DIXIE MALL REDEVELOPMENT

MISSISSAUGA, ON

PEDESTRIAN WIND ASSESSMENT

PROJECT #2100834
DECEMBER 2, 2022

SUBMITTED TO

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1. INTRODUCTION

Rowan Williams Davies & Irwin Inc. (RWDI) was retained to conduct a qualitative assessment of the pedestrian wind conditions expected around the proposed Dixie Mall Redevelopment project in Mississauga, Ontario. This effort is intended to inform good design and has been conducted in support of the project's application for Zoning By-Law Amendment and Official Plan Amendment.

The proposed development includes demolition of a portion of the existing mall at the corner of QEW and Haig Blvd and construction of five residential towers on three Slate blocks (Images 1 and 2). The site is surrounded by the mall and golf courses to the northeast through southeast and by mainly low-rise residential developments and roadways in the remaining directions. Lake Ontario is located approximately 2.7 km to the southeast.

The proposed development consists of two towers of 9 and 12 storeys on Slate Block 1, a tower of 22 storeys on Block 2 and two towers of 18 and 25 storeys on Block 3 (Image 2, 3 and 4). The proposed buildings include low podiums and surrounded by dense landscaping, and they are expected to be considerably shorter than the future buildings on the redevelopment site to the northeast and east.

Image 1: Aerial View of the Existing Site and Surroundings (Credit: Google Maps)

