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January 13, 2020

RWDI# 1802465

Bosa Development Ltd.
 1300-2025 Willingdon Avenue
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Attention: Dan Diebolt

Email: DDiebolt@thinkbosa.com

RE: DOCKSIDE GREEN PHASE A1 – ACOUSTICAL SITE ASSESSMENT v4

As requested, RWDI have conducted an acoustical assessment for Phase A1 of the Dockside Green development. Phase A1 involves the construction of three residential towers along Tyee Road. Noise monitoring was conducted for a period of 48-hours at three locations on the Phase A1 site to characterize noise levels at the facades of the three future buildings (A1-1, A1-2 and A1-3). An analysis was subsequently carried out to determine if the current façade design would provide sufficient exterior-to-interior noise reduction to satisfy the interior noise level limits of the City of Victoria Master Development Agreement (MDA). In cases where the façade design is expected to be insufficient, recommendations are provided for design modifications. Recommendations are also provided for additional noise mitigation measures.

City of Victoria Master Development Agreement

Schedule H of the City of Victoria Master Development Agreement (MDA) requires that interior noise levels in Phase A1 buildings due to exterior sources such as traffic and industry not exceed the following limits:

- Bedrooms 35 dBA
- Living, Dining, Rec. Rooms 40 dBA
- Kitchen, Bathrooms, Hallways 45 dBA

These noise level limits are expressed in terms of the $L_{eq}(24)$ (24-hour equivalent sound level). The $L_{eq}(24)$ is essentially a 24-hour average sound level but is more precisely defined as that steady sound level which would produce the same sound energy exposure, over a 24-hour period, as would the actual fluctuating sound level. The MDA also recommends various noise mitigation measures to assist in achieving the interior noise level limits. These mitigation measures are considered in a later section of this report.

Noise Monitoring

From March 7 to 9, 2018, continuous noise monitoring was conducted over a 48-hour period at three locations on the site of Phase A-1. The monitoring was conducted using Type 1 sound level meters (SLM) which were configured to collect complete statistical descriptions of the noise environment, including spectral data, every 15 minutes.

The SLM microphones were setup on tripods at heights of approximately 1.7 m above the ground. **Figure 1** provides an aerial photograph showing the approximate locations of the three monitoring sites relative to the Phase A1 site boundaries.

