REPORT

73 HUGHSON STREET NORTH

HAMILTON, ONTARIO

PEDESTRIAN WIND COMFORT ASSESSMENT

PROJECT #2302150
May 24, 2023

SUBMITTED TO

73 Hughson Project LP

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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 73 Hughson Street North in Hamilton, Ontario. The objective of this assessment is to provide an evaluation of the potential wind impact of the proposed development in preparation for an upcoming Site Plan Approval (SPA) application.

The project site is located west of Hughson Street N. between Wilson Street and Rebecca Street to the north and south, respectively, surrounded by low-rise suburban neighbourhoods to the north and east, and taller residential and office buildings to the south and west towards downtown Hamilton (Image 1).

The project will consist of a 30-storey mixed-use residential building on a 4-storey podium (Image 2). The proposed building is approximately 100 meters in height and contains 330 residential units, 412 square meters of retail space, and 3 levels of underground parking. The building will have a stepped form, which is favourable for reducing wind impacts. In addition to sidewalks and properties near the project site, key areas of interest for this assessment include the main entrances, and above-grade outdoor amenities on Level 7, 13, and the tower rooftop (Image 3).

Image 1: Aerial view of the existing site and surroundings
Source: Google Maps

Image 2: Conceptual massing of the proposed project

1. INTRODUCTION

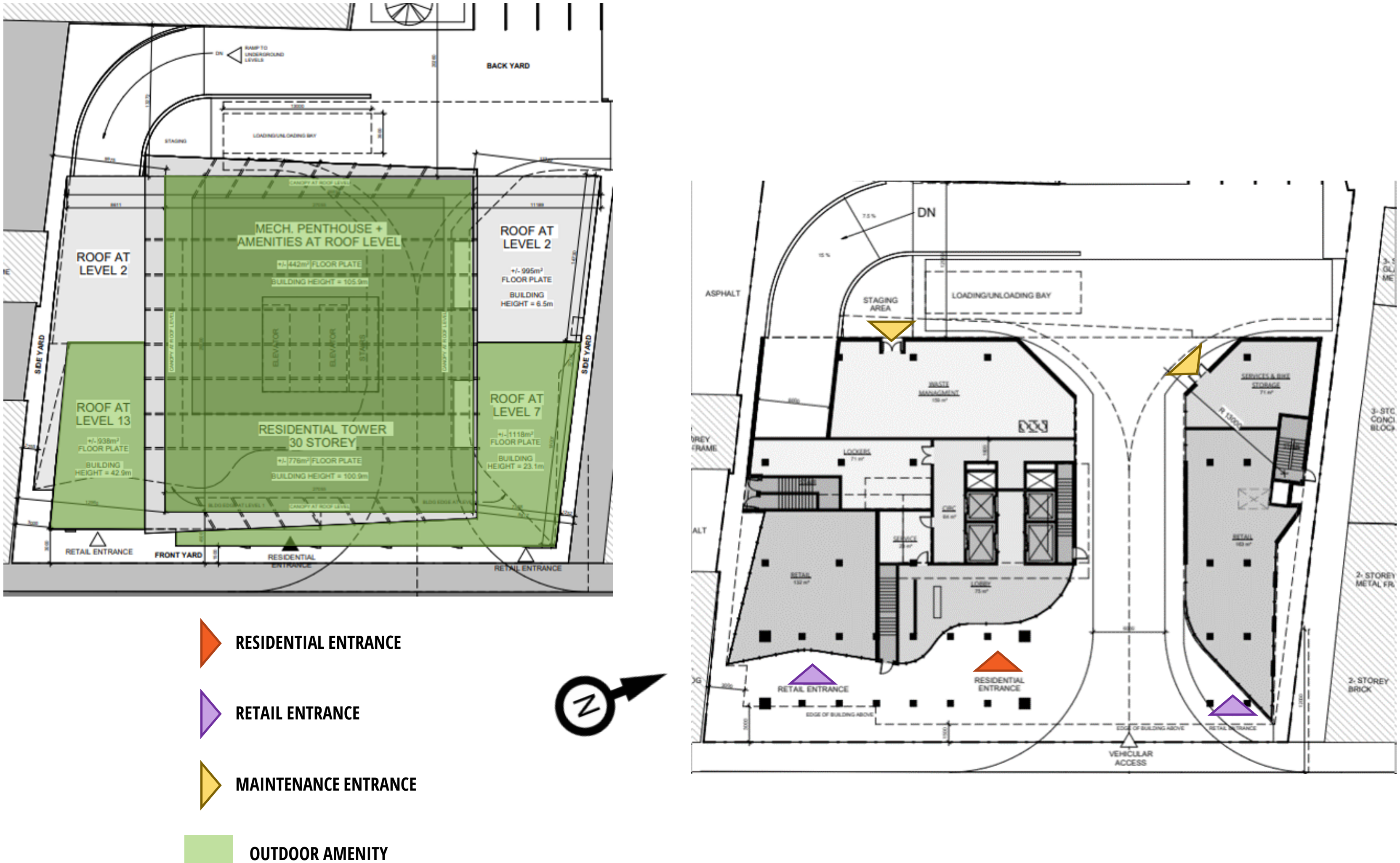


Image 3: Development site plan and ground floor plan identifying key outdoor areas of interest

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 John C. Munro Hamilton International Airport;
- 3D model and updated floorplans of the proposed project received on May 1, 2023;
- The use of *Orbital Stack*, an in-house CFD tool;
- Wind tunnel studies completed by RWDI for similar projects in Hamilton;
- RWDI's engineering judgment, experience, and expert knowledge of wind flows around buildings[1-3]; and,
- The RWDI pedestrian wind comfort and safety criteria.

