DNV·GL

PENDLETON SOLAR ENERGY CENTRE

Acoustic Audit Report

EDF Renewables Canada, Inc.

Document No.: 10160645-HOU-R-01
Issue: B**, Status:** FINAL
Date: 24 January 2020

IMPORTANT NOTICE AND DISCLAIMER

1. This document is intended for the sole use of the Customer as detailed on the front page of this document to whom the document is addressed and who has entered into a written agreement with the DNV GL entity issuing this document ("DNV GL"). To the extent permitted by law, neither DNV GL nor any group company (the "Group") assumes any responsibility whether in contract, tort including without limitation negligence, or otherwise howsoever, to third parties (being persons other than the Customer), and no company in the Group other than DNV GL shall be liable for any loss or damage whatsoever suffered by virtue of any act, omission or default (whether arising by negligence or otherwise) by DNV GL, the Group or any of its or their servants, subcontractors or agents. This document must be read in its entirety and is subject to any assumptions and qualifications expressed therein as well as in any other relevant communications in connection with it. This document may contain detailed technical data which is intended for use only by persons possessing requisite expertise in its subject matter.

2. This document is protected by copyright and may only be reproduced and circulated in accordance with the Document Classification and associated conditions stipulated or referred to in this document and/or in DNV GL's written agreement with the Customer. No part of this document may be disclosed in any public offering memorandum, prospectus, or stock exchange listing, circular, or announcement without the express and prior written consent of DNV GL. A Document Classification permitting the Customer to redistribute this document shall not thereby imply that DNV GL has any liability to any recipient other than the Customer.

3. This document has been produced from information relating to dates and periods referred to in this document. This document does not imply that any information is not subject to change. Except and to the extent that checking or verification of information or data is expressly agreed within the written scope of its services, DNV GL shall not be responsible in any way in connection with erroneous information or data provided to it by the Customer or any third party, or for the effects of any such erroneous information or data whether or not contained or referred to in this document.

4. Any energy forecasts, estimates, or predictions are subject to factors not all of which are within the scope of the probability and uncertainties contained or referred to in this document and nothing in this document guarantees any energy output, including factors such as wind speed or irradiance.

KEY TO DOCUMENT CLASSIFICATION

Strictly Confidential	:	For disclosure only to named individuals within the Customer's organization.
Private and Confidential	:	For disclosure only to individuals directly concerned with the subject matter of the document within the Customer's organization.
Commercial in Confidence	:	Not to be disclosed outside the Customer's organization.
DNV GL only	:	Not to be disclosed to non-DNV GL staff
Customer's Discretion	:	Distribution for information only at the discretion of the Customer (subject to the above Important Notice and Disclaimer and the terms of DNV GL's written agreement with the Customer).
Published	:	Available for information only to the general public (subject to the above Important Notice and Disclaimer).

Project name:	Pendleton Solar Energy Centre	DNV GL - Energy
Report title:	Acoustic Audit Report	GL Garrad Hassan Canada, Inc.
Customer:	EDF Renewables Canada, Inc.	70 Richmond Street East
	Pendleton Energy Centre LP	Suite 315, M5C 1N8
	53 Jarvis Street, Ste 300	Toronto, Canada
	Toronto, Ontario M5C 2H2	Enterprise No.: 860480037
Contact person:	Ariane Côté	
Date of issue:	24 January 2020	
Project No.:	10160645	
Work Order:	183094-HOU-P-01-A	
Document No.:	10160645-HOU-R-01	
Issue/Status:	B/FINAL	

Task and objective:
This report contains acoustic analysis of the Pendleton Solar Energy Centre conducted by DNV GL on behalf of EDF Renewables Canada, Inc.

Prepared by:	Verified by:	Approved by:
K. Varnik Senior Acoustic Engineer	A. Nercessian Project Analyst	G. Constantin Project Manager

☐ Strictly Confidential
☐ Private and Confidential
☐ Commercial in Confidence
☐ DNV GL only
☒ Customer's Discretion
☐ Published

Keywords:
Solar, Acoustic Audit, Ontario

© 2020 GL Garrad Hassan Canada, Inc. All rights reserved. Reference to part of this report which may lead to misinterpretation is not permissible.

Issue	Date	Reason for Issue	Prepared by	Verified by	Approved by
A	20 December 2019	Draft	K. Varnik	A. Nercessian	G. Constantin
B	24 January 2020	Final	K. Varnik	A. Nercessian	G. Constantin

Table of contents

Appendices

List of tables

List of figures

1 INTRODUCTION

EDF Renewables Canada, Inc. ("EDF" or the "Customer") retained GL Garrad Hassan Canada, Inc. ("DNV GL") to provide an acoustic audit for the operational Pendleton Solar Energy Centre (the "Project" or "Pendleton") located in the Township of Alfred and Plantagenet. This report presents the results of DNV GL's analysis.

This audit was conducted to demonstrate compliance with Condition D1 of the Renewable Energy Approval (REA) [1] for the Project in accordance to the requirements of *O. Reg 359/09* and the *Environmental Protection Act,* RSO 1990, c.E,19, Section 47.4. The intent of this audit is to provide an evaluation of the actual noise at receptors due to the operation of the Project (immission) and evaluate the actual noise emission of the inverter/transformer clusters (emission). The methodology for the audit was discussed with the Ontario Ministry of Environment, Conservation and Parks (MECP) prior to conducting the measurements [2].

This report is written to conform to Ministry of Environment (MOE) Publications NPC-103 [3], NPC-233 [4], NPC-300 [5] and the conditions of the REA approval.

Section 2 describes the physical and acoustic environment at the measurement locations, as well as the applicable regulations. Section 3 details the equipment used. Section 4 covers the methodology employed. The results of the measurement campaign are presented in Section 5, and general conclusions with respect to the results obtained are summarized in Section 6.

2 SITE DESCRIPTION

2.1 Project location

The Project is located on the approximately 5 km west of the City of Curran, Ontario, at the southeast corner of County Roads 2 and 19, within the Township of Alfred and Plantagenet. A map illustrating the site plan and all significant noise sources is presented in Figure 2-1. The measurement locations for the survey are closer than all the nearest receptors in each cardinal direction (North, South, West), except to the east, where there was no nearby receptor.

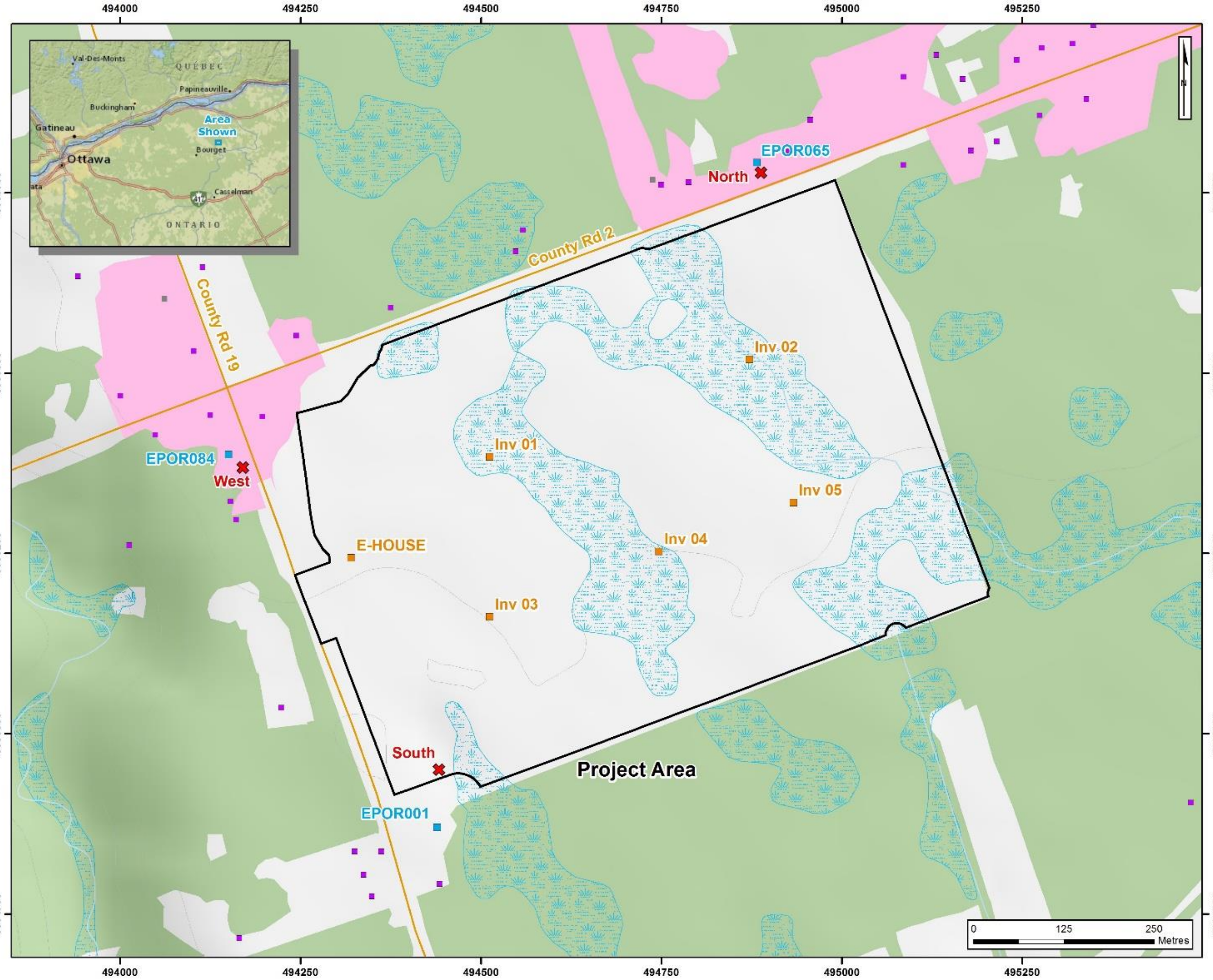

Figure 2-1 Site plan identifying sound sources and receptors

2.2 Solar facility description

The primary noise sources are the five (5) inverter/transformer clusters. Photographs of all 5 clusters can be found in Appendix A.

Specifically, the Project has the following noise sources:

- Five (5) SMA Sunny Central 2750-EV-US 2.75MW inverter units; and
- Five (5) Cooper Power inverter step-up transformers rated at 2.5 MVA.

Since the Project operates from sunrise to sunset, strict operating hours are not defined.

The DNV GL field engineer confirmed that the installed inverters were Sunny Central 2750-EV-US 2.75MW and were contained inside geometric area enclosures as described in the pre-construction Acoustic Assessment Report (AAR) prepared by Stantec [6] and were located within the allowable polygons of the REA [1].

Transformer/inverter clusters were installed in five of the six permitted polygons.

A list of the equipment, IDs, coordinates and allowable polygons is shown in Table 2-1. This report will be using the on-site ID in the first column of Table 2-1 when describing equipment throughout the report, unless otherwise specified.

