FINAL REPORT

284-286 DUNLOP ST W & 119-121 HENRY ST

BARRIE, ON

PEDESTRIAN WIND ASSESSMENT

PROJECT #2100802

FEBRUARY 26, 2021

SUBMITTED TO

Dean Artenosi
dean@artengroup.com

Arten Development Group
2162 Major Mackenzie Drive
Vaughan, ON L6A 1P7
T: 905.737.0125

SUBMITTED BY

Jessica Confalone
Project Manager
Jessica.Confalone@rwdi.comm

Hanqing Wu, Ph.D., P.Eng.
Senior Technical Director / Principal

Frank Kriksic
Microclimate Consultant / Principal
Frank.Kriksic@rwdi.com

Rowan Williams Davies & Irwin Inc. (RWDI)
600 Southgate Drive
Guelph, ON N1G 4P6
T: 519.823.1311 x 2076
F: 519.823.1316

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 Arten Development Group to conduct a qualitative desktop wind assessment for the pedestrian wind conditions at the proposed residential/ commercial development at 284-286 Dunlop Street West and 119-212 Henry Street in Barrie, Ontario (see **Image 1**). A wind assessment is required by the City of Barrie for the Zoning By-Law Amendment as per their Terms of Reference.

This assessment is based on the following:

- a review of regional long-term wind data;
- design drawings received from Urbanscape Architects on February 16, 2021;
- wind-tunnel studies undertaken by RWDI for similar projects;
- our engineering judgement and knowledge of wind flows around buildings[1-3]; and
- use of 3D software developed by RWDI (*WindEstimator*[2]) for estimating the potential wind conditions around generalized building forms.

This approach provides a screening-level estimation of potential wind comfort conditions. Conceptual wind control measures to improve wind comfort are recommended, where necessary. Wind tunnel testing may be required to quantify these wind conditions and optimize the wind control measures presented herein.

Note that other issues related to wind loads, snow, door operability, stack effect, etc., are not considered within the scope of this assessment.

Image 1: Proposed Development – Rendered View Looking West *(courtesy of Urbanscape Architects)*

1. 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. 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. 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. SITE INFORMATION

The proposed development fronts on both Dunlop Street West and Henry Street, just west of Anne Street North (see **Image 2**).

The site is currently occupied by two commercial and two residential properties. The area surrounding the site is primarily low-rise commercial to the south and west, with low-rise residential to the north and east. There are a couple of taller (eight storey) residential buildings located approximately 130 m to the southeast. Highway 400 is situated about 250 m to the west and Lake Simcoe is about 1,200 m to the east.

The proposed project is a 16-storey residential / commercial tower with a total of 11,518 sm of gross floor area. Pedestrian areas of greatest interest include the proposed building entrances, public sidewalk and walkways, outdoor amenity spaces and the surface parking areas.

Image 2: Aerial View of Existing Site and Surrounding
(Courtesy of Google™ Earth)

3. LOCAL WIND CLIMATE

Wind statistic recorded at Lake Simcoe Regional Airport, located approximately 16 km to the northeast, were analyzed for summer and winter seasons to determine the local wind directionality. The results are presented in the form of graphic wind roses in **Image 3**.

The most frequent winds blow from the west through northwest directions in both the summer and winter seasons. The southeast winds are relatively frequent in the summer and east winds in the winter, but they are of lower wind speeds.

It is our opinion that the most significant winds at the project site for comfort would be from the northwest quadrant and easterly directions, although all directions are considered in this assessment.