2.2 CFD for Wind Simulation

CFD is a numerical technique that can be used for simulating wind flow in complex environments. For modelling winds around buildings, CFD techniques are used to generate a virtual wind tunnel where flows around the site, surroundings and the study building are simulated at full scale. The computational domain that covers the site and surroundings are divided into millions of small cells where calculations are performed, which allows for the "mapping" of wind conditions across the entire study domain. CFD excels as a tool for wind modelling and presentation for providing early design advice, comparing different design and site scenarios, resolving complex flow physics, and helping diagnose problematic wind conditions.

Gust conditions are infrequent but deserve special attention due to their potential impact on pedestrian safety. The computational modelling method used in the current assessment does not quantify the transient behaviour of the wind, including wind gusts. The effect of gust, i.e., wind safety, is predicted qualitatively in this assessment using analytical methods and wind-tunnel-based empirical models[1]. The assessment has been conducted by experienced microclimate specialists in order to provide an accurate prediction of wind conditions.

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

2. METHODOLOGY

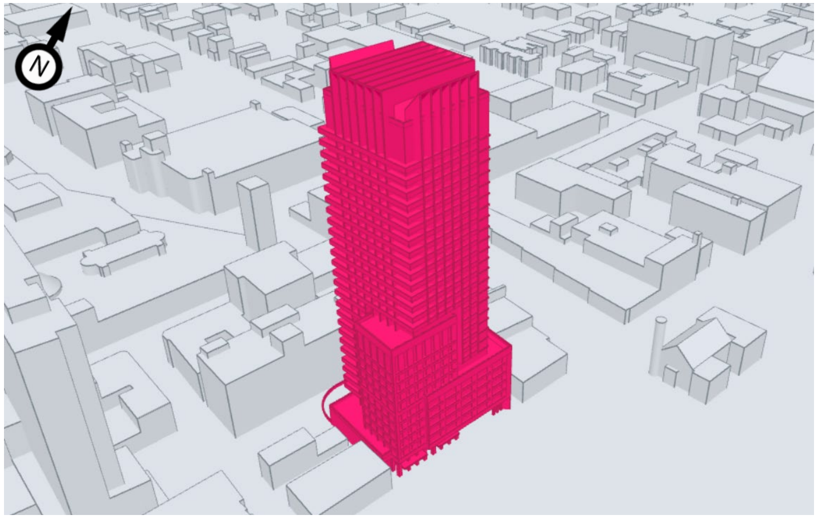
2.3 Simulation Model

CFD simulations were completed for two scenarios:

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

The computer models of the proposed building is shown in Image 4, and the Existing and Proposed scenarios with the proximity model are shown in Images 5 and 6, respectively. The 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).

Wind approaching the modelled area from 16 directions (starting at 0°, at 22.5° increments around the compass), were simulated, accounting for the effects of the atmospheric boundary layer and terrain impacts. Wind data in concerned areas 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 John C. Munro Hamilton International Airport to determine the wind speeds and frequencies in the areas of concern.