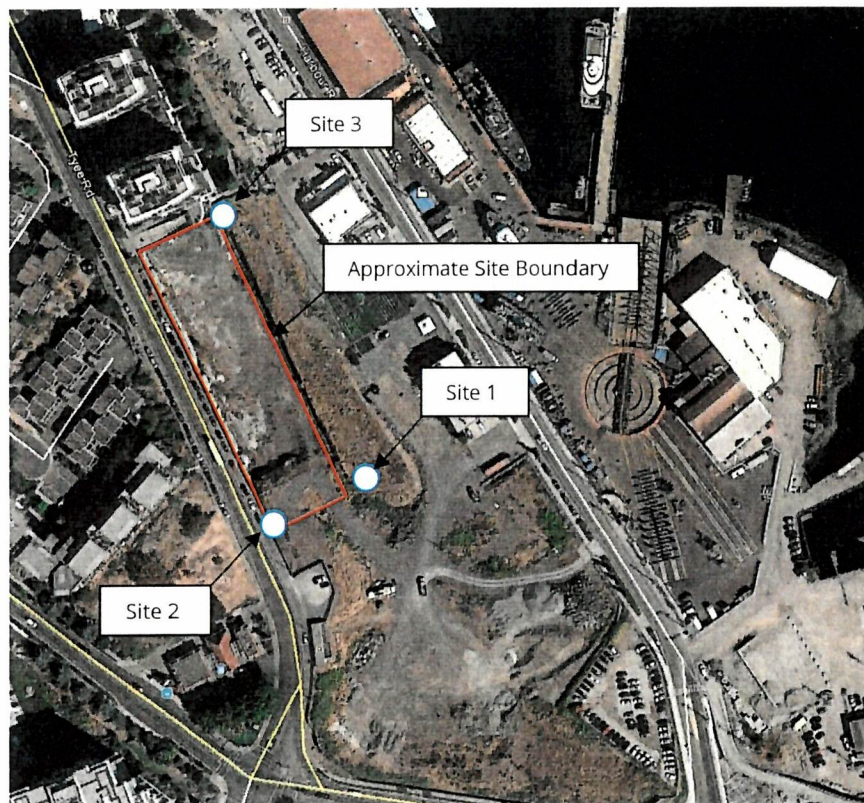


Figure 1: Site Map

Site 1 was located near the southeastern corner of the site boundary on a grassy berm which is elevated above Harbour Road. Site 2 was located near the southwestern corner of the site boundary on ground which was approximately level with Tyee Road. Site 3 was located near the northeastern corner of the site boundary on a berm which is elevated relative to Harbour Road. The $L_{eq}(24)$ at all three sites were influenced by noise from traffic on Tyee Road, Harbour Road, and Esquimalt Road, and noise from activity at the Point Hope Shipyard.



Noise Monitoring Results

The results of the noise monitoring are summarized in **Table 1** in terms of the daytime sound level (L_d), the nighttime sound level (L_n), and the $L_{eq}(24)$ measured at the three sites. The L_d is the equivalent sound level for the daytime period (7 a.m. to 10 p.m.) while the L_n is the equivalent sound level for the nighttime period (10 p.m. to 7 a.m.). Noise history charts are provided in **Appendix A** for the three sites which show the variation in equivalent sound levels (L_{eq}) in 15-minute intervals over the 48-hour monitoring period. Also shown in these charts for each 15-min interval are the maximum sound level (L_{max}) and the ninety-percent exceedance level¹ (L_{90}).

Table 1: Results of Dockside Phase A1 Noise Monitoring, March 7-8, 2018

Site	Location	L_d (dBA)		L_n (dBA)		$L_{eq}(24)$ (dBA)	
		Mar. 7-8	Mar. 8-9	Mar. 7-8	Mar. 8-9	Mar. 7-8	Mar. 8-9
1	Southeast property line	56	54	47	48	54	52
2	Southwest property line	67	66	58	58	65	64
3	Northeast property line	59	63	48	50	58	61

Table 1 shows that the $L_{eq}(24)$ at the three sites ranged from 52 to 65 dBA. Noise levels were highest at Site 2 due to its proximity to Tyee Road. Despite having similar setbacks from Tyee Road and Harbour Road, noise levels at Site 3 were higher than at Site 1. This result is due to the closer proximity of Site 3 to activity that was occurring at the Point Hope Shipyard (based on observations by the field engineer).

Before using the $L_{eq}(24)$ in **Table 1** to assess the sufficiency of the Phase A1 building facades, the $L_{eq}(24)$ have been averaged over the two, 24-hour periods. An allowance has also been made to account for noise level increases due to traffic growth over a 10-year period. Assuming an average traffic growth rate of 2% per year, the $L_{eq}(24)$ would be expected to increase by approximately 1 dBA (assuming no change in average vehicle speed and heavy truck mixes). Additionally, the $L_{eq}(24)$ measured at site 2 have been further adjusted because the monitoring location was closer to Tyee Road than the western facades of the Phase A1 buildings will be. This difference in setback distances has been estimated to result in a -2 dBA adjustment. No setback adjustments were necessary for the $L_{eq}(24)$ measured at the other two sites. This is because their setback distances from the various important sources of noise were large enough that the relatively small differences between the locations of these sites

¹ The L_{90} is often used to characterize the more steady background noise level against which discrete noise events, such as individual vehicle pass-bys, are experienced.

and the respective building facades would be acoustically negligible. **Table 2** presents the average, adjusted $L_{eq}(24)$ which are used in the proceeding building façade analysis.

Table 2: Average $L_{eq}(24)$

Site	Location	Average $L_{eq}(24)$ (dBA)*
1	Southeast property line	54
2	Southwest property line	64
3	Northeast property line	61

* Adjusted by 1 dBA for 10-year traffic growth

Building Façade Analysis

Approach

The sound transmission loss modelling software INSUL was used to estimate the octave band transmission losses (TL) (i.e., exterior-to-interior noise reductions) of the exterior wall and glazing assemblies that are currently specified for the Phase A1 buildings. Interior noise levels were then estimated by subtracting the transmission losses of the exterior wall and window assemblies from the measured traffic frequency spectra. Since all the building facades are expected to include some bedrooms, the MDA limit of $L_{eq}(24)$ 35 dBA for bedrooms (the lowest limit) has been used to assess the sufficiency of the façade design.

