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Trillium Line Level 1 Proximity Study

Proposed Multi-Storey Building
93 Norman Street
Ottawa, Ontario

Prepared For

Tamarack (Norman) Corporation

March 3, 2021

Report: PG2760-2

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1.0 Introduction

Paterson Group (Paterson) was commissioned by the Tamarack (Norman) Corporation to conduct a Level 1 Trillium Line proximity study for the proposed multi-storey building to be located at 93 Norman Street in the City of Ottawa.

The objective of the current study was to:

❑ Review all current information provided by the City of Ottawa with regards to the infrastructure of the Trillium Line.

❑ Liaise between the City of Ottawa and the Tamarack (Norman) Corporation consultant team involved with the aforementioned project.

The following report has been prepared specifically and solely for the aforementioned project which is described herein. It contains a collaboration of architectural, civil, structural, geotechnical, and shoring design information as they pertain to the aforementioned project.

2.0 Development Details

Based on available drawings, it is understood that the proposed development consists of a multi-storey building with 2 underground levels. The underground parking structure is expected to occupy the majority of the site.

The following is known about the Trillium Line in the vicinity of the subject site:

❑ The Trillium Line rail runs parallel to the west boundary of the site.

❑ The existing Trillium Line rail is located at the ground surface at an approximate geodetic elevation of 56 m, while the 93 Norman Street site is located up the slope to the east at an approximate geodetic elevation of 61.6 m.

❑ Based on the subsurface profile encountered at the borehole locations at the subject site, bedrock is expected at depths of approximately 1.6 to 2.4 m, corresponding to approximate geodetic elevations of 60.1 to 59.2 m.

3.0 Construction Methodology and Impact Review

Paterson has prepared a construction methodology summary along with possible impacts on the adjacent segment of the Trillium Line based on the current building design details. The Construction Methodology and Impact Review is provided in Appendix 1 and presents the anticipated construction items, impact review and mitigation program recommended for the existing Trillium Line railway. One of the main issues will be vibrations associated with the bedrock blasting removal program. It is recommended that a vibration monitoring program be implemented to ensure vibration levels remain below recommended tolerances. Details of a recommended vibration monitoring program are presented below.

3.1 Vibration Monitoring and Control Program

Due to the presence of the existing Trillium Line railway, the contractor should take extra precaution to minimize vibrations. The vibration monitoring program will be required for the full construction duration for blasting operations, dewatering, backfilling and compaction, construction traffic and other construction activities. The purpose of the Vibration Monitoring and Control Program (VMCP) is to provide a description of the measures to be implemented by the contractor to manage excavation operations and any other vibration sources during the construction for the proposed development. The VMCP will also provide a guideline for assessing results against the relevant vibration impact assessment criteria and recommendations to meet the required limits.

The monitoring program will incorporate real time results at the Trillium Line corridor structure adjacent to the subject site. The monitoring equipment should consist of a tri-axial seismograph, capable of measuring vibration intensities up to 254 mm/s at a frequency response of 2 to 250 Hz. The monitoring equipment should be placed at the west boundary of the 93 Norman Street site, adjacent to the Trillium Line rail corridor.

The location should be reviewed periodically throughout construction to ensure that the monitoring equipment remains with the rail line structure at the closest radius to the construction activities. The vibration monitor locations should be approved by the project manager prior to installation.

During construction, the vibration monitor will be relocated for the ‘worst case’ location for each construction activity. When an event is triggered, Paterson will review the results and provide any necessary feedback. Otherwise, the vibration results will be summarized in the weekly report.

Proposed Vibration Limits

The excavation operations should be planned and conducted under the supervision of a licensed professional engineer who is an experienced bedrock excavation consultant. The following table outlines the vibration limits for the Trillium Line railway:

Table 1 - Structure Vibration Limits for the Trillium Line Railway

Dominant Frequency Range (Hz)	Peak Particle Velocity (mm/s)	Event	Description of Event
<40	>10	trigger level	Warning e-mail sent to contractor.
<40	≥15	exceedance level	Exceedance e-mail and phone call to the contractor. All operations are ceased to review on-site activities.
>40	>15	trigger level	Warning e-mail sent to contractor.
>40	≥25	exceedance level	Exceedance e-mail and phone call to the contractor. All operations are ceased to review on-site activities.

Monitoring Data

The monitoring protocol should include the following information:

Trigger Level Event

☐ Paterson will review all vibrations over the established warning level, and;
☐ Paterson will notify the contractor if any vibrations occur due to construction activities and are close to exceedance level.

Exceedance Level Event

☐ Paterson will notify all the relevant stakeholders via email
☐ Ensure monitors are functioning
☐ Issue the vibration exceedance result

The data collected should include the following:

☐ Measured vibration levels
☐ Distance from the construction activity to monitoring location
☐ Vibration type

Monitoring should be compliant with all related regulations.

3.2 Incident/Exceedance Reporting

In case an incident/exceedance occurs from construction activities, the Senior Project Management and any relevant personnel should be notified immediately. A report should be completed which contains the following:

☐ Identify the location of vibration exceedance
☐ The date, time and nature of the exceedance/incident
☐ Purpose of the exceeded monitor and current vibration criteria
☐ Identify the likely cause of the exceedance/incident
☐ Describe the response action that has been completed to date
☐ Describe the proposed measures to address the exceedance/incident.

The contractor should implement mitigation measures for future excavation or any construction activities as necessary and provide updates on the effectiveness of the improvement. Response actions should be pre-determined prior to excavation, depending on the approach provided to protect elements. Processes and procedures should be in-place prior to completing any vibrations to identify issues and react in a quick manner in the event of an exceedance.

4.0 Proximity Study Requirement Responses

Paterson was informed by the City of Ottawa that a Level 1 Trillium Line Proximity Study should be completed for the proposed development. A Level 1 Trillium Line Proximity Study is required where the proposed development is located within the City of Ottawa's Development Zone of Influence.

The following table lists the applicable requirements for Level 1 studies and the response for each item:

Table 2
List of Trillium Line Level 1 Proximity Study Requirements

Level 1 Projects	Response
A site plan of the development with the centreline or reference line of the Trillium Line structure and/or right-of-way located and the relevant distances between the Trillium Line and developer's structure shown clearly;	See Trillium Line Proximity Plan (Drawing No. PG2760-2 dated February 2021) presented in Appendix A.
Plan and cross-sections of the development locating the Trillium Line structure/right-of-way and founding elevations relative to the development, including any underground storage tanks and associated piping;	Refer to the Trillium Line Proximity Plan (Drawing No. PG2760-2 dated February 2021) and Cross-Section A-A' (Drawing No. PG2760-3 dated February 2021) presented in Appendix A.
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;	Refer to Geotechnical Investigation: Paterson Group Report PG2760-1 Revision 2 dated February 17, 2021 presented in Appendix B.
Structural, foundation, excavation and shoring drawings;	Structural, foundation, excavation and shoring drawings will be provided prior to the Site Plan Agreement. Based on available design details, the proposed building foundation will consist of conventional footings placed directly over a clean, bedrock surface. No negative impacts are anticipated for the Trillium Line due to the proposed building location.
Acknowledgment that the potential for noise, vibration, electro-magnetic interference and stray current from Trillium Line operations have been considered in the design of the project, and appropriate mitigation measures applied.	Refer to the Transportation Noise and Vibration Assessment which is presented in Appendix C.

We trust that this information satisfies your immediate request.

Best Regards,

Paterson Group Inc.

NPatey

Nicole Patey, B.Eng.

LICENSED PROFESSIONAL ENGINEER
Mar. 3, 2021
S. S. DENNIS
100519516
Scott Dennis
PROVINCE OF ONTARIO

Scott Dennis

Scott S. Dennis, P.Eng.

Report Distribution

☐ Tamarack (Norman) Corporation (e-mail copy)
☐ Paterson Group (1 copy)

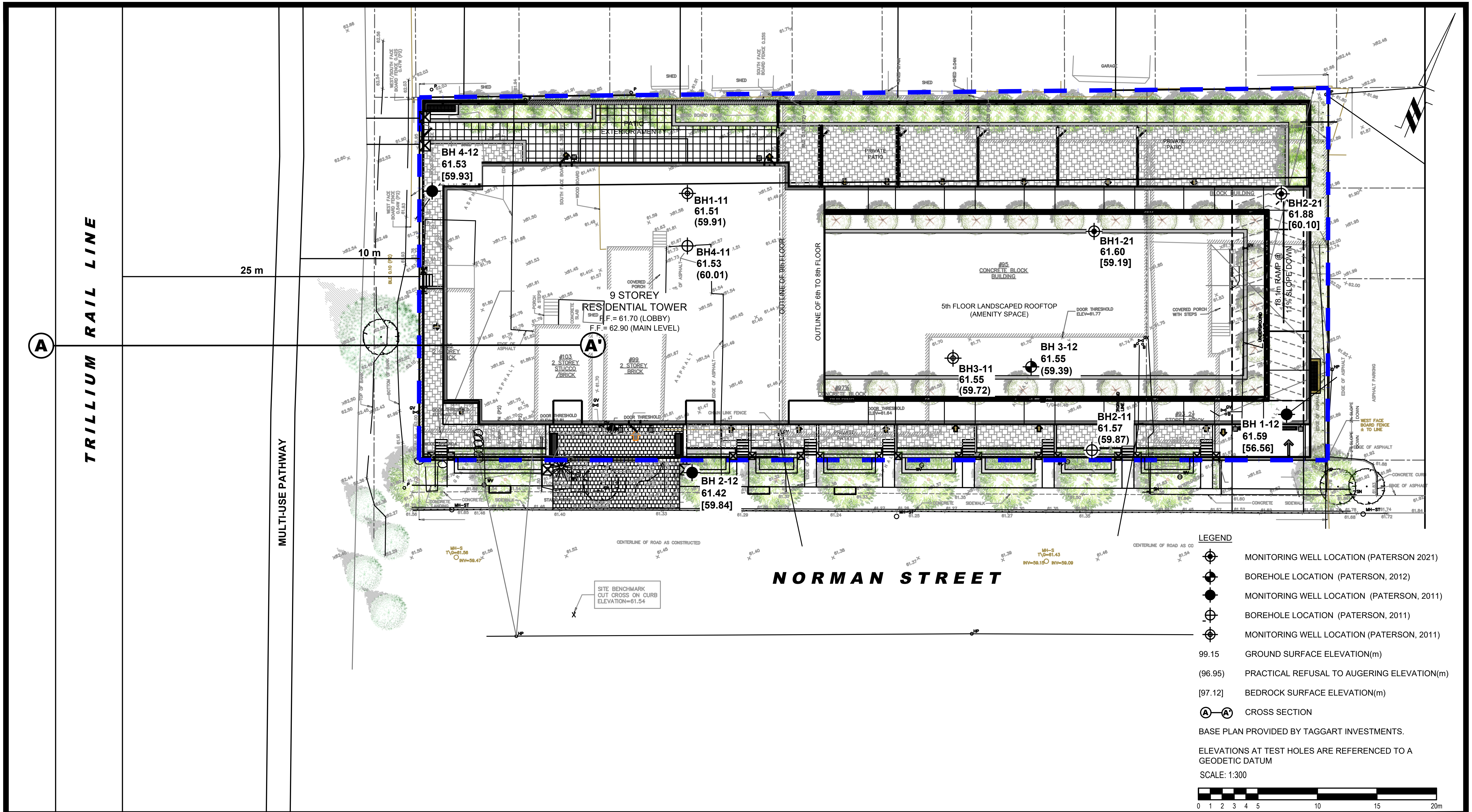
APPENDIX A

Trillium Line Proximity Plan

Cross Section A-A’

Draft Plan of Survey

Construction Methodology and Impact Review



LEGEND

⊕	MONITORING WELL LOCATION (PATERSON 2021)
⊕	BOREHOLE LOCATION (PATERSON, 2012)
●	MONITORING WELL LOCATION (PATERSON, 2011)
⊕	BOREHOLE LOCATION (PATERSON, 2011)
⊕	MONITORING WELL LOCATION (PATERSON, 2011)
99.15	GROUND SURFACE ELEVATION(m)
(96.95)	PRACTICAL REFUSAL TO AUGERING ELEVATION(m)
[97.12]	BEDROCK SURFACE ELEVATION(m)
Ⓐ—Ⓐ'	CROSS SECTION

BASE PLAN PROVIDED BY TAGGART INVESTMENTS.

ELEVATIONS AT TEST HOLES ARE REFERENCED TO A GEODETIC DATUM

SCALE: 1:300

0 1 2 3 4 5 10 15 20m

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NO.	REVISIONS	DATE	INITIAL

TAMARACK (NORMAN) CORPORATION

PROP. MULTI-STOREY BUILDING - 93 NORMAN STREET

OTTAWA, ONTARIO

Title:

TRILLIUM PROXIMITY LINE

Scale: 1:300
Date: 02/2021
Drawn by: RCG
Report No.: PG2760-2
Checked by: NP
Dwg. No.: PG2760-2
Approved by: SD
Revision No.:

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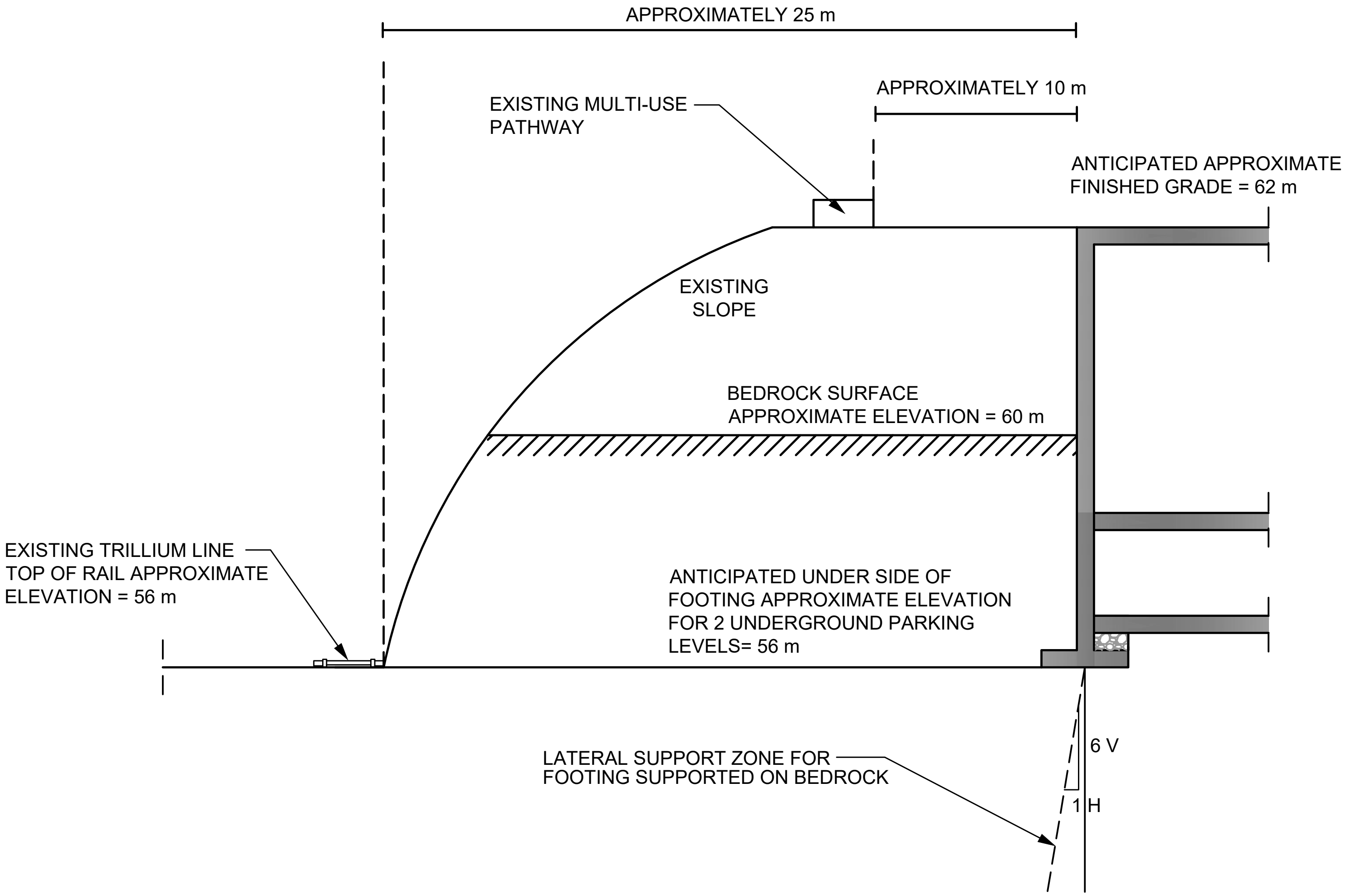
CROSS SECTION A -A '



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TAMARACK (NORMAN) CORPORATION
TRILLIUM LINE PROXIMITY STUDY
93 NORMAN STREET

OTTAWA, **ONTARIO**

Title:

CROSS SECTION A-A'

Scale: N.T.S.
Date: 02/2021
Drawn by: YA
Report No.: PG2760-2
Checked by: NP
Drawing No.: PG2760-3
Approved by: SD
Revision No.:

p:\autocad drawings\geotechnical\pg27xx\pg2760\pg2760-cross section a-a'.dwg

I REQUIRE THIS PLAN TO BE
DEPOSITED UNDER THE
LAND TITLES ACT.

________ ________, 2012

BRIAN J. WEBSTER
ONTARIO LAND SURVEYOR

PLAN 4R-______
RECEIVED AND DEPOSITED

DATE ____________

REPRESENTATIVE FOR THE
LAND REGISTRAR FOR THE
LAND TITLES DIVISION OF
OTTAWA-CARLETON NO. 4

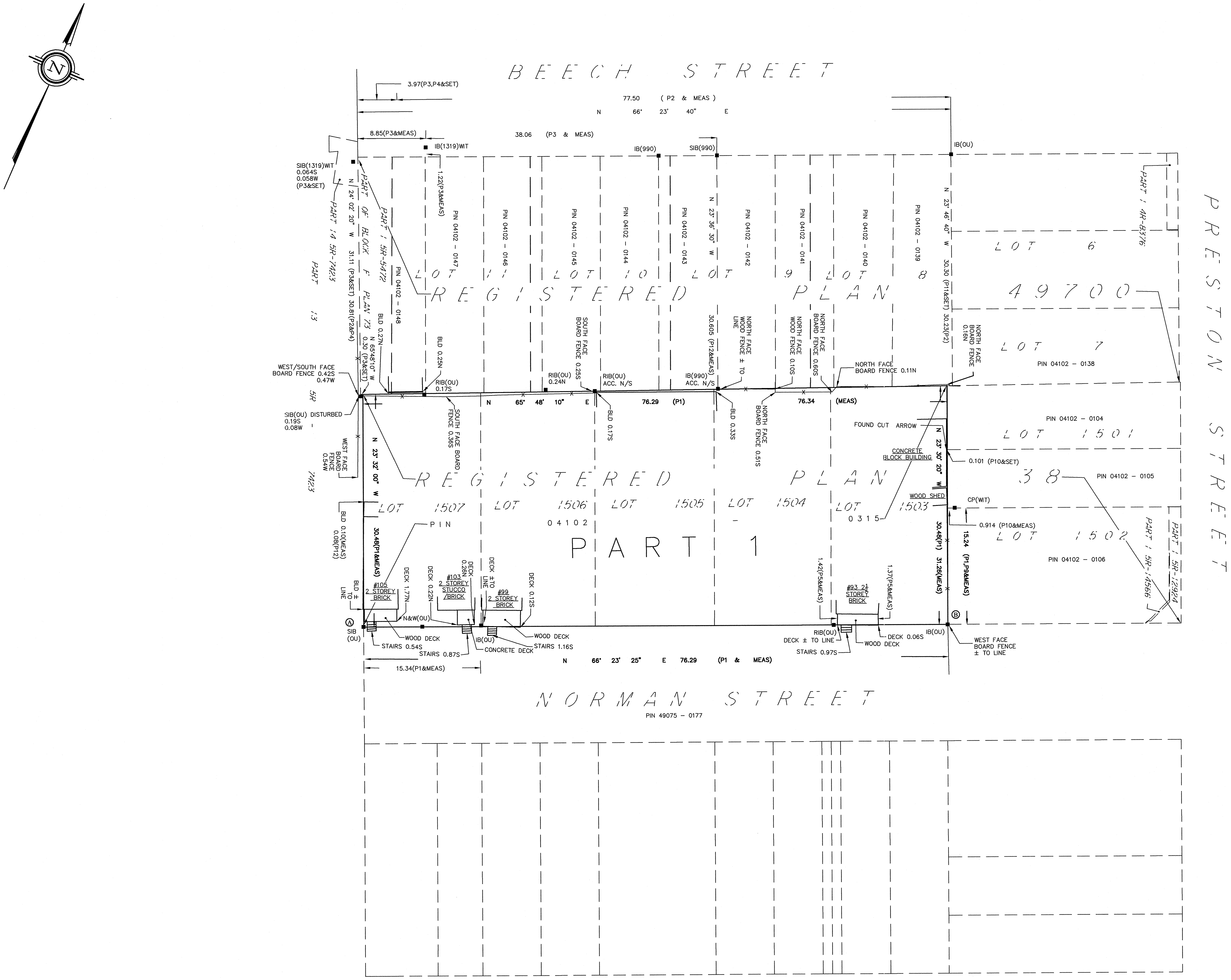
SCHEDULE

PART	*DESCRIPTION*	*PIN*	*AREA* (m^2)
1	LOTS 1503-1507 REG. PLAN 38	ALL OF PIN 04102-0315	2356.1

DRAFT PLAN OF SURVEY of

LOTS 1503, 1504, 1505, 1506, 1507
REGISTERED PLAN 38
CITY OF OTTAWA
MUNICIPALITY OF OTTAWA-CARLETON

Stantec Geomatics Ltd.



METRIC CONVERSION

DISTANCES AND COORDINATES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

GRID SCALE CONVERSION

DISTANCES ARE GROUND AND CAN BE CONVERTED TO GRID BY MULTIPLYING BY THE COMBINED SCALE FACTOR OF 0.99999.

BEARING NOTE

ALL BEARINGS ARE GRID AND ARE DERIVED USING THE CAN-NET VIRTUAL REFERENCE STATION NETWORK, REFERRING TO MTM ZONE 9, NAD(83)(CSRS)(1997.0)(ORIGINAL)

OBSERVED REFERENCE POINTS (ORPs) DERIVED FROM GPS OBSERVATIONS USING THE CAN-NET VIRTUAL REFERENCE STATION NETWORK:
MTM ZONE 9, NAD83 (CSRS) (1997.0) (ORIGINAL).
COORDINATES TO URBAN ACCURACY PER SEC 14(2) OF O.REG. 216/10

POINT ID	NORTHING	EASTING
Ⓐ	5029155.25	366607.89
Ⓑ	5029185.81	366677.81

COORDINATES CANNOT, IN THEMSELVES, BE USED TO RE-ESTABLISH CORNERS OR BOUNDARIES SHOWN ON THIS PLAN.

SURVEYOR'S CERTIFICATE

I CERTIFY THAT :

1. THIS SURVEY AND PLAN ARE CORRECT AND IN ACCORDANCE WITH THE SURVEYS ACT, THE SURVEYORS ACT AND THE LAND TITLES ACT AND THE REGULATIONS MADE UNDER THEM.
2. THE SURVEY WAS COMPLETED ON THE 30 DAY OF AUGUST , 2012

DATE

BRIAN J. WEBSTER
ONTARIO LAND SURVEYOR

LEGEND

■	DENOTES	FOUND MONUMENTS
□	"	SET MONUMENTS
IB	"	IRON BAR
IBØ	"	ROUND IRON BAR
SIB	"	STANDARD IRON BAR
SSIB	"	SHORT STANDARD IRON BAR
CC	"	CUT CROSS
CP	"	CONCRETE PIN
WIT	"	WITNESS
PIN	"	PROPERTY IDENTIFICATION NUMBER
MEAS	"	MEASURED
PROP	"	PROPORTIONED
OU	"	ORIGIN UNKNOWN
SG	"	STANTEC GEOMATICS LTD.
P1	"	REGISTERED PLAN 38
P2	"	REGISTERED PLAN 49700
P3	"	W&S DATED MAY 15, 1990
P4	"	5R-5472
P5	"	AOV DATED FEBRUARY 15, 1984
P6	"	AOG DATED NOVEMBER 5, 1975
P7	"	JGP DATED JULY 17, 1972
P8	"	W&S DATED SEPTEMBER 19, 1988
P9	"	W&S DATED OCTOBER 25, 1988
P10	"	FSD DATED OCTOBER 20, 2009
P11	"	AOV DATED AUGUST 19, 1987
P12	"	JGP DATED SEPTEMBER 21, 1988

Stantec

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DRAWN BY: CM	CHECKED BY: CM	PM: FP	FIELD: CM/CA	PROJECT No.:

DRAWING: 161612812 114 F1.dwg

V:\01-616\active\161612812_taggart_norman street_fp\reference_plan\analysis\dwg

Construction Methodology and Impact Review		
Construction Item	**Potential Impact**	**Mitigation Program**
Item A - Installation of Temporary Shoring System - Where adequate space is not available for the overburden to be sloped, the overburden along the perimeter of the proposed building footprint will need to be shored in order to complete the construction of the underground parking levels. The shoring system is anticipated to consist of a soldier pile and lagging or interlocking sheet pile system along the west side of the site adjacent to the Trillium Line.	Vibration issues during shoring system installation	Design of the temporary shoring system, in particular vibrations during installation, will take into consideration the presence of the proposed Trillium Line. Installation of the shoring system is not anticipated to have an adverse impact on the Trillium Line, nonetheless, a vibration monitoring device is recommended to be installed to monitor vibrations. The vibration monitor would be remotely connected to permit real time monitoring and a vibration monitoring program would be implemented as detailed in Subsection 3.1 - Vibration Monitoring and Control Program of Paterson Group Report PG2760-2 dated February 17, 2021.
Item B - Bedrock Blasting and Removal Program - Blasting of the bedrock will be required for the proposed building and parking garage structure construction. It is expected that up to approximately 4 m of bedrock removal is required based on the current design concepts for the proposed development.	Structural damage of Trillium Line due to vibrations from blasting program.	Structural damage to the Trillium Line during bedrock blasting and removal is not anticipated, nonetheless, a vibration monitoring device is recommended to be installed along the rail corridor to monitor vibrations. The vibration monitor would be remotely connected to permit real time monitoring and a vibration monitoring program would be implemented as detailed in Subsection 3.1 - Vibration Monitoring and Control Program of Paterson Group Report PG2760-2 dated February 17, 2021.
Item C - Construction of Footings and Foundation Walls - The proposed building will include 2 levels of underground parking. Therefore, the footings will be placed over a clean, surface sounded limestone bedrock bearing surface.	Building footing loading on adjacent Trillium Line, and excavation within the lateral support zone of the Trillium Line.	Due to the distance between the proposed building and the Trillium Line, the zone of influence from the proposed footings will not intersect the rail line structure. Further, although the underground parking levels for the proposed building will extend approximately 6 m below existing ground surface, due to the approximate 25 m distance between the proposed building and rail line structure, the building excavation will not impact the lateral support zone of the Trillium Line.

APPENDIX B

Geotechnical Investigation:

Report PG2760-1 Revision 2

dated February 17, 2021

Geotechnical Engineering

Environmental Engineering

Hydrogeology

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Geotechnical Investigation

Proposed Multi-Storey Building
93 Norman Street
Ottawa, Ontario

Prepared For

Tamarack (Norman) Corporation

February 17, 2021

Report: PG2760-1
Revision 2

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1.0 Introduction

Paterson Group (Paterson) was commissioned by Tamarack (Norman) Corporation to conduct a geotechnical investigation for a proposed multi-storey building to be located at 93 Norman Street in the City of Ottawa, Ontario (refer to Figure 1 - Key Plan in Appendix 2 of this report).

The objectives of the current investigation were to:

❏ Determine the subsoil and groundwater conditions at this site by means of boreholes.

❏ Provide geotechnical recommendations for the design of the proposed development including construction considerations which may affect the design.

The following report has been prepared specifically and solely for the aforementioned project which is described herein. It contains our findings and includes geotechnical recommendations pertaining to the design and construction of the subject development as they are understood at the time of writing this report.

Investigating the presence or potential presence of contamination on the subject property was not part of the scope of work for this geotechnical investigation.

2.0 Proposed Project

Based on the available conceptual drawings, it is our understanding that a nine (9) storey multi-storey structure with two (2) levels of underground parking encompassing the majority of the site is currently being proposed for the subject site.

It is also expected that the proposed development will be serviced with municipal sewer and water.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The field program for the current geotechnical investigation was carried out on February 3, 2021 by extending a total of 2 boreholes (BH 1-21 and BH 2-21) to a maximum depth of 7 m below the existing ground surface. Relevant test holes completed during the previous investigations (BH 1 through BH 4 and BH 1-12 through BH 4-12) have also been included in the current Geotechnical Investigation Report. The aforementioned boreholes were distributed in a manner to provide general coverage of the subject site taking into consideration of site features, underground utilities and previous boreholes. The locations of the boreholes are shown on Drawing PG2760-1 - Test Hole Location Plan included in Appendix 2.

The boreholes were drilled using a truck-mounted auger drill rig operated by a two-person crew. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer. The drilling procedure consisted of augering to the required depths at the selected locations, sampling and testing the overburden.

Sampling and In Situ Testing

Soil samples were recovered using a 50 mm diameter split-spoon sampler or from the auger flights. The split-spoon and auger samples were classified on site, placed in sealed plastic bags, and transported to our laboratory for further review. The depths at which the split-spoon and auger samples were recovered from the boreholes are shown as SS and AU, respectively, on the Soil Profile and Test Data sheets in Appendix 1.

The Standard Penetration Test (SPT) was conducted in conjunction with the recovery of the split-spoon samples. The SPT results are recorded as “N” values on the Soil Profile and Test Data sheets. The “N” value is the number of blows required to drive the split-spoon sampler 300 mm into the soil after a 150 mm initial penetration using a 63.5 kg hammer falling from a height of 760 mm.

Diamond drilling was carried out at 7 borehole locations (BH 1, BH3, BH 1-12, BH 2-12, BH 4-12, BH 1-21 and BH 2-21) to assess the bedrock quality. A recovery value and a Rock Quality Designation (RQD) value were calculated for each drilled section of bedrock and are shown on the Soil Profile and Test Data sheets in Appendix 1. The recovery value is the ratio, in percentage, of the length of the bedrock sample recovered over the length of the drilled section. The RQD value is the ratio, in percentage, of the total length of intact rock pieces longer than 100 mm in one drilled section over the length of the drilled section. These values are indicative of the quality of the bedrock.

Subsurface conditions observed in the boreholes were recorded in detail in the field. The soil profiles are presented on the Soil Profile and Test Data sheets in Appendix 1 of this report.

Groundwater

A 32 mm PVC groundwater monitoring well was installed in BH 1, BH 3, BH 1-12, BH 2-12, BH 4-12, BH 1-21 and BH 2-21 to permit monitoring of the groundwater levels subsequent to the completion of the sampling program.

Monitoring Well Installation

Typical monitoring well construction details are described below:

- ☐ 1.5 to 3.0 m of slotted 32 mm diameter PVC screen at the base of borehole.
- ☐ 32 mm diameter PVC riser pipe from the top of the screen to the ground surface.
- ☐ No.3 silica sand backfill within annular space around screen.
- ☐ 300 mm thick bentonite hole plug directly above PVC slotted screen.
- ☐ Clean backfill from top of bentonite plug to the ground surface.

Refer to the Soil Profile and Test Data sheets in Appendix 1 for specific well construction details.

Sample Storage

All samples from the current geotechnical investigation will be stored in the laboratory for a period of one month after issuance of this report. They will then be discarded unless we are otherwise directed.

3.2 Field Survey

The borehole locations and ground surface elevation at each borehole location were surveyed by Paterson using a handheld GPS and referenced to geodetic datum.

The borehole location and ground surface elevation at each test hole location are presented on Drawing PG2760-1 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

Soil and bedrock samples were recovered from the subject site and visually examined in our laboratory to review the results of the field logging.

4.0 Observations

4.1 Surface Conditions

The subject site is located on the north side of Norman Street to the west of the intersection of Preston Street and Norman Street. The site is bordered to the north by single family residential dwellings, to the south by Norman Street followed by single family residential dwellings, and to the east by commercial properties. The site is bordered to the west by a pedestrian pathway followed by the existing Trillium Line.

The subject site was formerly occupied by several single family residential dwellings and commercial slab-on-grade buildings which were recently demolished. At the present time, the site has been re-graded to match the neighbouring properties and Norman Street.

4.2 Subsurface Profile

The subsurface profile at the borehole locations generally consists of a pavement structure and/or fill underlain by a silty sand and/or a glacial till deposit followed by a grey limestone bedrock.

The underlying grey limestone bedrock was cored at BH 1, BH 3, BH 1-12, BH 2-12, BH 4-12, BH 1-21 and BH 2-21 beginning at approximate depths varying between 1.6 and 2.4 m below the existing ground surface, extending to a maximum depth of 11.7 m. Based on our observations, the upper 1 to 2 m of the bedrock is of fair to good quality, while the majority of the remainder of the bedrock core was noted to be good to excellent quality. Specific details of the subsurface profile at each test hole location are presented on the Soil Profile and Test Data sheets in Appendix 1.

Based on available geological mapping, the subject site is located in an area where the bedrock consists of interbedded limestone and shale of the Verulam Formation.

4.3 Groundwater

The recorded groundwater levels recorded at the monitoring wells installed at BH 1, BH 3, BH 1-12, BH 2-12, BH 4-12, BH 1-21 and BH 2-21 are presented in Table 1. It should be noted that groundwater levels fluctuate periodically throughout the year and higher levels could be encountered at the time of construction.

Table 1 - Groundwater Measurements at Monitoring Well Locations

Borehole Number	Ground Elevation (m)	Groundwater Levels		Recording Date
		Depth (m)	Elevation (m)	
BH 1	61.51	1.37	60.14	June 6, 2011
		1.86	59.65	September 5, 2012
BH 3	61.55	1.74	59.81	June 6, 2011
		1.86	59.69	September 5, 2012
BH 1-12	61.59	2.05	59.54	September 5, 2012
BH 2-12	61.42	1.84	59.58	September 5, 2012
BH 4-12	61.53	2.53	59.00	September 5, 2012
BH 1-21	61.60	1.78	59.82	February 9, 2021
BH 2-21	61.88	1.85	60.03	February 9, 2021

5.0 Discussion

5.1 Geotechnical Assessment

The subject site is considered satisfactory, from a geotechnical perspective, for the proposed multi-storey building. It is recommended that the proposed multi-storey building be founded on conventional spread footings placed on clean, surface sounded bedrock.

Considering the shallow depth to bedrock, it is expected that the adjacent buildings are founded on bedrock. Therefore, underpinning is not expected to be required at this site. However, test pits should be excavated at the start of construction, which are observed by Paterson, to confirm the depth and founding conditions of the adjacent structures located in close proximity to the subject site, to determine if underpinning is required.

Bedrock removal will be required to complete the underground parking levels. Line drilling and controlled blasting is recommended where large quantities of bedrock need to be removed. The blasting operations should be planned and completed under the guidance of a professional engineer with experience in blasting operations. It is expected that the vertical walls of the bedrock surface will be grinded to provide a suitable substrate surface for the foundation drainage and waterproofing system.

In addition, it is expected that bedrock stabilization measures will most likely be required along the vertical walls of the bedrock surface, which will be evaluated during the excavation program and determined by the geotechnical consultant at the time of construction.

The above and other considerations are further discussed in the following sections.

5.2 Site Grading and Preparation

Stripping Depth

Due to the depth of the bedrock at the subject site and the anticipated founding level for the proposed multi-storey building, it is anticipated that all existing overburden material will be excavated from within the footprint of the proposed multi-storey building.

Bedrock Removal

It is expected that line-drilling in conjunction with hoe-ramming or controlled blasting will be required to remove the bedrock for the underground parking levels. In areas of weathered bedrock and where only a small quantity of bedrock is to be removed, bedrock removal may be possible by hoe-ramming.

Prior to considering blasting operations, the blasting effects on the existing services, buildings and other structures should be addressed. A pre-blast or pre-construction survey of the existing structures located in proximity of the blasting operations should be carried out prior to commencing site activities. The extent of the survey should be determined by the blasting consultant and should be sufficient to respond to any inquiries/claims related to the blasting operations.

As a general guideline, peak particle velocities (measured at the structures) should not exceed 25 mm per second during the blasting program to reduce the risks of damage to the existing structures.

The blasting operations should be planned and conducted under the supervision of a licensed professional engineer who is also an experienced blasting consultant.

Vibration Considerations

Construction operations are also the cause of vibrations, and possibly, sources of nuisance to the community. Therefore, means to reduce the vibration levels should be incorporated in the construction operations to maintain, as much as possible, a cooperative environment with the residents.

