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Environmental Noise Monitoring

For

Southwest Anthony Henday Drive
At
Wedgewood Heights Residential Neighborhood
in
Edmonton, AB

During Fall 2017

Prepared for:
ISL Engineering and Land Services Ltd.

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APEGA Permit to Practice #P7735

10/25/2017

aci Project #: 16-085
October 25, 2017

Executive Summary

aci Acoustical Consultants Inc., of Edmonton AB, was retained by ISL Engineering and Land Services Ltd. (ISL) to conduct an environmental noise monitoring for the Southwest section of Anthony Henday Drive (SWAHD) within the residential neighborhood of Wedgewood Heights, in Edmonton, Alberta. The purpose of the work was to conduct long-term environmental noise monitoring at 2 locations adjacent to the roadway in Fall 2017 and to assess the results along with previously monitored noise levels at the same locations in Spring 2017 and in Fall 2016.

Throughout the Fall 2016, Spring 2017, and Fall 2017 noise monitorings a total of eight (8) 24-hour assessments periods have been selected for assessment including 2 periods with a northwest wind, 5 periods with a west/southwest wind, and 1 period with a southeast wind.

The noise monitoring results for the 8 assessment periods spanning approximately 1-year, are relatively consistent for each location. The noise monitoring results indicated that the highest monitored noise levels were obtained when the wind was from the southeast, south, or south-southwest and the lowest monitored noise levels were obtained when the wind was from the northwest. Given the location of the noise monitors and the proximity and orientation relative to SWAHD, it would generally be expected that the highest noise levels would be when the wind is from a south or southwesterly direction. The noise monitoring results generally match with this assertion.

In addition to the broadband A-weighted L_{eq} sound levels, the 24-hour 1/3 octave band L_{eq} sound levels for all 8 assessment periods show the typical trend of low frequency noise (near 63 – 80 Hz) resulting from engines and exhaust, as well as mid-high frequency noise (near 1,000 Hz) resulting from tire noise at each of the noise monitoring locations. Again, there is good consistency spanning all 8 assessment periods.

Finally, at noise monitor location M6b (located on residential property), the highest sustained 24-hour noise level under acceptable weather conditions obtained for the entire 8-weeks worth of data collection was 59.6 dBA $L_{eq}24$. The absolute highest monitored noise level obtained for the entire 8-weeks was 60.7 dBA $L_{eq}24$, however, that was obtained during a period of high wind from the SE with wind and leaf rustling noise dominating. As such, at no time during the full 8-weeks of data collection (spanning approximately 1-year) did the noise levels exceed 60 dBA under acceptable weather conditions and at no time did the noise levels come near 65 dBA $L_{eq}24$, regardless of weather conditions.

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1.0 Introduction

aci Acoustical Consultants Inc., of Edmonton AB, was retained by ISL Engineering and Land Services Ltd. (ISL) to conduct an environmental noise monitoring for the Southwest section of Anthony Henday Drive (SWAHD) within the residential neighborhood of Wedgewood Heights, in Edmonton, Alberta. The purpose of the work was to conduct long-term environmental noise monitoring at 2 locations adjacent to the roadway in Fall 2017 and to assess the results along with previously monitored noise levels at the same locations in Spring 2017 and in Fall 2016.

2.0 Location Description

2.1. Roadways

SWAHD spans from Yellowhead Trail in the northwest end of the City to Calgary Trail / Gateway Boulevard in the southeast end of the City. Throughout the entire span (approximately 20 km), SWAHD is a twinned road with at least 2-lanes in each direction. North of Lessard Road, the road surface is comprised of conventional asphalt pavement (ACP). Starting at Lessard Road and continuing southeast, the material used is Portland Cement Concrete Pavement (PCCP) with the exception of the bridges (with asphalt surfaces). This concrete has a screeded surface with the grooves oriented parallel to the direction of traffic flow. The posted speed limit throughout is 100 km/hr. Near the study area, there are currently grade separated interchanges at the following locations:

- Callingwood Road / 62 Avenue
- Lessard Road
- Cameron Heights Drive

2.2. Adjacent Development

The study area is specific to the Wedgewood Heights residential neighborhood (Wedgewood Heights), as indicated in Figure 1. The adjacent roads include SWAHD to the west and south, Lessard Road to the north, and the interchange between SWAHD and Lessard Road to the west and northwest. Relative to SWAHD, the nearest residents are approximately 135 m away. The residential development within Wedgewood Heights is comprised of single family detached houses. On the western and southwest portion of Wedgewood Heights, the residential lots back directly onto the Transportation and Utility Corridor (TUC) and SWAHD. Starting from the northwest, there is a 1.83 m (6 ft) wood fence at the rear property line for the residential lots backing onto the TUC. This extends along the western property line until approximately 1634 Welbourn Cove. Further south of this point, the lots have chainlink fences at the rear property line.

2.3. Topography

Topographically, for the northern portion of Wedgewood Heights, the ground is relatively flat in between the western-most residents and SWAHD and Lessard Road. The land is generally covered in tall field grasses. There is a narrow row of trees which extends north-south approximately 42 m west of the residential property lines. During the summer foliage months, this row of trees blocks the line-of-sight to SWAHD. Approximately midway north-south, there is a gap in the trees (approximately 180 m in length) where there is direct line-of-sight to SWAHD. Moving further south, Wedgewood Heights curves to the southeast such that the residential lots back to the southwest. For these areas, there is a berm (approximately 3 m tall) that runs parallel with SWAHD in between SWAHD and the residential lots. Near the south end, there is also the start of a small gully that leads in to the Wedgewood Ravine to the south. There is also a wider area of trees and bushes, blocking the line-of-sight. At the south end of Wedgewood Heights is the Wedgewood Ravine which is approximately 30 m deep and filled with tall trees and bushes.

3.0 Measurement Methods

As part of the study, two (2) long-term environmental noise monitorings were conducted within the study area, as indicated in Figure 1. The western noise monitor (Location M6) was identical to the location used for previous noise studies in 2007 and 2013 as well as the more recent studies in Fall 2016 and Spring 2017. The eastern nose monitor (Location M6b) was selected based on consultation with the Wedgewood Heights residential community and is the same as the recent studies in Fall 2016 and Spring 2017. A detailed description of each location is provided below. The measurements were conducted collecting broadband A-weighted as well as 1/3-octave band sound levels. This enabled a detailed analysis of the noise climate. The Fall 2017 noise monitors collected data for approximately 4-weeks and then the data during various weather conditions was used to derive the 24-hour noise monitoring results. The noise monitoring data was assessed for weekdays under "typical" traffic conditions. In particular, measurements avoided any holidays, major construction activity that would re-route traffic nearby, and other occurrences which would affect the normal traffic on the road. In addition, the noise monitorings were conducted in Fall conditions with minimal-to-no foliage on the trees and no snow cover on the ground. The road surfaces were dry and there was no precipitation during the period for which the data were assessed. The noise monitorings were each accompanied by a digital audio recording for more detailed post process analysis. Finally, a portable weather monitor was used within the area to obtain local weather conditions. Refer to Appendix I for a detailed description of the measurement equipment used. All noise measurement instrumentation was calibrated at the start of each measurement and then checked afterwards to ensure that there had been negligible calibration drift over the duration of the measurement period.

Noise Monitor M6

Noise Monitor M6 was located approximately 810 m south of Lessard Road and 100 m northeast of (perpendicular to) SWAHD (northbound lanes) as shown in Figure 1 and Figure 2. This put the noise monitor approximately 40 m west of the rear fence of the residence at 1644 Welbourn Cove. At this location, there was partial line-of-sight to SWAHD through a row of trees. The Fall 2016 noise monitor was started at 12:30 on Thursday September 29, 2016 and ran for approximately 2-weeks until 09:20 on Thursday, October 13, 2016. The Spring 2017 noise monitor was started at 17:00 on Wednesday May 03, 2017 and ran for approximately 2-weeks until 10:00 on Tuesday May 16, 2017. The Fall 2017 noise monitor was started at 18:00 on Saturday September 23, 2017 and ran for approximately 4-weeks until 14:00 on Thursday October 19, 2017.

Noise Monitor M6b

Noise Monitor M6b was placed in the backyard at the residence at 1664 Welbourn Cove. The noise monitor was located approximately mid-yard (north-south) at 2 m from the rear property line and with the microphone at a height of 1.2 m as per the Alberta Transportation noise criteria. This placed the noise monitor approximately 890 m south of Lessard Road and 150 m from SWAHD (northbound lanes) as shown in Figure 1 and Figure 3. At this location, there was no line-of-sight to SWAHD due to the trees and topography. The Fall 2016 noise monitor was started at 13:30 on Thursday September 29, 2016 and ran for approximately 2-weeks until 10:45 on Thursday, October 13, 2016. The Spring 2017 noise monitor was started at 17:00 on Wednesday May 03, 2017 and ran for approximately 2-weeks until 10:00 on Tuesday May 16, 2017. The Fall 2017 noise monitor was started at 18:00 on Saturday September 23, 2017 and ran for approximately 4-weeks until 14:00 on Thursday October 19, 2017.

4.0 Noise Monitoring Results

Throughout the Fall 2016, Spring 2017, and Fall 2017 noise monitorings a total of eight (8) 24-hour assessments periods have been selected for assessment. The 8 periods were selected based on the following criteria.

- Weekday traffic starting Monday morning until early Friday evening
- No precipitation
- Wind below approximately 20 km/hr
- Generally sustained wind from a narrow range of direction for 24-continuous hours (i.e. not wind from east for a few hours then west for a few hours, etc.)

This resulted in 2 periods with a northwest wind, 5 periods with a west/southwest wind, and 1 period with a southeast wind. The detailed weather data for all 8 assessment periods is presented in Appendix II. Spanning a 1-year period, there was essentially 2-months of data collection, during which there were no periods with a north, northeast, or east wind that met the 4 criteria listed above. However, these wind directions would render SWAHD downwind for the residential receptors within Wedgewood Heights, generally resulting in lower traffic noise levels. As such, the fact that there was no data obtained with these wind conditions is of minimal consequence in terms of assessing the traffic noise impact from SWAHD within Wedgewood. The greater interest is with wind blowing from the direction of SWAHD towards the residential receptors.

4.1. Location M6

The noise monitoring results for the 8 assessment periods for location M6 are provided in Table 1 and in Figures 4 – 11 (broadband A-weighted L_{eq} sound levels provided). The results indicate that the highest monitored noise levels were obtained when the wind was from the southeast, south, or south-southwest. Conversely, the lowest monitored noise levels were obtained when the wind was from the northwest. Given the specific location of the noise monitor and the proximity and orientation relative to SWAHD, it would generally be expected that the highest noise levels would be when the wind is from a southwesterly direction. The noise monitoring results generally match with this assertion.

It is important to note that the noise monitoring results over all 8 assessment periods, spanning approximately 1-year, are relatively consistent with a logarithmic average of 63.5 dBA L_{eq}24 and a variance of just -1.1 / +0.6 dBA L_{eq}24. When removing the lower noise levels associated with the northwest conditions, there is even greater consistency over the remaining 6 assessment periods.

Table 1. Location M6 Noise Monitoring Results

Date / Time / Weather	L_{eq}24 (dBA)	L_{eq}Day (dBA)	L_{eq}Night (dBA)
18:00 Oct 05 - 18:00 Oct 06, 2016 NW Wind 5 - 10 km/hr	62.4	63.1	60.8
12:00 Oct 11 - 12:00 Oct 12, 2016 W/SW/S Wind 0 - 10 km/hr	63.6	64.6	61.2
16:00 May 03 - 16:00 May 04, 2017 W/SW/S Wind 0 - 10 km/hr	62.8	63.0	62.6
12:00 Sept 25 - 12:00 Sept 26, 2017 S/SW Wind near calm	64.1	65.1	61.7
06:00 Sept 28 - 06:00 Sept 29, 2017 SE Wind 0 - 10 km/hr	64.1	65.2	61.0
05:00 Oct 03 - 05:00 Oct 04, 2017 S/SW Wind near calm	63.9	64.5	62.6
22:00 Oct 04 - 22:00 Oct 05, 2017 S/SW Wind near calm	63.6	64.5	61.2
19:00 Oct 11 - 19:00 Oct 12, 2017 NW Wind 5 - 15 km/hr	63.4	64.6	60.1

In addition to the broadband A-weighted L_{eq} sound levels, the 24-hour 1/3 octave band L_{eq} sound levels for all 8 assessment periods are provided in Figure 12. The results show the typical trend of low frequency noise (near 63 – 80 Hz) resulting from engines and exhaust, as well as mid-high frequency noise (near 1,000 Hz) resulting from tire noise. Again, there is good consistency spanning all 8 assessment periods.

4.2. Location M6b

The noise monitoring results for the 8 assessment periods for location M6b are provided in Table 2 and in Figures 13 – 20 (broadband A-weighted L_{eq} sound levels provided). Similar to location M6, the results indicate that the highest monitored noise levels were obtained when the wind was from the southeast, south, or south-southwest and the lowest monitored noise levels were obtained when the wind was from the northwest. Again, given the specific location of the noise monitor and the proximity and orientation relative to SWAHD, it would generally be expected that the highest noise levels would be when the wind is from a south or southwesterly direction. The noise monitoring results generally match with this assertion.

Similar to location M6, the noise monitoring results over all 8 assessment periods, spanning approximately 1-year, are relatively consistent with a logarithmic average of 58.2 dBA L_{eq}24 and a variance of -2.4 / +1.4 dBA L_{eq}24. When removing the lower noise levels associated with the northwest conditions, there is even greater consistency over the remaining 6 assessment periods.

Table 2. Location M6b Noise Monitoring Results

Date / Time / Weather	L_{eq}24 (dBA)	L_{eq}Day (dBA)	L_{eq}Night (dBA)
18:00 Oct 05 - 18:00 Oct 06, 2016 NW Wind 5 - 10 km/hr	55.8	56.6	53.9
12:00 Oct 11 - 12:00 Oct 12, 2016 W/SW/S Wind 0 - 10 km/hr	58.4	59.4	55.8
16:00 May 03 - 16:00 May 04, 2017 W/SW/S Wind 0 - 10 km/hr	57.2	56.8	57.6
12:00 Sept 25 - 12:00 Sept 26, 2017 S/SW Wind near calm	58.4	59.4	56.0
06:00 Sept 28 - 06:00 Sept 29, 2017 SE Wind 0 - 10 km/hr	59.6	60.8	56.5
05:00 Oct 03 - 05:00 Oct 04, 2017 S/SW Wind near calm	58.8	59.5	57.1
22:00 Oct 04 - 22:00 Oct 05, 2017 S/SW Wind near calm	59.0	60.0	56.8
19:00 Oct 11 - 19:00 Oct 12, 2017 NW Wind 5 - 15 km/hr	57.1	58.3	54.0

In addition to the broadband A-weighted L_{eq} sound levels, the 24-hour 1/3 octave band L_{eq} sound levels for all 8 assessment periods are provided in Figure 21. The results show the typical trend of low frequency noise (near 63 – 80 Hz) resulting from engines and exhaust, as well as mid-high frequency noise (near 1,000 Hz) resulting from tire noise. Again, there is good consistency spanning all 8 assessment periods.

Further, given that location M6b was on residential property, a review was conducted for all the data obtained (all 8-weeks) regardless of the weather conditions. The data indicated the absolute maximum monitored 24-hour noise level was approximately 60.7 dBA L_{eq}24. This occurred during a period of high wind from the southeast. Wind noise and leaf rustling dominated the noise climate during this period, negating this as an accurate measure of the traffic noise. There were a few other periods in which the noise levels were in the 60 dBA range, all of which were during high-wind conditions. The 24-hour period with the highest monitored noise levels under acceptable wind conditions, in which traffic noise from SWAHD was clearly the dominant noise source, was the period between 06:00 September 28, 2017 until 06:00 September 29, 2017, which resulted in a noise level of 59.6 dBA L_{eq}24, as indicated in Table 2. As such, at no time during the full 8-weeks of data collection (spanning approximately 1-year) did the noise levels exceed 60 dBA under acceptable weather conditions and at no time did the noise levels come near 65 dBA L_{eq}24, regardless of weather conditions.

5.0 Conclusion

Throughout the Fall 2016, Spring 2017, and Fall 2017 noise monitorings a total of eight (8) 24-hour assessments periods have been selected for assessment including 2 periods with a northwest wind, 5 periods with a west/southwest wind, and 1 period with a southeast wind.

The noise monitoring results for the 8 assessment periods spanning approximately 1-year, are relatively consistent for each location. The noise monitoring results indicated that the highest monitored noise levels were obtained when the wind was from the southeast, south, or south-southwest and the lowest monitored noise levels were obtained when the wind was from the northwest. Given the location of the noise monitors and the proximity and orientation relative to SWAHD, it would generally be expected that the highest noise levels would be when the wind is from a south or southwesterly direction. The noise monitoring results generally match with this assertion.

In addition to the broadband A-weighted L_{eq} sound levels, the 24-hour 1/3 octave band L_{eq} sound levels for all 8 assessment periods show the typical trend of low frequency noise (near 63 – 80 Hz) resulting from engines and exhaust, as well as mid-high frequency noise (near 1,000 Hz) resulting from tire noise at each of the noise monitoring locations. Again, there is good consistency spanning all 8 assessment periods.

Finally, at noise monitor location M6b (located on residential property), the highest sustained 24-hour noise level under acceptable weather conditions obtained for the entire 8-weeks worth of data collection was 59.6 dBA L_{eq}24. The absolute highest monitored noise level obtained for the entire 8-weeks was 60.7 dBA L_{eq}24, however, that was obtained during a period of high wind from the SE with wind and leaf rustling noise dominating. As such, at no time during the full 8-weeks of data collection (spanning approximately 1-year) did the noise levels exceed 60 dBA under acceptable weather conditions and at no time did the noise levels come near 65 dBA L_{eq}24, regardless of weather conditions.

6.0 References

- *"Noise Attenuation Guidelines for Provincial Highways Under Provincial Jurisdiction Within Cities and Urban Areas"*, by Alberta Transportation. October, 2002.
- *Environmental Noise Study For Southwest Anthony Henday Drive in Edmonton, AB*. Prepared for ISL Engineering and Land Services Ltd., by aci Acoustical Consultants Inc., October 24, 2017.
- *Environmental Noise Study For Southwest Anthony Henday Drive at Wedgewood Heights Residential Neighborhood in Edmonton, AB*. Prepared for ISL Engineering and Land Services Ltd., by aci Acoustical Consultants Inc., December, 2016.
- *Environmental Noise Survey and Computer Modeling for Southwest Anthony Henday Drive in Edmonton, Alberta,* prepared for UMA Engineering Ltd., by aci Acoustical Consultants Inc., October, 2007.
- *Environmental Noise Study for Southwest Anthony Henday Drive in Edmonton, Alberta*, prepared for AECOM, by aci Acoustical Consultants Inc., December, 2013.
- 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.