Table 2-1 Coordinates of Project components

As-built equipment			Allowable polygon per REA Schedule B for inverter and transformer		
On-Site ID	**Easting (m)**	**Northing (m)**	**Schedule B Source ID**	**Easting (m)**	**Northing (m)**
Inv 1	494511	5035383	inv_01 trans_01	494439 494390 494724 494734	5035324 5035456 5035569 5035408
Inv 2	494871	5035519	inv_06 trans_06	494734 494724 494950 495019	5035408 5035563 5035671 5035488
Inv 3	494512	5035162	inv_03 trans_03	494563 494488 494745 494757	5034996 5035197 5035254 5035069
Inv 4	494747	5035253	inv_04 trans_04	494757 494745 495079 495125	5035069 5035254 5035329 5035208
Inv 5	494932	5035320	inv_05 trans_05	494745 494734 495019 495079	5035254 5035408 5035488 5035329

Note: Exact locations of the inverter clusters do not appear in the REA. Instead, an allowable polygon in which each inverter and transformer may be placed was listed.

2.3 Regulatory approval

The Project was granted an approval of the REA application on 3 April 2018, to engage in a renewable energy project in respect of Class 3 solar facility consisting of the construction, installation, operation, use, and retiring of such a facility with a capacity of up to approximately 12 MW [1].

For the purposes of this report, an "Acoustic Audit" means an investigative procedure consisting of measurements of all sources of noise emissions due to the operation of the equipment assessed to determine compliance with the Noise Performance Limits set out in the Approval. This study demonstrates compliance with condition D1 of the REA.

In accordance with the REA, an AAR was prepared by Stantec [6] in October 2017 to reflect the Project facilities modelled noise emissions. As such, DNV GL can be considered an Independent Acoustical Consultant for the purpose of conducting the audit.

2.4 Points of reception

Three receptors in different cardinal directions, among those identified in the pre-construction AAR conducted by Stantec [6], were selected to be representative Points of Reception (PoR), for the purpose of conducting an acoustic audit. These measurement locations were based on the closest and/or loudest modeled receptors in each cardinal direction (except to the east of the Project where there is no nearby receptor) in the AAR and were provided to an MECP acoustic reviewer [2]. According to the AAR, receptor (EPORO65) located on the Country Road 2 had the highest pre-construction modeled values.

The locations of all measurements and associated PoRs according to the AAR [6] are presented in Table 2-2 and on the site map in Figure 2-1. The AAR contains multiple layout scenarios, and the loudest modeled value from the preconstruction acoustic assessment is presented for each PoR.

Table 2-2 Measurement locations

Measurement Locations						AAR receptor coordinates				
ID	**Height (m)**	**Easting (m)**	**Northing (m)**	**Distance to nearest source (m)**	**Nearest Source ID**	**ID**	**Easting (m)**	**Northing (m)**	**Distance to nearest source (m)**	**Modeled sound level (dBA)**
North	1.5	494887	5035778	259	Inv 2	EPOR065	494882	5035792	256	40
South	1.5	494441	5034950	224	Inv 3	EPOR001	494439	5034870	272	38
West	1.5	494169	5035369	342	Inv 1	EPOR084	494150	5035387	347	37

For the South location, site access was not obtained, so the measurement location was relocated closer to the Project facility, which allowed DNV GL to better capture any Project contribution. Photographs of the monitoring stations at each measurement location are shown in Appendix B. A history of the communication with the landowners is shown in Appendix D.

2.5 Determination of applicable noise limits

The general area consists of rural land. The land usage is typical of rural areas in southern Ontario with dwellings built near the roadways. Receptors within 1 km of the Project area are considered to be in a Class 3 (or rural) acoustical environment. In a Class 3 area, natural sounds dominate the sounds of the ambient environment. NPC-233 provides sound level limits for Class 3 areas.

The REA requires that the Project comply with the noise limits within Publication NPC-233. This requires that the noise sources comply with one-hour equivalent sound level (LAeq-1 hour) limits. A solar facility will generally run during the daytime period where the class 3 limits are 45 dBA. Per NPC-300, the sound level limit is considered to be the higher of the prescribed exclusionary limit for a Class 3 area, or the background sound level [5]. The limits are 45 dBA for a facility operating during daytime, and 40 dBA for a facility operating during nighttime.

3 EQUIPMENT

The acoustic and meteorological measurements data gathered in the context of this study were obtained using the instruments listed in Table 3-1 (see Appendix B for photographs at sound measurement locations).

Table 3-1 Equipment for acoustic measurements

Equipment	Serial number
Larson Davis sound meter model 831C Class I	10368
Free Field ½ inch microphone model 377B02	303859
Preamplifier model PRM831	051224
Vaisala WXT520 Weather Sensor	P1320473

The sound meter used by DNV GL meets the International Electrotechnical Commission (IEC) 61672 Class 1 specifications [7]. The accuracy of the sound meter calibration was verified on site before and after each measurement with a Larson Davis CAL200 Class I calibrator; the differential calibration was never greater than 0.5 dBA. The calibration certificates of all instruments can be found in Appendix C.

It should be noted that in addition to measuring sound levels, the Larson Davis sound meter also recorded audio files throughout the measurement period. In addition to observations from the DNV GL field engineer, this facilitates the screening of events and determining if the corresponding high sound level is representative of the ambient noise or if it is a transient event that can be removed from analysis.

4 METHODOLOGY

The REA permit for this Project [1] requires measurements of the actual sound propagation (immission) from the operation of the Facility in order to determine the Project's contribution the sound levels at nearby residences and its compliance with MECP prescribed limits. Additionally, the REA has requested that the actual noise emissions of the inverter/transformer clusters and the substation be evaluated (emission). There is no substation transformer built at this Project; only the inverter transformer cluster emission was measured.

The methodology employed in the present study is based on the following standards related to acoustic noise measurements:

- Basic Comprehensive CofA (Air) – User Guide (Appendix B), Ontario MOE, Environmental Assessment and Approvals Branch (2011);
- NPC-103, Ministry publication of the Model Municipal Noise Control By-Law (1978);
- International Standards for Environmental Noise Measurement ISO 1996 (-1, -2); and
- IEEE Std C57.12.90, Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers.

Environmental noise measurements are often influenced by weather, namely wind and rain. To reduce the undesired effect of wind-induced noise, DNV GL uses a foam wind screen. According to industry best practices and the specifications of the wind screen, the wind-induced noise is kept within an acceptable range for wind speeds below approximately 5.5 m/s at the measurement height (1.5 m above ground level [agl]). Humidity is monitored to confirm the absence of rain during the measurement period. Measurements taken during periods of rain, if any, are not considered valid due to the influence of rain-induced noise. The manufacturer of the sound meter confirms that humidity levels above 90% do not affect noise measurements, but might only affect the associated uncertainty, which remains within an acceptable range for this campaign. In addition, the measurements were attended and properly planned to be conducted during sunny weather, with low winds. Humidity and high winds are therefore not typically encountered during solar facility acoustic audits.

4.1 Noise source measurements (emission)

Sound pressure level (SPL) measurements were carried out at one inverter/transformer cluster (Inv 5). The Project layout is shown in Figure 2-1.

The measurement locations around the inverter cluster were based on the ANSI/IEEE C57.12.90 standard [8]. These measurement locations around the inverter/transformer skid are shown in Figure 4-1.

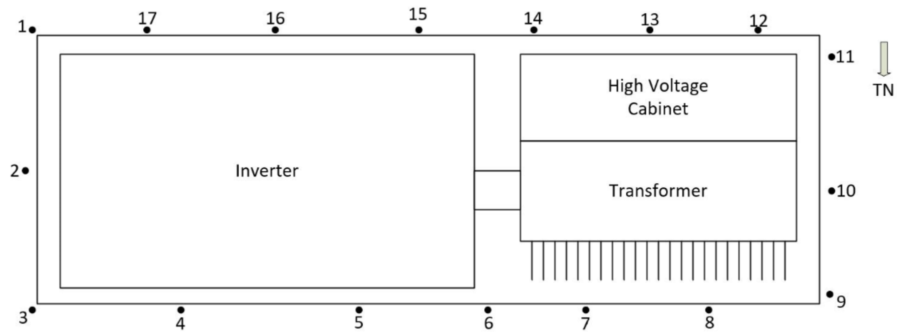

Figure 4-1 E-Test Measurement Locations at Inverter / Transformer Cluster 5

At each measurement point, 30-second measurements of equivalent continuous A-weighted sound levels (LA_{eq}) were taken.

The measurements were taken during full production hours, on a sunny day, with equipment operating at full capacity.

The sound power levels (PWL)of the inverter/transformer cluster and substation were then calculated according to ANSI/IEEE C57.12.90 [8]. The results for the inverter/transformer cluster are presented in Section 5.1.

4.2 Measurements to evaluate noise levels at PoRs (immission)

Three representative PoRs were selected and agreed upon in discussions with the MECP [2]. The three impacted PoRs were chosen on the western, northern, and southern sides of the solar facility. The measurements were taken according to NPC-103, which allows intermittent sounds to be filtered, provided that the accumulated valid time is at least 20 minutes to represent the 1-hour LA_{eq}. The measurement locations are shown on the site map in Figure 2-1. All measurements were taken at a height of 1.5 m agl.

Measurements of the equivalent continuous A-weighted sound pressure levels (LA_{eq}) were taken at 1-second intervals for a 1-hour period minimum. The ninetieth percentile A-weighted sound pressure levels (LA_{90}) were then calculated for the measurement period. As well, the 60-second LA_{eq} were identified. The results are presented in Section 5.2.

The original measurements were taken on 19 September 2019, during sunny conditions when the equipment was operating at full capacity. Measurements at the West location were redone on 19 October 2019, after it was determined that the plant did not reach full capacity during that original measurement.

Table 4-1 Coordinates of all measurement points (UTM18 NAD83)

ID	Easting (m)	Northing (m)
North	494887	5035778
South	494441	5034950
West	494169	5035369

Photographs of each location are presented in Appendix A.

5 ANALYSIS AND RESULTS

All measurements recorded by the sound level meters were analyzed. The meteorological instruments and the DNV GL field engineer confirmed that all sound levels presented in this report were measured at wind speeds below 5.5 m/s (20 km/h) at 1.5 m. The maximum wind speed during the measurement period was 4.1 m/s, and wind speeds were generally calm. Relative humidity did not exceed 90% during the measurement period. Importantly, the Project reached full capacity for the majority of the measurement period. Hourly weather data from Environment Canada is shown in Appendix E .

5.1 Inverter/transformer cluster (emission)

5.1.1 Determination of broadband sound power level (PWL)

A methodology based on ANSI/IEEE C57.12.90 [8] was used for the PWL calculation of the inverter/transformer cluster. The microphones were placed 0.3 m from the sides of the cluster. The overall inverter/transformer cluster dimensions are shown in Table 5-1. The locations of the measurements are shown in Figure 4-1.

Table 5-1 Inverter / transformer cluster dimensions

L1	Length	6.2 m
L2	Width	1.8 m
L3	Height	2.3 m

The measurement locations at the inverter/transformer cluster are based on the ANSI/IEEE C57.12.90 approach and pictures are presented in Appendix A. The PWL emitted by the inverter/transformer cluster was evaluated from the seventeen measurement locations and the corresponding measurement surface (S), as defined in [8]. The PWL was then calculated for each measurement location and logarithmically averaged for all measurements.

