53-71 Plains Road East

Burlington, Ontario

Pedestrian Wind Assessment

RWDI # 1700434
December 18, 2017

SUBMITTED TO

Marko A. Juricic
Brooklyn Contracting Inc.
3245 Harvester Rd., Unit #14,
Burlington ON., L7N 3T7
marko@brooklyncontract.com

SUBMITTED BY

Rowan Williams Davies & Irwin Inc.
600 Southgate Drive
Guelph, Ontario N1G 4P6
519.823.1311

Neetha Vasan, M.A.Sc., LEED AP
Technical Co-ordinator
neetha.vasan@rwdi.com

Hanqing Wu, Ph.D., P.Eng.
Senior technical Director / Principal
hanqing.wu@rwdi.com

Dan Bacon
Associate / Senior Project Manager
dan.bacon@rwdi.com



This document is intended for the sole use of the party to whom it is addressed and may contain information that is privileged and/or confidential. If you have received this in error, please notify us immediately.

® RWDI name and logo are registered trademarks in Canada and the United States of America

1. INTRODUCTION

Rowan Williams Davies & Irwin Inc. (RWDI) was retained by Bellacor Design to assess the wind effects at pedestrian areas around the proposed development at 53-71 Plains Road East in Burlington, Ontario. This report has been prepared to meet the requirements set by the City of Burlington regarding the Official Plan Amendment and Rezoning application for the site. The objective of the current assessment is to provide a qualitative evaluation of pedestrian wind comfort conditions around updated design of the proposed development. This qualitative assessment is based on:

- a review of regional long-term meteorological data for Burlington;
- design drawings received from srm Architects Inc. on December 8, 2017;
- our engineering judgement and knowledge of wind flows around buildings [1] [2] [3];
- our experience with wind tunnel modelling of buildings with similar geometries as the proposed development, and projects in the Burlington area[1][3]; and,
- the use of software developed by RWDI (*WindEstimator*[2]) for estimating the potential wind comfort conditions around generalized building forms.

This approach provides a screening-level estimation of potential wind impact on and around the proposed development. To quantify these conditions or refine any conceptual mitigation measures, physical scale model tests would be required.

Other wind issues associated with wind loads, door operability or air quality are not considered within the scope of this assessment.



Image 1 - Aerial View of Development Site
(*Photo Courtesy of Google™ Earth)*

[1] 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.
[2] 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.
[3] 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.

2. SITE AND BUILDING INFORMATION

The proposed site is located in the block bound by Plains Rd E, Cooke Blvd, Masonry Ct and Clearview Ave in Burlington, Ontario (Image 1). Currently, part of the site is occupied by a one-storey commercial building and a large parking lot, and the remainder is undeveloped land (see Image 1). The development site is surrounded by low commercial and residential buildings and parking lots within a 1 km radius of the site. Similar terrain extends farther to the northeast and southwest and Lake Ontario is about 1 km to the east. The terrain beyond the immediate vicinity to the west and northwest is primarily undeveloped land, farms and nature reserves. The Niagara Escarpment sloped up towards the west and is about 2 km from the site.

Hereafter references to buildings and surroundings will be based on "Project North" which is parallel to Cooke Blvd, and about 50° off "True North" (see Images 1 and 2).

The proposed project consists of two buildings (12 and 10 storeys tall) (Image 2). The ground floor comprises of retail spaces and townhouse along Cooke Blvd and Plains Rd E. Upper levels consist of residential units, with an outdoor amenity space on Level 2 between the towers. Apart from the elevated amenity space, main outdoor pedestrian areas include building entrances and sidewalks along Plains Rd, Cooke Blvd and Clearview Ave and bus-stops on Plains Rd.

