Noise and Vibration Assessment DRAFT

Eglinton East LRT

HDR. Inc.

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Executive Summary

SLR Consulting (Canada) Ltd., was retained by HDR Inc., on behalf of the City of Toronto, to conduct an environmental noise and vibration assessment for the proposed Eglinton East Light Rail Transit (EELRT) Project. The proposed EELRT will operate along Eglinton Avenue, Kingston Road, Morningside Avenue, Ellesmere Road, Military Trail, Sheppard Avenue East, and Neilson Road. This work is being done as part of the TPAP (Transit Project Assessment Process) for the overall 10% design Environmental Project Report (EPR). The study length is approximately 18 kilometers with 27 proposed stops. The assessment is intended to address noise and vibration portions following Ontario Regulation 231/08: Transit Project and Metrolinx Undertakings (O.Reg. 231/08) for the City of Toronto (City) to obtain a Notice to Proceed for the EELRT from the Minister of the Environment, Conservation, and Parks (MECP).

In particular the noise and vibration assessment objectives are as follows:

- to assess future "build" and "no-build" sound levels from transportation noise sources, including the EELRT in the 'build' scenario in the area (i.e., noise levels with and without the proposed project taking place);
- to assess sound levels on the surrounding noise-sensitive receptors from the Maintenance and Storage Facility on Sheppard Avenue East, east of Morningside Avenue;
- to use these predictions to assess potential impacts according to the applicable guidelines;
- to specify preliminary mitigation measures where required; and
- to assess the potential for construction noise and vibration, along with providing a Code of Practice to minimize potential impacts.

The potential environmental noise and vibration impacts of the proposed undertaking have been assessed. Both operational and construction noise and vibration impacts have been considered. The conclusions and recommendations are as follows:

Operational Noise

- The results show that changes in sound levels resulting from the proposed project are expected to be very minor for the receptors along Eglinton Avenue East, and Sheppard Avenue.
- In the areas surrounding Military Trail, the USTC Campus, and Neilson Road, unmitigated excesses over the criteria are predicted at Receptors 19, 25 to 30, 33, 41 to 43, and 56 to 58. Mitigation in these areas is feasible and can include noise barriers, track treatment, and wheel treatment. Sound levels are driven by wheel squeal from the turns in the LRT track alignment. With the implementation of track/wheel treatments and noise barriers, the EELRT is expected to meet the applicable guidelines at all noise sensitive areas. Preliminary noise barrier locations are shown in **Figure 28**.
- Stationary noise from the Maintenance and Storage Facility has been assessed at the surrounding noise-sensitive points of reception. Based on a preliminary assessment, excesses of the NPC-300 guidelines are predicted at some of the surrounding receptors.
- With the implementation of track/wheel treatments and property line noise barriers, the MSF is expected to meet applicable guidelines at all points of reception. Preliminary noise barrier locations are provided in **Figure 37**.

- Noise levels from TPSS units will need to be evaluated as the project proceeds, but feasible mitigation measures can be used to ensure compliance with the noise guidelines.
- As the project design proceeds, the mitigation measures should be reviewed by an Acoustical Consultant to ensure that the applicable criteria are met for the final design.

Operational Vibration

- Maximum ground-borne vibration levels from operational EELRT movements are predicted to meet the MOEE/TTC Protocol criteria. Therefore, no additional mitigation measures are anticipated to be required.
- As the project design proceeds, the mitigation measures should be be reviewed by an Acoustical Consultant to ensure that the applicable criteria are met for the final design.

Construction Noise and Vibration

- Construction noise and vibration impacts are temporary in nature but may be noticeable at times in nearby residential NSAs. Methods to minimize construction noise and vibration impacts should be included in the Construction Code of Practice, as outlined in Section 6.

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1.0 Introduction

SLR Consulting (Canada) Ltd., was retained by HDR Inc., on behalf of the City of Toronto to conduct an environmental noise and vibration assessment for the proposed Eglinton East LRT (EELRT), as part of the TPAP (Transit Project Assessment Process). This work is being done to contribute to the overall 10% design Environmental Project Report (EPR).

The assessment is intended to address noise, and vibration portions of the Ontario Regulation 231/08: Transit Project and Metrolinx Undertakings (O.Reg. 231/08) in order for the City of Toronto (City) to obtain a Notice to Proceed for the EELRT from the Minister of the Environment, Conservation, and Parks (MECP).

In this assessment, SLR has reviewed the surrounding area with respect to the following guidelines:

- MECP / Ontario Ministry of Transportation (MTO), "A Protocol for Dealing With Noise Concerns During the Preparation, Review and Evaluation of Provincial Highways Environmental Assessments (1986)", for operational road noise.
- MECP/ Toronto Transit Commission (TTC), Protocol for Noise and Vibration Assessment for the Proposed Scarborough Rapid Transit Extension (MECP/TTC, 1993), for operational light-rail noise.
- MECP Publication NPC-300 (2013), which sets out acceptable noise criteria for the Maintenance and Storage Facility (MSF) operations.
- U.S. Federal Transit Administration (FTA) Transit Noise and Vibration Assessment Manual (FTA-VA-90-1003-06) and the U.S. Federal Highway Administration (FHWA) Highway Construction Noise Handbook (FHWA-HEP-06-015) guidance, which provide guidance on acceptable levels of construction noise.
- The City of Toronto Noise By-law (Chapter 591 of the Municipal Code).
- The City of Toronto Construction Vibration By-law 514-2008 (Chapter 363 of the Municipal Code).

1.1 Project Understanding

The Eglinton East Light-Rail Transit (EELRT) is an 18 kilometer project that includes up to 27 stops, three connections to GO Transit (Kennedy, Eglinton & Guildwood), and connection to the proposed Durham-Scarborough Bus Rapid Transit. Of particular importance, the EELRT will serve historically underserved communities in the City travelling through or adjacent to seven Neighbourhood Improvement Areas (NIAs) and would bring higher-order transit to within walking distance of an additional 49,000 people, including an equity-weighted population of 30,000. A context plan and an overview of the study area for the project is shown in **Figure 1**. Plans showing the technically preferred alternative are shown in **Appendix A**.

The EELRT network is divided into three major project areas or components:

1 Kennedy Station to Malvern alignment

2 Maintenance and Storage Facility, north of Sheppard Avenue and Conlins Road.

3 McCowan to Neilson alignment along Sheppard Avenue

1.2 Report Objectives

1.2.1 Transportation Noise and Vibration Objectives

The objectives of this study are as follows:

- to assess existing sound levels at the anticipated date of construction and the future "build" sound levels from road and light-rail traffic noise sources in the area (i.e., noise levels with and without the proposed project taking place);
- to use these predictions to assess potential impacts according to the applicable guidelines;
- to specify mitigation measures where required;
- to assess future vibration levels from the light-rail traffic in the area; and
- to assess the potential for construction noise and vibration and provide a Code of Practice to minimize potential impacts.

2.0 Existing Conditions – Environmental Noise

A summary of the existing conditions is presented in the following sections. The existing noise environment is established based on measurement data conducted by SLR Consulting staff at representative noise-sensitive receptors in the Project Area. Measurements are used to refine modelled existing ambient background conditions for assessing operational noise from the EELRT, and stationary sound levels from the future Maintenance and Storage Facility (MSF). Short-term measurements were conducted to calibrate and check the accuracy of the roadway noise prediction model for existing conditions. A glossary of sound basics can be found in **Appendix B**.

2.1 Outdoor Noise Monitoring Methodology

Sound level measurements were collected at 18 locations that are representative of the noise-sensitive receptors outlined in **Section 2.3.2.** below. These monitoring locations are provided in **Figures 2-27**. Unattended 48-hour measurements of existing roadway traffic sound levels were conducted from May 10 to May 12, 2023. Attended short-term measurements of traffic induced sound levels were conducted on April 25, May 10, May 12, and November 22, 2023.

Sound level measurements were collected with a Larson Davis 824 and 831 sound level meter/real-time analyzers. The weather conditions consisted of sunny/cloudy skies with approximate temperatures ranging from 4-23°C, low winds (less than 10 km/h), and a relative humidity between 26% and 83%. There were no periods of precipitation during the measurement period.

Periods of intrusive construction-related noise were omitted from measurements.

2.2 Noise Monitoring Results

Table 1 shown below presents the results of the long-term noise monitoring program. **Table 2** presents the results of the short-term noise monitoring program.

Table 1: Long-term Noise Monitoring Results

Monitor	Location	Minimum, L_{eq} (1-hour) (dBA)			Daytime L_{eq} (16-hour) (dBA)	Night-time L_{eq} (8-hour) (dBA)
		Day (7AM-7PM)	Eve (7PM-11PM)	Night (11PM-7AM)		
LT01	West Tunnel	61	60	52	62	58
LT02	MSF	50	53	50	55	55
LT03	Morningside	62	62	57	63	60
LT04	Sheppard	56	56	51	58	56

Table 2: Short-term Noise Monitoring Results

Monitor Location	Location	L_{eq} (10 min) (dBA)	Distance to Road Centreline (m)	Vehicle Breakdown (# of each)		
				Cars	Medium Trucks	Heavy Trucks
ST01	Eglinton Ave at Bimbrok Rd	70	27	149	8	0
ST02	Kingston Ave South of Morningside	66	30	190	6	2
ST03	Morningside adjacent to Pan Am Centre	68	20	166	0	0
ST04	Sheppard Ave at Conlins Rd	67	24	93	1	0
ST05	Eglinton Ave at Haven Place	68	20	331	23	8
ST06	Eglinton Ave at Commonwealth Ave	67	20	272	10	8
ST07	Eglinton Ave at Mason	66	26	249	7	5
ST08	Kingston Rd at Morningside	66	41	416	11	3
ST09	Kingston Rd at Celeste Drive	71	22	395	8	5
ST010	Sheppard Ave at Murison Blvd	67	27	96	4	2
ST011	Sheppard Ave and Neilson Rd	61	22	120	1	0
ST012	Sheppard Ave at Lapsley Rd	66	15	81	1	1
ST013	Sheppard Avee at Scunthorpe Rd	64	16	120	5	0
ST014	Sheppard Avee at Havenview Rd	66	16	137	1	0
ST015	Realigned Military Trail near Chartway Blvd	55	750	N/A	N/A	N/A
Notes: [1] Counts for Highway 401 were not obtainable at the location of the measurement						

2.3 Noise Monitoring Conclusions

Table 1 outlines the long-term monitoring results at noise sensitive PORs. **Table 2** provides results and spot-checks for assessing existing traffic sound levels for major roadways.

- Short term measurements were used to help calibrate the noise prediction model.
- L_{eq} sound levels are generally higher than the MECP/TTC Protocol guideline minimums for assessing LRT noise impacts, of 55 dBA and 50 dBA during the daytime/night-time.
- Minimum 1-hour L_{eq} sound levels will be used when assessing the stationary noise from the MSF, and construction noise.

- Additional noise monitoring is recommended at noise-sensitive receptors around the Ellesmere and Military Trail segment of the EELRT as the design progresses.

3.0 Operational Noise Impacts – Main Line Operations

For transportation projects, operational noise is of primary importance. This section of the report provides an analysis of operational noise impacts from road traffic and light-rail traffic noise related to this undertaking.

3.1 Applicable Guidelines

There are several transportation noise guidelines that are applicable to this project. Ontario provincial policies and guidelines from the MTO and the MECP are directly applicable under the TPAP process for transportation projects and are discussed in detail in this report. The guidelines most applicable to municipal roadway and light-rail projects are:

- MECP / MTO "A Protocol for Dealing With Noise Concerns During the Preparation, Review and Evaluation of Provincial Highways Environmental Assessments (1986)", for operational road noise ("the MECP/MTO Joint Protocol").
- MECP/TTC, "Protocol for Noise and Vibration Assessment for the Proposed Scarborough Rapid Transit Extension (MECP/TTC, 1993)", for operational light-rail noise ("the MECP/TTC Protocol").

3.1.1 MECP/MTO Joint Protocol

Ontario has a number of guidelines and documents related to assessing road traffic noise impacts. The most applicable document applicable to municipal roadway projects under a Class EA project is the MECP/MTO Joint Protocol.

The Joint Protocol sets out an Outdoor Objective sound level of 55 dBA L_{eq} (Day), or the existing ambient, whichever is higher. The evaluation of noise impacts is related to the change in cumulative sound levels from existing conditions. Assessments are based on a minimum 10-year future horizon year (i.e, on traffic volumes 10 years after the completion of the project).

Noise mitigation is warranted when increases in sound level over the "no-build" ambient are greater than 5 dB. Mitigation measures can include changes in vertical profiles and horizontal alignments, noise barriers, and noise reducing asphalts. Noise mitigation, where applied, must be administratively, economically, and technically feasible, and must provide at least 5 dB of reduction averaged over the first row of noise-sensitive receivers. Mitigation measures are restricted to within the roadway right-of-way. Off right-of-way noise mitigation, such as window upgrades and air conditioning, is not considered. Noise mitigation requirements are summarized in

Table 3 below:

Table 3: Summary of Mitigation Efforts Under the MECP/MTO Joint Protocol

Future Sound Levels L_{eq} (16h)	Change in Noise Level Above "No-Build" Ambient (dBA)	Mitigation Effort Required
< 55 dBA	0 to 5 dBA	None
	> 5 dBA	
> 55 dBA	0 to 5 dBA	None
	> 5 dBA	• Investigate noise control measures on right-of-way. • If project cost is not significantly affected introduce noise control measure within right-of-way. • Noise control measures, where introduced, should achieve a minimum of 5 dBA attenuation averaged over first row receivers. • Mitigated to ambient, as administratively, economically, and technically feasible.
Notes: Values are overall daytime energy equivalent sound levels, L_{eq} (16h) in dBA, between 7 AM and 11 PM.		

In this assessment, the MECP/MTO Joint Protocol has been used to evaluate impacts of road traffic noise and LRT traffic noise combined.

3.1.2 MECP/TTC Protocol

The MECP/TTC Protocol has also been adopted for this project. The Protocol outlines two separate criteria. The limit at a point of reception for the predicted L_{eq} Daytime for rail transit is 55 dBA or the ambient L_{eq} 16-hour, whichever is higher. Similarly, for L_{eq} Night-time the limit is 50 dBA or the ambient L_{eq} 8-hour, whichever is higher.

A single vehicle pass-by sound level ($L_{pass\text{-}by}$) is also specified in the TTC Protocol with an 80 dBA limit.

Noise mitigation is warranted when increases in sound level over the "no-build" ambient are greater than 5 decibel (dB) or the overall future "build" sound level is greater than 55 dBA during the daytime, or 50 dBA during the night-time. Noise mitigation requirements are summarized in **Table 4** below:

Table 4: TTC Noise Criteria for Light Rail Transit Projects

Time Period	Limit
Daytime L_{eq} (16hr) (7AM to 11PM)	5 dB relative to the higher of pre-project sound levels or 55 dBA
Night-time L_{eq} (8hr) (11PM to 7AM)	5 dB relative to the higher of pre-project sound levels or 50 dBA
$L_{pass\text{-}by}$	80 dBA

The MECP/TTC protocol only assesses LRT-related noise only, and not the cumulative change including road traffic noise.

3.2 Location of Noise-Sensitive Areas Within the Study Area

3.2.1 Definition of Noise-Sensitive Areas (NSAs) and Outdoor Living Area (OLA)

Under the MECP/MTO Joint Protocol, noise impacts from transportation projects are evaluated at “noise sensitive areas”, commonly referred to as NSAs. The outdoor living area (OLA) is the part of an outdoor area used for quiet enjoyment. The OLA is typically an area at ground level accommodating outdoor living activities. For sound level calculation purposes, the usual distance from the dwelling unit wall is 3 m where the actual OLA is not known. The vertical height is 1.5 metres (approximate head-height) above ground level. Where unknown, the side closest to the source of noise is assumed. Paved areas for multiple dwelling residential units are not defined as OLAs. The OLA may include private areas used by individual dwelling occupants or “common” areas used by multi-tenant dwelling occupants. Only daytime noise levels are considered.

Under the MECP/MTO Joint Protocol, NSAs include the following land-uses, provided they have an OLA associated with them:

- Private homes (single family units and townhouses);
- Multiple unit buildings such as apartments, provided they have a communal OLA associated with them;
- Hospitals and nursing homes for the aged, provided they have an OLA for use by patients;
- Schools, educational facilities, and daycare centres where there are OLAs for students;
- Campgrounds that provide overnight accommodation;
- Hotels and motels with outdoor communal OLAs for visitors; and
- Churches and places of worship.

The following land uses are generally not considered to qualify for NSAs:

- Apartment balconies;
- Cemeteries;
- Parks and picnic areas not part of a defined OLA;
- All commercial; and
- All industrial.

Under the MECP/TTC Protocol, noise impacts during the daytime are evaluated at the OLA, similar to the MECP/MTO Joint Protocol. Night-time sound levels are assessed in the plane of bedroom windows.

3.2.2 Representative NSAs for Analysis

Sixty-two (62) NSAs have been used in the analysis to represent worst-case potential noise impacts at all nearby noise-sensitive land uses within the study area. If the guidelines are met at these locations, they will be met at all other noise sensitive locations. NSAs were chosen to assess areas with similar overall noise levels and similar changes in noise (“build” versus “sound level at anticipated date of construction”). These NSAs and modelled receptor locations are described in **Table 5**. The locations of the representative noise receptors used in the analysis are shown in **Figure 2** to **Figure 27**.

Table 5: Representative NSAs Considered in Analysis

Receptor Location	Description	Distance to Road Centre-line (m)	Location of Property in Relation to Road
Receptor 1	83 Town Haven Pl.	28	South
Receptor 2	84 Falmouth Ave.	80	South
Receptor 3	1-2774 Oswego Rd.	24	North
Receptor 4	2800 Barbados Blvd.	27	North
Receptor 5	331 Trudelle St.	87	North
Receptor 6	7 Centre St.	66	North
Receptor 7	3231 Eglington Ave. East	33	South
Receptor 8	91 Muir Dr.	145	South
Receptor 9	3752 Kingston Rd.	32	North
Receptor 10	1 Cromwell Rd.	29	North
Receptor 11	117 Dale Ave.	30	North
Receptor 12	37 Greenvale Ter.	27	North
Receptor 13	17 Celeste Dr.	41	North
Receptor 14	4200 Kingston Rd.	24	North
Receptor 15	4315 Kingston Rd.	36	South
Receptor 16	4325 Kingston Rd.	37	South
Receptor 17	305 Tefft Rd.	28	East
Receptor 18	38 Warnsworth St.	32	West
Receptor 19	3307 Ellesmere Rd.	81	South
Receptor 20	54 Challenger Ct.	209	East
Receptor 21	44 Challenger Ct.	217	East
Receptor 22	36 Challenger Ct.	217	East
Receptor 23	22 Challenger Ct.	227	East
Receptor 24	16 Challenger Ct.	241	East
Receptor 25	95 Chartway Blvd.	217	North
Receptor 26	89 Chartway Blvd.	152	North
Receptor 27	71 Chartway Blvd.	103	North

Receptor Location	Description	Distance to Road Centre-line (m)	Location of Property in Relation to Road
Receptor 28	61 Chartway Blvd.	81	North
Receptor 29	819 Military Trail	63	Southwest
Receptor 30	208 Bonspiel Dr.	29	West
Receptor 31	198 Bonspiel Dr.	28	West
Receptor 32	136 Bonspiel Dr.	30	West
Receptor 33	42 Bradworthy Ct.	36	North
Receptor 34	170 Murison Blvd.	35	South
Receptor 35	32 Scotney Grove	38	North
Receptor 36	17 Winstanley Cr.	32	North
Receptor 37	28 Curtis Cr.	36	South
Receptor 38	2 Murison Blvd	33	South
Receptor 39	23 Greenshaw Cr.	42	North
Receptor 40	23 Blackwater Cr.	37	North
Receptor 41	22 Coltman Cr.	40	South
Receptor 42	46 Hutcherson Sq.	37	North
Receptor 43	93 McClure Cr.	34	South
Receptor 44	318 Burrows Hall Blvd.	42	South
Receptor 45	36 Howell Sq.	38	North
Receptor 46	31 Griffen Dr.	32	North
Receptor 47	32 Goskin Ct.	33	South
Receptor 48	122 Purvis Cr.	32	South
Receptor 49	86 Purvis Cr.	32	South
Receptor 50	45 Sunburst Sq.	36	North
Receptor 51	105 spring Forest Sq.	20	South
Receptor 52	55 Prince William Ct.	21	South
Receptor 53	32 Carlingwood Ct.	22	South
Receptor 54	64 Glenstroke Dr.	36	South
Receptor 55	42 Hallbank Ter.	36	South
Receptor 56	50 Blackwater Cres.	39	East
Receptor 57	46 Hutcherson Sq.	38	West
Receptor 58	56 Hutchson Sq.	43	West
Receptor 59	20 Kessack Ct.	37	East
Receptor 60	145 Berner Trail	32	West
Receptor 61	33 Cosworth Cr.	31	West
Receptor 62	64 Quantrell Trail	39	East

3.3 Road Traffic Data

The evaluation of noise impacts is determined by the change in cumulative sound levels from the 2041 “no-build” scenario to the future “build” scenario. Assessments are based on a mature state of development or at the start of construction. Accordingly, a design year of 2041 applies to this project.

Traffic information for the 2041 “no build” and “build” scenarios for multiple roadways were provided by HDR Inc., and are found in **Appendix B**. The data is further summarized in **Table 6** and

Table 7. Traffic data was provided as Average Annual Daily Traffic (AADT), with the percentage of commercial vehicles, day/night traffic split and posted speeds.

Table 6: 2041 “No-Build” Traffic Information at Anticipated Date of Construction

Roadway	Section	Traffic Volumes (AADT)	Day % [1]	% Medium Trucks	% Heavy Trucks	Posted Speed (km/h)
Eglinton Avenue East	Kennedy to McCowan – EB	10,000	93	1.8	0.2	50
	Danforth to Kennedy – WB	14,500	93	1.8	0.2	50
	McCowan to Kingston – EB	6,250	93	1.8	0.2	50
	Kingston to Danforth – WB	10,500	93	1.8	0.2	50
Kingston Road	Eglington to Guildwood/Westlake – EB	22,250	93	1.8	0.2	50
	Guildwood/Westlake to Eglington – WB	23,000	93	1.8	0.2	50
	Guildwood/Westlake to Morningside – EB	16,000	93	1.8	0.2	50
	Morningside to Guildwood/Westlake – WB	18,000	93	1.8	0.2	50
Morningside Avenue	Kingston-Ellesmere – NB	10,000	93	1.8	0.2	50
	Kingston-Ellesmere – SB	9,500	93	1.8	0.2	50
USTC Campus (Military Trail)	Ellesmere and Morningside – NB	3,450	93	1.8	0.2	50
	Ellesmere and Morningside – SB	3,750	93	1.8	0.2	50
Ellesmere Road	Morningside and Military Trail – EB	10,000	93	1.8	0.2	50
	Morningside and Military Trail – WB	9,500	93	1.8	0.2	50
Morningside Avenue.	South of Hwy 401 to UTSC – NB	13,500	93	1.8	0.2	50
	South of Hwy 401 to UTSC – SB	12,500	93	1.8	0.2	50

Roadway	Section	Traffic Volumes (AADT)	Day % [1]	% Medium Trucks	% Heavy Trucks	Posted Speed (km/h)
	North of Hwy 401 to Sheppard Ave. East – NB	15,750	93	1.8	0.2	50
	North of Hwy 401 to Sheppard Ave. East – SB	11,500	93	1.8	0.2	50
Sheppard Avenue East	Markham to Washburn Way – EB	5,000	93	1.8	0.2	50
	Markham to Morningside – WB	8,500	93	1.8	0.2	50
	Washburn Way to Morningside – EB	7,250	93	1.8	0.2	50
	Markham to Morningside – WB	8,500	93	1.8	0.2	50
	West of Markham Road – EB	7,500	93	1.8	0.2	50
	West of Markham Road – WB	8,250	93	1.8	0.2	50
	Morningside to Meadowvale – EB	6,000	93	1.8	0.2	50
	Morningside to Meadowvale – WB	10,500	93	1.8	0.2	50
Neilson Road	Sheppard to Tapscott – NB	10,500	93	1.8	0.2	50
	Sheppard to Tapscott – SB	10,500	93	1.8	0.2	50

Table 7: 2041 "Build" Traffic Information at Anticipated Date of Construction

Roadway	Section	Traffic Volumes (AADT)	Day % [1]	% Medium Trucks	% Heavy Trucks	Posted Speed (km/h)
Eglinton Avenue East	Kennedy to McCowan – EB	9,000	93	1.8	0.2	50
	Danforth to Kennedy – WB	13,250	93	1.8	0.2	50
	McCowan to Kingston – EB	5,750	93	1.8	0.2	50
	Kingston to Danforth – WB	7,500	93	1.8	0.2	50
Kingston Road	Eglington to Guildwood/Westlake – EB	14,500	93	1.8	0.2	50
	Guildwood/Westlake to Eglington – WB	11,750	93	1.8	0.2	50
	Guildwood/Westlake to Morningside – EB	11,000	93	1.8	0.2	50

Roadway	Section	Traffic Volumes (AADT)	Day % [1]	% Medium Trucks	% Heavy Trucks	Posted Speed (km/h)
	Morningside to Guildwood/Westlake – WB	11,000	93	1.8	0.2	50
Morningside Avenue	Kingston-Ellesmere – NB	8,500	93	1.8	0.2	50
	Kingston-Ellesmere – SB	8,000	93	1.8	0.2	50
USTC Campus (Military Trail)	Ellesmere and Morningside – NB	3,500	93	1.8	0.2	50 [1]
	Ellesmere and Morningside – SB	3,750	93	1.8	0.2	50 [1]
Ellesmere Road	Morningside and Military Trail – EB	8,500	93	1.8	0.2	50
	Morningside and Military Trail – WB	8,000	93	1.8	0.2	50
Morningside Avenue.	South of Hwy 401 to UTSC – NB	11,500	93	1.8	0.2	50
	South of Hwy 401 to UTSC – SB	11,000	93	1.8	0.2	50
	North of Hwy 401 to Sheppard Ave. East – NB	16,000	93	1.8	0.2	50
	North of Hwy 401 to Sheppard Ave. East – SB	10,750	93	1.8	0.2	50
Sheppard Avenue East	Markham to Washburn Way – EB	6,000	93	1.8	0.2	50
	Markham to Morningside – WB	5,500	93	1.8	0.2	50
	Washburn Way to Morningside – EB	6,000	93	1.8	0.2	50
	Markham to Morningside – WB	5,500	93	1.8	0.2	50
	West of Markham Road – EB	9,500	93	1.8	0.2	50
	West of Markham Road – WB	7,250	93	1.8	0.2	50
	Morningside to Meadowvale – EB	6,500	93	1.8	0.2	50
	Morningside to Meadowvale – WB	11,500	93	1.8	0.2	50
Neilson Road	Sheppard to Tapscott – NB	10,000	93	1.8	0.2	50
	Sheppard to Tapscott – SB	8,500	93	1.8	0.2	50
Notes: [1] Modelled at 50 km/h due to STAMSON speed restrictions.						