Table 5-2 summarizes the pertinent information for all measurement locations that were used to assess the PWL of the inverter/transformer cluster identified as Inv4 in the Stantec AAR [6] and Inv 5 on-site. It should be noted that inverters were fully operating during the measurement. A history of the plant operating level is graphically shown in Figure 5-2.

It should be noted that inverters were fully operating as shown in Figure 5-5. Ventilation in the sheds is with passive air flow through vents. No air flow was coming out of the vents during the measurements

Table 5-2 Summary of inverter/transformer cluster sound power measurements (Inv 5)

Measurement Location		MS: Measurement surface				Source
ID	**LAeq [30 sec]**	**Method used**	**Distance from cluster (d) [m]**	**Measured from**	**Area of Measurement surface (S) [m²]**	**PWL [dBA]**
1	77.8	C57.12.90	0.3	Inverter Corner	31.4	92.8
2	78.9			Inverter Side		93.9
3	71.8			Inverter Corner		86.7
4	62.6			Inverter Side		77.6
5	62.7			Inverter Side		77.7
6	66.4			Inverter Corner		81.4
7	65.1			TF Side	31.6	80.5
8	60.1			TF Side		75.5
9	59.8			TF corner		75.2
10	61.4			TF Side		76.8
11	60.8			TF corner		76.2
12	64.6			TF Side		80.0
13	69.0			TF Side		84.4
14	74.1			TF Side		89.5
15	78.9			Inverter Side	31.4	93.8
16	80.3			Inverter Side		95.3
17	79.1			Inverter Side		94.0
Average LA_{eq} [30 sec]	67.4	Transformer Only			31.6	**82.4**[a]
	76.8	Inverter Only			31.4	**91.7**[a]

[a]Does not include tonal penalty

Measurements taken by DNV GL were performed at 0.3 m per IEEE C57.12.90. Surface areas were calculated per C57.12.90 based on the dimensions of each component. Both the inverter and transformer remained operational throughout the test. It is not possible to perfectly isolate the noise from each component. Separate values for the individual components are presented, based on averaging individual measurements and specifying a different measurement surface (S) for each component. The measurement locations were separated between the transformer and inverter, based on proximity to the closest component.

The measured sound power value was 91.7 dBA for the inverter and 82.4 dBA for the transformer. In the AAR, the sound power values were also 91.7 dBA and 82.4 dBA for the inverter and transformer respectively, which included a 5-dB tonal penalty on both components. The combined value of the noise sources in the AAR was 92.2 dBA and the combined value of measurements was 92.2 dBA. The reported sound levels are likely to be slightly louder than the true sound levels of each component, since the adjacent equipment influences the measurements. Therefore, the measured source sound levels in this report can be considered conservative. As shown in Table 5-3, the combined values of the components are very similar to the REA limits and pre-construction noise assessment and show compliance when numerically rounded with the same level of precision.

Table 5-3 Sound power levels for the Inverter/Transformer Cluster

Source description	Measured sound power level [dBA]	Modeled sound power level from the AAR [a]	REA allowable sound power level [a] [dBA]
Inverter unit	91.7	91.7	92
Transformer	82.4	82.4	82
Combined Value of Inverter/Transformer Cluster	92.2	92.2	92.4
	[a] Includes 5-dB tonal penalty		

5.1.2 Determination of a tonal component

Tonality checks at the source were based on the ISO 1996-2 [9]. The 17 sets of 1/3 octave band measurements were averaged to determine a total LA_{eq} spectrum representative of the inverter/transformer cluster. Table 5-4 and Figure 5-1 present the averaged 1/3 octave band SPL spectrum.

As defined in ISO 1996-2 [9], a tonal component represents a peak within the spectrum with a difference of 5 dB or more with both adjacent 1/3 octave bandwidths. As shown in Table 5-4 and Figure 5-1, no tonality was emitted from the device. No tonality penalty has been applied to the sound sources.

Table 5-4 One-third octave band frequency spectrum of Inverter/Transformer Cluster 5

Frequency [Hz]	**6.3**	**8**	**10**	**12.5**	**16**	**20**	**25**	**31.5**	**40**	**50**	**63**	**80**
SPL [dBA]	-20.9	-11.8	-2.6	9.1	17.7	23.3	27.8	33.7	38.8	41.9	45.1	47.8

Frequency [Hz]	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**
SPL [dBA]	50.4	52.4	55.1	59.8	61.4	63.4	65.4	65.1	64.8	65.2	64.2	62.4

Frequency [Hz]	**1600**	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**	**12500**	**16000**	**20000**
SPL [dBA]	60.7	59.8	61.9	60.5	49.2	52.4	51.7	37.6	34.4	26.6	20.7	12.2

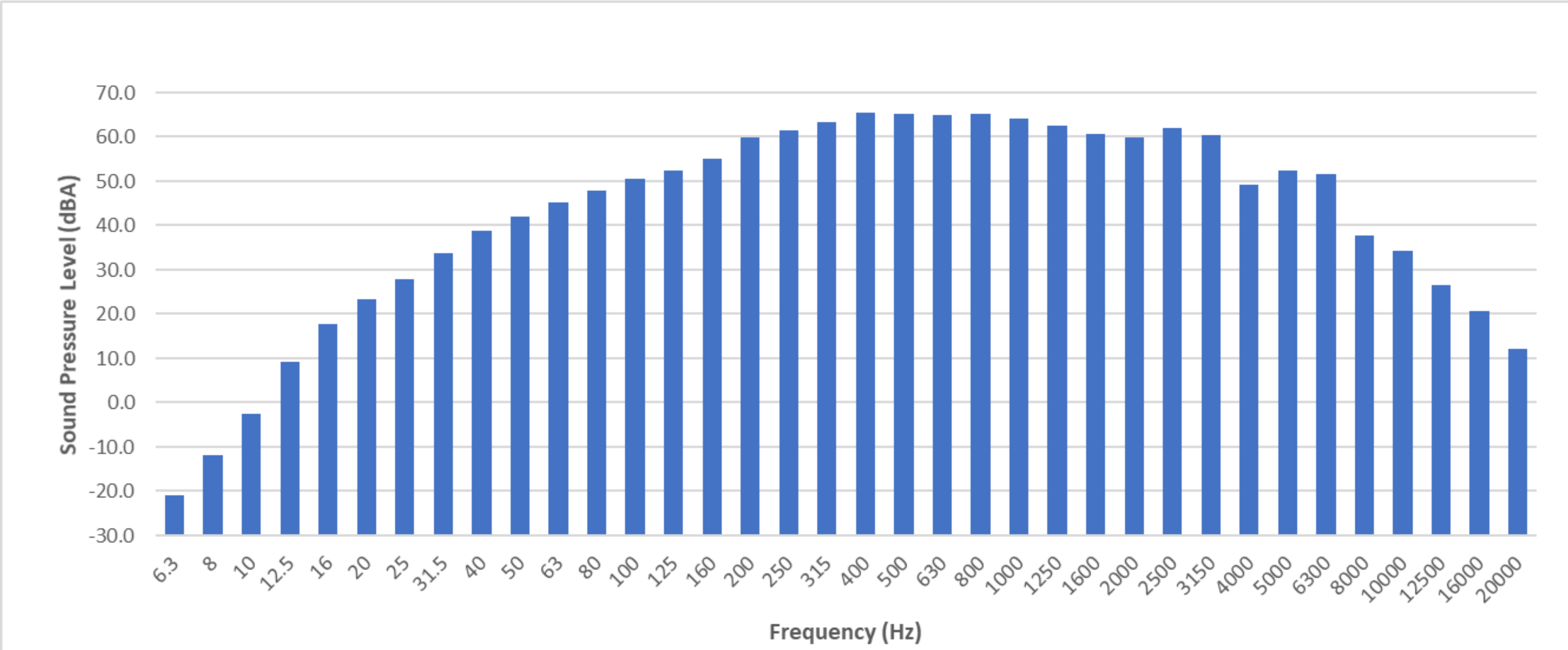

Figure 5-1 Measured One-third octave band spectrum SPL of Inverter / Transformer Cluster 5

5.2 Points of reception (immission)

5.2.1 Determination of sound pressure levels at PoRs

The noise environment, as recorded by the instrumentation and perceived by DNV GL staff during the measurement campaign, was mainly characterized by the following:

- Vehicular traffic on adjacent Roads
- Natural sounds including insect noise, migrating birds, and brush

In order to capture the ambient noise level, the averaging interval of the sound meter was set to 1 second. The LA_{eq} – or Equivalent Continuous Level – recorded by the sound meter is the equivalent continuous sound that would contain the same sound energy as the time varying sound. The LA_{90} – or ninetieth percentile A-weighted sound levels – is the level exceeded for 90% of the time and is calculated from the LA_{eq}, 1-second measurements.

Table 5-5 presents a summary of the results of the measurement campaign at the receptors.

Table 5-5 Summary of results obtained from measurement campaign

Measurement point ID	Measurement date (2019)	Measurement period (EDT)	Audible sound levels (dBA)					Class 3 NPC-300 sound level limits (Day/Night)
			Reported LA_{eq}	Unfiltered LA_{eq}	Lowest LA_{90} (60 sec)	Lowest LA_{eq} (60 sec)	Lowest LA_{eq} (60 sec, Insect)	
North	19-Sep	15:02-16:13	**39.1** [a]	59.7	37.8	39.6	37.1 [a]	40 /45
South	19-Sep	13:18-14:31	**38.9** [a]	45.3	41.5	42.4	33.7 [a]	40 /45
West	19-Oct	14:29-15:53	**38.3**	56.1	30.1	35.3	N/A [b]	40 / 45

[a] Adjusted for insect noise as described in 5.2.2

[b] Insect noise was not as prevalent at this location, and so no adjustment was made.

Measurements were originally performed on Thursday, 19 September 2019. One measurement (West) was discarded and re-performed on Saturday, 19 October 2019 because the Project was not operating at sufficient capacity on the first day.

Insect noise and traffic noise were the biggest influence on the sound environment, and overall traffic levels were louder during the weekdays.

Insect noise was prevalent throughout the entire North and South measurement periods, and less noticeable at the West location. Insect noise was prevalent at higher frequencies. As described in section 5.2.2, the value of the high frequencies contaminated with high insect noise at the North and South locations were adjusted with consideration to levels at adjacent frequencies.

During the North measurement, 150 vehicles were counted by the on-site staff. Periods between the vehicles were included in reported results, and measurement samples with vehicle noise was removed. The sound levels fluctuate significantly for the North and West locations based on noise from vehicles, the South location is farther away from the busy road.

The unfiltered LA_{eq} is presented in Table 5-6 with sound levels between 45.3 dBA and 59.7 dBA. Samples with background sounds were removed from the dataset following the guidelines set forth in NPC-103 [3].

