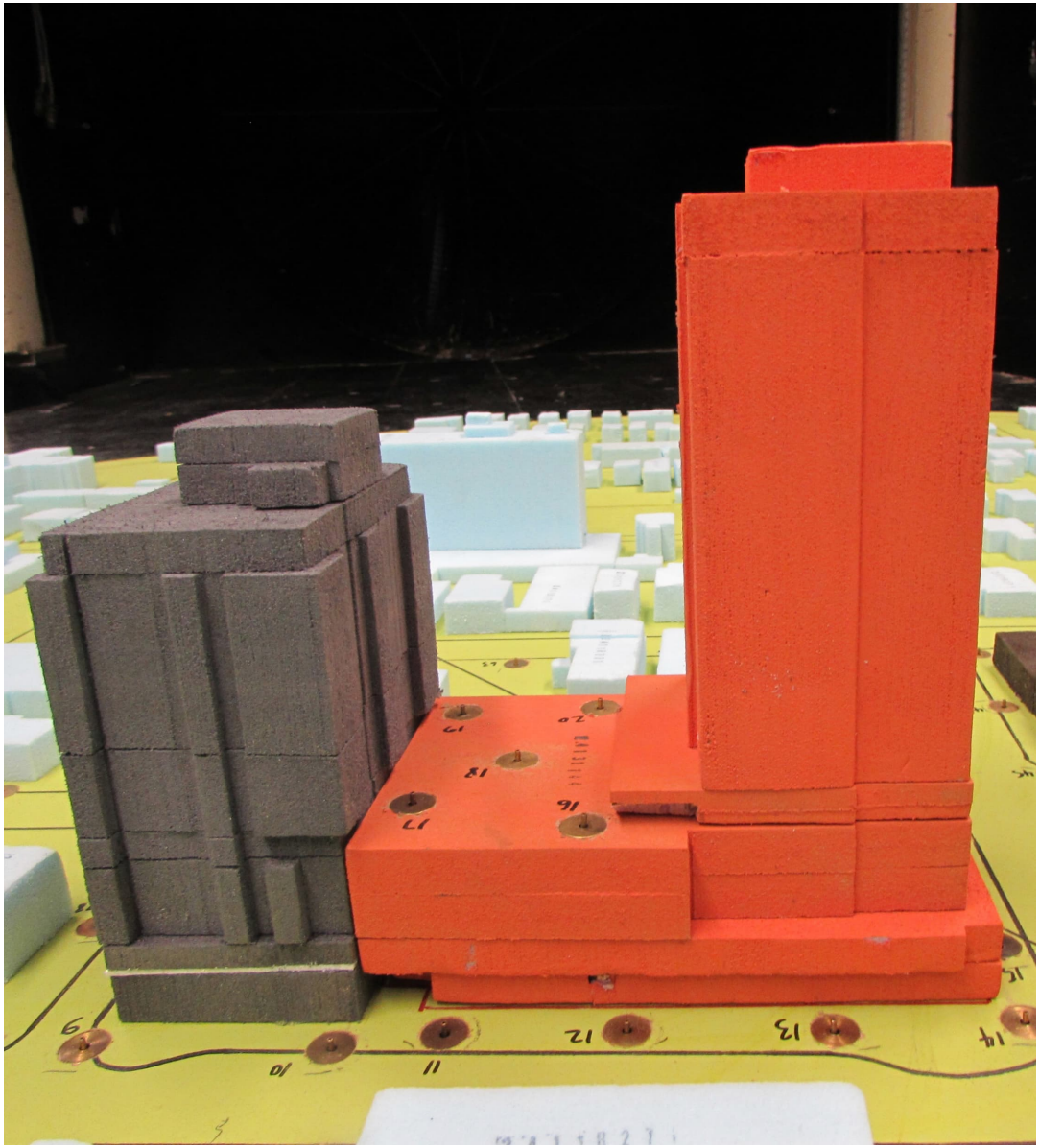
100 Stone Road West, Suite 201
Guelph, Ontario, N1G 5L3
226.706.8080 | SLRCONSULTING.COM

Date: June 21, 2024

Re: Pedestrian Wind Study
2030 Caroline Street
Burlington, Ontario
SLR Project #241.031144.00001



Prepared by:
SLR Consulting (Canada) Ltd.
100 Stone Road West – Suite 201
Guelph, ON N1G 5L3

For:
Inaria Burlington Inc.
C/O Carriage Gate Homes Inc.
2119 Old Lakeshore Road
Burlington, Ontario L7R 1C8



Tahrana Lovlin, MAES, P.Eng.
Principal, Microclimate

Revision	Date	Prepared by	Checked by	Approved by
0	June 21, 2024	Stefan Gopaul / Tahrana Lovlin	Nishat Nourin	Tahrana Lovlin

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1.0 Introduction

SLR Consulting (Canada) Ltd. (SLR) was retained Inaria Burlington Inc. to conduct a quantitative pedestrian wind study for the proposed development at 2030 Caroline Street in Burlington, Ontario. This report is in support of a combined Official Plan Amendment (OPA) and Zoning Bylaw Amendment (ZBA) application for the development.

1.1 Existing Development

The proposed development is located at 2030 Caroline Street, between Elizabeth Street and John Street. The site is currently cleared for construction of the proposed development. Figure 1 provides an aerial view of the immediate study area.

Immediately surrounding the site is an adjacent 17-storey residential development to the southeast, with low-rise residential and commercial buildings in all other directions. Beyond the immediate surroundings are also low-rise developments in all directions, with Lake Ontario to the east through south.

Typically, developments approved for Site Plan Approval (SPA) within a 500 m radius are included as existing surroundings, on the assumption that they will be constructed prior to the proposed development. A review of available information showed the developments at 421-431 Brant Street and at 2082-2090 James Street under construction, with the developments at 409 Brant Street, and at 535-551 Brant Street are approved for SPA. These four developments were therefore included as part of the existing surroundings.



Figure 1: Aerial view of existing site & surroundings
Credit: Bing Maps, 2024

1.2 Proposed Development

The proposed development, based on drawings received in December 2023, consists of a 26-storey commercial and residential building with a six-storey parking garage, with a total height of approximately 87 m, including the mechanical penthouse. **Figure 2** shows a conceptual rendering of the proposed development.

1.3 Areas of Interest

Areas of interest for pedestrian wind conditions include those areas which pedestrians are expected to use on a frequent basis. Typically, these include sidewalks, main entrances, transit stops, plazas and parks. On-site areas of interest are shown in **Figure 3**. There are several transit stops along Brant Street near the development, in addition to the one along James Street, close to the intersection with Brant Street.

The main residential entrance is situated in the centre of the north facade, on Caroline Street, while secondary entrances and exits are located in the centre of the east and west facades. There is an outdoor amenity spaces are located on the 7th floor (podium roof).

Note that Project North is approximately 45° counter-clockwise from True North. When referring to the building, Project North is used; when referring to wind directions, True North is used.

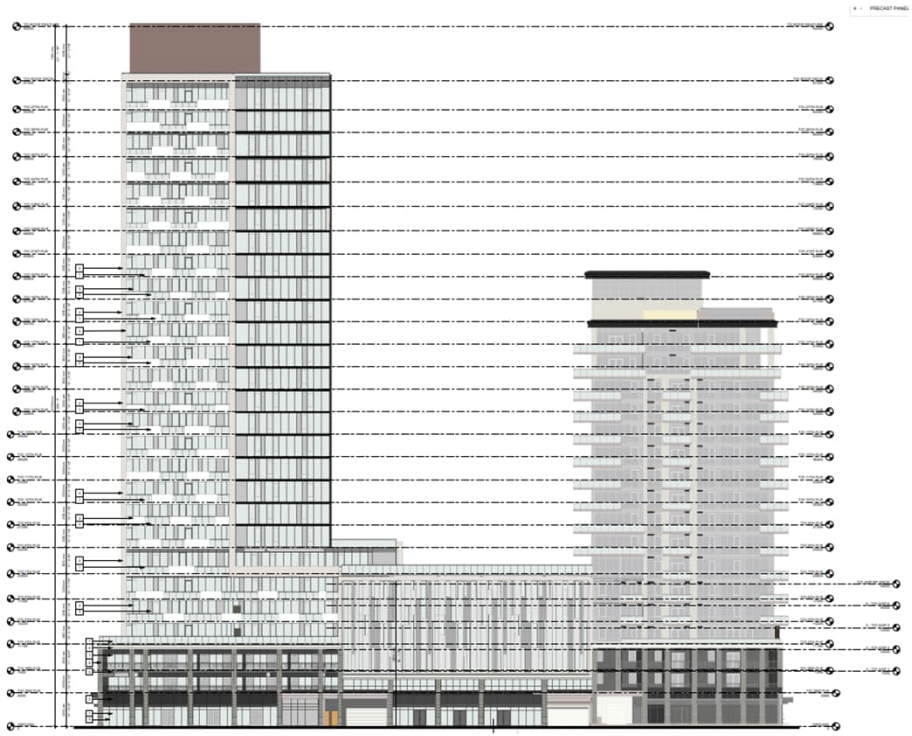


Figure 2: West elevation
Credit: Chamberlain Architect Services Limited (dated December 15, 2023)

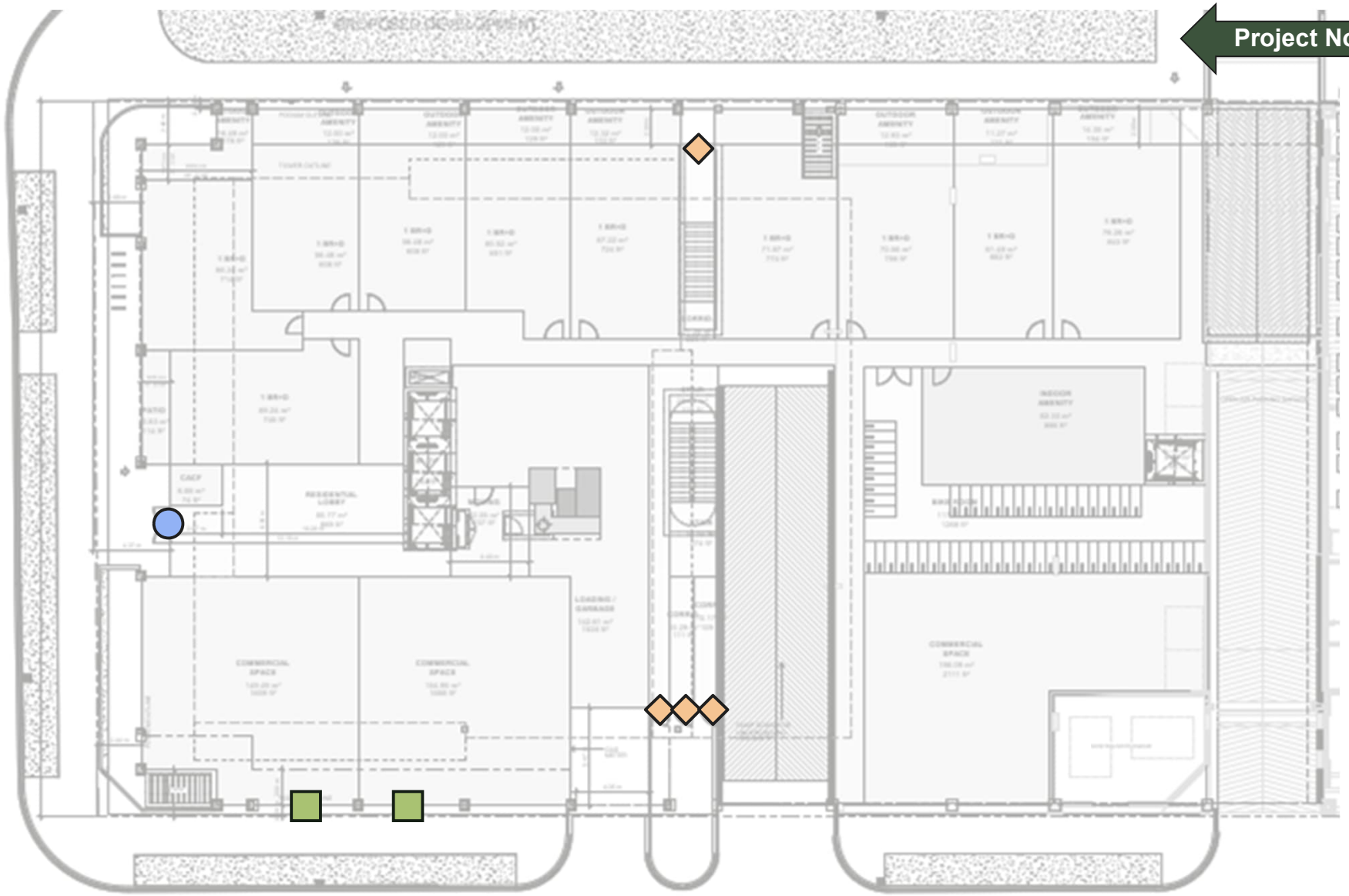


Figure 3: Areas of Interest – Grade level
(received January 5, 2024)

2.0 Approach

The objective of the wind tunnel study is to assist the design team and City Planning officials in making informed decisions about the building form considered and its influence on pedestrian comfort. This quantitative analysis involves the construction of a physical model of the development and surrounding features that influence wind flow. The physical model is instrumented with probes and tested in a wind tunnel. Afterwards, the wind tunnel data are combined with regional meteorological data; this analysis is then compared to the relevant wind criteria and standards to determine how appropriate the wind conditions are for the intended pedestrian usage.

