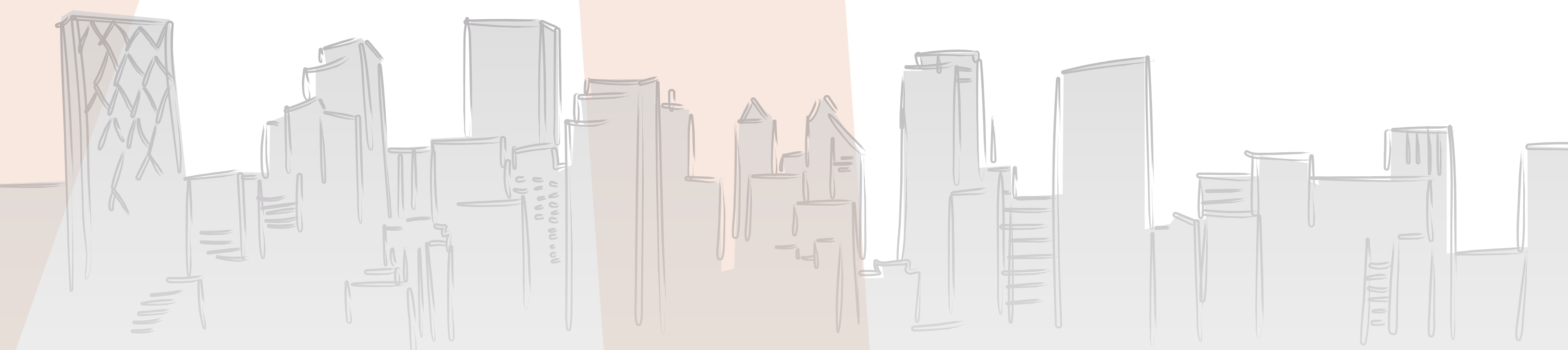
QuantumPlace®
CONSULTING



Hillstone Aggregates

Annual Operations Report 2023 (Submitted June 2024)

Reporting Period: January to December 2023

TABLE OF CONTENTS

QuantumPlace®
CONSULTING

1.0 INTRODUCTION

This report is prepared for 2023 in conformance with the Phase 2 Development Permit #PRDP202004084 and the Master Site Development Plan (MSDP): Hillstone Aggregates (February 23, 2021) and is an overview of activity within the quarter section: NW 36 026 04 W5.

The quarter section has two land use designations, the west portion is designated as A-SML and the east portion is designated as S-NAT. The west portion comprises Phase 1 to 3 as outlined in the MSDP. Phase 2 began gravel mining operations in 2021.

An application for renewal of the Development Permit (DP) was submitted in April of 2023 and is awaiting the closure of the LPRT appeal brought in October of 2023 for a decision. Rocky View County Administration has confirmed that operations may continue while the renewal application is reviewed as long as the previous DP conditions are met.

2.0 OPERATION DETAILS

CONTACT INFORMATION:

Gustavo Rojas -Sales Manager

Phone: (403)899-4238   Email: grojas@hillstoneagg.com

SITE COMPLAINTS/INCIDENT REPORTS:

- No incident reports.
- No complaints received by Hillstone Aggregates or their representatives.
- 1 visit from bylaw enforcement agents – October 31, 2023 (see section 2.2 for memo regarding visit).

Complaints regarding Hillstone Aggregates have been submitted to County Administration. These complaints have not been shared so we cannot remark on the number or outcome of the complaints.

EXTRACTION DETAILS:

- Moved 866,238 tonnes of material from January 1 – December 31, 2023.
- See **Table 1** for the inventory at the end of December 2023.

Table 1: Onsite Inventory as of December 31, 2023

Description	Unit	Quantity
40mm Drain Rock	Tonne	10,073.45
25mm Road Gravel	Tonne	21,579.82
40mm Road Gravel	Tonne	4,175.88
3" Minus	Tonne	12,000.01
Bedding Sand	Tonne	5,803.52
MF Sand	Tonne	7,206.71
20mm Drain Rock	Tonne	14,560.80

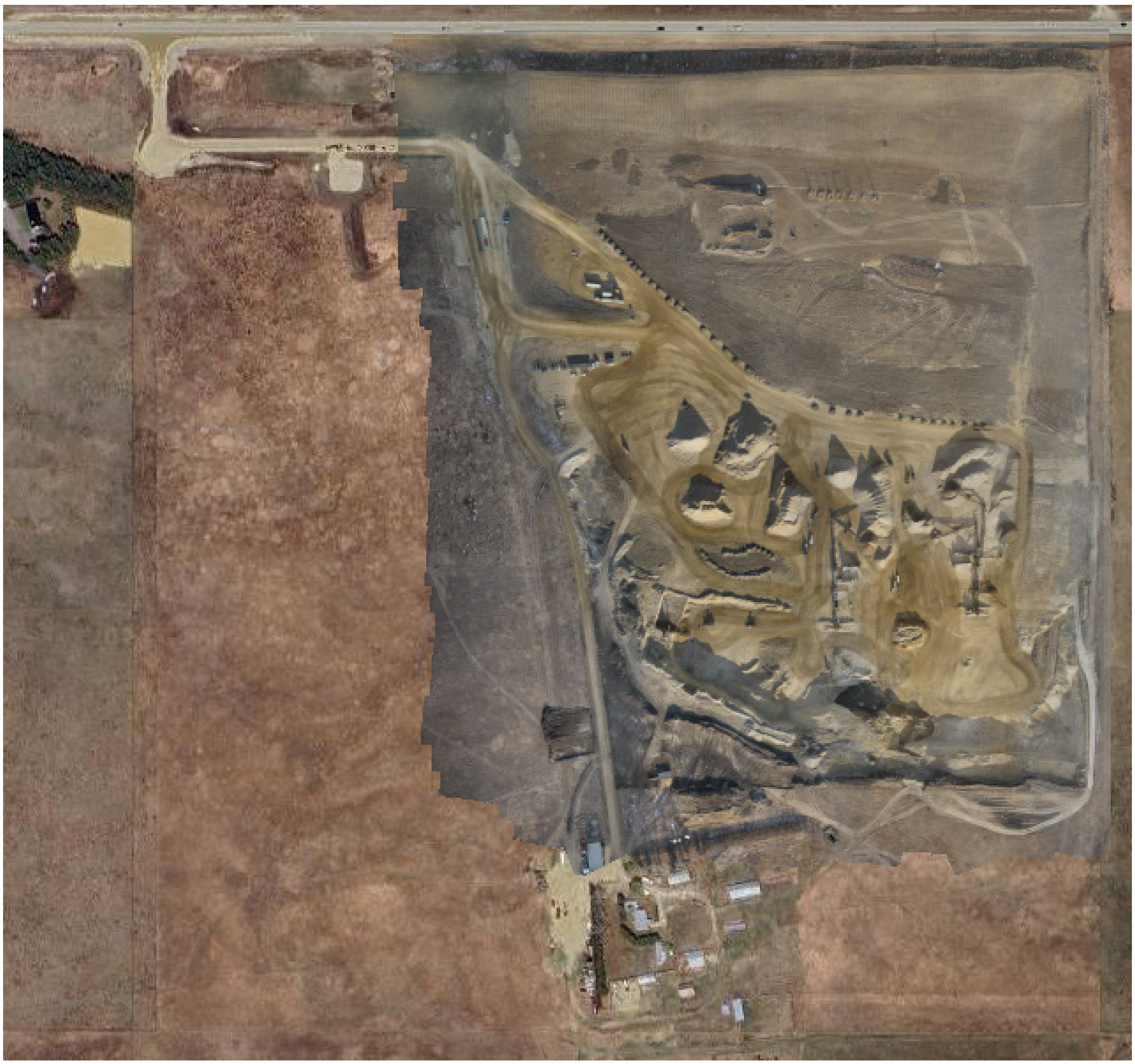
A summary of the monthly groundwater monitoring is included per the existing development conditions as **Appendix A**.

CONTINUED ONSITE PROCEDURES:

- Noise and air quality monitoring systems were installed in September 2021. Monitoring stations were replaced with new models in January 2023 (**Appendix B**).
- New groundwater monitoring wells were established in November 2023 to replace those removed as operations progress.

- Pit watering with calcium chloride is used to control dust.
- Active pit area is maintained below the 40.00 ac maximum as per the existing development conditions.

2.1 OPERATION SITE PHOTO



Captured November 30,2023

HILLSTONE AGGREGATES

MEMO

To: Quantum Place Team

From: Hillstone Aggregates Team

Date: November 3, 2023

Subject: Rocky View County Officer Visit

I trust this memo finds you well. I would like to inform the team of recent adjustments to our operational schedule and noise mitigation strategies at Hillstone Aggregates.

On October 31st, representatives from Rocky View County engaged in a discussion regarding early morning noise disturbances. It was emphasized that no machinery should be operational or warming up before 7:00 am. Historically, our warm-up procedures started at 6:30 am to facilitate production at 7:00 am.

To address safety concerns, effective October 30th, our pit will now be open from 8:00 am to 5:00 pm. This change is intended to prevent trucks from operating in the dark morning hours, reducing potential risks for local motorists. Despite proactive communication about the schedule adjustment, there was an incident involving a truck arriving earlier than 7:00 am. We have swiftly collaborated with the trucking company to rectify the situation and prevent future occurrences.

Furthermore, in an effort to minimize noise disruptions, we have revised our equipment warm-up time to commence at 7:00 am instead of the previous 6:30 am start time.

Should you have any questions or require additional information, please don't hesitate to contact us.

Gustavo Rojas
General/Sales Manager
403.899.4238

APPENDIX A – Groundwater Elevations and Monitoring Summaries

Hillstone Aggregates

			Groundwater Levels - Field Records Jan 2023		Groundwater Levels - Field Records Feb 2023		Groundwater Levels - Field Records Mar 2023		Groundwater Levels - Field Records Apr 2023		Groundwater Levels - Field Records May 2023		Groundwater Levels - Field Records June 2023	
			Recording Date:		*Recording Date:*		*Recording Date:*		*Recording Date: April 19, 2023*		*Recording Date: May 17, 2023*		*Recording Date: June 4, 2023*	
Monitoring well Number (MW)	**Geodetic Ground Elevation at MW (GE)**	**Top of Casing to Ground (TOCG)**	**Groundwater Elevation (Meters below Grade) (GE - MBTOC + TOCG)**	**Notes**	**Groundwater Elevation (Meters below Grade) (GE - MBTOC + TOCG)**	**Notes**	**Groundwater Elevation (Meters below Grade) (GE - MBTOC + TOCG)**	**Notes**	**Groundwater Elevation (Meters below Grade) (GE - MBTOC + TOCG)**	**Notes**	**Groundwater Elevation (Meters below Grade) (GE - MBTOC + TOCG)**	**Notes**	**Groundwater Elevation (Meters below Grade) (GE - MBTOC + TOCG)**	**Notes**
12MW01	1289.6	0.5	x	Frozen	x	Frozen	x	Frozen	1280.4	Blocked	1287.01	Blocked	1282.85	blocked
12MW02	1289.1	0.5	x	Frozen	x	Frozen	x	Frozen	1276.22	Wet	1276.19	Wet	1289.6	Missed
12MW03	1287.5	0.4	x	Frozen	x	Frozen	x	Frozen	1276.36	Blocked	1276.26	Blocked	1274.4	wet
12MW04	1287	0.4	x	Frozen	x	Frozen	x	Frozen	1276.68	Wet	1276.6	Blocked	1274.9	wet
15MW01	1291	1	x	Frozen	x	Frozen	x	Frozen	1273.39	Wet	1273.35	Wet	1273.35	Wet
15MW02	1288	1	x	Frozen	x	Frozen	x	Frozen	1276.1	Wet	1276.08	Wet	1276.1	Wet
15MW03	1288	0.85	x	Frozen	x	Frozen	x	Frozen	1275.5	Wet	1275.11	Wet	1275.1	Wet
15MW06	1284.5	1.1	x	Frozen	x	Frozen	x	Frozen	1274.25	Wet	1274.21	Wet	1274.14	Wet
23MW01*	1,284.67	0.57												
23MW03*	1,292.27	0.67												
23MW04*	1,293.47	0.71												
23MW05*	1,291.31	0.85												

	Groundwater Levels - Field Records July 2023		Groundwater Levels - Field Records August 2023		Groundwater Levels - Field Records September 2023		Groundwater Levels - Field Records October 2023		Groundwater Levels - Field Records November 2023		Groundwater Levels - Field Records December 2023	
	Recording Date: July 6,2023		*Recording Date: August 2, 2023*		*Recording Date: September 11,2023*		*Recording Date: October 23, 2023*		*Recording Date: November 10, 2023*		*Recording Date: December 20, 2023*	
Monitoring well Number (MW)	**Groundwater Elevation (Meters below Grade) (GE - MBTOC + TOCG)**	**Notes**	**Groundwater Elevation (Meters below Grade) (GE - MBTOC + TOCG)**	**Notes**	**Groundwater Elevation (Meters below Grade) (GE - MBTOC + TOCG)**	**Notes**	**Groundwater Elevation (Meters below Grade) (GE - MBTOC + TOCG)**	**Notes**	**Groundwater Elevation (Meters below Grade) (GE - MBTOC + TOCG)**	**Notes**	**Groundwater Elevation (Meters below Grade) (GE - MBTOC + TOCG)**	**Notes**
12MW01	1283.1	blocked	1282.9	blocked	1289.8	Blocked	1282.2426	Blocked	1289.36	Blocked	1289.36	Blocked
12MW02	1276.6	wet	1276.1	wet	1275.5	Wet	1275.4462	Wet	1275.98	Wet	1275.69	Wet
12MW03	1275.65	wet	1275.45	wet	1274.2	Wet	1273.8359	Wet	1274.37	Wet	1275.2	Wet
12MW04	1276.6	dry	1276.65	dry	1287.5	Blocked	1276.5762	Blocked	1287.4	Blocked	1287.4	Blocked
15MW01	1273.5	Wet	1273.3	Wet	1273.3	Wet	1273.2452	Wet	1274.1	Wet	1273.17	Wet
15MW02	1276	Wet	1276.05	Wet	1276.3	Wet	1276.2444	Wet	1275.74	Wet	1276.16	Wet
15MW03	1274.95	Wet	1275.05	Wet	1276.0	Wet	1275.9536	Wet	1276.16	Wet	1275.89	Wet
15MW06	1274.1	Wet	1274.15	Wet	1274.2	Wet	1274.2484	Wet	1274.47	Wet	1274.15	Wet
23MW01*											1,275.69	Wet
23MW03*											1,278.69	Wet
23MW04*											1,279.27	Wet
23MW05*											1,276.74	Wet

*Installed November 2023

APPENDIX B – Air Quality & Noise Monitoring Data Collection Report

* To comply with monitoring requirements we have supplied the data from the 2023 monitoring year. In future years, further summaries will be provided.

aci Acoustical Consultants Inc.
5031 – 210 Street
Edmonton, Alberta, Canada T6M 0A8
Phone: (780) 499-1591
www.aciacoustical.com

2023 Annual Summary Report

Noise Monitoring
For The
Hillstone Aggregates Gravel Pit (NW 36-26-04-W5M)

Prepared for:

Hillstone Aggregates
c/o QuantumPlace

PERMIT TO PRACTICE
ACI ACOUSTICAL CONSULTANTS INC.
Signature
Date 6/03/2023
PERMIT NUMBER: P 7735
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

PROFESSIONAL LICENSEE (ENGINEERING) ALBERTA
PATRICK FROMENT
Member ID :196923

06/03/2024

Prepared by:
P. Froment, B.Sc., B.Ed., P.L.(Eng.)
aci Acoustical Consultants Inc.
Edmonton, Alberta
APEGA Permit to Practice #P7735

aci Project #:23-081
June 03, 2024

Table of Contents

List of Tables

List of Figures

1.0 Introduction

aci Acoustical Consultants Inc., of Edmonton AB, was retained by QuantumPlace Developments Ltd. on behalf of Hillstone Aggregates Ltd. to provide an environmental noise monitoring summary report, from January to December 2023, for the Hillstone Aggregate Gravel Pit (the Pit) in Rocky View County, AB. The purpose of the work was to review the monitoring results of the noise levels collected by a previous consultancy firm. The results of noise data from the three (3) separate stations will be summarized within this annual report.

2.0 Location Description

The Pit is located approximately 9 km north-northeast of Cochrane, Alberta, at NW 36-26-04 W5M within Rocky View County, as indicated in Figure 1. The Project is bound on the east, south and west by open fields and on the north by Highway 567. Highway 567 is considered a heavily traveled highway, is composed of 10% heavy vehicles, and has a posted speed limit of 100 km/hr. In addition, approximately 1.6 km west of the Project boundary is Highway 22. Highway 22 is a heavily traveled highway, is composed of 7.6% heavy vehicles and has posted speed limit of 100 km/hr. Therefore, due to Highways 567 & 22, traffic noise has a significant impact on the noise climate of the study area.