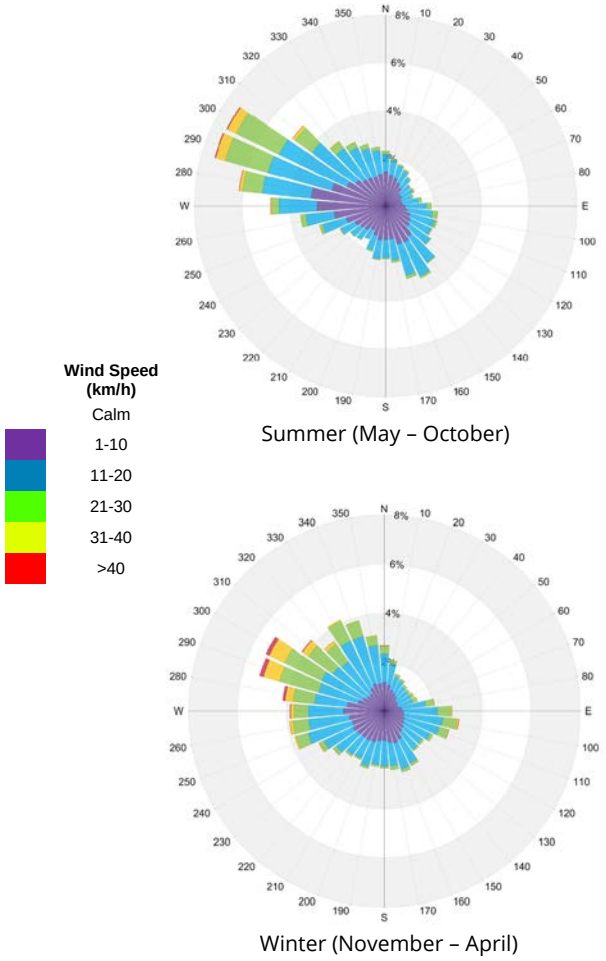


Image 3: Directional Distribution of Winds Recorded at Lake Simcoe Regional Airport 2003 - 2016

4. CRITERIA

The pedestrian wind criteria used in the current study are based on those referenced in the City of Barrie's Terms of Reference. The criteria are outlined below.

4.1 Pedestrian Safety

Pedestrian safety is associated with excessive gust wind speeds that can adversely affect a pedestrian's balance and footing. If strong winds that can affect a person's balance (**90 km/h**) occur more than 0.1% of the time or 9 hours per year, the wind conditions are considered severe.

4.2 Pedestrian Comfort

Sitting (≤ 10 km/h): Calm or light breezes desired for outdoor seating areas where one can read a paper without having it blown away.

Standing (≤ 15 km/h): Gentle breezes suitable for main building entrances and bus stops.

Walking (≤ 20 km/h): 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 met.

Wind conditions are considered suitable for *sitting, standing* or *walking* if the associated mean wind speeds are expected for at least four out of five days (80% of the time). Wind control measures are typically required at locations where winds are rated as *uncomfortable,* they exceed the wind safety criterion, or they are incompatible with the intended pedestrian use.

Note that these wind speeds are assessed at the pedestrian height (i.e., 1.5 m above grade or the concerned floor level), typically lower than those recorded in the airport (10 m height and open terrain).

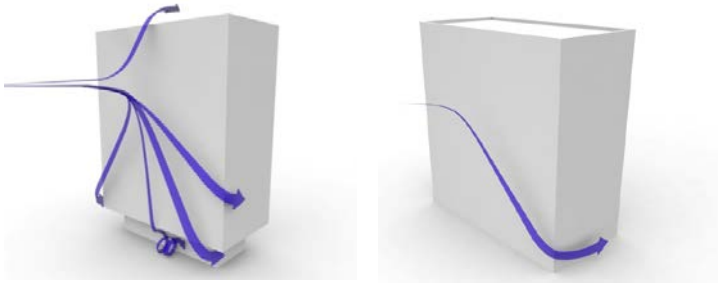
These criteria for wind forces represent average wind tolerance. They are sometimes subjective and regional differences in wind climate and thermal conditions as well as variations in age, health, clothing, etc. can also affect people's perception of the wind climate.

