HGC ENGINEERING
NOISE | VIBRATION | ACOUSTICS

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# Road Traffic Noise Survey
# Lakeview Community Association
# Calgary, Alberta

Prepared for:

Lakeview Community Association
6110 34 Street
Calgary, Alberta
T3E 5L6

Prepared by

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APEGA ID: 242669
October 11, 2022

PROFESSIONAL ENGINEER
IAN R. BONSMA
ALBERTA

**PERMIT TO PRACTICE**
**HOWE GASTMEIER CHAPNIK LIMITED**
RM SIGNATURE:
RM APEGA ID #: 242669
DATE: October 11, 2022
**PERMIT NUMBER: P008861**
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

October 11, 2022

Project No. 02200088

# VERSION CONTROL

Road Traffic Noise Survey, Lakeview Community Association

| Ver. | Date | Version Description | Prepared By |
|---|---|---|---|
| 1 | October 11, 2022 | Road Traffic Noise Survey Report | S. Baig |

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# Table of Contents

# 1 Introduction

Howe Gastmeier Chapnik Limited ("HGC Engineering") was retained by Lakeview Community Association ("LCA") to conduct a traffic noise survey to determine the sound levels at dwellings in the Lakeview residential community adjacent to Glenmore Trail SW. Glenmore Trail SW has recently undergone road widening from four lanes to six lanes. It is understood that a traffic noise assessment was previously completed in 2016, prior to the construction undertaking, to measure baseline sound levels. The LCA requested that sound monitoring be conducted at the same three residential locations as the original study, to determine if there are significant changes to the road traffic noise as a result of the road widening.

Glenmore Trail SW includes an existing acoustic barrier along the south side, separating the highway from residential dwellings. The barrier varies in height but is nearly continuous between 37 Street SW and Crowchild Trail SW. It is understood that this barrier was not altered during the recent road widening project.

The following noise survey summarizes the criteria, methodology and results obtained from the monitoring.

# 2 Criteria

Guidelines for acceptable levels of road traffic noise impacting residential developments are provided in the City of Calgary "Surface Transportation Noise Policy", Policy Number TP003, dated July 31, 2017. The Design Noise Level ("DNL"), "an amount of noise that is considered acceptable, and above which would be considered annoying", for outdoor leisure areas ("OLAs") is set based on the adjacency of the development to a designated truck route. The DNL in residential areas for OLAs is a 24-hour $L_{EQ}$ of 60 dBA or for developments adjacent to a designated truck route, the DNL is an $L_{10}$ limit of 65 dBA, where during a peak hour the noise level of 65 dBA is exceeded for 10% of the hour (a maximum of six minutes in the hour). Glenmore Trail SW is identified as a truck route by the City of Calgary.

The term "Outdoor Leisure Area" ("OLA") is used in reference to an outdoor patio, a backyard, a common area allocated outside a multi-storey residential building or other area where passive

recreation is expected to occur. For sound level measurements, the typical location is 3.0 metres from the house or 4.5 metres from the property line, with a microphone height of 1.5 metres.

For road construction projects and potential retrofit acoustic barriers along an adjacent truck route, the warrant for attenuation is determined based on the above policy. Sound levels need to exceed an $L_{10}$ of 65 dBA, and the economic and technical feasibility of a retrofit barrier would need to be determined.

# 3 Methodology

Sound level monitoring was conducted at three residences where the LCA had obtained permission for the monitoring. The noise monitoring locations are shown in Figure 1.

HGC Engineering visited the site and surrounding area on May 31, 2022, to install the sound level monitors at 5408 Ladbrooke Drive SW, 2944 Lathom Crescent SW, and 6123 Lockinvar Road SW, complying with the requirements given in the Transportation Noise Policy. Due to an instrumentation malfunction the sound level monitoring at 6123 Lockinvar Road SW was repeated starting on September 7, 2022.

A Norsonic Precision Sound Analyser, Model Nor140 was installed at 5408 Ladbrooke Drive SW, a Svantek 977 sound level meter was deployed at 6123 Lockinvar Road SW and a Svantek 971 sound level meter was installed at 2944 Lathom Crescent SW. Calibration of the sound level meters was verified using a portable sound level calibrator prior to deployment and during retrieval of the equipment. The measurement instrumentation used in this study is summarized in Table 1. The sound level monitors are maintained in yearly calibration by a third-party NIST traceable lab. Yearly and factory calibration certificates for the measurement instruments are included under Appendix B.

**Table 1: Measurement Instrumentation Summary**

| Location | Instrumentation Make and Model | Serial Number | Date Deployed | Date Retrieved |
|---|---|---|---|---|
| 5408 Ladbrooke Drive SW | Norsonic Nor140 sound level meter | 1407451 | May 31, 2022 | June 9, 2022 |
| 6123 Lockinvar Road SW | Svantek 977 sound level meter | 98080 | September 7, 2022 | September 14, 2022 |
| 2944 Lathom Crescent SW | Svantek 971 sound level meter | 41988 | June 6, 2022 | June 11, 2022* |

Regional weather conditions during sound monitoring periods were obtained using Alberta Climate Information Service ("ACIS") online data viewer tool. Canada Olympic Park ("COP") Upper was found to be the closest regional meteorological station, at a distance of approximately 10 km from the monitoring locations. Meteorological data was used to identify periods of suitable sound monitoring where no external interference from inclement weather, such as rain and high winds were present.

The sound level monitors were deployed for a duration of approximately one-week to capture representative road traffic noise and to allow for removal of data during inclement weather conditions. The deployment and retrieval dates are provided in Table 1. Road traffic sound levels were dominant at the monitoring locations.

The sound level monitors were configured to collect data in 1-second intervals, $L_{EQ}$ [1 second], to allow for exclusion of short duration extraneous contributions from nearby sources such as dog barking or birds chirping. In addition, 10 minute and one hour sound level data were also collected. The 24-hour ($L_{EQ}$ [24 hr]) average sound levels were determined from the collected data and were not filtered for any interference. The $L_{EQ}$ sound level is defined as the energy-equivalent sound level and represents the integrated sound exposure level of both steady and time-varying sounds over the duration of the measurement. As previously discussed, the DNL for residential outdoor amenity areas adjacent to a truck route, is set as an $L_{10}$ of 65 dBA during a peak hour. The sound level monitors also recorded the $L_{10}$ on an hourly basis. Upon completion of the monitoring, exceedances of the $L_{10}$ [1 hr] of 65 dBA were reviewed to confirm whether the dominant noise source was attributed to road traffic or extraneous noise sources (animals, lawnmowers, etc.). The review included listening to audio recordings of the events and assessing the one-third octave band

frequency data. Where extraneous noise sources dominated the measurements, the $L_{10}$ [1 hr] was recalculated after removing the periods of interference.