Figure 1. Study Area

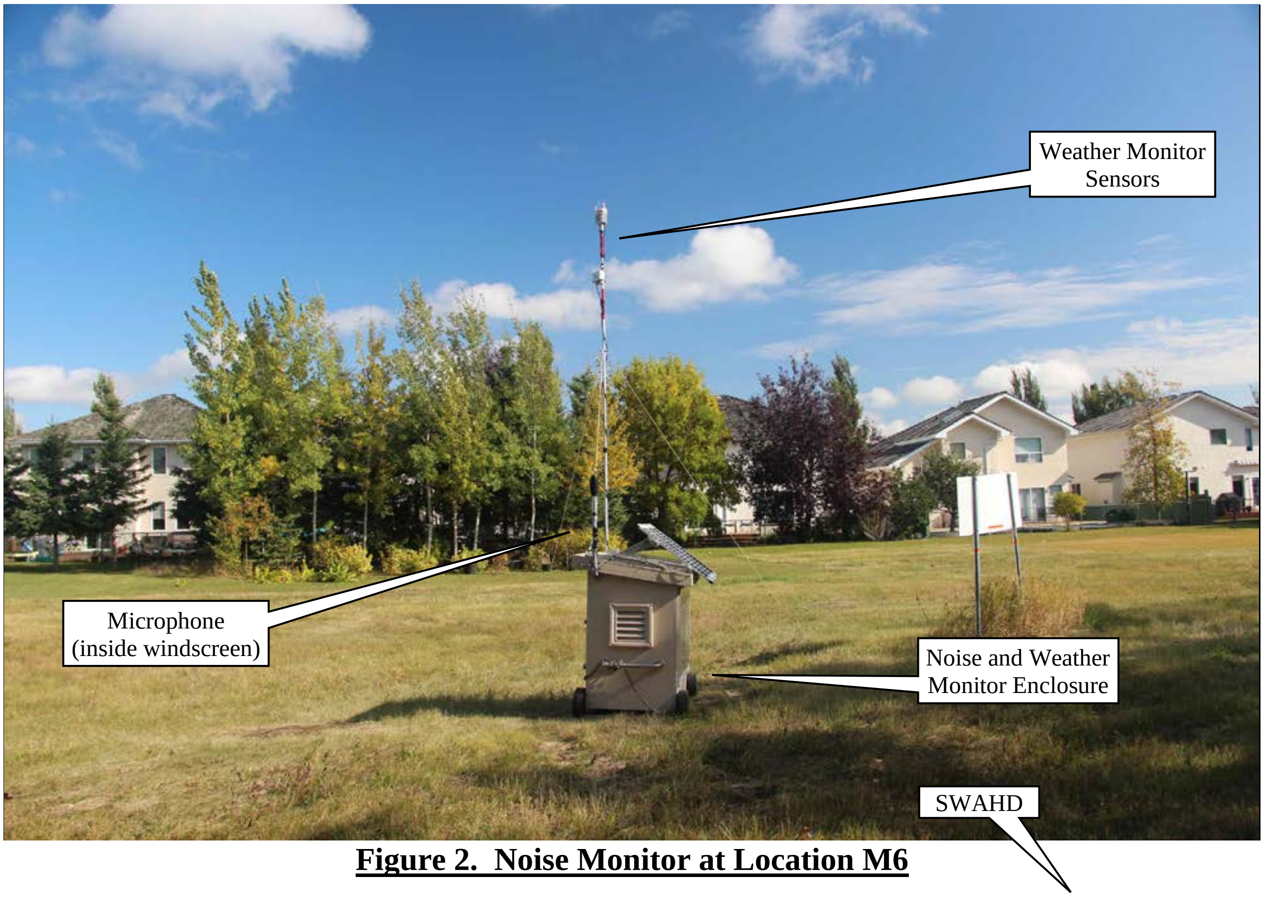

Figure 2. Noise Monitor at Location M6

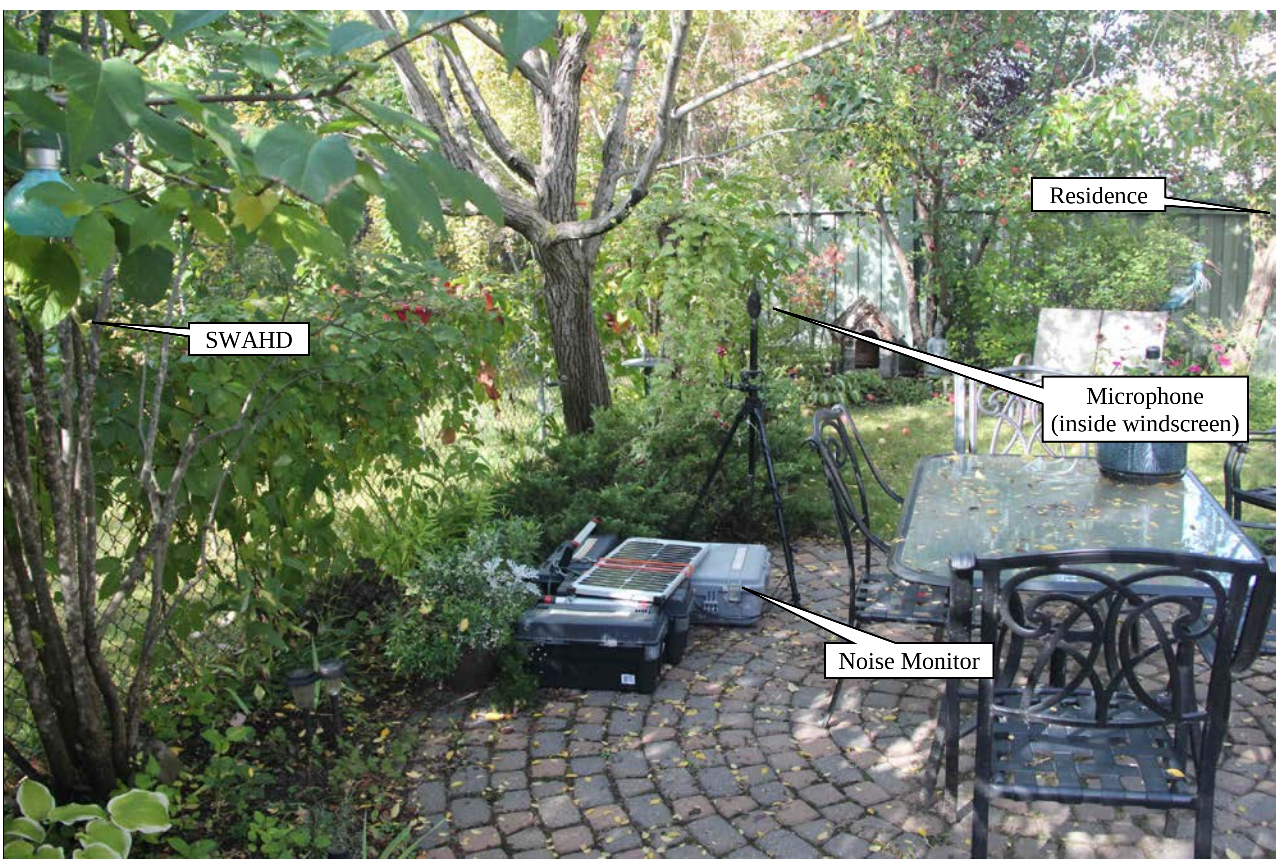

Figure 3. Noise Monitor at Location M6b

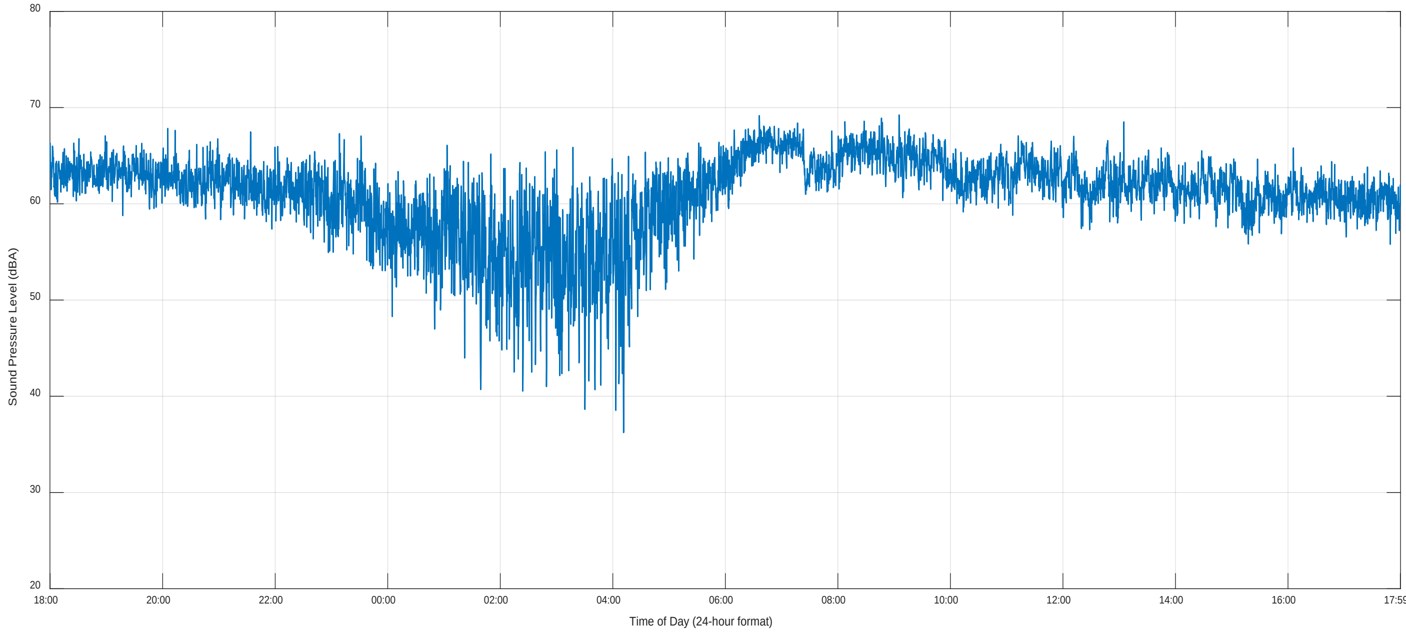

Figure 4. 24-Hour L_{eq} Sound Levels at Monitor Location M6 (October 05 – 06, 2016)

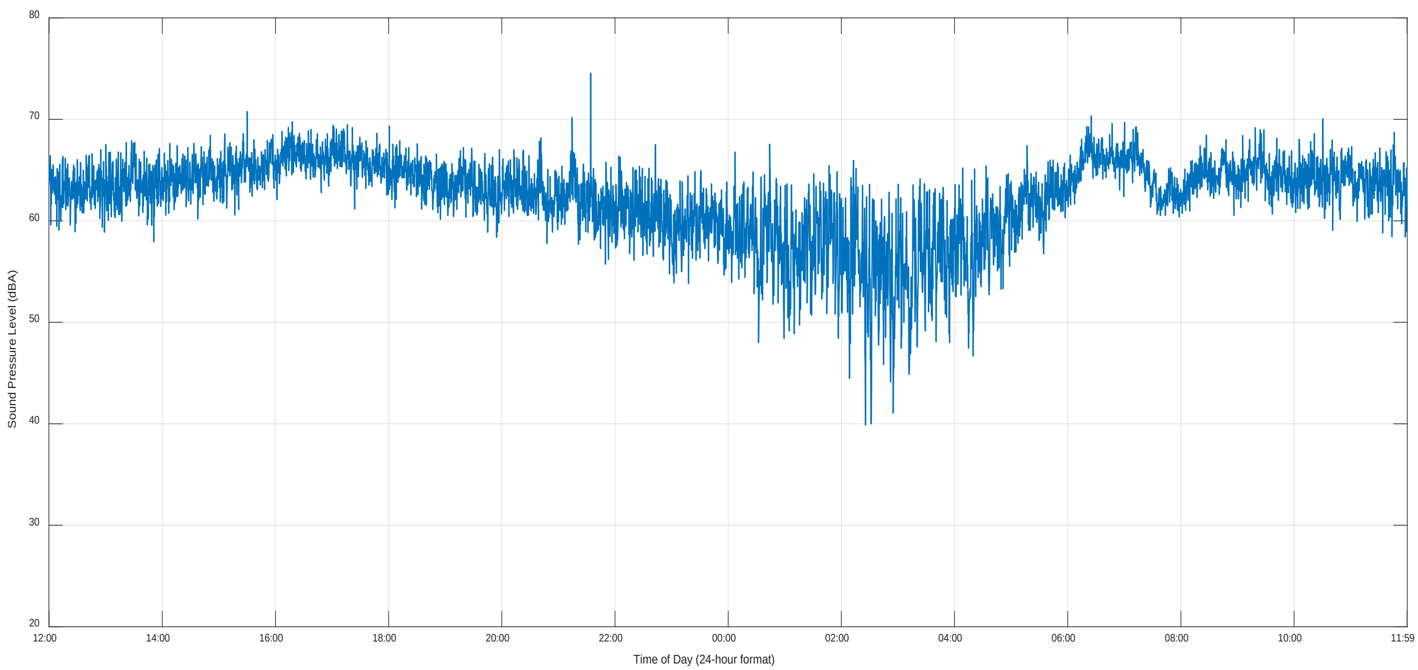

Figure 5. 24-Hour L_{eq} Sound Levels at Monitor Location M6 (October 11 – 12, 2016)

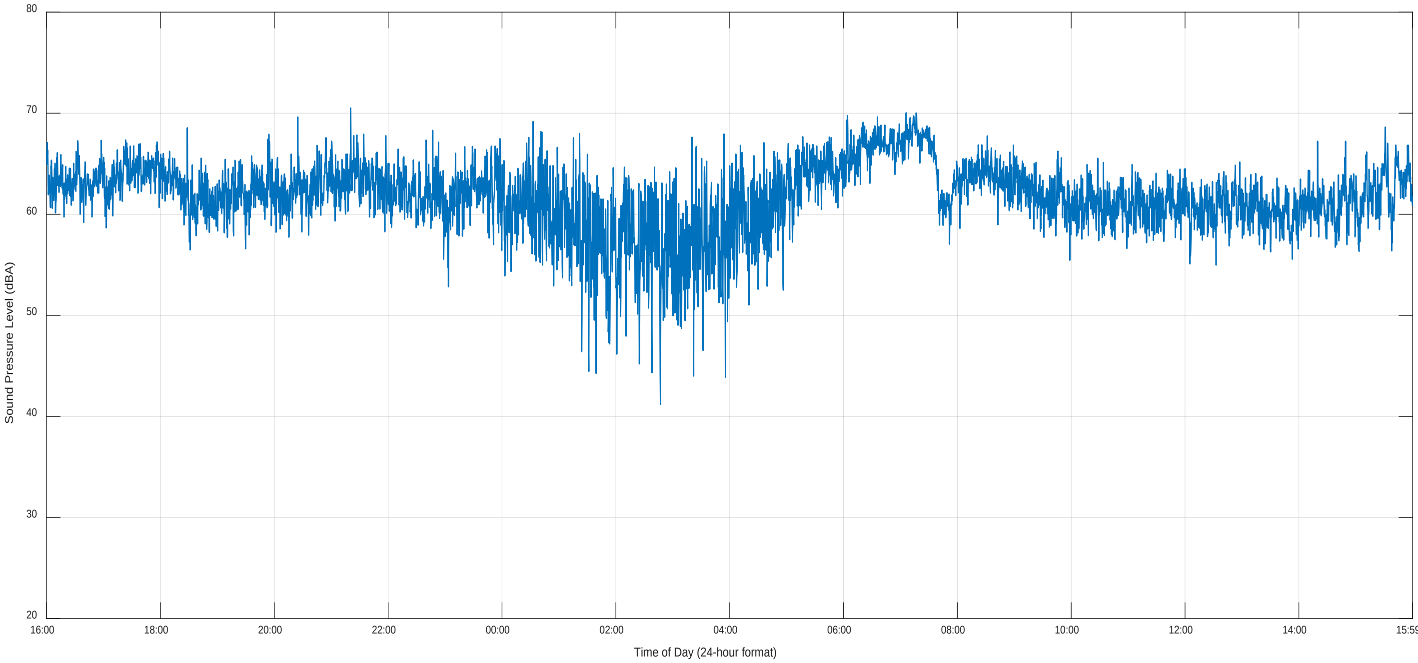

Figure 6. 24-Hour L_{eq} Sound Levels at Monitor Location M6 (May 03 – 04, 2017)

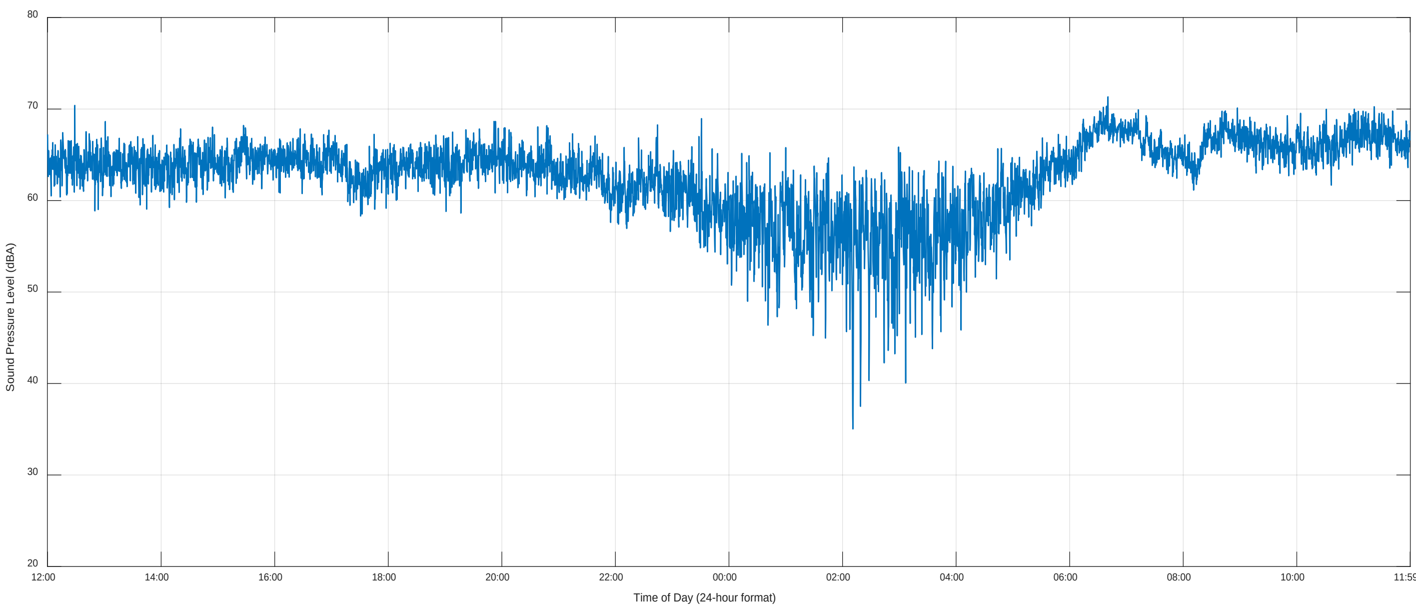

Figure 7. 24-Hour L_{eq} Sound Levels at Monitor Location M6 (September 25 – 26, 2017)

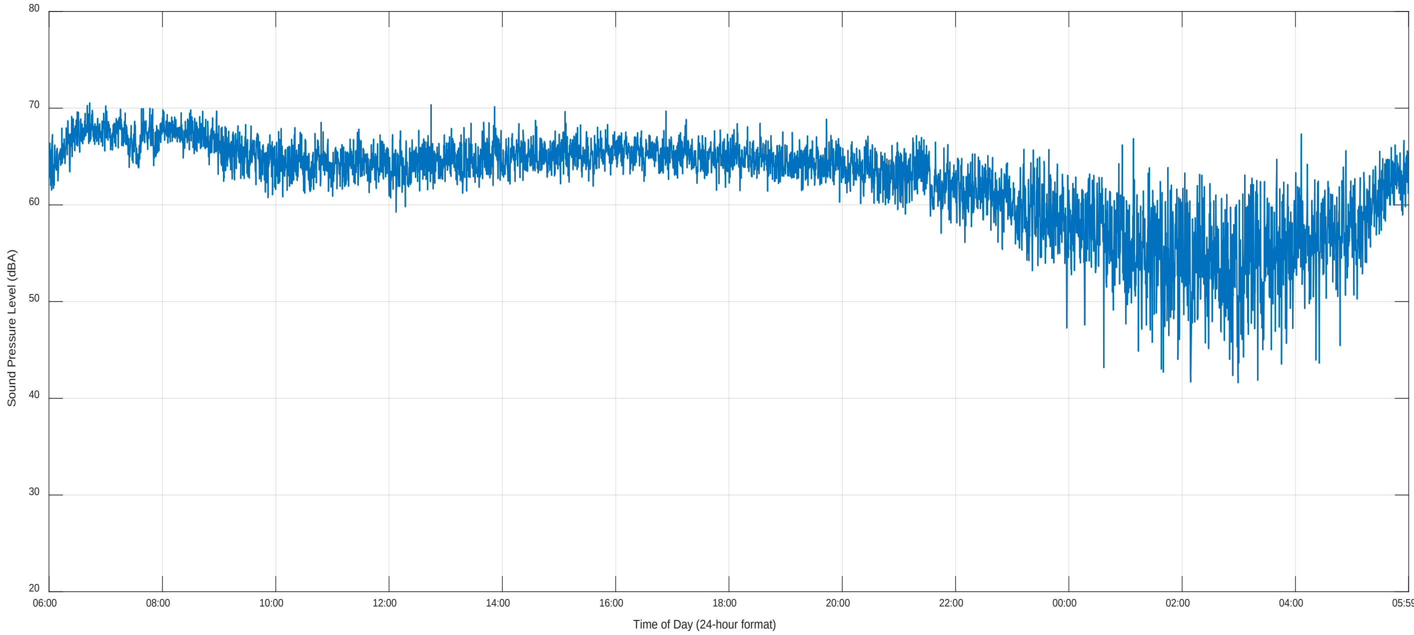

Figure 8. 24-Hour L_{eq} Sound Levels at Monitor Location M6 (September 28 – 29, 2017)

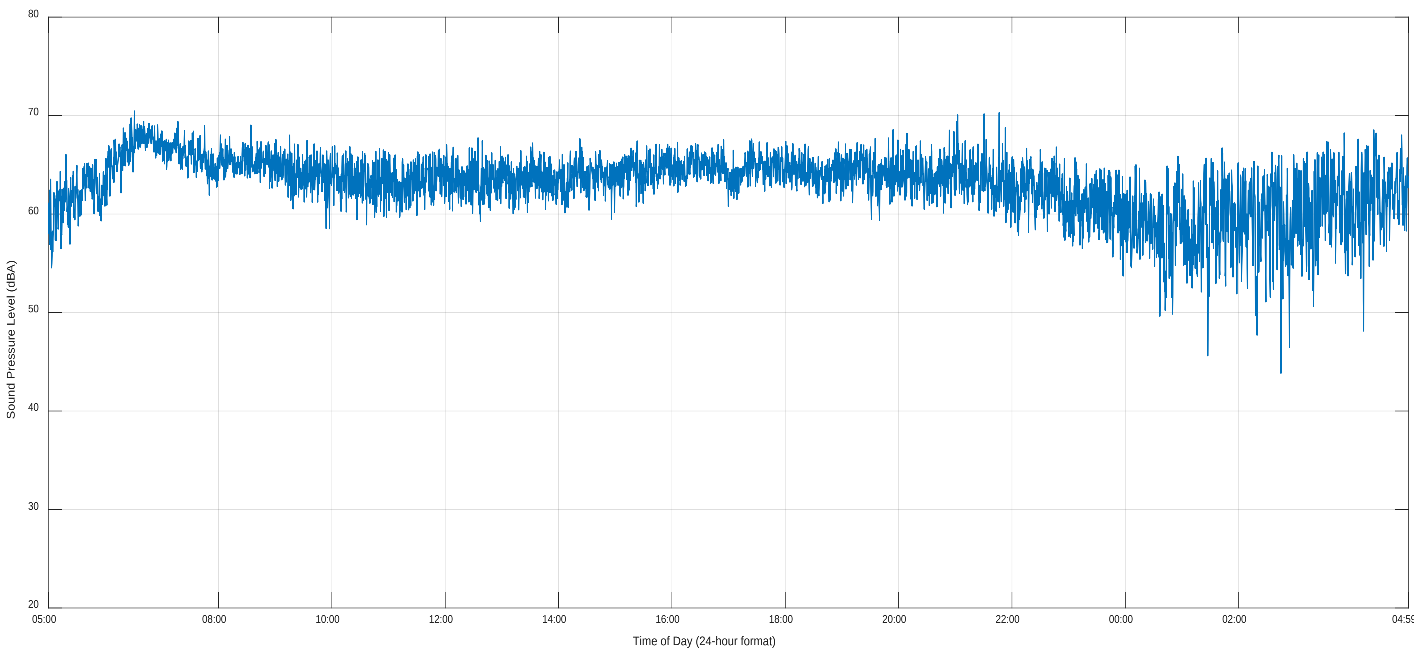

Figure 9. 24-Hour L_{eq} Sound Levels at Monitor Location M6 (October 03 – 04, 2017)