The operating hours for the Pit are:

Winter Hours (November – April)

- 8:00 a.m. to 4 p.m. Monday to Friday
- Saturday (Upon Request)

Summer Hours (May – October)

- 7:00 a.m. to 5 p.m. Monday to Friday
- 7:00 a.m. to 3 p.m. Saturday

Topographically, the study area is relatively flat with no substantial hills or berms apart from the visual mitigation berm along the northern boundary of the Pit. The vegetation in the general area consists mainly of grain crops and some small patches of trees and shrubs. Given the relative distance between the noise sources and closest impacted residences, the vegetative sound absorption is considered minimal to moderate.

3.0 Monitoring Station Description

As illustrated in Figure 1, the environmental monitoring stations were located along the northwest, north and east perimeter of the Site. The stations were at the following locations:

AQ6 (DT002)- Lat: 51degrees 16’11.48”N Long: 114 26’4.40” W

AQ7(DT001)- (January – October) Lat: 51 16’6.49”N Long: 114 26’21.75”W (November-December) Lat: 51 16’10.49” N Long: 114 26’35.34” W

AQ8 (DT003)- Lat: 51 15’59.05” N Long: 114 25’54.94”W

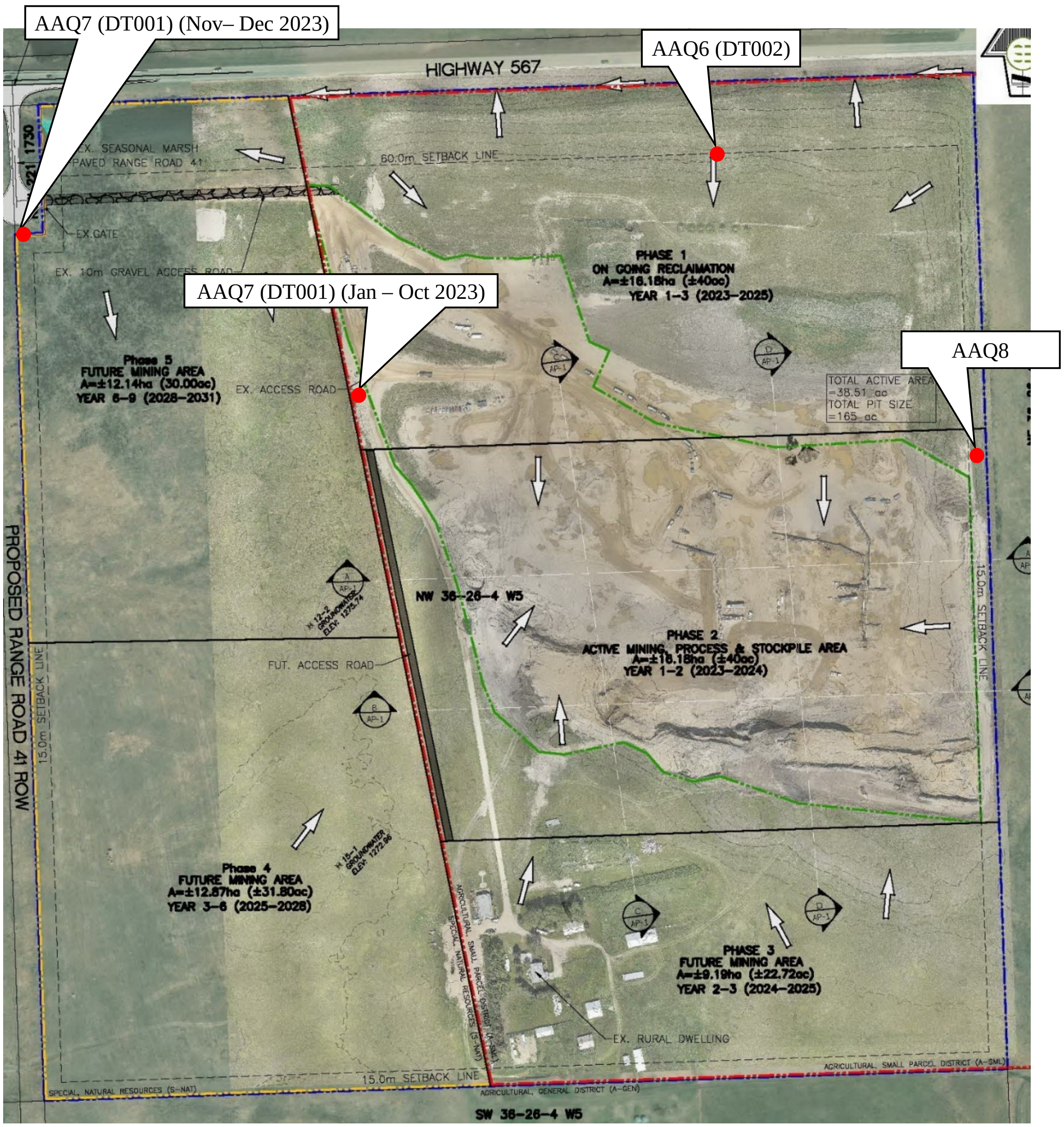


Figure 1. Study Area

4.0 Descriptors & Thresholds

Environmental noise levels from industrial noise sources are commonly described in terms of equivalent sound levels or L_{eq}. This is the level of a steady sound having the same acoustic energy, over a given time period, as the fluctuating sound. In addition, this energy averaged level is A–weighted to account for the reduced sensitivity of average human hearing to low frequency sounds. These L_{eq} in dBA, which are the most common environmental noise measure, are often given for daytime (07:00 to 22:00) L_{eq}Day and night-time (22:00 to 07:00) L_{eq}Night while other criteria use the entire 24-hour period as L_{eq}24.

As per the DP, the permissible sound level (PSL) for this site is 65 dBA L_{eq}-1Hour.

Refer to Appendix I for a description of the acoustical terminology and Appendix II for a list of common noise sources.

5.0 Results and Discussion

5.1. North Station

The data from the North Station is from January 1, 2023, to December 12, 2023.

Table 1. North Station - (ADA_AQ6) 2023 Sound Level Measurement Results

Month	Leq (Monthly Averages)	Minimum Value (dBA)	Maximum Value (dBA)
January	47.8	31.7	79.0
February	48.0	31.7	85.5
March	46.2	35.6	81.4
April	47.8	39.6	77.9
May	48.4	39.9	82.5
June	49.2	40.6	73.5
July	49.0	40.6	66.9
August	49.7	39.9	78.5
September	49.8	39.9	76.3
October	50.9	38.4	95.7
November	57.8	39.9	103.4
December	50.9	38.4	87.6
Average	49.6	38.0	82.4
Minimum	46.2	31.7	66.9
Maximum	57.8	40.6	103.4

As indicated in Table 1, the average noise levels for the North station ranged from 46.2 – 57.8 dBA with an average of 49.6 dBA. The minimum noise level for 2023 was 31.7 while the maximum level was 103.4 dBA. There were 1,587 exceedances of the 10-minute L_{eq} values[1]. It is important to note that there isn't a way of determining the cause of the exceedances and that the 1,587 exceedances represent 3.6% of the total of 43,800 10-minute periods within a given year.

As indicated in Table 1 and in Figure 1 & Figure 2, apart from November 2023, the average noise levels from the Pit were relatively consistent between months. Operational logs should be reviewed to see if there was a change at the pit, or if similarly to other aci monitoring sites, meteorological conditions (primarily high winds) caused the higher noise levels.

[1] The 1-hour exceedances were not available from the former consultant providing noise monitoring services.

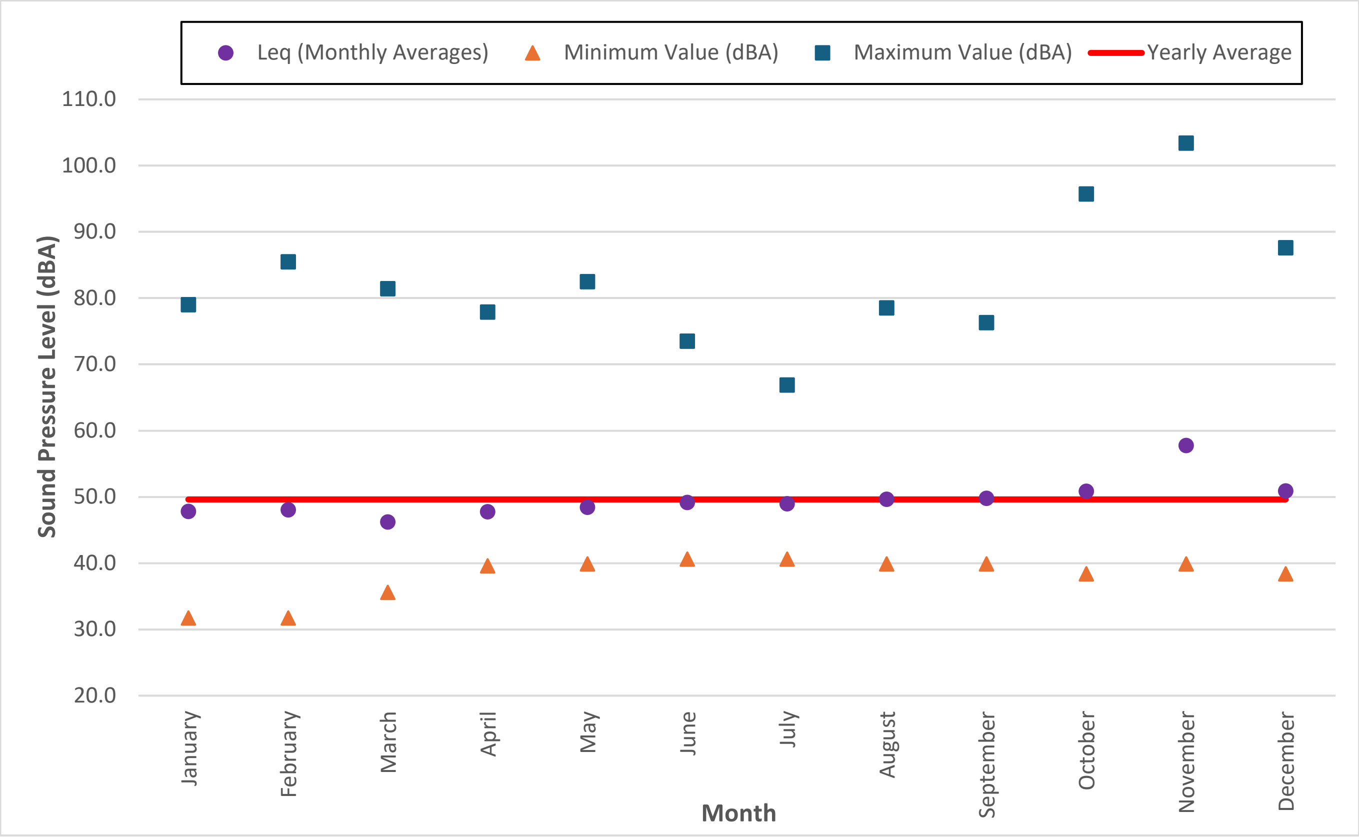


Figure 1. North Station - 2023 - Monthly Sound Levels

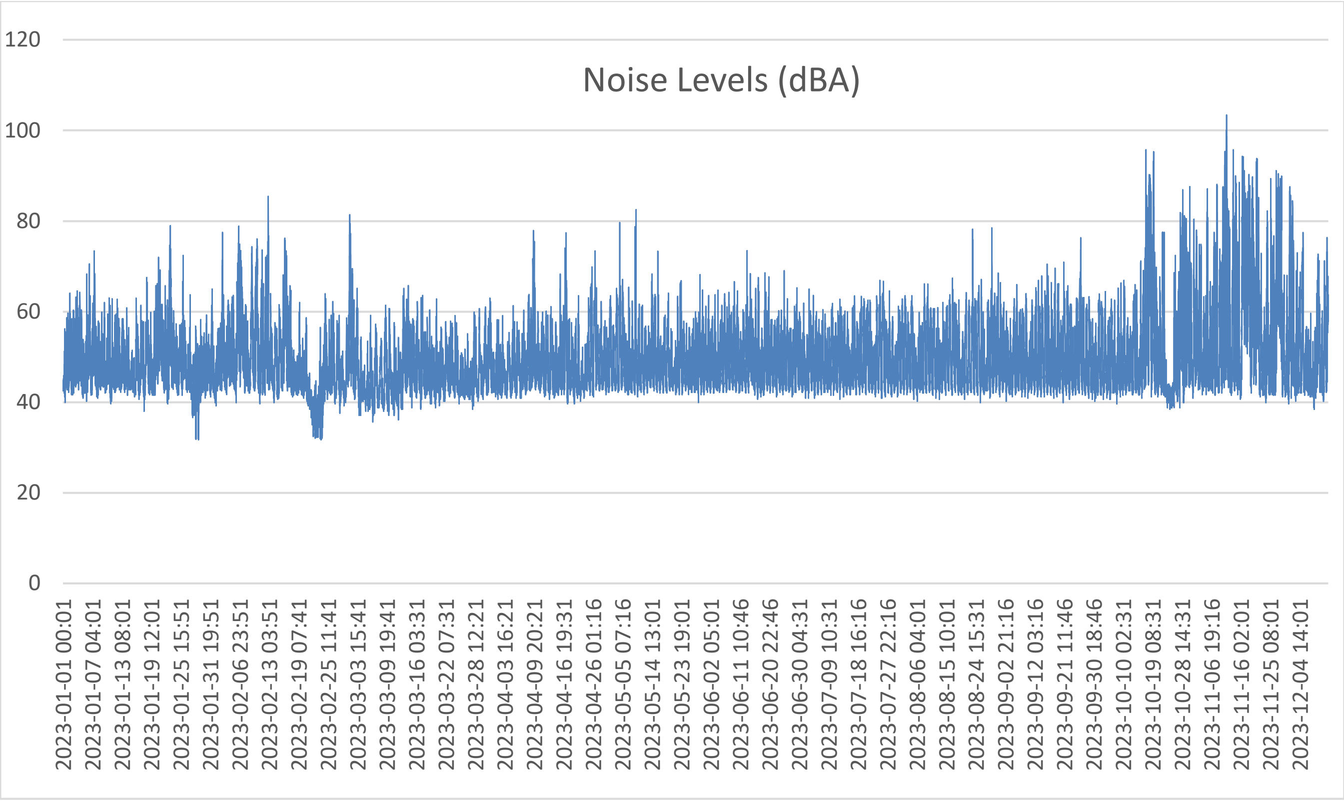


Figure 2. North Station 2023 – 10-minute Leq Sound Levels

5.2. West Station

The data from the West station is from February 15, 2023, to December 12, 2023.

Table 2. West Station - (ADA_AQ7) 2023 Sound Level Measurement Results

Month	Leq (Monthly Averages)	Minimum Value (dBA)	Maximum Value (dBA)
February	46.6	42.0	64.2
March	46.7	42.7	74.5
April	47.1	42.7	88.0
May	51.1	40.0	98.9
June	50.3	44.5	93.7
July	49.1	40.0	87.2
August	49.6	40.0	93.0
September	50.4	40.0	92.8
October	48.1	43.8	81.5
November	45.6	39.6	52.8
December	45.8	41.2	55.8
Average	48.2	41.5	80.2
Minimum	45.6	39.6	52.8
Maximum	51.1	44.5	98.9

As indicated in Table 2, the average noise levels for the West station ranged from 45.6 – 51.1 dBA with an average of 48.2 dBA. The minimum noise level for 2023 was 39.6 while the maximum level was 98.9 dBA. There were 354 exceedances of the 10-minute L_{eq} values[2]. Again, it is important to note that there isn't a way of determining the cause of the exceedances and that the 354 exceedances represent 0.8% of the total of 43,800 10-minute periods within a given year.

As indicated in Table 2 and in Figure 3 & Figure 4, the average noise levels from the Pit were relatively consistent between months. The noise levels were elevated from May – September which would be consistent with typical activities at the pit, however this would need to be verified with the operational logs.

[2] The 1-hour exceedances were not available from the former consultant providing noise monitoring services.