For the current development, wind speeds comfortable for *walking* are appropriate for sidewalks and lower wind speeds comfortable for *standing* are required for building entrances where pedestrians may linger. Wind speeds comfortable for *sitting* are appropriate for outdoor dining terraces and roof terrace during the summer, when these areas will be mainly used.

5. PEDESTRIAN WINDS

Predicting wind speeds and occurrence frequencies is complicated. It involves 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 regarding pedestrian wind conditions around buildings, yielding a broad knowledge base. This knowledge has been incorporated into RWDI's proprietary software that allows, in many situations, for a screening-level numerical estimation of pedestrian wind conditions without wind tunnel testing.

Since the surrounding buildings are shorter than the proposed project, the proposed building will be fully exposed to winds from all directions. Taller buildings tend to intercept the stronger winds at higher elevations and redirect them to the ground level. Such a *Downwashing Flow* (see **Image 4a**) is the main cause for increased wind activity around taller buildings at the grade level. When oblique winds are deflected down by a building, a localized increase in wind activity or *Corner Acceleration* can be expected around the downwind building corner at pedestrian level (see **Image 4b**). If these building/wind combinations occur for prevailing winds, there is a greater potential for increased wind activity.



a) Downwashing Flow **b) Corner Acceleration**

Image 4: General Wind Flow Patterns around Taller Buildings

6. ANTICIPATED WIND CONDITIONS

6.1 Existing Wind Conditions

The existing wind conditions on-site are likely comfortable for *sitting* / *standing* during the summer and *walking* during the winter. No wind safety exceedances are likely to occur on or around the existing site.

6.2 Proposed Wind Conditions

Given the height of the proposed building and the low height of the immediate surroundings, the project will be quite exposed to the prevailing winds. **Images 6 and 7** present the anticipated grade level wind comfort conditions for summer and winter, respectively. No wind safety exceedances are expected around this project.

6.2.1 Building Entrances

The building's residential and commercial entrances are located on the east façade (indicated by green and gold arrows respectively in **Image 5**). These entrances are well situated with respect to prevailing winds. The residential entrance is predicted to have appropriate wind conditions year-round (i.e., comfortable for *sitting* in summer and *standing* in winter). This is, in part due, to the fact that this entrance is well recessed into the building façade. The commercial entrance will be comfortable for *walking* in winter (**Image 7**) which is less than ideal for a building entrance and would benefit from an overhead canopy and/or recessing this entrance into the façade to protect from winter easterly winds downwashing from the building façade above (see **Images 4a, 7, 8 and 8**).

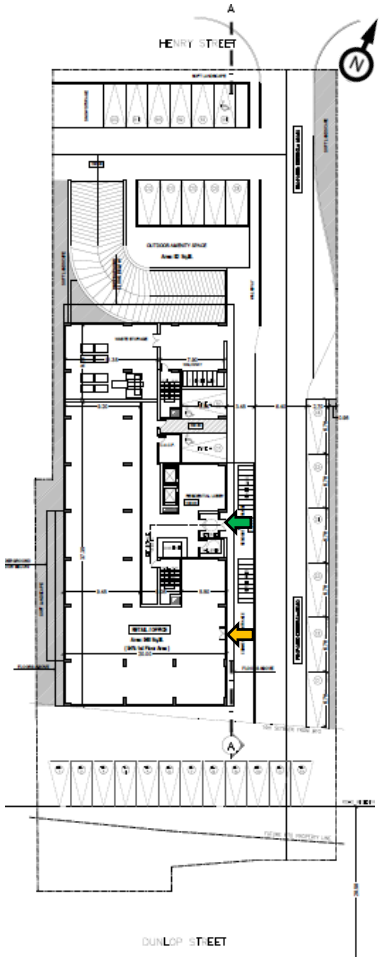
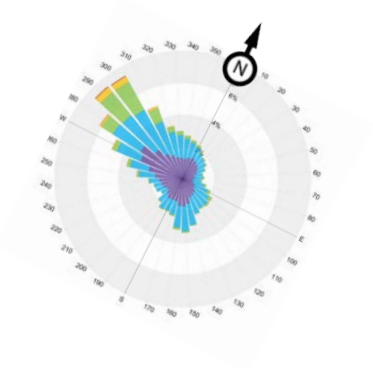


