REPORT

4103 PALLADIUM WAY

BURLINGTON, ONTARIO

PEDESTRIAN WIND COMFORT ASSESSMENT

PROJECT #2410829
11/26/2024

SUBMITTED TO

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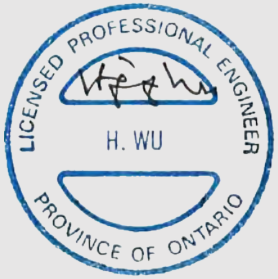
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1. INTRODUCTION

RWDI AIR Inc. (“RWDI”) was retained to conduct a pedestrian wind assessment for the proposed retirement home (RTH) to the east of a long term care facility (“LTC”) at 4103 Palladium Way in Burlington, Ontario. Since receiving the original approval for the LTC and 6-storey RTH, an increase in the height of the RTH building, from 6-storeys to 8-storeys, is being proposed. To address city requirements, a qualitative wind study for the 8-storey RTH building is being completed. At the time of the study the LTC facility is under construction and for the purposes of this study the LTC building is deemed existing. The objective of this assessment is to provide an evaluation of the potential wind impact of the proposed development in support of the planning approvals.

The existing project site is located northeast of the intersection of Walkers Line and Palladium Way to the north of the existing Halton Court Services Provincial Office, mostly surrounded by open spaces with natural vegetation with low-rise suburban neighbourhoods in easterly and southerly directions (Image 1).

The existing LTC is a five (5) storey rectangular building with two internal courtyards. The proposed RTH is an eight (8) storey rectangular building with terraces on Level 2; the broad facades of the RTH are toward north and south directions - see Image 2. The proposal includes outdoor patios at grade. In addition to walkways on and around the project site, key areas of interest for this assessment include building entrances, central parking lot, drop-off areas, outdoor patios / courtyards and Level 2 terraces of RTH (Image 3).

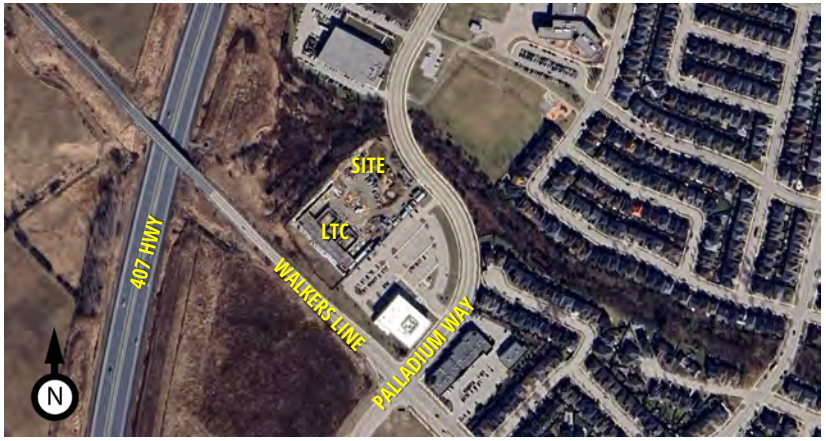


Image 1: Aerial View of the Existing Site and Surroundings
Source: Google Maps

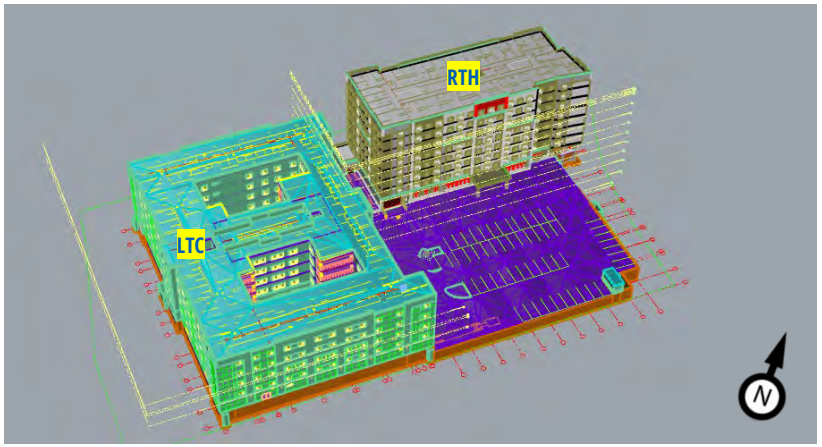


Image 2: 3D Views of the Project (courtesy of: Esposto Architects Inc.)