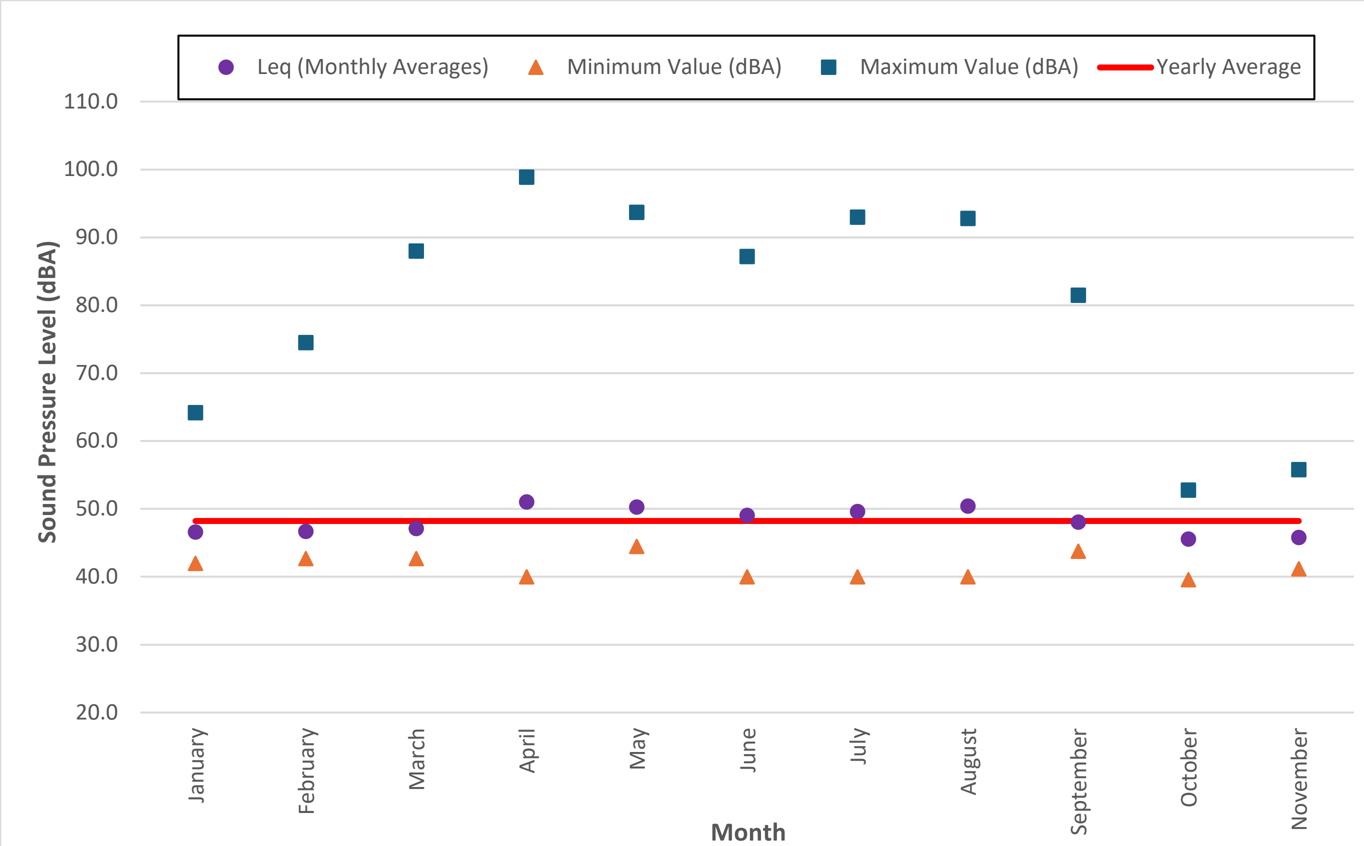


Figure 3. West Station - 2023 - Monthly Sound Levels

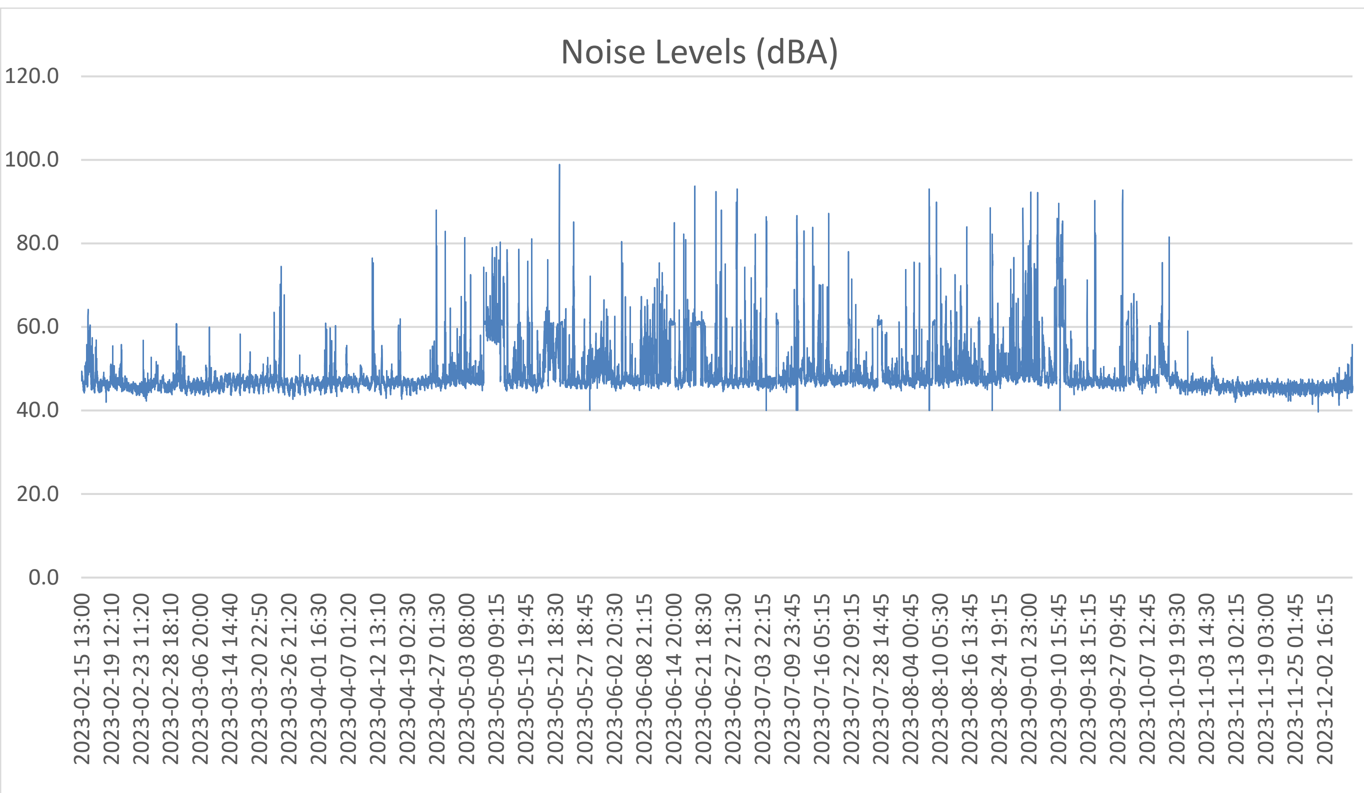


Figure 4. West Station 2023 – 10-minute Leq Sound Levels

5.3. East Station

The data from the North station is from February 15, 2023, to February 20, 2023. All other data was lost.

Table 3. East Station - (ADA_AQ8) 2023 Sound Level Measurement Results

Month	Leq (Monthly Averages)	Minimum Value (dBA)	Maximum Value (dBA)
February	46.5	33.2	74.6

As indicated in Table 3, the average noise levels for the East station for February ranged from 33.2 – 74.6 dBA with an average of 46.5 dBA. There were 38 exceedances of the 10-minute L_{eq} value[1]. Figure 5 illustrates the trace of the 10-minute noise levels for the month.

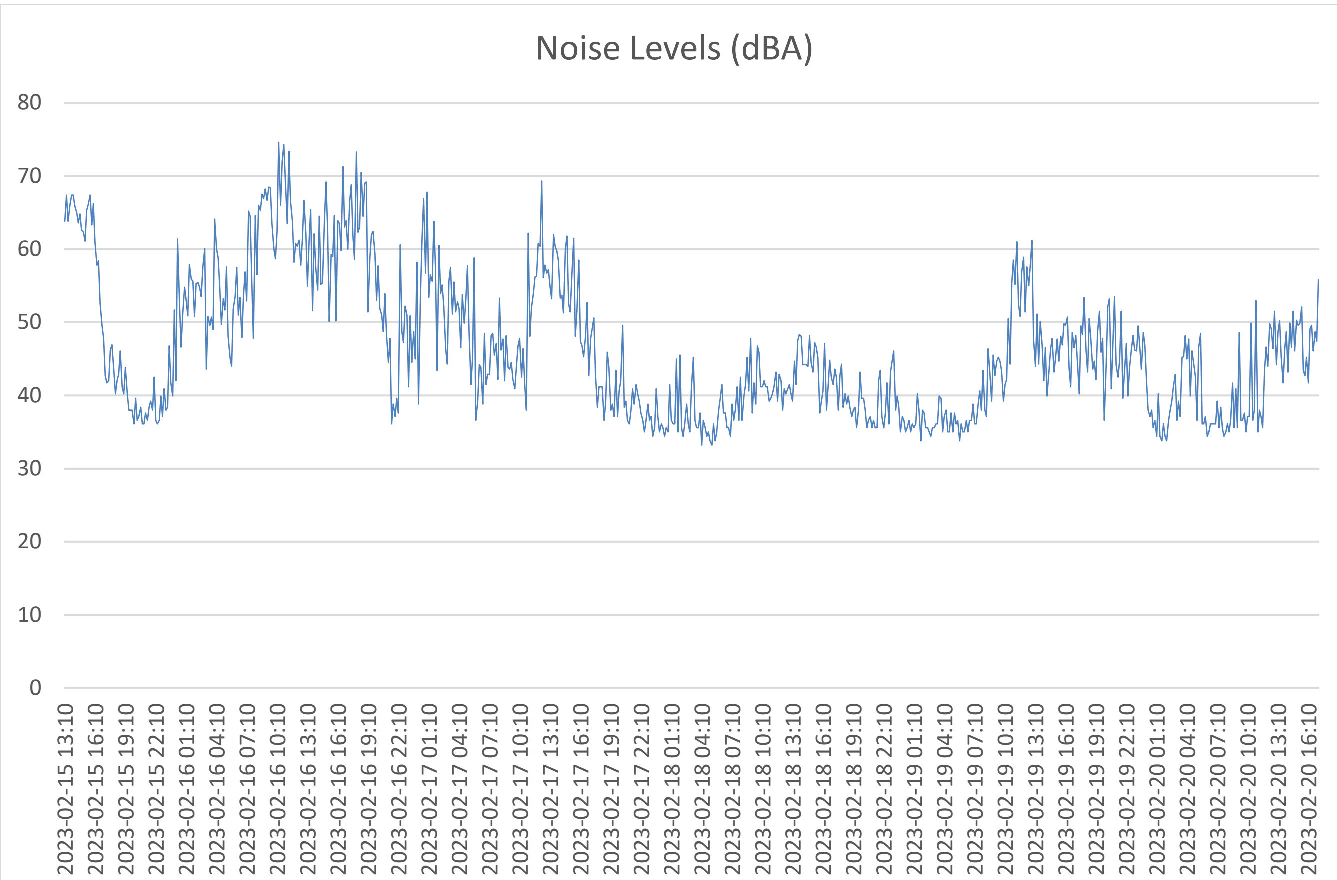


Figure 5. East Station 2023 – 10-minute Leq Sound Levels

[1] The 1-hour exceedances were not available from the former consultant providing noise monitoring services.

6.0 Summary of 2023

The average noise levels for the North station ranged from 46.2 – 57.8 dBA with an average of 49.6 dBA. The minimum noise level for 2023 was 31.7 while the maximum level was 103.4 dBA. There were 1,587 exceedances of the 10-minute L_{eq} values which represents 3.6% of the total of 43,800 10-minute periods within a given year.

The average noise levels for the West station ranged from 45.6 – 51.1 dBA with an average of 48.2 dBA. The minimum noise level for 2023 was 39.6 while the maximum level was 98.9 dBA. There were 354 exceedances of the 10-minute L_{eq} value which represents 0.8% of the total of 43,800 10-minute periods within a given year.

Due to a loss of data, the for the East station data was limited to February 15, 2023, to February 20, 2023.

7.0 Recommendations/Updates for 2024

On March 12, 2024, a new environmental monitoring station was implemented at the East location by aci. New stations were installed by aci at the West and North locations on April 18, 2024[1]. These stations are part of a new noise monitoring program at the Pit that will ensure that data is available to Hillstone Aggregates throughout 2024 and into the future. The new stations have the ability to provide status updates of the equipment and alerts of exceedances. In addition, audio recordings of short-term high noise levels will also be recorded. From experience, noise levels above 80 – 90 dBA are typically attributed to abnormal activities near the noise monitor and not from activities associated with the Pit. The audio recording will allow aci to confirm the cause of high noise levels exceedances. With the ability to monitor the weather conditions and the short-term high noise events not associated with Pit operations, it is anticipated that there will significantly fewer instances in which the monitored noise levels exceed 80 dBA[2].

Lastly, future reports will identify trends associated with the noise levels from year to year. The three locations will allow for the determination of the impact of the Pit as operations move from phase to phase.

[1] Location and details of the monitoring stations will be provided in the 2024 annual report.
[2] Which previously could not be denied or confirmed to be associated with operations within the Pit.

8.0 References

- International Organization for Standardization (ISO), *Standard 1996-1, Acoustics – Description, measurement and assessment of environmental noise – Part 1: Basic quantities and assessment procedures, 2003*, Geneva Switzerland.
- International Organization for Standardization (ISO), *Standard 9613-1, Acoustics – Attenuation of sound during propagation outdoors – Part 1: Calculation of absorption of sound by the atmosphere, 1993*, Geneva Switzerland.
- International Organization for Standardization (ISO), *Standard 9613-2, Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation, 1996*, Geneva Switzerland.
- *Engineering Noise Control, Theory and Practice*. David A. Bies and Colin H. Hansen, 2003, Spon Press
- *Noise and Vibration Control Engineering, Principles and Applications*. Istvan L. Ver and Leo L. Beranek, 2006, John Wiley & Sons Inc.

Appendix I THE ASSESSMENT OF ENVIRONMENTAL NOISE (GENERAL)

Sound Pressure Level

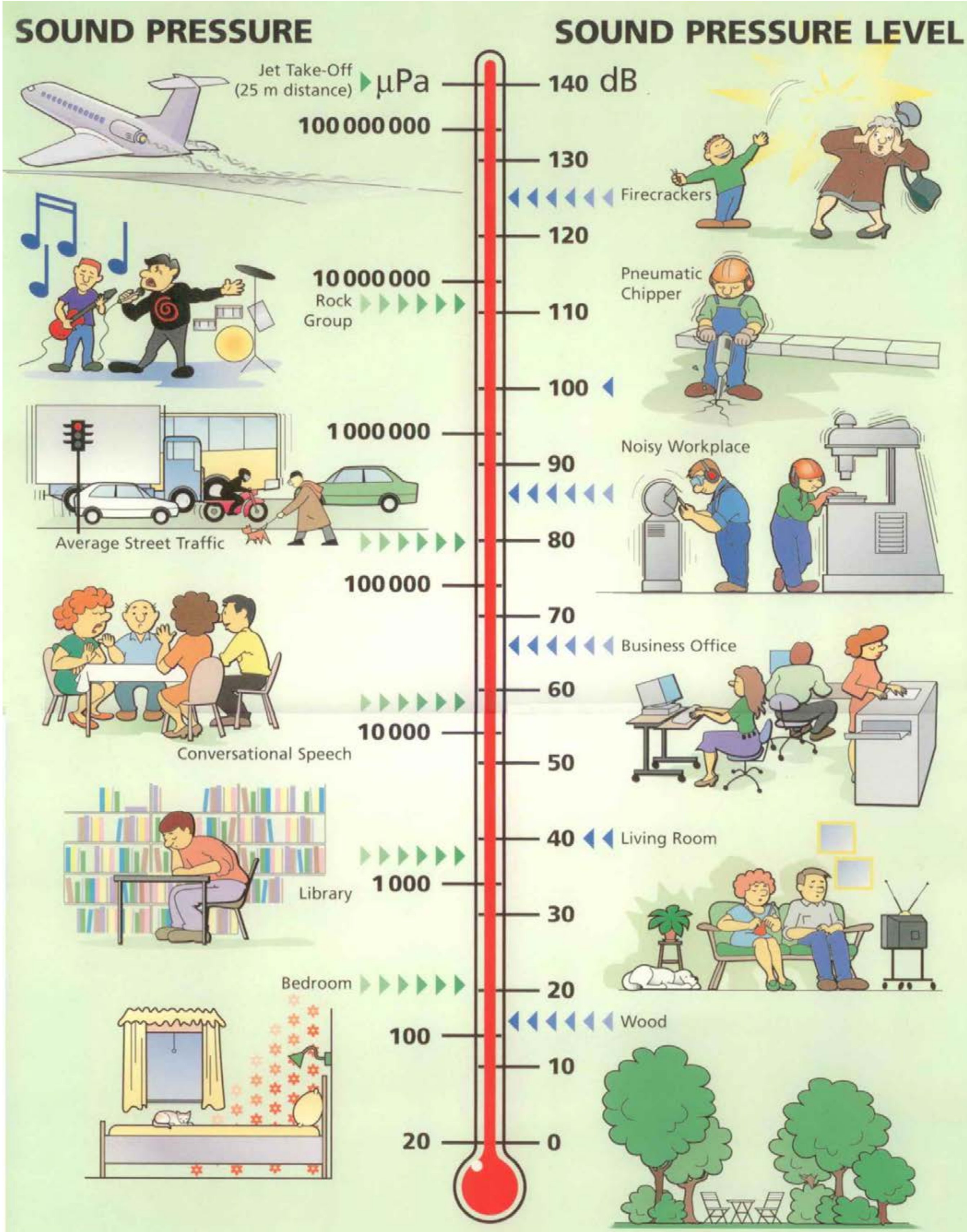
Sound pressure is initially measured in Pascal's (Pa). Humans can hear several orders of magnitude in sound pressure levels, so a more convenient scale is used. This scale is known as the decibel (dB) scale, named after Alexander Graham Bell (telephone guy). It is a base 10 logarithmic scale. When we measure pressure we typically measure the RMS sound pressure.

$$SPL = 10\log_{10}\left[\frac{P_{RMS}^{2}}{P_{ref}^{2}}\right] = 20\log_{10}\left[\frac{P_{RMS}}{P_{ref}}\right]$$

Where: SPL = Sound Pressure Level in dB
P_{RMS} = Root Mean Square measured pressure (Pa)
P_{ref} = Reference sound pressure level ($P_{ref} = 2\text{x}10^{-5}$ Pa = 20 μPa)

This reference sound pressure level is an internationally agreed upon value. It represents the threshold of human hearing for "typical" people based on numerous testing. It is possible to have a threshold which is lower than 20 μPa which will result in negative dB levels. As such, zero dB does not mean there is no sound!