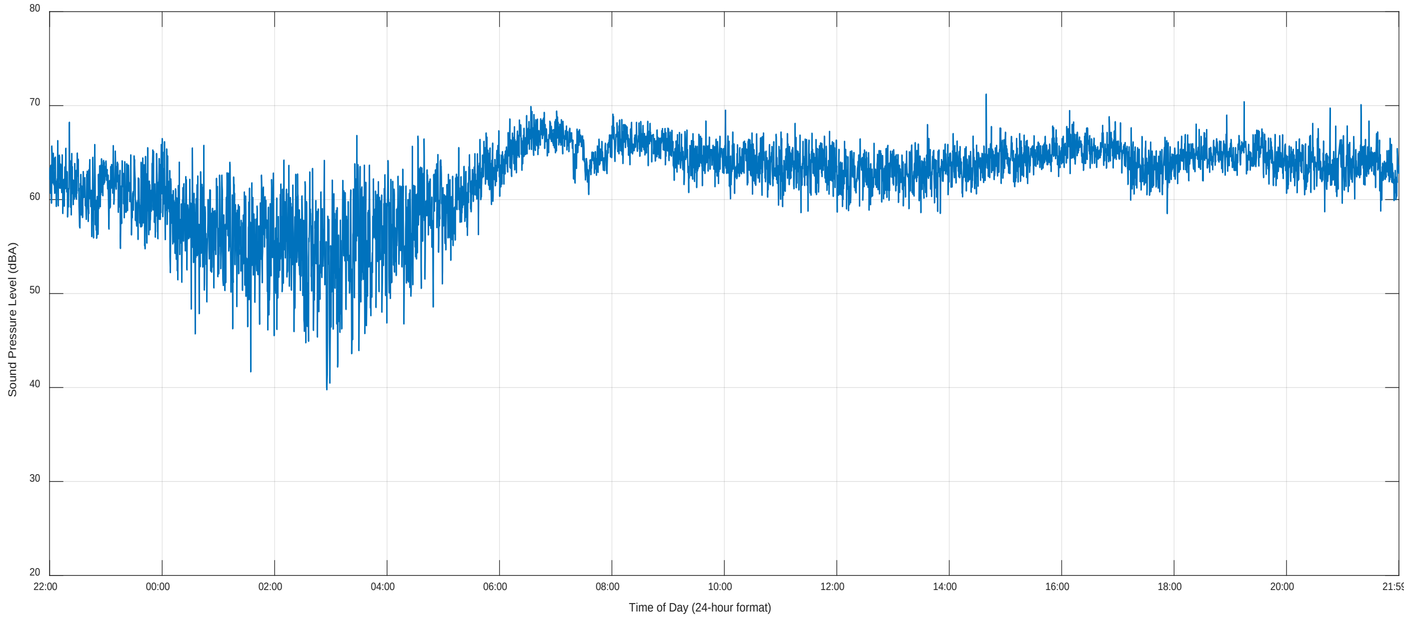

Figure 10. 24-Hour L_{eq} Sound Levels at Monitor Location M6 (October 04 – 05, 2017)

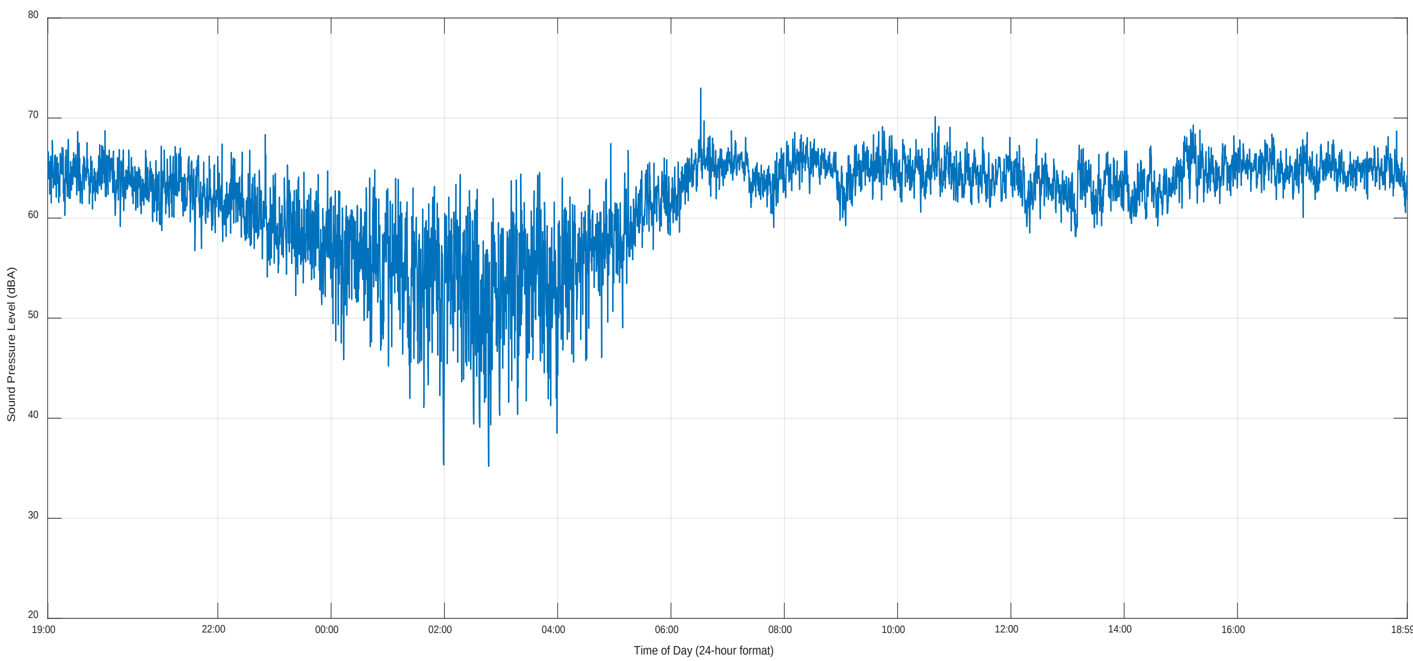

Figure 11. 24-Hour L_{eq} Sound Levels at Monitor Location M6 (October 11 – 12, 2017)

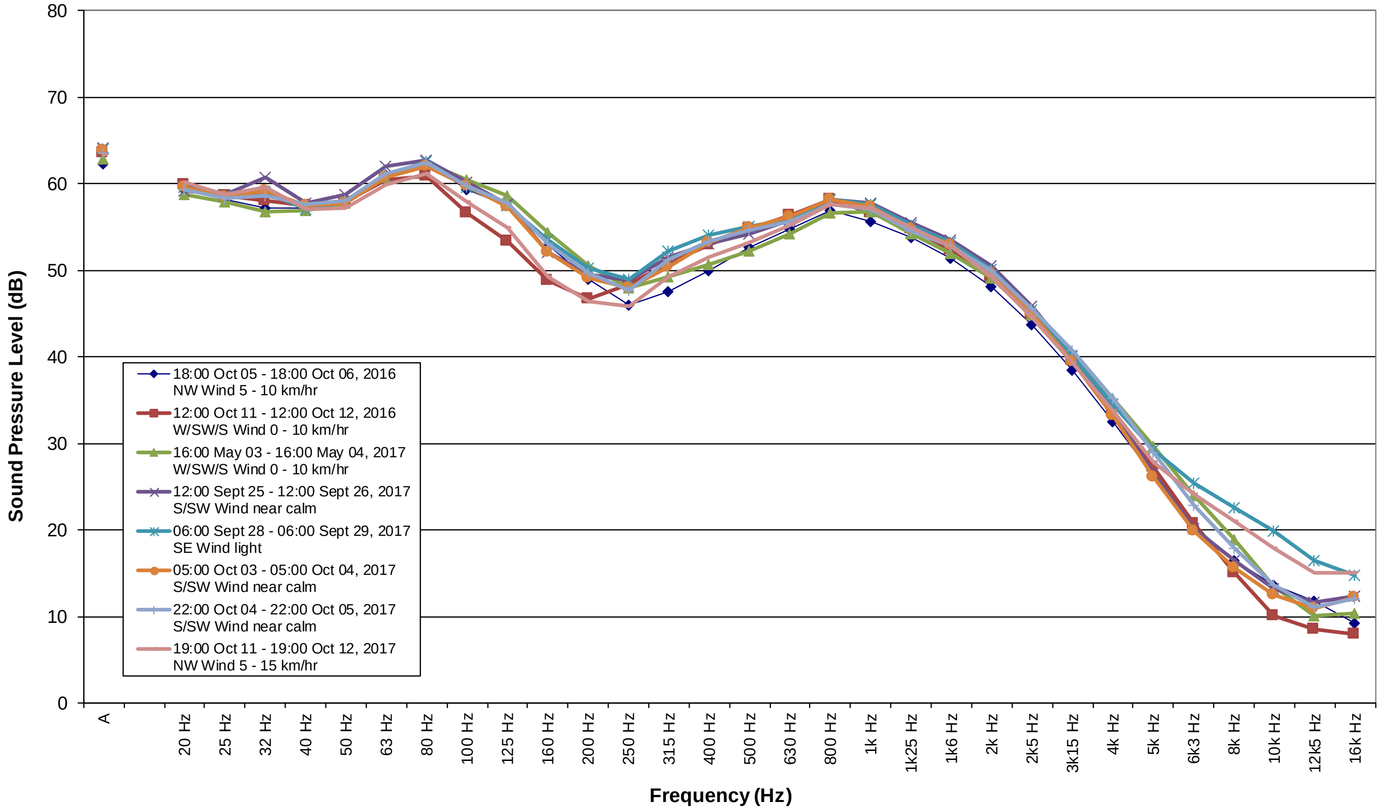

Figure 12. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location M6

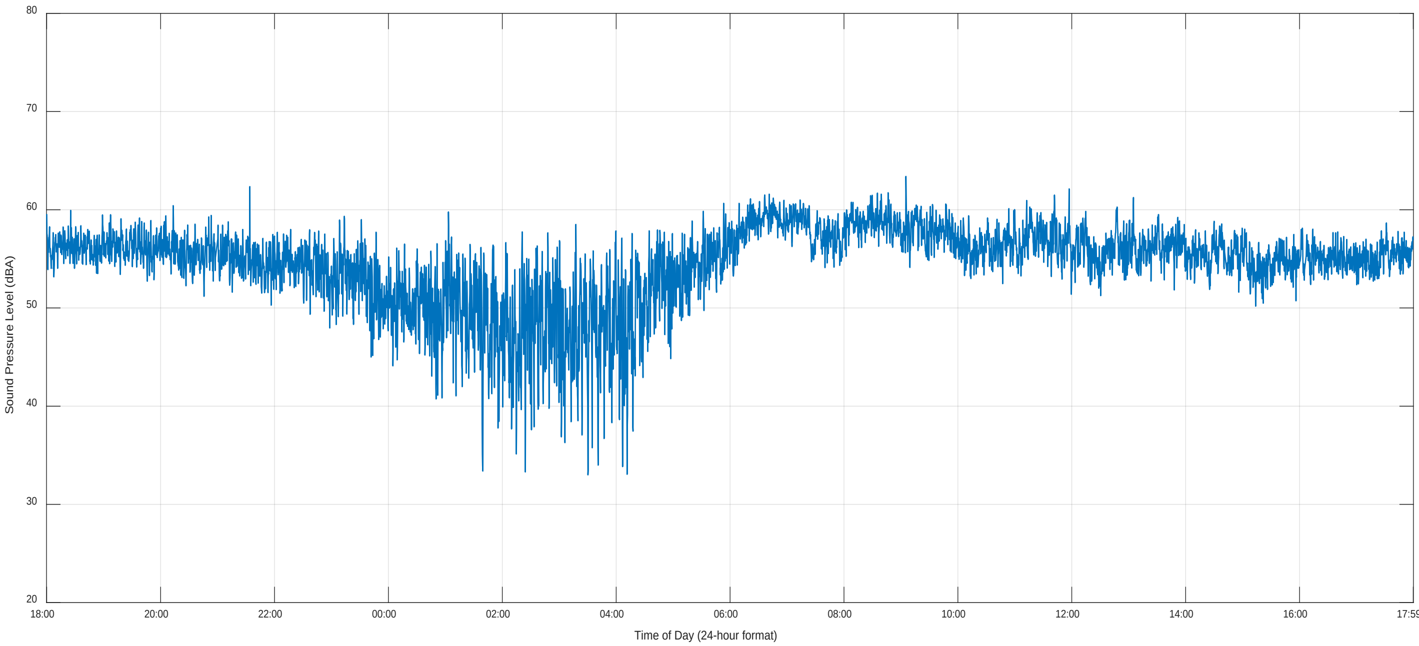

Figure 13. 24-Hour L_{eq} Sound Levels at Monitor Location M6b (October 05 – 06, 2016)

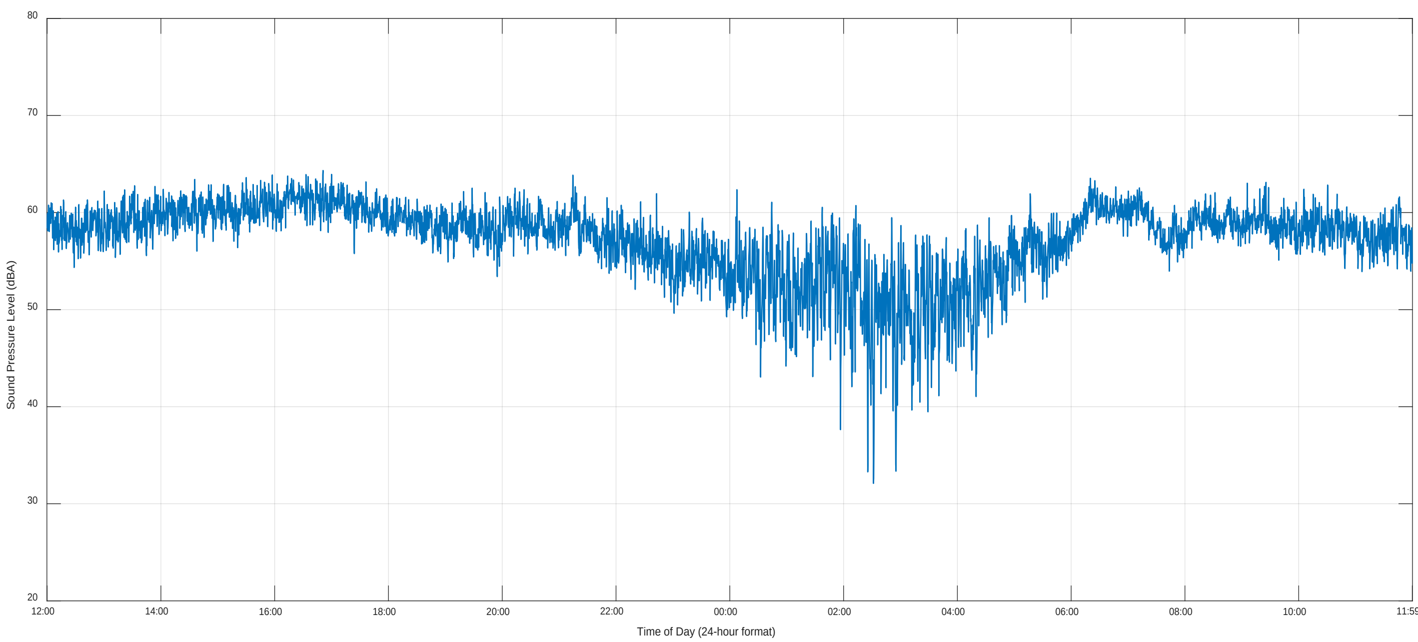

Figure 14. 24-Hour L_{eq} Sound Levels at Monitor Location M6b (October 11 – 12, 2016)

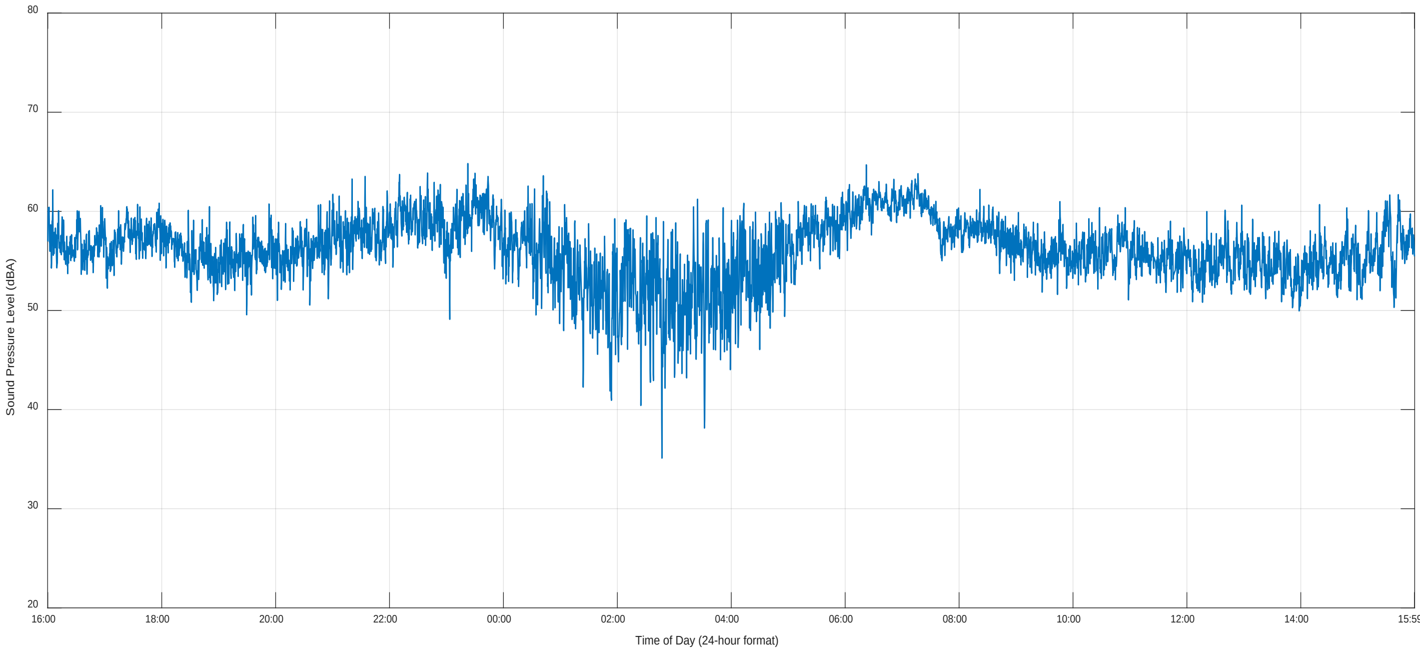

Figure 15. 24-Hour L_{eq} Sound Levels at Monitor Location M6b (May 03 – 04, 2017)

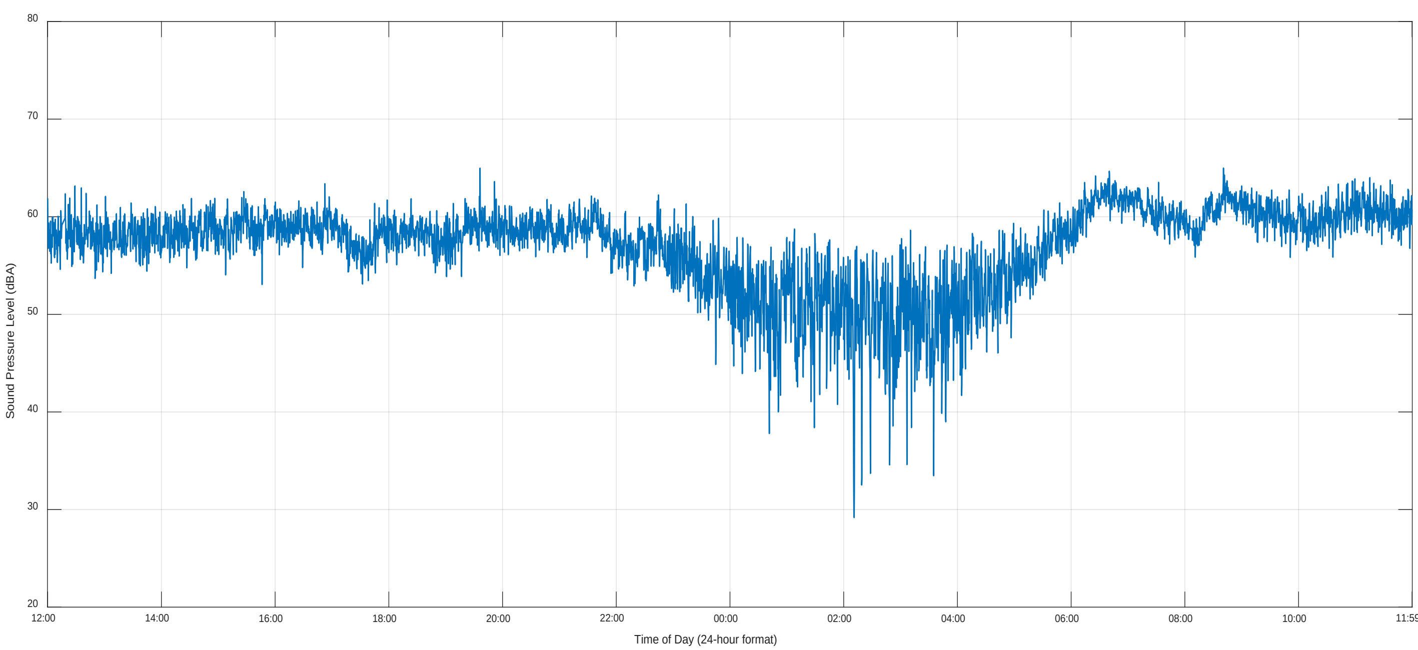

Figure 16. 24-Hour L_{eq} Sound Levels at Monitor Location M6b (September 25 – 26, 2017)