1. INTRODUCTION

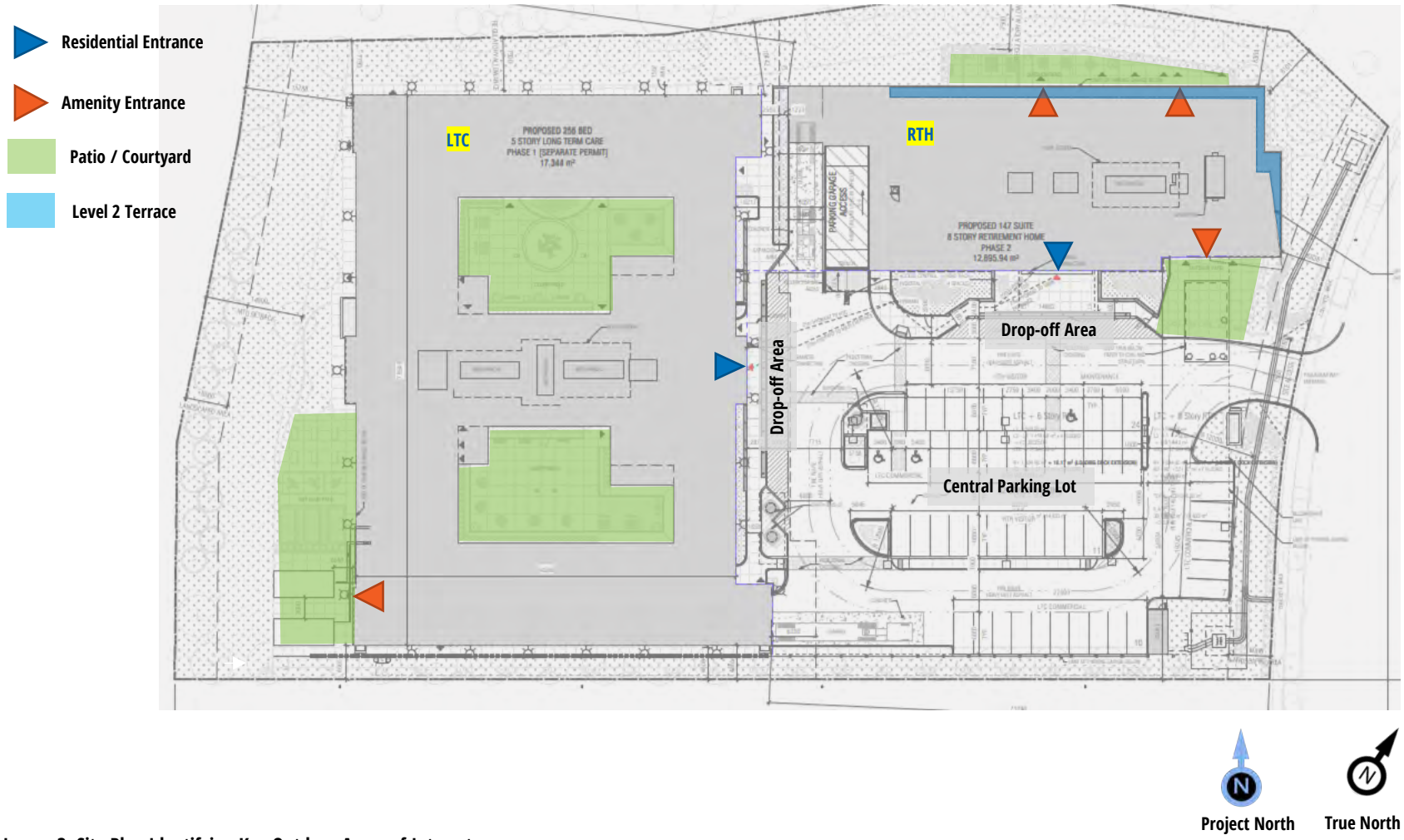


Image 3: Site Plan Identifying Key Outdoor Areas of Interest

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 Hamilton International Airport;
- 3D model and drawings of the proposed project received on September 24, 2024;
- 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 city of Burlington wind comfort and safety criteria.

Note that other wind related 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

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 with LTC and surroundings, and
- Proposed: addition of the proposed RTH.

The computer model of the proposed RTH 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 1.5 m above concerned levels, to the mean wind speed at a reference height. The data was then combined with meteorological records obtained from Hamilton International Airport to determine the wind speeds and frequencies in the simulated areas.