3.4 Noise Modelling Methods

3.4.1 Light-Rail Noise Model

Future rail sound levels at the proposed development were predicted using the sound level data and algorithms contained in the FTA Transit Noise And Vibration Impact Assessment Manual. These modelling algorithms are included in the Cadna/A noise propagation modelling software. In the absence of any manufacturer provided sound levels, FTA reference sound levels with a source sound exposure level of 82 dBA at 15m (50ft) and a source height of 0.6m (2ft) (FTA Manual for rail/transit cars) were used for the light-rail system as per the Environmental Guide for Noise and Vibration Impact Assessment (Metrolinx, October 2020).

3.4.2 Roadway Noise Model

The roadway noise prediction model used is the ORNAMENT road noise prediction algorithm produced by the MECP. The MECP “STAMSON” highway noise prediction model is a computerized version of this method. Both methods are simplified versions of the United States Federal Highway Administration Method. A Cadna/A implementation of the STAMSON/ ORNAMENT model was used for the noise analysis because of its ability of handle complex ground elevations, multiple barriers, and receptors. The Cadna/A software also considers screening from buildings that are located between the roadways and the NSAs. The sound power levels, and noise source heights used in Cadna/A are found in **Appendix C**.

The noise prediction model relies on the use of vehicle noise emission levels to generate a noise source that can then be assessed at the receptors based on the following factors:

- speeds for the roadways in the area used in the noise analysis;
- pavement surface used for construction of the roadway (hot mix asphaltic pavement for all roadways);
- elevations, contours, and locations of all the NSA’s near the right-of-way;
- roadway grades;
- intervening rows of homes and barriers;
- type of ground cover, soft or hard ground;
- percentage of commercial traffic; and
- distance from the roadway.

The model uses the following vehicle classifications:

Automobiles -	Two axles and four wheels designed primarily for the transportation of nine or fewer passengers, or transportation of cargo (light trucks). This classification includes motorcycles. Generally, the gross vehicle weight is less than 4,500 kilograms.
Medium trucks -	Two axles and six wheels designed for the transportation of cargo. Generally, the gross vehicle weight is greater than 4,500 kilograms but less than 12,000 kilograms.
Heavy trucks -	Three or more axles and designed for the transportation of cargo. Generally, the gross vehicle weight is greater than 12,000 kilograms.

Distances, roadway heights, and receptor locations were obtained from plan drawings supplied by HDR Inc., in addition to aerial photography.

3.4.3 Light-Rail Wheel Squeal

Wheel squeal from the EELRT is expected to occur when the turning radii of track is less than 700 feet (~200m). There are several known track and wheel treatments that can reduce wheel squeal provided a minimum turning radii of 100 ft (~30m) is maintained.

The effects of wheel squeal have been modelled using SLR's in-house database for light-rail transit power levels. An operating speed of 15-20 km/h was assumed for turns based on information provided by HDR Inc., specifically around the realigned Military Trail and USTC Campus. A point source was positioned in the centre of the turn and an operating time was calculated based on the number of rail passbys, the length of the turn, and the speed travelled. The sound power level assumed for the wheel squeal was obtained from SLR's in-house database.

3.5 Noise Modelling Results

Noise modelling was completed for the "Technically Preferred Option". **Table 8** presents a comparison of predicted "no build" versus future "build" sound levels at OLA receptors in the study area, during the 16-hour daytime period, per the MECP/MTO Joint Protocol.

Table 8: MECP/MTO Joint Protocol – Comparison of Year 2041 "No-Build" Versus "Build" Sound Levels – Unmitigated

Receptor No.	Predicted Sound Levels [1] (L_{eq} (16h), dBA)		Change ("Build" Minus "No Build")	Investigation of Noise Mitigation Required? (Yes/No)
	"No Build"	"Build"		
Rec 1	57.4	57.8	0.4	No
Rec 2	55.3	55.9	0.6	No
Rec 3	56.0	57.3	1.3	No
Rec 4	55.2	56.3	1.1	No
Rec 5	53.7	55.1	1.4	No
Rec 6	50.0	51.0	1.0	No
Rec 7	60.1	63.0	2.9	No
Rec 8	61.6	62.3	0.7	No
Rec 9	64.3	64.6	0.3	No
Rec 10	60.7	61.4	0.7	No
Rec 11	56.9	57.8	0.9	No
Rec 12	60.2	61.7	1.5	No
Rec 13	60.0	61.2	1.2	No
Rec 14	58.7	60.0	1.3	No
Rec 15	62.5	64.2	1.7	No
Rec 16	62.6	64.2	1.6	No
Rec 17	58.8	58.4	-0.4	No

Receptor No.	Predicted Sound Levels [1] (L_{eq} (16h), dBA)		Change ("Build" Minus "No Build")	Investigation of Noise Mitigation Required? (Yes/No)
	"No Build"	"Build"		
Rec 18	56.6	57.6	1.0	No
Rec 19	58.7	69.7	11.0	**Yes**
Rec 20	50.0	50.3	0.3	No
Rec 21	50.0	51.9	1.9	No
Rec 22	50.0	53.4	3.4	No
Rec 23	50.0	54.0	4.0	No
Rec 24	50.0	53.7	3.7	No
Rec 25	50.0	58.8	8.8	**Yes**
Rec 26	50.0	62.6	12.6	**Yes**
Rec 27	50.0	66.4	16.4	**Yes**
Rec 28	50.0	67.7	17.7	**Yes**
Rec 29	59.6	66.4	6.8	**Yes**
Rec 30	57.7	62.9	5.2	**Yes**
Rec 31	57.0	60.8	3.8	No
Rec 32	58.2	60.3	2.1	No
Rec 33	58.7	68.9	10.2	**Yes**
Rec 34	58.0	59.3	1.3	No
Rec 35	58.0	58.9	0.9	No
Rec 36	58.4	58.9	0.5	No
Rec 37	57.7	58.6	0.9	No
Rec 38	56.5	56.6	0.1	No
Rec 39	56.3	56.2	-0.1	No
Rec 40	58.4	61.2	2.8	No
Rec 41	57.8	63.9	6.1	**Yes**
Rec 42	58.6	67.3	8.7	**Yes**
Rec 43	58.7	67.9	9.2	**Yes**
Rec 44	57.6	60.2	2.6	No
Rec 45	58.2	60.4	2.2	No
Rec 46	58.4	58.8	0.4	No
Rec 47	58.3	58.9	0.6	No
Rec 48	58.7	59.7	1.0	No
Rec 49	58.7	59.4	0.7	No
Rec 50	58.4	58.4	0.0	No
Rec 51	61.1	62.0	0.9	No
Rec 52	61.0	61.1	0.1	No
Rec 53	61.1	61.6	0.5	No

Receptor No.	Predicted Sound Levels [1] (L_{eq} (16h), dBA)		Change ("Build" Minus "No Build")	Investigation of Noise Mitigation Required? (Yes/No)
	"No Build"	"Build"		
Rec 54	58.4	58.7	0.3	No
Rec 55	58.1	58.5	0.4	No
Rec 56	60.8	72.6	11.8	**Yes**
Rec 57	61.4	73.9	12.5	**Yes**
Rec 58	60.2	68.2	8.0	**Yes**
Rec 59	58.0	58.6	0.6	No
Rec 60	59.9	60.4	0.5	No
Rec 61	61.3	61.1	-0.2	No
Rec 62	57.7	57.6	-0.1	No

Notes:

[1] Predicted sound levels are the sum of road traffic and LRT-related noise. The provided sound level is the higher of the "no-build" L_{eq} (16hr) or 50 dBA. The point of reception is the OLA.

Table 9 presents a comparison of predicted "no build", "build" and "build compared to the TTC Protocol.

Table 9: MECP/TTC Protocol – Comparison of Existing Ambient Versus Year 2041 "Build" Sound Levels – Unmitigated

Receptor No.	Predicted Sound Levels (dBA)				Change ("Build" Minus "No Build", dBA)		$L_{pass\text{-}by}$ Sound Level[4] (dBA)	Investigation of Noise Mitigation Required? (Yes/No)
	Existing Ambient[1]		"Build" Scenario[2]					
	Day [3]	Night [3]	Day [3]	Night [3]	Day [3]	Night [3]		
Rec 1	57.3	50.0	44.8	41.7	-12.5	-8.3	76.6	No
Rec 2	55.5	50.0	37.2	34.1	-18.3	-15.9	73.1	No
Rec 3	55.0	50.0	41.8	38.7	-13.2	-11.3	77.0	No
Rec 4	55.0	50.0	40.6	37.6	-14.4	-12.4	76.7	No
Rec 5	55.0	50.0	36.8	33.7	-18.2	-16.3	72.7	No
Rec 6	55.0	50.0	31.3	28.3	-23.7	-21.7	73.8	No
Rec 7	58.9	50.0	44.7	41.6	-14.2	-8.4	76.2	No
Rec 8	60.7	50.0	35.2	32.2	-25.5	-17.8	70.6	No
Rec 9	64.7	53.4	44.6	41.6	-20.1	-11.8	76.3	No
Rec 10	61.5	50.2	41.9	38.9	-19.6	-11.3	76.5	No
Rec 11	57.8	50.0	40.6	37.5	-17.2	-12.5	76.5	No
Rec 12	61.2	50.0	43.1	40.1	-18.1	-9.9	76.7	No
Rec 13	61.0	50.0	41.3	38.2	-19.7	-11.8	75.5	No
Rec 14	59.7	50.0	41.0	37.9	-18.7	-12.1	77.0	No
Rec 15	63.4	52.2	44.4	41.3	-19.0	-10.9	75.9	No
Rec 16	63.4	52.2	44.3	41.3	-19.1	-10.9	75.9	No

Receptor No.	Predicted Sound Levels (dBA)				Change ("Build" Minus "No Build", dBA)		$L_{pass\text{-}by}$ Sound Level[4] (dBA)	Investigation of Noise Mitigation Required? (Yes/No)
	Existing Ambient[1]		"Build" Scenario[2]					
	Day [3]	Night [3]	Day [3]	Night [3]	Day [3]	Night [3]		
Rec 17	58.8	50.0	43.2	40.1	-15.6	-9.9	76.6	No
Rec 18	56.6	50.0	42.4	39.3	-14.2	-10.7	76.3	No
Rec 19	58.1	50.0	69.4	66.3	11.3	16.3	73.0	**Yes**
Rec 20	55.0	50.0	49.6	46.5	-5.4	-3.5	69.0	No
Rec 21	55.0	50.0	51.5	48.4	-3.5	-1.6	68.9	No
Rec 22	55.0	50.0	53.2	50.1	-1.8	0.1	68.9	No
Rec 23	55.0	50.0	53.9	50.8	-1.1	0.8	68.7	No
Rec 24	55.0	50.0	53.5	50.4	-1.5	0.4	68.4	No
Rec 25	55.0	50.0	58.7	55.7	3.7	5.7	68.9	**Yes**
Rec 26	55.0	50.0	62.5	59.5	7.5	9.5	70.4	**Yes**
Rec 27	55.0	50.0	66.3	63.3	11.3	13.3	72.0	**Yes**
Rec 28	55.0	50.0	67.7	64.6	12.7	14.6	73.0	**Yes**
Rec 29	59.6	50.0	65.5	62.4	5.9	12.4	74.0	**Yes**
Rec 30	57.7	50.0	61.4	58.3	3.7	8.3	76.5	**Yes**
Rec 31	57.0	50.0	58.5	55.5	1.5	5.5	76.6	**Yes**
Rec 32	58.2	50.0	55.8	52.8	-2.4	2.8	76.5	No
Rec 33	59.0	50.0	68.4	65.4	9.4	15.4	75.9	**Yes**
Rec 34	58.4	50.0	54.5	51.4	-3.9	1.4	76.0	No
Rec 35	58.4	50.0	51.3	48.3	-7.1	-1.7	75.8	No
Rec 36	58.7	50.0	49.7	46.7	-9.0	-3.3	76.3	No
Rec 37	58.1	50.0	50.8	47.8	-7.3	-2.2	75.9	No
Rec 38	56.9	50.0	45.2	42.1	-11.7	-7.9	76.2	No
Rec 39	56.6	50.0	53.0	50.0	-3.6	0.0	75.4	No
Rec 40	58.7	50.0	58.0	55.0	-0.7	5.0	75.9	No
Rec 41	58.2	50.0	62.7	59.7	4.5	9.7	75.6	**Yes**
Rec 42	58.9	50.0	66.7	63.6	7.8	13.6	75.9	**Yes**
Rec 43	59.0	50.0	67.3	64.2	8.3	14.2	76.1	**Yes**
Rec 44	58.0	50.0	57.2	54.2	-0.8	4.2	75.4	No
Rec 45	58.5	50.0	56.4	53.3	-2.1	3.3	75.8	No
Rec 46	58.7	50.0	45.5	42.5	-13.2	-7.5	76.3	No
Rec 47	58.7	50.0	48.7	45.7	-10.0	-4.3	76.2	No
Rec 48	58.7	50.0	46.2	43.2	-12.5	-6.8	76.3	No
Rec 49	58.7	50.0	46.9	43.8	-11.8	-6.2	76.3	No
Rec 50	58.4	50.0	43.9	40.9	-14.5	-9.1	75.9	No
Rec 51	61.1	50.0	46.9	43.8	-14.2	-6.2	77.3	No
Rec 52	61.0	50.0	46.6	43.6	-14.4	-6.4	77.3	No

Receptor No.	Predicted Sound Levels (dBA)				Change (“Build” Minus “No Build”, dBA)		$L_{pass-by}$ Sound Level[4] (dBA)	Investigation of Noise Mitigation Required? (Yes/No)
	Existing Ambient[1]		“Build” Scenario[2]					
	Day [3]	Night [3]	Day [3]	Night [3]	Day [3]	Night [3]		
Rec 53	61.1	50.0	46.6	43.5	-14.5	-6.5	77.2	No
Rec 54	58.4	50.0	44.4	41.3	-14.0	-8.7	75.9	No
Rec 55	58.1	50.0	43.7	40.6	-14.4	-9.4	75.9	No
Rec 56	60.5	50.0	72.3	69.3	11.8	19.3	75.7	**Yes**
Rec 57	61.0	50.0	73.7	70.6	12.7	20.6	75.8	**Yes**
Rec 58	59.6	50.0	67.6	64.6	8.0	14.6	75.4	**Yes**
Rec 59	57.3	50.0	53.9	50.9	-3.4	0.9	75.9	No
Rec 60	59.3	50.0	55.3	52.3	-4.0	2.3	76.3	No
Rec 61	60.7	50.0	50.1	47.0	-10.6	-3.0	76.4	No
Rec 62	57.1	50.0	46.8	43.8	-10.3	-6.2	75.7	No

Notes:

[1] Existing Ambient sound levels are the higher of the predicted sound levels due to road traffic, or 55 dBA during the day and 50 dBA during the night.

[2] Build Scenario sound levels are from LRT activity only.

[3] Daytime sound levels are L_{eq} (16h) values, at the OLA; night-time sound levels are L_{eq} (8h) values, at the closest bedroom window.

[4] $L_{pass-by}$ sound level estimated using Appendix F of FTA Transit Noise and Vibration Assessment Manual, and assumes LRT vehicles operating at maximum speeds (60 km/h)

3.6 Discussion of Noise Impacts

The location of the noise receptors are shown in **Figure 2** to **Figure 27**. The results show that changes in sound levels resulting from the proposed project are expected to be very minor for the receptors along Eglinton Avenue East, and Sheppard Avenue

In the areas surrounding Military Trail, the USTC Campus, and Neilson Road, the EELRT’s addition will create meaningful changes in sound level in excess of the criteria. Specifically, the noise sensitive areas shown as Receptors 19, 25 to 30, 33, 41 to 43, and 56 to 58 will be affected. An investigation of noise mitigation measures in this area has been completed.

Mitigation in these areas is feasible and can include noise barriers, track treatment, and wheel treatment. Sound levels are driven by wheel squeal from the turns in the LRT track alignment. The assumed mitigation measures are:

- The use of “resilient wheels” on the LRT trains, which incorporate elastomer springs between the tire and wheel rim to provide compliance between these components. Examples of resilient wheels include the Bochum 54 and 84 wheels, and the SAB wheel. These are generally effective in reducing or eliminating wheel squeal at curves of radii greater than about 30 m (100 ft). As a conservatism, a reduction of 10 dB to wheel squeal noise has been assumed. The actual reduction may be higher.
- Noise barriers, in the form of noise walls, at some locations. Locations of the preliminary noise barriers and heights are included in **Figure 28**.

Mitigated sound levels are presented in **Table 10** and

Table 11 below for the above mentioned NSAs.

Table 10: MECP/MTO Joint Protocol – Comparison of Year 2041 "No-Build" Versus "Build" Sound Levels – Mitigated

Receptor No.	Predicted Sound Levels[1] (L_{eq} (16h), dBA)		Change ("Build" Minus "No Build", dBA)	Further Investigation of Noise Mitigation Required? (Yes/No)
	"No Build"	"Build"		
Rec 19	58.7	60.9	2.2	No
Rec 25	50.0	50.0	0.0	No
Rec 26	50.0	50.4	0.4	No
Rec 27	50.0	54.0	4.0	No
Rec 28	50.0	55.5	5.5	**Yes**
Rec 29	59.6	60.3	0.7	No
Rec 30	57.7	58.9	1.2	No
Rec 33	58.7	60.7	2.0	No
Rec 41	57.8	58.6	0.8	No
Rec 42	58.6	58.1	-0.5	No
Rec 43	58.7	56.1	-2.6	No
Rec 56	60.8	56.7	-4.1	No
Rec 57	61.4	57.6	-3.8	No
Rec 58	60.2	56.7	-3.5	No

Notes:

[1] Predicted sound levels are the sum of road traffic and LRT-related noise. The provided sound level is the higher of the "no-build" L_{eq} (16hr) or 50 dBA. The point of reception is the OLA.

Table 11: MECP/TTC Protocol – Comparison of Existing Ambient Versus Year 2041 "Build" Sound Levels – Mitigated

Receptor No.	Predicted Sound Levels (dBA)				Change ("Build" minus "No Build")		Further Investigation of Noise Mitigation Required?
	Existing Ambient [1]		"Build" Scenario [2]				
	Day [3]	Night [3]	Day [3]	Night [3]	Day [3]	Night [3]	(Yes/No)
Rec 19	58.1	50.0	56.4	53.3	-1.7	3.3	No
Rec 25	55.0	50.0	45.8	42.7	-9.2	-7.3	No
Rec 26	55.0	50.0	49.6	46.5	-5.4	-3.5	No
Rec 27	55.0	50.0	53.4	50.3	-1.6	0.3	No
Rec 28	55.0	50.0	54.7	51.7	-0.3	1.7	No
Rec 29	59.6	50.0	52.6	49.5	-7.0	-0.5	No
Rec 30	57.7	50.0	52.9	49.8	-4.8	-0.2	No
Rec 31	57.0	50.0	51.7	48.7	-5.3	-1.3	No
Rec 33	59.0	50.0	55.7	52.6	-3.3	2.6	No
Rec 41	58.2	50.0	50.7	47.7	-7.5	-2.3	No
Rec 42	58.9	50.0	49.6	46.6	-9.3	-3.4	No
Rec 43	59.0	50.0	50.5	47.4	-8.5	-2.6	No
Rec 56	60.5	50.0	53.1	50.1	-7.4	0.1	No
Rec 57	61.0	50.0	54.2	51.2	-6.8	1.2	No
Rec 58	59.6	50.0	50.1	47	-9.5	-3	No

Notes:

[1] Existing Ambient sound levels are the higher of the predicted sound levels due to road traffic, or 55 dBA during the day and 50 dBA during the night.

[2] Build Scenario sound levels are from LRT activity only.

[3] Daytime sound levels are L_{eq} (16h) values, at the OLA; night-time sound levels are L_{eq} (8h) values, at the closest bedroom window.

Based on the sound levels presented in **Table 10** and

Table 11 above, mitigation measures in the form of noise barriers and track/wheel treatments are expected to reduce the increases from the “no-build” to “build” conditions to less than 5 dBA.

3.7 Discussion and Investigation of Noise Mitigation

There are anticipated noise impacts for this project that are above some the noise impact criteria in the MTO Joint Protocol for Noise and the TTC Protocol. Noise barriers and various track/wheel treatment options were quantitatively assessed. These mitigation measures are feasible and would providing between a 5 and 20 dB reduction in sound levels for receivers. A combination of mitigation measures should be investigated as the design of the EELRT progresses. This is a common mitigation measure for LRT trains. Refer to U.S. Federal Transit Administration / Transportation Research Board “TCRP Report 23” wheel Rail Noise Control Manual”, 1997 which is available online at https://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_23.pdf

It is also recommended that additional ambient noise measurements be undertaken at these receptors to further quantify the existing sound levels during the daytime and night-time.

4.0 Operational Noise Impacts – Maintenance and Storage Facility

The proposed Maintenance and Storage Facility (MSF) is located on northern side of Sheppard Avenue, specifically the north-west corner of Sheppard Ave and Conlins Road. A scaled area location plan showing the site with respect to the surrounding area and modelled noise-sensitive receptors is provided in **Figure 29**. A site layout plan, showing the Facility arrangement and source locations, is provided in **Figure 30**. The location of the Facility at Conlins Road and Sheppard Avenue East is zoned under the Former City of Scarborough Employment District By-Law No. 24982 (Rouge). Land-use based on the existing surrounding uses is as follows:

- North: a mix of “OR – Open Space Recreation”, “RD – Residential Detached”.
- East: “RD – Residential Detached”, “RT” – Residential Townhouse, and “RS” – Residential Semi Detached”.
- South: Sheppard Avenue East, portions of the Former City of Scarborough District By-Law No. 24982 (Rouge) and “E”– Employment Industrial”.
- West: “Employment Industrial”, and “Utility and Transportation”.

A copy of the relevant land use maps from the City of Toronto are included in **Appendix D**.

4.1 Applicable Guidelines

The applicable guidelines for assessing noise from the MSF are the “stationary noise” guidelines contained in MECP Publication NPC-300. The NPC-300 guideline sets out sound level limits for two main types of stationary noise sources:

- Non-impulsive, “continuous” (steady) noise sources such as ventilation fans, mechanical equipment, and vehicles while moving within the property boundary of an industry. Continuous noise is measured using 1-hour average sound exposures (Leq (1-hr) values), in dBA; and

- Impulsive noise, which is a “banging” type noise characterized by rapid rise time and decay. Impulsive noise is measured using a logarithmic mean (average) level (LLM) of the impulses in a one-hour period, in dBAI.

The applicable noise limits at a point of reception are the higher of:

- The existing ambient sound level due to road (and in some cases, rail) traffic, or
- The exclusion limits set out in the guideline.

The NPC-300 exclusionary limits for a Class 1 Area are summarized in Error! Reference source not found. for steady sound sources, and Error! Reference source not found. for impulsive sources.

Table 12: NPC-300 Class 1 Area Continuous (Steady, Non-Impulsive) Sound – Exclusionary Limits

Time Period	Outdoor Points of Reception L_{eq} (1h), dBA	Plane of Window of Noise Sensitive Spaces, L_{eq} (1h), dBA [1]
07:00 – 19:00	50	50
19:00 – 23:00	50	50
23:00 – 07:00	n/a	45
Notes: [1] or minimum hourly L_{eq} of background noise, whichever is higher		

Table 13: NPC-300 Class 1 Area Impulsive Sound - Exclusionary Limits

Time of Day	No. of Impulses in 1-hour Period	Minimum Exclusionary Sound Level Limit, L_{eq}(1-hr), dBAI[1]	
		Plane of Window[2]	Outdoors[3]
Daytime/Evening (0700-2300h)	9 or more	50	50
	7 to 8	55	55
	5 to 6	60	60
	4	65	65
	3	70	70
	2	75	75
	1	80	80
Night-time (2300-0700h)	9 or more	45	n/a
	7 to 8	50	n/a
	5 to 6	55	n/a
	4	60	n/a
	3	65	n/a
	2	70	n/a
	1	75	n/a
Notes:			

Time of Day	No. of Impulses in 1-hour Period	Minimum Exclusionary Sound Level Limit, L_{eq}(1-hr), dBAI[1]	
		Plane of Window[2]	Outdoors[3]

[1] Or minimum hourly L_{eq} of background noise; whichever is higher.
[2] Applicable for windows opening into “noise-sensitive spaces” as defined in NPC-300.
[3] Sound level limits during night-time hours are not applicable at outdoor points of reception.