This report has been prepared in accordance with the City of Burlington *Pedestrian Level Wind Study Guidelines and Terms of Reference (June 2020).*

2.1 Scale Model Construction

A 1:400 scale model of the proposed development at 2030 Caroline Street was constructed based on drawing information received by SLR from Chamberlain Architect Services Limited on December 15, 2023.

The proximity model of the surrounding area was built in block form for a radius of approximately 480 m from the site centre. As existing buildings surrounding the site will influence wind characteristics, existing buildings, in-construction buildings, and those buildings with SPA were included in the model for both the Existing Configuration and Proposed Configuration (per Section 1.1).

SLR assessed two configurations, for comparison, as follows:

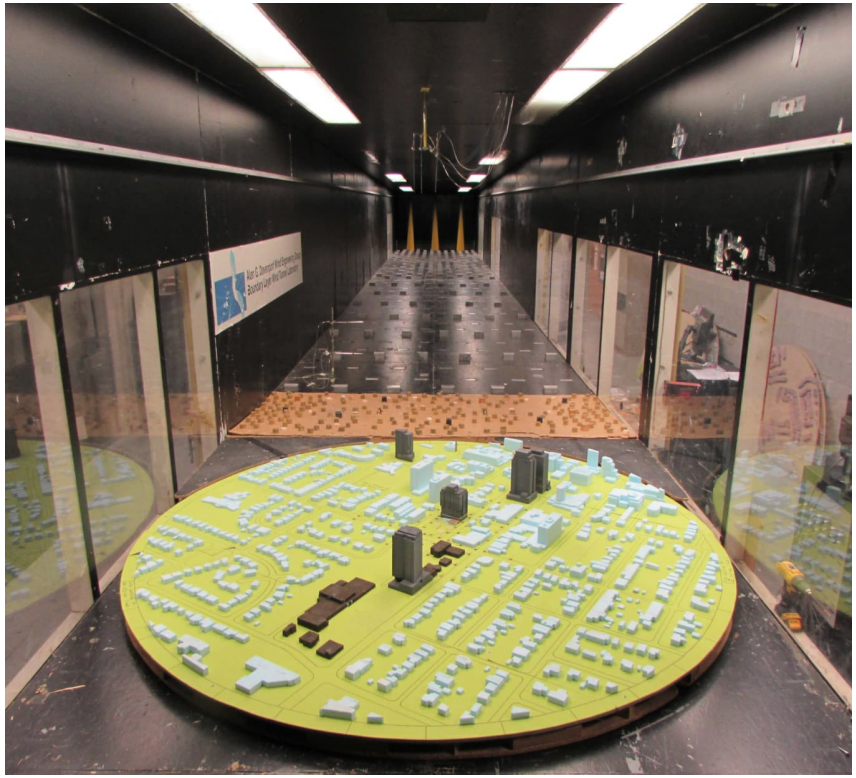
- **Existing Configuration:** Existing site with existing, in-construction, and SPA-approved surroundings.
- **Proposed Configuration:** Proposed development with existing, in-construction, and SPA-approved surroundings.

Photographs of the wind tunnel model showing both the Existing Configuration and the Proposed Configuration are included in Figures 4a and 4b.

2.2 Wind Tunnel

Wind tunnel tests were conducted in the Alan G. Davenport Wind Engineering Group Boundary-Layer Wind Tunnel Laboratory at the University of Western Ontario. The upstream test section of the wind tunnel included generic roughness blocks and turbulence-generating spires to modify the wind flow approaching the model. These features develop characteristics of the wind flow that are similar to the actual site. The test model is rotated on a turn-table to simulate different wind directions with the upstream terrain being changed as appropriate to reflect the various upwind conditions encountered around the site.

The test model was equipped with 89 omni-directional probes to record wind speed at the pedestrian-level (approximately 1.5 m above grade). The orientation of the model was rotated in 10° intervals on the turn-table to permit measurement of wind speed at each probe location for 36 wind directions. The wind tunnel data were then combined with the wind climate model for this region to predict the occurrence of wind speeds in the pedestrian realm and compare against wind criteria for comfort and safety.





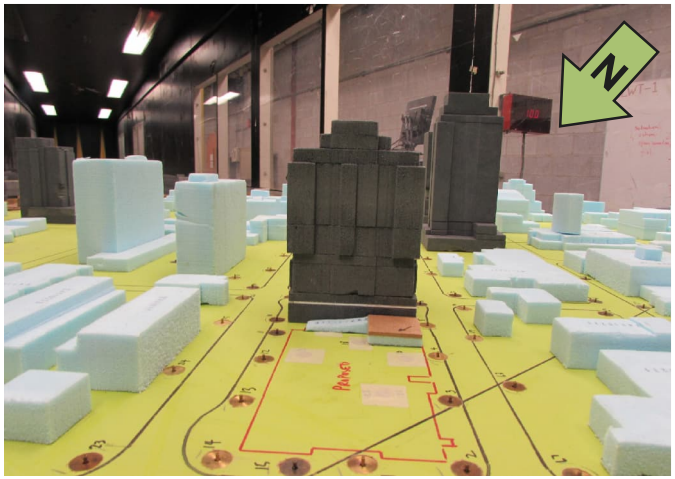
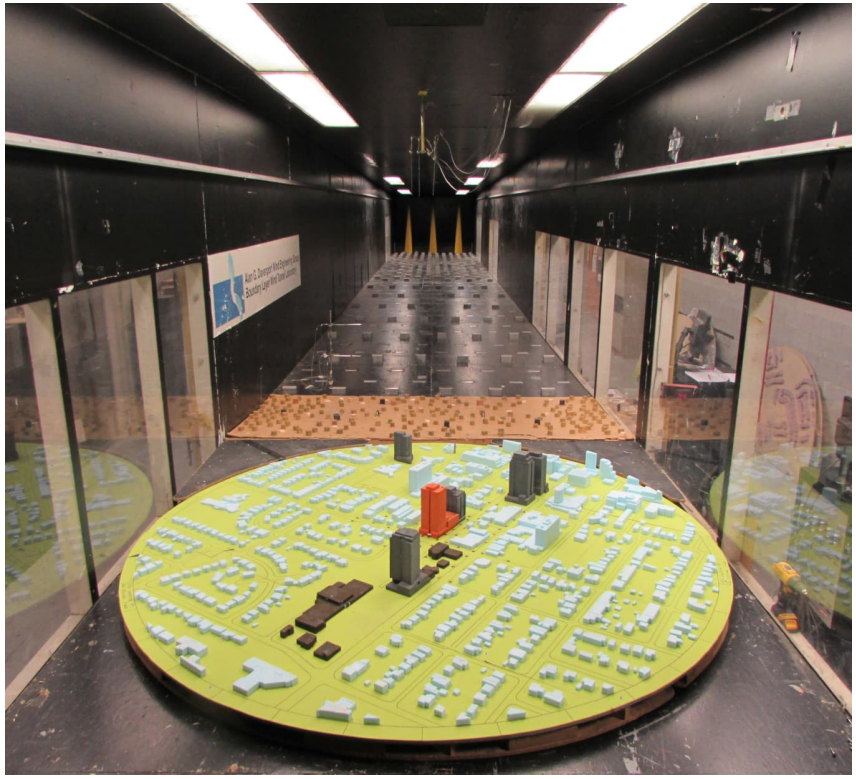
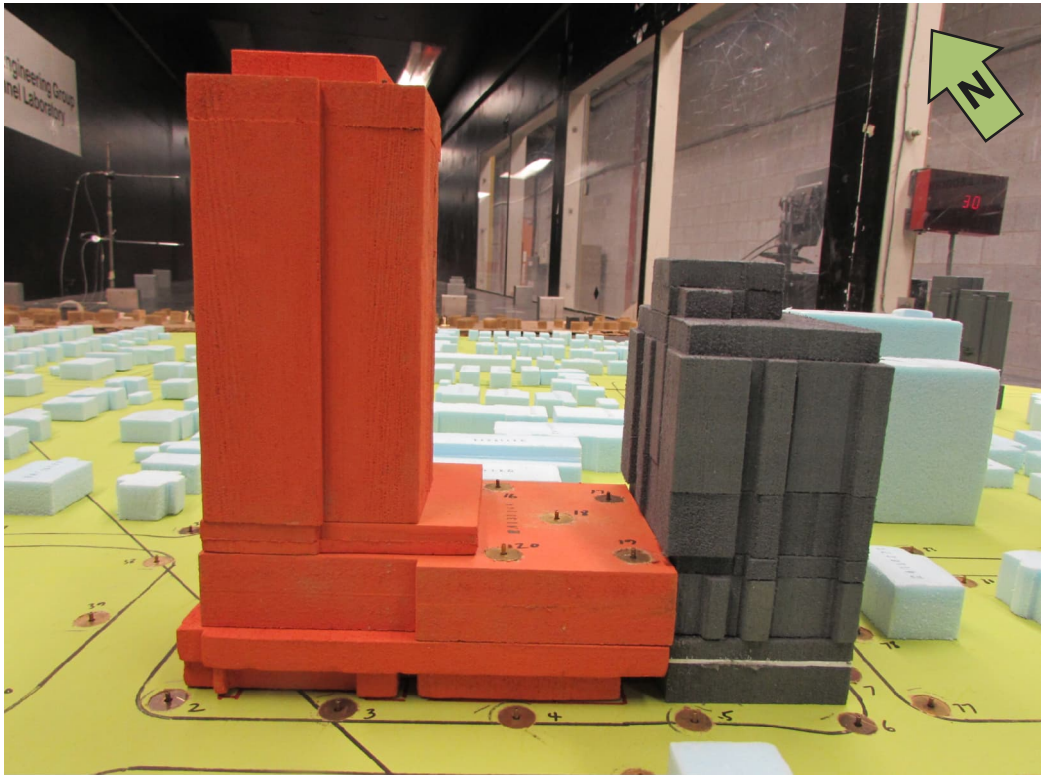


Figure 4a: Existing Configuration





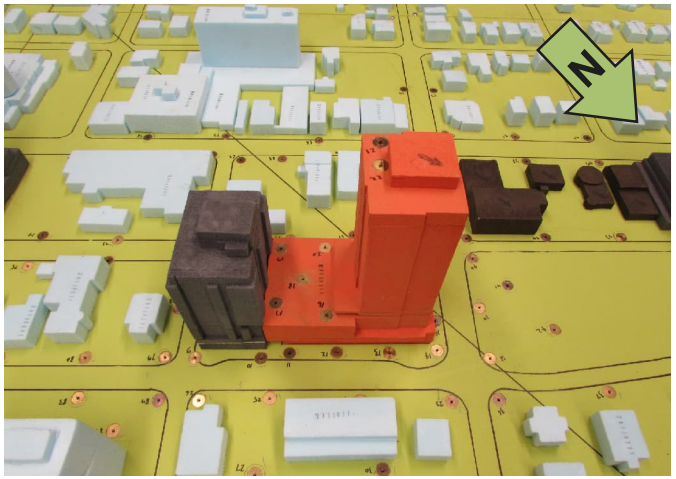


Figure 4b: Proposed Configuration

2.3 Wind Climate

Wind data recorded at John C. Munro International Airport in Hamilton for the period of 1993 to 2019 were obtained and analysed to create a wind climate model for the region. Annual and seasonal wind distribution diagrams ("wind roses") are shown in Figure 5. These diagrams illustrate the percentage of time wind blows from the 16 main compass directions. Of main interest are the longest peaks that identify the most frequently occurring wind directions. The annual wind rose indicates that wind approaching from the southwest and northeast quadrants are most prevalent. The seasonal wind roses readily show how the prevalent winds shift throughout the year. The seasonal wind roses show daytime winds, from 6:00 – 23:00, while the annual wind rose shows all hours.