# 4 Results & Discussion

Figure 2 shows a graphical representation of the data collected at 5408 Ladbrooke Drive SW during the monitoring period from May 31 to June 9, 2022. The sound levels measured at 5408 Ladbrooke Drive SW are quantified in Table 2. The $L_{EQ}$ is shown in both 1-minute and 24-hour time intervals. The $L_{10}$ [1 hr] is also shown along with the City of Calgary DNL of 65 dBA. Shaded periods of inclement weather are shown where wind speeds exceed 25 km/h or if any precipitation was observed. Elevated wind speeds typically result in elevated sound levels from leaves rustling in trees, or with high enough wind speeds, pseudo noise on the microphone. Precipitation will not only cause elevated levels at the microphone due to impacts of rain on the windscreen but also and more importantly, road traffic noise can increase significantly with wet roads. The sound levels measured at 5408 Ladbrooke Drive SW were found to be below the DNL criteria over the course of the monitoring period.

**Table 2: 5408 Ladbrooke Drive SW, Sound Level Monitoring Summary**

| Date | Sound Pressure Level [dBA] | | Peak $L_{10}$ Hour* |
|---|---|---|---|
| | $L_{EQ}$ [24 hr]$^{+}$ | Peak $L_{10}$ [1 hr] | |
| Tue 05-31-22 | 57 | 62 | 1:00 PM |
| Wed 06-01-22 | 61 | 64 | 7:00 AM |
| Thu 06-02-22 | 61 | 64 | 5:00 PM |
| Fri 06-03-22 | 57 | 63 | 5:00 AM |
| Sat 06-04-22 | 58 | 63 | 6:00 PM |
| Sun 06-05-22 | 59 | 63 | 7:00 AM |
| Mon 06-06-22 | 61 | 64 | 12:00 PM |
| Tue 06-07-22 | 58 | 64 | 6:00 AM |
| Wed 06-08-22 | 57 | 62 | 4:00 PM |

$^{+}$ Unfiltered
* Note: Peak Daily $L_{10}$ omits periods of inclement weather.

A previous traffic noise assessment completed by Patching Associated Acoustical Engineering Ltd., dated June 1, 2016, prior to the road widening, indicated that the peak $L_{10}$ [1 hr] at 5408 Ladbrooke

Drive SW were 62.7 dBA and 62.2 dBA. A comparison to the 2016 data demonstrates that $L_{10}$ at 5408 Ladbrooke Drive SW has increased by several decibels following the completion of the road widening project.

Figure 3 illustrates the unattended sound level data collected at 6123 Lockinvar Road SW from September 7 to 14, 2022. The sound levels measured at 6123 Lockinvar Road SW are summarized in Table 3. In general, the road traffic noise measured at 6123 Lockinvar Road SW demonstrated the highest sound levels when compared to the other monitoring locations. The $L_{10}$ [1 hr] was found to exceed the DNL criteria on several instances mainly during peak evening hours. The Peak $L_{10}$ [1 hr] was in excess of the 65 dBA DNL on September 7 and 10, 2022. Upon review of the audio recordings during the instances of excess, the main contributing noise source was attributed to road traffic.

**Table 3: 6123 Lockinvar Road SW, Sound Level Monitoring Summary**

| Date | Sound Pressure Level [dBA] | | Peak $L_{10}$ Hour* |
|---|---|---|---|
| | $L_{EQ}$ [24 hr]+ | Peak $L_{10}$ [1 hr] | |
| Wed 09-07-22 | 62 | **68** | 2:00 PM |
| Thu 09-08-22 | 59 | 65 | 6:00 AM |
| Fri 09-09-22 | 59 | 65 | 11:00 AM |
| Sat 09-10-22 | 58 | **66** | 7:00 PM |
| Sun 09-11-22 | 57 | 60 | 4:00 PM |
| Mon 09-12-22 | 60 | 65 | 5:00 PM |
| Tue 09-13-22 | 60 | 65 | 5:00 PM |

+ Unfiltered.
*Note: Peak Daily $L_{10}$ omits periods of inclement weather. Values **bolded and underlined** are exceedances above the DNL.

The previous noise survey indicated that the peak $L_{10}$ [1 hr] at 6123 Lockinvar Road SW, were 61.2 dBA and 60.6 dBA. A comparison to the 2016 data demonstrates that $L_{10}$ [1 hr] at 6123 Lockinvar Road SW has increased by up to 7 decibels following the completion of road widening project.

Figure 4 shows the sound level data collected at 2944 Lathom Crescent SW from June 6 to June 11, 2022. The sound levels measured at 2944 Lathom Crescent SW are summarized in Table 4. The sound levels measured at 2944 Lathom Crescent SW were generally lower than those recorded at the

two other monitoring locations, which is consistent with the results from the previous study completed in 2016. The peak $L_{10}$ [1 hr] road traffic noise levels measured were found to be below the City of Calgary 65 dBA DNL criteria over the duration of the monitoring period.

**Table 4: 2944 Lathom Crescent SW, Sound Level Monitoring Summary**

| Date | Sound Pressure Level [dBA] | | Peak $L_{10}$ Hour* |
|---|---|---|---|
| | $L_{EQ}$ [24 hr]+ | Peak $L_{10}$ [1 hr] | |
| Mon 06-06-22 | 60 | 61 | 12:00 PM |
| Tue 06-07-22 | 56 | 61 | 6:00 AM |
| Wed 06-08-22 | 57 | 62 | 3:00 PM |
| Thu 06-09-22 | 57 | 59 | 6:00 AM |
| Fri 06-10-22 | 58 | 63 | 9:00 AM |

+ Unfiltered.
* Note: Peak Daily $L_{10}$ omits periods of inclement weather.

The noise monitoring study from 2016 indicates that the peak $L_{10}$ [1 hr] at 2944 Lathom Crescent SW, was measured as 60.3 dBA and 60.5 dBA. A comparison to the 2016 data demonstrates that $L_{10}$ for the peak hour at 2944 Lathom Crescent SW has remained relatively unchanged since the completion of the road widening project.