Impulsive noise sources associated with the MSF, such as the decoupling of LRT cars, will be infrequent, and have not been assessed further. This should be further investigated as the project proceeds though detailed design. Information regarding number and locations of car decoupling, locations for welding, hammering, etc. have not been designed at this stage but will be investigated as part of future noise and vibration assessments for the MSF.

Sound level limits for assessing noise produced by emergency equipment operating in non-emergency situations, such as during routine monthly testing or maintenance, are 5 dB greater than the limits otherwise applicable to stationary sources. Additionally, emergency equipment operating in non-emergency situations is to be assessed independently of all other stationary noise sources. Specifications for emergency generators are unknown at this time, and impacts from these sources have not been investigated further. This should be further investigated as the project proceeds though detailed design.

4.2 Points of Reception

A review of the existing noise-sensitive receptors was completed by SLR personnel. 11 surrounding points of reception (PORs) have been identified as being representative of the most sensitive PORs in the vicinity of the MSF. If the guideline limits are met at these locations, they will be met everywhere. All points of reception are shown in **Figure 29**. The PORs are summarized below. Each POR will have an associated outdoor point of reception (OPOR) located to simulate the potential worst-case noise level.

POR 1: Is a two (2) storey detached house located east of the Facility at 1 Antelope Drive in Toronto, Ontario. An outdoor point of reception is located south of the residence. The worst-case impacts on this receptor are located on the second-floor windows (4.5 m in height) on the west and north façade.

POR 2: Is a two (2) storey detached house located east of the Facility at 3 Antelope Drive in Toronto, Ontario. An outdoor point of reception is located south of the residence. The worst-case impacts on this receptor are located on the second-floor windows (4.5 m in height) on the north façade.

POR 3: Is a two (2) storey detached house located east of the Facility at 45 Upper Rouge Trail in Toronto, Ontario. An outdoor point of reception is located north of the residence. The worst-case impacts on this receptor are located on the second-floor windows (4.5 m in height) on the western and northern sides of the residence.

POR 4: Is a two (2) storey detached house located east of the Facility at 4 Antelope Drive, in Toronto, Ontario. An outdoor point of reception is located north of the residence. The worst-case impacts on this receptor are located on the second-floor windows (4.5 m in height) on the north side of the residence.

POR 5: Is a two (2) storey detached house located east of the Facility at 55 Upper Rouge Trail in Toronto, Ontario. An outdoor point of reception is located south of the residence. The worst-case impacts on this receptor are located on the second-floor windows (4.5 m in height) on the west and north façade.

POR 6: Is a two (2) storey detached house located east of the Facility at 65 Upper Rouge Trail in Toronto, Ontario. An outdoor point of reception is located south of the residence. The worst-case impacts on this receptor are located on the second-floor windows (4.5 m in height) on the north façade.

POR 7: Is a two (2) storey detached house located east of the Facility at 66 Upper Rouge Trail in Toronto, Ontario. An outdoor point of reception is located north of the residence. The worst-case impacts on this receptor are located on the second-floor windows (4.5 m in height) on the western and northern sides of the residence. boundary.

POR 8: Is a two (2) storey detached house located east of the Facility at 68 Upper Rouge Trail, in Toronto, Ontario. An outdoor point of reception is located north of the residence. The worst-case impacts on this receptor are located on the second-floor windows (4.5 m in height) on the north side of the residence.

POR 9: Is a two (2) storey detached house located north-west of the Facility at 67 Gennela Square, in Toronto, Ontario. An outdoor point of reception is located south of the residence. The worst-case impacts on this receptor are located on the second-floor windows (4.5 m in height) on the north side of the residence.

POR 10: Is the Alvin Curling Public School located east of the Facility at 50 Upper Rouge Trail, in Toronto, Ontario. The worst-case impacts on this receptor are located on the second-floor windows (6.0 m in height) on the west side of the school.

POR 11: Is the Extendicare Rouge Valley Assisted Living Facility located south of the Facility at 551 Conlins Road, in Toronto, Ontario. The worst-case impacts on this receptor are located on the second-floor windows (4.5 m in height) on the west side of the school.

4.3 Assumed Noise Sources

The mechanical design of the MSF has not progressed to the point where actual equipment selections have been made. As a result, the noise impact assessment has been based on they types and numbers of equipment located at similar facilities, such as the Eglington Crosstown MSF at Mount Dennis, and the TTC Wilson Station MSF.

The following noise sources are assumed:

- Ten (10) heating, ventilation, and air conditioning units, rated at 20 tonnes each;
- Seven (7) exhaust fans servicing the maintenance bays;
- Four (4) make-up air units; and
- Movement of LRTs throughout the yard for storage and maintenance.

The sound levels for all sources listed above, were assumed based on SLR's in-house database for similar types of equipment. Noise from LRT movements were predicted using the FTA modelling algorithms. In the absence of any manufacturer provided sound levels, FTA reference sound levels with a source sound exposure level of 82 dBA at 15m (50ft) and a source height of 0.6m (2ft) (FTA Manual for rail/transit cars) were used for the light-rail system as per the Environmental Guide for Noise and Vibration Impact Assessment (Metrolinx, October 2020).

The assumed modelled locations of the significant noise sources are shown in **Figure 30**. Sound level data used in the assessment were obtained from SLR's in-house database for similar types of equipment. The data used in the analysis is provided in **Appendix E**.

4.4 Impact Assessment

4.4.1 Operating Conditions/Scenarios

Based on assumptions made, the MSF is expected to be in operation 24 hours per day, 7 days per week. To represent a worst-case simulation of the noise emissions, all exhaust fans, HVAC units, and MUAs were assumed to be in operation continuously (100% duty cycle) throughout the daytime and evening, and 50% duty cycle was assumed for the night-time operations. Exhaust fans are not expected to be in operation during the night-time period as maintenance is assumed to be scheduled during the daytime.

4.4.2 Noise Impact Modelling

were modelled using Cadna/A, a computerized version of the internationally recognized ISO 9613-2 noise propagation algorithms. This is the preferred noise modelling methodology of the MECP. The ISO 9613 equations account for:

- Source to receiver geometry
- Distance attenuation
- Atmospheric absorption
- Reflections off of the ground and ground absorption
- Reflections off of vertical walls
- Screening effects of buildings, terrain, and purpose-built noise barriers (noise walls, berms, etc.).

The following additional parameters were used in the modelling, which are consistent with providing a conservative (worst-case assessment of noise levels):

- Temperature: 10°C
- Relative Humidity: 70%
- Ground Absorption G: G=1.0 (absorptive) as default global parameter, specific reflective areas such as paved areas and parking lots defined as G=0.0 (reflective).
- Reflection: An order of reflection of 1 was used (accounts for noise reflecting from walls)
- Wall Absorption Coefficients: Set to 0.21 (21 % of energy is absorbed, 79% reflected)
- Terrain: Assumed to be flat

4.4.3 Predicted Stationary Sound Levels – Unmitigated

The predicted sound levels at each receptor are summarized in Error! Reference source not found. and Error! Reference source not found. for façade and outdoor amenity areas, respectively for continuous noise. Predicted sound level contours are shown in **Figure 31** to **Figure 33** for continuous noise for daytime/evening and night-time operations at 4.5m, and 1.5m respectively. A sample modelling output file for POR1 is included in
Appendix F.

Table 14: Stationary Noise - Continuous – Results for Façades - Unmitigated

Receptor ID	Point of Reception Description	Predicted Sound Level (L_{eq} – 1hr) (dBA)			Performance Limits (L_{eq}) (dBA)			Meets Guideline? (Y/N)
		Day	Eve	Night	Day	Eve	Night	
POR 1	1 Antelope Drive	50	49	49	50	50	45	**No**
POR 2	3 Antelope Drive	44	43	43	50	50	45	Yes
POR 3	45 Upper Rouge Trail	43	42	42	50	50	45	Yes
POR 4	4 Antelope Drive	42	41	41	50	50	45	Yes
POR 5	55 Upper Rouge Trail	42	41	41	50	50	45	Yes
POR 6	65 Upper Rouge Trail	42	41	41	50	50	45	Yes
POR 7	66 Upper Rouge Trail	44	43	43	50	50	45	Yes
POR 8	68 Upper Rouge Trail	53	53	53	50	50	45	**No**
POR 9	67 Gennela Square	42	40	39	50	50	45	Yes
POR 10	Alvin Curling Public School	58	58	N/A [1]	50	50	N/A [1]	**No**
POR 11	Extendicare Rouge Valley	49	49	48	50	50	45	No
Notes: [1] Institutional facilities such as schools are not assessed during the night-time period when they are inactive, per NPC-300.								

Table 15: Stationary Noise - Continuous – Results for Outdoor Points of Reception - Unmitigated

Receptor ID	Point of Reception Description	Predicted Sound Level (L_{eq} – 1hr) (dBA)			Performance Limits (L_{eq}) (dBA)			Meets Guideline? (Y/N)
		Day	Eve	Night	Day	Eve	Night	
OPOR1	1 Antelope Drive	51	51	50	50	50	45	**No**
OPOR2	3 Antelope Drive	43	43	41	50	50	45	Yes
OPOR3	45 Upper Rouge Trail	42	41	40	50	50	45	Yes
OPOR4	4 Antelope Drive	39	38	38	50	50	45	Yes
OPOR5	55 Upper Rouge Trail	42	41	40	50	50	45	Yes
OPOR6	65 Upper Rouge Trail	41	40	39	50	50	45	Yes
OPOR7	66 Upper Rouge Trail	55	55	55	50	50	45	**No**
OPOR8	68 Upper Rouge Trail	55	55	55	50	50	45	**No**
OPOR9	67 Gennela Square	41	39	38	50	50	45	Yes

Based on the sound levels presented in Error! Reference source not found. and Error! Reference source not found. excesses of the NPC-300 guidelines are predicted at POR1, POR8, POR 10, OPOR1, OPOR7, and OPOR8. Mitigation strategies were investigated to achieve reduction in sound levels at the applicable PORs and associated OPORs.

4.4.4 Predicted Stationary Sound Levels - Mitigated

Mitigation measures were investigated. The assumed mitigation measures are:

- Similar to operational noise, the use of "resilient wheels" on the LRT trains, which incorporate elastomer springs between the tire and wheel rim to provide compliance between these components. As a conservatism, a reduction of 10 dB to wheel squeal noise has been assumed. The actual reduction may be higher.
- Noise barriers, in the form of a 2.0 m high noise wall, located along the property line of the facility, as shown in **Figure 37**.

The predicted mitigated sound levels at the surrounding points of reception are presented in Error! Reference source not found. and Error! Reference source not found.in **Figure 34** to **Figure 36** for daytime/evening and night-time operations at 4.5m (PORs) and 1.5m (OPORs), respectively.

Table 16: Stationary Noise - Continuous – Results for Façades - Mitigated

Receptor ID	Point of Reception Description	Predicted Sound Level (L_{eq} – 1hr) (dBA)			Performance Limits (L_{eq}) (dBA)			Meets Guideline? (Y/N)
		Day	Eve	Night	Day	Eve	Night	
POR 1	1 Antelope Drive	46	45	43	50	50	45	Yes
POR 2	3 Antelope Drive	42	41	39	50	50	45	Yes
POR 3	45 Upper Rouge Trail	41	41	39	50	50	45	Yes
POR 4	4 Antelope Drive	38	37	36	50	50	45	Yes
POR 5	55 Upper Rouge Trail	39	38	37	50	50	45	Yes
POR 6	65 Upper Rouge Trail	38	36	36	50	50	45	Yes
POR 7	66 Upper Rouge Trail	39	38	37	50	50	45	Yes
POR 8	68 Upper Rouge Trail	40	40	38	50	50	45	Yes
POR 9	67 Gennela Square	39	38	35	50	50	45	Yes
POR 10	Alvin Curling Public School	49	49	N/A[1]	50	50	N/A[1]	Yes

Receptor ID	Point of Reception Description	Predicted Sound Level (L_{eq} – 1hr) (dBA)			Performance Limits (L_{eq}) (dBA)			Meets Guideline? (Y/N)
		Day	Eve	Night	Day	Eve	Night	
POR 11	Extendicare Rouge Valley	47	47	45	50	50	45	Yes
Notes: [1] Institutional facilities are not assessed during the night-time period per NPC-300.								

Table 17: Stationary Noise - Continuous – Results for Outdoor Points of Reception - Mitigated

Receptor ID	Point of Reception Description	Predicted Sound Level (L_{eq} – 1hr) (dBA)			Performance Limits (L_{eq}) (dBA)			Meets Guideline? (Y/N)
		Day	Eve	Night	Day	Eve	Night	
OPOR1	1 Antelope Drive	45	45	42	50	50	45	Yes
OPOR2	3 Antelope Drive	43	42	41	50	50	45	Yes
OPOR3	45 Upper Rouge Trail	41	41	39	50	50	45	Yes
OPOR4	4 Antelope Drive	37	34	35	50	50	45	Yes
OPOR5	55 Upper Rouge Trail	41	40	39	50	50	45	Yes
OPOR6	65 Upper Rouge Trail	41	40	39	50	50	45	Yes
OPOR7	66 Upper Rouge Trail	41	41	39	50	50	45	Yes
OPOR8	68 Upper Rouge Trail	41	41	39	50	50	45	Yes
OPOR9	67 Gennela Square	37	36	33	50	50	45	Yes

Based on the sound levels presented in Error! Reference source not found. and Error! Reference source not found., noise levels from MSF can meet the NPC-300 guideline limits with the incorporation of feasible mitigation measures. The final design and selection of mitigation measures would be made during the detailed design of the MSF, to ensure the applicable guideline limits are met.

5.0 Operational Noise Impacts – Traction Power Sub-Stations

The project will include a number of Traction Power Sub-Stations (TPSSs) which use alternating current (AC) electricity from the local grid to provide the direct current (DC) electrical power needed to operate the LRT line. The TPSSs are small buildings approximately the size of a shipping container and will generally be located about one every kilometer along the route. There are exhaust fans, transformers, and other noise sources associated with the TPSS buildings.

The locations of the TPSS units have not been specified at this time, and therefore a noise impact assessment cannot be completed until later in the project design process. The TPSS units are “stationary sources” under MECP Publication NPC-300, and the Class 1 Area noise guideline limits specified in Section 4.1 will apply.

An assessment of potential noise impacts from TPPS units should be completed as the design progresses. If required, there are feasible mitigation measures which can be used to ensure the applicable noise guideline limits are met.

6.0 Operational Vibration Assessment

6.1 Applicable Guideline Limits

The MECP/TTC Protocol has been adopted for this project. The Protocol outlines ground-borne vibration limits, and states that vibration levels must not exceed 0.1 mm/s RMS (72 VdB re: 1µ·in/sec) for any residential point of reception within 15 metres of the LRT tracks.

6.1.1 Methodology

Vibration levels were predicted at sensitive receptors along the corridor. Levels are predicted in using the methodology outlined in the FTA Transit Noise and Vibration Impact Manual (FTA, 2006). Corrections for both speed and setback distance have been accounted for. The assumptions for predictions of operational vibration are listed in the section below.

6.1.2 Assumptions

The following assumptions have been made for the prediction of operational vibration at the vibration-sensitive receptors:

- Maximum design speed of 60 km/h;
- FTA Base Curve – Rapid/Light-Rail;
- No Special Vehicle Parameters;
- No Special Track Conditions;
- No Special Track Treatments;
- No Track Configuration Effects;
- Standard Geology;
- Wood Frame House Building Foundation (-5 VdB)
- Receiver located at grade; and
- No Resonance Amplification.

6.2 Vibration Assessment

Vibration levels at the Project’s foundations were determined using adjustments for distance, speed of LRT movement and worst-case soil characteristics contained in the U.S. Federal Transit Administration (“FTA”) Transit Noise and Vibration Impact Assessment Manual.
The reduction of predicted levels due to the building’s foundation elements were not included as a conservative assessment. The estimated vibration levels at the points of reception are summarized below in **Table 18**. A sample calculation is provided in **Appendix F**.

Table 18: Predicted RMS Vibration Levels at Receptors - Operational LRT Movement

Receptor No.	Distance to Track (m)	Predicted Vibration Level (mm/s, RMS)	Meets MECP/TTC Protocol Limit of 0.100 mm/s, RMS?	Mitigation Investigation Needed (Yes/No)
Rec 1	24	0.032	Yes	No
Rec 2	75	0.009	Yes	No
Rec 3	23	0.033	Yes	No
Rec 4	25	0.031	Yes	No
Rec 5	88	0.007	Yes	No
Rec 6	62	0.011	Yes	No
Rec 7	38	0.020	Yes	No
Rec 8	159	0.002	Yes	No
Rec 9	36	0.021	Yes	No
Rec 10	24	0.032	Yes	No
Rec 11	25	0.031	Yes	No
Rec 12	26	0.030	Yes	No
Rec 13	35	0.022	Yes	No
Rec 14	21	0.037	Yes	No
Rec 15	32	0.024	Yes	No
Rec 16	33	0.023	Yes	No
Rec 17	23	0.033	Yes	No
Rec 18	26	0.030	Yes	No
Rec 19	61	0.011	Yes	No
Rec 20	215	0.001	Yes	No
Rec 21	215	0.001	Yes	No
Rec 22	217	0.001	Yes	No
Rec 23	221	0.001	Yes	No
Rec 24	233	0.001	Yes	No
Rec 25	214	0.001	Yes	No
Rec 26	149	0.002	Yes	No
Rec 27	104	0.005	Yes	No
Rec 28	81	0.008	Yes	No
Rec 29	48	0.015	Yes	No
Rec 30	26	0.030	Yes	No
Rec 31	27	0.029	Yes	No
Rec 32	30	0.026	Yes	No
Rec 33	35	0.022	Yes	No

Receptor No.	Distance to Track (m)	Predicted Vibration Level (mm/s, RMS)	Meets MECP/TTC Protocol Limit of 0.100 mm/s, RMS?	Mitigation Investigation Needed (Yes/No)
Rec 34	33	0.023	Yes	No
Rec 35	39	0.020	Yes	No
Rec 36	32	0.024	Yes	No
Rec 37	34	0.023	Yes	No
Rec 38	27	0.029	Yes	No
Rec 39	41	0.019	Yes	No
Rec 40	35	0.022	Yes	No
Rec 41	36	0.021	Yes	No
Rec 42	36	0.021	Yes	No
Rec 43	30	0.026	Yes	No
Rec 44	41	0.019	Yes	No
Rec 45	37	0.021	Yes	No
Rec 46	30	0.026	Yes	No
Rec 47	32	0.024	Yes	No
Rec 48	30	0.026	Yes	No
Rec 49	30	0.026	Yes	No
Rec 50	35	0.022	Yes	No
Rec 51	20	0.038	Yes	No
Rec 52	19	0.040	Yes	No
Rec 53	19	0.040	Yes	No
Rec 54	36	0.021	Yes	No
Rec 55	36	0.021	Yes	No
Rec 56	37	0.021	Yes	No
Rec 57	37	0.021	Yes	No
Rec 58	43	0.017	Yes	No
Rec 59	36	0.021	Yes	No
Rec 60	26	0.030	Yes	No
Rec 61	30	0.026	Yes	No
Rec 62	39	0.020	Yes	No

Vibration levels from LRT operations are expected to meet the criteria at all receptors, and vibration mitigation is not anticipated to be required. This should be confirmed as the project proceeds to detail design.

7.0 Construction Noise and Vibration Impacts

Construction noise and vibration impacts are temporary in nature, and largely unavoidable. Although for some periods and types of work, construction noise and vibration may be noticeable, with adequate controls, impacts can be minimized. This section of the report provides an overview of the by-law and recommends a Code of Practice to minimize impacts.

7.1 Construction Noise and Vibration Assessment Guidelines

7.1.1 Construction Noise Guidelines

In Ontario, there are no limits on overall construction noise levels. There are limits on the noise levels which can be emitted from specific items of equipment, and limitations on the timing of construction activities.

7.1.1.1 City of Toronto Noise Bylaw

The City of Toronto noise by-law is enshrined in Chapter 591 of the Municipal Code. Construction noise is a regulated activity under Section 591-2.3. This section states:

> § 591-2.3. Construction.
>
> No person shall emit or cause or permit the emission of sound resulting from any operation of construction equipment or any construction that is clearly audible at a point of reception:
>
> (1) from 7 p.m. to 7 a.m. the next day, except until 9 a.m. on Saturdays; and
>
> (2) all day on Sundays and statutory holidays.

Therefore, construction activities are generally prohibited during the overnight period. However, there may be some activities, such as crane work or the continuous pouring of concrete, which may require nigh-time activity. In these cases, an exemption must be sought under Section 591-3.3 of the By-law prior to the start of work. The exemption application will require:

a) Reasons supporting an exemption permit;
b) A noise mitigation plan;
c) A statement certified by a professional engineer or acoustical consultant for any sounds that are not technically or operationally feasible to control.

As the project proceeds and the construction plan is developed, the Contractor should seek any required exemptions.

7.1.1.2 MECP Publication NPC-115

The MECP stipulates limits on noise emissions from individual items of equipment, rather than for overall construction noise. In the presence of persistent noise complaints, sound emission standards for the various types of construction equipment used on the project should be checked to ensure that they meet the specified limits contained within MECP Publication NPC-115 – “Construction Equipment”. These limits are provided in **Table 19**.

Table 19: NPC-115 Maximum Noise Emission Levels for Typical Construction Equipment

Type of Unit	Maximum Sound Level [1]	Distance (m)	Power Rating (kW)
Excavation Equipment [2]	83	15	<75
	85	15	>75
Pneumatic Equipment [3]	85	7	-
Portable Compressors	76	7	-

Notes:

[1] Maximum permissible sound levels presented here are for equipment manufactured after January 1, 1981.

[2] Excavation equipment includes bulldozers, backhoes, front end loaders, graders, excavators, steam rollers and other equipment capable of being used for similar applications.

[3] Pneumatic equipment includes pavement breakers.

As the project proceeds and the construction plan is developed, the Contractor should ensure that equipment used meets the Publication NPC-115 noise emission limits.

7.1.2 Construction Vibration Guidelines

Blasting is not expected to occur as part of this project's construction processes. Regardless, vibration from construction activities can affect surrounding structures. The City of Toronto By-Law 514-2008 specifies "Do-Not-Exceed" threshold limits as listed in **Table 20** to address structural concerns for nearby adjacent structures:

Table 20: City of Toronto "Do-Not-Exceed" Threshold Limits

Frequency of Vibration (Hz)	Peak Particle Velocity (mm/s)
Less than 4	8 [1]
Between 4 and 10	15
Greater than 10	25

Note:

[1] While the threshold limit is 8 mm/s for frequencies below 4 Hz, 62.5% of the threshold limit, i.e., 5 mm/s, is given as an appropriate cautionary threshold for most structures and typically serves as the industry best practice for defining the Zone of Influence.

The Construction Vibration By-law requires that any application for a permit for construction, including demolition, shall submit as part of the permit application a vibration control assessment, outlining:

- The nature of the construction activity;
- The identification of a "zone of influence" (ZOI) where vibration impacts could potentially occur, and The identification of structures, residences, vibration sensitive uses, and buildings designated under the Ontario Heritage Act within the ZOI area;
- A Pre-construction consultation, inspection and monitoring program;
- Monitoring of vibrations during construction; and
- A public communications and complaint protocol.

7.1.2.1 Zone of Influence of Construction Vibration

The City of Toronto By-Law requires determination of the ZOI associated with construction activities. Chapter 363 of The City of Toronto Municipal Code defines this as follows:

> "The area of land within or adjacent to a construction site, including any buildings or structures, that potentially may be impacted by vibrations emanating from a construction activity where the peak particle velocity measured at the point of reception is equal to or greater than five (5) mm/sec at any frequency or such greater area where specific site conditions are identified by the professional engineer in a preliminary vibration study."

Heritage designated/listed properties have a more stringent 3 mm/s limit as noted previously.

For this study the model recommended by the Federal Transit Administration (FTA) in the United States has been applied for prediction of vibration impacts during construction and to establish the extent of the ZOI. The source vibration levels associated with the equipment planned for shoring/excavation were specified based on data in the FTA document, as well as SLR's own measurement data collected on construction projects.

The ZOI was determined based on the following numerical model:

$$\mathrm{PPV}_{equip} = \mathrm{PPV}_{ref} \times (25/D)^{\gamma}$$ [1]

Where:

- PPV_{equip} is the estimated peak particle (ground) velocity at distance D from the equipment;
- PPV_{ref} is the peak particle (ground) velocity due to operation of the source equipment at an offset distance of 25 ft (7.6 m); and,
- γ is the ground vibration decay factor (γ = 1.25).

Estimation of the ZOI requires solving equation (1) for D when PPV_{ref} = 5 mm/sec for general adjacencies or 3 mm/s for designated/listed heritage property, respectively. This calculation is completed for each anticipated equipment type to establish the maximum (worst-case) offset of the ZOI from the extent of the construction activity.

The source level for the equipment used in this study (PPV_{ref}), and associated ZOI offset distances for each case are summarized in **Table 21**.