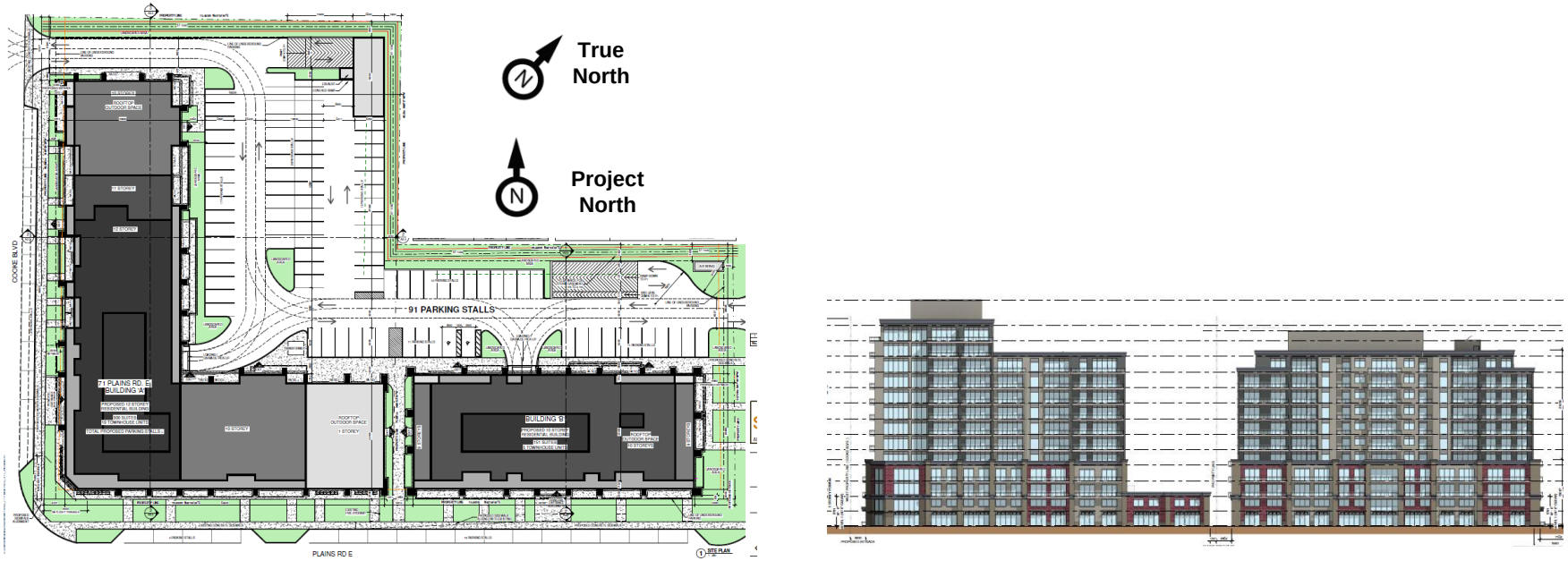


Image 2 – Site Plan (left) and South Elevation (right)

3. METEOROLOGICAL DATA

Long-term wind statistics recorded at the Burlington Piers meteorological station and Hamilton International Airport were analyzed to determine the local wind climate. Similar wind directionality was observed for these stations as depicted in Figures 3a and 3b. While Burlington Piers is closer to the project site (approx. 5 km) when compared to Hamilton International Airport (approx. 17 km) the wind speeds measured at Burlington Piers appear to be considerably lower than those measured at the airport. In order for a conservative assessment, meteorological data from Hamilton International Airport has therefore been used as a reference for wind conditions at the proposed site.

The distributions of wind frequency and directionality for the summer (May through October) and winter (November through April) seasons are shown in Image 3. Winds are frequent from the southwest through west, northeast and east-northeast in both seasons. Strong winds of a mean speed greater than 30 km/h measured at the airport (at an anemometer height of 10m) occur more often in the winter than in the summer. Winds from these directions could potentially be the source of uncomfortable or even sever wind conditions, depending upon the site exposure or development design. The analysis methods have accounted for these and all winds directions.

