REPORT

BURLINGTON WATERFRONT
2020 LAKESHORE ROAD

BURLINGTON, ON

PEDESTRIAN WIND STUDY
RWDI # 2104441
October 20, 2021

SUBMITTED TO

Burlington 2020 Lakeshore Inc.

SUBMITTED BY

Jennifer Shoniker
Technical Coordinator
Jennifer.Shoniker@rwdi.com

Saba Saneinejad, Ph.D.
Associate Principal | Senior Technical Coordinator
saba.saneinejad@rwdi.com

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

RWDI
600 Southgate Drive
Guelph, Ontario, Canada N1G 4P6
T: 519.823.1311

CANADA'S BEST MANAGED COMPANIES Platinum member

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. Accessible document formats provided upon request.
® RWDI name and logo are registered trademarks in Canada and the United States of America

EXECUTIVE SUMMARY

RWDI was retained to conduct a pedestrian wind assessment for the proposed Burlington Waterfront 2020 Lakeshore Road in Burlington, ON (Image 1). Based on our wind-tunnel testing for the proposed development under the Existing and Proposed configurations (Images 2A and 2B), and the local wind records (Image 3), the potential wind comfort and safety conditions are predicted as shown on site plans in Figures 1A through 3B, while the associated wind speeds are listed in Table 1. These results can be summarized as follows:

- The existing wind conditions on and around the site are comfortable for the intended pedestrian use throughout the year, except one location near the southwest corner of the existing building on site where conditions are uncomfortable during the winter.
- With the proposed building in place, increased wind speeds are predicted around the building due to the interception of strong winds at higher elevation and their subsequent redirection to the ground level. The predicted wind conditions are comfortable for the intended pedestrian use during the summer. In the winter, due to the seasonally stronger winds, uncomfortable conditions are predicted at various areas on around the project site.
- The pedestrian wind safety criterion is met at most of the assessed areas in the Existing configuration except two locations. With the addition of the proposed development, this criterion is expected to be exceeded at a few grade-level locations.
- Testing was completed without any existing or proposed landscaping. Existing and proposed landscaping would help to reduce winds, especially during the summer months.

TABLE OF CONTENTS

1 INTRODUCTION 1

1.1 Project Description 1

1.2 Objectives 1

2 BACKGROUND AND APPROACH 2

2.1 Wind Tunnel Study Model 2

2.2 Meteorological Data 5

2.3 Burlington Pedestrian Wind Criteria 6

2.4 Generalized Wind Flows 7

3 RESULTS AND DISCUSSION 7

3.1 Grade Level (Locations 1 through 80) 7

3.1.1 Existing Configuration 7

3.1.2 Proposed Configuration 8

4 APPLICABILITY OF RESULTS 10

5 REFERENCES 10

LIST OF FIGURES

Figure 1A: Pedestrian Wind Comfort Conditions – Existing Configuration – Summer
Figure 1B: Pedestrian Wind Comfort Conditions – Proposed Configuration – Summer

Figure 2A: Pedestrian Wind Comfort Conditions – Existing Configuration – Winter
Figure 2B: Pedestrian Wind Comfort Conditions – Proposed Configuration – Winter

Figure 3A: Pedestrian Wind Safety Conditions – Existing Configuration – Annual
Figure 3B Pedestrian Wind Safety Conditions – Proposed Configuration – Annual

LIST OF TABLES

Table 1: Pedestrian Wind Comfort and Safety Conditions

1 INTRODUCTION

RWDI was retained to conduct a pedestrian wind assessment for the proposed Burlington Waterfront – 2020 Lakeshore Road project in Burlington, ON. This report presents the project objectives, approach and the main results from RWDI's assessment and provides conceptual wind control measures, where necessary.

1.1 Project Description

The project (site shown in Image 1) is located at the southwest corner of Lakeshore Road and Elizabeth Street along the shores of Lake Ontario. It consists of two residential towers, 35 and 30 stories in height a top a 4-storey shared podium.

1.2 Objectives

The objective of the study was to assess the effect of the proposed development on local conditions in pedestrian areas on and around the study site and provide recommendations for minimizing adverse effects, if needed. This quantitative assessment was based on wind speed measurements on a scale model of the project and its surroundings in one of RWDI's boundary-layer wind tunnels. These measurements were combined with the local wind records and compared to the Burlington criteria for gauging wind comfort and safety in pedestrian areas. The assessment focused on critical pedestrian areas, including building entrances, public sidewalks and amenity space.



Image 1: Aerial View of Existing Site and Surroundings (Photo Courtesy of Google™ Earth)

2 BACKGROUND AND APPROACH

2.1 Wind Tunnel Study Model

To assess the wind environment around the proposed project, a 1:400 scale model of the project site and surroundings was constructed for the wind tunnel tests of the following configurations:

A - Existing: Existing site with existing surroundings (Image 2A), and,

B - Proposed: Proposed project with existing surroundings (Image 2B).

The wind tunnel model included all relevant surrounding buildings and topography within an approximately 480m radius of the study site. The wind and turbulence profiles in the atmospheric boundary layer beyond the modelled area were also simulated in RWDI's wind tunnel. The wind tunnel model was instrumented with 89 specially designed wind speed sensors to measure mean and gust speeds at a full-scale height of approximately 1.5 m above local grade in pedestrian areas throughout the study site. Wind speeds were measured for 36 directions in 10-degree increments. The measurements at each sensor location were recorded in the form of ratios of local mean and gust speeds to the mean wind speed at a reference height above the model. The placement of wind measurement locations was based on our experience and understanding of the pedestrian usage for this site.

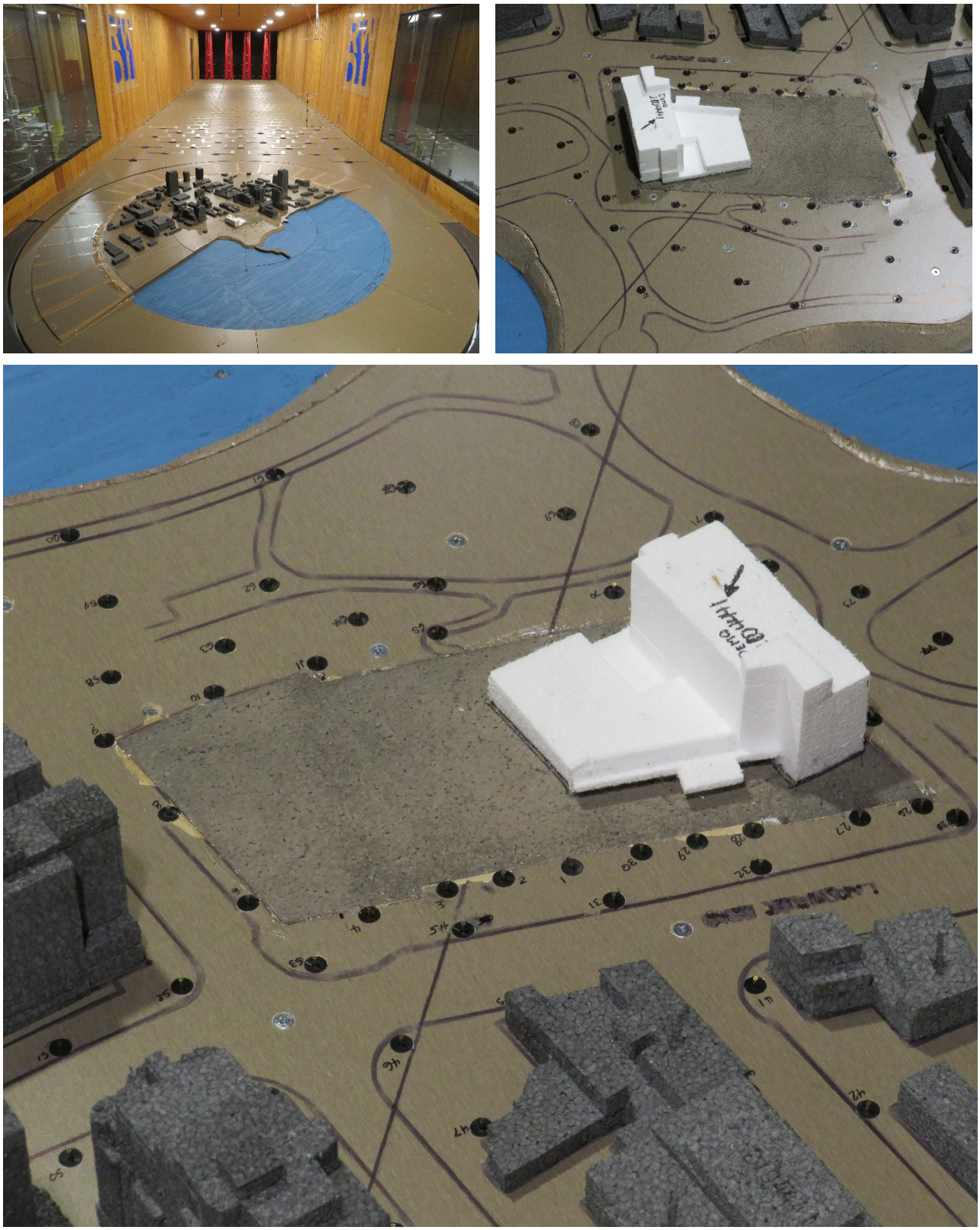
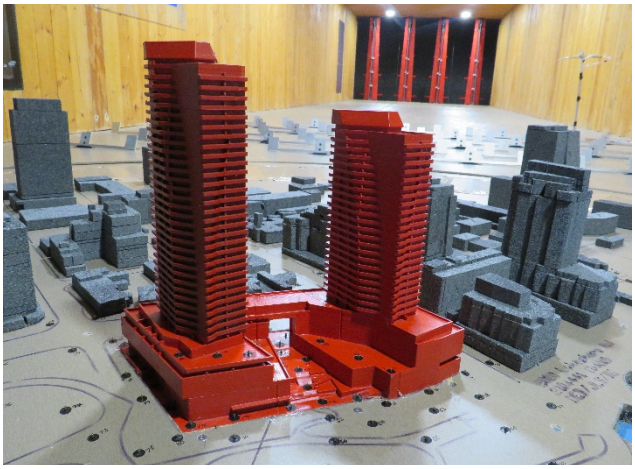