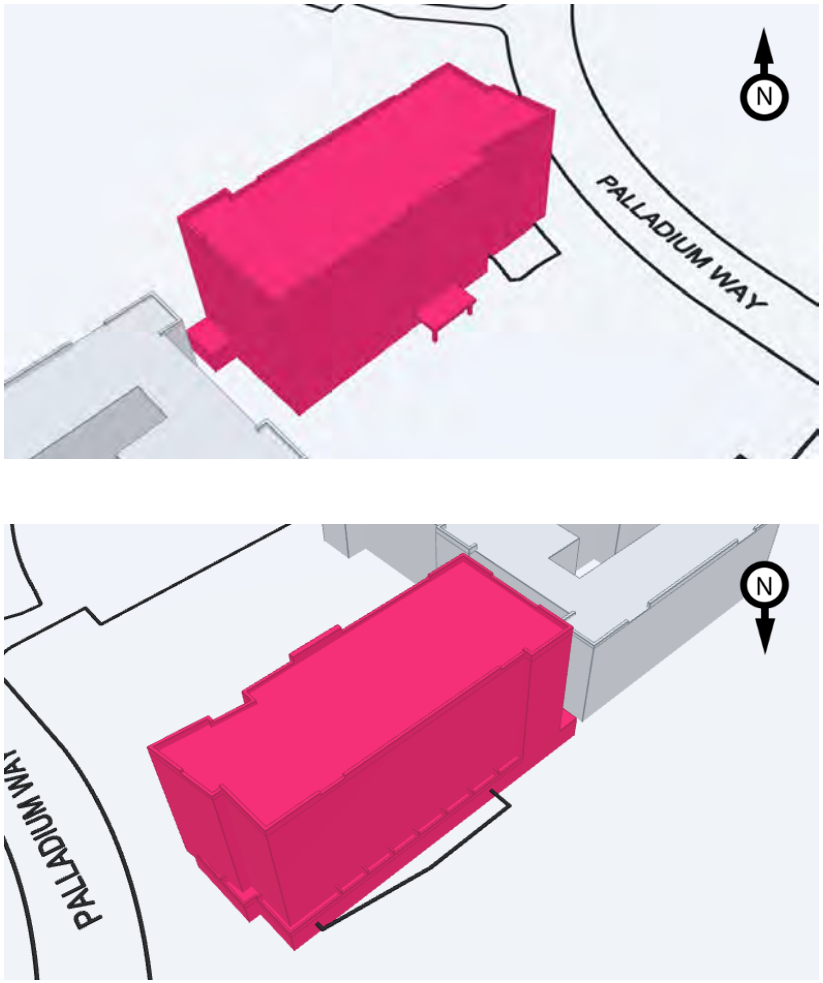


Image 4: Computer Model of the Proposed RTH

2. METHODOLOGY

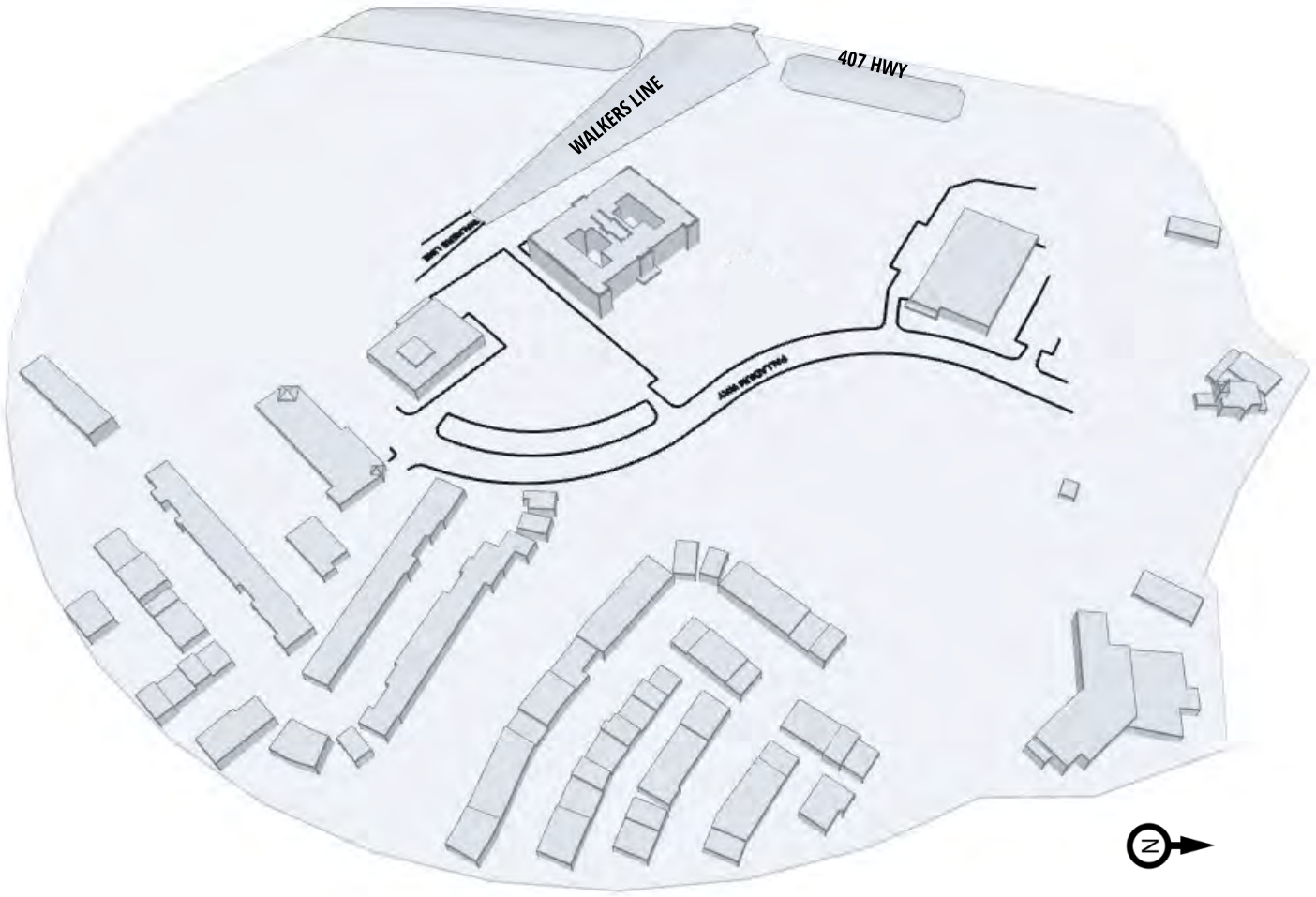


Image 5a: Computer Model of the Existing Site and Extended Surroundings

2. METHODOLOGY

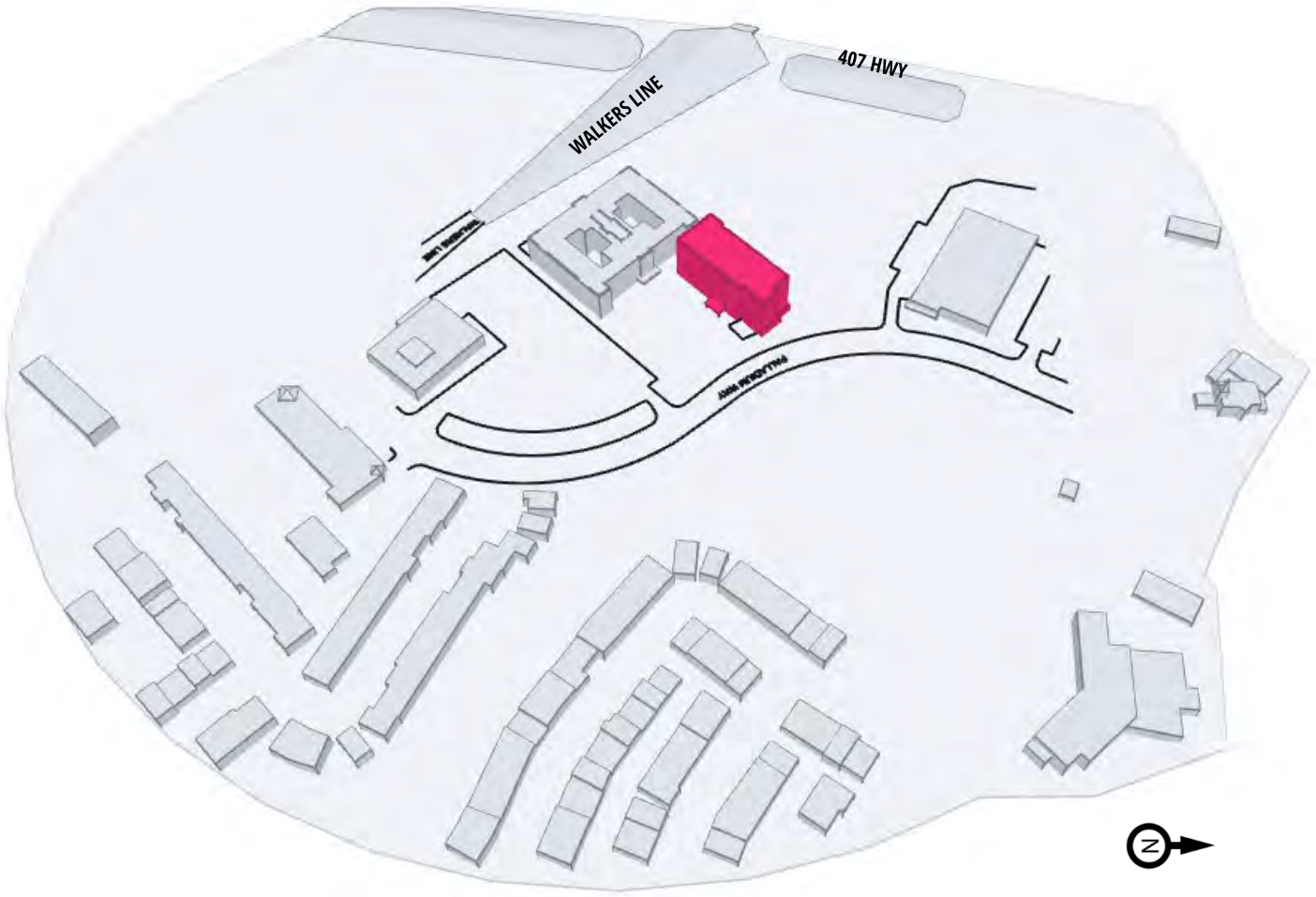


Image 5b: Computer Model of the Proposed Site and Extended Surroundings

2. METHODOLOGY

2.4 Meteorological Data

Wind statistics recorded at Hamilton International Airport between 1990 and 2020, 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 northeast and southwest directions are predominant in both summer and winter, as indicated by the wind roses.

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.