# 5 Conclusion

In summary, HGC Engineering conducted a sound level survey of road traffic at three residential properties adjacent to Glenmore Trail SW to determine if the road traffic sound levels exceeded the City of Calgary Design Noise Level of 65 dBA outlined in the Surface Transportation Noise Policy. The results indicated that the $L_{10}$ [1 hr] levels were below the DNL for dwellings at 5408 Ladbrooke Drive SW and 2944 Lathom Crescent SW. The maximum $L_{10}$ [1 hr] recorded at 5408 Ladbrooke Drive SW was 64 dBA during the monitoring period. The $L_{10}$ [1 hr] at 6123 Lockinvar Road SW was below the DNL for the majority of the monitoring period, however on September 7 and 10, 2022 the peak hour $L_{10}$ was measured as 68 dBA and 66 dBA, respectively. On September 7, the DNL was exceeded from 14:00 to 21:00. On September 10, the DNL was exceeded from 19:00 to 21:00 and 22:00 to 23:00. Upon review of the sound recordings road traffic noise from trucks and motorcycles were dominant. A comparison to the traffic noise survey completed in 2016 indicates that the peak $L_{10}$ [1 hr] values have increased by a few decibels at 5408 Ladbrooke Drive SW and by up to 7 dBA

at 6123 Lockinvar Road SW. The $L_{10}$ [1 hr] at 2944 Lathom Crescent SW has remained similar to the levels reported in 2016, with a maximum $L_{10}$ [1 hr] of 63 dBA during the monitoring campaign.

# REFERENCES

1. City of Calgary, *Surface Transportation Noise Policy*, 2017-07.
2. *Alberta Climate Information Service (ACIS) Data Products & Tools.* Government of Alberta. https://acis.alberta.ca/acis/
   [Accessed: September 16, 2022]
3. Patching Associates – Acoustical Engineering Ltd., *Lakeview Community Association Glenmore Trail Noise Monitoring Study*, 2016-06.

