**September 29, 2014**

## BURNCO AGGREGATE PROJECT

# Noise Baseline Study

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REPORT

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# 1.0 INTRODUCTION

BURNCO Rock Products Ltd. (BURNCO) is planning the development of a sand and gravel pit in Howe Sound, British Columbia (BC) to provide high quality construction aggregate for use in the BC lower mainland. The proposed BURNCO Howe Sound facility will hereafter be referred to as the Project. Golder Associates Ltd. (Golder) has been retained by BURNCO to conduct an Environmental Impact Assessment (EIA) for the Project. The EIA includes an assessment of environmental noise from the Project. To appropriately assess the impact of environmental noise from the Project it is necessary to characterize the existing acoustic environment in the Project area (i.e., the current noise levels in the area as a result of natural noise sources, human activities, and existing industrial noise sources). This report presents the results of a noise baseline study conducted during the summer of 2012 and fall of 2013 for the purpose of characterizing the existing acoustic environment.

In BC, there are no provincial noise requirements or standard methods for completing baseline noise surveys or environmental noise assessments for gravel load-out facilities like the Project. In the absence of formal guidance, the environmental noise from the Project will be assessed in accordance with noise regulations specified by the British Columbia Oil and Gas Commission (the Commission) in the document *British Columbia Noise Control Best Practices Guideline* (Commission 2009); hereafter referred to as the Guideline. The Guideline is only strictly applicable to oil and gas facilities, but is assumed to represent best practices for treatment of environmental noise from all industrial facilities in BC. Where the Guideline is lacking in specific details, additional guidance has been taken from noise regulations and guidelines published by other Canadian regulatory bodies.

The noise baseline study for the Project was conducted in accordance with the Guideline. Additional guidance for conducting the noise baseline study and processing the data was obtained from the Alberta Energy Resources Conservation Board (ERCB) document *Directive 038: Noise Control* (EUB 2007); hereafter referred to as Directive 038. In many ways Directive 038 is similar to the Guideline, but Directive 038 provides more details on appropriate methods for conducting field measurements than are available in the Guideline. Further guidance on the processing of noise baseline data was taken from the Health Canada document *Useful Information for Environmental Assessments* (Health Canada 2010); hereafter referred to as the Health Canada Guidance.

The focus of the environmental noise assessment is to determine Project-related changes to the existing or baseline noise levels in the Project area. Both the predicted change in noise levels as a result of the Project and the absolute cumulative noise levels predicted during Project construction and operation will be compared to relevant assessment criteria specified in the Guideline and in the Health Canada Guidance. Both the Guideline and Health Canada Guidance assess noise from a receptor perspective and recommend assessing environmental noise levels at locations where humans are likely to be exposed. The Guideline defines appropriate receptor locations as permanently or seasonally occupied dwellings within 1.5 kilometres (km) of the Project or, in the absence of any such dwellings, unoccupied locations 1.5 km from the Project. Health Canada expands this definition of an appropriate receptor to also include daycares, schools, hospitals, places of worship, nursing homes, and places important to First Nations and Inuit communities. Both the Guideline and Health Canada Guidance were considered when selecting receptors for baseline noise monitoring.

The objective of the noise baseline study is to establish the existing acoustic environment within the Project area. Later, as part of the EIA, this baseline information will be used, in combination with a computer noise model of the Project, to predict Project-related changes in noise levels and the absolute cumulative noise levels during Project construction and operation.

# 2.0 STUDY AREA

The Project will be located on a flat, glaciological fan-delta deposit comprising sand and gravel on the western shore of Howe Sound's Thornborough Channel, north of Gambier Island and approximately 22 km west-southwest of Squamish and 35 km northwest of Vancouver. The Local Study Area (LSA) for assessment of environmental noise from the Project extends out 1.5 km in all directions from the Project fence line or boundary. This definition of the noise LSA is consistent with the Guideline. The Regional Study Area (RSA) for assessment of environmental noise from the Project extends out 5 km in all directions from the Project fence line or boundary. The Guideline, Directive 038, and the Health Canada all lack any instructions for defining a noise RSA. In the absence of regulatory guidance, the noise RSA for the Project has been selected to include the entire area over which direct or cumulative effects from the Project could potentially be observed. Beyond 5 km noise is expected to be attenuated to such a level that it cannot be discerned from the ambient noise that is already in an area.

The noise RSA can currently be described as a recreation area used for hunting, fishing, camping, marine parks, and yacht clubs. Logging operations began in 2013 and are ongoing adjacent to the project site. There is an established recreational community (the McNab Strata Community) to the south east, adjacent to the proposed Project within the noise LSA. The McNab Strata Community will hereafter be referred to as the Community. The Community consists of approximately 12 to 15 seasonally occupied dwellings. The shortest distance between the Community and the Project fence line or boundary is about 450 metres (m). On the opposite side of the Thornbrough Channel (i.e., on the north side of Gambier Island), south of the Project site, there are several seasonably occupied dwellings, children's summer camps, and yacht club outstations. The receptors on the opposite side of the Thornbrough Channel are more than 3 km from the Project fence line or boundary. As such, they are outside of the noise LSA but still within the noise RSA.

According to the Guideline, the seasonally occupied dwellings in the Community are the only relevant noise sensitive receptors for the Project. Since the seasonally occupied dwellings, summer camps, and yacht clubs on the opposite side of the Thornbrough Channel are farther than 1.5 km from the Project fence line or boundary, the Guideline does not consider them relevant noise sensitive receptors. However, in the interest of characterizing existing noise levels across the entire RSA, baseline monitoring was conducted for more receptors than would be strictly considered relevant by the Guideline.

Baseline noise monitoring was conducted from four noise receptors:

- NR1 (BURNCO East) is located near the west shore of McNab Creek, within the noise LSA. NR1 was located approximately 50 m from McNab Creek and approximately 550 m upstream from Howe Sound, whereas the Community is located further downstream – the shortest distance between the Community dwelling and Howe Sound is less than 100 m. It was necessary to deploy NR1 farther upstream than the Community to ensure security of the noise monitoring equipment: the downstream area where McNab Creek meets Howe Sound is quite busy and it was not certain whether the noise monitoring equipment would be safe if left unattended in this area. Because the Community is located closer to Howe Sound than NR1 and because of the fact that water in McNab Creek beside the Community flows through a narrower channel than beside NR1, it is likely that the influence of sound generated by the ocean in Howe Sound and by the faster flowing water in McNab Creek on the baseline noise levels is larger at the Community than at NR1. Likewise, the baseline noise levels at the Community are also likely influenced by

noise from temporary power generators and human activities, whereas the baseline noise levels at NR1 are not. In summary, the baseline noise levels at NR1 are estimated to be lower than the baseline noise levels at the Community. Also NR1 is not within the forest and few wildlife including birds and insects were observed around the location resulting in little influence from wildlife on the recorded noise levels at NR1. The measured noise levels at NR1 are representative of open terrain besides slow flowing water with little or no bird, insect and wildlife activity. NR1 was measured before logging operations began, and therefore baseline noise levels will be corrected.

- NR2 (BURNCO West) is an unoccupied location approximately 500 m west of the Project fence line or boundary, in a densely forested area within the noise LSA. NR2 was selected to characterize baseline noise levels west of the Project, where there are no noise sensitive receptors as defined by either the Guideline or the Health Canada Guidance. In situations where there are no noise sensitive receptors, the Guideline indicates that environmental noise should be assessed at 1.5 km from the Project fence line or boundary, but in this case measuring baseline noise levels at 1.5 km was not feasible or logical. Although the Project itself will be located on a flat, glaciological fan-delta deposit, this flat area is bounded on three sides (west, north, and east) by coastal mountains. As a result, locations 1.5 km west of the Project fence line or boundary are inaccessible by land vehicle and are blocked from the Project itself by terrain. As a compromise between the Guideline and the challenging terrain, NR2 was located as far up the mountains west of the Project fence line or boundary as could be readily accessed. Baseline noise levels at NR2 are believed to be representative of baseline noise levels in the densely forested portions of the noise RSA, where the baseline noise levels are mainly influenced by natural sounds due to wildlife, birds and insects and wind through trees. NR2 was measured before logging operations began, and therefore baseline noise levels will be corrected.

- NR3 (BURNCO North) is an unoccupied location approximately 1.5 km north of the Project fence line or boundary, in a densely forested area on the edge of the noise LSA. NR3 was selected to characterize baseline noise levels north of the Project, where there are no noise sensitive receptors as defined by either the Guideline or the Health Canada Guidance. NR3 is located approximately 400 m from McNab Creek. Baseline noise levels at NR3 are believed to be representative of baseline noise levels in the densely forested areas close to the fast flowing water of McNab Creek and areas where the baseline noise levels are mainly influenced by rapid flowing water and other natural sound due to wildlife, birds and insect and wind. NR3 was measured before logging operations began, and therefore baseline noise levels will be corrected.

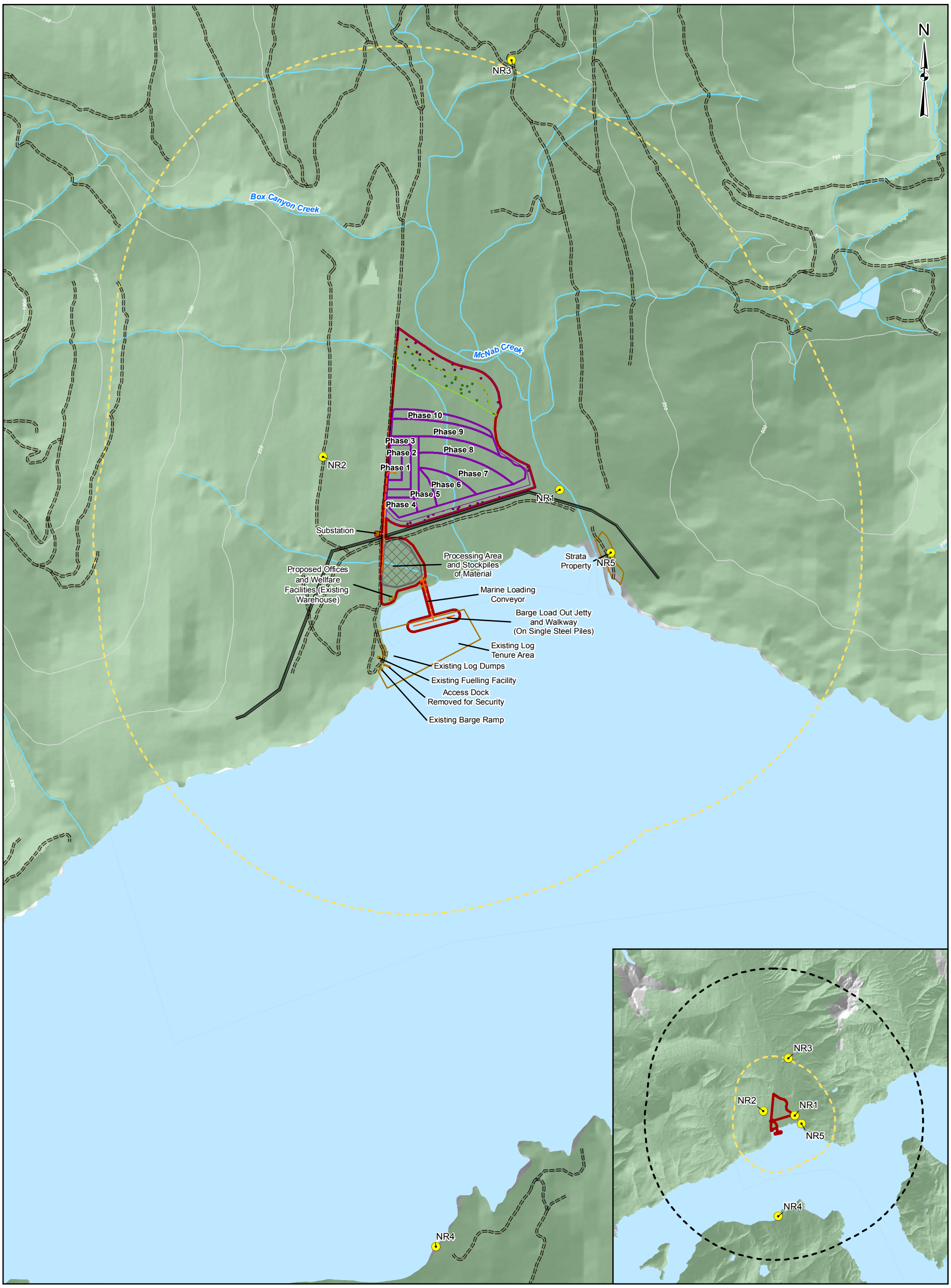
- NR4 (BURNCO South) is located within a children's summer camp on Gambier Island, across the Thornbrough Channel from the Project. NR4 is located further than 1.5 km from the Project fence line or boundary and is thus outside the noise LSA; it is, however, within the noise RSA. NR4 is located on the end of a disused dock and is immediately adjacent to Howe Sound. Baseline noise levels at NR4 are representative of baseline noise levels at the seasonally occupied dwellings, summer camps, and yacht club outstations close to the shore of Howe Sound or locations where human activities including sounds of ocean water dominate the baseline noise levels during daytime. NR4 was measured before logging operations began, and therefore baseline noise levels will be corrected.

- NR5 (Community) is centrally located within the Community, approximately 500 m from the Project fence line and located within the noise LSA. Baseline noise levels at NR5 are representative of baseline noise levels at the seasonally occupied dwellings in the Community. Baseline noise levels at NR5 were measured while logging was occurring and not occurring, and therefore are used to determine the logging correction at the other four receptor positions.

Table 1 provides the Universal Transverse Mercator (UTM) coordinates for the selected monitoring locations (NR1 – NR5). Figure 1 shows the location of the noise monitoring sites relative to the Project fence line or boundary. Photographs taken at the monitoring locations are presented in Photographs 1 to 5.