Table 5-6 Summary of sound sample filtering

	Unfiltered number of recorded samples	Unfiltered LA_{eq}	Number of remaining filtered samples	Reported LA_{eq}
North	4252	59.7	2361	39.1*
South	4417	45.3	4346	38.9*
West	5057	56.1	1996	38.3

* Adjusted for insect noise as described in 5.2.2

Figure 5-2 and Figure 5-3 present the temporal variation of LA_{eq},10 sec. These figures provide a snapshot of the fluctuations of sound levels during the three measurement periods. It also shows the LA_{90}, LA_{50} and unfiltered LA_{eq} calculated for each of the periods corresponding to each receptor. The energy production data is also shown for the day of the measurements. The time stamp is in Eastern Daylight Time (EDT).

The temporal variation of the LA_{eq} measurements is presented for each measurement location individually in Figure 5-4 to Figure 5-6. These graphs also show the lowest short-term (1-second LA_{eq} during the measurement period of each measurement location. This is an alternative method of evaluating the steady state LA_{eq} contribution of the solar facility by filtering out ambient noise. This is supported by NPC-103.3.4.e: Procedure for Measurement of Steady or Impulsive Sound:

> *a minimum of three observations with a minimum observation time of 15 s each shall be made. The observed average reading for each of the observations shall be noted as well as the minimum and the maximum of the range of sound levels during each observation period. If the difference between any two observed average readings is greater than 3 dB, a minimum of six observations shall be made. For the purpose of adjustments for intermittency the duration of the sound in any one hour shall be noted.*

However, since the existing noise environment is dominated by traffic and insect noise, which causes sound levels to fluctuate throughout the monitoring periods, additional analysis is presented.

These metrics combined with the figures are presented to support the filtering used as well as the conclusions.

During individual measurements, there are small periods when the solar facility is operating below 100%. However, there is no reduction in sound levels during these periods.

Figure 5-2 and Figure 5-3 present the measured sound levels at all measurement points, without adjustments, as well as the corresponding LA_{eq}, L50 and L90. The individual time history for the South and North locations in Figure 5-4and Figure 5-5 are presented after the adjustment for insect noise that was prevalent on September 19th, as described in Section 5.2.2. Figure 5-6 presents the West location measurement from October 19th, without any adjustments for insect noise.

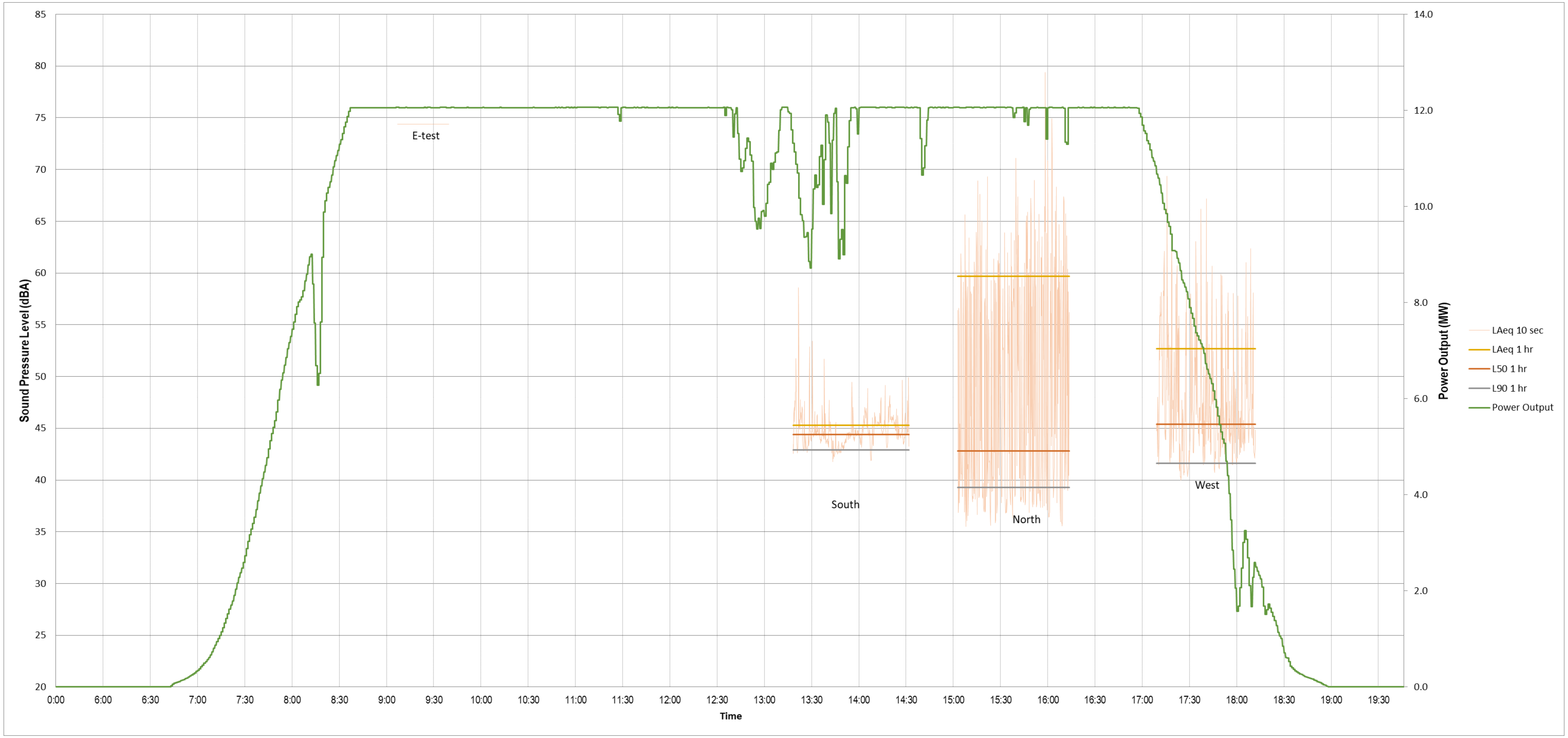

Figure 5-2 Measured SPL at Pendleton 19 September 2019 (EDT)

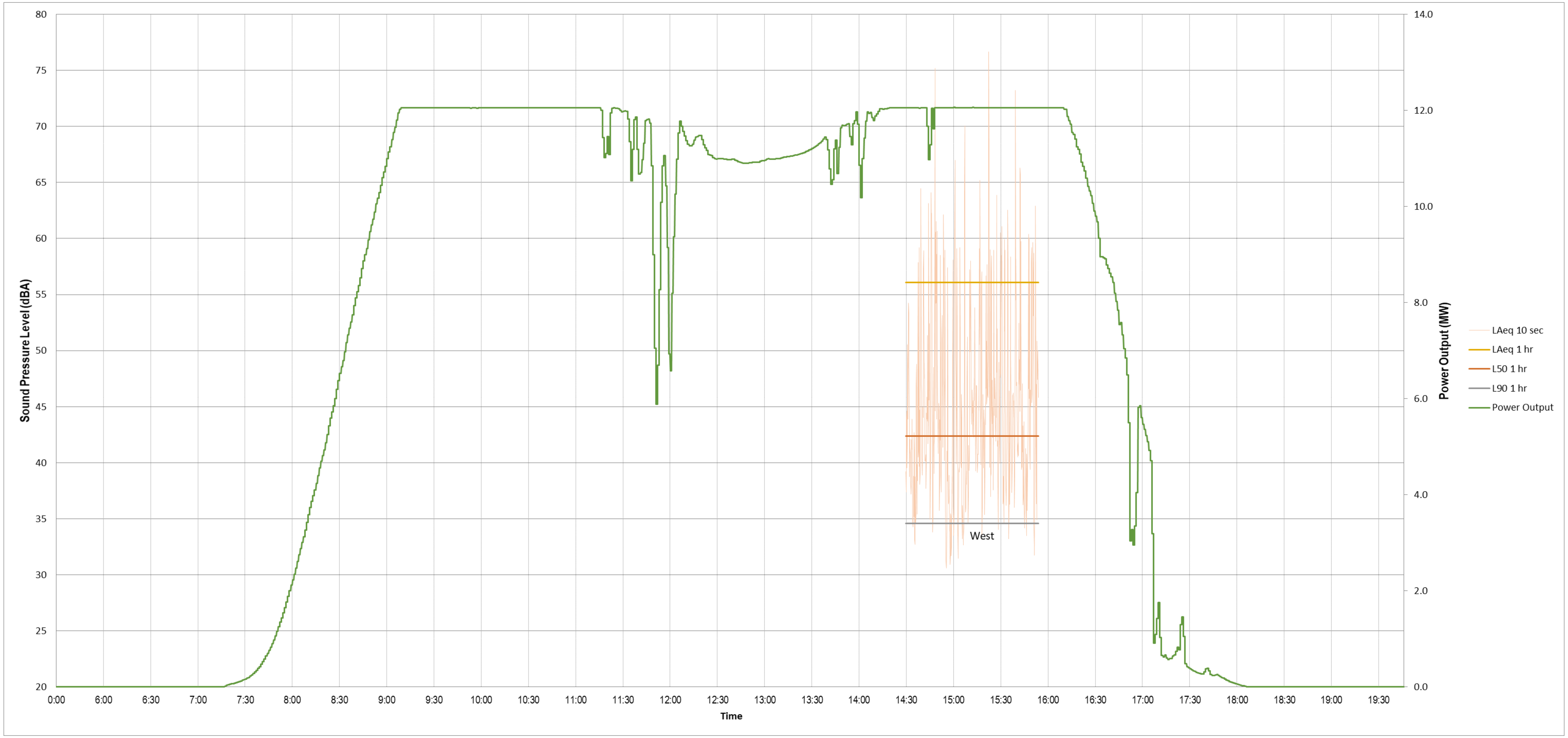

Figure 5-3 Measured SPL at Pendleton 19 October 2019 (EDT)