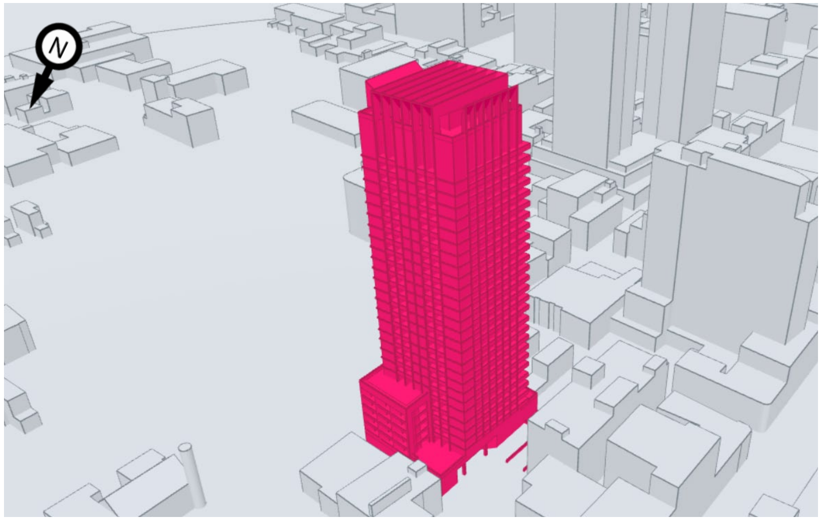


Image 4: Computer model of the proposed project

2. METHODOLOGY

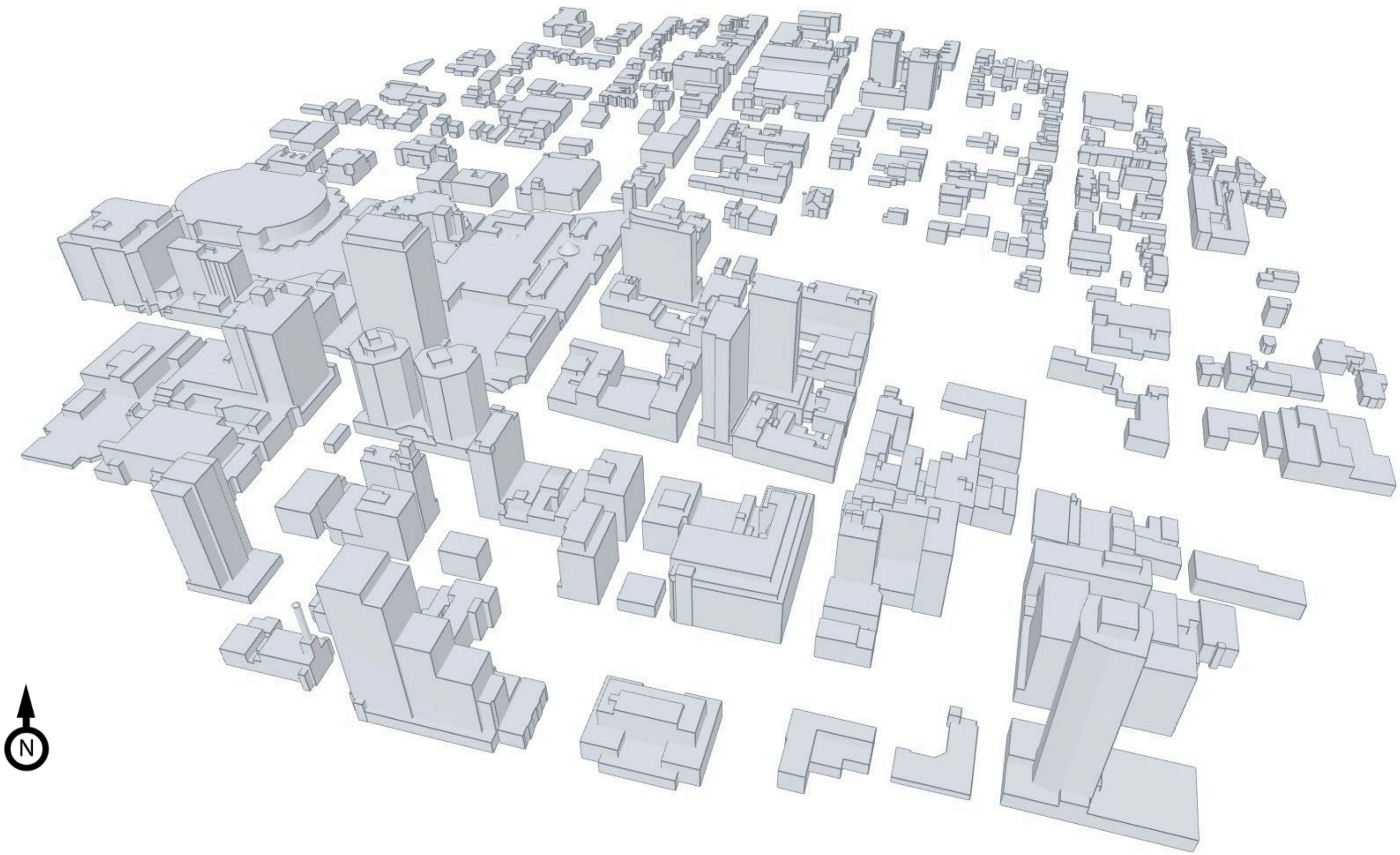


Image 5: Computer model of the existing site and extended surroundings

2. METHODOLOGY

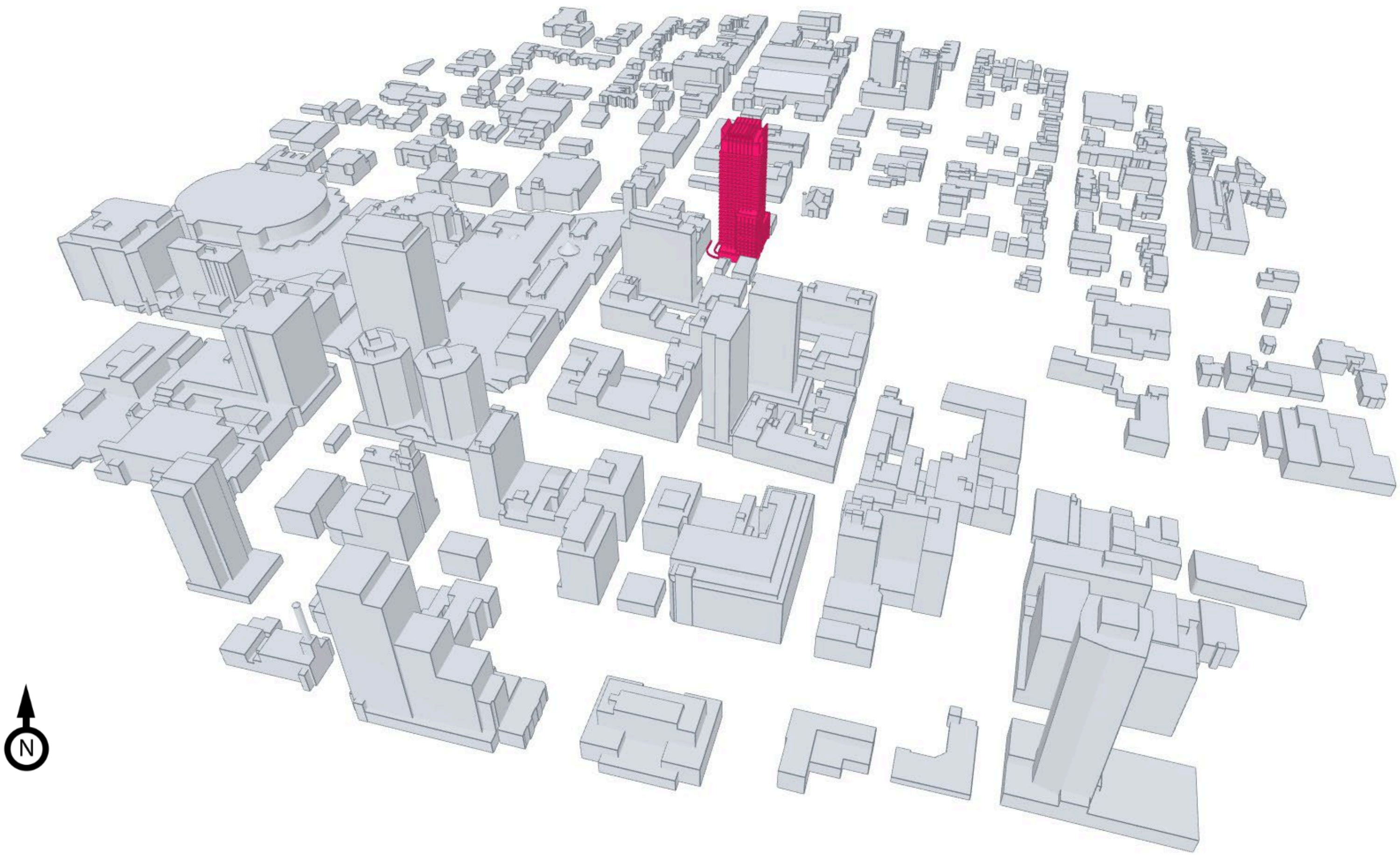


Image 6: Computer model of the proposed development with existing surroundings

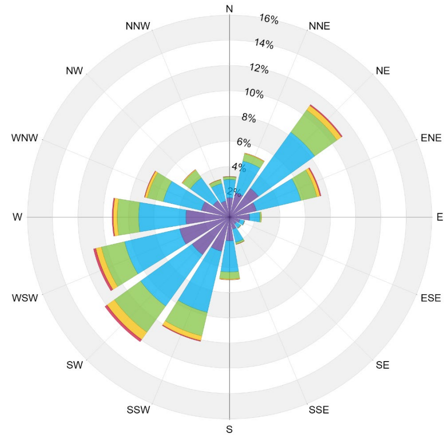
2. METHODOLOGY

Long-term wind data recorded at John C. Munro Hamilton International Airport between 1990 and 2020, inclusive, were analyzed for the summer (May to October) and winter (November to April) months. Image 7 graphically depicts the directional distributions of wind frequencies and speeds for these periods.

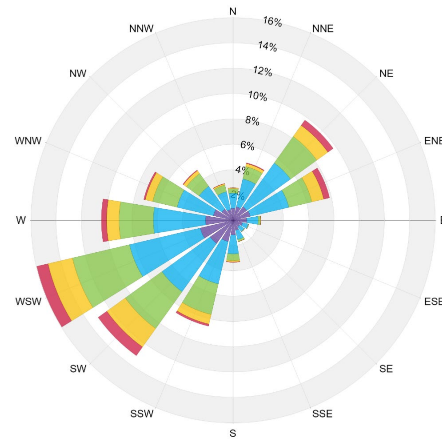
When all directions are considered, winds from the northeast and southwest are predominant in the both the summer and winter, as indicated by the wind roses.

Strong winds of a mean speed greater than 30 km/h measured at the airport (at an anemometer height of 10m) are more frequent in the winter (red and yellow bands in Image 7). 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)



Winter
(November through April)

Wind Speed (km/h)	Probability (%) Summer	Winter
Calm	3.8	2.2
1-10	33.7	21.8
11-20	43.2	39.5
21-30	15.5	23.9
31-40	3.0	9.1
>40	0.8	3.6

Image 7: Directional distribution of wind approaching John C. Munro Hamilton International Airport (1990 to 2020)

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 the balance and footing of a person. 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 Presentation of Results

The results of the assessment are presented and discussed in detail in Sections 4.3 and 4.4. 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 level. 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 areas where the criterion may be exceeded are indicated in Image 12. The discussion includes recommendations for wind control to reduce the potential for high wind speeds for the consideration of the design team.

