593 LAURIER AVENUE WEST

OTTAWA, ON

PEDESTRIAN WIND ASSESSMENT
PROJECT #1903548
NOVEMBER 22, 2019

SUBMITTED TO

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1. INTRODUCTION

Rowan Williams Davies & Irwin Inc. (RWDI) was retained by Henry Investments to assess the pedestrian wind conditions for the proposed development at 593 Laurier Ave. W. in Ottawa, ON (see Image 1).

This Preliminary Wind Analysis was completed in support of the Site Plan Approval application for the City of Ottawa as required under the City's Terms of Reference - Wind Analysis. The assessment was based on the following:

- a review of regional long-term meteorological data for Ottawa;
- design drawings received from Project1 Studio on November 5, 2019;
- wind-tunnel studies undertaken by RWDI for similar projects in the Ottawa Area;
- 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 an estimation of potential wind conditions. Conceptual wind control measures to improve wind comfort are recommended, where necessary. To quantify these conditions or refine any conceptual mitigation measures, physical scale-model tests in a boundary-layer wind tunnel would be required.

Note that other wind issues such as those related to wind loads, door operability, air quality, snow drifting, etc., are not considered in the scope of this assessment.

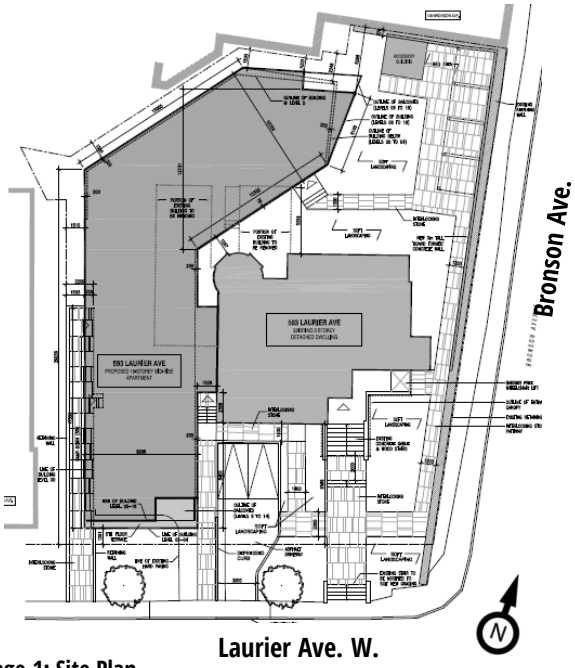


Image 1: Site Plan

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. BUILDING AND SITE INFORMATION

The proposed development is located at the northwest corner of the intersection of Laurier Ave. W. and Bronson Ave. in Ottawa, ON (see Image 2). The site is currently occupied by a 3-storey detached house, most of which will remain on site, while smaller portion to the north and west will be demolished.

The site is generally surrounded by high-rise buildings to the north through east to southeast, and by a mixture of low to mid-rise buildings and grassed lands in other directions (see Image 2). The Ottawa River is located approximately 700 m to the north and Downtown Ottawa is located approximately 1 km to the northeast.

The proposed development consists of addition of a new 16-storey building to the west and north of the existing 3-storey building on site (see Images 1 and 3).

Public pedestrian areas on and around the development include the building entrances, sidewalks and an outdoor amenity area at grade.

Image 2: Aerial View of the Existing Site and its Surrounding
(Courtesy of Google™ earth)

Image 3: 3D Rendering of the Proposed Development (View from Southeast)

3. METEOROLOGICAL DATA

Meteorological data from Ottawa Macdonald-Cartier International Airport for the period from 1985 to 2015 were used as a reference for wind conditions in the area. Wind data from other stations in the Ottawa area were also reviewed and it was deemed that the data set from the airport were most applicable.

This airport is located approximately 11 km to the south of the project site. Local wind speeds and directions may be affected by the nearby Ottawa River because there is the potential for winds to accelerate along the river valley, resulting in increased wind activity on site. This exposure is taken into account in the subsequent pedestrian wind analysis.

The distributions of wind frequency and directionality for four seasons are shown in Image 4. When all winds are considered, winds from the west-northwest, east-northeast and southwest directions are predominant for all seasons.

Strong winds of a mean speed greater than 30 km/h measured at the airport (red and yellow bands) occur most often in the winter and least often in the summer. Strong winds from the west-northwest and east-northeast are prevalent throughout the year. Winds from these directions potentially could be the source of uncomfortable wind conditions, depending upon the site exposure or development design.