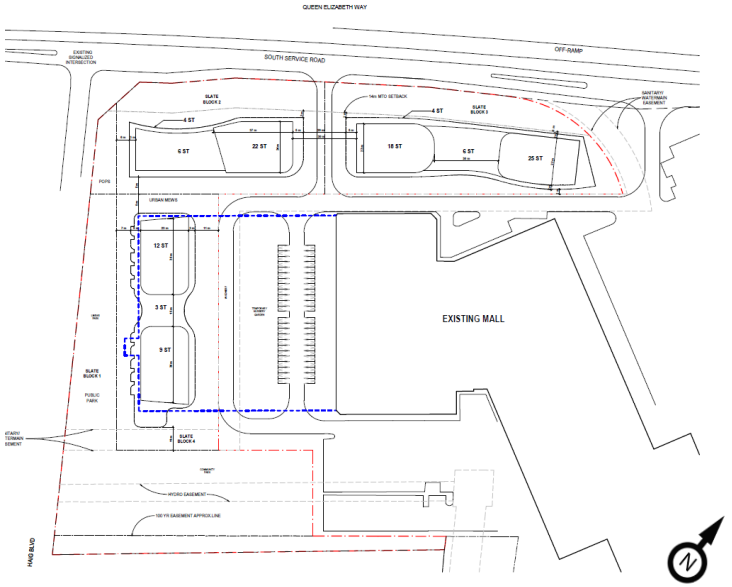


Image 2: Roof Plan of the Proposed Dixie Mall Redevelopment

1. INTRODUCTION

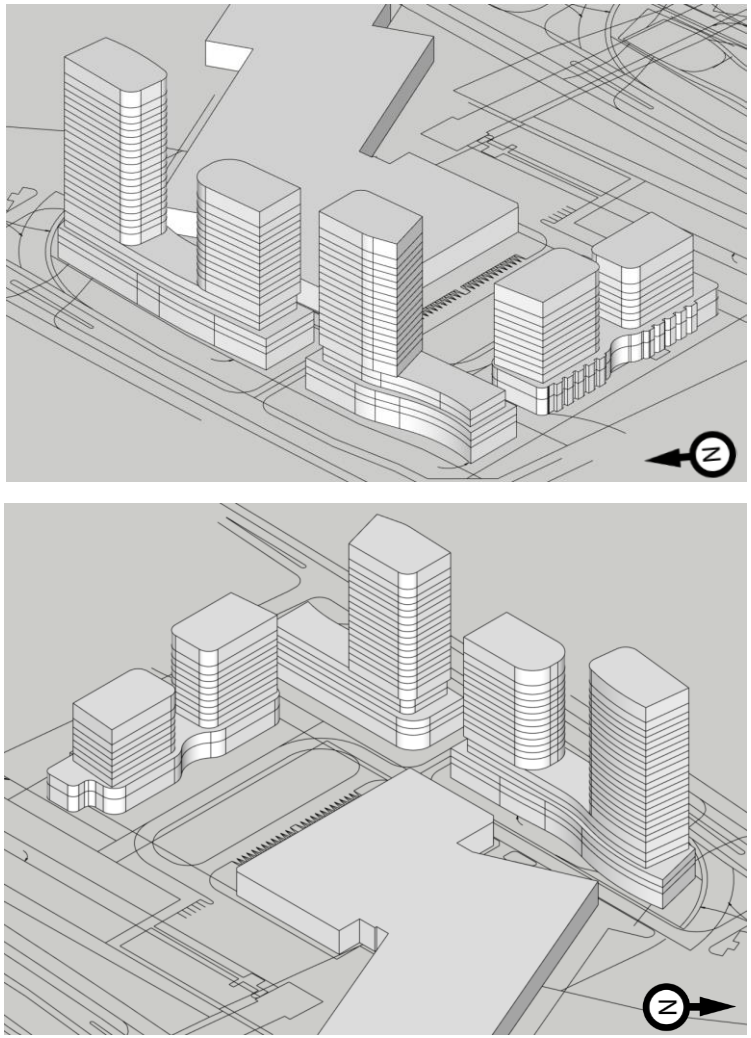


Image 3: 3D Views of the Buildings

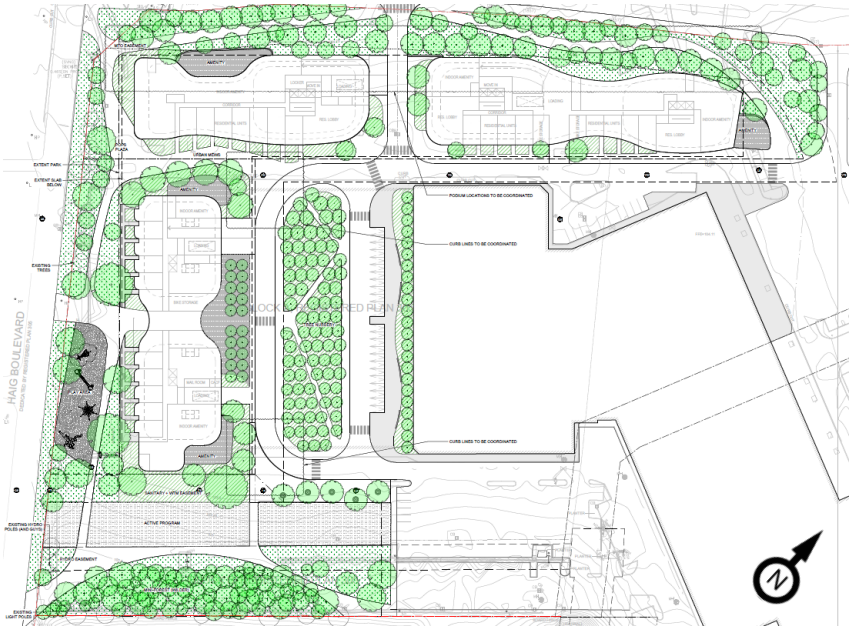


Image 4: Landscaping Plan for Development

2. METHODOLOGY

Predicting wind speeds and occurrence frequencies is complex. It involves the combined 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. In some situations, this knowledge and experience, together with literature, allow for a reliable, consistent and efficient desktop estimation of pedestrian wind conditions without wind-tunnel testing. This approach provides a screening-level estimation of potential wind conditions and offers conceptual wind control measures for improved wind comfort, where necessary.

In order to quantify and confirm the predicted conditions or refine any of the suggested conceptual wind control measures, physical scale model tests in a boundary-layer wind tunnel would be required.

RWDI's assessment is based on the following:

- Design drawings and models received by RWDI in November 2022;
- A review of the regional long-term meteorological data from Billy Bishop Toronto City Airport;
- Use of RWDI's proprietary software (*WindEstimator*[1]) for providing a screening-level numerical estimation of potential wind conditions around generalized building forms;
- Wind-tunnel studies and desktop assessments undertaken by RWDI for projects in the Mississauga Area and around the world;
- RWDI's engineering judgement and knowledge of wind flows around buildings[2, 3]; and,
- Mississauga Criteria for pedestrian wind comfort and safety.

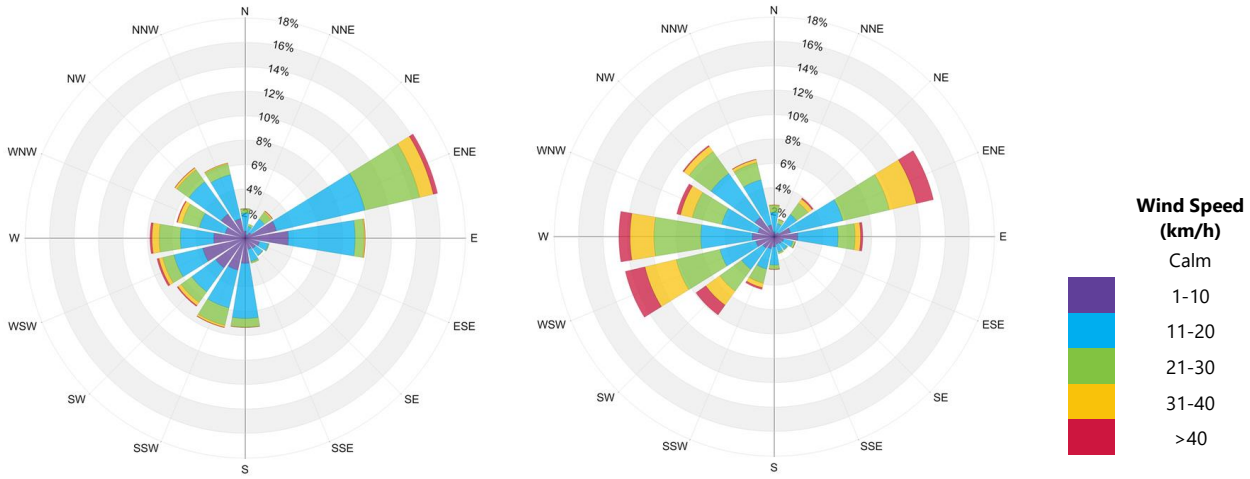
Note that other microclimate issues such as those relating to cladding and structural wind loads, door operability, snow impact, building air quality, noise, vibration, etc. are not part of the scope of this assessment.