Image 2A: Wind Tunnel Study Model – Existing Configuration





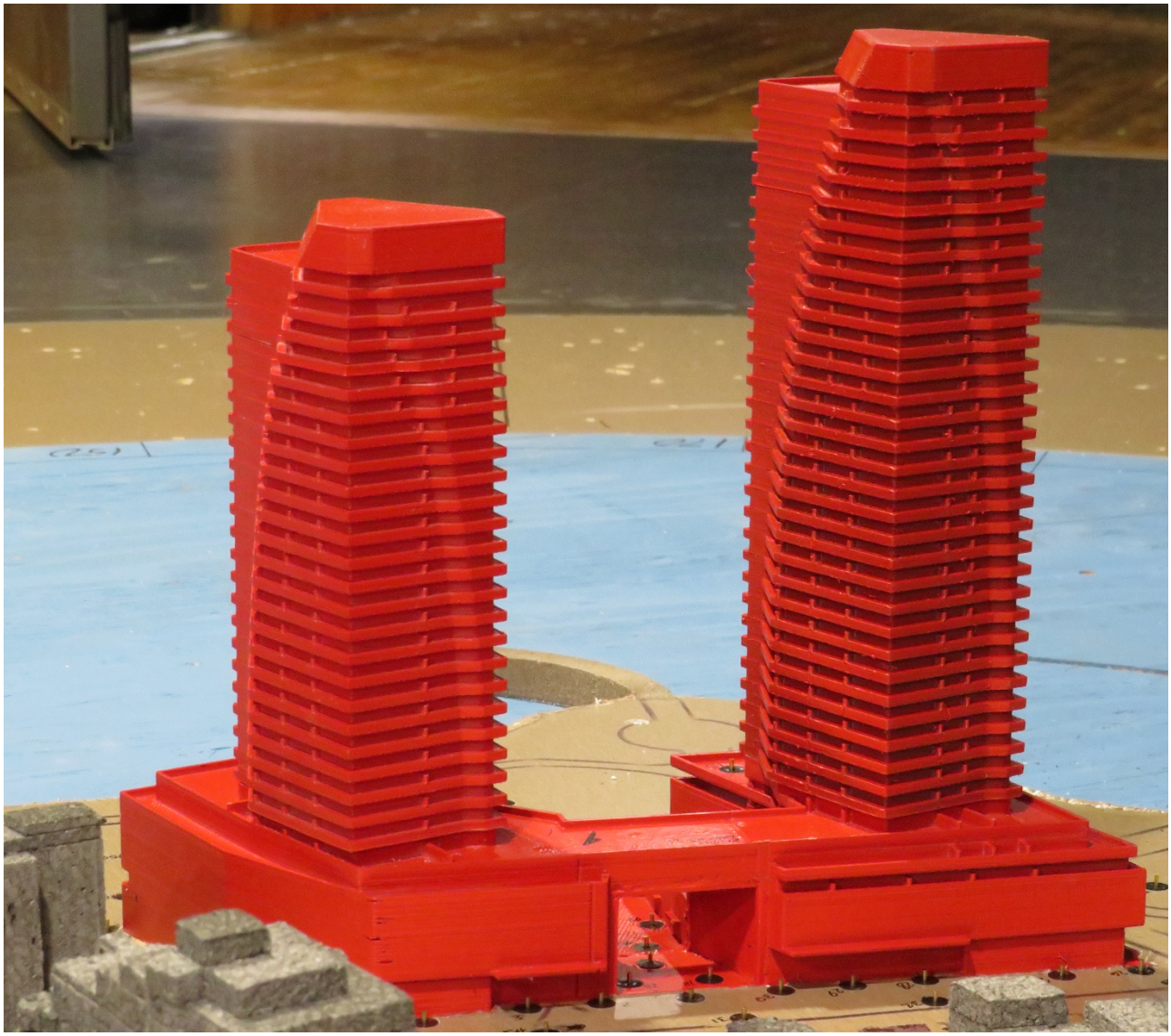
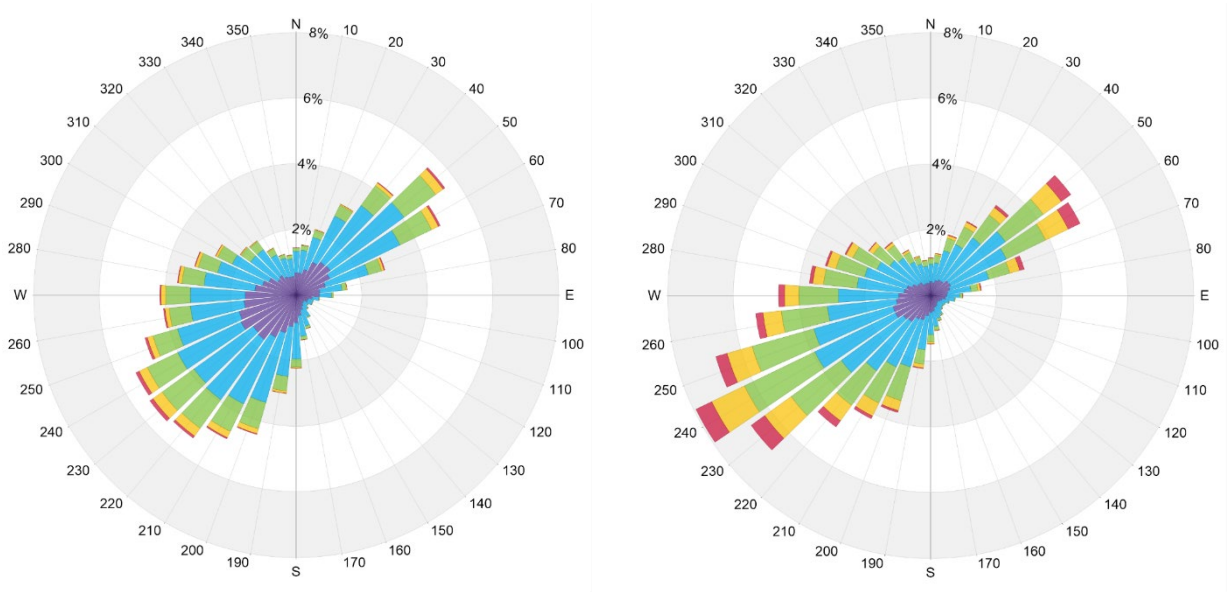


Image 2B: Wind Tunnel Study Model – Proposed Configuration

2.2 Meteorological Data

Wind statistics recorded at Hamilton International Airport between 1990 and 2020, inclusive, were analyzed for the summer (May through October) and winter (November through April) seasons. Image 3 graphically depicts the directional distributions of wind frequencies and speeds for these two seasons. Winds from the northeast and southwest directions are predominant in both summer and winter, as indicated by the wind roses. Strong winds of a mean speed greater than 30 km/h, measured at the airport (at an anemometer height of 10 m), occur for 3.8% and 12.6% of the time during the summer and winter seasons, respectively.

