524 YORK ROAD (PHASE 2)

NIAGARA-ON-THE-LAKE, ONTARIO

PEDESTRIAN WIND ASSESSMENT

PROJECT #2505589
FEBRUARY 18, 2025

SUBMITTED TO

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1. INTRODUCTION

Rowan Williams Davies & Irwin Inc. (RWDI) was retained to conduct a pedestrian wind assessment for the proposed dual branded hotel with two restaurant pads at 524 York Road (Phase 2) in Niagara-on-the-Lake, ON. The objective of this assessment is to provide an evaluation of the potential wind impact of the proposed development in support of the planning application which will include an OPA and SPA.

The project site is located on the north side of York Road between Glendale Avenue and Counsell Street (Image 1). The site is surrounded by low buildings, roadways and open lands in all directions, followed by rural areas to the north, east and south. The City of St. Catharines is located to the west and Lake Ontario to the distant north.

The project will consist of a 10-storey hotel building and two restaurant buildings across a large parking lot to the west (Images 2 and 3). In addition to sidewalks and properties near the project site, key areas of interest for this assessment include the building entrances, parking lots, and outdoor patios associated with the proposed buildings (Image 3).

Image 1: Aerial view of the existing site and surroundings (Source: Google Earth)

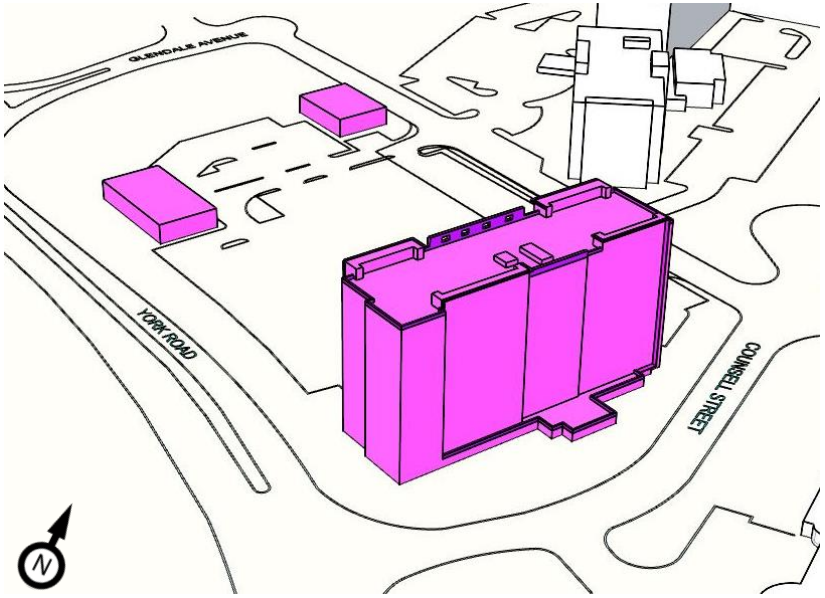


Image 2: 3D view of the proposed project

1. INTRODUCTION

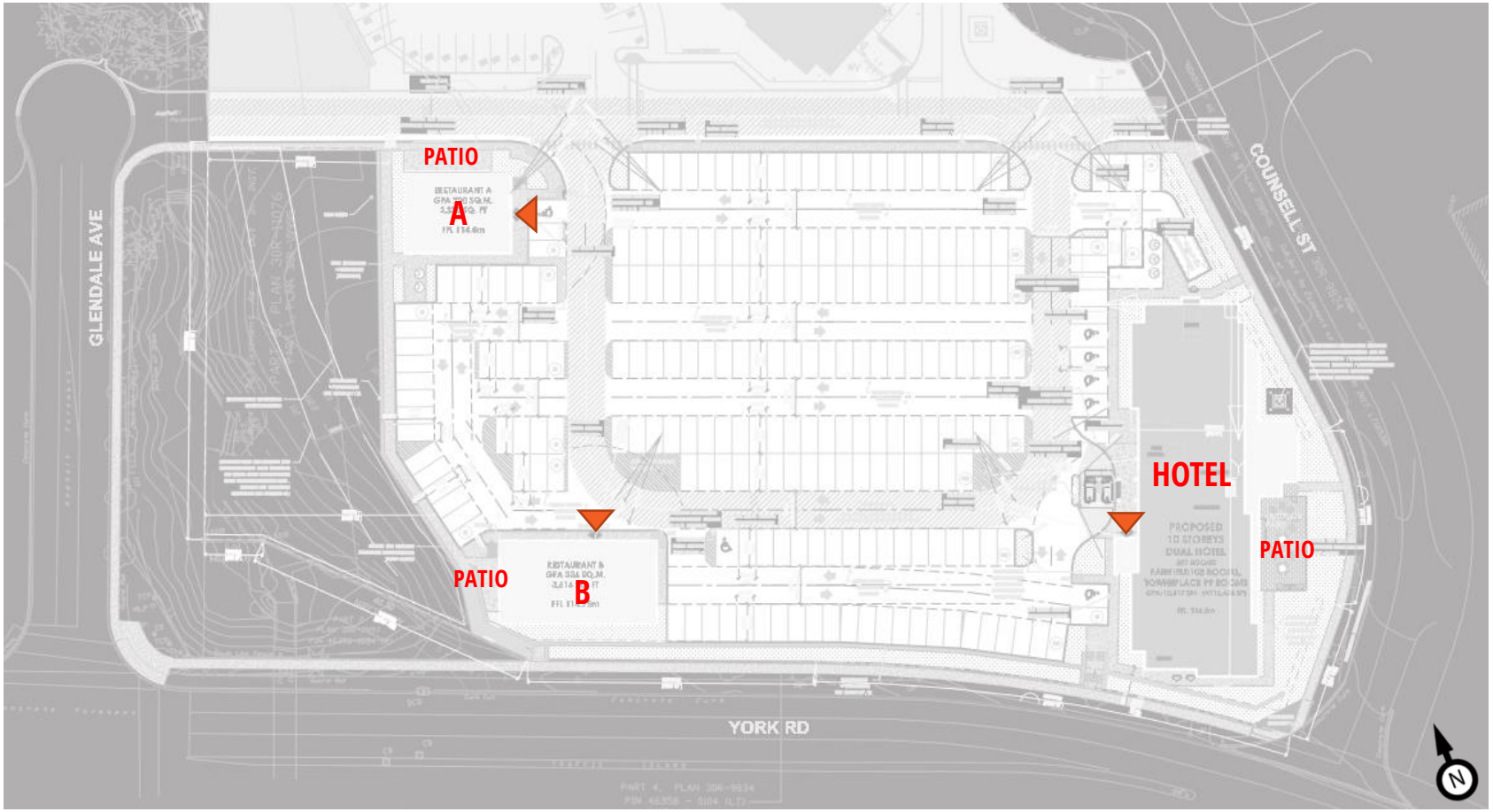


Image 3: Site Plan of the Proposed Hotel and Restaurants A and B

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 Niagara Falls International Airport in NY;
- 3D model and site plan of the proposed project received on December 5, 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,
- Region of Niagara wind comfort and safety criteria.

Note that other wind-related issues such as cladding and structural wind loads, door operability, air quality, snow impact, 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.

2.3 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 development 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 winds 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 Niagara Falls International Airport to determine the wind speeds and frequencies in the simulated areas.