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.

3. METEOROLOGICAL DATA

Wind data from Billy Bishop Toronto City Airport for the period from 1990 to 2019 were used as a reference for wind conditions in the area as this is the nearest station to the site with long-term, hourly wind data. The distributions of wind frequency and directionality for the summer (May through October) and winter (November through April) seasons are shown in the wind roses in Image 5.

Strong winds of a mean speed greater than 30 km/h measured at the airport at an anemometer height of 10 m occur more often in the winter than in the summer and they are from the southwest through west and east-northeast directions. Winds from these directions potentially could be the source of uncomfortable or severe wind conditions, depending upon the site exposure and development design.



Summer (May through October) **Winter (November through April)**

Image 5: Directional Distribution of Wind Approaching Billy Bishop Toronto City Airport

4. WIND CRITERIA

The Mississauga pedestrian wind criteria, developed in June 2014, are specified in the Urban Design Terms of Reference, "Pedestrian Wind Comfort and Safety Studies". The criteria are as follows:

4.1 Safety Criterion

Pedestrian safety is associated with excessive gust 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 Criteria

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 (≤ 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 above criteria 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.

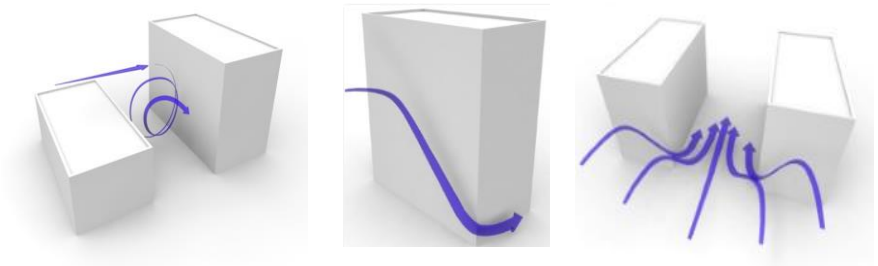
For the current development, wind speeds comfortable for walking are appropriate for sidewalks and parking lots, lower wind speeds comfortable for standing are required at the main building entrances and drop-off areas, and conditions suitable for sitting are required on outdoor amenity spaces at and above grade during the summer when these areas are typically in use.

5. RESULTS AND DISCUSSION

5.1 Wind Flow Around Buildings

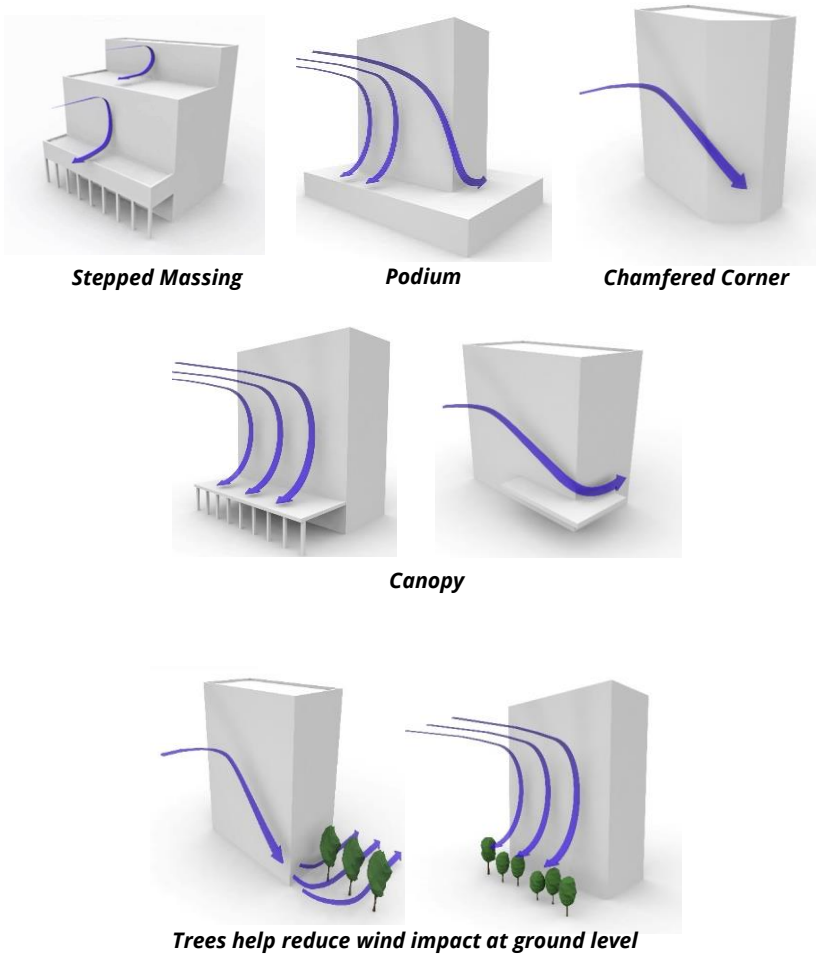
Buildings taller than surroundings tend to intercept the stronger winds at higher elevations and redirect them to the ground level (Downwashing, Image 6a). These winds subsequently move around exposed building corners (Corner Acceleration, 6b), and along the gap between buildings (Channelling Effect, 6c), causing increased wind activity at grade. If these building / wind combinations occur for prevailing winds, there is a greater potential for increased wind activity and uncomfortable conditions.

