APRIL 2021

Q9 planning + design

LRT PROXIMITY STUDY – LEVEL 1

KINGSETT CAPITAL / IVANHOE CAMBRIDGE
100 BAYSHORE DRIVE
OTTAWA, ONTARIO

Report Date:

APRIL, 2021

Report Prepared for:

KingSett Capital / Ivanhoe Cambridge

1.0 INTRODUCTION

Q9 Planning + Design has been retained by Ivanhoe Cambridge and KingSett Capital to prepare a Level 1 Light Rail Transit (LRT) Proximity Study for the two-tower rental apartment development with tenant-serving amenity spaces and above-grade parking levels in a shared low-rise podium.

This project is proposed to be located at 100 Bayshore Drive which directly abuts the existing Bayshore Bus Rapid Transit Station (BRT). As the Stage 2 LRT line is extended west with completion targeted for 2025, the existing Bayshore BRT will be converted to a Bus Rapid Station and a Light Rail Transit (LRT) hub.

The objective of the LRT Level 1 Proximity Study is to review all applicable information from the City of Ottawa with regards to the LRT line and station near to the proposed development. A second objective is to review the aforementioned information against the projects collective reports and plans.

1.1 OVERVIEW

In December 2019, an Official Plan Amendment and Zoning By-law Amendment were submitted to the City of Ottawa for the proposed development to permit the proposed heights, allow limited front yard parking, and to seek relief from certain policies of the Official Plan that were originally intended for broader purposes and therefore not applicable to the subject site. On November 25, 2020, the Official Plan and Zoning By-law Amendment were approved by City Council.

1.2 PROJECT

The proposed development is for a two-tower, shared podium rental residential development. Tower 1 (East) is proposed to be 30 storeys with approximately 292 units and a total of 271,430 square feet of Gross Floor Area (GFA). Tower 2 (West) will be 27 storeys, 262 units, and 277,425 square feet of GFA. The development structure is a shared 3-storey parking podium with roof-top amenity space, including a Level 4 Podium Pavilion. The main entrances for both towers would face Woodridge Crescent.

This project features a direct connection to the adjacent OC Transpo Station (future LRT station), among other considerations given to the projects location.

2.0 SITE & CONTEXT

2.1 SITE

The subject site, municipally identified as 100 Bayshore Drive, is situated to the west of the existing Bayshore Shopping Centre, north of Highway 417 and the Bayshore Transit Station. The subject site is ideally located to capitalize on the existing and future infrastructure of the transit network.

The site itself is a rough rectangular shape with Woodridge Crescent running along the north boundary of the site and will serve as the site access.

The site itself consists of two property parcels as shown below in the following image. These parcels make up a total area of 6743.4 m2 m2, with 90 m of frontage on Woodridge Crescent. The legal description for the lands is: Nepean CON 2 PT LOT 17 PLAN;465465 PT BLKS I J K and L; RP4R542 PT PART 1, PIN NO.S 047010117 AND 047010118

The following presents the site statistics.

- Site Area: 6,743 m2
- Site Frontage: 90 m (Woodridge Crescent)
- Site Depth: irregular

Figure 1: Aerial close view of Subject Site

2.2 CONTEXT

The proposed development is adjacent to the Bayshore-Accora community, in Ward 7 (Bay). This community contains a mix of uses and is roughly bounded by Holly Acres Road (west), Carling Avenue (north), Highway 417 (south), and Bayshore Drive (east). This community's main identifiers are the Bayshore Shopping Centre, the medium and high-rise apartment buildings which are visible from Highway 417, and lastly, Accora Village. The latter is a collection of two-storey medium density townhome rentals that makeup most of the land area of the Bayshore-Belltown neighbourhood.

Given the future integration of improved transit, it is expected and planned that this community will see intensification. The project at 100 Bayshore Drive is one component of that proposed intensification.

The existing community provides transit, amenities, and affordable housing, with a pedestrian network that will continue to be improved upon.