Image 5: Ground Floor Plan with Entrances Shown

6. ANTICIPATED WIND CONDITIONS

Predicted
SUMMER
Wind Comfort Conditions

- Sitting / Standing
- Walking
- Uncomfortable / Unsafe



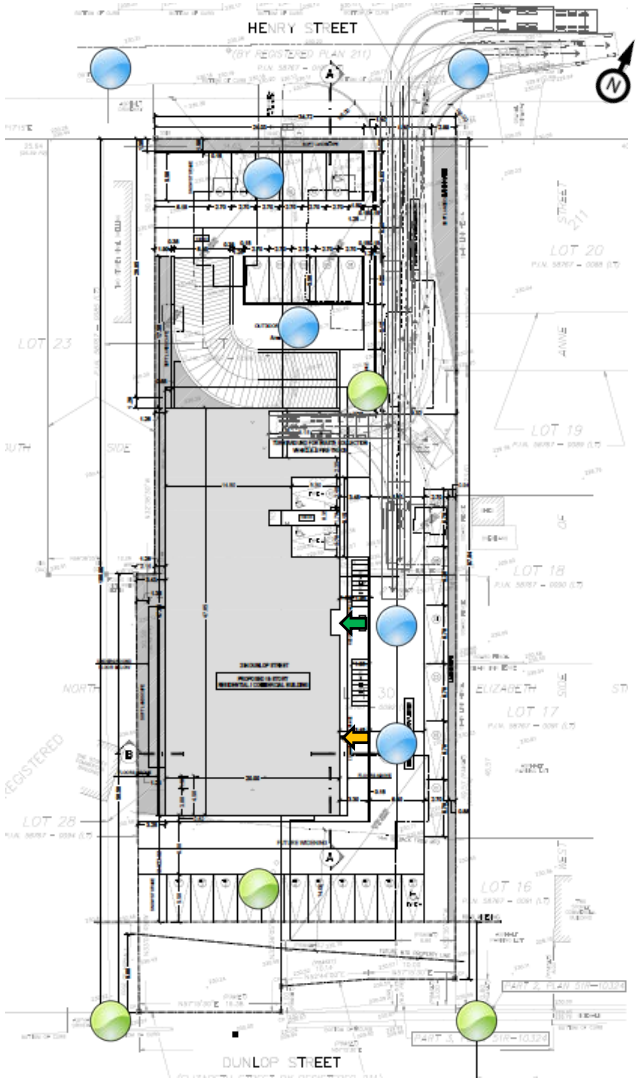
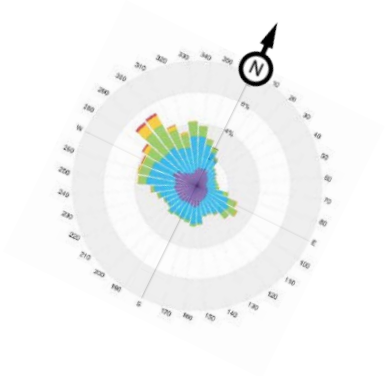