Design details such as stepped massing, tower setback from a podium edge, deep canopies close to ground level, wind screens / tall trees with dense underplanting, etc. (Image 7) can help reduce wind speeds. The choice and effectiveness of these measures would depend on the exposure and orientation of the site with respect to the prevailing wind directions and the size and massing of the proposed buildings.



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

Image 6: Generalized Wind Flows



Stepped Massing ***Podium*** ***Chamfered Corner***

Canopy

Trees help reduce wind impact at ground level

Image 7: Examples of Common Wind Control Measures

5.2 Existing Scenario

The existing site is occupied by a low building and parking lots, and immediately surrounded by suburban neighbourhoods with roadways and low commercial and residential buildings. As such, there are no significant structures on or around the site that would deflect ambient winds to the ground to cause adverse wind impacts. Currently, wind conditions on walkways and parking lots on and around the site are considered comfortable for standing in the summer and for walking in the winter.

Wind speeds exceeding the safety criterion are not expected on or around the site.

5.3 Proposed Scenario: Wind Flow

The proposed towers, between 9 and 25 storeys, are significantly taller than buildings in the surrounding area and, therefore, will be exposed to the winds from all directions. Strong downwashing, corner accelerating, and channelling flows are predicted to result in increased wind activity on the nearby pedestrian areas. This is primarily caused by the prevailing winds from the southwest through west and east-northeast directions, as shown in Image 8.

Several features of the proposed design are favourable towards reducing the potential for severe wind impacts, including:

- low podiums at the bases of the proposed towers, especially the large west podium on Block 2;
- curved corners of towers and podiums;
- Self sheltering of the towers on Blocks 2 and 3 for the prevailing southwest and east-northeast winds; and
- proposed landscaping on site and future buildings to the northeast through southeast.

The following sections provide a discussion of the potential wind conditions around the project, taking these features into account. The expected wind conditions at grade are shown in Images 9a and 9b.