The following construction equipments could be a source of vibrations: piling rig, hoe ram, compactor, dozer, crane, truck traffic, etc. The construction of the shoring system using soldier piles or sheet piling will require the use of these equipments. Vibrations, whether it is caused by blasting operations or by construction operations, could be the cause of the source of detrimental vibrations on the adjoining buildings and structures. Therefore, it is recommended that all vibrations be limited.

Two parameters are used to determine the permissible vibrations, namely, the maximum peak particle velocity and the frequency. For low frequency vibrations, the maximum allowable peak particle velocity is less than that for high frequency vibrations. As a guideline, the peak particle velocity should be less than 15 mm/s between frequencies of 4 to 12 Hz, and 50 mm/s above a frequency of 40 Hz (interpolate between 12 and 40 Hz). It should be noted that these guidelines are for today's construction standards. Considering that several old or sensitive buildings are encountered in the vicinity of the subject site, considerations should be given to lowering these guidelines. Considering that these guidelines are above perceptible human level and, in some cases, could be very disturbing to some people, it is recommended that a pre-construction survey be completed to minimize the risks of claims during or following the construction of the proposed building.

Fill Placement

Excavated limestone bedrock could be used as select subgrade material around the proposed building footings, provided the excavated bedrock is suitably crushed to 50 mm in its longest dimension and approved by the geotechnical consultant at the time of placement. Alternatively, an engineered fill such as an OPSS Granular A or Granular B Type II compacted to 98% of its SPMDD could be placed around the proposed footings.

5.3 Foundation Design

Bearing Resistance Values

Footings placed on clean, surface sounded bedrock at the proposed founding elevation can be designed using a factored bearing resistance value at ultimate limit states (ULS) of **5,000 kPa.** A geotechnical resistance factor of 0.5 was applied to the bearing resistance value at ULS.

A clean, surface-sounded bedrock bearing surface should be free of loose materials, and have no near surface seams, voids, fissures or open joints which can be detected from surface sounding with a rock hammer.

A factored bearing resistance value at ULS of **6,000 kPa**, incorporating a geotechnical resistance factor of 0.5, could be used if founded on limestone bedrock and the bedrock is free of seams, fractures and voids within 1.5 m below the founding level. This could be verified by completing and probing 50 mm diameter drill holes to a depth of 1.5 m below the founding level within the footprint(s) of the footing(s). At least one drill hole should be completed per major footing. The drill hole inspection should be carried out by the geotechnical consultant.

Lateral Support

The bearing medium under footing-supported structures is required to be provided with adequate lateral support with respect to excavations and different foundation levels. Adequate lateral support is provided to a sound bedrock bearing medium when a plane extending down and out from the bottom edge of the footing at a minimum of 1H:6V (or flatter) passes only through sound bedrock or a material of the same or higher capacity as the bedrock, such as concrete. A weathered bedrock bearing medium will require a lateral support zone of 1H:1V (or flatter).

Settlement

Footings bearing on an acceptable bedrock bearing surface and designed using the bearing resistance values provided herein will be subjected to negligible potential post-construction total and differential settlements.

5.4 Design for Earthquakes

For design purposes, the site class for seismic site response can be taken as **Class A** for the foundations considered at this site. A site specific shear wave velocity test is required to confirm the seismic site classification. The soils underlying the subject site are not susceptible to liquefaction. Refer to the latest revision of the Ontario Building Code for a full discussion of the earthquake design requirements.

5.5 Basement Slab

All overburden soil will be removed from the subject site leaving the bedrock as the founding medium for the lower basement floor slab. If storage or other uses of the lower level where a concrete floor slab will be used, it is recommended that the upper 200 mm of sub-slab fill consists of 19 mm clear crushed stone. All backfill material within the footprint of the proposed building should be placed in maximum 300 mm thick loose layers and compacted to at least 98% of its SPMDD.

In consideration of the groundwater conditions encountered at the time of the fieldwork, a subfloor drainage system, consisting of lines of perforated drainage pipe subdrains connected to a positive outlet, should be provided in the clear stone under the lower basement floor.

5.6 Basement Wall

It is understood that the basement walls are to be poured against a waterproofing system, which will be placed against the exposed bedrock face. Below the bedrock surface, a nominal coefficient for at-rest earth pressure of 0.05 is recommended in conjunction with a bulk unit weight of 24.5 kN/m^3 (effective 15.5 kN/m^3). A seismic earth pressure component will not be applicable for the foundation wall, which is to be poured against the bedrock face. It is expected that the seismic earth pressure will be transferred to the underground floor slabs, which should be designed to accommodate these pressures. A hydrostatic groundwater pressure should be added for the portion below the groundwater level.

Where soil is to be retained, the conditions can be well-represented by assuming the retained soil has a coefficient for at-rest earth pressure of 0.5 in conjunction with a bulk (drained) unit weight of 20 kN/m^3. Undrained conditions are anticipated (i.e. below the groundwater level). Therefore, the applicable effective (undrained) unit weight of the retained soil can be taken as 13 kN/m^3, where applicable. A hydrostatic pressure should be added to the total static earth pressure when using the effective unit weight.

Two distinct conditions, static and seismic, must be reviewed for design calculations. The parameters for design calculations for the two conditions are presented below.

Static Conditions

The static horizontal earth pressure (p_o) can be calculated using a triangular earth pressure distribution equal to $K_o \cdot \gamma \cdot H$ where:

K_o = at-rest earth pressure coefficient of the applicable retained material
γ = unit weight of fill of the applicable retained soil (kN/m^3)
H = height of the wall (m)

An additional pressure having a magnitude equal to $K_o \cdot q$ and acting on the entire height of the wall should be added to the above diagram for any surcharge loading, q (kPa), that may be placed at ground surface adjacent to the wall. The surcharge pressure will only be applicable for static analyses and should not be used in conjunction with the seismic loading case.

Actual earth pressures could be higher than the “at-rest” case if care is not exercised during the compaction of the backfill materials to maintain a minimum separation of 0.3 m from the walls with the compaction equipment.

Seismic Conditions

The total seismic force (P_{AE}) includes both the earth force component (P_o) and the seismic component (ΔP_{AE}).

The seismic earth force (ΔP_{AE}) can be calculated using $0.375 \cdot a_c \cdot \gamma \cdot H^2/g$ where:

a_c = $(1.45 - a_{max}/g)a_{max}$
γ = unit weight of fill of the applicable retained soil (kN/m^3)
H = height of the wall (m)
g = gravity, 9.81 m/s^2

The peak ground acceleration, (a_{max}), for the Ottawa area is 0.32g according to OBC 2012. Note that the vertical seismic coefficient is assumed to be zero.

The earth force component (P_o) under seismic conditions can be calculated using $P_o = 0.5\ K_o\ \gamma\ H^2$, where $K_o = 0.5$ for the soil conditions noted above.

The total earth force (P_{AE}) is considered to act at a height, h (m), from the base of the wall, where:
$h = \{P_o \cdot (H/3) + \Delta P_{AE} \cdot (0.6 \cdot H)\}/P_{AE}$

The earth forces calculated are unfactored. For the ULS case, the earth loads should be factored as live loads, as per OBC 2012.

5.7 Rock Anchor Design

The geotechnical design of grouted rock anchors in sedimentary bedrock is based upon two possible failure modes. The anchor can fail either by shear failure along the grout/rock interface or by pullout of a 60 to 90 degree cone of rock with the apex of the cone near the middle of the bonded length of the anchor. It should be noted that interaction may develop between the failure cones of anchors that are relatively close to one another resulting in a total group capacity smaller than the sum of the load capacity of each anchor taken individually.

A third failure mode of shear failure along the grout/steel interface should also be reviewed by a qualified structural engineer to ensure all typical failure modes have been reviewed. Typical rock anchor suppliers, such as Dywidag Systems International (DSI Canada), have qualified personnel on staff to recommend appropriate rock anchor size and materials.

It should be further noted that centre to centre spacing between bond lengths be at least four (4) times the anchor hole diameter and greater than 1.2 m to lower the group influence effects. It is also recommended that anchors in close proximity to each other be grouted at the same time to ensure any fractures or voids are completely in-filled and that fluid grout does not flow from one hole to an adjacent empty one.

Anchors can be of the “passive” or the “post-tensioned” type, depending on whether the anchor tendon is provided with post-tensioned load or not prior to being put into service.

Regardless of whether an anchor is of the passive or the post tensioned type, it is recommended that the anchor be provided with a bonded length, or fixed anchor length, at the base of the anchor, which will provide the anchor capacity, as well an unbonded length, or free anchor length, between the rock surface and the start of the bonded length. As the depth at which the apex of the shear failure cone develops is midway along the bonded length, a fully bonded anchor would tend to have a much shallower cone, and therefore less geotechnical resistance, than one where the bonded length is limited to the bottom part of the overall anchor.

Permanent anchors should be provided with corrosion protection. As a minimum, this requires that the entire drill hole be filled with cementitious grout. The free anchor length is provided by installing a plastic sleeve to act as a bond break.

Grout to Rock Bond

Generally, the unconfined compressive strength of limestone ranges between 60 and 120 MPa, which is stronger than most routine grouts. A factored tensile grout to rock bond resistance value at ULS of **1.0 MPa**, incorporating a resistance factor of 0.3, can be used. A minimum grout strength of 40 MPa is recommended.

Rock Cone Uplift

As discussed previously, the geotechnical capacity of the rock anchors depends on the dimensions of the rock anchors and the configuration of the anchorage system. Based on existing subsoils information, a **Rock Mass Rating (RMR) of 65** was assigned to the bedrock, and Hoek and Brown parameters (**m and s**) were taken as **0.575 and 0.00293**, respectively.

Recommended Rock Anchor Lengths

Rock anchor lengths can be designed based on the required loads. Rock anchor lengths for some typical loads have been calculated and are presented in Table 3. Load specified rock anchor lengths can be provided, if required.

For our calculations the following parameters were used.

Table 2 - Parameters used in Rock Anchor Review	
Grout to Rock Bond Strength - Factored at ULS	1.0 MPa
Compressive Strength - Grout	40 MPa
Rock Mass Rating (RMR) - Good quality Limestone Hoek and Brown parameters	65 m=0.575 and s=0.00293
Unconfined compressive strength - Limestone bedrock	60 MPa
Unit weight - Submerged Bedrock	15 kN/m^3
Apex angle of failure cone	60°
Apex of failure cone	mid-point of fixed anchor length

From a geotechnical perspective, the fixed anchor length will depend on the diameter of the drill holes. Recommended anchor lengths for a 75 and 125 mm diameter hole are provided in Table 3.

Table 3 - Recommended Rock Anchor Lengths - Grouted Rock Anchor

Diameter of Drill Hole (mm)	**Anchor Lengths (m)**			**Factored Tensile Resistance (kN)**
	Bonded Length	**Unbonded Length**	**Total Length**	
75	1.2	0.6	1.8	250
	1.9	1	2.9	500
	3	1.5	4.5	1000
125	1.1	0.5	1.6	250
	1.5	0.9	2.4	500
	2.6	1	3.6	1000

It is recommended that the anchor drill hole diameter be within 1.5 to 2 times the rock anchor tendon diameter and the anchor drill holes be inspected by geotechnical personnel and should be flushed clean prior to grouting. The use of a grout tube to place grout from the bottom up in the anchor holes is further recommended.

The geotechnical capacity of each rock anchor should be proof tested at the time of construction. More information on testing can be provided upon request. Compressive strength testing is recommended to be completed for the rock anchor grout. A set of grout cubes should be tested for each day grout is prepared.

5.8 Pavement Structure

For design purposes, it is recommended that the rigid pavement structure for the lowest level of the underground parking structure should consist of Category C2, 32 MPa concrete at 28 days with air entrainment of 5 to 8%. The recommended rigid pavement structure is further presented in Table 4 below. The flexible pavement structure presented in Table 5 should be used for at grade access lanes and heavy loading parking areas overlying the podium deck.

Table 4 - Recommended Rigid Pavement Structure - Lower Parking Level

Thickness (mm)	Material Description
150	**Exposure Class C2 - 32 MPa Concrete** (5 to 8% Air Entrainment)
300	**BASE** - OPSS Granular A Crushed Stone
SUBGRADE - Existing imported fill, or OPSS Granular B Type I or II material placed over bedrock.	

To control cracking due to shrinking of the concrete floor slab, it is recommended that strategically located saw cuts be used to create control joints within the concrete floor slab of the lower underground parking level. The control joints are generally recommended to be located at the center of the column lines and spaced at approximately 24 to 36 times the slab thickness (for example; a 0.15 m thick slab should have control joints spaced between 3.6 and 5.4 m). The joints should be cut between 25 and 30% of the thickness of the concrete floor slab and completed as early as 4 hour after the concrete has been poured during warm temperatures and up to 12 hours during cooler temperatures.

Table 5 - Recommended Asphalt Pavement Structure - Access Lanes and Heavy Loading Parking Areas

Thickness (mm)	Material Description
40	**Wear Course** - Superpave 12.5 Asphaltic Concrete
50	**Binder Course** - Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
300	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - OPSS Granular B Type II overlying the Concrete Podium Deck.	

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project.

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type II material. The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 98% of the material's SPMDD using suitable vibratory equipment.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Water Suppression System and Foundation Drainage

The building design will incorporate a water suppression system which will consist of a horizontal concrete hydraulic barrier at the base of the excavation and a waterproofing membrane for the vertical surfaces. The water suppression system will reduce water infiltration volumes at post construction which can then be managed by the building sump pit system.

To manage and control groundwater infiltration over the long term, the following water suppression system is recommended to be installed for the foundation walls and subfloor drainage (refer to Figure 2 for an illustration of a typical Groundwater Suppression System in Appendix 2 of this report):

❏ A waterproofing membrane will be required to lessen the effect of water infiltration for the underground parking levels starting at **2.5 m** below the existing ground surface (which is approximately at the long-term ground water level). The waterproofing membrane will consist of bentonite panels fastened to the shoring system and the grinded bedrock surface. The membrane should extend to the bottom of the excavation at the founding level of the proposed footings and extended horizontally over the approved bedrock surface and/or concrete mud slab(if chosen) a minimum of 600 mm. Consideration can be given to doubling the bentonite panels in isolated areas where groundwater infiltration is observed to be high at the time of construction.

❏ A composite drainage layer will be placed from finished grade to the bottom of the foundation wall. It is recommended that the composite drainage system (such as Delta Drain 6000 or equivalent) extend down to the bottom of the foundation wall. It is expected that 150 mm diameter sleeves placed at 3 m centres be cast in the foundation wall at the footing interface to allow the infiltration of water to flow to an interior perimeter drainage pipe. The perimeter drainage pipe should direct water to the sump pit(s) within the lower basement area.

Subfloor Drainage

Subfloor drainage is recommended to control water infiltration below the lowest underground parking level slab that breaches the horizontal hydraulic barrier. For design purposes it is recommended that a 150 mm diameter perforated pipe be placed in each bay over the concrete hydraulic barrier. The final spacing of the underfloor drainage system should be confirmed at the time of completing the excavation when water infiltration can be better assessed.

Foundation Backfill

Above the bedrock surface, backfill against the exterior sides of the foundation walls should consist of free-draining non frost susceptible granular materials. The greater part of the site excavated materials will be frost susceptible and, as such, are not recommended for re-use as backfill against the foundation walls, unless used in conjunction with a drainage geocomposite, such as Miradrain G100N or Delta Drain 6000, connected to the perimeter foundation drainage system. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should otherwise be used for this purpose.

6.2 Elevator Waterproofing System

It is expected that additional bedrock removal below the building's perimeter strip footings will be required to accommodate the elevator shaft. In addition, it is expected that the elevator shaft will extend below the invert level of the subfloor drainage system and will thus be theoretically designed under submerged conditions. As a result, the following elevator shaft waterproofing options are recommended:

Option 1 - Full Waterproofing System

The horizontally applied Colphene BSW H waterproofing membrane (or approved other) should be placed on an adequately prepared mud slab and extend vertically within the inside of the temporary forms of the elevator raft slab. Once the concrete raft slab and elevator shaft sidewalls are poured in place, it is recommended that a waterproofing membrane, such as Colphene Torch'n Stick (or approved other) should be applied to the exterior of the elevator pit sidewalls. The Colphene Torch'n Stick waterproofing membrane should extend over the vertical portion of the previously applied Colphene BSW H waterproofing membrane installed on the concrete raft slab in accordance with the manufacturers specifications. As a secondary defence, a continuous PVC waterstop such as Southern waterstop 14RCB or equivalent should be installed within the concrete raft slab below the elevator pit sidewalls.

A protection board should be placed over the waterproofing membrane to protect the waterproofing membrane from damage during backfilling operations. The area between the elevator pit and bedrock excavation face should be in-filled with lean concrete, OPSS Granular B Type 2 or Granular A crushed stone. Refer to Figure 3 - Option 1 - Elevator Waterproofing Detail in Appendix 2 of this report for specific details of the elevator waterproofing.

Option 2 - Partial Waterproofing System

As a result of the size and configuration of the proposed raft slab of the elevator shaft, the following economical waterproofing option can be considered. This option consists of omitting the previously recommended horizontally applied Colphene BSW H waterproofing membrane wrapped around the bottom and sidewalls of the concrete raft slab of the elevator shaft as detailed above in Option 1.

Once the concrete raft slab and elevator pit sidewalls are poured in place, it is recommended that a waterproofing membrane, such as Colphene Torch'n Stick (or approved other) should be applied to the exterior of the elevator pit sidewalls and horizontally over the elevator raft slab in accordance to the manufacturers specifications. As a secondary defence, a continuous PVC waterstop such as Southern waterstop 14RCB or equivalent should be installed within the concrete raft slab below the elevator pit sidewalls.

A protection board should be placed over the waterproofing membrane to protect the waterproofing membrane from damage during backfilling operations. The area between the elevator shaft and bedrock excavation face should be in-filled with lean concrete, OPSS Granular B Type 2 or Granular A crushed stone. Refer to Figure 4 - Option 2 - Elevator Waterproofing Detail in Appendix 2 of this report for specific details of the elevator waterproofing

6.3 Protection of Footings Against Frost Action

Perimeter footings of heated structures are required to be insulated against the deleterious effects of frost action. A minimum of 1.5 m of soil cover alone should be provided in this regard.

Exterior unheated footings, such as those for isolated exterior piers, are more prone to deleterious movement associated with frost action than the exterior walls of the structure proper and require additional protection, such as soil cover of 2.1 m or a combination of soil cover and foundation insulation.

6.4 Excavation Side Slopes and Temporary Shoring

The side slopes of the shallow excavations anticipated at this site should either be cut back at acceptable slopes or be retained by shoring systems from the start of the excavation until the structure is backfilled.

Unsupported Excavations

The excavation side slopes above the groundwater level extending to a maximum depth of 3 m should be cut back at 1H:1V or flatter. The flatter slope is required for excavation below groundwater level. The subsoil at this site is considered to be mainly a Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

Slopes in excess of 3 m in height should be periodically inspected by the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress.

It is recommended that a trench box be used at all times to protect personnel working in trenches with steep or vertical sides. It is expected that services will be installed by “cut and cover” methods and excavations will not be left open for extended periods of time.

Rock Stabilization

Excavation side slopes in sound bedrock can be carried out using almost vertical side walls. A minimum 1 m horizontal ledge, should be left between the bottom of the overburden excavation and the top of the bedrock surface to provide an area to allow for potential sloughing or to provide a stable base for the overburden shoring system.

Horizontal rock anchors may be required at specific locations to prevent pop-outs of the bedrock, especially in areas where fractures in the bedrock are conducive to the failure of the bedrock surface.

The requirements for horizontal rock anchors and bedrock stabilization measures will be evaluated during the excavation program and determined by the geotechnical consultant at the time of construction.

Temporary Shoring

Temporary shoring may be required to support the overburden soil where insufficient room is available for open cut methods. The shoring requirements will depend on the depth of the excavation, the proximity of the adjacent buildings and underground structures and the elevation of the adjacent building foundations and underground services. The design and approval of the shoring system will be the responsibility of the shoring contractor and the shoring designer who is a licensed professional engineer and is hired by the shoring contractor. It is the responsibility of the shoring contractor to ensure that the temporary shoring is in compliance with safety requirements, designed to avoid any damage to adjacent structures and include dewatering control measures.

In the event that subsurface conditions differ from the approved design during the actual installation, it is the responsibility of the shoring contractor to commission the required experts to re-assess the design and implement the required changes. The designer should also take into account the impact of a significant precipitation event and designate design measures to ensure that a precipitation will not negatively impact the shoring system or soils supported by the system. Any changes to the approved shoring design system should be reported immediately to the owner’s structural designer prior to implementation.

For design purposes, the temporary system may consist of soldier pile and lagging system or interlocking steel sheet piling. Any additional loading due to street traffic, construction equipment, adjacent structures and facilities, etc., should be added to the earth pressures described below. These systems can be cantilevered, anchored or braced. Generally, it is expected that the shoring systems will be provided with tie-back rock anchors to ensure their stability. It is further recommended that the toe of the shoring be adequately supported to resist toe failure by means of rock bolts or extending the piles into the bedrock through pre-augered holes if a soldier pile and lagging system is used.

The geotechnical design of grouted rock anchors in sedimentary bedrock is based upon two possible failure modes. The anchor can fail either by shear failure along the grout/rock interface or by pullout of a 60 to 90 degree cone of rock with the apex of the cone near the middle of the bonded length of the anchor.

The anchor derives its capacity from the bonded portion, or fixed anchor length, at the base of the anchor. An unbonded portion, or free anchor length, is also usually provided between the rock surface and the start of the bonded length. Because the depth at which the apex shear failure cone develops is midway along the bonded length, a fully bonded anchor would tend to have a much shallower cone, and therefore less capacity, than one where the bonded length was just the bottom part of the overall anchor.

The design of the rock anchors for temporary shoring can be based on the values provided in Subsection 5.7 of the present report.

The earth pressures acting on the shoring system may be calculated using the following parameters.

Table 6 - Soil Parameters for Shoring System Design

Parameters	Values
Active Earth Pressure Coefficient (K_a)	0.33
Passive Earth Pressure Coefficient (K_p)	3
At-Rest Earth Pressure Coefficient (K_o)	0.5
Unit Weight (γ), kN/m^3	20
Submerged Unit Weight (γ), kN/m^3	13

Soldier Pile and Lagging System

The active earth pressure acting on a soldier pile and lagging shoring system can be calculated using a rectangular earth pressure distribution with a maximum pressure of 0.65 K γ H for strutted or anchored shoring or a triangular earth pressure distribution with a maximum value of K γ H for a cantilever shoring system. H is the height of the excavation.

The active earth pressure should be used where wall movements are permissible while the at-rest pressure should be used if no movement is permissible.

The total unit weight should be used above the groundwater level while the submerged unit weight should be used below the groundwater level.

The hydrostatic groundwater pressure should be added to the earth pressure distribution wherever the submerged unit weights are used for earth pressure calculations should the level on the groundwater not be lowered below the bottom of the excavation. If the groundwater level is lowered, the total unit weight for the soil should be used full weight, with no hydrostatic groundwater pressure component.

6.5 Pipe Bedding and Backfill

Bedding and backfill materials should be in accordance with the most recent Material Specifications and Standard Detail Drawings from the Department of Public Works and Services, Infrastructure Services Branch of the City of Ottawa.

At least 150 mm of OPSS Granular A should be used for bedding for sewer and water pipes when placed on soil subgrade. The bedding should extend to the spring line of the pipe. Cover material, from the spring line to at least 300 mm above the obvert of the pipe should consist of OPSS Granular A (concrete or PSM PVC pipes) or sand (concrete pipe). The bedding and cover materials should be placed in maximum 225 mm thick lifts compacted to a minimum of 95% of the material's SPMDD.

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (about 1.8 m below finished grade) should match the soils exposed at the trench walls to reduce the potential differential frost heaving. The trench backfill should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 95% of the material's SPMDD.

6.6 Groundwater Control

Groundwater Infiltration

The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

The rate of flow of groundwater into the excavation through the overburden and bedrock should be moderate for the expected subsurface conditions at this site. It is anticipated that pumping from open sumps will be sufficient to control the groundwater influx through the sides of the excavations.

A temporary Ministry of Environment, Conservation and Parks (MECP) permit to take water (PTTW) may be required if more than 400,000 L/day of ground and/or surface water are to be pumped during the construction phase. At least 4 to 5 months should be allowed for completion of the application and issuance of the permit by the MECP.

For typical ground or surface water volumes being pumped during the construction phase, typically between 50,000 to 400,000 L/day, it is required to register on the Environmental Activity and Sector Registry (EASR). A minimum of two to four weeks should be allotted for completion of the EASR registration and the Water Taking and Discharge Plan to be prepared by a Qualified Person as stipulated under O.Reg. 63/16. If a project qualifies for a PTTW based upon anticipated conditions, an EASR will not be allowed as a temporary dewatering measure while awaiting the MECP review of the PTTW application.

Adverse Effects from Dewatering on Adjacent Structures

Based on the subsurface conditions encountered at the subject site, it is anticipated that the adjacent structures are founded on bedrock or the dense glacial till deposit. Therefore, in our opinion, no adverse effects from short term and long term dewatering are expected for surrounding structures.

6.7 Winter Construction

Precautions must be taken if winter construction is considered for this project. The subsoil conditions at this site mostly consist of frost susceptible materials. In presence of water and freezing conditions ice could form within the soil mass. Heaving and settlement upon thawing could occur.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures by the use of straw, propane heaters and tarpaulins or other suitable means. In this regard, the base of the excavations should be insulated from sub-zero temperatures immediately upon exposure and until such time as heat is adequately supplied to the building and the footings are protected with sufficient soil cover to prevent freezing at founding level.

The trench excavations should be carried out in a manner to avoid the introduction of frozen materials, snow or ice into the trenches. Precaution must be taken where excavations are carried in proximity of existing structures which may be adversely affected due to the freezing conditions. In particular, it should be recognized that where a shoring system is used, the soil behind the shoring system will be subjected to freezing conditions and could result in heaving of the structure(s) placed within or above frozen soil. Provisions should be made in the contract document to protect the walls of the excavations from freezing, if applicable.

7.0 Recommendations

A materials testing and observation services program is a requirement for the provided foundation design data to be applicable. The following aspects of the program should be performed by the geotechnical consultant:

❏ Review of the geotechnical aspects of the excavating contractor’s shoring design, prior to construction.

❏ Observe and approve the installation of the water suppression system.

❏ Review proposed waterproofing and foundation drainage design and requirements.

❏ Review the bedrock stabilization and excavation requirements.

❏ Observation of all bearing surfaces prior to the placement of concrete.

❏ Sampling and testing of the concrete and fill materials used.

❏ Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.

❏ Observation of all subgrades prior to backfilling.

❏ Field density tests to determine the level of compaction achieved.

❏ Sampling and testing of the bituminous concrete including mix design reviews.

A report confirming that these works have been conducted in general accordance with our recommendations could be issued, upon request, following the completion of a satisfactory materials testing and observation program by the geotechnical consultant.

8.0 Statement of Limitations

The recommendations provided in this report are in accordance with our present understanding of the project. We request permission to review our recommendations when the drawings and specifications are completed.

A soils investigation is a limited sampling of a site. Should any conditions at the site be encountered which differ from those at the test locations, we request immediate notification to permit reassessment of our recommendations.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Tamarack (Norman) Corporation or their agents is not authorized without review by Paterson for the applicability of our recommendations to the alternative use of the report.

Paterson Group Inc.

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Scott Dennis

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PROVINCE OF ONTARIO

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APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase I - II Environmental Site Assessment
95, 97 and 99 Norman Street
Ottawa, Ontario

DATUM Referenced to a Geodetic Datum

FILE NO. **PE2327**

REMARKS

HOLE NO. **BH 1**

BORINGS BY CME 75 Power Auger

DATE 2011 May 31

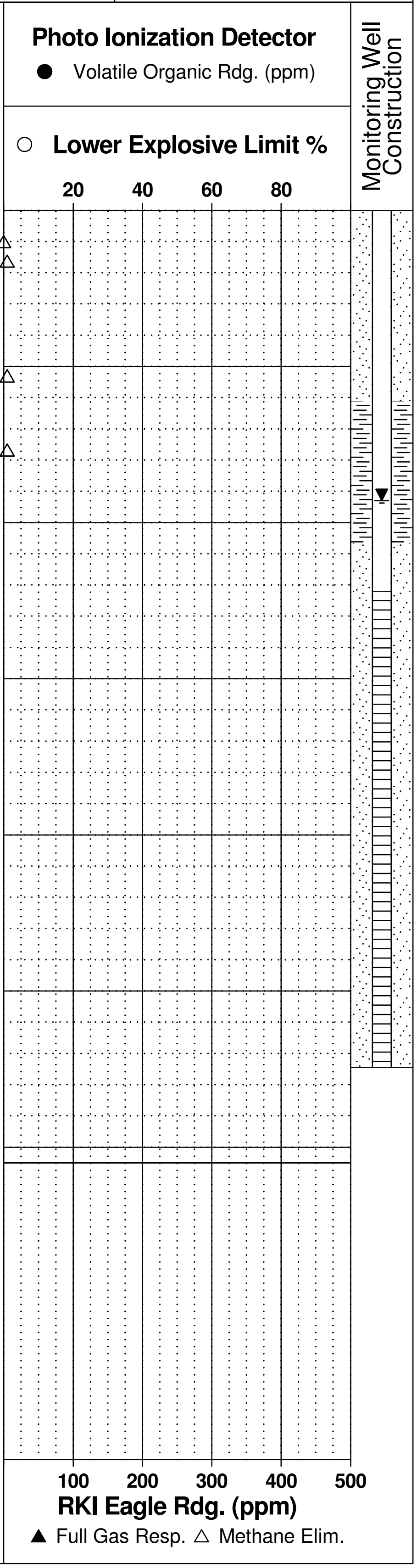
SOIL DESCRIPTION	Depth (m)
GROUND SURFACE	
FILL: Sand and gravel	0.30
PEAT	1.27
Loose to dense, grey **SILTY SAND** with gravel and cobbles	1.60
BEDROCK: Grey limestone	6.10
End of Borehole	

(GWL @ 1.37 m depth- June 6, 2011)

(GWL @ 1.86 m depth - Sept 5, 2012)

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
AU	2		
SS	3	100	9
SS	4		50+
RC	1	100	74
RC	2	100	100
RC	3	100	90
RC	4	100	100

DEPTH (m)	ELEV. (m)
0	61.51
1	60.51
2	59.51
3	58.51
4	57.51
5	56.51
6	55.51



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SOIL PROFILE AND TEST DATA

Phase I - II Environmental Site Assessment
95, 97 and 99 Norman Street
Ottawa, Ontario

DATUM Referenced to a Geodetic Datum

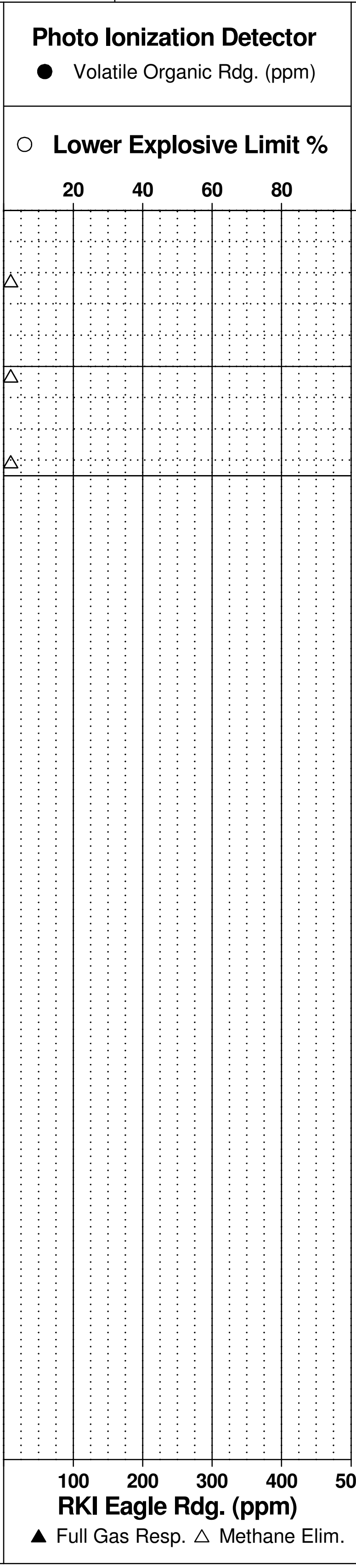
FILE NO. PE2327

REMARKS

HOLE NO. BH 2

BORINGS BY CME 75 Power Auger **DATE** 2011 May 31

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	61.51
Asphaltic concrete 0.15							
FILL: Crushed stone 0.30		AU	1				
FILL: Brown silty sand with gravel		AU	2				
		SS	3	42	4	1	60.51
1.45							
Dense, brown **SILTY SAND** with gravel and cobbles 1.70		SS	4	73	50+		
End of Borehole Practical refusal to augering @ 1.70m depth							



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SOIL PROFILE AND TEST DATA

Phase I - II Environmental Site Assessment
95, 97 and 99 Norman Street
Ottawa, Ontario

DATUM Referenced to a Geodetic Datum

FILE NO. PE2327

REMARKS

HOLE NO. BH 3

BORINGS BY CME 75 Power Auger

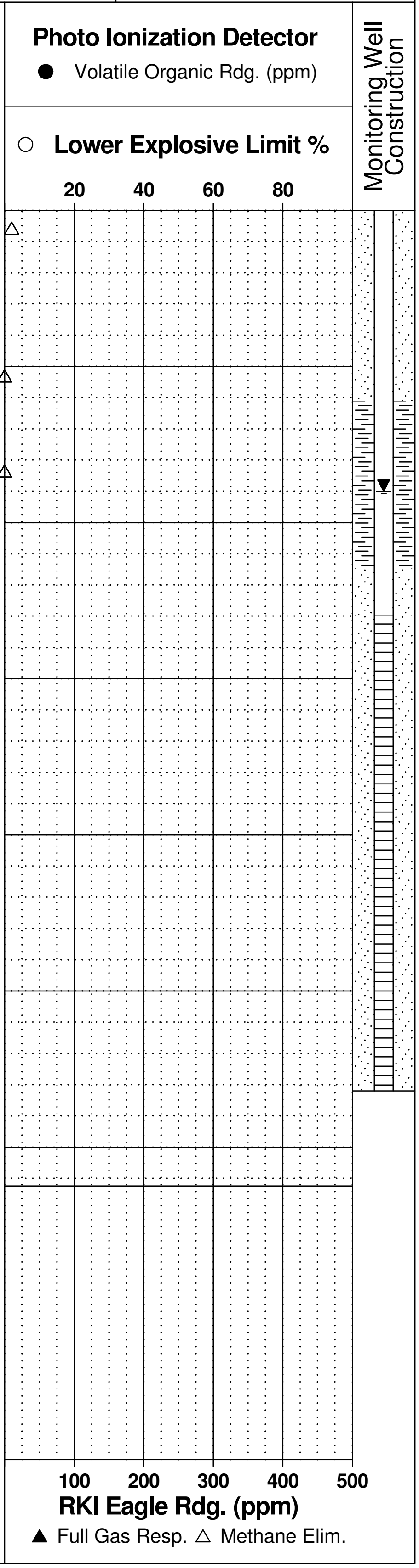
DATE 2011 May 31

SOIL DESCRIPTION		SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	61.55
25mm Asphaltic concrete over crushed stone	0.18	AU	1				
FILL: Brown silty sand with gravel	1.30	SS	2	92	6	1	60.55
PEAT	1.45						
Brown **SILTY SAND** with peat, trace marl	1.83	SS	3	25	50+		
						2	59.55
		RC	1	100	43		
						3	58.55
		RC	2	100	93		
BEDROCK: Grey limestone						4	57.55
		RC	3	100		5	56.55
	6.25	RC	4	100	100	6	55.55

End of Borehole

(GWL @ 1.74 m depth - June 6, 2011)

(GWL @ 1.86 m depth - Sept 5, 2012)



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SOIL PROFILE AND TEST DATA

Phase I - II Environmental Site Assessment
95, 97 and 99 Norman Street
Ottawa, Ontario

