April 12, 2018

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To Whom It May Concern,

RE: Proposed TED Building Quinpool Road Wind Impact Qualitative Assessment

The proposed 8 storey (plus penthouse) mixed use development project is located on the south side of Quinpool Street in Halifax (66290 & 6298 Quinpool, and 6331 & 6325 Pepperell). To the east, is the West End United Baptist Church and most of the other buildings on the block range in height from 2-3 storeys in height. The 8-storey building will replace three 3-storey buildings (See Fig.1).

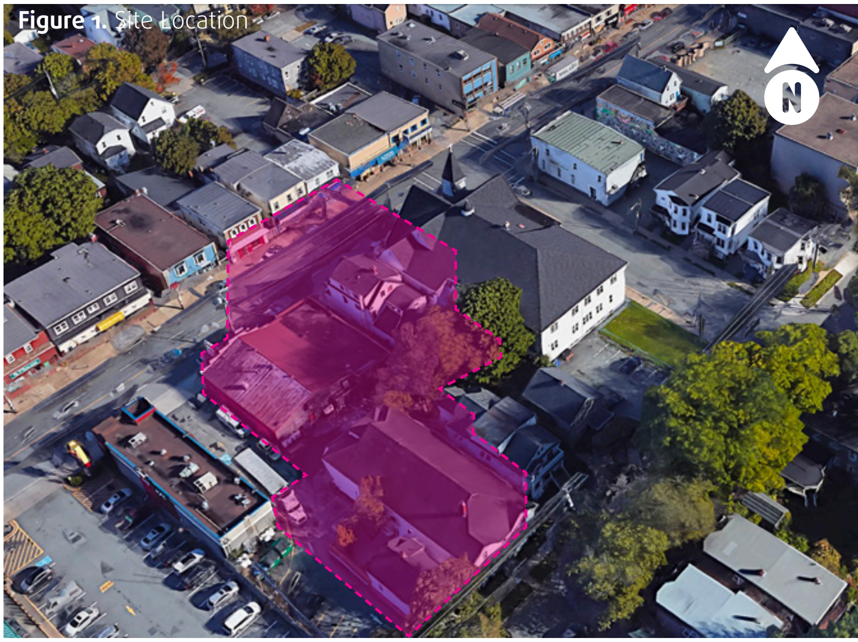


Figure 1. Site Location

The following assessment looks to interpret the likely wind impacts on surrounding properties and sidewalks as a result of the construction of the proposed development. Wind data recorded at the local Shearwater Airport between 1953 and 2000 was assembled and analyzed using Windrose Pro 2.3 to understand the intensity, frequency, and direction of winds at the proposed site. The resulting diagram (Fig. 2) shows that the highest and most frequent annual wind speeds from the west and south and Fig 3. Shows this pattern in the context of the site.

Throughout the year, much of the stronger winds which could impact human thermal comfort come from the west (~13% of the time winds are greater than 5m/s), from the north and north-west (~12% of the time) and from the south and south-west (~9% of the time).

Wind changes in direction and intensity throughout the year. Strong winds (>20 mph) are usually associated with uncomfortable conditions for pedestrians. In Figure 4, the strongest winds occur most frequently in the winter (from the west and north west) and spring (mostly from the west but occasionally from the north east). It is these winds that can cause uncomfortable thermal conditions in downtowns as a result of building design, though mature street trees can significantly reduce the impacts of strong winds around large buildings.

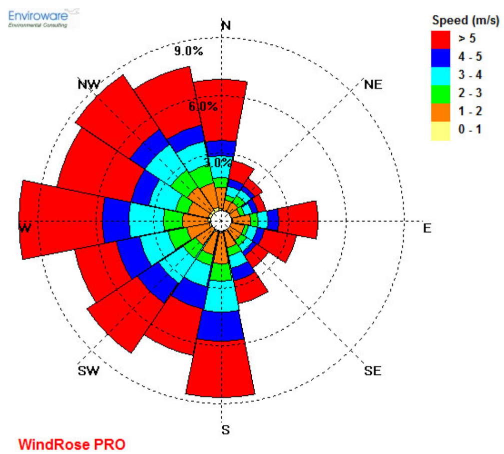


Figure 2. Wind Rose for Shearwater Airport. Annual wind diagram shows winds in the FROM direction.