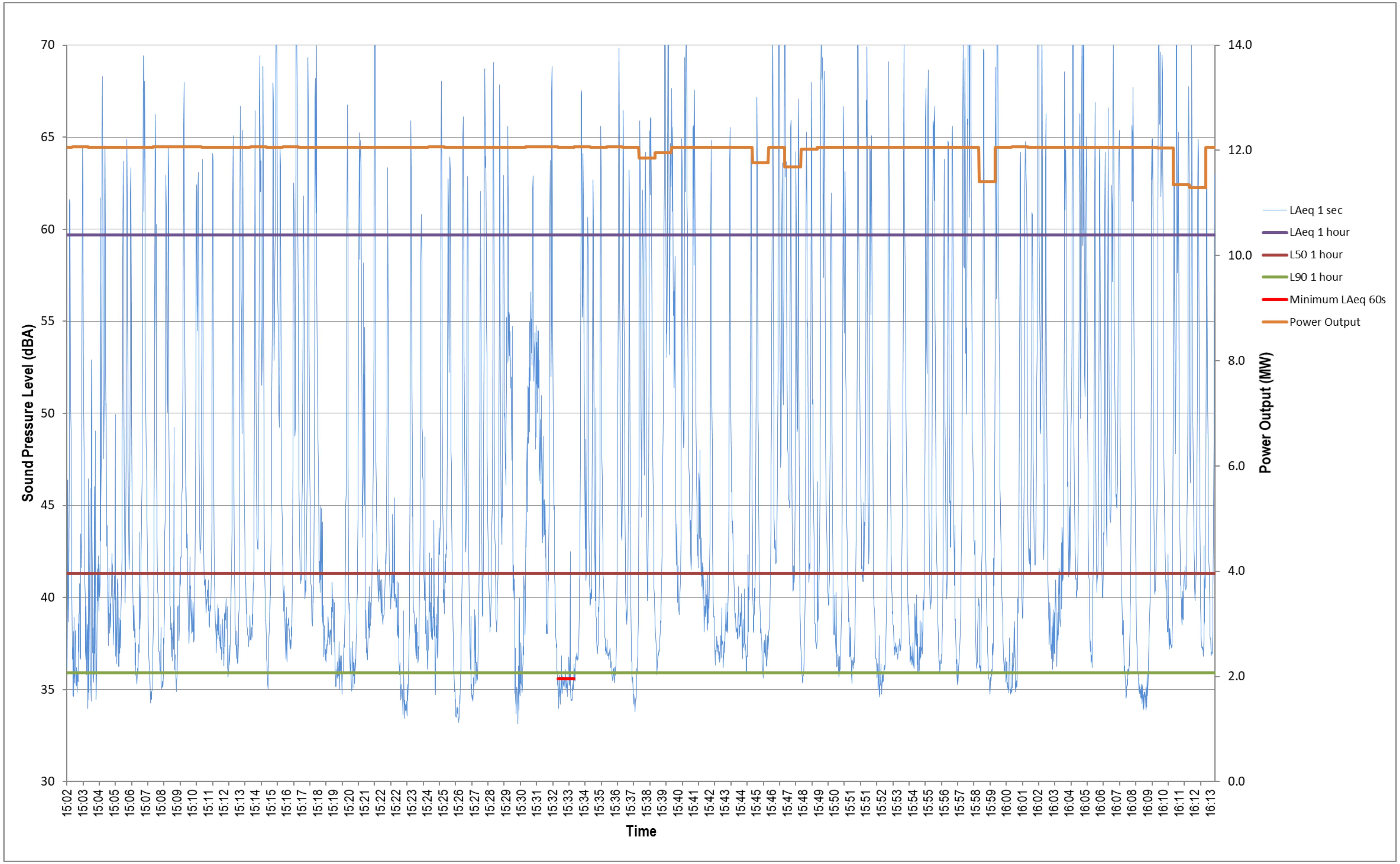

Figure 5-4 Measured SPL at North Location 19 September 2019 (EDT) Adjusted for insect noise

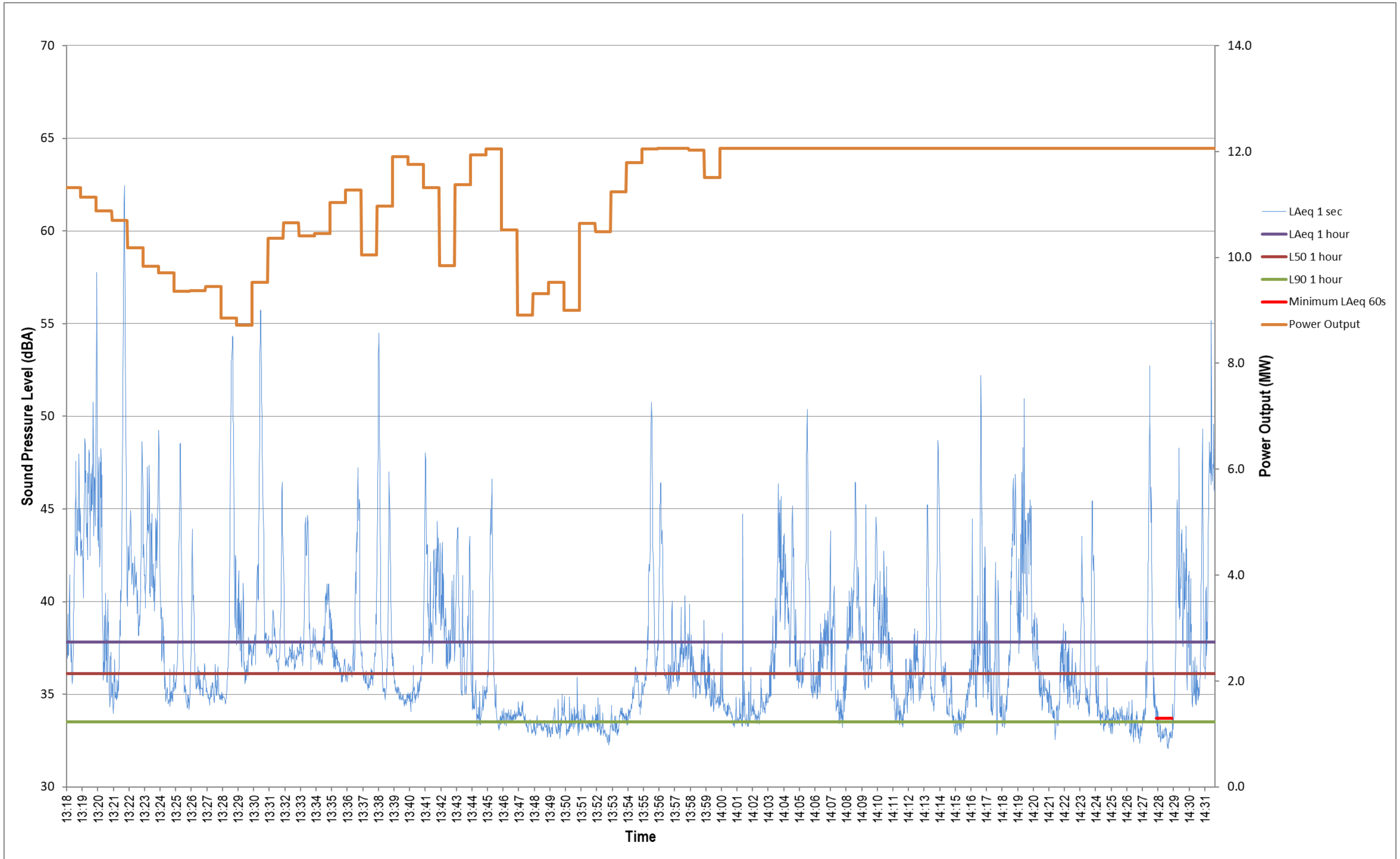

Figure 5-5 Measured SPL at South Location 19 September 2019 (EDT) Adjusted for insect noise

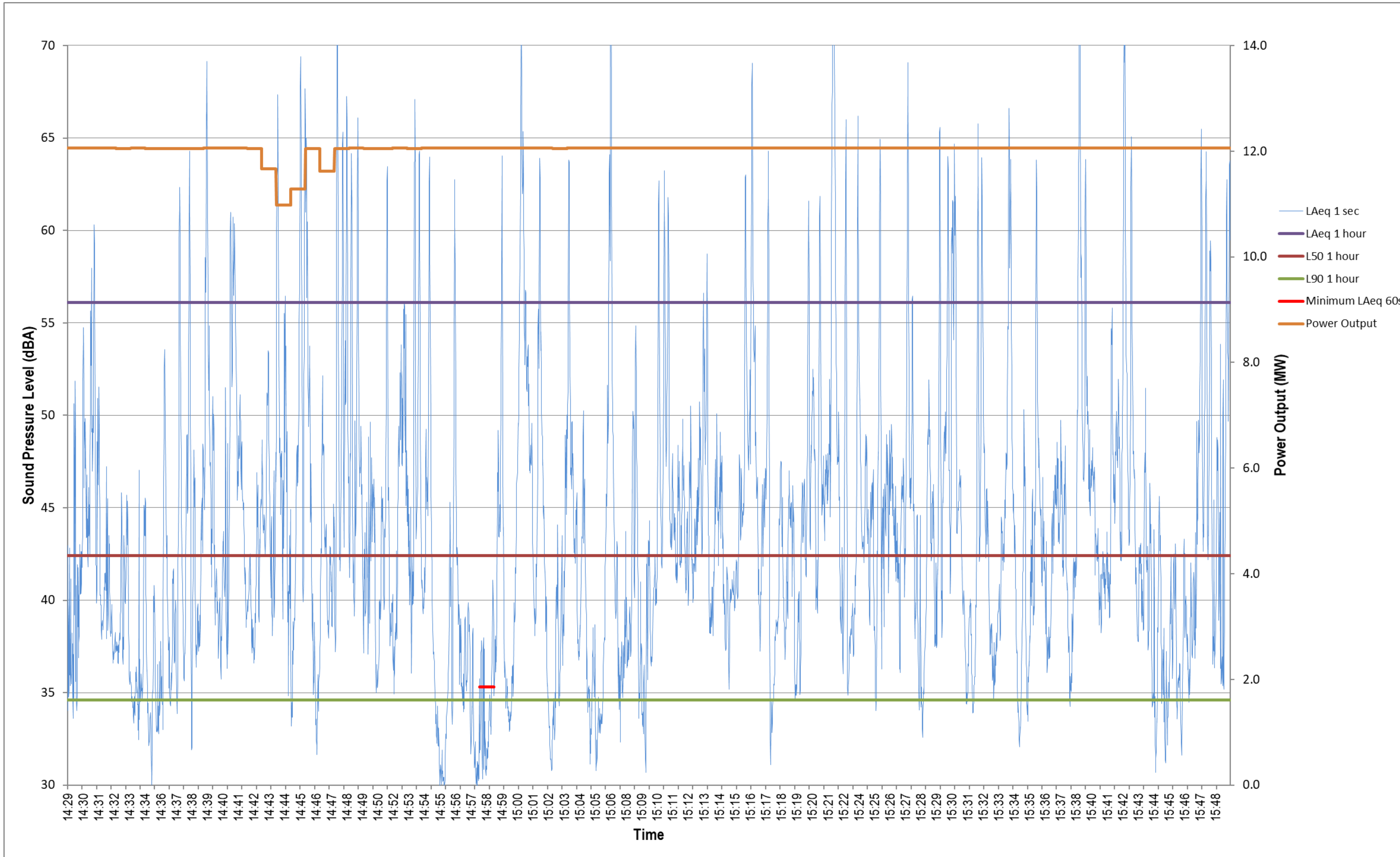

Figure 5-6 Measured SPL at West Location 19 October 2019 (EDT)

5.2.2 Determination of tonality at PoRs

The LA_{eq} 1/3 octave band sound pressure levels were averaged over the entire measurement period for each measurement location to determine a long-term audible LA_{eq} spectrum. The averaged 1/3 octave band SPL spectrums are presented in Table 5-7 through Table 5-9. It should be noted that these are values represent the unfiltered values of what was measured on-site, and not the reported values in Table 5-5.