The directions from which stronger winds (e.g., > 30 km/h) approach are also of interest as they have the highest potential of creating problematic wind conditions, depending upon site exposure and the building configurations. The wind roses in Figure 5 also identify the directional frequency of these stronger winds, as indicated in the figure's legend colour key. On an annual basis, strong winds occur from the southwest and northeast quadrants. All wind speeds and directions were included in the wind climate model.

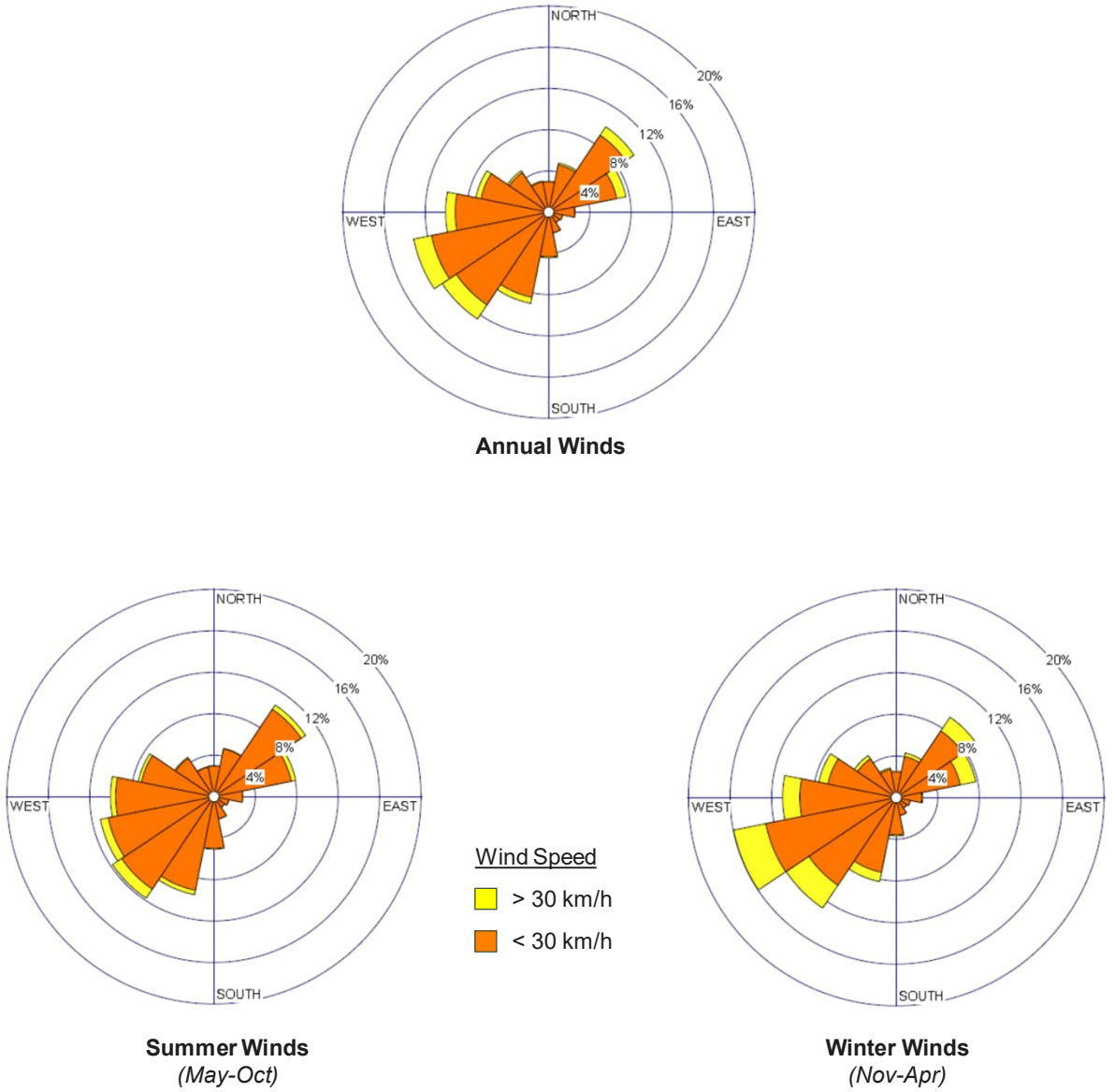


Figure 5: Wind Roses for John C. Munroe International Airport (1993 to 2019)

3.0 Pedestrian Wind Criteria

Wind comfort conditions are discussed in terms of being acceptable for certain pedestrian activities and are based on predicted wind force and the expected frequency of occurrence. Wind chill, clothing, humidity and exposure to direct sun, for example, all affect a person's thermal comfort; however, these influences are not considered in the wind comfort criteria.

The criteria utilized for this analysis is provided by the City of Burlington, in the document *Pedestrian Level Wind Study Guidelines and Terms of Reference (June 2020).* The comfort criteria, which is based on certain predicted hourly gust-equivalent mean (GEM) wind speeds being exceeded 20% of the time, are summarized in Table 1. By allowing for a 20% exceedance, it assumes wind speeds will be comfortable for the corresponding activity at least four out of five days. The comfort criteria consider only daytime hours, between 6:00am and 11:00pm. GEM is defined as the maximum of either mean wind speed or gust wind speed divided by 1.85.

The criterion for wind safety in the table is based on hourly gust wind speeds that are exceeded nine hours per year (approximately 0.1% of the time). When more than one event is predicted annually, wind mitigation measures are then advised. The wind safety criterion is shown in Table 2.

Table 1: Wind Comfort Criteria

Comfort Category	GEM Wind Speed Exceeded 20% of the Time	Description of Wind Comfort
Sitting	≤ 10 km/h	Calm or light breezes desired for outdoor restaurants and seating areas where one can read a paper comfortably.
Standing	≤ 14 km/h	Gentle breezes suitable for main building entrances and transit stops.
Leisurely Walking	≤ 17 km/h	Moderate breezes suitable for walking along pedestrian thorough fares.
Fast Walking	≤ 20 km/h	Strong breezes that can be tolerated if one's objective is to walk, run or cycle without lingering.
Uncomfortable	> 20 km/h	Strong winds of this magnitude are considered a nuisance for most activities, and wind mitigation is typically recommended.

Table 2: Wind Safety Criterion

Criterion	Gust Wind Speed Exceeded Once Per Year (0.1%)	Description of Wind Effects
Exceeded	> 90 km/h	Excessive gust speeds that can adversely affect a pedestrian's balance and footing. Wind mitigation is typically required.

4.0 Results

Figures 6a through 7d present graphical images of the wind comfort conditions for the summer and winter months around the proposed development. These represent the seasonal extremes of best and worst case. The “comfort zones” shown are based on an integration of wind speed and frequency for all 36 wind directions tested with the seasonal wind climate model. The presence of mature trees can lead to wind comfort levels that are marginally more comfortable than shown, during seasons when foliage is present. Annual wind safety results are provided in Appendix A, as well as in Figures 8a and 8b.

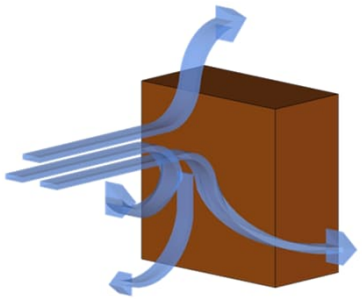
There are generally accepted wind comfort levels that are desired for various pedestrian uses. However, in some climates these may be difficult to achieve in the winter due to the overall climate. For sidewalks, walkways and pathways, wind comfort suitable for fast walking are desirable year-round but may not be feasible in the winter. For main entrances, transit stops, and public amenity spaces such as parks and playgrounds, wind conditions conducive to standing are preferred throughout the year. For on-site amenity areas, wind conditions suitable for sitting or standing are desirable during the summer, with stronger wind flows, conducive to fast walking, tolerated in the winter. The most stringent category of sitting is desirable during the summer for dedicated seating areas, such as patios, where calmer wind is expected for the comfort of patrons.

4.1 Building Entrances, Retail Entrances & Sidewalks (Locations 1 to 15)

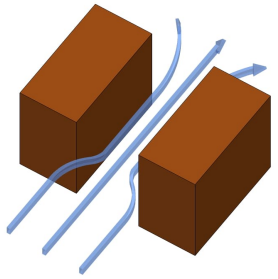
In the Existing Configuration, wind conditions on the site are generally suitable for fast walking or better throughout the year (Figures 6a and 6b). The exception is at the southeast corner of the adjacent building (Location 9) where wind conditions are uncomfortable in the winter. Also, the wind conditions at the entrance to the adjacent building are suitable for standing the summer and leisurely walking in the winter.

With the addition of the proposed development, wind conditions are generally suitable for fast walking or better throughout the year on the surrounding sidewalks (Figures 7a and 7b). Two exceptions are along the north facade of the building (Locations 2 and 15) where wind conditions are uncomfortable in the winter. To improve wind conditions in these areas we recommend the design team include a canopy along the entire west facade of the building, wrapping around the southwest corner, to deflect the downwashing flows from the tower. Alternatively, a larger step back could be included at the podium on the west side of the tower. Another area with uncomfortable wind conditions in the winter is the southwest corner of the adjacent existing tower (Location 6).