2.2.1 Pedestrain Network

Richmond Road, a four-lane arterial road, has a sidewalk on the north side. Holly Acres Road, Carling Avenue, and Bayshore Drive, are all four-lane arterial roads and contain sidewalks on both sides of the street. Lastly, Woodridge Crescent, a collector, contains sidewalks on both sides of the street, has pedestrian crossings both existing and planned, is a two-lane road with some on-street parking available. The following image depicts the existing pedestrian infrastructure. Pedestrian crossings (PXOs), which are not crossings otherwise found at intersections, are also identified on this plan, both existing and proposed.

2.2.2 Transit Network

Along Woodridge Crescent, the transit route is no. 85 which provides all-day service between Bayshore Station and Terrasses de la Chaudière in Gatineau, operating every 15-minutes during peak periods. On weekends, service is reduced to between 15- and 30-minutes. The nearest eastbound bus stop serving Route #85 is located along the frontage of the proposed development, while the nearest westbound bus stop is located approximately 300 metres west of the site. The eastbound bus stop provides amenities including a route map, schedule and bench.

The development abuts the Bayshore Rapid Transit Station, a major bus rapid transit station that provides access to the City-wide rapid transit network with direct connections to the Light Rail Transit (LRT) terminus at Tunney's Pasture Station. The Bayshore Station is planned to be upgraded as part of the Stage 2 LRT project which include expansion of

the LRT system to Moodie Drive, with Bayshore Station becoming a major LRT station targeted to open by 2025.

The following is an extract of the routes near the site.

Figure 2: Extract of OC Transpo Transit Map

3.0 BACKGROUND

Ivanhoe Cambridge and KingSett Capital have already been engaged with the City of Ottawa on the overall development of this site and the dynamic relationship with the existing and future configuration of Bayshore Station. These discussions took place prior to the application submissions in 2019 and have resulted in transfer of land, proposed easements, and an agreement for the proposed above-grade pedestrian bridge connection from the project into the station itself.