Wind statistics were combined with the wind tunnel data to predict the frequency of occurrence of full-scale wind speeds. The full-scale wind predictions were then compared with the wind criteria for pedestrian comfort and safety.



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

Wind Speed (km/h)	Probability (%) Summer	Winter
Calm	3.9	2.3
1-10	33.7	21.7
11-20	43.1	39.5
21-30	15.5	23.9
31-40	3.0	9.0
>40	0.8	3.6

Image 3: Directional Distribution of Winds Approaching Hamilton International Airport between 1990 and 2020

2.3 Burlington Pedestrian Wind Criteria

The Burlington pedestrian wind criteria, developed in March 2020, are specified in the Guidelines and Terms of Reference, "Pedestrian Level Wind Study". The following defines the criterion in detail.

Comfort Category	GEM Speed (km/h)	Description
Sitting	≤ 10	Calm or light breezes • Appropriate for dedicated seating areas such as cafés, patios, and outdoor amenity areas
Standing	≤ 14	Gentle breezes • Appropriate for main building entrances, bus stops, and other places where pedestrians may linger
Leisurely Walking	≤ 17	Moderate winds • Appropriate for shopping and strolling along retail streets and parks
Fast Walking	≤ 20	Relative higher speed winds • Appropriate for areas where pedestrians are walking, running, or cycling without lingering
Uncomfortable	> 20	Strong winds • Inappropriate due to nuisance for all pedestrian activities • Wind mitigation measures required

Notes:

(1) GEM is defined as the maximum mean wind speed or gust speed divided by 1.85 (whichever is larger). Gust speed can be directly measured in a wind tunnel or represented by mean wind speed + 3*RMS (Root Mean Square) wind speed.

(2) GEM speeds listed above are based on a seasonal exceedance of 20% of the time between 06:00 and 23:00. The criterion has been met if the wind speeds occur at least four out of five days.

Safety Criterion	Gust Speed (km/h)	Description
Exceeded	> 90	• Excessive gust speeds • Adverse effect on pedestrian's balance and footing • Wind mitigation is required

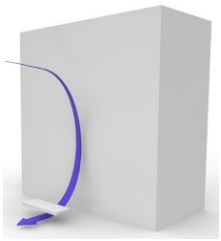
Notes:

(1) Based on an annual exceedance of 9 hours or 0.1% of the time for 24 hours a day.

(2) Gust speed can be directly measured in a wind tunnel or represented by mean wind speed + 3*RMS wind speed.

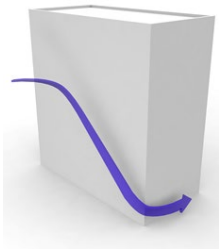
2.4 Generalized Wind Flows

In our discussion of wind conditions, reference may be made to the following generalized wind flows (Image 4):



DOWNWASHING

Tall buildings tend to intercept the stronger winds at higher elevations and redirect them to the ground level. This is often the main cause for wind accelerations around large buildings at the pedestrian level.



CORNER ACCELERATION

When winds approach at an oblique angle to a tall façade and are deflected down, a localized increase in the wind activity or corner acceleration can be expected around the exposed building corners at pedestrian level.

Image 4: Generalized Wind Flows

If these building/wind combinations occur for prevailing winds, there is a greater potential for increased wind activity. Design details such as setting back a tall tower from the edges of a podium, deep canopies close to ground level, wind screens, tall trees with dense landscaping, etc. (Image 5) 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.

3 RESULTS AND DISCUSSION

The predicted wind conditions are shown on site plans in Figures 1A through 3B located in the "Figures" section of this report. These conditions and the associated wind speeds are also represented in Table 1, located in the "Tables" section of this report. The following is a detailed discussion of the suitability of the predicted wind conditions for the anticipated pedestrian use of each area of interest.

3.1 Grade Level (Locations 1 through 80)

Wind conditions comfortable for walking or strolling are appropriate for sidewalks and walkways as pedestrians will be active and less likely to remain in one area for prolonged periods of time. Lower wind speeds conducive to standing are preferred at building entrances and drop-off areas where pedestrians are apt to linger.

3.1.1 Existing Configuration

Wind conditions on and around the existing site are comfortable for standing or leisurely walking in the summer (Figure 1A) and mostly comfortable for leisurely walking or fast walking during the winter (Figure 2A). These wind speeds are appropriate for the intended use of the pedestrian areas throughout the year. Uncomfortable

conditions exist near the southwest corner of the existing building during the winter (Location 80 in Figure 2A). The pedestrian wind safety criterion is met at most areas assessed except an area near the southwest corner of the building and to the east of our site along Lakeshore Blvd (Figure 3A).

3.1.2 Proposed Configuration

With the proposed development in place, higher wind speeds are generally predicted on and around the site. These elevated wind conditions are primarily due to the height of the proposed towers. Downwashing of the prevailing winds off the tall building façades will redirect winds to the ground level, these redirected winds can be strong and turbulent, especially around exposed building corners (see Image 4).

During the summer season, wind conditions on and around the site are predicted to be comfortable for fast walking or better (Figure 1B), which is suitable for the intended use. Higher winds are expected at one area within the passageway/plaza area with wind conditions becoming uncomfortable (Location 14).

During the winter, seasonally stronger winds are expected to cause increased wind speeds throughout the site (Figure 2B). Wind conditions at most sidewalks and walkways are expected to be comfortable for fast walking or better. Uncomfortable wind conditions are expected at the northwest and southwest corners of the building, within the open passageway/plaza area, as well as areas in the park to the south. Uncomfortable wind speeds are also predicted at an isolated area to the east of the site across Elizabeth Street, respectively.

Main entrances to the proposed development are situated near Locations 3, 4, 7, 10, 13, 15, 23, 25, 27, 28 and 29 in Figures 1B, 2B and 3B. Wind conditions at most entrances during the summer and winter are expected to be comfortable for sitting or standing, which is appropriate. Wind speeds at 2 locations during the summer and a few locations during the winter are expected to be higher than desired for an entrance.

Wind speeds at most locations assessed meet the pedestrian wind safety criterion (Figure 3B), except for areas around the western corners of the building and within the plaza area. The area to the east of our site along Lakeshore Blvd which exceeded the safety criterion in the Existing configuration is eliminated.

To mitigate the wind impact of the proposed development, the use of wind screens and coniferous/marcescent landscaping elements near the building corners and throughout the park area to the south is recommended to diffuse the energy of accelerating winds. To reduce winds in the plaza area the addition of overhead/trellis structures would help to diffuse downwashing winds off the tall facades. Also including screens or plantings to the north and south of the plaza would disrupt predominate winds flowing into the space. To shelter doorway areas where needed, it is recommended to either recess the entrances or by adding screens/landscaping on both sides of the entrances. Examples of the proposed wind control solutions are shown in Images 5 and 6.