**Figure 1: Road Traffic Noise Monitoring Locations**

**Figure 2: Unattended Sound Level Monitoring**
**5408 Ladbrooke Drive SW, Calgary, AB**
**From May 31 to June 9, 2022**

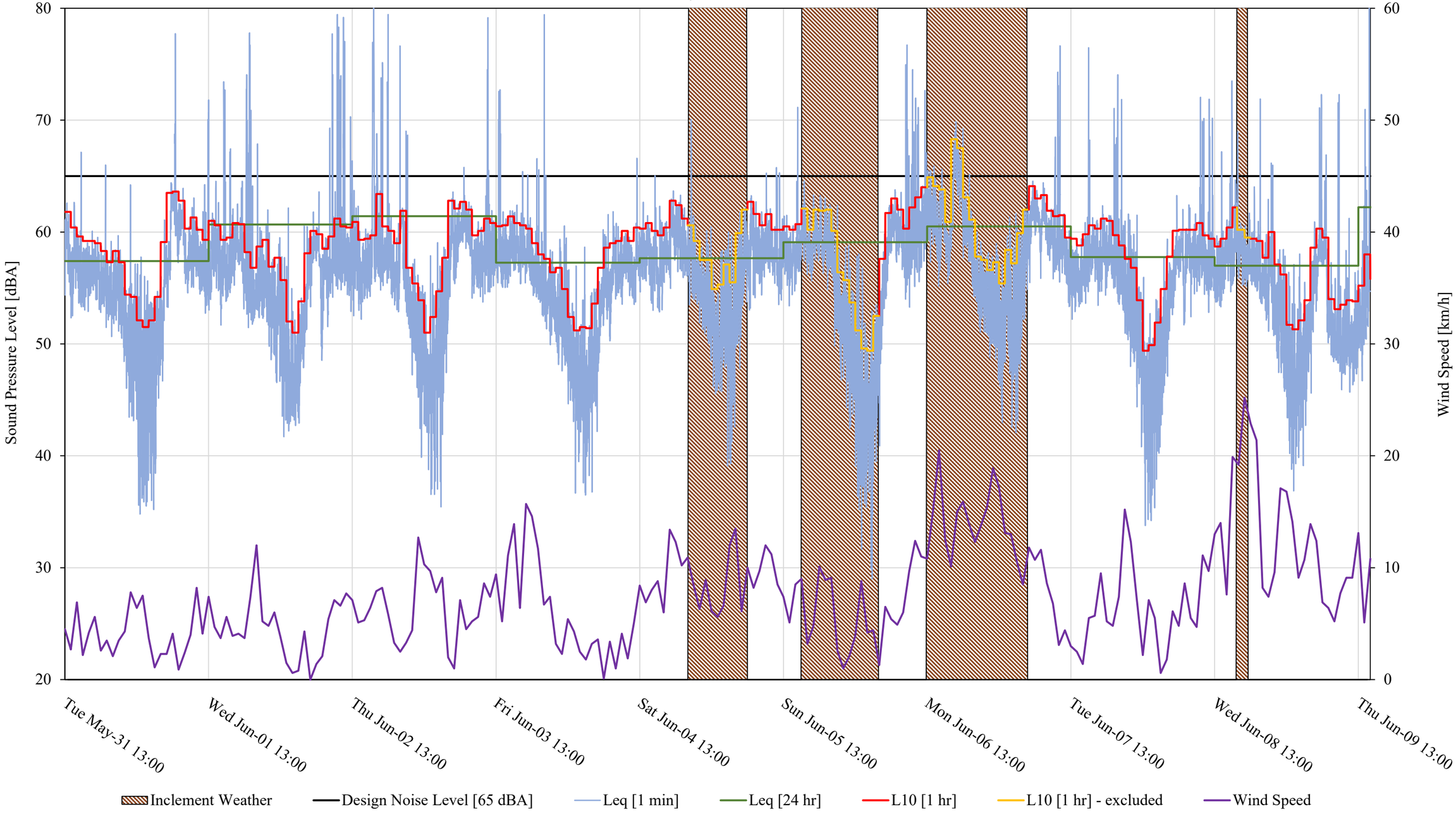


**Figure 3: Unattended Sound Level Monitoring**
**6123 Lockinvar Road SW, Calgary, AB**
**From September 7 to 14, 2022**

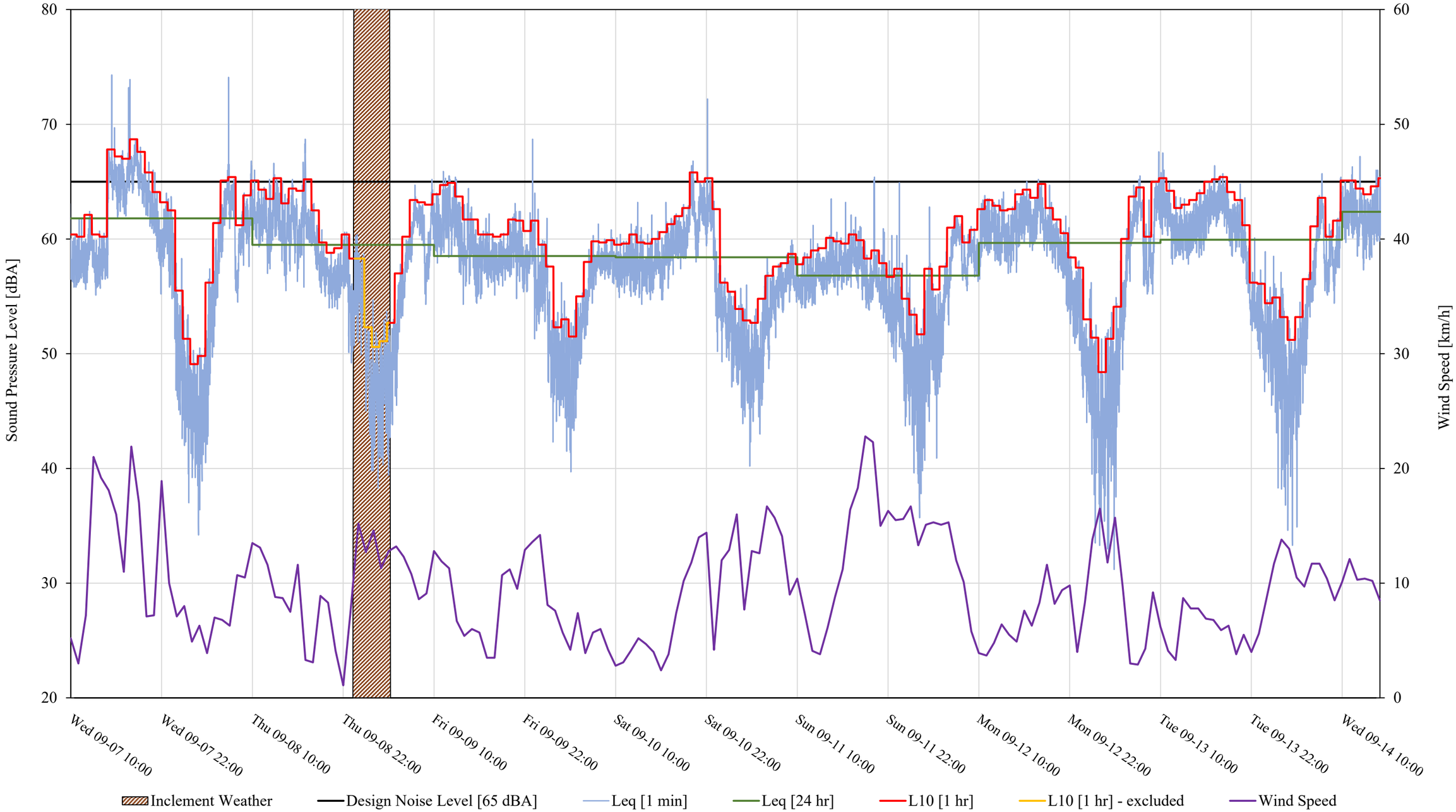
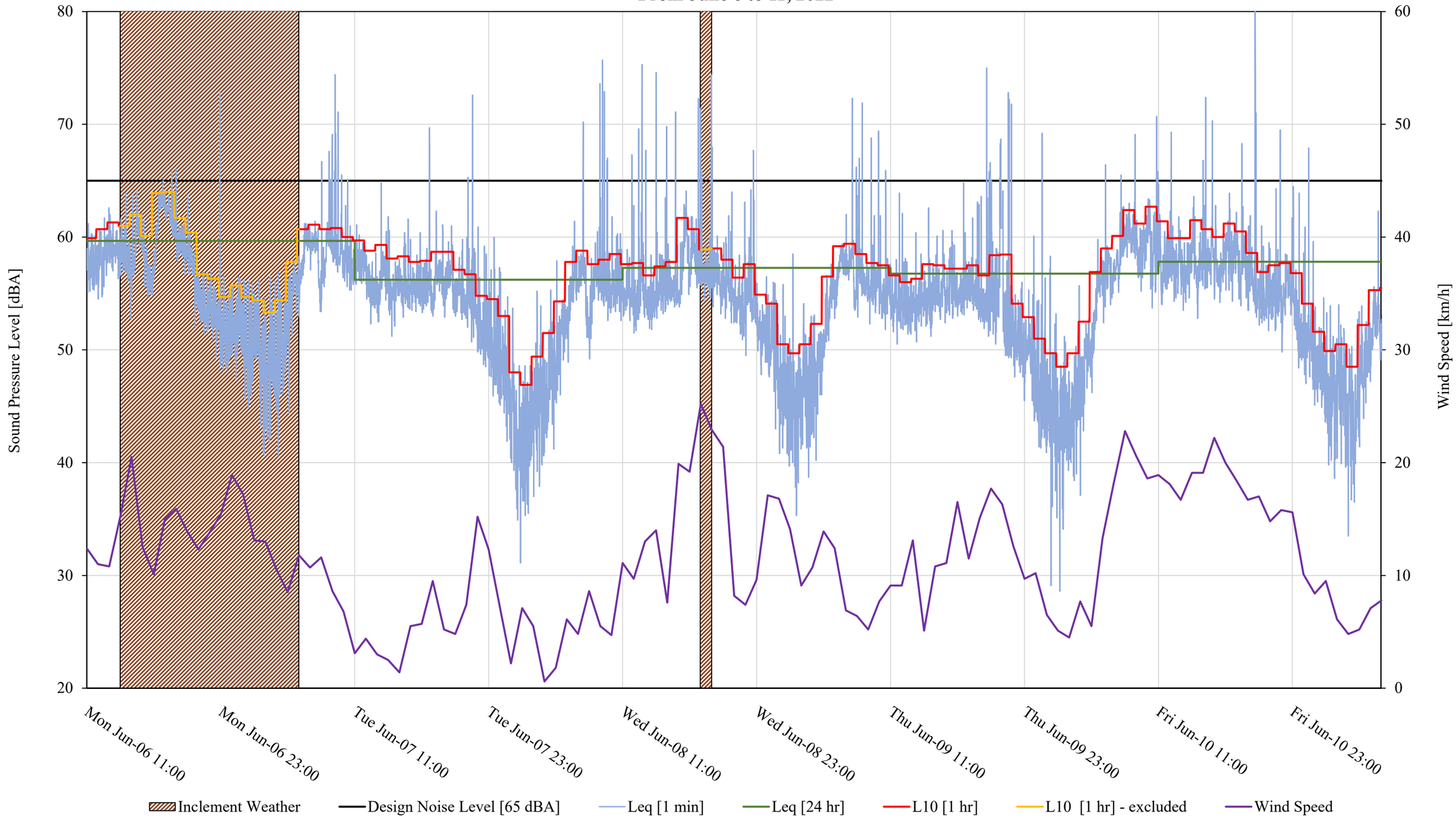