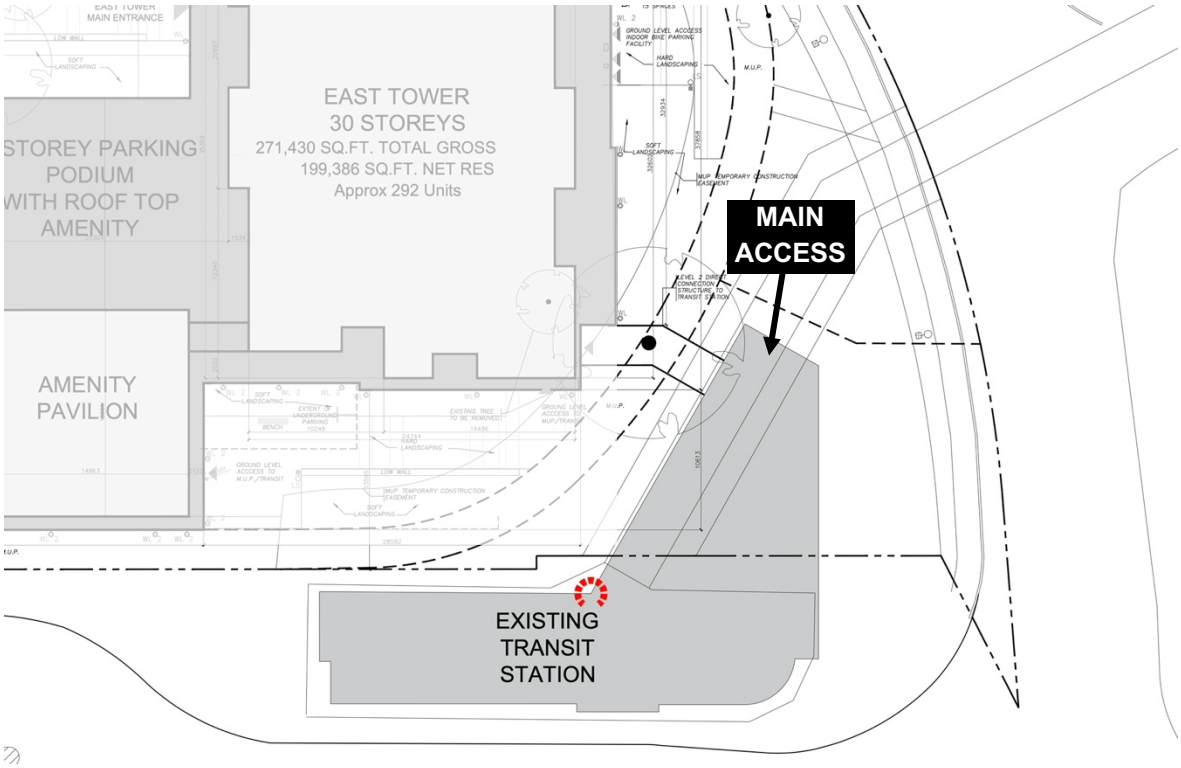

Figure 3: Plan identifying main pedestrian access

The location of the main pedestrian entrance of the new station building was identified at these early discussions as being at the north corner of the station. This is the driving factor as to why OC transpo and the City of Ottawa identified the location of the multi-use pathway as extending from the existing Woodridge Crescent sidewalk, through the east edge of the site, to bring pedestrians to the front door of the station. It was identified as the shortest route between the pedestrian sidewalk and the station.

As a result of these early discussions, there is a certainty in the proposed station design and the proposed development design that ensures the two structures along with the bridge link can and will function effectively.

4.0 LRT DETAILS – BAYSHORE STATION

The City of Ottawa has provided details with regards to the Bayshore Station in order to facilitate coordinated development where all significant elements or impactful elements have been reviewed in conjunction with the proposed development. The following is a review of the Bayshore details of note important to this project and this site.

4.1 REMOVALS PLAN

It is confirmed and acknowledged that the existing fences and curbs along the south abutting property line will be removed. The three existing trees closest to the east and south property lines are also required to be removed.

4.2 PROPOSED STATION IMPROVEMENTS

The proposed station improvements include a new station that will feature the main pedestrian entrance at the north east as shown on the plan below. This will have a pedestrian connection to the multi-use pathway.

To the south of the subject site and west of the transit station there are proposed to be 4 bus laybys in the first 11 metres of the station area with an additional 2 laybys on the south side of the concrete curb.

The proposed light rail track is further south of this. The map on the folllowing page details the location of the approximate centreline in relation to the proposed development. The distance between the south property line of the subject site and the approximate centreline of the LRT track is 60 m.

Due to the proximity to the proposed centreline of the Light Rail track identified above and the direct physical connection to the proposed Bayshore station via a third level pedestrian bridge, a review of potential impacts has been reviewed from a geotechnical perspective and a vibration monitoring perspective. The following includes the review from Golders who prepared the Geotechnical Report as well as a review from Gradient Wind who prepared the Noise and Vibration Study.