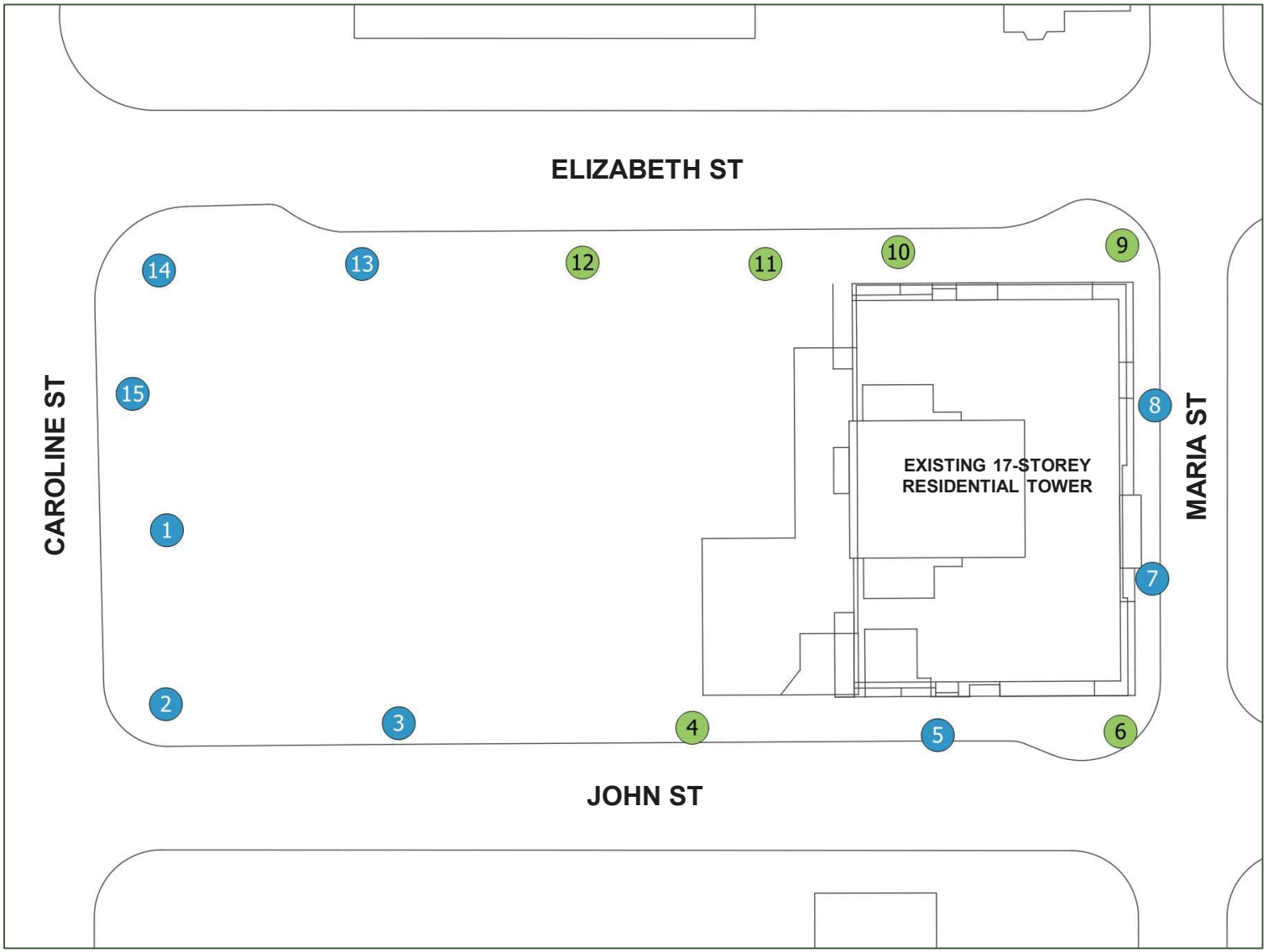
At the main entrance (Location 1) wind conditions are conducive to standing in the summer and leisurely walking in the winter in the Proposed Configuration. At the retail entrances and exits (near Locations 3 and 13, respectively) wind conditions are suitable for standing in the summer and leisurely walking in the winter. If calmer wind conditions are desired at the retail entrances, we suggest recessing the entrances from the main facade and/or including local wind screens on either side of the doors.

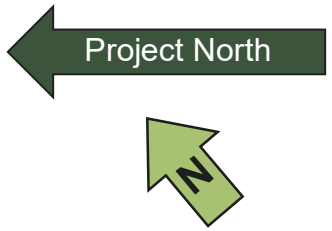


Downwashing Flow



Channeling Flow





Predicted Comfort Classes

- (#) Sitting
- (#) Standing
- (#) Leisurely Walking
- (#) Fast walking
- (#) Uncomfortable

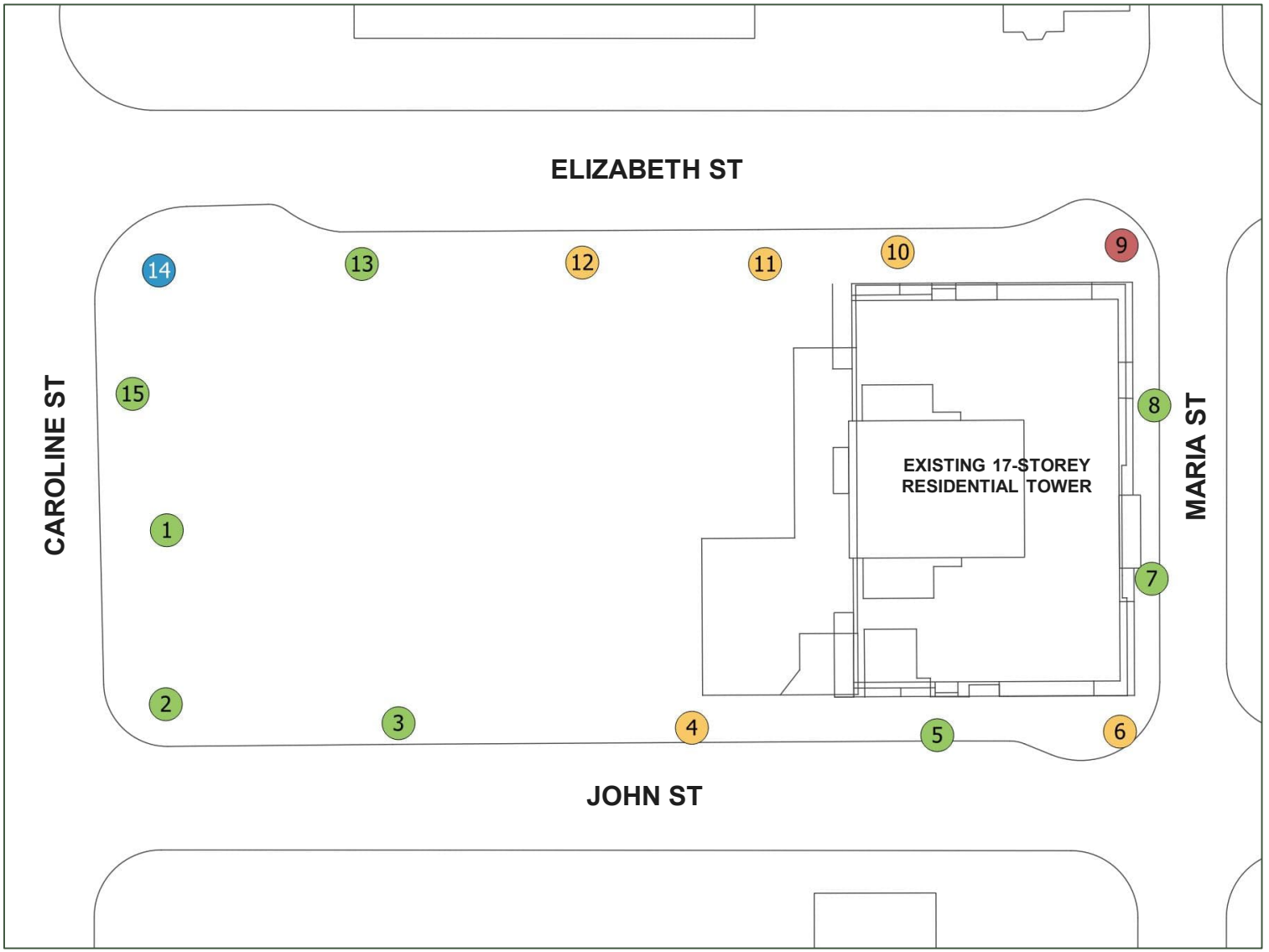
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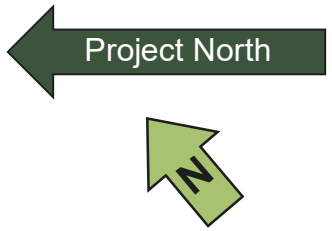
1) Not to scale.

2) Pedestrian level wind sensor location. (#)

3) Diagram may be divided by levels (e.g., grade, amenity floors, etc.).

Figure 6a: Existing Configuration – Pedestrian Wind Conditions – On-Site Walkways – Summer





Predicted Comfort Classes

- (#) Sitting
- (#) Standing
- (#) Leisurely Walking
- (#) Fast walking
- (#) Uncomfortable

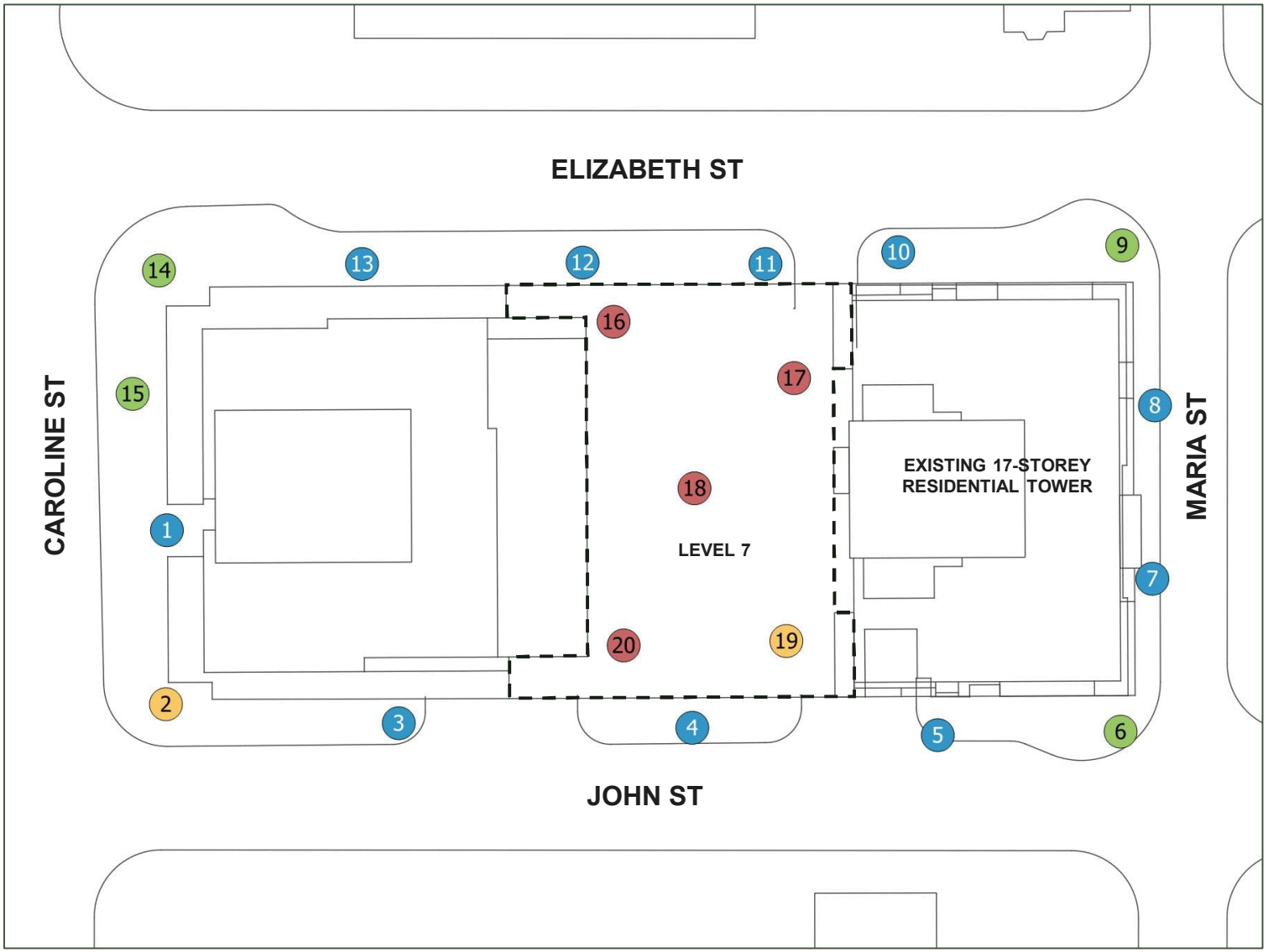
Notes:

1) Not to scale.

2) Pedestrian level wind sensor location. (#)

3) Diagram may be divided by levels (e.g., grade, amenity floors, etc.).