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 outdoor amenity areas, seating areas etc., especially during the summer when these areas are typically in use.

4.2 Wind Flow around the Project

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*. Stepped massing, low roofs and canopies diffuse downwash and reduce the potential wind impact on the ground level. These flow patterns are illustrated in Image 8.

The project, at approximately 100m, will be taller most buildings that exist in the surrounding area. However, buildings of taller or similar height to the southwest are expected to shelter the project from prevailing southwesterly winds. The project is expected to redirect winds around it; however, potential wind impacts would be moderated by the shelter from nearby surrounding buildings, and positive features of the proposed massing design.

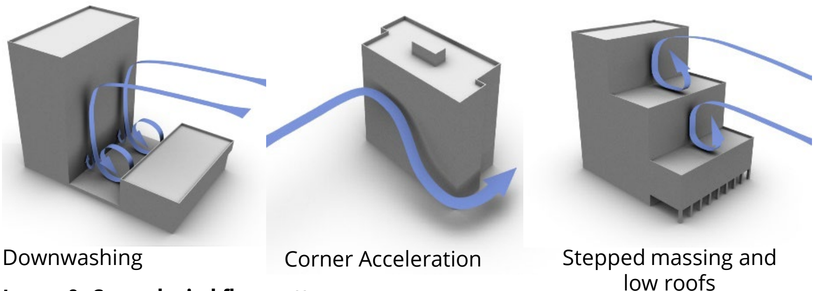


Image 8: General wind flow patterns

4. RESULTS AND DISCUSSION

4.3 Existing Scenario

The existing site consists of an open lot adjacent to low-rise neighbouring buildings. Wind speeds in the existing scenario are considered comfortable for sitting or standing in the summer (Image 9a) and for standing or strolling in the winter (Image 9b).

Wind conditions at all areas near the project site are expected to meet the safety criterion.

4.4 Proposed Scenario

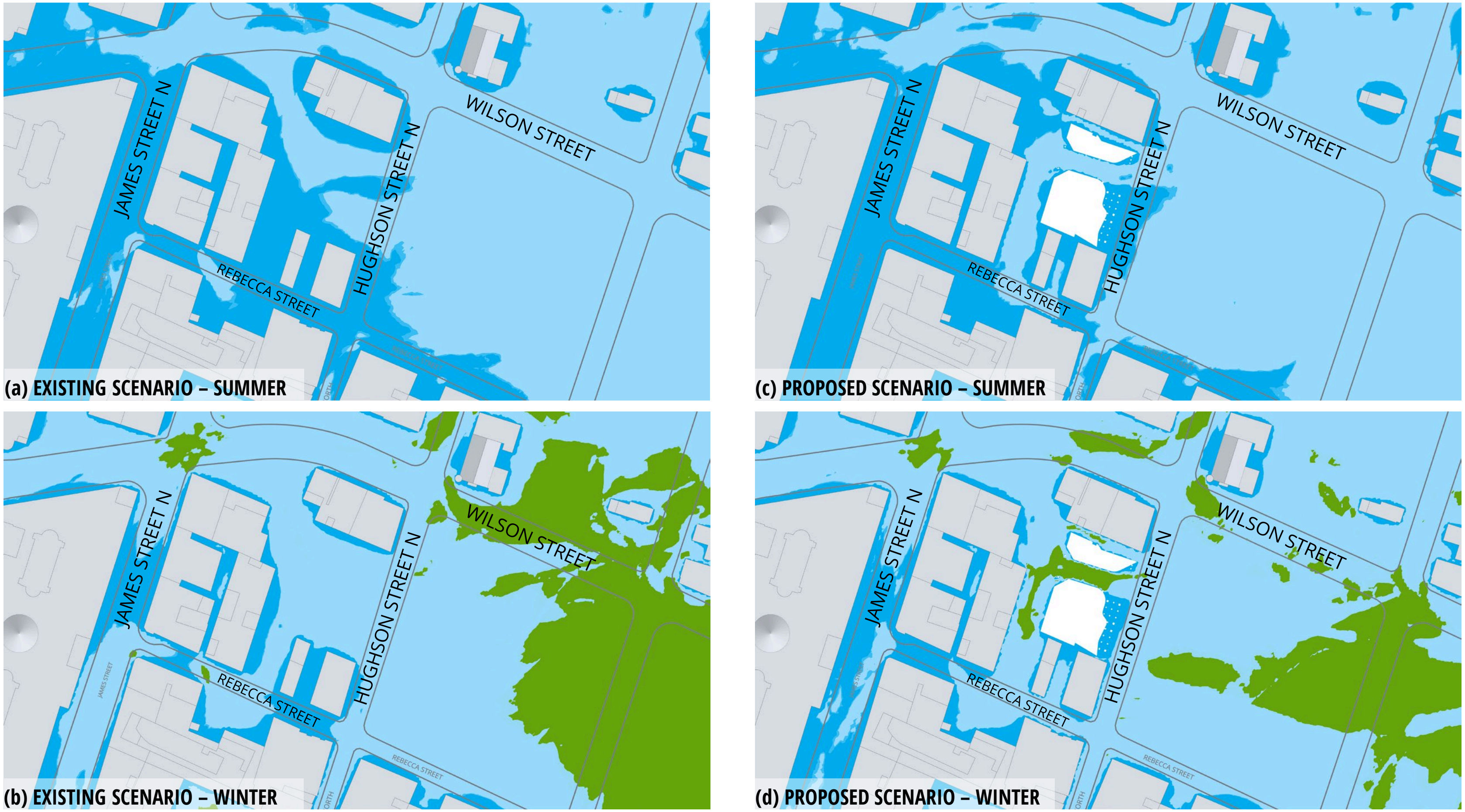
4.4.1 Sidewalks and Neighbouring Properties