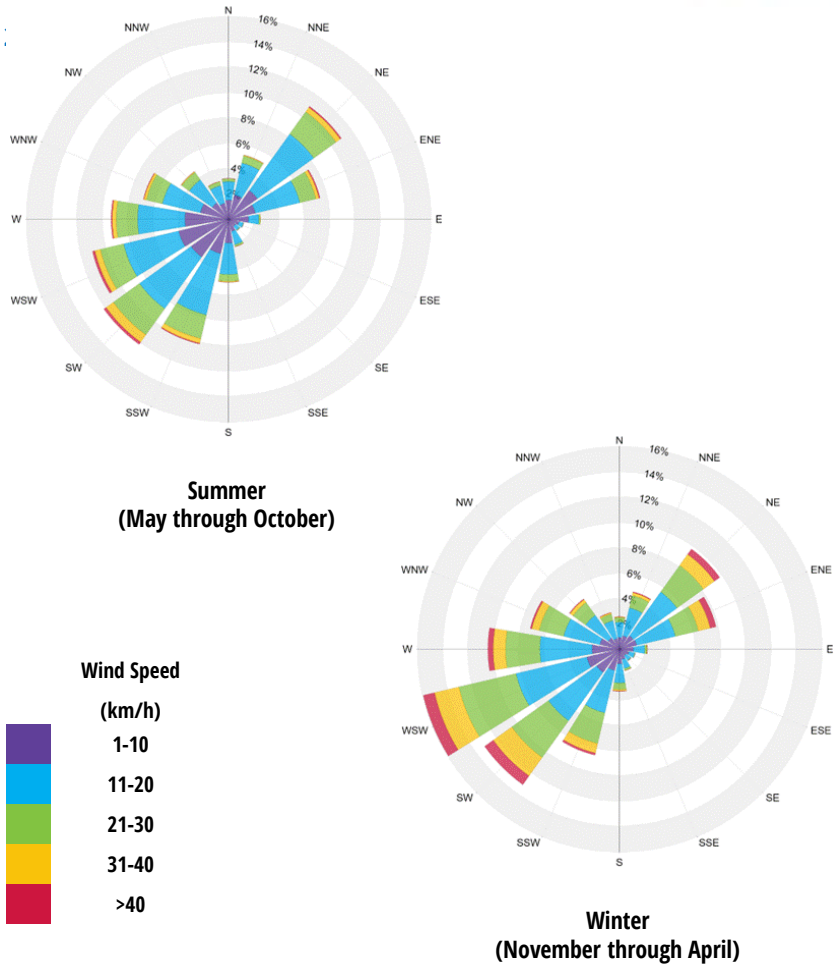


Image 6: Directional Distribution of Wind Approaching Hamilton International Airport (1990 to 2020)

3. WIND CRITERIA

The Burlington pedestrian wind criteria, developed in March 2020, are specified in the Guidelines and Terms of Reference, "Pedestrian Level Wind Study". The table to the right defines the criteria for both wind comfort and safety.

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, leisurely walking or fast 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 Fast Walking are categorized as 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.

3.2 Pedestrian Safety

Pedestrian safety is associated with excessive Gust Speeds that can adversely affect a person's balance and footing (based on an annual exceedance of 9 hours or 0.1% of the time). These are usually infrequent events but deserve special attention due to the potential impact on pedestrian safety.

Comfort Category	GEM Speed (km/h)	Description
Sitting	≤ 10	Calm or light breezes Appropriate for dedicated seating areas such as cafes, patios, and outdoor amenity areas
Standing	≤ 14	Gentle breezes Appropriate for main building entrances, bus stops, and other places where pedestrians may linger
Leisurely Walking	≤ 17	Moderate winds Appropriate for shopping and strolling along retail streets and parks
Fast Walking	≤ 20	Relative higher wind speeds Appropriate for areas where pedestrians are walking, running, or cycling without lingering
Uncomfortable	> 20	Strong winds Inappropriate due to nuisance for all pedestrian activities Wind mitigation measures are required

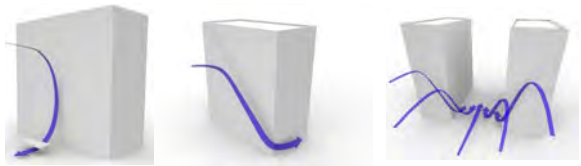
Safety Criterion	Gust Speed (km/h)	Description
Exceeded	> 90	Excessive gust speeds Adverse effect on pedestrian's balance and footing Wind mitigation is required

4. RESULTS AND DISCUSSION

4.1 Wind Flow around Buildings

Wind tends to flow over open lands or 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 accelerate around exposed building corners (*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. These flow patterns are illustrated in Image 7.

The RTH and LTC are taller than the surroundings; these buildings are expected to redirect winds around them. Positively, the RTH is aligned with the prevailing southwest and northeast winds which will reduce the potential wind impacts at grade. In addition, the potential for wind channelling at the gap between the two buildings is not expected to be significant because the gap is perpendicular to the prevailing winds (see Image 8).



a) Downwashing *b) Corner Acceleration* *c) Channelling*

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 9 presents the existing and proposed wind conditions for the summer and winter seasons at grade. Image 10 shows the predicted wind conditions on Level 2 terraces in the proposed configuration. 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.

Wind conditions in all areas immediately around the project site in both configurations are expected to meet the wind safety criterion. 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 fast or leisurely walking 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 outdoor patios and terraces, especially during the summer when these areas are typically in use.