Table 5-7 One-third octave band frequency spectrum at North measurement location

Frequency [Hz]	**6.3**	**8**	**10**	**12.5**	**16**	**20**	**25**	**31.5**	**40**	**50**	**63**	**80**
SPL [dBA]	-29.7	-24.9	-19.6	-9.9	-6.4	-0.3	9.0	13.3	20.2	28.4	31.3	37.3

Frequency [Hz]	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**
SPL [dBA]	43.9	48.3	44.3	44.5	43.9	46.4	47.9	48.6	48.4	50.8	51.2	50.4

Frequency [Hz]	**1600**	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**	**12500**	**16000**	**20000**
SPL [dBA]	49.0	46.4	42.5	40.6	37.7	36.4	28.2	27.9	20.0	9.4	4.1	1.1

Table 5-8 One-third octave band frequency spectrum at South measurement location

Frequency [Hz]	**6.3**	**8**	**10**	**12.5**	**16**	**20**	**25**	**31.5**	**40**	**50**	**63**	**80**
SPL [dBA]	-37.5	-33.2	-27.6	-19.9	-11.4	-2.8	4.6	5.7	9.8	16.1	25.3	26.9

Frequency [Hz]	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**
SPL [dBA]	28.0	30.2	27.2	30.6	30.1	28.7	26.8	25.9	26.4	27.4	28.1	26.6

Frequency [Hz]	**1600**	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**	**12500**	**16000**	**20000**
SPL [dBA]	24.9	21.2	20.3	29.3	39.2	39.0	22.9	38.4	27.4	5.4	7.7	2.5

Table 5-9 One-third octave band frequency spectrum at West measurement location

Frequency [Hz]	**6.3**	**8**	**10**	**12.5**	**16**	**20**	**25**	**31.5**	**40**	**50**	**63**	**80**
SPL [dBA]	-40.0	-35.3	-28.5	-20.2	-12.6	-4.1	2.5	9.3	18.5	26.0	28.8	37.5

Frequency [Hz]	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**
SPL [dBA]	41.2	46.8	45.0	45.2	40.7	42.3	40.0	42.7	44.7	46.7	48.0	46.0

Frequency [Hz]	**1600**	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**	**12500**	**16000**	**20000**
SPL [dBA]	43.5	40.6	36.7	34.1	30.7	27.6	22.9	20.6	13.4	6.5	1.8	-0.7

As defined in ISO 1996-2 [9], a tonal component represents a peak within the 1/3 octave spectrum with a difference of 5 dB or more with both adjacent 1/3 octave bandwidths.

As shown in Figure 5-7 through Figure 5-9, no audible tonality from the solar facility as defined in [9] occurs for any of the three receptors. Insect noise was prevalent in the measurements at the South and North locations. Octave band sound levels at both measurement locations were corrected for insect noise. The octave bands before and after adjustment are shown in the figures.

The West location was farther away from the Project area, and no adjustment for insect noise was needed. There were no tonal peaks at the West location. Amplitudes of higher frequencies gradually decline at a steady rate.

The North location had consistent insect noise in the 3150, 5000 and 8000 Hz bands. The South location had consistent insect noise in the 4000, 5000 and 8000 Hz band with levels near 40 dBA, while the other bands were all below 31 dBA. At the North location, noise from vehicle activity increase the overall sound levels, so the adjustment to the one-third octave bands is less noticeable in Figure 5-7.

It should be noted that, in Table 5-4, the loudest octave band frequencies from the inverter cluster are below 1000 Hz. High-frequency noise detected at measurement locations does not originate from the inverter clusters, but rather, from insects.

For the measurement data, the tonal peaks of insect noise were replaced by averaging adjacent one-third octave bands. The insect noise was observed by the field technician and is audible in the recorded audio samples.

No tone from the solar equipment was perceived by the DNV GL field engineer at the PoRs during the measurements. Thus, no 5-dB tonal penalty was applied to the measured sound levels at the PoRs.