Positively, elements of the proposed building massing, including the stepped massing, coarse façade detail, wide undercuts, and deep canopies, in conjunction with the dense surrounding buildings found in downtown Hamilton to the southwest, help to moderate the impact of wind speeds flowing around the proposed project building. As a result, wind speeds around the proposed project are predicted to meet the safety criterion.

Although the introduction of a relatively tall building in a low-rise context will result in a slight increase in wind speeds, the impact of the project will be limited to the site. The project is expected to improve wind conditions near neighbouring properties on Wilson Street, as the tall tower massing will diffuse prevailing winds from the southwest.

The resulting wind speeds at most sidewalks and areas outside the property are expected to continue to be comfortable for sitting or standing in the summer (Image 9c), and for standing or strolling in the winter (Image 9d). These conditions are appropriate for pedestrian use of the sidewalks.

4. RESULTS AND DISCUSSION



(a) EXISTING SCENARIO – SUMMER

(b) EXISTING SCENARIO – WINTER

(c) PROPOSED SCENARIO – SUMMER

(d) PROPOSED SCENARIO – WINTER

COMFORT: SITTING | STANDING | STROLLING | WALKING | UNCOMFORTABLE

SAFETY: The criterion will be met at all areas.

N

Image 9: Predicted wind conditions – GROUND LEVEL

4.4.2 Entrances

The main residential and commercial entrances are recessed from the Hughson Street sidewalk and are located under building canopies, mitigating the potential impact of downwashing wind flows. As a result, wind conditions winds along this façade are expected to be comfortable for sitting or standing in the summer and winter (Image 10). On the rear of the building, similar wind conditions are expected throughout the year (Image 11). Wind conditions at all entrances are considered appropriate for the intended operation.