**Figure 4: Unattended Sound Level Monitoring**
**2944 Lathom Crescent SW, Calgary, AB**
**From June 6 to 11, 2022**



# APPENDIX A

## Site Photos

**Sound Level Monitoring Station at 5408 Ladbrooke Drive SW**

**Sound Level Monitoring Station at 6123 Lockinvar Road SW**

**Sound Level Monitoring Station at 2944 Lathom Crescent SW**

# APPENDIX B

## Calibration Certifications

# *CERTIFICATE of CALIBRATION*

| | | | |
|---|---|---|---|
| Make : | Norsonic | Reference # : | 169022 |
| Model : | NOR140 | Customer : | HGC Engineering<br>Mississauga, ON |
| Descr. : | Sound Level Meter Type 1 | | |
| Serial # : | 1407451 | P. Order : | Sean Richardson |
| Asset # : | N140-10 | | |

Cal. status : Received in spec's, no adjustment made.

*Navair Technologies certifies that the above listed instrument was calibrated on date noted and was released from this laboratory performing in accordance with the specifications set forth by the manufacturer.*

*Unless otherwise noted in the calibration report a 4:1 accuracy ratio was maintained for this calibration.*

*Our calibration system complies with the requirements of ISO-9001-2015 and is registered under certificate CA96/269, working standards used for calibration are certified by or traceable to the National Research Council of Canada or the National Institute of Standards and Technology.*

Calibrated : Dec 29, 2021 By :

Cal. Due : Dec 29, 2022 T. Beilin

Temperature : 23 °C ± 2 °C Relative Humidity : 30% to 70%

Standards used : J-216 J-303 J-512

## *Navair Technologies*

REPAIR AND CALIBRATION TRACEABLE TO NRC AND NIST

6375 Dixie Rd. Mississauga, ON, L5T 2E7 http: // www.navair.com

Phone : 800-668-7440 Fax: 905 565 8325 e-Mail: service @ navair.com

## 2. CALIBRATION (vibrational)

LEVEL METER function; Range: High; Input signal: 140dB;

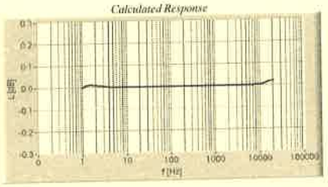
| Characteristic | Reference frequency [Hz] | Correct value [dB] | Indication [dB] | Error [dB] |
|---|---|---|---|---|
| HP1 | 79.58 | 140.0 | 140.0 | 0.0 |

Calibration measured with the accelerometer DYTRAN type 3185D No. 2975. Calibration factor: -0.33dB

## 3. FREQUENCY RESPONSE (electrical)

LEVEL METER function; Characteristic: HP; Range: High; input=175 dB;

*Calculated Response*




*Measured Response (f-frequency, L-level)*

| f [Hz] | L [dB] |
|---|---|
| 1 | -0.0 |
| 1000 | 0.0 |
| 20000 | -0.1 |

All frequencies are nominal center values for the 1/3 octave bands

## 4. INTERNAL NOISE LEVEL (electrical)

LEVEL METER function; Range: Low;

| | |
|---|---|
| Characteristic | HP1 |
| Indication [dB] | 42.7 |

### ENVIRONMENTAL CONDITIONS

| Temperature | Relative humidity | Ambient pressure |
|---|---|---|
| 20 °C | 27% | 1008 hPa |

### TEST EQUIPMENT

| Item | Manufacturer | Model | Serial no. | Description |
|---|---|---|---|---|
| 1. | SVANTEK | SVAN 401 | 84 | Signal generator |
| 2. | SVANTEK | SVAN 912A | 15900 | Sound & Vibration Analyser |
| 3. | RIGOL | DM3068 | DM30155100773 | Digital multimeter |
| 4. | SVANTEK | SV30A | 24563 | Acoustic calibrator |
| 5. | SVANTEK | ST02 | - | Microphone equivalent electrical impedance (18pF) |
| 6. | DYTRAN | 3233A | 747 | Reference accelerometer |

### CONFORMITY & TEST DECLARATION

1. Herewith Svantek company declares that this instrument has been calibrated and tested in compliance with the internal ISO9001 procedures and meets all specification given in the Manual(s) or respectively surpass them.
2. The acoustic calibration was performed using the Sound Calibrator and is traceable to the GUM (Central Office of Measures) reference standard - sound level calibrator type 4231 No 2292773.
3. The vibrational calibration was performed using the Back-to-Back Comparison method and is traceable to the GUM (Central Office of Measures) reference standard - accelerometer type 8305 No 1435233.
4. The information appearing on this sheet has been compiled specifically for this instrument. This form is produced with advanced equipment & procedures which permit comprehensive quality assurance verification of all data supplied herein.
5. This calibration sheet shall not be reproduced except in full, without written permission of the SVANTEK Ltd.

Calibration specialist: Krzysztof Kubel ..... Test date: 2022-04-12



SVANTEK

ISO9001 certified

# FACTORY CALIBRATION DATA OF THE *SVAN 977C No. 98080*

**with preamplifier SVANTEK type SV12L No. 21113 and microphone MICROTECH type MK255 No. 21109**

## SOUND LEVEL METER

## 1. CALIBRATION (electrical)

LEVEL METER function; Characteristic: A; $f_{ref}$=1 kHz; Input signal =114.0dB;

| Range | Low (120dB) | High (137dB) |
|---|---|---|
| Indication [dB] | 114.0 | 114.0 |
| Error [dB] | -0.0 | -0.0 |

## 2. CALIBRATION* (acoustical)

LEVEL METER function; Range: High; Reference frequency: 1000 Hz; Sound Pressure Level: : 114.04 dB.

| Characteristic | Correct value [dB] | Indication [dB] | Error [dB] |
|---|---|---|---|
| Z | 114.04 | 114.06 | 0.02 |
| A | 114.04 | 114.06 | 0.02 |
| C | 114.04 | 114.06 | 0.02 |

Calibration measured with the microphone MICROTECH type MK255 No. 21109. Calibration factor: 0.16 dB.