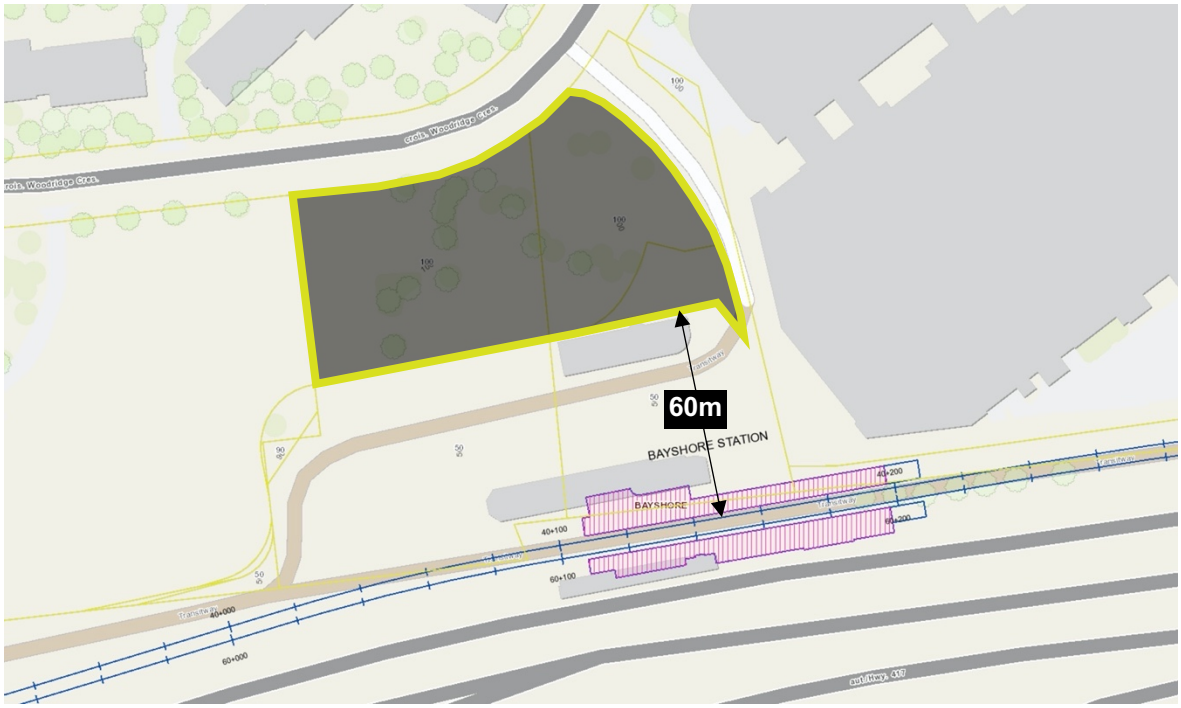

Figure 4: Plan identifying distance between subject property and approximate centreline of the Confederation West rail line