DATUM Referenced to a Geodetic Datum

FILE NO. **PE2327**

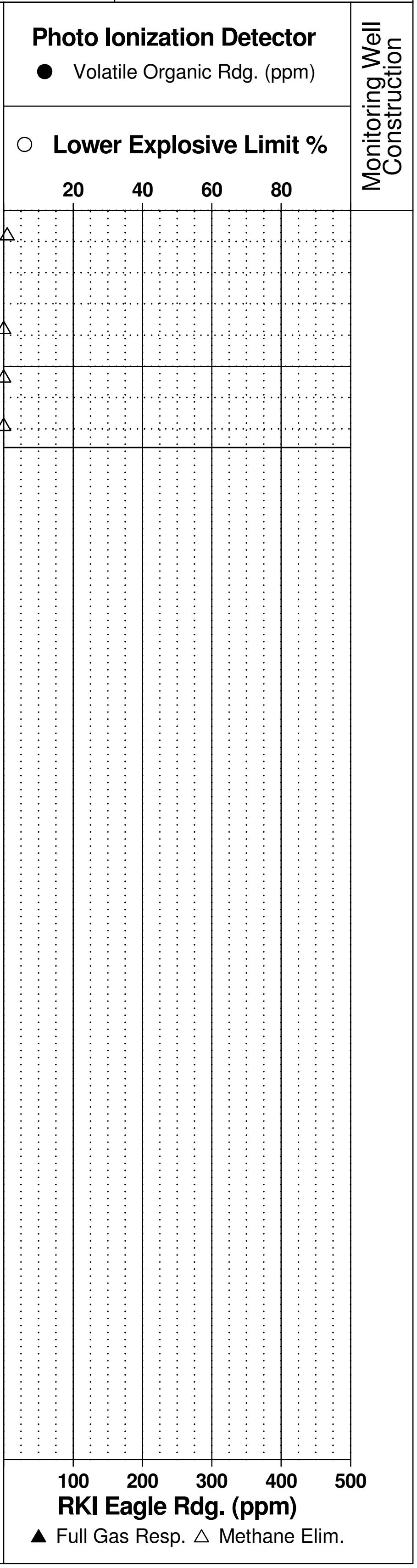
REMARKS

HOLE NO. **BH 4**

BORINGS BY CME 75 Power Auger

DATE 2011 May 31

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	61.53
Asphaltic concrete 0.05						
FILL: Crushed stone with sand 0.43	AU	1				
PEAT/TOPSOIL	AU	3				
	SS	2	0	4	1	60.53
1.52	AU	4				
End of Borehole Practical refusal to augering @ 1.52m depth						



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Multi-Storey Building - 101 Norman Street
Ottawa, Ontario

DATUM Referenced to a Geodetic Datum

REMARKS

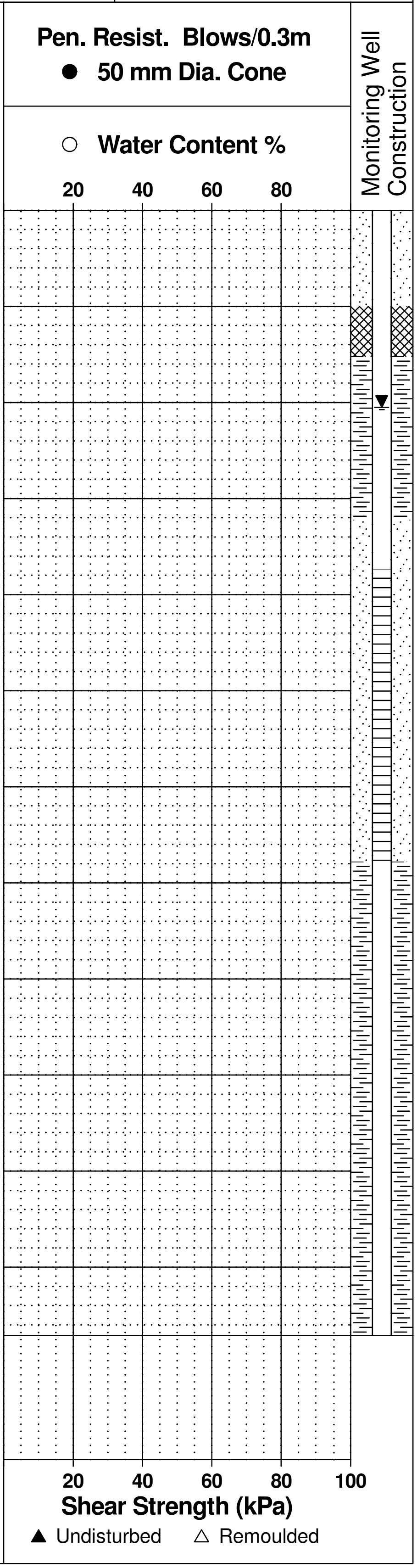
BORINGS BY CME 55 Power Auger

DATE 2012 August 29

FILE NO. PG2760

HOLE NO. BH 1-12

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						
50mm Asphaltic concrete over crushed stone 0.25	AU	1			0	61.59
	AU	2				
FILL: Brown silty sand with gravel, cobbles, brick 1.45	SS	3	42	30	1	60.59
GLACIAL TILL: Brown silty sand with gravel, cobbles, boulders, trace clay 2.03	SS	4		50+		
					2	59.59
	RC	1	100	83		
					3	58.59
	RC	2	100	80		
					4	57.59
BEDROCK: Grey limestone						
	RC	3	100	86		
					5	56.59
					6	55.59
	RC	4	100	76		
					7	54.59
	RC	5	100	82		
					8	53.59
					9	52.59
BEDROCK: Grey limestone	RC	6	100	100		
					10	51.59
	RC	7	100	86	11	50.59
11.71						
End of Borehole						
(GWL @ 2.05m-Sept. 5, 2012)						



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Multi-Storey Building - 101 Norman Street
Ottawa, Ontario

DATUM Referenced to a Geodetic Datum

FILE NO. PG2760

REMARKS

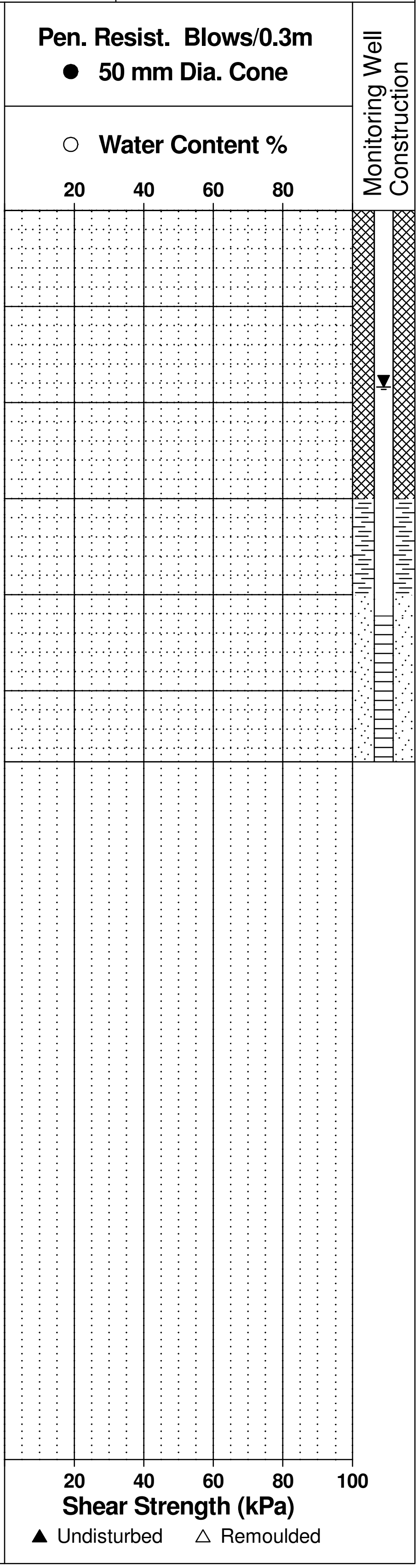
HOLE NO. BH 2-12

BORINGS BY CME 55 Power Auger

DATE 2012 August 29

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	61.42
50mm Asphaltic concrete over crushed stone (0.30)	AU	1				
	AU	2				
FILL: Brown silty sand with gravel, cobbles					1	60.42
	SS	3	42	10		
- topsoil with trace wood chips from 1.2 to 1.5m depth (1.58)	SS	4	100	50+		
	RC	1	95	64	2	59.42
					3	58.42
BEDROCK: Grey limestone	RC	2	100	85		
					4	57.42
	RC	3	100	83	5	56.42
(5.74) End of Borehole						

(GWL @ 1.84m-Sept. 5, 2012)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Multi-Storey Building - 101 Norman Street
Ottawa, Ontario

DATUM Referenced to a Geodetic Datum

FILE NO. PG2760

REMARKS

HOLE NO. BH 3-12

BORINGS BY CME 55 Power Auger

DATE 2012 August 30

SOIL DESCRIPTION		SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	61.55
25mm Asphaltic concrete over crushed stone	0.25	AU	1				
FILL: Brown silty sand with clay, trace gravel and brick		AU	2				
		SS	3	57	50+	1	60.55
	1.60						
GLACIAL TILL: Brown sitly sand with gravel, cobbles and boulders, trace clay		SS	4	63	50+		
	2.16					2	59.55

End of Borehole

Practical refusal to augering at 2.16 m depth

(GWL @ 1.80m-Sept. 5, 2012)

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

Piezometer Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Multi-Storey Building - 101 Norman Street
Ottawa, Ontario

DATUM Referenced to a Geodetic Datum

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2012 August 30

FILE NO. **PG2760**

HOLE NO. **BH 4-12**

SOIL DESCRIPTION		SAMPLE				DEPTH (m)	ELEV. (m)
GROUND SURFACE		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
25mm Asphaltic concrete over crushed stone	0.30	AU	1			0	61.53
FILL: Brown silty sand, trace gravel	0.69	AU	2				
Compact, brown **SILTY SAND,** trace gravel	1.07	SS	3	58	18	1	60.53
GLACIAL TILL: Brown silty sand with gravel, cobbles, boulders, trace clay	1.60	SS	4	100	50+		
		RC	1	91	50	2	59.53
		RC	2	100	100	3	58.53
BEDROCK: Grey limestone		RC	3	100	100	4 5	57.53 56.53
		RC	4	100	100	6 7	55.53 54.53
		RC	5	100	100	8	53.53
BEDROCK: Grey limestone		RC	6	100	100	9 10	52.53 51.53
	11.68	RC	7	100	100	11	50.53
End of Borehole (GWL @ 2.53m-Sept. 5, 2012)							

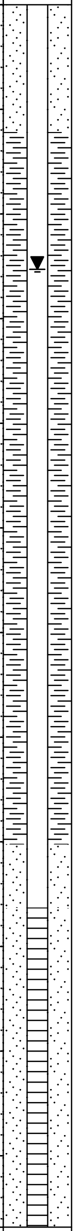
Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

Monitoring Well Construction



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Multi-Storey Building - 101 Norman Street
Ottawa, Ontario

DATUM Referenced to a Geodetic Datum

REMARKS

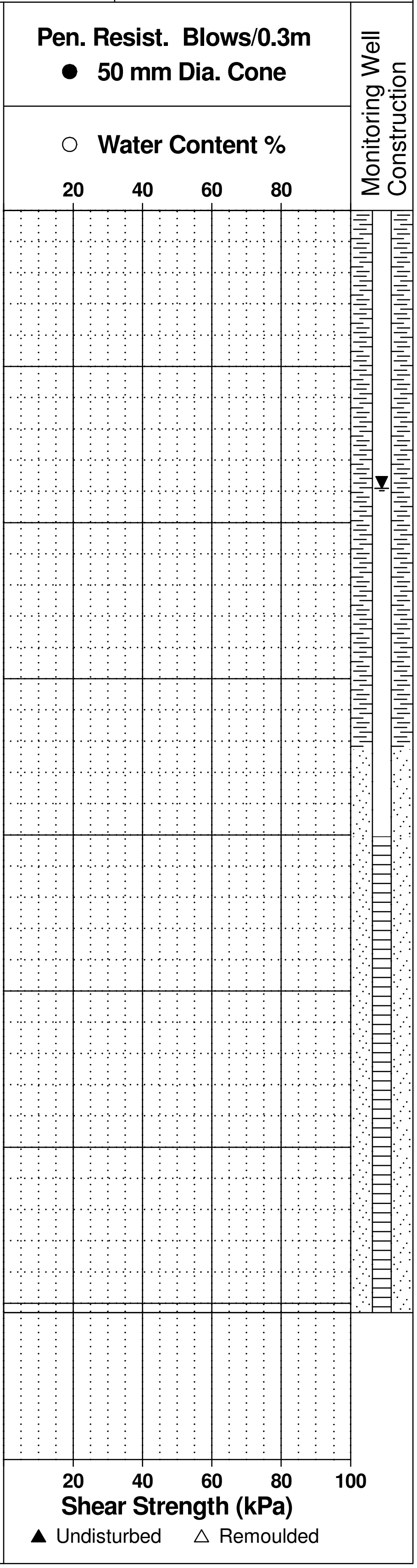
BORINGS BY CME-55 Low Clearance Drill

DATE 2021 February 3

FILE NO. **PG2760**

HOLE NO. **BH 1-21**

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	61.60
FILL: Brown silty sand trace gravel, crushed stone and organics 0.13	AU	1				
FILL: Brown silty sand trace gravel and crushed stone	SS	2		10	1	60.60
	SS	3		2		
2.10					2	59.60
FILL: Brown silty sand trace gravel 2.41	SS	4		+50		
BEDROCK Excellent quality Grey Limestone	RC	1	100	85		
					3	58.60
	RC	2	100	100		
					4	57.60
					5	56.60
	RC	3	100	97		
					6	55.60
	RC	4	100	91		
7.06					7	54.60
End of Borehole						
(GWL @ 1.78 m depth - Feb 9, 2021)						



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Multi-Storey Building - 101 Norman Street
Ottawa, Ontario

DATUM Referenced to a Geodetic Datum

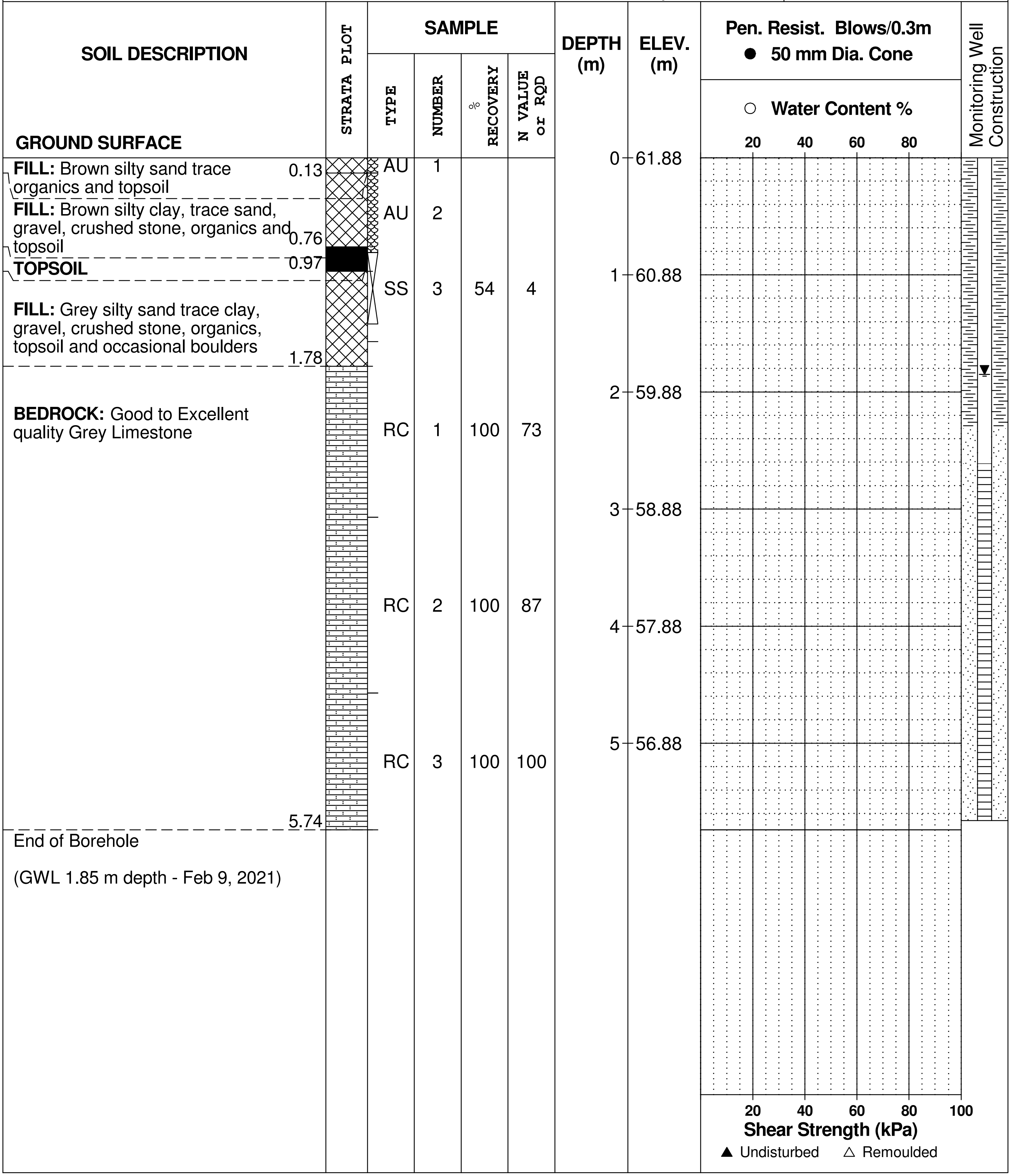
REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE 2021 February 3

FILE NO. PG2760

HOLE NO. BH 2-21



SOIL DESCRIPTION	TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
FILL: Brown silty sand trace organics and topsoil 0.13	AU	1		
FILL: Brown silty clay, trace sand, gravel, crushed stone, organics and topsoil 0.76	AU	2		
TOPSOIL 0.97				
FILL: Grey silty sand trace clay, gravel, crushed stone, organics, topsoil and occasional boulders 1.78	SS	3	54	4
BEDROCK: Good to Excellent quality Grey Limestone	RC	1	100	73
	RC	2	100	87
	RC	3	100	100
5.74 End of Borehole				

(GWL 1.85 m depth - Feb 9, 2021)

DEPTH (m)	ELEV. (m)
0	61.88
1	60.88
2	59.88
3	58.88
4	57.88
5	56.88

SYMBOLS AND TERMS

SOIL DESCRIPTION

Behavioural properties, such as structure and strength, take precedence over particle gradation in describing soils. Terminology describing soil structure are as follows:

Desiccated	-	having visible signs of weathering by oxidation of clay minerals, shrinkage cracks, etc.
Fissured	-	having cracks, and hence a blocky structure.
Varved	-	composed of regular alternating layers of silt and clay.
Stratified	-	composed of alternating layers of different soil types, e.g. silt and sand or silt and clay.
Well-Graded	-	Having wide range in grain sizes and substantial amounts of all intermediate particle sizes (see Grain Size Distribution).
Uniformly-Graded	-	Predominantly of one grain size (see Grain Size Distribution).

The standard terminology to describe the strength of cohesionless soils is the relative density, usually inferred from the results of the Standard Penetration Test (SPT) 'N' value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm.

Relative Density	'N' Value	Relative Density %
Very Loose	<4	<15
Loose	4-10	15-35
Compact	10-30	35-65
Dense	30-50	65-85
Very Dense	>50	>85

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory vane tests, penetrometer tests, unconfined compression tests, or occasionally by Standard Penetration Tests.

Consistency	Undrained Shear Strength (kPa)	'N' Value
Very Soft	<12	<2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their “sensitivity”. The sensitivity is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil.

Terminology used for describing soil strata based upon texture, or the proportion of individual particle sizes present is provided on the Textural Soil Classification Chart at the end of this information package.

ROCK DESCRIPTION

The structural description of the bedrock mass is based on the Rock Quality Designation (RQD).

The RQD classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be a result of closely-spaced discontinuities (resulting from shearing, jointing, faulting, or weathering) in the rock mass and are not counted. RQD is ideally determined from NXL size core. However, it can be used on smaller core sizes, such as BX, if the bulk of the fractures caused by drilling stresses (called “mechanical breaks”) are easily distinguishable from the normal in situ fractures.

RQD %	**ROCK QUALITY**
90-100	Excellent, intact, very sound
75-90	Good, massive, moderately jointed or sound
50-75	Fair, blocky and seamy, fractured
25-50	Poor, shattered and very seamy or blocky, severely fractured
0-25	Very poor, crushed, very severely fractured

SAMPLE TYPES

SS - Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))

TW - Thin wall tube or Shelby tube

PS - Piston sample

AU - Auger sample or bulk sample

WS - Wash sample

RC - Rock core sample (Core bit size AXT, BXL, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

MC% - Natural moisture content or water content of sample, %
LL - Liquid Limit, % (water content above which soil behaves as a liquid)
PL - Plastic limit, % (water content above which soil behaves plastically)
PI - Plasticity index, % (difference between LL and PL)

Dxx - Grain size which xx% of the soil, by weight, is of finer grain sizes
These grain size descriptions are not used below 0.075 mm grain size
D10 - Grain size at which 10% of the soil is finer (effective grain size)
D60 - Grain size at which 60% of the soil is finer

Cc - Concavity coefficient = $(D30)^2$ / (D10 x D60)
Cu - Uniformity coefficient = D60 / D10

Cc and Cu are used to assess the grading of sands and gravels:
Well-graded gravels have: $1 < Cc < 3$ and $Cu > 4$
Well-graded sands have: $1 < Cc < 3$ and $Cu > 6$
Sands and gravels not meeting the above requirements are poorly-graded or uniformly-graded.
Cc and Cu are not applicable for the description of soils with more than 10% silt and clay (more than 10% finer than 0.075 mm or the #200 sieve)

CONSOLIDATION TEST

p'_o - Present effective overburden pressure at sample depth
p'_c - Preconsolidation pressure of (maximum past pressure on) sample
Ccr - Recompression index (in effect at pressures below p'_c)
Cc - Compression index (in effect at pressures above p'_c)

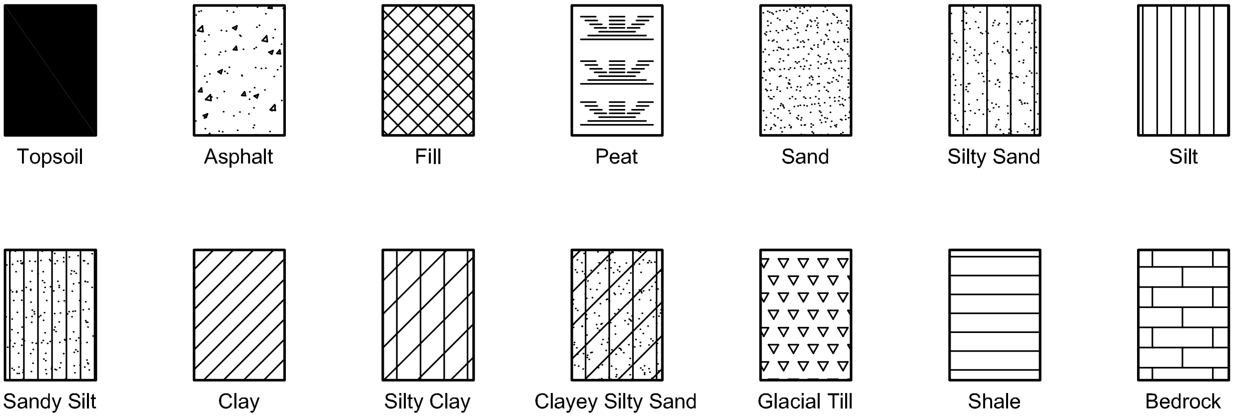
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

PERMEABILITY TEST

k - Coefficient of permeability or hydraulic conductivity is a measure of the ability of water to flow through the sample. The value of k is measured at a specified unit weight for (remoulded) cohesionless soil samples, because its value will vary with the unit weight or density of the sample during the test.

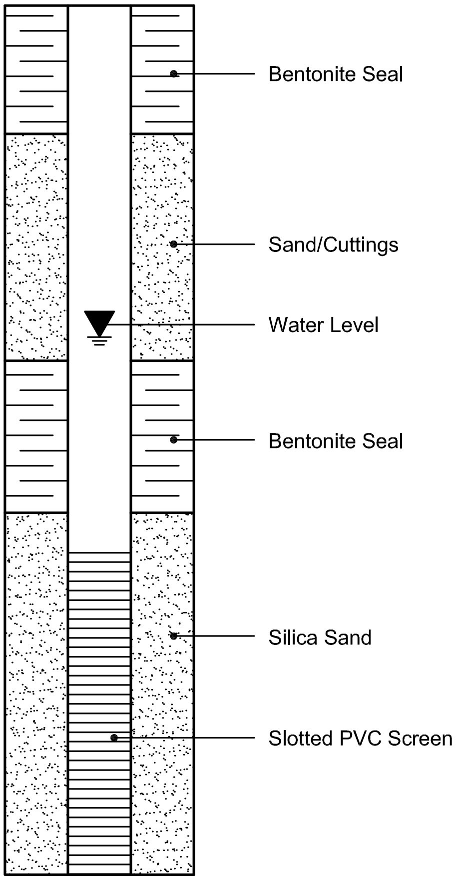
SYMBOLS AND TERMS (continued)

STRATA PLOT

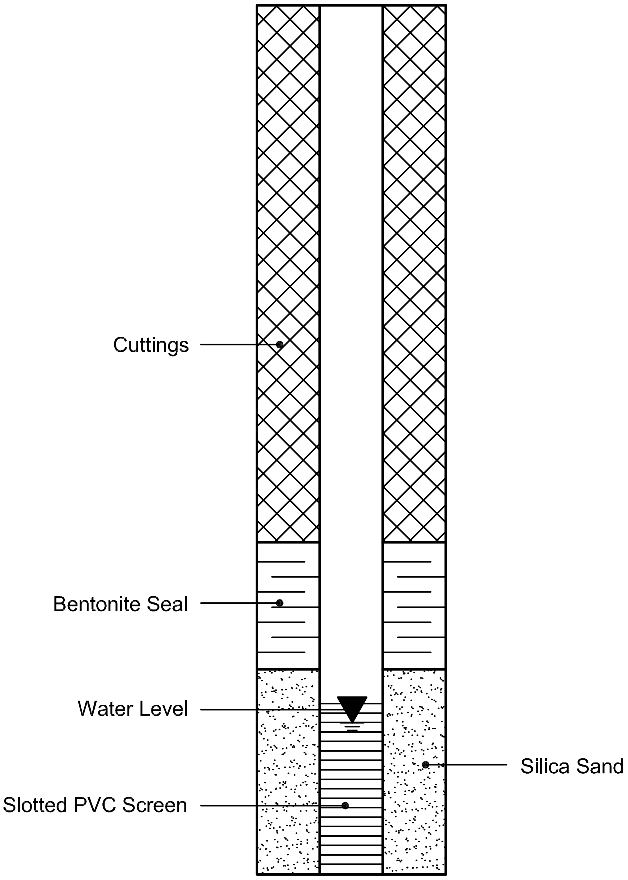


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



APPENDIX 2

FIGURE 1 - KEY PLAN

FIGURE 2 - GROUNDWATER SUPPRESSION SYSTEM

FIGURE 3 - OPTION 1 - ELEVATOR WATERPROOFING DETAIL

FIGURE 4 - OPTION 2 - ELEVATOR WATERPROOFING DETAIL

DRAWING PG2760-1 - TEST HOLE LOCATION PLAN

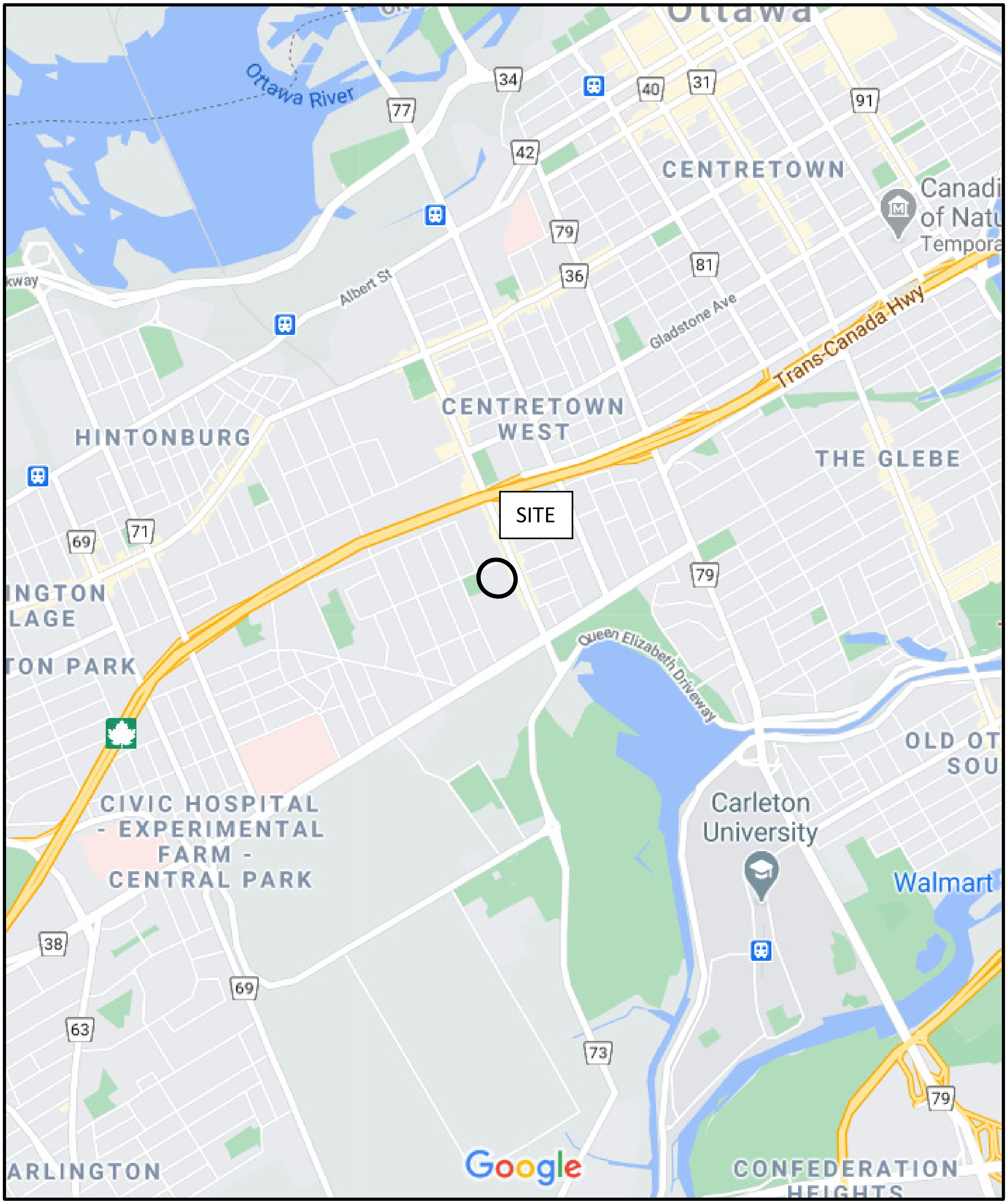
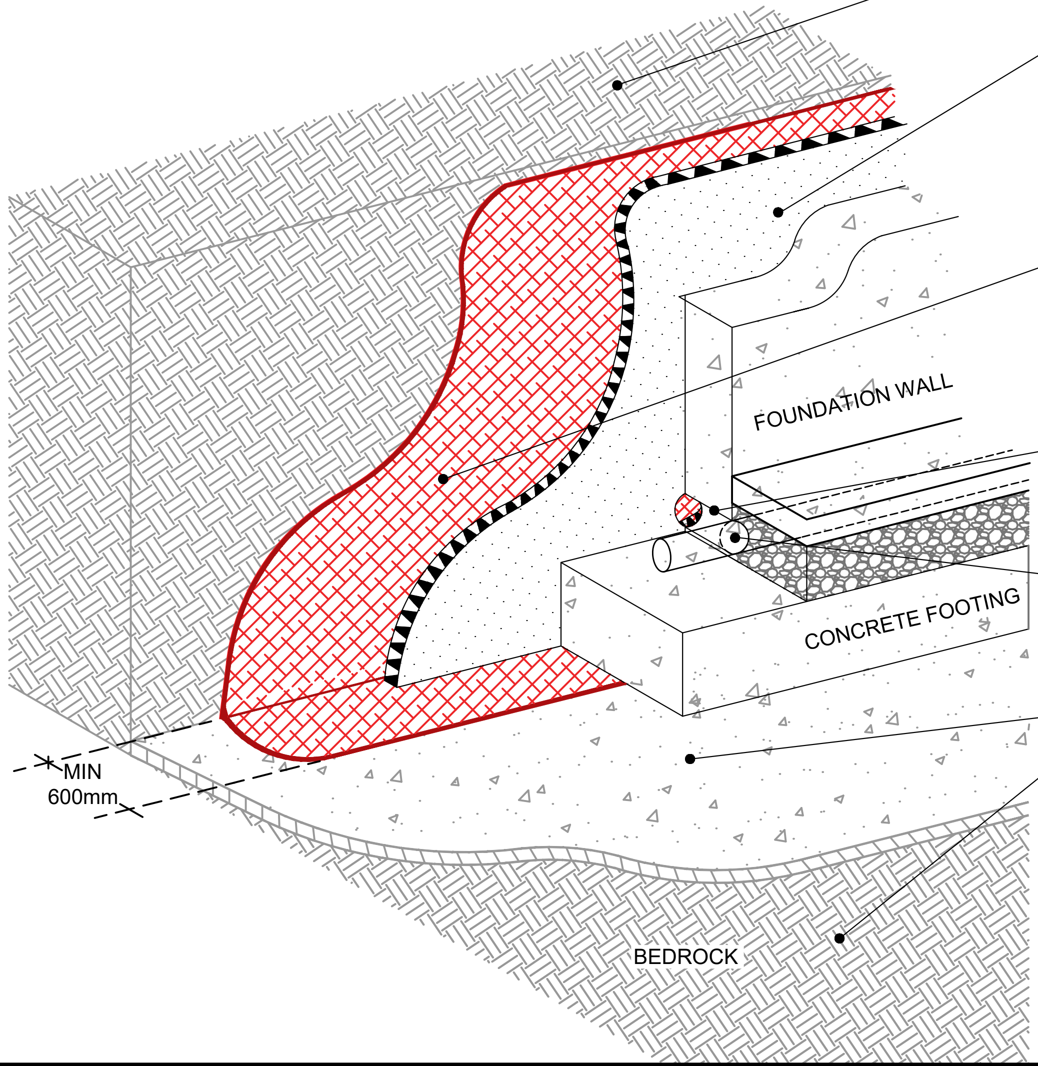


FIGURE 1

KEY PLAN

patersongroup



SMOOTH AND FLAT BEDROCK SURFACE ADEQUATELY PREPARED FOR THE PLACEMENT OF THE WATERPROOFING MEMBRANE

COMPOSITE FOUNDATION DRAINAGE MEMBRANE 6000 SERIES MEMBRANE BY DELTA DRAIN, G100N BY MIRADRAIN OR EQUIVALENT. INSTALL IN HORIZONTAL LIFTS WITH MINIMUM 150mm HORIZONTAL AND VERTICAL OVERLAP IN SHINGLE FASHION WITH GEOTEXTILE FACING AWAY FROM THE APPLICATOR. MECHANICALLY SECURE VERTICAL AND HORIZONTAL JOINTS WITH BLUESKIN WP200 AND BLUESKIN PRIMER OR EQUIVALENT.

150miL GRANULAR BENTONITE SURFACING LAMINATED TO 20miL THICK HDPE MEMBRANE. INSTALL IN HORIZONTAL LIFTS TO MANUFACTURERS SPECIFICATIONS IN SHINGLE FASHION WITH THE HDPE SIDE FACING APPLICATOR TO AN ADEQUATELY PREPARED SUBSTRATE SURFACE. WATER PROOFING MEMBRANE TO EXTEND FROM 2.5m BELOW FINISHED GRADE

150mm DIAMETER SOLID PVC SLEEVE PLACED THROUGH THE BASE OF THE EXTERIOR FOUNDATION WALL AT APPROXIMATELY 3.0m SPACING AROUND THE EXTERIOR PERIMETER OF THE STRUCTURE

THE SLEEVES SHOULD BE MECHANICALLY CONNECTED TO THE COMPOSITE FOUNDATION DRAINAGE MEMBRANE AND THE 150mm DIAMETER INTERIOR SUBFLOOR PERIMETER DRAINAGE SYSTEM GRAVITY CONNECTED TO THE SUMP PIT.