Transmission Losses of Building Façade

The estimated future $L_{eq}(24)$ at Site 2 of 64 dBA is considered to be representative of noise levels at the western façades of the three Phase A1 buildings. The estimated $L_{eq}(24)$ of 54 and 61 dBA at Sites 1 and 3, respectively, are considered representative of the range of noise levels on the eastern facades of the three buildings. To achieve the MDA limit of $L_{eq}(24)$ 35 dBA in bedrooms:

1. The western facades should provide a TL of at least 29 dBA.
2. The eastern facades should provide TL of at least 19 to 26 dBA.
3. The southern and northern facades should (conservatively) provide a TL of at least 29 dBA.

Exterior Walls

It is understood that the three buildings will have the following three exterior wall assemblies:



Exterior Wall #1

EXTERIOR: STEEL STUD WALL @ CONCRETE BALCONY/TERRACE CURB – COMPOSITE METAL PANEL SYSTEM

–	METAL COMPOSITE WALL PANELS (RAINSYSTEM SYSTEM)
2"	GALVANIZED METAL (VERTICAL) Z-GIRTS
2"	NON-COMBUSTIBLE SEMI RIGID INSULATION (R8)
	AIR BARRIER (SELF ADHERING MEMBRANE)
1/2"	EXTERIOR GYPSUM SHEATHING
6"	STEEL STUDS @16" O.C.
6"	BATT INSULATION (R20)
6 mil	POLYETHYLENE VAPOUR BARRIER (POLY V.B.)
1 3/8"	AIR SPACE
1 5/8"	STEEL STUDS @16" O.C.
1/2"	GYPSUM WALLBOARD, PAINTED

Exterior Wall #2

EXTERIOR: STEEL STUD WALL – CEMENTITIOUS PANEL FINISH

–	CEMENTITIOUS PANEL
1 1/2"	VERTICAL SUPPORT
–	METAL SUPPORT BRACKET
2"	NON-COMBUSTIBLE SEMI RIGID INSULATION (R8)
	AIR BARRIER
1/2"	EXTERIOR GYPSUM SHEATHING
6"	STEEL STUDS @16" O.C.
6"	BATT INSULATION (R20)
6 mil	POLYETHYLENE VAPOUR BARRIER (POLY V.B.)
1/2"	GYPSUM WALLBOARD, PAINTED

Exterior Wall #3

EXTERIOR: CONCRETE WALL – ABOVE GRADE (INTERIOR INSULATED) – PAINT FINISH

–	ELASTOMERIC PAINT FINISH
6" MIN.	C.I.P. CONCRETE WALL (REF. TO STRUCT.)
2"	SPRAY FOAM INSULATION (R12)
7/8"	AIR GAP
1 5/8"	STEEL STUDS @ 16" O.C. (BRACED AS REQUIRED)
2 1/2"	BATT INSULATION (R8)
1/2"	GYPSUM WALLBOARD – PAINTED WHERE EXPOSED
	(* SUBSTITUTE MOISTURE RESIST. GYPSUM WALLBOARD @ TUBS & SHOWERS)
1/4"	* CERAMIC TILE ON ADHESIVE @ TUBS & SHOWERS

Using the sound isolation modelling software INSUL, we estimate that all three exterior wall assemblies will provide a TL of at least 29 dBA as per our minimum criterion.

Glazing

We understand that the glazing on this project will consist of the following assemblies of Starline 9000 Window Wall (indicated by red boxes):

9000 WINDOW WALL – Based on a double glazed 23mm IGU

GLASS EXT.	GAP	GLASS INT.	TEST NUMBER	STC	OITC
4mm Ann.	14mm AIR	4mm Ann.	TL7227	33	27
5mm Ann.	14mm AIR	5mm Ann.	TL7226	34	28
4mm Ann.	16mm AIR	5mm Ann.	TL7225	37	30
6mm Lam. (PVB 0.8mm)	10mm AIR	6mm Lam. (PVB 0.8mm)	TL2564	38	30
4mm Ann.	13mm AIR	6mm Ann.	TL7334	36	31
5mm Ann.	13mm AIR	6mm Ann.	TL7341	37	31
4mm Ann.	13mm AIR	6mm Lam. (PVB 0.8mm)	TL7296	38	31
6mm Ann.	11mm AIR	6mm Lam. (PVB 0.8mm)	TL7338	39	32
5mm Ann.	13mm AIR	6mm Lam. (PVB 0.8mm)	TL7340	40	32

Test data provide by Starline indicates that these glazing assemblies will provide a TL of at least 29 dBA as per our minimum criterion.