Figure 6b: Existing Configuration – Pedestrian Wind Conditions – On-Site Walkways – Winter



Project North

N

Predicted Comfort Classes

- (#) Sitting
- (#) Standing
- (#) Leisurely Walking
- (#) Fast walking
- (#) Uncomfortable
- Outdoor Amenity Area

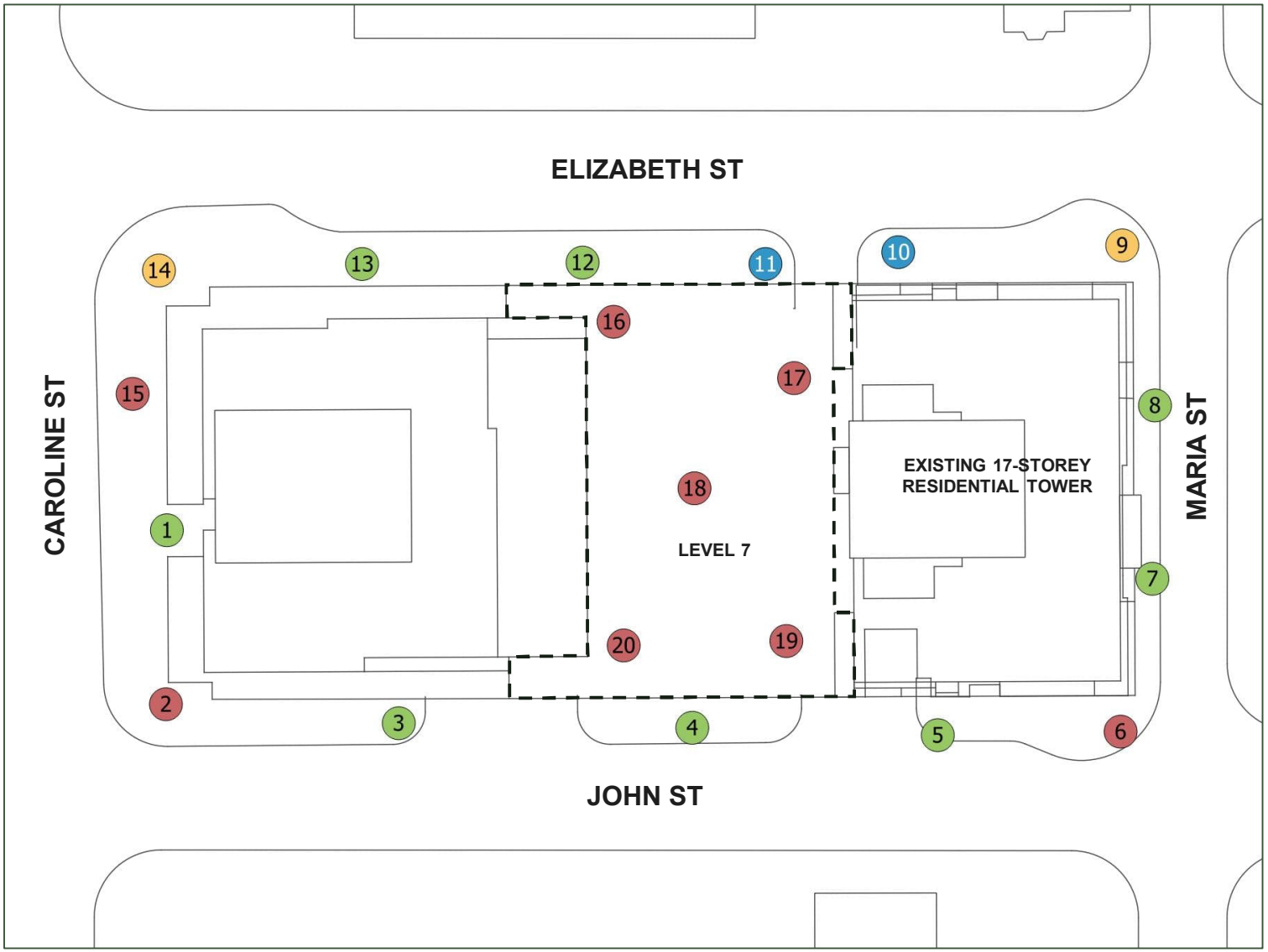
Notes:

1) Not to scale.

2) Pedestrian level wind sensor location. (#)

3) Diagram may be divided by levels (e.g., grade, amenity floors, etc.).

Figure 7a: Proposed Configuration – Pedestrian Wind Conditions – Building Entrances, Retail Entrances & Sidewalks – Summer



Project North

N

Predicted Comfort Classes

- (#) Sitting
- (#) Standing
- (#) Leisurely Walking
- (#) Fast walking
- (#) Uncomfortable
- Outdoor Amenity Area

Notes:

1) Not to scale.

2) Pedestrian level wind sensor location. (#)

3) Diagram may be divided by levels (e.g., grade, amenity floors, etc.).

Figure 7b: Proposed Configuration – Pedestrian Wind Conditions – Building Entrances, Retail Entrances & Sidewalks – Winter

The design team should be aware the main entrance to the proposed development is directly exposed to the southwesterly prevailing winds. In addition to the canopy recommended earlier, we recommend including a vestibule at the main entrance to minimize the airflow into the building on windy days, as these winds could exacerbate issues with stack effect, due to the direct connection between the doors and the elevator shaft.

The main entrance to the adjacent 17-storey building is located on the south facade (near Location 7), where wind conditions remain comfortable for standing in the summer and leisurely walking in the winter of the Proposed Configuration (Figures 7a and 7b).

4.2 Outdoor Amenity Terraces (Locations 16 to 22)

Wind conditions on the 7th floor outdoor amenity terrace (Locations 16 through 20) are generally uncomfortable throughout the year (Figures 7a and 7b). The exception is on the southwest corner of the terrace (Location 19), where wind conditions in the summer are conducive to fast walking.

The strong wind flows that occur on the 7th floor terrace are partially due to the downwashing of the prevailing winds off the proposed and adjacent towers. These wind flows are then channel between the towers, creating local accelerations.

To improve wind conditions on the 7th floor terrace, the design team should consider mitigation options including, but not limited to:

- Wind screens on the north and south edges of the space.
- Pergolas and/or trellises over passive activity areas.
- Local wind screens throughout the space, to the north and south of passive activity areas.

4.3 Surrounding Sidewalks (Locations 23 through 65)

Wind conditions on the surrounding sidewalks of Caroline Street, Maria Street, Elizabeth Street, John Street, and Brant Street are generally comfortable for fast walking or better throughout the year in the Existing Configuration (Figures 8a and 8b). The exceptions are along Maria Street and Elizabeth Street in the winter, where wind conditions are considered to be uncomfortable (Locations 25, 26, 77, 78, and 87). Uncomfortable wind conditions also occur on John Street (Location 74) and on Brant Street in the winter (Location 49). At the nearby transit stops (Locations 52 and 65) wind conditions are comfortable for sitting or standing year-round in the Existing Configuration.

In the Proposed Configuration, wind conditions on the surrounding sidewalks are generally remain comfortable for fast walking or better year-round (Figures 9a and 9b). The exceptions are along Caroline Street and Maria Street in the winter where wind conditions uncomfortable in the winter (Locations 38, 39, 77 and 78). In addition, uncomfortable wind conditions occur on Brant Street (Location 39) and on John Street (Locations 68 and 74) in the winter. At the nearby transit stops wind conditions remain conducive to sitting or standing year-round (Locations 52 and 65) in the Proposed Configuration.

To improve wind conditions along the nearby sidewalks of Caroline Street at the Site Plan stage of development, the design team should consider wind mitigation measures to deflect and disrupt the downwashing flows from the prevailing southwesterly winds. The details of such features can be determined at the time.

4.4 Wind Safety

In the Existing Configuration, the wind safety criterion is generally met on-site and off-site on an annual basis (Figure 10a). The exceptions are along Maria Street (Location 88) and along Brant Street (Location 49).

In the Proposed Configuration, the wind safety criterion is generally met at grade on-site and off-site on an annual basis (Figure 10b). The two exceptions are again on Maria Street (Location 88) and on Brant Street (Location 49). On-site, the wind safety criterion is exceeded on the 7th floor terrace (Locations 16, 17, 18, and 20).

To improve wind safety conditions on the 7th floor terrace at the detailed design stage, we recommend the inclusion of mitigation features that were previously described in Sections 4.1 and 4.2. SLR will work with the design team to develop wind control solutions for the proposed development.

5.0 Updated Architectural Information

SLR received updated architectural information from Chamberlain Architect Services Limited dated June 21, 2024. We understand that in response to comments received from the City and the public through the pre-submission consultation process, one notable modification has been made to the design of the project. The location of the tower atop the podium has shifted approximately 3 m to the north and approximately 2.5 m to the east, thereby creating a separation distance of more than 40 m between the proposed tower and the existing tower to the south. To accommodate this separation distance, the horizontal projection of the podium beyond the balconies has been adjusted. The projection is now approximately 1.5 m on the north side of the tower at the northeast corner.

The reduction in the podium projection beyond the tower and balconies will have minimal influence on wind conditions in the vicinity. We expect wind conditions in the middle of the north facade (Location 15) to remain similar to those presented in this report. And there is the potential for windy conditions at the northeast corner of the building (Location 14).

In addition, the height of the building has increased from approximately 87 m to approximately 95 m (both values include the mechanical penthouse). This is an increase in height of less than 10%, which is minimal, and hence we do not expect a change in overall wind conditions at grade.

We recommend the overall wind conditions, including the adverse wind conditions identified in Section 4.0, be addressed at the Site Plan Approval (SPA) stage of the planning process. During detailed design, the team will be able to focus on the architectural details required to mitigate wind conditions, where necessary.

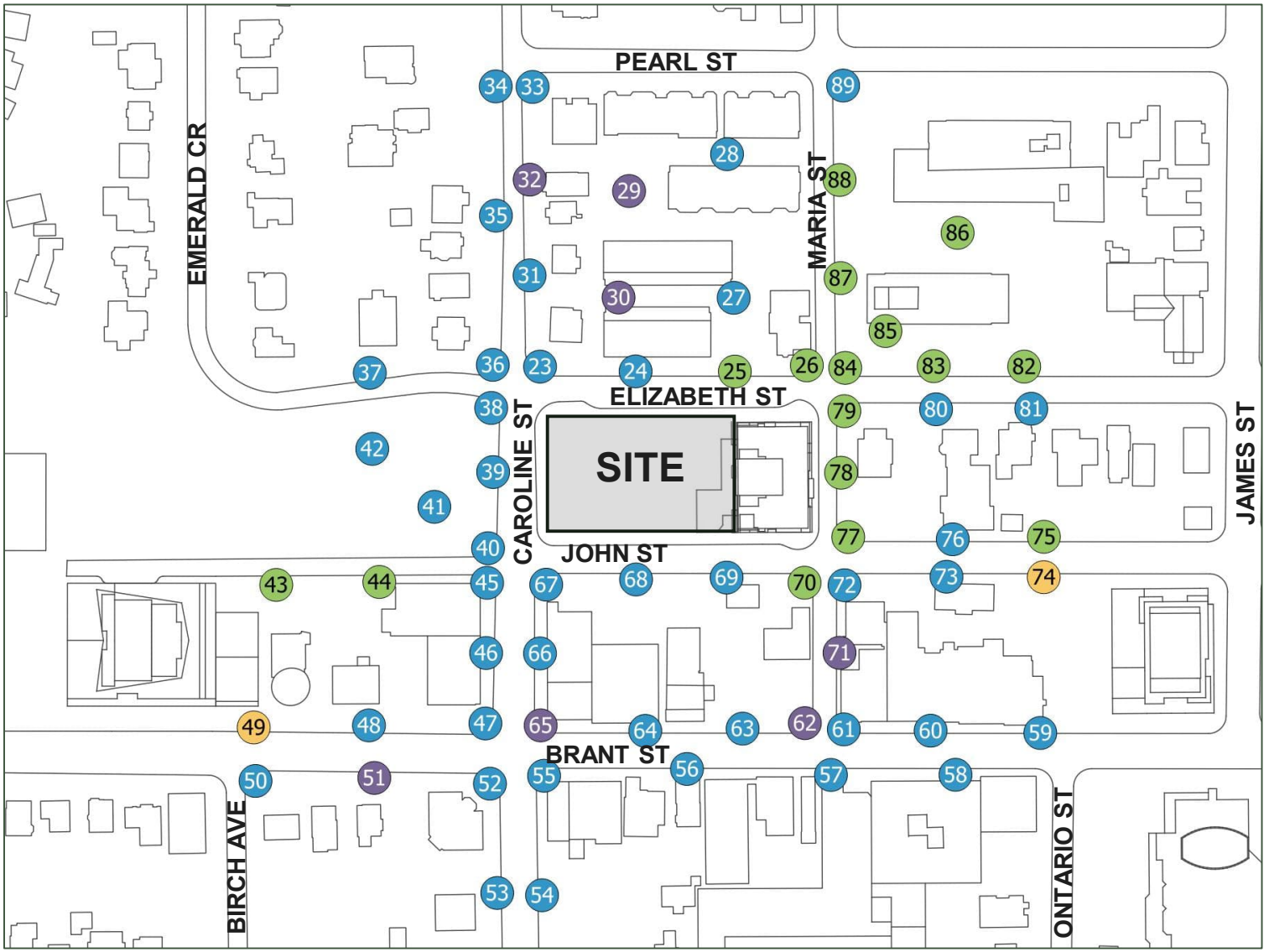


Figure 8a: Existing Configuration – Pedestrian Wind Conditions – Surrounding Sidewalks – Summer