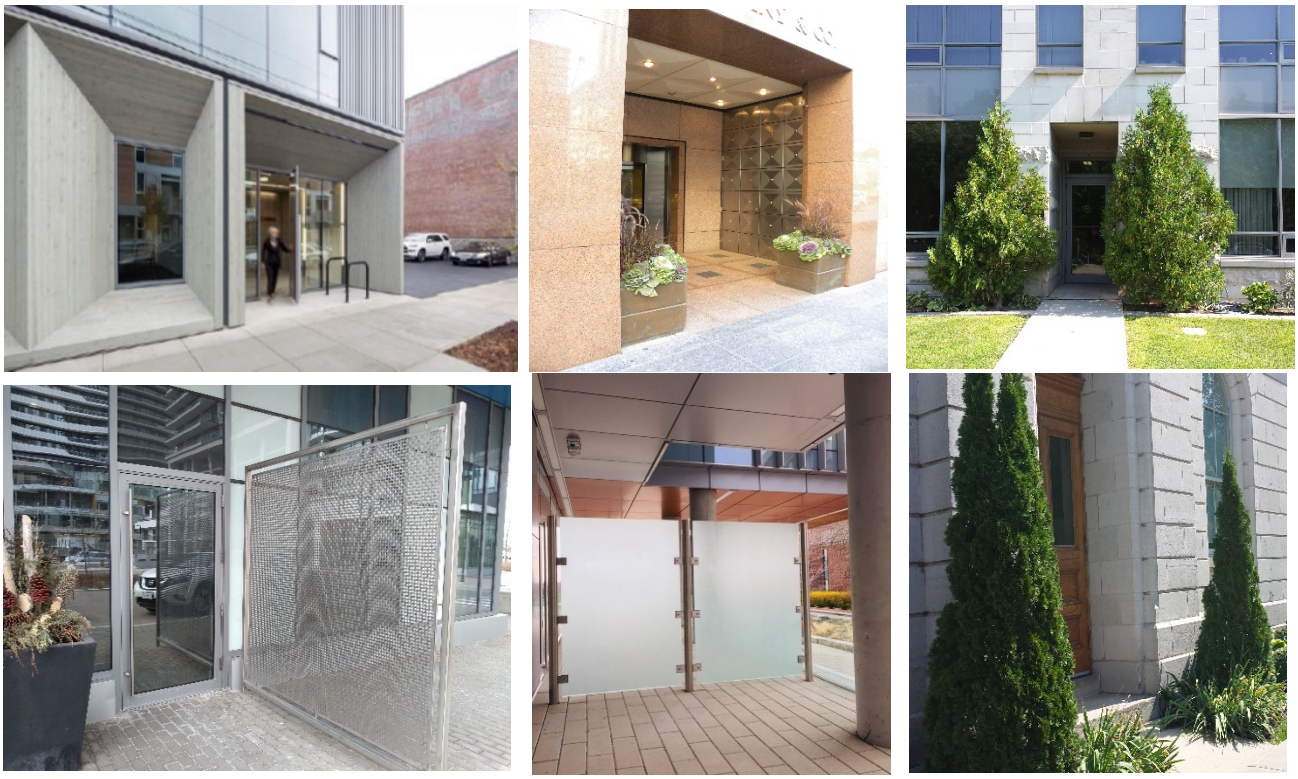


Image 5: Examples of Positive Design Features for Entrances

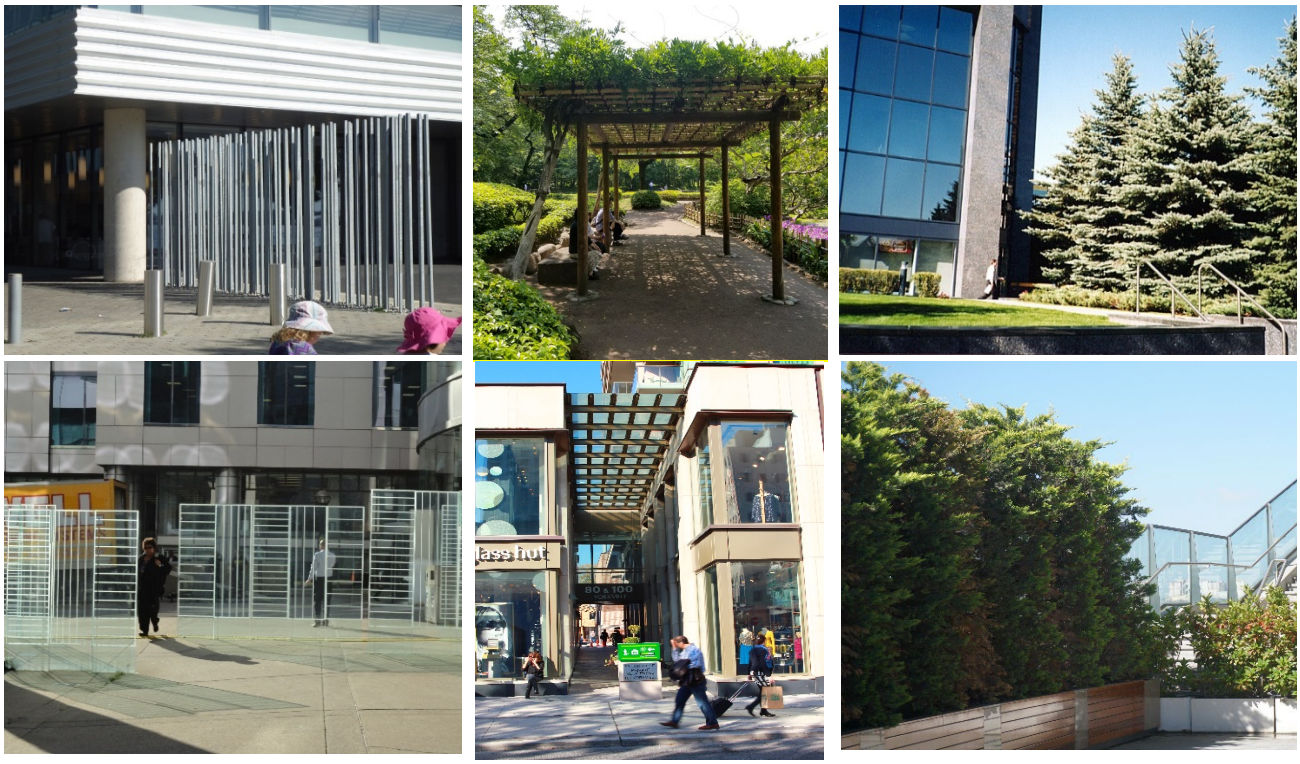


Image 6: Examples of the Use of Wind Screens, Trellises and Landscaping at Grade Level

4 APPLICABILITY OF RESULTS

The wind conditions presented in this report pertain to the model of the Burlington Waterfront – 2020 Lakeshore Road constructed using the drawings and information listed below. Should there be any design changes that deviate from this list of drawings, the wind condition predictions presented may change. Therefore, if changes in the design are made, it is recommended that RWDI be contacted and requested to review their potential effects on wind conditions.

File Name	File Type	Date Received (mm/dd/yyyy)
WTRFR_12576_ARC_INT_R21.rvt	Revit	9/14/2021
WTRFR_12576_ARC_SIT_R21.rvt	Revit	9/14/2021
2021-09-03_12576_Burlington Waterfront_ConsultantSubmission.pdf	Adobe Portable Document Format	9/8/2021
WTRFR_12576_ARC_INT_R21_bmpoolman-Sheet - A211 - FLOOR PLAN - LEVEL CITY.dwg	AutoCAD drawing	9/8/2021

Yours Truly,
RWDI



Jennifer Shoniker
Technical Coordinator



Saba Saneinejad, Ph.D.
Senior Technical Coordinator / Associate



Dan Bacon
Senior Project Manager / Principal

5 REFERENCES

1. ASCE Task Committee on Outdoor Human Comfort (2004). *Outdoor Human Comfort and Its Assessment*, 68 pages, American Society of Civil Engineers, Reston, Virginia, USA.

2. Williams, C.J., Hunter, M.A. and Waechter, W.F. (1990). "Criteria for Assessing the Pedestrian Wind Environment," *Journal of Wind Engineering and Industrial Aerodynamics*, Vol.36, pp.811-815.

3. Williams, C.J., Soligo M.J. and Cote, J. (1992). "A Discussion of the Components for a Comprehensive Pedestrian Level Comfort Criteria," *Journal of Wind Engineering and Industrial Aerodynamics*, Vol.41-44, pp.2389-2390.

4. Soligo, M.J., Irwin, P.A., and Williams, C.J. (1993). "Pedestrian Comfort Including Wind and Thermal Effects," *Third Asia-Pacific Symposium on Wind Engineering*, Hong Kong.

5. Soligo, M.J., Irwin, P.A., Williams, C.J. and Schuyler, G.D. (1998). "A Comprehensive Assessment of Pedestrian Comfort Including Thermal Effects," *Journal of Wind Engineering and Industrial Aerodynamics*, Vol.77&78, pp.753-766.

6. Williams, C.J., Wu, H., Waechter, W.F. and Baker, H.A. (1999). "Experiences with Remedial Solutions to Control Pedestrian Wind Problems," *Tenth International Conference on Wind Engineering*, Copenhagen, Denmark.