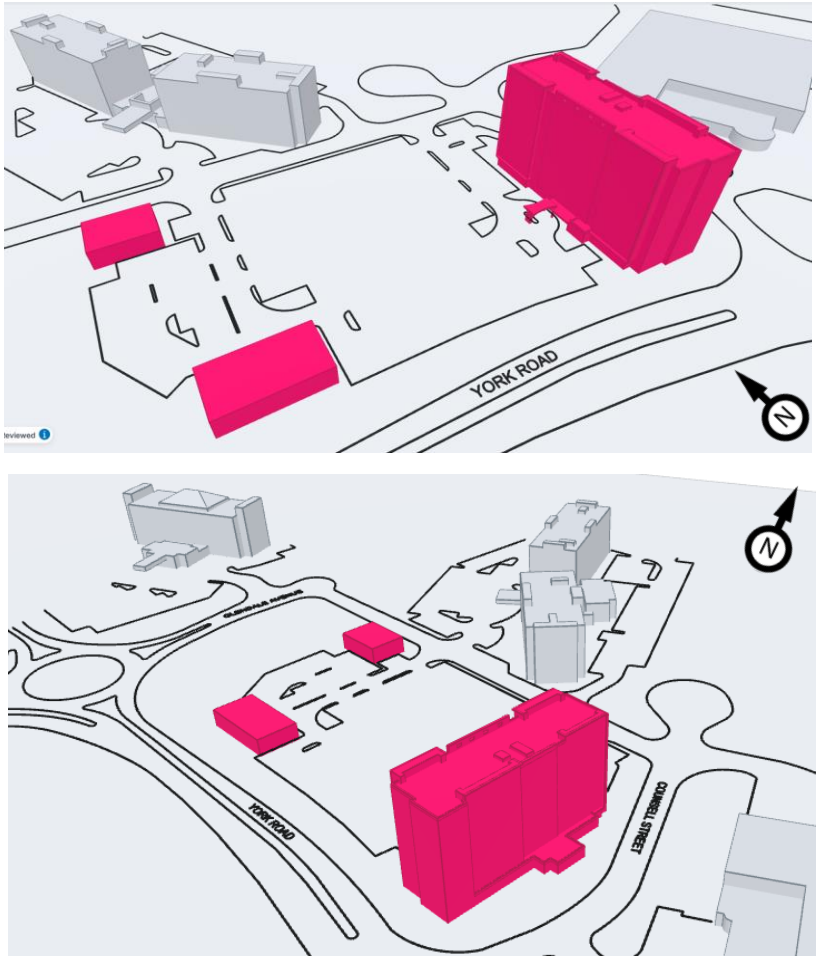


Image 4: Computer Model of the Project

2. METHODOLOGY

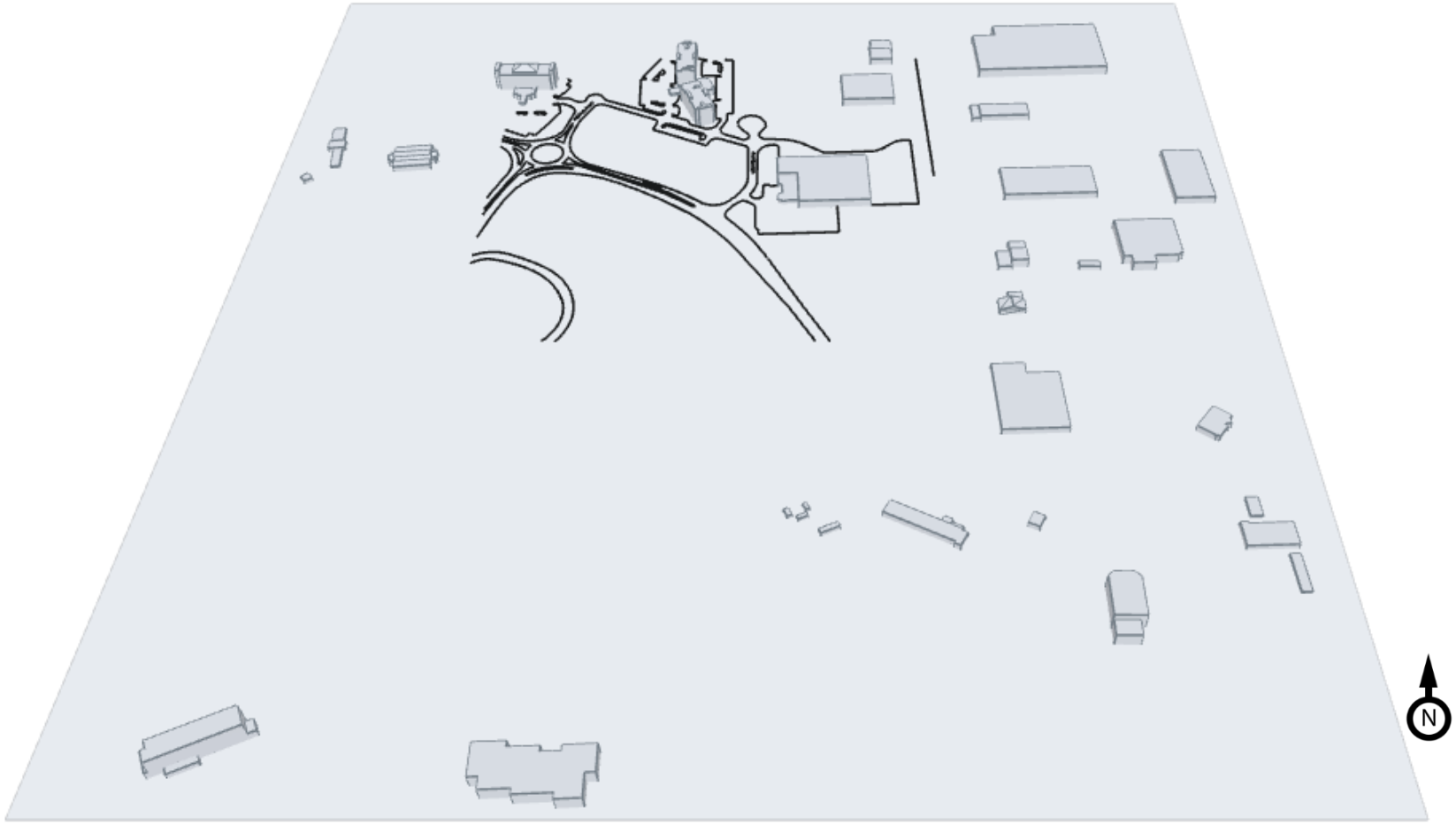


Image 5a: Computer Model of the Existing Site and Surroundings

2. METHODOLOGY

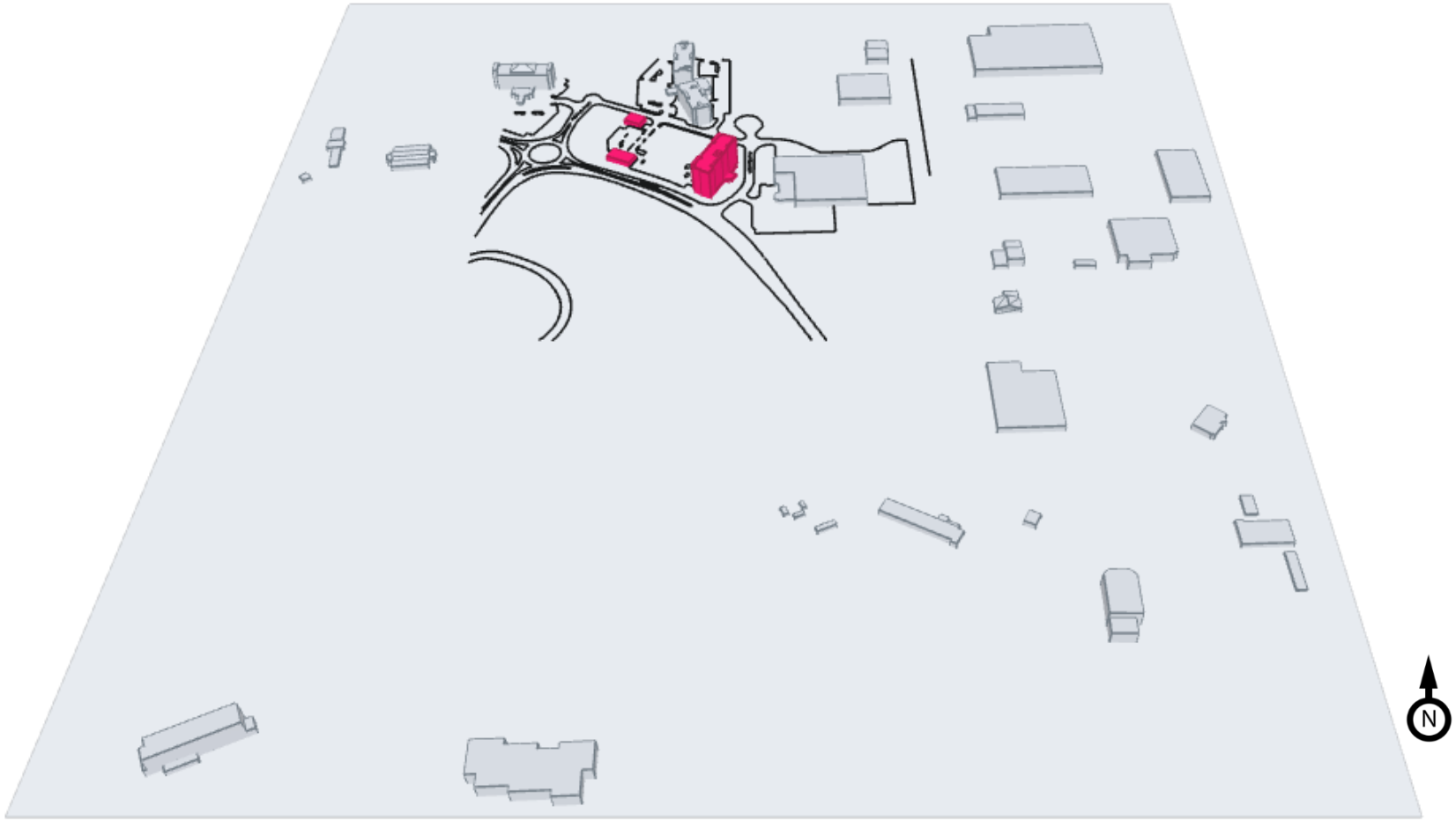
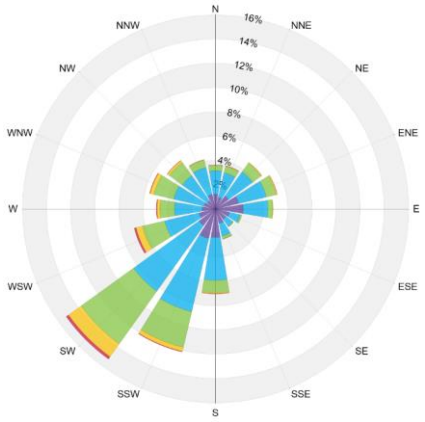


Image 5b: Computer Model of the Proposed Development and Existing Surroundings

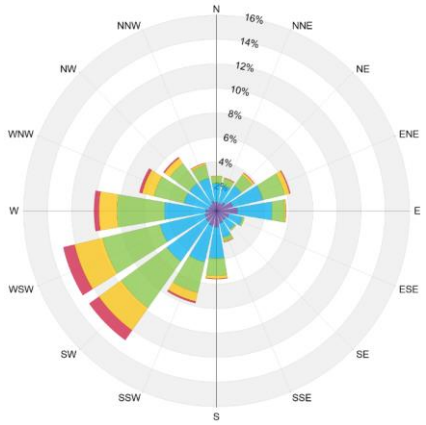
3. METEOROLOGICAL DATA

Wind statistics recorded at Niagara Falls International Airport between 1991and 2021, inclusive, were analyzed for the Summer (May through October) and Winter (November through April) seasons. Image 6 graphically depicts the directional distributions of wind frequencies and speeds for these two seasons.

Winds are predominately from the southwest direction throughout the year, with secondary winds from the northwest and northeast directions, 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) occur for 3.9% and 12.8% of the time during the summer and winter seasons, respectively, and they are primarily from the southwesterly direction.