**Table 1: Coordinates for Selected Baseline Noise Monitoring Sites**

| Monitoring Location | Description | UTM (NAD83, Zone 10) | |
|---|---|---|---|
| | | Easting (m) | Northing (m) |
| NR1 – BURNCO East | Unoccupied location east of McNab Creek and within the Project fence line or boundary – representative of open areas besides slow flowing water and little wildlife, bird and insect activity. | 472286 | 5490348 |
| NR2 – BURNCO West | Unoccupied location approximately 500 m west of the Project fence line or boundary – representative of heavily forested western portions of the noise RSA and other areas that are heavily forested and have wildlife, bird and insect activity and sound from wind in trees. | 471028 | 5490525 |
| NR3 – BURNCO North | Unoccupied location approximately 1.5 km north of the Project fence line or boundary – representative of forested areas close to fast flowing water at the northern portions of the noise RSA. And areas which are forested are close to fast flowing water and have wildlife, bird and insect activity. | 472029 | 5492630 |
| NR4 – BURNCO South | Children's summer camp on Gambier Island – representative of seasonally occupied dwellings, summer camps, and yacht club outstations close to the shore of Howe Sound within the noise RSA. | 471629 | 5486330 |
| NR5 – McNab Strata Community | Seasonally occupied residence in the McNab Creek Community located approximately 500 m from the Project fence line – representative of all residences within the Community. | 472556 | 5490015 |




**LEGEND**

- Project Boundary
- Local Study Area
- Regional Study Area
- Proposed Aggregate Pit Area
- Planted Forest (Organics and Washed Fines)
- Berm (Organic + Wash Sediment Mixed and Planted)
- Processing Plant and Product Stockpile
- Existing Feature
- Conveyor Buffer
- Transmission Line
- Barge Load Out
- Conveyor
- Road (existing)
- Resource Road
- Contour (250m)
- Watercourse
- Noise Monitoring Location

**REFERENCE**

Parks/protected areas from BC LRDW, elevation and indian reserves from Geobase, base data from CanVec.
Projection: UTM Zone 10 Datum: NAD 83

500 0 500

SCALE 1:20,000 METRES

PROJECT

BURNCO ROCK PRODUCTS LTD.
BURNCO AGGREGATE PROJECT, HOWE SOUND, B.C.

TITLE

# STUDY AREA AND NOISE MONITORING LOCATIONS

Golder Associates

| PROJECT NO. 11-1422-0046 | | | PHASE No. | |
|---|---|---|---|---|
| DESIGN | ZY | 19 Nov. 2012 | SCALE AS SHOWN | REV. 1 |
| GIS | JP | 05 Nov. 2013 | FIGURE 2-1 | |
| CHECK | AC | 12 Jun. 2014 | | |
| REVIEW | RW | 12 Jun. 2014 | | |

Path: X:\Project Data\BC\McNab\Figures\MXD\Noise\BURNCO_NOISE_Figure_2-1_Noise_Study_Area.mxd

*Photograph 1: NR1 Noise Monitoring Setup*

*Photograph 2: NR2 Noise Monitoring Setup*

*Photograph 3: NR3 Noise Monitoring Setup*

*Photograph 4: NR4 Noise Monitoring Setup*

*Photograph 5: NR5 Noise Monitoring Setup*

# 3.0 METHODS

## 3.1 Monitoring Method

One survey of two to three days duration was completed at each of the first four noise monitoring locations. The monitoring measurements were conducted at NR1 and NR4 between August 14 and August 17 and at NR2 and NR3 between July 18 and July 21, 2012. Monitoring measurements at NR5 were conducted on October 15 and 16, 2013 while logging operations were ongoing, and between October 26 and 28, 2013, while no logging was occurring. Surveys of this type and duration provide information on daily variability in noise levels as well as an expected typical or average daily condition.

Model 2250 Brüel and Kjær Type I integrating sound level meters were used to collect the noise measurements and audio recordings; this type of meter logs noise levels and records audio data over intervals selected by the user. Data parameters logged for the survey periods included:

- equivalent energy sound level over a one-minute time period ($L_{eq,\ 1min}$) in A-weighted decibels (dBA);
- 1/3 octave band values over a one-minute time period in unweighted decibels (dB); and
- audio data continuously in *.wav format files.

A Brüel and Kjær Type 4231 calibrator was used for calibrating the meters before and after each monitoring period to ensure the sound meter's variance was within 0.5 dB. The calibrator has an estimated uncertainty for sound pressure level of ±0.12 dB at a 99% confidence level. The calibration data were logged by the meter and calibration results were also described in field notes.

The Guideline does not specify weather conditions appropriate for baseline noise monitoring but Directive 038 indicates that baseline noise monitoring should only be conducted under favourable summertime conditions. In particular, Directive 038 requires monitoring be conducted in the absence of snow, water, or ice ground cover, and in the absence of steady precipitation. Directive 038 also specifies that baseline noise monitoring should only be conducted when wind speeds are less than 15 kilometres per hour (km/h).

For this survey, weather data were collected using Kestrel 4500 pocket weather meters from Nielsen Kellerman, set-up near the noise monitoring sites. The weather meters recorded wind speed and direction, temperature, and relative humidity data every five minutes. Data from the weather meters were used as required by Directive 038 for the interpretation of the logged noise data. Direct observations and field notes made by the study team included precipitation, cloud cover, wind direction, and observed audible sound sources; these field notes were also used to interpret the logged noise data.

## 3.2 Data Analysis Approach

Data were downloaded to a computer for analysis with the Brüel and Kjaer 7820 Evaluator® software program. The data were reviewed to identify noise sources from the audio recordings and, in accordance with Directive 038, to filter out invalid data, such as noise associated with the following sources:

- technician activities;
- vehicular traffic near the monitoring location;
- airplane flyovers;
- rain;
- thunder; and
- birds, insects, and other animal activities very near the monitoring location.

Noise from these sources was considered not representative of normal conditions at the monitoring locations and was removed as recommended in Directive 038.

During analysis of the data, noise sources were identified mainly from the audio recordings. Other indicators used to identify sources of noise were time of day and field observations. Hourly equivalent energy sound levels ($L_{eq, 1hr}$) values were calculated for each hour of the survey period from the valid one-minute data, and these $L_{eq, 1hr}$ values were then used to establish daytime, nighttime and day-nighttime baseline levels ($L_{eq, day}$, $L_{eq, night}$ and $L_{eq, dn}$, respectively) as per the Guideline and Health Canada Guidance. The Guideline defines daytime as the time period between 7:00 AM and 10:00 PM, and nighttime as the time period between 10:00 PM and 7:00 AM.

Calculated $L_{eq, 1hr}$, $L_{eq, day}$, $L_{eq, night}$ and $L_{eq, dn}$ values in A-weighted decibels (dBA) for the sound monitoring locations NR1, NR2, NR3, NR4, and NR5 are provided in the following sections. All $L_{eq, 1hr}$ values used to calculate $L_{eq, day}$ or $L_{eq, night}$ or $L_{eq, dn}$ were based on at least 30 minutes of valid $L_{eq, 1min}$ data in that hour.

Although low frequency noise (LFN) is not discussed by the Guideline, Directive 038 indicates that LFN may be an issue even when the broadband noise level is otherwise acceptable. Directive 038 lays out specific criteria for determining if LFN is an issue during a baseline noise survey. Directive 038 considers an LFN condition to exist if:

- the difference between the C-weighted (dBC) and A-weighted (dBA) noise levels is greater than 20 dB; and
- a distinct tone exists at a frequency below 250 Hz.

A-weighting (and dBA) refers to a specific set of spectral weights that can be applied to measured data to approximate the response of the human auditory system; A-weighting tends to emphasize the middle frequency spectral bands. C-weighting (and dBC) refers to a specific set of spectral weights that tends to emphasize the low frequency spectral bands.

According to Directive 038, a distinct tone exists if:

- the linear sound level of one band is 10 dB or more above at least one of the adjacent bands within two 1/3 octave band widths; and
- there is a drop off of at least 5 dB in level bandwidths on the opposite side.

An overview of the valid minutes of baseline noise data for each monitoring location is shown in Table 2. Directive 038 requires a minimum of three hours of valid daytime monitoring data and three hours of valid nighttime monitoring data before an acoustic environmental baseline study program is considered sufficient. At these four monitoring locations, the three hour requirement was met for both the daytime and nighttime periods.

**Table 2: Overview of Valid Minutes of Baseline Noise Data for Each Monitoring Location**

| Location | Valid Daytime [minutes] | Excluded Daytime [minutes] | Valid Nighttime [minutes] | Excluded Nighttime [minutes] | Total Valid Day+Night [minutes] | Total Excluded Day+Night [minutes] |
|---|---|---|---|---|---|---|
| NR1 | 1,647 | 103 | 1,080 | 0 | 2,727 | 103 |
| NR2 | 2,267 | 347 | 1,590 | 30 | 3,857 | 377 |
| NR3 | 2,204 | 407 | 1,464 | 156 | 3,668 | 563 |
| NR4 | 1,364 | 175 | 1,042 | 38 | 2,406 | 213 |
| NR5 (with logging) | 642 | 264 | 325 | 215 | 967 | 479 |
| NR5 (without logging) | 1,427 | 91 | 988 | 32 | 2,415 | 123 |

# 4.0 MEASURED BASELINE NOISE LEVELS

## 4.1 Monitoring Location NR1

### 4.1.1 Broadband Noise Results

The baseline noise levels at NR1 were found to be influenced primarily by constant noise associated with flowing water in McNab Creek. The terrain is relatively flat in the area near NR1 and the creek bed is wider, and so the water noise from the McNab Creek is quieter here than at other locations along the creek where the terrain is steeper and water flows faster. The environment near NR1 is not nearly as densely forested as the environment surrounding receptors NR2 and NR3; therefore, the influence of birds, insects, and other wildlife was found to be much smaller at NR1 than at these other receptors. Because the baseline noise levels at NR1 were dominated by noise from the slowly flowing water of McNab Creek and because this noise is relatively constant throughout the day, there is not much difference between the daytime and nighttime baseline noise levels measured at NR1. NR1 is believed to be representative of open spaces besides McNab Creek, which have slowly flowing water nearby and little wildlife activity.

Unfiltered $L_{eq,\ 1min}$ values recorded at NR1 are shown in Figure 2. Filtered $L_{eq,\ 1hr}$ values along with $L_{eq,\ day}$, $L_{eq,\ night}$ and $L_{eq,\ dn}$ values at this monitoring location are presented in Table 3. Weather data, recorded near the NR1 monitoring site are presented in Figures 3 and 4.

**Table 3: Filtered Hourly Noise Levels at NR1**

| Date | Start Hour | $L_{eq,\ 1hr}$ [dBA] |
|---|---|---|
| 08/15/2012 | 10:00 AM | 37 |
| 08/15/2012 | 11:00 AM | 39 |
| 08/15/2012 | 12:00 PM | 36 |
| 08/15/2012 | 1:00 PM | 35 |
| 08/15/2012 | 2:00 PM | 34 |
| 08/15/2012 | 3:00 PM | 40 |
| 08/15/2012 | 4:00 PM | 34 |
| 08/15/2012 | 5:00 PM | 34 |
| 08/15/2012 | 6:00 PM | 36 |
| 08/15/2012 | 7:00 PM | 36 |
| 08/15/2012 | 8:00 PM | 36 |
| 08/15/2012 | 9:00 PM | 36 |
| 08/15/2012 | 10:00 PM | 36 |
| 08/15/2012 | 11:00 PM | 36 |
| 08/16/2012 | 12:00 AM | 36 |
| 08/16/2012 | 1:00 AM | 36 |
| 08/16/2012 | 2:00 AM | 36 |
| 08/16/2012 | 3:00 AM | 36 |
| 08/16/2012 | 4:00 AM | 36 |
| 08/16/2012 | 5:00 AM | 36 |

| Date | Start Hour | $L_{eq, 1hr}$ [dBA] |
|---|---|---|
| 08/16/2012 | 6:00 AM | 37 |
| 08/16/2012 | 7:00 AM | 37 |
| 08/16/2012 | 8:00 AM | 36 |
| 08/16/2012 | 9:00 AM | 36 |
| 08/16/2012 | 10:00 AM | 35 |
| 08/16/2012 | 11:00 AM | 34 |
| 08/16/2012 | 12:00 PM | 34 |
| 08/16/2012 | 1:00 PM | 33 |
| 08/16/2012 | 2:00 PM | 33 |
| 08/16/2012 | 3:00 PM | 33 |
| 08/16/2012 | 4:00 PM | 33 |
| 08/16/2012 | 5:00 PM | 34 |
| 08/16/2012 | 6:00 PM | 35 |
| 08/16/2012 | 7:00 PM | 35 |
| 08/16/2012 | 8:00 PM | 35 |
| 08/16/2012 | 9:00 PM | 35 |
| 08/16/2012 | 10:00 PM | 35 |
| 08/16/2012 | 11:00 PM | 35 |
| 08/17/2012 | 12:00 AM | 35 |
| 08/17/2012 | 1:00 AM | 35 |
| 08/17/2012 | 2:00 AM | 35 |
| 08/17/2012 | 3:00 AM | 35 |
| 08/17/2012 | 4:00 AM | 36 |
| 08/17/2012 | 5:00 AM | 36 |
| 08/17/2012 | 6:00 AM | 36 |
| 08/17/2012 | 7:00 AM | 36 |
| 08/17/2012 | 8:00 AM | 36 |
| Daytime Average ($L_{eq, day}$) | 7:00 AM to 10:00 PM | 36 |
| Nighttime Average ($L_{eq, night}$) | 10:00 PM to 7:00 AM | 36 |
| Day-Nighttime Average ($L_{eq, dn}$) | | 42 |