4. RESULTS AND DISCUSSION

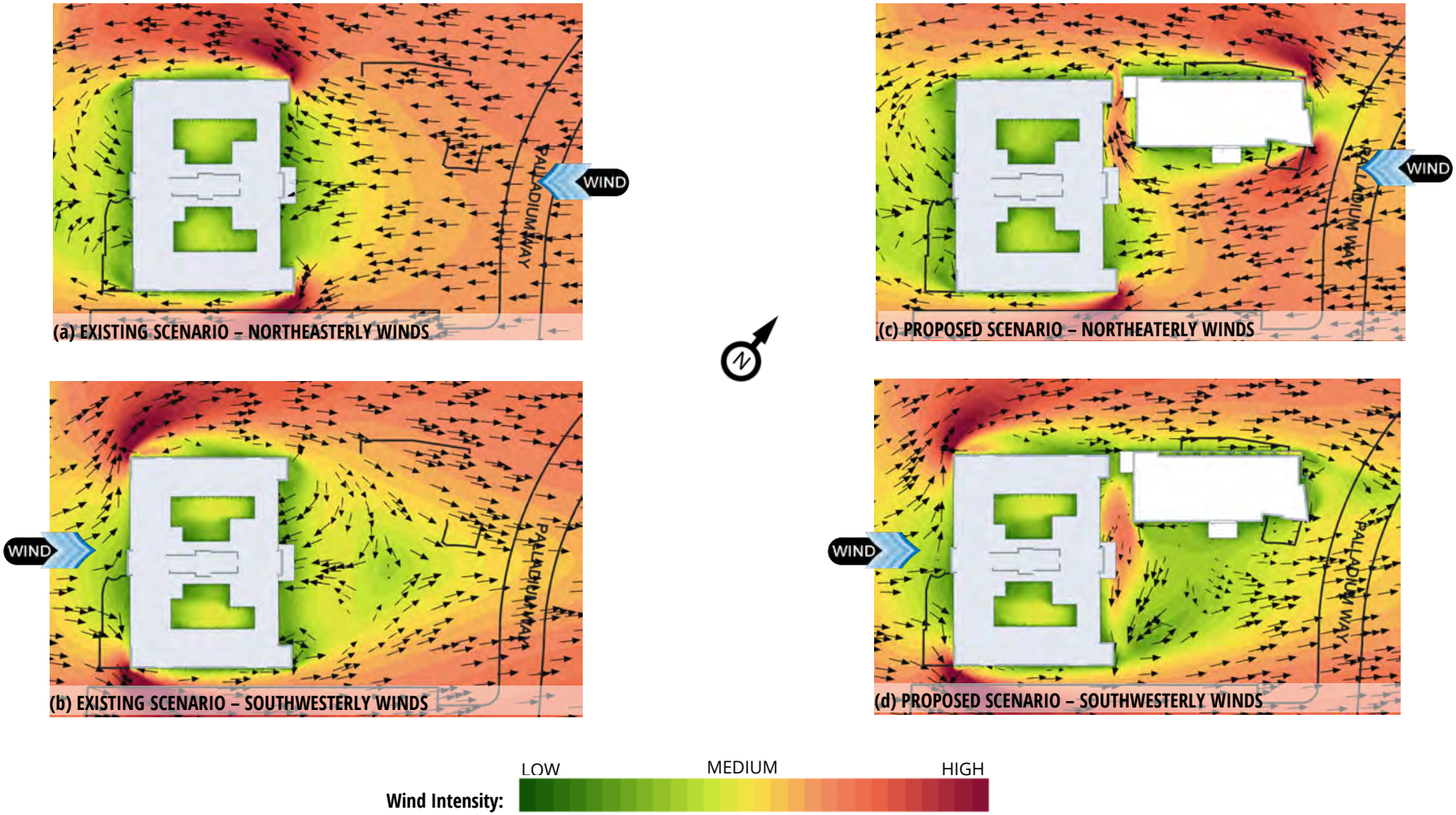


Image 8: Prevailing Wind Patterns Around the Project Site in Existing and Proposed Scenarios

4.3 Existing Scenario

The existing site (including the LTC) is exposed to prevailing winds. Wind conditions at most areas in the existing scenario are considered comfortable for leisurely walking or better in the summer (Image 9a), and fast walking or better in the winter (Image 9b). Higher wind speeds near northern and southern building corners are comfortable for fast walking during the summer and uncomfortable during the winter.

The resultant wind speeds near the main entrances and the drop-off area of the LTC are comfortable for sitting or standing throughout the year; these speeds are suitable for the intended use.

Wind speeds at the internal courtyards of the LTC are low and comfortable for sitting during the summer and siting/standing during the winter. Slightly higher wind speeds at the western patio of the LTC are comfortable for standing during the summer and mostly comfortable for leisurely walking during the winter. Considering the added benefit of landscaping, these predicted conditions may be considered suitable for intended use.

4.4 Proposed Scenario

With addition of the proposed RTH, overall wind speeds are expected to be reduced in immediate surroundings of the site. However, locally high wind speeds can occur at the gap between the two buildings (Images 9c and 9d).

4.4.1 Nearby Walkways and Central Parking Lot

The resulting wind speeds at most walkways and central parking lot are expected to be comfortable for leisurely walking in the summer and fast walking in the winter. These conditions are appropriate for general active use of the area. Higher wind speeds near the exposed northern corners of the LTC and RTH, the gap between them, and the area to the south of the LTC are expected to be comfortable for fast walking during the summer (Image 9c); during the winter, these higher wind speeds can be uncomfortable for pedestrian use, similar to the existing wind conditions (Image 9d).