[1] Structural Vibration, Part 3: Effects of Vibrations on Structures, Deutsche Norm, February 1999

Table 21: Summary of ZOI Offset Associated with Construction Activities

Equipment/Activity	Peak Particle Velocity – PPV @ 1m Setback (mm/s)	ZOI[1] Setback Distance (m)	Heritage Building ZOI[2] Setback Distance (m)
Vibratory Roller	107	8	11
Compactor	166	10	15
Large Bulldozer	48	6	4
Loaded Trucks	41	4	6
Excavator	9	2	3

Note:

[1] The Zone of Influence is the offset distance from the equipment/source at which ground vibration levels are estimated to not exceed 5 mm/s.

[2] The Zone of Influence offset distance for designated/listed heritage properties uses a vibration threshold of 3 mm/s.

7.2 Predicted Construction Vibration Levels

The predicted peak vibration levels for the receptors during groundwork activities, considering the 5 mm/s and 3 mm/s PPV target level criteria are presented in **Table 22**.

Table 22: Predicted Construction Vibration Levels at Sensitive Receptors

Receptor No.	Distance to Track (m)	Predicted Vibration Level (PPV, mm/s)					Meets 5 mm/s Guideline? (Y/N)
		Compactor	Vibratory Roller	Large Bulldozer	Loaded Trucks	Excavator	
Rec 1	24	1.413	0.907	0.404	0.346	0.080	Y
Rec 2	75	0.256	0.164	0.073	0.063	0.014	Y
Rec 3	23	1.506	0.967	0.431	0.368	0.085	Y
Rec 4	25	1.329	0.853	0.380	0.325	0.075	Y
Rec 5	88	0.201	0.129	0.058	0.049	0.011	Y
Rec 6	62	0.340	0.219	0.097	0.083	0.019	Y
Rec 7	38	0.709	0.455	0.203	0.173	0.040	Y
Rec 8	159	0.083	0.053	0.024	0.020	0.005	Y
Rec 9	36	0.769	0.494	0.220	0.188	0.044	Y
Rec 10	24	1.413	0.907	0.404	0.346	0.080	Y
Rec 11	25	1.329	0.853	0.380	0.325	0.075	Y
Rec 12	26	1.253	0.805	0.358	0.307	0.071	Y
Rec 13	35	0.802	0.515	0.229	0.196	0.045	Y
Rec 14	21	1.726	1.109	0.494	0.422	0.098	Y
Rec 15	32	0.918	0.589	0.262	0.225	0.052	Y
Rec 16	33	0.876	0.563	0.251	0.214	0.050	Y
Rec 17	23	1.506	0.967	0.431	0.368	0.085	Y
Rec 18	26	1.253	0.805	0.358	0.307	0.071	Y

Receptor No.	Distance to Track (m)	Predicted Vibration Level (PPV, mm/s)					Meets 5 mm/s Guideline? (Y/N)
		Compactor	Vibratory Roller	Large Bulldozer	Loaded Trucks	Excavator	
Rec 19	61	0.349	0.224	0.100	0.085	0.020	Y
Rec 20	215	0.053	0.034	0.015	0.013	0.003	Y
Rec 21	215	0.053	0.034	0.015	0.013	0.003	Y
Rec 22	217	0.052	0.033	0.015	0.013	0.003	Y
Rec 23	221	0.051	0.032	0.014	0.012	0.003	Y
Rec 24	233	0.047	0.030	0.013	0.011	0.003	Y
Rec 25	214	0.053	0.034	0.015	0.013	0.003	Y
Rec 26	149	0.091	0.059	0.026	0.022	0.005	Y
Rec 27	104	0.157	0.101	0.045	0.038	0.009	Y
Rec 28	81	0.228	0.146	0.065	0.056	0.013	Y
Rec 29	48	0.500	0.321	0.143	0.122	0.028	Y
Rec 30	26	1.253	0.805	0.358	0.307	0.071	Y
Rec 31	27	1.184	0.760	0.339	0.290	0.067	Y
Rec 32	30	1.011	0.649	0.289	0.247	0.057	Y
Rec 33	35	0.802	0.515	0.229	0.196	0.045	Y
Rec 34	33	0.876	0.563	0.251	0.214	0.050	Y
Rec 35	39	0.682	0.438	0.195	0.167	0.039	Y
Rec 36	32	0.918	0.589	0.262	0.225	0.052	Y
Rec 37	34	0.838	0.538	0.240	0.205	0.047	Y
Rec 38	27	1.184	0.760	0.339	0.290	0.067	Y
Rec 39	41	0.633	0.406	0.181	0.155	0.036	Y
Rec 40	35	0.802	0.515	0.229	0.196	0.045	Y
Rec 41	36	0.769	0.494	0.220	0.188	0.044	Y
Rec 42	36	0.769	0.494	0.220	0.188	0.044	Y
Rec 43	30	1.011	0.649	0.289	0.247	0.057	Y
Rec 44	41	0.633	0.406	0.181	0.155	0.036	Y
Rec 45	37	0.738	0.474	0.211	0.181	0.042	Y
Rec 46	30	1.011	0.649	0.289	0.247	0.057	Y
Rec 47	32	0.918	0.589	0.262	0.225	0.052	Y
Rec 48	30	1.011	0.649	0.289	0.247	0.057	Y
Rec 49	30	1.011	0.649	0.289	0.247	0.057	Y
Rec 50	35	0.802	0.515	0.229	0.196	0.045	Y
Rec 51	20	1.857	1.193	0.531	0.454	0.105	Y
Rec 52	19	2.006	1.288	0.574	0.491	0.113	Y
Rec 53	19	2.006	1.288	0.574	0.491	0.113	Y
Rec 54	36	0.769	0.494	0.220	0.188	0.044	Y
Rec 55	36	0.769	0.494	0.220	0.188	0.044	Y

Receptor No.	Distance to Track (m)	Predicted Vibration Level (PPV, mm/s)					Meets 5 mm/s Guideline? (Y/N)
		Compactor	Vibratory Roller	Large Bulldozer	Loaded Trucks	Excavator	
Rec 56	37	0.738	0.474	0.211	0.181	0.042	Y
Rec 57	37	0.738	0.474	0.211	0.181	0.042	Y
Rec 58	43	0.589	0.378	0.168	0.144	0.033	Y
Rec 59	36	0.769	0.494	0.220	0.188	0.044	Y
Rec 60	26	1.253	0.805	0.358	0.307	0.071	Y
Rec 61	30	1.011	0.649	0.289	0.247	0.057	Y
Rec 62	39	0.682	0.438	0.195	0.167	0.039	Y

Vibration impacts from construction are not anticipated. Regardless, as the project proceeds and the construction plan is developed, the Contractor should submit as part of the permit applications the required vibration control assessments and forms.

7.3 Construction Noise and Vibration Code of Practice

To minimize the potential for construction noise and vibration impacts, as the project design and construction plan proceeds, it is recommended that provisions be written into the contract documentation for the Contractor, as outlined below:

- Construction should be limited to the time periods allowed by the City Noise By-law. If construction activities are required outside of these hours, the Contractor must seek permits / exemptions directly from the City in advance.
- All equipment should be properly maintained to limit noise emissions. As such, all construction equipment should be operated with effective muffling devices that are in good working order.
- Screening level predictions of construction noise levels should be completed, particularly for areas where construction activity may occur for long durations, such as laydown yards, platforms or traction power substations. Sound levels may be predicted using the methods outlined in the U.S. FHWA *Construction Noise Handbook*. Where sound levels at residences are predicted to exceed 75 dBA during the day or 70 dBA at night, then noise control measures should be developed to reduce noise levels as much as is practicable. Such measures could include:
    - Staging of operations;
    - Hoarding or other noise barriers; and
    - Use of alternate construction methods.
- The Contract documents should contain a provision that any initial noise complaint will trigger verification that the general noise control measures agreed to are in effect.
- In the presence of persistent noise complaints, all construction equipment should be verified to comply with MOE NPC-115 guidelines.
- In the presence of persistent complaints and subject to the results of a field investigation, alternative noise control measured may be required, where reasonably available. In selecting appropriate noise control and mitigation measures, consideration should be given to the technical, administrative and economic feasibility of the various alternatives.

- The Contractor should submit as part of the permit applications the vibration control assessments and forms required under City of Toronto By-Law 514-2008, and follow any recommendations and requirements.

8.0 Conclusions and Recommendations

The potential environmental noise impacts of the proposed undertaking have been assessed. Both operational and construction noise and vibration impacts have been considered. The conclusions and recommendations are as follows:

Operational Noise

- The results show that changes in sound levels resulting from the proposed project are expected to be very minor for the receptors along Eglinton Avenue East, and Sheppard Avenue.
- In the areas surrounding Military Trail, the USTC Campus, and Neilson Road, unmitigated excesses over the criteria are predicted at Receptors 19, 25 to 30, 33, 41 to 43, and 56 to 58. Mitigation in these areas is feasible and can include noise barriers, track treatment, and wheel treatment. Sound levels are driven by wheel squeal from the turns in the LRT track alignment. With the implementation of track/wheel treatments and noise barriers, the EELRT is expected to meet the applicable guidelines at all noise sensitive areas. Preliminary noise barrier locations are shown in **Figure 28**.
- Stationary noise from the Maintenance and Storage Facility has been assessed at the surrounding noise-sensitive points of reception. Based on a preliminary assessment, excesses of the NPC-300 guidelines are predicted at some of the surrounding receptors.
- With the implementation of track/wheel treatments and property line noise barriers, the MSF is expected to meet applicable guidelines at all points of reception. Preliminary noise barrier locations are provided in **Figure 37**.
- Traction Power Sub-stations (TPSS) will need to be evaluated as the project proceeds, but feasible mitigation measures can be used to ensure compliance with the noise guidelines.
- As the project design proceeds, the mitigation measures should be reviewed by an Acoustical Consultant to ensure that the applicable criteria are met for the final design.
- An acoustic audit should be performed when all mitigative measures are implemented to confirm noise reduction and compliance with NPC-300 limits.

Operational Vibration

- Maximum ground-borne vibration levels from operational EELRT movements are predicted to meet the MOEE/TTC Protocol criteria. Therefore, no additional mitigation measures are anticipated to be required.
- As the project design proceeds, the mitigation measures should be be reviewed by an Acoustical Consultant to ensure that the applicable criteria are met for the final design.

Construction Noise and Vibration

- Construction noise and vibration impacts are temporary in nature but may be noticeable at times in nearby residential NSAs. Methods to minimize construction noise and vibration impacts should be included in the Construction Code of Practice, as outlined in Section 6.

9.0 Closure

Should you have questions on the above report, please contact the undersigned.

Regards,

SLR Consulting (Canada) Ltd.

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Senior Acoustics Consultant

DRAFT

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Principal Acoustics Engineer

10.0 References

City of Toronto Construction Vibration By-law 514-2008, Chapter 363 of the Municipal Code.

City of Toronto Noise By-law, Chapter 591 of the Municipal Code.

Ontario Ministry of the Environment, Conservation and Parks (MECP), 1977, *Model Municipal Noise Control Bylaw,* which includes Publication NPC-115 – Construction Equipment

Ontario Ministry of the Environment, Conservation and Parks (MECP) and Ontario Ministry of Transportation (MTO), 1986, “Joint Protocol”, *A Protocol for Dealing with Noise Concerns During the Preparation, Review and Evaluation of Provincial Highways Environmental Assessments*

Ontario Ministry of the Environment, Conservation and Parks (MECP), 1989, Ontario Road Noise Analysis Method for Environment and Transportation (ORNAMENT)

Ontario Ministry of the Environment, Conservation and Parks (MECP) and Toronto Transit Commission (TTC), 1993, *Protocol for Noise and Vibration Assessment for the Proposed Scarborough Rapid Transit Extension*.

Ontario Ministry of the Environment, Conservation and Parks (MECP), 2000, STAMSON v5.04: Road, Rail and Rapid Transit Noise Prediction Model

Ontario Ministry of the Environment, Conservation and Parks (MECP), 2013, *Environmental Noise Guideline*: *Stationary and Transportation Sources – Approval and Planning, Publication NPC-300*

U.S. Federal Highway Administration (FHWA), 2006, *Highway Construction Noise Handbook* FHWA-HEP-06-015.

U.S. Federal Transit Administration (FTA), 2006. *Transit Noise and Vibration Impact Assessment Manual.* FTA-VA-90-1003-06.

Figures

Noise and Vibration Assessment DRAFT

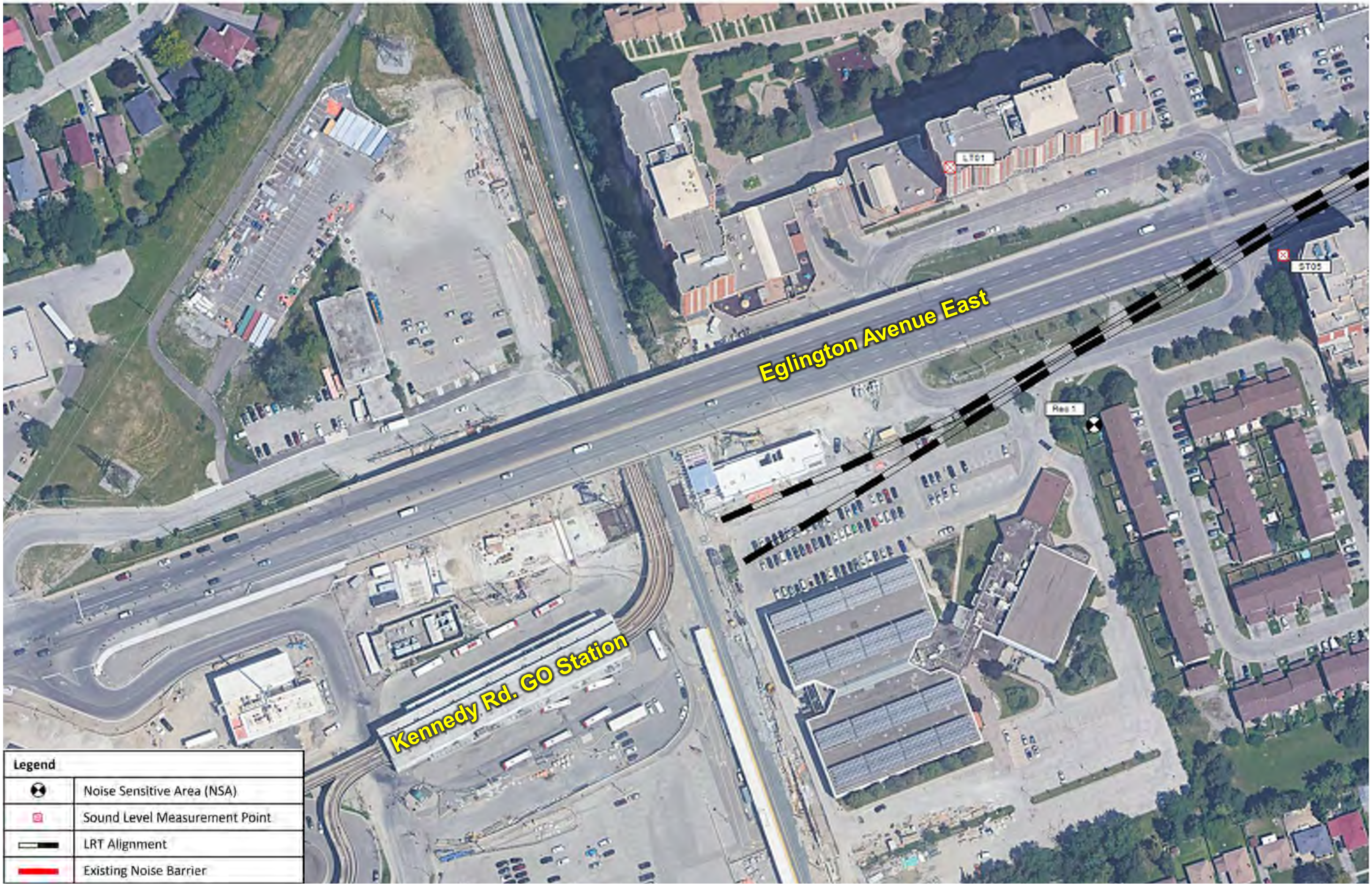
Eglinton East LRT

HDR. Inc.

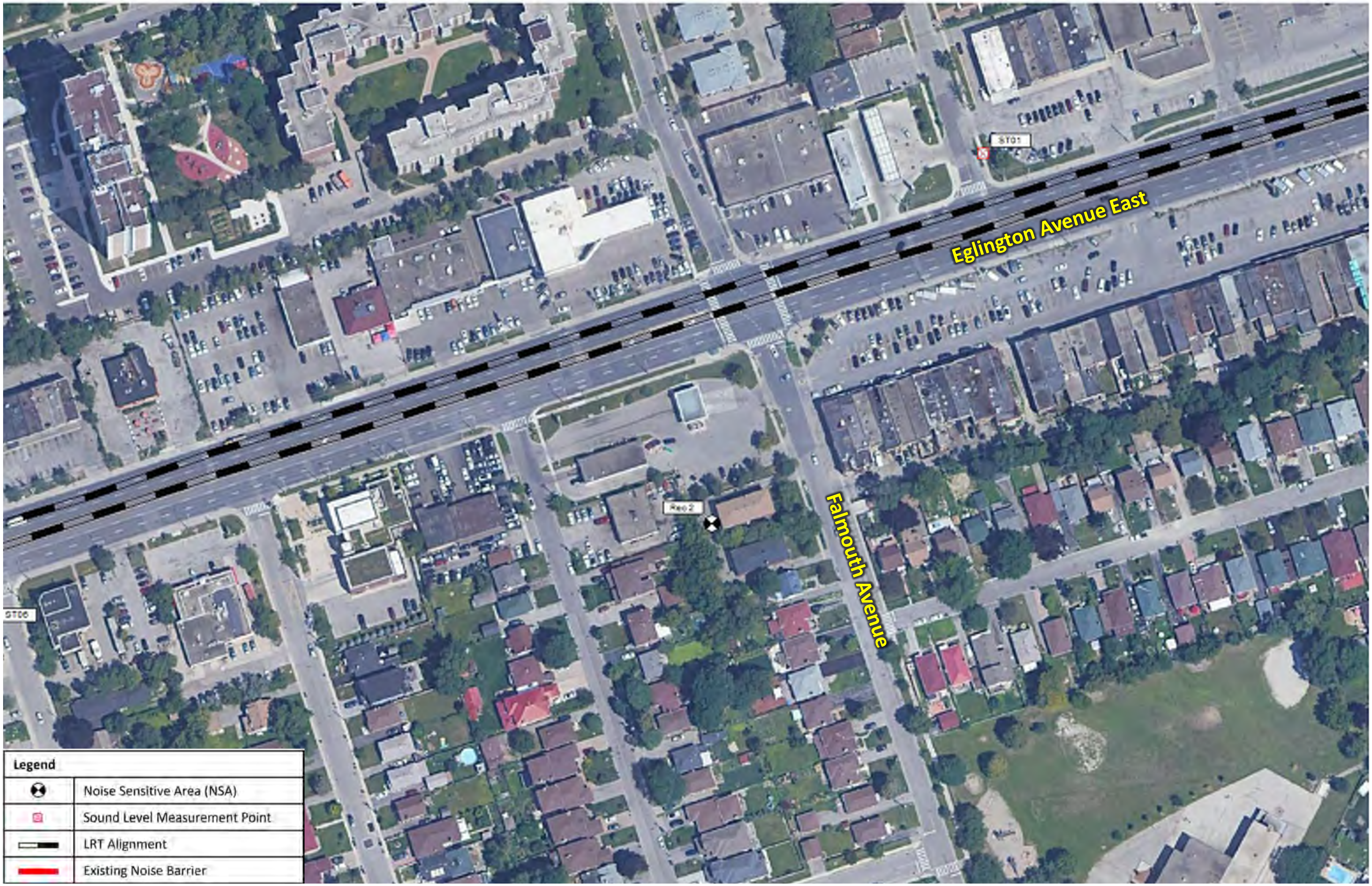
SLR Project No.: 241.030932.00001

May 15, 2024

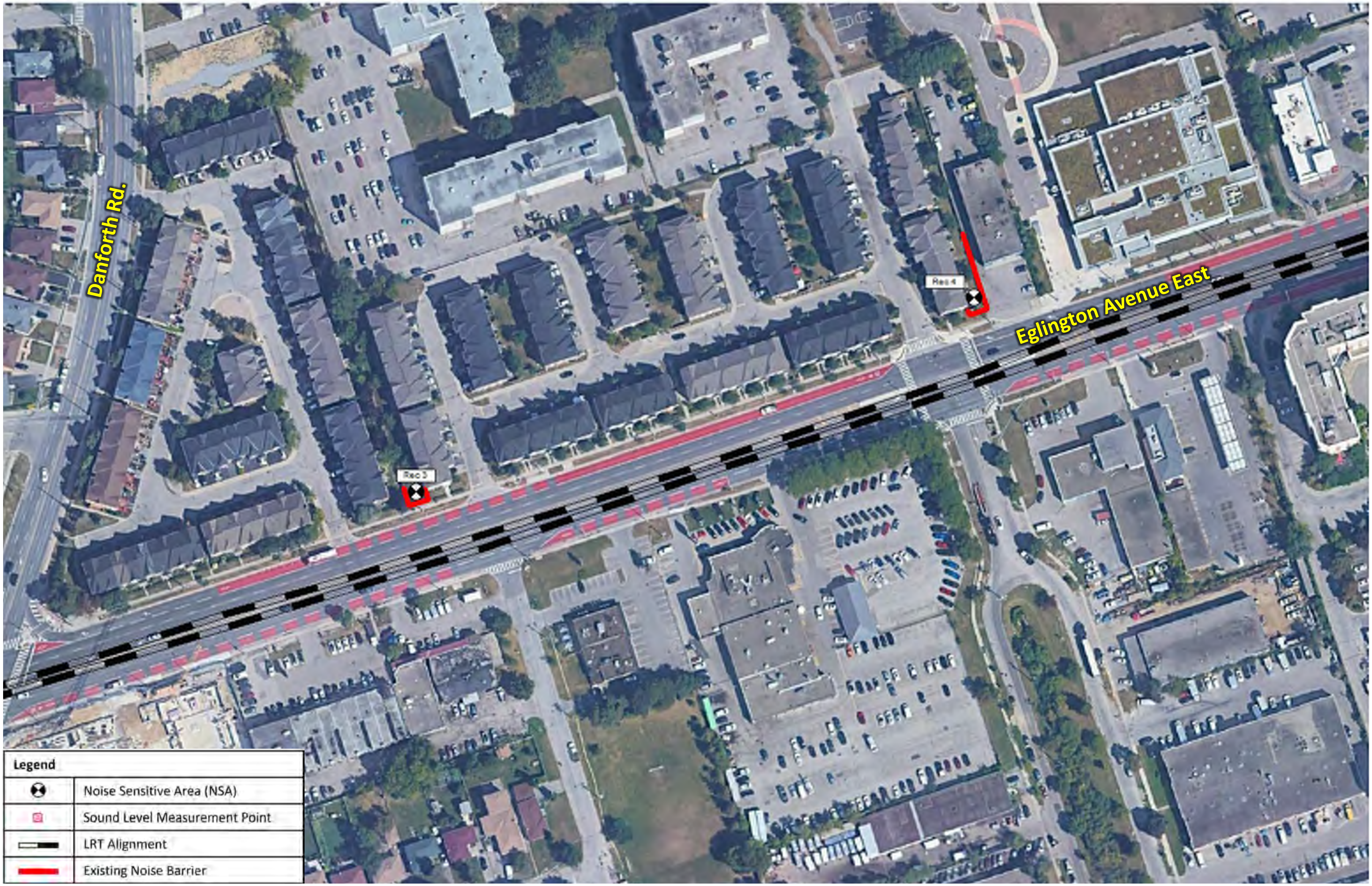
HDR	True North	Scale: 1: 60,000	METRES	SLR
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024 · Rev 0.0	Figure No. **1**	
STUDY AREA		Project No. 241.03932.00001		



HDR	True North	Scale: 1: 2,000	METRES	SLR
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024	Rev 0.0	Figure No. **2**
NOISE SENSITIVE RECEPTOR 1		Project No. 241.03932.00001		



HDR	True North	Scale: 1: 2,000	METRES	SLR
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024	Rev 0.0	Figure No. **3**	
NOISE SENSITIVE RECEPTOR 2		Project No. 241.03932.00001		