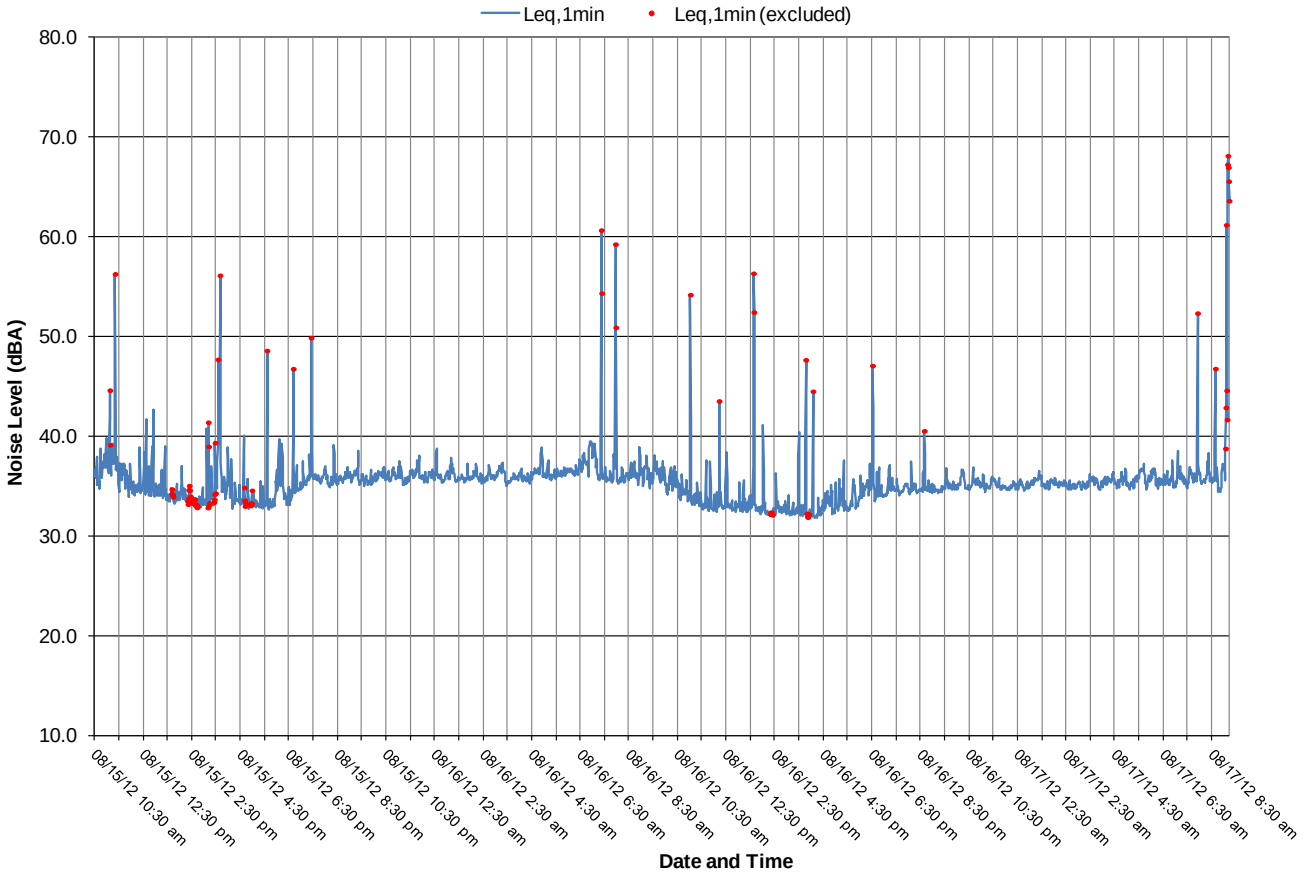



*Figure 2: Unfiltered One-Minute Noise Levels at NR1*

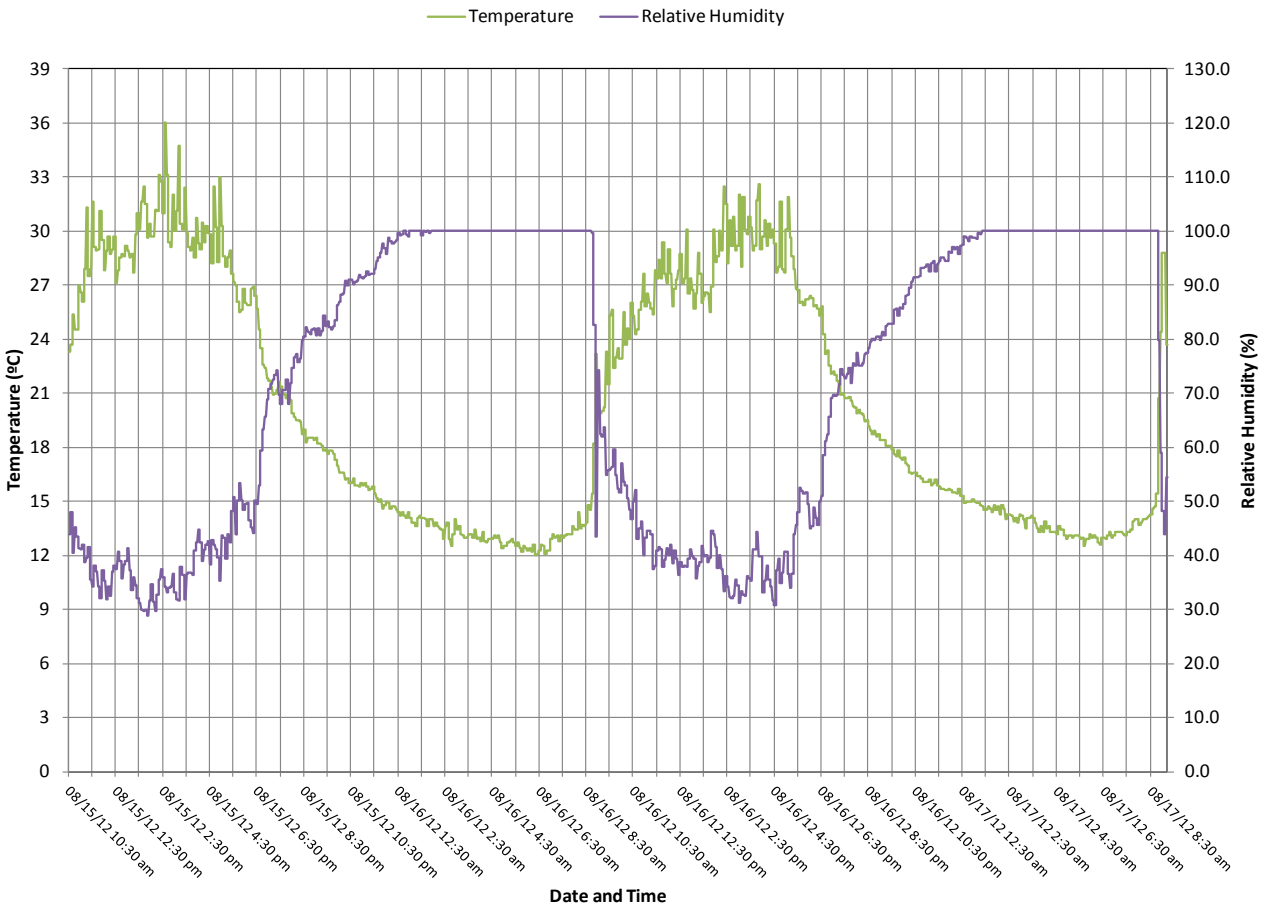



*Figure 3: Weather Information (Temperature and Humidity) for NR1*

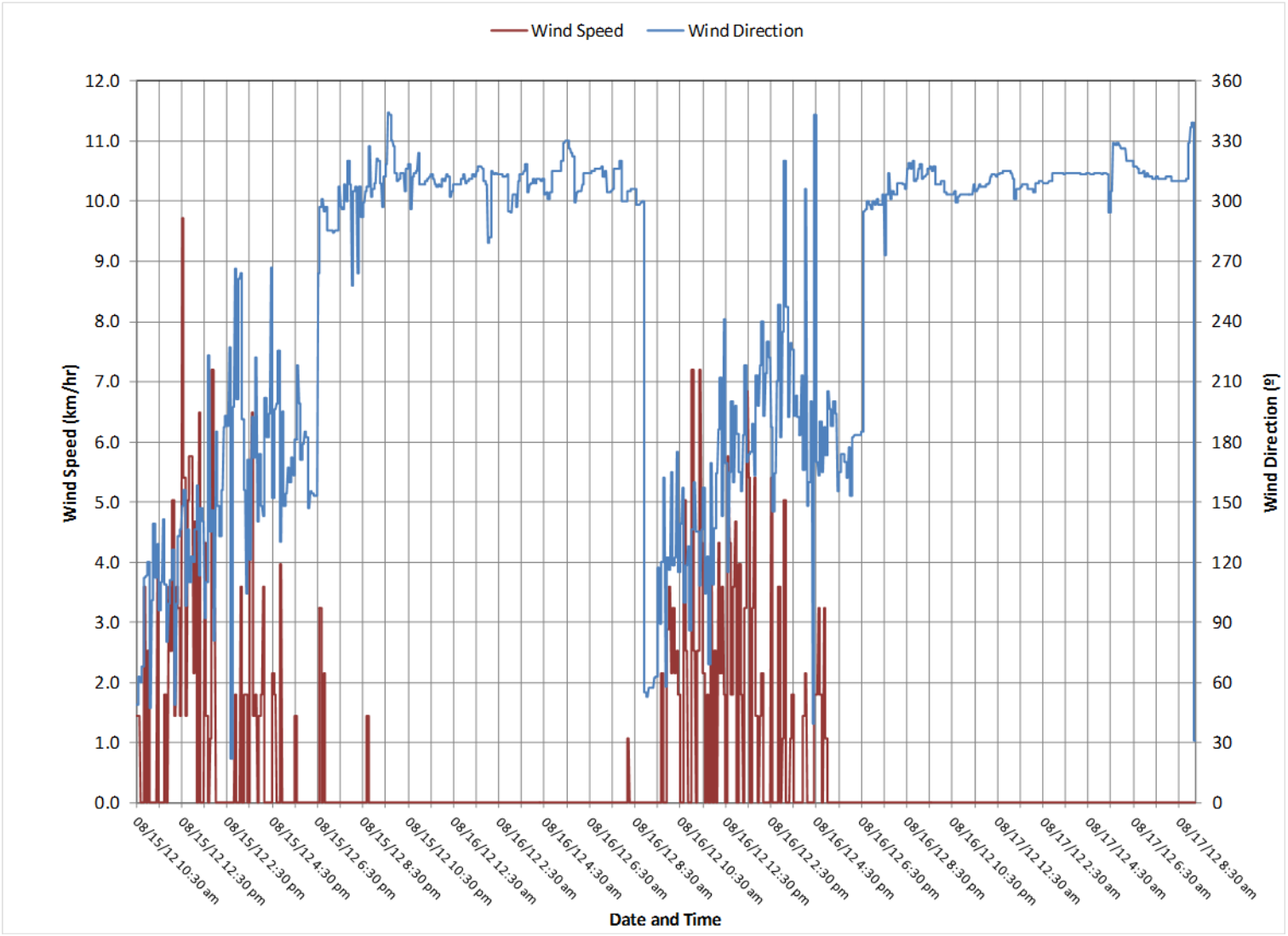



*Figure 4: Weather Information (Wind Speed and Direction) for NR1*

### 4.1.2 Low Frequency Noise Results

Table 4 presents the result of LFN analysis conducted using the 1/3 octave band spectra corresponding to valid one-minute noise samples for NR1.

**Table 4: Low Frequency Noise Analysis at Monitoring Location NR1**

| Period | dBC – dBA | Number of tones below 250 Hz | LFN issue? |
|---|---|---|---|
| Daytime (7:00 AM – 10:00 PM) | 10.7 | 0 | no |
| Nighttime (10:00 PM – 7:00 AM) | 3.4 | 0 | no |

Table 4 indicates that the difference between the A-weighted and C-weighted noise levels is always less than 20 dB and that there are no tones present below 250 Hz. Therefore, there was no LFN issue during the daytime or nighttime periods of the NR1 survey.

## 4.2 Monitoring Location NR2

### 4.2.1 Broadband Noise Results

NR2 is located in the heavily forested area on the west of noise LSA. The baseline noise levels at NR2 were found to be primarily influenced by natural sound from birds, insects, and the rustling of leaves. Since birds and most other wildlife are more likely to be active during the daytime period, baseline noise levels at NR2 were found to be higher during the daytime; this result is also consistent with a noise environment dominated by natural sources. NR2 is believed to be representative of the heavily forest areas where the noise environment is dominated by natural sound sources of wildlife and wind through the trees.

Unfiltered $L_{eq,\ 1min}$ values recorded at NR2 are shown in Figure 5. Filtered $L_{eq,\ 1hr}$ values along with $L_{eq,\ day}$, $L_{eq,\ night}$ and $L_{eq,\ dn}$ values at this monitoring location are presented in Table 5. Active precipitation or rain was the cause of the invalid data for the hours starting at 7:00 AM, 9:00 AM, 10:00 AM and 1:00 PM of July 20, 2012. Weather data recorded near the NR2 monitoring site are presented in Figures 6 and 7.

**Table 5: Filtered Hourly Noise Levels at NR2**

| Date | Start Hour | $L_{eq, 1hr}$ [dBA] |
|---|---|---|
| 07/18/2012 | 10:00 AM | 38 |
| 07/18/2012 | 11:00 AM | 38 |
| 07/18/2012 | 12:00 PM | 38 |
| 07/18/2012 | 1:00 PM | 40 |
| 07/18/2012 | 2:00 PM | 41 |
| 07/18/2012 | 3:00 PM | 40 |
| 07/18/2012 | 4:00 PM | 40 |
| 07/18/2012 | 5:00 PM | 43 |
| 07/18/2012 | 6:00 PM | 42 |
| 07/18/2012 | 7:00 PM | 43 |
| 07/18/2012 | 8:00 PM | 41 |
| 07/18/2012 | 9:00 PM | 39 |
| 07/18/2012 | 10:00 PM | 32 |
| 07/18/2012 | 11:00 PM | 32 |
| 07/19/2012 | 12:00 AM | 32 |
| 07/19/2012 | 1:00 AM | 32 |
| 07/19/2012 | 2:00 AM | 32 |
| 07/19/2012 | 3:00 AM | 32 |
| 07/19/2012 | 4:00 AM | 39 |
| 07/19/2012 | 5:00 AM | 41 |
| 07/19/2012 | 6:00 AM | 40 |
| 07/19/2012 | 7:00 AM | 39 |
| 07/19/2012 | 8:00 AM | 44 |
| 07/19/2012 | 9:00 AM | 39 |
| 07/19/2012 | 10:00 AM | 41 |
| 07/19/2012 | 11:00 AM | 39 |
| 07/19/2012 | 12:00 PM | 38 |
| 07/19/2012 | 1:00 PM | 42 |
| 07/19/2012 | 2:00 PM | 40 |
| 07/19/2012 | 3:00 PM | 37 |
| 07/19/2012 | 4:00 PM | 39 |
| 07/19/2012 | 5:00 PM | 42 |
| 07/19/2012 | 6:00 PM | 40 |
| 07/19/2012 | 7:00 PM | 40 |
| 07/19/2012 | 8:00 PM | 39 |
| 07/19/2012 | 9:00 PM | 39 |
| 07/19/2012 | 10:00 PM | 33 |
| 07/19/2012 | 11:00 PM | 32 |

| Date | Start Hour | $L_{eq,\ 1hr}$ [dBA] |
|---|---|---|
| 07/20/2012 | 12:00 AM | 33 |
| 07/20/2012 | 1:00 AM | 32 |
| 07/20/2012 | 2:00 AM | 33 |
| 07/20/2012 | 3:00 AM | 37 |
| 07/20/2012 | 4:00 AM | 37 |
| 07/20/2012 | 5:00 AM | 41 |
| 07/20/2012 | 6:00 AM | 39 |
| 07/20/2012 | 7:00 AM | Not Valid[(a)] |
| 07/20/2012 | 8:00 AM | 48 |
| 07/20/2012 | 9:00 AM | Not Valid[(a)] |
| 07/20/2012 | 10:00 AM | Not Valid[(a)] |
| 07/20/2012 | 11:00 AM | 49 |
| 07/20/2012 | 12:00 PM | 48 |
| 07/20/2012 | 1:00 PM | Not Valid[(a)] |
| 07/20/2012 | 2:00 PM | 47 |
| 07/20/2012 | 3:00 PM | 45 |
| 07/20/2012 | 4:00 PM | 45 |
| 07/20/2012 | 5:00 PM | 45 |
| 07/20/2012 | 6:00 PM | 43 |
| 07/20/2012 | 7:00 PM | 43 |
| 07/20/2012 | 8:00 PM | 39 |
| 07/20/2012 | 9:00 PM | 37 |
| 07/20/2012 | 10:00 PM | 41 |
| 07/20/2012 | 11:00 PM | 34 |
| 07/21/2012 | 12:00 AM | 33 |
| 07/21/2012 | 1:00 AM | 33 |
| 07/21/2012 | 2:00 AM | 41 |
| 07/21/2012 | 3:00 AM | 34 |
| 07/21/2012 | 4:00 AM | 36 |
| 07/21/2012 | 5:00 AM | 39 |
| 07/21/2012 | 6:00 AM | 41 |
| 07/21/2012 | 7:00 AM | 42 |
| 07/21/2012 | 8:00 AM | 40 |
| Daytime Average ($L_{eq,\ day}$) | 7:00 AM to 10:00 PM | 43 |
| Nighttime Average ($L_{eq,\ night}$) | 10:00 PM to 7:00 AM | 37 |
| Day-Nighttime Average ($L_{eq,\ dn}$) | | 45 |