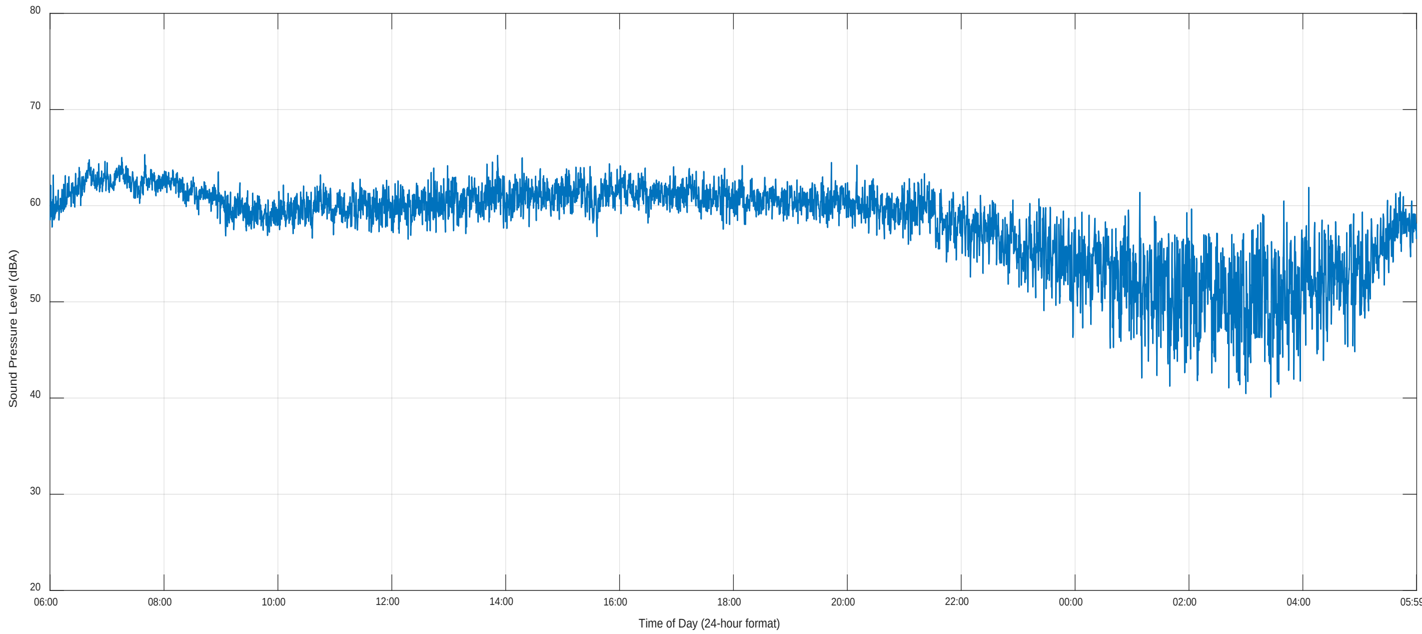

Figure 17. 24-Hour L_{eq} Sound Levels at Monitor Location M6b (September 28 – 29, 2017)

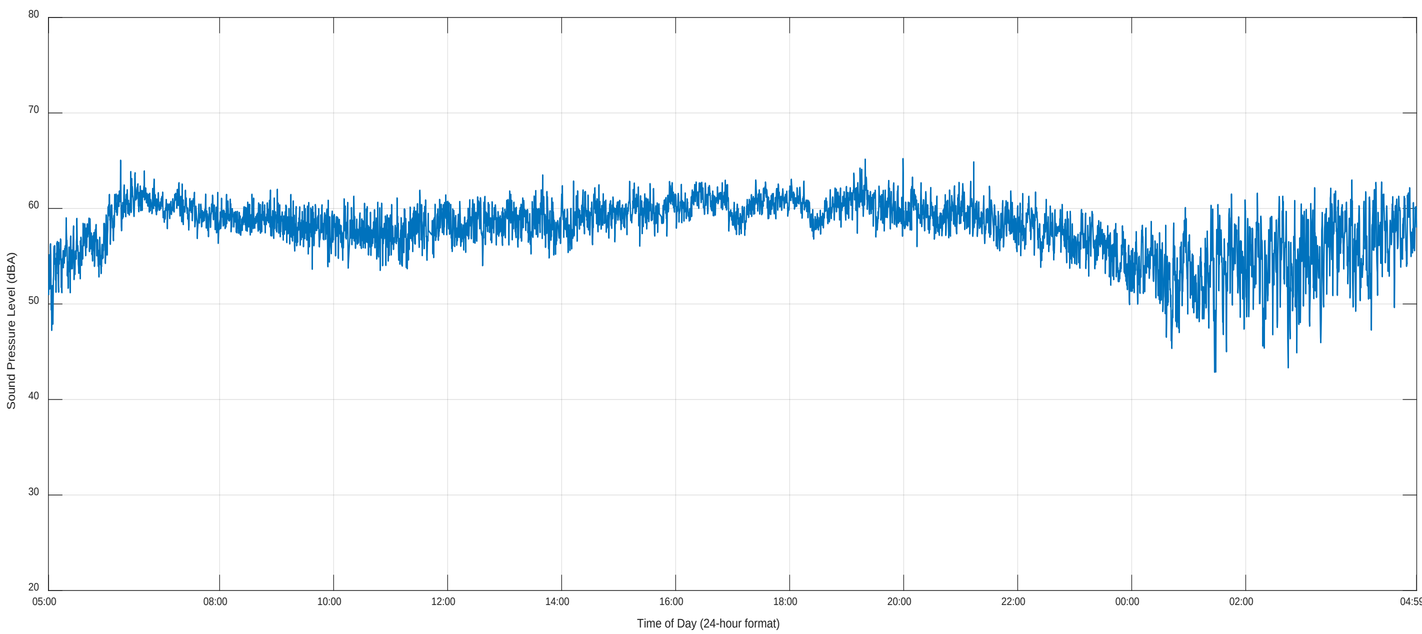

Figure 18. 24-Hour L_{eq} Sound Levels at Monitor Location M6b (October 03 – 04, 2017)

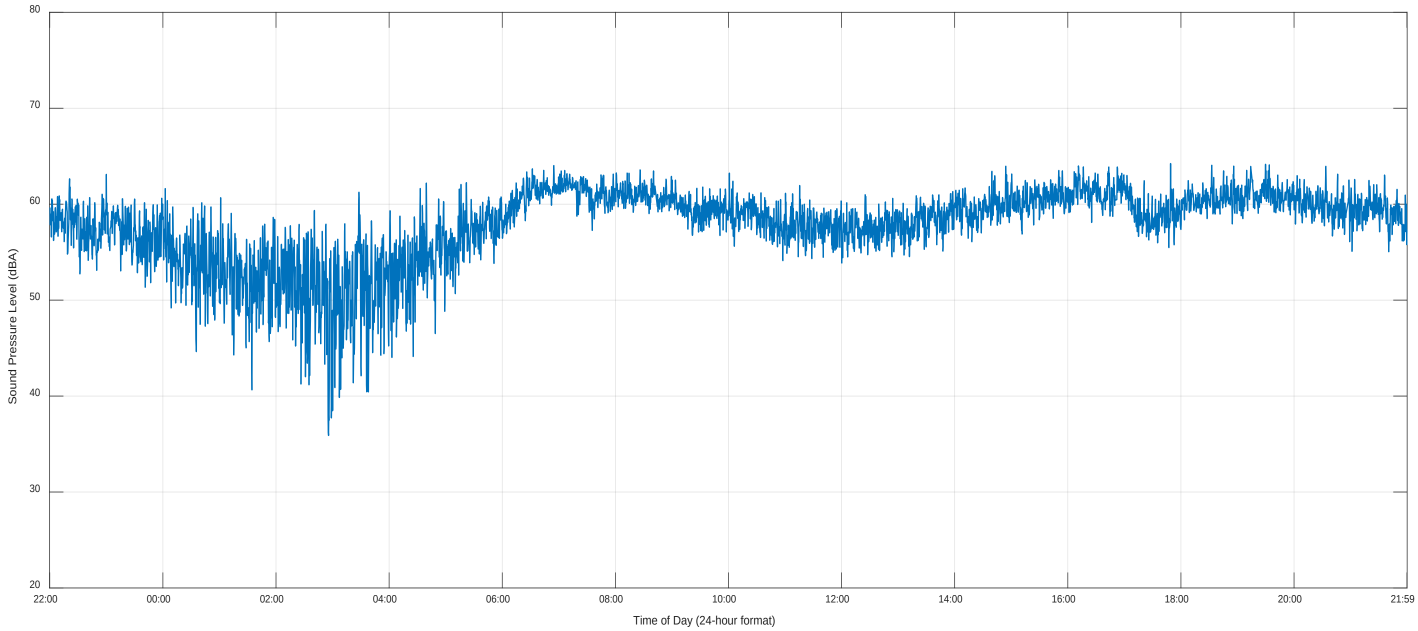

Figure 19. 24-Hour L_{eq} Sound Levels at Monitor Location M6b (October 04 – 05, 2017)

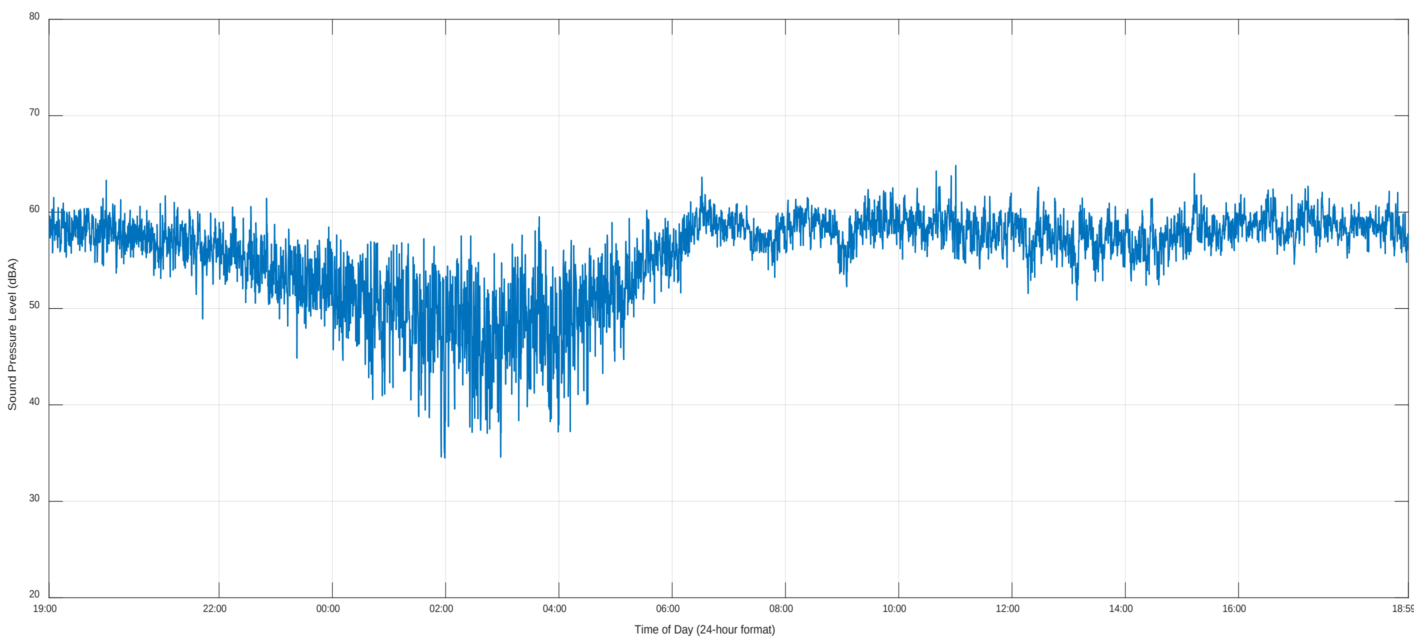

Figure 20. 24-Hour L_{eq} Sound Levels at Monitor Location M6b (October 11 – 12, 2017)

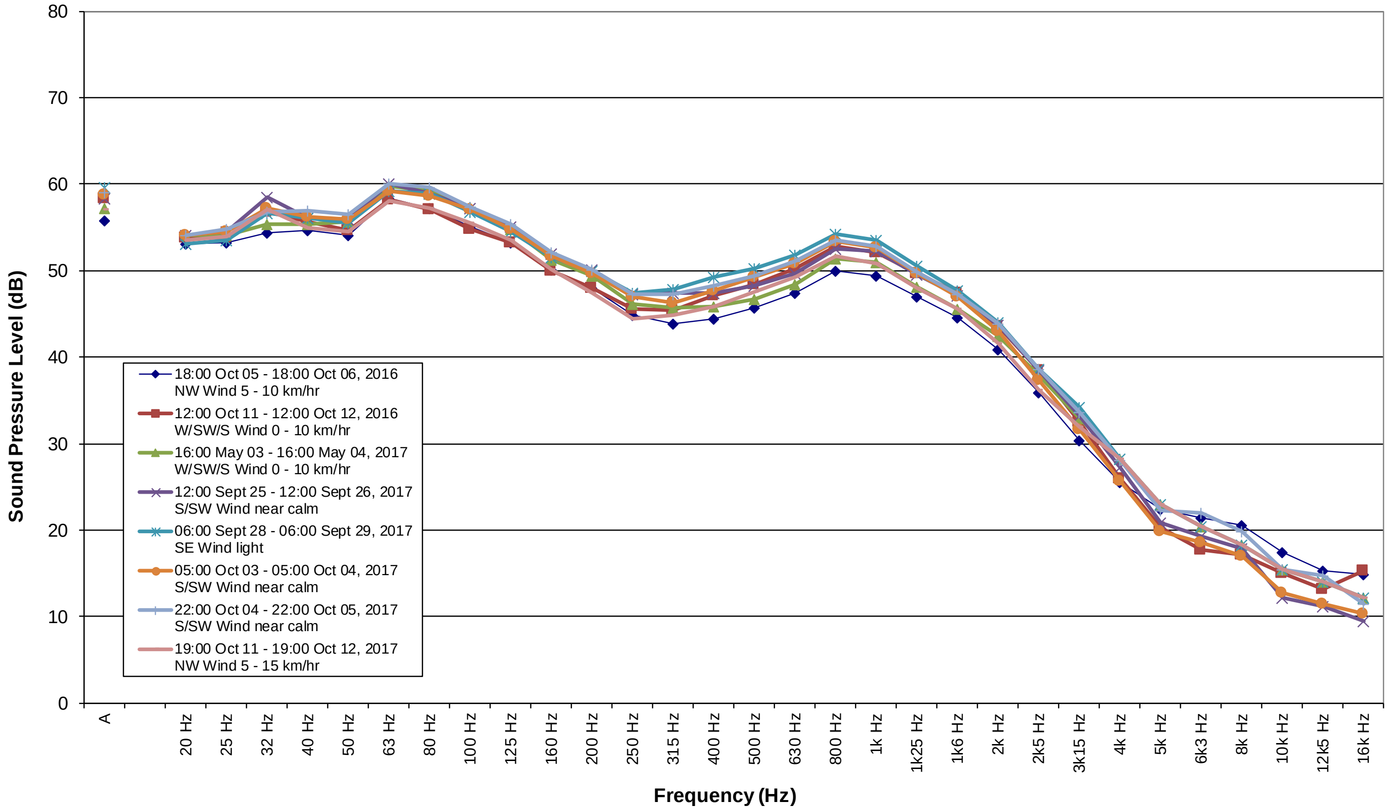

Figure 21. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location M6b

Appendix I. MEASUREMENT EQUIPMENT USED

Noise Monitors

The environmental noise monitoring equipment used consisted of Brüel and Kjær Type 2250 Precision Integrating Sound Level Meters enclosed in environmental cases, with tripods, and weather protective microphone hoods. The systems acquired data in 15-second L_{eq} samples using 1/3 octave band frequency analysis and overall A-weighted and C-weighted sound levels. The sound level meters conform to Type 1, ANSI S1.4, ANSI S1.43, IEC 61672-1, IEC 60651, IEC 60804 and DIN 45657. The 1/3 octave filters conform to S1.11 – Type 0-C, and IEC 61260 – Class 0. The calibrator conforms to IEC 942 and ANSI S1.40. The sound level meters, pre-amplifiers and microphones were certified on November 10, 2016 and May 09, 2017 and the calibrator (type B&K 4231) was certified on January 18, 2017 by a NIST NVLAP Accredited Calibration Laboratory for all requirements of ISO 17025: 1999 and relevant requirements of ISO 9002:1994, ISO 9001:2000 and ANSI/NCSL Z540: 1994 Part 1. Simultaneous digital audio was recorded directly on the sound level meter using a 8 kHz sample rate for more detailed post-processing analysis. Refer to the next section in the Appendix for a detailed description of the various acoustical descriptive terms used.

Weather Monitor

The weather monitoring equipment used for the study consisted of an Orion Weather Station 9510-A-1 with a WXT520 Self-Aspirating Radiation Shield Sensor Unit, a Weather MicroServer 9590 Data-logger, and a Lightning Arrestor. The Data-logger and batteries were located in a grounded, weather protective case. The Sensor Unit was mounted on a sturdy survey tripod (with supporting guy-wires) at approximately 5.0 m above ground. The system was set up to record data in 1-minute samples obtaining the wind-speed, peak wind-speed, and wind-direction in a rolling 2-minute average as well as the 1-minute temperature, relative humidity, barometric pressure, rain rate and total rain accumulation.

Record of Calibration Results

Description	Date	Time	Pre / Post	Calibration Level	Calibrator Model	Serial Number
M6	September 23 2017	11:00	Pre	93.9 dBA	B&K 4231	2594693
M6	October 19 2017	14:10	Post	93.8 dBA	B&K 4231	2594693
M6B	September 23 2017	12:00	Pre	93.9 dBA	B&K 4231	2594693
M6B	October 19 2017	15:00	Post	93.8 dBA	B&K 4231	2594693

B&K 4231 Calibrator Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY
ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP® CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.37706

Instrument: **Acoustical Calibrator**
Model: **4231**
Manufacturer: **Brüel and Kjær**
Serial number: **2594693**
Class (IEC 60942): **1**
Barometer type:
Barometer s/n:

Date Calibrated: **1/18/2017** *Cal Due:*

Status:	Received	Sent
In tolerance:	X	X
Out of tolerance:		
See comments:		

Contains non-accredited tests: __Yes _X_ No

Customer: **ACI Acoustical Consultants Inc.**
Tel/Fax: **780-414-6373 / -6376**
Address: **5031 - 210 Street, Edmonton, Alberta, CANADA T6M 0A8**

Tested in accordance with the following procedures and standards:
Calibration of Acoustical Calibrators, Scantek Inc., Rev. 10/1/2010

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31061	Jul 27, 2016	Scantek, Inc./ NVLAP	Jul 27, 2017
DS-360-SRS	Function Generator	88077	Sep 15, 2016	ACR Env./ A2LA	Sep 15, 2018
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Sep 15, 2016	ACR Env./ A2LA	Sep 15, 2017
HM30-Thommen	Meteo Station	1040170/39633	Nov 1, 2016	ACR Env./ A2LA	Nov 1, 2017
140-Norsonic	Real Time Analyzer	1403978	Mar 17, 2016	Scantek, Inc. / NVLAP	Mar 17, 2017
PC Program 1018 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
4192-Brüel&Kjær	Microphone	2854675	Nov 11, 2016	Scantek, Inc. / NVLAP	Nov 11, 2017
1203-Norsonic	Preamplifier	92268	Oct 17, 2016	Scantek, Inc./ NVLAP	Oct 17, 2017

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK)

Calibrated by:	Jeremy Gotwalt	**Authorized signatory:**	Steven E. Marshall
Signature	[signature]	Signature	Steven E Marshall
Date	1/18/17	Date	1/20/2017

Document stored as: Z:\Calibration Lab\Cal 2017\BNK4231_2594693_M1.doc Page 1 of 2

B&K 2250 Unit #6 SLM Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP® CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.37313

Instrument: **Sound Level Meter**
Model: **2250**
Manufacturer: **Brüel and Kjær**
Serial number: **2661161**
Tested with: **Microphone 4189 s/n 2650730**
Preamplifier ZC0032 s/n 9935
Type (class): **1**
Customer: **ACI Acoustical Consultants Inc.**
Tel/Fax: **780-414-6373 / -6376**

Date Calibrated: **11/10/2016** *Cal Due:*

Status:	**Received**	**Sent**
In tolerance:	X	X
Out of tolerance:		
See comments:		

Contains non-accredited tests: __Yes X No
Calibration service: __ Basic X Standard
Address: **5031 - 210 Street**
Edmonton, Alberta, CANADA
T6M 0A8

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., Rev. 6/26/2015
SLM & Dosimeters – Acoustical Tests, Scantek Inc., Rev. 7/6/2011

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31061	Jul 27, 2016	Scantek, Inc./ NVLAP	Jul 27, 2017
DS-360-SRS	Function Generator	88077	Sep 15, 2016	ACR Env./ A2LA	Sep 15, 2018
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Sep 15, 2016	ACR Env./ A2LA	Sep 15, 2017
HM30-Thommen	Meteo Station	1040170/39633	Nov 1, 2016	ACR Env./ A2LA	Nov 1, 2017
PC Program 1019 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1251-Norsonic	Calibrator	30878	Nov 10, 2016	Scantek, Inc./ NVLAP	Nov 10, 2017

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK).

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
22.1	100.26	38.2

Calibrated by:	Jeremy Gotwalt	**Authorized signatory:**	Valentin Buzduga
Signature	[signature]	Signature	[signature]
Date	11/10/16	Date	11/14/2016

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B&K 2250 Unit #6 Microphone Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP®
CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.37314

Instrument: **Microphone**
Model: **4189**
Manufacturer: **Brüel & Kjær**
Serial number: **2650730**
Composed of:

Date Calibrated: **11/10/2016** *Cal Due:*

Status:	Received	Sent
In tolerance:	X	X
Out of tolerance:		
See comments:		

Contains non-accredited tests: __Yes _X_ No

Customer: **ACI Acoustical Consultants Inc.**
Tel/Fax: **780-414-6373/-6376**
Address: **5031 - 210 Street, Edmonton, Alberta, CANADA T6M 0A8**

Tested in accordance with the following procedures and standards:
Calibration of Measurement Microphones, Scantek, Inc., Rev. 2/25/2015

Instrumentation used for calibration: N-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31061	Jul 27, 2016	Scantek, Inc./ NVLAP	Jul 27, 2017
DS-360-SRS	Function Generator	88077	Sep 15, 2016	ACR Env./ A2LA	Sep 15, 2018
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Sep 15, 2016	ACR Env./ A2LA	Sep 15, 2017
HM30-Thommen	Meteo Station	1040170/39633	Nov 1, 2016	ACR Env./ A2LA	Nov 1, 2017
PC Program 1017 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1253-Norsonic	Calibrator	28326	Nov 10, 2015	Scantek, Inc./ NVLAP	Nov 10, 2016
1203-Norsonic	Preamplifier	92268	Oct 17, 2016	Scantek, Inc./ NVLAP	Oct 17, 2017
4180-Brüel&Kjær	Microphone	2246115	Oct 26, 2015	NPL-UK / UKAS	Oct 26, 2017

Instrumentation and test results are traceable to SI - BIPM through standards maintained by NPL (UK) and NIST (USA)

Calibrated by:	Jeremy Gotwalt	Authorized signatory:	Valentin Buzduga
Signature	[signature]	Signature	[signature]
Date	11/10/16	Date	11/14/2016

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B&K 2250 Unit #10 SLM Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY
ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP®
CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.38469

Instrument: **Sound Level Meter**
Model: **2250**
Manufacturer: **Brüel and Kjær**
Serial number: **3007542**
Tested with: **Microphone 4189 s/n 2978664**
Preamplifier ZC0032 s/n 22379
Type (class): **1**
Customer: **ACI Acoustical Consultants Inc.**
Tel/Fax: **780-414-6373 / 780-414-6376**

Date Calibrated: **5/9/2017** *Cal Due:*

Status:	Received	Sent
In tolerance:	X	X
Out of tolerance:		
See comments:		

Contains non-accredited tests: __Yes _X_ No
Calibration service: __ Basic _X_ Standard
Address: **5031 - 210 Street**
Edmonton, Alberta
CANADA T6M 0A8

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., Rev. 6/26/2015
SLM & Dosimeters – Acoustical Tests, Scantek Inc., Rev. 7/6/2011

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31061	Jul 27, 2016	Scantek, Inc./ NVLAP	Jul 27, 2017
DS-360-SRS	Function Generator	88077	Sep 15, 2016	ACR Env./ A2LA	Sep 15, 2018
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Sep 15, 2016	ACR Env./ A2LA	Sep 15, 2017
HM30-Thommen	Meteo Station	1040170/39633	Nov 1, 2016	ACR Env./ A2LA	Nov 1, 2017
PC Program 1019 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1251-Norsonic	Calibrator	30878	Nov 10, 2016	Scantek, Inc./ NVLAP	Nov 10, 2017

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK).

