUSSION

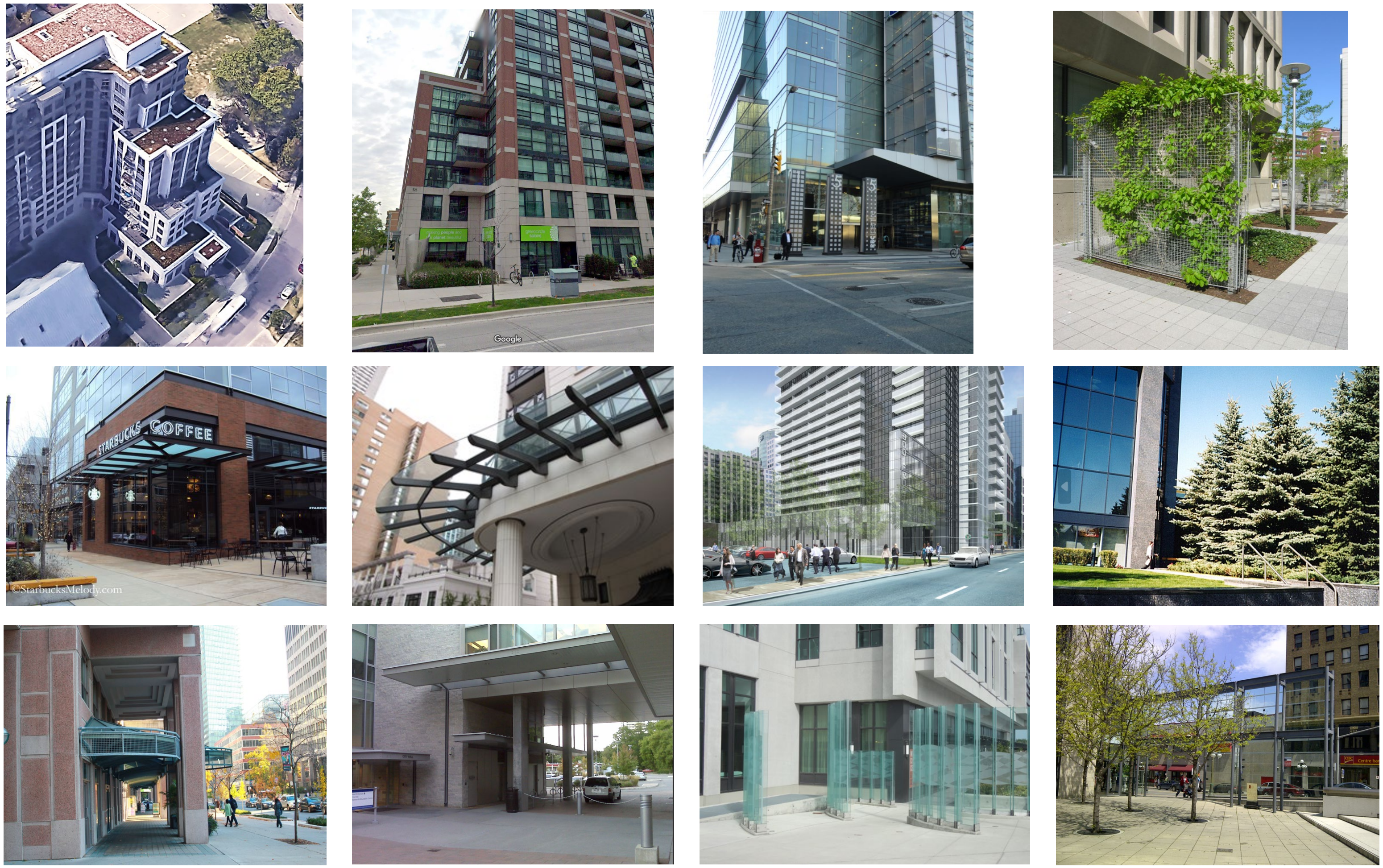


Image 9: Examples of Wind Control Features around Tall Buildings

5.5 Proposed Scenario: Wind Comfort

5.5.3 Entrances

Low wind speeds comfortable for sitting or standing are desired for building entrances. At this stage of the conceptual masterplan, no building entrances are identified, but the criterion is expected to be met for all entrances to the low-rise buildings.

For the 15-storey buildings, higher-than-desired wind speeds are expected along some building facades in the winter and, to a lesser extent, in the summer, depending on their locations and exposure. If feasible, main building entrances should be placed away from the uncomfortable areas identified in Image 8b.

To create comfortable wind conditions around the future entrances, several wind mitigation measures may be considered, including recessing entrances from the main facades, re-entrant building corners, designing canopies above entrances and installing screens/planters on both sides of the entrances. See photos in Image 10 for examples of wind control features.

Image 10: Examples of Wind Control Features for Main Entrances for Tall Buildings

5.5 Proposed Scenario: Wind Comfort

5.5.4 Potential Above-ground Amenity Areas

While large podiums and tower setbacks are positive design features to reduce wind impacts at grade level, increased wind activity is generally expected on the podium spaces where outdoor terraces are often planned. Due to the downwashing flows as well as the increased elevations and exposure, wind speeds on podiums are often higher than desired for passive activities such as sitting, reading and dining.