In general, a difference of 1 – 2 dB is the threshold for humans to notice that there has been a change in sound level. A difference of 3 dB (factor of 2 in acoustical energy) is perceptible and a change of 5 dB is strongly perceptible. A change of 10 dB is typically considered a factor of 2. This is quite remarkable when considering that 10 dB is 10-times the acoustical energy!


SOUND PRESSURE
SOUND PRESSURE LEVEL
Jet Take-Off
(25 m distance)
µPa
140 dB
100 000 000
130
Firecrackers
120
10 000 000
Rock
Group
110
Pneumatic
Chipper
100
1 000 000
Noisy Workplace
90
Average Street Traffic
80
100 000
70
Business Office
60
10 000
Conversational Speech
50
40
Living Room
Library
1 000
30
Bedroom
20
Wood
100
10
20
0

Frequency

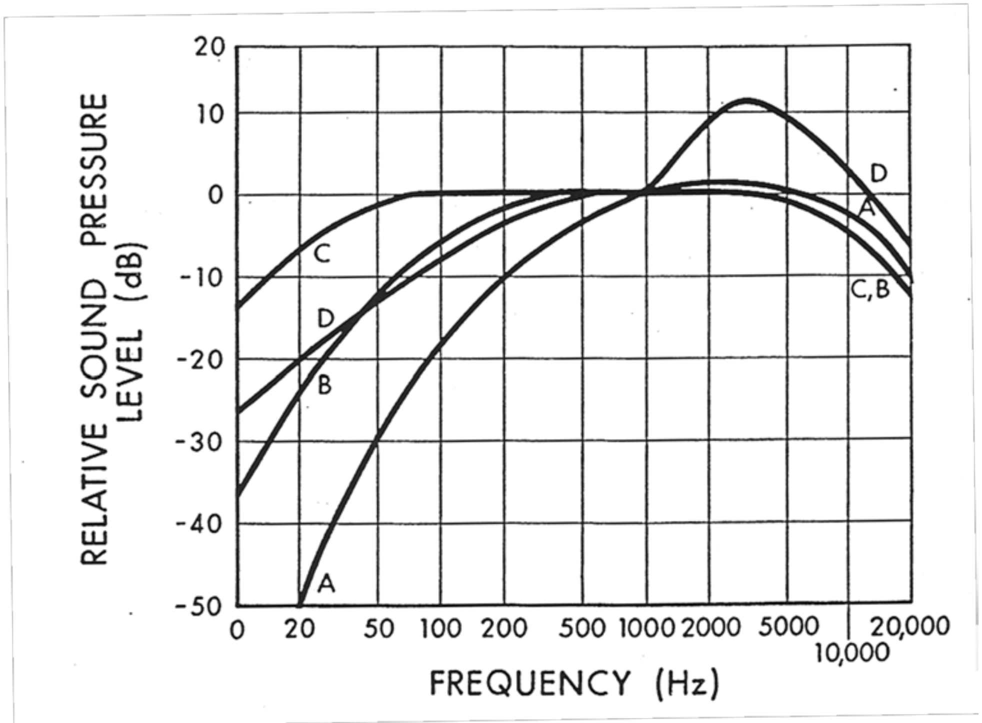
The range of frequencies audible to the human ear ranges from approximately 20 Hz to 20 kHz. Within this range, the human ear does not hear equally at all frequencies. It is not very sensitive to low frequency sounds, is very sensitive to mid frequency sounds and is slightly less sensitive to high frequency sounds. Due to the large frequency range of human hearing, the entire spectrum is often divided into 31 bands, each known as a 1/3 octave band.

The internationally agreed upon center frequencies and upper and lower band limits for the 1/1 (whole octave) and 1/3 octave bands are as follows:

Lower Band Limit	Whole Octave Center Frequency	Upper Band Limit
11	**16**	22
22	**31.5**	44
44	**63**	88
88	**125**	177
177	**250**	355
355	**500**	710
710	**1000**	1420
1420	**2000**	2840
2840	**4000**	5680
5680	**8000**	11360
11360	**16000**	22720

Lower Band Limit	1/3 Octave Center Frequency	Upper Band Limit
14.1	**16**	17.8
17.8	**20**	22.4
22.4	**25**	28.2
28.2	**31.5**	35.5
35.5	**40**	44.7
44.7	**50**	56.2
56.2	**63**	70.8
70.8	**80**	89.1
89.1	**100**	112
112	**125**	141
141	**160**	178
178	**200**	224
224	**250**	282
282	**315**	355
355	**400**	447
447	**500**	562
562	**630**	708
708	**800**	891
891	**1000**	1122
1122	**1250**	1413
1413	**1600**	1778
1778	**2000**	2239
2239	**2500**	2818
2818	**3150**	3548
3548	**4000**	4467
4467	**5000**	5623
5623	**6300**	7079
7079	**8000**	8913
8913	**10000**	11220
11220	**12500**	14130
14130	**16000**	17780
17780	**20000**	22390

Human hearing is most sensitive at approximately 3500 Hz which corresponds to the ¼ wavelength of the ear canal (approximately 2.5 cm). Because of this range of sensitivity to various frequencies, we typically apply various weighting networks to the broadband measured sound to more appropriately account for the way humans hear. By default, the most common weighting network used is the so-called “A-weighting”. It can be seen in the figure that the low frequency sounds are reduced significantly with the A-weighting.



Combination of Sounds

When combining multiple sound sources the general equation is:

$$\Sigma SPL_n = 10\log_{10}\left[\sum_{i=1}^{n} 10^{\frac{SPL_i}{10}}\right]$$

Examples:

- Two sources of 50 dB each add together to result in 53 dB.
- Three sources of 50 dB each add together to result in 55 dB.
- Ten sources of 50 dB each add together to result in 60 dB.
- One source of 50 dB added to another source of 40 dB results in 50.4 dB

It can be seen that, if multiple similar sources exist, removing or reducing only one source will have little effect.

Sound Level Measurements

Over the years a number of methods for measuring and describing environmental noise have been developed. The most widely used and accepted is the concept of the Energy Equivalent Sound Level (L_{eq}) which was developed in the US (1970's) to characterize noise levels near US Air-force bases. This is the level of a steady state sound which, for a given period of time, would contain the same energy as the time varying sound. The concept is that the same amount of annoyance occurs from a sound having a high level for a short period of time as from a sound at a lower level for a longer period of time.
The L_{eq} is defined as:

$$L_{eq} = 10\log_{10}\left[\frac{1}{T}\int_0^T 10^{\frac{dB}{10}}\,dT\right] = 10\log_{10}\left[\frac{1}{T}\int_0^T \frac{P^2}{P_{ref}^2}\,dT\right]$$

We must specify the time period over which to measure the sound. i.e. 1-second, 10-seconds, 15-seconds, 1-minute, 1-day, etc. **An L_{eq} is meaningless if there is no time period associated**.

In general there a few very common L_{eq} sample durations which are used in describing environmental noise measurements. These include:

- L_{eq}24 - Measured over a 24-hour period
- L_{eq}Night - Measured over the night-time (typically 22:00 – 07:00)
- L_{eq}Day - Measured over the day-time (typically 07:00 – 22:00)
- L_{DN} - Same as L_{eq}24 with a 10 dB penalty added to the night-time

Statistical Descriptor

Another method of conveying long term noise levels utilizes statistical descriptors. These are calculated from a cumulative distribution of the sound levels over the entire measurement duration and then determining the sound level at xx % of the time.

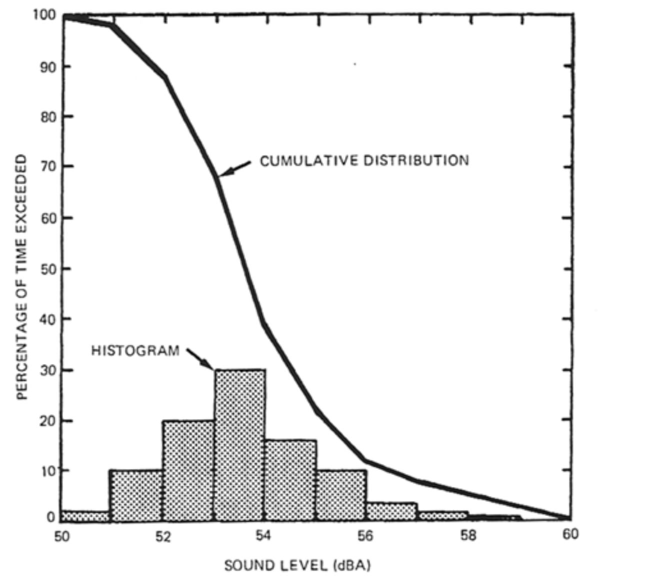


Figure 16.6 Statistically processed community noise showing histogram and cumulative distribution of A weighted sound levels.

Industrial Noise Control, Lewis Bell, Marcel Dekker, Inc. 1994

The most common statistical descriptors are:

L_{min} - minimum sound level measured
L_{01} - sound level that was exceeded only 1% of the time
L_{10} - sound level that was exceeded only 10% of the time.
- Good measure of intermittent or intrusive noise
- Good measure of Traffic Noise

L_{50} - sound level that was exceeded 50% of the time (arithmetic average)
- Good to compare to L_{eq} to determine steadiness of noise

L_{90} - sound level that was exceeded 90% of the time
- Good indicator of typical “ambient” noise levels

L_{99} - sound level that was exceeded 99% of the time
L_{max} - maximum sound level measured

These descriptors can be used to provide a more detailed analysis of the varying noise climate:

- If there is a large difference between the L_{eq} and the L_{50} (L_{eq} can never be any lower than the L_{50}) then it can be surmised that one or more short duration, high level sound(s) occurred during the time period.
- If the gap between the L_{10} and L_{90} is relatively small (less than 15 – 20 dBA) then it can be surmised that the noise climate was relatively steady.

Sound Propagation

In order to understand sound propagation, the nature of the source must first be discussed. In general, there are three types of sources. These are known as 'point', 'line', and 'area'. This discussion will concentrate on point and line sources since area sources are much more complex and can usually be approximated by point sources at large distances.

Point Source

As sound radiates from a point source, it dissipates through geometric spreading. The basic relationship between the sound levels at two distances from a point source is:

$$\therefore SPL_1 - SPL_2 = 20\log_{10}\left(\frac{r_2}{r_1}\right)$$

Where: SPL_1 = sound pressure level at location 1, SPL_2 = sound pressure level at location 2
r_1 = distance from source to location 1, r_2 = distance from source to location 2

Thus, the reduction in sound pressure level for a point source radiating in a free field is **6 dB per doubling of distance**. This relationship is independent of reflectivity factors provided they are always present. Note that this only considers geometric spreading and does not take into account atmospheric effects. Point sources still have some physical dimension associated with them, and typically do not radiate sound equally in all directions in all frequencies. The directionality of a source is also highly dependent on frequency. As frequency increases, directionality increases.

Examples (note no atmospheric absorption):

- A point source measuring 50 dB at 100m will be 44 dB at 200m.
- A point source measuring 50 dB at 100m will be 40.5 dB at 300m.
- A point source measuring 50 dB at 100m will be 38 dB at 400m.
- A point source measuring 50 dB at 100m will be 30 dB at 1000m.

Line Source

A line source is similar to a point source in that it dissipates through geometric spreading. The difference is that a line source is equivalent to a long line of many point sources. The basic relationship between the sound levels at two distances from a line source is:

$$SPL_1 - SPL_2 = 10\log_{10}\left(\frac{r_2}{r_1}\right)$$

The difference from the point source is that the '20' term in front of the 'log' is now only 10. Thus, the reduction in sound pressure level for a line source radiating in a free field is **3 dB per doubling of distance**.

Examples (note no atmospheric absorption):

- A line source measuring 50 dB at 100m will be 47 dB at 200m.
- A line source measuring 50 dB at 100m will be 45 dB at 300m.
- A line source measuring 50 dB at 100m will be 44 dB at 400m.
- A line source measuring 50 dB at 100m will be 40 dB at 1000m.

Atmospheric Absorption

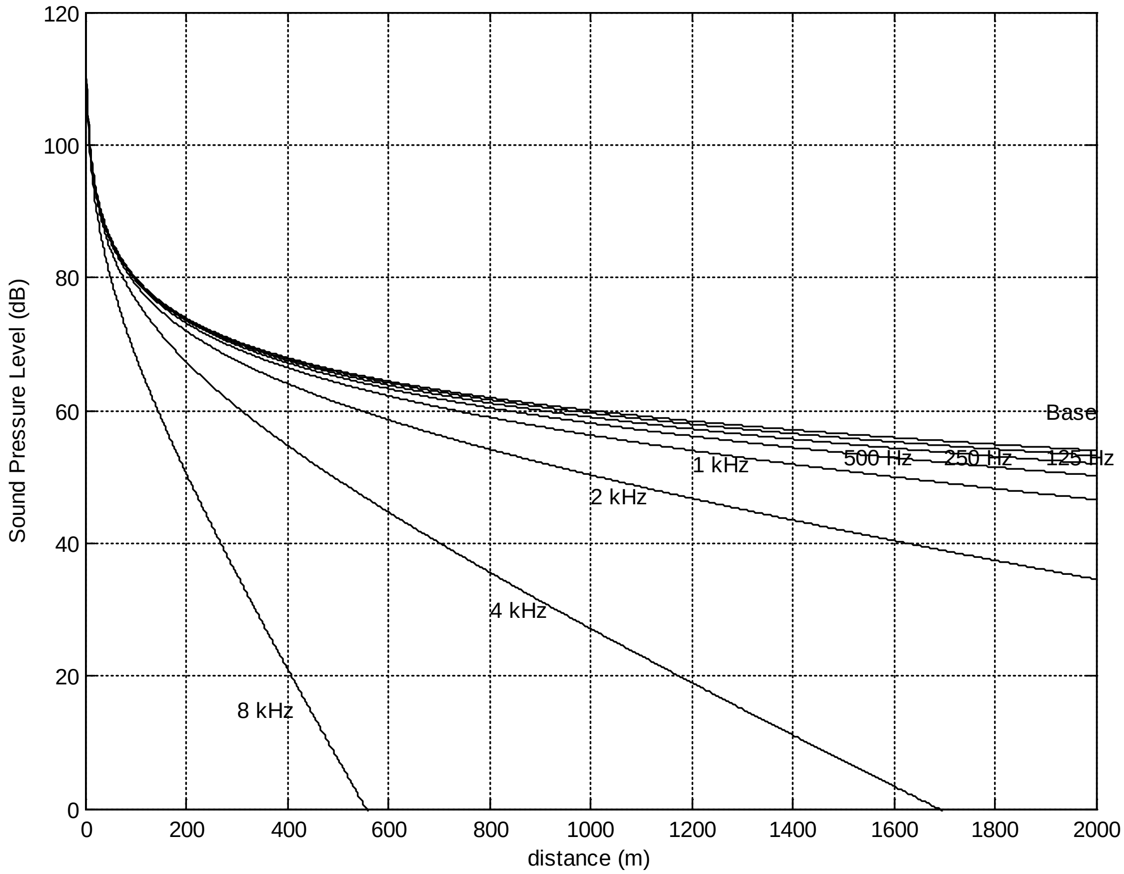
As sound transmits through a medium, there is an attenuation (or dissipation of acoustic energy) which can be attributed to three mechanisms:

1) **Viscous Effects** - Dissipation of acoustic energy due to fluid friction which results in thermodynamically irreversible propagation of sound.
2) **Heat Conduction Effects** - Heat transfer between high and low temperature regions in the wave which result in non-adiabatic propagation of the sound.
3) **Inter Molecular Energy Interchanges** - Molecular energy relaxation effects which result in a time lag between changes in translational kinetic energy and the energy associated with rotation and vibration of the molecules.