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
22.5	100.05	43.4

Calibrated by:	Jeremy Gotwalt	**Authorized signatory:**	Steven E. Marshall
Signature	[signature]	Signature	[signature]
Date		Date	5/9/2017

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B&K 2250 Unit #10 Microphone Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY
ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP®
CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.38470

Instrument:	**Microphone**	*Date Calibrated:* **5/8/2017**	*Cal Due:*		
Model:	**4189**	*Status:*	**Received**	**Sent**
Manufacturer:	**Brüel & Kjær**	*In tolerance:*	**X**	**X**
Serial number:	**2978664**	*Out of tolerance:*		
Composed of:		*See comments:*		

Contains non-accredited tests: __Yes _X_ No

Customer: **ACI Acoustical Consultants Inc.**
Tel/Fax: **780-414-6373/780-414-6376**
Address: **5031 - 210 Street, Edmonton, Alberta, CANADA T6M 0A8**

Tested in accordance with the following procedures and standards:
Calibration of Measurement Microphones, Scantek, Inc., Rev. 2/25/2015

Instrumentation used for calibration: N-1504 Norsonic Test System:

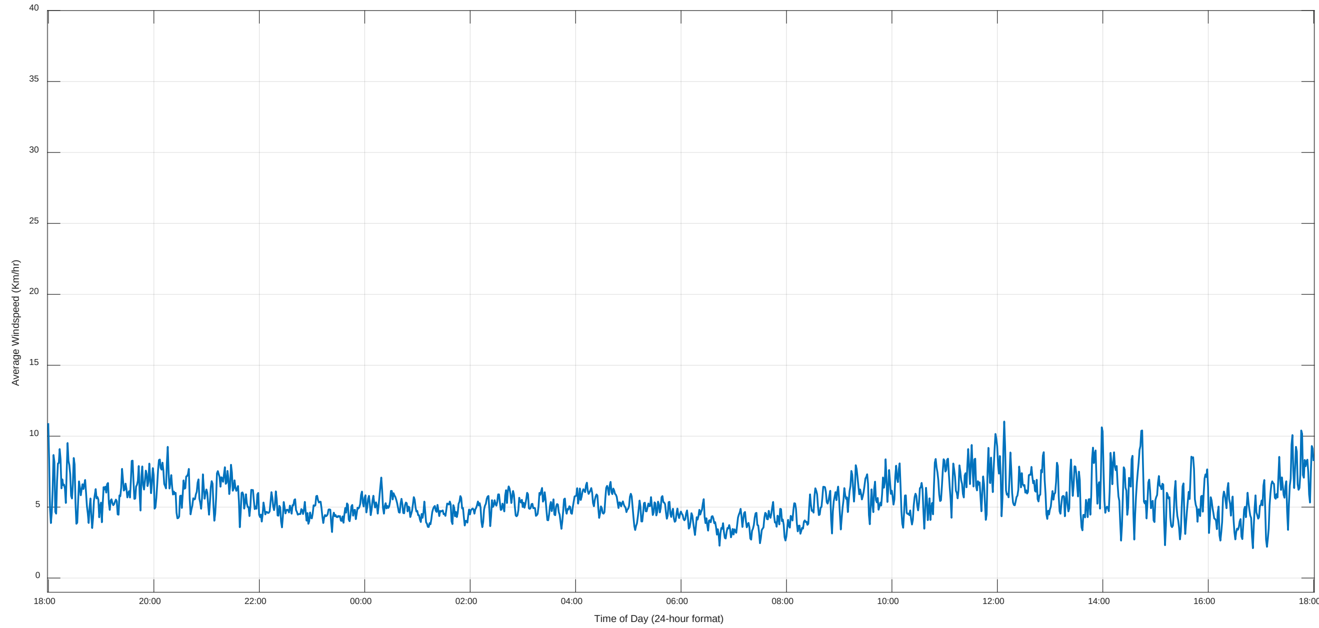
Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31061	Jul 27, 2016	Scantek, Inc./ NVLAP	Jul 27, 2017
DS-360-SRS	Function Generator	88077	Sep 15, 2016	ACR Env./ A2LA	Sep 15, 2018
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Sep 15, 2016	ACR Env./ A2LA	Sep 15, 2017
HM30-Thommen	Meteo Station	1040170/39633	Nov 1, 2016	ACR Env./ A2LA	Nov 1, 2017
PC Program 1017 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1253-Norsonic	Calibrator	28326	Nov 10, 2016	Scantek, Inc./ NVLAP	Nov 10, 2017
1203-Norsonic	Preamplifier	92268	Oct 17, 2016	Scantek, Inc./ NVLAP	Oct 17, 2017
4180-Brüel&Kjær	Microphone	2246115	Oct 26, 2015	NPL-UK / UKAS	Oct 26, 2017

Instrumentation and test results are traceable to SI - BIPM through standards maintained by NPL (UK) and NIST (USA)

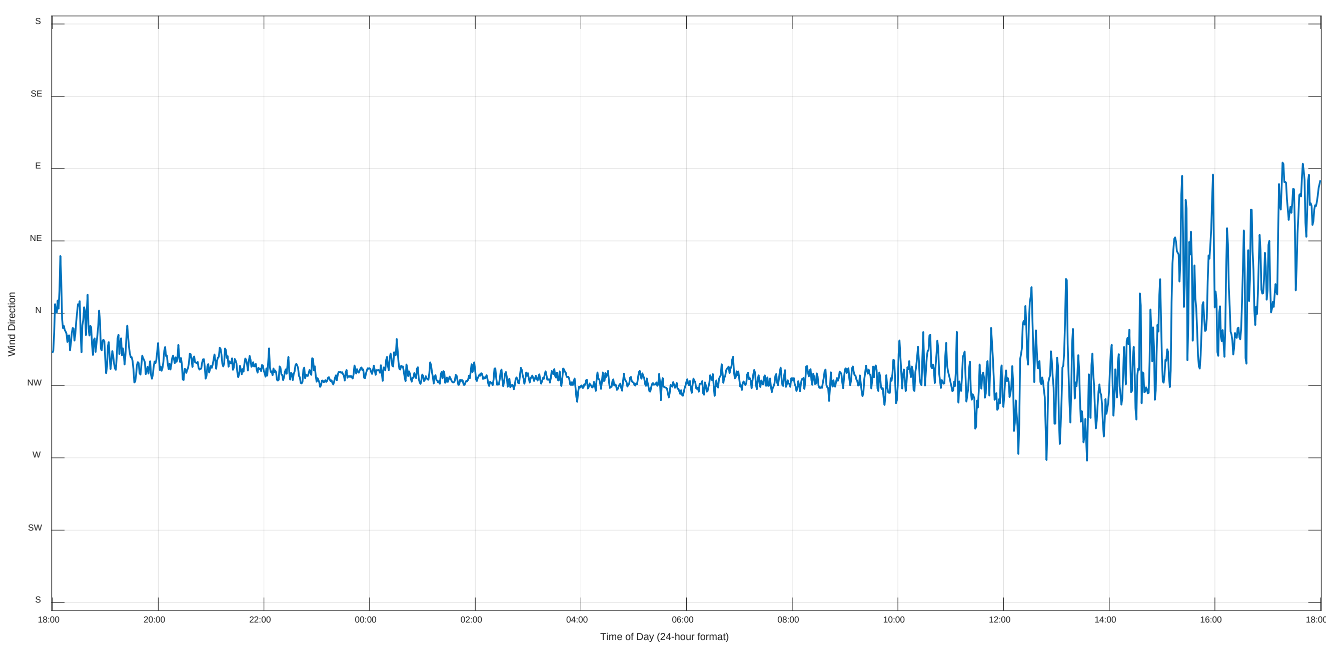
Calibrated by:	Jeremy Gotwalt	**Authorized signatory:**	Steven E. Marshall
Signature	[signature]	Signature	[signature]
Date	5/8/17	Date	5/9/2017

Calibration Certificates or Test Reports shall not be reproduced, except in full, without written approval of the laboratory.
This Calibration Certificate or Test Reports shall not be used to claim product certification, approval or endorsement by NVLAP, NIST, or any agency of the federal government.
Document stored as: Z:\Calibration Lab\Mic 2017\B&K4189_2978664_M1.doc Page 1 of 2

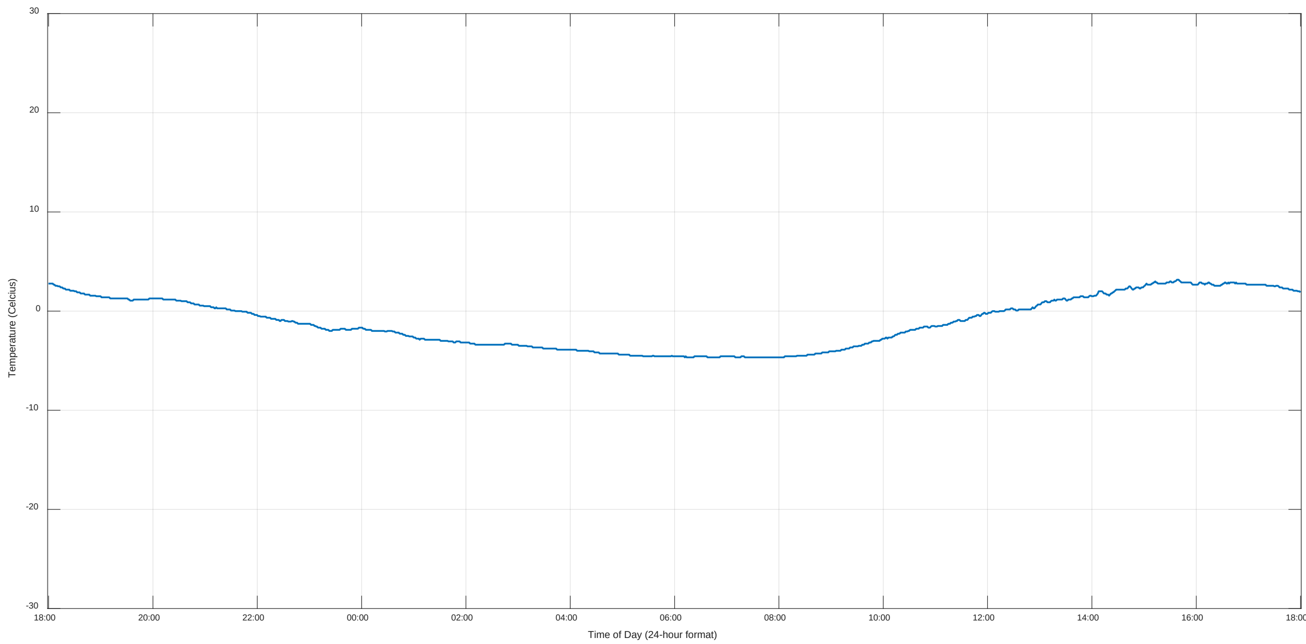
Appendix II. NOISE MONITORING WEATHER DATA



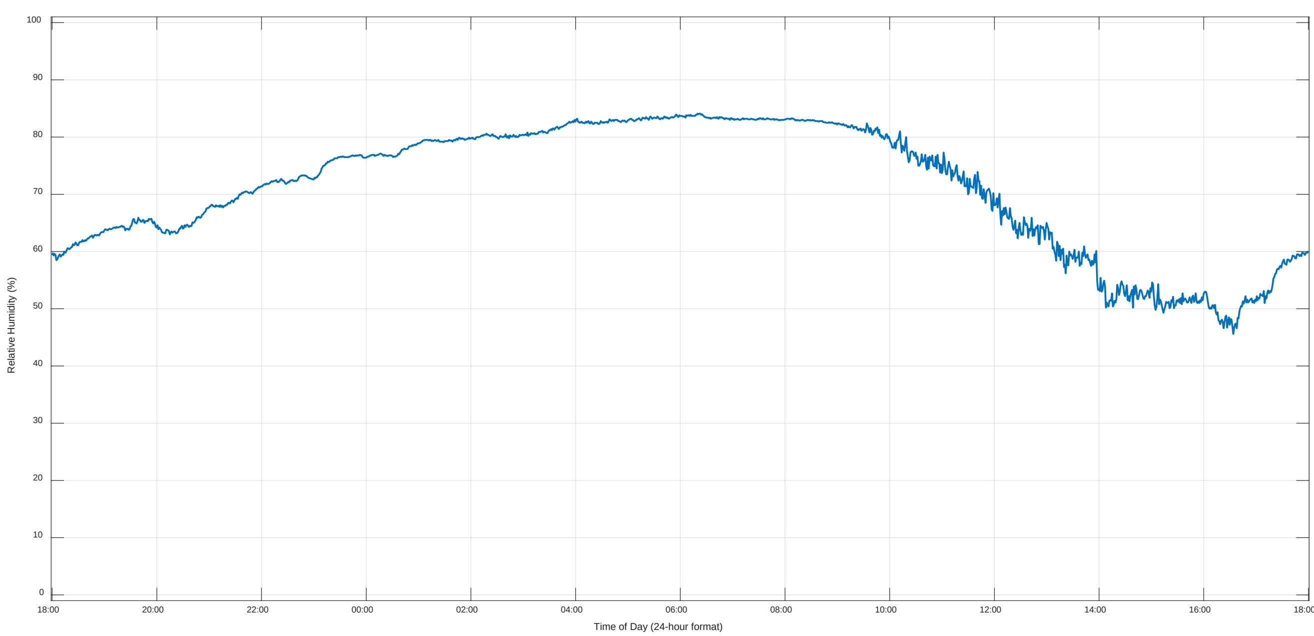
October 05 – 06, 2016 Monitored Wind Speed



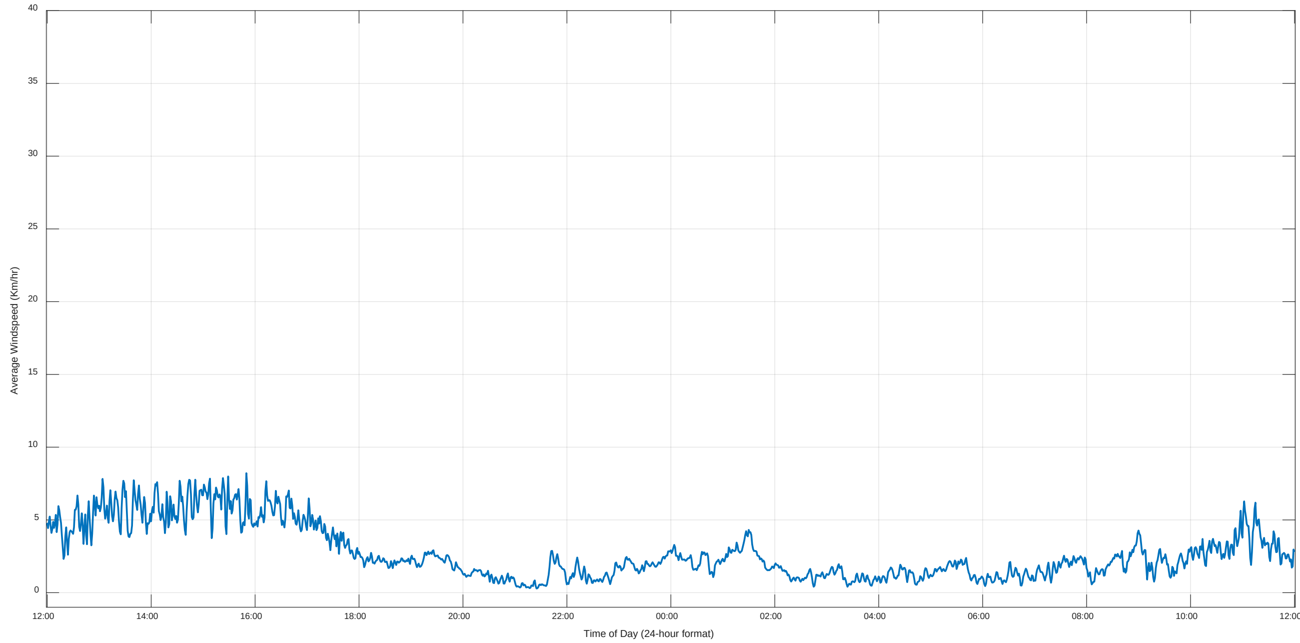
October 05 – 06, 2016 Monitored Wind Direction



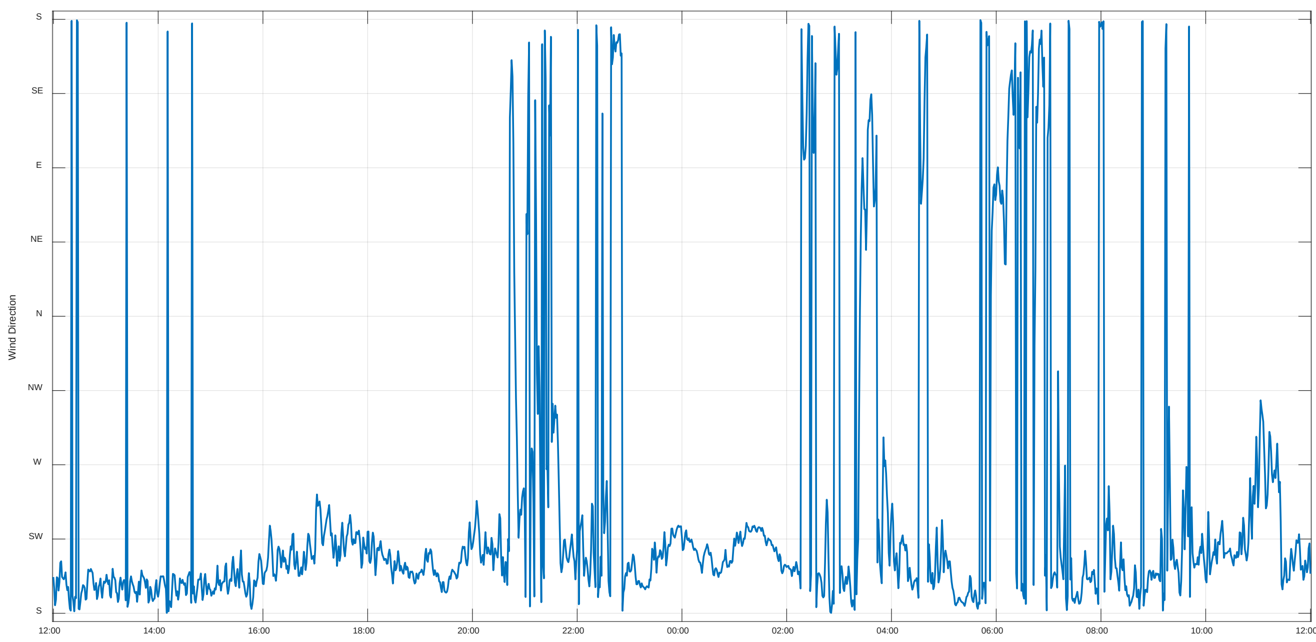
October 05 – 06, 2016 Monitored Temperature



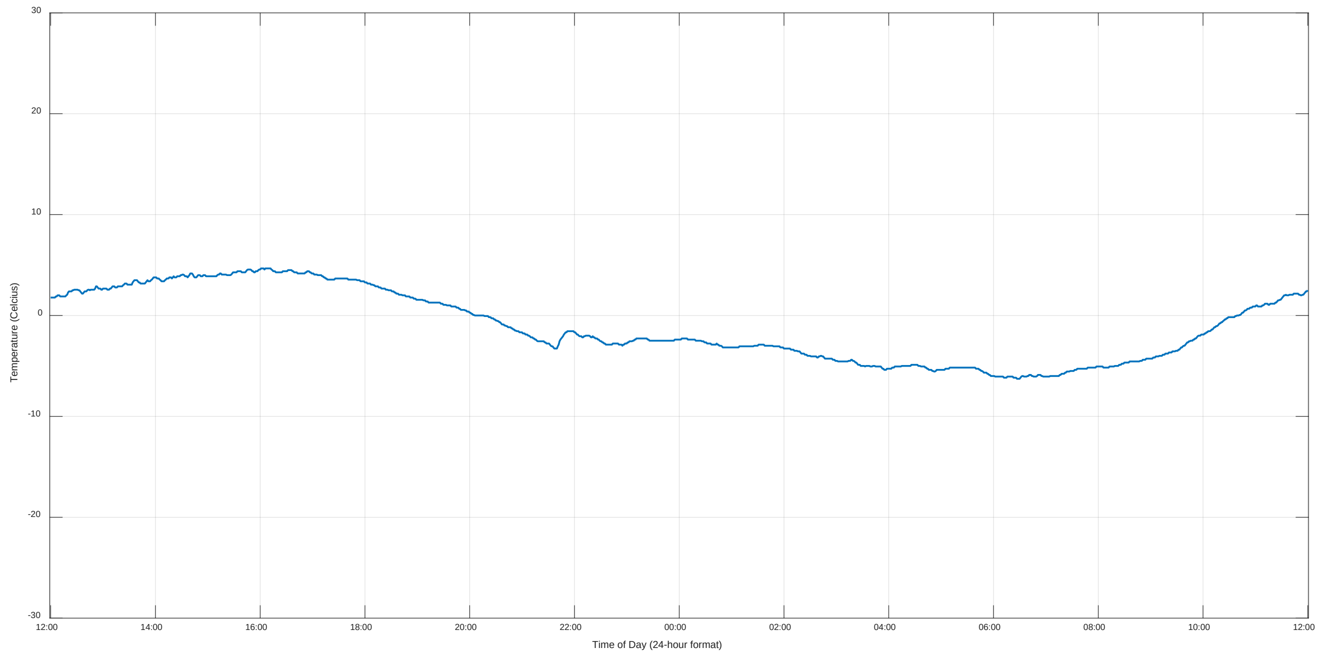
October 05 – 06, 2016 Monitored Relative Humidity