MINIMUM 100mm THICK, 15 MPa CONCRETE MUD SLAB (OPTIONAL)

CLEAN SURFACE SOUNDED BEDROCK APPROVED BY THE GEOTECHNICAL CONSULTANT

patersongroup
consulting engineers

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TAMARACK (NORMAN) CORPORATION

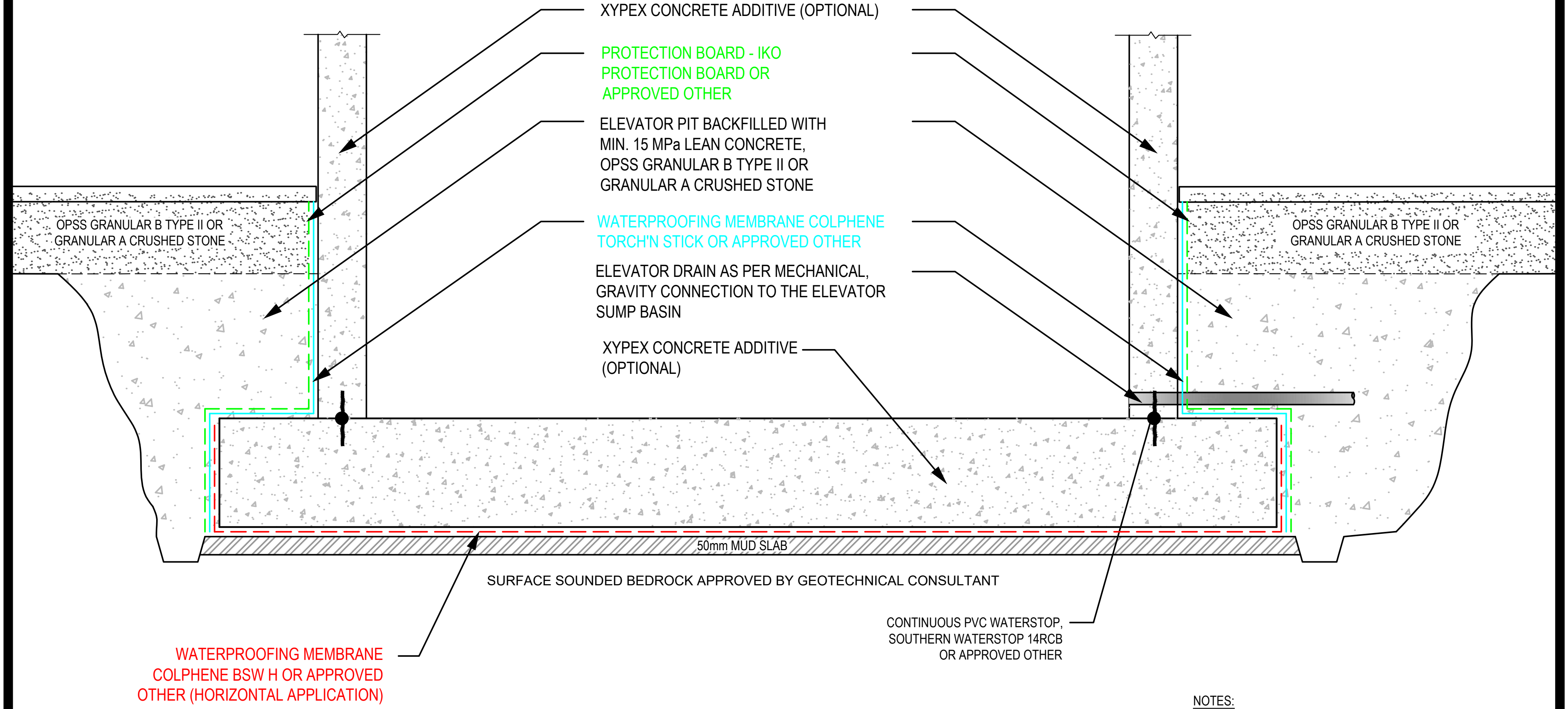
PROPOSED MULTI-STOREY BUILDING
93 NORMAND STREET

OTTAWA, ONTARIO

Title:

GROUNDWATER SUPPRESSION SYSTEM

Scale: NTS
Date: 01/2021
Drawn by: RCG
Report No.: PG2760-1
Checked by: RG
Drawing No.: FIG.2
Approved by: DG
Revision No.:



NOTES:

1. IT IS RECOMMENDED THAT PERIODIC INSPECTIONS BE COMPLETED BY THE GEOTECHNICAL CONSULTANT AT THE TIME OF CONSTRUCTION DURING THE INSTALLATION OF THE ELEVATOR WATERPROOFING MEMBRANE(S).

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TAMARACK (NORMAN) CORPORATION

PROPOSED MULTI-STOREY BUILDING
93 NORMAN STREET
OTTAWA, ONTARIO

Title:

OPTION 1 - ELEVATOR WATERPROOFING DETAIL

Scale: N.T.S.	**Date:** 01/2021
Drawn by: MPG	**Report No.:** PG2760-1
Checked by: RG	**Drawing No.:** FIG. 3
Approved by: RG	**Revision No.:**

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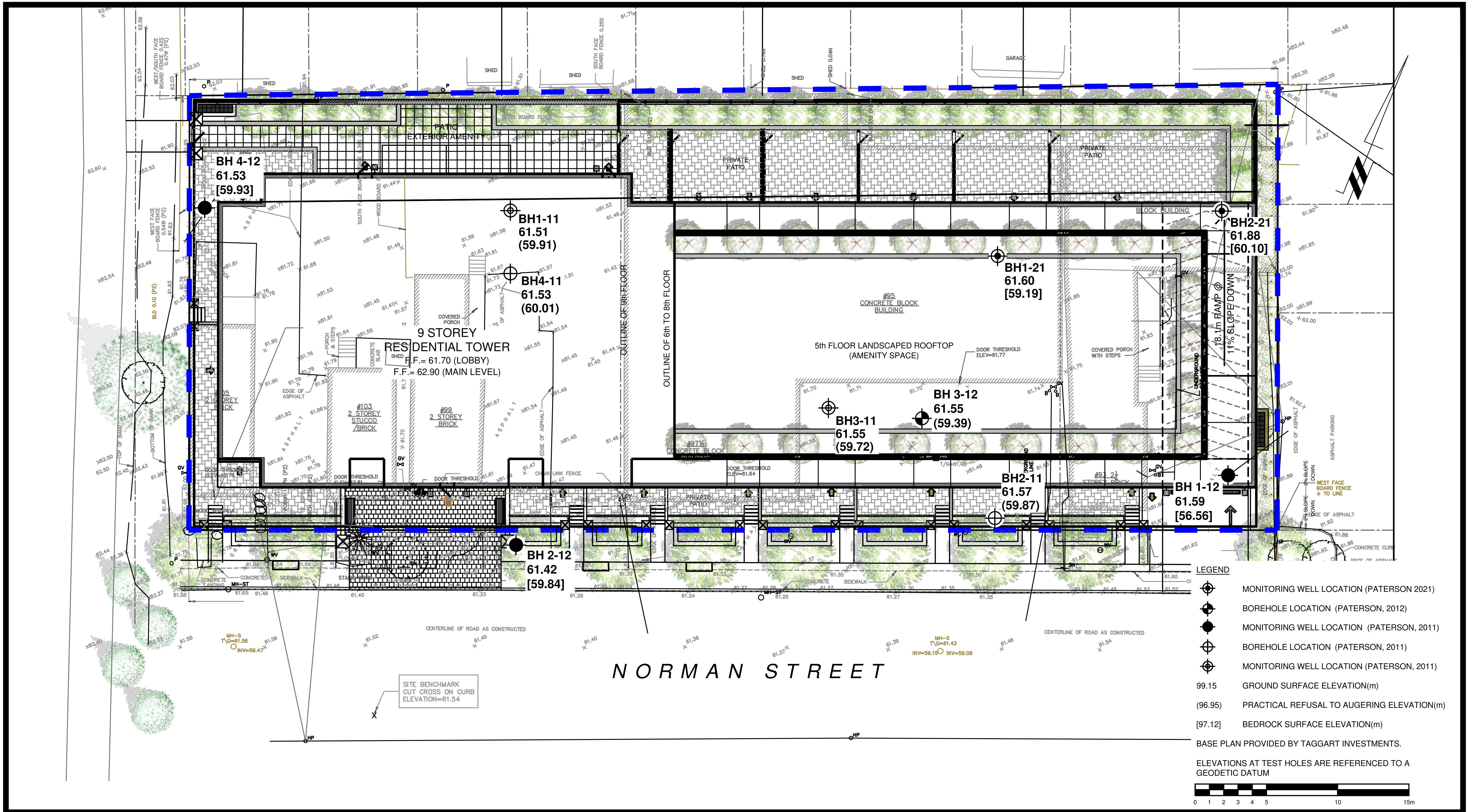

LEGEND

⊕	MONITORING WELL LOCATION (PATERSON 2021)
◐	BOREHOLE LOCATION (PATERSON, 2012)
●	MONITORING WELL LOCATION (PATERSON, 2011)
⊕	BOREHOLE LOCATION (PATERSON, 2011)
⊕	MONITORING WELL LOCATION (PATERSON, 2011)
99.15	GROUND SURFACE ELEVATION(m)
(96.95)	PRACTICAL REFUSAL TO AUGERING ELEVATION(m)
[97.12]	BEDROCK SURFACE ELEVATION(m)

BASE PLAN PROVIDED BY TAGGART INVESTMENTS.

ELEVATIONS AT TEST HOLES ARE REFERENCED TO A GEODETIC DATUM

0 1 2 3 4 5 10 15m

patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

NO.	REVISIONS	DATE	INITIAL
1	UPDATED TO LATEST CONCEPTUAL PLAN, 2021 BOREHOLES ADDED TO PLAN	05/02/2021	RG

TAMARACK (NORMAN) CORPORATION

GEOTECHNICAL INVESTIGATION
PROP. MULTI-STOREY BUILDING - 93 NORMAN STREET

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:250	Date: 01/2021
Drawn by: RCG	Report No.: PG2760-1
Checked by: RG	Dwg. No.: PG2760-1
Approved by: SD	Revision No.: 1

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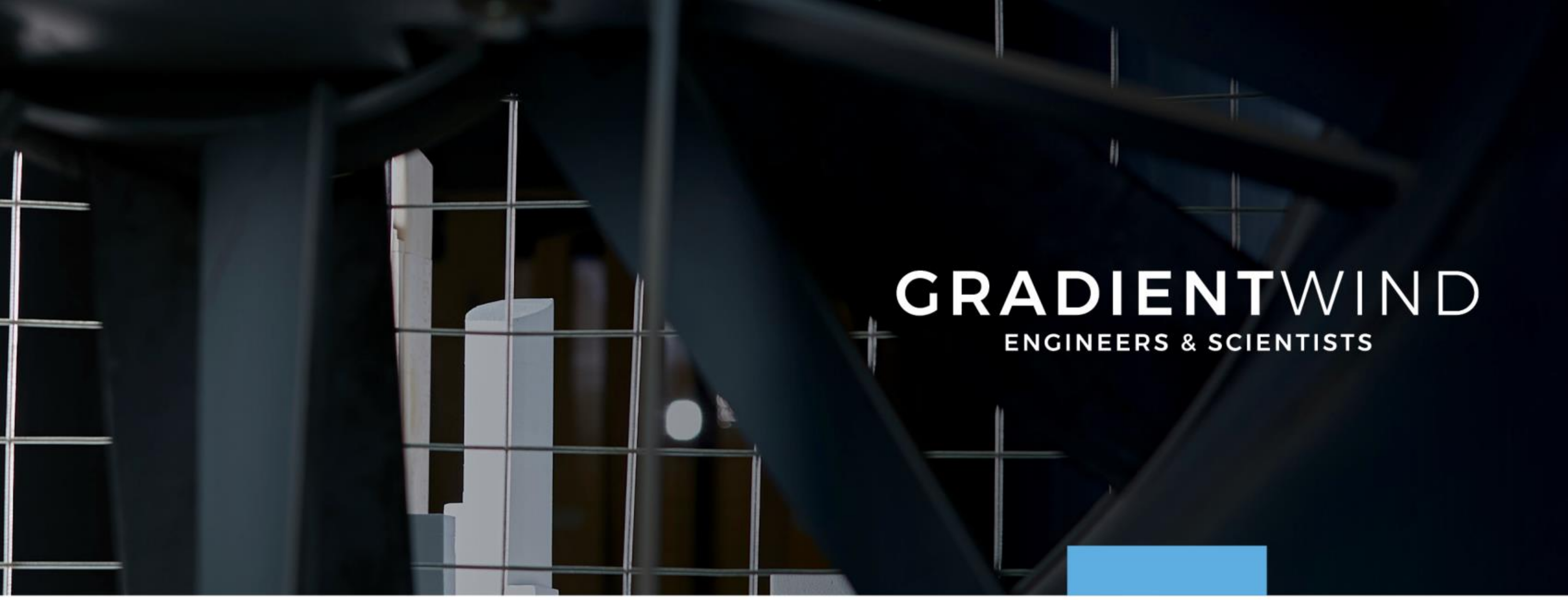
APPENDIX C

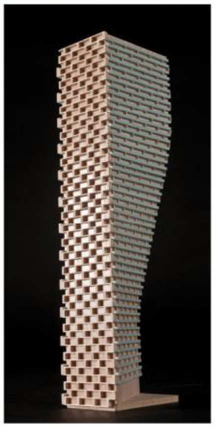
Transportation Noise and Vibration Assessment prepared by Gradient Wind Engineers & Scientists dated March 1, 2021

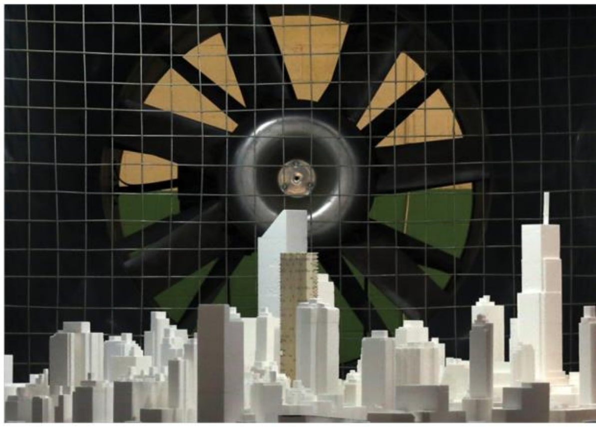


TRANSPORTATION NOISE AND VIBRATION ASSESSMENT

93 Norman Street
Ottawa, Ontario

REPORT: 21-011 – Transportation Noise and Vibration





March 1, 2021

PREPARED FOR
Tamarack (Norman) Corporation
708-225 Metcalfe Street
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PREPARED BY
Giuseppe Garro, MASc. Junior Environmental Scientist
Joshua Foster, P.Eng., Principal

EXECUTIVE SUMMARY

This report describes a transportation noise and vibration assessment in support of a Site Plan Control (SPC) application for the proposed development located at 93 Norman Street in Ottawa, Ontario. The development comprises a residential building which rises to 9 storeys at the west and 5 storeys at the east of the property. The primary sources of transportation noise include Preston Street, Highway 417, and the O-Train Line 2 (Trillium Line) light rail. As the site is in proximity to the O-Train Line 2 Light Rail Transit (LRT) line, a ground vibration impact assessment from the LRT on the proposed development was conducted following the procedures outlined in the Federal Transit Authorities (FTA) protocol. Figure 1 illustrates a complete site plan with the surrounding context.

The assessment is based on (i) theoretical noise prediction methods that conform to the Ministry of the Environment, Conservation and Parks (MECP) and City of Ottawa requirements; (ii) noise level criteria as specified by the City of Ottawa's Environmental Noise Control Guidelines (ENCG); (iii) future vehicular traffic volumes based on the City of Ottawa's Official Plan roadway classifications; (iv) architectural drawings provided by Roderick Lahey Architect Inc. in February 2021; and (v), ground-borne vibration criteria as specified by the Federal Transit Authority (FTA) Protocol.

The results of the current analysis indicate that noise levels will range between 51 and 71 dBA during the daytime period (07:00-23:00) and between 46 and 63 dBA during the nighttime period (23:00-07:00). The highest noise level (71 dBA) occurs at the north façade, which is most exposed to Highway 417. Building components with a higher Sound Transmission Class (STC) rating will be required where exterior noise levels exceed 65 dBA, as indicated in Figure 3.

Results of the calculation also indicate the development will require central air conditioning, or similar mechanical ventilation, which will allow occupants to keep windows closed to maintain a comfortable indoor living environment. A Warning Clause will also be required on all Lease, Purchase and Sale Agreements, as summarized in Section 6.

Noise levels at the Level 6 and rooftop terraces are expected to exceed 55 dBA during the daytime period without a noise barrier. If these areas are to be used as outdoor living areas, noise control measures are required to reduce noise levels as close as possible to 55 dBA where technically and administratively feasible. Further analysis investigated the noise mitigating impact of raising the perimeter guards from 1.2 m to 2.5 m above the walking surface (see Table 4). Results of the investigation proved that noise levels cannot easily be reduced to 55 dBA. It was determined that a noise barrier over 2.2 meters in height would be required to reduce noise levels to below 60 dBA at both receptors. However, the inclusion of a noise barrier/perimeter guard greater than 1.5 meters in height would negatively impact the space architecturally by blocking views. Therefore, it is not feasible to protect the amenity terraces with a high noise barrier or other control measure. As mitigated noise levels are above 55 dBA, a Warning Clause is required. The guard must be constructed from materials having a minimum surface density of 20 kg/m^2 (STC rating of 30) and contain no gaps. Design of the guardrail will conform to the requirements outlined in Part 5 of the ENCG and Section 6 of this report.

Estimated vibration levels at the foundation nearest to the O-Train LRT are expected to be 0.07mm/s RMS (69 dBV), based on the FTA protocol and an offset distance of 24 m to the nearest track centerline. Details of the calculation are provided in Appendix A. 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.

With regard to stationary noise impacts, a stationary noise study is recommended for the site during the detailed design once mechanical plans for the proposed building become available. The stationary noise study would assess impacts of stationary noise from rooftop mechanical units serving the proposed building on surrounding noise-sensitive areas. This study will include recommendations for any noise control measures that may be necessary to ensure noise levels fall below ENCG limits. Noise impacts can generally be minimized by judicious selection and placement of the equipment.

An initial assessment of the area identified several low-rise buildings in the immediate vicinity. As the development's mechanical equipment will primarily reside on the building's high roof in the mechanical penthouse, stationary noise impacts onto the surroundings are not expected to be a concern. Similarly, stationary noise impacts from existing buildings onto the proposed development are expected to be negligible as only a few nearby properties possess standard sized Rooftop Units (RTU) which are positioned several meters away from the development.

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1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Tamarack (Norman) Corporation to undertake a transportation noise and vibration assessment in support of a Site Plan Control (SPC) application for the proposed development located at 93 Norman Street in Ottawa in Ottawa, Ontario. This report summarizes the methodology, results, and recommendations related to the assessment of exterior and interior noise levels generated by local transportation noise and vibration sources.

Our work is based on theoretical noise calculation methods conforming to the City of Ottawa[1] and Ministry of the Environment, Conservation and Parks (MECP)[2] guidelines. Noise calculations were based on architectural drawings provided by Roderick Lahey Architect Inc. in February 2021, with future traffic volumes corresponding to the City of Ottawa's Official Plan (OP) roadway classifications.

2. TERMS OF REFERENCE

The focus of this transportation noise and vibration assessment is the proposed residential development located at 93 Norman Street in Ottawa, Ontario. The subject site is situated on a rectangular parcel of land bounded by Beech Street to the north, Preston Street to the east, Norman Street to the south, and the O-Train Line 2 (Trillium Line) light rail to the west. The development comprises a residential building which rises to 9 storeys at the west and 5 storeys at the east of the property. The development includes two levels of underground parking.

The ground floor comprises residential space and lobby. Vehicular access to underground parking is provided from Norman Street. The 5-storey podium portion on the eastern part of the building comprises residential suites and an outdoor amenity terrace on the roof (Level 6). The 9-storey massing on the western part of the building comprises residential suites from Levels 1-9. Outdoor amenities are provided at the Mechanical Penthouse Level.

The site is surrounded by a mix of mid and high-rise buildings from the northeast clockwise to the southwest, and mostly low-rise buildings in the remaining compass directions. The primary sources of

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[1] City of Ottawa Environmental Noise Control Guidelines, January 2016

[2] Ontario Ministry of the Environment and Climate Change – Environmental Noise Guidelines, Publication NPC-300, Queens Printer for Ontario, Toronto, 2013

transportation noise include Preston Street, Highway 417, and the O-Train Line 2 (Trillium Line) light rail. The primary source of ground-borne vibration is the O-Train Line 2 light rail line to the west. As per City of Ottawa's Official Plan, the light rail line is situated within 75 m from the nearest property line. As a result, a ground vibration impact assessment from the light rail system on the proposed development was conducted following the procedures outlined in the Federal Transit Authorities (FTA) protocol. Figure 1 illustrates a complete site plan with surrounding context.

With regard to stationary noise impacts, a stationary noise study is recommended for the site during the detailed design once mechanical plans for the proposed building become available. This study would assess impacts of stationary noise from rooftop mechanical units serving the proposed building on surrounding noise-sensitive areas. This study will include recommendations for any noise control measures that may be necessary to ensure noise levels fall below ENCG limits. Noise impacts can generally be minimized by judicious selection and placement of the equipment.

3. OBJECTIVES

The principal objectives of this study are to (i) calculate the future noise levels on the study buildings produced by local road and railway traffic, (ii) predict vibration levels on the study building produced from the light rail system, and (iii) ensure that interior and exterior noise and vibration levels do not exceed the allowable limits specified by the City of Ottawa's Environmental Noise Control Guidelines as outlined in Section 4.2 of this report.

4. METHODOLOGY

4.1 Background

Noise can be defined as any obtrusive sound. It is created at a source, transmitted through a medium, such as air, and intercepted by a receiver. Noise may be characterized in terms of the power of the source or the sound pressure at a specific distance. While the power of a source is characteristic of that particular source, the sound pressure depends on the location of the receiver and the path that the noise takes to reach the receiver. Measurement of noise is based on the decibel unit, dBA, which is a logarithmic ratio referenced to a standard noise level (2×10^{-5} Pascals). The 'A' suffix refers to a weighting scale, which better represents how the noise is perceived by the human ear. With this scale, a doubling of power results in a

3 dBA increase in measured noise levels and is just perceptible to most people. An increase of 10 dBA is often perceived to be twice as loud.

4.2 Roadway Traffic Noise

4.2.1 Criteria for Roadway Traffic Noise

For surface roadway traffic noise, the equivalent sound energy level, L_{eq}, provides a measure of the time-varying noise levels, which is well correlated with the annoyance of sound. It is defined as the continuous sound level, which has the same energy as a time-varying noise level over a period of time. For roadways, the L_{eq} is commonly calculated on the basis of a 16-hour (L_{eq16}) daytime (07:00-23:00) / 8-hour (L_{eq8}) nighttime (23:00-07:00) split to assess its impact on residential buildings. The City of Ottawa's Environmental Noise Control Guidelines (ENCG) specifies that the recommended indoor noise limit range (that is relevant to this study) is 45 and 40 dBA for living rooms and sleeping quarters respectively for roadway as listed in Table 1. Based on Gradient Wind's experience, more comfortable indoor noise levels should be targeted, towards 42, and 37 dBA, respectively, to control peak noise and deficiencies in building envelope construction.

TABLE 1: INDOOR SOUND LEVEL CRITERIA (ROAD) [3]

Type of Space	Time Period	L_{eq} (dBA)
General offices, reception areas, retail stores, etc.	07:00 – 23:00	50
Living/dining/den areas of **residences**, hospitals, schools, nursing/retirement homes, day-care centres, theatres, places of worship, libraries, individual or semi-private offices, conference rooms, etc.	07:00 – 23:00	45
Sleeping quarters of hotels/motels	23:00 – 07:00	45
Sleeping quarters of **residences**, hospitals, nursing/retirement homes, etc.	23:00 – 07:00	40

---

[3] Adapted from ENCG 2016 – Tables 2.2b and 2.2c

Predicted noise levels at the plane of window (POW) dictate the action required to achieve the recommended sound levels. An open window is considered to provide a 10 dBA reduction in noise, while a standard closed window is capable of providing a minimum 20 dBA noise reduction[4]. A closed window due to a ventilation requirement will bring noise levels down to achieve an acceptable indoor environment[5]. Therefore, where noise levels exceed 55 dBA daytime and 50 dBA nighttime, the ventilation for the building should consider the need for having windows and doors closed, which triggers the need for forced air heating with provision for central air conditioning. Where noise levels exceed 65 dBA daytime and 60 dBA nighttime, air conditioning will be required and building components will require higher levels of sound attenuation[6].

The sound level criterion for outdoor living areas (OLA) is 55 dBA, which applies during the daytime (07:00 to 23:00). When noise levels exceed 55 dBA, mitigation should be provided to reduce noise levels where technically and administratively feasible to acceptable levels at or below the criterion. Furthermore, noise levels at the OLA must not exceed 60 dBA if mitigation can be technically and administratively achieved.

4.2.2 Theoretical Roadway Noise Predictions

Noise predictions were performed with the aid of the MECP computerized noise assessment program, STAMSON 5.04, for road analysis. Appendix A includes the STAMSON 5.04 input and output data. Roadway traffic noise calculations were performed by treating each roadway segment as separate line sources of noise. In addition to the traffic volumes summarized in Table 2, theoretical noise predictions were based on the following parameters:

- Truck traffic on all roadways was taken to comprise 5% heavy trucks and 7% medium trucks, as per ENCG requirements for noise level predictions.
- The day/night split for all streets was taken to be 92%/8%, respectively.
- Ground surfaces were taken to be reflective due to the presence of hard (paved) ground. For highway traffic noise, absorptive ground surface was used to account for blockage due to the numerous houses situated between the study site and Highway 417.

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[4] Burberry, P.B. (2014). Mitchell's Environment and Services. Routledge, Page 125

[5] MOECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.8

[6] MOECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.1.3

- Topography was assumed to be a flat/gentle slope surrounding the study building.
- A difference in elevation for Highway 417 and the LRT was measured to be approximately 4 meters above grade and 7 meters below grade, respectively.
- For select sources where appropriate, receptors considered the proposed and/or existing buildings as a barrier partially or fully obstructing exposure to the source as illustrated by exposure angles in Figures 4-7.
- Noise receptors were strategically placed at 9 locations around the study area (see Figure 2).
- Receptor distances and exposure angles are illustrated in Figures 4-7.

4.2.1 Transportation Traffic Volumes

The ENCG dictates that noise calculations should consider future sound levels based on a roadway's classification at the mature state of development. Therefore, traffic volumes are based on the roadway classifications outlined in the City of Ottawa's Official Plan (OP) and Transportation Master Plan[7] which provide additional details on future roadway expansions. Average Annual Daily Traffic (AADT) volumes are then based on data in Table B1 of the ENCG for each roadway classification. Table 2 (below) summarizes the AADT values used for each roadway included in this assessment.

TABLE 2: TRANSPORTATION TRAFFIC DATA

Segment	Roadway Traffic Data	Speed Limit (km/h)	Traffic Volumes
Highway 417	8 Lane Freeway	100	**146,664**
Preston Street	2-Lane Urban Arterial Undivided	50	**15,000**
O-Train Line 2	Light Rail Transit	50	**192/24***

*Daytime/Nighttime volumes based on the City of Ottawa's Environmental Assessment for the LRT Project

---

[7] City of Ottawa Transportation Master Plan, November 2013

4.3 Indoor Noise Calculations

The difference between outdoor and indoor noise levels is the noise attenuation provided by the building envelope. According to common industry practice, complete walls and individual wall elements are rated according to the Sound Transmission Class (STC). The STC ratings of common residential walls built in conformance with the Ontario Building Code (2012) typically exceed STC 35, depending on exterior cladding, thickness and interior finish details. For example, brick veneer walls can achieve STC 50 or more. Standard commercially sided exterior metal stud walls have around STC 45. Standard good quality double-glazed non-operable windows can have STC ratings ranging from 25 to 40, depending on the window manufacturer, pane thickness and inter-pane spacing. As previously mentioned, the windows are the known weak point in a partition.

As per Section 4.2, when daytime noise levels from road sources at the plane of the window exceed 65 dBA, calculations must be performed to evaluate the sound transmission quality of the building components to ensure acceptable indoor noise levels. The calculation procedure[8] considers:

- Window type and total area as a percentage of total room floor area
- Exterior wall type and total area as a percentage of the total room floor area
- Acoustic absorption characteristics of the room
- Outdoor noise source type and approach geometry
- Indoor sound level criteria, which varies according to the intended use of a space

Based on published research[9], exterior walls possess specific sound attenuation characteristics that are used as a basis for calculating the required STC ratings of windows in the same partition. Due to the limited information available at the time of the study, which was prepared for site plan approval, detailed floor layouts and building elevations have not been finalized; therefore, detailed STC calculations could not be performed at this time. As a guideline, the anticipated STC requirements for windows have been estimated based on the overall noise reduction required for each intended use of space (STC = outdoor noise level – targeted indoor noise levels).

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[8] Building Practice Note: Controlling Sound Transmission into Buildings by J.D. Quirt, National Research Council of Canada, September 1985

[9] CMHC, Road & Rail Noise: Effects on Housing

4.4 Ground Vibration and Ground-borne Noise

Rail systems and heavy vehicles on roadways 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 or subway. Repetitive motion of the wheels on the track or rubber tires passing over an uneven surface causes vibration 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 millimeters 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.

4.4.1 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 the MECP. These standards indicate that the appropriate criteria for residences is 0.10 mm/s RMS for vibrations. For main line railways, a document titled *Guidelines for New Development in Proximity to Railway Operations*[10], 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. The Federal Transportation Authority (FTA) criterion was adopted as the appropriate standard for this study. As the main vibration source is due to the O-Trail LRT which has frequent events, the 0.10 mm/s RMS (72 dBV) vibration criteria and 35 dBA ground-borne noise criteria were adopted for this study.

4.4.2 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 Rapid Transit at a speed of 50 mph. Adjustment factors were considered based on the following information:

- The maximum operating speed of the LRT is 31 mph (50 km/h) at peak.
- The offset distance between the development and the closest track is 24 m.
- The vehicles are assumed to have soft primary suspensions.
- Tracks are welded and in good condition.
- Soil conditions do not efficiently propagate vibrations.
- Type of transit structure is Open Cut.
- The building's foundation coupling is Foundation in Rock.

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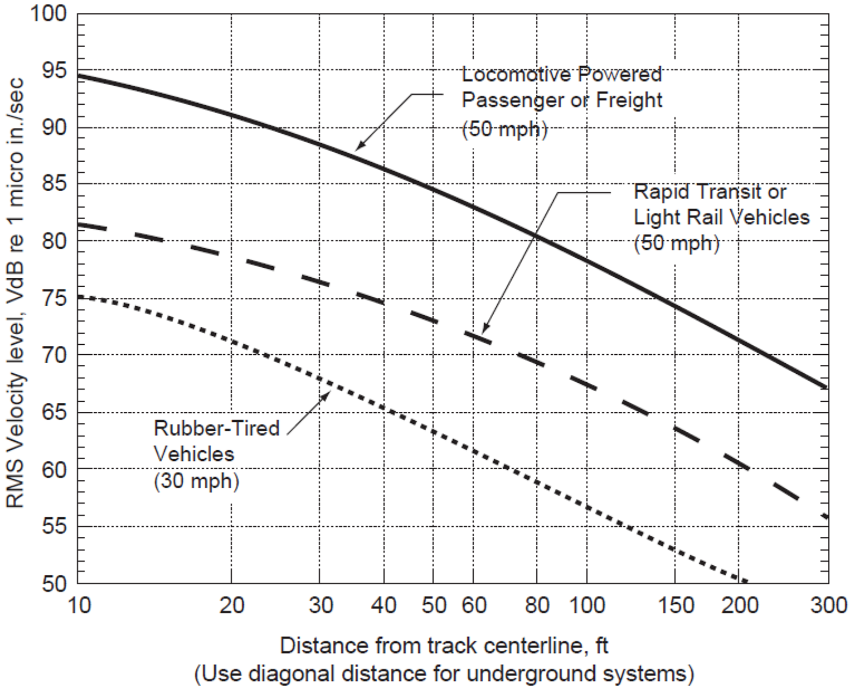
[10] Dialog and J.E. Coulter Associates Limited, prepared for The Federation of Canadian Municipalities and The Railway Association of Canada, May 2013

[11] C. E. Hanson; D. A. Towers; and L. D. Meister, Transit Noise and Vibration Impact Assessment, Federal Transit Administration, May 2006



FTA GENERALIZED CURVES OF VIBRATION LEVELS VERSUS DISTANCE (ADOPTED FROM FIGURE 10-1, FTA TRANSIT NOISE AND VIBRATION IMPACT ASSESSMENT)

5. RESULTS AND DISCUSSION

5.1 Transportation Noise Levels

The results of the transportation noise calculations are summarized in Table 3 below. A complete set of input and output data from all STAMSON 5.04 calculations are available in Appendix A.

TABLE 3: EXTERIOR NOISE LEVELS DUE TO TRANSPORTATION SOURCES

Receptor Number	Receptor Height Above Grade (m)	Receptor Location	STAMSON 5.04 Noise Level (dBA)	
			Day	Night
1	14.8	POW – 5th Floor – South Façade	56	49
2	14.8	POW – 5th Floor – East Façade	66	59
3	14.8	POW – 5th Floor – North Façade	69	61
4	26.8	POW – 9th Floor – East Façade	69	61
5	26.8	POW – 9th Floor – South Façade	51	46
6	26.8	POW – 9th Floor – West Façade	68	60
7	26.8	POW – 9th Floor – North Façade	71	63
8	17.8	OLA – 6th Floor Amenity Terrace	70	N/A*
9	29.8	OLA – Rooftop Terrace	68	N/A*

*Noise levels during the nighttime are not considered as per ENCG

The results of the current analysis indicate that noise levels will range between 51 and 71 dBA during the daytime period (07:00-23:00) and between 46 and 63 dBA during the nighttime period (23:00-07:00). The highest noise level (71 dBA) occurs at the north façade, which is most exposed to Highway 417.

5.2 Noise Control Measures

The noise levels predicted due to roadway traffic exceed the criteria listed in Section 4.2 for building components. As discussed in Section 4.3, the anticipated STC requirements for windows have been estimated based on the overall noise reduction required for each intended use of space (STC = outdoor noise level – targeted indoor noise levels). As per city of Ottawa requirements, detailed STC calculations will be required to be completed prior to building permit application for each unit type. The STC requirements for the windows are summarized below for various units within the development (see Figure 3):

- **Bedroom Windows**

(i) Bedroom windows facing east, north, and west will require a minimum STC of 34.

- **Living Room Windows**

(i) Living room windows facing east, north, and west will require a minimum STC of 29.

- **Exterior Walls**

(i) Exterior wall components on the east, north, and west façades will require a minimum STC of 45, which will be achieved with brick cladding or an acoustical equivalent according to NRC test data[12].

The STC requirements apply to windows, doors, spandrel panels and curtainwall elements. Exterior wall components on these façades are recommended to have a minimum STC of 45, where a window/wall system is used. A review of window supplier literature indicates that the specified STC ratings can be achieved by a variety of window systems having a combination of glass thickness and inter-pane spacing. We have specified an example window configuration, however several manufacturers and various combinations of window components, such as those proposed, will offer the necessary sound attenuation rating. It is the responsibility of the manufacturer to ensure that the specified window achieves the required STC. This can only be assured by using window configurations that have been certified by laboratory testing. The requirements for STC ratings assume that the remaining components of the building are constructed and installed according to the minimum standards of the Ontario Building Code. The specified STC requirements also apply to swinging and/or sliding patio doors.

Results of the calculations also indicate that the development will require central air conditioning, which will allow occupants to keep windows closed and maintain a comfortable living environment. In addition to ventilation requirements, Warning Clauses will also be required in all Lease, Purchase and Sale Agreements, as summarized in Section 6.

---

[12] J.S. Bradley and J.A. Birta. Laboratory Measurements of the Sound Insulation of Building Façade Elements, National Research Council October 2000.

5.3 Noise Barrier Calculation

Noise levels at the Level 6 and rooftop terraces are expected to exceed 55 dBA during the daytime period without a noise barrier. If these areas are to be used as outdoor living areas, noise control measures are required to reduce noise levels as close as possible to 55 dBA where technically and administratively feasible. Further analysis investigated the noise mitigating impact of raising the perimeter guards from 1.2 m to 2.5 m above the walking surface (see Table 4). Results of the investigation proved that noise levels cannot easily be reduced to 55 dBA. It was determined that a noise barrier over 2.2 meters in height would be required to reduce noise levels to below 60 dBA at both receptors. However, the inclusion of a noise barrier greater than 1.5 meters in height would negatively impact the space architecturally by blocking views. Therefore, it is not feasible to protect the amenity terraces with a high noise barrier or other control measure. As mitigated noise levels are above 55 dBA, a Warning Clause is required.

TABLE 4: RESULTS OF NOISE BARRIER INVESTIGATION

Receptor Number	Receptor Height Above Grade (m)	Receptor Location	Daytime L_{eq} Noise Levels (dBA)					
			No Barrier	With 1.2 m Barrier	With 1.5 m Barrier	With 2 m Barrier	With 2.2 m Barrier	With 2.5 m Barrier
8	17.8	OLA – 6th Floor Amenity Terrace	70	67	66	66	-	65
9	29.8	OLA – Rooftop Terrace	68	63	62	61	60	-

5.4 Ground Vibrations and Ground-Borne Noise Levels

Estimated vibration levels at the foundation nearest to the O-Train LRT are expected to be 0.07mm/s RMS (69 dBV), based on the FTA protocol and an offset distance of 24 m to the nearest track centerline. Details of the calculation are provided in Appendix A. 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. CONCLUSIONS AND RECOMMENDATIONS

The results of the current analysis indicate that noise levels will range between 51 and 71 dBA during the daytime period (07:00-23:00) and between 46 and 63 dBA during the nighttime period (23:00-07:00). The highest noise level (71 dBA) occurs at the north façade, which is most exposed to Highway 417. Building components with a higher Sound Transmission Class (STC) rating will be required where exterior noise levels exceed 65 dBA, as indicated in Figure 3.

