June 7, 2021

Tenblock
30 Soudan Avenue, Suite 200
Toronto, Ontario M4S 1V6

Re: Vibration Study
25 St. Mary Street, Toronto
Gradient Wind File No.: 20-291-Vibration

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Tenblock to undertake a vibration impact study in support of an Official Plan (OPA), Zoning By-law Amendment (ZBA) and Site Plan Control (SPC) Applications for the proposed development located at 25 St. Mary Street in Toronto, Ontario (hereinafter referred to as the "study site"). This study examines (i) the vibration impact of the surrounding environment on the proposed development, (ii) the impact of vibration generated by the proposed development on the surrounding environment, and (iii) the vibration impact of the proposed development on itself. This assessment is based on the City of Toronto Terms of Reference for Vibration Studies[1], the guidelines prepared by the Ministry of the Environment, Conservation and Parks (MECP), Toronto Transit Commission and Canadian Railway Association, as well architectural drawings provided by gh3*, dated June 7, 2021.

The proposed development comprises a 59-storey tower on the west side and a 54-storey tower on the east side of the study site. The towers are connected by a bridge on Levels 3 and 4. The site is surrounded by low-rise residential and commercial buildings from south to southeast and mid to high-rise residential and mixed-use buildings from east to southwest counter-clockwise. The primary sources of transportation noise are St. Mary Street located along the north of the study site, Yonge Street located to the east, Bay Street located to the west, and Charles Street West to the north. Figure A1 illustrates the site location with the surrounding context.

[1] https://www.toronto.ca/city-government/planning-development/application-forms-fees/building-toronto-together-a-development-guide/application-support-material-terms-of-reference/

1. IMPACT OF SURROUNDING ENVIRONMENT

Transit systems and railways can produce perceptible levels of ground vibrations, especially when they are in close proximity to residential neighbourhoods or vibration-sensitive buildings. Similar to sound waves in air, vibrations in solids are generated at a source, propagated through a medium, and intercepted by a receiver. In the case of ground vibrations, the medium can be uniform, or more often, a complex layering of soils and rock strata. Also, similar to sound waves in air, ground vibrations produce perceptible motions and regenerated noise known as 'ground-borne noise' when the vibrations encounter a hollow structure such as a building. Ground-borne noise and vibrations are generated when there is excitation of the ground, such as from a train. Repetitive motion of the wheels on the track causes vibrations to propagate through the soil. When they encounter a building, vibrations pass along the structure of the building beginning at the foundation and propagating to all floors. Air inside the building excited by the vibrating walls and floors represents regenerated airborne noise. Characteristics of the soil and the building are imparted to the noise, thereby creating a unique noise signature.

Human response to ground vibrations is dependent on the magnitude of the vibrations, which is measured by the root mean square (RMS) of the movement of a particle on a surface. Typical units of ground vibration measures are millimetres per second (mm/s), or inch per second (in/s). Since vibrations can vary over a wide range, it is also convenient to represent them in decibel units, or dBV. In North America, it is common practice to use the reference value of one micro-inch per second (µin/s) to represent vibration levels for this purpose. The threshold level of human perception to vibrations is about 0.10 mm/s RMS or about 72 dBV. Although somewhat variable, the threshold of annoyance for continuous vibrations is 0.5 mm/s RMS (or 85 dBV), five times higher than the perception threshold, whereas the threshold for significant structural damage is 10 mm/s RMS (or 112 dBV), at least one hundred times higher than the perception threshold level. Within construction, even higher vibration levels can be tolerated based on the recommendations of a blast engineer.

1.1 Ground Vibration Criteria

In the United States, the Federal Transportation Authority (FTA) has set vibration criteria for sensitive land uses next to transit corridors. Similar standards have been developed by a partnership between the MOECP and the Toronto Transit Commission[2]. These standards indicate that the appropriate criteria for residential buildings is 0.10 mm/s RMS for vibrations. For mainline railways, a document titled Guidelines for New Development in Proximity to Railway Operations[3] indicates that vibration conditions should not exceed 0.14 mm/s RMS averaged over a one-second time period at the first floor and above of the proposed building. As the main vibration source is due to the LRT lines, which will have frequent events, the 0.10 mm/s RMS (72 dBV) vibration criteria and 35 dBA ground-borne noise criteria were adopted for this study.

The potential requirement of a detailed vibration study is established by Guidelines for New Development in Proximity to Railway Operations. The guideline requires detailed vibration assessment for sites that are within 75 m of a railway. Similarly, the TTC requires a vibration study for development within 60 m of a subway or LRT line[4]. The nearest source of potential ground vibration is TTC Subway Line 1, located approximately 150 metres east of the proposed development. The nearest rail line is over one kilometre away. As the development is outside the 75 and 60 metres influence area of the rail and TTC lines, respectively, the vibration impacts from transportation sources are expected to be minimal. Image 1 (below) and Figure 1 show the proximity of the site to the closest subway lines.