(a) This hour contained fewer than 30 minutes of valid data

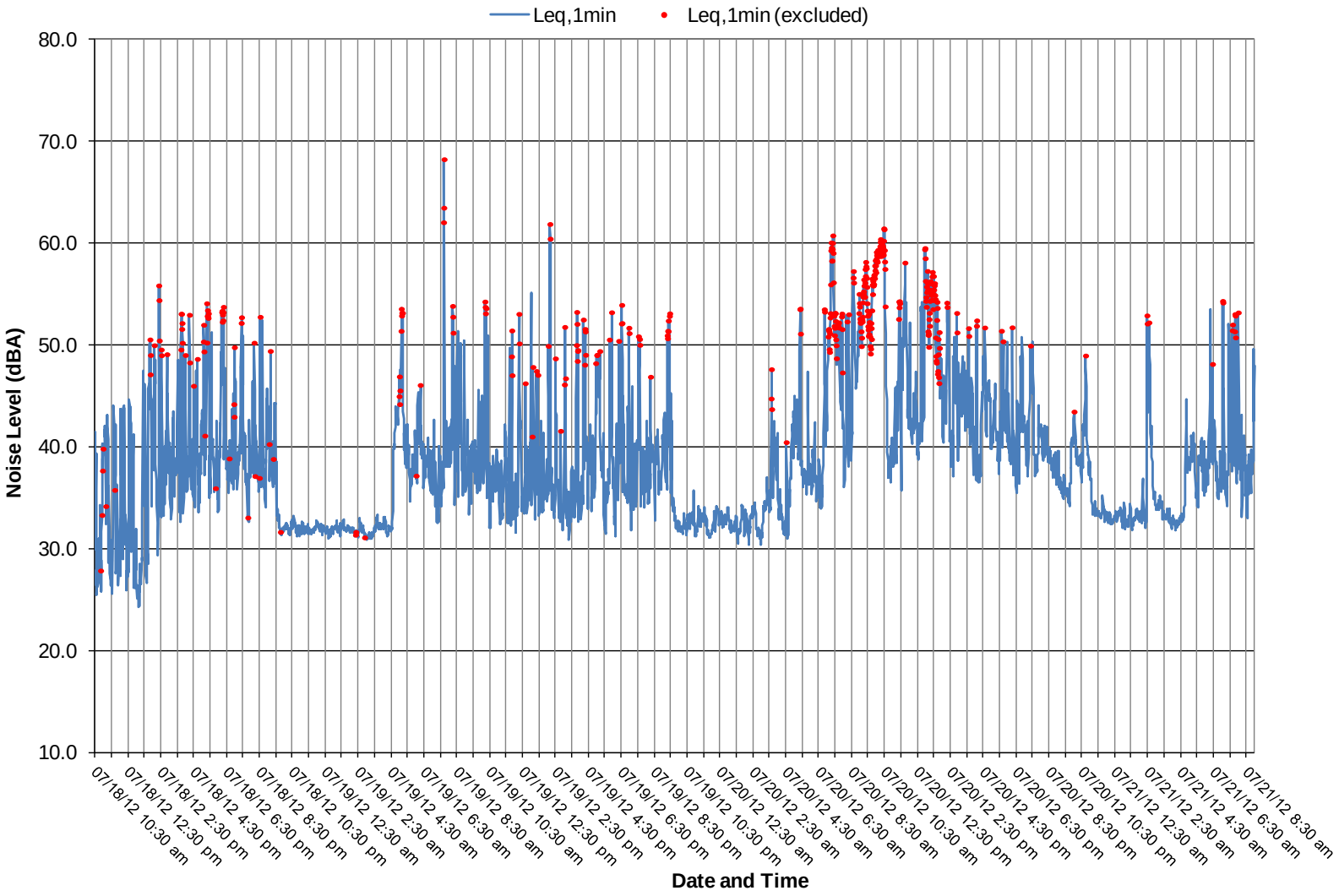



*Figure 5: Unfiltered One-Minute Noise Levels at NR2*

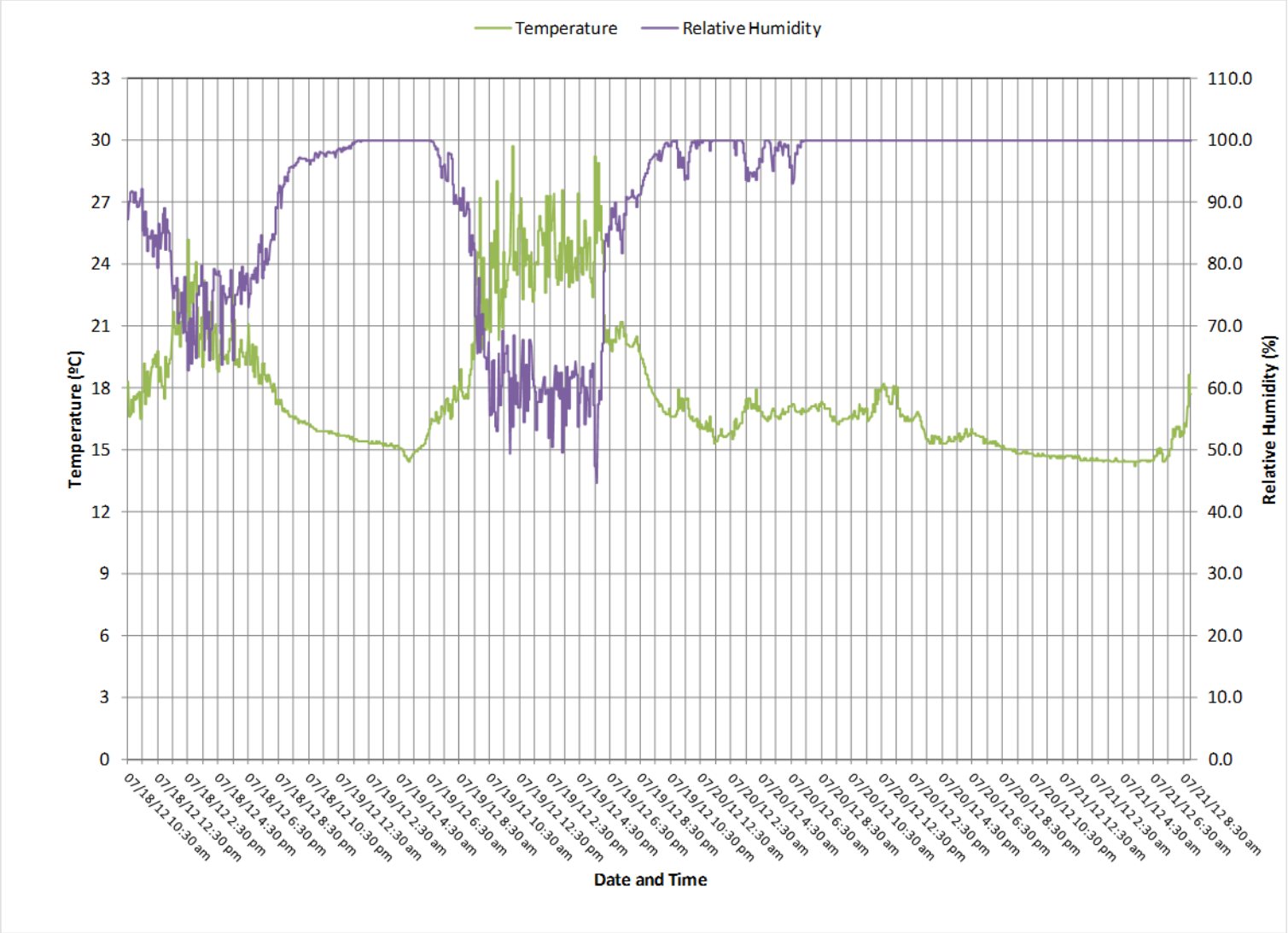



*Figure 6: Weather Information (Temperature and Humidity) for NR2*

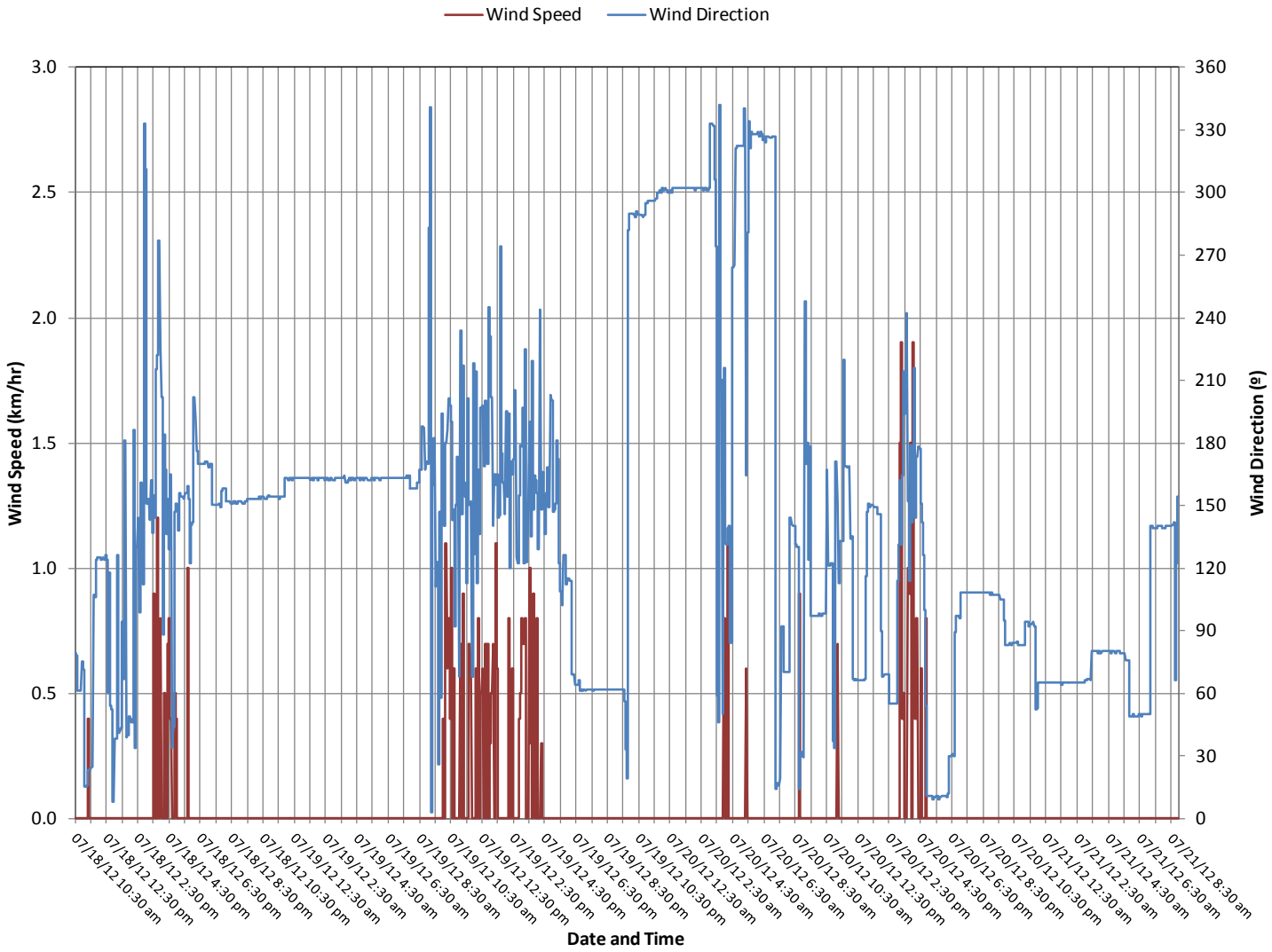



*Figure 7: Weather Information (Wind Speed and Direction) for NR2*

### 4.2.2 Low Frequency Noise Results

Table 6 presents the result of LFN analysis conducted using the 1/3 octave band spectra corresponding to valid one-minute noise samples for NR2.

**Table 6: Low Frequency Noise Analysis at Monitoring Location NR2**

| Period | dBC – dBA | Number of tones below 250 Hz | LFN issue? |
|---|---|---|---|
| Daytime (7:00 AM – 10:00 PM) | 1.9 | 0 | no |
| Nighttime (10:00 PM – 7:00 AM) | 2.2 | 0 | no |

Table 6 indicates that the difference between the A-weighted and C-weighted noise levels is always less than 20 dB and that there are no tones present below 250 Hz. Therefore, there was no LFN issue during the daytime or nighttime periods of NR2 survey.

## 4.3 Monitoring Location NR3

### 4.3.1 Broadband Noise Results

The baseline noise levels at NR3 were mainly influenced by water noise from McNab Creek, as well as noise from natural sounds, such as birds, insects, and rustling leaves. The water noise from McNab Creek is constantly high because of the terrain elevation drop in the area and the narrower water bed in the upstream of McNab Creek (i.e., the water in the creek is moving quickly in the vicinity of NR3). Because the water noise is dominant and constant throughout the day, there is not much difference between the daytime and nighttime noise levels at NR3. NR3 is believed to be representative of the forested areas nearby the faster flowing water of McNab Creek.

Unfiltered $L_{eq\ 1min}$ values recorded at NR3 are shown in Figure 8. Filtered $L_{eq,\ 1hr}$ values along with $L_{eq,\ day}$, $L_{eq\ night}$ and $L_{eq,\ dn}$ values at this monitoring location are presented in Table 7. Active precipitation or rain was the reason for the invalid data for the hours starting at 7:00 AM, 9:00 AM, 10:00 AM and 1:00 PM of July 20, 2012. Weather data, recorded near the NR3 monitoring site are presented in Figures 9 and 10.