The following table illustrates the attenuation coefficient of sound at standard pressure (101.325 kPa) in units of dB/100m.

Temperature °C	Relative Humidity (%)	Frequency (Hz) 125	250	500	1000	2000	4000
30	20	0.06	0.18	0.37	0.64	1.40	4.40
	50	0.03	0.10	0.33	0.75	1.30	2.50
	90	0.02	0.06	0.24	0.70	1.50	2.60
20	20	0.07	0.15	0.27	0.62	1.90	6.70
	50	0.04	0.12	0.28	0.50	1.00	2.80
	90	0.02	0.08	0.26	0.56	0.99	2.10
10	20	0.06	0.11	0.29	0.94	3.20	9.00
	50	0.04	0.11	0.20	0.41	1.20	4.20
	90	0.03	0.10	0.21	0.38	0.81	2.50
0	20	0.05	0.15	0.50	1.60	3.70	5.70
	50	0.04	0.08	0.19	0.60	2.10	6.70
	90	0.03	0.08	0.15	0.36	1.10	4.10

- As frequency increases, absorption tends to increase
- As Relative Humidity increases, absorption tends to decrease
- There is no direct relationship between absorption and temperature
- **The net result of atmospheric absorption is to modify the sound propagation of a point source from 6 dB/doubling-of-distance to approximately 7 – 8 dB/doubling-of-distance (based on anecdotal experience)**



Atmospheric Absorption at 10ºC and 70% RH

Meteorological Effects

There are many meteorological factors which can affect how sound propagates over large distances. These various phenomena must be considered when trying to determine the relative impact of a noise source either after installation or during the design stage.

Wind
- Can greatly alter the noise climate away from a source depending on direction
- Sound levels downwind from a source can be increased due to refraction of sound back down towards the surface. This is due to the generally higher velocities as altitude increases.
- Sound levels upwind from a source can be decreased due to a "bending" of the sound away from the earth's surface.
- Sound level differences of ±10dB are possible depending on severity of wind and distance from source.
- Sound levels crosswind are generally not disturbed by an appreciable amount
- Wind tends to generate its own noise, however, and can provide a high degree of masking relative to a noise source of particular interest.

Temperature
- Temperature effects can be similar to wind effects
- Typically, the temperature is warmer at ground level than it is at higher elevations.
- If there is a very large difference between the ground temperature (very warm) and the air aloft (only a few hundred meters) then the transmitted sound refracts upward due to the changing speed of sound.
- If the air aloft is warmer than the ground temperature (known as an *inversion*) the resulting higher speed of sound aloft tends to refract the transmitted sound back down towards the ground. This essentially works on Snell's law of reflection and refraction.
- Temperature inversions typically happen early in the morning and are most common over large bodies of water or across river valleys.
- Sound level differences of ±10dB are possible depending on gradient of temperature and distance from source.

Rain
- Rain does not affect sound propagation by an appreciable amount unless it is very heavy
- The larger concern is the noise generated by the rain itself. A heavy rain striking the ground can cause a significant amount of highly broadband noise. The amount of noise generated is difficult to predict.
- Rain can also affect the output of various noise sources such as vehicle traffic.

Summary
- In general, these wind and temperature effects are difficult to predict
- Empirical models (based on measured data) have been generated to attempt to account for these effects.
- Environmental noise measurements must be conducted with these effects in mind. Sometimes it is desired to have completely calm conditions, other times a "worst case" of downwind noise levels are desired.

Topographical Effects

Similar to the various atmospheric effects outlined in the previous section, the effect of various geographical and vegetative factors must also be considered when examining the propagation of noise over large distances.

Topography

- One of the most important factors in sound propagation.
- Can provide a natural barrier between source and receiver (i.e. if berm or hill in between).
- Can provide a natural amplifier between source and receiver (i.e. large valley in between or hard reflective surface in between).
- Must look at location of topographical features relative to source and receiver to determine importance (i.e. small berm 1km away from source and 1km away from receiver will make negligible impact).

Grass

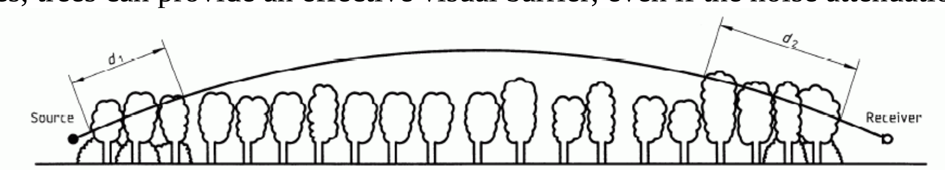
- Can be an effective absorber due to large area covered
- Only effective at low height above ground. Does not affect sound transmitted direct from source to receiver if there is line of sight.
- Typically less absorption than atmospheric absorption when there is line of sight.
- Approximate rule of thumb based on empirical data is:

$$A_g = 18\log_{10}(f) - 31 \qquad (dB/100m)$$

Where: A_g is the absorption amount

Trees

- Provide absorption due to foliage
- Deciduous trees are essentially ineffective in the winter
- Absorption depends heavily on density and height of trees
- No data found on absorption of various kinds of trees
- Large spans of trees are required to obtain even minor amounts of sound reduction
- In many cases, trees can provide an effective visual barrier, even if the noise attenuation is negligible.



NOTE — $d_f = d_1 + d_2$

For calculating d_1 and d_2, the curved path radius may be assumed to be 5 km.

Figure A.1 — Attenuation due to propagation through foliage increases linearly with propagation distance d_f through the foliage

Table A.1 — Attenuation of an octave band of noise due to propagation a distance d_f through dense foliage

Propagation distance d_f	Nominal midband frequency Hz							
m	63	125	250	500	1 000	2 000	4 000	8 000
$10 \leq d_f \leq 20$	Attenuation, dB: 0	0	1	1	1	1	2	3
$20 \leq d_f \leq 200$	Attenuation, dB/m: 0,02	0,03	0,04	0,05	0,06	0,08	0,09	0,12

Tree/Foliage attenuation from ISO 9613-2:1996

Bodies of Water

- Large bodies of water can provide the opposite effect to grass and trees.
- Reflections caused by small incidence angles (grazing) can result in larger sound levels at great distances (increased reflectivity, Q).
- Typically air temperatures are warmer high aloft since air temperatures near water surface tend to be more constant. Result is a high probability of temperature inversion.
- Sound levels can “carry” much further.

Snow

- Covers the ground for approximately 1/2 of the year in northern climates.
- Can act as an absorber or reflector (and varying degrees in between).
- Freshly fallen snow can be quite absorptive.
- Snow which has been sitting for a while and hard packed due to wind can be quite reflective.
- Falling snow can be more absorptive than rain, but does not tend to produce its own noise.
- Snow can cover grass which might have provided some means of absorption.
- Typically sound propagates with less impedance in winter due to hard snow on ground and no foliage on trees/shrubs.

Appendix II SOUND LEVELS OF FAMILIAR NOISE SOURCES

Used with Permission Obtained from the Alberta Energy Regulator Directive 038 (February, 2007)

Source[1]	Sound Level (dBA)
Bedroom of a country home	30
Soft whisper at 1.5 m	30
Quiet office or living room	40
Moderate rainfall	50
Inside average urban home	50
Quiet street	50
Normal conversation at 1 m	60
Noisy office	60
Noisy restaurant	70
Highway traffic at 15 m	75
Loud singing at 1 m	75
Tractor at 15 m	78-95
Busy traffic intersection	80
Electric typewriter	80
Bus or heavy truck at 15 m	88-94
Jackhammer	88-98
Loud shout	90
Freight train at 15 m	95
Modified motorcycle	95
Jet taking off at 600 m	100
Amplified rock music	110
Jet taking off at 60 m	120
Air-raid siren	130

[1] Cottrell, Tom, 1980, *Noise in Alberta*, Table 1, p.8, ECA80 - 16/1B4 (Edmonton: Environment Council of Alberta).

SOUND LEVELS GENERATED BY COMMON APPLIANCES

Used with Permission Obtained from the Alberta Energy Regulator Directive 038 (February, 2007)

Source[1]	**Sound level at 3 feet (dBA)**
Freezer	38-45
Refrigerator	34-53
Electric heater	47
Hair clipper	50
Electric toothbrush	48-57
Humidifier	41-54
Clothes dryer	51-65
Air conditioner	50-67
Electric shaver	47-68
Water faucet	62
Hair dryer	58-64
Clothes washer	48-73
Dishwasher	59-71
Electric can opener	60-70
Food mixer	59-75
Electric knife	65-75
Electric knife sharpener	72
Sewing machine	70-74
Vacuum cleaner	65-80
Food blender	65-85
Coffee mill	75-79
Food waste disposer	69-90
Edger and trimmer	81
Home shop tools	64-95
Hedge clippers	85
Electric lawn mower	80-90

[1] Reif, Z. F., and Vermeulen, P. J., 1979, "Noise from domestic appliances, construction, and industry," Table 1, p.166, in Jones, H. W., ed., *Noise in the Human Environment*, vol. 2, ECA79-SP/1 (Edmonton: Environment Council of Alberta).

Annual Air Monitoring Data Reporting

Hillstone Aggregates Development

QuantumPlace on behalf of Hillstone Aggregates

203, 1026 – 16th Avenue NW, Calgary, AB T2M 0K6

Prepared by:

SLR Consulting (Canada) Ltd.

200 - 708 11th Avenue SW, Calgary, AB T2R 0E4

SLR Project No.: 203.050442.00002

June 3, 2024

Revision: 0

Making Sustainability Happen

Revision Record

Revision	Date	Prepared By	Checked By	Authorized By
0	June 3, 2024	Tania Guha	Nadine de Bruyn	Craig Vatcher

Statement of Limitations

This report has been prepared by SLR Consulting (Canada) Ltd. (SLR) for QuantumPlace Developments Ltd. (the Client) on behalf of Hillstone Aggregates Ltd. in accordance with the scope of work and all other terms and conditions of the agreement between such parties. SLR acknowledges and agrees that the Client may provide this report to government agencies, interest holders, and/or Indigenous communities as part of project planning or regulatory approval processes. Copying or distribution of this report, in whole or in part, for any other purpose other than as aforementioned is not permitted without the prior written consent of SLR.

Any findings, conclusions, recommendations, or designs provided in this report are based on conditions and criteria that existed at the time work was completed and the assumptions and qualifications set forth herein.

This report may contain data or information provided by third party sources on which SLR is entitled to rely without verification and SLR does not warrant the accuracy of any such data or information.

Nothing in this report constitutes a legal opinion nor does SLR make any representation as to compliance with any laws, rules, regulations, or policies established by federal, provincial territorial, or local government bodies, other than as specifically set forth in this report. Revisions to legislative or regulatory standards referred to in this report may be expected over time and, as a result, modifications to the findings, conclusions, or recommendations may be necessary.

Executive Summary

Hillstone Aggregates (Hillstone) is required to submit an annual air monitoring data report associated with the Hillstone Aggregate Development (the Project; formerly Big Hill Springs Gravel Pit) to Rocky View County (the County), Alberta for 2023. This is to meet the requirement by County environmental protection regulations for industrial development permits. SLR Consulting (Canada) Ltd. (SLR) has completed this report for QuantumPlace (the Client) on behalf of Hillstone Aggregates summarizing the Hillstone air monitoring data for 2023.

This annual report summarizes the results from the ongoing air quality monitoring program, where fine particulate matter ($PM_{2.5}$), coarse particulate matter (PM_{10}), and total suspended particulate matter (TSP) were monitored at three stations located within the project area. Since there are no air quality objectives or standards in Alberta for PM_{10}, it is therefore excluded from this report. This report also includes the meteorological parameters like air temperature, wind direction and wind speed, monitored simultaneously at the three stations.

Both the $PM_{2.5}$ and TSP concentrations are compared with the Alberta Ambient Air Quality Objectives (AAAQO) and the Canadian Ambient Air Quality Standards (CAAQS). Data gaps were identified and opportunities for improvement of the air monitoring program for the project are indicated. This report only summarizes the data provided by the Client and does not include any data validation as monitoring was not conducted by SLR.

Table of Contents

Tables in Text

Figures in Text

Appended Figures

Acronyms and Abbreviations

AAAQO	Alberta Ambient Air Quality Objectives
CAAQS	Canadian Ambient Air Quality Standards
$PM_{2.5}$	Fine particulate matter
PM_{10}	Coarse particulate matter
TSP	Total suspended particulate matter

1.0 Introduction

Hillstone Aggregates (Hillstone) is required to submit an annual air monitoring data report associated with the Hillstone Aggregates Development (the Project; formerly Big Hill Springs Gravel Pit) to Rocky View County (the County) for 2023. This annual report summarizes the results from the ongoing air quality monitoring program and is required by County environmental protection regulations for industrial development permits. The program for 2023 consisted of three monitoring stations surrounding the Project area and monitored the concentration of fine particulate matter ($PM_{2.5}$), coarse particulate matter (PM_{10}), and total suspended particulate matter (TSP). Meteorological data was also monitored simultaneously at the three stations.

SLR Consulting (Canada) Ltd. (SLR) was retained to produce this report for QuantumPlace (the Client) and summarize the Hillstone monitoring data and associated meteorology for 2023. Both $PM_{2.5}$ and TSP data are compared with the Alberta Ambient Air Quality Objectives (AAAQO) and the Canadian Ambient Air Quality Standards (CAAQS). There are no air quality objectives or standards in Alberta for PM_{10} and therefore it is excluded. Data gaps were identified and opportunities for improvement of the air monitoring program for the Project are indicated. This report only summarizes the data provided by the Client and does not include any data validation as monitoring was not conducted by SLR.

1.1 Project Site and Monitoring Locations

The Project is located at NW36-26-04 W5M, south of Provincial Hwy 567 and approximately 2 km east of Provincial Hwy 22. The site is approximately 8 km northeast of Cochrane and 3 km northwest of Big Hill Springs Provincial Park. Most of the surrounding area is designated as Agricultural (A-GEN) District. Other districts include S-NAT, A-SML. Further west along Provincial Hwy 567 there are Heavy and Light Industrial Districts (I-HVY and I-LHT) located on north side of the road.

The three monitoring stations AQ6, AQ7, and AQ8 are located within the Project property boundary. The stations' coordinates are presented in Table 1, and the location of the monitoring stations are shown in Figure A. Note that the base satellite imagery shown in Figure A may not be reflective of 2023 or current site conditions.

Table 1: Air Quality and meteorological monitoring stations

Monitoring Station ID	Coordinates	Notes
AQ6	51°16'11.48" N, 114°26'4.40" W	Located south of Provincial Hwy 567. Located north of Phase 2.
AQ7	51°16'6.49" N, 114°26'21.75" W	Located adjacent to haul road. Located west from Phase 2.
AQ8	51°15'59.05" N, 114°25'54.94" W	Located adjacent to haul road. Located east of Phase 2.

2.0 Data Summary

2.1 Meteorological Data

Meteorological parameters considered for the current report include wind speed, wind direction and temperature. The parameters were measured at 10-minute intervals from January 1st until April 14th and at 15-minute intervals from April 14th until December 12th at all three monitoring stations.