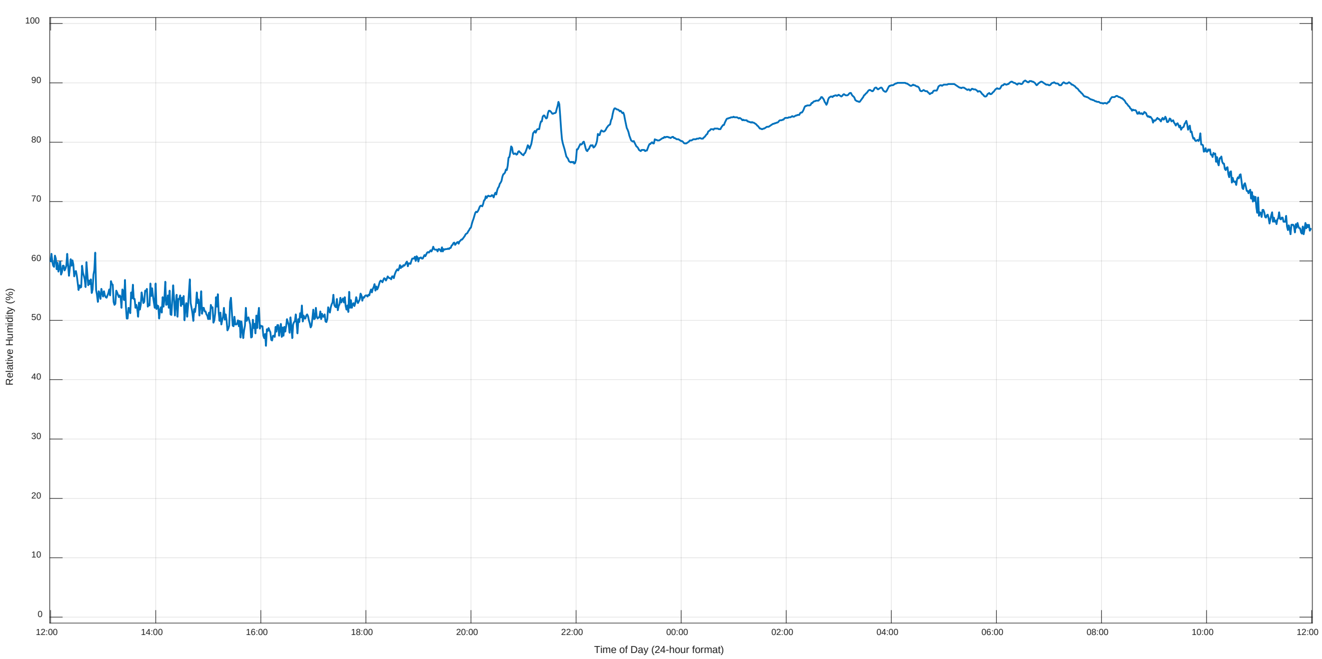
October 11 – 12, 2016 Monitored Wind Speed



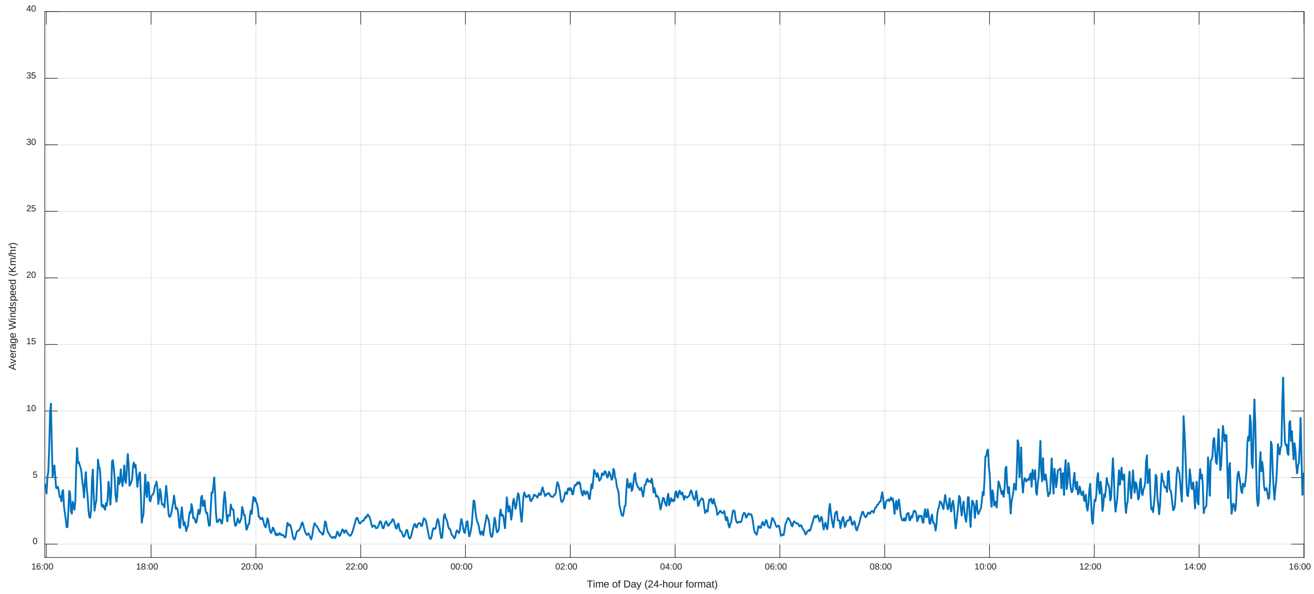
October 11 – 12, 2016 Monitored Wind Direction



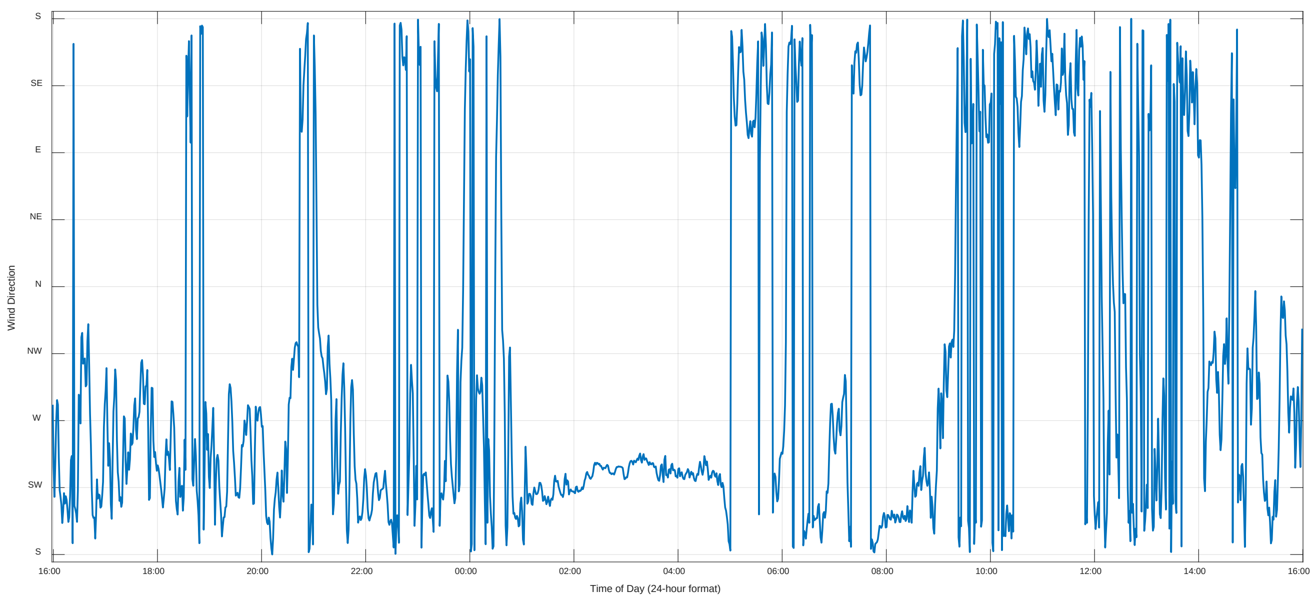
October 11 – 12, 2016 Monitored Temperature



October 11 – 12, 2016 Monitored Relative Humidity



May 03 – 04, 2017 Monitored Wind Speed



May 03 – 04, 2017 Monitored Wind Direction

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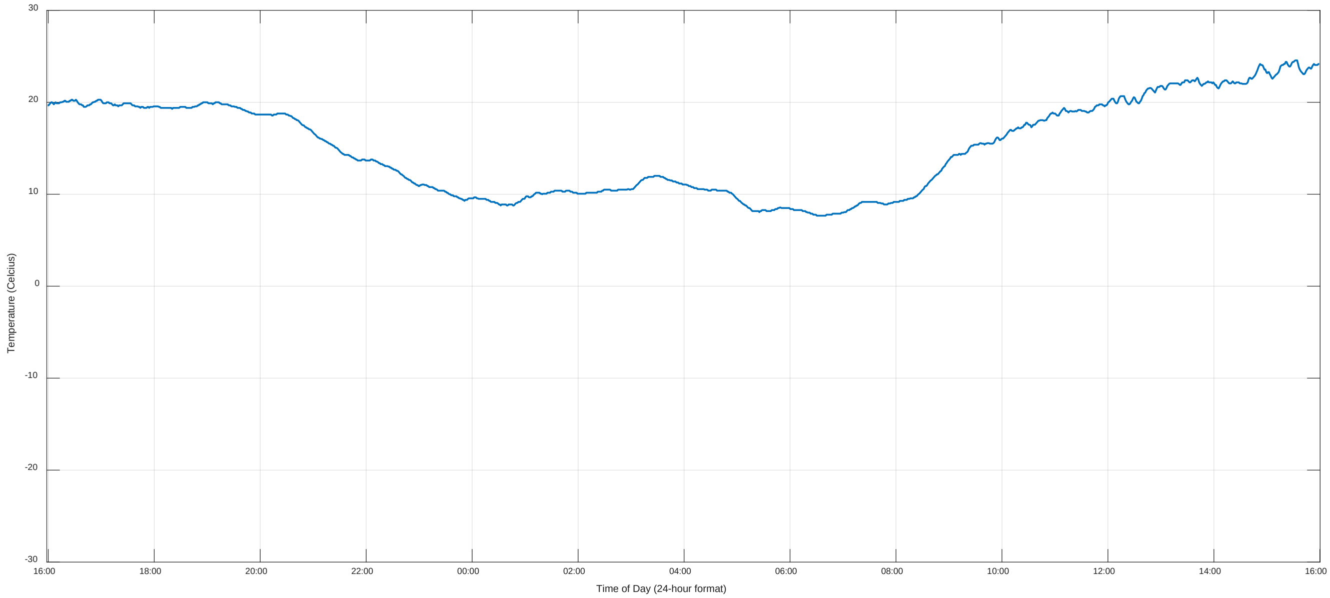
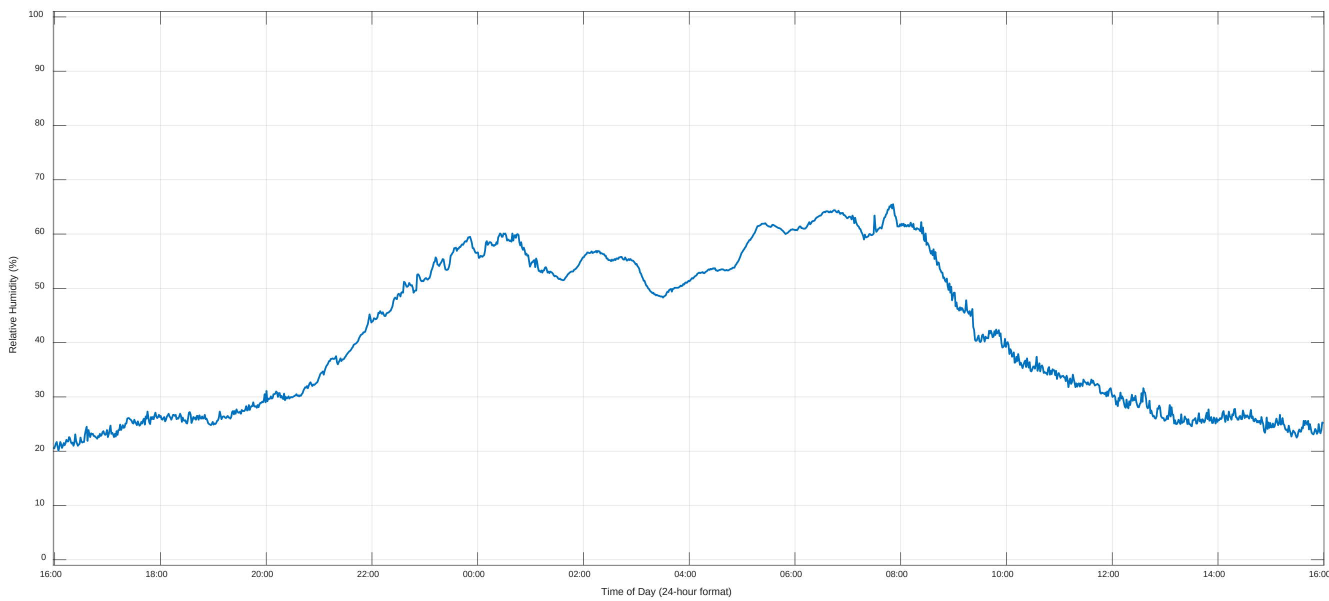
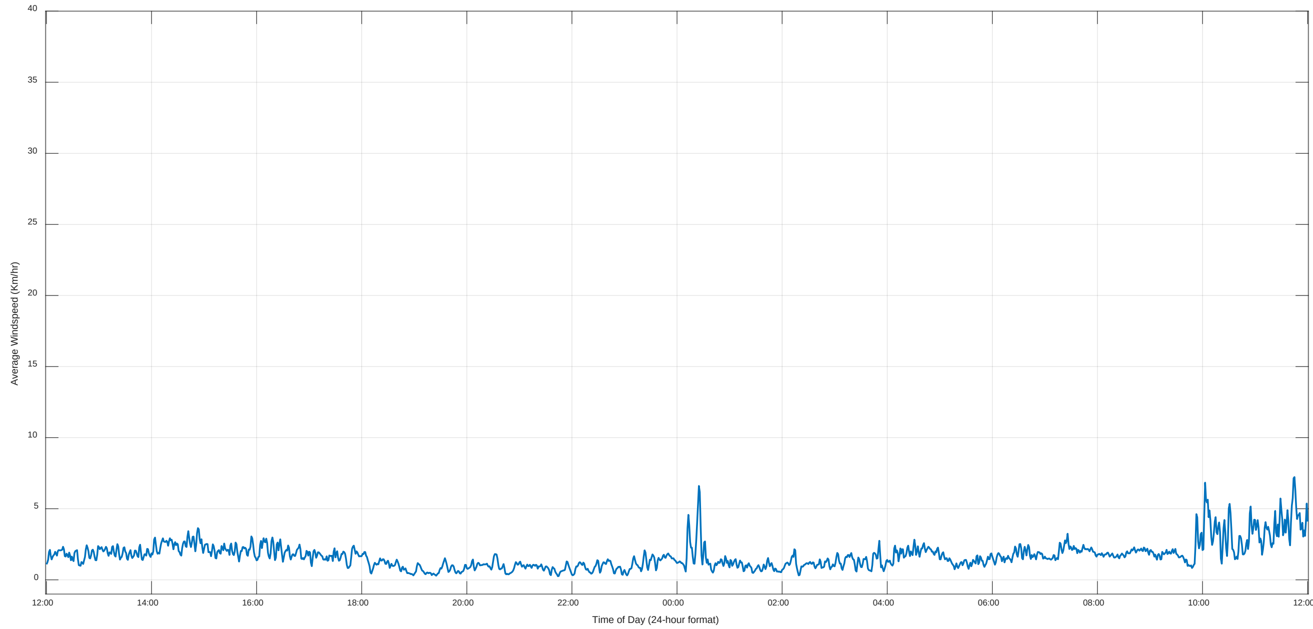


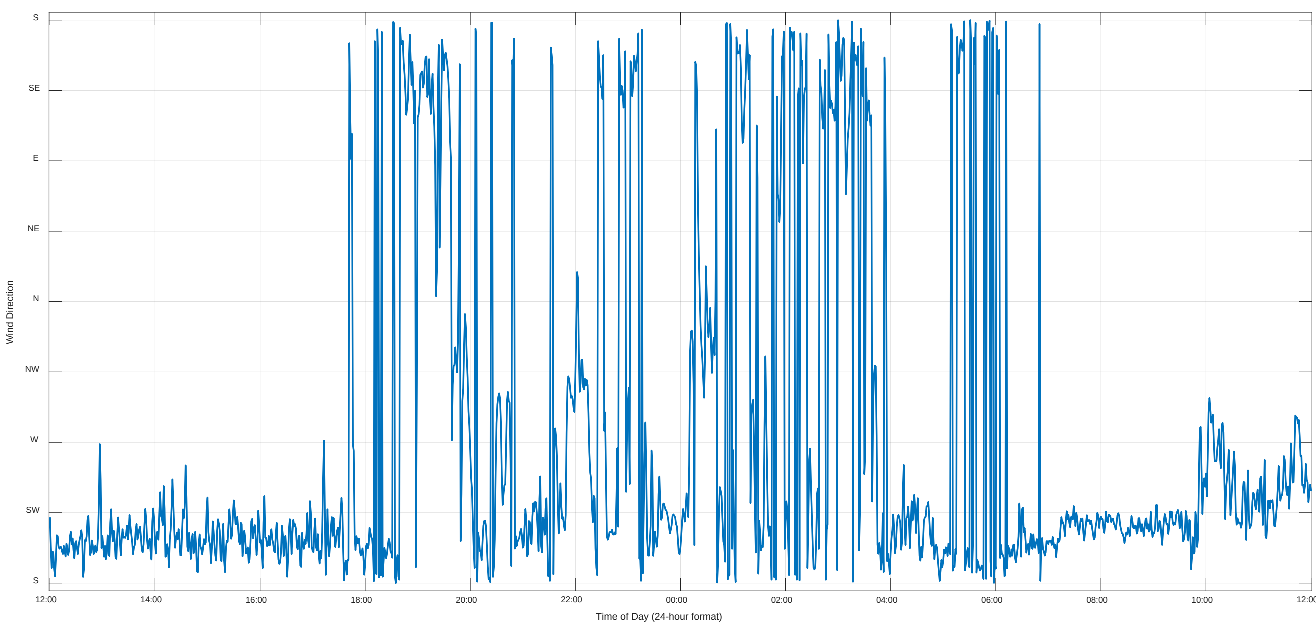
May 03 – 04, 2017 Monitored Temperature



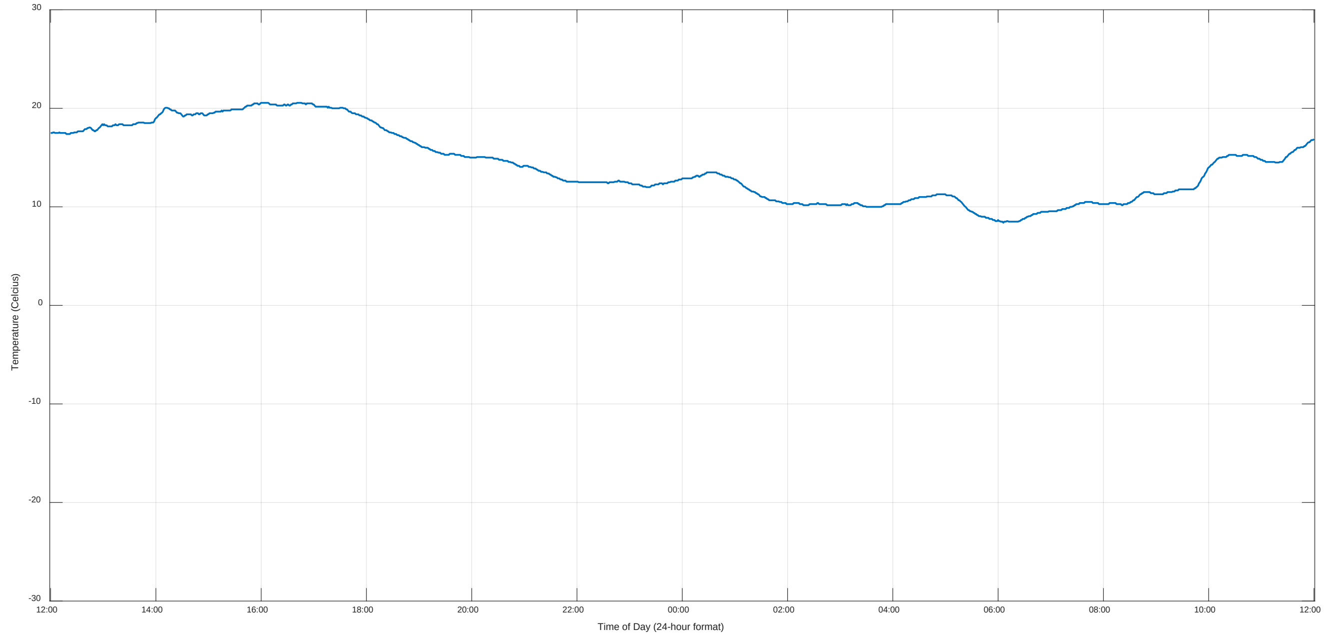
May 03 – 04, 2017 Monitored Relative Humidity