Note that the existing site is windy and the only notable adverse impact the proposed RTH on local wind conditions is the slight wind channelling effect in the gap between the two buildings. Based on the site plan, this area is near loading zone and is not expected to be frequented by pedestrians, therefore the high wind activity predicted may not raise a concern. Also note that, the street trees and natural vegetation on and near the site will lower wind speeds around them. Coniferous trees afford wind control benefits in the winter months as well. Therefore, if improved conditions are desired, the design team may increase the density of evergreen landscaping.

4. RESULTS AND DISCUSSION

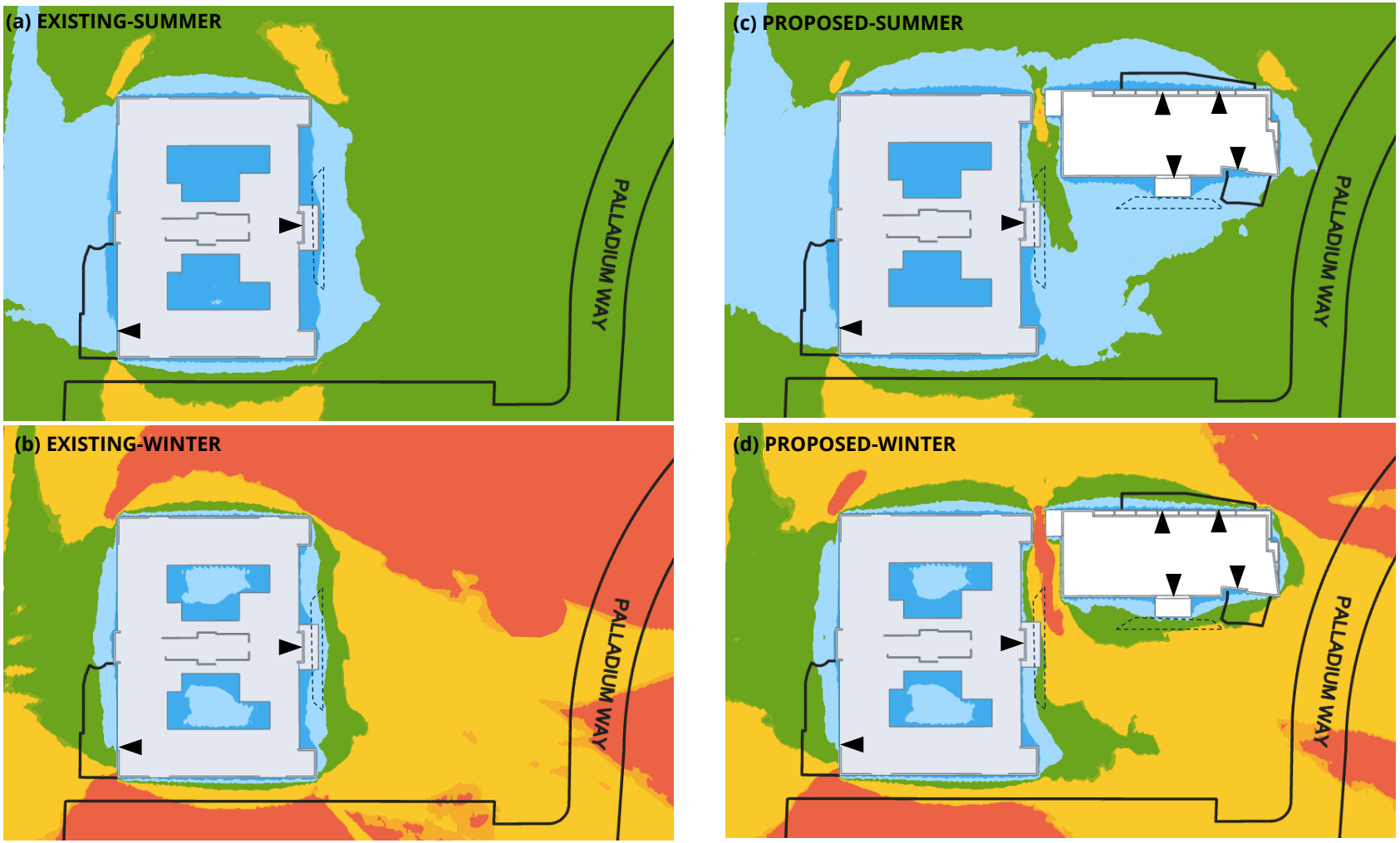


Image 9: Predicted Wind Conditions

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November 26, 2024

4.4.2 Building Entrances and Drop-off Areas

The main entrances are away from building corners and the identified windy areas of the site. Also, the residential entrances are equipped with a canopies that can protect patrons from wind and other weather elements. As a result, wind conditions near all entrances are expected to be comfortable for sitting or standing throughout the year (Images 9c and 9d).

Wind speeds at the drop off areas are expected to be mostly comfortable for standing in the summer and leisurely or fast walking during the winter (Image 9d). These speeds during the winter are slightly higher than desired. Improved conditions are attainable by adding strategic landscaping, as was discussed in section 4.4.1.

4.4.3 Outdoor Courtyards and Patios

Wind conditions at the courtyards and the western patio of the LTC are not expected to be influenced by the presence of the RTH.