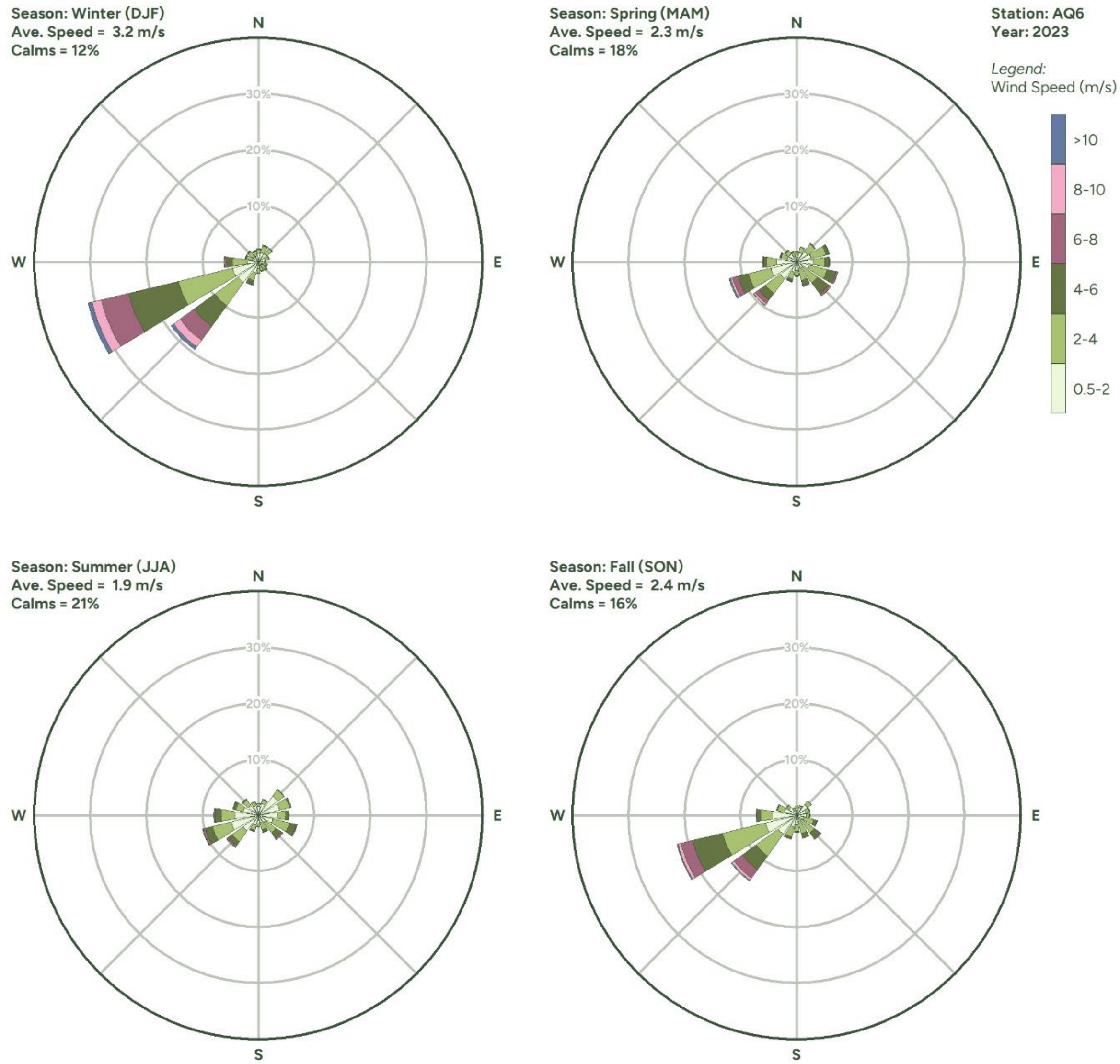
2.1.1 Wind Speed and Direction

The wind data completeness for all the three stations are summarized in Table 2. Among the three stations, the annual data completeness for wind direction and speed is highest for the AQ6 station (94.7%) and lowest for the AQ8 station (46.3%). Seasonal wind roses for all stations are presented in Figures 1 through 3 to identify the seasonal variability and predominant wind. Wind roses represent the relative frequency of wind direction in each season; however, it should be noted that seasons with poor data completeness are not always representative of true site characteristics. For example, at station AQ8, the wind roses for summer to winter are not representative of the seasonal prevailing wind scenario at that station.

Table 2: Data percent (%) completeness for wind direction and wind speed at all stations

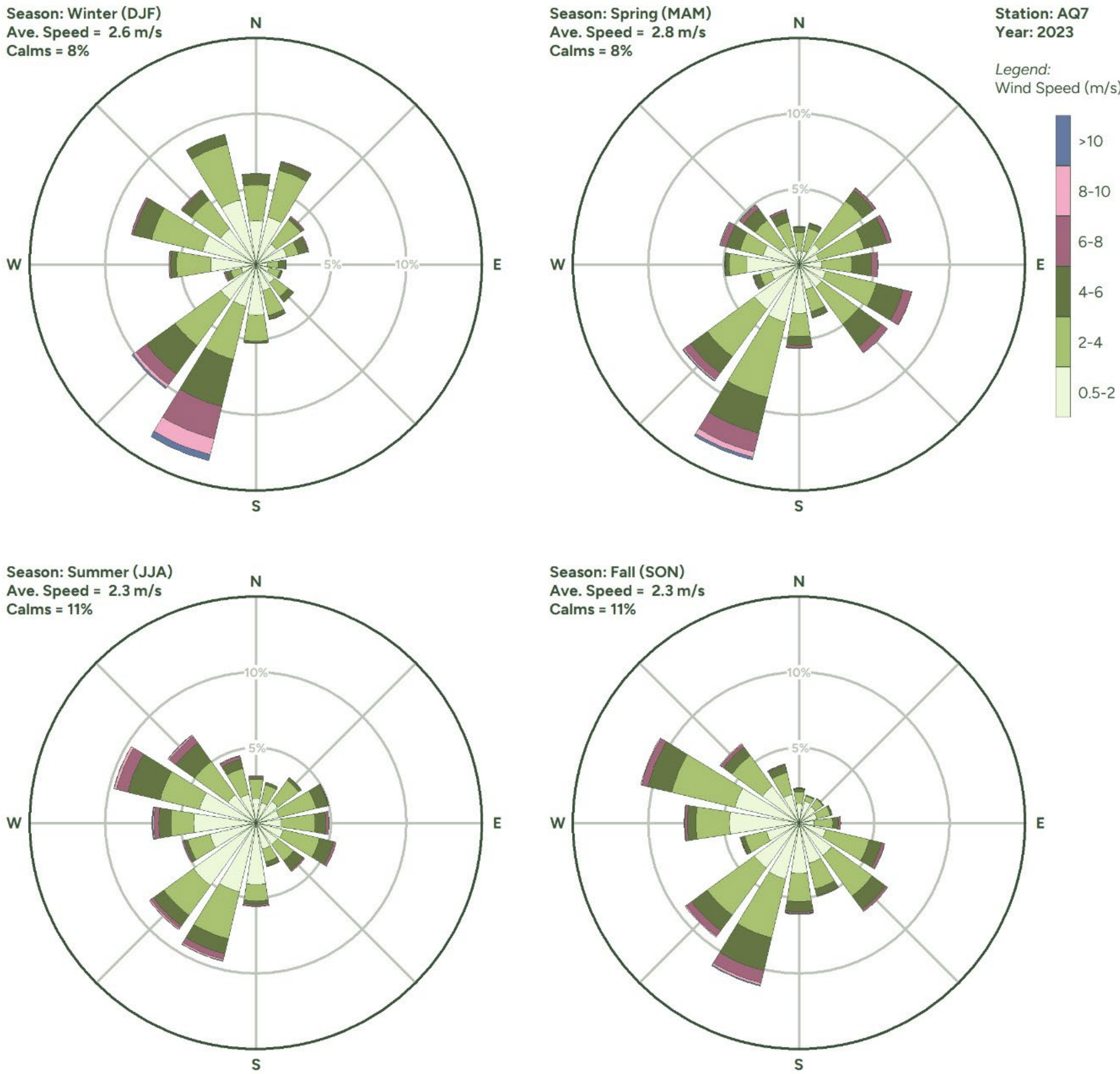
Month	AQ6 Station		AQ7 Station		AQ8 Station	
	Wind Direction	Wind Speed	Wind Direction	Wind Speed	Wind Direction	Wind Speed
January	100.0	100.0	0.0	0.0	0.0	0.0
February	99.6	99.6	43.8	43.8	42.7	42.7
March	99.2	99.2	65.6	65.6	90.6	90.6
April	99.9	99.9	79.9	79.9	99.0	99.0
May	99.7	99.7	98.1	98.1	99.9	99.9
June	99.4	99.4	96.5	96.5	99.0	99.0
July	100.0	100.0	96.4	96.4	9.7	9.7
August	100.0	100.0	87.0	87.0	0.0	0.0
September	99.9	99.9	71.4	71.4	0.0	0.0
October	100.0	100.0	50.8	50.8	5.6	5.6
November	100.0	100.0	80.8	80.8	71.4	71.4
December	40.1	40.1	22.8	22.8	40.1	40.1
ANNUAL	**94.7**	**94.7**	**66.1**	**66.1**	**46.3**	**46.3**

Figure 1: Seasonal wind rose diagrams for station AQ6



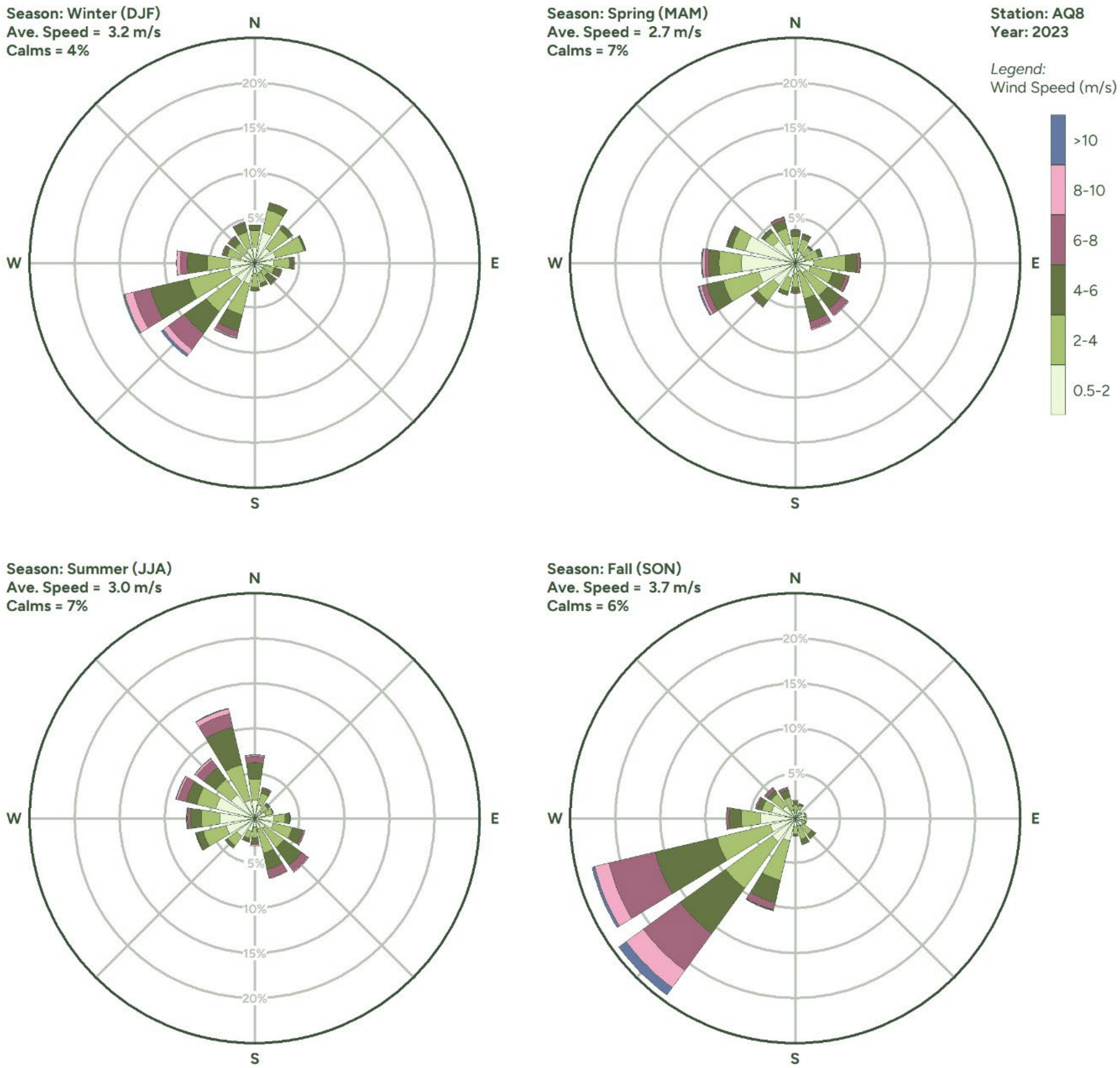
As shown in Figure 1, for station AQ6 the predominant winds are from the southwest and are strongest (> 6 m/s) in the winter and fall seasons. Calm wind speeds are observed 12% to 21% of seasonally collected data. The highest average wind speed observed (3.2 m/s) occurs during winter and the lowest (1.9 m/s) occurs in summer.

Figure 2: Seasonal wind rose diagrams for station AQ7



As shown in Figure 2, for station AQ7 the predominant winds are from the southwest and are strongest (> 6 m/s) in the winter and spring seasons. Calm wind speeds are observed 8% to 11% of seasonally collected data. The highest average wind speed observed (2.8 m/s) occurs during spring and the lowest (2.3 m/s) occurs in the summer and fall seasons.

Figure 3: Seasonal wind rose diagrams for station AQ8



Per Figure 3, for station AQ8 the predominant winds are from the southwest and are strongest (> 6 m/s) in the fall season. Calm wind speeds are observed during 4% to 7% of the seasonally collected data. The highest average wind speed observed (3.7 m/s) occurs during fall and the lowest (2.7 m/s) occurs in spring.

2.1.2 Temperature

Hourly average values were calculated for each station from the data provided and are summarized by month in Tables 2 through 4. Monthly and seasonal patterns that were observed at the three stations are what would be reasonably expected.

Table 3: Summary of hourly temperatures observed for station AQ6

Month	Completeness (%)	Average (ºC)	Minimum (ºC)	Maximum (ºC)
January	100.0	-3.4	-32.5	8.5
February	100.0	-6.0	-37.1	7.5
March	99.7	-8.0	-25.1	7.7
April	100.0	3.0	-11.7	21.7
May	99.7	13.0	-1.7	27.2
June	99.4	14.1	0.5	27.1
July	100.0	15.3	2.8	31.1
August	100.0	15.4	1.6	31.8
September	99.9	11.2	-3.3	27.0
October	100.0	3.7	-19.3	23.5
November	100.0	0.6	-12.2	15.0
December	40.1	-1.3	-12.8	12.8
ANNUAL	**94.8**	**5.2**	**-37.1**	**31.8**

Table 4: Summary of hourly temperatures observed for station AQ7

Month	Completeness (%)	Average (ºC)	Minimum (ºC)	Maximum (ºC)
January	0.0			
February	43.8	-11.5	-37.8	5.0
March	65.6	-6.4	-26.6	7.7
April	79.9	4.0	-11.9	22.0
May	98.1	12.9	-3.4	27.6
June	96.5	13.8	-0.7	27.0
July	96.4	15.1	1.5	30.5
August	87.0	15.6	-0.9	31.5
September	71.4	12.7	-0.8	27.2
October	50.8	6.3	-19.6	23.9
November	80.7	0.5	-12.1	15.0
December	22.8	-0.6	-12.3	12.4
ANNUAL	**66.1**	**7.7**	**-37.8**	**31.5**

Table 5: Summary of hourly temperatures observed for station AQ8

Month	Completeness (%)	Average (ºC)	Minimum (ºC)	Maximum (ºC)
January	0.0			
February	42.7	-11.2	-33.6	5.3
March	90.6	-7.1	-23.2	7.7
April	100.0	3.1	-10.8	21.6
May	99.9	13.1	-7.0	27.0
June	99.0	14.1	2.1	26.9
July	9.7	12.4	4.7	26.7
August	0.0			
September	0.0			
October	7.5	-7.1	-12.5	-1.5
November	71.4	0.3	-11.2	14.8
December	40.1	-1.1	-11.8	12.3
ANNUAL	**46.5**	**3.5**	**-33.6**	**27.0**

At station AQ6, the highest recorded temperature in August at 31.8ºC and the lowest recorded temperature occurred in February at -37.1ºC. At station AQ7, the highest recorded temperature occurred during August at 31.5ºC and the lowest recorded temperature occurred during February at -37.8ºC. For station AQ8, there was no data available for January, August, and September. Based on the available data, the highest recorded temperature was in June at 26.9ºC and the lowest recorded temperature was in February at -33.6ºC.

2.2 Air Quality Data

Air quality parameters considered for this report include $PM_{2.5}$ and TSP. The parameters were measured at 10-minute intervals from January 1st until April 14th, and at 15-minute intervals from April 14th until December 12th at stations AQ6 and AQ7. The data completeness is summarized in Table 5 below. For $PM_{2.5}$, both the hourly averaged and 24-hour averaged values were calculated from the data provided. For TSP, 24-hour averaged values were calculated from the data provided. For station AQ8, in absence of hourly data, the daily average value of $PM_{2.5}$ was summarized from the daily reports provided by the Client.

For this report, the measured concentrations are compared against the AAAQO and CAAQS for $PM_{2.5}$ and TSP concentrations at different averaging periods. It should be noted that data validation and corrections could not be conducted on the provided data as prescribed by provincial or federal guidelines, as the equipment setup and data collection was not conducted by SLR. Therefore, values and data gaps cannot be investigated or corrected by SLR.
This report only serves as a summary of the data provided. Summarized hourly, 24-hour, and annual averaged data in the Tables and Figures below are compared to their respective AAAQO and CAAQS. Station AQ6 data is summarized in Tables 5 to 7 and Figures 4 to 5, station AQ7 data is summarized in Tables 8 to 10 and Figures 6 to 7, and station AQ8 data is summarized in Table 11 and Figure 8. The AAAQO and CAAQS 1-hour and 24-hour averaging period values are indicated in the Tables. The annual average TSP AAAQO is 60.0 µg/m³ and the annual average $PM_{2.5}$ CAAQS is 8.8 µg/m³.