Typical wind control measures for podium terraces may include tall guardrails and landscaping rows along the perimeters, trellises at the bases of the towers and local landscaping elements around any planned seating areas.

High wind speeds are also expected on any rooftop terraces, if any, due to increased elevations and exposure. For these areas, tall guardrails should be considered along the roof terrace perimeters, together with local landscaping around any designated seating areas.

Note that the wind safety limit may be exceeded in some above-grade areas, depending on their elevations and exposure. This may not be a serious concern since these windy events typically occur in cold months when limited use of the outdoor amenity is anticipated.

Image 11 provides examples for wind control for above-grade amenity areas.

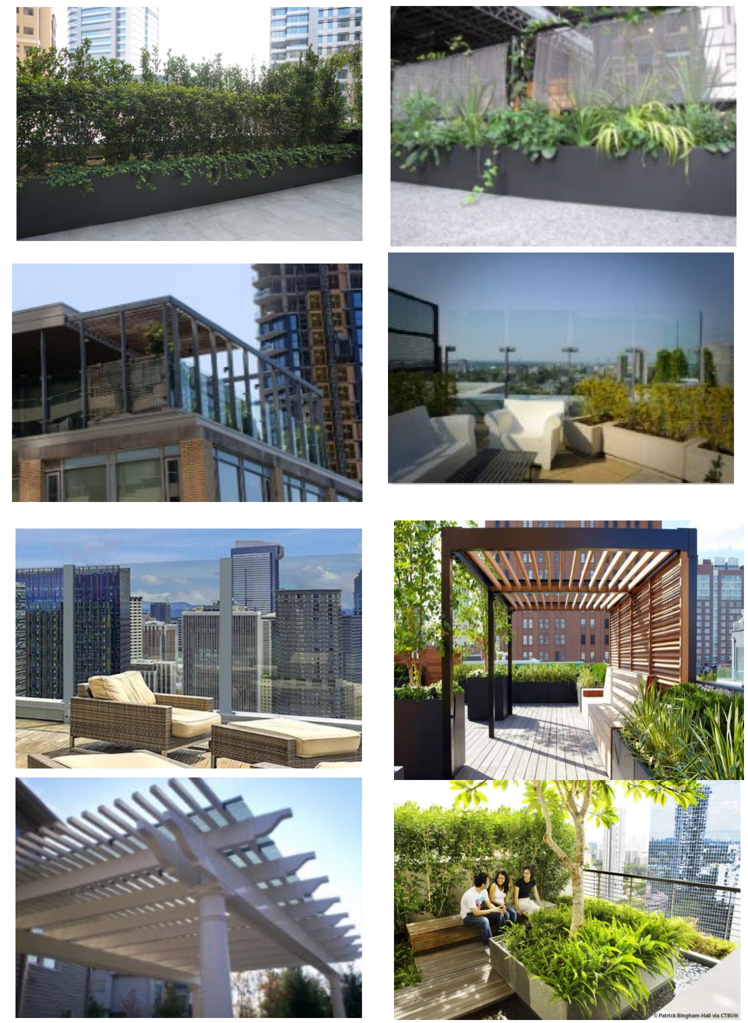


Image 11: Examples of Wind Control Features for Above-ground Amenities

6. SUMMARY

RWDI was retained to provide an assessment of the potential pedestrian level wind impact of the proposed Argo Neyagawa project in Oakville, Ontario. Our assessment was based on the local wind climate, the current conceptual design of the proposed development, the existing surrounding buildings, our experience with wind tunnel testing of similar buildings, and screening-level modelling of wind flows around buildings.

Our findings are summarized as follows:

- The project site is currently largely unoccupied and fully exposed to winds from all directions. As a result, moderate wind activity is generally expected on and around the site, with slightly elevated wind speeds in the winter.
- The preliminary concept plan consists of a range of low-rise townhouses and two 15-storey buildings. Wind conditions around the low buildings are expected to be similar to those that currently exist in the area, and suitable for the intended pedestrian uses of sidewalks, walkways, entrances and green outdoor spaces.
- The conceptual design of the 15-storey buildings incorporates several wind-responsive features such as tower stepbacks or podiums and chamfered corners, which will moderate the potential wind impacts on the surroundings.
- Increased wind speeds are predicted along the space between the 15-storey buildings and around the northeast and southwest building corners. The resultant wind conditions may become uncomfortable in the winter or potentially exceed the wind safety criterion.
- Depending on the future location and design of the entrances and potential terraces at the podium and roof levels for the 15-storey buildings, higher-than-desired wind speeds may also be expected.
- General design guidelines and wind control measures are provided in the report for these potential windy areas. Further wind studies can be conducted at a later design stage to quantify the wind conditions and to develop wind control solutions.

7. STATEMENT OF LIMITATIONS

Design Assumptions

The findings/recommendations in this report are based on the preliminary building geometry and conceptual architectural drawings communicated to RWDI in January and February 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 (mm/dd/yyyy)
23059P09_Argo Neyagawa_RVT2023_sun_shadow_study	dwg	02/14/2024
03_Preliminary Concept Plan_v1_2023-12-11	pdf	01/29/2024

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.

Limitations

This report was prepared by Rowan Williams Davies & Irwin Inc. for Argo Neyagawa Corporation ("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.