**Table 7: Filtered Hourly Noise Levels at NR3**

| Date | Start Hour | $L_{eq, 1hr}$ [dBA] |
|---|---|---|
| 07/18/2012 | 12:00 PM | 41 |
| 07/18/2012 | 1:00 PM | 42 |
| 07/18/2012 | 2:00 PM | 40 |
| 07/18/2012 | 3:00 PM | 41 |
| 07/18/2012 | 4:00 PM | 40 |
| 07/18/2012 | 5:00 PM | 40 |
| 07/18/2012 | 6:00 PM | 41 |
| 07/18/2012 | 7:00 PM | 41 |
| 07/18/2012 | 8:00 PM | 42 |
| 07/18/2012 | 9:00 PM | 43 |
| 07/18/2012 | 10:00 PM | 38 |
| 07/18/2012 | 11:00 PM | 38 |
| 07/19/2012 | 12:00 AM | 38 |
| 07/19/2012 | 1:00 AM | 38 |
| 07/19/2012 | 2:00 AM | 39 |
| 07/19/2012 | 3:00 AM | 39 |
| 07/19/2012 | 4:00 AM | 39 |
| 07/19/2012 | 5:00 AM | 44 |
| 07/19/2012 | 6:00 AM | 43 |
| 07/19/2012 | 7:00 AM | 42 |
| 07/19/2012 | 8:00 AM | 42 |
| 07/19/2012 | 9:00 AM | 42 |
| 07/19/2012 | 10:00 AM | 41 |
| 07/19/2012 | 11:00 AM | 40 |
| 07/19/2012 | 12:00 PM | 40 |
| 07/19/2012 | 1:00 PM | 41 |
| 07/19/2012 | 2:00 PM | 39 |
| 07/19/2012 | 3:00 PM | 38 |
| 07/19/2012 | 4:00 PM | 39 |
| 07/19/2012 | 5:00 PM | 38 |
| 07/19/2012 | 6:00 PM | 37 |
| 07/19/2012 | 7:00 PM | 38 |
| 07/19/2012 | 8:00 PM | 39 |
| 07/19/2012 | 9:00 PM | 42 |
| 07/19/2012 | 10:00 PM | 37 |
| 07/19/2012 | 11:00 PM | 37 |
| 07/20/2012 | 12:00 AM | 37 |
| 07/20/2012 | 1:00 AM | 38 |

| Date | Start Hour | $L_{eq,\ 1hr}$ [dBA] |
|---|---|---|
| 07/20/2012 | 2:00 AM | 39 |
| 07/20/2012 | 3:00 AM | 40 |
| 07/20/2012 | 4:00 AM | 40 |
| 07/20/2012 | 5:00 AM | 44 |
| 07/20/2012 | 6:00 AM | 42 |
| 07/20/2012 | 7:00 AM | Not Valid[(a)] |
| 07/20/2012 | 8:00 AM | 42 |
| 07/20/2012 | 9:00 AM | Not Valid[(a)] |
| 07/20/2012 | 10:00 AM | Not Valid[(a)] |
| 07/20/2012 | 11:00 AM | 44 |
| 07/20/2012 | 12:00 PM | 44 |
| 07/20/2012 | 1:00 PM | Not Valid[(a)] |
| 07/20/2012 | 2:00 PM | 44 |
| 07/20/2012 | 3:00 PM | 45 |
| 07/20/2012 | 4:00 PM | 43 |
| 07/20/2012 | 5:00 PM | 42 |
| 07/20/2012 | 6:00 PM | 41 |
| 07/20/2012 | 7:00 PM | 43 |
| 07/20/2012 | 8:00 PM | 43 |
| 07/20/2012 | 9:00 PM | 44 |
| 07/20/2012 | 10:00 PM | 42 |
| 07/20/2012 | 11:00 PM | 42 |
| 07/21/2012 | 12:00 AM | 43 |
| 07/21/2012 | 1:00 AM | 43 |
| 07/21/2012 | 2:00 AM | 43 |
| 07/21/2012 | 3:00 AM | 43 |
| 07/21/2012 | 4:00 AM | 43 |
| 07/21/2012 | 5:00 AM | 47 |
| 07/21/2012 | 6:00 AM | 44 |
| 07/21/2012 | 7:00 AM | 45 |
| 07/21/2012 | 8:00 AM | 45 |
| 07/21/2012 | 9:00 AM | 45 |
| Daytime Average ($L_{eq,\ day}$) | 7:00 AM to 10:00 PM | 42 |
| Nighttime Average ($L_{eq,\ night}$) | 10:00 PM to 7:00 AM | 41 |
| Day-Nighttime Average ($L_{eq,\ dn}$) | | 48 |

(a) This hour contained fewer than 30 minutes of valid data

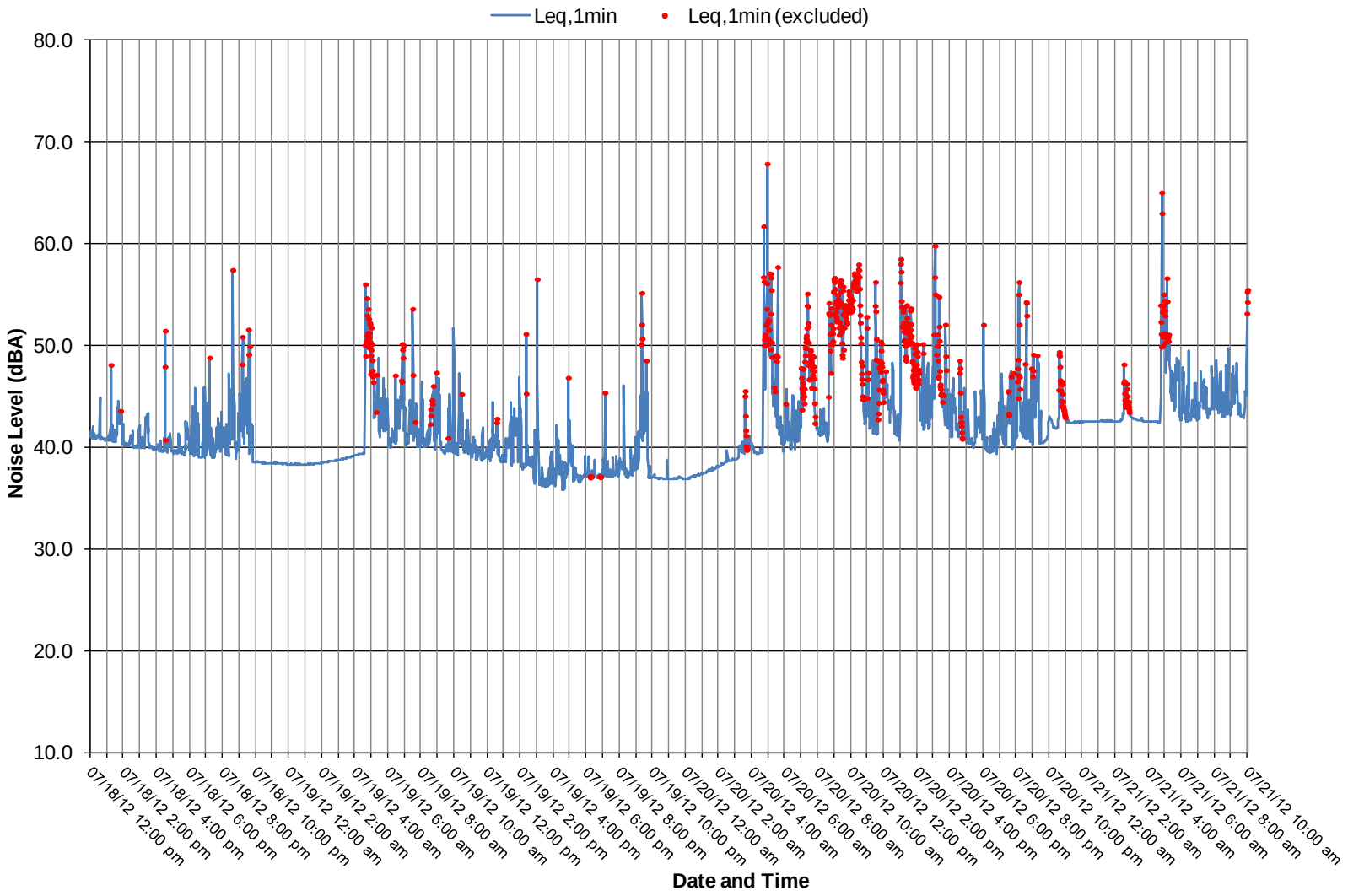



*Figure 8: Unfiltered One-Minute Noise Levels at NR3*

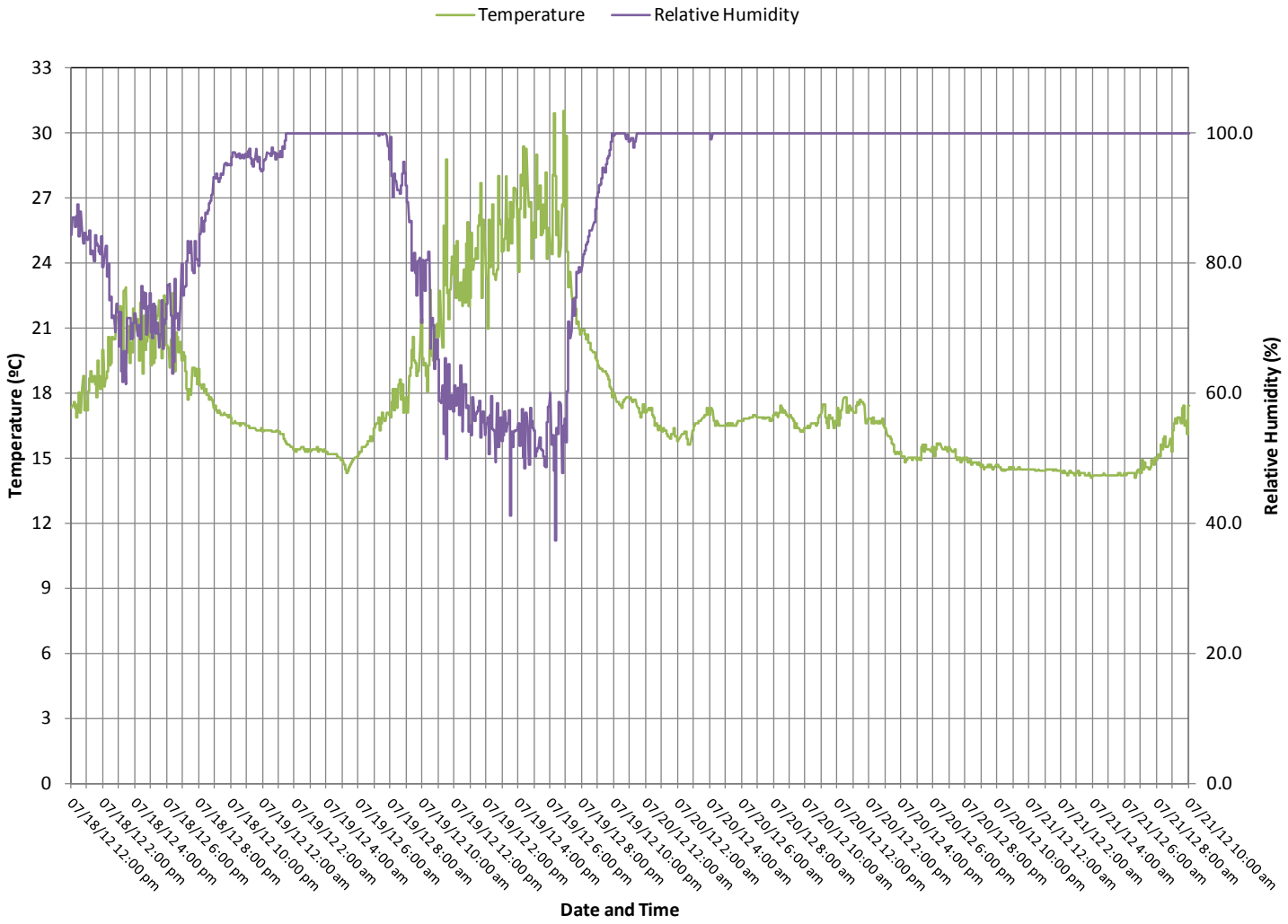



*Figure 9: Weather Information (Temperature and Humidity) for NR3*

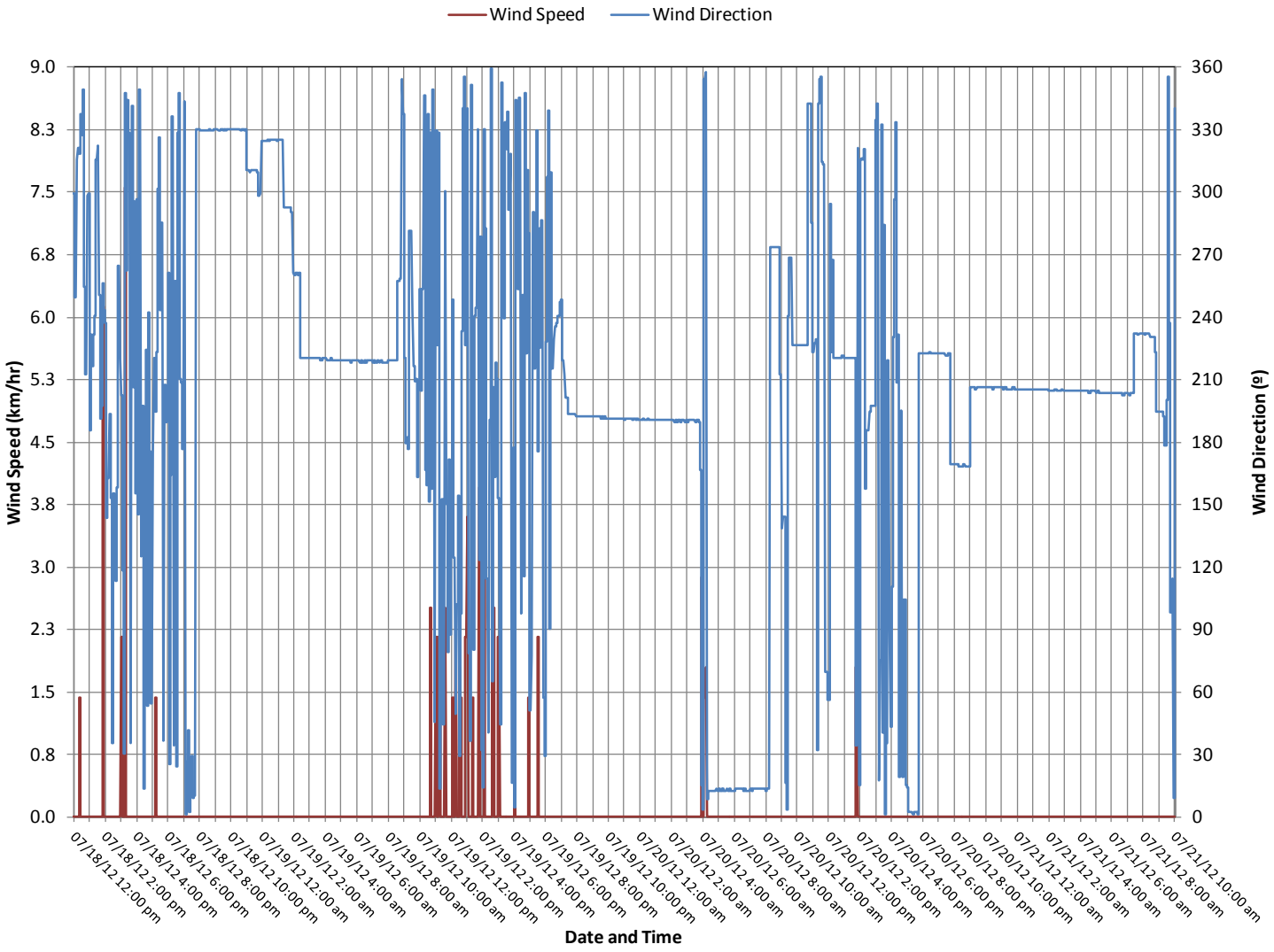



*Figure 10: Weather Information (Wind Speed and Direction) for NR3*

### 4.3.2 Low Frequency Noise Results

Table 8 presents the result of LFN analysis conducted using the 1/3 octave band spectra corresponding to valid one-minute noise samples for NR3.