HDR

EGLINTON AVENUE EAST LRT

NOISE SENSITIVE RECEPTORS 3 AND 4

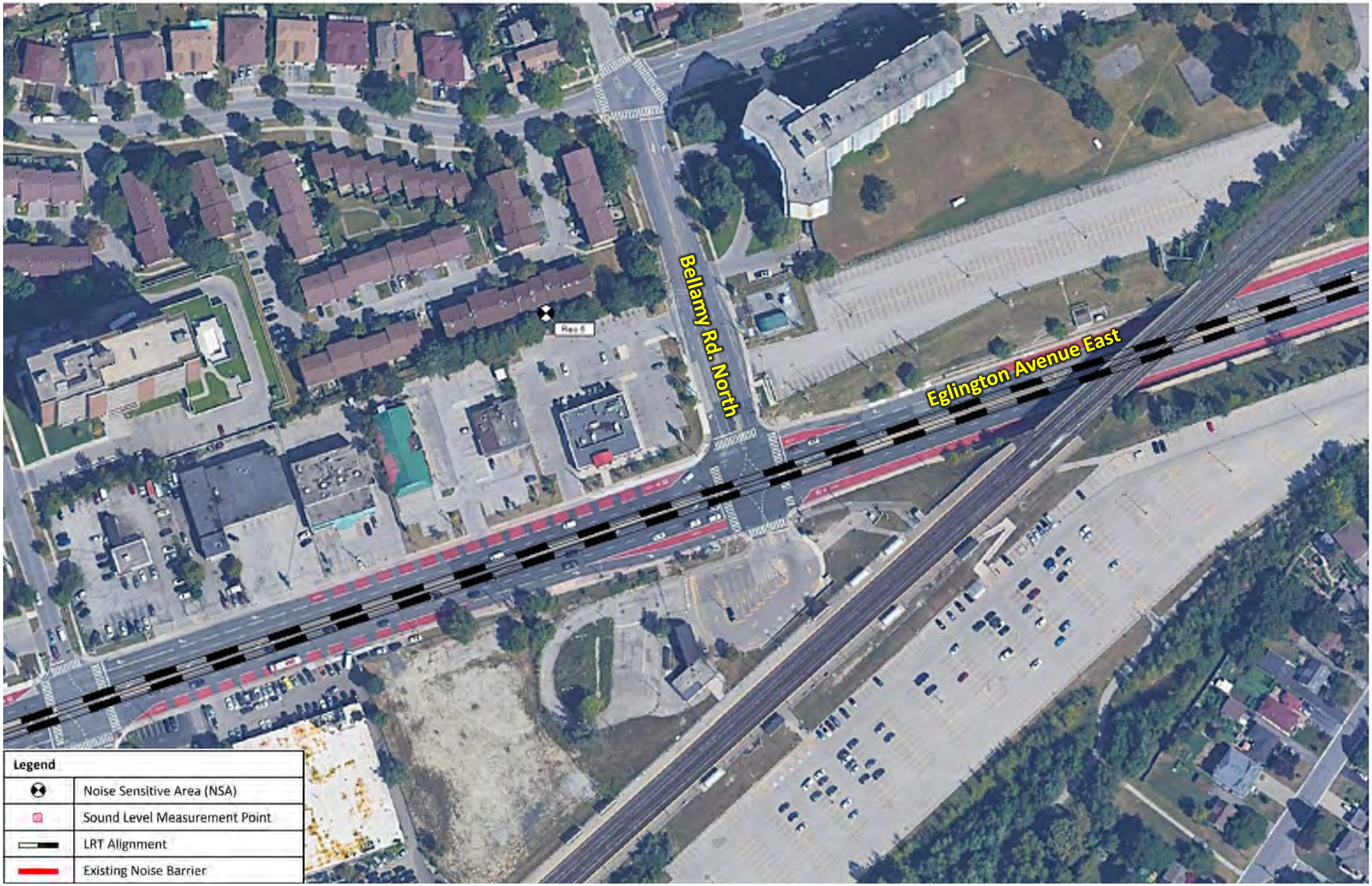
True North

Scale: 1: 2,000 METRES

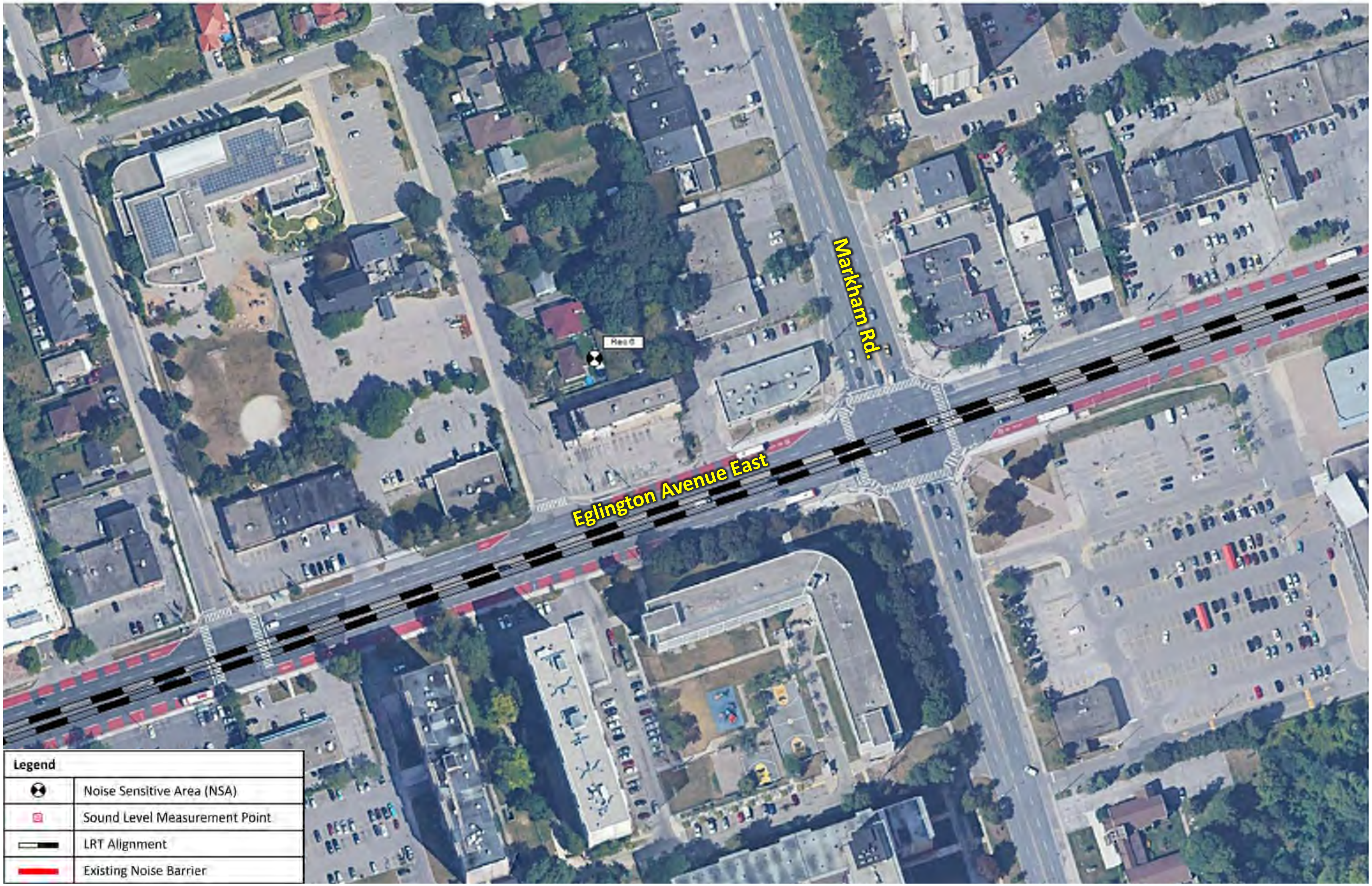
Date: Jan 12, 2024 Rev 0.0

Project No. 241.03932.00001

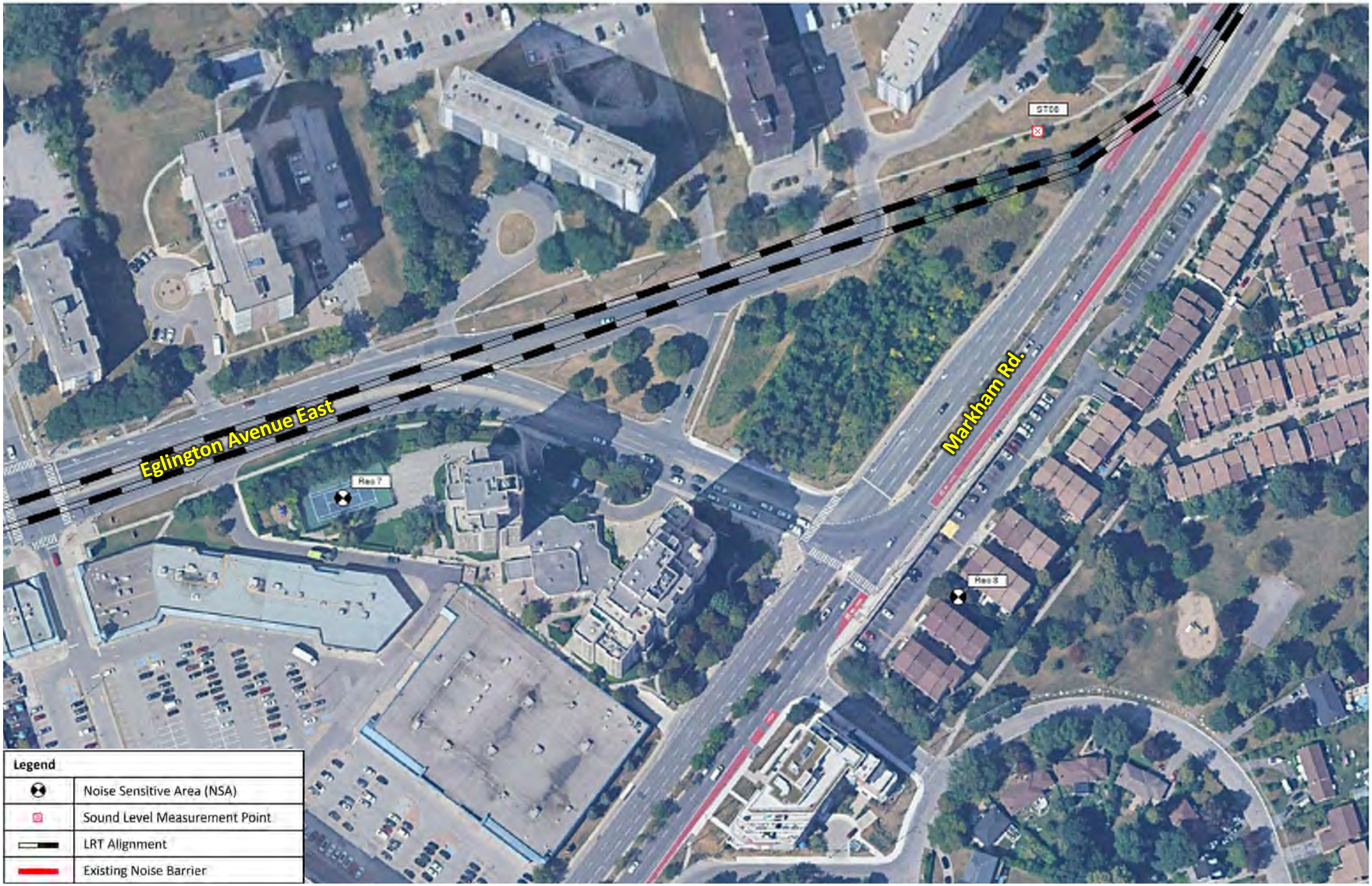
Figure No. 4



HDR	True North	Scale: 1: 2,000		METRES	SLR
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024	Rev 0.0	Figure No. 5	
NOISE SENSITIVE RECEPTOR 5		Project No. 241.03932.00001			



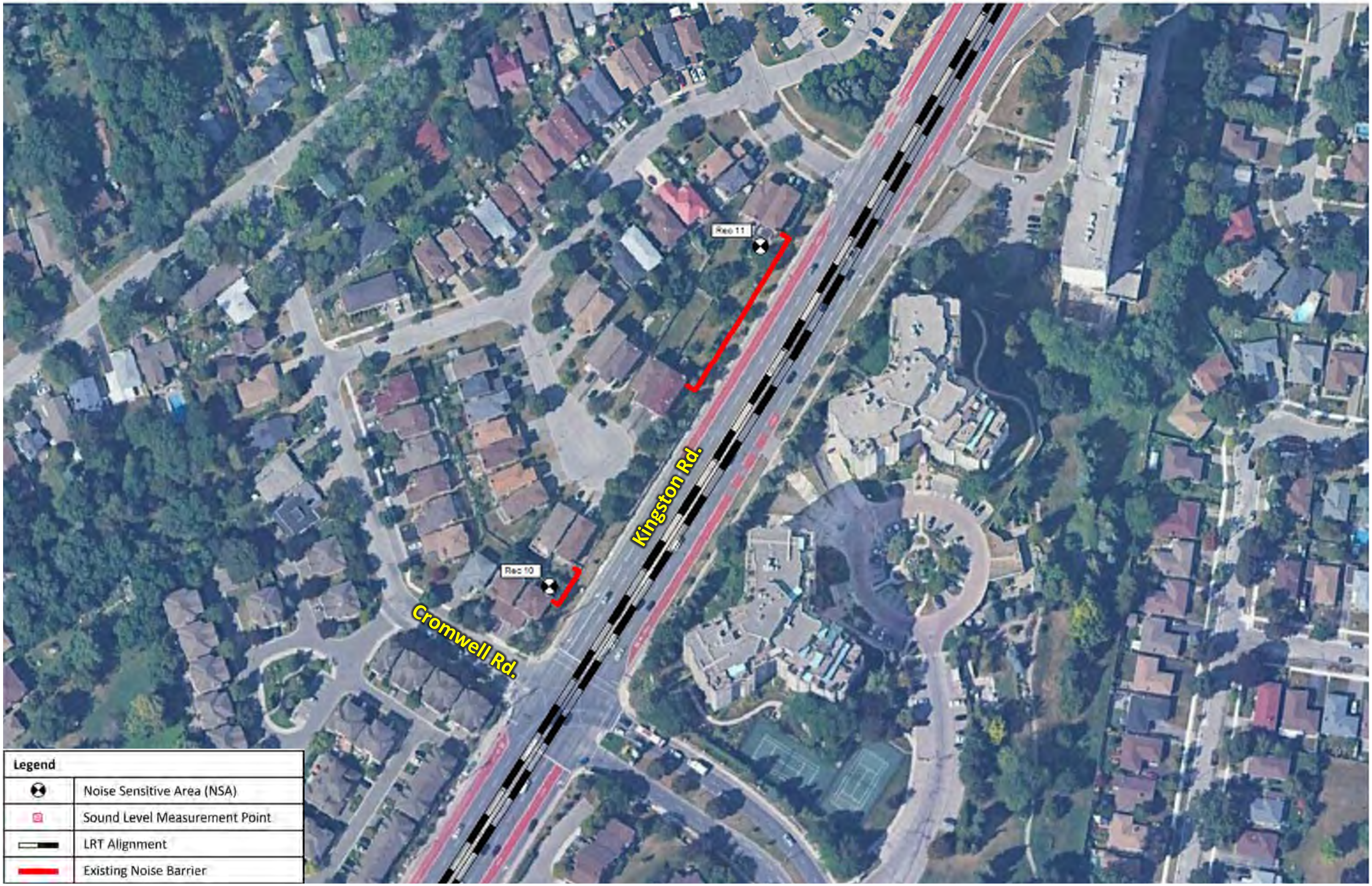
HDR	True North	Scale: 1: 2,000	METRES	SLR
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024 · Rev 0.0	Figure No. 6	
NOISE SENSITIVE RECEPTOR 6		Project No. 241.03932.00001		



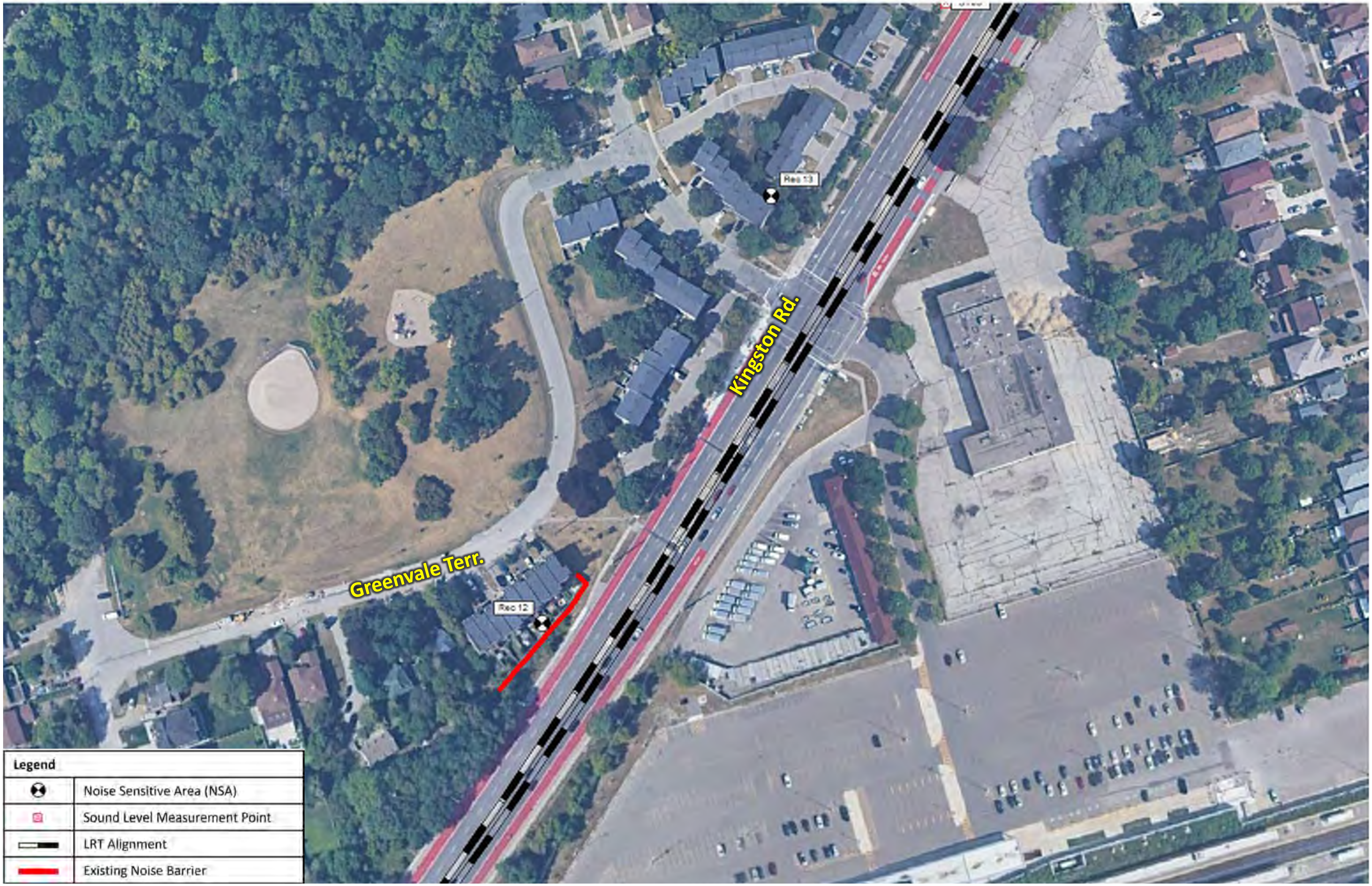
HDR	True North	Scale: 1: 2,000	METRES	SLR
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024 / Rev 0.0	Figure No. 7	
NOISE SENSITIVE RECEPTORS 7 AND 8		Project No. 241.03932.00001		

HDR	True North	Scale: 1: 2,000	METRES
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024 Rev 0.0	Figure No. 8
NOISE SENSITIVE RECEPTOR 9		Project No. 241.03932.00001	

SLR



HDR	True North	Scale: 1: 2,000	METRES	SLR
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024 / Rev 0.0	Figure No. 9	
NOISE SENSITIVE RECEPTORS 10 AND 11		Project No. 241.03932.00001		



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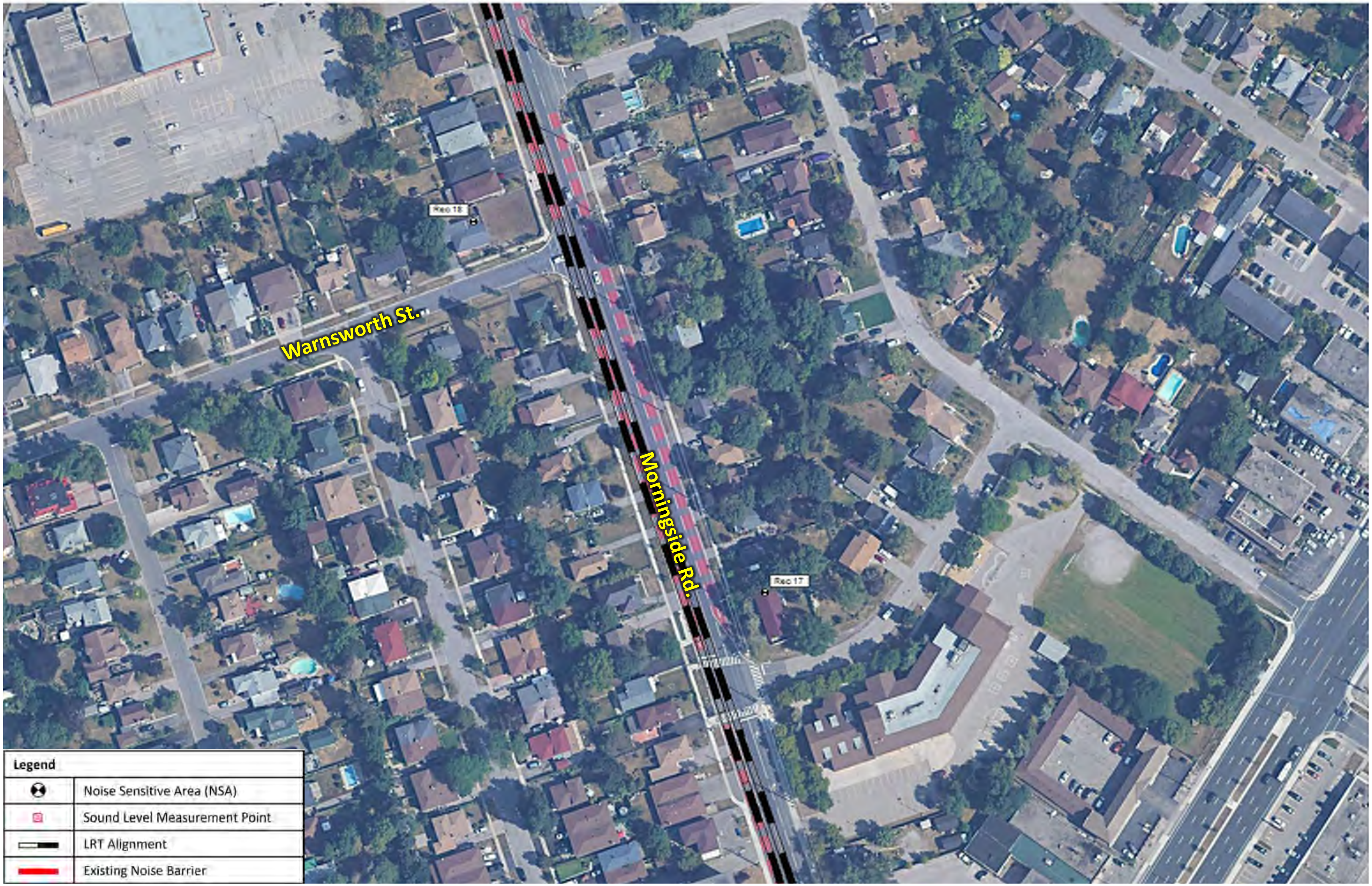
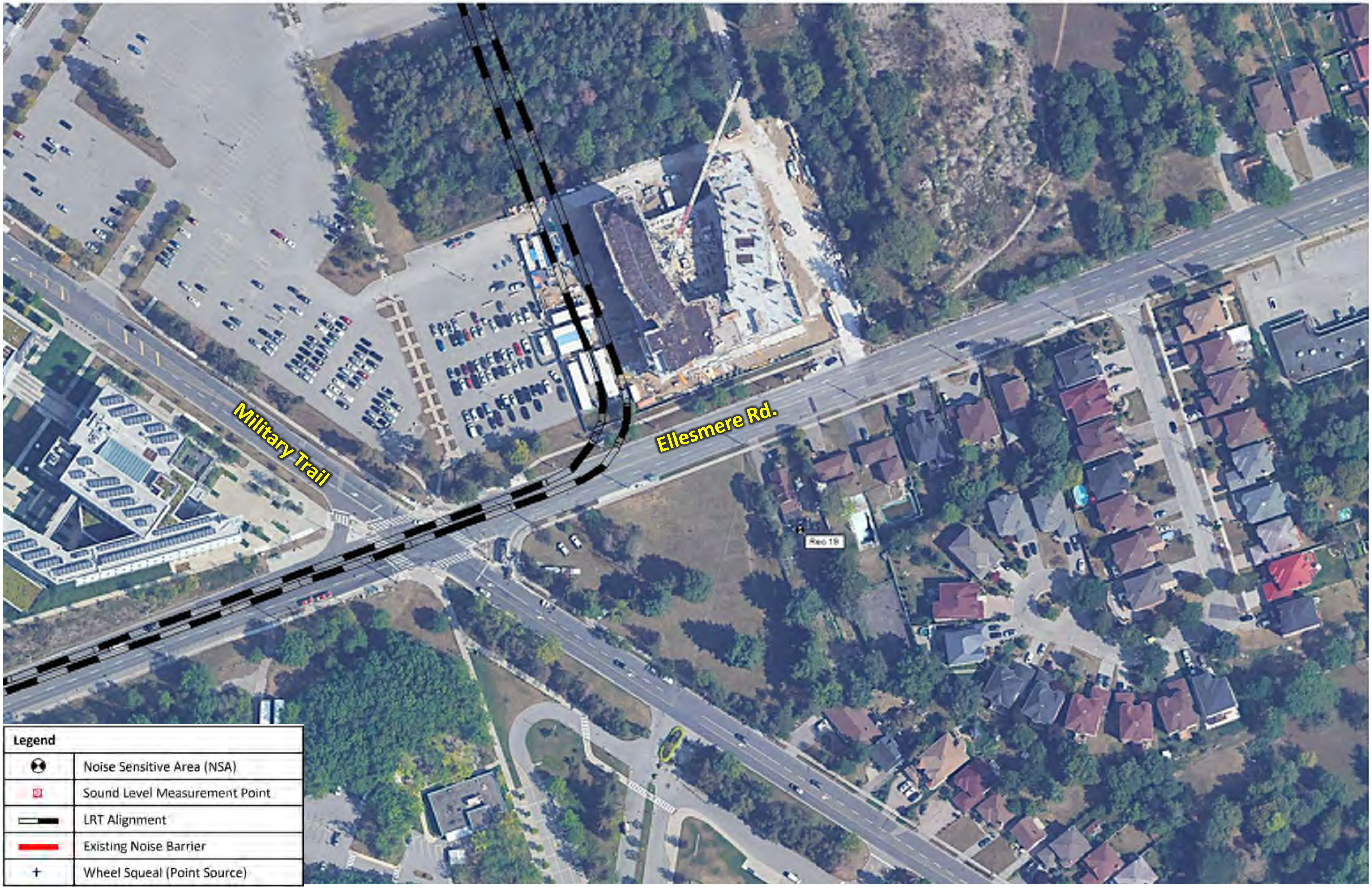
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024	Rev 0.0	Figure No. 10	
NOISE SENSITIVE RECEPTORS 12 AND 13		Project No. 241.03932.00001			