Summer
(May through October)



Winter
(November through April)

Wind Speed (km/h)	Probability (%) Summer	Winter
Calm	10.4	5.9
1-10	23.4	16.1
11-20	42.6	36.3
21-30	19.7	28.9
31-40	3.3	9.8
>40	0.6	3.0

Image 6: Directional Distribution of Wind Approaching Niagara International Airport (1991 to 2021)

4. WIND CRITERIA

The criteria specified in the *Region of Niagara: Pedestrian Level Wind Study Terms of Reference* are used in the current study, as presented below. The criteria consider pedestrian comfort (pertaining to common wind speeds conducive to different levels of human activity) and safety (pertaining to infrequent but strong gusts that could affect a person's footing).

For the current development, wind speeds comfortable for walking are appropriate for sidewalks and walkways, lower wind speeds comfortable for standing are desired at entrances. Calm wind speeds suitable for sitting are desired on patio and roof terraces in the summer. Higher wind speeds may be considered appropriate for the outdoor areas in the winter, as such areas will get little to no use in the severe cold climate during the winter months in Niagara-on-the-Lake.

Comfort Category	Speed (km/h)	Description	Area of Application
Sitting	**≤ 10 at least 80% of the time**	**Light breezes desired for outdoor seating areas where one can read a paper without having it blown away.**	**Park benches, restaurant and café seating, balconies, amenity terraces, children's areas, etc. intended for relaxed, and usually seated activities.**
Standing	**≤ 15 at least 80% of the time**	**Gentle breezes suitable for passive pedestrian activities where a breeze may be tolerated**	**Main entrances, bus-stops, dog areas, and other outdoor areas where seated activities are not expected.**
Walking	**≤ 20 at least 80% of the time**	**Relatively high speeds that can be tolerated during intentional walking, running and other active movements.**	**Sidewalks, parking lots, alleyways and areas where pedestrian activity is primarily for walking.**
Uncomfortable	**> 20 more than 20% of the time**	**Strong winds, considered a nuisance for most activities.**	**Not acceptable in areas with pedestrian access**
Safety Criterion	**Gust (km/h)**	**Description**	**Area of Application**
Exceeded	**> 90 At least 0.1 % of the time (9 hours) in a year)**	**Excessive gusts that can adversely affect one's balance and footing. Wind mitigation is typically required.**	**Not acceptable in any area of interest**

5. RESULTS AND DISCUSSION

5.1 Wind Flow Around the Project

Wind generally tends to flow over buildings of uniform height or empty lands without disruption. Buildings that are taller than their surroundings tend to intercept and redirect winds around them. The mechanism in which winds are directed down the height of a building is called *Downwashing*. These flows subsequently move around exposed building corners, causing a localized increase in wind activity due to *Corner Acceleration*. When two buildings are situated side by side, wind flow tends to accelerate through the space between the buildings due to *channelling effect* caused by the gap. These flow patterns are schematically illustrated in Image 7.

The project, at 10 storeys, will be taller than the buildings that exist in the immediate surrounding area. Thus, it is expected to redirect winds to the ground level. The wind impact of the proposed project, however, would be localized and limited, due to the moderate building height.