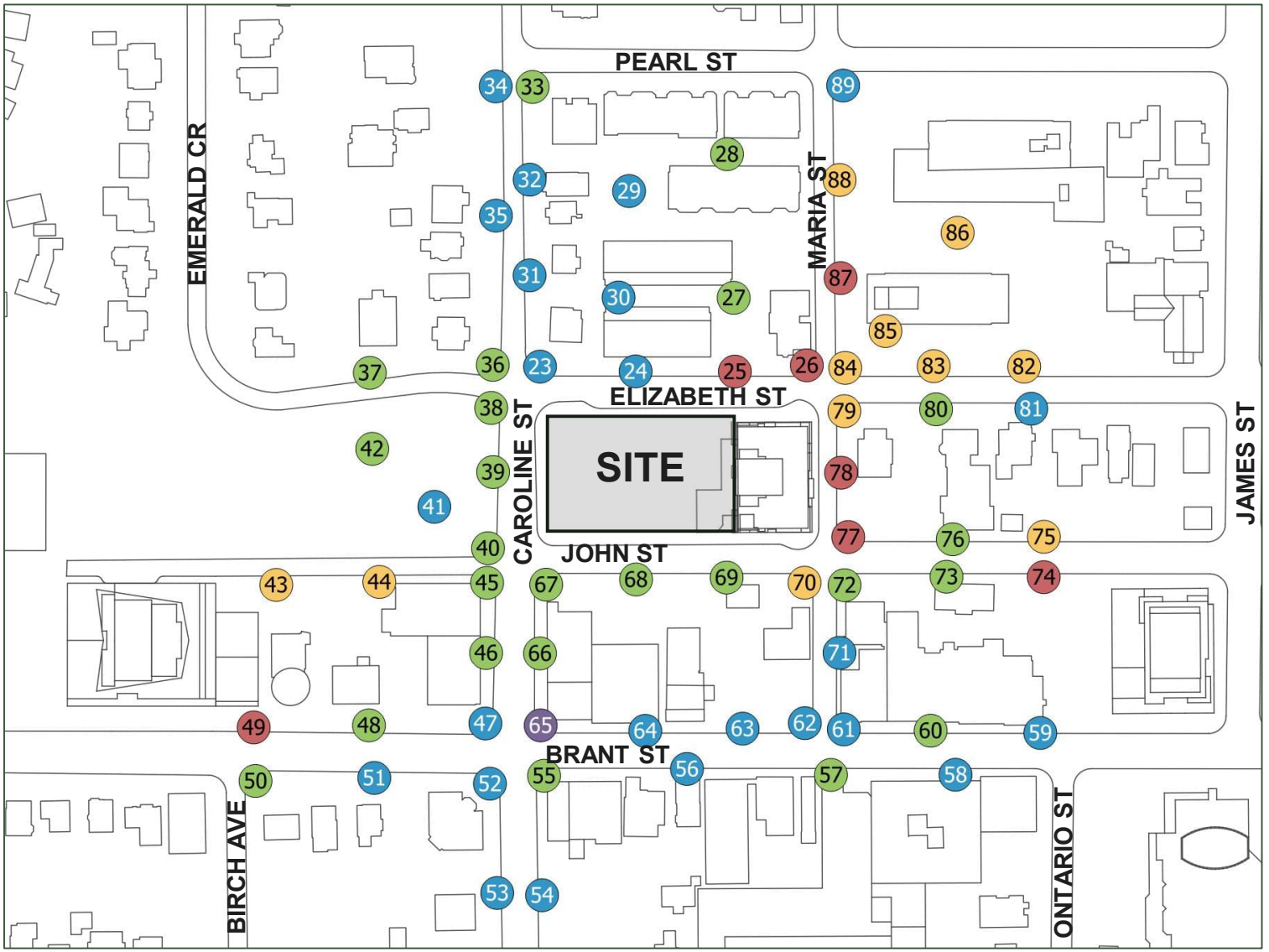


Figure 8b: Existing Configuration – Pedestrian Wind Conditions – Surrounding Sidewalks – Winter

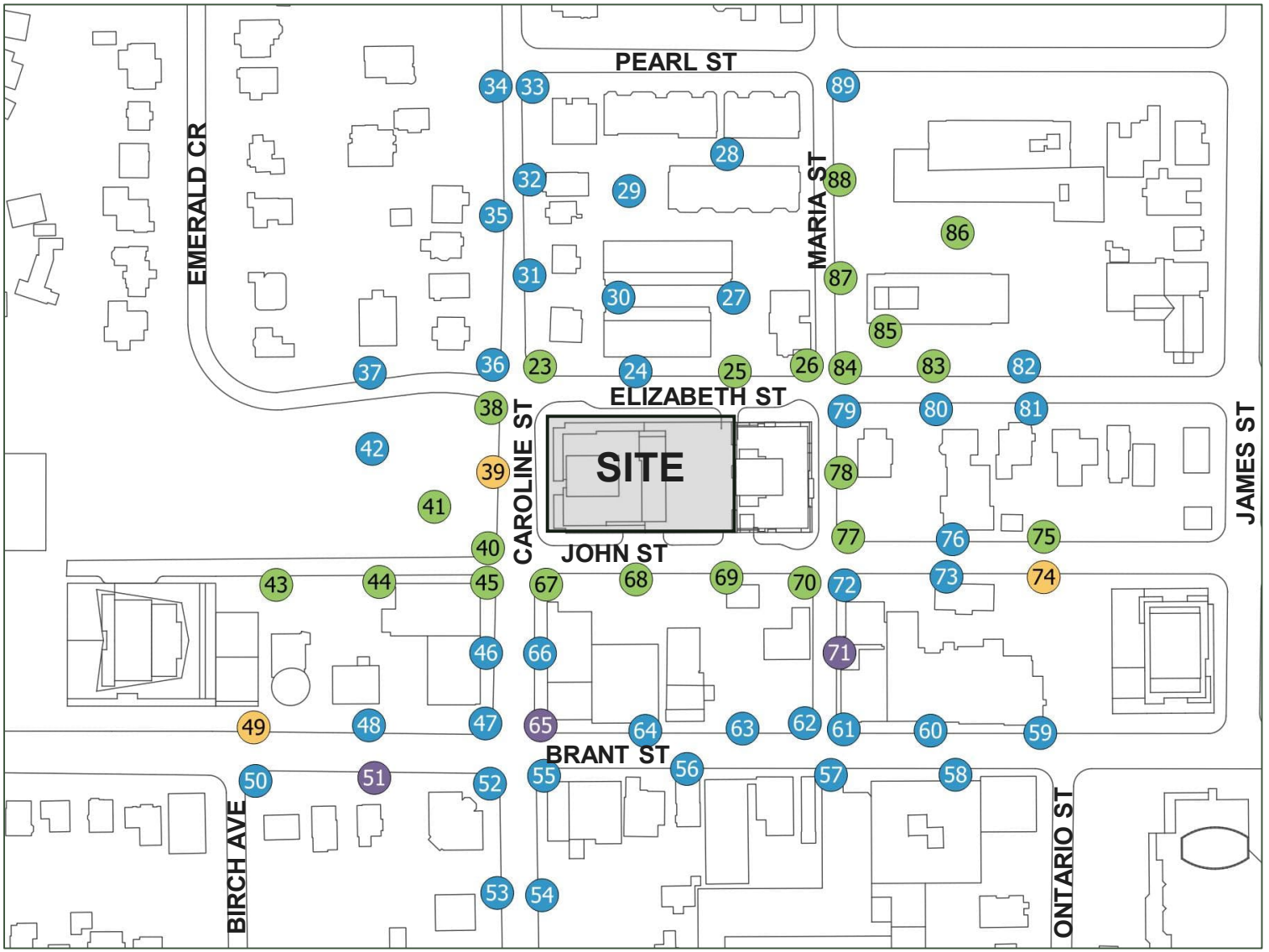


Figure 9a: Proposed Configuration – Pedestrian Wind Conditions – Surrounding Sidewalks – Summer

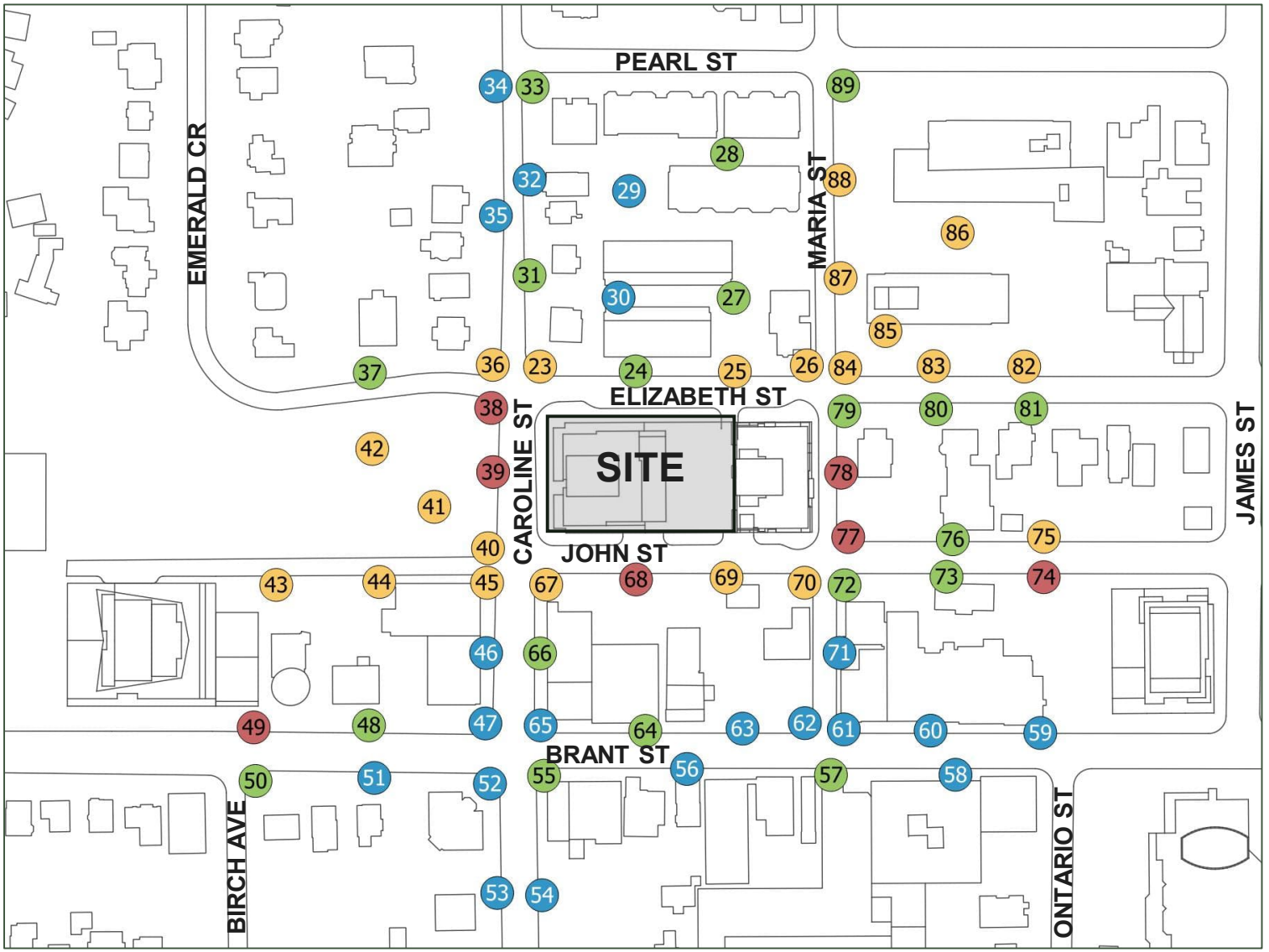


Figure 9b: Proposed Configuration – Pedestrian Wind Conditions – Surrounding Sidewalks – Winter