RESIDENTIAL ENTRANCE

RETAIL ENTRANCE

MAINTENANCE ENTRANCE

COMFORT CATEGORIES

SITTING	STANDING	STROLLING	WALKING	UNCOMFORTABLE

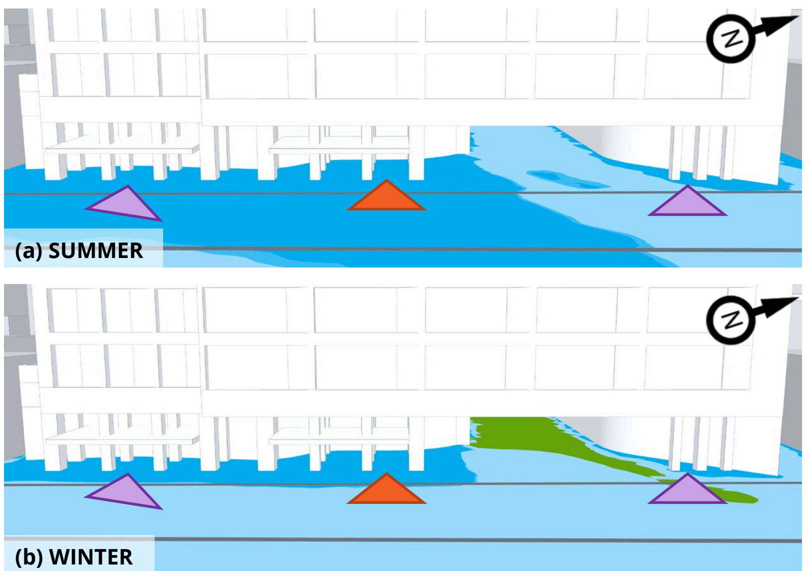


Image 10: Predicted wind conditions – HUGHSON STREET ENTRANCES

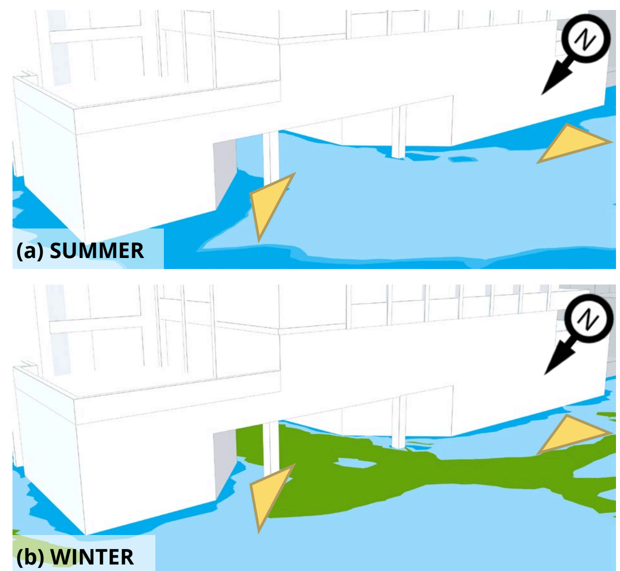


Image 11: Predicted wind conditions – REAR MAINTENANCE ENTRANCES

4.4.3 Above-Grade Outdoor Amenities

Wind speed increases with elevation; the Level 7 amenity would be exposed to northeasterly prevailing winds, the Level 13 amenity would be exposed to southwesterly prevailing winds, and the Rooftop amenity would be exposed to a combination of prevailing winds, all due to the elevation of each amenity above the nearby surroundings (Image 12). As such, conditions on these amenities are expected to be too windy for passive use without the use of wind control measures. High wind speeds in the winter may be acceptable as the area will likely not be occupied frequently in the cold months, however, the uncomfortable conditions and potentially unsafe wind speeds expected on the Level 13 and Rooftop amenities will require mitigation measures to alleviate concerns.

We encourage the design team to consider features like tall parapets and wind screens (minimum 1.8 m in height), tall planters and trees with underplanting, and trellises on the lower two terraces to reduce wind speeds in the summer. These features, when placed along the perimeter of the amenities, will help reduce the exposure to prevailing winds and diffuse the impact of downwashing flows. In addition, features like wind screens may be interspersed throughout the terrace or used to surround designated seating areas. Some examples of wind control features are shown in Image 13. RWDI can guide the selection and placement of such features for wind control as the design advances.