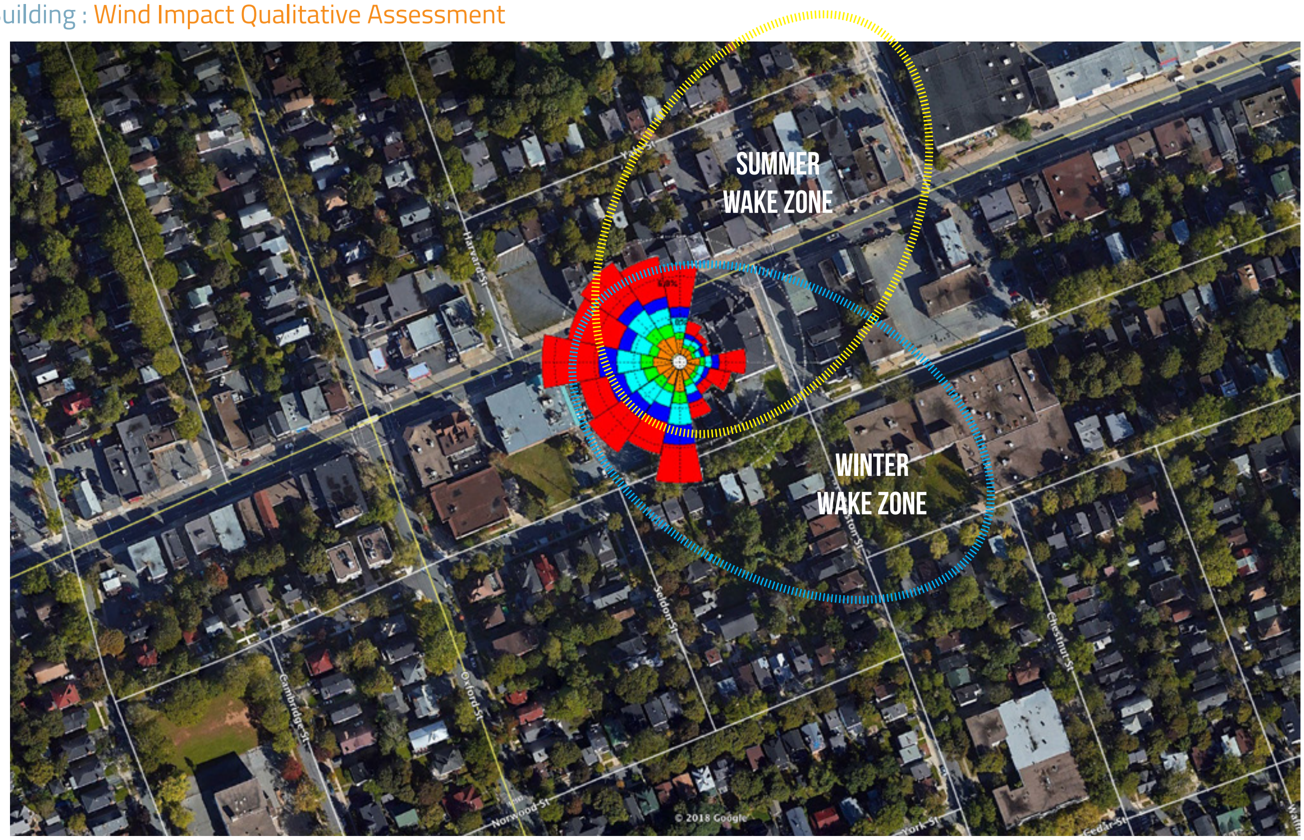


Figure 3. Wind Rose overlain on top of the proposed development site.