Industrial sources such as heavy manufacturing can cause vibrations due to the operations of equipment like punch presses. Quarries and gravel pits can also create vibrations due to blasting operations. No such facilities were found within 500 m of the site and are not of concern for vibration impacts.

[2] MOECP/TTC Protocol for Noise and Vibration Assessment for the Proposed Yonge-Spadina Subway Loop, June 16, 1993
[3] Dialog and J.E. Coulter Associates Limited, prepared for The Federation of Canadian Municipalities and The Railway Association of Canada, May 2013
[4] https://www.ttc.ca/Service_Advisories/Construction/Subway_noise_vibration.jsp

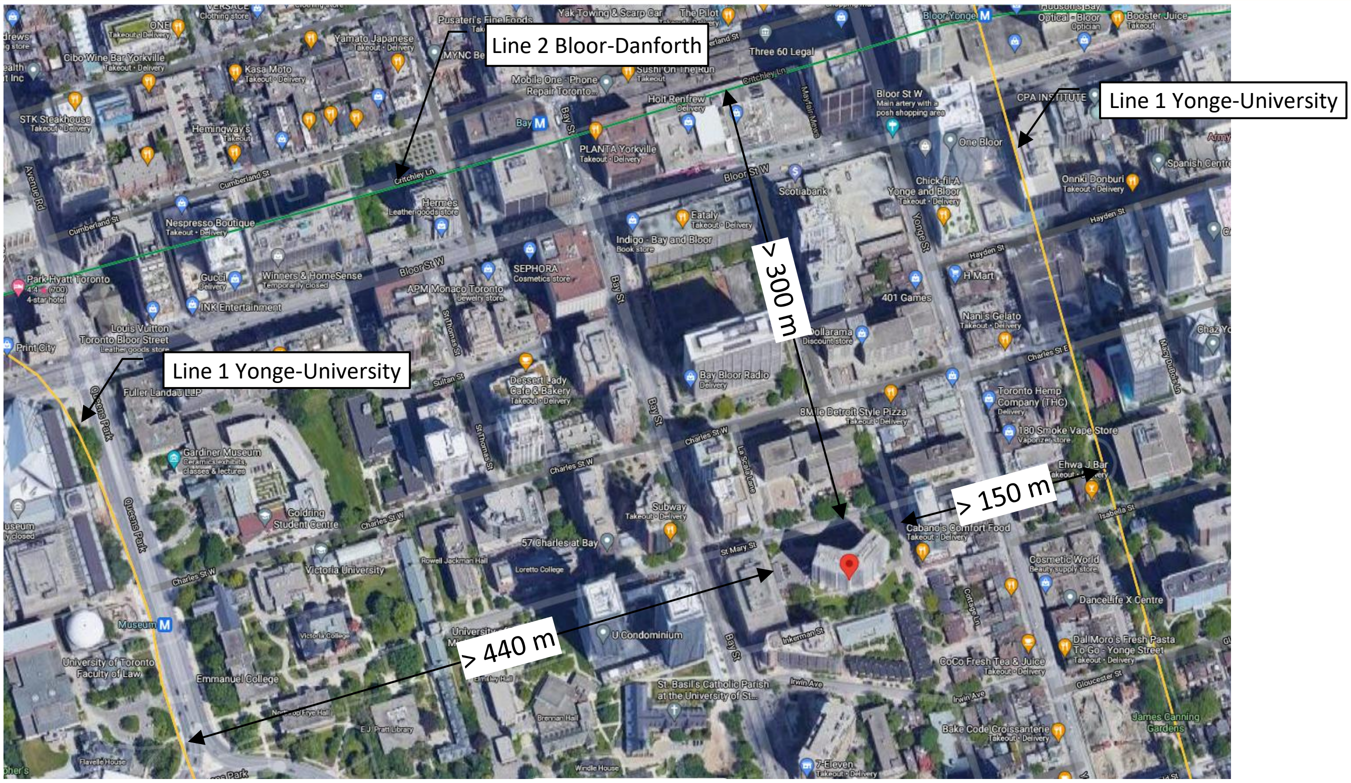


IMAGE 1: THE SUBWAY LINES IN THE PROXIMITY OF THE STUDY SITE

2. IMPACT OF VIBRATION GENERATED BY A PROPOSED DEVELOPMENT

The proposed development is a residential building and operationally will have no significant source of vibrations impacting the surrounding environment.

During the construction of the building, activities such as blasting, hole ramping and other excavation techniques have the potential to create short-term transient vibrations on the surroundings. Vibrations from construction will be controlled through the Construction Management Plan prepared by Lithos. This plan will outline the details of the vibration monitoring program. The monitoring program will establish limits based on NPC-119[5], USBM RI8507 and OSMRE.

[5] Ministry of the Environment, Publication NPC-119 Blasting control

3. IMPACTS OF VIBRATIONS ON THE BUILDING ITSELF

Large pieces of HVAC equipment such as cooling towers, fluid coolers, generators, pumps, air handling equipment and such will be isolated for vibrations using spring isolators and pads as appropriate. The use of such vibration controls will limit any vibrion impacts to the building itself. During the detailed design of the development, the vibration isolation of equipment should be reviewed by a qualified consultant.