Mechanical Ventilation

The Canadian Mortgage and Housing Corporation document "Road and Rail Noise: Effects on Housing", which is referenced in the MDA, includes the following language:

Because the noise insulation criteria cannot be met by conventional windows when they are open to provide ventilation, alternative means of ventilation are necessary if the noise level at that wall is above 55 dB.

This requirement will be satisfied as each unit will have a heat recovery ventilator unit which will supply fresh air.

I trust this has provided all the information you require at this time. Please do not hesitate to contact me should you have any questions or concerns regarding this report.



Andrew Williamson, P.Eng.
Acoustical Specialist
RWDI

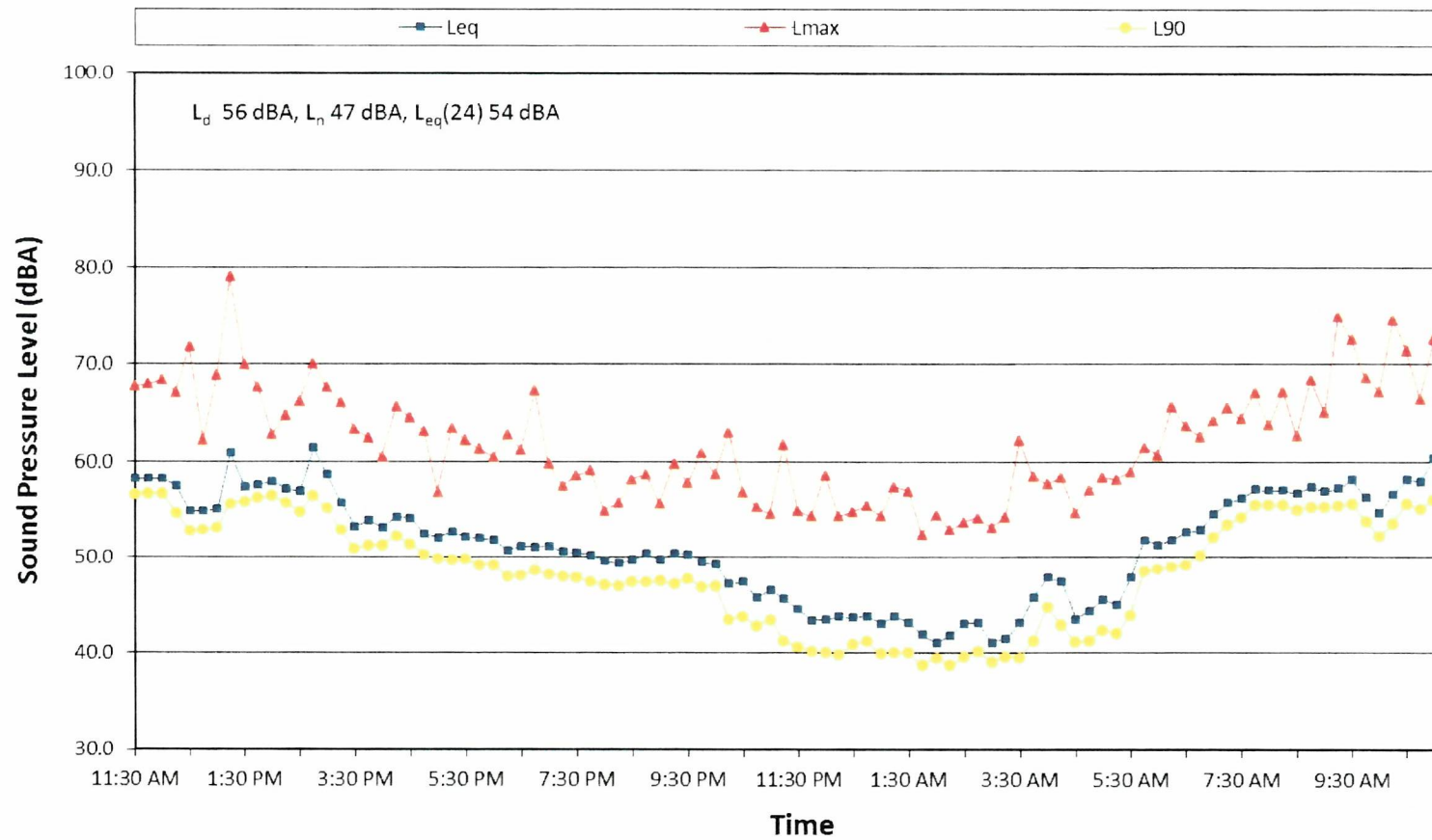


APPENDIX A: NOISE HISTORY CHARTS



Dockside Green - Phase A-1
Site 1 - SE Property Line, March 7-8, 2018

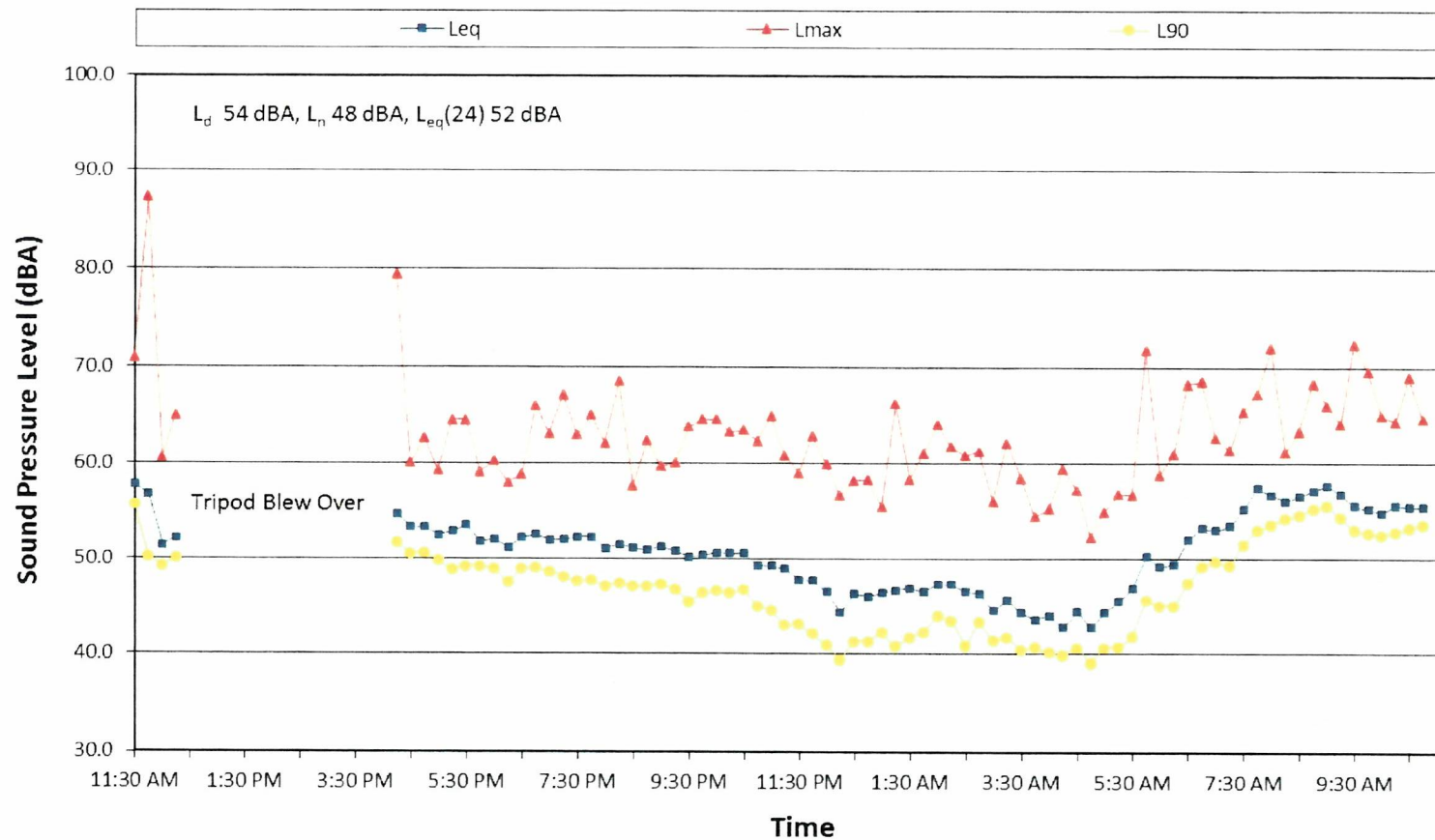
noise levels in 15-minute intervals





Dockside Green - Phase A-1