## 3. LINEARITY TEST* (electrical)

LEVEL METER function; Range: Low; Characteristic: A;

$f_{ref}$= 31.5 Hz

| Nominal result LEQ [dB] | 22.0 | 23.0 | 24.0 | 25.0 | 30.0 | 40.0 | 60.0 | 80.0 |
|---|---|---|---|---|---|---|---|---|
| Error [dB] | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

$f_{ref}$= 1000 Hz

| Nominal result LEQ [dB] | 22.0 | 23.0 | 24.0 | 25.0 | 30.0 | 40.0 | 60.0 | 80.0 | 100.0 | 120.0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Error [dB] | 0.0 | 0.0 | 0.0 | -0.0 | -0.0 | -0.0 | -0.0 | -0.0 | 0.0 | -0.0 |

$f_{ref}$= 8000 Hz

| Nominal result LEQ [dB] | 22.0 | 23.0 | 24.0 | 25.0 | 30.0 | 40.0 | 60.0 | 80.0 | 100.0 | 119.0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Error [dB] | 0.0 | 0.0 | 0.0 | -0.0 | -0.0 | -0.0 | -0.0 | 0.0 | 0.0 | -0.0 |

LEVEL METER function; Range: High; Characteristic: A;

$f_{ref}$= 31.5 Hz

| Nominal result LEQ [dB] | 35.0 | 36.0 | 37.0 | 38.0 | 40.0 | 60.0 | 80.0 | 97.0 |
|---|---|---|---|---|---|---|---|---|
| Error [dB] | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | -0.0 | -0.0 | 0.0 |

$f_{ref}$= 1000 Hz

| Nominal result LEQ [dB] | 35.0 | 36.0 | 37.0 | 38.0 | 40.0 | 60.0 | 80.0 | 100.0 | 120.0 | 137.0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Error [dB] | 0.1 | 0.0 | 0.0 | 0.0 | -0.0 | -0.0 | -0.0 | 0.0 | -0.0 | 0.0 |

$f_{ref}$= 8000 Hz

| Nominal result LEQ [dB] | 35.0 | 36.0 | 37.0 | 38.0 | 40.0 | 60.0 | 80.0 | 100.0 | 120.0 | 136.0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Error [dB] | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -0.0 | 0.0 | 0.0 | -0.0 | 0.0 |

## 4. TONE BURST RESPONSE*

LEVEL METER function; Range: **Low**; Characteristic: A; $f_{ref}$= 4000 Hz; Burst duration: 2 s

Steady level nominal result = 117dB

| Result | Detector | Duration [ms] | 1000 | 500 | 200 | 100 | 50 | 20 | 10 | 5 | 2 | 1 | 0.5 | 0.25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAX | Fast | **Indication [dB]** | 117.0 | 116.9 | 116.0 | 114.4 | 112.2 | 108.7 | 105.8 | 102.9 | 99.0 | 96.0 | 92.9 | 89.9 |
| | | **Error [dB]** | 0.0 | 0.0 | 0.0 | 0.0 | -0.0 | -0.0 | -0.1 | 0.0 | -0.0 | -0.1 | -0.1 | -0.1 |
| | Slow | **Indication [dB]** | 115.0 | 113.0 | 109.6 | 106.8 | 103.9 | 100.0 | 97.0 | 94.0 | 90.0 | - | - | - |
| | | **Error [dB]** | 0.0 | 0.1 | -0.0 | -0.0 | -0.0 | -0.0 | -0.0 | -0.0 | -0.0 | - | - | - |
| SEL | - | **Indication [dB]** | 117.0 | 114.0 | 110.0 | 107.0 | 104.0 | 100.0 | 97.0 | 94.0 | 90.0 | 87.0 | 83.9 | 80.9 |
| | | **Error [dB]** | 0.0 | -0.0 | 0.0 | 0.0 | -0.0 | 0.0 | -0.0 | -0.0 | -0.0 | -0.1 | -0.1 | -0.1 |

Steady level nominal result = 57dB

| Result | Detector | Duration [ms] | 1000 | 500 | 200 | 100 | 50 | 20 | 10 | 5 | 2 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAX | Fast | **Indication [dB]** | 57.0 | 57.0 | 56.0 | 54.4 | 52.2 | 48.7 | 45.9 | 42.9 | 39.0 | 36.0 |
| | | **Error [dB]** | 0.0 | 0.0 | 0.0 | -0.0 | -0.0 | -0.0 | -0.0 | -0.0 | -0.0 | -0.1 |
| | Slow | **Indication [dB]** | 55.0 | 53.0 | 49.6 | 46.8 | 43.9 | 40.0 | 37.0 | 34.0 | 30.0 | - |
| | | **Error [dB]** | 0.0 | 0.0 | -0.0 | -0.0 | -0.0 | -0.0 | -0.0 | -0.0 | 0.0 | - |
| SEL | - | **Indication [dB]** | 57.0 | 54.0 | 50.0 | 47.0 | 44.0 | 40.0 | 37.0 | 34.0 | 30.1 | 27.0 |
| | | **Error [dB]** | 0.0 | -0.0 | 0.0 | 0.0 | -0.0 | 0.0 | 0.0 | -0.0 | 0.0 | 0.0 |

Steady level nominal result = 33.0dB

| Result | Detector | Duration [ms] | 1000 | 500 | 200 |
|---|---|---|---|---|---|
| MAX | Fast | **Indication [dB]** | 33.0 | 33.0 | 32.0 |
| | | **Error [dB]** | 0.0 | 0.1 | 0.0 |
| | Slow | **Indication [dB]** | 31.1 | 29.0 | 25.7 |
| | | **Error [dB]** | 0.0 | 0.1 | 0.1 |
| SEL | - | **Indication [dB]** | 33.0 | 30.1 | 26.1 |
| | | **Error [dB]** | 0.0 | 0.0 | 0.1 |

LEVEL METER function; Range: **High**; Characteristic: A, $f_{ref}$= 4000 Hz; Burst duration 2 s