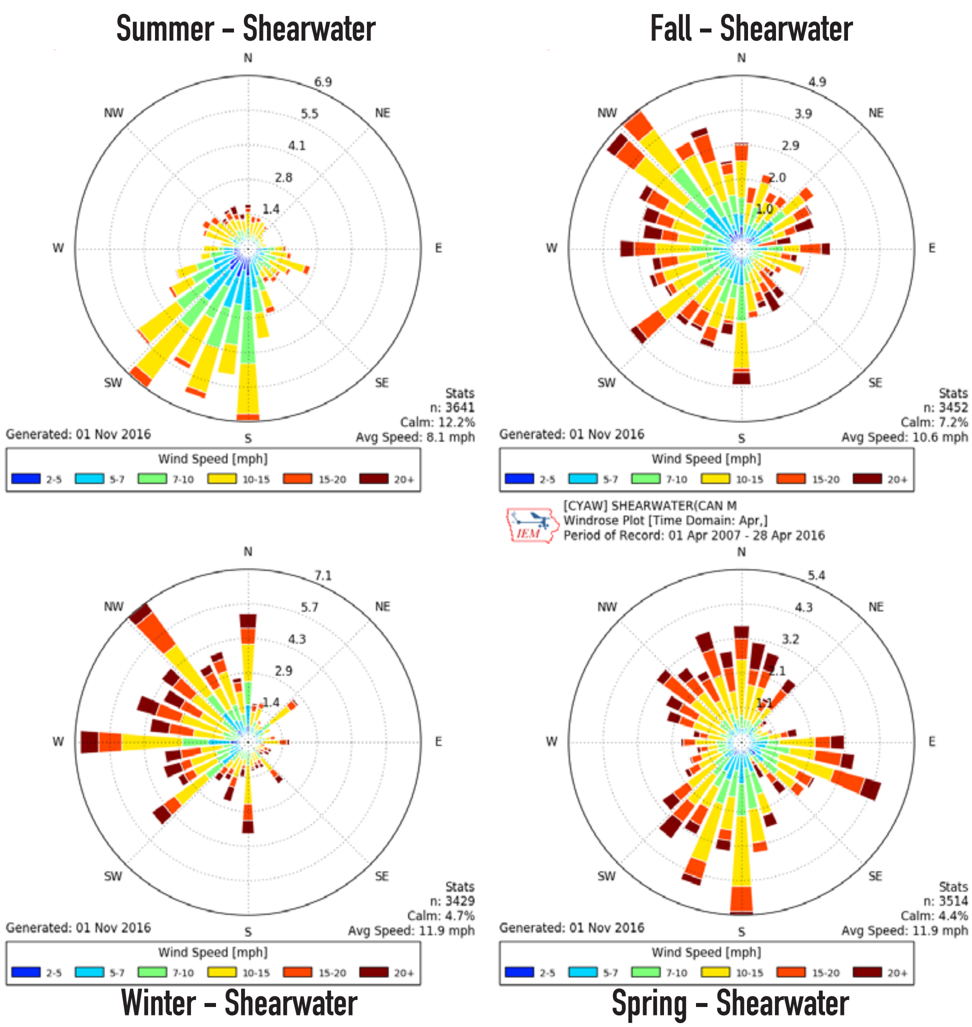


Figure 4. Seasonal Wind Direction for Shearwater Airport

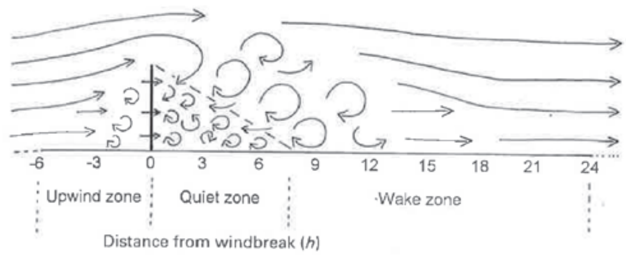
The street trees on Quinpool Road are very sporadic and do not offer much wind protection, however, future streetscape improvements should include street trees which when mature, could offer significant buffering from natural winds and artificially induced winds resulting from future taller buildings on Quinpool and Pepperell. Pepperell Street is significantly more abundant with mature street trees and every effort should be taken to preserve these trees to mitigate wind conditions on the street.

During fall and winter months, strong winds blow predominantly from the north-west and west (See Fig 4). Throughout the spring strong winds can blow in many directions but predominantly from the north east (nor-easters), east and north directions. In the summer, winds predominantly originate from the south and south west, however, very little wind exceeds 20 mph.

The proposed development replaces several 3-storey buildings between Quinpool and Pepperell Streets. Generally most buildings in the neighbourhood range from 2-3 storeys, though the Centre Plan has designate Quinpool as an urban corridor that could receive significantly more height and density.

Urban Windbreak Impacts

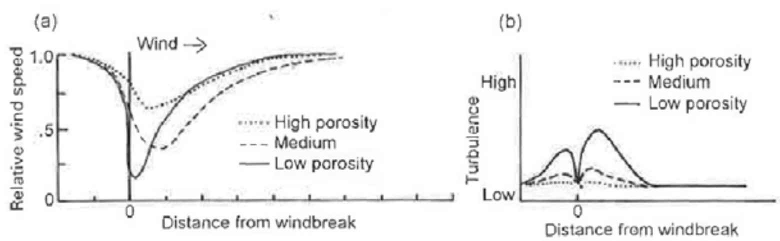
As shown in Fig. 5 the new building will impact sidewalk conditions differently at different times of the year and at different sidewalks on either Quinpool or Pepperell. In the winter and fall, when it's coldest, Quinpool and Pepperell Streets is somewhat aligned with the prevailing wind direction (westerly), and in the summer, prevailing wind from the south and southwest.