Results of the calculation also indicate the development will require central air conditioning, or similar mechanical ventilation, which will allow occupants to keep windows closed to maintain a comfortable indoor living environment. A Warning Clause will also be required to be placed on all Lease, Purchase and Sale Agreements, as summarized below:

> *"Purchasers/tenants are advised that despite the inclusion of noise control features in the development and within the building units, sound levels due to increasing roadway traffic may, on occasion, interfere with some activities of the dwelling occupants, as the sound levels exceed the sound level limits of the City and the Ministry of the Environment, Conservation and Parks. To help address the need for sound attenuation, this development includes:*

- *STC rated multi-pane glazing elements*
- *STC rated exterior walls*
- *Acoustic barriers*

> *This dwelling unit has also been designed with air conditioning. Air conditioning will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the City and the Ministry of the Environment, Conservation and Parks.*
>
> *To ensure that provincial sound level limits are not exceeded, it is important to maintain these sound attenuation features."*

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.'"*

Noise levels at the Level 6 and rooftop terraces are expected to exceed 55 dBA during the daytime period without a noise barrier. If these areas are to be used as outdoor living areas, noise control measures are required to reduce noise levels as close as possible to 55 dBA where technically and administratively feasible. Further analysis investigated the noise mitigating impact of raising the perimeter guards from 1.2 m to 2.5 m above the walking surface (see Table 4). Results of the investigation proved that noise levels cannot easily be reduced to 55 dBA. It was determined that a noise barrier over 2.2 meters in height would be required to reduce noise levels to below 60 dBA at both receptors. However, the inclusion of a noise barrier/perimeter guard greater than 1.5 meters in height would negatively impact the space architecturally by blocking views. Therefore, it is not feasible to protect the amenity terraces with a high noise barrier or other control measure. As mitigated noise levels are above 55 dBA, a Warning Clause is required (see Figure 3).

The guard must be constructed from materials having a minimum surface density of 20 kg/m^2 (STC rating of 30) and contain no gaps. Design of the guardrail will conform to the requirements outlined in Part 5 of the ENCG. The following information will be required by the City for review prior to installation of the barrier:

1. Shop drawings, signed and sealed by a qualified Professional Engineer licenced by the Professional Engineers of Ontario, showing the details of the acoustic barrier systems components, including material specifications.
2. Structural drawing(s), signed by a qualified Professional Engineer licenced by the Professional Engineers of Ontario, showing foundation details, and specifying design criteria, climatic design loads, as well as applicable geotechnical data used in the design.
3. Layout plan, and wall elevations, showing proposed colours and patterns.

Estimated vibration levels at the foundation nearest to the O-Train LRT are expected to be 0.07mm/s RMS (69 dBV), based on the FTA protocol and an offset distance of 24 m to the nearest track centerline. Details of the calculation are provided in Appendix A. 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.

With regard to stationary noise impacts, a stationary noise study is recommended for the site during the detailed design once mechanical plans for the proposed building become available. The stationary noise study would assess impacts of stationary noise from rooftop mechanical units serving the proposed building on surrounding noise-sensitive areas. This study will include recommendations for any noise control measures that may be necessary to ensure noise levels fall below ENCG limits. Noise impacts can generally be minimized by judicious selection and placement of the equipment.

An initial assessment of the area identified several low-rise buildings in the immediate vicinity. As the development's mechanical equipment will primarily reside on the building's high roof in the mechanical penthouse, stationary noise impacts onto the surroundings are not expected to be a concern. Similarly, stationary noise impacts from existing buildings onto the proposed development are expected to be negligible as only a few nearby properties possess standard sized Rooftop Units (RTU) which are positioned several meters away from the development.

This concludes our transportation noise and vibration assessment and report. If you have any questions or wish to discuss our findings, please advise us. In the interim, we thank you for the opportunity to be of service.

Sincerely,

Gradient Wind Engineering Inc.

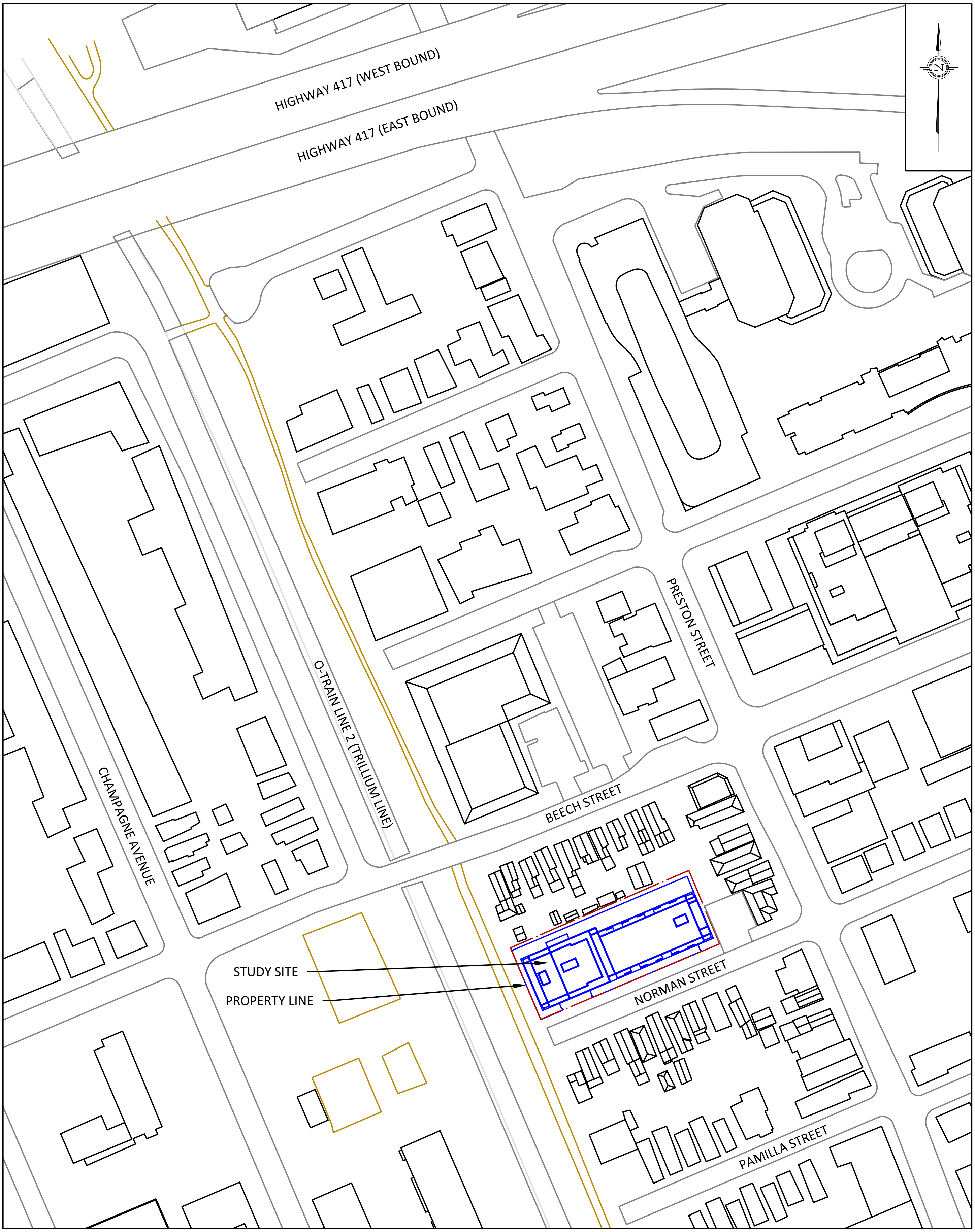
G. Garro

Giuseppe Garro, MASc.
Junior Environmental Scientist

LICENSED PROFESSIONAL ENGINEER
Josh Foster
J. R. FOSTER
100155655
March 1, 2021
PROVINCE OF ONTARIO

Joshua Foster, P.Eng.
Principal

Gradient Wind File #21-011-Transportation Noise and Vibration



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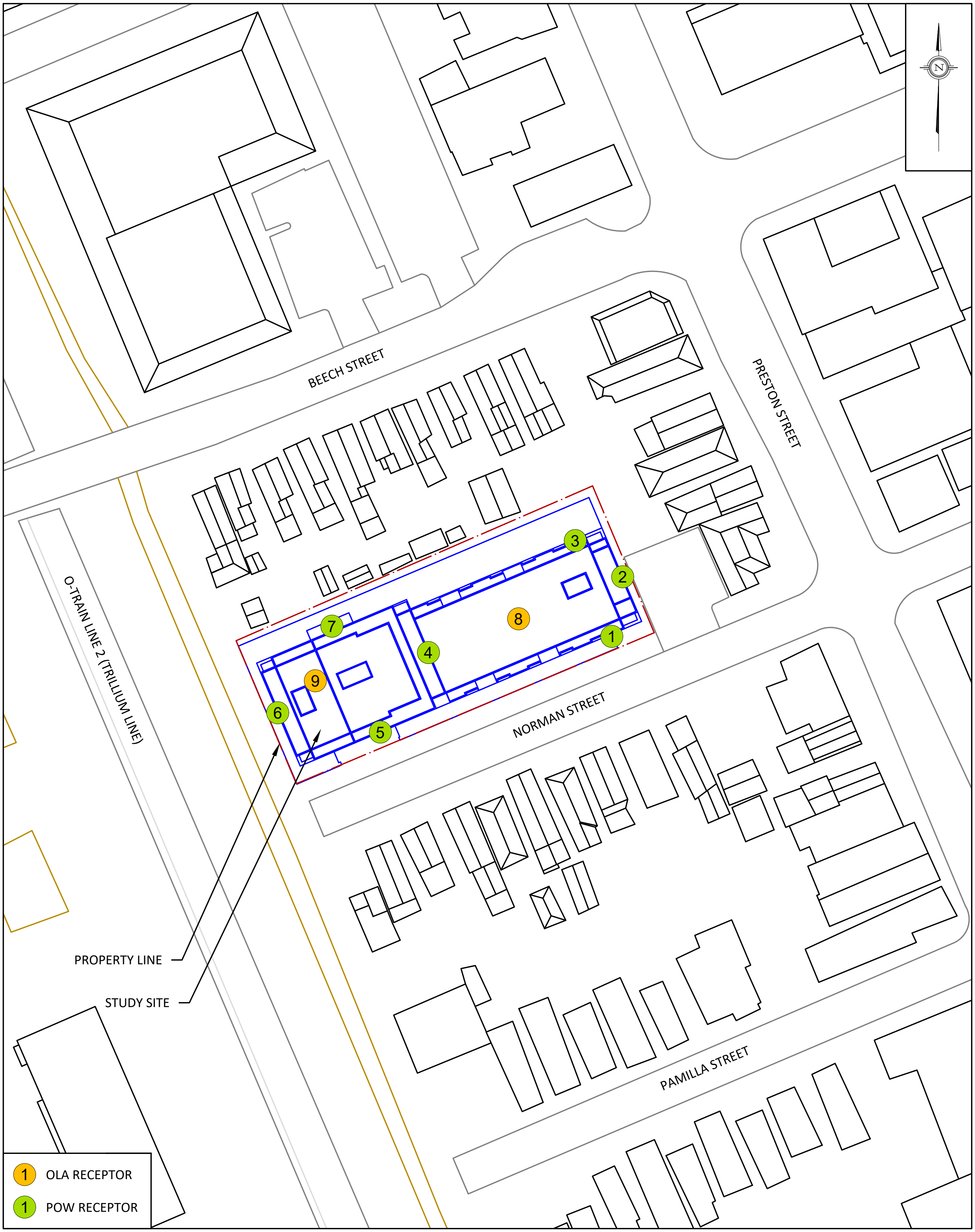
PROJECT	93 NORMAN STREET, OTTAWA TRANSPORTATION NOISE ASSESSMENT
SCALE	1:2000 (APPROX.)
DRAWING NO.	21-011-1
DATE	FEBRUARY 24, 2021
DRAWN BY	O.R
DESCRIPTION	FIGURE 1: SITE PLAN AND SURROUNDING CONTEXT



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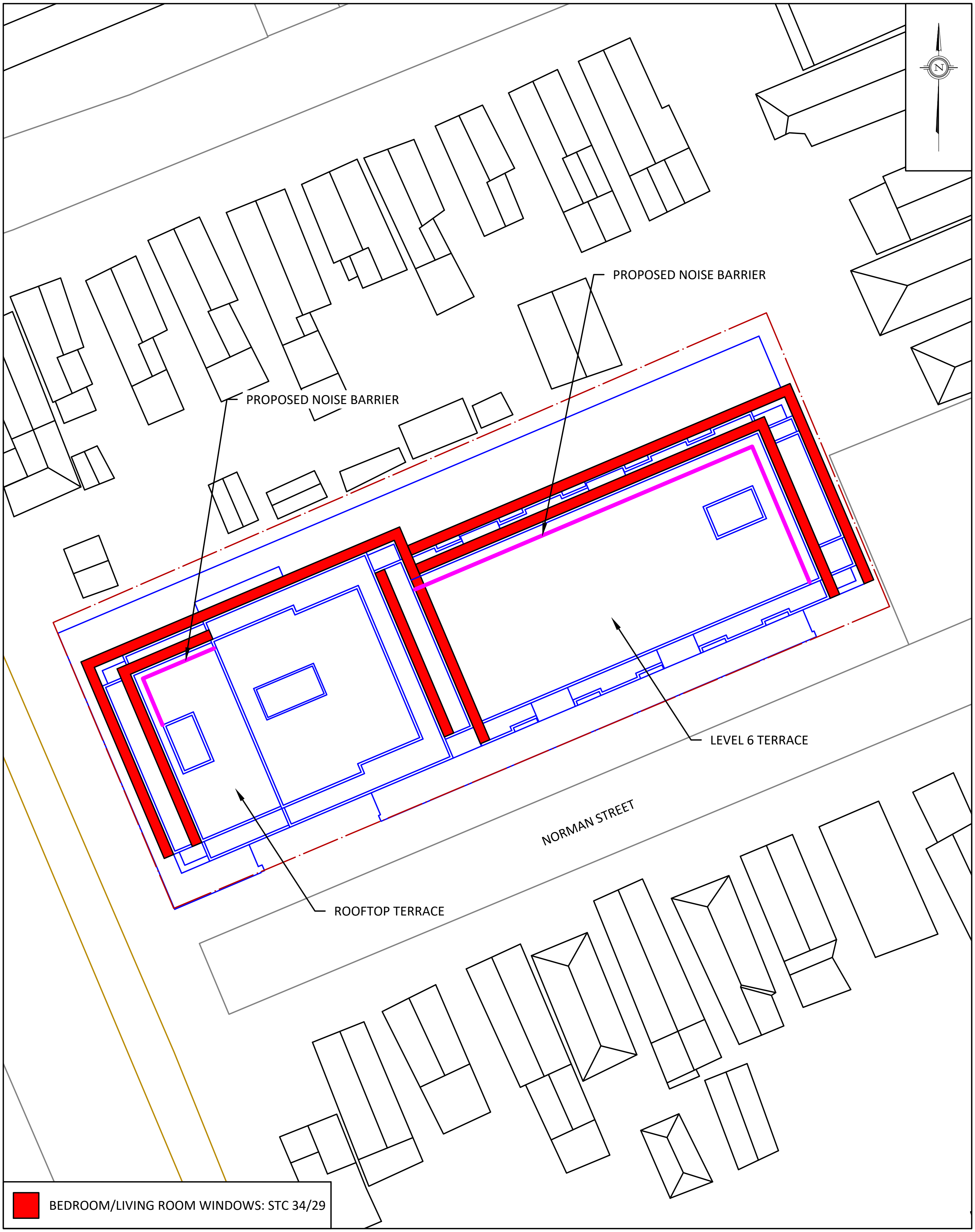
PROJECT	93 NORMAN STREET, OTTAWA TRANSPORTATION NOISE ASSESSMENT
SCALE	1:1000 (APPROX.)
DRAWING NO.	21-011-2
DATE	FEBRUARY 24, 2021
DRAWN BY	G.G.
DESCRIPTION	FIGURE 2: RECEPTOR LOCATIONS



🟥 BEDROOM/LIVING ROOM WINDOWS: STC 34/29

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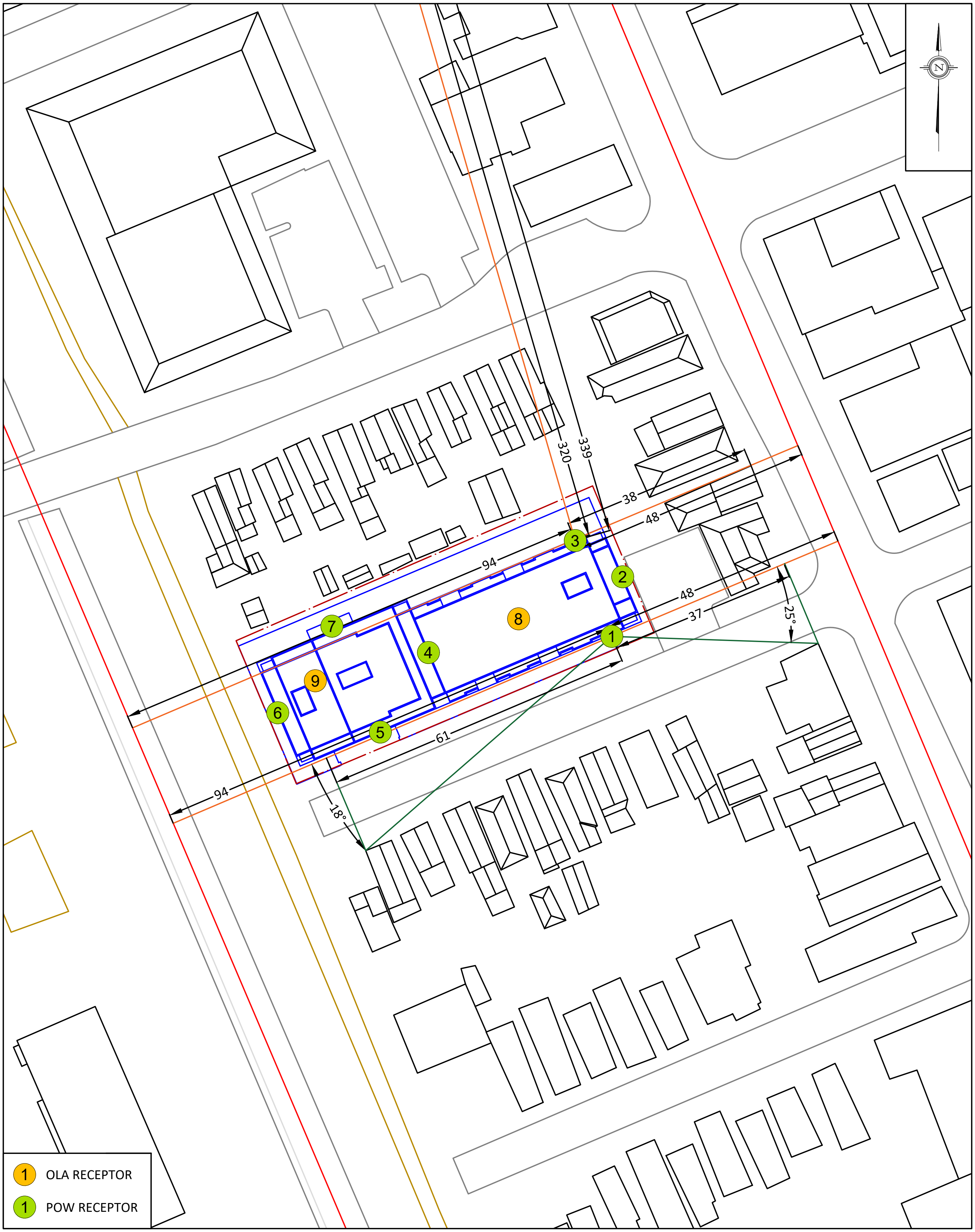
PROJECT 93 NORMAN STREET, OTTAWA TRANSPORTATION NOISE ASSESSMENT		DESCRIPTION FIGURE 3: WINDOW STC REQUIREMENTS
SCALE 1:500(APPROX.)	DRAWING NO. 21-011-3	
DATE FEBRUARY 24, 2021	DRAWN BY G.G.	



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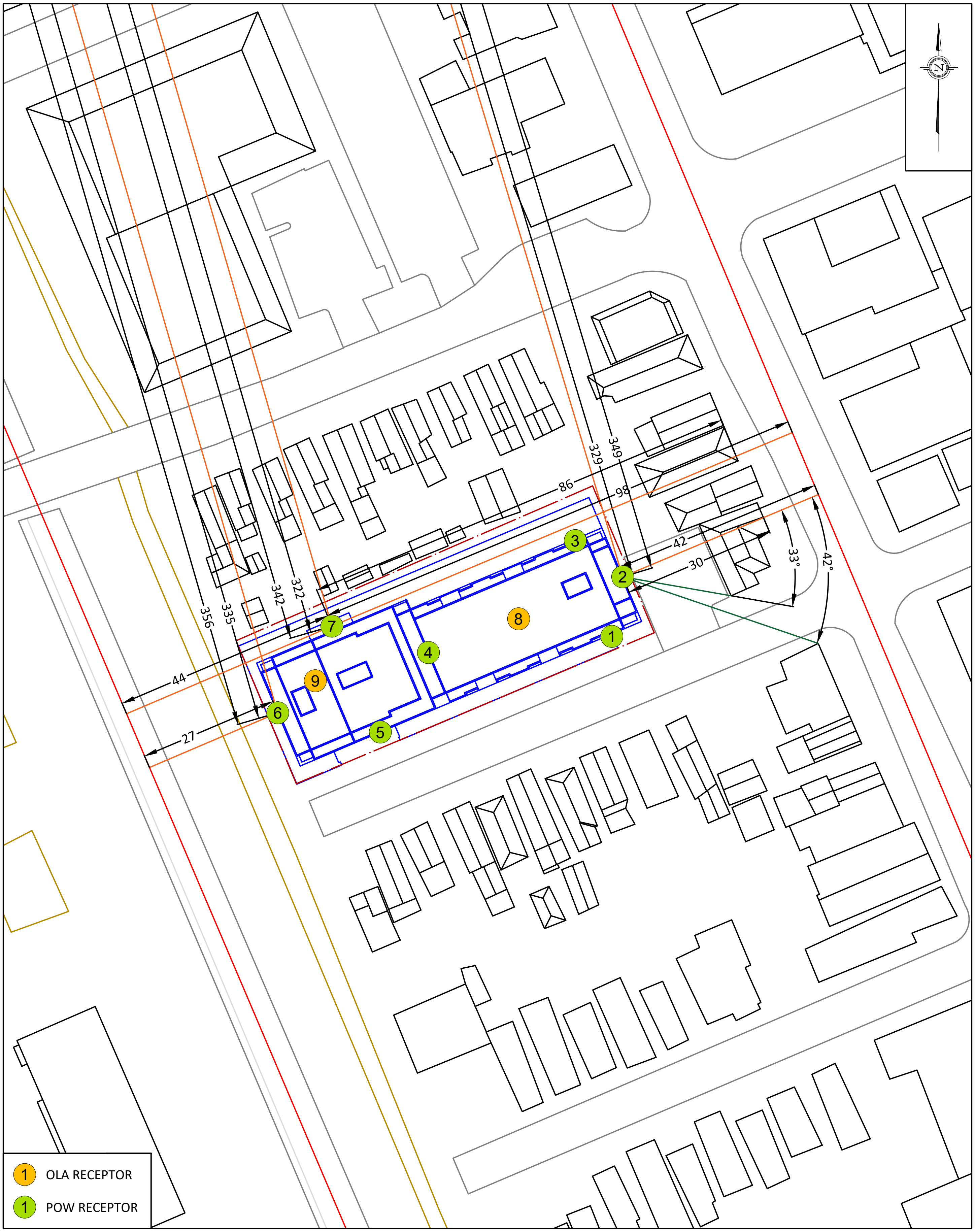
PROJECT	93 NORMAN STREET, OTTAWA TRANSPORTATION NOISE ASSESSMENT
SCALE	1:1000(APPROX.)
DRAWING NO.	21-011-4
DATE	FEBRUARY 24, 2021
DRAWN BY	G.G.
DESCRIPTION	FIGURE 4: RECEPTOR INPUT PARAMETERS



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PROJECT
93 NORMAN STREET, OTTAWA
TRANSPORTATION NOISE ASSESSMENT

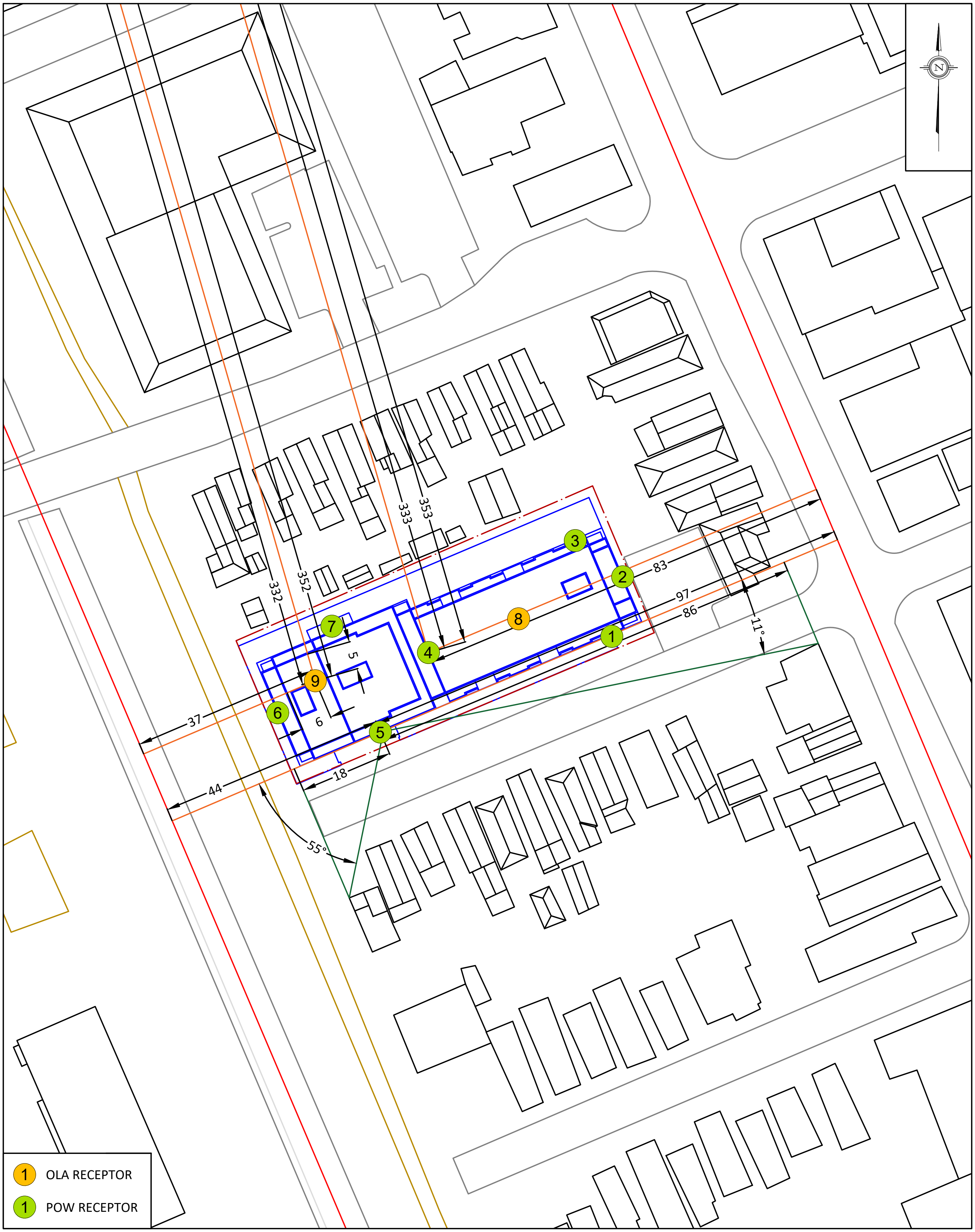
SCALE
1:1000 (APPROX.)

DRAWING NO.
21-011-5

DATE
FEBRUARY 24, 2021

DRAWN BY
G.G.

DESCRIPTION
FIGURE 5:
RECEPTOR INPUT PARAMETERS



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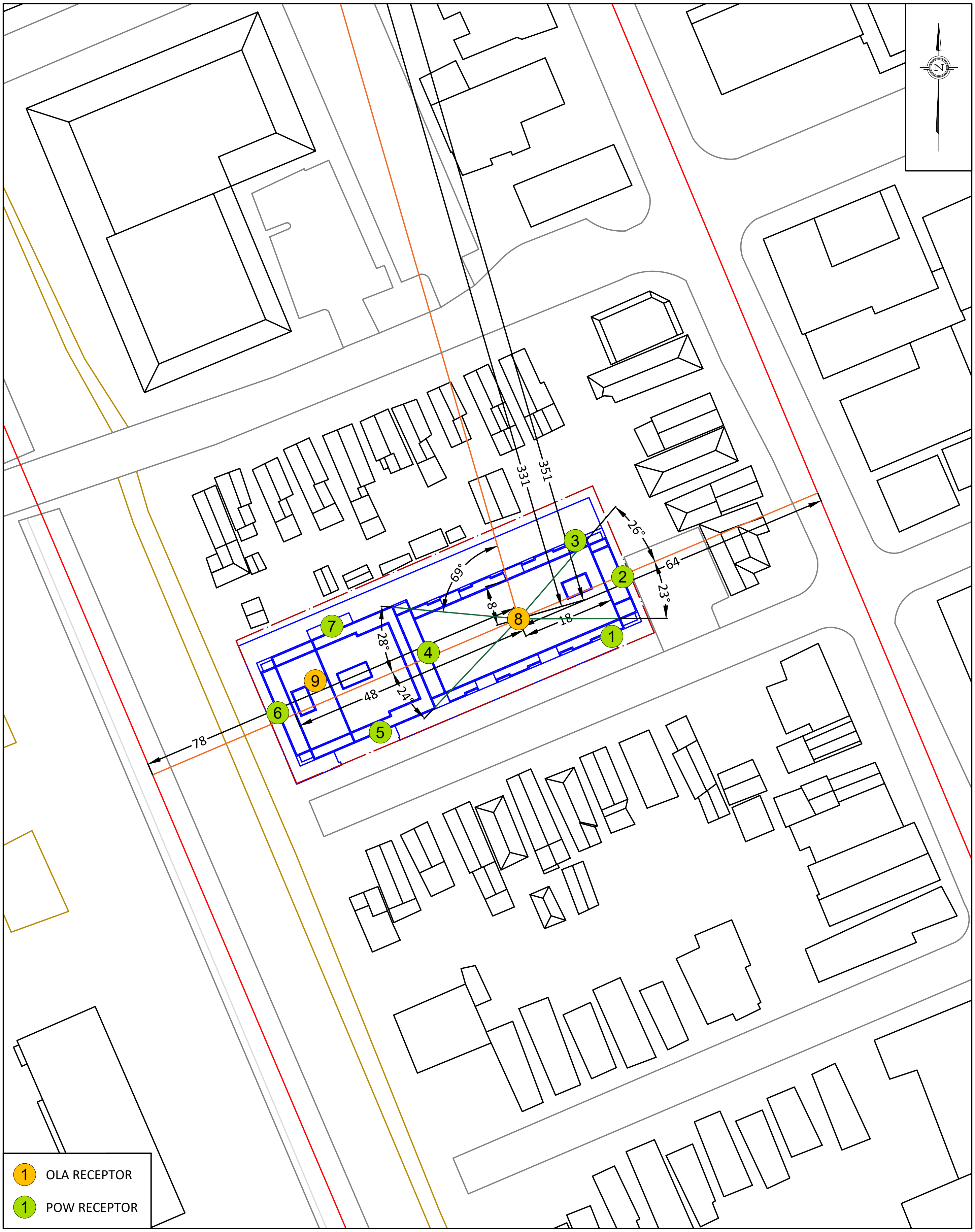
PROJECT	93 NORMAN STREET, OTTAWA TRANSPORTATION NOISE ASSESSMENT
SCALE	1:1000(APPROX.)
DRAWING NO.	21-011-6
DATE	FEBRUARY 24, 2021
DRAWN BY	G.G.
DESCRIPTION	FIGURE 6: RECEPTOR INPUT PARAMETERS



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PROJECT	93 NORMAN STREET, OTTAWA TRANSPORTATION NOISE ASSESSMENT
SCALE	1:1000 (APPROX.)
DRAWING NO.	21-011-7
DATE	FEBRUARY 24, 2021
DRAWN BY	G.G.
DESCRIPTION	FIGURE 7: RECEPTOR INPUT PARAMETERS

APPENDIX A

STAMSON 5.04 – INPUT AND OUTPUT DATA

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2021 16:53:39
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r1.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Preston St (day/night)
----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Preston St (day/night)
--------------------------------------------
Angle1   Angle2           :   0.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  48.00 / 48.00  m
Receiver height           :  14.80 / 14.80  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  25.00 deg   Angle2 : 90.00 deg
Barrier height            :   7.00 m
Barrier receiver distance :  37.00 / 37.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Results segment # 1: Preston St (day)
-------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
```

```
-------------+--------------+-------------+---------------
       1.50 !       14.80 !        4.54 !         4.54

ROAD (54.86 + 49.73 + 0.00) = 56.02 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
------------------------------------------------------------------------
--
     0     25   0.00  68.48   0.00  -5.05  -8.57   0.00   0.00   0.00
54.86
------------------------------------------------------------------------
--
    25     90   0.00  68.48   0.00  -5.05  -4.42   0.00   0.00  -9.28
49.73
------------------------------------------------------------------------
--

Segment Leq : 56.02 dBA

Total Leq All Segments: 56.02 dBA

Results segment # 1: Preston St (night)
---------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver     ! Barrier     ! Elevation of
Height  (m) ! Height   (m) ! Height  (m) ! Barrier Top  (m)
-------------+--------------+-------------+---------------
       1.50 !       14.80 !        4.54 !         4.54

ROAD (47.26 + 42.13 + 0.00) = 48.42 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
------------------------------------------------------------------------
--
     0     25   0.00  60.88   0.00  -5.05  -8.57   0.00   0.00   0.00
47.26
------------------------------------------------------------------------
--
    25     90   0.00  60.88   0.00  -5.05  -4.42   0.00   0.00  -9.28
42.13
------------------------------------------------------------------------
--

Segment Leq : 48.42 dBA

Total Leq All Segments: 48.42 dBA
```

```
RT/Custom data, segment # 1: LRT (day/night)
--------------------------------------------
1 - 4-car SRT:
Traffic volume    :   192/24    veh/TimePeriod
Speed             :    50 km/h

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2            : -90.00 deg   0.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      2       (Reflective ground surface)
Receiver source distance   :  94.00 / 94.00  m
Receiver height            :  14.80 / 14.80  m
Topography                 :      3       (Elevated; no barrier)
Elevation                  :   7.00 m
Reference angle            :   0.00

Results segment # 1: LRT (day)
------------------------------

Source height = 0.50 m

RT/Custom (0.00 + 45.04 + 0.00) = 45.04 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90      0   0.00  56.02  -7.97  -3.01   0.00   0.00   0.00  45.04
----------------------------------------------------------------------

Segment Leq : 45.04 dBA

Total Leq All Segments: 45.04 dBA

Results segment # 1: LRT (night)
--------------------------------

Source height = 0.50 m

RT/Custom (0.00 + 39.02 + 0.00) = 39.02 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90      0   0.00  50.00  -7.97  -3.01   0.00   0.00   0.00  39.02
----------------------------------------------------------------------

Segment Leq : 39.02 dBA

Total Leq All Segments: 39.02 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 56.35
                         (NIGHT): 48.89
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2021 16:53:47
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r2.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Preston St1 (day/night)
-----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Preston St1 (day/night)
---------------------------------------------
Angle1   Angle2           : -90.00 deg   33.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  42.00 / 42.00  m
Receiver height           :  14.80 / 14.80  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 33.00 deg
Barrier height            :   7.00 m
Barrier receiver distance :  30.00 / 30.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Road data, segment # 2: PRESTON ST2 (day/night)
-----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)
```

```
* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: PRESTON ST2 (day/night)
---------------------------------------------
Angle1   Angle2           :  33.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  42.00 / 42.00  m
Receiver height           :  14.80 / 14.80  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  42.00 deg   Angle2 : 90.00 deg
Barrier height            :   7.00 m
Barrier receiver distance :  30.00 / 30.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Road data, segment # 3: HYW 417 EB (day/night)
----------------------------------------------
Car traffic volume  : 59370/5163  veh/TimePeriod  *
Medium truck volume :  4723/411   veh/TimePeriod  *
Heavy truck volume  :  3373/293   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  73332
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 3: HYW 417 EB (day/night)
--------------------------------------------
Angle1   Angle2           :   0.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 329.00 / 329.00 m
```

```
Receiver height            :  14.80 / 14.80  m
Topography                 :      3        (Elevated; no barrier)
Elevation                  :   4.00 m
Reference angle            :   0.00