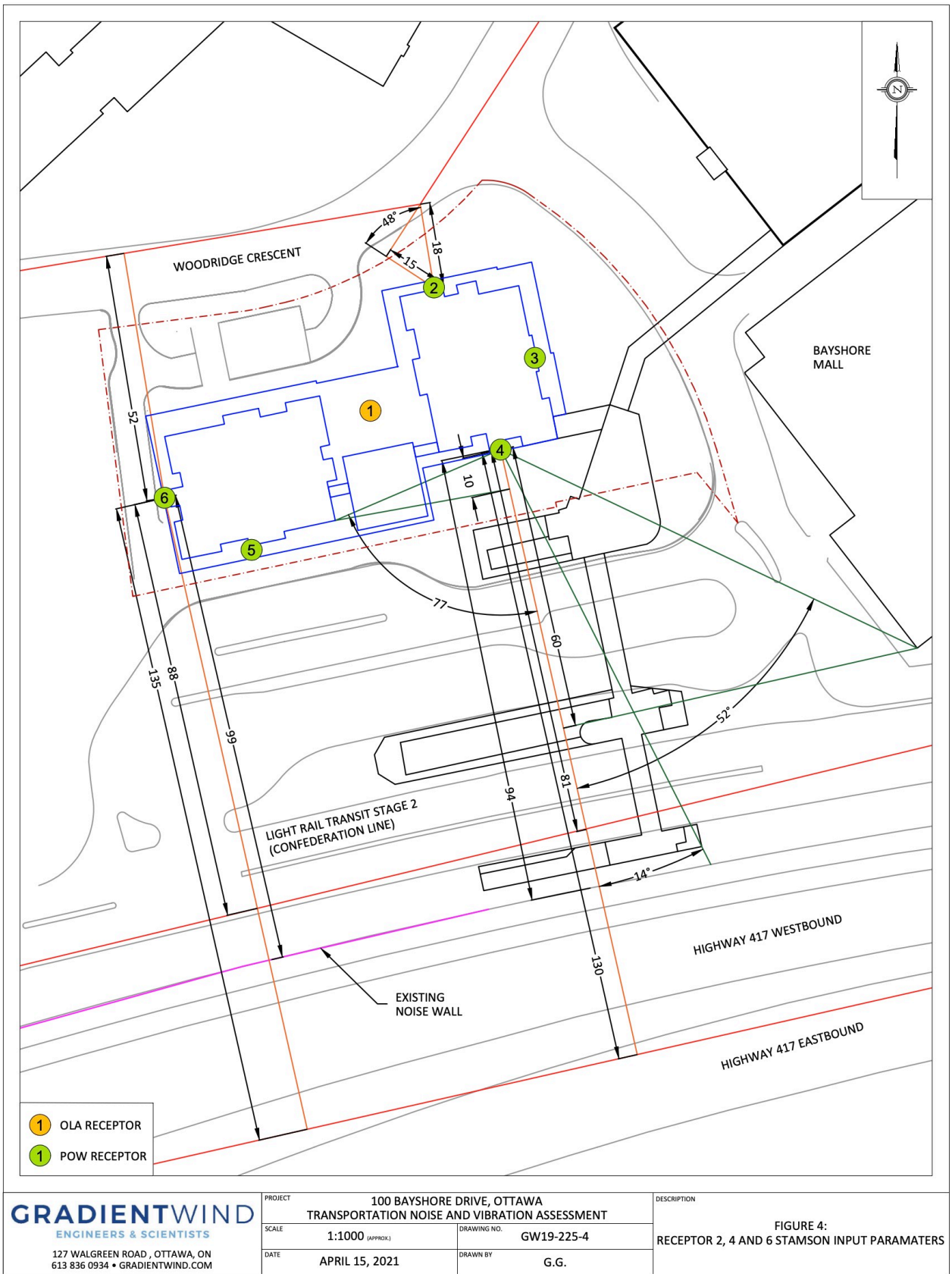

Figure 5: Plan prepared by Gradient Wind which also identifies the building proposed in relation to the Bayshore Station infrastructure

5.0 GEOTECHNICAL MONITORING

The following review has been prepared by Golders and includes vibration monitoring, and a vibration monitoring plan:

5.1 VIBRATION MONITORING

5.1.1 Scope

Pursuant to Section 5.10 of the Geotechnical Investigation Report (Golder Report No. 19134931-3000 dated March 2021) for this project, vibration monitoring is required for nearby Bayshore LRT Station which is sensitive to vibrations during construction activities, or which may be affected by construction activities (e.g., excavation and dewatering).

5.1.2 Vibration Monitoring

Construction activities shall be controlled to limit the peak particle velocities at the adjacent LRT Station such that vibration induced damage will be avoided.

The following table defines the frequency dependent peak vibration limits for all construction activities (activities including piling, excavating and compacting are particularly vibration-inducive).

Frequency Range (Hz)	Vibration Limits (mm/sec)
< 10	5
10 to 40	5 to 45 (sliding log scale)
> 40	45

Vibration monitoring points shall be established as required and shall be monitored and maintained on a regular basis over the entire construction duration. The monitoring equipment should be placed at the south boundary of the site, adjacent to the Bayshore LRT Station.

The monitoring plan shall clearly identify all monitoring points and vibration monitoring equipment to be used. The monitoring shall include but not be limited to ground vibration and peak sound pressure level.

The vibration monitoring shall be conducted by a specialist sub-contractor with a minimum of 5 years of experience carrying out vibration monitoring and vibration studies.

All instrumentation shall have been calibrated annually and be capable of measuring and

recording frequencies in three mutually perpendicular directions. A calibrations certificate shall be included as part of the Monitoring Plan.

Vibration intensive construction activities (e.g., piling, excavation, compaction, etc.) shall commence at the farthest points of work from the LRT Station to assess the ground vibration attenuation characteristics and to confirm the anticipated ground vibration levels based on the Contractor's proposal.

If the vibration monitoring demonstrates that construction activities are resulting in vibrations that exceed the aforementioned vibration limits, the Contractor shall be required to stop and immediately adjust their operation including the use of different equipment until the construction vibrations are below the specified vibration limits.

Vibration equipment/instrumentation:

- Vibration monitoring shall be carried out with an Instantel Minimate Plus seismograph, or an approved equivalent, capable of monitoring on a continuous basis and providing peak levels at regular intervals (no greater than 5 minutes), as well as, full waveform data.
- The vibration monitoring equipment shall be capable of measuring vibration intensities up to 254 mm/s at a frequency response of 2 to 250 Hz.
- The vibration monitor shall be equipped with a real time warning system consisting of either a red flashing light or an air horn alert when the threshold value is reached.