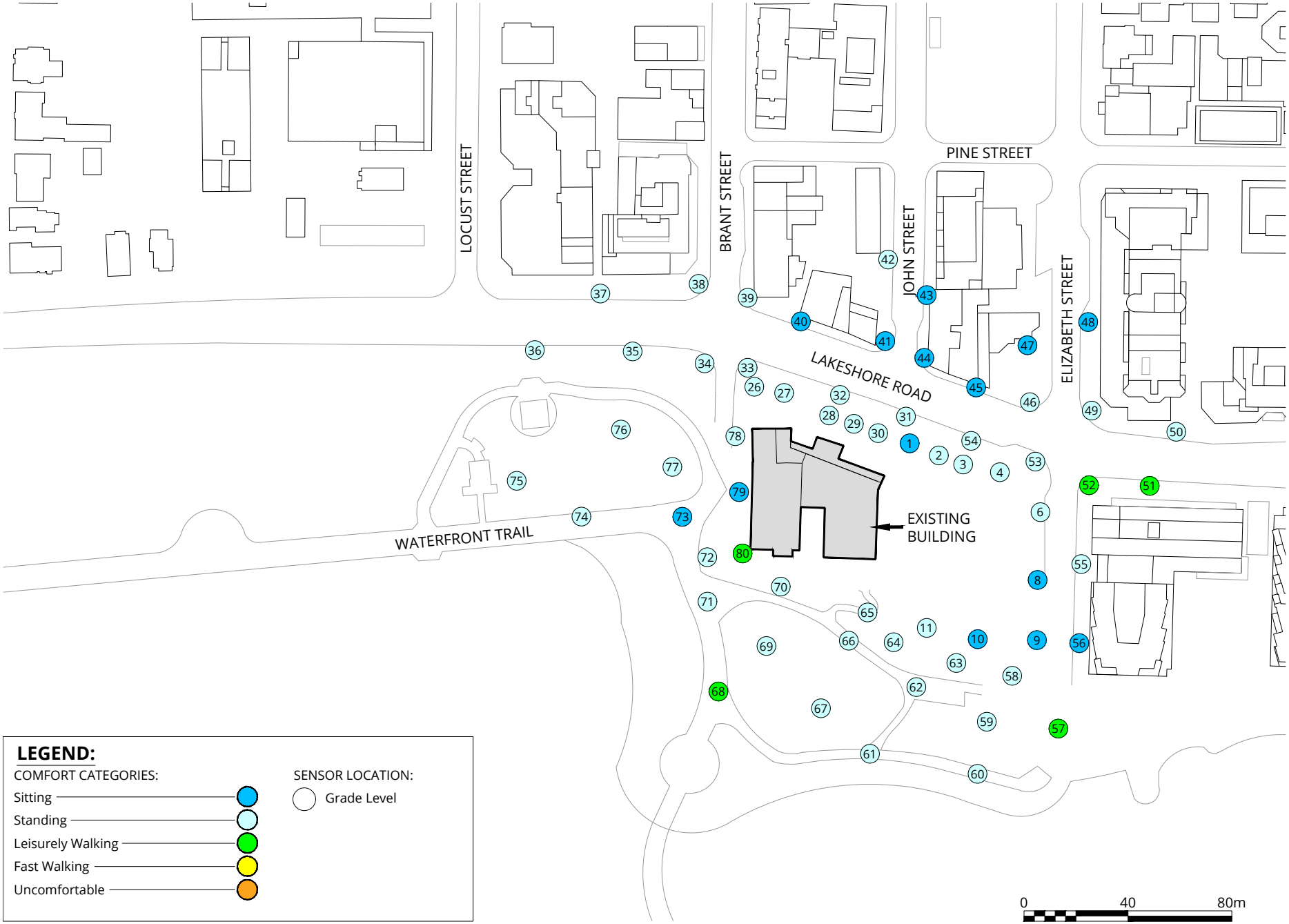
7. Lawson, T.V. (1973). "Wind Environment of Buildings: A Logical Approach to the Establishment of Criteria", *Report No. TVL 7321*, Department of Aeronautic Engineering, University of Bristol, Bristol, England.

8. Durgin, F. H. (1997). "Pedestrian Level Wind Criteria Using the Equivalent average", *Journal of Wind Engineering and Industrial Aerodynamics*, Vol. 66, pp.215-226.

9. Wu, H. and Kriksic, F. (2012). "Designing for Pedestrian Comfort in Response to Local Climate", *Journal of Wind Engineering and Industrial Aerodynamics*, Vol.104-106, pp.397-407.

10. Wu, H., Williams, C.J., Baker, H.A. and Waechter, W.F. (2004), "Knowledge-based Desk-Top Analysis of Pedestrian Wind Conditions", *ASCE Structure Congress 2004,* Nashville, Tennessee.

FIGURES



LEGEND:

COMFORT CATEGORIES:
- Sitting
- Standing
- Leisurely Walking
- Fast Walking
- Uncomfortable

SENSOR LOCATION:
- Grade Level

Pedestrian Wind Comfort Conditions

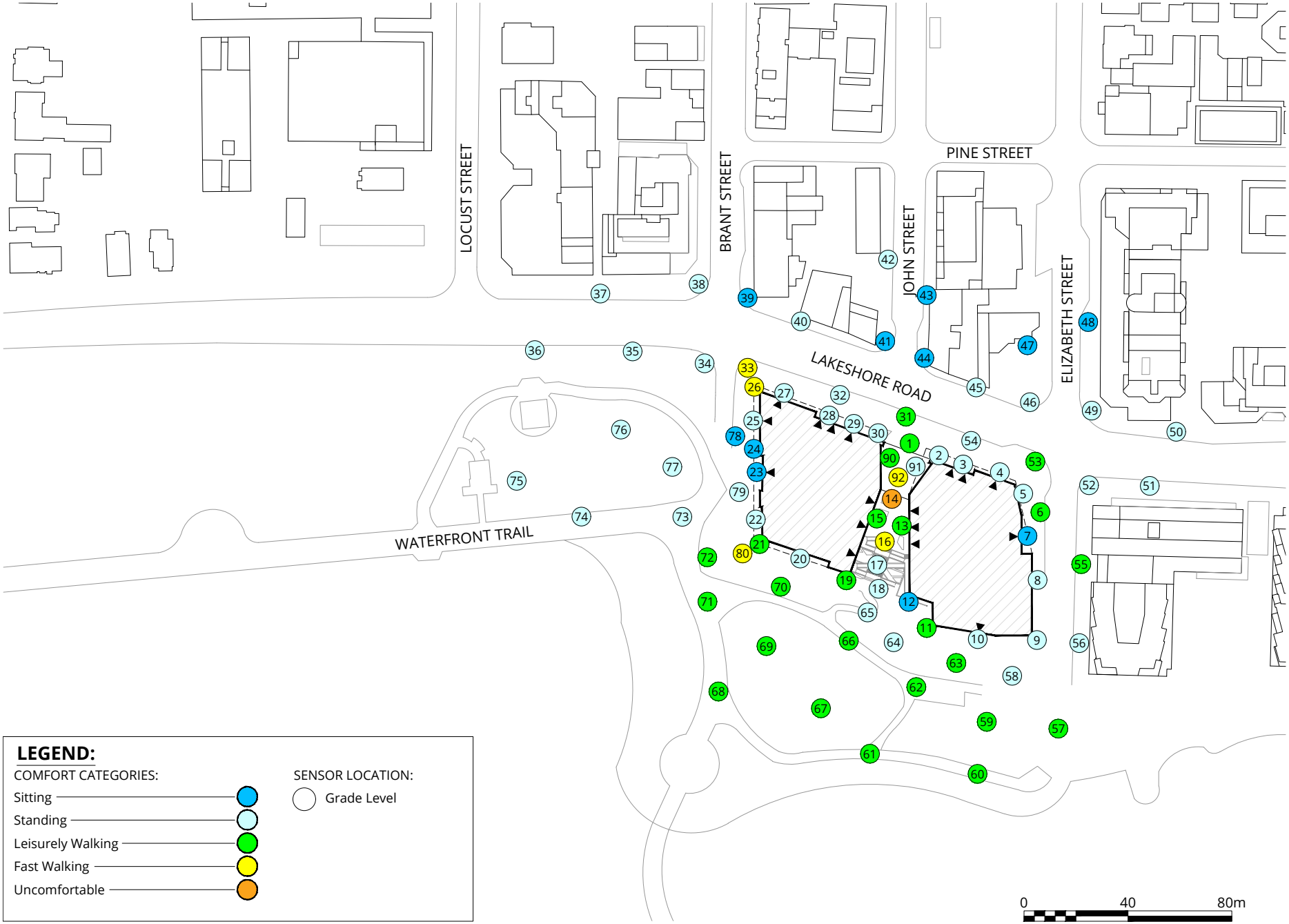
Existing Configuration
Summer (May to October, 6:00 to 23:00)