HDR	True North	Scale: 1: 2,000	METRES	SLR
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024 · Rev 0.0	Figure No. **11**	
NOISE SENSITIVE RECEPTOR 14		Project No. 241.03932.00001		

HDR	True North	Scale: 1: 2,000	METRES	SLR
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024 Rev 0.0	Figure No. 12	
NOISE SENSITIVE RECEPTORS 15 AND 16		Project No. 241.03932.00001		

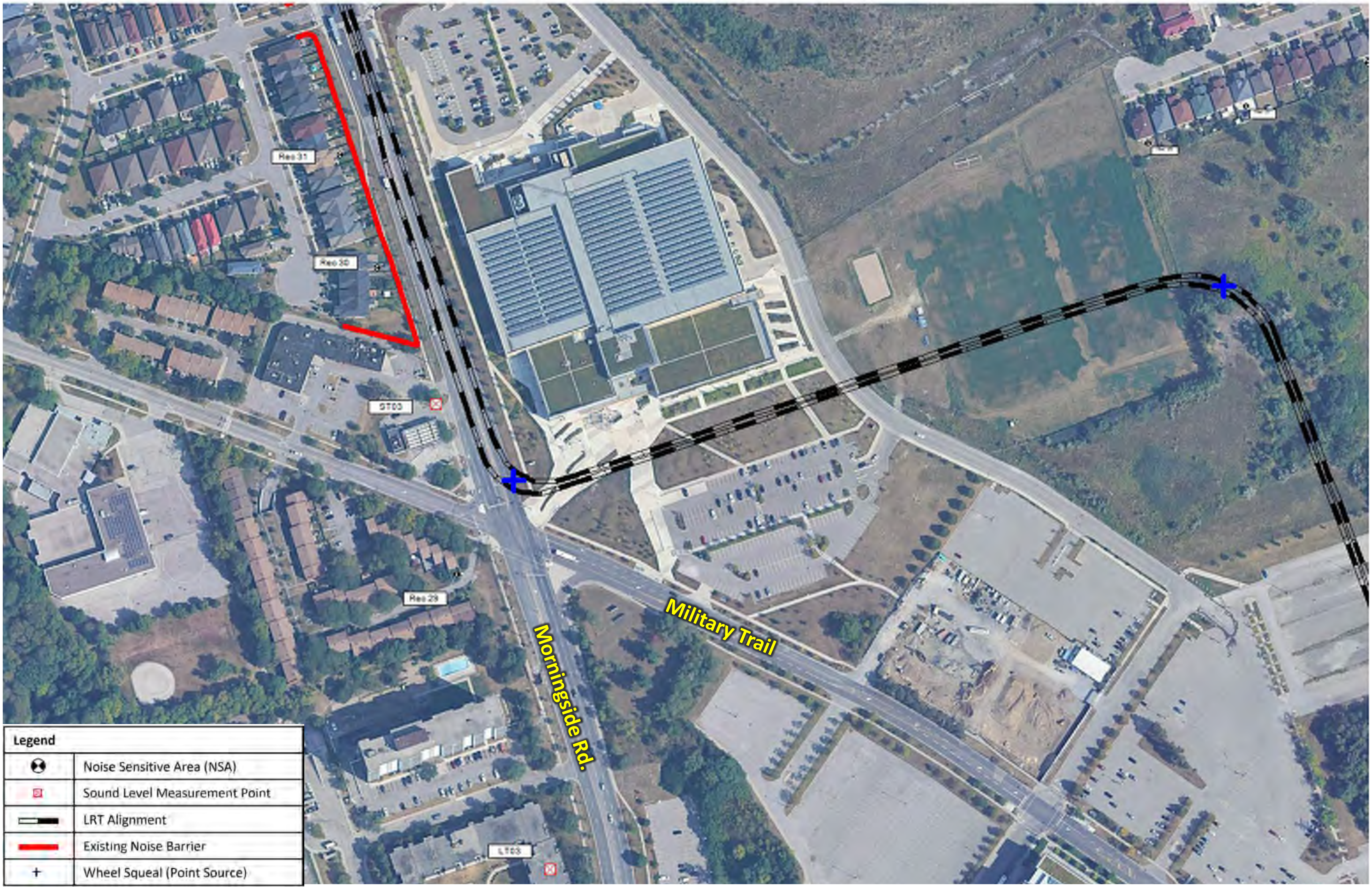


HDR	True North	Scale: 1: 2,000	METRES	SLR
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024 / Rev 0.0	Figure No. 13	
NOISE SENSITIVE RECEPTORS 17 AND 18		Project No. 241.03932.00001		

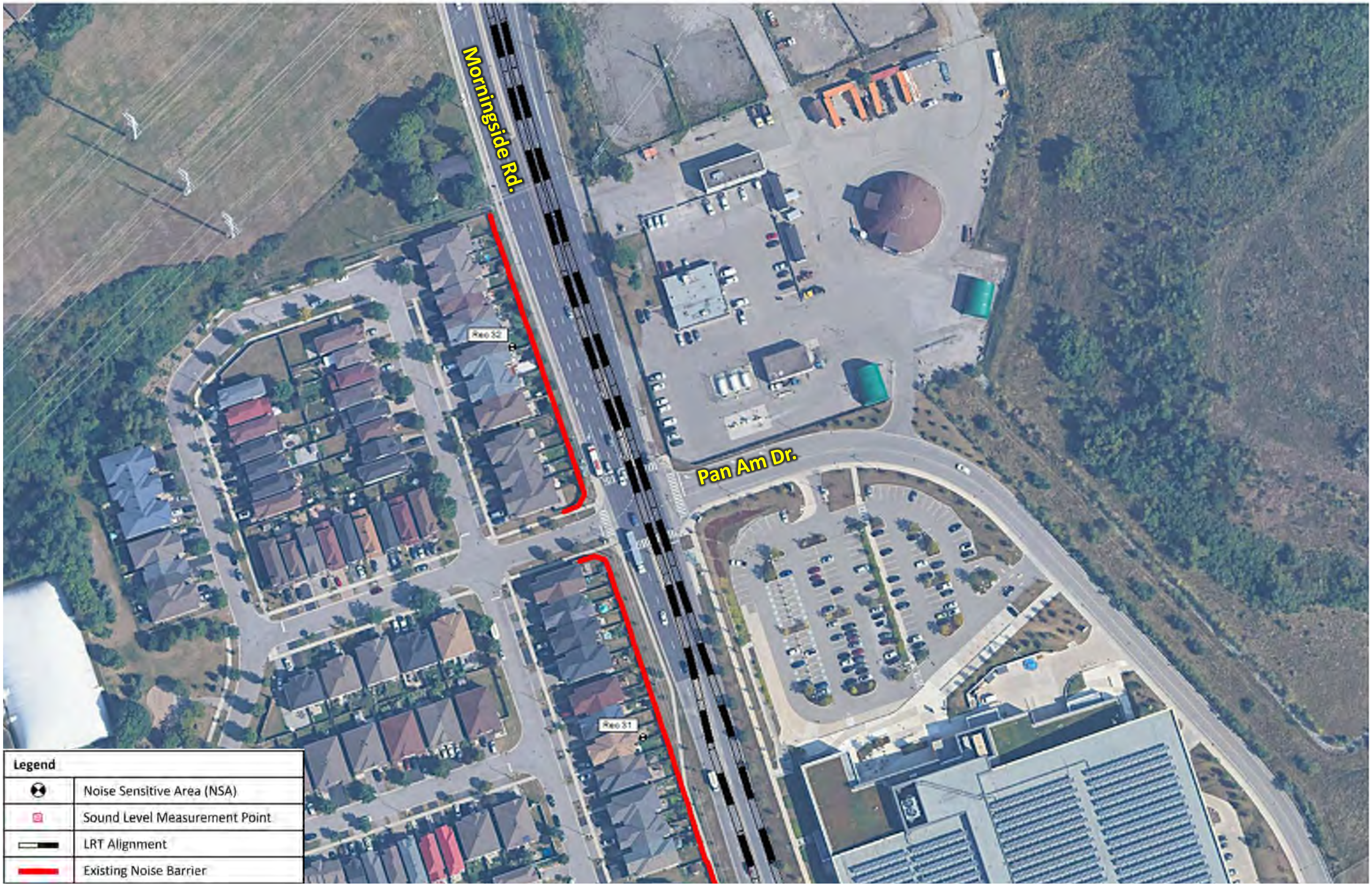


HDR	True North	Scale: 1: 2,000	METRES	SLR
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024 / Rev 0.0	Figure No. 14	
NOISE SENSITIVE RECEPTOR 19		Project No. 241.03932.00001		

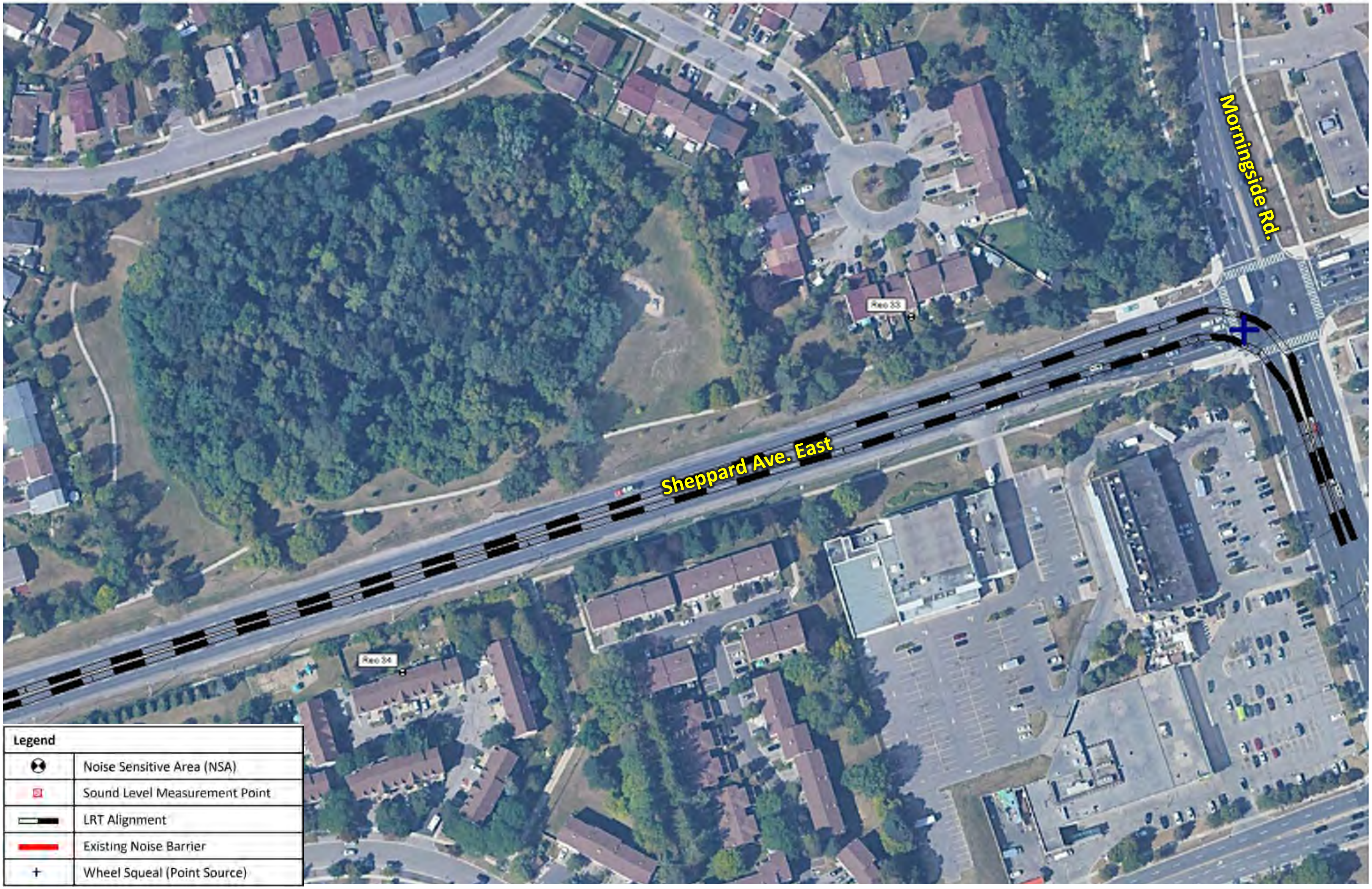
HDR	True North	Scale: 1: 2,000		METRES
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024	Rev 0.0	Figure No. 15
NOISE SENSITIVE RECEPTORS 20 TO 28		Project No. 241.03932.00001		



HDR	True North	Scale: 1: 3,000	METRES	SLR
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024 Rev 0.0	Figure No. 16	
NOISE SENSITIVE RECEPTORS 29 AND 30		Project No. 241.03932.00001		

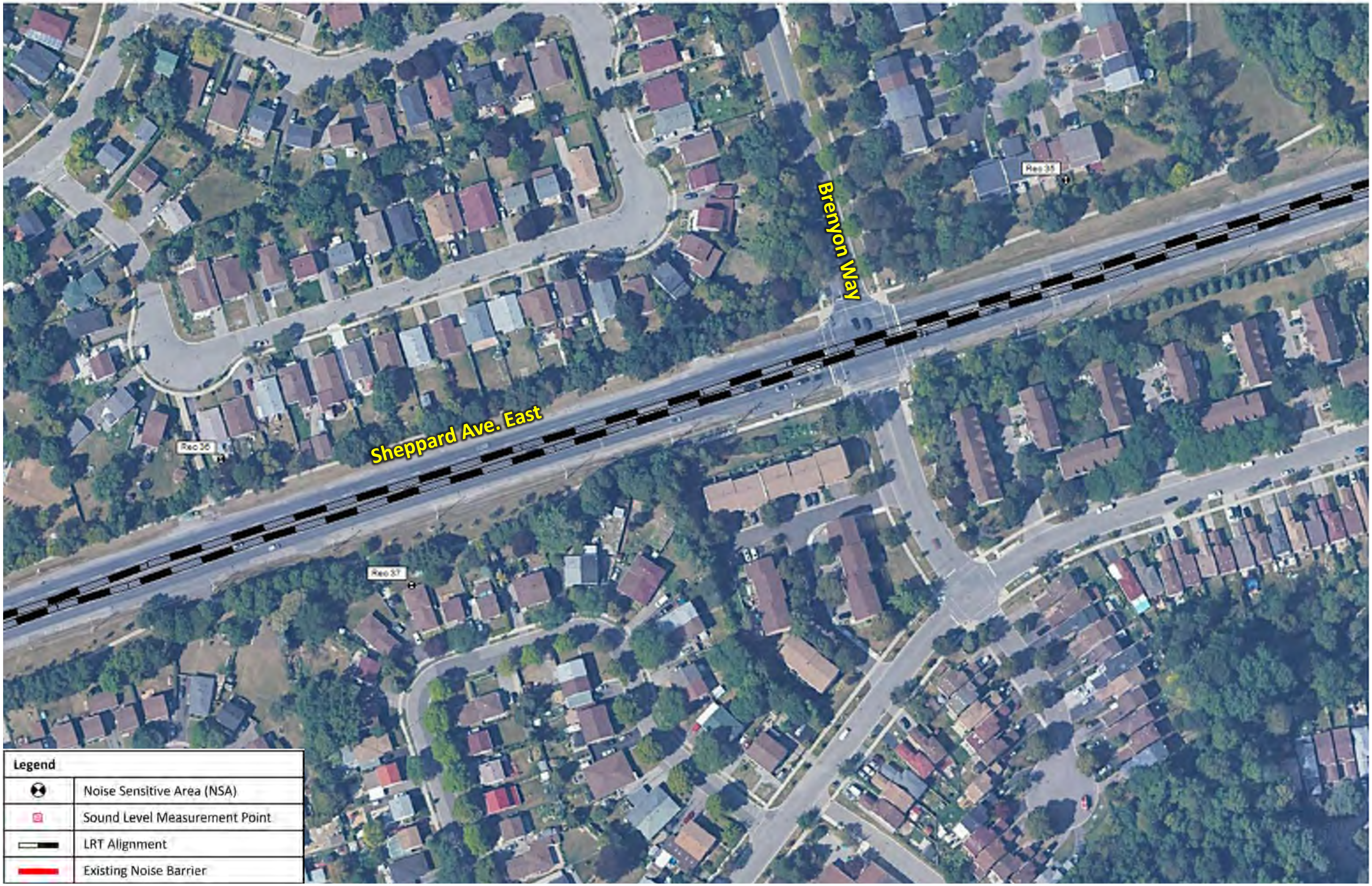


HDR	True North	Scale: 1: 2,000	METRES
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024 Rev 0.0	Figure No. **17**
NOISE SENSITIVE RECEPTORS 31 AND 32		Project No. 241.03932.00001	

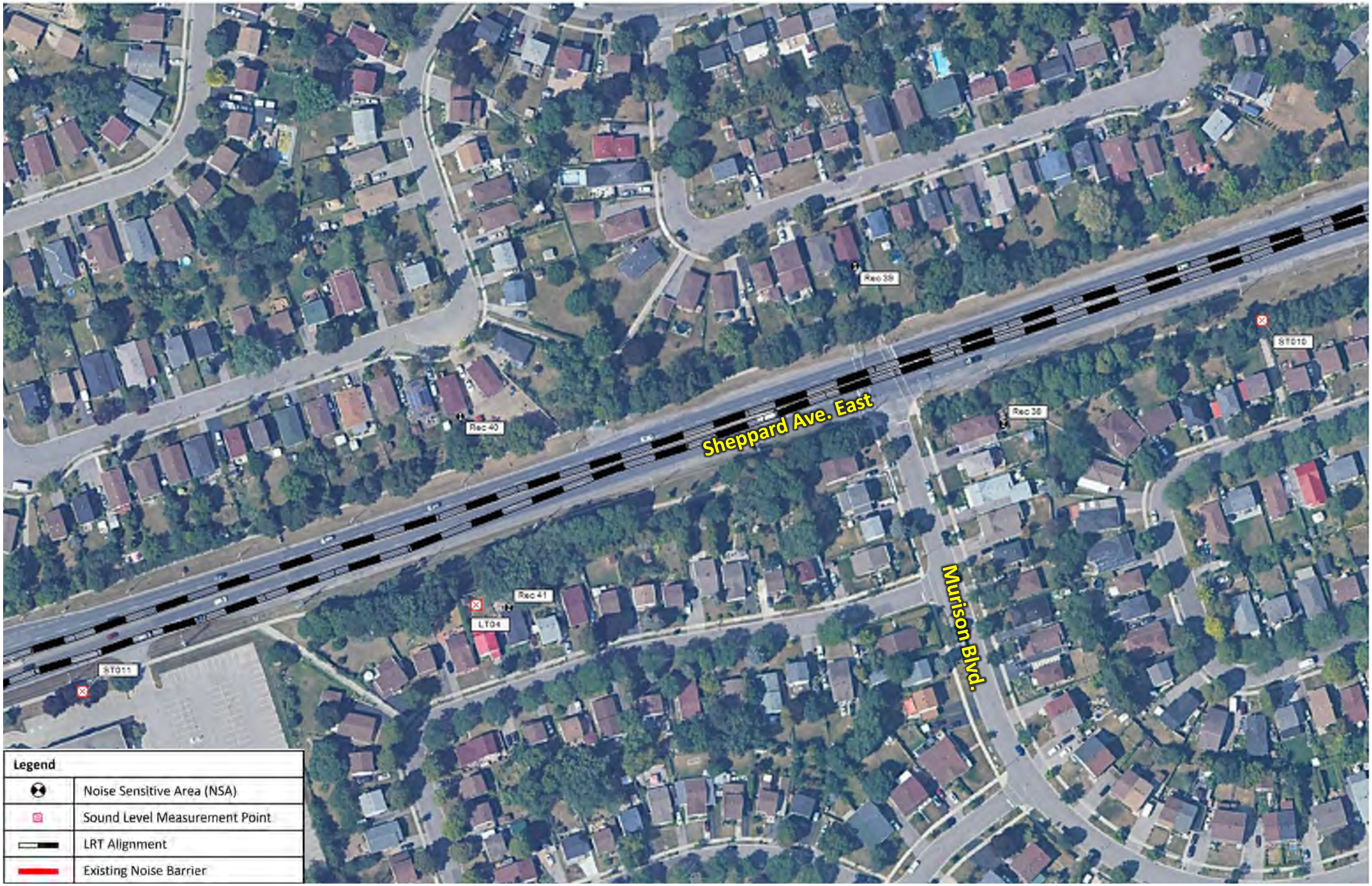


HDR	True North	Scale: 1: 2,000	METRES
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024 / Rev 0.0	Figure No. **18**
NOISE SENSITIVE RECEPTORS 33 AND 34		Project No. 241.03932.00001	

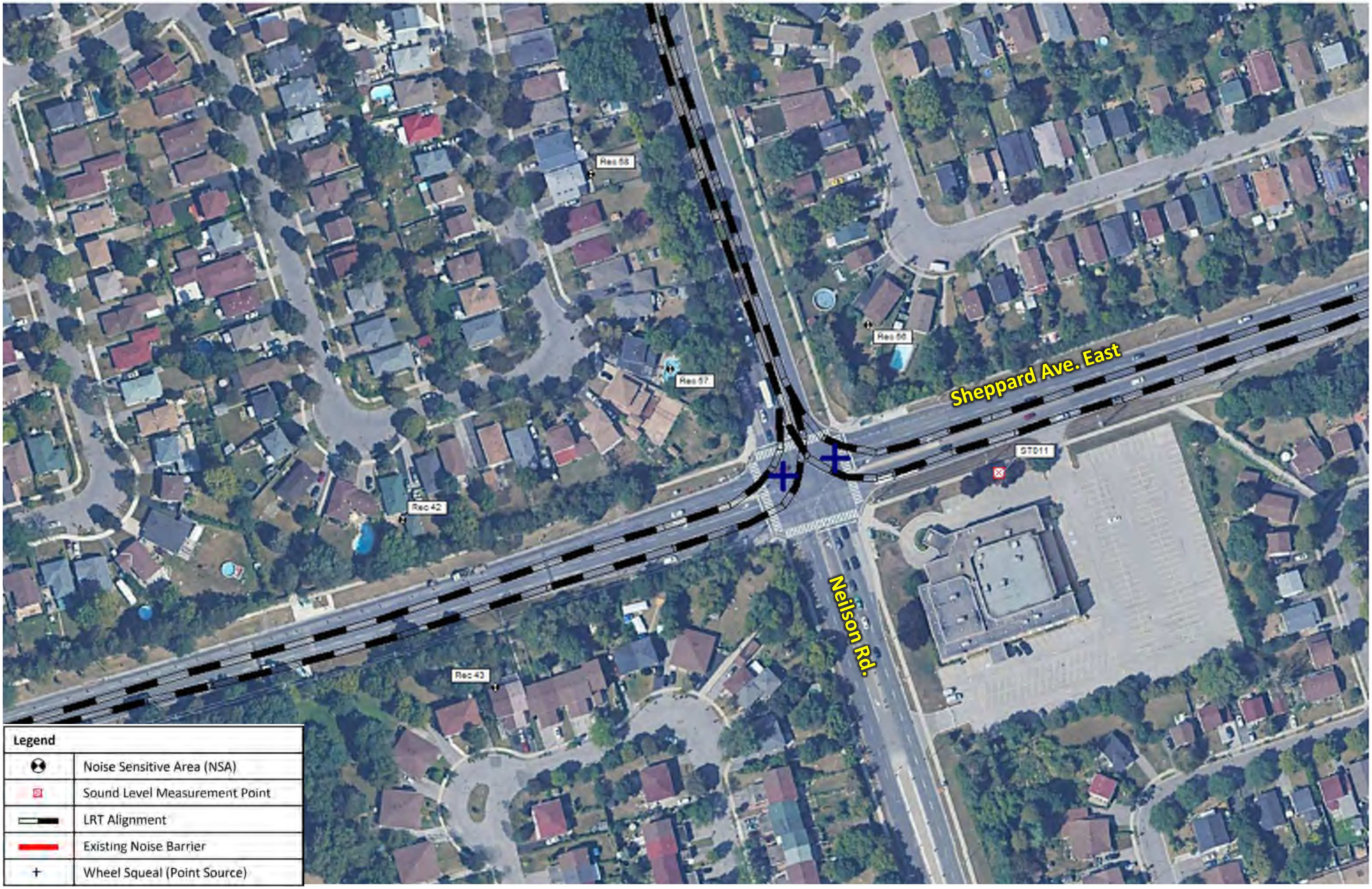
SLR



HDR	True North	Scale: 1: 2,000	METRES	SLR
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024 / Rev 0.0	Figure No. 19	
NOISE SENSITIVE RECEPTORS 35 TO 37		Project No. 241.03932.00001		