Image 6: Predicted *SUMMER* Wind Comfort Conditions

6. ANTICIPATED WIND CONDITIONS

Predicted
WINTER
Wind Comfort Conditions

- Sitting / Standing
- Walking
- Uncomfortable / Unsafe



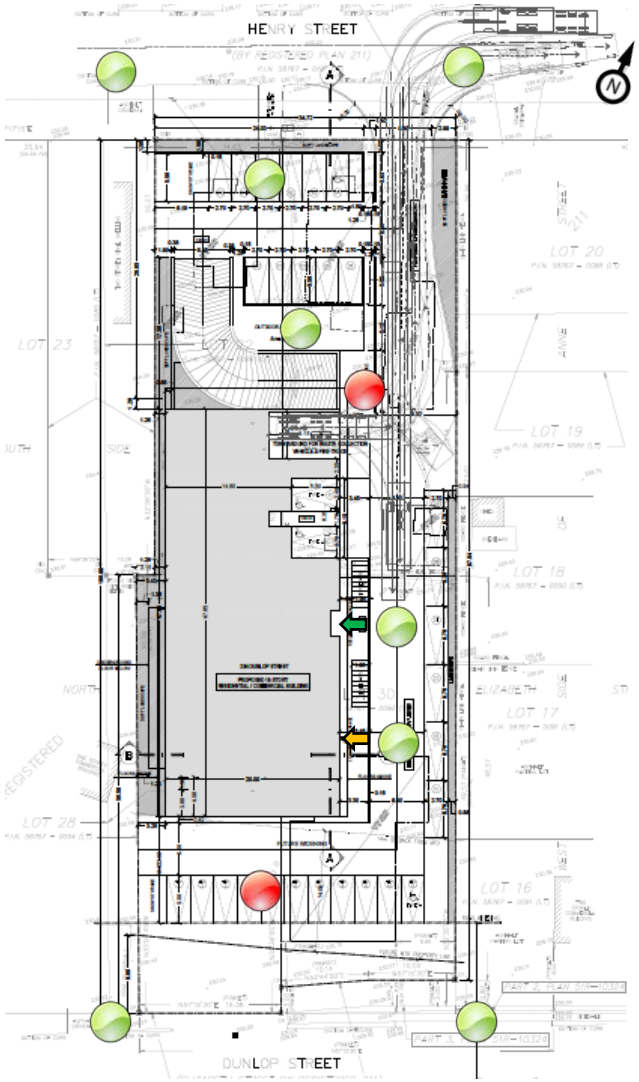


Image 7: Predicted *WINTER* Wind Comfort Conditions

6.2.2 Sidewalks / Walkways

The public sidewalk along Dunlop Street West is expected to experience in an increase in wind speeds relative to existing, however conditions should remain appropriate (i.e., comfortable for *walking* on a year-round basis) as indicated in **Images 6 and 7**. Existing wind conditions along Henry Street will not be affected by the proposed building.

The on-site walkway along the east side of the proposed building will be subjected to accelerations near the northeast building corner which are likely to make local conditions comfortable for *walking* in summer and *uncomfortable* in winter (see **Images 6 and 7**). These winter conditions are not ideal for a walkway and would be caused by both westerly and easterly winds accelerating around that building corner (as per example in **Image 4b**). Given the available space we believe that the installation of 3m tall coniferous landscaping or a vertical wind screen that is at least 60% just west of this corner would help shelter pedestrians using this walkway (see **Image 8**).

6.2.3 Parking Areas

This parking areas to the north of the building are expected to have appropriate wind conditions on an annual basis. The areas to the south however, will be subjected to westerly winds being redirected by the building's west façade and accelerating around the southwest corner causing *uncomfortable* conditions in the winter. To improve these conditions would require the installation of 5m tall coniferous trees or an architectural wind screen as per **Image 8**.