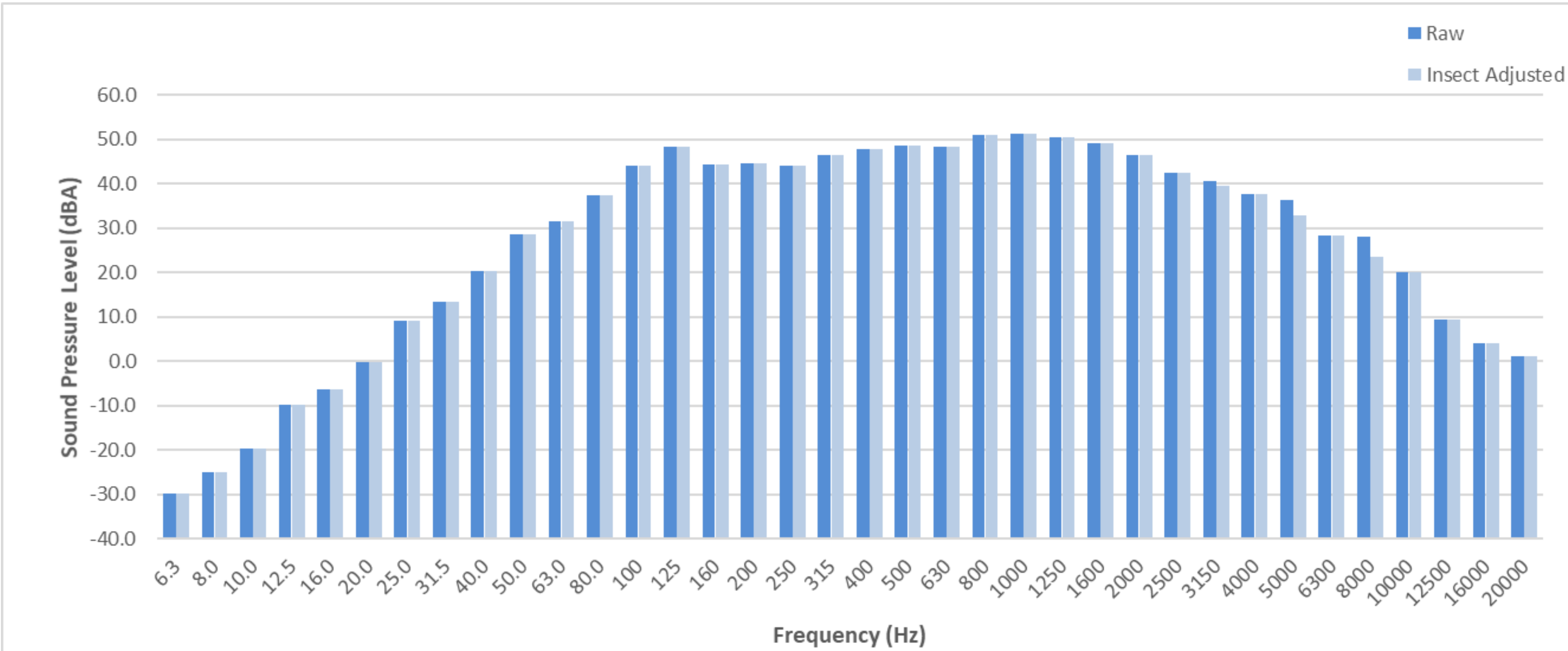

Figure 5-7 One-third octave band spectrum at North monitoring location

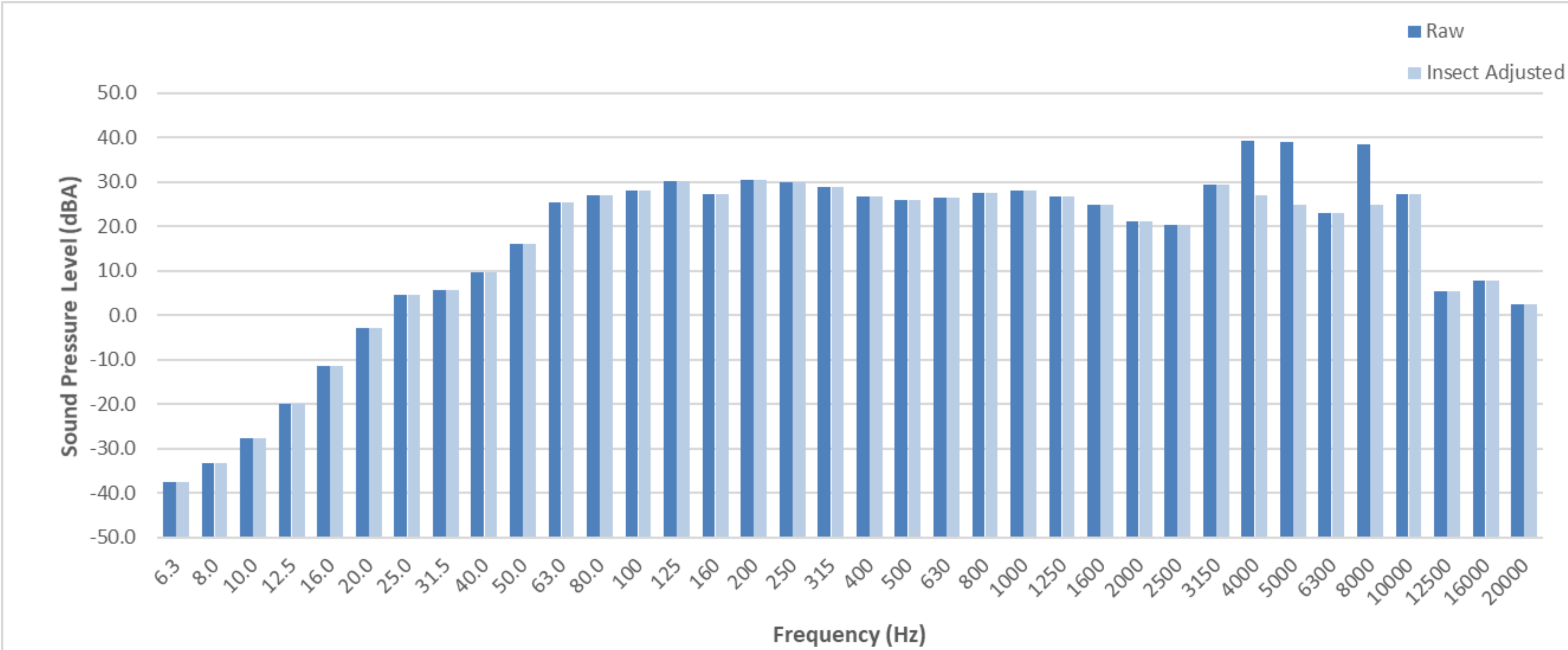

Figure 5-8 One-third octave band spectrum at South monitoring location

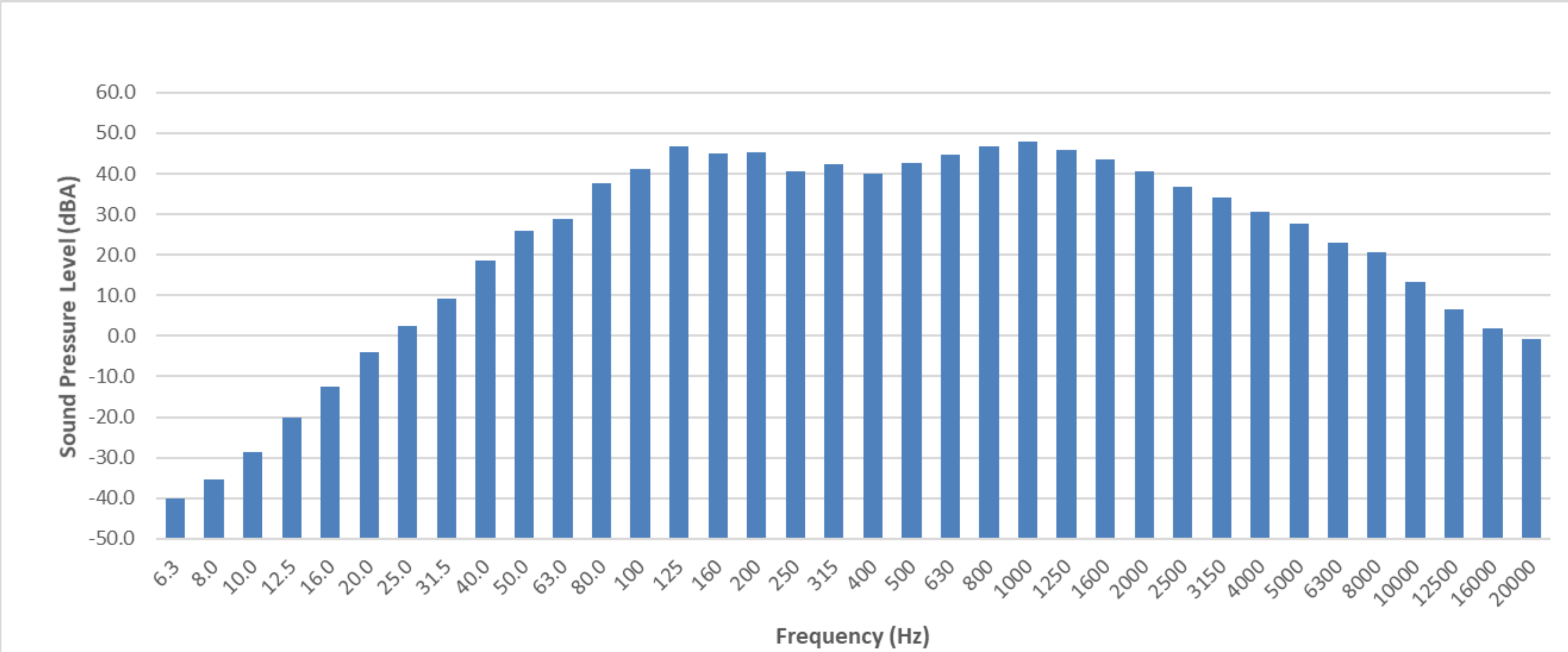

Figure 5-9 One-third octave band spectrum at West monitoring location

6 CONCLUSION

DNV GL performed an acoustic audit of the Pendleton Solar Energy Centre in order to demonstrate compliance with Condition D1 of the Project REA [1]. The methodology was discussed with the MECP prior to conducting the measurements and was agreed upon [2]. The objectives of this analysis were twofold:

- To assess and characterize the actual noise emitted by the inverter/transformer clusters (emission);
- To verify that the Project's contribution to the noise levels at the residences or vacant lot receptors complies with prescribed limits (immission).

An emission test (E-test) was performed at a noise inverter cluster, when the facility was operating at full capacity, to the fulfill the requirements of the Project REA. There was no tonality observed and measured at the sources. The inverter/transformer cluster sound levels are similar to the value used in the Acoustic Assessment Report [6] for the pre-construction noise simulation. The sound emitted from the components could not be fully isolated from each other. Therefore, the presented levels for each component can be considered conservative because the noise from adjacent equipment would increase the measured value of each component. The sources are therefore considered to be in line with the overall equipment sound level limits in the Project REA [1] and the pre-construction AAR.

A solar facility will generally run during the daytime period where the NPC-300 class 3 limits are 45 dBA. Even with the heavy contribution of traffic noise, all reported LA_{eq} values are within this limit. There will be some weeks of the year with extended sunlight hours, and the Project may run during hours considered as evening or nighttime. The measurements are well below the daytime 45 dBA limit, and after consideration for the existing soundscape and the conservative placement of the measurement location, the Project contribution can be shown to be below 40 dBA at all three selected PoRs.

The Project shows that, during periods when there is a pause in the traffic, measurements are below the sound level limits described in NPC-233 at all three locations using the methods described in NPC-103. This is further supported by the L90 values shown in the graphs for the north and west locations. This can be shown both in the visual graphs, as well as with the lowest measured 1-minute L90 and 1-minute LA_{eq}. Per NPC-103, a minimum of three observations with a minimum observation time of 15 seconds each shall be made for a steady noise source, such as a solar facility. There are many 15 second periods, between intermittent sounds, where 15 second samples show sound levels below 40 dBA.

No tonality from the facility was measured or observed during the measurement period at any of the three PoRs. No tonal penalty was applied to the measured sound levels at receptors. The measurements were conducted on sunny days. All equipment was in full operation, with the energy production reaching its maximal capacity.

Considering the various metrics and conservative placement of the measurement locations, the Project was found to be in compliance with Condition D1 of the REA.

7 REFERENCES

[1] Ontario Ministry of the Environment and Climate Change. Pendleton Solar Energy Centre, Renewable Energy Approval, number 3116-AWEQUG. 3 April 2018.

[2] Noise Monitoring Protocol (DNV GL) presented to Miroslav Ubovic (MECP), and subsequent emails, dated 2 and 4 June 2019.

[3] MOE Publication NPC-103, Procedures. 1978.

[4] MOE Publication NPC-233, Information to be submitted for approval of stationary sources of sound. 1995.

[5] MOE Publication NPC-300, Environmental Noise Guideline, Stationary and Transportation Sources - Approval and Planning Publication NPC-300", August 2013.

[6] Stantec. Pendleton Solar Energy Centre Acoustic Assessment Report. 2017. File 160950878. 24 October 2017.

[7] International Electrotechnical Commission, "IEC 61672 Electroacoustics – Sound Level Meter," First Edition 2002-05.

[8] IEEE Std C57.12.90 - Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers. 2015.

[9] ISO 1996-2 "Acoustics -- Description, measurement and assessment of environmental noise – Part 2: Determination of environmental noise levels".

APPENDIX A – PICTURES OF INVERTER CLUSTERS

Figure A-1 Transformer / Inverter Cluster 1

Figure A-2 Transformer / Inverter Cluster 2

Figure A-3 Inverter cluster 3

Figure A-4 Inverter cluster 4

Figure A-5 Inverter cluster 5

APPENDIX B – PICTURES OF SOUND MEASUREMENT LOCATIONS


Figure B-1. North measurement location facing EPOR065 to the north and to the Project to the south


Figure B-2. South measurement location facing Project to the north and EPOR001 to the south

Figure B-3. West measurement location facing EPOR084 and facing the Project to the east

APPENDIX C – INSTRUMENT CALIBRATION CERTIFICATES

Calibration Certificate

Certificate Number 2019004758
Customer:
GL Garrad Hassan Canada
4100 Rue Molson Suite 100
Montreal,QC H1Y 3N1,Canada

Model Number	831C	***Procedure Number***	D0001.8384
Serial Number	10368	***Technician***	Ron Harris
Test Results	**Pass**	***Calibration Date***	18 Apr 2019
Initial Condition	AS RECEIVED same as shipped	***Calibration Due***	18 Apr 2020
		Temperature	23.83 °C ± 0.25 °C
Description	Larson Davis Model 831C Class 1 Sound Level Meter Firmware Revision: 03.3.0R3	***Humidity***	48.8 %RH ± 2.0 %RH
		Static Pressure	87.26 kPa ± 0.13 kPa

Evaluation Method ***Tested with:*** ***Data reported in dB re 20 μPa.***

Larson Davis PRM831. S/N 051224
PCB 377B02. S/N 303859
Larson Davis CAL200. S/N 9079
Larson Davis CAL291. S/N 0108

Compliance Standards Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8378:

IEC 60651:2001 Type 1	ANSI S1.4-2014 Class 1
IEC 60804:2000 Type 1	ANSI S1.4 (R2006) Type 1
IEC 61260:2014 Class 1	ANSI S1.11-2014 Class 1
IEC 61672:2013 Class 1	ANSI S1.43 (R2007) Type 1

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005.
Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

This report may not be reproduced, except in full, unless permission for the publication of an approved abstract is obtained in writing from the organization issuing this report.

Correction data from Larson Davis SoundAdvisor Model 831C Reference Manual, I831C.01 Rev B, 2017-03-31

For 1/4" microphones, the Larson Davis ADP024 1/4" to 1/2" adaptor is used with the calibrators and the Larson Davis ADP043 1/4" to

VAISALA

Test report no. H31-18130045

TEST REPORT

Product family WXT530 series
Product type WXT536
Order code 6B1B2A1D1A1B
Serial number P1320473
Manufacturer Vaisala Oyj, Finland
Test date 27 March 2018

This test report certifies that the product was thoroughly tested and inspected, and found to meet its published test limits when it was shipped from Vaisala.

Test results

Test	Result	Lower limit	Upper limit	Unit
Rain response	394	345	575	mV
Zero wind speed	0	0	0.4	m/s
Pressure difference	-0.14	-1	1	hPa
Temperature difference	0.04	-2	2	°C
Humidity difference	-1	-10	10	%RH
Heating current	0.72	0.6	0.8	A
Current (service port)	0.96	0.5	2	mA
Communication (service port)	pass	PASS	PASS	-
Current (main port)	0.61	0.5	2	mA
Communication (main port)	pass	PASS	PASS	-

Ambient conditions / Humidity 15.7 ±5 %RH, Temperature 23.2 ±1 °C, Pressure 1013.07 ±1 hPa.

Signature

Technician

This report shall not be reproduced except in full, without the written approval of Vaisala. *DOC233154-A.doc*

Vaisala Oyj | PO Box 26, FI-00421 Helsinki, Finland
Phone +358 9 894 91 | Fax +358 9 8949 2227

APPENDIX D – LANDOWNER REQUESTS

Parcel Name	Pin	Address / Location	Notes
EPOR065	541090119	PT S1/2 LT 19 CON 7 NORTH PLANTAGENET PT 1 46R5563 TOWNSHIP OF ALFRED AND PLANTAGENET	Access granted.
EPOR064	541090120	PT S1/2 LT 19 CON 7 NORTH PLANTAGENET PT 1 46R4146; ALFRED/PLANTAGENET	Alterative site, EPOR065 has already accepted the study.
EPOR001	541090178	PT LT 20 CON 8 NORTH PLANTAGENET PT 4 46R5263; ALFRED/PLANTAGENET	No contact information found for landowner. Measurement was taken near property on facility grounds.
EPOR084	541090163	PT LT 21 CON 8 NORTH PLANTAGENET AS IN R19158; ALFRED/PLANTAGENET	Access granted.
EPOR006	541090176	PT LT 20 CON 8 NORTH PLANTAGENET PT 1 & 2 46R2184; ALFRED/PLANTAGENET	Alterative site, EPOR065 has already accepted the study.