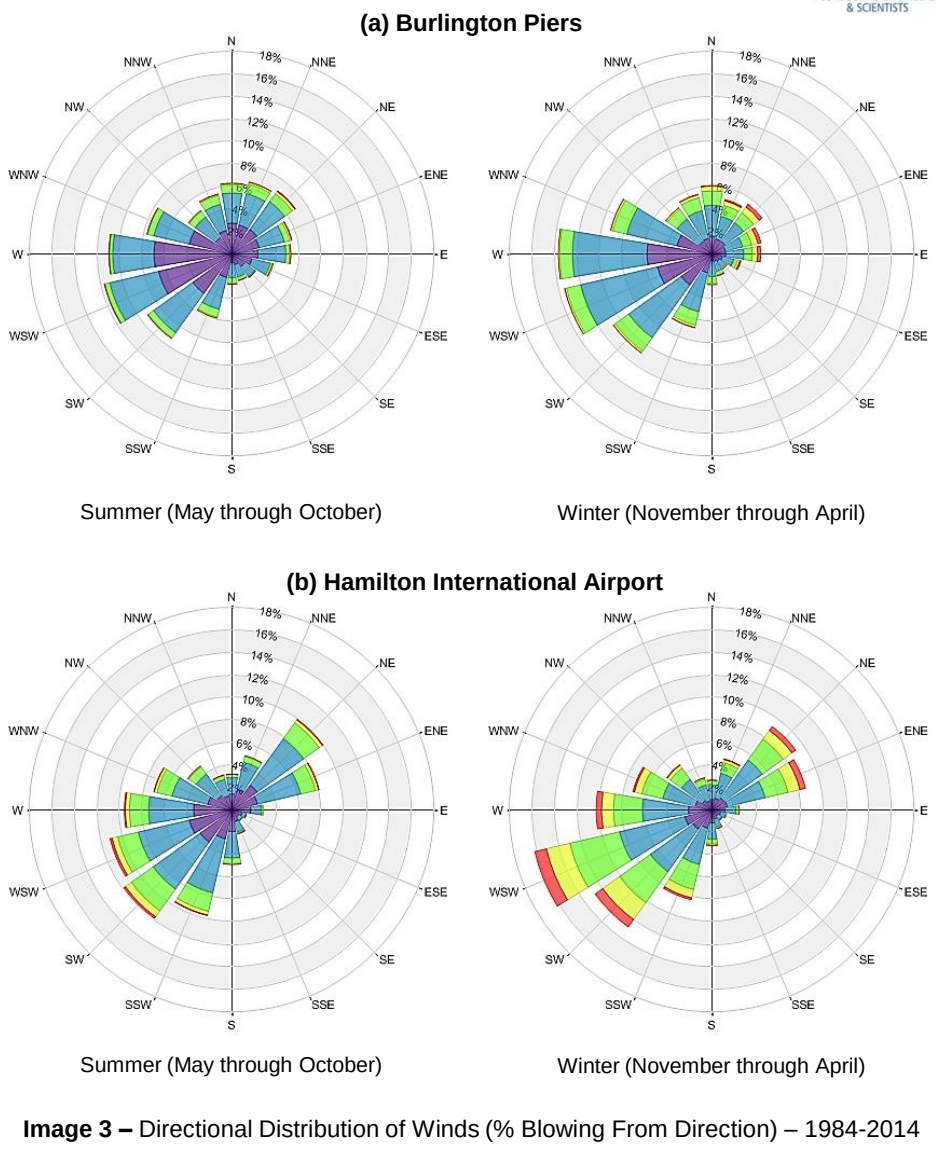


Image 3 – Directional Distribution of Winds (% Blowing From Direction) – 1984-2014

4. PEDESTRIAN WIND CRITERIA

The RWDI wind comfort criteria deal with both pedestrian safety and comfort, as they relate to the force of the wind. These criteria have been developed by RWDI through research and consulting practice since 1974, and have been published in numerous academic journals. They have also been widely accepted by municipal authorities as well as by the building design and city planning community.