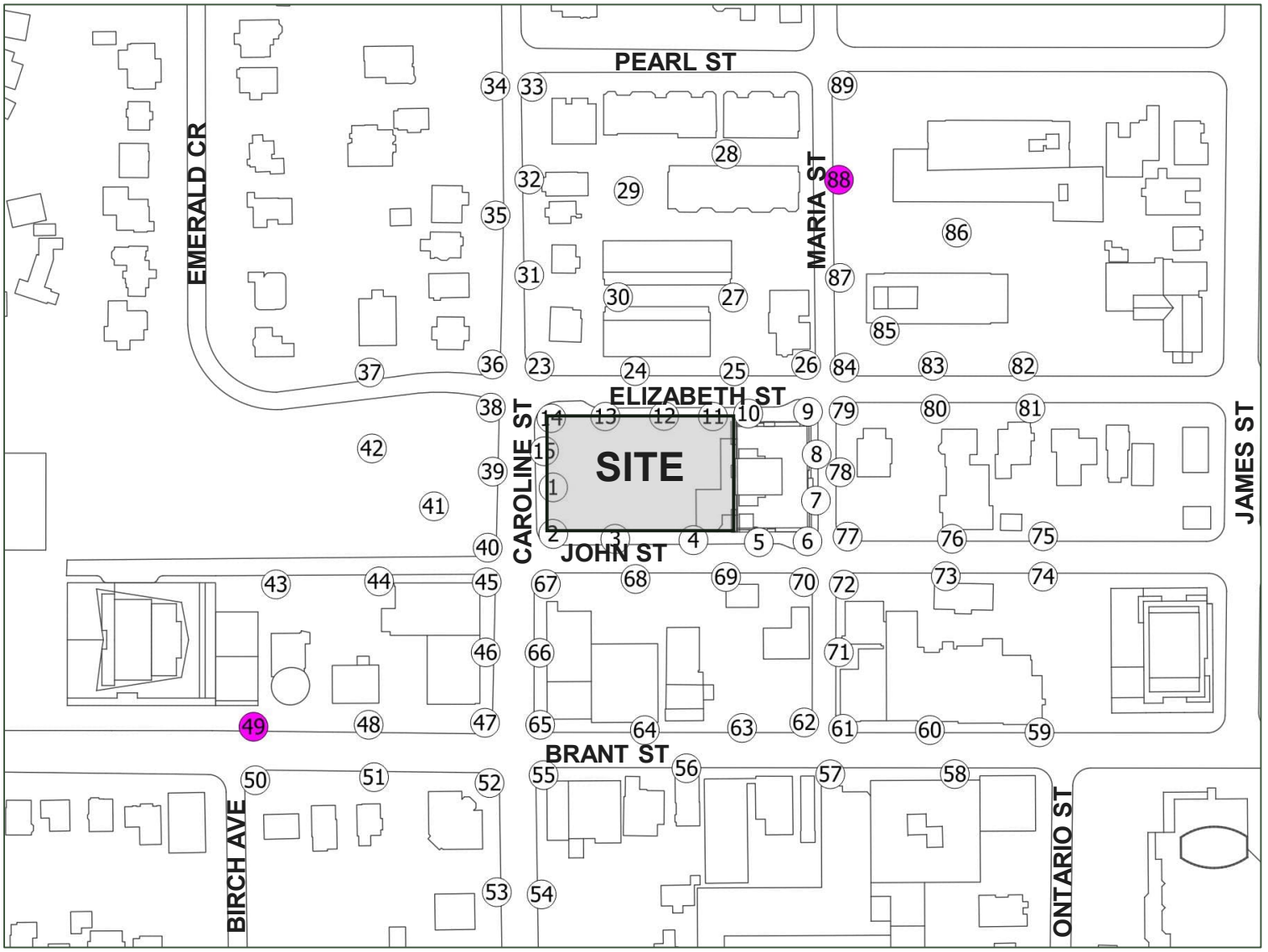


Figure 9a: Existing Configuration – Pedestrian Wind Safety Conditions – Annual

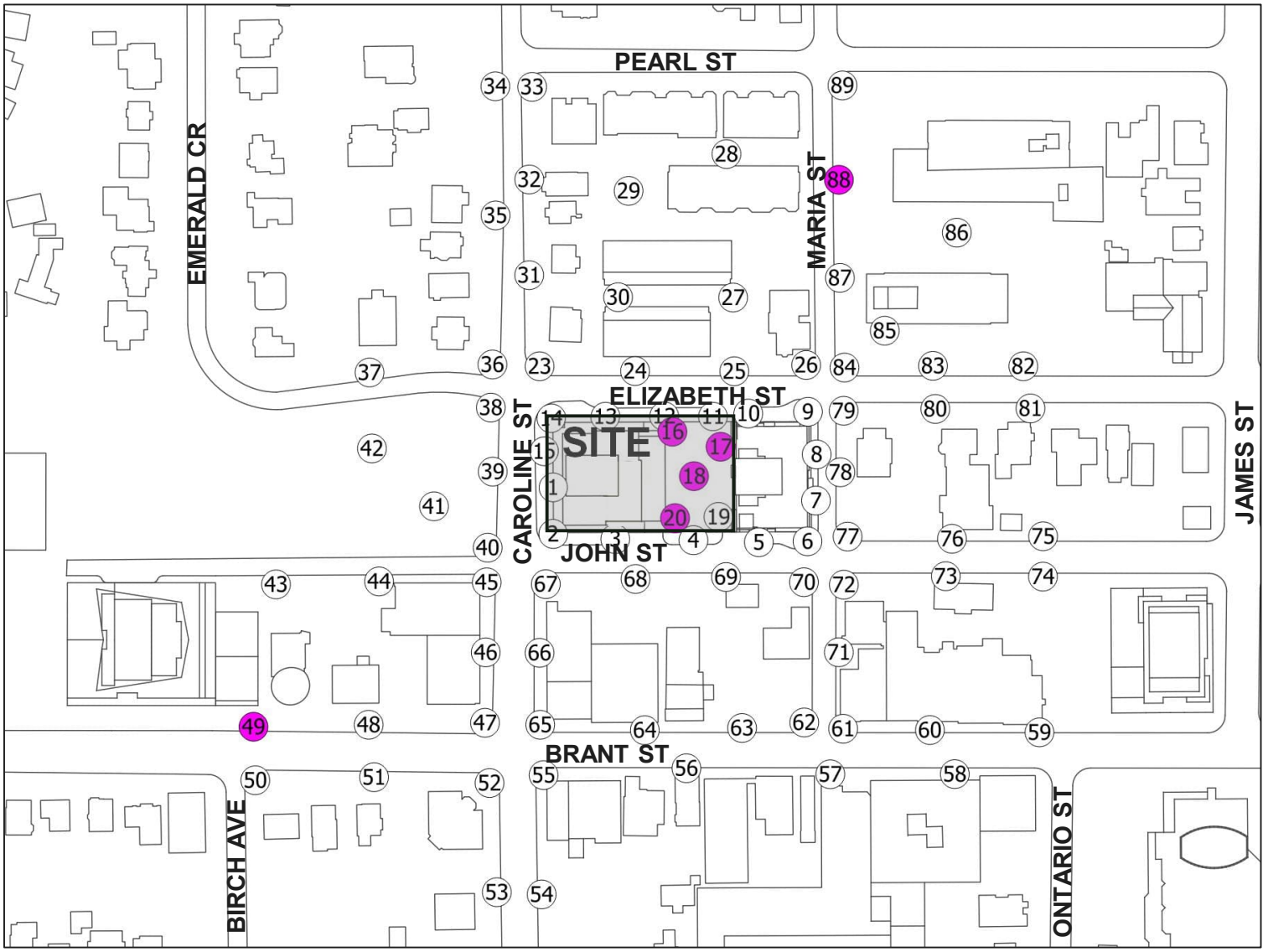


Figure 9b: Proposed Configuration – Pedestrian Wind Safety Conditions – Annual

6.0 Conclusion & Recommendations

The pedestrian wind conditions predicted for the proposed development at 2030 Caroline Street in Burlington, Ontario, have been assessed through wind tunnel modeling techniques. Based on the results of our assessment, the following conclusions have been reached:

- In both the Existing Configuration and Proposed Configuration, two off-site areas exceed the wind safety criterion. In the Proposed Configuration, the wind safety criterion is exceeded on the 7th floor terrace at four locations. Recommendations for wind control measures are provided.
- On-site wind conditions are generally suitable for the intended use throughout the year in both the Existing Configuration and Proposed Configuration. In the Proposed Configuration, uncomfortable wind conditions occur in the winter along the north side of the building. Recommendations are provided for this area and the retail entrances.
- Wind conditions on the 7th floor terrace are windier than desired throughout the year. Wind control measures are recommended.
- SLR will work with the design team to determine practical and effective wind control measures prior to the next planning submission. SLR is confident the problematic wind conditions described herein can be mitigated satisfactorily through mitigative design elements.

7.0 Statement of Limitations

This report has been prepared by SLR Consulting (Canada) Ltd. (SLR) for Inaria Burlington Inc. (Client) in accordance with the scope of work and all other terms and conditions of the agreement between such parties. SLR acknowledges and agrees that the Client may provide this report to government agencies, interest holders, and/or Indigenous communities as part of project planning or regulatory approval processes. Copying or distribution of this report, in whole or in part, for any other purpose other than as aforementioned is not permitted without the prior written consent of SLR.

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8.0 References

Alan G. Davenport Wind Engineering Group, “Wind Tunnel Testing: A General Outline” May 2007.

Blocken, B., and J. Carmeliet (2004) “Pedestrian Wind Environment around Buildings: Literature Review and Practical Examples” *Journal of Thermal Environment and Building Science*, 28(2).

Cochran, L. (2004) “Design Features to Change and/or Ameliorate Pedestrian Wind Conditions” ASCE Structures Conference 2004.

Davenport, A.G. (1972) "An Approach to Human Comfort Criteria for Environmental Wind Conditions", *Colloquium on Building Climatology*, Stockholm, September 1972.

Durgin, F.H. (1997) “Pedestrian level wind criteria using the equivalent average” *Journal of Wind Engineering and Industrial Aerodynamics* 66.

Isyumov, N. and Davenport, A.G., (1977) “The Ground Level Wind Environment in Built-up Areas”, Proc. of 4th Int. Conf. on Wind Effects on Buildings and Structures, London, England, Sept. 1975, Cambridge University Press, 1977.

Isyumov, N., (1978) “Studies of the Pedestrian Level Wind Environment at the Boundary Layer Wind Tunnel Laboratory of the University of Western Ontario”, *Jrnl. Industrial Aerodynamics*, Vol. 3, 187-200, 1978.

Irwin, P.A. (2004) “Overview of ASCE Report on Outdoor Comfort Around Buildings: Assessment and Methods of Control” ASCE Structures Conference 2004.

Kapoor, V., Page, C., Stefanowicz, P., Livesey, F., Isyumov, N., (1990) “Pedestrian Level Wind Studies to Aid in the Planning of a Major Development”, *Structures Congress Abstracts*, American Society of Civil Engineers, 1990.

Koss, H.H. (2006) “On differences and similarities of applied wind criteria” *Journal of Wind Engineering and Industrial Aerodynamics* 94.

Soligo, M.J., P.A., Irwin, C.J. Williams, G.D. Schuyler (1998) “A Comprehensive Assessment of Pedestrian Comfort Including Thermal Effects” *Journal of Wind Engineering and Industrial Aerodynamics* 77/78.

Stathopoulos, T., H. Wu and C. Bedard (1992) “Wind Environment Around Buildings: A Knowledge-Based Approach” *Journal of Wind Engineering and Industrial Aerodynamics* 41/44.