**Table 8: Low Frequency Noise Analysis at Monitoring Location NR3**

| Period | dBC – dBA | Number of tones below 250 Hz | LFN issue? |
|---|---|---|---|
| Daytime (7:00 AM – 10:00 PM) | 0.8 | 0 | no |
| Nighttime (10:00 PM – 7:00 AM) | 3.8 | 1 | no |

Table 8 indicates that the difference between the A-weighted and C-weighted noise levels is always less than 20 dB. Therefore, there was no LFN issue during the daytime or nighttime periods of NR3 survey.

## 4.4 Monitoring Location NR4

### 4.4.1 Broadband Noise Results

The baseline noise levels at NR4 were influenced by human activities at the children's camp during daytime, water noise from Howe Sound, and natural noise from birds, insects, and rustling leaves. Camp-related activities caused higher noise levels for the hours during daytime.

Unfiltered $L_{eq,\ 1min}$ values recorded at NR4 are shown in Figure 11. Filtered $L_{eq,\ 1hr}$ values along with $L_{eq,\ day}$, $L_{eq,\ night}$ and $L_{eq,\ dn}$ values at this monitoring location are presented in Table 9. Weather data, recorded near the NR4 monitoring site are presented in Figures 12 and 13.

**Table 9: Filtered Hourly Noise Levels at NR4**

| Date | Start Hour | $L_{eq, 1hr}$ [dBA] |
|---|---|---|
| 08/15/12 | 3:00 PM | 45 |
| 08/15/12 | 4:00 PM | 44 |
| 08/15/12 | 5:00 PM | 43 |
| 08/15/12 | 6:00 PM | 45 |
| 08/15/12 | 7:00 PM | 41 |
| 08/15/12 | 8:00 PM | 43 |
| 08/15/12 | 9:00 PM | 34 |
| 08/15/12 | 10:00 PM | 31 |
| 08/15/12 | 11:00 PM | 28 |
| 08/16/12 | 12:00 AM | 29 |
| 08/16/12 | 1:00 AM | 28 |
| 08/16/12 | 2:00 AM | 30 |
| 08/16/12 | 3:00 AM | 31 |
| 08/16/12 | 4:00 AM | 29 |
| 08/16/12 | 5:00 AM | 32 |
| 08/16/12 | 6:00 AM | 40 |
| 08/16/12 | 7:00 AM | 42 |
| 08/16/12 | 8:00 AM | 44 |
| 08/16/12 | 9:00 AM | 42 |
| 08/16/12 | 10:00 AM | 43 |
| 08/16/12 | 11:00 AM | 43 |
| 08/16/12 | 12:00 PM | 45 |
| 08/16/12 | 1:00 PM | 45 |
| 08/16/12 | 2:00 PM | 43 |
| 08/16/12 | 3:00 PM | 44 |
| 08/16/12 | 4:00 PM | 45 |
| 08/16/12 | 5:00 PM | 43 |
| 08/16/12 | 6:00 PM | 46 |
| 08/16/12 | 7:00 PM | 44 |
| 08/16/12 | 8:00 PM | 42 |
| 08/16/12 | 9:00 PM | 35 |
| 08/16/12 | 10:00 PM | 33 |
| 08/16/12 | 11:00 PM | 35 |
| 08/17/12 | 12:00 AM | 31 |
| 08/17/12 | 1:00 AM | 28 |
| 08/17/12 | 2:00 AM | 28 |
| 08/17/12 | 3:00 AM | 30 |
| 08/17/12 | 4:00 AM | 29 |

| Date | Start Hour | $L_{eq, 1hr}$ [dBA] |
|---|---|---|
| 08/17/12 | 5:00 AM | 32 |
| 08/17/12 | 6:00 AM | 40 |
| 08/17/12 | 7:00 AM | 42 |
| 08/17/12 | 8:00 AM | 45 |
| 08/17/12 | 9:00 AM | 45 |
| Daytime Average ($L_{eq, day}$) | 7:00 AM to 10:00 PM | 44 |
| Nighttime Average ($L_{eq, night}$) | 10:00 PM to 7:00 AM | 33 |
| Day-Nighttime Average ($L_{eq, dn}$) | | 44 |

NR4 is located within a children's camp and baseline noise levels at NR4 are necessarily influenced by camp-related activities, especially during daytime. However, these intense human activities are likely common to all potential receptors (i.e., seasonally occupied dwellings, summer camps, yacht club outstations) within the noise RSA. Therefore, baseline noise levels at NR4 can be considered representative of baseline noise levels in the recreation areas close to the shore of Howe Sound within RSA during summer, when human activities dominate the baseline noise levels during the daytime.