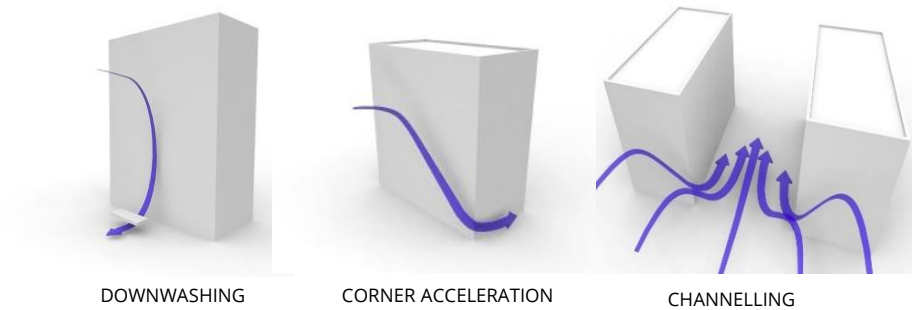


Image 7: General Wind Flow Patterns

5.2 Simulation Results

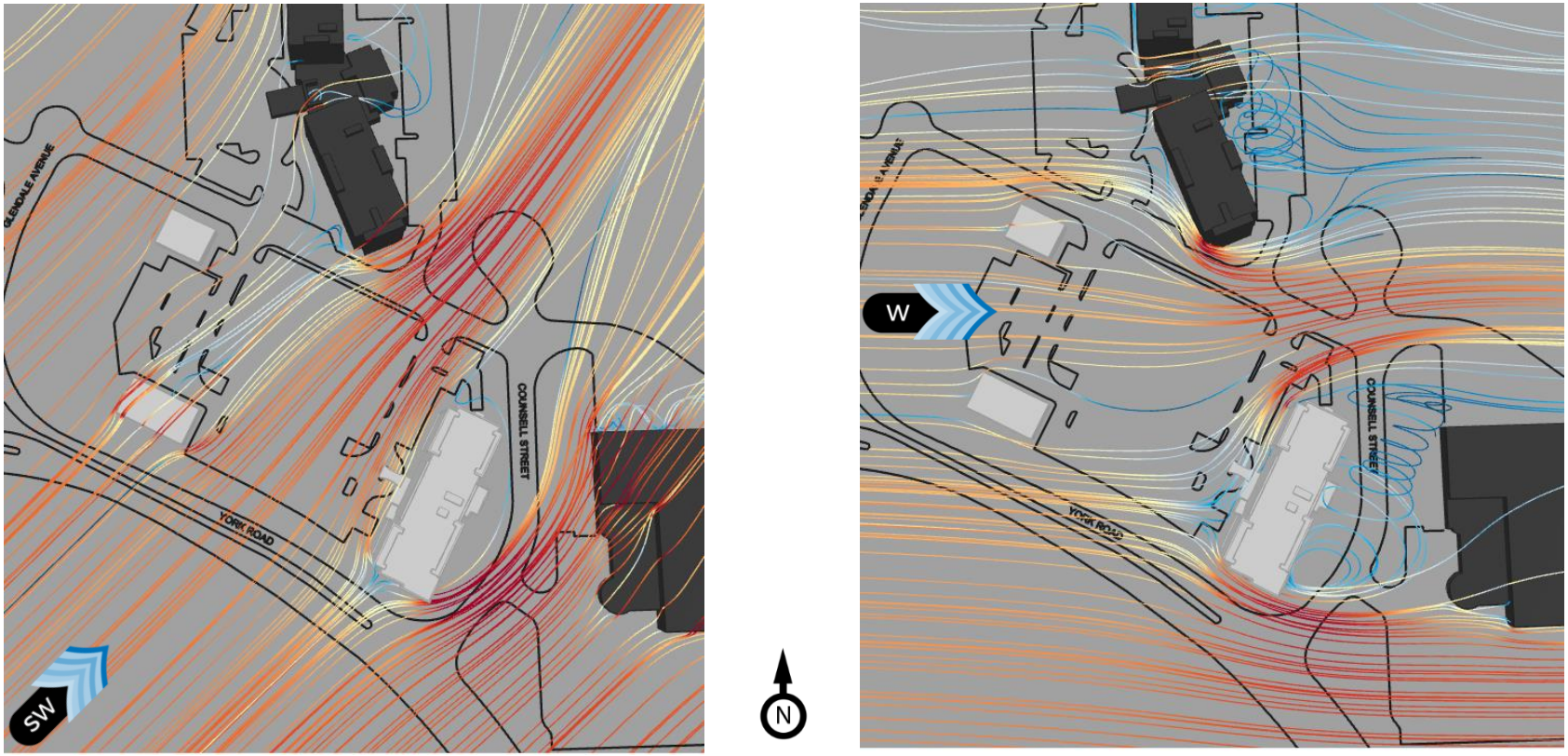
The proposed design has several positive features for wind control. For instance, the main entrance to the Hotel building is sheltered by a large canopy and a low building element to the south; and the entrances to the restaurant buildings and the patios for the Hotel and Restaurant A are located on the leeward side(s) of the buildings for the prevailing southwest and west winds. This is shown by the predicted wind flow streams in Image 8.

The predicted wind comfort conditions for the Existing and Proposed configurations are presented in Images 9 and 10 for the summer and winter seasons, respectively. The results are presented as colour contours of wind speeds calculated based on the wind criteria (Section 4). The contours represent wind speeds at a horizontal plane approximately 1.5 m above the ground level.

The assessment against the safety criterion (Section 4) was conducted qualitatively based on the predicted wind conditions and our extensive experience with wind tunnel assessments in the Niagara region.

A detailed discussion of the expected wind conditions with respect to the prescribed criteria and applicability of the results follows in Section 5.3. The discussion also includes recommendations for wind control to reduce the potential of high wind speeds for the design team's consideration.