Zones with altered airflow caused by a windbreak. Vertical dimension is magnified for illustration. Vertical line indicates windbreak; *h* = height of windbreak. Large eddies = strong turbulence. Uninterrupted airflow in the open is to the left of the upwind zone, and to the right of the wake zone. Widths of zones are approximate. Based on several sources.

Figure 5. Windbreak Diagram

Wake zones for zero porosity structures (like a building) can extend 8-30 times the height of a structure. An 8-storey building can generate increased wind speeds between 200-650 metres on the downwind wake side (see Fig. 5). Beyond the wake zone, there is typically more turbulence and eddies as a result of more turbulent air. This can be characterized as being slightly more gusty winds with quiet periods interspersed with gusts of wind. Directly behind the windbreak, the quiet zone can extend from up to 8m on the downwind side. In this quiet zone, wind speeds can actually be reduced and street trees can play a big part in the wind reduction. At the edges of the building, wind speeds can increase as wind flows around the structure and accelerates. This can be even more pronounced when between two tall buildings creating a wind funnel effect.

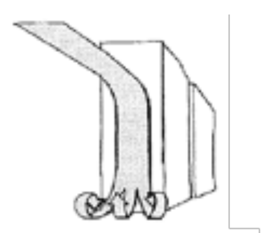


Effect of windbreak porosity on **streamline and turbulent airflows.** (a) Streamline airflow based on treebelts **of different foliage densities;** wind measurements at 1.4 m height. From **Heisler & DeWalle (1988) with** permission of Elsevier Science Publishers. **(b) Generalized expected turbulence** pattern based on Robinette (1972), Rosenberg *et al.* (1983), Heisler & DeWalle (1988), McNaughton (1988).

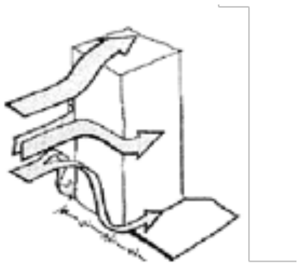
Figure 6. Porosity Diagram

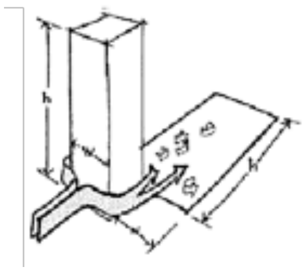
Wind Impacts from tall Buildings

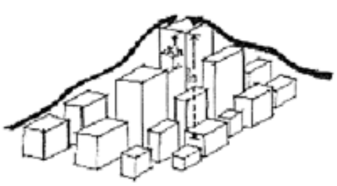
There will be a number of impacts from the new building including:



1. **Downwash**: Wind speed increases with height so when a tower is exposed to wind, the pressure differential between the top and the bottom of tower forces the high pressure at the top down the windward face dramatically increasing pedestrian wind speeds. The taller the exposed face is, the higher the wind speed will be at the base. The stepback at the







2nd storey of the Quinpool side of the new building will receive the bulk of this downwash while on Pepperell Street, the stepback at the third storey will reduce impacts on Pepperell sidewalk. As a reference, a 30 storey building can cause up to 100% increase in wind speeds at the base unless downwash is mitigated by a podium.

2. **The corner effect**: at the windward corners of buildings there can be unexpected increases in wind speeds as wind forces around the windward corners from high pressure on the windward face to low pressure on the lee side. Some of the ways to decrease this impact is to create pyramidal steps which increases the surface area of the edges. This has been designed into the TED Building.
3. **The Wake Effect:** Wake is generally caused by both the downwash and corner effect. The greatest impact area occurs within an area of direct proportion to the tower height and width on the downwind side of the wind. Impacts are minimized by creating a stepback base on the building.
4. **Building Groups:** The effects that occur individually around buildings cannot be applied directly to groups of buildings. The cumulative effect of many clustered tall buildings, like in this situation, can create a wide range of different wind scenarios that must be modelled as a group to understand the cumulative impacts.

Pedestrian Comfort:

Pedestrian comfort and safety is an important factor to consider in the design of a building and an area's built form, especially in a windier coastal city such as Halifax. The design of a building will impact how wind interacts at the ground level, impacting the pedestrian experience. The Beaufort scale is an empirical measure that relates wind speed to observed conditions on land and sea. The attached Beaufort scale is a general summary of how wind affects people and different activities, and distinguishes at what points wind speeds can become uncomfortable or dangerous.