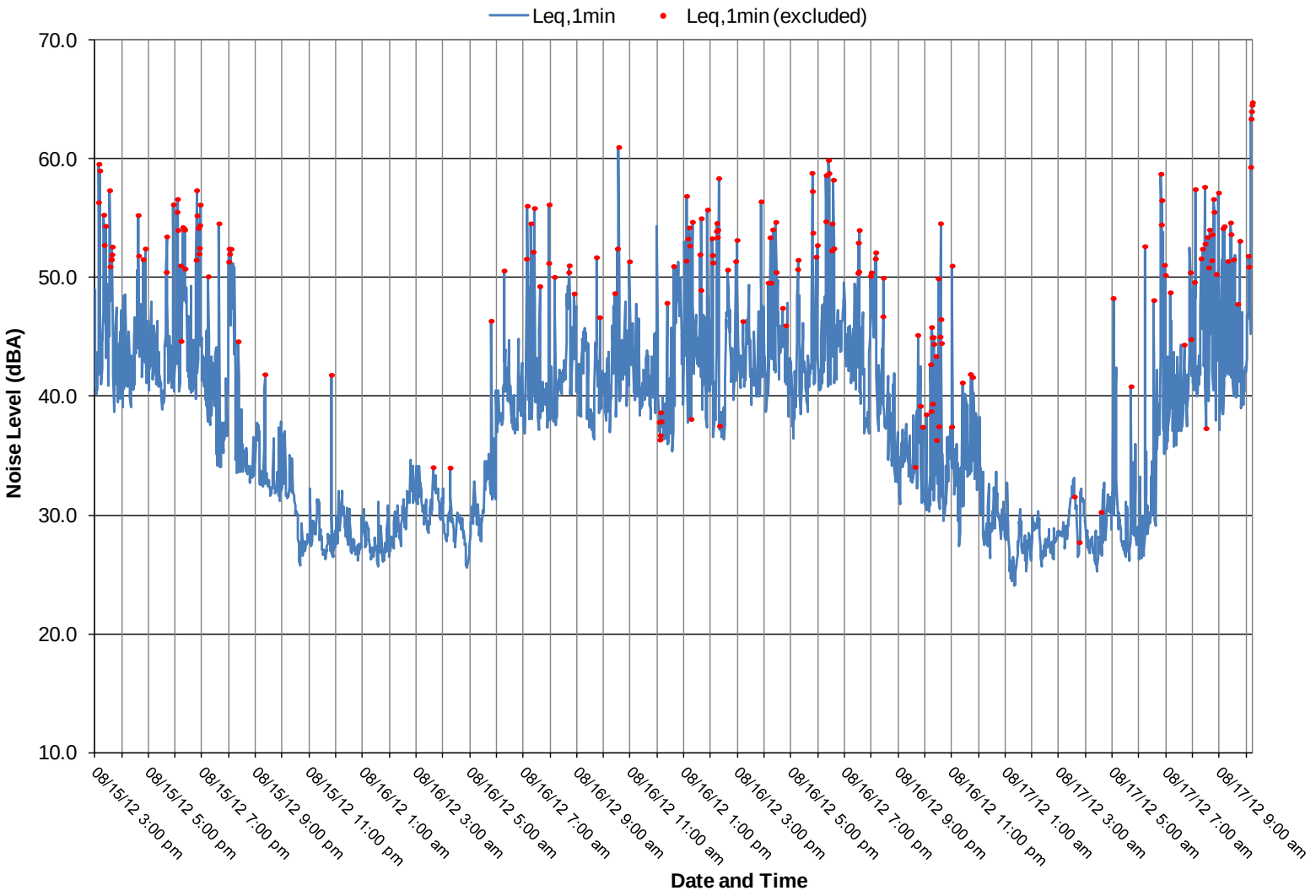



*Figure 11: Unfiltered One-Minute Noise Levels at NR4*

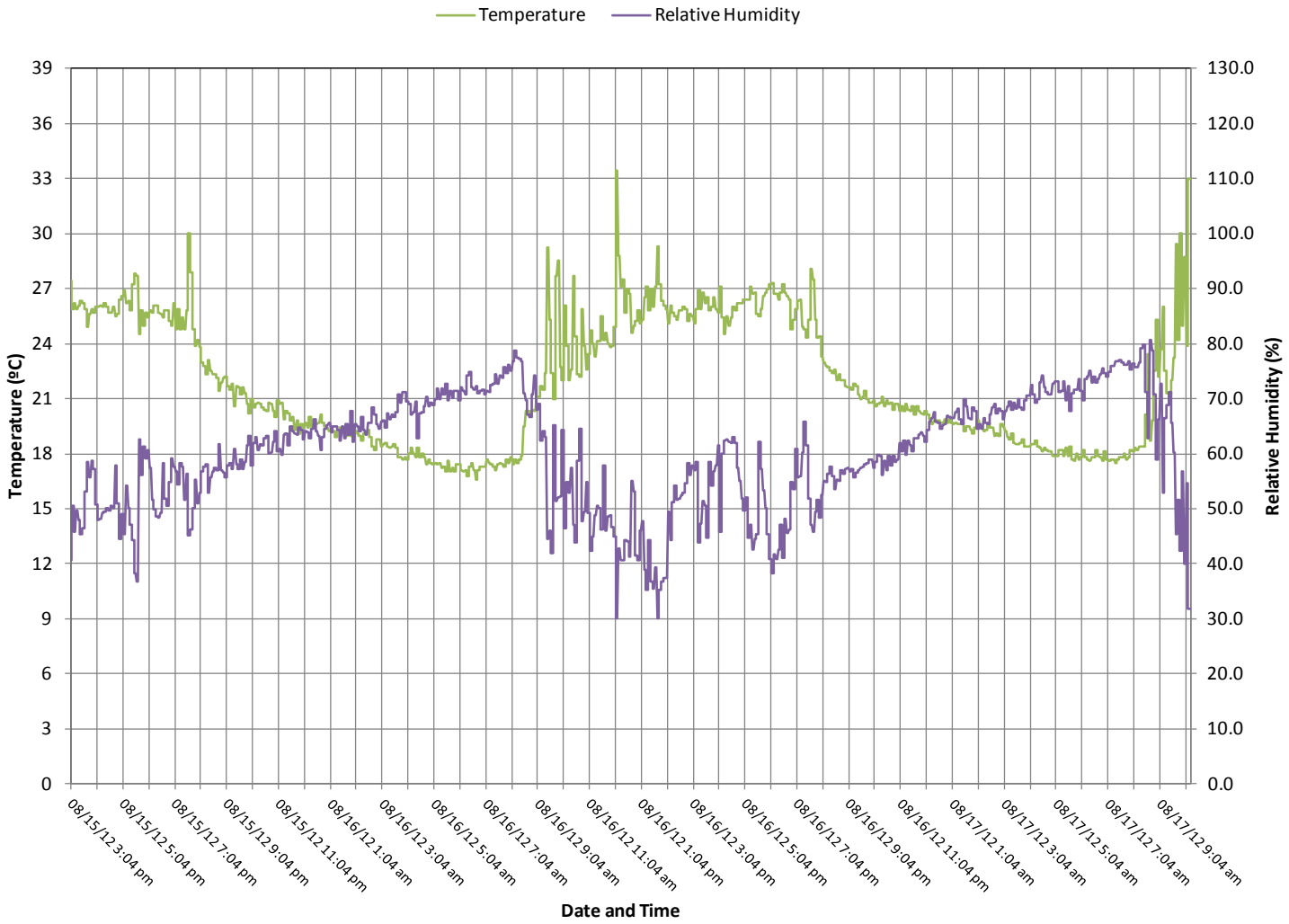



*Figure 12: Weather Information (Temperature and Humidity) for NR4*

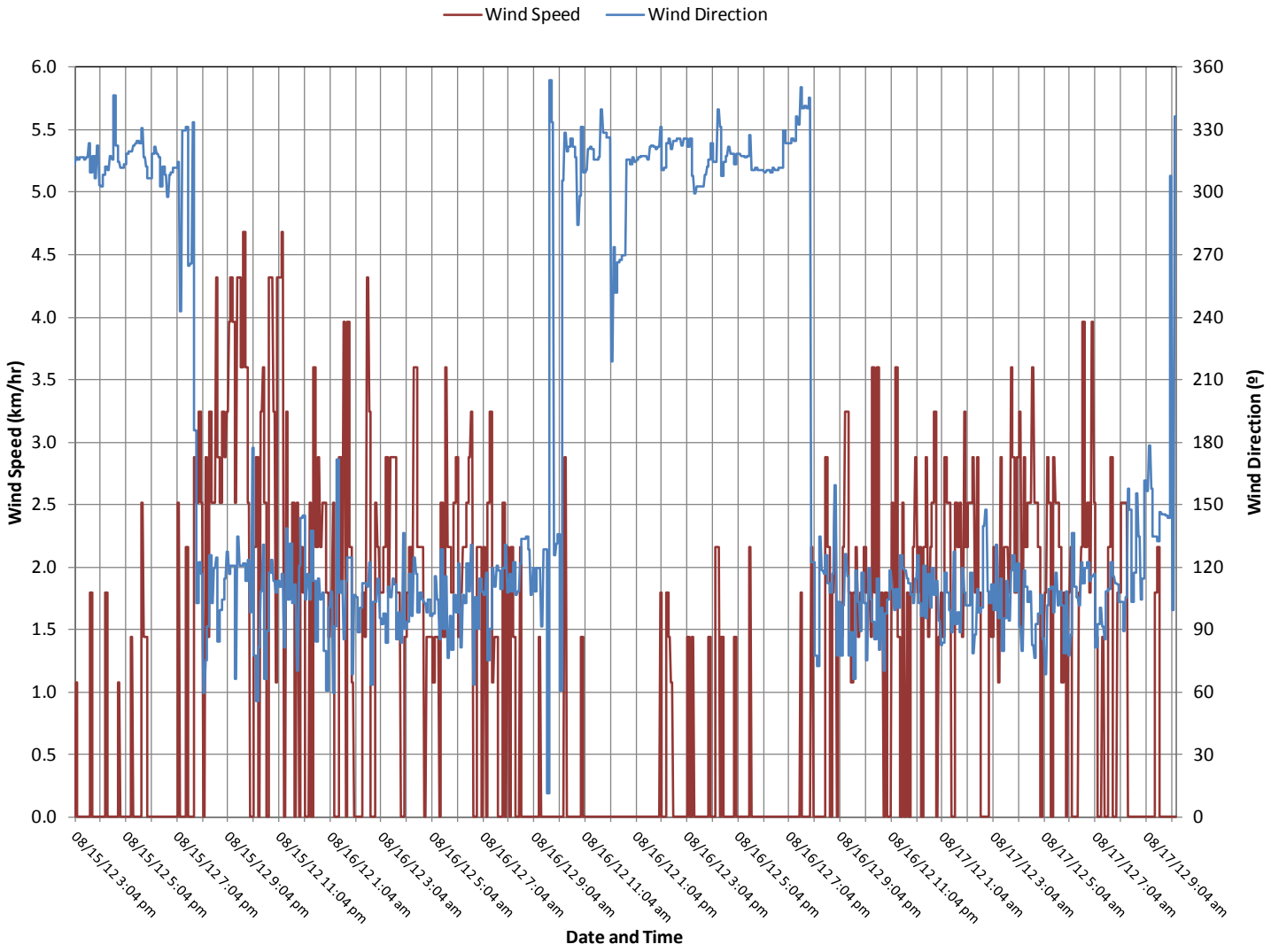



*Figure 13: Weather Information (Wind Speed and Direction) for NR4*

### 4.4.2 Low Frequency Noise Results

Table 10 presents the result of LFN analysis conducted using the 1/3 octave band spectra corresponding to valid one-minute noise samples for NR4.

**Table 10: Low Frequency Noise Analysis at Monitoring Location NR4**

| Period | dBC – dBA | Number of tones below 250 Hz | LFN issue? |
|---|---|---|---|
| Daytime (7:00 AM – 10:00 PM) | 11.1 | 0 | no |
| Nighttime (10:00 PM – 7:00 AM) | 14.1 | 0 | no |

Table 10 indicates that the difference between the A-weighted and C-weighted noise levels is always less than 20 dB and that there are no tones present below 250 Hz. Therefore, there was no LFN issue during the daytime or nighttime periods of NR4 survey.

## 4.5 Monitoring Location NR5 – with logging

### 4.5.1 Broadband Noise Results

NR5 is located within the Community, approximately 500 m from the Project fence line. The baseline noise levels at NR5 were found to be influenced primarily by logging activities, fast flowing water in McNab Creek, wave activity in Howe Sound, human activities including power generation in the community and on the beach, wildlife, birds and insects and wind in the trees. Since logging activities only occur during the day, and birds and most other wildlife are more likely to be active during the daytime period, baseline noise levels at NR5 were found to be higher during the daytime.

Unfiltered $L_{eq,\ 1min}$ values recorded at NR5 are shown in Figure 14. Filtered $L_{eq,\ 1hr}$ values along with $L_{eq,\ day}$, $L_{eq,\ night}$ and $L_{eq,\ dn}$ values at this monitoring location are presented in Table 11. The invalid data for the hours from 8:00 PM to 1:00 AM of October 15 and 16, 2013 was due to wind. Weather data, recorded near the NR5 monitoring site are presented in Figures 15 and 16.

**Table 11: Filtered Hourly Noise Levels at NR5 (with logging)**

| Date | Start Hour | $L_{eq, 1hr}$ [dBA] |
|---|---|---|
| 10/15/13 | 5:00 PM | Not Valid[(a)] |
| 10/15/13 | 6:00 PM | 38 |
| 10/15/13 | 7:00 PM | 40 |
| 10/15/13 | 8:00 PM | Not Valid[(a)] |
| 10/15/13 | 9:00 PM | Not Valid[(a)] |
| 10/15/13 | 10:00 PM | Not Valid[(a)] |
| 10/15/13 | 11:00 PM | Not Valid[(a)] |
| 10/16/13 | 12:00 AM | Not Valid[(a)] |
| 10/16/13 | 1:00 AM | Not Valid[(a)] |
| 10/16/13 | 2:00 AM | 37 |
| 10/16/13 | 3:00 AM | 34 |
| 10/16/13 | 4:00 AM | 34 |
| 10/16/13 | 5:00 AM | 36 |
| 10/16/13 | 6:00 AM | 41 |
| 10/16/13 | 7:00 AM | 44 |
| 10/16/13 | 8:00 AM | 44 |
| 10/16/13 | 9:00 AM | 43 |
| 10/16/13 | 10:00 AM | 42 |
| 10/16/13 | 11:00 AM | 45 |
| 10/16/13 | 12:00 PM | 45 |
| 10/16/13 | 1:00 PM | 44 |
| 10/16/13 | 2:00 PM | 43 |
| 10/16/13 | 3:00 PM | 42 |
| 10/16/13 | 4:00 PM | 40 |
| 10/16/13 | 5:00 PM | 37 |
| Daytime Average ($L_{eq, day}$) | 7:00 AM to 10:00 PM | 43 |
| Nighttime Average ($L_{eq, night}$) | 10:00 PM to 7:00 AM | 37 |
| Day-Nighttime Average ($L_{eq, dn}$) | | 45 |

(a) This hour contained fewer than 30 minutes of valid data

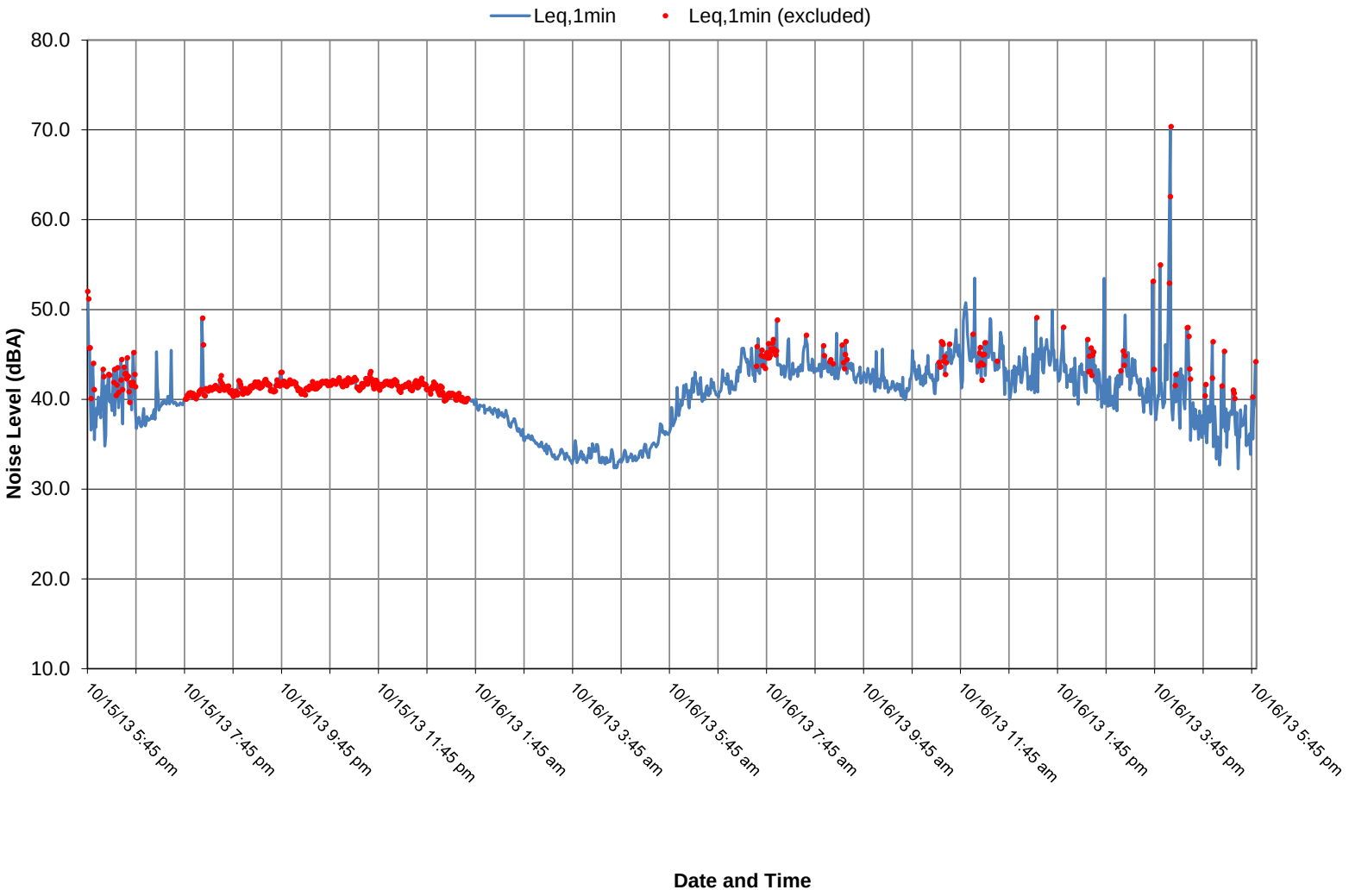



*Figure 14: Unfiltered One-Minute Noise Levels at NR5 (with logging)*

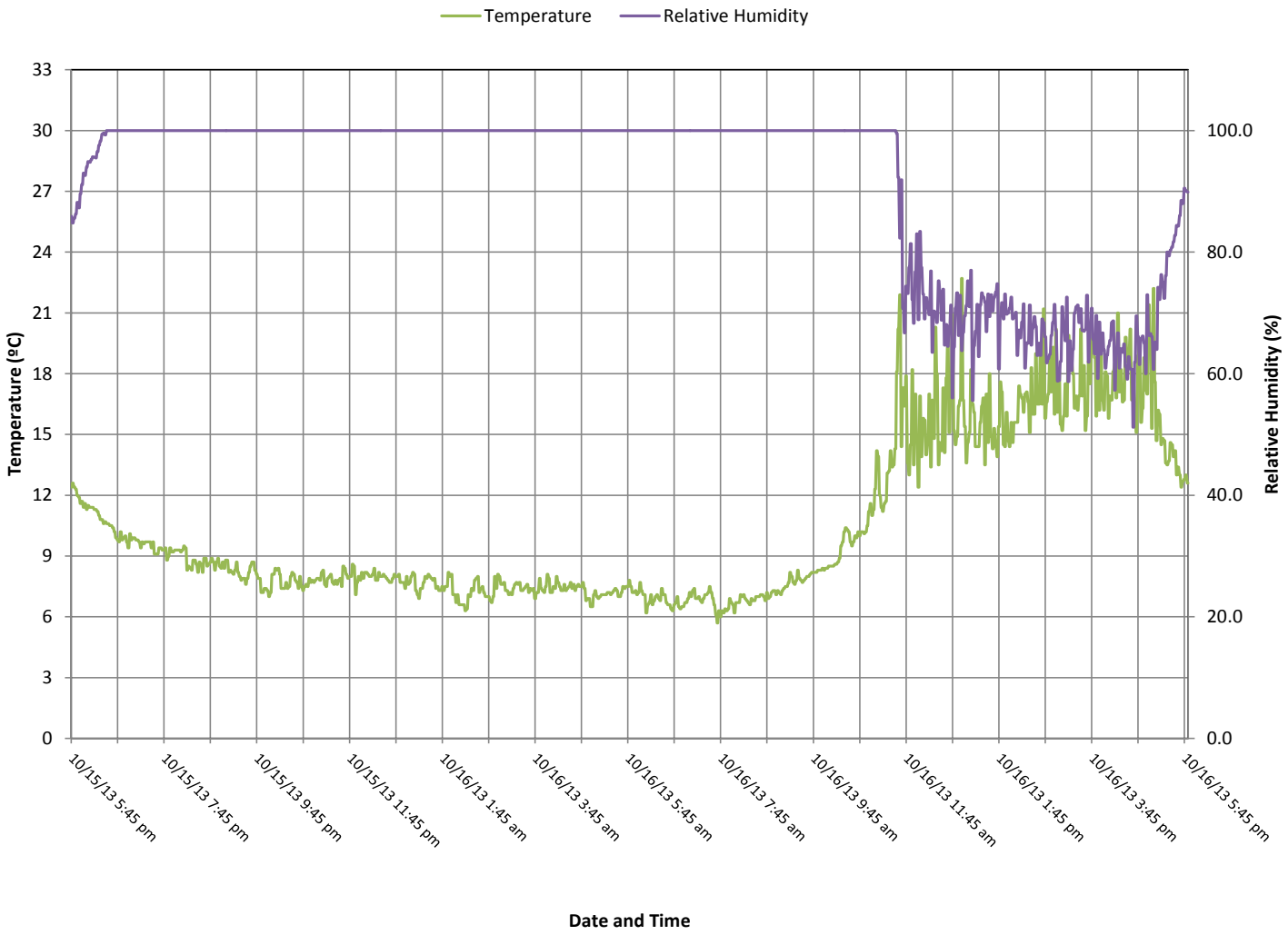



*Figure 15: Weather Information (Temperature and Humidity) for NR5 (with logging)*