Site 1 - SE Property Line, March 8-9, 2018

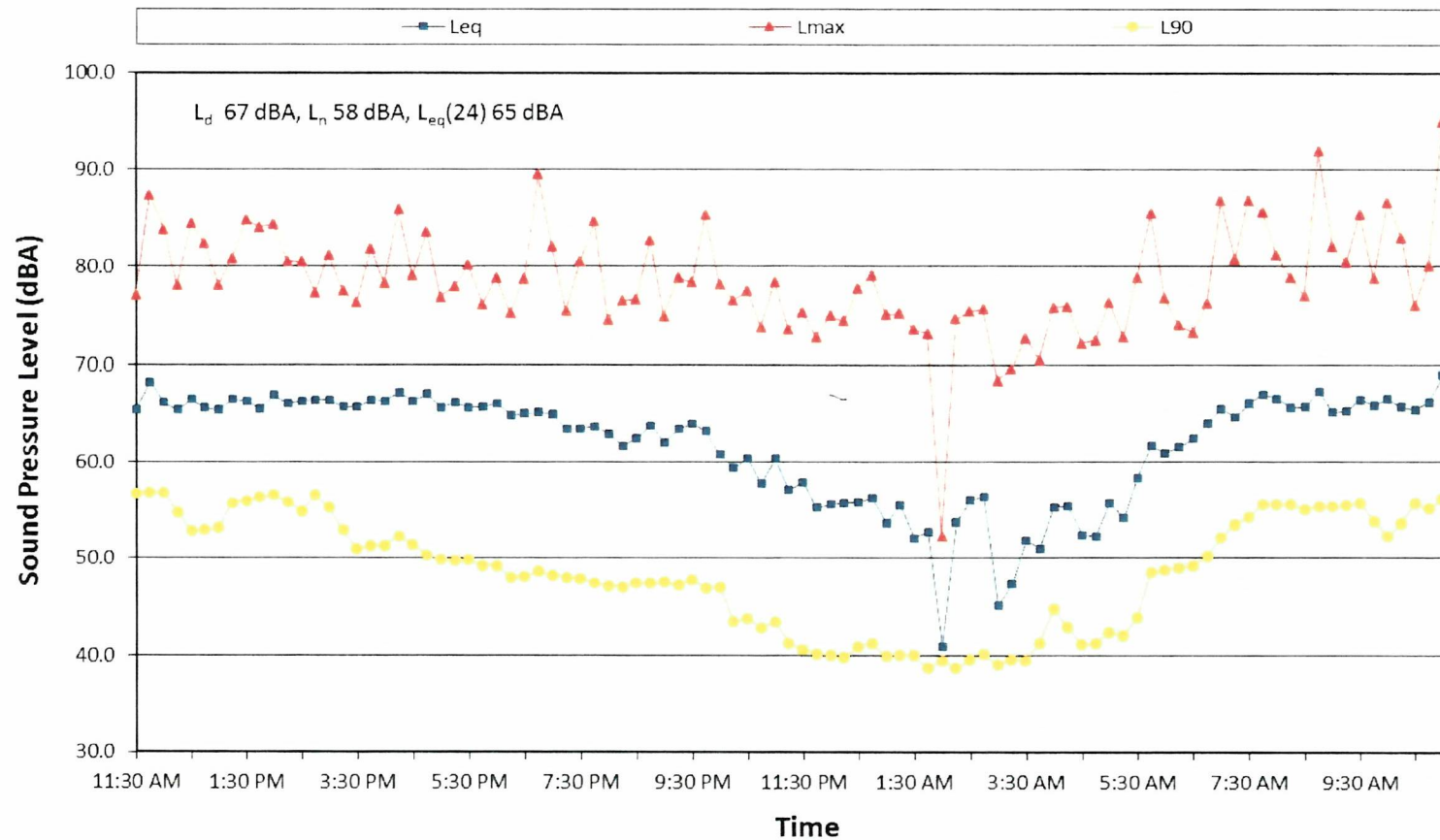
noise levels in 15-minute intervals





Dockside Green - Phase A-1
Site 2 - SW Property Line, March 7-8, 2018

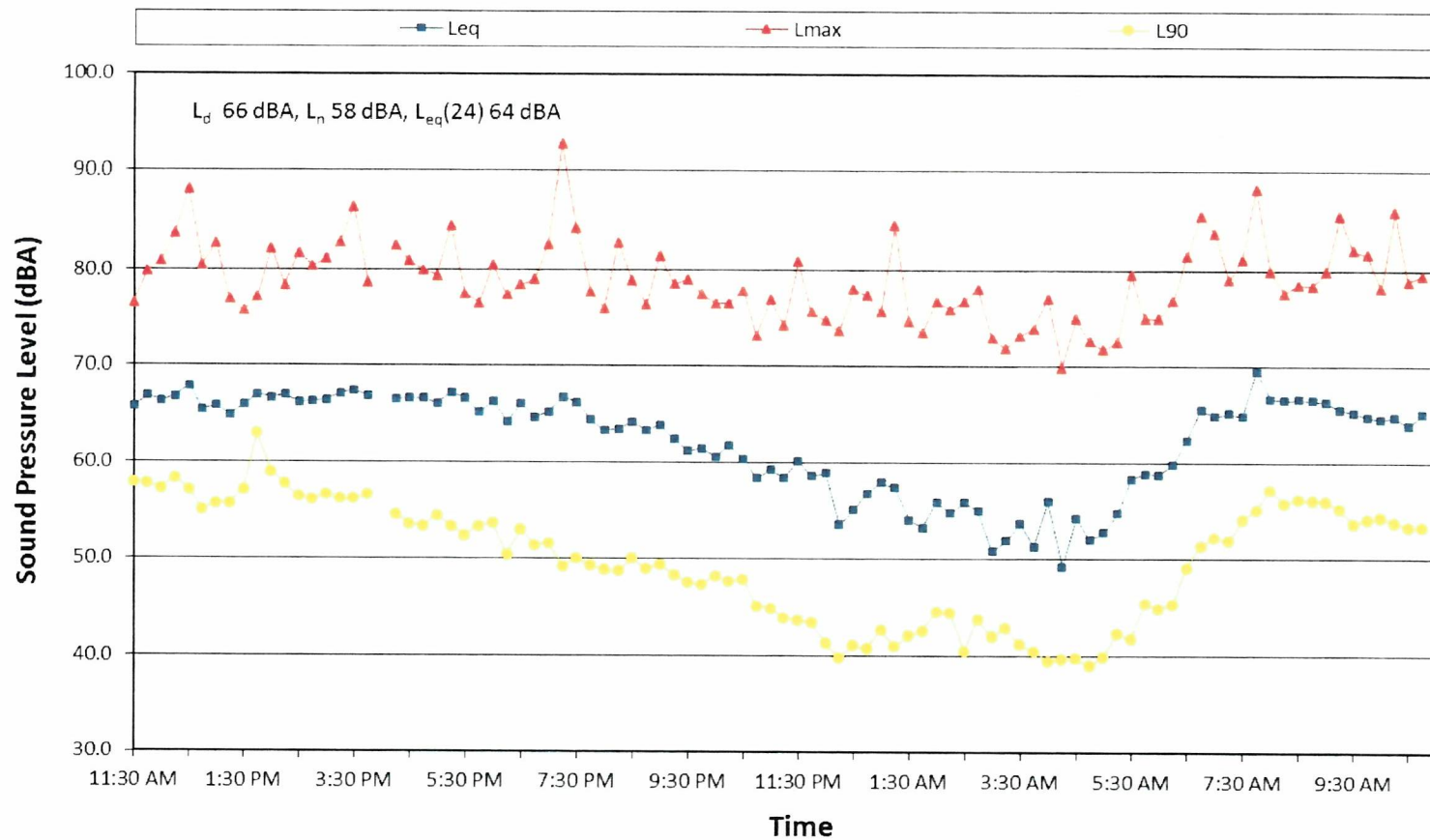
noise levels in 15-minute intervals





Dockside Green - Phase A-1