Road data, segment # 4: HWY 417 WB (day/night)
----------------------------------------------
Car traffic volume  : 59370/5163  veh/TimePeriod  *
Medium truck volume :  4723/411   veh/TimePeriod  *
Heavy truck volume  :  3373/293   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  73332
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 4: HWY 417 WB (day/night)
--------------------------------------------
Angle1   Angle2            :   0.00 deg   90.00 deg
Wood depth                 :      0        (No woods.)
No of house rows           :      0 / 0
Surface                    :      1        (Absorptive ground surface)
Receiver source distance   : 349.00 / 349.00 m
Receiver height            :  14.80 / 14.80  m
Topography                 :      3        (Elevated; no barrier)
Elevation                  :   4.00 m
Reference angle            :   0.00

Results segment # 1: Preston St1 (day)
--------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
------------+-------------+-------------+---------------
       1.50 !       14.80 !        5.30 !         5.30

ROAD (0.00 + 53.87 + 0.00) = 53.87 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
```

```
--------------------------------------------------------------------------
--
   -90     33   0.00  68.48   0.00  -4.47  -1.65   0.00   0.00  -8.49
53.87
--------------------------------------------------------------------------
--

Segment Leq : 53.87 dBA

Results segment # 2: PRESTON ST2 (day)
--------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver     ! Barrier      ! Elevation of
Height  (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
------------+--------------+--------------+---------------
       1.50 !        14.80 !         5.30 !          5.30

ROAD (51.00 + 51.10 + 0.00) = 54.06 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
    33     42   0.00  68.48   0.00  -4.47 -13.01   0.00   0.00   0.00
51.00
--------------------------------------------------------------------------
--
    42     90   0.00  68.48   0.00  -4.47  -5.74   0.00   0.00  -7.17
51.10
--------------------------------------------------------------------------
--

Segment Leq : 54.06 dBA

Results segment # 3: HYW 417 EB (day)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 62.69 + 0.00) = 62.69 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
     0     90   0.14  81.40   0.00 -15.30  -3.40   0.00   0.00   0.00
62.69
--------------------------------------------------------------------------
--
```

```
Segment Leq : 62.69 dBA

Results segment # 4: HWY 417 WB (day)
--------------------------------------

Source height = 1.50 m

ROAD (0.00 + 62.40 + 0.00) = 62.40 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-----------------------------------------------------------------------------
--
     0     90   0.14  81.40   0.00 -15.60  -3.40   0.00   0.00   0.00
62.40
-----------------------------------------------------------------------------
--

Segment Leq : 62.40 dBA

Total Leq All Segments: 66.12 dBA

Results segment # 1: Preston St1 (night)
-----------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
-------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.50 !       14.80 !        5.30 !         5.30

ROAD (0.00 + 46.27 + 0.00) = 46.27 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-----------------------------------------------------------------------------
--
   -90     33   0.00  60.88   0.00  -4.47  -1.65   0.00   0.00  -8.49
46.27
-----------------------------------------------------------------------------
--

Segment Leq : 46.27 dBA

Results segment # 2: PRESTON ST2 (night)
-----------------------------------------

Source height = 1.50 m
```

```
Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.50 !       14.80 !        5.30 !         5.30

ROAD (43.40 + 43.50 + 0.00) = 46.46 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-----------------------------------------------------------------------------
--
    33     42   0.00  60.88   0.00  -4.47 -13.01   0.00   0.00   0.00
43.40
-----------------------------------------------------------------------------
--
    42     90   0.00  60.88   0.00  -4.47  -5.74   0.00   0.00  -7.17
43.50
-----------------------------------------------------------------------------
--

Segment Leq : 46.46 dBA

Results segment # 3: HYW 417 EB (night)
---------------------------------------

Source height = 1.49 m

ROAD (0.00 + 55.09 + 0.00) = 55.09 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-----------------------------------------------------------------------------
--
     0     90   0.14  73.80   0.00 -15.30  -3.40   0.00   0.00   0.00
55.09
-----------------------------------------------------------------------------
--

Segment Leq : 55.09 dBA

Results segment # 4: HWY 417 WB (night)
---------------------------------------

Source height = 1.49 m

ROAD (0.00 + 54.80 + 0.00) = 54.80 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-----------------------------------------------------------------------------
--
```

```
     0     90   0.14  73.80   0.00 -15.60  -3.40   0.00   0.00   0.00
54.80
----------------------------------------------------------------------------
--

Segment Leq : 54.80 dBA

Total Leq All Segments: 58.52 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 66.12
                         (NIGHT): 58.52
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2021 16:53:55
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r3.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: PRESTON ST (day/night)
----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: PRESTON ST (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  48.00 / 48.00  m
Receiver height           :  14.80 / 14.80  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 0.00 deg
Barrier height            :   7.00 m
Barrier receiver distance :  38.00 / 38.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Road data, segment # 2: HWY 417 EB (day/night)
----------------------------------------------
Car traffic volume  : 59370/5163  veh/TimePeriod  *
Medium truck volume :  4723/411   veh/TimePeriod  *
Heavy truck volume  :  3373/293   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)
```

```
* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  73332
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: HWY 417 EB (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 320.00 / 320.00 m
Receiver height           :  14.80 / 14.80  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   4.00 m
Reference angle           :   0.00

Road data, segment # 3: HWY 417 WB (day/night)
----------------------------------------------
Car traffic volume  : 59370/5163  veh/TimePeriod  *
Medium truck volume :  4723/411   veh/TimePeriod  *
Heavy truck volume  :  3373/293   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  73332
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 3: HWY 417 WB (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 339.00 / 339.00 m
Receiver height           :  14.80 / 14.80  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   4.00 m
Reference angle           :   0.00
```

```
Results segment # 1: PRESTON ST (day)
--------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
-------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
-------------+--------------+--------------+---------------
       1.50 !       14.80 !        4.27 !          4.27

ROAD (0.00 + 49.71 + 0.00) = 49.71 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
----------------------------------------------------------------------------
--
   -90      0   0.00  68.48   0.00  -5.05  -3.01   0.00   0.00 -10.71
49.71
----------------------------------------------------------------------------
--

Segment Leq : 49.71 dBA

Results segment # 2: HWY 417 EB (day)
--------------------------------------

Source height = 1.50 m

ROAD (0.00 + 65.84 + 0.00) = 65.84 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
----------------------------------------------------------------------------
--
   -90     90   0.14  81.40   0.00 -15.17  -0.39   0.00   0.00   0.00
65.84
----------------------------------------------------------------------------
--

Segment Leq : 65.84 dBA

Results segment # 3: HWY 417 WB (day)
--------------------------------------

Source height = 1.50 m

ROAD (0.00 + 65.55 + 0.00) = 65.55 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
----------------------------------------------------------------------------
--
```

```
   -90      90    0.14   81.40    0.00 -15.45   -0.39    0.00    0.00    0.00
65.55
------------------------------------------------------------------------------
--

Segment Leq : 65.55 dBA

Total Leq All Segments: 68.76 dBA

Results segment # 1: PRESTON ST (night)
---------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
-------------+--------------+--------------+---------------
       1.50 !        14.80 !         4.27 !          4.27

ROAD (0.00 + 42.11 + 0.00) = 42.11 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
------------------------------------------------------------------------------
--
   -90       0    0.00   60.88    0.00  -5.05   -3.01    0.00    0.00 -10.71
42.11
------------------------------------------------------------------------------
--

Segment Leq : 42.11 dBA

Results segment # 2: HWY 417 EB (night)
---------------------------------------

Source height = 1.49 m

ROAD (0.00 + 58.24 + 0.00) = 58.24 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
------------------------------------------------------------------------------
--
   -90      90    0.14   73.80    0.00 -15.17   -0.39    0.00    0.00    0.00
58.24
------------------------------------------------------------------------------
--

Segment Leq : 58.24 dBA
```

```
Results segment # 3: HWY 417 WB (night)
---------------------------------------

Source height = 1.49 m

ROAD (0.00 + 57.96 + 0.00) = 57.96 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.14  73.80   0.00 -15.45  -0.39   0.00   0.00   0.00
57.96
--------------------------------------------------------------------------
--

Segment Leq : 57.96 dBA

Total Leq All Segments: 61.17 dBA

RT/Custom data, segment # 1: LRT (day/night)
--------------------------------------------
1 - 4-car SRT:
Traffic volume    :   192/24    veh/TimePeriod
Speed             :    50 km/h

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           :   0.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  94.00 / 94.00  m
Receiver height           :  14.80 / 14.80  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   7.00 m
Reference angle           :   0.00

Results segment # 1: LRT (day)
------------------------------

Source height = 0.50 m

RT/Custom (0.00 + 45.04 + 0.00) = 45.04 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
     0     90   0.00  56.02  -7.97  -3.01   0.00   0.00   0.00  45.04
----------------------------------------------------------------------

Segment Leq : 45.04 dBA

Total Leq All Segments: 45.04 dBA
```

```
Results segment # 1: LRT (night)
--------------------------------

Source height = 0.50 m

RT/Custom (0.00 + 39.02 + 0.00) = 39.02 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
     0     90   0.00  50.00  -7.97  -3.01   0.00   0.00   0.00  39.02
----------------------------------------------------------------------

Segment Leq : 39.02 dBA

Total Leq All Segments: 39.02 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 68.78
                         (NIGHT): 61.19
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2021 16:54:08
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r4.te                 Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: PRESTON ST (day/night)
----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth         :   0.00
    Number of Years of Growth           :   0.00
    Medium Truck % of Total Volume      :   7.00
    Heavy Truck  % of Total Volume      :   5.00
    Day (16 hrs) % of Total Volume      :  92.00

Data for Segment # 1: PRESTON ST (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  83.00 / 83.00  m
Receiver height           :  26.80 / 26.80  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Road data, segment # 2: HWY 417 EB (day/night)
----------------------------------------------
Car traffic volume  : 59370/5163  veh/TimePeriod  *
Medium truck volume :  4723/411   veh/TimePeriod  *
Heavy truck volume  :  3373/293   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  73332
    Percentage of Annual Growth         :   0.00
    Number of Years of Growth           :   0.00
    Medium Truck % of Total Volume      :   7.00
```

```
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: HWY 417 EB (day/night)
--------------------------------------------
Angle1   Angle2           :   0.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 333.00 / 333.00 m
Receiver height           :  26.80 / 26.80  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   4.00 m
Reference angle           :   0.00

Road data, segment # 3: HWY 417 WB (day/night)
----------------------------------------------
Car traffic volume  : 59370/5163  veh/TimePeriod  *
Medium truck volume :  4723/411   veh/TimePeriod  *
Heavy truck volume  :  3373/293   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  73332
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 3: HWY 417 WB (day/night)
--------------------------------------------
Angle1   Angle2           :   0.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 353.00 / 353.00 m
Receiver height           :  26.80 / 26.80  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   4.00 m
Reference angle           :   0.00

Results segment # 1: PRESTON ST (day)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 61.05 + 0.00) = 61.05 dBA
```

```
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
------------------------------------------------------------------------
--
   -90     90   0.00  68.48   0.00  -7.43   0.00   0.00   0.00   0.00
61.05
------------------------------------------------------------------------
--

Segment Leq : 61.05 dBA

Results segment # 2: HWY 417 EB (day)
------------------------------------

Source height = 1.50 m

ROAD (0.00 + 64.92 + 0.00) = 64.92 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
------------------------------------------------------------------------
--
     0     90   0.00  81.40   0.00 -13.46  -3.01   0.00   0.00   0.00
64.92
------------------------------------------------------------------------
--

Segment Leq : 64.92 dBA

Results segment # 3: HWY 417 WB (day)
------------------------------------

Source height = 1.50 m

ROAD (0.00 + 64.67 + 0.00) = 64.67 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
------------------------------------------------------------------------
--
     0     90   0.00  81.40   0.00 -13.72  -3.01   0.00   0.00   0.00
64.67
------------------------------------------------------------------------
--

Segment Leq : 64.67 dBA

Total Leq All Segments: 68.64 dBA
```

```
Results segment # 1: PRESTON ST (night)
---------------------------------------

Source height = 1.50 m

ROAD (0.00 + 53.45 + 0.00) = 53.45 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.00  60.88   0.00  -7.43   0.00   0.00   0.00   0.00
53.45
--------------------------------------------------------------------------

Segment Leq : 53.45 dBA

Results segment # 2: HWY 417 EB (night)
---------------------------------------

Source height = 1.49 m

ROAD (0.00 + 57.33 + 0.00) = 57.33 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
     0     90   0.00  73.80   0.00 -13.46  -3.01   0.00   0.00   0.00
57.33
--------------------------------------------------------------------------

Segment Leq : 57.33 dBA

Results segment # 3: HWY 417 WB (night)
---------------------------------------

Source height = 1.49 m

ROAD (0.00 + 57.07 + 0.00) = 57.07 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
     0     90   0.00  73.80   0.00 -13.72  -3.01   0.00   0.00   0.00
57.07
--------------------------------------------------------------------------

Segment Leq : 57.07 dBA

Total Leq All Segments: 61.04 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 68.64
                         (NIGHT): 61.04
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2021 16:54:18
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r5.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Preston St (day/night)
----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Preston St (day/night)
--------------------------------------------
Angle1   Angle2           :   0.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  97.00 / 97.00  m
Receiver height           :  26.80 / 26.80  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  11.00 deg   Angle2 : 90.00 deg
Barrier height            :   7.00 m
Barrier receiver distance :  86.00 / 86.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Results segment # 1: Preston St (day)
-------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
```

```
------------+-------------+-------------+--------------
       1.50 !       26.80 !        4.36 !         4.36

ROAD (48.23 + 47.10 + 0.00) = 50.72 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
     0     11   0.00  68.48   0.00  -8.11 -12.14   0.00   0.00   0.00
48.23
--------------------------------------------------------------------------
--
    11     90   0.00  68.48   0.00  -8.11  -3.58   0.00   0.00  -9.69
47.10
--------------------------------------------------------------------------
--

Segment Leq : 50.72 dBA

Total Leq All Segments: 50.72 dBA

Results segment # 1: Preston St (night)
---------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       26.80 !        4.36 !         4.36

ROAD (40.64 + 39.51 + 0.00) = 43.12 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
     0     11   0.00  60.88   0.00  -8.11 -12.14   0.00   0.00   0.00
40.64
--------------------------------------------------------------------------
--
    11     90   0.00  60.88   0.00  -8.11  -3.58   0.00   0.00  -9.69
39.51
--------------------------------------------------------------------------
--

Segment Leq : 43.12 dBA

Total Leq All Segments: 43.12 dBA
```

```
RT/Custom data, segment # 1: LRT (day/night)
--------------------------------------------
1 - 4-car SRT:
Traffic volume    :   192/24    veh/TimePeriod
Speed             :    50 km/h

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2            : -90.00 deg   0.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      2       (Reflective ground surface)
Receiver source distance   :  44.00 / 44.00  m
Receiver height            :  26.80 / 26.80  m
Topography                 :      3       (Elevated; no barrier)
Elevation                  :   7.00 m
Reference angle            :   0.00

Results segment # 1: LRT (day)
------------------------------

Source height = 0.50 m

RT/Custom (0.00 + 48.34 + 0.00) = 48.34 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90      0   0.00  56.02  -4.67  -3.01   0.00   0.00   0.00  48.34
----------------------------------------------------------------------

Segment Leq : 48.34 dBA

Total Leq All Segments: 48.34 dBA

Results segment # 1: LRT (night)
--------------------------------

Source height = 0.50 m

RT/Custom (0.00 + 42.32 + 0.00) = 42.32 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90      0   0.00  50.00  -4.67  -3.01   0.00   0.00   0.00  42.32
----------------------------------------------------------------------

Segment Leq : 42.32 dBA

Total Leq All Segments: 42.32 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 52.70
                         (NIGHT): 45.75
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2021 16:54:27
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r6.te                Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: HWY 417 EB (day/night)
----------------------------------------------
Car traffic volume  : 59370/5163  veh/TimePeriod  *
Medium truck volume :  4723/411   veh/TimePeriod  *
Heavy truck volume  :  3373/293   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  73332
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: HWY 417 EB (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 335.00 / 335.00 m
Receiver height           :  26.80 / 26.80  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   4.00 m
Reference angle           :   0.00

Road data, segment # 2: HWY 417 WB (day/night)
----------------------------------------------
Car traffic volume  : 59370/5163  veh/TimePeriod  *
Medium truck volume :  4723/411   veh/TimePeriod  *
Heavy truck volume  :  3373/293   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  73332
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
```

```
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: HWY 417 WB (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 356.00 / 356.00 m
Receiver height           :  26.80 / 26.80  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   4.00 m
Reference angle           :   0.00

Results segment # 1: HWY 417 EB (day)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 64.90 + 0.00) = 64.90 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90      0   0.00  81.40   0.00 -13.49  -3.01   0.00   0.00   0.00
64.90
--------------------------------------------------------------------------
--

Segment Leq : 64.90 dBA

Results segment # 2: HWY 417 WB (day)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 64.63 + 0.00) = 64.63 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90      0   0.00  81.40   0.00 -13.75  -3.01   0.00   0.00   0.00
64.63
--------------------------------------------------------------------------
--

Segment Leq : 64.63 dBA

Total Leq All Segments: 67.78 dBA
```

```
Results segment # 1: HWY 417 EB (night)
---------------------------------------

Source height = 1.49 m

ROAD (0.00 + 57.30 + 0.00) = 57.30 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90      0   0.00  73.80   0.00 -13.49  -3.01   0.00   0.00   0.00
57.30
--------------------------------------------------------------------------
--

Segment Leq : 57.30 dBA

Results segment # 2: HWY 417 WB (night)
---------------------------------------

Source height = 1.49 m

ROAD (0.00 + 57.04 + 0.00) = 57.04 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90      0   0.00  73.80   0.00 -13.75  -3.01   0.00   0.00   0.00
57.04
--------------------------------------------------------------------------
--

Segment Leq : 57.04 dBA

Total Leq All Segments: 60.18 dBA

RT/Custom data, segment # 1: LRT (day/night)
--------------------------------------------
1 - 4-car SRT:
Traffic volume    :   192/24    veh/TimePeriod
Speed             :    50 km/h

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  27.00 / 27.00  m
Receiver height           :  26.80 / 26.80  m
Topography                :      3       (Elevated; no barrier)
```

```
Elevation                    :   7.00 m
Reference angle              :   0.00

Results segment # 1: LRT (day)
------------------------------

Source height = 0.50 m

RT/Custom (0.00 + 53.47 + 0.00) = 53.47 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.00  56.02  -2.55   0.00   0.00   0.00   0.00  53.47
----------------------------------------------------------------------

Segment Leq : 53.47 dBA

Total Leq All Segments: 53.47 dBA

Results segment # 1: LRT (night)
--------------------------------

Source height = 0.50 m

RT/Custom (0.00 + 47.45 + 0.00) = 47.45 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.00  50.00  -2.55   0.00   0.00   0.00   0.00  47.45
----------------------------------------------------------------------

Segment Leq : 47.45 dBA

Total Leq All Segments: 47.45 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 67.94
                         (NIGHT): 60.41
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2021 16:54:40
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r7.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: PRESTON ST (day/night)
----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: PRESTON ST (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  98.00 / 98.00  m
Receiver height           :  26.80 / 26.80  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 0.00 deg
Barrier height            :   7.00 m
Barrier receiver distance :  86.00 / 86.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Road data, segment # 2: HWY 417 EB (day/night)
----------------------------------------------
Car traffic volume  : 59370/5163  veh/TimePeriod  *
Medium truck volume :  4723/411   veh/TimePeriod  *
Heavy truck volume  :  3373/293   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)
```

```
* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  73332
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: HWY 417 EB (day/night)
--------------------------------------------
Angle1   Angle2          : -90.00 deg   90.00 deg
Wood depth               :      0       (No woods.)
No of house rows         :      0 / 0
Surface                  :      1       (Absorptive ground surface)
Receiver source distance : 322.00 / 322.00 m
Receiver height          :  26.80 / 26.80  m
Topography               :      3       (Elevated; no barrier)
Elevation                :   4.00 m
Reference angle          :   0.00

Road data, segment # 3: HWY 417 WB (day/night)
----------------------------------------------
Car traffic volume  : 59370/5163  veh/TimePeriod  *
Medium truck volume :  4723/411   veh/TimePeriod  *
Heavy truck volume  :  3373/293   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  73332
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 3: HWY 417 WB (day/night)
--------------------------------------------
Angle1   Angle2          : -90.00 deg   90.00 deg
Wood depth               :      0       (No woods.)
No of house rows         :      0 / 0
Surface                  :      1       (Absorptive ground surface)
Receiver source distance : 342.00 / 342.00 m
Receiver height          :  26.80 / 26.80  m
Topography               :      3       (Elevated; no barrier)
Elevation                :   4.00 m
Reference angle          :   0.00
```

```
Results segment # 1: PRESTON ST (day)
--------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
-------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
-------------+--------------+--------------+---------------
       1.50 !       26.80 !        4.59 !          4.59

ROAD (0.00 + 48.00 + 0.00) = 48.00 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
----------------------------------------------------------------------------
--
   -90      0   0.00  68.48   0.00  -8.15  -3.01   0.00   0.00  -9.31
48.00
----------------------------------------------------------------------------
--

Segment Leq : 48.00 dBA

Results segment # 2: HWY 417 EB (day)
--------------------------------------

Source height = 1.50 m

ROAD (0.00 + 68.08 + 0.00) = 68.08 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
----------------------------------------------------------------------------
--
   -90     90   0.00  81.40   0.00 -13.32   0.00   0.00   0.00   0.00
68.08
----------------------------------------------------------------------------
--

Segment Leq : 68.08 dBA

Results segment # 3: HWY 417 WB (day)
--------------------------------------

Source height = 1.50 m

ROAD (0.00 + 67.82 + 0.00) = 67.82 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
----------------------------------------------------------------------------
--
```

```
   -90     90   0.00  81.40   0.00 -13.58   0.00   0.00   0.00   0.00
67.82
------------------------------------------------------------------------------
--

Segment Leq : 67.82 dBA

Total Leq All Segments: 70.98 dBA

Results segment # 1: PRESTON ST (night)
---------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver     ! Barrier      ! Elevation of
Height  (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
------------+--------------+--------------+---------------
       1.50 !        26.80 !         4.59 !          4.59

ROAD (0.00 + 40.41 + 0.00) = 40.41 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
------------------------------------------------------------------------------
--
   -90      0   0.00  60.88   0.00  -8.15  -3.01   0.00   0.00  -9.31
40.41
------------------------------------------------------------------------------
--

Segment Leq : 40.41 dBA

Results segment # 2: HWY 417 EB (night)
---------------------------------------

Source height = 1.49 m

ROAD (0.00 + 60.48 + 0.00) = 60.48 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
------------------------------------------------------------------------------
--
   -90     90   0.00  73.80   0.00 -13.32   0.00   0.00   0.00   0.00
60.48
------------------------------------------------------------------------------
--

Segment Leq : 60.48 dBA
```

```
Results segment # 3: HWY 417 WB (night)
---------------------------------------

Source height = 1.49 m

ROAD (0.00 + 60.22 + 0.00) = 60.22 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.00  73.80   0.00 -13.58   0.00   0.00   0.00   0.00
60.22
--------------------------------------------------------------------------
--

Segment Leq : 60.22 dBA

Total Leq All Segments: 63.38 dBA

RT/Custom data, segment # 1: LRT (day/night)
--------------------------------------------
1 - 4-car SRT:
Traffic volume    :   192/24    veh/TimePeriod
Speed             :    50 km/h

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           :   0.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  44.00 / 44.00  m
Receiver height           :  26.80 / 26.80  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   7.00 m
Reference angle           :   0.00

Results segment # 1: LRT (day)
------------------------------

Source height = 0.50 m

RT/Custom (0.00 + 48.34 + 0.00) = 48.34 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
     0     90   0.00  56.02  -4.67  -3.01   0.00   0.00   0.00  48.34
----------------------------------------------------------------------

Segment Leq : 48.34 dBA

Total Leq All Segments: 48.34 dBA
```

```
Results segment # 1: LRT (night)
--------------------------------

Source height = 0.50 m

RT/Custom (0.00 + 42.32 + 0.00) = 42.32 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
     0     90   0.00  50.00  -4.67  -3.01   0.00   0.00   0.00  42.32
----------------------------------------------------------------------

Segment Leq : 42.32 dBA

Total Leq All Segments: 42.32 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 71.01
                         (NIGHT): 63.42
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2021 16:54:48
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r8.te                Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: PRESTON ST (day/night)
----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: PRESTON ST (day/night)
--------------------------------------------
Angle1   Angle2            : -90.00 deg   90.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      2       (Reflective ground surface)
Receiver source distance   :  64.00 / 64.00  m
Receiver height            :  17.80 / 17.80  m
Topography                 :      2       (Flat/gentle slope; with barrier)
Barrier angle1             : -26.00 deg   Angle2 : 23.00 deg
Barrier height             :  16.30 m
Barrier receiver distance  :  18.00 / 18.00  m
Source elevation           :   0.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00

Road data, segment # 2: HWY 417 EB (day/night)
----------------------------------------------
Car traffic volume  : 59370/5163  veh/TimePeriod  *
Medium truck volume :  4723/411   veh/TimePeriod  *
Heavy truck volume  :  3373/293   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)
```

```
* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  73332
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: HWY 417 EB (day/night)
--------------------------------------------
Angle1   Angle2           : -69.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 331.00 / 331.00 m
Receiver height           :  17.80 / 17.80  m
Topography                :      4       (Elevated; with barrier)
Barrier angle1            : -69.00 deg   Angle2 : 90.00 deg
Barrier height            :  16.30 m
Elevation                 :   4.00 m
Barrier receiver distance :   8.00 / 8.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Road data, segment # 3: HWY 417 WB (day/night)
----------------------------------------------
Car traffic volume  : 59370/5163  veh/TimePeriod  *
Medium truck volume :  4723/411   veh/TimePeriod  *
Heavy truck volume  :  3373/293   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  73332
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 3: HWY 417 WB (day/night)
--------------------------------------------
Angle1   Angle2           : -69.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
```

```
Receiver source distance  : 351.00 / 351.00 m
Receiver height           :  17.80 / 17.80  m
Topography                :      4       (Elevated; with barrier)
Barrier angle1            : -69.00 deg   Angle2 : 90.00 deg
Barrier height            :  16.30 m
Elevation                 :   4.00 m
Barrier receiver distance :   8.00 / 8.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Results segment # 1: PRESTON ST (day)
-------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.50 !       17.80 !       13.21 !        13.21

ROAD (57.69 + 43.57 + 57.89) = 60.88 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90    -26   0.00  68.48   0.00  -6.30  -4.49   0.00   0.00   0.00
57.69
--------------------------------------------------------------------------
--
   -26     23   0.00  68.48   0.00  -6.30  -5.65   0.00   0.00 -12.95
43.57
--------------------------------------------------------------------------
--
    23     90   0.00  68.48   0.00  -6.30  -4.29   0.00   0.00   0.00
57.89
--------------------------------------------------------------------------
--

Segment Leq : 60.88 dBA

Results segment # 2: HWY 417 EB (day)
-------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
```

```
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       17.80 !       17.41 !        17.41

ROAD (0.00 + 66.62 + 0.00) = 66.62 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -69     90   0.00  81.40   0.00 -13.44  -0.54   0.00   0.00  -1.09
66.33*
   -69     90   0.05  81.40   0.00 -14.12  -0.65   0.00   0.00   0.00
66.62
--------------------------------------------------------------------------
--

 * Bright Zone !

Segment Leq : 66.62 dBA

Results segment # 3: HWY 417 WB (day)
-------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       17.80 !       17.43 !        17.43

ROAD (0.00 + 66.35 + 0.00) = 66.35 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -69     90   0.00  81.40   0.00 -13.69  -0.54   0.00   0.00  -1.01
66.16*
   -69     90   0.05  81.40   0.00 -14.39  -0.65   0.00   0.00   0.00
66.35
--------------------------------------------------------------------------
--

 * Bright Zone !

Segment Leq : 66.35 dBA

Total Leq All Segments: 70.06 dBA
```

```
Results segment # 1: PRESTON ST (night)
---------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.50 !       17.80 !       13.21 !         13.21

ROAD (50.09 + 35.98 + 50.29) = 53.28 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
------------------------------------------------------------------------------
--
   -90    -26   0.00  60.88   0.00  -6.30  -4.49   0.00   0.00   0.00
50.09
------------------------------------------------------------------------------
--
   -26     23   0.00  60.88   0.00  -6.30  -5.65   0.00   0.00 -12.95
35.98
------------------------------------------------------------------------------
--
    23     90   0.00  60.88   0.00  -6.30  -4.29   0.00   0.00   0.00
50.29
------------------------------------------------------------------------------
--

Segment Leq : 53.28 dBA

Results segment # 2: HWY 417 EB (night)
---------------------------------------

Source height = 1.49 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.49 !       17.80 !       17.41 !         17.41

ROAD (0.00 + 59.02 + 0.00) = 59.02 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
------------------------------------------------------------------------------
--
   -69     90   0.00  73.80   0.00 -13.44  -0.54   0.00   0.00  -1.09
58.73*
```

```
   -69     90   0.05  73.80   0.00 -14.12  -0.65   0.00   0.00   0.00
59.02
--------------------------------------------------------------------------
--

 * Bright Zone !

Segment Leq : 59.02 dBA

Results segment # 3: HWY 417 WB (night)
---------------------------------------

Source height = 1.49 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.49 !       17.80 !       17.43 !        17.43

ROAD (0.00 + 58.76 + 0.00) = 58.76 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -69     90   0.00  73.80   0.00 -13.69  -0.54   0.00   0.00  -1.01
58.56*
   -69     90   0.05  73.80   0.00 -14.39  -0.65   0.00   0.00   0.00
58.76
--------------------------------------------------------------------------
--

 * Bright Zone !

Segment Leq : 58.76 dBA

Total Leq All Segments: 62.46 dBA

RT/Custom data, segment # 1: LRT 1 (day/night)
----------------------------------------------
1 - 4-car SRT:
Traffic volume    :   192/24    veh/TimePeriod
Speed             :    50 km/h

Data for Segment # 1: LRT 1 (day/night)
---------------------------------------
Angle1   Angle2           : -90.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
```

```
Receiver source distance  :  78.00 / 78.00  m
Receiver height           :  17.80 / 17.80  m
Topography                :      4        (Elevated; with barrier)
Barrier angle1            : -24.00 deg   Angle2 : 0.00 deg
Barrier height            :  28.30 m
Elevation                 :   7.00 m
Barrier receiver distance :  48.00 / 48.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

RT/Custom data, segment # 2: LRT 2 (day/night)
----------------------------------------------
1 - 4-car SRT:
Traffic volume    :   192/24    veh/TimePeriod
Speed             :    50 km/h

Data for Segment # 2: LRT 2 (day/night)
---------------------------------------
Angle1   Angle2           :   0.00 deg   90.00 deg
Wood depth                :      0        (No woods.)
No of house rows          :      0 / 0
Surface                   :      2        (Reflective ground surface)
Receiver source distance  :  78.00 / 78.00  m
Receiver height           :  17.80 / 17.80  m
Topography                :      4        (Elevated; with barrier)
Barrier angle1            :   0.00 deg   Angle2 : 28.00 deg
Barrier height            :  28.30 m
Elevation                 :   7.00 m
Barrier receiver distance :  48.00 / 48.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Results segment # 1: LRT 1 (day)
--------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
-------------+--------------+--------------+--------------
       0.50 !       17.80 !        7.15 !         7.15

RT/Custom (44.51 + 20.11 + 0.00) = 44.52 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
```

```
   -90    -24   0.00  56.02  -7.16  -4.36   0.00   0.00   0.00  44.51
--------------------------------------------------------------------------
   -24      0   0.00  56.02  -7.16  -8.75   0.00   0.00 -20.00  20.11
--------------------------------------------------------------------------

Segment Leq : 44.52 dBA

Results segment # 2: LRT 2 (day)
--------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
-------------+--------------+--------------+---------------
       0.50 !        17.80 !         7.15 !          7.15

RT/Custom (0.00 + 20.78 + 44.24) = 44.25 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj  SubLeq
--------------------------------------------------------------------------
     0     28   0.00  56.02  -7.16  -8.08   0.00   0.00 -20.00  20.78
--------------------------------------------------------------------------
    28     90   0.00  56.02  -7.16  -4.63   0.00   0.00   0.00  44.24
--------------------------------------------------------------------------

Segment Leq : 44.25 dBA

Total Leq All Segments: 47.40 dBA

Results segment # 1: LRT 1 (night)
----------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
-------------+--------------+--------------+---------------
       0.50 !        17.80 !         7.15 !          7.15

RT/Custom (38.49 + 14.09 + 0.00) = 38.50 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj  SubLeq
--------------------------------------------------------------------------
   -90    -24   0.00  50.00  -7.16  -4.36   0.00   0.00   0.00  38.49
--------------------------------------------------------------------------
   -24      0   0.00  50.00  -7.16  -8.75   0.00   0.00 -20.00  14.09
--------------------------------------------------------------------------
```

```
Segment Leq : 38.50 dBA

Results segment # 2: LRT 2 (night)
----------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       0.50 !       17.80 !        7.15 !         7.15

RT/Custom (0.00 + 14.76 + 38.21) = 38.23 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
     0     28   0.00  50.00  -7.16  -8.08   0.00   0.00 -20.00  14.76
----------------------------------------------------------------------
    28     90   0.00  50.00  -7.16  -4.63   0.00   0.00   0.00  38.21
----------------------------------------------------------------------

Segment Leq : 38.23 dBA

Total Leq All Segments: 41.38 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 70.08
                         (NIGHT): 62.49
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2021 16:54:57
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r8b1.te              Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: PRESTON ST (day/night)
----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: PRESTON ST (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  64.00 / 64.00  m
Receiver height           :  17.80 / 17.80  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -26.00 deg   Angle2 : 23.00 deg
Barrier height            :  17.50 m
Barrier receiver distance :  18.00 / 18.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Road data, segment # 2: HWY 417 EB (day/night)
----------------------------------------------
Car traffic volume  : 59370/5163  veh/TimePeriod  *
Medium truck volume :  4723/411   veh/TimePeriod  *
Heavy truck volume  :  3373/293   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)
```

```
* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  73332
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: HWY 417 EB (day/night)
--------------------------------------------
Angle1   Angle2             : -69.00 deg   90.00 deg
Wood depth                  :      0       (No woods.)
No of house rows            :      0 / 0
Surface                     :      1       (Absorptive ground surface)
Receiver source distance    : 331.00 / 331.00 m
Receiver height             :  17.80 / 17.80  m
Topography                  :      4       (Elevated; with barrier)
Barrier angle1              : -69.00 deg   Angle2 : 90.00 deg
Barrier height              :  17.50 m
Elevation                   :   4.00 m
Barrier receiver distance :   8.00 / 8.00   m
Source elevation            :   0.00 m
Receiver elevation          :   0.00 m
Barrier elevation           :   0.00 m
Reference angle             :   0.00

Road data, segment # 3: HWY 417 WB (day/night)
----------------------------------------------
Car traffic volume  : 59370/5163  veh/TimePeriod  *
Medium truck volume :  4723/411   veh/TimePeriod  *
Heavy truck volume  :  3373/293   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  73332
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 3: HWY 417 WB (day/night)
--------------------------------------------
Angle1   Angle2             : -69.00 deg   90.00 deg
Wood depth                  :      0       (No woods.)
No of house rows            :      0 / 0
Surface                     :      1       (Absorptive ground surface)
```

```
Receiver source distance  : 351.00 / 351.00 m
Receiver height           :  17.80 / 17.80  m
Topography                :      4        (Elevated; with barrier)
Barrier angle1            : -69.00 deg   Angle2 : 90.00 deg
Barrier height            :  17.50 m
Elevation                 :   4.00 m
Barrier receiver distance :   8.00 / 8.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Results segment # 1: PRESTON ST (day)
-------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       17.80 !       13.21 !        13.21

ROAD (57.69 + 40.81 + 57.89)  = 60.84 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90    -26   0.00  68.48   0.00  -6.30  -4.49   0.00   0.00   0.00
57.69
--------------------------------------------------------------------------
--
   -26     23   0.00  68.48   0.00  -6.30  -5.65   0.00   0.00 -15.72
40.81
--------------------------------------------------------------------------
--
    23     90   0.00  68.48   0.00  -6.30  -4.29   0.00   0.00   0.00
57.89
--------------------------------------------------------------------------
--

Segment Leq : 60.84 dBA

Results segment # 2: HWY 417 EB (day)
-------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
```

```
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
-------------+--------------+--------------+---------------
       1.50 !       17.80 !       17.41 !         17.41

ROAD (0.00 + 62.40 + 0.00) = 62.40 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-----------------------------------------------------------------------------
--
   -69     90   0.00  81.40   0.00 -13.44  -0.54   0.00   0.00  -5.02
62.40
-----------------------------------------------------------------------------
--

Segment Leq : 62.40 dBA

Results segment # 3: HWY 417 WB (day)
-------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
-------------+--------------+--------------+---------------
       1.50 !       17.80 !       17.43 !         17.43

ROAD (0.00 + 62.15 + 0.00) = 62.15 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-----------------------------------------------------------------------------
--
   -69     90   0.00  81.40   0.00 -13.69  -0.54   0.00   0.00  -5.01
62.15
-----------------------------------------------------------------------------
--