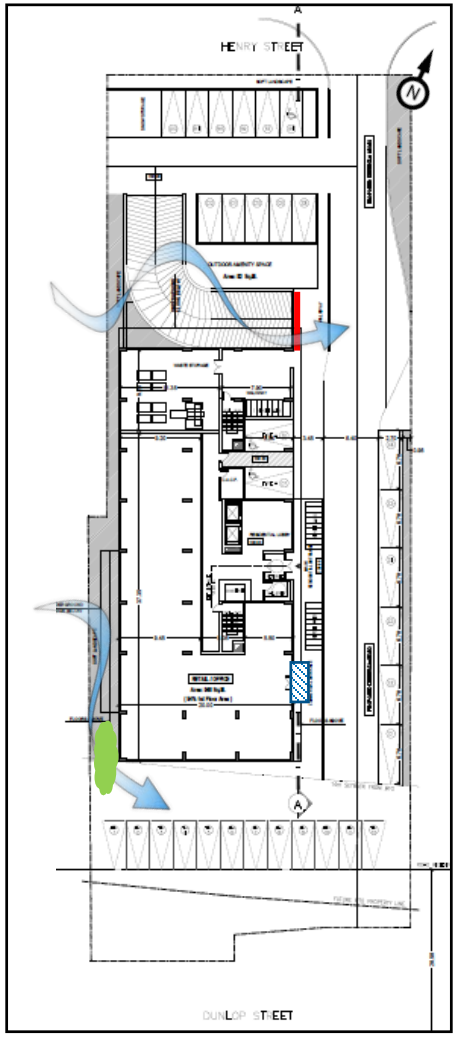
6.2.4 Outdoor Amenity at Grade Level

As can be seen in **Image 6**, this amenity area is predicted to be comfortable for *sitting / standing* in the summer which is appropriate for an outdoor amenity space. No wind control is recommended.

6.2.5 Outdoor Amenity at Roof Level

As wind speeds naturally increase with height above grade, the proposed amenity space at roof level will be exposed to significantly stronger winds than will exist at grade level. As a result, we expect conditions there to be comfortable for *walking* in summer. These conditions are less than ideal for passive pedestrian use. To provide wind protection to the most important passive use areas from the prevailing westerly winds we recommend that some wind control measures be strategically installed as per the examples shown in **Image 9**.

7. RECOMMENDATIONS



LEGEND:

- 5m tall, coniferous trees, tightly spaced
- 3m tall vertical wind screen or coniferous trees >60% solid
- Canopy above commercial entrance, no more than 4m above grade OR recess entrance into façade

Image 8: Recommended Wind Control Concepts

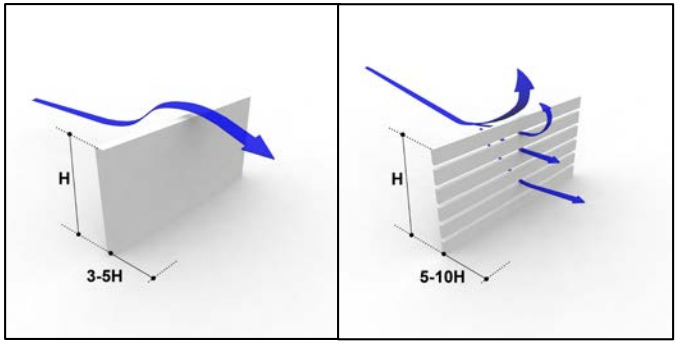


Image 9: Guidelines for Installing Vertical Wind Screens (solid on left and porous on right)