HDR	True North	Scale: 1: 2,000		METRES	SLR
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024	Rev 0.0	Figure No. 20	
NOISE SENSITIVE RECEPTORS 38 TO 41		Project No. 241.03932.00001			



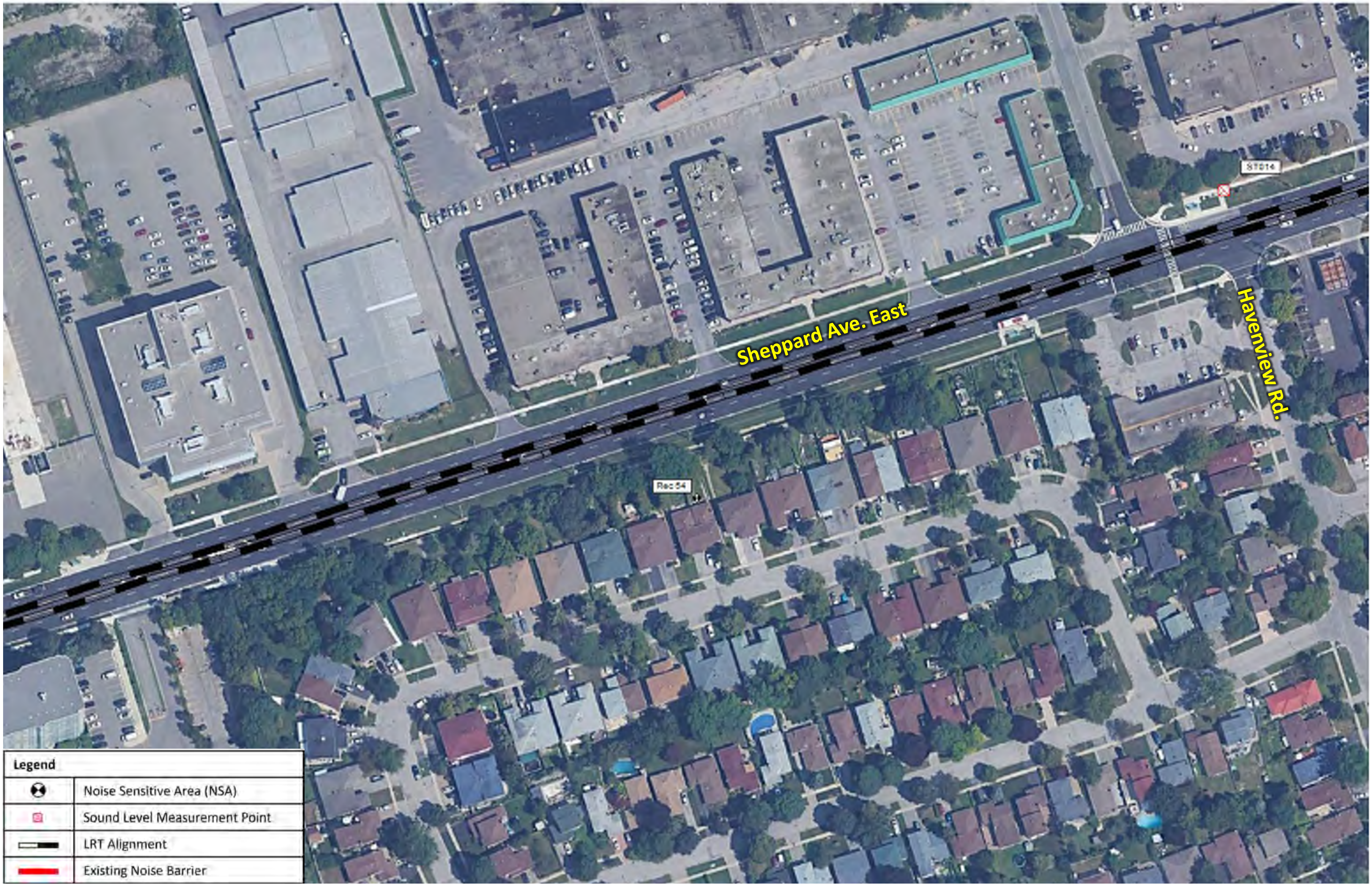
Legend	
⊗	Noise Sensitive Area (NSA)
⊠	Sound Level Measurement Point
▭▬	LRT Alignment
▬	Existing Noise Barrier
+	Wheel Squeal (Point Source)

HDR	True North	Scale: 1: 2,000		METRES	SLR
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024	Rev 0.0	Figure No. 21	
NOISE SENSITIVE RECEPTORS 42, 43 AND 56 TO 58		Project No. 241.03932.00001			

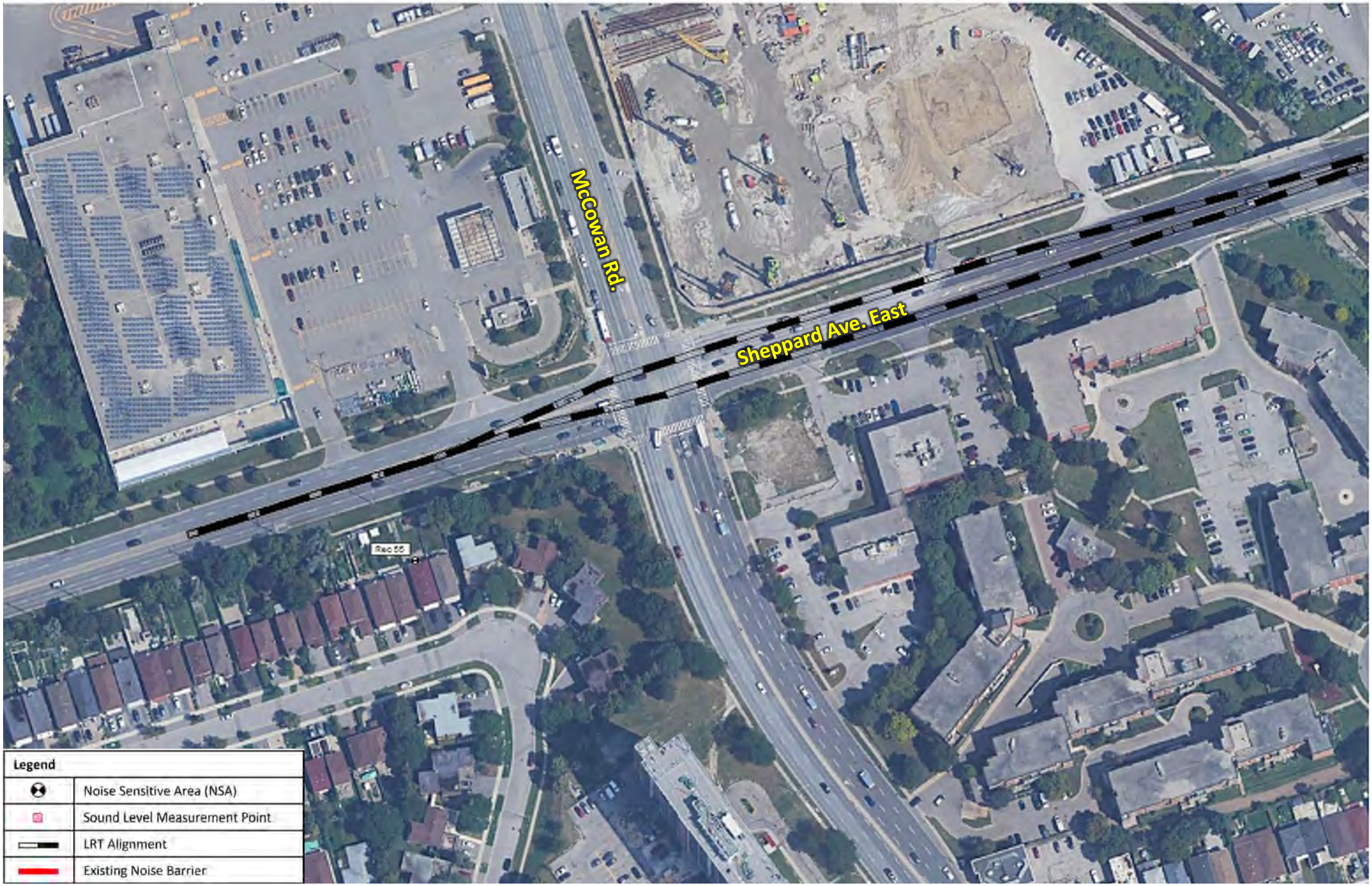
HDR	True North	Scale: 1: 2,000	METRES	SLR
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024 / Rev 0.0	Figure No. **22**	
NOISE SENSITIVE RECEPTORS 44 TO 47		Project No. 241.03932.00001		

HDR	True North	Scale: 1: 2,000	METRES	SLR
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024 Rev 0.0	Figure No. 23	
NOISE SENSITIVE RECEPTORS 48 TO 50		Project No. 241.03932.00001		

HDR	True North	Scale: 1: 2,000	METRES	SLR
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024 Rev 0.0	Figure No. 24	
NOISE SENSITIVE RECEPTORS 51 TO 53		Project No. 241.03932.00001		



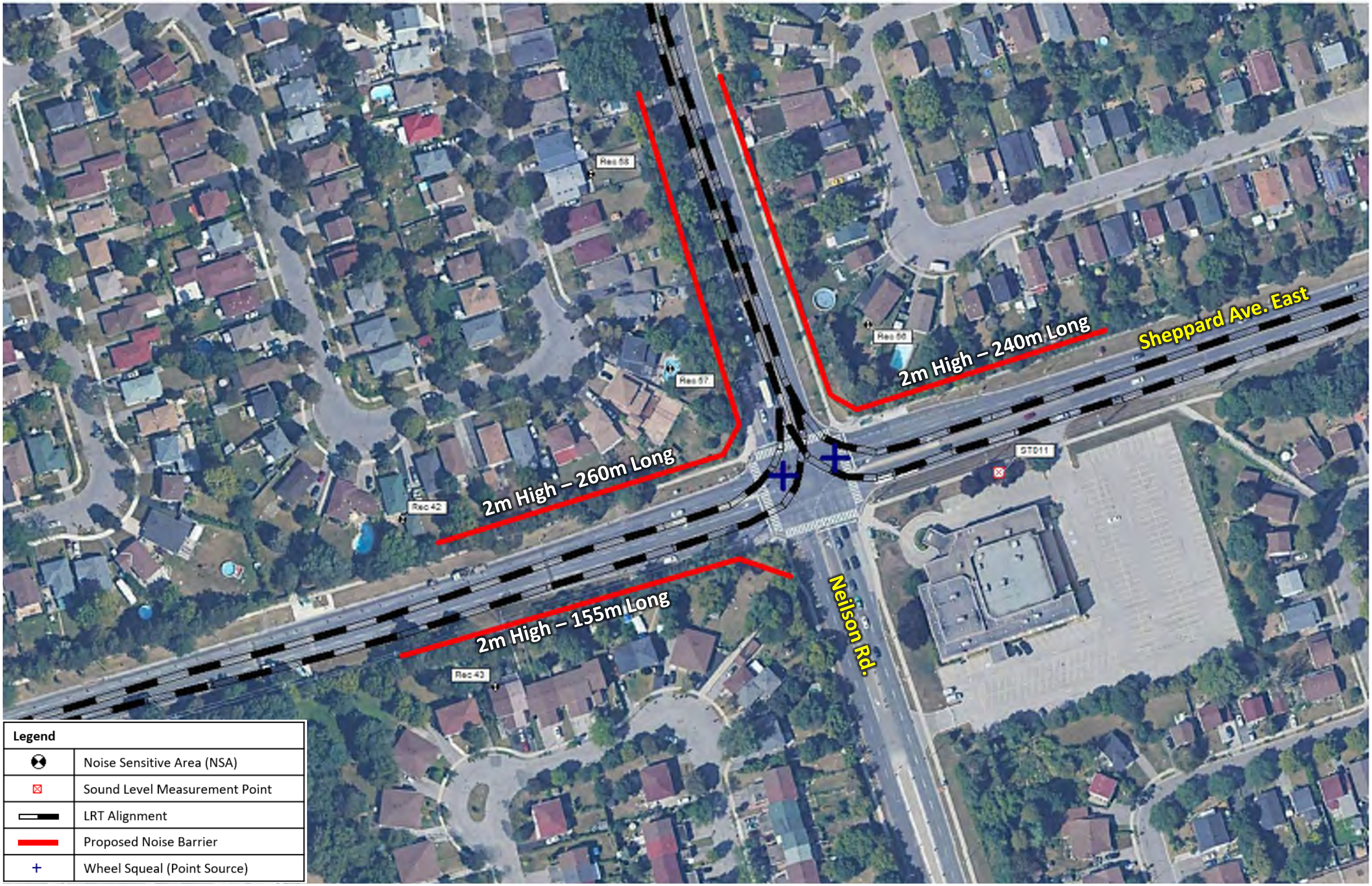
HDR	True North	Scale: 1: 2,000	METRES	SLR
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024 / Rev 0.0	Figure No. **25**	
NOISE SENSITIVE RECEPTOR 54		Project No. 241.03932.00001		



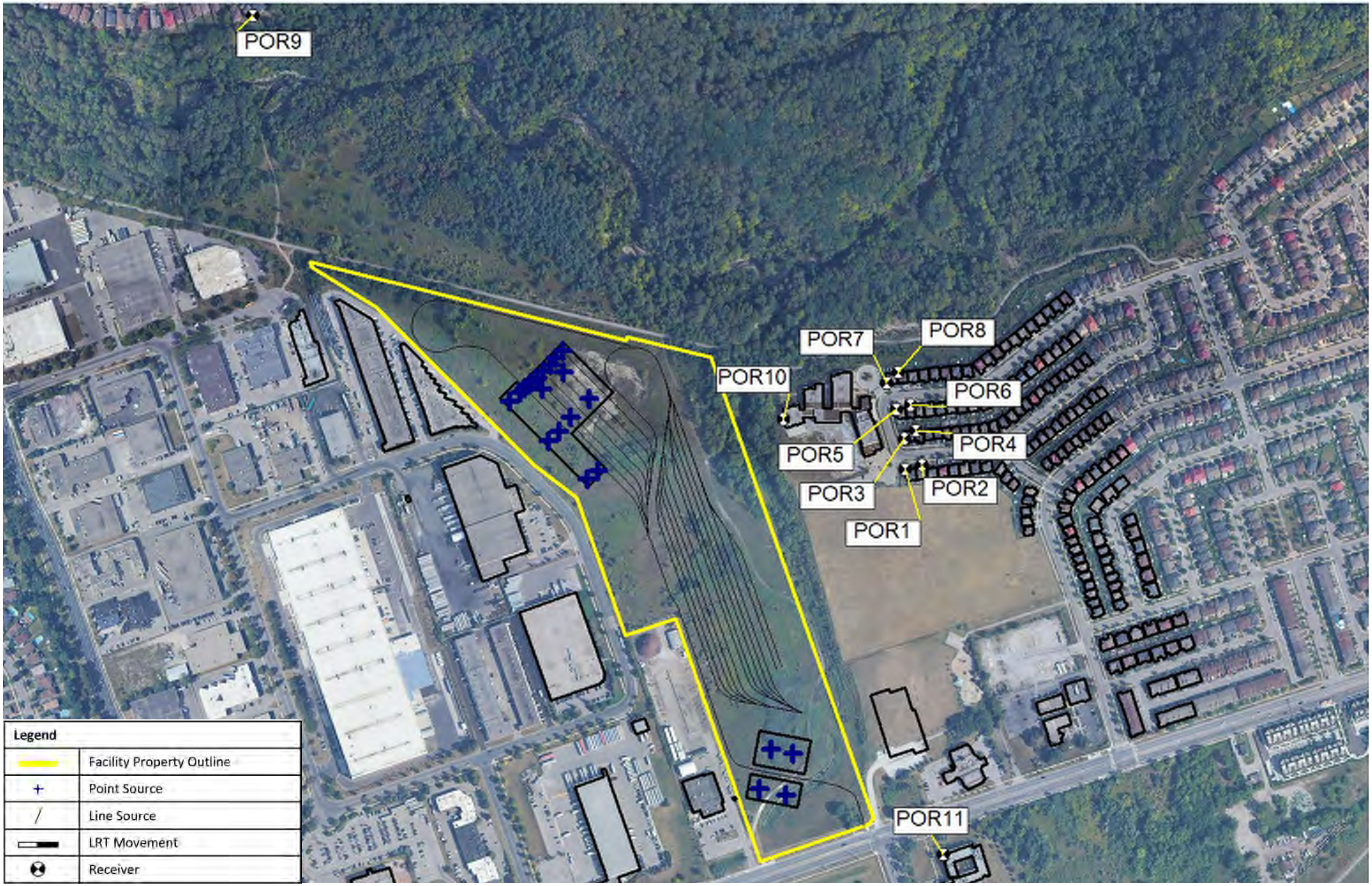
HDR	True North	Scale: 1: 2,000	METRES
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024 Rev 0.0	Figure No. 26
NOISE SENSITIVE RECEPTOR 55		Project No. 241.03932.00001	

SLR

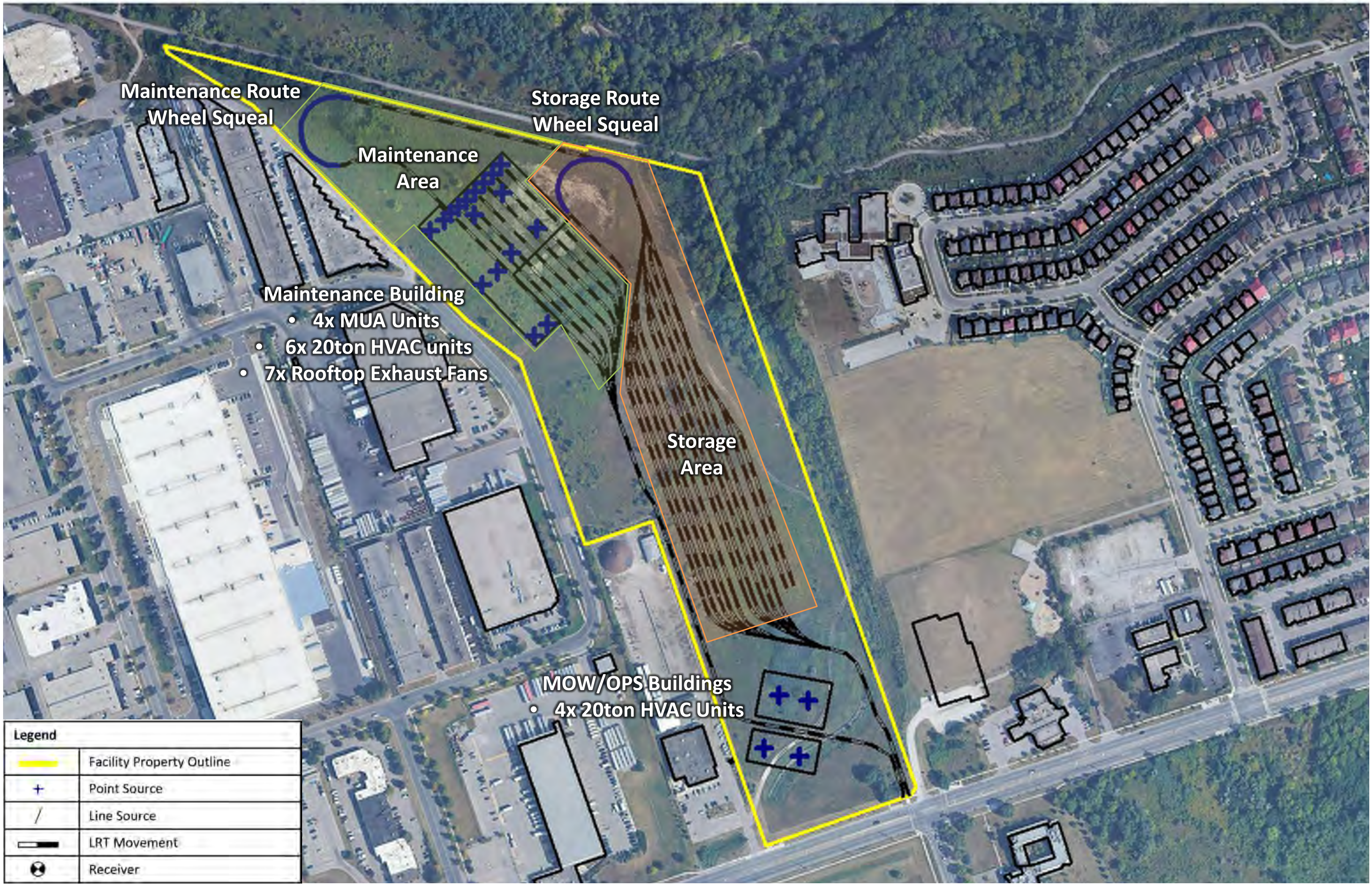
HDR	True North	Scale: 1: 2,000	METRES	SLR
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024	Rev 0.0	
NOISE SENSITIVE RECEPTORS 59 TO 62		Project No. 241.03932.00001	Figure No. **27**	



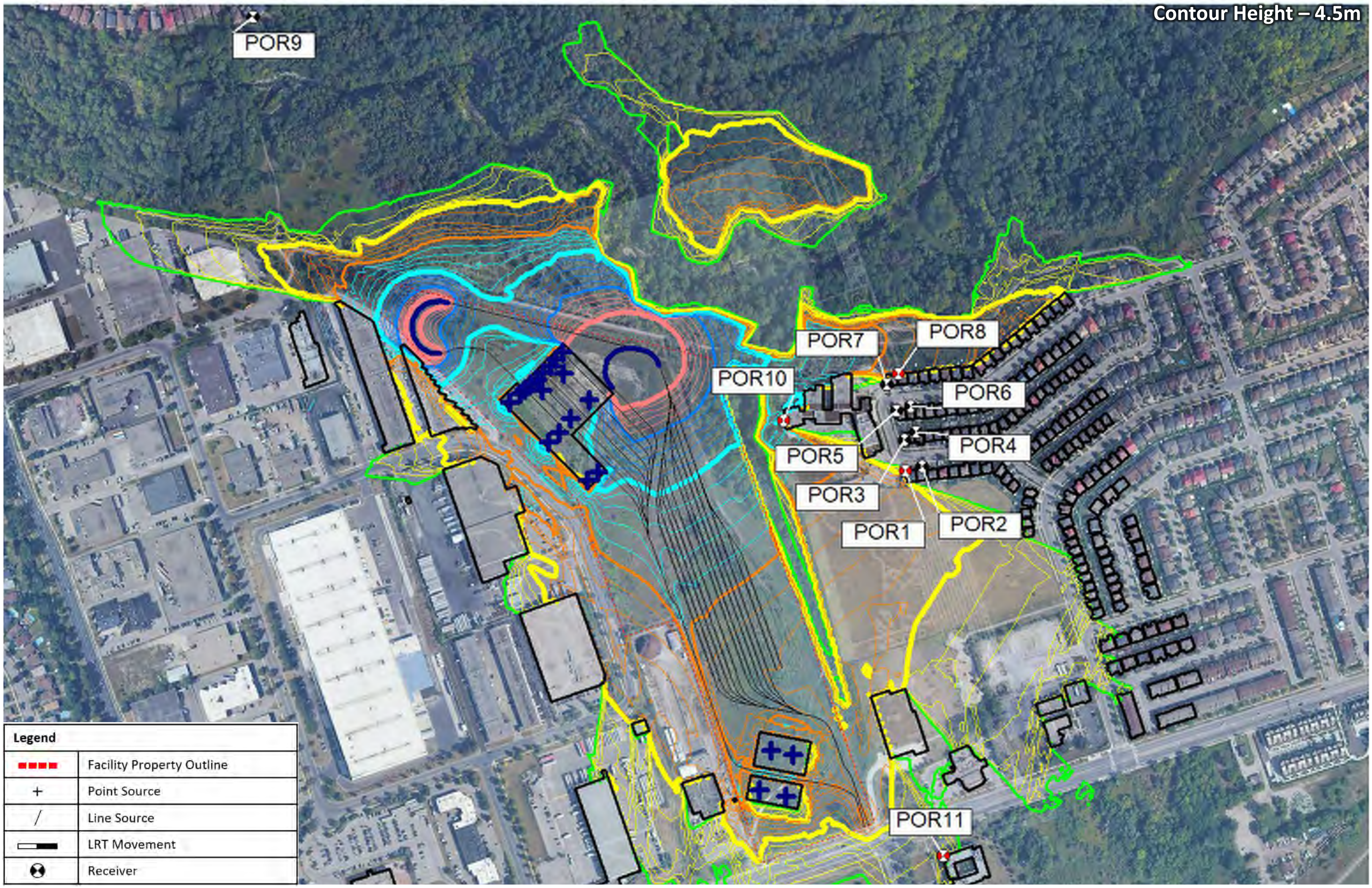
HDR	True North	Scale: 1: 2,000	METRES	SLR
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024 / Rev 0.0	Figure No. 28	
PRELIMINARY NOISE BARRIER LOCATIONS EELRT ALIGNMENT		Project No. 241.03932.00001		