This concludes our vibration study, should you have any questions, or wish to discuss our findings further, please call us (613) 836-0934 or contact us by e-mail at joshua.foster@gradientwind.com. In the interim, we thank you for the opportunity to be of service.

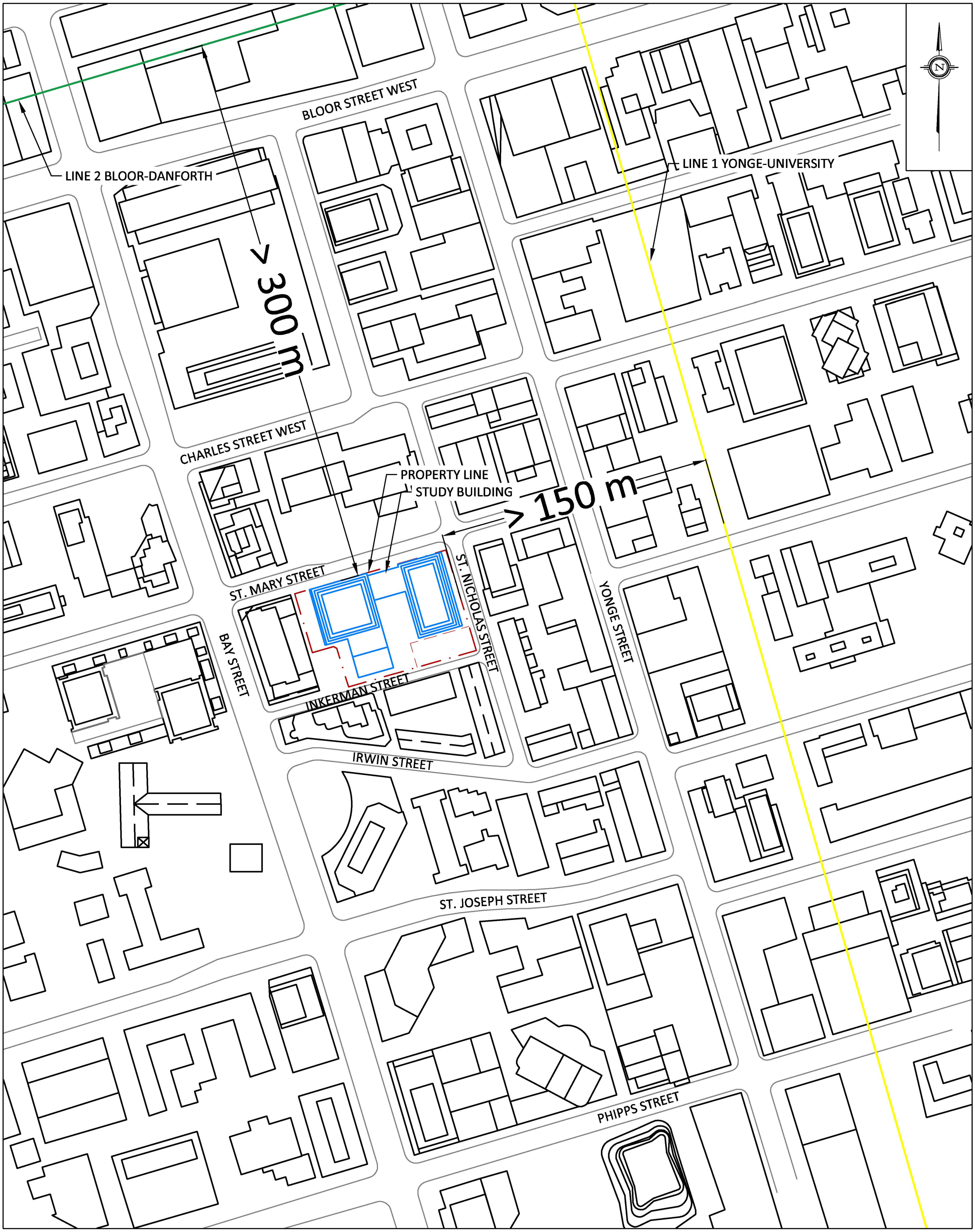
Sincerely,

Gradient Wind Engineering Inc.

Efser Kara, MSc, LEED GA
Acoustic Scientist

Joshua Foster, P.Eng.
Principal

Gradient Wind File #20-291-Vibration Memo



GRADIENTWIND ENGINEERS & SCIENTISTS 127 WALGREEN ROAD, OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM	PROJECT 25 ST. MARY STREET, TORONTO VIBRATION STUDY		DESCRIPTION FIGURE 1: SITE PLAN AND SURROUNDING CONTEXT
	SCALE 1:3000 Approx.	DRAWING NO. 20-291-1	
	DATE JUNE 7, 2021	DRAWN BY N.M.P. & E.K.	