5. RESULTS AND DISCUSSION



(a) Southwest Wind

(b) West Wind

Image 8: Wind Flow Pattern for the Prevailing Southwest and West Winds

5. RESULTS AND DISCUSSION

(a) EXISTING

(b) PROPOSED

COMFORT: SITTING | STANDING | WALKING | UNCOMFORTABLE

Entrance P: Patio

Image 9: Predicted Wind Conditions – SUMMER

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5. RESULTS AND DISCUSSION

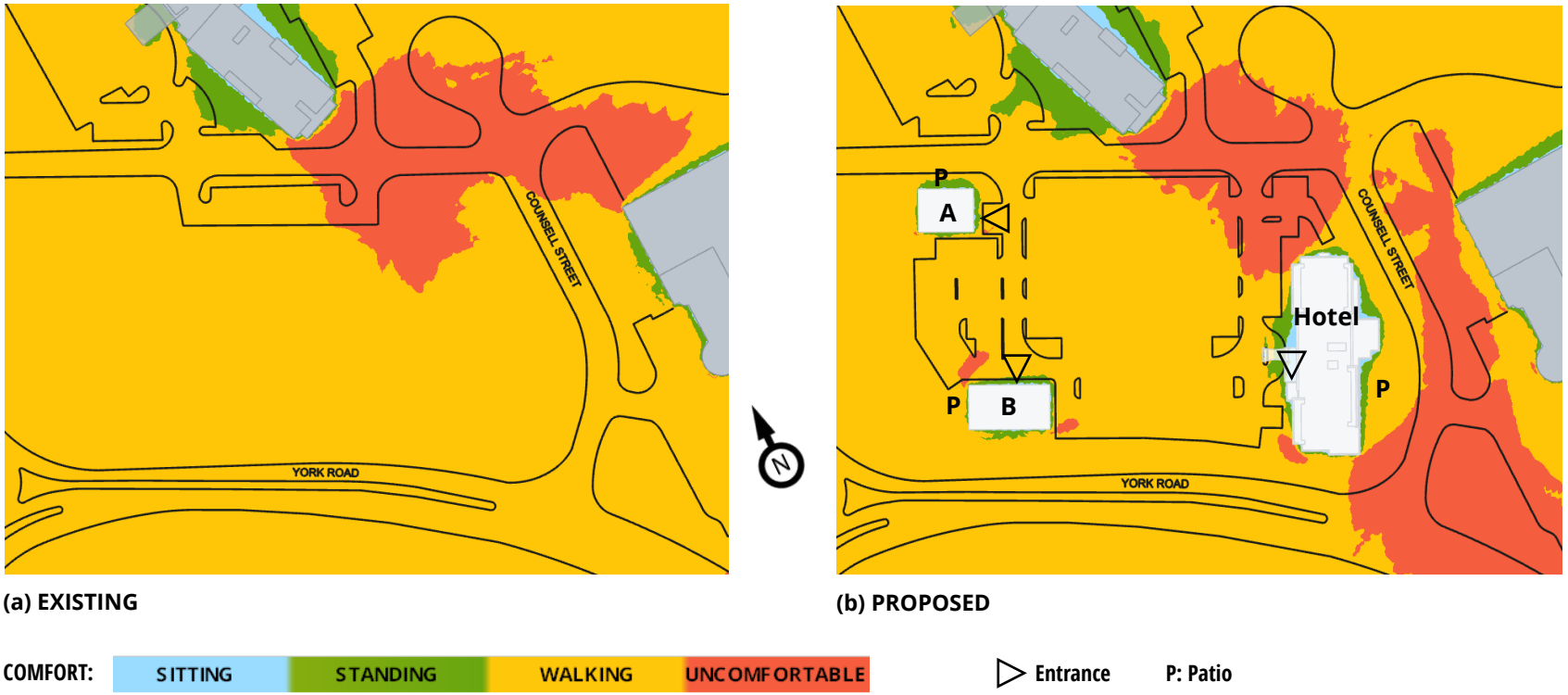

Image 10: Predicted Wind Conditions – WINTER

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5.3 Existing Scenario

The existing site is vacant and has relatively low surroundings. The prevailing southwesterly and westerly winds will flow uninterruptedly over the site. As a result, wind conditions at most areas on and around the existing site are comfortable for walking or standing in the summer (Image 9a) and for walking in the winter (Image 10b).

Uncomfortable wind conditions may occur in the winter around the existing hotel building to the north of the project site (red area in Image 10b), where wind safety exceedances may also occur in the same area.

5.4 Proposed Scenario

As mentioned in Sections 5.1 and 5.2, the proposed project benefits from the moderate building height and several wind-responsive design features. The proposed development is not expected to have a negative impact on wind conditions in the extended surrounding areas. While increased wind speeds are predicted around the exposed building corners, a slight decrease in wind speeds is expected in the perimeter the proposed buildings.

5.4.1 Sidewalks, walkways and parking lots

Wind conditions on the sidewalks, walkways and parking lots on and around the project site are generally expected to be comfortable for standing or walking in the summer (Image 9b) and for walking in the winter (Image 10b), which are suitable for the intended use.

Increased wind speeds are predicted around the northwest, southwest and southeast corners of the proposed hotel, resulting in uncomfortable wind conditions in the winter between the proposed hotel and the existing hotel to the north and along Counsell Street, especially at the intersection with York Road (Image 10b). This increase in wind speeds is mainly caused by the prevailing southwest and west winds downwashing off the proposed hotel and channelling along the gaps between the proposed and existing buildings (Image 8).

Wind speeds in these uncomfortable areas (Image 10b) may exceed the safety criterion.

Note that no existing or proposed trees were included in the current computer simulations, and they would help reduce wind speeds locally around them, especially in the summer. To extend the wind benefits of trees to the winter season, coniferous or marcescent trees should be considered as they will retain their foliage year-round. In addition, future developments in the surrounding areas to the southwest and west would further reduce the wind activity on and around the site.

5.4.2 Entrances

Due to the proposed large canopy and entrance location, wind conditions around the main entrance to the Hotel building are predicted to be comfortable for sitting or standing throughout the year and are considerable to be suitable for the use of a main entrance (Images 9b and 10b).