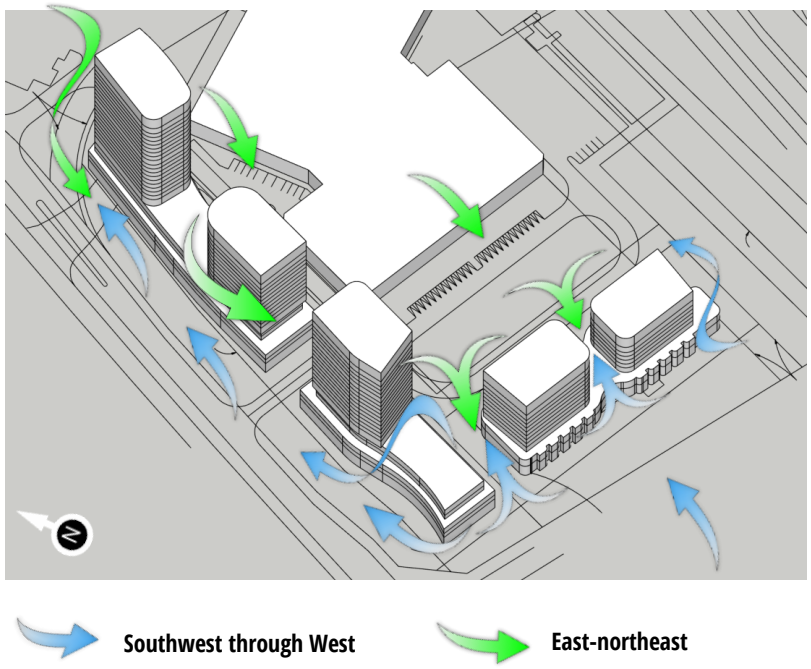


Image 8: Predicted Flow Pattern of Prevailing Winds

5.4 Proposed Scenario: Predicted Wind Conditions

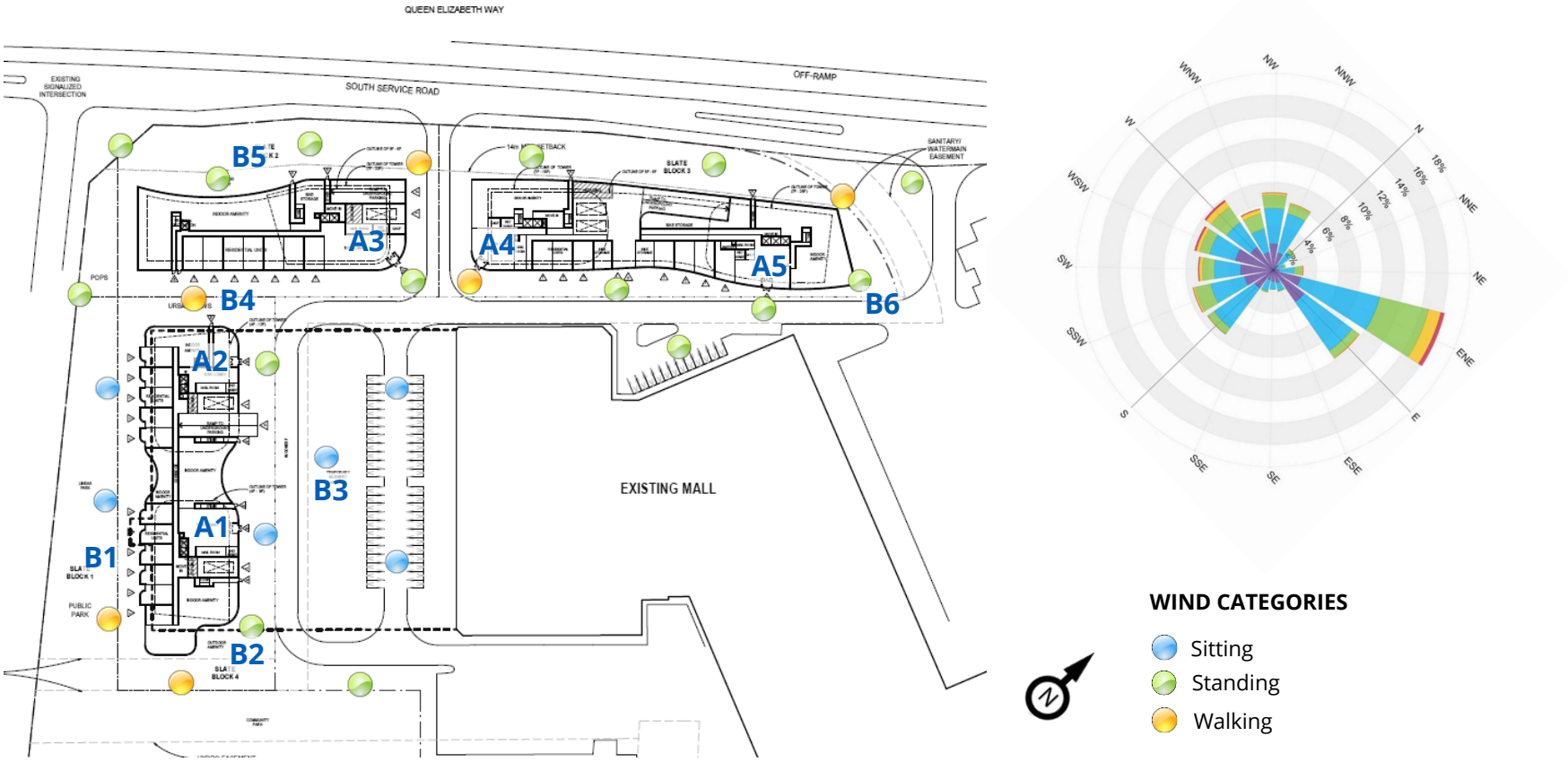


Image 9a: Predicted Wind Conditions at Grade - Summer

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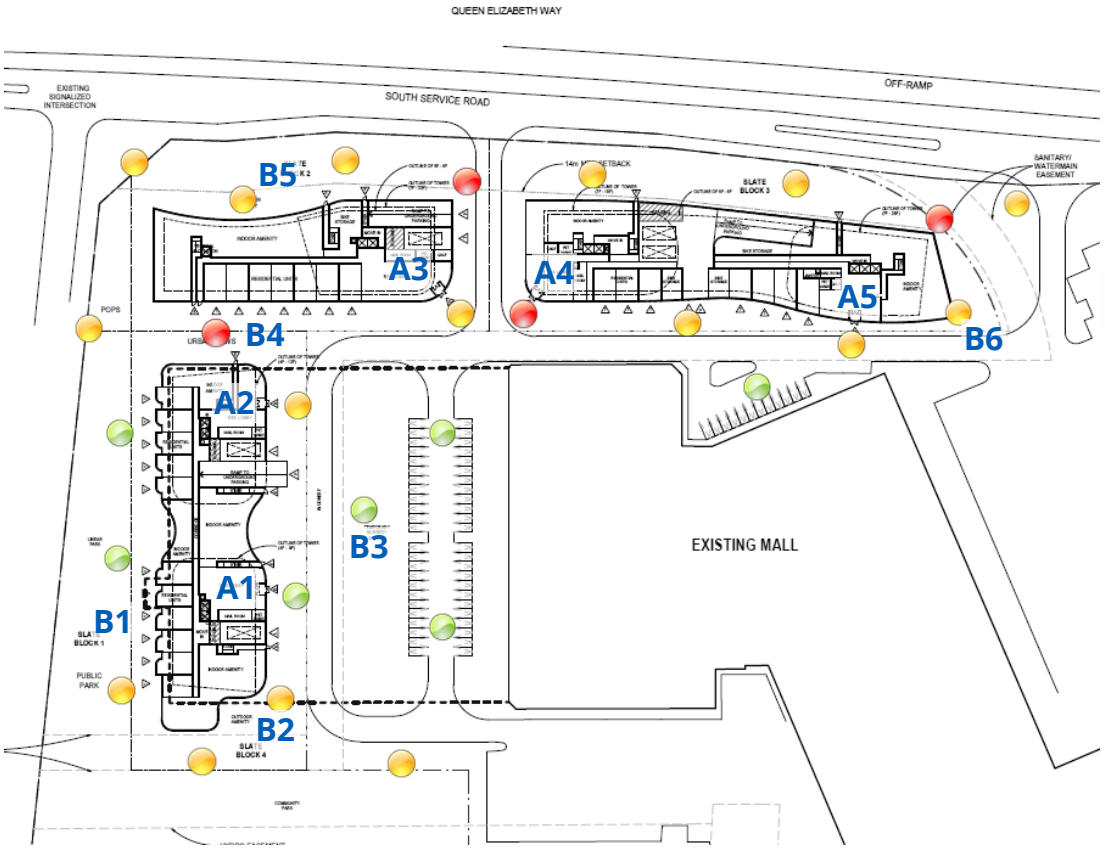
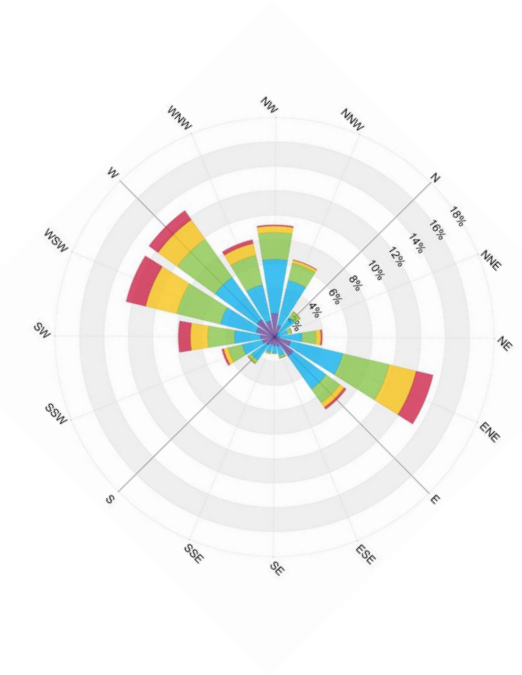
5.4 Proposed Scenario: Predicted Wind Conditions





WIND CATEGORIES

- Sitting
- Standing
- Walking
- Uncomfortable and Potential Safety Exceedance

Image 9b: Predicted Wind Conditions at Grade - Winter

5.5 Proposed Scenario: Wind Safety

The proposed towers are significantly taller than their surroundings and are expected to deflect the prevailing winds down to the podium and ground levels (Image 8).

At the ground level, there is a potential that wind speeds may exceed the wind safety limit along Urban Mews between Blocks 1 and 2, and around the exposed corners of towers on Blocks 2 and 3, as shown by the red dots in Image 9b.

The wind safety limit may also be exceeded on several podium terraces. This may not be a serious concern, as these windy events typically occur in the winter when limited use of podium amenities is anticipated.

Wind-tunnel testing should be conducted at a later design stage to quantify these wind conditions and to develop wind control solutions where required.

5.6 Proposed Scenario: Wind Comfort

5.6.1 Main Entrances

Five main entrances are identified for the five proposed towers (Locations A1 through A5 in Images 9a and 9b). They are each designed with a vestibule and lobby, providing an indoor waiting area for residents on windy or cold days. During the summer (Image 9a), suitable wind conditions comfortable for sitting or standing are predicted for all entrances, except A4 where wind speeds are likely comfortable for walking, due to the potential corner accelerating and channelling flows of the prevailing winds.

In the winter, due to seasonal variation in wind climate, higher-than-desired wind speeds are expected for Entrances A2 through A4 (Image 9b). If feasible, lower wind speeds can be achieved by relocating these entrances further away from building corners, recessing the entrances from the main facades and/or installing wind screens or planters on both sides of the entrances – see photos in Image 10 for examples.