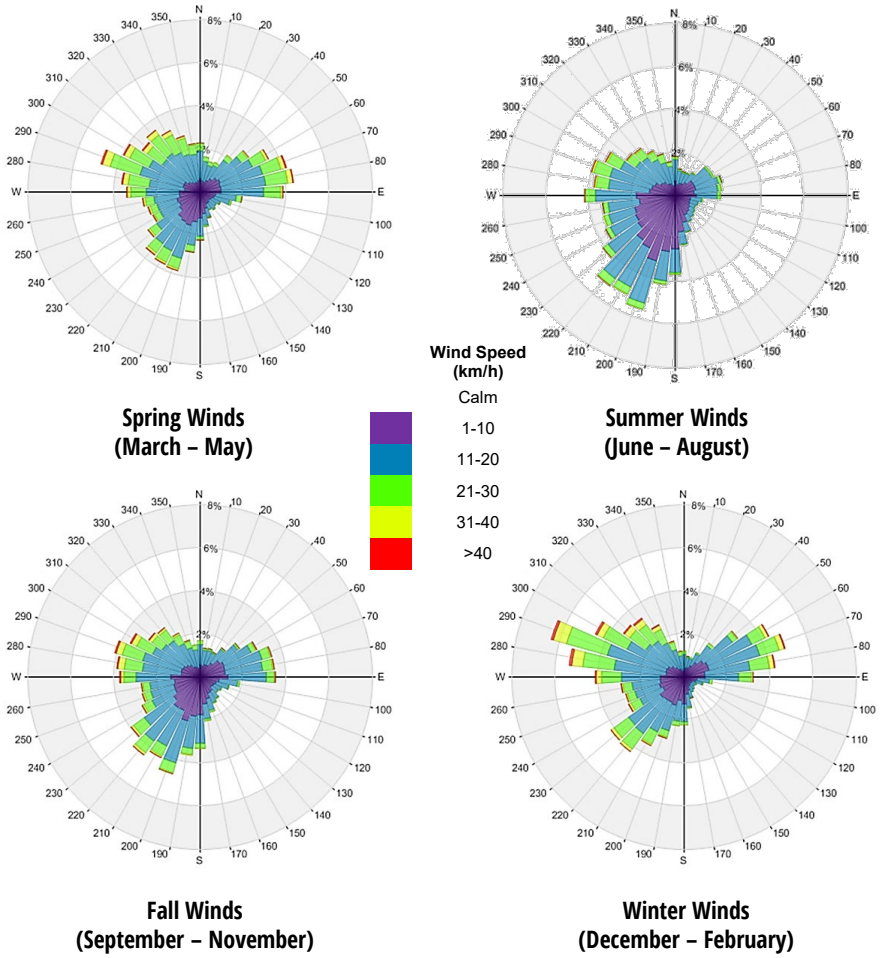


Image 4: Directional Distribution of Winds Recorded at Ottawa Macdonald-Cartier International Airport (1985 to 2015)

4. PEDESTRIAN WIND CRITERIA

The RWDI pedestrian wind criteria are used in the current study. 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 city planning communities including the City of Ottawa. The criteria are as follows:

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.

Pedestrian Comfort

Wind comfort can be categorized by typical pedestrian activities:

- **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 (≤ 14 km/h)**: Gentle breezes suitable for main building entrances and bus stops.
- **Strolling (≤ 17 km/h)**: Moderate winds that would be appropriate for window shopping and strolling along a downtown street, plaza or park.
- **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 or they exceed the wind safety criterion.

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 proposed development, wind speeds comfortable for strolling or walking are appropriate for sidewalks; wind speeds comfortable for standing are required for building entrances, where pedestrians may linger; and lower wind speeds comfortable for sitting are desired for outdoor amenity area in the summer when these areas will used most often.

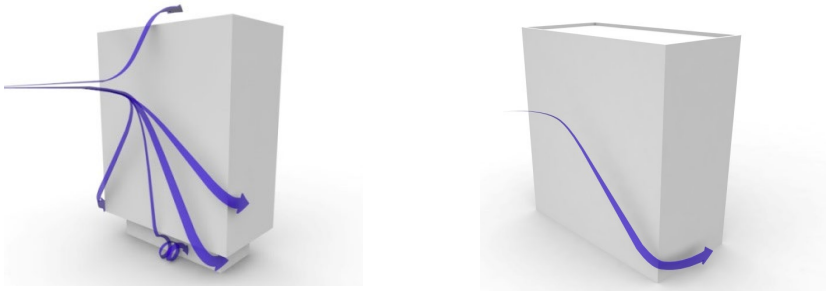
5. PEDESTRIAN WIND CONDITIONS

5.1 Background

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 qualitative, screening-level numerical estimation of pedestrian wind conditions without wind tunnel testing.

The proposed building is taller than its immediate surroundings in the direction of the prevailing northwesterly, southwesterly and northeasterly winds and therefore is exposed to those winds. In such a case, the building tends to intercept the stronger winds at higher elevations and redirect them to the ground level. Such a downwashing flow (see Image 5a) is the main cause for increased wind activity around tall buildings at the grade level. When oblique winds are deflected down by a building, a localized increase in the wind activity can be expected around the exposed building corner at pedestrian level (see Image 5b). If these building/wind combinations occur for prevailing winds, there is a greater potential for increased wind activity.