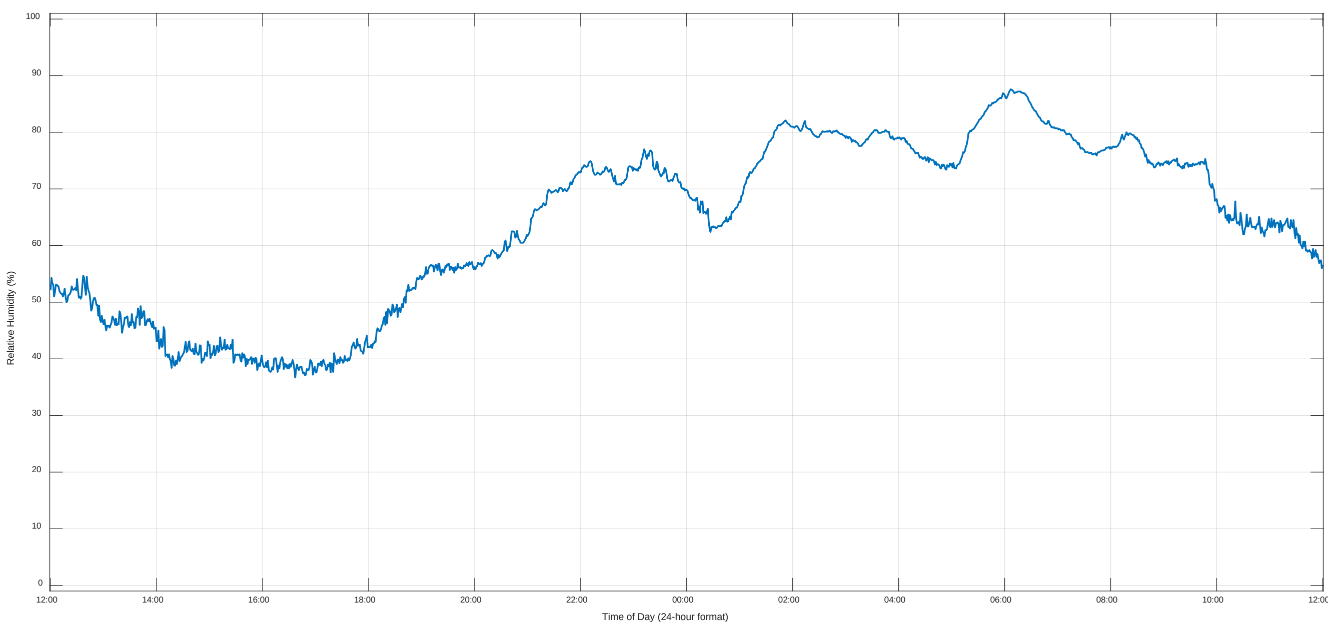
September 25 – 26, 2017 Monitored Wind Speed



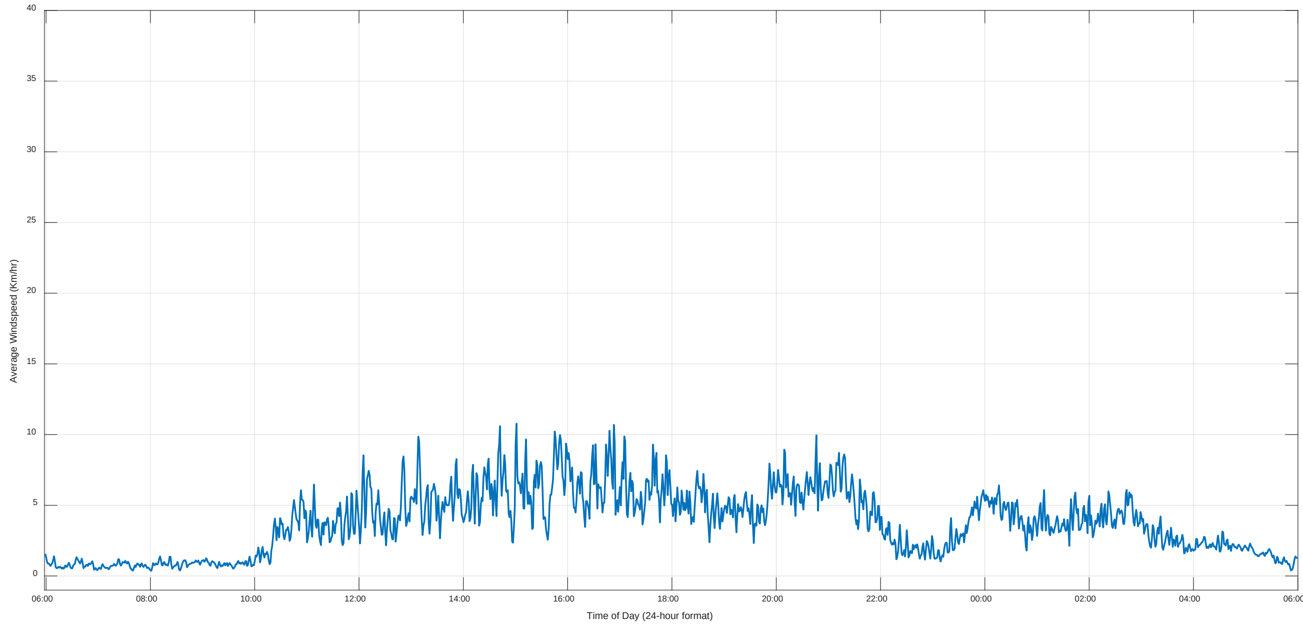
September 25 – 26, 2017 Monitored Wind Direction



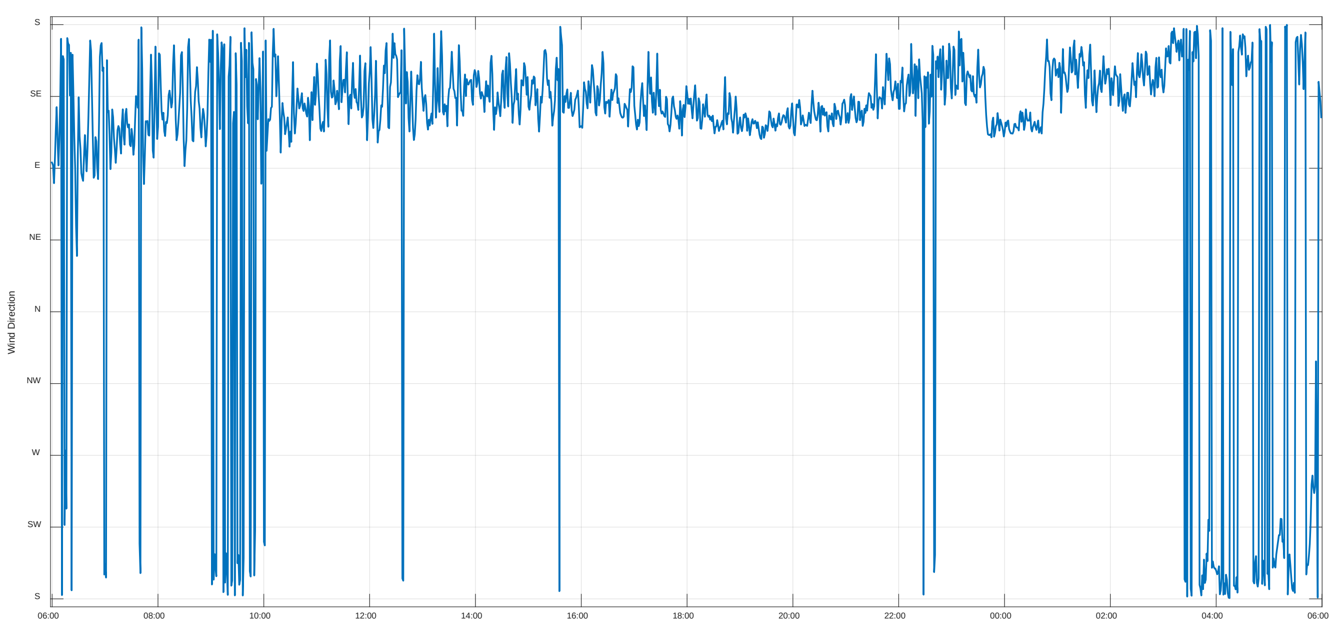
September 25 – 26, 2017 Monitored Temperature



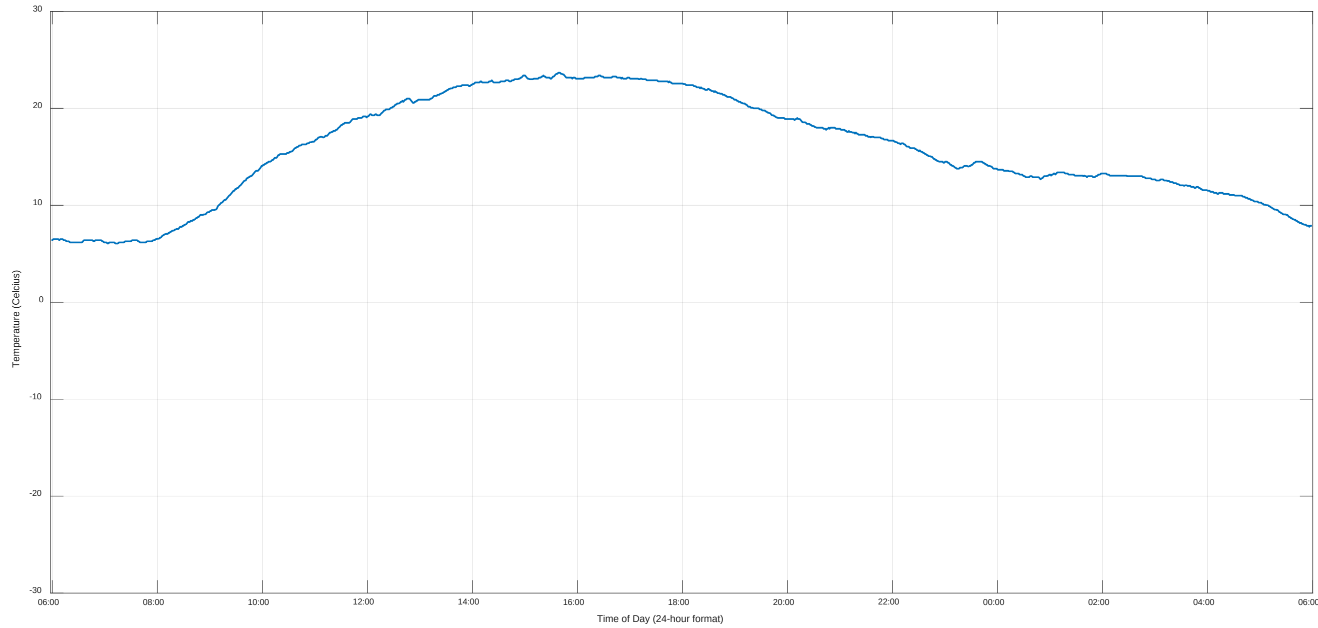
September 25 – 26, 2017 Monitored Relative Humidity



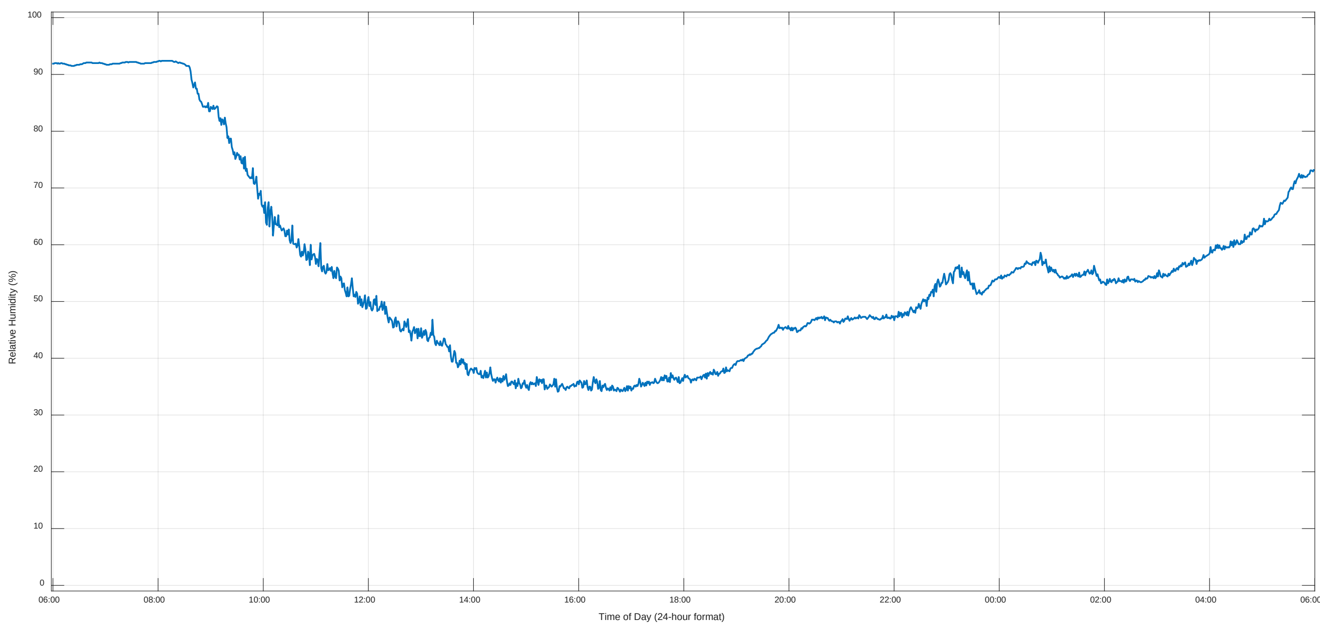
September 28 – 29, 2017 Monitored Wind Speed



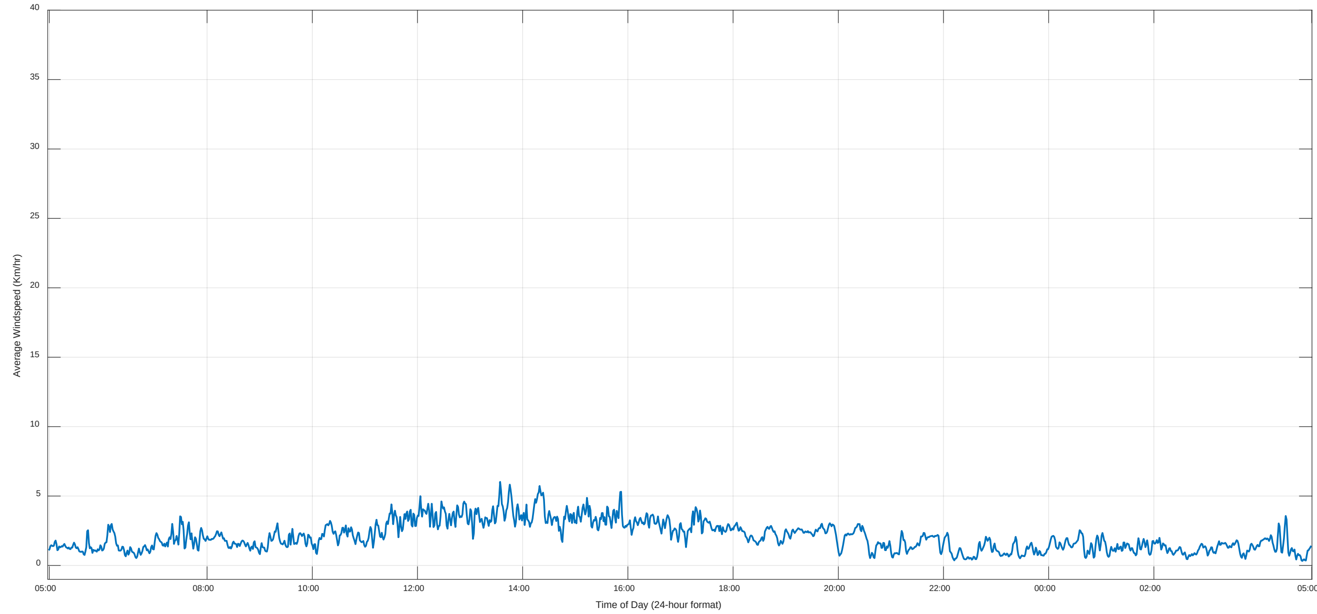
September 28 – 29, 2017 Monitored Wind Direction



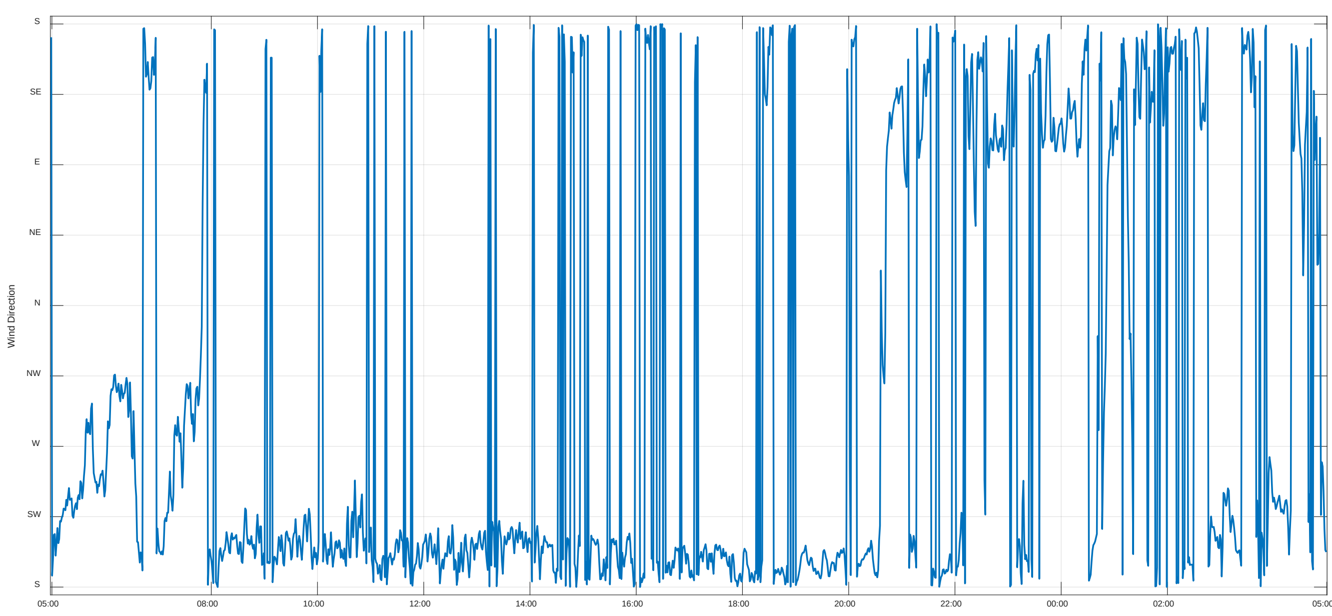
September 28 – 29, 2017 Monitored Temperature



September 28 – 29, 2017 Monitored Relative Humidity



October 03 – 04, 2017 Monitored Wind Speed



October 03 – 04, 2017 Monitored Wind Direction

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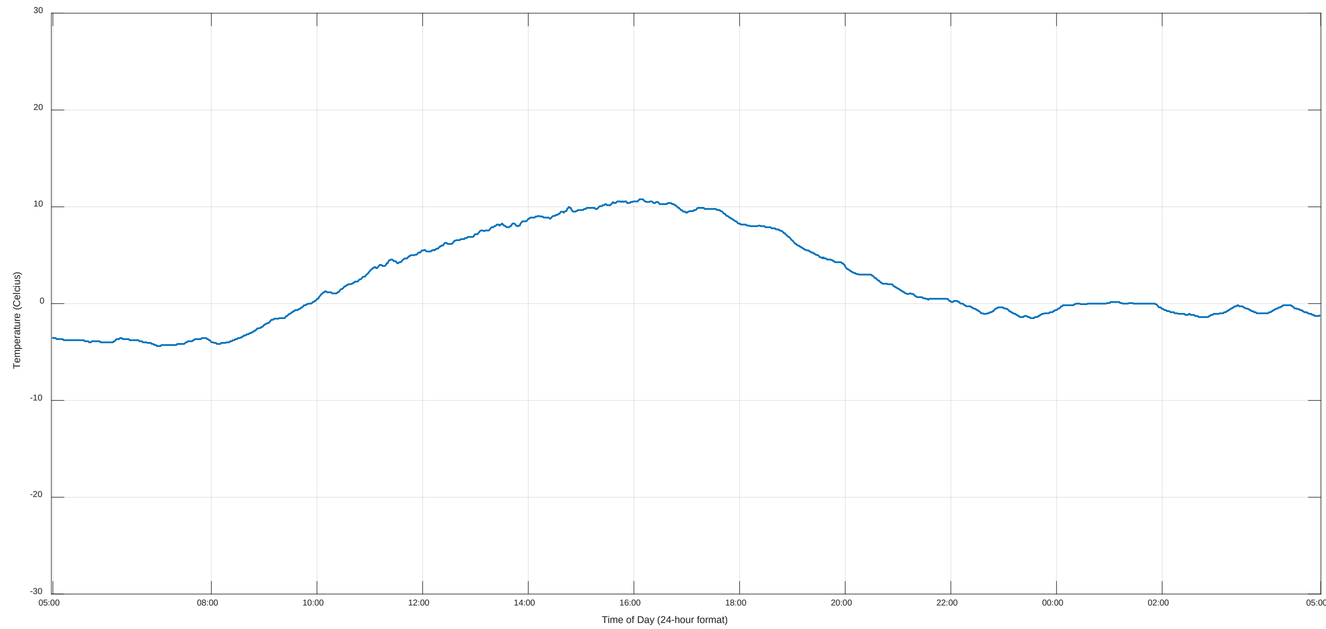
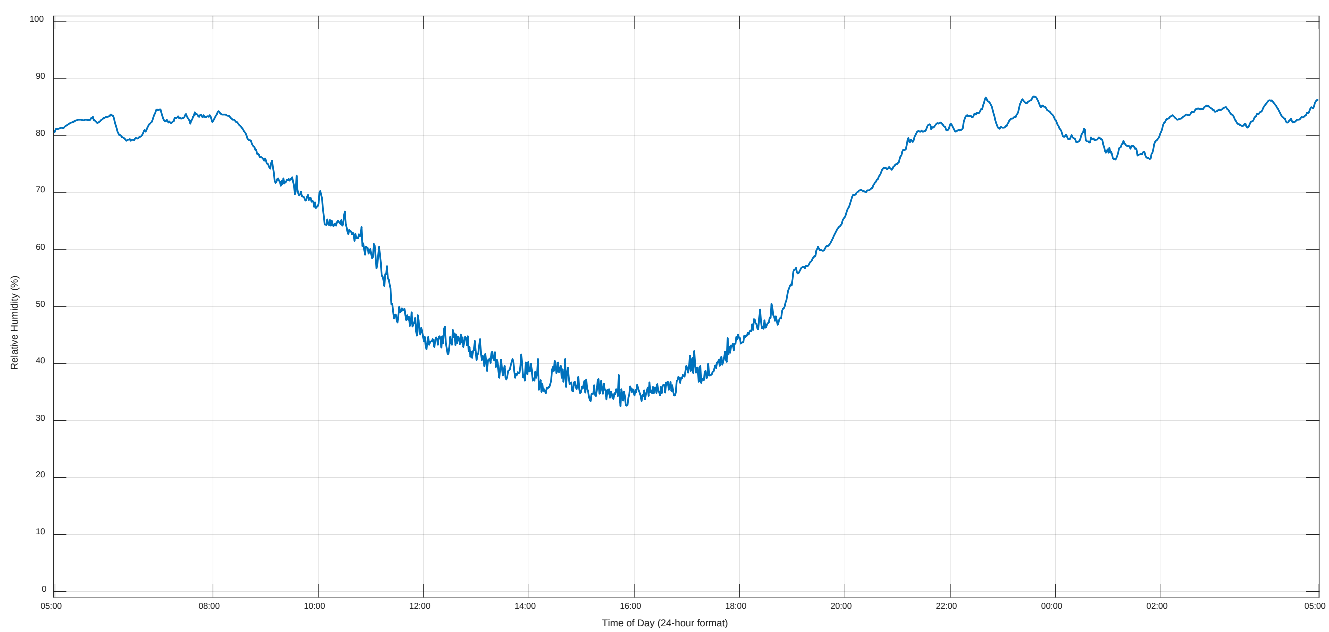
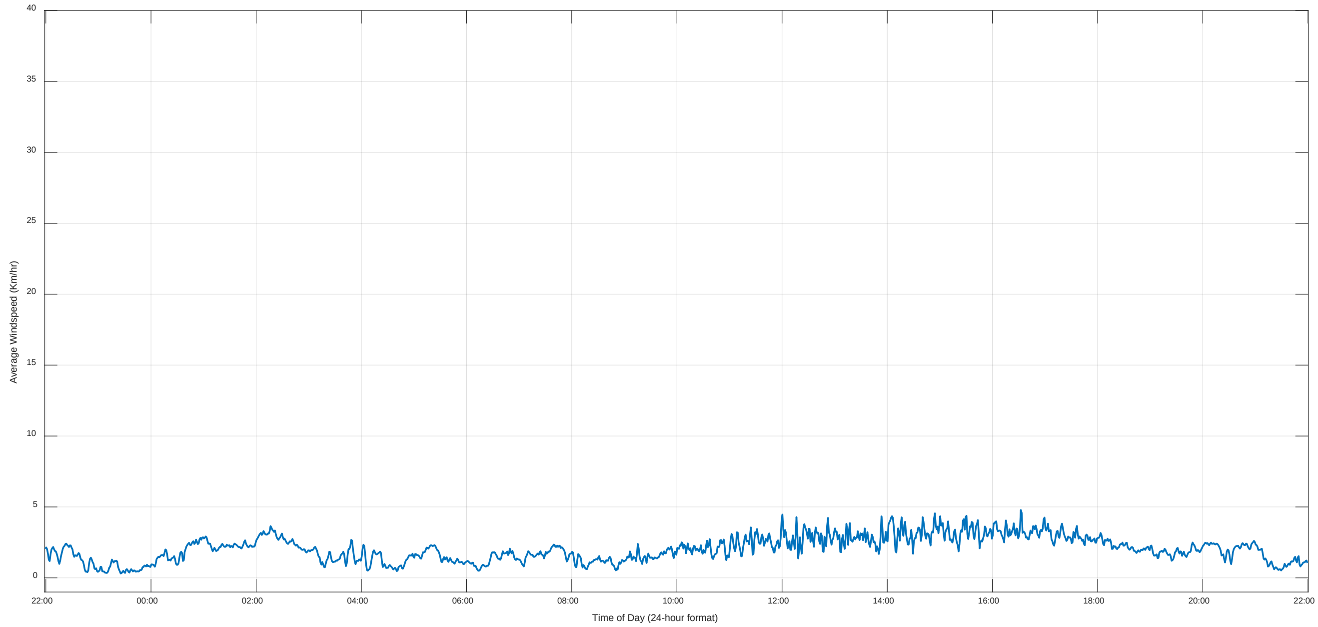