Image 10: Examples of Wind Control Measures for Entrances

5.6 Proposed Scenario: Wind Comfort

5.6.2 Outdoor Amenities

The landscaping plan in Image 4 shows six landscaped outdoor amenity areas. Given the local wind climate and proposed dense landscaping, suitable wind conditions comfortable for sitting or standing are expected for most areas in the summer (B1 through B3, B5 and B6 in Image 9a), except the proposed Urban Mews (B4) where wind speeds are predicted to be comfortable for walking, due to the prevailing winds being channelled between Blocks 1 and 2. In addition to the proposed trees, additional hardscaping elements, such as screens and trellises, may be considered, if lower wind speeds are desired for the area.

Increased wind speeds are expected for outdoor areas in the winter, due to the seasonal wind climate and reduced protection offered by landscaping. As shown in Image 9b, wind speeds on outdoor amenities at grade are expected to be comfortable for walking at B1 through B3, B5 and B6, and may become uncomfortable at B4. Winter conditions may not be a concern for outdoor amenity areas due to reduced usage.

5.6.3 Sidewalks, Walkways and Parking Spaces

Pedestrians are typically active in these areas and high wind speeds comfortable for walking are acceptable. This criterion is satisfied for all areas in the summer (Image 9a). In the winter, uncomfortable wind conditions may occur from time to time around the exposed building corners (see red markers in Image 9b).

Again, wind-tunnel tests should be conducted to quantify these wind conditions and, if needed, to develop wind control solutions. Typical wind control measures for building corners may range from massing changes (e.g., additional tower setbacks and corner articulations) to architectural and landscaping features such as canopies, trellises, screens and coniferous trees – see photos in Image 11 for examples.

5.6.4 Above-ground Terraces

There are large podium spaces that can potentially be used for outdoor amenity, including the areas between the towers on Block 1 at the 4th floor (C1 in Image 12), on the west portion of Block 2 at the 7th floor (C2) and between the towers on Block 3 at the 7th floor (C3),

While podiums and setbacks are positive measures for reducing the wind impact on the ground level, increased wind speeds are expected for podium terraces, due to the increased elevations/exposure, and winds downwashing off the towers and channelling between towers.

In the event that undesirable conditions occur during the summer, taller parapets, windscreens, privacy fences and landscaping may be incorporated to provide sheltering for amenity users. Wind control measures may also include trellises and canopies to reduce downwashing winds (Image 13).