Segment Leq : 62.15 dBA

Total Leq All Segments: 66.62 dBA

Results segment # 1: PRESTON ST (night)
---------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
```

```
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
-------------+--------------+--------------+---------------
       1.50 !       17.80 !       13.21 !        13.21

ROAD (50.09 + 33.21 + 50.29) = 53.25 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
------------------------------------------------------------------------
--
   -90    -26   0.00  60.88   0.00  -6.30  -4.49   0.00   0.00   0.00
50.09
------------------------------------------------------------------------
--
   -26     23   0.00  60.88   0.00  -6.30  -5.65   0.00   0.00 -15.72
33.21
------------------------------------------------------------------------
--
    23     90   0.00  60.88   0.00  -6.30  -4.29   0.00   0.00   0.00
50.29
------------------------------------------------------------------------
--

Segment Leq : 53.25 dBA

Results segment # 2: HWY 417 EB (night)
---------------------------------------

Source height = 1.49 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
-------------+--------------+--------------+---------------
       1.49 !       17.80 !       17.41 !        17.41

ROAD (0.00 + 54.80 + 0.00) = 54.80 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
------------------------------------------------------------------------
--
   -69     90   0.00  73.80   0.00 -13.44  -0.54   0.00   0.00  -5.02
54.80
------------------------------------------------------------------------
--

Segment Leq : 54.80 dBA
```

```
Results segment # 3: HWY 417 WB (night)
---------------------------------------

Source height = 1.49 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
-------------+--------------+--------------+---------------
       1.49 !       17.80 !       17.43 !        17.43

ROAD (0.00 + 54.56 + 0.00) = 54.56 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
---------------------------------------------------------------------------
--
   -69     90   0.00  73.80   0.00 -13.69  -0.54   0.00   0.00  -5.01
54.56
---------------------------------------------------------------------------
--

Segment Leq : 54.56 dBA

Total Leq All Segments: 59.03 dBA

RT/Custom data, segment # 1: LRT 1 (day/night)
----------------------------------------------
1 - 4-car SRT:
Traffic volume    :   192/24    veh/TimePeriod
Speed             :    50  km/h

Data for Segment # 1: LRT 1 (day/night)
---------------------------------------
Angle1   Angle2            : -90.00 deg   0.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      2       (Reflective ground surface)
Receiver source distance   :  78.00 / 78.00  m
Receiver height            :  17.80 / 17.80  m
Topography                 :      4       (Elevated; with barrier)
Barrier angle1             : -24.00 deg   Angle2 : 0.00 deg
Barrier height             :  28.30 m
Elevation                  :   7.00 m
Barrier receiver distance  :  48.00 / 48.00  m
Source elevation           :   0.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00
```

```
RT/Custom data, segment # 2: LRT 2 (day/night)
----------------------------------------------
1 - 4-car SRT:
Traffic volume    :   192/24    veh/TimePeriod
Speed             :    50  km/h

Data for Segment # 2: LRT 2 (day/night)
---------------------------------------
Angle1   Angle2           :   0.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  78.00 / 78.00  m
Receiver height           :  17.80 / 17.80  m
Topography                :      4       (Elevated; with barrier)
Barrier angle1            :   0.00 deg   Angle2 : 28.00 deg
Barrier height            :  28.30 m
Elevation                 :   7.00 m
Barrier receiver distance :  48.00 / 48.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Results segment # 1: LRT 1 (day)
--------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
-------------+--------------+--------------+---------------
       0.50 !       17.80 !        7.15 !         7.15

RT/Custom (44.51 + 20.11 + 0.00) = 44.52 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90    -24   0.00  56.02  -7.16  -4.36   0.00   0.00   0.00  44.51
----------------------------------------------------------------------
   -24      0   0.00  56.02  -7.16  -8.75   0.00   0.00 -20.00  20.11
----------------------------------------------------------------------

Segment Leq : 44.52 dBA
```

```
Results segment # 2: LRT 2 (day)
--------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
------------+-------------+-------------+--------------
       0.50 !       17.80 !        7.15 !          7.15

RT/Custom (0.00 + 20.78 + 44.24) = 44.25 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------
     0     28   0.00  56.02  -7.16  -8.08   0.00   0.00 -20.00  20.78
-----------------------------------------------------------------------
    28     90   0.00  56.02  -7.16  -4.63   0.00   0.00   0.00  44.24
-----------------------------------------------------------------------

Segment Leq : 44.25 dBA

Total Leq All Segments: 47.40 dBA

Results segment # 1: LRT 1 (night)
----------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
------------+-------------+-------------+--------------
       0.50 !       17.80 !        7.15 !          7.15

RT/Custom (38.49 + 14.09 + 0.00) = 38.50 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------
   -90    -24   0.00  50.00  -7.16  -4.36   0.00   0.00   0.00  38.49
-----------------------------------------------------------------------
   -24      0   0.00  50.00  -7.16  -8.75   0.00   0.00 -20.00  14.09
-----------------------------------------------------------------------

Segment Leq : 38.50 dBA
```

```
Results segment # 2: LRT 2 (night)
----------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
-------------+--------------+--------------+---------------
        0.50 !        17.80 !         7.15 !          7.15

RT/Custom (0.00 + 14.76 + 38.21) = 38.23 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
     0     28   0.00  50.00  -7.16  -8.08   0.00   0.00 -20.00  14.76
----------------------------------------------------------------------
    28     90   0.00  50.00  -7.16  -4.63   0.00   0.00   0.00  38.21
----------------------------------------------------------------------

Segment Leq : 38.23 dBA

Total Leq All Segments: 41.38 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 66.67
                         (NIGHT): 59.10
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2021 16:55:05
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r8b2.te              Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: PRESTON ST (day/night)
----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: PRESTON ST (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  64.00 / 64.00  m
Receiver height           :  17.80 / 17.80  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -26.00 deg   Angle2 : 23.00 deg
Barrier height            :  17.80 m
Barrier receiver distance :  18.00 / 18.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Road data, segment # 2: HWY 417 EB (day/night)
----------------------------------------------
Car traffic volume  : 59370/5163  veh/TimePeriod  *
Medium truck volume :  4723/411   veh/TimePeriod  *
Heavy truck volume  :  3373/293   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)
```

```
* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  73332
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: HWY 417 EB (day/night)
--------------------------------------------
Angle1   Angle2            : -69.00 deg   90.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   : 331.00 / 331.00 m
Receiver height            :  17.80 / 17.80  m
Topography                 :      4       (Elevated; with barrier)
Barrier angle1             : -69.00 deg   Angle2 : 90.00 deg
Barrier height             :  17.80 m
Elevation                  :   4.00 m
Barrier receiver distance  :   8.00 / 8.00   m
Source elevation           :   0.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00

Road data, segment # 3: HWY 417 WB (day/night)
----------------------------------------------
Car traffic volume  : 59370/5163  veh/TimePeriod  *
Medium truck volume :  4723/411   veh/TimePeriod  *
Heavy truck volume  :  3373/293   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  73332
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 3: HWY 417 WB (day/night)
--------------------------------------------
Angle1   Angle2            : -69.00 deg   90.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      1       (Absorptive ground surface)
```

```
Receiver source distance  : 351.00 / 351.00 m
Receiver height           :  17.80 / 17.80  m
Topography                :      4        (Elevated; with barrier)
Barrier angle1            : -69.00 deg   Angle2 : 90.00 deg
Barrier height            :  17.80 m
Elevation                 :   4.00 m
Barrier receiver distance :   8.00 / 8.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Results segment # 1: PRESTON ST (day)
-------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
-------------+--------------+--------------+---------------
       1.50 !       17.80 !       13.21 !        13.21

ROAD (57.69 + 40.22 + 57.89) = 60.84 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90    -26   0.00  68.48   0.00  -6.30  -4.49   0.00   0.00   0.00
57.69
--------------------------------------------------------------------------
--
   -26     23   0.00  68.48   0.00  -6.30  -5.65   0.00   0.00 -16.31
40.22
--------------------------------------------------------------------------
--
    23     90   0.00  68.48   0.00  -6.30  -4.29   0.00   0.00   0.00
57.89
--------------------------------------------------------------------------
--

Segment Leq : 60.84 dBA

Results segment # 2: HWY 417 EB (day)
-------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
```

```
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
-------------+--------------+--------------+---------------
       1.50 !        17.80 !        17.41 !         17.41

ROAD (0.00 + 62.07 + 0.00) = 62.07 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-----------------------------------------------------------------------------
--
   -69     90   0.00  81.40   0.00 -13.44  -0.54   0.00   0.00  -5.35
62.07
-----------------------------------------------------------------------------
--

Segment Leq : 62.07 dBA

Results segment # 3: HWY 417 WB (day)
-------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
-------------+--------------+--------------+---------------
       1.50 !        17.80 !        17.43 !         17.43

ROAD (0.00 + 61.85 + 0.00) = 61.85 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-----------------------------------------------------------------------------
--
   -69     90   0.00  81.40   0.00 -13.69  -0.54   0.00   0.00  -5.31
61.85
-----------------------------------------------------------------------------
--

Segment Leq : 61.85 dBA

Total Leq All Segments: 66.39 dBA

Results segment # 1: PRESTON ST (night)
---------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
```

```
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
-------------+--------------+--------------+---------------
       1.50 !       17.80 !       13.21 !        13.21

ROAD (50.09 + 32.62 + 50.29) = 53.24 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90    -26   0.00  60.88   0.00  -6.30  -4.49   0.00   0.00   0.00
50.09
--------------------------------------------------------------------------
--
   -26     23   0.00  60.88   0.00  -6.30  -5.65   0.00   0.00 -16.31
32.62
--------------------------------------------------------------------------
--
    23     90   0.00  60.88   0.00  -6.30  -4.29   0.00   0.00   0.00
50.29
--------------------------------------------------------------------------
--

Segment Leq : 53.24 dBA

Results segment # 2: HWY 417 EB (night)
---------------------------------------

Source height = 1.49 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
-------------+--------------+--------------+---------------
       1.49 !       17.80 !       17.41 !        17.41

ROAD (0.00 + 54.47 + 0.00) = 54.47 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -69     90   0.00  73.80   0.00 -13.44  -0.54   0.00   0.00  -5.35
54.47
--------------------------------------------------------------------------
--

Segment Leq : 54.47 dBA
```

```
Results segment # 3: HWY 417 WB (night)
---------------------------------------

Source height = 1.49 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
-------------+--------------+--------------+---------------
       1.49 !       17.80 !       17.43 !        17.43

ROAD (0.00 + 54.25 + 0.00) = 54.25 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
----------------------------------------------------------------------------
--
   -69     90   0.00  73.80   0.00 -13.69  -0.54   0.00   0.00  -5.31
54.25
----------------------------------------------------------------------------
--

Segment Leq : 54.25 dBA

Total Leq All Segments: 58.79 dBA

RT/Custom data, segment # 1: LRT 1 (day/night)
----------------------------------------------
1 - 4-car SRT:
Traffic volume    :   192/24    veh/TimePeriod
Speed             :    50  km/h

Data for Segment # 1: LRT 1 (day/night)
---------------------------------------
Angle1   Angle2            : -90.00 deg   0.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      2       (Reflective ground surface)
Receiver source distance   :  78.00 / 78.00  m
Receiver height            :  17.80 / 17.80  m
Topography                 :      4       (Elevated; with barrier)
Barrier angle1             : -24.00 deg   Angle2 : 0.00 deg
Barrier height             :  28.30 m
Elevation                  :   7.00 m
Barrier receiver distance  :  48.00 / 48.00  m
Source elevation           :   0.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00
```

```
RT/Custom data, segment # 2: LRT 2 (day/night)
----------------------------------------------
1 - 4-car SRT:
Traffic volume    :   192/24    veh/TimePeriod
Speed             :    50 km/h

Data for Segment # 2: LRT 2 (day/night)
---------------------------------------
Angle1   Angle2            :   0.00 deg   90.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      2       (Reflective ground surface)
Receiver source distance  :  78.00 / 78.00  m
Receiver height            :  17.80 / 17.80  m
Topography                 :      4       (Elevated; with barrier)
Barrier angle1             :   0.00 deg   Angle2 : 28.00 deg
Barrier height             :  28.30 m
Elevation                  :   7.00 m
Barrier receiver distance :  48.00 / 48.00  m
Source elevation           :   0.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00

Results segment # 1: LRT 1 (day)
--------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       0.50 !       17.80 !        7.15 !         7.15

RT/Custom (44.51 + 20.11 + 0.00) = 44.52 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90    -24   0.00  56.02  -7.16  -4.36   0.00   0.00   0.00  44.51
----------------------------------------------------------------------
   -24      0   0.00  56.02  -7.16  -8.75   0.00   0.00 -20.00  20.11
----------------------------------------------------------------------

Segment Leq : 44.52 dBA
```

```
Results segment # 2: LRT 2 (day)
--------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       0.50 !       17.80 !        7.15 !         7.15

RT/Custom (0.00 + 20.78 + 44.24) = 44.25 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
     0     28   0.00  56.02  -7.16  -8.08   0.00   0.00 -20.00  20.78
----------------------------------------------------------------------
    28     90   0.00  56.02  -7.16  -4.63   0.00   0.00   0.00  44.24
----------------------------------------------------------------------

Segment Leq : 44.25 dBA

Total Leq All Segments: 47.40 dBA

Results segment # 1: LRT 1 (night)
----------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       0.50 !       17.80 !        7.15 !         7.15

RT/Custom (38.49 + 14.09 + 0.00) = 38.50 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90    -24   0.00  50.00  -7.16  -4.36   0.00   0.00   0.00  38.49
----------------------------------------------------------------------
   -24      0   0.00  50.00  -7.16  -8.75   0.00   0.00 -20.00  14.09
----------------------------------------------------------------------

Segment Leq : 38.50 dBA
```

```
Results segment # 2: LRT 2 (night)
----------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
-------------+--------------+--------------+---------------
        0.50 !        17.80 !         7.15 !         7.15

RT/Custom (0.00 + 14.76 + 38.21) = 38.23 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
     0     28   0.00  50.00  -7.16  -8.08   0.00   0.00 -20.00  14.76
----------------------------------------------------------------------
    28     90   0.00  50.00  -7.16  -4.63   0.00   0.00   0.00  38.21
----------------------------------------------------------------------

Segment Leq : 38.23 dBA

Total Leq All Segments: 41.38 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 66.44
                         (NIGHT): 58.87
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2021 16:55:13
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r8b3.te              Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: PRESTON ST (day/night)
----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: PRESTON ST (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  64.00 / 64.00  m
Receiver height           :  17.80 / 17.80  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -26.00 deg   Angle2 : 23.00 deg
Barrier height            :  18.30 m
Barrier receiver distance :  18.00 / 18.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Road data, segment # 2: HWY 417 EB (day/night)
----------------------------------------------
Car traffic volume  : 59370/5163  veh/TimePeriod  *
Medium truck volume :  4723/411   veh/TimePeriod  *
Heavy truck volume  :  3373/293   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)
```

```
* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  73332
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: HWY 417 EB (day/night)
--------------------------------------------
Angle1   Angle2            : -69.00 deg   90.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   : 331.00 / 331.00 m
Receiver height            :  17.80 / 17.80  m
Topography                 :      4       (Elevated; with barrier)
Barrier angle1             : -69.00 deg   Angle2 : 90.00 deg
Barrier height             :  18.30 m
Elevation                  :   4.00 m
Barrier receiver distance :   8.00 / 8.00   m
Source elevation           :   0.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00

Road data, segment # 3: HWY 417 WB (day/night)
----------------------------------------------
Car traffic volume  : 59370/5163  veh/TimePeriod  *
Medium truck volume :  4723/411   veh/TimePeriod  *
Heavy truck volume  :  3373/293   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  73332
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 3: HWY 417 WB (day/night)
--------------------------------------------
Angle1   Angle2            : -69.00 deg   90.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      1       (Absorptive ground surface)
```

```
Receiver source distance  : 351.00 / 351.00 m
Receiver height           :  17.80 / 17.80  m
Topography                :      4        (Elevated; with barrier)
Barrier angle1            : -69.00 deg   Angle2 : 90.00 deg
Barrier height            :  18.30 m
Elevation                 :   4.00 m
Barrier receiver distance :   8.00 / 8.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Results segment # 1: PRESTON ST (day)
-------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.50 !       17.80 !       13.21 !        13.21

ROAD (57.69 + 39.32 + 57.89) = 60.83 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90    -26   0.00  68.48   0.00  -6.30  -4.49   0.00   0.00   0.00
57.69
--------------------------------------------------------------------------
--
   -26     23   0.00  68.48   0.00  -6.30  -5.65   0.00   0.00 -17.21
39.32
--------------------------------------------------------------------------
--
    23     90   0.00  68.48   0.00  -6.30  -4.29   0.00   0.00   0.00
57.89
--------------------------------------------------------------------------
--

Segment Leq : 60.83 dBA

Results segment # 2: HWY 417 EB (day)
-------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
```

```
Source       ! Receiver    ! Barrier     ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       17.80 !       17.41 !        17.41

ROAD (0.00 + 60.85 + 0.00) = 60.85 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
---------------------------------------------------------------------------
--
   -69     90   0.00  81.40   0.00 -13.44  -0.54   0.00   0.00  -6.58
60.85
---------------------------------------------------------------------------
--

Segment Leq : 60.85 dBA

Results segment # 3: HWY 417 WB (day)
-------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver    ! Barrier     ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       17.80 !       17.43 !        17.43

ROAD (0.00 + 60.66 + 0.00) = 60.66 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
---------------------------------------------------------------------------
--
   -69     90   0.00  81.40   0.00 -13.69  -0.54   0.00   0.00  -6.51
60.66
---------------------------------------------------------------------------
--

Segment Leq : 60.66 dBA

Total Leq All Segments: 65.55 dBA

Results segment # 1: PRESTON ST (night)
---------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver    ! Barrier     ! Elevation of
```

```
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
-------------+--------------+--------------+---------------
       1.50 !       17.80 !       13.21 !        13.21

ROAD (50.09 + 31.72 + 50.29) = 53.23 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
------------------------------------------------------------------------------
--
   -90    -26   0.00  60.88   0.00  -6.30  -4.49   0.00   0.00   0.00
50.09
------------------------------------------------------------------------------
--
   -26     23   0.00  60.88   0.00  -6.30  -5.65   0.00   0.00 -17.21
31.72
------------------------------------------------------------------------------
--
    23     90   0.00  60.88   0.00  -6.30  -4.29   0.00   0.00   0.00
50.29
------------------------------------------------------------------------------
--

Segment Leq : 53.23 dBA

Results segment # 2: HWY 417 EB (night)
---------------------------------------

Source height = 1.49 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
-------------+--------------+--------------+---------------
       1.49 !       17.80 !       17.41 !        17.41

ROAD (0.00 + 53.25 + 0.00) = 53.25 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
------------------------------------------------------------------------------
--
   -69     90   0.00  73.80   0.00 -13.44  -0.54   0.00   0.00  -6.57
53.25
------------------------------------------------------------------------------
--

Segment Leq : 53.25 dBA
```

```
Results segment # 3: HWY 417 WB (night)
---------------------------------------

Source height = 1.49 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
-------------+--------------+--------------+---------------
       1.49 !        17.80 !        17.43 !         17.43

ROAD (0.00 + 53.06 + 0.00) = 53.06 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
---------------------------------------------------------------------------
--
   -69     90   0.00  73.80   0.00 -13.69  -0.54   0.00   0.00  -6.51
53.06
---------------------------------------------------------------------------
--

Segment Leq : 53.06 dBA

Total Leq All Segments: 57.95 dBA

RT/Custom data, segment # 1: LRT 1 (day/night)
----------------------------------------------
1 - 4-car SRT:
Traffic volume    :   192/24    veh/TimePeriod
Speed             :    50  km/h

Data for Segment # 1: LRT 1 (day/night)
---------------------------------------
Angle1   Angle2            : -90.00 deg   0.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      2       (Reflective ground surface)
Receiver source distance   :  78.00 / 78.00  m
Receiver height            :  17.80 / 17.80  m
Topography                 :      4       (Elevated; with barrier)
Barrier angle1             : -24.00 deg   Angle2 : 0.00 deg
Barrier height             :  28.30 m
Elevation                  :   7.00 m
Barrier receiver distance  :  48.00 / 48.00  m
Source elevation           :   0.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00
```

```
RT/Custom data, segment # 2: LRT 2 (day/night)
----------------------------------------------
1 - 4-car SRT:
Traffic volume     :   192/24    veh/TimePeriod
Speed              :    50  km/h

Data for Segment # 2: LRT 2 (day/night)
---------------------------------------
Angle1   Angle2            :   0.00 deg   90.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      2       (Reflective ground surface)
Receiver source distance   :  78.00 / 78.00  m
Receiver height            :  17.80 / 17.80  m
Topography                 :      4       (Elevated; with barrier)
Barrier angle1             :   0.00 deg   Angle2 : 28.00 deg
Barrier height             :  28.30 m
Elevation                  :   7.00 m
Barrier receiver distance :  48.00 / 48.00  m
Source elevation           :   0.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00

Results segment # 1: LRT 1 (day)
--------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       0.50 !       17.80 !        7.15 !          7.15

RT/Custom (44.51 + 20.11 + 0.00) = 44.52 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90    -24   0.00  56.02  -7.16  -4.36   0.00   0.00   0.00  44.51
----------------------------------------------------------------------
   -24      0   0.00  56.02  -7.16  -8.75   0.00   0.00 -20.00  20.11
----------------------------------------------------------------------

Segment Leq : 44.52 dBA
```

```
Results segment # 2: LRT 2 (day)
--------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
-------------+--------------+--------------+---------------
        0.50 !        17.80 !         7.15 !          7.15

RT/Custom (0.00 + 20.78 + 44.24) = 44.25 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
     0     28   0.00  56.02  -7.16  -8.08   0.00   0.00 -20.00  20.78
----------------------------------------------------------------------
    28     90   0.00  56.02  -7.16  -4.63   0.00   0.00   0.00  44.24
----------------------------------------------------------------------

Segment Leq : 44.25 dBA

Total Leq All Segments: 47.40 dBA

Results segment # 1: LRT 1 (night)
----------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
-------------+--------------+--------------+---------------
        0.50 !        17.80 !         7.15 !          7.15

RT/Custom (38.49 + 14.09 + 0.00) = 38.50 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90    -24   0.00  50.00  -7.16  -4.36   0.00   0.00   0.00  38.49
----------------------------------------------------------------------
   -24      0   0.00  50.00  -7.16  -8.75   0.00   0.00 -20.00  14.09
----------------------------------------------------------------------

Segment Leq : 38.50 dBA
```

```
Results segment # 2: LRT 2 (night)
----------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       0.50 !       17.80 !        7.15 !         7.15

RT/Custom (0.00 + 14.76 + 38.21) = 38.23 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------
     0     28   0.00  50.00  -7.16  -8.08   0.00   0.00 -20.00  14.76
-----------------------------------------------------------------------
    28     90   0.00  50.00  -7.16  -4.63   0.00   0.00   0.00  38.21
-----------------------------------------------------------------------

Segment Leq : 38.23 dBA

Total Leq All Segments: 41.38 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 65.62
                         (NIGHT): 58.05
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2021 16:55:23
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r8b4.te              Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: PRESTON ST (day/night)
----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: PRESTON ST (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  64.00 / 64.00  m
Receiver height           :  17.80 / 17.80  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -26.00 deg   Angle2 : 23.00 deg
Barrier height            :  18.80 m
Barrier receiver distance :  18.00 / 18.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Road data, segment # 2: HWY 417 EB (day/night)
----------------------------------------------
Car traffic volume  : 59370/5163  veh/TimePeriod  *
Medium truck volume :  4723/411   veh/TimePeriod  *
Heavy truck volume  :  3373/293   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)
```

```
* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  73332
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: HWY 417 EB (day/night)
--------------------------------------------
Angle1   Angle2           : -69.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 331.00 / 331.00 m
Receiver height           :  17.80 / 17.80  m
Topography                :      4       (Elevated; with barrier)
Barrier angle1            : -69.00 deg   Angle2 : 90.00 deg
Barrier height            :  18.80 m
Elevation                 :   4.00 m
Barrier receiver distance :   8.00 / 8.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Road data, segment # 3: HWY 417 WB (day/night)
----------------------------------------------
Car traffic volume   : 59370/5163  veh/TimePeriod  *
Medium truck volume  :  4723/411   veh/TimePeriod  *
Heavy truck volume   :  3373/293   veh/TimePeriod  *
Posted speed limit   :   100 km/h
Road gradient        :     0 %
Road pavement        :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  73332
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 3: HWY 417 WB (day/night)
--------------------------------------------
Angle1   Angle2           : -69.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
```

```
Receiver source distance  : 351.00 / 351.00 m
Receiver height           :  17.80 / 17.80  m
Topography                :      4        (Elevated; with barrier)
Barrier angle1            : -69.00 deg   Angle2 : 90.00 deg
Barrier height            :  18.80 m
Elevation                 :   4.00 m
Barrier receiver distance :   8.00 / 8.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Results segment # 1: PRESTON ST (day)
-------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver     ! Barrier     ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
------------+--------------+-------------+---------------
       1.50 !       17.80 !       13.21 !        13.21

ROAD (57.69 + 38.50 + 57.89) = 60.82 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90    -26   0.00  68.48   0.00  -6.30  -4.49   0.00   0.00   0.00
57.69
--------------------------------------------------------------------------
--
   -26     23   0.00  68.48   0.00  -6.30  -5.65   0.00   0.00 -18.03
38.50
--------------------------------------------------------------------------
--
    23     90   0.00  68.48   0.00  -6.30  -4.29   0.00   0.00   0.00
57.89
--------------------------------------------------------------------------
--

Segment Leq : 60.82 dBA

Results segment # 2: HWY 417 EB (day)
-------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
```

```
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
------------+-------------+-------------+--------------
       1.50 !       17.80 !       17.41 !        17.41

ROAD (0.00 + 59.28 + 0.00) = 59.28 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
----------------------------------------------------------------------------
--
   -69     90   0.00  81.40   0.00 -13.44  -0.54   0.00   0.00  -8.14
59.28
----------------------------------------------------------------------------
--

Segment Leq : 59.28 dBA

Results segment # 3: HWY 417 WB (day)
-------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
------------+-------------+-------------+--------------
       1.50 !       17.80 !       17.43 !        17.43

ROAD (0.00 + 59.10 + 0.00) = 59.10 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
----------------------------------------------------------------------------
--
   -69     90   0.00  81.40   0.00 -13.69  -0.54   0.00   0.00  -8.07
59.10
----------------------------------------------------------------------------
--

Segment Leq : 59.10 dBA

Total Leq All Segments: 64.58 dBA

Results segment # 1: PRESTON ST (night)
---------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
```

```
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       17.80 !       13.21 !        13.21

ROAD (50.09 + 30.91 + 50.29) = 53.23 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90    -26   0.00  60.88   0.00  -6.30  -4.49   0.00   0.00   0.00
50.09
--------------------------------------------------------------------------
--
   -26     23   0.00  60.88   0.00  -6.30  -5.65   0.00   0.00 -18.03
30.91
--------------------------------------------------------------------------
--
    23     90   0.00  60.88   0.00  -6.30  -4.29   0.00   0.00   0.00
50.29
--------------------------------------------------------------------------
--

Segment Leq : 53.23 dBA

Results segment # 2: HWY 417 EB (night)
---------------------------------------

Source height = 1.49 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.49 !       17.80 !       17.41 !        17.41

ROAD (0.00 + 51.68 + 0.00) = 51.68 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -69     90   0.00  73.80   0.00 -13.44  -0.54   0.00   0.00  -8.14
51.68
--------------------------------------------------------------------------
--

Segment Leq : 51.68 dBA
```

```
Results segment # 3: HWY 417 WB (night)
---------------------------------------

Source height = 1.49 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
-------------+--------------+--------------+---------------
       1.49 !        17.80 !        17.43 !         17.43

ROAD (0.00 + 51.50 + 0.00) = 51.50 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -69     90   0.00  73.80   0.00 -13.69  -0.54   0.00   0.00  -8.07
51.50
--------------------------------------------------------------------------
--

Segment Leq : 51.50 dBA

Total Leq All Segments: 56.98 dBA

RT/Custom data, segment # 1: LRT 1 (day/night)
----------------------------------------------
1 - 4-car SRT:
Traffic volume     :   192/24    veh/TimePeriod
Speed              :    50 km/h

Data for Segment # 1: LRT 1 (day/night)
---------------------------------------
Angle1   Angle2            : -90.00 deg   0.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      2       (Reflective ground surface)
Receiver source distance   :  78.00 / 78.00  m
Receiver height            :  17.80 / 17.80  m
Topography                 :      4       (Elevated; with barrier)
Barrier angle1             : -24.00 deg   Angle2 : 0.00 deg
Barrier height             :  28.30 m
Elevation                  :   7.00 m
Barrier receiver distance  :  48.00 / 48.00  m
Source elevation           :   0.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00
```

```
RT/Custom data, segment # 2: LRT 2 (day/night)
----------------------------------------------
1 - 4-car SRT:
Traffic volume    :   192/24    veh/TimePeriod
Speed             :    50  km/h

Data for Segment # 2: LRT 2 (day/night)
---------------------------------------
Angle1   Angle2            :   0.00 deg   90.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      2       (Reflective ground surface)
Receiver source distance   :  78.00 / 78.00  m
Receiver height            :  17.80 / 17.80  m
Topography                 :      4       (Elevated; with barrier)
Barrier angle1             :   0.00 deg   Angle2 : 28.00 deg
Barrier height             :  28.30 m
Elevation                  :   7.00 m
Barrier receiver distance :  48.00 / 48.00  m
Source elevation           :   0.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00

Results segment # 1: LRT 1 (day)
--------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       0.50 !       17.80 !        7.15 !         7.15

RT/Custom (44.51 + 20.11 + 0.00) = 44.52 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90    -24   0.00  56.02  -7.16  -4.36   0.00   0.00   0.00  44.51
----------------------------------------------------------------------
   -24      0   0.00  56.02  -7.16  -8.75   0.00   0.00 -20.00  20.11
----------------------------------------------------------------------

Segment Leq : 44.52 dBA
```

```
Results segment # 2: LRT 2 (day)
--------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
-------------+--------------+--------------+---------------
        0.50 !        17.80 !         7.15 !          7.15

RT/Custom (0.00 + 20.78 + 44.24) = 44.25 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
------------------------------------------------------------------------
     0     28   0.00  56.02  -7.16  -8.08   0.00   0.00 -20.00  20.78
------------------------------------------------------------------------
    28     90   0.00  56.02  -7.16  -4.63   0.00   0.00   0.00  44.24
------------------------------------------------------------------------

Segment Leq : 44.25 dBA

Total Leq All Segments: 47.40 dBA

Results segment # 1: LRT 1 (night)
----------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
-------------+--------------+--------------+---------------
        0.50 !        17.80 !         7.15 !          7.15

RT/Custom (38.49 + 14.09 + 0.00) = 38.50 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
------------------------------------------------------------------------
   -90    -24   0.00  50.00  -7.16  -4.36   0.00   0.00   0.00  38.49
------------------------------------------------------------------------
   -24      0   0.00  50.00  -7.16  -8.75   0.00   0.00 -20.00  14.09
------------------------------------------------------------------------

Segment Leq : 38.50 dBA
```

```
Results segment # 2: LRT 2 (night)
----------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       0.50 !       17.80 !        7.15 !          7.15

RT/Custom (0.00 + 14.76 + 38.21) = 38.23 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
     0     28   0.00  50.00  -7.16  -8.08   0.00   0.00 -20.00  14.76
----------------------------------------------------------------------
    28     90   0.00  50.00  -7.16  -4.63   0.00   0.00   0.00  38.21
----------------------------------------------------------------------

Segment Leq : 38.23 dBA

Total Leq All Segments: 41.38 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 64.66
                         (NIGHT): 57.10
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2021 16:55:32
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r9.te                Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: HWY 417 EB (day/night)
----------------------------------------------
Car traffic volume  : 59370/5163  veh/TimePeriod  *
Medium truck volume :  4723/411   veh/TimePeriod  *
Heavy truck volume  :  3373/293   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  73332
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: HWY 417 EB (day/night)
--------------------------------------------
Angle1   Angle2            : -90.00 deg   0.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   : 332.00 / 332.00 m
Receiver height            :  29.80 / 29.80  m
Topography                 :      4       (Elevated; with barrier)
Barrier angle1             : -90.00 deg   Angle2 : 0.00 deg
Barrier height             :  28.30 m
Elevation                  :   4.00 m
Barrier receiver distance  :   5.00 / 5.00   m
Source elevation           :   0.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00

Road data, segment # 2: HWY 417 WB (day/night)
----------------------------------------------
Car traffic volume  : 59370/5163  veh/TimePeriod  *
Medium truck volume :  4723/411   veh/TimePeriod  *
Heavy truck volume  :  3373/293   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)
```

```
* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  73332
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: HWY 417 WB (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 352.00 / 352.00 m
Receiver height           :  29.80 / 29.80  m
Topography                :      4       (Elevated; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 0.00 deg
Barrier height            :  28.30 m
Elevation                 :   4.00 m
Barrier receiver distance :   5.00 / 5.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Results segment # 1: HWY 417 EB (day)
-------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       29.80 !       29.37 !        29.37

ROAD (0.00 + 64.94 + 0.00) = 64.94 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90      0   0.00  81.40   0.00 -13.45  -3.01   0.00   0.00  -0.82
64.11*
   -90      0   0.00  81.40   0.00 -13.45  -3.01   0.00   0.00   0.00
64.94
--------------------------------------------------------------------------
--
```

```
 * Bright Zone !

Segment Leq : 64.94 dBA

Results segment # 2: HWY 417 WB (day)
-------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver     ! Barrier      ! Elevation of
Height  (m) ! Height  (m)  ! Height  (m)  ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.50 !       29.80 !       29.40 !        29.40

ROAD (0.00 + 64.68 + 0.00) = 64.68 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90      0   0.00  81.40   0.00 -13.70  -3.01   0.00   0.00  -0.78
63.90*
   -90      0   0.00  81.40   0.00 -13.70  -3.01   0.00   0.00   0.00
64.68
--------------------------------------------------------------------------
--

 * Bright Zone !

Segment Leq : 64.68 dBA

Total Leq All Segments: 67.82 dBA

Results segment # 1: HWY 417 EB (night)
---------------------------------------

Source height = 1.49 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver     ! Barrier      ! Elevation of
Height  (m) ! Height  (m)  ! Height  (m)  ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.49 !       29.80 !       29.37 !        29.37

ROAD (0.00 + 57.34 + 0.00) = 57.34 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
```

```
----------------------------------------------------------------------------
--
   -90      0   0.00  73.80   0.00 -13.45  -3.01   0.00   0.00  -0.82
56.51*
   -90      0   0.00  73.80   0.00 -13.45  -3.01   0.00   0.00   0.00
57.34
----------------------------------------------------------------------------
--

 * Bright Zone !

Segment Leq : 57.34 dBA

Results segment # 2: HWY 417 WB (night)
----------------------------------------

Source height = 1.49 m

Barrier height for grazing incidence
-------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.49 !       29.80 !       29.40 !        29.40

ROAD (0.00 + 57.08 + 0.00) = 57.08 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
----------------------------------------------------------------------------
--
   -90      0   0.00  73.80   0.00 -13.70  -3.01   0.00   0.00  -0.78
56.30*
   -90      0   0.00  73.80   0.00 -13.70  -3.01   0.00   0.00   0.00
57.08
----------------------------------------------------------------------------
--

 * Bright Zone !