Table 6: Summary of hourly $PM_{2.5}$ observations for station AQ6

Month	Completeness (%)	Average (µg/m³)	Minimum (µg/m³)	Maximum (µg/m³)	Number of Exceedances (AAAQO)	AAAQO (µg/m³)
January	100.0	1.0	0.0	99.5	2	80.0
February	100.0	2.1	0.0	61.8	0	
March	99.7	5.9	0.0	97.3	1	
April	100.0	2.4	0.0	37.2	0	
May	99.7	31.6	0.0	394.8	78	
June	99.4	12.7	0.0	144.8	22	
July	100.0	25.6	0.0	150.8	43	
August	100.0	20.9	0.0	105.0	6	
September	99.9	0.0	0.0	0.0	0	
October	100.0	0.0	0.0	0.0	0	
November	100.0	0.0	0.0	0.0	0	
December	40.3	0.0	0.0	0.0	0	
ANNUAL	**94.8**	**9.1**	**0.0**	**394.8**	**152**[1]	

[1] Total number of annual exceedances is defined as the total number of hours the 1-Hour average was exceeded.

Figure 4: Hourly $PM_{2.5}$ plot for station AQ6

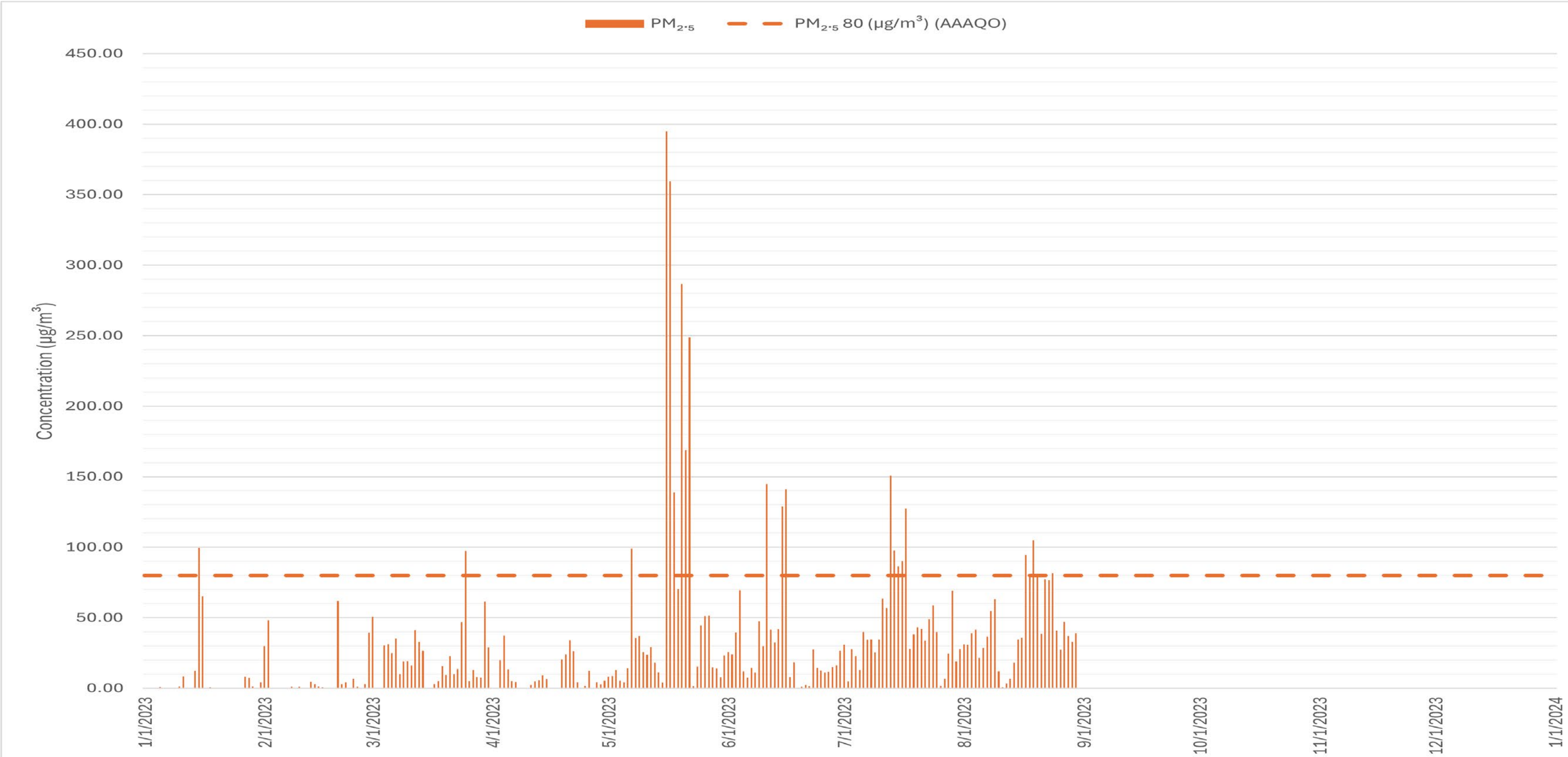


Table 7: Summary of 24-hour $PM_{2.5}$ observations for station AQ6

Month	Completeness (%)	Average (µg/m³)	Minimum (µg/m³)	Maximum (µg/m³)	Number of Exceedances (AAAQO)	Number of Exceedances (CAAQS)	AAAQO (µg/m³)	CAAQS (µg/m³)
January	100.0	1.0	0.0	15.9	0	0	29.0	27.0
February	100.0	2.1	0.0	25.4	0	0		
March	100.0	5.9	0.0	24.6	0	0		
April	100.0	2.4	0.0	19.7	0	0		
May	100.0	31.5	0.2	246.7	8	9		
June	100.0	12.8	0.0	65.0	3	3		
July	100.0	25.6	0.3	97.2	8	9		
August	100.0	20.9	0.0	45.1	7	9		
September	100.0	0.0	0.0	0.0	0	0		
October	100.0	0.0	0.0	0.0	0	0		
November	100.0	0.0	0.0	0.0	0	0		
December	41.9	0.0	0.0	0.0	0	0		
ANNUAL	**95.1**	**9.1**	**0.0**	**246.7**	**26**[1]	**30**[1]		

[1] Total number of annual exceedances is defined as the total number of days the 24-Hour average was exceeded.

Table 8: Summary of 24-hour TSP observations for station AQ6

Month	Completeness (%)	Average (µg/m³)	Minimum (µg/m³)	Maximum (µg/m³)	Number of Exceedances (AAAQO)	AAAQO (µg/m³)
January	100.0	26.7	4.4	383.6	2	100.0
February	100.0	8.8	4.3	49.3	0	
March	100.0	45.7	5.0	659.3	3	
April	100.0	13.5	5.0	103.3	1	
May	100.0	43.2	7.6	235.7	3	
June	100.0	20.9	4.7	68.9	0	
July	100.0	13.1	4.1	136.6	1	
August	100.0	20.7	5.2	172.4	2	
September	100.0	14.3	4.5	76.3	0	
October	100.0	20.4	4.1	316.8	1	
November	100.0	8.5	4.0	53.3	0	
December	41.9	6.1	4.1	15.3	0	
ANNUAL	**95.1**	**21.1**	**4.0**	**659.3**	**13**[1]	

[1] Total number of annual exceedances is defined as the total number of days the 24-Hour average was exceeded.

Figure 5: 24-hour $PM_{2.5}$ and TSP plot for station AQ6

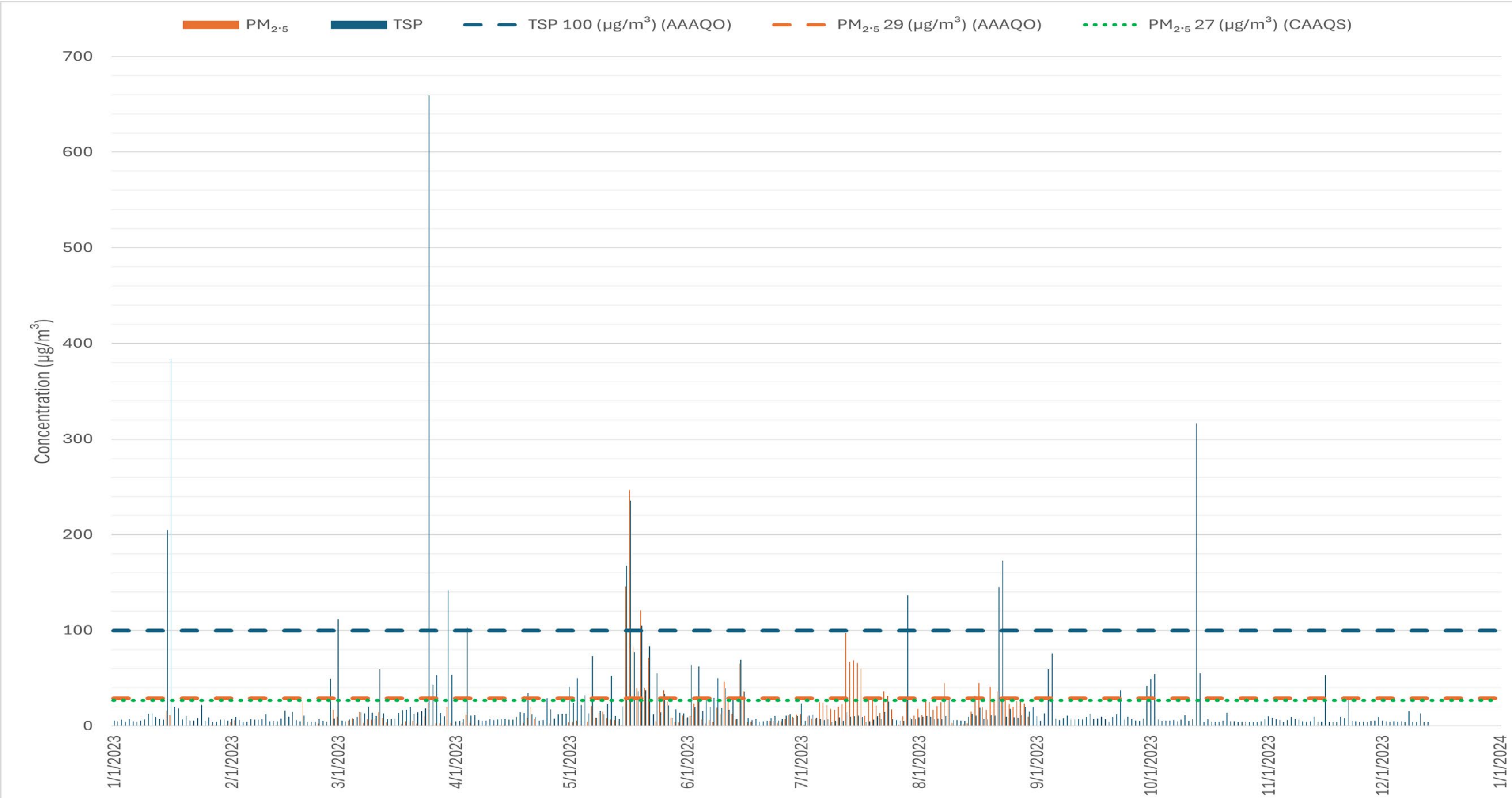


Table 9: Summary of hourly $PM_{2.5}$ observations for AQ7

Month	Completeness (%)	Average (µg/m³)	Minimum (µg/m³)	Maximum (µg/m³)	Number of Exceedances (AAAQO)	AAAQO (µg/m³)
January	0.0					80.0
February	0.0					
March	1.5	22.5	22.2	22.8	0	
April	79.9	21.9	19.1	30.8	0	
May	98.1	36.1	18.0	400.3	64	
June	96.5	25.9	18.0	131.6	24	
July	96.4	39.1	18.2	154.4	70	
August	87.0	35.5	18.2	133.2	21	
September	71.4	31.3	20.3	140.9	14	
October	50.8	24.1	20.3	35.8	0	
November	80.7	21.2	18.0	34.4	0	
December	22.8	21.6	18.2	32.0	0	
ANNUAL	**57.3**	**29.8**	**18.0**	**400.3**	**193**[1]	

[1] Total number of annual exceedances is defined as the total number of hours the 1-Hour average was exceeded.

Figure 6: Hourly $PM_{2.5}$ plot for station AQ7

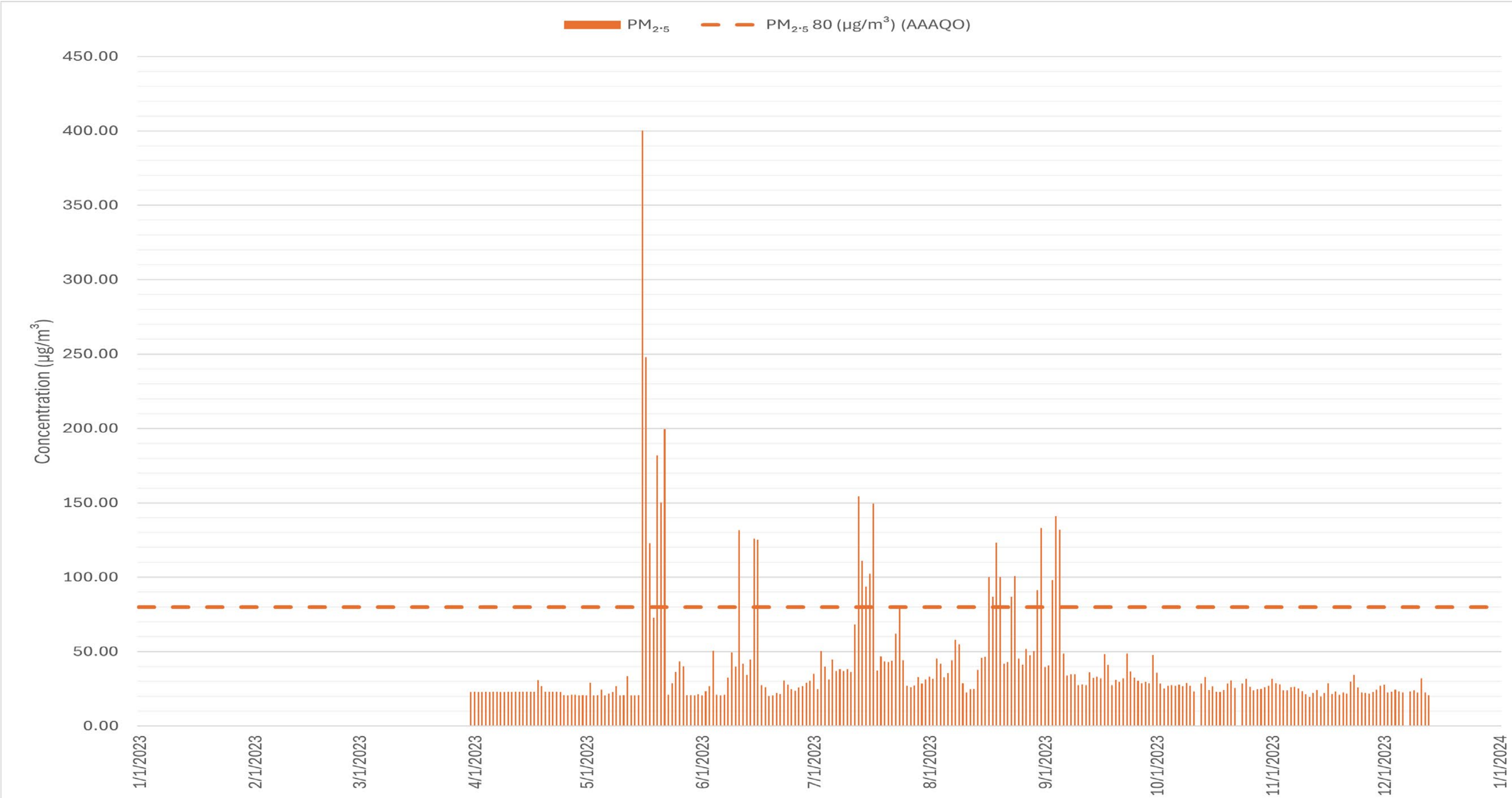


Table 10: Summary of 24-hour $PM_{2.5}$ observations for station AQ7

Month	Completeness (%)	Average (µg/m³)	Minimum (µg/m³)	Maximum (µg/m³)	Number of Exceedances (AAAQO)	Number of Exceedances (CAAQS)	AAAQO (µg/m³)	CAAQS (µg/m³)
January	0						29	27
February	0							
March	3	23	23	23	0	0		
April	100	22	20	23	0	0		
May	100	36	20	161	8	8		
June	100	27	19	89	4	5		
July	100	39	20	106	18	21		
August	100	38	20	120	23	25		
September	100	34	24	118	10	14		
October	94	24	22	28	0	2		
November	100	22	19	27	0	1		
December	39	22	20	24	0	0		
ANNUAL	**70**	**30**	**19**	**161**	**63**[1]	**76**[1]		

[1] Total number of annual exceedances is defined as the total number of days the 24-Hour average was exceeded.