Detailed discussions on the potential wind comfort conditions at key pedestrian areas are provided in the Sections 5.2 to 5.4.



(a) Downwashing flow **(b) Corner acceleration**

Image 5: Typical Wind Flows around Taller Buildings

5.2 Sidewalks

The tall and dense buildings to the east of the site (as seen in Image 2) are expected to provide protection at the site from strong easterly and northeasterly winds. The proposed development has a large setback at the grade from the sidewalks of Laurier Ave. W. which helps reduce wind accelerations along these sidewalks. Wind conditions along the sidewalks of Laurier Ave. W. are expected to be comfortable for standing or strolling throughout the year, which are considered appropriate for the intended usage for pedestrians using the sidewalks.

The sidewalks along Bronson Ave. are generally protected from the prevailing northwesterly winds by the building massing itself and the proposed building has also a large setback from these sidewalks. Wind conditions are predicted to be suitable for standing or strolling throughout the year.

5.3 Entrances

The entrances to the proposed development are marked as A1 through A4 in Image 6. A1 and A2 are recessed. This is a appositive design feature as it provides an area that is protected from the prevailing winds. Also, they are located on the south side of the building, and therefore protected from the prevailing northwesterly and northeasterly winds by the building itself. Wind conditions suitable for standing are expected at these entrances throughout the year.

Slightly higher wind speeds are expected at A3 and A4 with conditions comfortable for standing during summer and fall, and strolling during spring and winter. If these entrances are not frequently used, the predicted conditions are considered appropriate. If desired, calmer wind conditions at these entrances can be achieved by recessing them into the façade, or installing windscreens/planters on two sides of them. In addition, a canopy above these entrances can provide further wind protection. Examples of these wind mitigation measures are shown in Image 7.

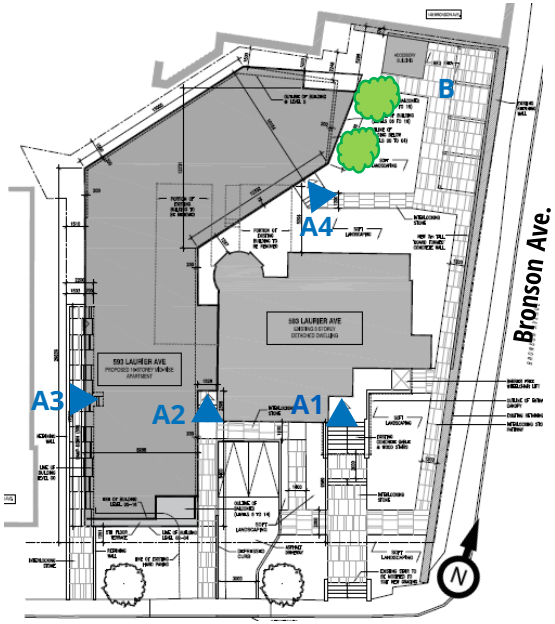


Image 6: Site Plan Showing the Building Entrances

Image 7: Examples of Wind Control Features for the Entrances

5.3 Outdoor amenity area

An outdoor amenity area is located at the grade level to the northeast of the proposed development (marked by B in Image 6). As a result of acceleration of the northwesterly winds around the tall tower, as well as exposure to the easterly and northeasterly winds, wind speeds at this area are expected to be comfortable for standing or strolling during the summer when it will be mainly used. These speeds might be higher than desired for the intended use of this area. To reduce exposure to winds accelerating around the tower corner towards this area, we recommend planting trees at the landscaped area to the west of the outdoor amenity area (marked in Image 6). Additionally, trees or tall guardrails to the east of this area, along the edge of the retaining wall, will reduce exposure to the easterly winds while trellises above this area will help to protect it from winds accelerating down the tower. Examples of these wind mitigation measures are shown in Image 8.

Image 8: Examples of Wind Control Features at the Amenity Area

6. SUMMARY

RWDI completed a Preliminary Wind Analysis for the proposed 593 Laurier Ave. W. development in Ottawa, ON in support of the SPA submission.

The wind assessment was based on the local wind climate, surrounding buildings, our past experience with wind tunnel testing of similar buildings, and screening-level 3D modelling of wind flows around the development.

The proposed development includes several positive design features such as the building setback at the grade from Laurier Ave. W. and Bronson Ave., and the recessed entrances along the south facade. Wind conditions are expected to be suitable for the intended usage at the sidewalks and south entrances throughout the year. Higher winds are predicted during the winter at entrances A3 and A4. Higher than desired wind speeds are also expected at the outdoor amenity area at the grade during the summer.

Conceptual wind mitigation measures to improve wind conditions at the entrances are discussed and photograph examples are provided for reference.

7. APPLICABILITY OF RESULTS

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.