Beaufort Scale

	2-5 mph	calm
	5-7 mph	light breeze
	7-10 mph	gentle breeze
	10-15 mph	moderate breeze
	15-20 mph	fresh breeze
	+20 mph	strong breeze

A building can impact both the wind speed and the wind turbulence at the pedestrian level. Wind turbulence not only creates uncomfortable environments through the rising of dust and other particles, it also decreases the temperature on the site. A properly designed building can mitigate some of the negative impacts of wind on the street level.

Seasonal Wind Impacts

Looking at the seasonal wind impacts (Fig. 4), in the winter and fall, the prevailing direction for strong winds (in excess of 20 mph) come from the northwest, west and north wind directions are. Approximately 48% of all winds come from the northwest. Winter winds are also stronger than those in the summer, with around fifteen percent of all winds reaching speeds above 20 mph. Strong winds only occur about 5% of the time in the north to west quadrant winter and about 3.5% of the time from the south to west quadrant. Quinpool is almost perpendicular to the prevailing wind direction from the north-west meaning that winter winds are not usually funneled in the direction of the street which might accelerate them impacting human thermal

comfort. The building will have the most pronounced effect when the winds come from the south west following the direction of the street. In these situations, the corner of Quinpool and Preston Street will be noticeably windier and colder; however, this only occurs less than 5% of the time.
In the fall wind directions are generally the same as winter but with less wind speeds than the winter. During the winter and fall the north-west corner of the building and the sidewalk on the north of the building will experience higher wind speeds on Quinpool Road sidewalks north of the new building. The stepback at the second storey will mitigate much of these impacts. This impact could be lessened by planting wind tolerant trees on the southern Quinpool streetscape in front of the development.

During the summer the majority of winds come from the southwest quadrant, approximately 85% of the time. There are very little winds that exceed 20 mph in the summer so the new building will have very little impact during the summer months except in very windy conditions. The orientation of Quinpool and Pepperell will tend to increase summer wind speeds coming from the southwest. The Street trees on Pepperell will have a significant impact on reducing summer wind speeds on Pepperell.

In the spring, strong winds come from many directions with some of the most frequent coming from the north, northeast and even the easterly directions. During the spring this wind direction will have some impact when the winds come from the northeast. “Nor-easters” will create particularly windier conditions on both Quinpool and Pepperell Street. Winds from these directions at high wind speeds only occur about 6% of the time. Still, the spring conditions will be the most pronounced of all the seasons as a result of the new building and about 5-6% of the time it will be windier and colder than it is today.

COMFA Model (Brown and Gillespie, 1995)

Dr. Robert Brown of the University of Guelph developed the COMFA model to model human thermal comfort as a result of a number of variables including wind speed. Human thermal comfort is more pronounced during low-activity situations like sitting than during high-activity situations like running. The model is explained in the paper by Brown and LeBlanc (2003). Mr. LeBlanc was also the co-author with Dr. Brown in the 2008 ed. “Landscape Architectural Graphic Standards”, Microclimate chapter. This model is the basis for the theoretical assessment of human thermal comfort changes as a result of the building explained below.

Wind Comfort Assessment

Changes in wind speed as a result of buildings vary depending on wind direction and building morphology. On Quinpool sides of the proposed building, ‘streamlines’ can occur where the wind is accelerated through the openings between buildings when the wind is oriented in the same direction as the street. This orientation occurs at low frequencies throughout the year, being most pronounced in the spring. The 3 storey conditions on Pepperell and the large existing street trees will significantly mitigate the impacts of the 8 storey building as compared to Quinpool Road sidewalks. The new building could result in increased uncomfortable coonditions 3-4% of the time in the winter, 5-6% of the time in the spring and almost no impact in the summer. These reduced thermal comfort conditions are the trade-off for intensification and increased density in the urban core.

Summary

This new proposed 8-storey building will have a marginal impact on increased pedestrian discomfort in the Quinpool and Pepperell Street areas. The existing street trees on Pepperell Street will be important in mitigating wind impacts as a result of development and every effort should be made to preserve them during and after construction. Any new street trees on Quinpool would help mitigate the impacts of taller buildings on the sidewalk conditions and HRM should make every effort to intensify the public urban forest program on the new planned density corridors of the Centre Plan. The design of the building with a 2 and 3 storey podium will significantly improve the impacts of the building on human thermal comfort on the street and surrounding neighbourhood.

If you have any questions, please contact me at your convenience.

Sincerely,
Original Signed

Robert LeBlanc, President
Ekistics Plan + Design