Segment Leq : 57.08 dBA

Total Leq All Segments: 60.22 dBA

RT/Custom data, segment # 1: LRT (day/night)
---------------------------------------------
1 - 4-car SRT:
Traffic volume    :   192/24    veh/TimePeriod
Speed             :    50  km/h

Data for Segment # 1: LRT (day/night)
--------------------------------------
```

```
Angle1   Angle2           :   0.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  37.00 / 37.00  m
Receiver height           :  29.80 / 29.80  m
Topography                :      4       (Elevated; with barrier)
Barrier angle1            :   0.00 deg   Angle2 : 90.00 deg
Barrier height            :  28.30 m
Elevation                 :   7.00 m
Barrier receiver distance :   6.00 / 6.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Results segment # 1: LRT (day)
------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       0.50 !       29.80 !       25.05 !        25.05

RT/Custom (0.00 + 37.02 + 0.00) = 37.02 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
     0     90   0.00  56.02  -3.92  -3.01   0.00   0.00 -12.07  37.02
----------------------------------------------------------------------

Segment Leq : 37.02 dBA

Total Leq All Segments: 37.02 dBA

Results segment # 1: LRT (night)
--------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       0.50 !       29.80 !       25.05 !        25.05

RT/Custom (0.00 + 31.00 + 0.00) = 31.00 dBA
```

```
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
     0     90   0.00  50.00  -3.92  -3.01   0.00   0.00 -12.07  31.00
----------------------------------------------------------------------

Segment Leq : 31.00 dBA

Total Leq All Segments: 31.00 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 67.83
                         (NIGHT): 60.23
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2021 16:55:40
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r9b1.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: HWY 417 EB (day/night)
----------------------------------------------
Car traffic volume  : 59370/5163  veh/TimePeriod  *
Medium truck volume :  4723/411   veh/TimePeriod  *
Heavy truck volume  :  3373/293   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  73332
    Percentage of Annual Growth         :   0.00
    Number of Years of Growth           :   0.00
    Medium Truck % of Total Volume      :   7.00
    Heavy Truck  % of Total Volume      :   5.00
    Day (16 hrs) % of Total Volume      :  92.00

Data for Segment # 1: HWY 417 EB (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 332.00 / 332.00 m
Receiver height           :  29.80 / 29.80  m
Topography                :      4       (Elevated; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 0.00 deg
Barrier height            :  29.50 m
Elevation                 :   4.00 m
Barrier receiver distance :   5.00 / 5.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Road data, segment # 2: HWY 417 WB (day/night)
----------------------------------------------
Car traffic volume  : 59370/5163  veh/TimePeriod  *
Medium truck volume :  4723/411   veh/TimePeriod  *
Heavy truck volume  :  3373/293   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)
```

```
* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  73332
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: HWY 417 WB (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 352.00 / 352.00 m
Receiver height           :  29.80 / 29.80  m
Topography                :      4       (Elevated; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 0.00 deg
Barrier height            :  29.50 m
Elevation                 :   4.00 m
Barrier receiver distance :   5.00 / 5.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Results segment # 1: HWY 417 EB (day)
-------------------------------------


Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver    ! Barrier     ! Elevation of
Height   (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       29.80 !       29.37 !        29.37

ROAD (0.00 + 59.88 + 0.00) = 59.88 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90      0   0.00  81.40   0.00 -13.45  -3.01   0.00   0.00  -5.05
59.88
--------------------------------------------------------------------------
--

Segment Leq : 59.88 dBA
```

```
Results segment # 2: HWY 417 WB (day)
-------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver     ! Barrier      ! Elevation of
Height  (m) ! Height  (m)  ! Height  (m)  ! Barrier Top  (m)
------------+--------------+--------------+---------------
       1.50 !        29.80 !        29.40 !         29.40

ROAD (0.00 + 59.65 + 0.00) = 59.65 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90      0   0.00  81.40   0.00 -13.70  -3.01   0.00   0.00  -5.04
59.65
--------------------------------------------------------------------------
--

Segment Leq : 59.65 dBA

Total Leq All Segments: 62.78 dBA

Results segment # 1: HWY 417 EB (night)
---------------------------------------

Source height = 1.49 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver     ! Barrier      ! Elevation of
Height  (m) ! Height  (m)  ! Height  (m)  ! Barrier Top  (m)
------------+--------------+--------------+---------------
       1.49 !        29.80 !        29.37 !         29.37

ROAD (0.00 + 52.28 + 0.00) = 52.28 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90      0   0.00  73.80   0.00 -13.45  -3.01   0.00   0.00  -5.05
52.28
--------------------------------------------------------------------------
--

Segment Leq : 52.28 dBA
```

```
Results segment # 2: HWY 417 WB (night)
---------------------------------------

Source height = 1.49 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.49 !       29.80 !       29.40 !        29.40

ROAD (0.00 + 52.05 + 0.00) = 52.05 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90      0   0.00  73.80   0.00 -13.70  -3.01   0.00   0.00  -5.04
52.05
--------------------------------------------------------------------------
--

Segment Leq : 52.05 dBA

Total Leq All Segments: 55.18 dBA

RT/Custom data, segment # 1: LRT (day/night)
--------------------------------------------
1 - 4-car SRT:
Traffic volume    :   192/24    veh/TimePeriod
Speed             :    50  km/h

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           :   0.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  37.00 / 37.00  m
Receiver height           :  29.80 / 29.80  m
Topography                :      4       (Elevated; with barrier)
Barrier angle1            :   0.00 deg   Angle2 : 90.00 deg
Barrier height            :  29.50 m
Elevation                 :   7.00 m
Barrier receiver distance :   6.00 / 6.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: LRT (day)
-------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
-------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
------------+-------------+-------------+--------------
       0.50 !       29.80 !       25.05 !        25.05

RT/Custom (0.00 + 34.77 + 0.00) = 34.77 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
------------------------------------------------------------------------
     0     90   0.00  56.02  -3.92  -3.01   0.00   0.00 -14.32  34.77
------------------------------------------------------------------------

Segment Leq : 34.77 dBA

Total Leq All Segments: 34.77 dBA

Results segment # 1: LRT (night)
---------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
-------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
------------+-------------+-------------+--------------
       0.50 !       29.80 !       25.05 !        25.05

RT/Custom (0.00 + 28.75 + 0.00) = 28.75 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
------------------------------------------------------------------------
     0     90   0.00  50.00  -3.92  -3.01   0.00   0.00 -14.32  28.75
------------------------------------------------------------------------

Segment Leq : 28.75 dBA

Total Leq All Segments: 28.75 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 62.78
                          (NIGHT): 55.19
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2021 16:55:52
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r9b2.te              Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: HWY 417 EB (day/night)
----------------------------------------------
Car traffic volume  : 59370/5163  veh/TimePeriod  *
Medium truck volume :  4723/411   veh/TimePeriod  *
Heavy truck volume  :  3373/293   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  73332
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: HWY 417 EB (day/night)
--------------------------------------------
Angle1   Angle2            : -90.00 deg   0.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   : 332.00 / 332.00 m
Receiver height            :  29.80 / 29.80  m
Topography                 :      4       (Elevated; with barrier)
Barrier angle1             : -90.00 deg   Angle2 : 0.00 deg
Barrier height             :  29.80 m
Elevation                  :   4.00 m
Barrier receiver distance  :   5.00 / 5.00   m
Source elevation           :   0.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00

Road data, segment # 2: HWY 417 WB (day/night)
----------------------------------------------
Car traffic volume  : 59370/5163  veh/TimePeriod  *
Medium truck volume :  4723/411   veh/TimePeriod  *
Heavy truck volume  :  3373/293   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)
```

```
* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  73332
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: HWY 417 WB (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 352.00 / 352.00 m
Receiver height           :  29.80 / 29.80  m
Topography                :      4       (Elevated; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 0.00 deg
Barrier height            :  29.80 m
Elevation                 :   4.00 m
Barrier receiver distance :   5.00 / 5.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Results segment # 1: HWY 417 EB (day)
-------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       29.80 !       29.37 !        29.37

ROAD (0.00 + 59.36 + 0.00) = 59.36 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90      0   0.00  81.40   0.00 -13.45  -3.01   0.00   0.00  -5.58
59.36
--------------------------------------------------------------------------
--

Segment Leq : 59.36 dBA
```

```
Results segment # 2: HWY 417 WB (day)
-------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
-------------+--------------+--------------+---------------
       1.50 !        29.80 !        29.40 !         29.40

ROAD (0.00 + 59.17 + 0.00) = 59.17 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90      0   0.00  81.40   0.00 -13.70  -3.01   0.00   0.00  -5.52
59.17
--------------------------------------------------------------------------
--

Segment Leq : 59.17 dBA

Total Leq All Segments: 62.28 dBA

Results segment # 1: HWY 417 EB (night)
---------------------------------------

Source height = 1.49 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
-------------+--------------+--------------+---------------
       1.49 !        29.80 !        29.37 !         29.37

ROAD (0.00 + 51.76 + 0.00) = 51.76 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90      0   0.00  73.80   0.00 -13.45  -3.01   0.00   0.00  -5.58
51.76
--------------------------------------------------------------------------
--

Segment Leq : 51.76 dBA
```

```
Results segment # 2: HWY 417 WB (night)
---------------------------------------

Source height = 1.49 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.49 !       29.80 !       29.40 !        29.40

ROAD (0.00 + 51.57 + 0.00) = 51.57 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90      0   0.00  73.80   0.00 -13.70  -3.01   0.00   0.00  -5.52
51.57
--------------------------------------------------------------------------
--

Segment Leq : 51.57 dBA

Total Leq All Segments: 54.68 dBA

RT/Custom data, segment # 1: LRT (day/night)
--------------------------------------------
1 - 4-car SRT:
Traffic volume    :   192/24    veh/TimePeriod
Speed             :    50  km/h

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2             :   0.00 deg   90.00 deg
Wood depth                  :      0       (No woods.)
No of house rows            :      0 / 0
Surface                     :      2       (Reflective ground surface)
Receiver source distance    :  37.00 / 37.00  m
Receiver height             :  29.80 / 29.80  m
Topography                  :      4       (Elevated; with barrier)
Barrier angle1              :   0.00 deg   Angle2 : 90.00 deg
Barrier height              :  29.80 m
Elevation                   :   7.00 m
Barrier receiver distance   :   6.00 / 6.00   m
Source elevation            :   0.00 m
Receiver elevation          :   0.00 m
Barrier elevation           :   0.00 m
Reference angle             :   0.00
```

```
Results segment # 1: LRT (day)
------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
-------------+--------------+--------------+---------------
       0.50 !       29.80 !       25.05 !        25.05

RT/Custom (0.00 + 34.28 + 0.00) = 34.28 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
     0     90   0.00  56.02  -3.92  -3.01   0.00   0.00 -14.81  34.28
----------------------------------------------------------------------

Segment Leq : 34.28 dBA

Total Leq All Segments: 34.28 dBA

Results segment # 1: LRT (night)
--------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
-------------+--------------+--------------+---------------
       0.50 !       29.80 !       25.05 !        25.05

RT/Custom (0.00 + 28.26 + 0.00) = 28.26 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
     0     90   0.00  50.00  -3.92  -3.01   0.00   0.00 -14.81  28.26
----------------------------------------------------------------------

Segment Leq : 28.26 dBA

Total Leq All Segments: 28.26 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 62.28
                         (NIGHT): 54.69
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2021 16:56:16
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r9b3.te              Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: HWY 417 EB (day/night)
----------------------------------------------
Car traffic volume  : 59370/5163  veh/TimePeriod  *
Medium truck volume :  4723/411   veh/TimePeriod  *
Heavy truck volume  :  3373/293   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  73332
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: HWY 417 EB (day/night)
--------------------------------------------
Angle1   Angle2            : -90.00 deg   0.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   : 332.00 / 332.00 m
Receiver height            :  29.80 / 29.80  m
Topography                 :      4       (Elevated; with barrier)
Barrier angle1             : -90.00 deg   Angle2 : 0.00 deg
Barrier height             :  30.30 m
Elevation                  :   4.00 m
Barrier receiver distance  :   5.00 / 5.00   m
Source elevation           :   0.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00

Road data, segment # 2: HWY 417 WB (day/night)
----------------------------------------------
Car traffic volume  : 59370/5163  veh/TimePeriod  *
Medium truck volume :  4723/411   veh/TimePeriod  *
Heavy truck volume  :  3373/293   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)
```

```
* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  73332
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: HWY 417 WB (day/night)
--------------------------------------------
Angle1   Angle2            : -90.00 deg   0.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   : 352.00 / 352.00 m
Receiver height            :  29.80 / 29.80  m
Topography                 :      4       (Elevated; with barrier)
Barrier angle1             : -90.00 deg   Angle2 : 0.00 deg
Barrier height             :  30.30 m
Elevation                  :   4.00 m
Barrier receiver distance  :   5.00 / 5.00   m
Source elevation           :   0.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00

Results segment # 1: HWY 417 EB (day)
-------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       29.80 !       29.37 !        29.37

ROAD (0.00 + 57.75 + 0.00) = 57.75 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90      0   0.00  81.40   0.00 -13.45  -3.01   0.00   0.00  -7.18
57.75
--------------------------------------------------------------------------
--

Segment Leq : 57.75 dBA
```

```
Results segment # 2: HWY 417 WB (day)
--------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
-------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
-------------+--------------+--------------+---------------
       1.50 !       29.80 !       29.40 !        29.40

ROAD (0.00 + 57.59 + 0.00) = 57.59 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
----------------------------------------------------------------------------
--
   -90      0   0.00  81.40   0.00 -13.70  -3.01   0.00   0.00  -7.09
57.59
----------------------------------------------------------------------------
--

Segment Leq : 57.59 dBA

Total Leq All Segments: 60.68 dBA

Results segment # 1: HWY 417 EB (night)
----------------------------------------

Source height = 1.49 m

Barrier height for grazing incidence
-------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
-------------+--------------+--------------+---------------
       1.49 !       29.80 !       29.37 !        29.37

ROAD (0.00 + 50.16 + 0.00) = 50.16 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
----------------------------------------------------------------------------
--
   -90      0   0.00  73.80   0.00 -13.45  -3.01   0.00   0.00  -7.18
50.16
----------------------------------------------------------------------------
--

Segment Leq : 50.16 dBA
```

```
Results segment # 2: HWY 417 WB (night)
---------------------------------------

Source height = 1.49 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
------------+-------------+-------------+--------------
       1.49 !       29.80 !       29.40 !        29.40

ROAD (0.00 + 49.99 + 0.00) = 49.99 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90      0   0.00  73.80   0.00 -13.70  -3.01   0.00   0.00  -7.09
49.99
--------------------------------------------------------------------------
--

Segment Leq : 49.99 dBA

Total Leq All Segments: 53.09 dBA

RT/Custom data, segment # 1: LRT (day/night)
--------------------------------------------
1 - 4-car SRT:
Traffic volume     :   192/24    veh/TimePeriod
Speed              :    50  km/h

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2            :   0.00 deg   90.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      2       (Reflective ground surface)
Receiver source distance   :  37.00 / 37.00  m
Receiver height            :  29.80 / 29.80  m
Topography                 :      4       (Elevated; with barrier)
Barrier angle1             :   0.00 deg   Angle2 : 90.00 deg
Barrier height             :  30.30 m
Elevation                  :   7.00 m
Barrier receiver distance  :   6.00 / 6.00   m
Source elevation           :   0.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00
```

```
Results segment # 1: LRT (day)
------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       0.50 !       29.80 !       25.05 !        25.05

RT/Custom (0.00 + 33.54 + 0.00) = 33.54 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
     0     90   0.00  56.02  -3.92  -3.01   0.00   0.00 -15.55  33.54
----------------------------------------------------------------------

Segment Leq : 33.54 dBA

Total Leq All Segments: 33.54 dBA

Results segment # 1: LRT (night)
--------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       0.50 !       29.80 !       25.05 !        25.05

RT/Custom (0.00 + 27.52 + 0.00) = 27.52 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
     0     90   0.00  50.00  -3.92  -3.01   0.00   0.00 -15.55  27.52
----------------------------------------------------------------------

Segment Leq : 27.52 dBA

Total Leq All Segments: 27.52 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 60.69
                         (NIGHT): 53.10
```

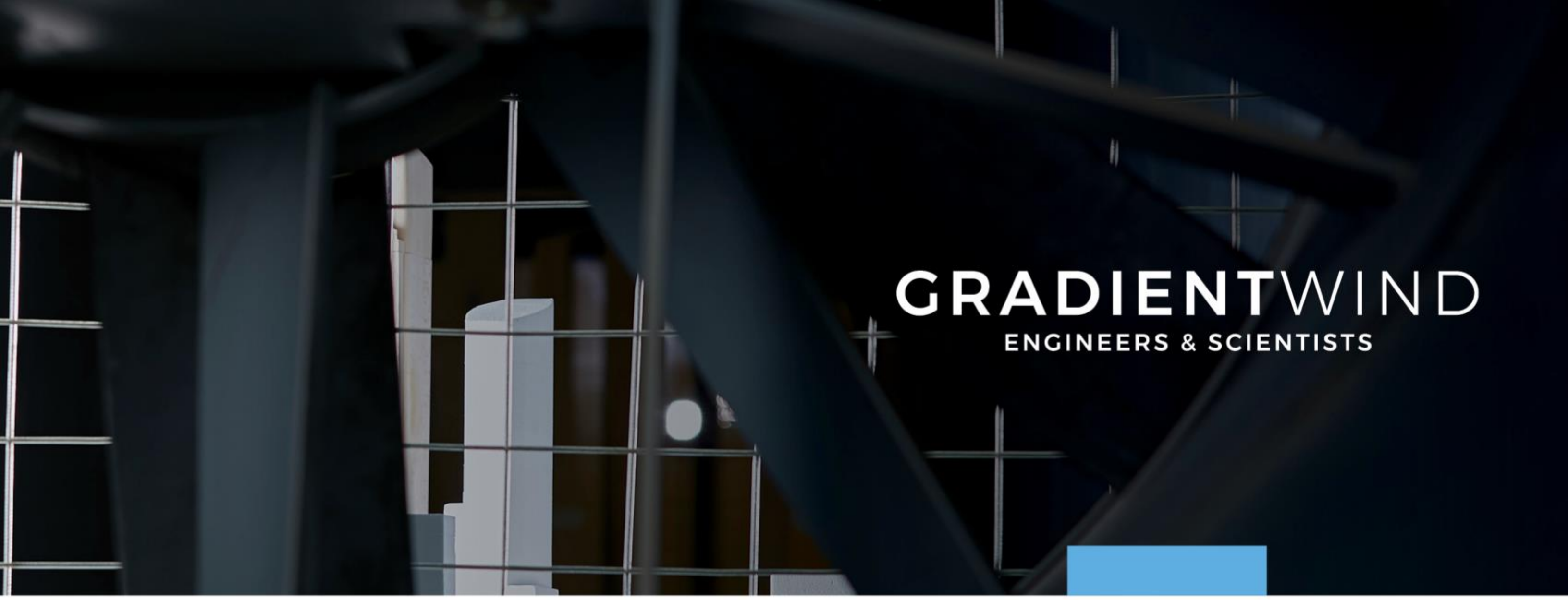
```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2021 16:56:25
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r9b4.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: HWY 417 EB (day/night)
----------------------------------------------
Car traffic volume  : 59370/5163  veh/TimePeriod  *
Medium truck volume :  4723/411   veh/TimePeriod  *
Heavy truck volume  :  3373/293   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  73332
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: HWY 417 EB (day/night)
--------------------------------------------
Angle1   Angle2            : -90.00 deg   0.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   : 332.00 / 332.00 m
Receiver height            :  29.80 / 29.80  m
Topography                 :      4       (Elevated; with barrier)
Barrier angle1             : -90.00 deg   Angle2 : 0.00 deg
Barrier height             :  30.50 m
Elevation                  :   4.00 m
Barrier receiver distance  :   5.00 / 5.00   m
Source elevation           :   0.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00

Road data, segment # 2: HWY 417 WB (day/night)
----------------------------------------------
Car traffic volume  : 59370/5163  veh/TimePeriod  *
Medium truck volume :  4723/411   veh/TimePeriod  *
Heavy truck volume  :  3373/293   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)
```

```
* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  73332
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: HWY 417 WB (day/night)
--------------------------------------------
Angle1   Angle2            : -90.00 deg   0.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   : 352.00 / 352.00 m
Receiver height            :  29.80 / 29.80  m
Topography                 :      4       (Elevated; with barrier)
Barrier angle1             : -90.00 deg   Angle2 : 0.00 deg
Barrier height             :  30.50 m
Elevation                  :   4.00 m
Barrier receiver distance  :   5.00 / 5.00   m
Source elevation           :   0.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00

Results segment # 1: HWY 417 EB (day)
-------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       29.80 !       29.37 !        29.37

ROAD (0.00 + 57.04 + 0.00) = 57.04 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90      0   0.00  81.40   0.00 -13.45  -3.01   0.00   0.00  -7.90
57.04
--------------------------------------------------------------------------
--

Segment Leq : 57.04 dBA
```

```
Results segment # 2: HWY 417 WB (day)
-------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
-------------+--------------+--------------+---------------
       1.50 !       29.80 !       29.40 !        29.40

ROAD (0.00 + 56.87 + 0.00) = 56.87 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
---------------------------------------------------------------------------
--
   -90      0   0.00  81.40   0.00 -13.70  -3.01   0.00   0.00  -7.81
56.87
---------------------------------------------------------------------------
--

Segment Leq : 56.87 dBA

Total Leq All Segments: 59.97 dBA

Results segment # 1: HWY 417 EB (night)
---------------------------------------

Source height = 1.49 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
-------------+--------------+--------------+---------------
       1.49 !       29.80 !       29.37 !        29.37

ROAD (0.00 + 49.44 + 0.00) = 49.44 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
---------------------------------------------------------------------------
--
   -90      0   0.00  73.80   0.00 -13.45  -3.01   0.00   0.00  -7.90
49.44
---------------------------------------------------------------------------
--

Segment Leq : 49.44 dBA
```

```
Results segment # 2: HWY 417 WB (night)
---------------------------------------

Source height = 1.49 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
-------------+--------------+--------------+---------------
       1.49 !       29.80 !       29.40 !        29.40

ROAD (0.00 + 49.27 + 0.00) = 49.27 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90      0   0.00  73.80   0.00 -13.70  -3.01   0.00   0.00  -7.81
49.27
--------------------------------------------------------------------------
--

Segment Leq : 49.27 dBA

Total Leq All Segments: 52.37 dBA

RT/Custom data, segment # 1: LRT (day/night)
--------------------------------------------
1 - 4-car SRT:
Traffic volume     :   192/24    veh/TimePeriod
Speed              :    50  km/h

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2            :   0.00 deg   90.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      2       (Reflective ground surface)
Receiver source distance   :  37.00 / 37.00  m
Receiver height            :  29.80 / 29.80  m
Topography                 :      4       (Elevated; with barrier)
Barrier angle1             :   0.00 deg   Angle2 : 90.00 deg
Barrier height             :  30.50 m
Elevation                  :   7.00 m
Barrier receiver distance :   6.00 / 6.00   m
Source elevation           :   0.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00
```

```
Results segment # 1: LRT (day)
------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
-------------+--------------+--------------+---------------
        0.50 !        29.80 !        25.05 !         25.05

RT/Custom (0.00 + 33.29 + 0.00) = 33.29 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
     0     90   0.00  56.02  -3.92  -3.01   0.00   0.00 -15.80  33.29
----------------------------------------------------------------------

Segment Leq : 33.29 dBA

Total Leq All Segments: 33.29 dBA

Results segment # 1: LRT (night)
--------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
-------------+--------------+--------------+---------------
        0.50 !        29.80 !        25.05 !         25.05

RT/Custom (0.00 + 27.27 + 0.00) = 27.27 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
     0     90   0.00  50.00  -3.92  -3.01   0.00   0.00 -15.80  27.27
----------------------------------------------------------------------

Segment Leq : 27.27 dBA

Total Leq All Segments: 27.27 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 59.98
                         (NIGHT): 52.38
```



GRADIENTWIND
ENGINEERS & SCIENTISTS

APPENDIX B

FTA VIBRATION CALCULATIONS

GW21-011 24-Feb-21

Possible Vibration Impacts
Predicted using FTA General Assesment

Train Speed 50 km/h 31 mph

	Distance from C/L	
	(m)	(ft)
LRT	24.0	78.7

Vibration

From FTA Manual Fig 10-1

Vibration Levels at distance from track	69	dBV re 1 micro in/sec

Adjustment Factors FTA Table 10-1

Speed reference 50 mph	-4.15	Speed Limit of 50 km/h (54.7 mph)
Vehicle Parameters	0	Assume Soft primary suspension, Wheels run true
Track Condition	0	None
Track Treatments	0	None
Type of Transit Structure	0	Open Cut
Efficient vibration Propagation	0	Propagation through rock
Vibration Levels at Fdn	65	
Coupling to Building Foundation	0	Foundation in rock
Floor to Floor Attenuation	-2.0	Ground Floor Occupied
Amplification of Floor and Walls	6	
Total Vibration Level	68.85	dBV or 0.070 mm/s
Noise Level in dBA	33.85	dBA

Table 10-1. Adjustment Factors for Generalized Predictions of Ground-Borne Vibration and Noise

Factors Affecting Vibration Source

Source Factor	Adjustment to Propagation Curve			Comment
		Reference Speed		
Speed	Vehicle Speed	50 mph	30 mph	Vibration level is approximately proportional to $20*\log(speed/speed_{ref})$. Sometimes the variation with speed has been observed to be as low as 10 to 15 $\log(speed/speed_{ref})$.
	60 mph	+1.6 dB	+6.0 dB	
	50 mph	0.0 dB	+4.4 dB	
	40 mph	-1.9 dB	+2.5 dB	
	30 mph	-4.4 dB	0.0 dB	
	20 mph	-8.0 dB	-3.5 dB	
Vehicle Parameters (not additive, apply greatest value only)				
Vehicle with stiff primary suspension	+8 dB			Transit vehicles with stiff primary suspensions have been shown to create high vibration levels. Include this adjustment when the primary suspension has a vertical resonance frequency greater than 15 Hz.
Resilient Wheels	0 dB			Resilient wheels do not generally affect ground-borne vibration except at frequencies greater than about 80 Hz.
Worn Wheels or Wheels with Flats	+10 dB			Wheel flats or wheels that are unevenly worn can cause high vibration levels. This can be prevented with wheel truing and slip-slide detectors to prevent the wheels from sliding on the track.
Track Conditions (not additive, apply greatest value only)				
Worn or Corrugated Track	+10 dB			If both the wheels and the track are worn, only one adjustment should be used. Corrugated track is a common problem. Mill scale on new rail can cause higher vibration levels until the rail has been in use for some time.
Special Trackwork	+10 dB			Wheel impacts at special trackwork will significantly increase vibration levels. The increase will be less at greater distances from the track.
Jointed Track or Uneven Road Surfaces	+5 dB			Jointed track can cause higher vibration levels than welded track. Rough roads or expansion joints are sources of increased vibration for rubber-tire transit.
Track Treatments (not additive, apply greatest value only)				
Floating Slab Trackbed	-15 dB			The reduction achieved with a floating slab trackbed is strongly dependent on the frequency characteristics of the vibration.
Ballast Mats	-10 dB			Actual reduction is strongly dependent on frequency of vibration.
High-Resilience Fasteners	-5 dB			Slab track with track fasteners that are very compliant in the vertical direction can reduce vibration at frequencies greater than 40 Hz.

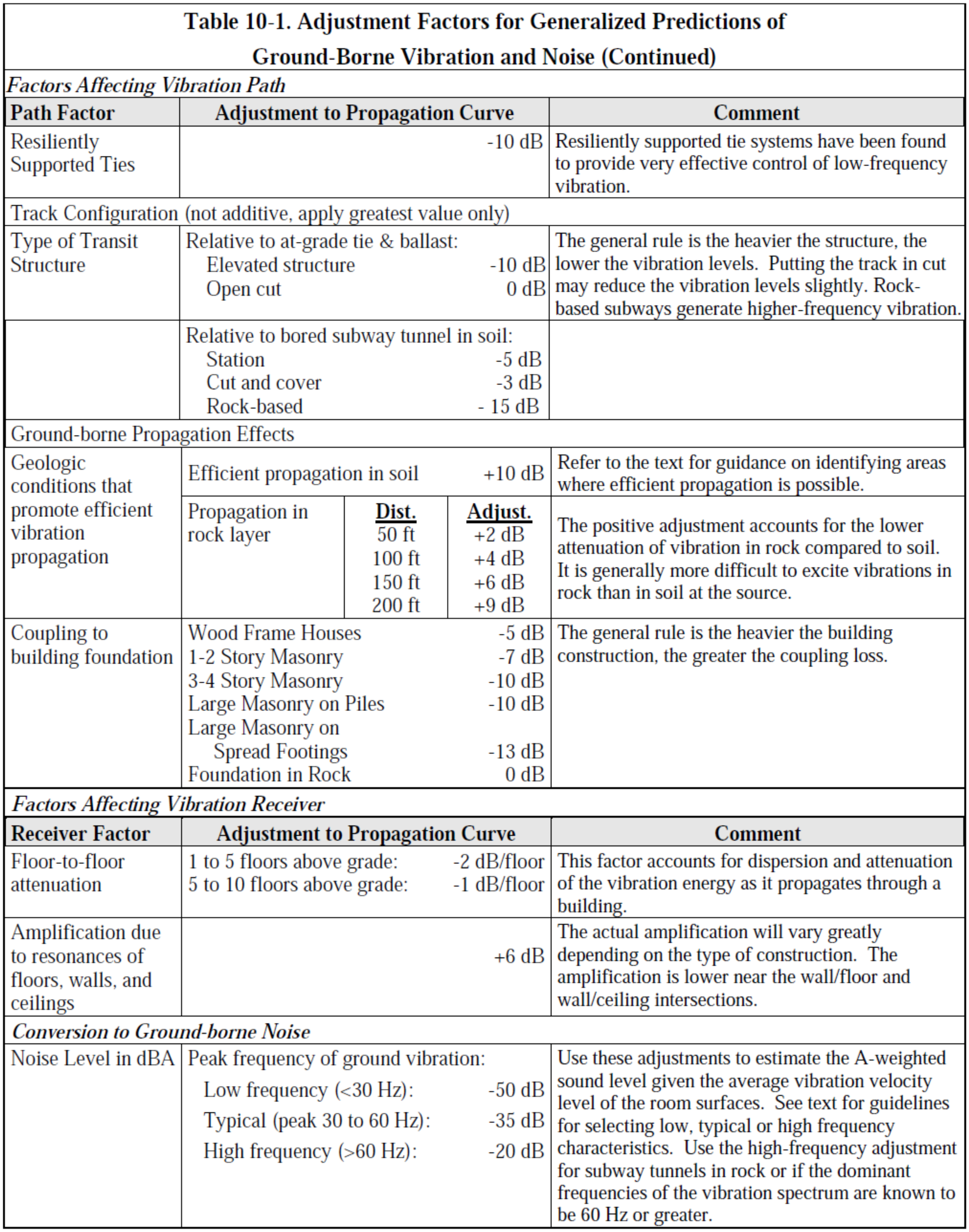


Table 10-1. Adjustment Factors for Generalized Predictions of Ground-Borne Vibration and Noise (Continued)

Factors Affecting Vibration Path

Path Factor	Adjustment to Propagation Curve	Comment
Resiliently Supported Ties	-10 dB	Resiliently supported tie systems have been found to provide very effective control of low-frequency vibration.
Track Configuration (not additive, apply greatest value only)		
Type of Transit Structure	Relative to at-grade tie & ballast: Elevated structure -10 dB Open cut 0 dB	The general rule is the heavier the structure, the lower the vibration levels. Putting the track in cut may reduce the vibration levels slightly. Rock-based subways generate higher-frequency vibration.
	Relative to bored subway tunnel in soil: Station -5 dB Cut and cover -3 dB Rock-based - 15 dB	
Ground-borne Propagation Effects		
Geologic conditions that promote efficient vibration propagation	Efficient propagation in soil +10 dB	Refer to the text for guidance on identifying areas where efficient propagation is possible.
	Propagation in rock layer **Dist.** / **Adjust.** 50 ft +2 dB 100 ft +4 dB 150 ft +6 dB 200 ft +9 dB	The positive adjustment accounts for the lower attenuation of vibration in rock compared to soil. It is generally more difficult to excite vibrations in rock than in soil at the source.
Coupling to building foundation	Wood Frame Houses -5 dB 1-2 Story Masonry -7 dB 3-4 Story Masonry -10 dB Large Masonry on Piles -10 dB Large Masonry on Spread Footings -13 dB Foundation in Rock 0 dB	The general rule is the heavier the building construction, the greater the coupling loss.

Factors Affecting Vibration Receiver

Receiver Factor	Adjustment to Propagation Curve	Comment
Floor-to-floor attenuation	1 to 5 floors above grade: -2 dB/floor 5 to 10 floors above grade: -1 dB/floor	This factor accounts for dispersion and attenuation of the vibration energy as it propagates through a building.
Amplification due to resonances of floors, walls, and ceilings	+6 dB	The actual amplification will vary greatly depending on the type of construction. The amplification is lower near the wall/floor and wall/ceiling intersections.
Conversion to Ground-borne Noise		
Noise Level in dBA	Peak frequency of ground vibration: Low frequency (<30 Hz): -50 dB Typical (peak 30 to 60 Hz): -35 dB High frequency (>60 Hz): -20 dB	Use these adjustments to estimate the A-weighted sound level given the average vibration velocity level of the room surfaces. See text for guidelines for selecting low, typical or high frequency characteristics. Use the high-frequency adjustment for subway tunnels in rock or if the dominant frequencies of the vibration spectrum are known to be 60 Hz or greater.

APPENDIX D

Proximity Assessment:

PG2760-LET.01 dated March 3, 2021

patersongroup

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March 3, 2021
Report: PG2760-LET.01

Tamarack (Norman) Corporation
235 Somerset Street West
Ottawa, Ontario
K2P 0J3

Attention: **Mr. Alex Turner**

Subject: **Proximity Assessment**
Proposed Multi-Storey Building
93 Norman Street - Ottawa

Dear Sir,

Further to your request and authorization, Paterson Group (Paterson) prepared the current letter report to summarize construction issues which could occur due to the proximity of the proposed development with respect to the subject alignment of the Trillium Line located adjacent to the site. The following letter should be read in conjunction with the Paterson Group Report PG2760-2 dated March 3, 2021.

1.0 Background Information

Based on current plans, it is understood that the proposed development will consist of a multi-storey building. The proposed building will have 2 levels of underground parking which will occupy the majority of the site.

The following sections summarize our existing soils information and construction precautions for the proposed development, which may impact the subject alignment of the Trillium Line.

It should be noted that the information submitted as part of the current Proximity Study will be supplemented with construction plans issued for construction, such as dewatering and discharge plans.

2.0 Subsurface Conditions

Based on existing geotechnical information, the subsurface conditions in the immediate area of the subject site and subject Trillium Line alignment consist of the following:

❑ Existing surface grade is at an elevation of approximately 61.6 m in the location of the proposed building, descending to the south west of the site to an approximate geodetic elevation 56 m in the location of the Trillium Line.
❑ The overburden thickness is approximately 1.6 to 2.4 m.
❑ Bedrock surface elevation is at approximately geodetic elevation of 60.1 to 59.2 m.
❑ The bedrock underlying the site consists of limestone with which is generally of good to excellent quality. Unconfined compressive strengths of similar limestone bedrock formations typically exceed 80 MPa.

Trillium Line Location

Available information indicates that the Trillium Line is located approximately 25 m from the west property line at the subject site. The top of rail (TOR) is anticipated to be located at approximate elevation 56 m (geodetic) adjacent to the proposed development site. The founding elevation of the proposed building adjacent to the rail line will extend below the elevation of the rail. However, the Trillium Line railway is not located within the building's lateral support zone, and will not be adversely affected. Further, the proposed building is not located within the rail line's lateral support zone, and will therefore not impact the founding support of the Trillium Rail line.

3.0 Construction Precautions and Recommendations

Influence of Proposed Development on Trillium Line

Based on existing soils information and building design details, the footings of the proposed building will be founded on good quality bedrock. Further, based on the approximate distance of 25 m between the proposed building and the Trillium Line railway, no lateral loads from the proposed building will be transferred to the railway and the Trillium Line will not be undermined.

Excavation and Temporary Shoring

The overburden along the perimeter of the proposed building footprint will need to be sloped or shored in order to complete the construction of the underground parking levels. Bedrock removal is also anticipated, which will be completed by line drilling, blasting and/or hoe ramming. The blasting and hoe ramming will be carried out by a contractor specializing in bedrock removal.

Where required, it is anticipated that the temporary shoring system adjacent to the Trillium Line corridor will consist of soldier piles and lagging or steel sheet piles designed for at-rest earth pressures, using a pressure coefficient of K_0=0.5 as per the geotechnical design recommendations outlined in the Geotechnical Investigation Report (Paterson Group Report PG2760-1 Revision 2 dated February 17, 2021).

The geotechnical engineer will review the stability of the rock face underlying the overburden. Following the review of the rock face, the geotechnical engineer will determine if rock reinforcement is required, and if so, the extent to which rock reinforcement is required. This determination will include consideration for the Trillium Line.

A seismograph would be installed at the western site boundary, adjacent to the Trillium Line corridor, to monitor vibrations during the bedrock removal program. A program detailing trigger levels and action levels is provided in Section 3.1 of the Paterson Group Report PG2760-2 dated March 3, 2021.

Pre-Construction Survey

A pre-construction survey will be required for the Trillium Line. Any existing structures in the immediate area of the proposed building will also undergo a pre-construction survey as per standard construction practices, where bedrock blasting will be required.

Groundwater Control

Groundwater observations during the recent geotechnical investigation indicated groundwater levels at an approximate depth of 2.3 m below the existing ground surface and within the bedrock. The design of the temporary shoring system and dewatering plans for the site will take into consideration the adjacent Trillium Line railway. These plans will be forwarded once they are available.

4.0 Conclusions and Recommendations

Based on the currently available information for the subject alignment of the proposed building and the existing subsurface information, the proposed building will not negatively impact the existing Trillium Line. It should be noted that the information submitted as part of the current Proximity Study will be supplemented with construction plans issued for construction, dewatering and discharge plans, and field monitoring program as described in the application conditions.

We trust that this information satisfies your immediate request.

Best Regards,

Paterson Group Inc.

NPatey

LICENSED PROFESSIONAL ENGINEER
March 3, 2021
S. S. DENNIS
100519516
Scott Dennis
PROVINCE OF ONTARIO

Scott Dennis

Nicole R. Patey, B.Eng.

Scott S. Dennis, P.Eng.