Steady level nominal result = 134dB

| Result | Detector | Duration [ms] | 1000 | 500 | 200 | 100 | 50 | 20 | 10 | 5 | 2 | 1 | 0.5 | 0.25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAX | Fast | **Indication [dB]** | 134.0 | 134.0 | 133.1 | 131.4 | 129.2 | 125.7 | 122.9 | 120.0 | 116.0 | 113.0 | 109.9 | 106.9 |
| | | **Error [dB]** | 0.0 | 0.0 | 0.0 | 0.0 | -0.0 | -0.0 | -0.1 | 0.0 | -0.0 | -0.0 | -0.1 | -0.1 |
| | Slow | **Indication [dB]** | 132.1 | 130.0 | 126.6 | 123.8 | 120.9 | 117.0 | 114.0 | 111.0 | 107.0 | - | - | - |
| | | **Error [dB]** | 0.0 | 0.1 | -0.0 | -0.0 | -0.0 | -0.0 | -0.0 | -0.0 | -0.0 | - | - | - |
| SEL | - | **Indication [dB]** | 134.0 | 131.0 | 127.0 | 124.0 | 121.0 | 117.0 | 114.0 | 111.0 | 107.0 | 104.0 | 100.9 | 97.9 |
| | | **Error [dB]** | 0.0 | -0.0 | 0.0 | 0.0 | -0.0 | 0.0 | -0.0 | -0.0 | -0.0 | -0.0 | -0.1 | -0.1 |

Steady level nominal result = 54dB

| Result | Detector | Duration [ms] | 1000 | 500 | 200 | 100 | 50 |
|---|---|---|---|---|---|---|---|
| MAX | Fast | **Indication [dB]** | 54.0 | 54.0 | 53.1 | 51.4 | 49.2 |
| | | **Error [dB]** | -0.0 | 0.0 | 0.0 | -0.0 | -0.0 |
| | Slow | **Indication [dB]** | 52.0 | 50.0 | 46.6 | 43.8 | 40.9 |
| | | **Error [dB]** | -0.0 | 0.0 | -0.0 | -0.0 | -0.0 |
| SEL | - | **Indication [dB]** | 54.0 | 51.0 | 47.1 | 44.1 | 41.1 |
| | | **Error [dB]** | -0.0 | -0.0 | 0.0 | 0.0 | 0.0 |

Steady level nominal result = 45dB

| Result | Detector | Duration [ms] | 1000 | 500 | 200 |
|---|---|---|---|---|---|
| MAX | Fast | **Indication [dB]** | 45.1 | 45.0 | 44.1 |
| | | **Error [dB]** | 0.0 | 0.0 | 0.0 |
| | Slow | **Indication [dB]** | 43.1 | 41.0 | 37.7 |
| | | **Error [dB]** | 0.0 | 0.0 | 0.1 |
| SEL | - | **Indication [dB]** | 45.1 | 42.1 | 38.1 |
| | | **Error [dB]** | 0.0 | 0.0 | 0.1 |

## 5. OVERLOAD INDICATION* (electrical)

LEVEL METER: Characteristic: A; **Range**: High; $f_{ref}$= 4000 Hz;

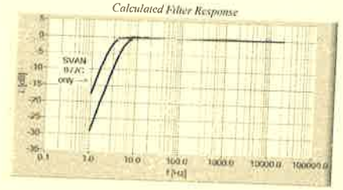
| Positive half cycle | Negative half cycle | |
|---|---|---|
| **Indication [dB]** | **Indication [dB]** | **Error [dB]** |
| 98.5 | 98.4 | 0.1 |



## 6. FREQUENCY RESPONSE – BAND AUDIO* (electrical)

LEVEL METER function; Characteristic: Z; Range: High; Input signal =135 dB;

*Calculated Filter Response*




*Measured Filter Response with Preamplifier SV12L*
*(f - frequency, L - level)*

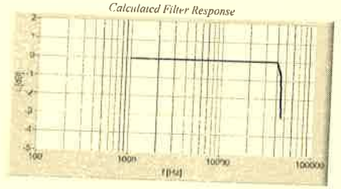
| f [Hz] | L [dB] | f [Hz] | L [dB] | f [Hz] | L [dB] | f [Hz] | L [dB] |
|---|---|---|---|---|---|---|---|
| 1 | -18.4 | 5 | -0.2 | 25 | 0.0 | 2000 | 0.0 |
| 1.25 | -14.3 | 6.3 | -0.1 | 31.5 | -0.0 | 4000 | -0.0 |
| 1.6 | -10.3 | 8 | 0.0 | 63 | 0.0 | 8000 | -0.0 |
| 2 | -6.7 | 10 | 0.0 | 125 | 0.0 | 16000 | -0.0 |
| 2.5 | -3.7 | 12.5 | 0.0 | 250 | 0.0 | 20000 | -0.1 |
| 3.15 | -1.7 | 16 | 0.0 | 500 | 0.0 | | |
| 4 | -0.7 | 20 | -0.0 | 1000 | 0.0 | | |

All frequencies are nominal center values for the 1/3 octave bands

## 7. FREQUENCY RESPONSE – BAND ULTRA* (electrical)

LEVEL METER function; Characteristic: HPE; Range: High; Input signal =135 dB;

*Calculated Filter Response*




*Measured Filter Response with Preamplifier SV12L*
*(f - frequency, L - level)*

| f [Hz] | L [dB] | f [Hz] | L [dB] | f [Hz] | L [dB] |
|---|---|---|---|---|---|
| 1000 | 0.0 | 16000 | -0.1 | 40000 | -0.2 |
| 2000 | 0.0 | 20000 | -0.1 | 43856* | -0.5 |
| 4000 | -0.0 | 25000 | -0.1 | 45255* | -2.7 |
| 8000 | -0.0 | 32000 | -0.1 | | |

All frequencies not marked by * are nominal center values for the 1/3 octave bands

## 8. INTERNAL NOISE LEVEL* (electrical - compensated)

LEVEL METER function ; Calibration factor: 0 dB;

| | Characteristic | Z | A | C |
|---|---|---|---|---|
| **Range Low** | **Level [dB]** | ≤20 | ≤11 | ≤10 |
| **Range High** | **Level [dB]** | ≤40 | ≤23 | ≤22 |

* measured with preamplifier SVANTEK type SV12L No. 21113.