5.2 VIBRATION MONITORING PLAN

At least two weeks in advance of construction, the Contractor shall submit to the Contract Administrator a detailed Vibration Monitoring Plan. This shall include:

- A detailed pre-construction survey of structures in areas where vibration monitoring is required. Any existing interior/exterior structural deficiencies (such as cracks) in the structures shall be identified during this pre-construction survey as well as the methodology for how these will be monitored during construction.
- A description of the scope of the monitoring program and the methodology required to meet the plans objectives.
- Locations of vibration monitoring
- Vibration monitoring equipment that will be used.
- Vibration specialist that will be used.

- Methodology confirming placement of vibration monitors relative to the construction (i.e., monitors which are relocated to follow current construction activities or the use of more monitors which do not need to be moved as often).
- Frequency of vibration readings.

Included in the Vibration Monitoring Plan shall be the Contractor's Contingency Plan which provides the mitigation and response plan for potential exceedances of the Review Limit assigned for the Vibration Limits specified. The Contingency plan shall include how the Contractor will first address the exceedance (such as immediately stopping all vibration inducing work and increasing monitoring frequency) and then how they will alter their construction methodology to ensure that no further vibration beyond the limit occurs.

Once the plan has been implemented, the Contractor shall provide weekly monitoring Reports detailing vibration readings. Reports shall be provided immediately if limits are exceeded. Information required to be required in the Monitoring Reports shall include:

- A written description of the monitoring activities completed that week.
- The date(s) and time(s) of all monitoring activities carried out.
- Changes to vibration monitoring locations to reflect construction progress.
- A statement indicating that the results of the monitoring show that the risks of vibration of LRT Station are within acceptable tolerances and construction practices as established on site can continue.

6.0 VIBRATION ASSESSMENT

The following material has been extracted from the Transportation Noise and Vibration Assessment prepared by Gradient Wind, dated April 28 2021. All items below are intended to be read as part of the complete study prepared by Gradient Wind. They are only extracted and presented below for informational purposes having regard to the scope of the Level 1 LRT Proximity Study.

6.1 "THEORETICAL GROUND VIBRATION PREDICTION PROCEDURE

Potential vibration impacts of the trains were predicted using the Federal Transit Authority's (FTA) Transit Noise and Vibration Impact Assessment[11] protocol. The FTA general vibration assessment is based on an upper bound generic set of curves that show vibration level attenuation with distance. These curves, illustrated in the figure on the following page, are based on ground vibration measurements at various transit systems throughout North America. Vibration levels at points of reception are adjusted by various factors to incorporate known characteristics of the system being analyzed, such as operating speed of vehicle, conditions of the track, construction of the track and geology, as well as the structural type of the impacted building structures. The vibration impact on the building was determined using a set of curves for LRT at a speed of 50 mph. Adjustment factors were considered based on the following information:

- The maximum operating speed of the light rail assumed to be 43 mph (70 km/h) at peak. This is considered to be conservative as the trains would be starting and stopping in and out of the station.
- The offset distance between the development and the closest track is 61 m
- The vehicles are assumed to have soft primary suspensions
- Tracks are not welded, though in otherwise good condition
- Soil conditions do not efficiently propagate vibrations
- The building's foundation coupling is large masonry on piles "

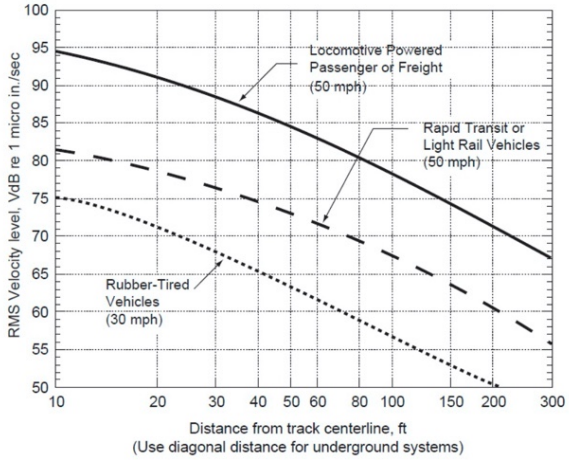

Figure 1: FTA Generalized Curves of Vibration Levels Versus Distance (Adopted from Figure 10-1, FTA Transit Noise and Vibration Impact)