Safety: Pedestrian safety is linked to excessive gust wind speeds that can adversely affect a pedestrian's balance and footing. If strong winds that can affect a person's balance occur more than 0.1% of the time or 9 hours per year, the wind conditions are considered severe.

Comfort: Wind conditions are considered suitable for sitting, standing, strolling or walking if the wind speeds corresponding to the respective categories are expected for at least four out of five days (80% of the time).

Sitting: Calm or light breezes desired for outdoor seating areas where one can read a paper without having it blown away.

Standing: Gentle breezes suitable for main building entrances and bus stops.

Strolling: Moderate winds that would be appropriate for window shopping and strolling along a downtown street, plaza or park.

Walking: Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering.

Uncomfortable: None of the comfort categories are satisfied.

Wind control measures are typically required at locations where winds exceed the wind safety criterion or are rated 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.

5. ASSESSMENT OF WIND CONDITIONS

5.1 Background

Predicting wind speeds and occurrence frequencies is complicated, involving the 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. This knowledge has been incorporated into RWDI's proprietary software (*WindEstimator*) that allows in many situations for a qualitative, screening-level numerical estimation of pedestrian wind conditions without wind tunnel testing.

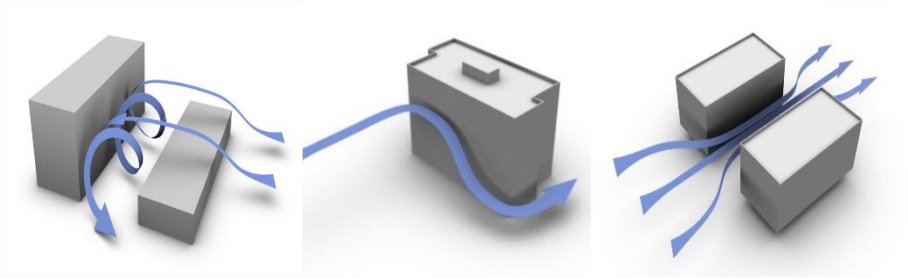
Generally, wind conditions suitable for walking or strolling are appropriate for sidewalks and parking lots; lower wind speeds comfortable for standing are preferred at major building entrances and bus-stops where people are likely to wait. On outdoor terraces and amenity spaces, it is generally desirable for wind conditions to be comfortable for sitting in the summer when these areas are in regular use. During the winter, these areas would not be used as frequently and increased wind activity would be considered appropriate.

5.2 Wind Conditions – Existing

The site is currently occupied by a parking lot and a one-storey building. Wind conditions on the site and along adjacent sidewalks are likely comfortable for standing or strolling in the summer and for strolling or walking in the winter. These conditions are appropriate for the intended use of the sidewalks and bus-stops.

5.3 Wind Conditions – Future

The proposed building is taller than surrounding buildings, which are primarily one or two-storeys tall. Buildings taller than their surroundings tend to intercept stronger winds found at higher elevations and redirect these flows to grade (see Image 4a). Such *downwashing flows* may subsequently accelerate around building corners (see Image 4b) or *channel* through gaps between closely spaced towers (Image 4c). Such *Downwashing* and *Channelling Flows are* often the main cause for wind accelerations around taller buildings at pedestrian level. The general wind flow pattern around the building is shown in Image 5.



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

Image 4 – Generic Wind Flow Pattern Types

5.3.1. Sidewalks and Parking Lots

Although taller than the surroundings, given the moderate height of the project, its impact on wind conditions around it would be limited. It is predicted that winds would accelerate around the building corners on Plains Rd E and Cooke Blvd (Image 5), resulting in conditions that would be of a strolling rating in the summer and walking rating in the winter along the two streets near the project. Occasionally, on windy days, wind speeds at the corners may become uncomfortable for walking in the winter.