Stathopoulos, T., and H. Wu (1995) “Generic models for pedestrian-level winds in built-up regions” *Journal of Wind Engineering and Industrial Aerodynamics* 54/55.

Wu, H., C.J. Williams, H.A. Baker and W.F. Waechter (2004) “Knowledge-based Desk-top Analysis of Pedestrian Wind Conditions”, ASCE Structures Conference 2004.

Appendix A

Pedestrian Wind Comfort & Safety Tables

Interpretation of Results

Example Table 1 below illustrates the wind comfort and safety criteria. The table provides the hourly mean wind speeds being exceeded 20% of the time for comfort for each of the four seasons for each configuration. It also categorizes the wind speeds as either sitting, standing, leisure walking, fast walking or uncomfortable. In addition, the table provides the gust wind speed exceeded 0.1% of the time annually.

For instance, at Location 1 there is not data in the Existing Configuration, while in the Proposed Configuration, wind conditions are suitable for sitting in the summer and standing in the winter.

At Location 3, wind conditions are suitable for sitting year-round in the Existing Configuration. In the Proposed Configuration, wind conditions are suitable for fast walking in the summer and are uncomfortable in the winter. In addition, the safety criteria is exceeded on an annual basis at Location 3 in the Proposed Configuration.

The categories are summarized in **Table A**.

Example Table 1: Pedestrian Wind Conditions

Location	Configuration	Wind Comfort		Wind Safety
		GEM Wind Speed Exceeded 20% of the Time (km/h)		Gust Speed Exceeded 0.1% of the Time (km/h)
		Summer	Winter	
1	Existing			35.7
1	Proposed	9.8	16.2	45.3
2	Existing	15.6	20.2	75.8
2	Proposed	17.2	26.0	87.6
3	Existing	8.9	7.0	42.9
3	Proposed	18.3	22.5	92.4

Example Table 2: Categories

Criteria	Speed
Sitting	≤ 10
Standing	≤ 14
Leisurely Walking	≤ 17
Fast Walking	≤ 20
Uncomfortable	≤ 20
Safety	> 90

Table B1-1: Pedestrian Wind Conditions

Location	Configuration	Wind Comfort		Wind Safety
		GEM Speed Exceeded 20% of the Time (km/h)		Gust Speed Exceeded 0.1% of the Time (km/h)
		Summer	Winter	
1	Existing	12.3	15.0	54.8
1	Proposed	12.7	15.6	60.9
2	Existing	11.8	14.6	53.3
2	Proposed	17.7	21.8	83.0
3	Existing	13.7	16.6	69.7
3	Proposed	12.3	15.5	59.6
4	Existing	15.0	18.3	73.1
4	Proposed	12.7	16.1	63.4
5	Existing	13.3	16.2	68.4
5	Proposed	12.9	16.6	66.3
6	Existing	15.7	19.7	72.6
6	Proposed	15.9	20.4	76.9
7	Existing	12.7	16.2	66.7
7	Proposed	13.0	16.2	67.2
8	Existing	13.2	15.9	73.8
8	Proposed	12.8	15.5	71.9
9	Existing	16.9	20.1	72.6
9	Proposed	16.6	19.7	72.7
10	Existing	15.4	19.2	78.7
10	Proposed	11.5	14.0	50.7

Table B1-2: Pedestrian Wind Conditions

Location	Configuration	Wind Comfort		Wind Safety
		GEM Speed Exceeded 20% of the Time (km/h)		Gust Speed Exceeded 0.1% of the Time (km/h)
		Summer	Winter	
11	Existing	15.7	18.9	80.2
11	Proposed	10.7	13.0	51.3
12	Existing	14.7	17.8	70.0
12	Proposed	12.4	15.1	62.0
13	Existing	13.1	15.8	61.7
13	Proposed	13.0	15.9	66.1
14	Existing	11.2	13.6	50.0
14	Proposed	15.8	19.7	75.1
15	Existing	12.5	15.3	55.9
15	Proposed	16.7	20.7	86.3
16	Existing			
16	Proposed	20.7	25.4	92.2
17	Existing			
17	Proposed	21.2	26.9	103.2
18	Existing			
18	Proposed	21.2	26.4	91.0
19	Existing			
19	Proposed	19.1	23.5	89.4
20	Existing			
20	Proposed	21.2	27.2	101.8

Table B1-3: Pedestrian Wind Conditions

Location	Configuration	Wind Comfort		Wind Safety
		GEM Speed Exceeded 20% of the Time (km/h)		Gust Speed Exceeded 0.1% of the Time (km/h)
		Summer	Winter	
21	Existing			
21	Proposed			
22	Existing			
22	Proposed			
23	Existing	11.1	13.8	51.1
23	Proposed	14.5	18.2	66.3
24	Existing	10.8	13.4	47.8
24	Proposed	13.1	16.9	82.4
25	Existing	16.4	20.3	71.9
25	Proposed	14.9	18.0	69.1
26	Existing	16.1	20.1	73.9
26	Proposed	14.3	17.7	66.8
27	Existing	13.0	16.0	60.8
27	Proposed	12.0	15.1	57.5
28	Existing	11.8	14.6	55.0
28	Proposed	12.5	15.8	61.7
29	Existing	9.6	12.0	44.4
29	Proposed	10.5	13.3	51.4
30	Existing	9.7	12.3	45.3
30	Proposed	11.0	13.7	51.3

Table B1-4: Pedestrian Wind Conditions

Location	Configuration	Wind Comfort		Wind Safety
		GEM Speed Exceeded 20% of the Time (km/h)		Gust Speed Exceeded 0.1% of the Time (km/h)
		Summer	Winter	
31	Existing	10.8	13.8	53.6
31	Proposed	12.1	15.8	66.4
32	Existing	10.0	12.6	44.6
32	Proposed	10.9	14.0	54.4
33	Existing	11.6	14.7	55.3
33	Proposed	11.9	15.1	55.8
34	Existing	10.9	13.7	49.3
34	Proposed	10.8	13.5	49.2
35	Existing	10.6	13.2	47.0
35	Proposed	10.6	13.4	50.4
36	Existing	11.6	14.6	52.4
36	Proposed	13.7	17.3	64.6
37	Existing	11.3	14.3	51.6
37	Proposed	11.7	14.6	52.2
38	Existing	12.0	14.9	51.8
38	Proposed	16.4	20.3	75.4
39	Existing	11.7	14.3	50.0
39	Proposed	18.2	22.1	83.6
40	Existing	12.2	15.1	53.3
40	Proposed	15.8	19.1	75.0

Table B1-5: Pedestrian Wind Conditions

Location	Configuration	Wind Comfort		Wind Safety
		GEM Speed Exceeded 20% of the Time (km/h)		Gust Speed Exceeded 0.1% of the Time (km/h)
		Summer	Winter	
41	Existing	11.2	13.8	47.8
41	Proposed	15.4	18.5	73.3
42	Existing	12.3	15.8	63.0
42	Proposed	13.8	17.1	60.7
43	Existing	15.4	19.6	71.0
43	Proposed	15.3	19.5	71.3
44	Existing	14.4	18.6	73.6
44	Proposed	15.3	19.3	81.2
45	Existing	13.8	16.6	64.9
45	Proposed	15.2	18.2	81.1
46	Existing	11.5	14.9	60.3
46	Proposed	10.3	13.0	49.4
47	Existing	10.7	13.4	50.9
47	Proposed	10.3	12.8	45.0
48	Existing	11.0	14.1	51.5
48	Proposed	11.2	14.1	50.4
49	Existing	17.8	23.1	92.7
49	Proposed	17.7	23.0	91.6
50	Existing	12.6	15.7	54.6
50	Proposed	12.6	15.7	55.5

Table B1-6: Pedestrian Wind Conditions

Location	Configuration	Wind Comfort		Wind Safety
		GEM Speed Exceeded 20% of the Time (km/h)		Gust Speed Exceeded 0.1% of the Time (km/h)
		Summer	Winter	
51	Existing	9.2	11.1	39.0
51	Proposed	9.5	11.4	40.3
52	Existing	10.7	13.3	50.1
52	Proposed	11.1	13.6	51.0
53	Existing	10.7	12.8	49.0
53	Proposed	10.7	12.8	47.3
54	Existing	10.9	13.5	49.7
54	Proposed	11.1	13.7	49.4
55	Existing	11.7	15.0	56.5
55	Proposed	12.3	15.4	65.1
56	Existing	10.2	12.5	48.9
56	Proposed	10.6	13.0	49.1
57	Existing	12.9	16.0	47.7
57	Proposed	12.8	16.1	47.7
58	Existing	10.5	12.3	50.4
58	Proposed	10.1	11.9	49.7
59	Existing	11.8	13.8	79.1
59	Proposed	11.9	14.0	77.6
60	Existing	11.8	14.4	58.5
60	Proposed	11.3	13.7	54.3

Table B1-7: Pedestrian Wind Conditions

Location	Configuration	Wind Comfort		Wind Safety
		GEM Speed Exceeded 20% of the Time (km/h)		Gust Speed Exceeded 0.1% of the Time (km/h)
		Summer	Winter	
61	Existing	11.0	13.3	50.8
61	Proposed	10.8	13.2	46.7
62	Existing	9.8	12.1	44.3
62	Proposed	10.2	12.9	46.0
63	Existing	10.2	12.7	45.2
63	Proposed	10.7	13.3	47.1
64	Existing	10.8	13.9	54.8
64	Proposed	11.0	14.0	52.5
65	Existing	7.8	9.9	41.5
65	Proposed	8.6	10.7	41.6
66	Existing	11.4	14.4	54.6
66	Proposed	12.0	14.6	58.9
67	Existing	11.3	14.2	56.3
67	Proposed	14.4	17.5	64.3
68	Existing	12.7	15.5	63.3
68	Proposed	16.6	20.8	75.2
69	Existing	13.9	17.0	61.2
69	Proposed	14.4	18.0	64.6
70	Existing	15.9	19.9	72.6
70	Proposed	14.9	18.7	68.8

Table B1-8: Pedestrian Wind Conditions

Location	Configuration	Wind Comfort		Wind Safety
		GEM Speed Exceeded 20% of the Time (km/h)		Gust Speed Exceeded 0.1% of the Time (km/h)
		Summer	Winter	
71	Existing	9.0	11.3	42.7
71	Proposed	9.1	11.3	39.2
72	Existing	12.9	16.3	58.4
72	Proposed	13.0	16.4	59.3
73	Existing	11.4	14.2	53.0
73	Proposed	11.8	14.8	54.4
74	Existing	17.2	20.5	79.3
74	Proposed	17.1	20.4	77.8
75	Existing	14.2	17.4	64.3
75	Proposed	14.3	17.6	64.4
76	Existing	11.7	14.7	61.2
76	Proposed	12.1	15.4	62.8
77	Existing	16.5	21.1	79.1
77	Proposed	16.5	21.0	79.2
78	Existing	16.1	20.4	79.4
78	Proposed	16.5	20.8	84.9
79	Existing	14.6	17.6	67.1
79	Proposed	13.9	16.7	70.3
80	Existing	13.2	16.4	59.9
80	Proposed	13.6	16.9	61.5

Table B1-9: Pedestrian Wind Conditions

Location	Configuration	Wind Comfort		Wind Safety
		GEM Speed Exceeded 20% of the Time (km/h)		Gust Speed Exceeded 0.1% of the Time (km/h)
		Summer	Winter	
81	Existing	11.1	13.8	49.9
81	Proposed	11.4	14.2	51.4
82	Existing	14.2	18.1	75.8
82	Proposed	14.0	17.7	73.8
83	Existing	15.0	19.0	76.5
83	Proposed	15.1	19.1	77.1
84	Existing	15.3	19.1	70.7
84	Proposed	14.5	18.2	74.1
85	Existing	14.3	18.1	69.2
85	Proposed	14.4	18.1	69.0
86	Existing	14.4	17.2	68.7
86	Proposed	14.4	17.1	70.2
87	Existing	16.8	20.9	78.8
87	Proposed	16.1	19.9	77.5
88	Existing	15.6	18.5	91.1
88	Proposed	15.1	17.7	90.8
89	Existing	11.8	14.0	66.2
89	Proposed	11.8	14.0	67.4