Site 2 - SW Property Line, March 8-9, 2018

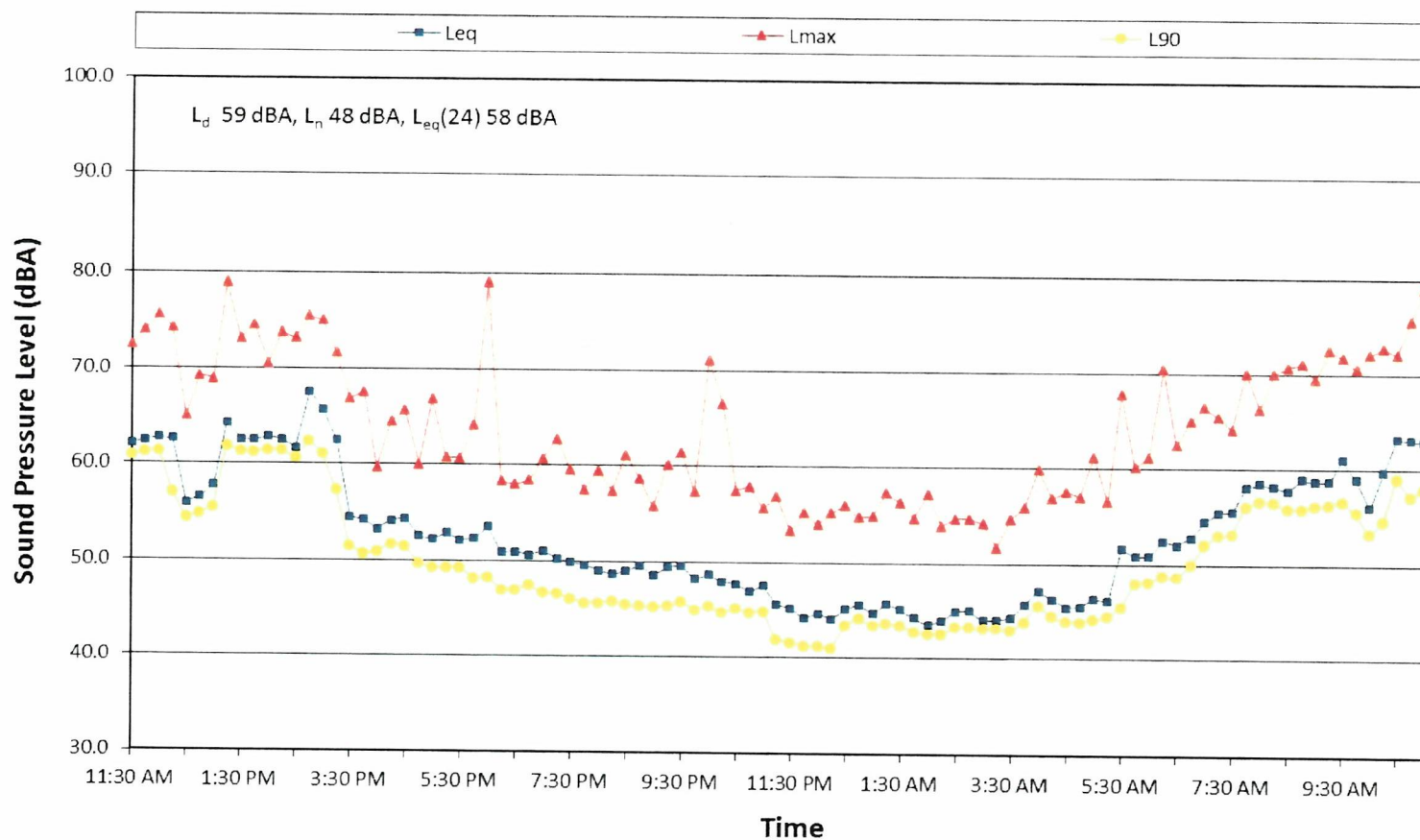
noise levels in 15-minute intervals





Dockside Green - Phase A-1
Site 3 - NE Property Line, March 7-8, 2018

noise levels in 15-minute intervals





Dockside Green - Phase A-1
Site 3 - NE Property Line , March 8-9, 2018

noise levels in 15-minute intervals