The north side of the building (the concave vertex of the L-shaped layout), the passageway between the buildings and the east side would be protected from the predominant southwest winds by the building. Wind conditions in the parking area and sidewalks on Clearview Ave are expected to be comfortable for standing in the summer and strolling in the winter. Similar conditions are expected at the bus-stops to the east and south on Plains Rd E.

Winds from the northeast are common, but not as frequent as the south-westerly winds. When winds are from the northeast, conditions in areas to the east of the project would not be affected much in the summer, but speeds will be slightly higher and comfortable for strolling or walking in the winter. However, it is to be noted that wind conditions after the completion of the project are expected to be similar to those experienced around the existing site. Therefore the predicted wind conditions may be acceptable at all areas including the bus-stops.

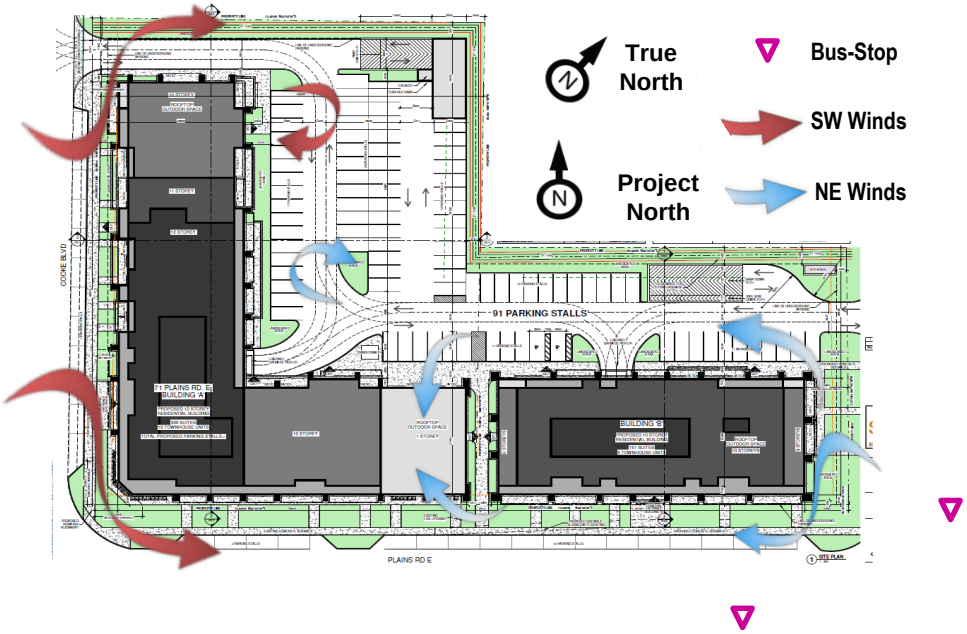


Image 5 – Expected Wind Flow Pattern around the Proposed Project

5.3 Wind Conditions – Future

5.3.2 Entrances

Image 6 shows the ground level floor plan of the proposed project. The entrances to the retail spaces are along Plains Road. Most townhouse entrances are recessed from the main façade, except those at the northeast corner of the project. The main residential lobby entrance on Cooke Blvd is recessed, but the other on Plains Road is not. Both are designed with vestibules and lobbies.

The recess of the western townhouse entrances and the main lobby entrance on Cooke Blvd is a positive feature. It allows the entrances to be protected by the enveloping massing on the sides and above. Other townhouse and retail entrances and the lobby entrance on Plains Road are largely protected by the building massing from the prevailing southwesterly winds. Wind conditions at all the residential entrances are expected to be appropriate for pedestrian use. However, when winds are from the northeast, conditions may be slightly windier at the townhouse entrances at the northeast corner of the project.

The retail entrance at the corner of Plains Road and Cooke Blvd. is more exposed to the prevailing winds and would be windier than desired for idling pedestrians. We understand that this area of Burlington is well covered by large and dense trees along the sidewalks. Deciduous trees are beneficial in reducing wind speeds at grade level during the summer. During the winter, when the trees are bare, they are not effective against wind.