8. EXAMPLES OF WIND CONTROL

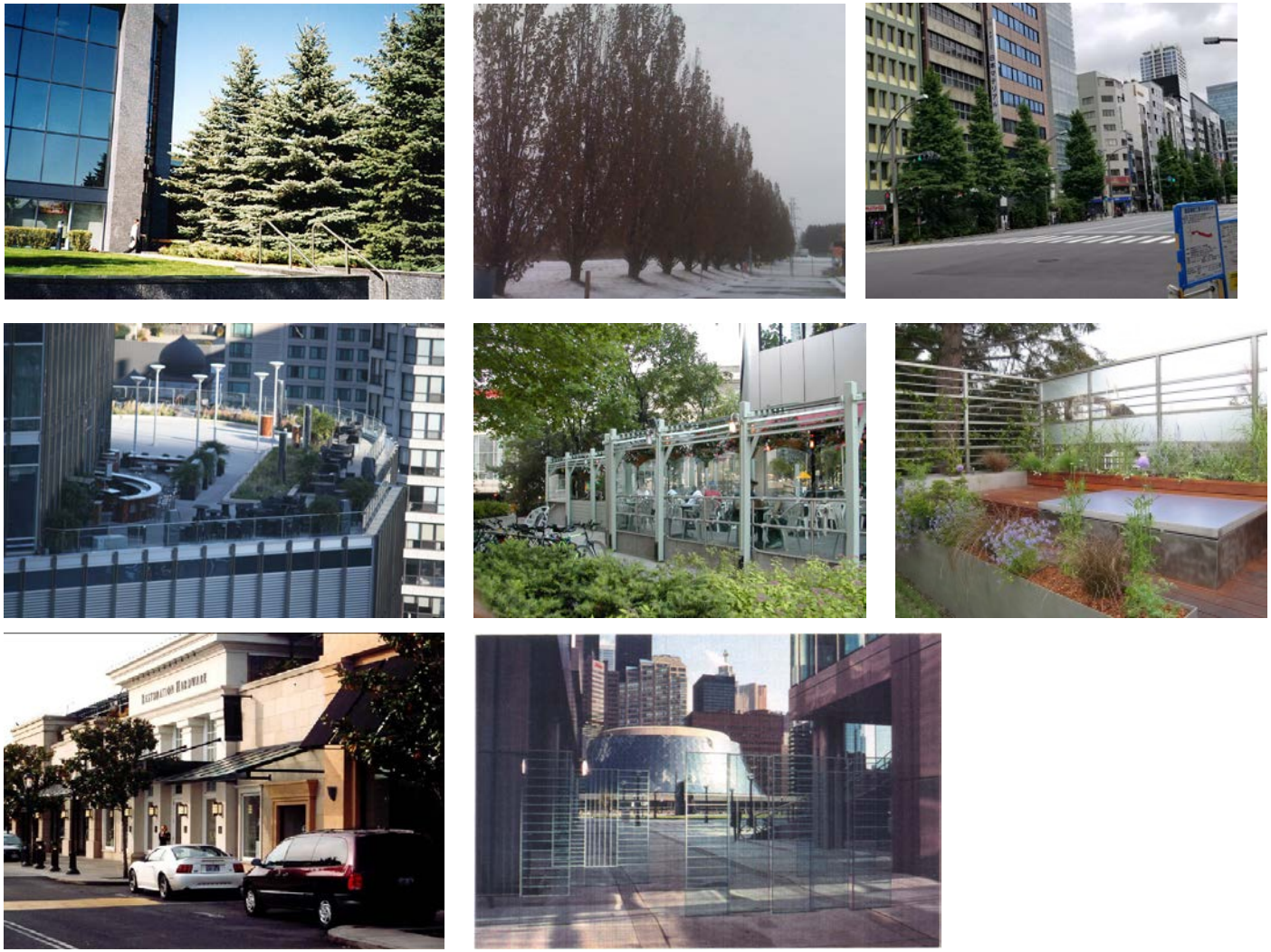


Image 10: Examples of Wind Control Features

9. SUMMARY

Wind conditions on and around the proposed residential development at 284-286 Dunlop Street West and 119-212 Henry Street in Barrie, Ontario are discussed in this report and our assessment is based on the local wind climate, surrounding buildings and our past experience with wind tunnel testing of similar buildings.

The proposed development has several positive design features such as well-situated entrances with respect to prevailing winds. Suggestions for improving wind conditions at the commercial entrance, an adjacent walkway, parking area and rooftop amenity space are provided in the report.

Wind tunnel testing may be required at a later design stage, as per the City's Terms of Reference, to quantify the wind conditions at the site and optimize the wind control measures presented herein.

10. APPLICABILITY OF RESULTS

The assessment presented in this report for the 284-286 Dunlop Street West and 119-212 Henry Street residential / commercial building development are based on the design drawings and 3D model received by RWDI on February 16, 2021.

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 pedestrian wind conditions discussed in this report. It is the responsibility of others to contact RWDI to initiate this process.