Wind speeds at the southern and northern patios of the RTH are predicted to be mostly comfortable for standing during the summer (Image 9c) and comfortable for leisurely walking during the winter (Image 9d). With added protection from the landscaping elements around these areas these wind speeds may be considered appropriate for intended use.

4.4.4 Northern Terraces of the RTH

The terraces on Level 2 of the RTH are equipped with tall privacy screens that can disrupt the path of prevailing winds flowing through these areas. The resultant wind speeds are mostly calm and comfortable for sitting during the summer (Image 10a) and standing during the winter (Image 10b). However, the terrace at the northeast corner of the RTH is exposed to building induced flows and can be uncomfortable throughout the year.

Improved conditions can be achieved by considering additional privacy screens or planters to the corner terrace. Overhead trellis may be considered above the main seating area in this terrace. In addition, locally taller perimeter guardrail may be considered. Some examples are illustrated in Image 11. Alternatively access to this terrace can be limited.

4. RESULTS AND DISCUSSION

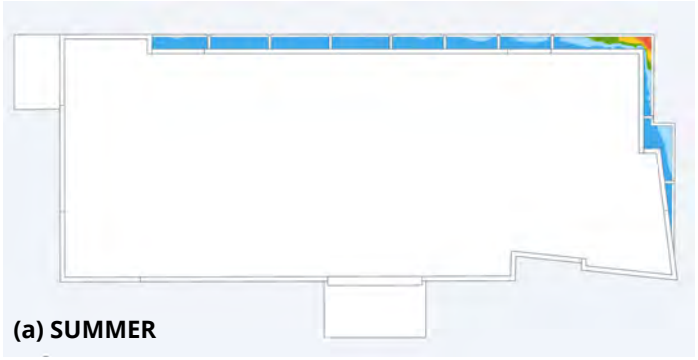


Image 10: Predicted Wind Conditions – PROPOSED – Level 2 Terraces



Image 11: Wind Control Strategies Applicable to the Corner Terrace

4.5 Updated Design

RWDI received more details on design of the northern patio of RTH on November 12, 2024. These drawings indicate 1.5 m tall screens around this area with trellises above seating areas (Highlighted in Image 12). The design team also communicated that they are considering 2 m tall screens around southern patio. With addition of these elements wind conditions are expected to be suitable for prolonged passive use during the summer.

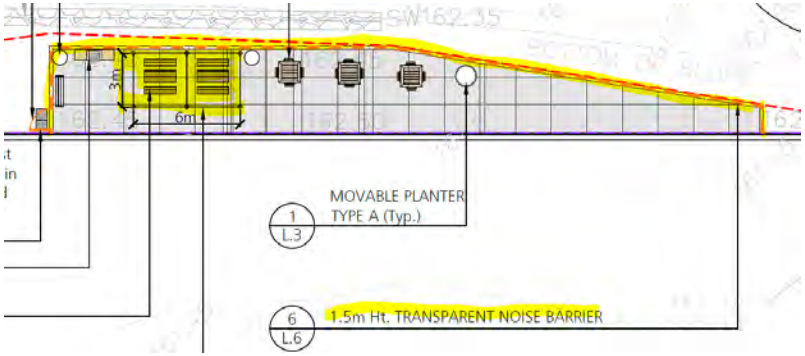


Image 12: Detailed Drawings of the Northern Patio of RTH

5. SUMMARY

RWDI was retained to provide an assessment of the potential pedestrian level wind impact of the proposed retirement home (RTH) to the east of existing long term care facility (LTC) at 4103 Palladium Way in Burlington, 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 Burlington pedestrian wind criteria for comfort and safety. Our findings are summarized as follows:

- Wind conditions are expected to meet the wind safety criterion in both configurations considered.
- The existing site is exposed to prevailing winds. The existing wind patterns on site are most influenced by the existing LTC. Wind conditions near all main entrances, drop-off area, courtyards and the outdoor patio of the LTC are appropriate for intended use. Wind speeds on and around the site are suitable for general pedestrian use during the summer. However uncomfortable conditions can occur during the winter to the north and south of the project site.
- The addition of the proposed RTH is expected to generally reduce wind speeds on and around the site. However, wind channelling can occur at the gap between the two buildings on site. Based on the site plan, this area is near loading zone and is not expected to be frequented by pedestrians, therefore the high wind activity predicted may not raise a concern.
- Wind conditions on site, including the main entrances, patios, courtyards, walkways and parking lot are expected to be appropriate for the intended usage. The project is not expected to have a significant adverse impact on wind conditions. However, slightly higher than desired wind speeds are expected at drop-off areas during the winter.
- Uncomfortable wind speeds are expected at the gap between the two buildings and to the north and south of the site near the building corners in the winter; however, these conditions may be acceptable as they are predicted to occur in areas that are not expected to be frequently visited or are comparable to the existing conditions.
- Wind speeds on the Level 2 terraces of RTH are predicted to be mostly appropriate for passive use; however, uncomfortable conditions can occur at the corner terrace.
- Wind control strategies have been discussed in the main body of report applicable to each area of interest. 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 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)
RTH	PDF	09/24/2024
23008 Palladium LTC FULL MODEL_2024_2	Revit	09/24/2024

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 RWDI AIR Inc. (“RWDI”) for Better Life Living (“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.