Burlington Waterfront 2020 Lakeshore Road - Burlington, ON

True North

Project #2104441

Drawn by: DBB	Figure: 1A
Approx. Scale:	1:2000
Date Revised:	Oct. 6, 2021



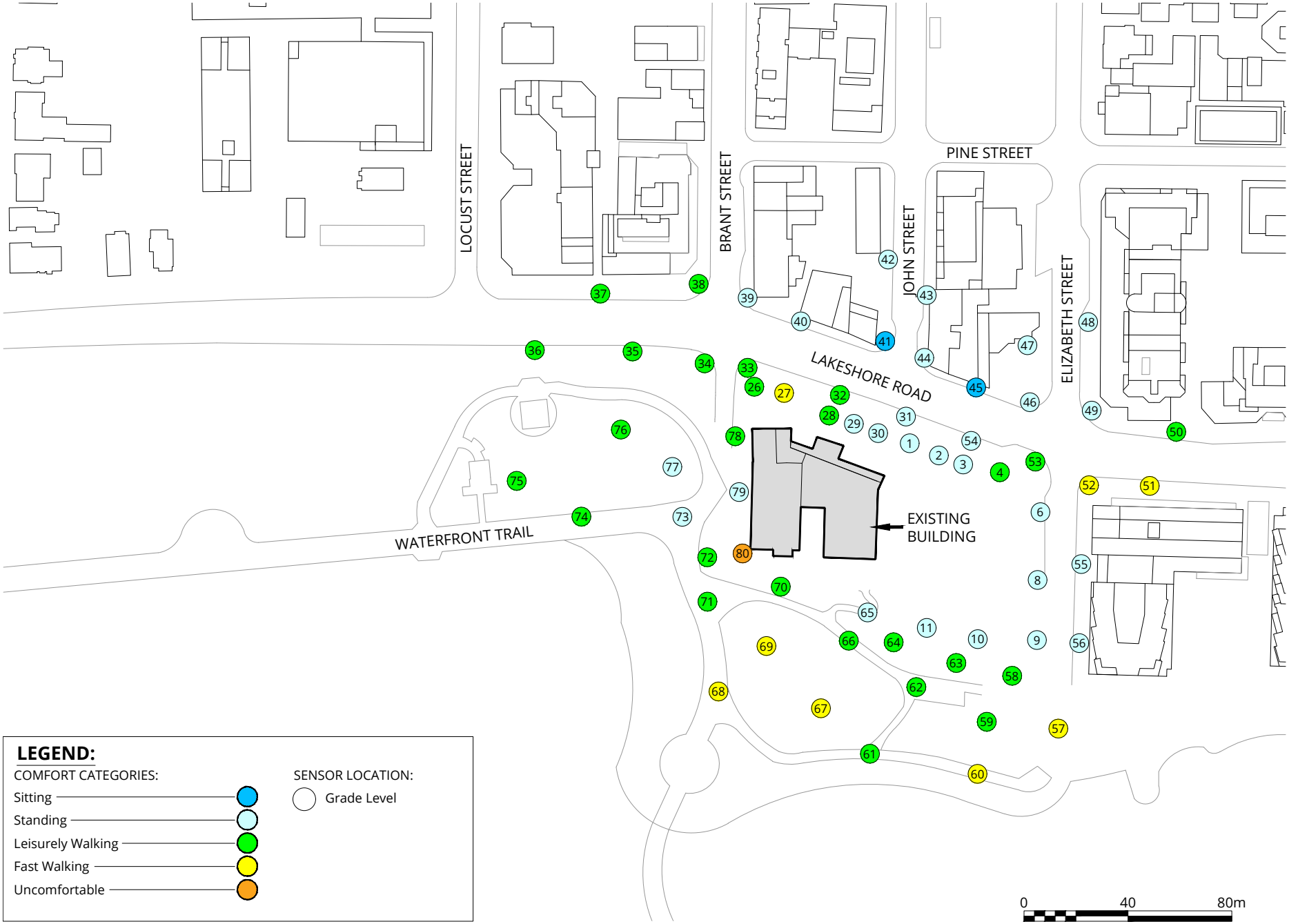
Pedestrian Wind Comfort Conditions
Proposed Configuration
Summer (May to October, 6:00 to 23:00)

Burlington Waterfront 2020 Lakeshore Road - Burlington, ON

True North

Project #2104441

Drawn by: DBB	Figure: 1B
Approx. Scale:	1:2000
Date Revised:	Oct. 15, 2021



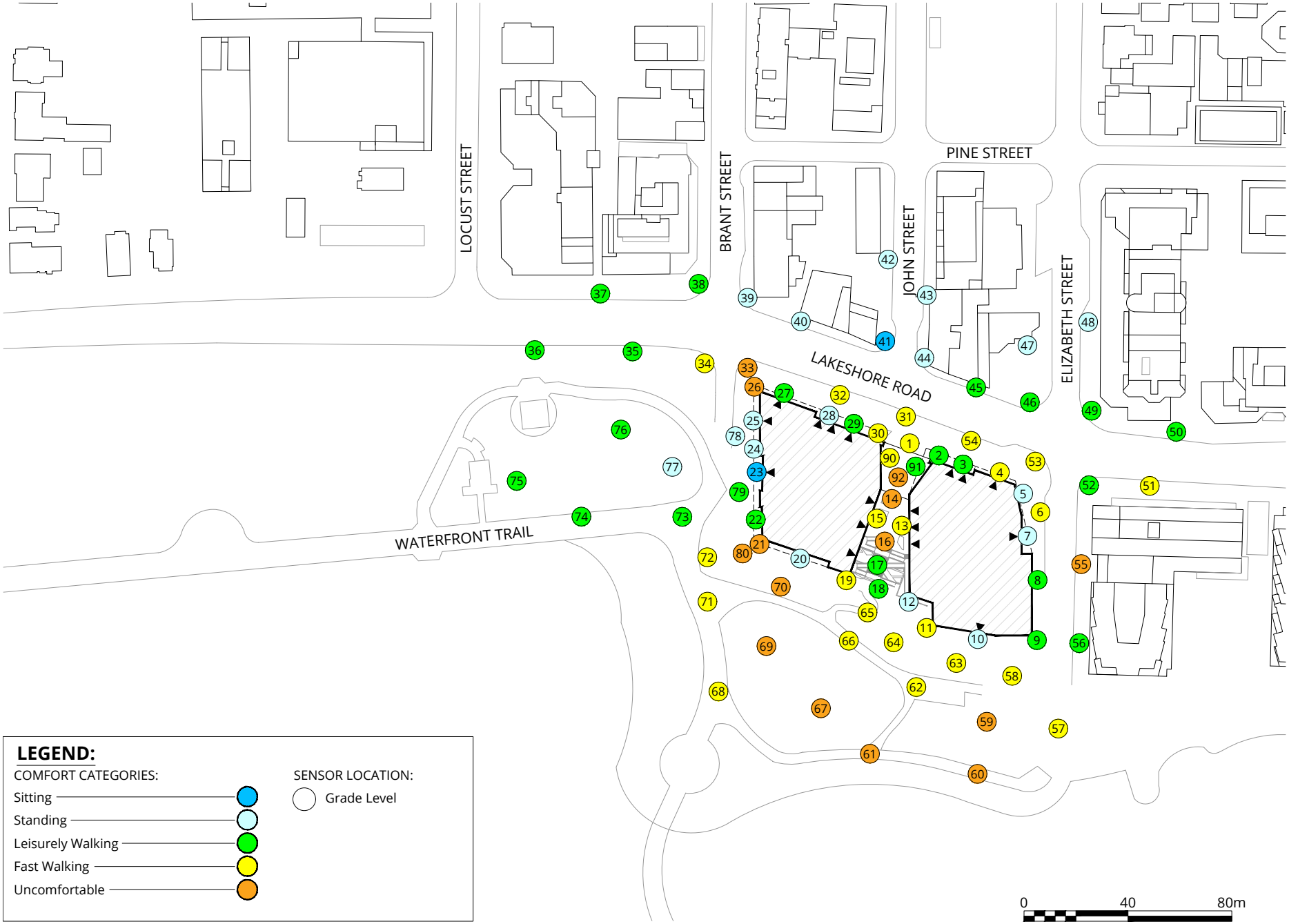
Pedestrian Wind Comfort Conditions
Existing Configuration
Winter (November to April, 6:00 to 23:00)