Table 11: Summary of 24-hour TSP observations for station AQ7

Month	Completeness (%)	Average (μg/m³)	Minimum (μg/m³)	Maximum (μg/m³)	Number of Exceedances (AAAQO)	AAAQO (μg/m³)
January	0.0					100.0
February	0.0					
March	3.2	11.4	11.4	11.4	0	
April	100.0	16.8	6.3	60.7	0	
May	100.0	80.0	6.5	384.3	8	
June	100.0	48.0	4.9	287.1	3	
July	100.0	193.5	7.0	1358.3	11	
August	100.0	1489.8	24.1	4806.8	27	
September	100.0	1809.0	793.1	6130.3	30	
October	93.5	169.4	4.4	2015.4	3	
November	100.0	17.9	5.1	38.6	0	
December	38.7	17.0	10.1	44.8	0	
ANNUAL	**69.9**	**457.0**	**4.4**	**6130.3**	**82**[1]	

[1] Total number of annual exceedances is defined as the total number of days the 24-Hour average was exceeded.

Figure 7: 24-hour $PM_{2.5}$ and TSP plot for station AQ7

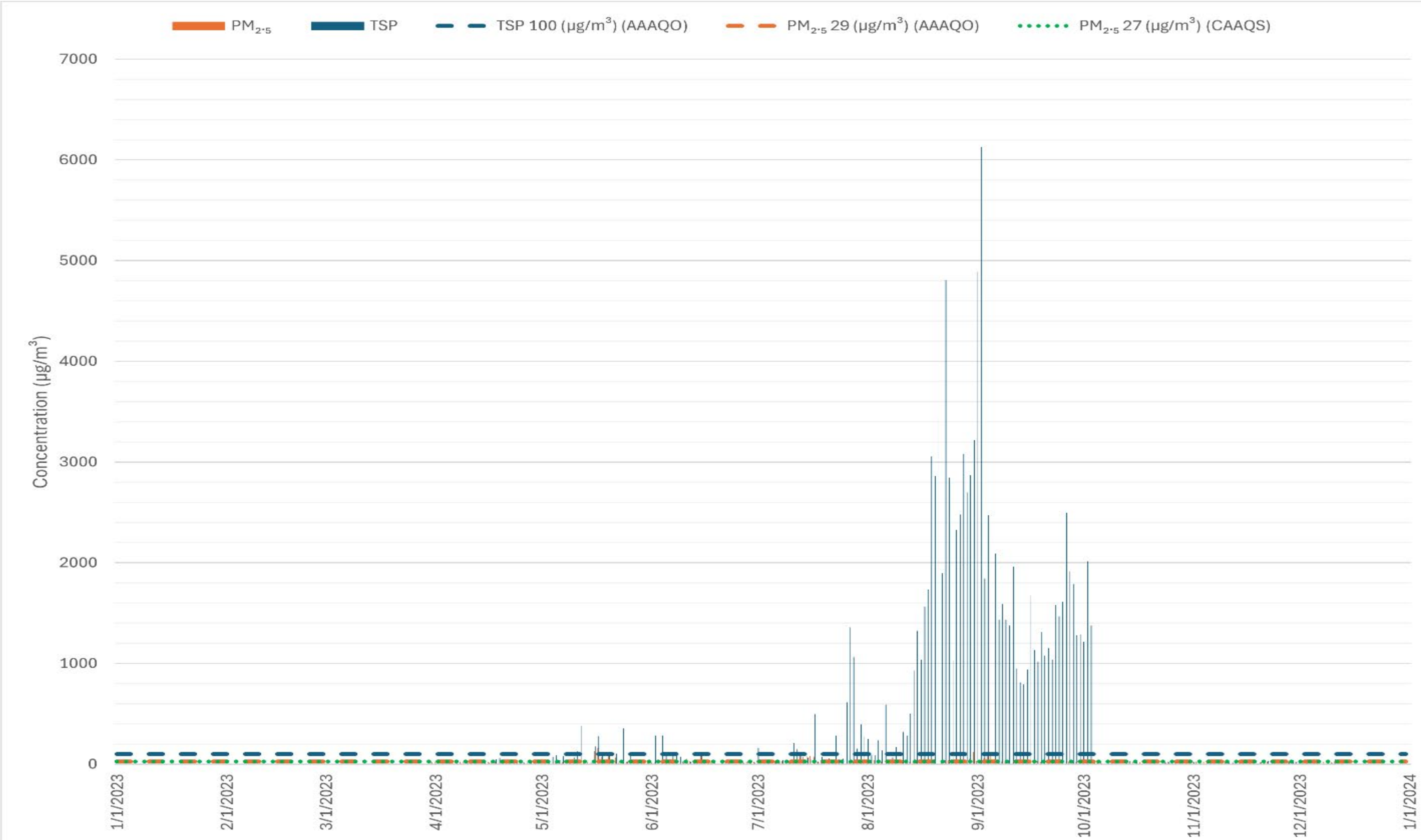
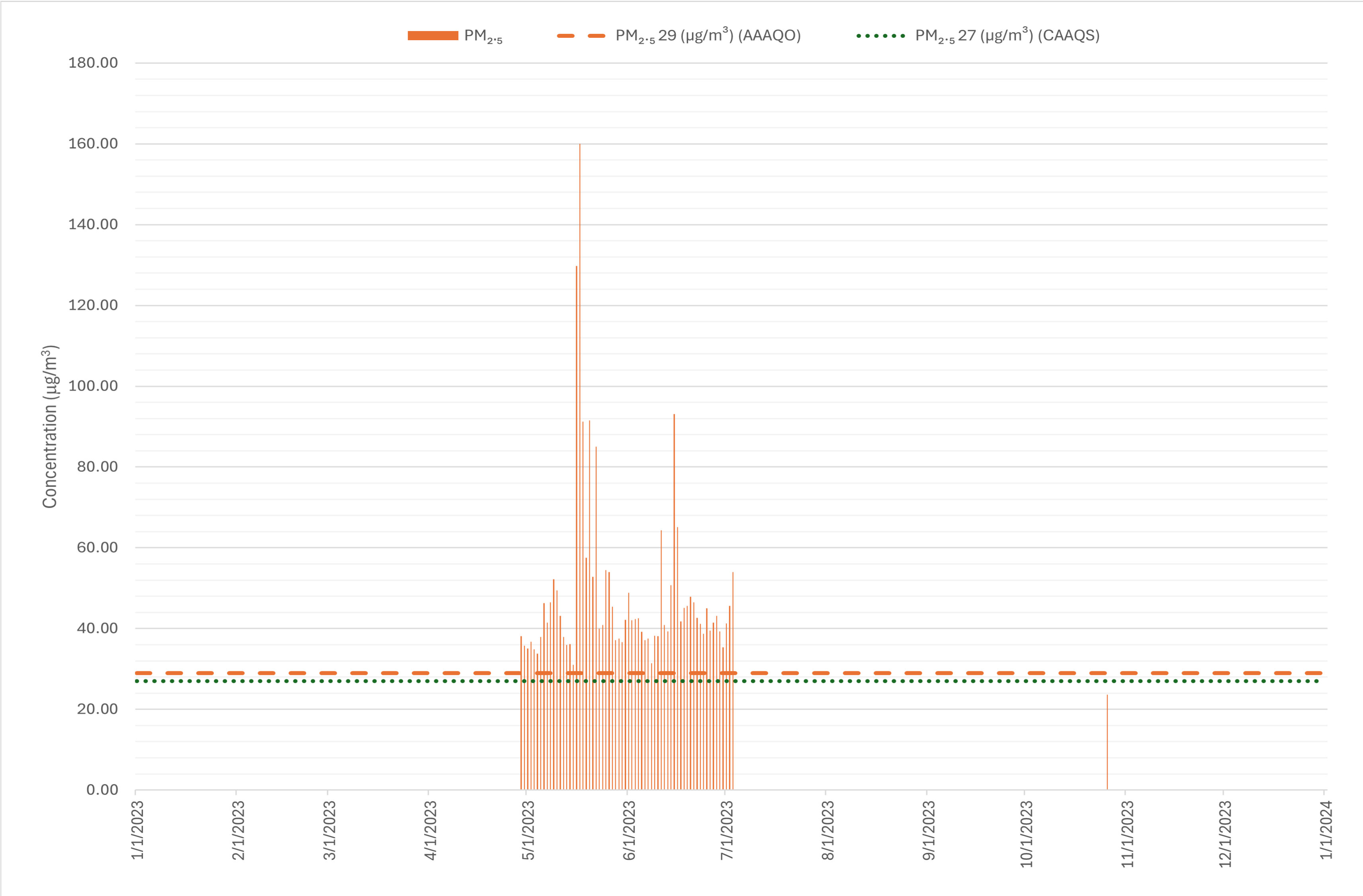


Table 12: Summary of 24-hour $PM_{2.5}$ observations for station AQ8

Month	Completeness (%)	Average (µg/m³)	Minimum (µg/m³)	Maximum (µg/m³)	Number of Exceedances (AAAQO)	Number of Exceedances (CAAQS)	AAAQO (µg/m³)	CAAQS (µg/m³)
January	0.0						29.0	27.0
February	0.0							
March	0.0							
April	6.7	36.9	35.7	38.1	2	2		
May	100.0	53.4	31.0	160.0	31	31		
June	100.0	44.8	31.4	93.1	30	30		
July	9.7	47.0	41.3	54.0	3	3		
August	0.0							
September	0.0							
October	3.2	23.6	23.6	23.6	0	0		
November	0.0							
December	0.0							
ANNUAL	**18.1**	**48.5**	**23.6**	**160.0**	**66**[1]	**66**[1]		

[1] Total number of annual exceedances is defined as the total number of days the 24-Hour average was exceeded.

Figure 8: 24-hour $PM_{2.5}$ plot for station AQ8



2.3 Conclusions and Recommendations

When comparing the monitoring data to the AAAQO and CAAQS, there were a significant number of exceedances in 2023. For the AAAQO, the hourly $PM_{2.5}$ concentration was exceeded 152 times at station AQ6, and 193 times at station AQ7. For station AQ8, the hourly $PM_{2.5}$ concentration was not available to be reported. When comparing the 24-hour $PM_{2.5}$, the AAAQO was exceeded 26 times at station AQ6, 63 times at station AQ7, and 66 times at station AQ8. For CAAQS, the 24-hour average $PM_{2.5}$ concentration was exceeded 30 times (out of 8760 hours) at station AQ6, 76 times at station AQ7, and 66 times at station AQ8.

For the AAAQO 24-hour TSP, the concentrations exceeded the objective 13 times at station AQ6, and 82 times for at station AQ7. TSP concentrations were not available for station AQ8. The annual AAAQO TSP was exceeded at station AQ6 and AQ7. Since hourly TSP data was not available for station AQ8, the annual average was not calculated.

The high number of AAAQO and CAAQS exceedances for the three monitoring stations are likely due to the proximity of the stations to site activity. For example, stations AQ7 and AQ8 are close to active haul roads along the perimeter of Phase 2, and therefore are more reflective of on-site air-quality conditions. Therefore, the values obtained from the stations may not necessarily be representative of concentrations expected off-site or at sensitive receptors. It is recommended that air dispersion modelling be conducted, and the air quality monitoring stations be repositioned according to modelling results for future Project phases.

3.0 Closure

If you should have any questions, please contact Craig Vatcher at cvatcher@slrconsulting.com, or Nadine de Bruyn at ndebruyn@slrconsulting.com.

Regards,

SLR Consulting (Canada) Ltd.

Craig Vatcher, CET, B.Tech., EP
Senior Project Manager

Nadine de Bruyn, M.A.Sc., P.Eng., EPt
Air Quality Engineer

4.0 References

Alberta Environment and Protected Areas (AEPA). 2019. Alberta Ambient Air Quality Objectives and Guidelines Summary (AAAQO). Retrieved from: https://open.alberta.ca/dataset/0d2ad470-117e-410f-ba4f-aa352cb02d4d/resource/4ddd8097-6787-43f3-bb4a-908e20f5e8f1/download/aaqo-summary-jan2019.pdf

Canadian Council of Ministers of the Environment (CCME). 2024. Canadian Ambient Air Quality Standards (CAAQS). Retrieved from: https://ccme.ca/en/air-quality-report

Figures

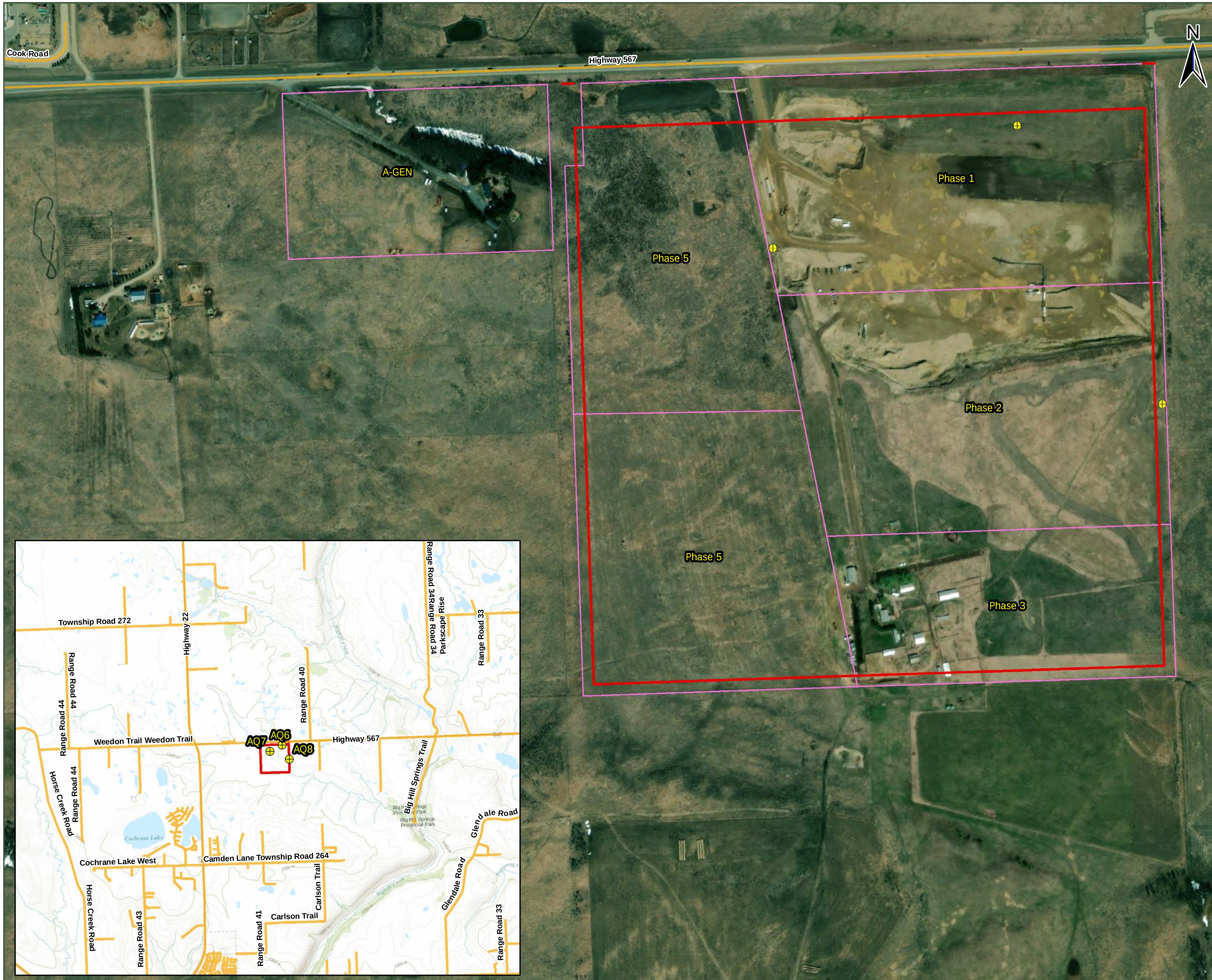
Annual Air Monitoring Data Reporting

Hillstone Aggregates Development

QuantumPlace on behalf of Hillstone Aggregates

SLR Project No.: 203.050442.00002

June 3, 2024



LEGEND:

- MONITORING STATIONS
- HILLSTONE SETBACKS
- OPERATIONAL PHASES

0 50 100 200 300 m

SCALE 1:5,000
PAGE SIZE 11 x 17
NAD 1983 UTM Zone 11N

THIS MAP IS FOR CONCEPTUAL PURPOSES ONLY AND SHOULD NOT BE USED FOR NAVIGATION

HILLSTONE AGGREGATES

2023 MONITORING REPORT

MONITORING LOCATIONS

SLR

FIGURE NO:
A

DATE: May 24, 2024

PROJECT NO: 203.050442.00002

GIS PATH: G:_Projects\203_050442_Hillstone\1_Maps\RPT\RPT_20240515_HillstoneAnnualReport203_050442_FigA_revB.mxd

Making Sustainability Happen