The proposed canopy wrapping around the southwest corner above the entrance (see image on the cover page) is a positive feature for wind protection. Other potential wind mitigation measures may involve installing wind screens on both sides of the entrance or recessing the entrance, similar to the townhouse entrances on Cooke Blvd. Examples of wind control measures at the corner entrance are shown in Image 8a.

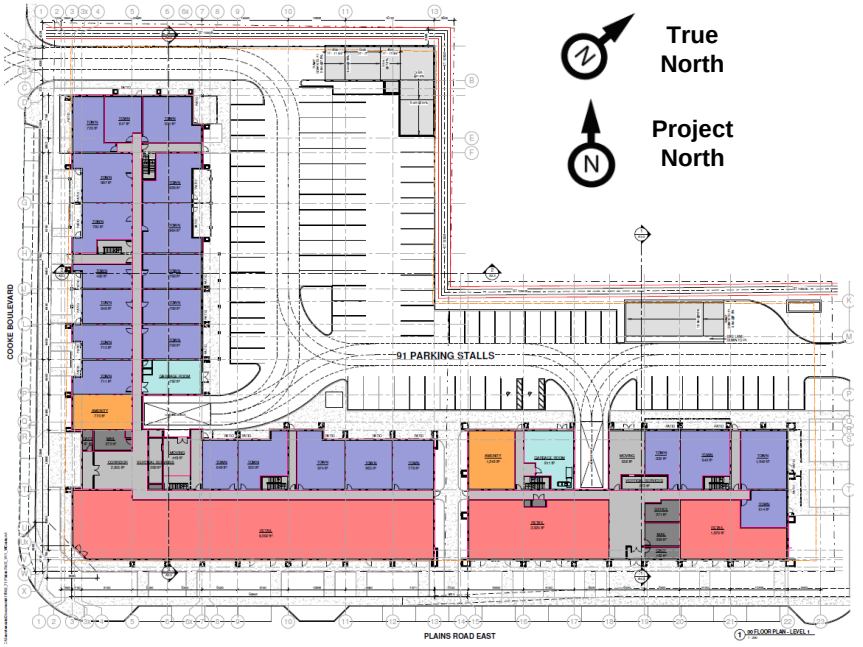


Image 6 – Ground Floor Plan

5.3 Wind Conditions – Future

5.3.3 Level 2 Outdoor Amenity

The location of the amenity terrace between the two towers is indicated on Images 5 and 7. The terrace is largely sheltered for the northeasterly and southwesterly winds by the towers. However, the area will be windier than desired from time to time due to winds redirected by the west tower and channelled between the two towers (Images 4c and 5).

Any tall and dense landscaping proposed on the terrace would reduce potential wind effects in the summer when the terrace would be in use. Canopies and trellises may be placed over activity areas, particularly on the north half of the terrace, to provide protection from winds downwashing off of the east façade of the west tower (Image 4a). It is also recommended that a 2 m or taller guardrails or dense landscaping of an equal height be considered along the north and south exposed edges of the terrace. Note that deciduous species will be effective only in the warmer months as described in Section 5.3.2; this may be acceptable as the terrace is unlikely to be used in the cold winter.

Examples of wind control measures on terraces are shown in Image 8b.