5.4 Proposed Scenario (continued)

5.4.2 Entrances

Suitable wind conditions are also predicted for the restaurant entrances in the summer (Image 9b), but slightly higher-than-desired wind speeds comfortable for walking are expected in the winter (Image 10b)

For improved wind conditions around the restaurant entrances, the design team may consider recessing the entrances into their respective facades, and/or adding planters or wind screens on both sides of the entrances. Examples are shown in Image 11.

5.4.3 Patio Areas

Low wind speeds comfortable for sitting or standing are desired for outdoor patios during the summer when these areas are typically in use. Wind conditions are predicted to be comfortable for standing on the patios of the Hotel and Restaurant A, and for walking on the more exposed patio of Restaurant B (Image 9b),

If desired, lower wind speeds can be achieved by screens or shrubs along the perimeters of the patios and trellises above these patios – see photos in Image 11 for examples.

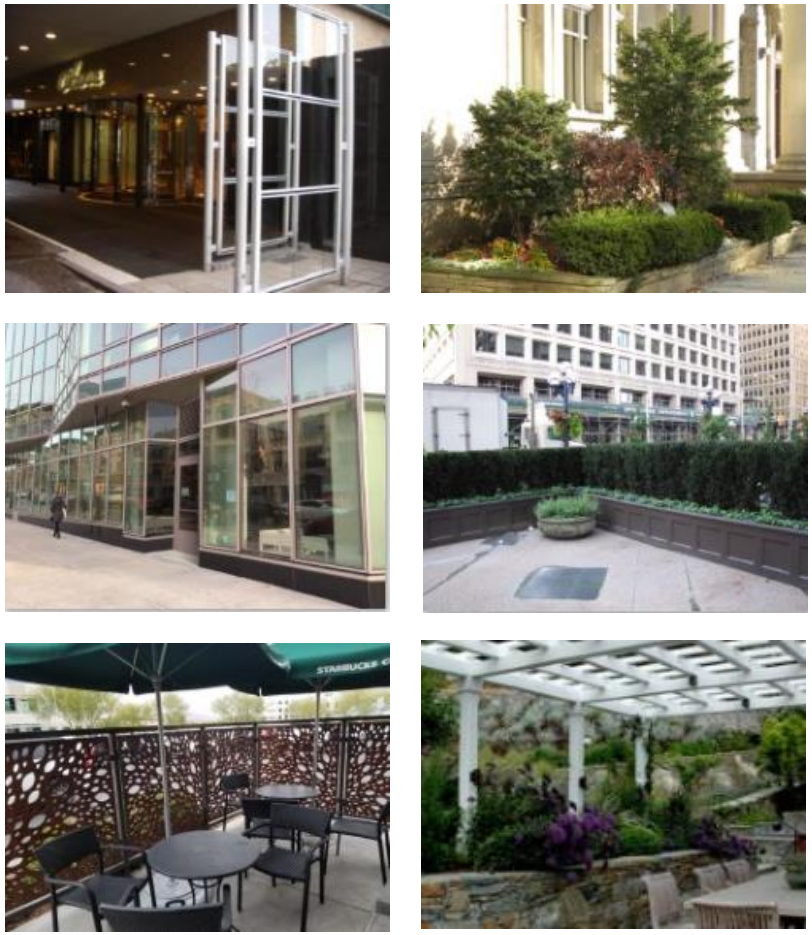

Image 11: Wind Control Measures for Outdoor Patios and Restaurant Entrances

6. SUMMARY

RWDI was retained to provide an assessment of the potential pedestrian level wind impact of the proposed hotel development at 542 York Road (Phase 2) in Niagara-on-the-Lake, ON. 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 wind criteria specified for the Region of Niagara. Our findings are summarized as follows:

- The existing wind conditions are suitable for active use for all areas in the summer and for most areas in the winter. Uncomfortable conditions and potential safety exceedances are expected to the north of the project site around the existing hotel building.
- The proposed buildings are expected to cause increased wind speeds, but any wind impact is expected to be local due to the moderate height of the hotel and several positive design features for wind control.
- Suitable wind conditions are predicted for most sidewalks, walkways and parking lots throughout the year. Uncomfortable wind conditions are expected in the winter between the proposed hotel building and the existing hotel to the north, as well as along Counsell Street, especially at the intersection with York Road. The gust speeds in these areas may exceed the wind safety criterion.
- Wind speeds are predicted to be suitable for the intended use of the main hotel entrance during both the summer and winter seasons and at the restaurant entrances in the summer.
- Higher-than-desired wind speeds are expected around the restaurant entrances in the winter and at all three outdoor patios in the summer. Conceptual wind control measures are discussed in the report. 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.

7. DESIGN ASSUMPTIONS

The findings/recommendations in this report are based on the building geometry and architectural drawings communicated to RWDI on December 5, 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)
24-012_524 York Road -Vrancor#2	Revit	12/5/2024
24-012_TPS & Fairfield Combo_NOTL_Site Plan	DWG	12/5/2024

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. 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.

8. STATEMENT OF LIMITATIONS

This report was prepared by Rowan Williams Davies & Irwin Inc. for Niagara York Road Inc. ("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.

9. 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.