COMFORT CATEGORIES

SITTING	STANDING	STROLLING	WALKING	UNCOMFORTABLE

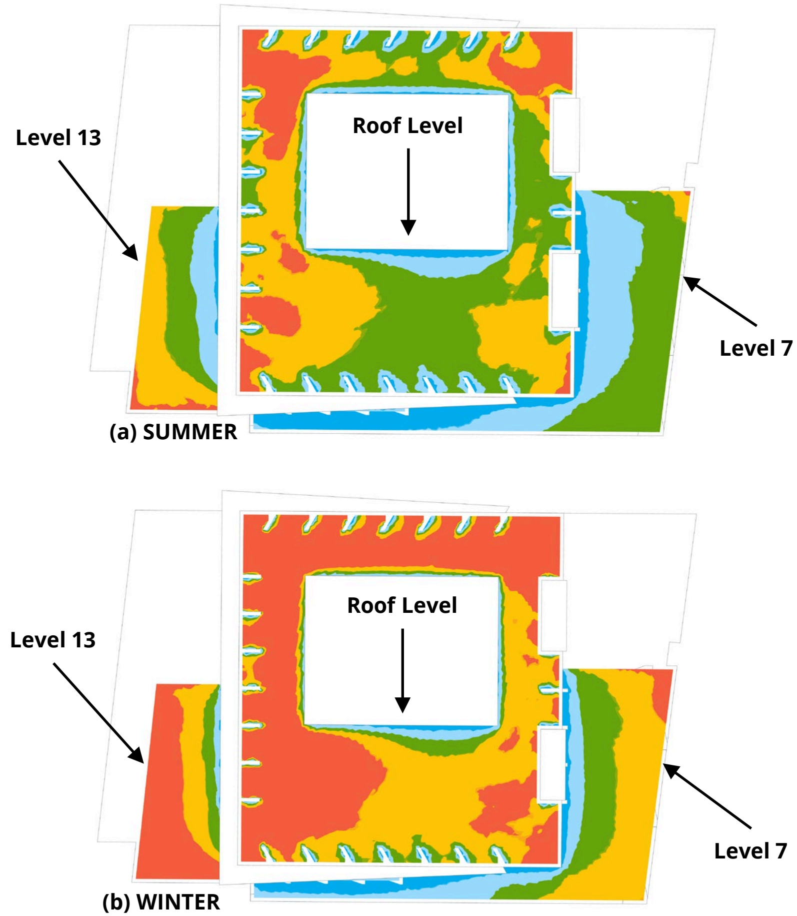


Image 12: Predicted wind conditions – ABOVE-GRADE OUTDOOR AMENITIES

4. RESULTS AND DISCUSSION

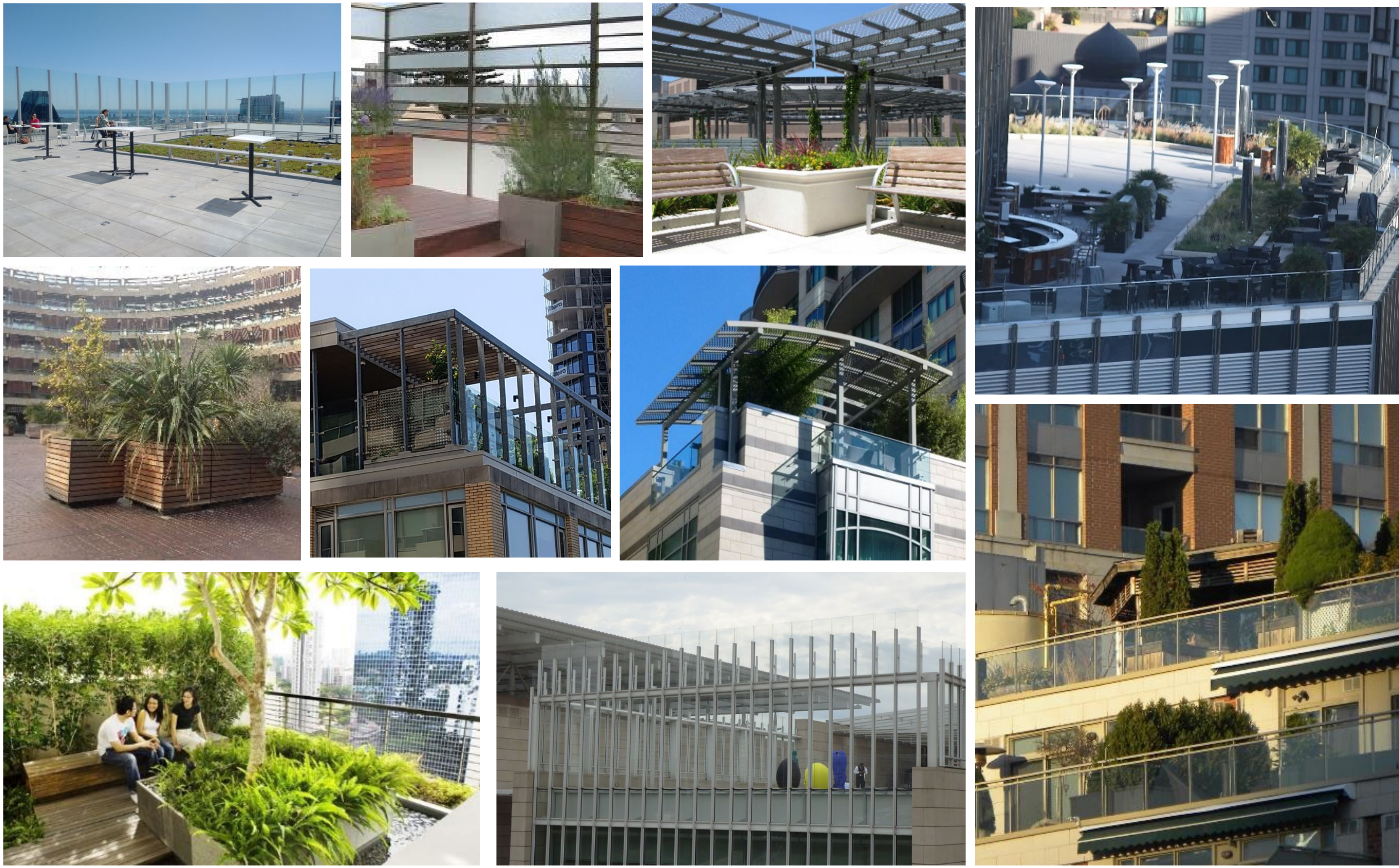


Image 13: Design strategies for wind control on terraces

5. SUMMARY

RWDI was retained to provide an assessment of the potential pedestrian level wind impact of the proposed project at 73 Hughson Street North in Hamilton, 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:

- Wind conditions are suitable for the intended pedestrian use, meeting the pedestrian safety criterion across the existing site throughout the year.
- The proposed building is taller than its surroundings, and therefore will redirect wind to ground level. However, several positive features in the massing design and proximity to surrounding buildings will help moderate wind impacts to a large extent.
- Wind conditions at ground level, including the surrounding sidewalks, and residential, retail, and maintenance entrances are expected to be appropriate for the intended usage through the year.
- Wind speeds on the above-grade outdoor amenity levels are predicted to be higher-than-desired for passive patron use in most areas throughout the year. Wind control strategies have been provided.
- Wind speeds are expected to meet the pedestrian safety criterion for all areas assessed in the Proposed scenario. However, areas on the Level 13 and the Rooftop outdoor amenity level could potentially exceed the safety criterion.

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. Wind tunnel testing should be conducted in later design stages to quantify the predicted wind conditions and refine the efficacy of potential wind control features.

6. DESIGN ASSUMPTIONS

The findings/recommendations in this report are based on the building geometry and architectural drawings communicated to RWDI in May 2023, 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)
73 Hughson_3DCAD_20230501	DWG	05/01/2023
23007 - 73 Hughson St N_Updated Concept Design Package_230428	PDF	05/01/2023
23007 - 73 Hughson St N_AFS_v22_ Floor Plan-Sheet - A1 - SITE PLAN	DWG	05/01/2023

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 73 Hughson Project LP ("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.

7. 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.