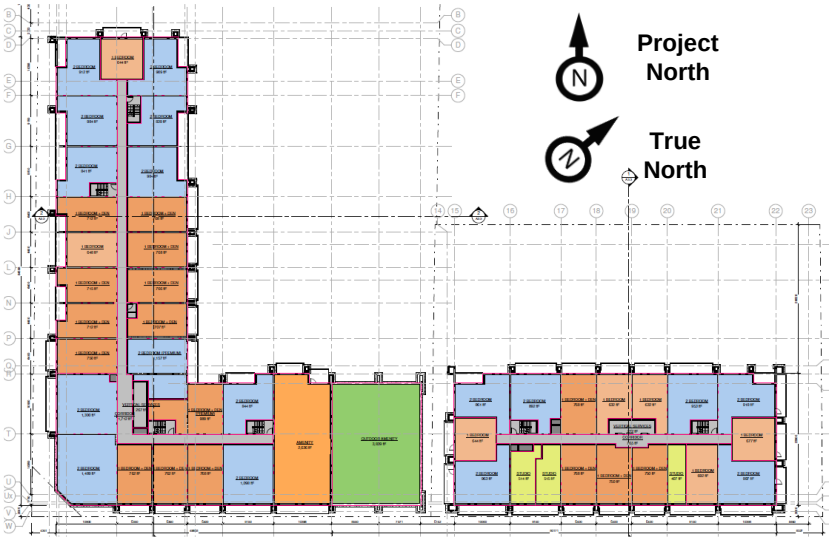


Image 7 – Level 2 Floor Plan

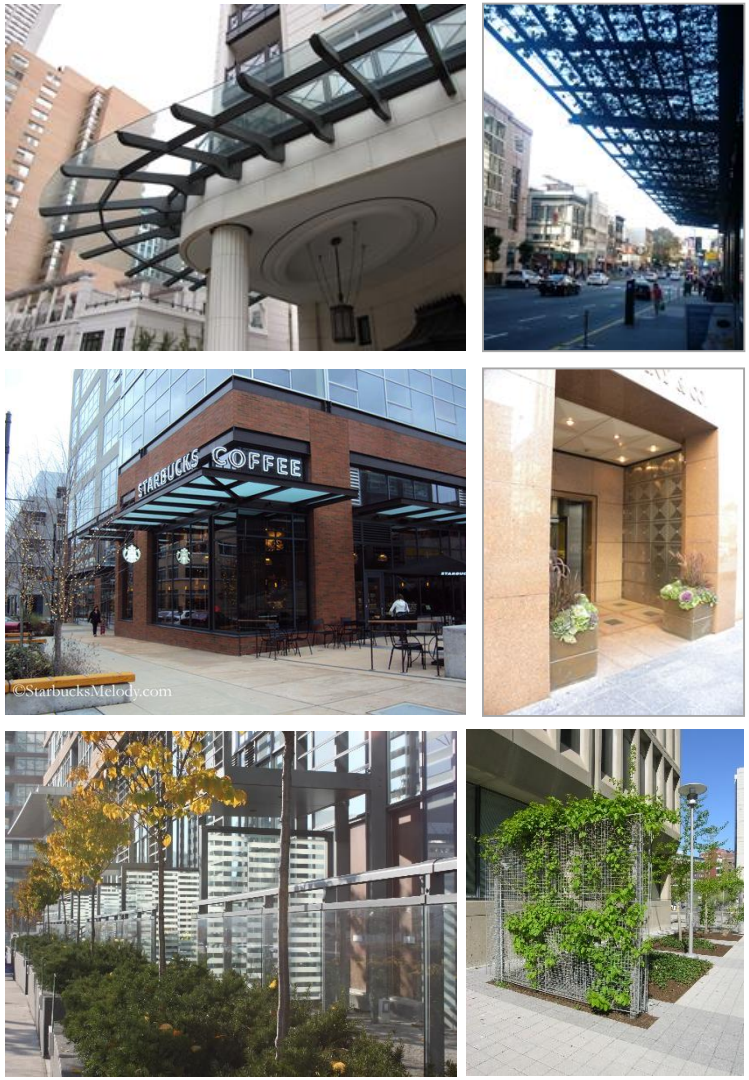


Image 8a – Examples of Wind Control Measures at Entrances and Sidewalks

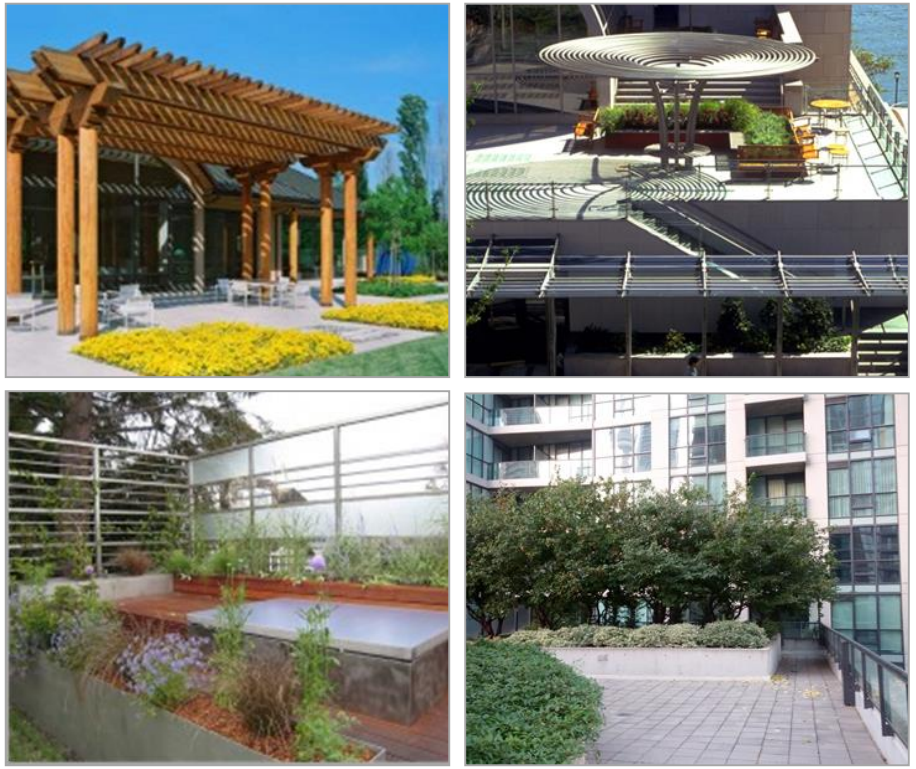


Image 8b – Examples of Wind Control Measures at on Terraces

6. SUMMARY

The proposed site is currently occupied by a one-storey building and open spaces, and surrounded predominantly by low-rise residential and commercial buildings. The proposed development would be taller than the general surroundings. The large towers protect downwind areas from prevailing winds, but they also redirect winds down on the upwind side. Therefore the proposed project would result in an increase in wind speeds in corner areas exposed to the prevailing southwest and northeast winds.

Although an increase in wind speeds is predicted around the project, it is expected that wind conditions after the completion of the proposed development will be suitable for pedestrian activities at most pedestrian areas at ground level. Wind speed categories are expected to be similar to existing conditions (standing or strolling in the summer and strolling or walking in the winter). Building corners along Plains Rd E and Cooke Blvd are likely to be uncomfortable for the retail entrance from time to time on particularly windy days. The proposed canopy will improve the wind conditions and additional wind control measures are also described in the report.

The comfort conditions predicted on the sidewalks are expected to extend to the retail and townhouse entrances on Plains, Cooke and Clearview. Suitable wind conditions are expected at the residential entrances and bus stops. Wind speeds at the Level 2 amenity terrace are expected to be higher than desired due to redirection of winds to the area by the towers. Suggestions for wind control have been provided for the Level 2 outdoor amenity terrace.

7. APPLICABILITY OF RESULTS

The assessment and recommendations presented in this report are based on the geometry and design drawings provided to RWDI. In the event of any significant changes to the design, construction or operation of the building or addition of surroundings in the future, RWDI could provide an assessment of their impact on the wind conditions discussed in this report. It is the responsibility of others to contact RWDI to initiate this process.