5. RESULTS AND DISCUSSION

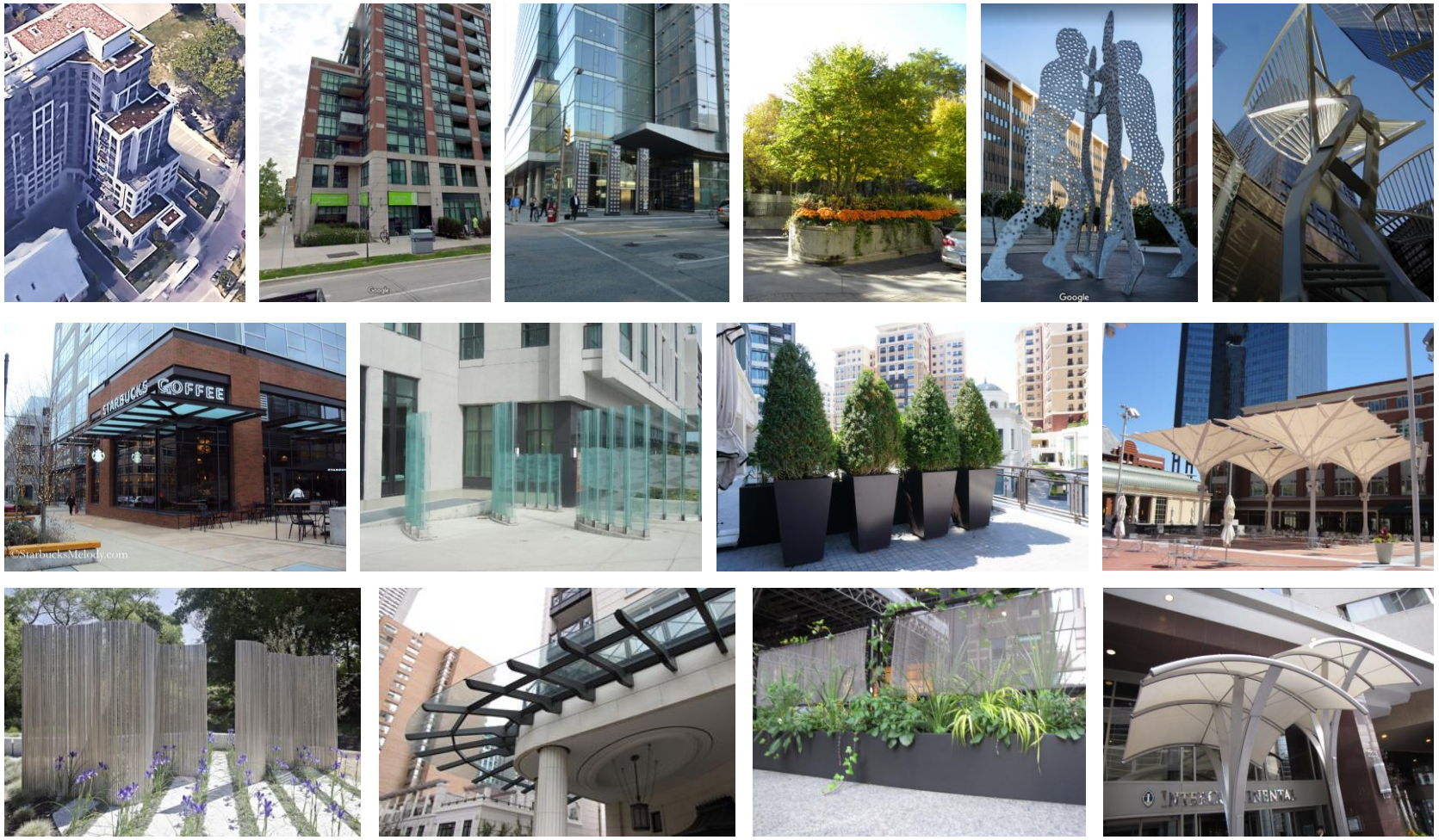


Image 11: Examples of Wind Control Measures for Building Corners

5. RESULTS AND DISCUSSION

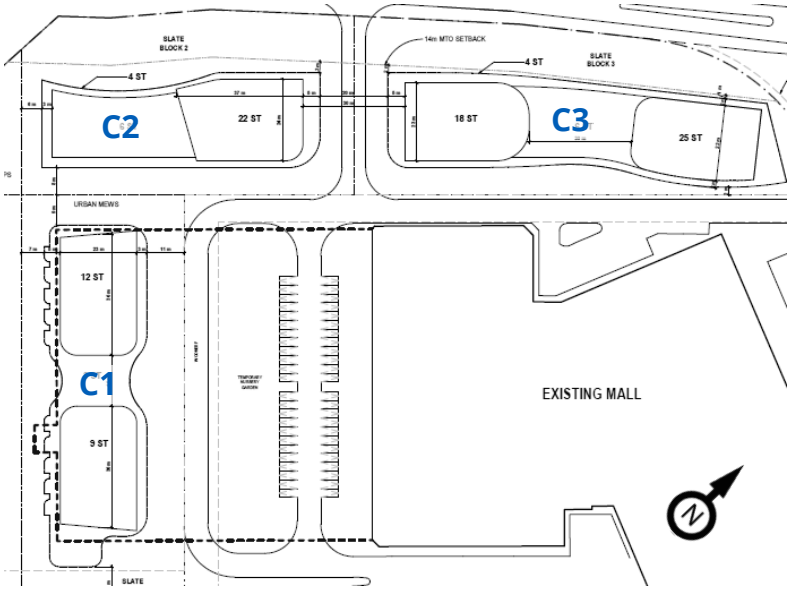


Image 12: Potential Podium Amenity Terraces

Image 13: Examples of Wind Control Features for Podium Terraces

7. SUMMARY

RWDI was retained to provide an assessment of the potential pedestrian level wind impact of the proposed Dixie Mall Redevelopment project in Mississauga, Ontario. Our assessment was based on the local wind climate, the current design of the proposed development, the existing surrounding buildings, our experience with wind tunnel testing of similar buildings, and screening-level modelling of wind flows around buildings.

Our findings are summarized as follows:

- The proposed project includes buildings taller than the existing surroundings and, therefore, will cause an increase in wind speeds around the buildings.
- The building design incorporated several wind-responsive features such as low podiums, curved corners for towers and podiums and landscaping, which will moderate the potential wind impacts on the surroundings. Future buildings to the northeast through southeast will further reduce the wind activity on the site.
- In general, suitable wind conditions are expected on all sidewalks, walkways and parking lots and on most entrances and ground-level amenities in the summer.
- In the winter, the seasonal wind climate is expected to result in elevated wind speeds at several building entrances and corner areas, where wind speeds may become uncomfortable and/or exceed the wind safety limit.
- Higher-than-desired wind speeds are also expected on the potential podium terraces.
- These predicted windy conditions can be mitigated by various measures as discussed in the report. RWDI will work with the design team to develop these measures as the project progresses.
- At a later stage of the design process, a wind-tunnel test is recommended to quantify the level and frequency of high wind activity, to confirm the need for wind control features, and to optimize mitigation efforts, where required.

8. STATEMENT OF LIMITATIONS

Design Assumptions

The findings/recommendations in this report are based on the building geometry and architectural drawings communicated to RWDI in November 2022. 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)
22138_Dixie_Floor plans-22-11-22	PDF	11/23/2022
2022-11-17_22138_Dixie_3D Massing - Master - Update	SKP	11/17/2022
L00_BASE_LANDSCAPE_221114	PDF	11/14/2022

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.

Limitations

This report was prepared by Rowan Williams Davies & Irwin Inc. for Slate Asset Management ("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.