Burlington Waterfront 2020 Lakeshore Road - Burlington, ON

True North

Project #2104441

Drawn by: DBB	Figure: 2A	
Approx. Scale: 1:2000		
Date Revised: Oct. 6, 2021		



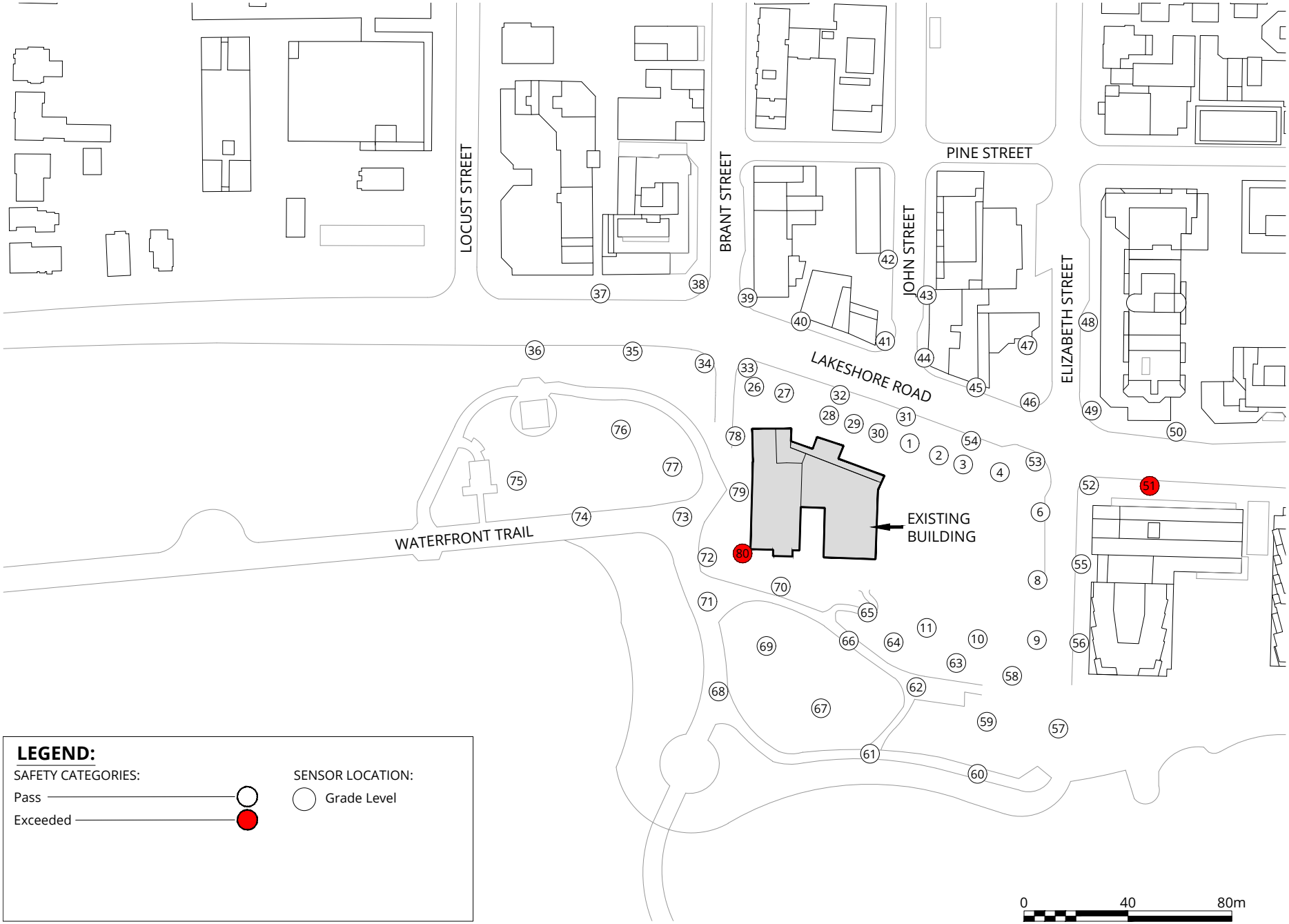
Pedestrian Wind Comfort Conditions
Proposed Configuration
Winter (November to April, 6:00 to 23:00)

Burlington Waterfront 2020 Lakeshore Road - Burlington, ON

True North

Project #2104441

Drawn by: DBB	Figure: 2B
Approx. Scale:	1:2000
Date Revised:	Oct. 15, 2021



Pedestrian Wind Safety Conditions
Existing Configuration
Annual (January to December, 0:00 to 23:00)

Burlington Waterfront 2020 Lakeshore Road - Burlington, ON

True North

Project #2104441

Drawn by: DBB	Figure: 3A	
Approx. Scale: 1:2000		
Date Revised: Oct. 6, 2021		



Pedestrian Wind Safety Conditions
Proposed Configuration
Annual (January to December, 0:00 to 23:00)

Burlington Waterfront 2020 Lakeshore Road - Burlington, ON

True North

Project #2104441

Drawn by: DBB	Figure: 3B
Approx. Scale:	1:2000
Date Revised:	Oct. 15, 2021

TABLES

Table 1: Pedestrian Wind Comfort and Safety Conditions

Location	Configuration	Wind Comfort				Wind Safety	
		Summer		Winter		Annual	
		Speed (km/h)	Rating	Speed (km/h)	Rating	Speed (km/h)	Rating
1	Existing	10	Sitting	13	Standing	61	Pass
	Proposed	15	Leisurely Walking	18	Fast Walking	79	Pass
2	Existing	11	Standing	14	Standing	67	Pass
	Proposed	13	Standing	15	Leisurely Walking	87	Pass
3	Existing	12	Standing	14	Standing	71	Pass
	Proposed	12	Standing	16	Leisurely Walking	75	Pass
4	Existing	12	Standing	15	Leisurely Walking	76	Pass
	Proposed	13	Standing	18	Fast Walking	83	Pass
5	Existing	-	-	-	-	-	-
	Proposed	12	Standing	14	Standing	66	Pass
6	Existing	12	Standing	14	Standing	70	Pass
	Proposed	16	Leisurely Walking	19	Fast Walking	76	Pass
7	Existing	-	-	-	-	-	-
	Proposed	10	Sitting	12	Standing	54	Pass
8	Existing	10	Sitting	13	Standing	55	Pass
	Proposed	12	Standing	15	Leisurely Walking	60	Pass
9	Existing	10	Sitting	13	Standing	53	Pass
	Proposed	14	Standing	17	Leisurely Walking	72	Pass
10	Existing	10	Sitting	13	Standing	55	Pass
	Proposed	11	Standing	14	Standing	68	Pass
11	Existing	11	Standing	14	Standing	58	Pass
	Proposed	15	Leisurely Walking	19	Fast Walking	78	Pass
12	Existing	-	-	-	-	-	-
	Proposed	10	Sitting	13	Standing	54	Pass
13	Existing	-	-	-	-	-	-
	Proposed	16	Leisurely Walking	20	Fast Walking	86	Pass
14	Existing	-	-	-	-	-	-
	Proposed	21	Uncomfortable	26	Uncomfortable	89	Pass
15	Existing	-	-	-	-	-	-
	Proposed	16	Leisurely Walking	20	Fast Walking	82	Pass
16	Existing	-	-	-	-	-	-
	Proposed	19	Fast Walking	25	Uncomfortable	98	Exceeded
17	Existing	-	-	-	-	-	-
	Proposed	14	Standing	17	Leisurely Walking	85	Pass
18	Existing	-	-	-	-	-	-
	Proposed	11	Standing	15	Leisurely Walking	69	Pass
19	Existing	-	-	-	-	-	-
	Proposed	15	Leisurely Walking	18	Fast Walking	78	Pass

Table 1: Pedestrian Wind Comfort and Safety Conditions

Location	Configuration	Wind Comfort				Wind Safety	
		Summer		Winter		Annual	
		Speed (km/h)	Rating	Speed (km/h)	Rating	Speed (km/h)	Rating
20	Existing	-	-	-	-	-	-
	Proposed	11	Standing	14	Standing	64	Pass
21	Existing	-	-	-	-	-	-
	Proposed	17	Leisurely Walking	23	Uncomfortable	93	Exceeded
22	Existing	-	-	-	-	-	-
	Proposed	12	Standing	16	Leisurely Walking	73	Pass
23	Existing	-	-	-	-	-	-
	Proposed	8	Sitting	10	Sitting	44	Pass
24	Existing	-	-	-	-	-	-
	Proposed	9	Sitting	11	Standing	49	Pass
25	Existing	-	-	-	-	-	-
	Proposed	11	Standing	13	Standing	57	Pass
26	Existing	14	Standing	17	Leisurely Walking	68	Pass
	Proposed	20	Fast Walking	25	Uncomfortable	98	Exceeded
27	Existing	14	Standing	18	Fast Walking	77	Pass
	Proposed	12	Standing	16	Leisurely Walking	74	Pass
28	Existing	11	Standing	15	Leisurely Walking	69	Pass
	Proposed	11	Standing	13	Standing	63	Pass
29	Existing	11	Standing	14	Standing	64	Pass
	Proposed	12	Standing	16	Leisurely Walking	71	Pass
30	Existing	11	Standing	14	Standing	62	Pass
	Proposed	14	Standing	18	Fast Walking	78	Pass
31	Existing	11	Standing	14	Standing	62	Pass
	Proposed	15	Leisurely Walking	20	Fast Walking	84	Pass
32	Existing	12	Standing	16	Leisurely Walking	69	Pass
	Proposed	14	Standing	19	Fast Walking	88	Pass
33	Existing	13	Standing	17	Leisurely Walking	69	Pass
	Proposed	18	Fast Walking	22	Uncomfortable	80	Pass
34	Existing	12	Standing	16	Leisurely Walking	60	Pass
	Proposed	14	Standing	18	Fast Walking	68	Pass
35	Existing	13	Standing	17	Leisurely Walking	66	Pass
	Proposed	12	Standing	15	Leisurely Walking	64	Pass
36	Existing	12	Standing	16	Leisurely Walking	62	Pass
	Proposed	12	Standing	15	Leisurely Walking	64	Pass
37	Existing	13	Standing	17	Leisurely Walking	67	Pass
	Proposed	12	Standing	15	Leisurely Walking	63	Pass
38	Existing	13	Standing	16	Leisurely Walking	67	Pass
	Proposed	14	Standing	17	Leisurely Walking	67	Pass