APPENDIX E – OTTAWA -ENVIRONMENTAL CANADA WEATHER RECORDS

Français

Government of Canada | Gouvernement du Canada

Search Canada.ca

MENU

Home > Environment and natural resources > Weather, Climate and Hazard > Past weather and climate > Historical Data

OTTAWA INTL A

ONTARIO

Current Station Operator: NAVCAN

Latitude:	45°19'00.000" N	**Longitude:**	75°40'00.000" W	**Elevation:**	114.90 m
Climate ID:	6106001	**WMO ID:**	71628	**TC ID:**	YOW

Hourly Data Report for September 19, 2019

TIME	Temp °C	Dew Point °C	Rel Hum %	Wind Dir 10's deg	Wind Spd km/h	Visibility km	Stn Press kPa	Hmdx	Wind Chill	Weather
00:00	9.7	6.5	81	36	2	24.1	101.28			NA
01:00	9.1	6.6	84	4	8	24.1	101.29			**Mainly Clear**
02:00	9.4	6.6	83	3	9	24.1	101.27			NA
03:00	8.6	6.3	85	35	10	24.1	101.25			NA
04:00	8.2	6.0	85	6	9	24.1	101.26			**Clear**
05:00	6.3	5.4	94	10	9	24.1	101.25			NA
06:00	6.5	5.6	94	9	3	24.1	101.26			NA
07:00	9.2	7.0	86	7	7	24.1	101.32			**Clear**
08:00	11.1	8.3	83	19	9	24.1	101.33			NA
09:00	14.6	8.7	68	18	5	24.1	101.30			NA
10:00	17.0	10.2	64	19	4	24.1	101.24			**Mainly Clear**
11:00	19.6	10.8	57	20	3	24.1	101.19			NA
12:00	20.5	10.7	53	16	7	24.1	101.15			NA
13:00	22.0	10.3	47	20	8	24.1	101.14			**Mainly Clear**
14:00	23.4	12.2	49	15	11	24.1	101.08	**26**		NA
15:00	23.5	10.8	44	16	18	24.1	101.00	**25**		NA
16:00	23.4	11.3	46	16	14	24.1	101.00	**25**		**Mainly Clear**
17:00	22.2	11.1	49	17	12	24.1	100.99			NA
18:00	19.4	11.2	59	17	7	24.1	100.98			NA
19:00	17.8	10.8	63	19	10	24.1	100.97			**Mostly Cloudy**
20:00	16.4	10.6	68	20	9	24.1	100.98			NA
21:00	14.9	10.0	72	18	10	24.1	100.97			NA
22:00	14.5	9.7	72	19	9	24.1	100.95			**Mostly Cloudy**
23:00	14.1	9.5	74	20	7	24.1	100.93			NA

Hourly Data Report for October 19, 2019

TIME	Temp °C	Dew Point °C	Rel Hum %	Wind Dir 10's deg	Wind Spd km/h	Visibility km	Stn Press kPa	Hmdx	Wind Chill	Weather
00:00	2.2	-0.4	83	28	8	24.1	100.31			NA
01:00	2.2	0.1	86	29	11	24.1	100.33			Clear
02:00	1.1	-0.2	92	28	9	24.1	100.37			NA
03:00	-0.3	-1.6	91	30	11	24.1	100.39		-4	NA
04:00	-0.4	-1.3	93	29	8	24.1	100.43		-3	Clear
05:00	-0.4	-1.0	96	26	3	24.1	100.43		-1	NA
06:00	-1.1	-1.5	97	27	5	24.1	100.48		-3	NA
07:00	0.3	0.2	99	31	7	24.1	100.51			Mainly Clear
08:00	1.8	1.1	95	24	4	24.1	100.58			NA
09:00	5.0	1.4	77	29	6	24.1	100.57			NA
10:00	6.9	1.6	69	32	7	24.1	100.59			Mainly Clear
11:00	8.2	1.1	60	30	9	24.1	100.56			NA
12:00	8.1	-0.1	56	29	8	24.1	100.50			NA
13:00	9.1	0.4	54	33	10	24.1	100.43			Mainly Clear
14:00	9.8	0.4	52	27	9	24.1	100.37			NA
15:00	10.1	0.9	53	29	10	24.1	100.34			NA
16:00	8.9	0.9	57	26	4	24.1	100.32			Mostly Cloudy
17:00	8.1	1.0	61	10	4	24.1	100.31			NA
18:00	4.3	1.3	81	6	7	24.1	100.34			NA
19:00	3.1	1.1	86	8	7	24.1	100.32			Clear
20:00	4.0	0.5	78	9	8	24.1	100.31			NA
21:00	4.6	0.1	72	11	10	24.1	100.28			NA
22:00	4.6	0.0	72	12	9	24.1	100.29			Clear
23:00	3.2	-0.2	78	13	3	24.1	100.27			NA

Daily Data Report for September 2019

DAY	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days	Cool Deg Days	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10's deg	Spd of Max Gust km/h
01	24.0	8.4	16.2	1.8	0.0	2.7	0.0	2.7		11	32
02	24.4	13.3	18.9	0.0	0.9	1.1	0.0	1.1		32	32
03	20.3	10.5	15.4	2.6	0.0	3.7	0.0	3.7		10	35
04	22.9	7.3	15.1	2.9	0.0	7.3	0.0	7.3		29	61
05	22.1	6.5	14.3	3.7	0.0	0.0	0.0	0.0		28	M
06	21.8	11.2	16.5	1.5	0.0	7.6	0.0	7.6		1	35
07	18.0	11.6	14.8	3.2	0.0	0.6	0.0	0.6		28	M
08	17.8	7.1	12.5	5.5	0.0	0.0	0.0	0.0		27	46
09	17.4	4.0	10.7	7.3	0.0	0.0	0.0	0.0		M	M
10	16.7	3.2	10.0	8.0	0.0	3.1	0.0	3.1		M	M
11	25.9	13.2	19.6	0.0	1.6	1.3	0.0	1.3		30	48
12	20.2	7.9	14.1	3.9	0.0	0.0	0.0	0.0		2	35
13	21.0	6.4	13.7	4.3	0.0	4.8	0.0	4.8		14	45
14	23.8	12.2	18.0	0.0	0.0	1.9	0.0	1.9		20	55
15	16.9	7.6	12.3	5.7	0.0	0.2	0.0	0.2		28	35
16	21.0	4.5	12.8	5.2	0.0	0.0	0.0	0.0		M	M
17	22.4	7.7	15.1	2.9	0.0	0.0	0.0	0.0		M	M
18	20.5	7.7	14.1	3.9	0.0	0.0	0.0	0.0		11	32
19	24.0	5.4	14.7	3.3	0.0	0.0	0.0	0.0		M	M
20	26.4	9.3	17.9	0.1	0.0	0.0	0.0	0.0		M	M
21	28.1	11.7	19.9	0.0	1.9	0.0	0.0	0.0		M	M
22	27.6	15.3	21.5	0.0	3.5	T	0.0	T		22	46
23	25.0	13.4	19.2	0.0	1.2	11.1	0.0	11.1		29	45
24	18.0	7.8	12.9	5.1	0.0	0.7	0.0	0.7		29	42
25	22.9	4.5	13.7	4.3	0.0	T	0.0	T		22	46
26	19.8	7.2	13.5	4.5	0.0	8.3	0.0	8.3		29	50
27	20.6	6.2	13.4	4.6	0.0	1.2	0.0	1.2		17	41
28	18.4	8.6	13.5	4.5	0.0	4.7	0.0	4.7		34	39
29	15.1	5.1	10.1	7.9	0.0	0.0	0.0	0.0		5	M
30	15.7	5.7	10.7	7.3	0.0	4.1	0.0	4.1		9	33
Sum				104.0	9.1	64.4	0.0	64.4			
Avg	21.3	8.4	14.8								
Xtrm	28.1	3.2								29^	61^

Daily Data Report for October 2019

DAY	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days	Cool Deg Days	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10's deg	Spd of Max Gust km/h
01	17.6	8.0	12.8	5.2	0.0	4.1	0.0	4.1		M	M
02	16.9	3.1	10.0	8.0	0.0	T	0.0	T		1	39
03	9.9	2.1	6.0	12.0	0.0	2.7	0.0	2.7		9	39
04	10.7	2.0	6.4	11.6	0.0	0.3	0.0	0.3		35	41
05	13.2	-3.1	5.1	12.9	0.0	0.0	0.0	0.0		M	M
06	18.0	5.1	11.6	6.4	0.0	0.9	0.0	0.9		19	46
07	17.6	7.3	12.5	5.5	0.0	T	0.0	T		19	39
08	16.8	1.5	9.2	8.8	0.0	0.0	0.0	0.0		M	M
09	16.4	1.8	9.1	8.9	0.0	0.0	0.0	0.0		M	M
10	18.7	2.6	10.7	7.3	0.0	0.0	0.0	0.0		7	M
11	20.2	2.6	11.4	6.6	0.0	0.0	0.0	0.0		8	35
12	14.3	4.7	9.5	8.5	0.0	1.6	0.0	1.6		10	32
13	15.8	0.4	8.1	9.9	0.0	0.0	0.0	0.0		13	35
14	12.4	2.8	7.6	10.4	0.0	0.6	0.0	0.6		23	37
15	14.8	0.6	7.7	10.3	0.0	0.0	0.0	0.0		22	35
16	15.6	5.7	10.7	7.3	0.0	16.2	0.0	16.2		16	59
17	9.9	7.0	8.5	9.5	0.0	15.0	0.0	15.0		34	48
18	9.5	0.4	5.0	13.0	0.0	T	0.0	T		29	45
19	10.4	-2.5	4.0	14.0	0.0	0.0	0.0	0.0		M	M
20	14.9	0.0	7.5	10.5	0.0	0.0	0.0	0.0		12	32
21	16.3	1.2	8.8	9.2	0.0	0.0	0.0	0.0		8	37
22	12.4	8.6	10.5	7.5	0.0	21.8	0.0	21.8		9	37
23	14.4	6.7	10.6	7.4	0.0	0.0	0.0	0.0		25	48
24	12.3	3.7	8.0	10.0	0.0	0.2	0.0	0.2		25	41
25	9.9	2.8	6.4	11.6	0.0	0.0	0.0	0.0		M	M
26	11.8	-0.2	5.8	12.2	0.0	T	0.0	T		8	39
27	11.6	4.7	8.2	9.8	0.0	29.5	0.0	29.5		7	48
28	14.8	4.8	9.8	8.2	0.0	T	0.0	T		29	32
29	18.3	4.4	11.4	6.6	0.0	0.0	0.0	0.0		20	48
30	12.7	7.2	10.0	8.0	0.0	3.3	0.0	3.3		32	32
31	9.6	7.0	8.3	9.7	0.0	35.2	0.0	35.2		25	76
Sum				286.8	0.0	131.4	0.0	131.4			
Avg	14.1	3.3	8.8								
Xtrm	20.2	-3.1								25^	76^

About DNV GL

Driven by our purpose of safeguarding life, property and the environment, DNV GL enables organizations to advance the safety and sustainability of their business. We provide classification, technical assurance, software and independent expert advisory services to the maritime, oil & gas and energy industries. We also provide certification services to customers across a wide range of industries. Combining leading technical and operational expertise, risk methodology and in-depth industry knowledge, we empower our customers' decisions and actions with trust and confidence. We continuously invest in research and collaborative innovation to provide customers and society with operational and technological foresight. Operating in more than 100 countries, our professionals are dedicated to helping customers make the world safer, smarter and greener.