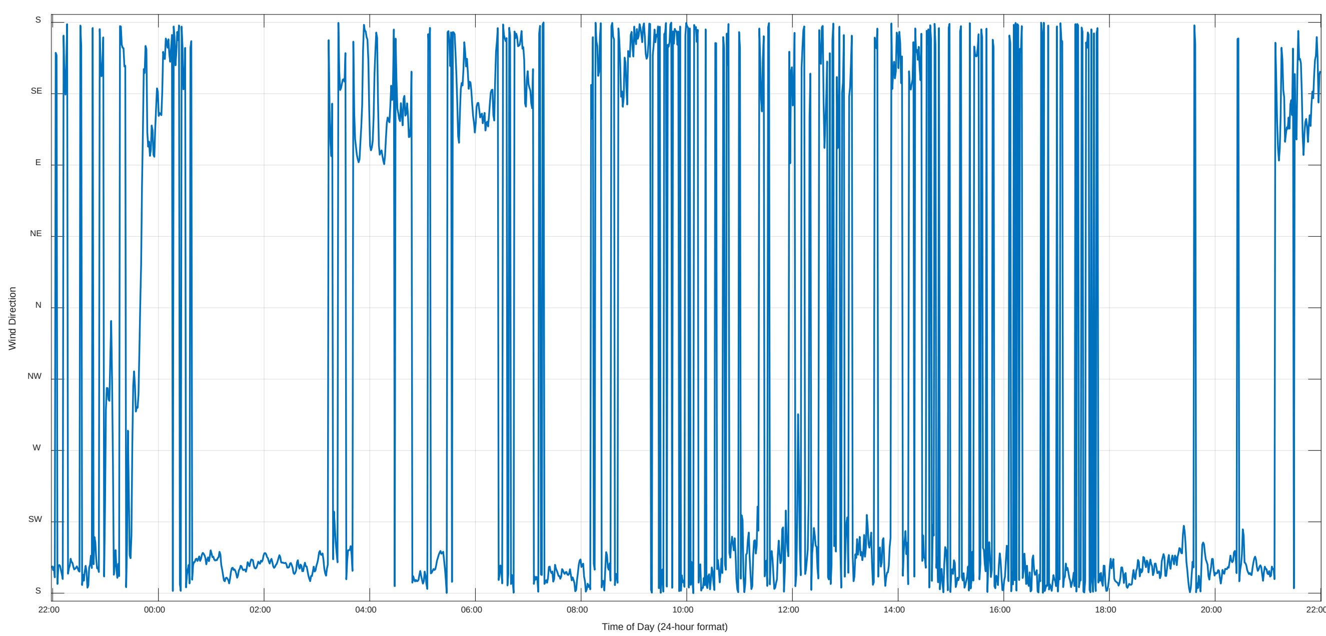
October 03 – 04, 2017 Monitored Temperature



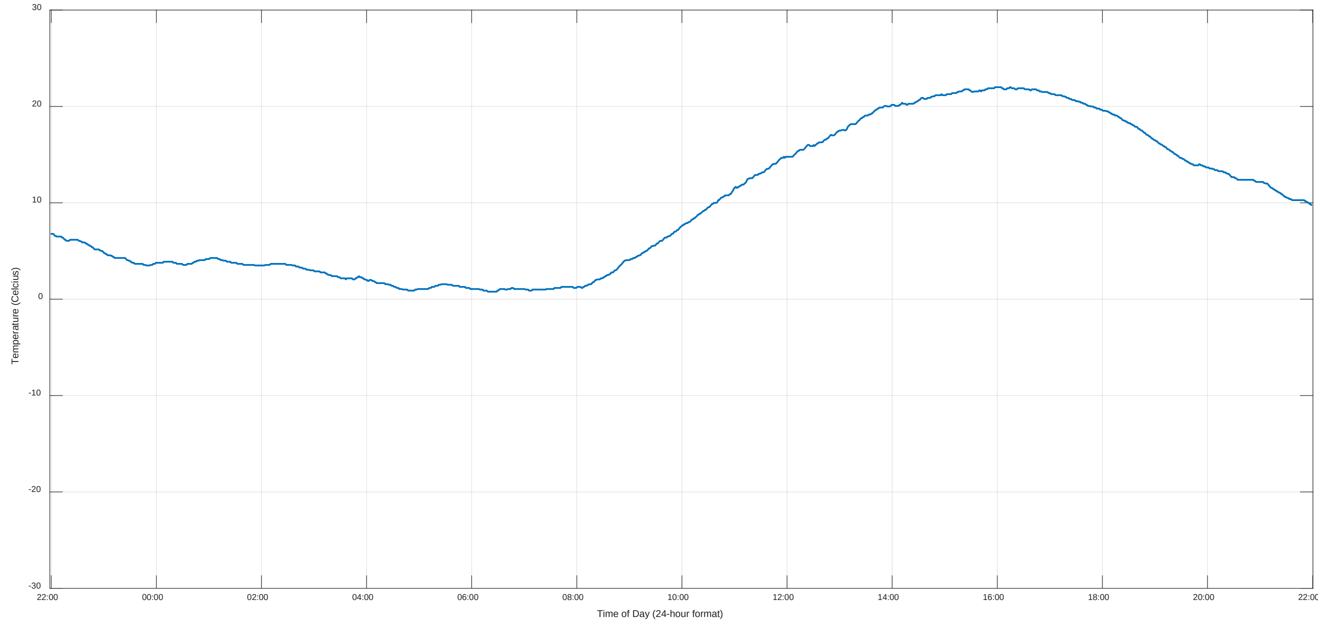
October 03 – 04, 2017 Monitored Relative Humidity



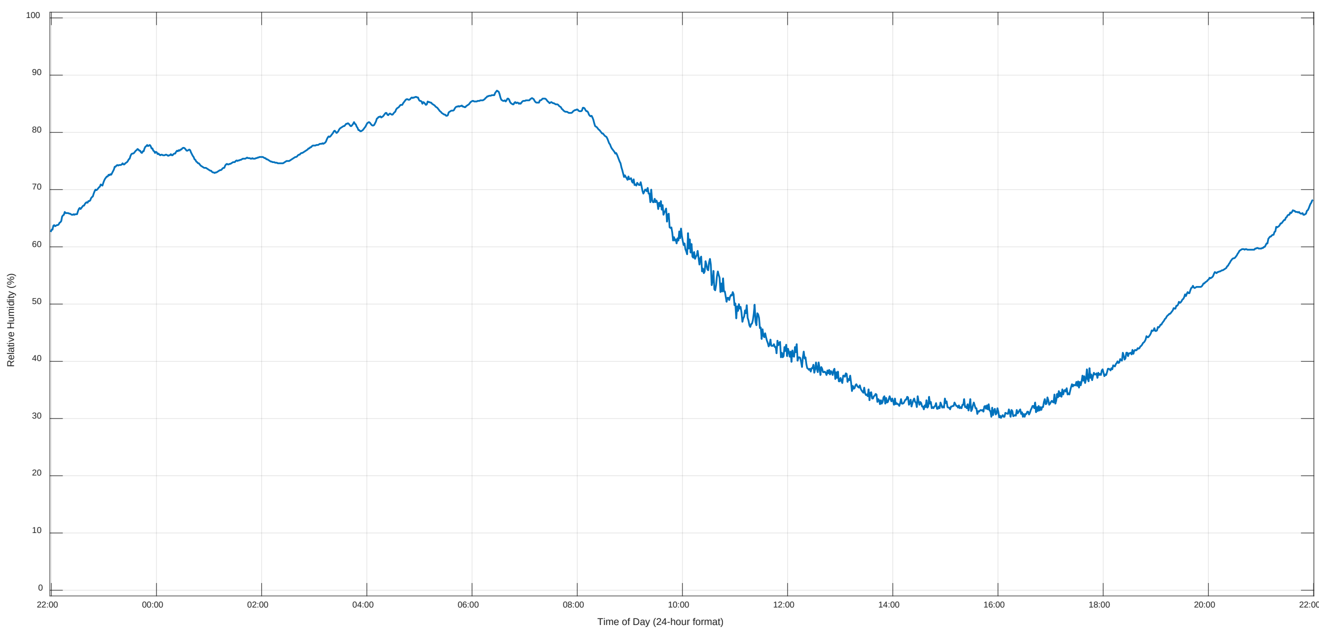
October 04 – 05, 2017 Monitored Wind Speed



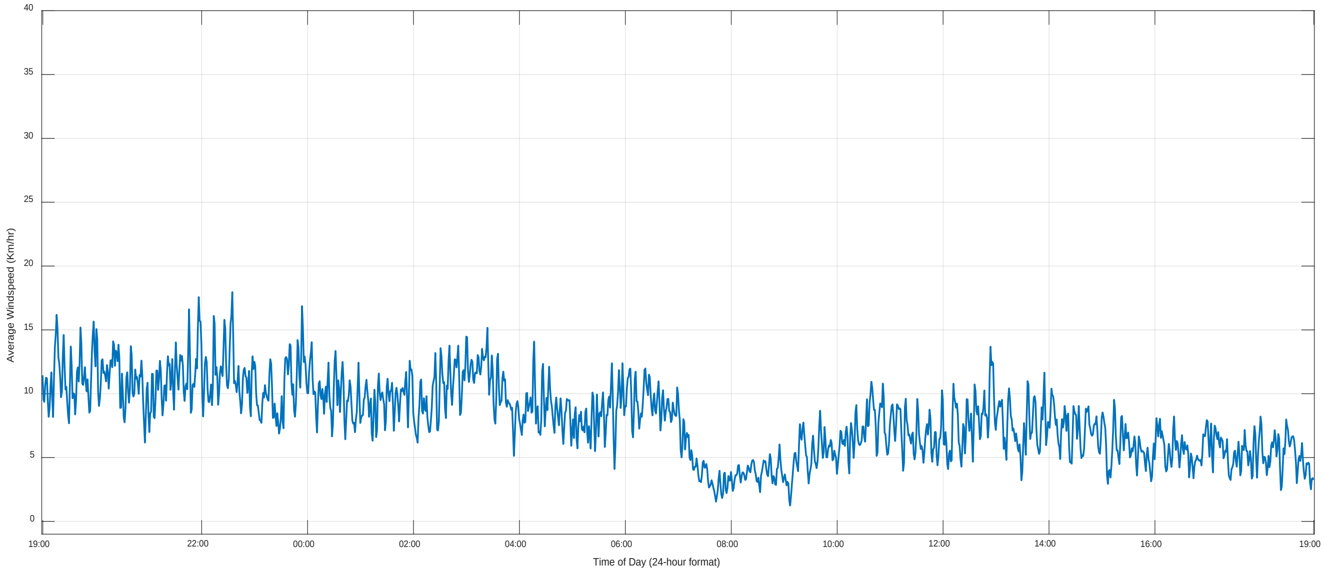
October 04 – 05, 2017 Monitored Wind Direction



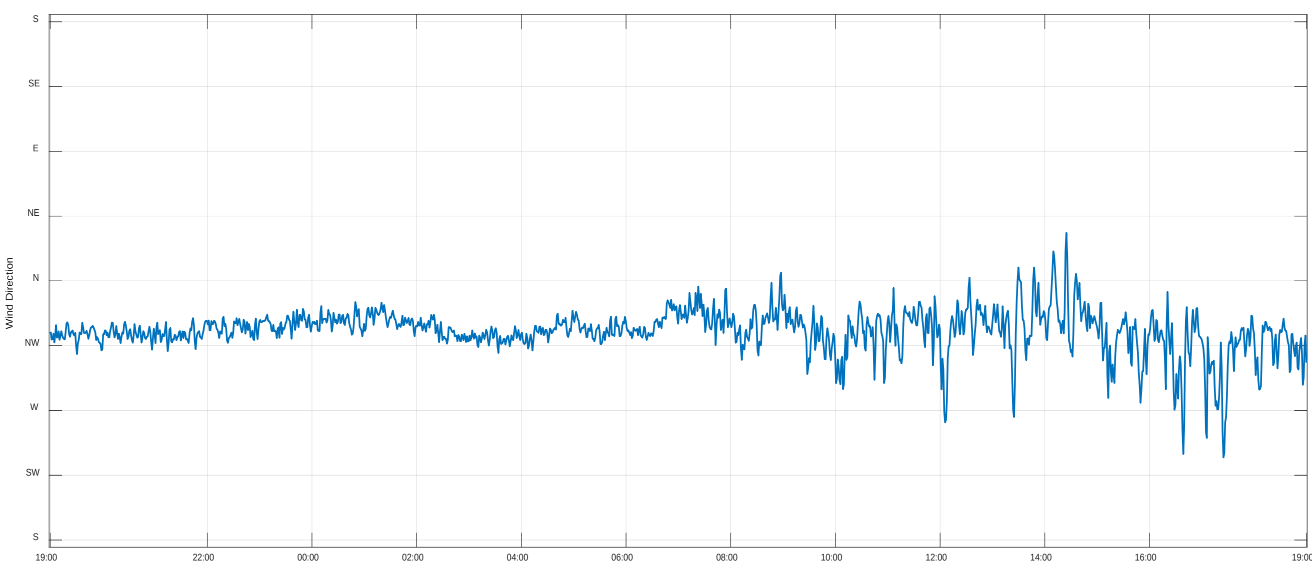
October 04 – 05, 2017 Monitored Temperature



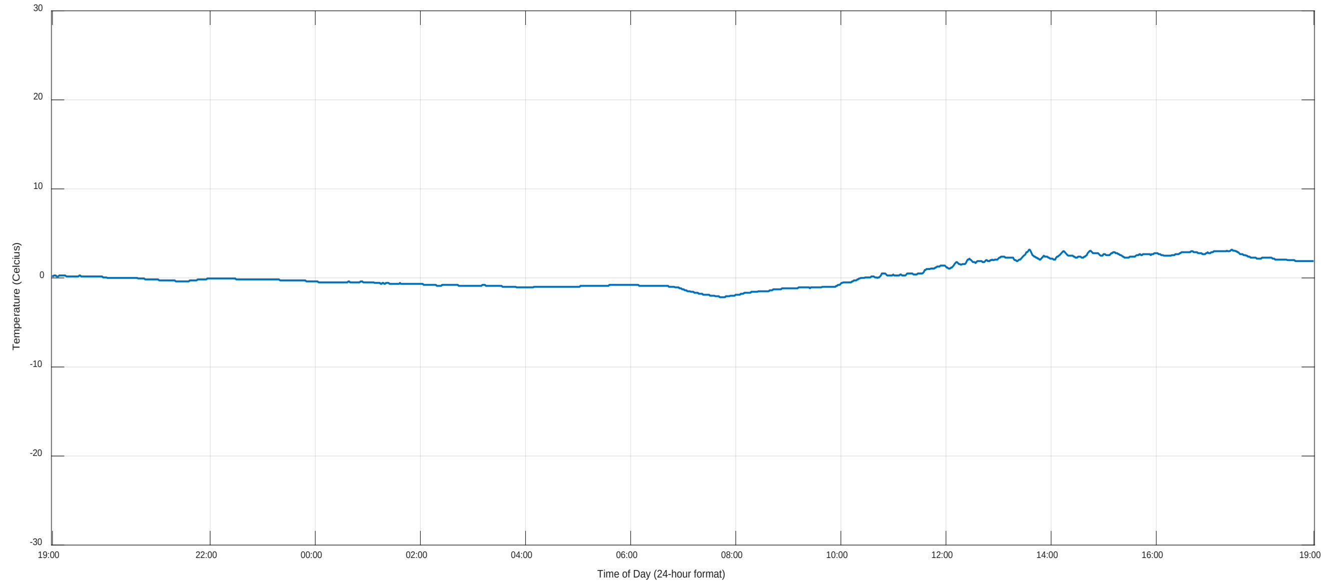
October 04 – 05, 2017 Monitored Relative Humidity



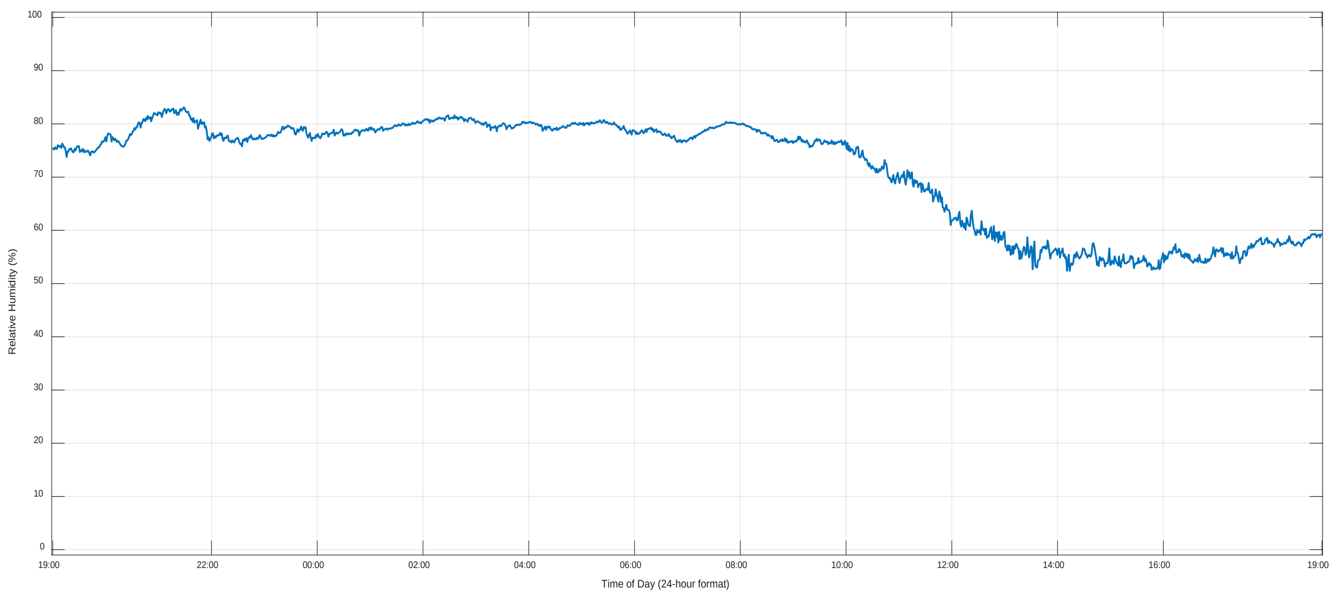
October 11 – 12, 2017 Monitored Wind Speed



October 11 – 12, 2017 Monitored Wind Direction



October 11 – 12, 2017 Monitored Temperature



October 11 – 12, 2017 Monitored Relative Humidity