6.2 "GROUND VIBRATIONS AND GROUND-BORNE NOISE LEVELS

Estimated vibration levels at the foundation nearest to the O-Train LRT are expected to be 0.012 mm/s RMS (54 dBV), based on the FTA protocol and an offset distance of 61 m to the nearest track centerline. Details of the calculation are provided in Appendix B. Since predicted vibration levels do not exceed the criterion of 0.10 mm/s RMS at the foundation, concerns due to vibration impacts on the site are not expected. As vibration levels are acceptable, correspondingly, regenerated noise levels are also expected to be acceptable."

6.3 "CONCLUSIONS AND RECOMMENDATIONS

…"In addition, the Rail Construction Program Office recommends that the warning clause identified below to be included in all agreements of purchase and sale and lease agreements for the proposed development including those prepared prior to the registration of the Site Plan Agreement:

"The Owner hereby acknowledges and agrees:

i) The proximity of the proposed development of the lands described in Schedule "A" hereto (the "Lands") to the City's existing and future transit operations, may result in noise, vibration, electromagnetic interferences, stray current transmissions, smoke and particulate matter (collectively referred to as "Interferences") to the development;

ii) It has been advised by the City to apply reasonable attenuation measures with respect to the level of the Interferences on and within the Lands and the proposed development; and

iii) The Owner acknowledges and agrees all agreements of purchase and sale and lease agreements, and all information on all plans and documents used for marketing purposes, for the whole or any part of the subject lands, shall contain the following clauses which shall also be incorporated in all transfer/deeds and leases from the Owner so that the clauses shall be covenants running with the lands for the benefit of the owner of the adjacent road:

'The Transferee/Lessee for himself, his heirs, executors, administrators, successors and assigns acknowledges being advised that a public transit light-rail rapid transit system (LRT) is proposed to be located in proximity to the subject lands, and the construction, operation and maintenance of the LRT may result in environmental impacts including, but not limited to noise, vibration, electromagnetic interferences, stray current transmissions, smoke and particulate matter (collectively referred to as the Interferences) to the subject lands. The Transferee/Lessee acknowledges and agrees that despite the inclusion of noise control features within the subject lands, Interferences

may continue to be of concern, occasionally interfering with some activities of the occupants on the subject lands.

The Transferee covenants with the Transferor and the Lessee covenants with the Lessor that the above clauses verbatim shall be included in all subsequent lease agreements, agreements of purchase and sale and deeds conveying the lands described herein, which covenants shall run with the lands and are for the benefit of the owner of the adjacent road.'"

"Estimated vibration levels at the foundation nearest to the O-Train LRT are expected to be 0.012 mm/s RMS (54 dBV), based on the FTA protocol and an offset distance of 61 m to the nearest track centerline. Details of the calculation are provided in Appendix B. Since predicted vibration levels do not exceed the criterion of 0.10 mm/s RMS at the foundation, concerns due to vibration impacts on the site are not expected. As vibration levels are acceptable, correspondingly, regenerated noise levels are also expected to be acceptable."

7.0 LEVEL 1 PROXIMITY STUDY REQUIREMENTS

The following outlines the requirements for level 1 projects with regards to the identified and scoped proximity study:

1 A site plan of the development with the centreline or reference line of the Confederation Line structure and/or right-of-way located and the relevant distances between the Confederation Line and developer's structure shown clearly;

The submitted Site Plan identifies the location of the proposed Bayshore Station in reference to the proposed development. Further, an extracted plan from the Gradient Wind study was also provided and identified the distance from the building to the approximate centreline of the confederation west line. Referenced below is also a preliminary identification of the location of the Level 2 pedestrian bridge connection and where it would connect with the transit station. Approximate location of knockout panel is noted.