Table 1: Pedestrian Wind Comfort and Safety Conditions

Location	Configuration	Wind Comfort				Wind Safety	
		Summer		Winter		Annual	
		Speed (km/h)	Rating	Speed (km/h)	Rating	Speed (km/h)	Rating
39	Existing	11	Standing	13	Standing	53	Pass
	Proposed	10	Sitting	13	Standing	51	Pass
40	Existing	8	Sitting	11	Standing	50	Pass
	Proposed	11	Standing	13	Standing	57	Pass
41	Existing	8	Sitting	10	Sitting	42	Pass
	Proposed	8	Sitting	10	Sitting	45	Pass
42	Existing	11	Standing	13	Standing	64	Pass
	Proposed	11	Standing	13	Standing	65	Pass
43	Existing	10	Sitting	12	Standing	50	Pass
	Proposed	10	Sitting	12	Standing	53	Pass
44	Existing	9	Sitting	11	Standing	45	Pass
	Proposed	9	Sitting	11	Standing	56	Pass
45	Existing	8	Sitting	10	Sitting	47	Pass
	Proposed	12	Standing	16	Leisurely Walking	73	Pass
46	Existing	11	Standing	13	Standing	55	Pass
	Proposed	14	Standing	17	Leisurely Walking	84	Pass
47	Existing	9	Sitting	12	Standing	50	Pass
	Proposed	10	Sitting	13	Standing	63	Pass
48	Existing	9	Sitting	12	Standing	48	Pass
	Proposed	9	Sitting	12	Standing	53	Pass
49	Existing	11	Standing	14	Standing	59	Pass
	Proposed	13	Standing	16	Leisurely Walking	74	Pass
50	Existing	14	Standing	17	Leisurely Walking	80	Pass
	Proposed	14	Standing	17	Leisurely Walking	85	Pass
51	Existing	15	Leisurely Walking	19	Fast Walking	96	Exceeded
	Proposed	14	Standing	18	Fast Walking	84	Pass
52	Existing	16	Leisurely Walking	19	Fast Walking	87	Pass
	Proposed	13	Standing	16	Leisurely Walking	70	Pass
53	Existing	14	Standing	16	Leisurely Walking	85	Pass
	Proposed	16	Leisurely Walking	20	Fast Walking	85	Pass
54	Existing	11	Standing	14	Standing	72	Pass
	Proposed	14	Standing	18	Fast Walking	86	Pass
55	Existing	11	Standing	14	Standing	58	Pass
	Proposed	17	Leisurely Walking	22	Uncomfortable	86	Pass
56	Existing	10	Sitting	14	Standing	62	Pass
	Proposed	13	Standing	17	Leisurely Walking	72	Pass
57	Existing	15	Leisurely Walking	19	Fast Walking	73	Pass
	Proposed	16	Leisurely Walking	20	Fast Walking	78	Pass

Table 1: Pedestrian Wind Comfort and Safety Conditions

Location	Configuration	Wind Comfort				Wind Safety	
		Summer		Winter		Annual	
		Speed (km/h)	Rating	Speed (km/h)	Rating	Speed (km/h)	Rating
58	Existing	12	Standing	15	Leisurely Walking	78	Pass
	Proposed	14	Standing	18	Fast Walking	74	Pass
59	Existing	13	Standing	17	Leisurely Walking	71	Pass
	Proposed	16	Leisurely Walking	21	Uncomfortable	82	Pass
60	Existing	14	Standing	18	Fast Walking	67	Pass
	Proposed	16	Leisurely Walking	21	Uncomfortable	76	Pass
61	Existing	14	Standing	17	Leisurely Walking	73	Pass
	Proposed	16	Leisurely Walking	21	Uncomfortable	78	Pass
62	Existing	13	Standing	16	Leisurely Walking	70	Pass
	Proposed	15	Leisurely Walking	20	Fast Walking	77	Pass
63	Existing	12	Standing	15	Leisurely Walking	64	Pass
	Proposed	15	Leisurely Walking	20	Fast Walking	84	Pass
64	Existing	12	Standing	15	Leisurely Walking	60	Pass
	Proposed	14	Standing	19	Fast Walking	80	Pass
65	Existing	11	Standing	14	Standing	61	Pass
	Proposed	13	Standing	18	Fast Walking	80	Pass
66	Existing	12	Standing	15	Leisurely Walking	62	Pass
	Proposed	15	Leisurely Walking	20	Fast Walking	82	Pass
67	Existing	14	Standing	18	Fast Walking	72	Pass
	Proposed	16	Leisurely Walking	21	Uncomfortable	79	Pass
68	Existing	15	Leisurely Walking	18	Fast Walking	71	Pass
	Proposed	16	Leisurely Walking	20	Fast Walking	76	Pass
69	Existing	14	Standing	18	Fast Walking	69	Pass
	Proposed	16	Leisurely Walking	21	Uncomfortable	78	Pass
70	Existing	13	Standing	17	Leisurely Walking	70	Pass
	Proposed	17	Leisurely Walking	22	Uncomfortable	86	Pass
71	Existing	13	Standing	17	Leisurely Walking	66	Pass
	Proposed	15	Leisurely Walking	19	Fast Walking	76	Pass
72	Existing	12	Standing	16	Leisurely Walking	66	Pass
	Proposed	15	Leisurely Walking	20	Fast Walking	80	Pass
73	Existing	10	Sitting	12	Standing	52	Pass
	Proposed	13	Standing	16	Leisurely Walking	76	Pass
74	Existing	12	Standing	15	Leisurely Walking	59	Pass
	Proposed	12	Standing	15	Leisurely Walking	69	Pass
75	Existing	12	Standing	15	Leisurely Walking	59	Pass
	Proposed	12	Standing	15	Leisurely Walking	61	Pass
76	Existing	12	Standing	15	Leisurely Walking	62	Pass
	Proposed	12	Standing	15	Leisurely Walking	64	Pass

Table 1: Pedestrian Wind Comfort and Safety Conditions

Location	Configuration	Wind Comfort				Wind Safety	
		Summer		Winter		Annual	
		Speed (km/h)	Rating	Speed (km/h)	Rating	Speed (km/h)	Rating
77	Existing	11	Standing	13	Standing	55	Pass
	Proposed	11	Standing	14	Standing	64	Pass
78	Existing	12	Standing	15	Leisurely Walking	71	Pass
	Proposed	10	Sitting	13	Standing	53	Pass
79	Existing	10	Sitting	13	Standing	58	Pass
	Proposed	12	Standing	15	Leisurely Walking	63	Pass
80	Existing	17	Leisurely Walking	23	Uncomfortable	97	Exceeded
	Proposed	19	Fast Walking	26	Uncomfortable	100	Exceeded
90	Existing	-	-	-	-	-	-
	Proposed	16	Leisurely Walking	20	Fast Walking	78	Pass
91	Existing	-	-	-	-	-	-
	Proposed	13	Standing	16	Leisurely Walking	63	Pass
92	Existing	-	-	-	-	-	-
	Proposed	20	Fast Walking	25	Uncomfortable	87	Pass

Season	Months	Hours
Summer	May - October	6:00 - 23:00 for comfort
Winter	November - April	6:00 - 23:00 for comfort
Annual	January - December	0:00 - 23:00 for safety
Configurations		
Existing	Existing site and surroundings	
Proposed	Project with existing surroundings	

Comfort Speed (km/h) (20% Seasonal Exceedance)	
≤ 10	Sitting
11 - 14	Standing
15 - 17	Leisurely Walking
18 - 20	Fast Walking
> 20	Uncomfortable

Safety Speed (km/h) (0.1% Annual Exceedance)	
≤ 90	Pass
> 90	Exceeded