## 9. INTERNAL NOISE LEVEL (acoustical - compensated)

LEVEL METER function; Characteristic: A;

| **Range** | Low | High |
|---|---|---|
| **Indication [dB]** | 15.3 | 19.5 |

Noise measured in special chamber, with reference microphone G.R.A.S type 40AN No. 73421

# VIBRATION LEVEL METER

## 1. CALIBRATION (electrical)

LEVEL METER function: Characteristic: HP10; f=79.58 Hz, Input signal =140 dB;

| **Range** | Low | High |
|---|---|---|
| **Indication [dB]** | 139.9 | 140.0 |
| **Error [dB]** | -0.1 | -0.0 |

# *CERTIFICATE of CALIBRATION*

| | | | |
|---|---|---|---|
| Make : | Svantek | Reference # : | 169040 |
| Model : | SVAN971 | Customer : | HGC Engineering<br>Mississauga, ON |
| Descr. : | Sound Level Meter Type 1 | | |
| Serial # : | 41988 | P. Order : | Sean Richardson |
| Asset # : | SV971-3 | | |

Cal. status : Received in spec's, no adjustment made.

*Navair Technologies certifies that the above listed instrument was calibrated on date noted and was released from this laboratory performing in accordance with the specifications set forth by the manufacturer.*

*Unless otherwise noted in the calibration report a 4:1 accuracy ratio was maintained for this calibration.*

*Our calibration system complies with the requirements of ISO-9001-2015 and is registered under certificate CA96/269, working standards used for calibration are certified by or traceable to the National Research Council of Canada or the National Institute of Standards and Technology.*

Calibrated : Dec 29, 2021 By : TB

Cal. Due : Dec 29, 2022 T. Beilin

Temperature : 23 °C ± 2 °C Relative Humidity : 30% to 70%

Standards used : J-216 J-303 J-512

## *Navair Technologies*

REPAIR AND CALIBRATION TRACEABLE TO NRC AND NIST

6375 Dixie Rd. Mississauga, ON, L5T 2E7 http: // www.navair.com

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# APPENDIX C

# Glossary of Acoustical Terms

## GLOSSARY OF ACOUSTICAL TERMS

**1/3-Octave Band:** A filter whose passband is 1/3-octave wide. Where an octave represents a doubling of frequency, 1/3-octave represents approximately a 25% increase, with three sequential increases of 25% approximating a doubling. This relationship is applied to both the width of the band, as well as the centre frequency of the band.

**Acoustic Barrier:** a wall, berm, wall/berm combination or similar structure, used as a noise control measure, and high enough to break the line-of-sight between the source and the receptor.

**A-Weighting:** This is a filter, often applied to a pressure signal or to a *SPL* or *PWL* spectrum, which attenuates or amplifies certain frequencies in accordance with international standards to approximate the frequency dependence of average human hearing.

**Background Sound Level:** the sound level that is present in the environment, produced by noise sources other than the source under impact assessment. For the purposes of noise assessments related to stationary sources, the background sound level is expressed in terms of the One-Hour Equivalent Sound Level ($L_{EQ}$).

**Energy Equivalent Sound Level ($L_{EQ}$):** The $L_{EQ}$ sound level is the *energy-equivalent sound level*, and represents the integrated sound exposure level of both steady and time-varying sounds over the duration of the measurement.

**$L_{10}$ Sound Level:** represents the sound level which is exceeded 10 percent of the time over the duration of the measurement, and is useful in identifying the contribution of heavy trucks and other loud vehicles to the overall sound level.

**$L_{90}$ Sound Level:** represents the sound level which is exceeded 90 percent of the time over the duration of the measurement, and is useful in identifying the contribution of steady sources to the overall sound level.

**Linear Weighting:** This is a term used to indicate that a measurement does not have *A-weighting* or any other frequency weighting applied to it.

**Point of Reception:** any location on a noise sensitive use where noise from a stationary source is received.

**Overall:** For the measurements in this report, indicates that the reported level (*SPL, SL*, etc.) is the summation of measurements of all audible frequencies (20 Hz to 20 kHz), whether or not A-weighted. Analogous to and alternately implemented as a passband filter from 20 Hz to 20 kHz.

**Sound Exposure Level, $L_{EQ}(h)$:** Expressed in dBA, this is the equivalent steady Sound Level which would produce the same A-weighted sound energy over a stated period of time, *h*, as a specified time-varying sound.

**Sound Level, *SL* or $L_A$:** Reported in dBA, is the A-weighted Sound Pressure Level.

**Sound Power, *w*:** This is the acoustic power output of a sound source, expressed in Watts. It is a function of the source parameters itself and is virtually independent of the environment in which it is located.

**Sound Pressure Level, *SPL*:** Reported in deciBels (dB), is 20 times the logarithmic ratio of the instantaneous sound pressure (in Pascals) of the sound being measured to that at the threshold of hearing (20 microPascals).

**Spectrum:** Sound Pressure signals may be passed through a parallel series of filters (e.g. *1/3-octave band*) to produce *SPL*s in each filter band. When these are presented in sequential order of filter band, a Sound Pressure Level spectrum is produced. A similar process may be applied to produce Sound Power Level or Sound Intensity Level spectra.

**Time Weighting:** This is an exponential time response function applied to the pressure signal being measured, effectively dampening the signal's response to quickly and highly varying sound pressures. Slow refers to a 1-second time constant, and Fast refers to a 125 ms time constant. Steady sounds are unaffected by time weightings. Also, time weighting functions are not applied to $L_{EQ}$s.

# APPENDIX D

## Acoustical Practitioners

**Ian Bonsma, P.Eng., INCE, Senior Engineer, Associate**

Ian Bonsma, P.Eng. has a Bachelor of Applied Science from the University of Waterloo and is registered as a practising Professional Engineer in the Provinces of British Columbia, Alberta, Saskatchewan, and Ontario. He has been practising in the field of noise, vibration, and acoustics for more than 17 years and is the Western Region Manager for HGC Engineering. Ian works in all areas of acoustical engineering covering a wide variety of projects including architectural design of buildings, industrial environmental noise, and vibration assessments. He guest lecturers at the University of Calgary and has provided numerous presentations on acoustics, noise and vibration.

**Sarim Baig, E.I.T., Project Consultant**

Sarim Baig works out of HGC Engineering's Western Canada office and is generally responsible for conducting site measurements as well as the deployment and maintenance of any instrumentation. He has experience working with several divisions within HGC Engineering and is mainly involved with data analysis and report writing. He has been involved with a number of noise feasibility studies in Ontario related to road traffic noise, completing predictive modelling analysis.