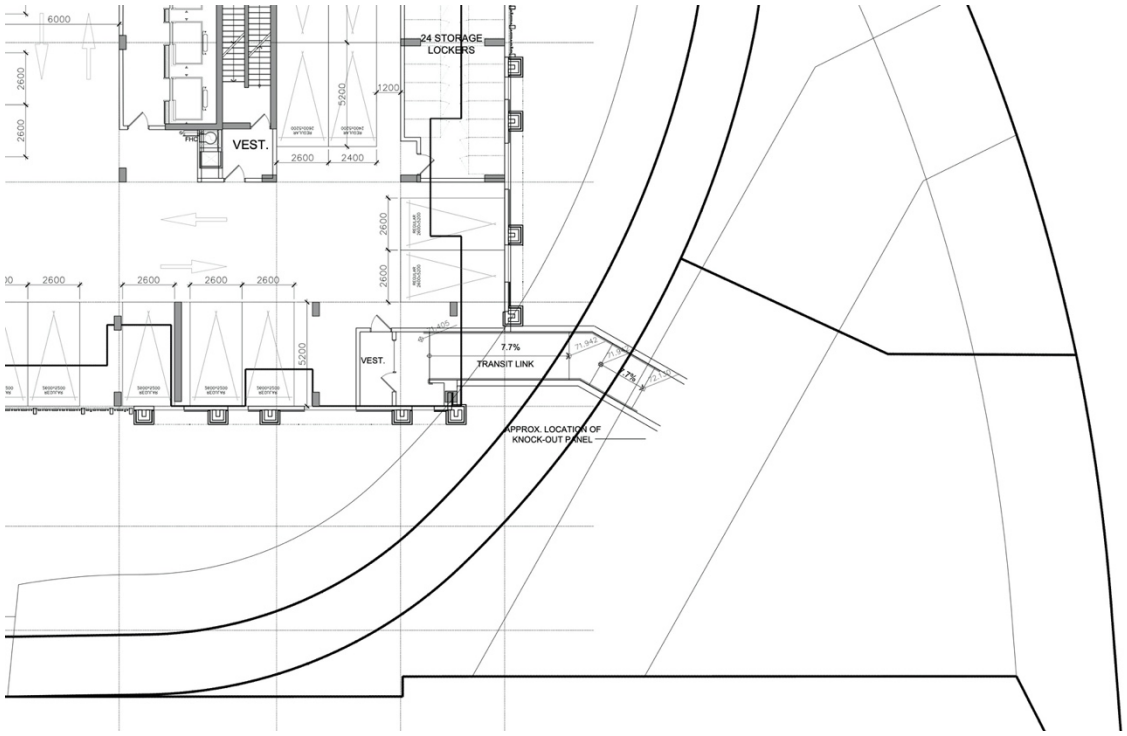

Figure 6: Extract of level 2 floor plan showing proposed transit link

2 Plan and cross-sections of the development locating the Confederation Line structure/right-of-way and founding elevations relative to the development, including any underground storage tanks and associated piping;

A cross-section of the development locating the Bayshore Station structure will be provided following first round of comment and response with the City of Ottawa when internal building details have become more certain and a CAD drawing of the proposed Bayshore Station can be incorporated into the model for accuracy.

3 A geotechnical investigation report showing up-to-date geotechnical conditions at the site of the development. The geotechnical investigation shall be prepared in accordance with the Geotechnical Investigation and Reporting Guidelines for Development Applications in the City;

A Geotechnical Report has been prepared by Golders and submitted with this Site Plan Control application.

4 Structural, foundation, excavation, and shoring drawings; and

Structural, foundation, excavation and shoring drawings will be provided prior to the Site Plan Agreement. No negative impacts are anticipated on the proposed LRT station or rail line due to the proposed building location, foundation details, or construction activities.

5 Acknowledgement that the potential for noise, vibration, electro-magnetic interference and stray current from Confederation Line operations have been considered in the design of the project, and appropriate mitigation measures applied.

As per the submitted Noise and Vibration Study as well as the Geotechnical Review, these considerations have been reviewed in the design of the project.

8.0 CONCLUSION

Based on the review of the context, proposed development, along with input from Golders and Gradient Wind on the matter of geotechnical conditions and vibration levels, there is no negative impact on the Confederation West line or Bayshore Station expected as a result of this development either during construction or following.

Please contact the author of this report for further details and information that may be required.

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