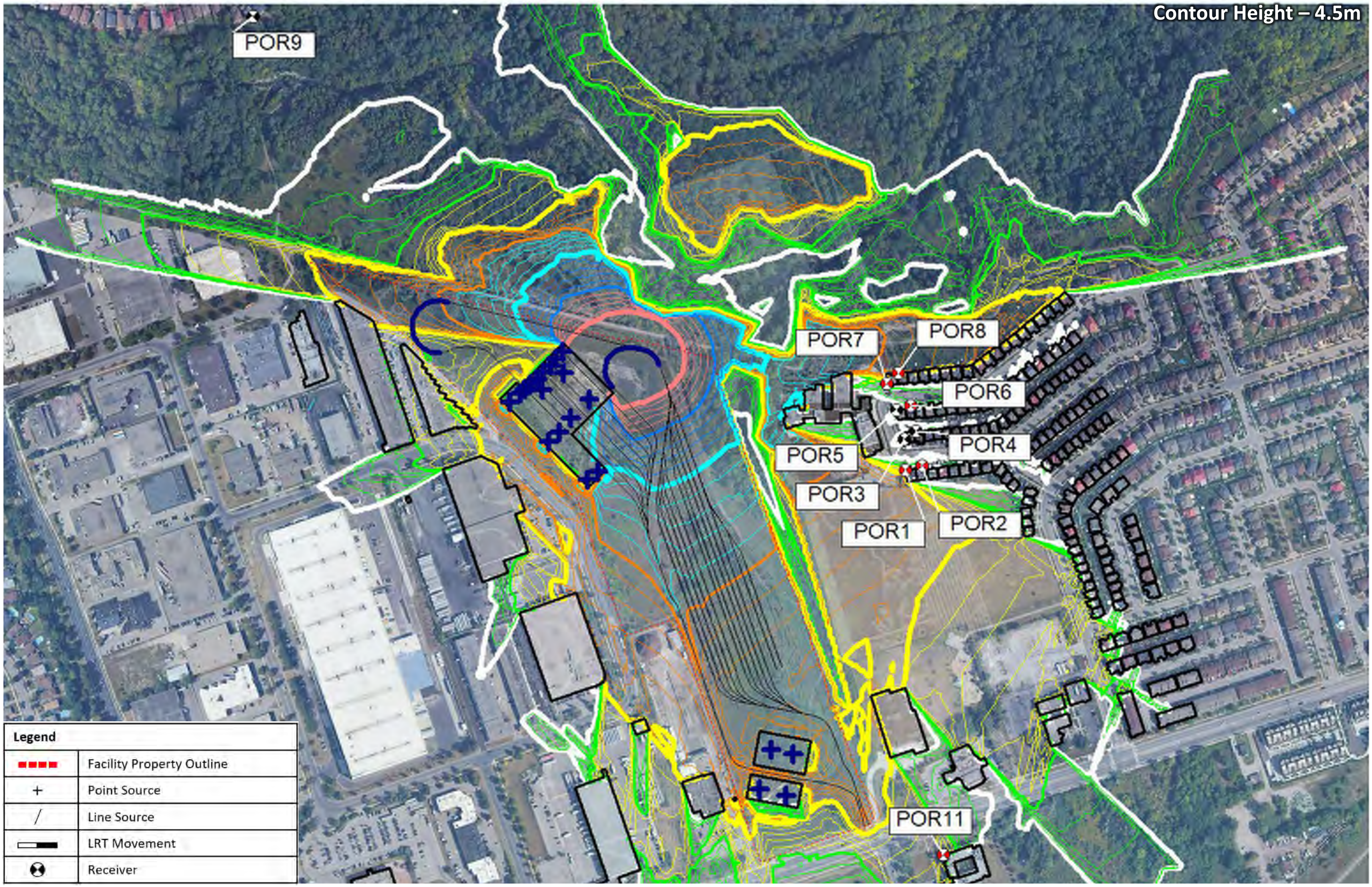
HDR	True North	Scale: 1: 6,000	METRES	SLR
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024 Rev 0.0	Figure No. 29	
SCALED AREA LOCATION PLAN – EELRT MAINTENANCE AND STORAGE FACILITY – CONLINS RD		Project No. 241.03932.00001		



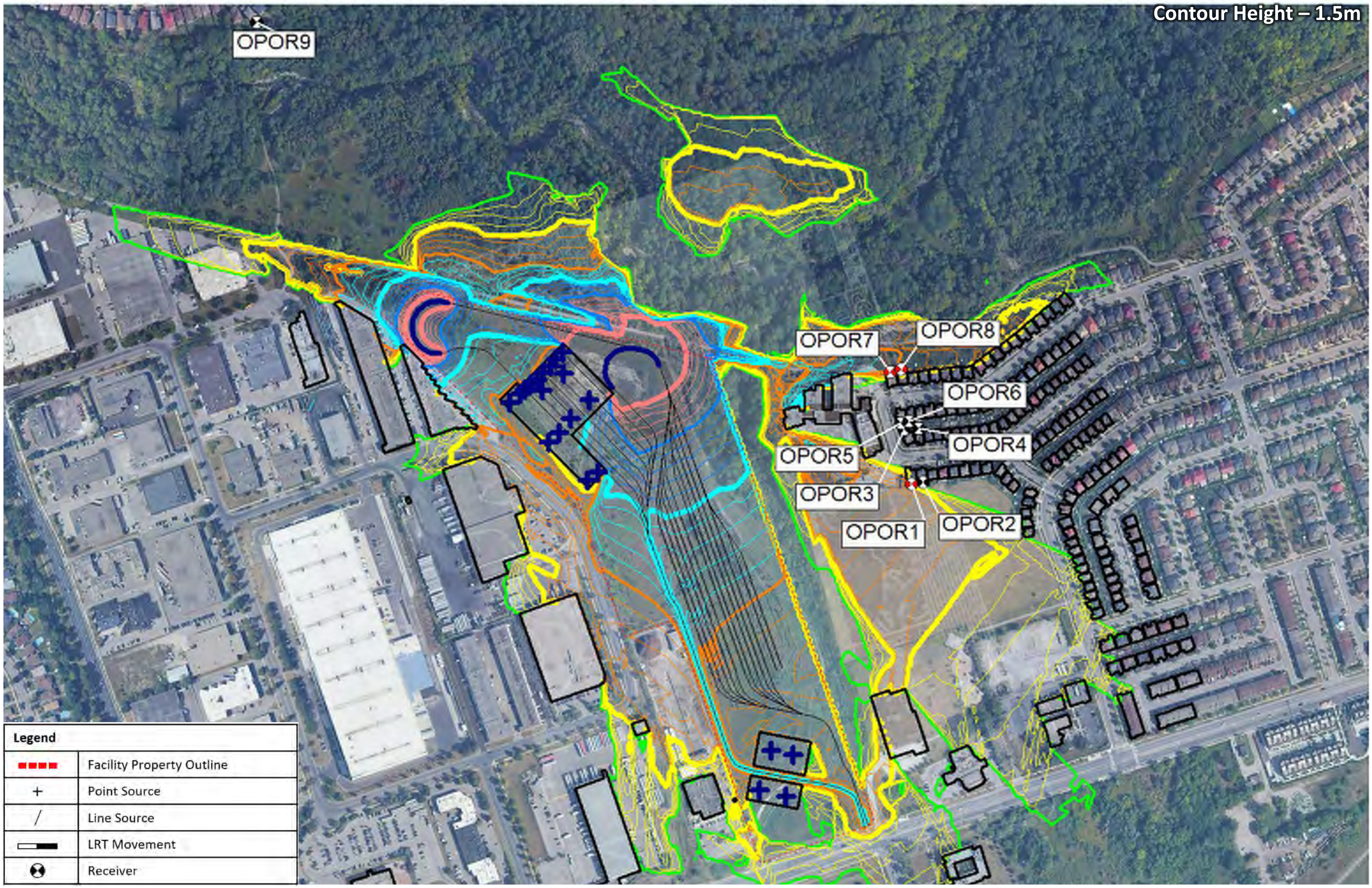
HDR	True North	Scale: 1: 4,500	METRES	SLR
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024	Rev 0.0	Figure No. 30
STATIONARY NOISE SOURCES MODELLED		Project No. 241.03932.00001		



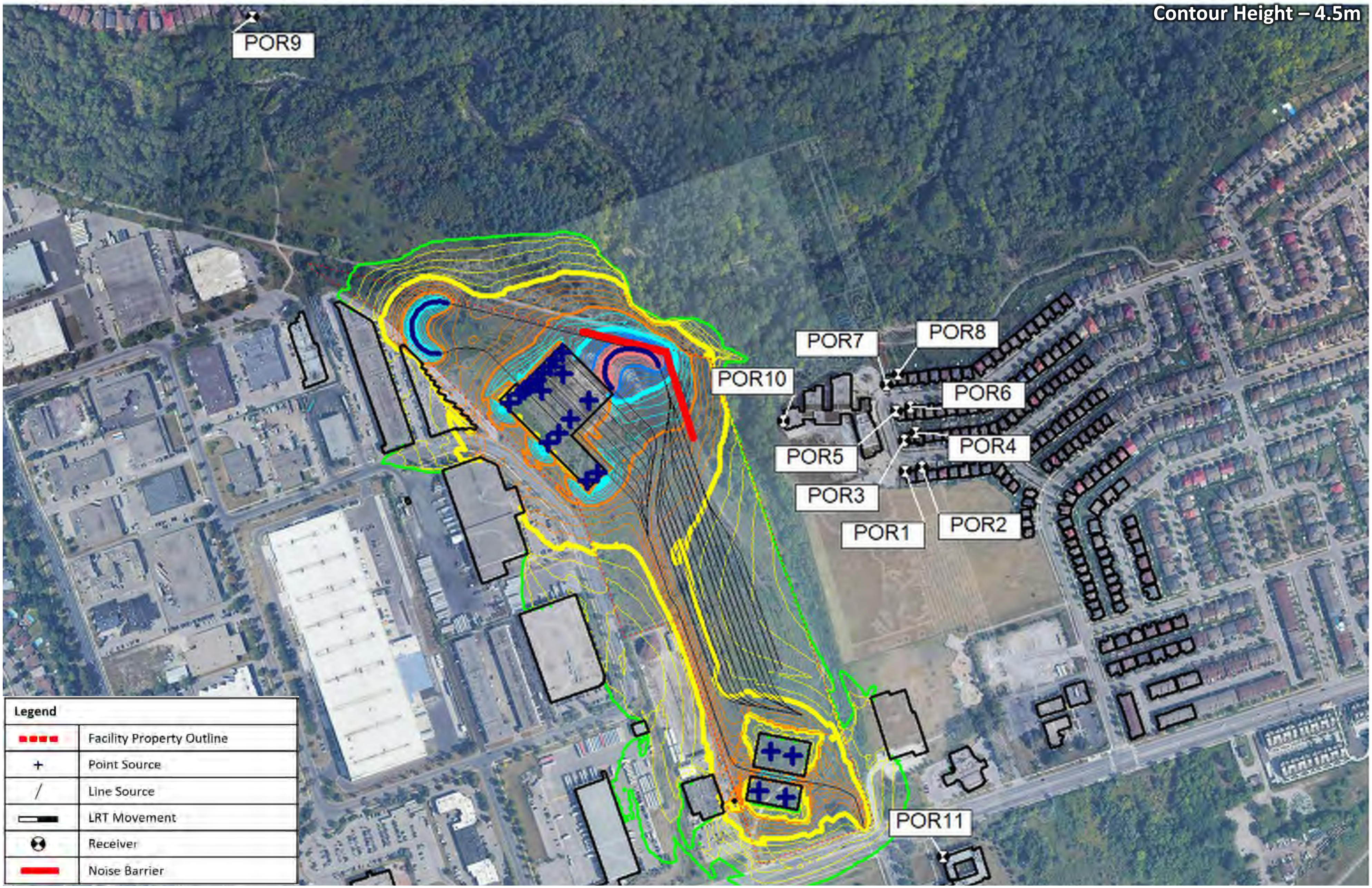
HDR	True North	Scale: 1: 4,500	METRES	SLR
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024 Rev 0.0	Figure No. 31	
PREDICTED CONTINUOUS STATIONARY NOISE LEVELS – SURROUNDING PORS DAYTIME/EVENING		Project No. 241.03932.00001		



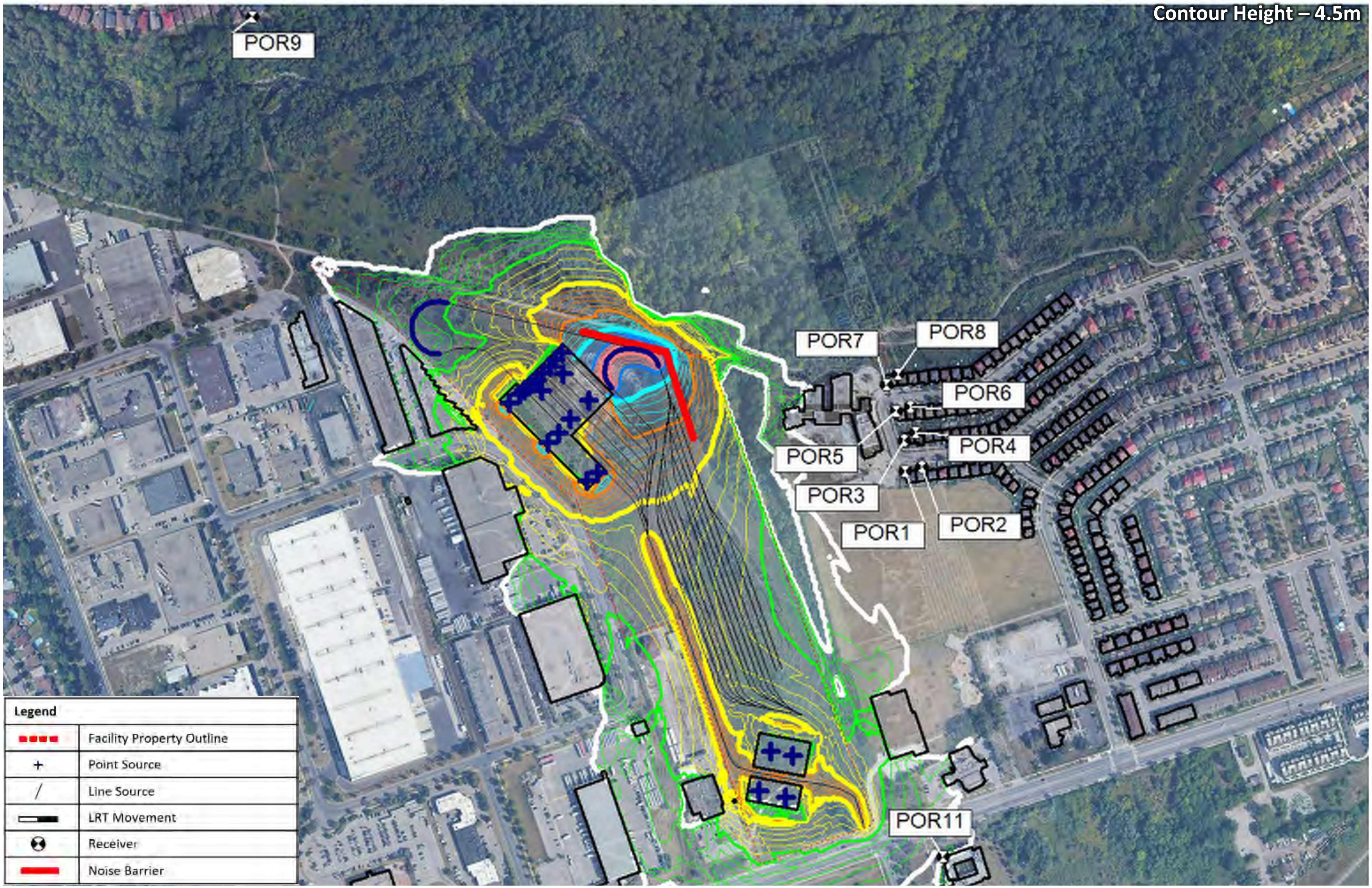
HDR	True North	Scale: 1: 4,500		METRES	SLR
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024	Rev 0.0	Figure No. 32	
PREDICTED CONTINUOUS STATIONARY NOISE LEVELS – SURROUNDING PORS NIGHT-TIME		Project No. 241.03932.00001			



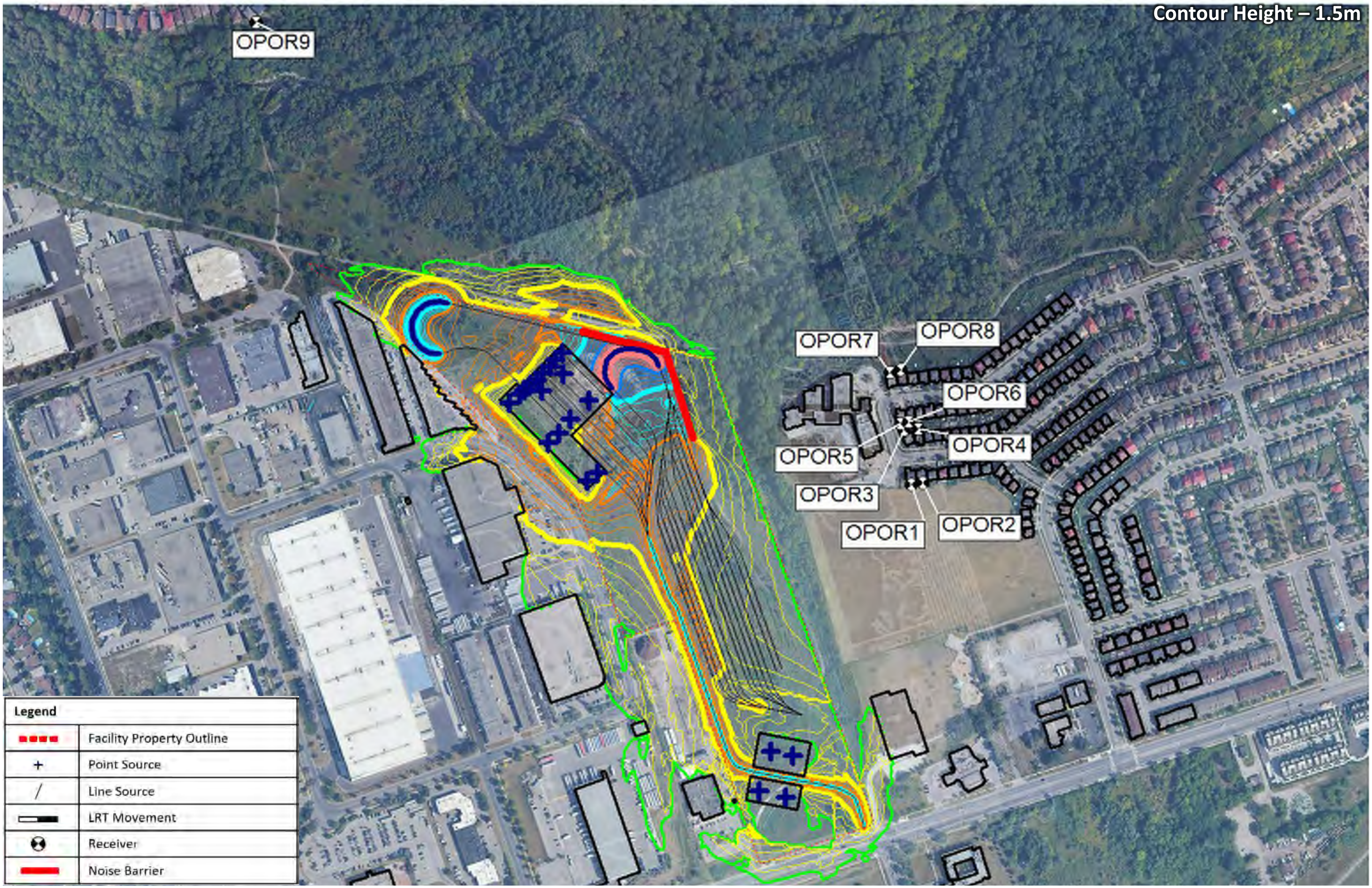
HDR	True North	Scale: 1: 4,500	METRES
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024	Rev 0.0
PREDICTED CONTINUOUS STATIONARY NOISE LEVELS – SURROUNDING OPORS DAYTIME/EVENING		Project No. 241.03932.00001	Figure No. 33



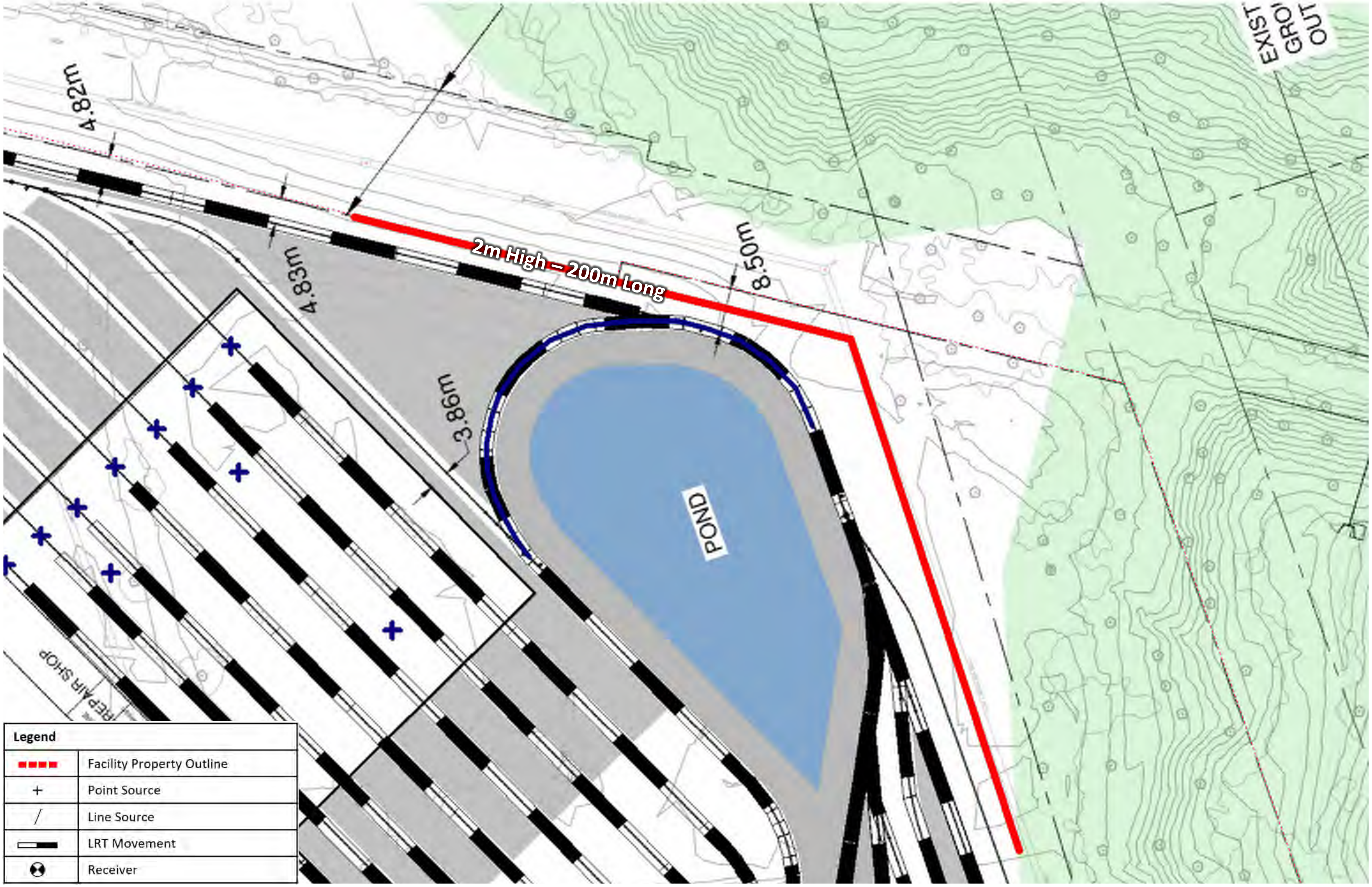
HDR	True North	Scale: 1: 4,500	METRES	SLR
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024 / Rev 0.0	Figure No. 34	
PREDICTED CONTINUOUS STATIONARY NOISE LEVELS – SURROUNDING PORS – MITIGATED – DAYTIME/EVENING		Project No. 241.03932.00001		



HDR	True North	Scale: 1: 4,500	METRES	SLR
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024 Rev 0.0	Figure No. 35	
PREDICTED CONTINUOUS STATIONARY NOISE LEVELS – SURROUNDING PORS – MITIGATED – NIGHT-TIME		Project No. 241.03932.00001		



HDR	True North	Scale: 1: 4,500	METRES	SLR
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024 Rev 0.0	Figure No. 36	
PREDICTED CONTINUOUS STATIONARY NOISE LEVELS – SURROUNDING OPORS - MITIGATED		Project No. 241.03932.00001		



HDR	True North	Scale: 1: 4,500	METRES	SLR
EGLINTON AVENUE EAST LRT		Date: Jan 12, 2024 — Rev 0.0	Figure No. 37	
PRELIMINARY NOISE BARRIER REQUIREMENTS – MAINTENANCE AND STORAGE FACILITY		Project No. 241.03932.00001		