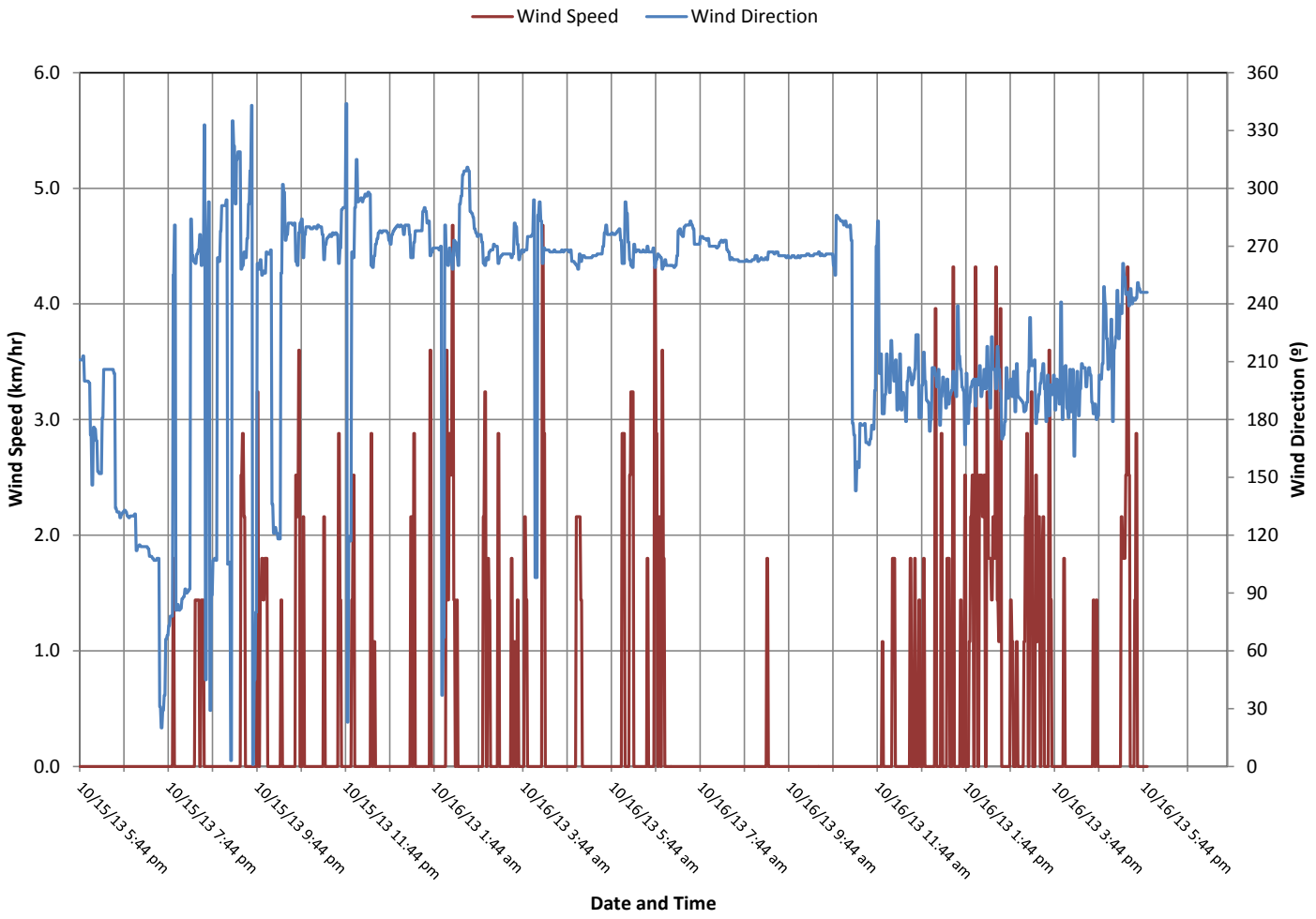



*Figure 16: Weather Information (Wind Speed and Direction) for NR5 (with logging)*

### 4.5.2 Low Frequency Noise Results

Table 12 presents the result of LFN analysis conducted using the 1/3 octave band spectra corresponding to valid one-minute noise samples for NR5.

**Table 12: Low Frequency Noise Analysis at Monitoring Location NR5 – with logging**

| Period | dBC – dBA | Number of tones below 250 Hz | LFN issue? |
|---|---|---|---|
| Daytime (7:00 AM – 10:00 PM) | 10.3 | 0 | no |
| Nighttime (10:00 PM – 7:00 AM) | 6.8 | 0 | no |

Table 12 indicates that the difference between the A-weighted and C-weighted noise levels is always less than 20 dB and that there are no tones present below 250 Hz. Therefore, there was no LFN issue during the daytime or nighttime periods of the NR5 survey.

## 4.6 Monitoring Location NR5 – without logging

### 4.6.1 Broadband Noise Results

Noise levels without logging activities were monitored at NR5 to characterize the logging effects in the LSA and RSA. The baseline noise levels at NR5 were found to be influenced primarily by fast flowing water in McNab Creek, wave activity in Howe Sound, human activities including power generation in the community and on the beach, wildlife, birds and insects and wind in the trees. Since logging activities only occur during the day, and birds and most other wildlife are more likely to be active during the daytime period, baseline noise levels at NR5 were found to be higher during the daytime.

Unfiltered $L_{eq,\ 1min}$ values recorded at NR5 are shown in Figure 17. Filtered $L_{eq,\ 1hr}$ values along with $L_{eq,\ day}$, $L_{eq,\ night}$ and $L_{eq,\ dn}$ values at this monitoring location are presented in Table 13. Weather data, recorded near the NR5 monitoring site are presented in Figures 18 and 19.

**Table 13: Filtered Hourly Noise Levels at NR5 – without logging**

| Date | Start Hour | $L_{eq, 1hr}$ [dBA] |
|---|---|---|
| 10/26/13 | 12:00 PM | 35 |
| 10/26/13 | 1:00 PM | 37 |
| 10/26/13 | 2:00 PM | 33 |
| 10/26/13 | 3:00 PM | 47 |
| 10/26/13 | 4:00 PM | 35 |
| 10/26/13 | 5:00 PM | 36 |
| 10/26/13 | 6:00 PM | 36 |
| 10/26/13 | 7:00 PM | 36 |
| 10/26/13 | 8:00 PM | 35 |
| 10/26/13 | 9:00 PM | 34 |
| 10/26/13 | 10:00 PM | 33 |
| 10/26/13 | 11:00 PM | 33 |
| 10/27/13 | 12:00 AM | 34 |
| 10/27/13 | 1:00 AM | 32 |
| 10/27/13 | 2:00 AM | 35 |
| 10/27/13 | 3:00 AM | 37 |
| 10/27/13 | 4:00 AM | 37 |
| 10/27/13 | 5:00 AM | 36 |
| 10/27/13 | 6:00 AM | 36 |
| 10/27/13 | 7:00 AM | 37 |
| 10/27/13 | 8:00 AM | 37 |
| 10/27/13 | 9:00 AM | 49 |
| 10/27/13 | 10:00 AM | 40 |
| 10/27/13 | 11:00 AM | 34 |
| 10/27/13 | 12:00 PM | 34 |
| 10/27/13 | 1:00 PM | 34 |
| 10/27/13 | 2:00 PM | 34 |
| 10/27/13 | 3:00 PM | 34 |
| 10/27/13 | 4:00 PM | 41 |
| 10/27/13 | 5:00 PM | 38 |
| 10/27/13 | 6:00 PM | 37 |
| 10/27/13 | 7:00 PM | 39 |
| 10/27/13 | 8:00 PM | 39 |
| 10/27/13 | 9:00 PM | 39 |
| 10/27/13 | 10:00 PM | 37 |
| 10/27/13 | 11:00 PM | 36 |
| 10/28/13 | 12:00 AM | 36 |
| 10/28/13 | 1:00 AM | 37 |

| Date | Start Hour | $L_{eq, 1hr}$ [dBA] |
|---|---|---|
| 10/28/13 | 2:00 AM | 37 |
| 10/28/13 | 3:00 AM | 38 |
| 10/28/13 | 4:00 AM | 38 |
| 10/28/13 | 5:00 AM | 39 |
| Daytime Average ($L_{eq, day}$) | 7:00 AM to 10:00 PM | 40 |
| Nighttime Average ($L_{eq, night}$) | 10:00 PM to 7:00 AM | 36 |
| Day-Nighttime Average ($L_{eq, dn}$) | | 43 |

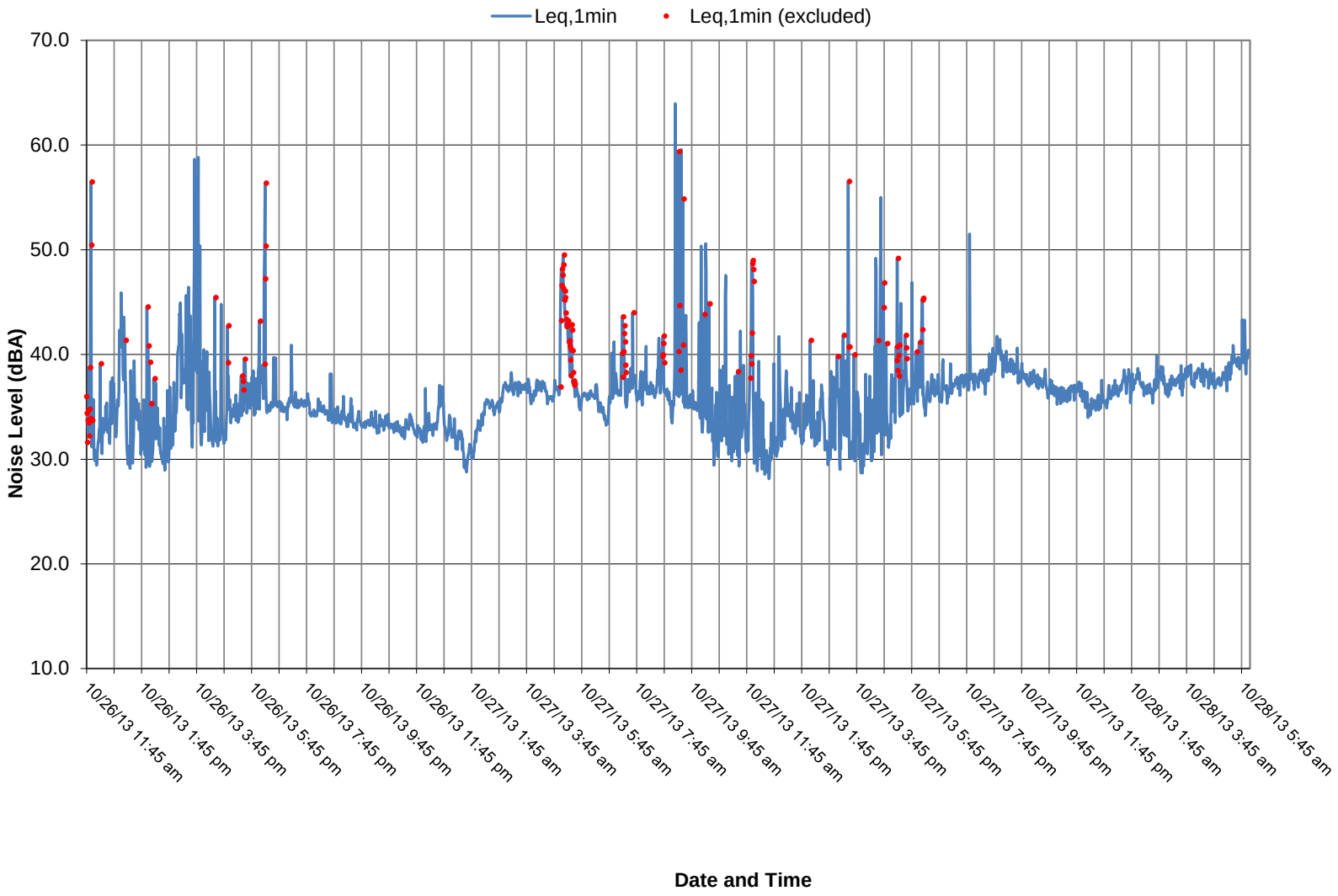



*Figure 17: Unfiltered One-Minute Noise Levels at NR5 (without logging)*

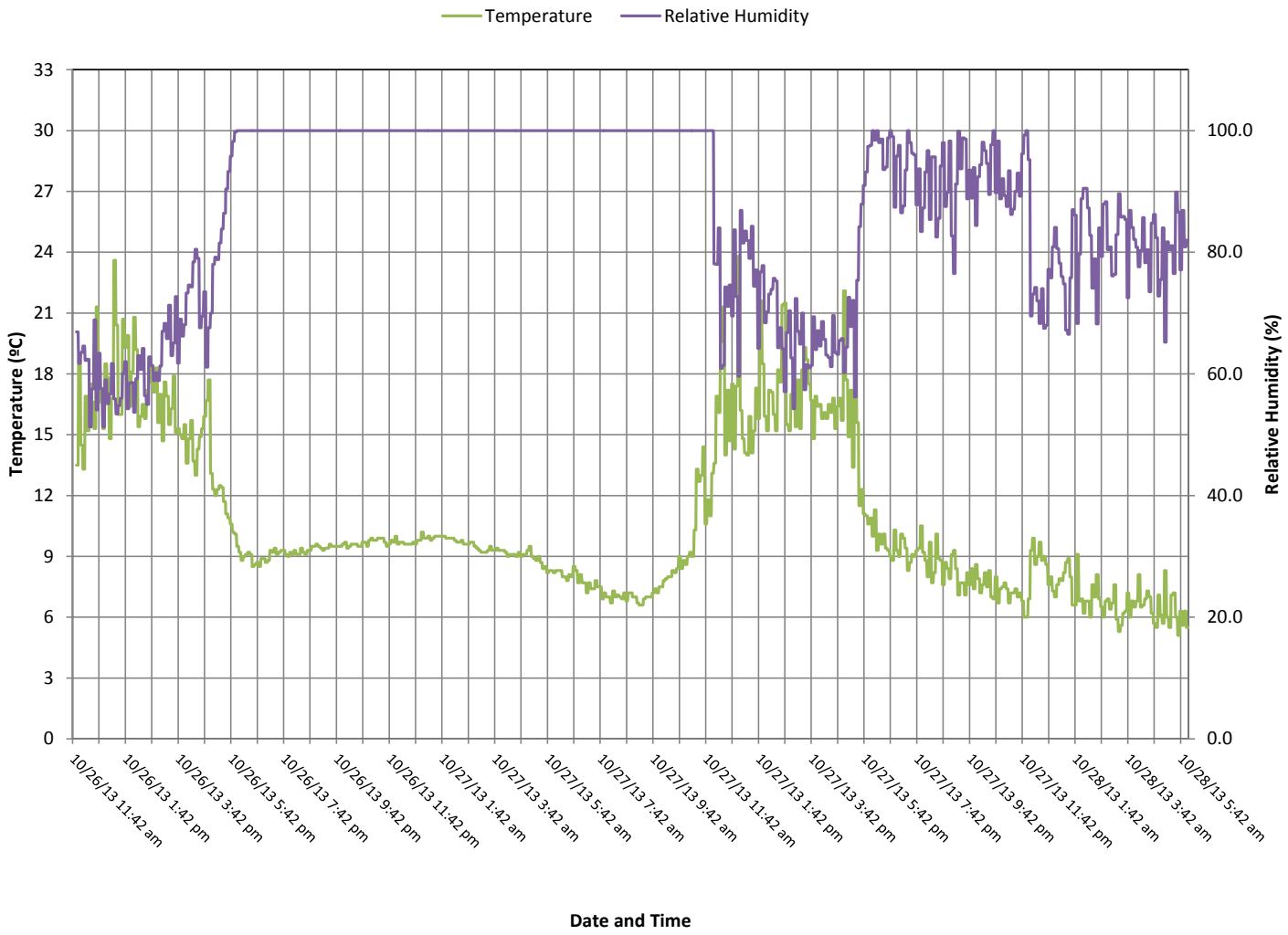



*Figure 18: Weather Information (Temperature and Humidity) for NR5 (without logging)*

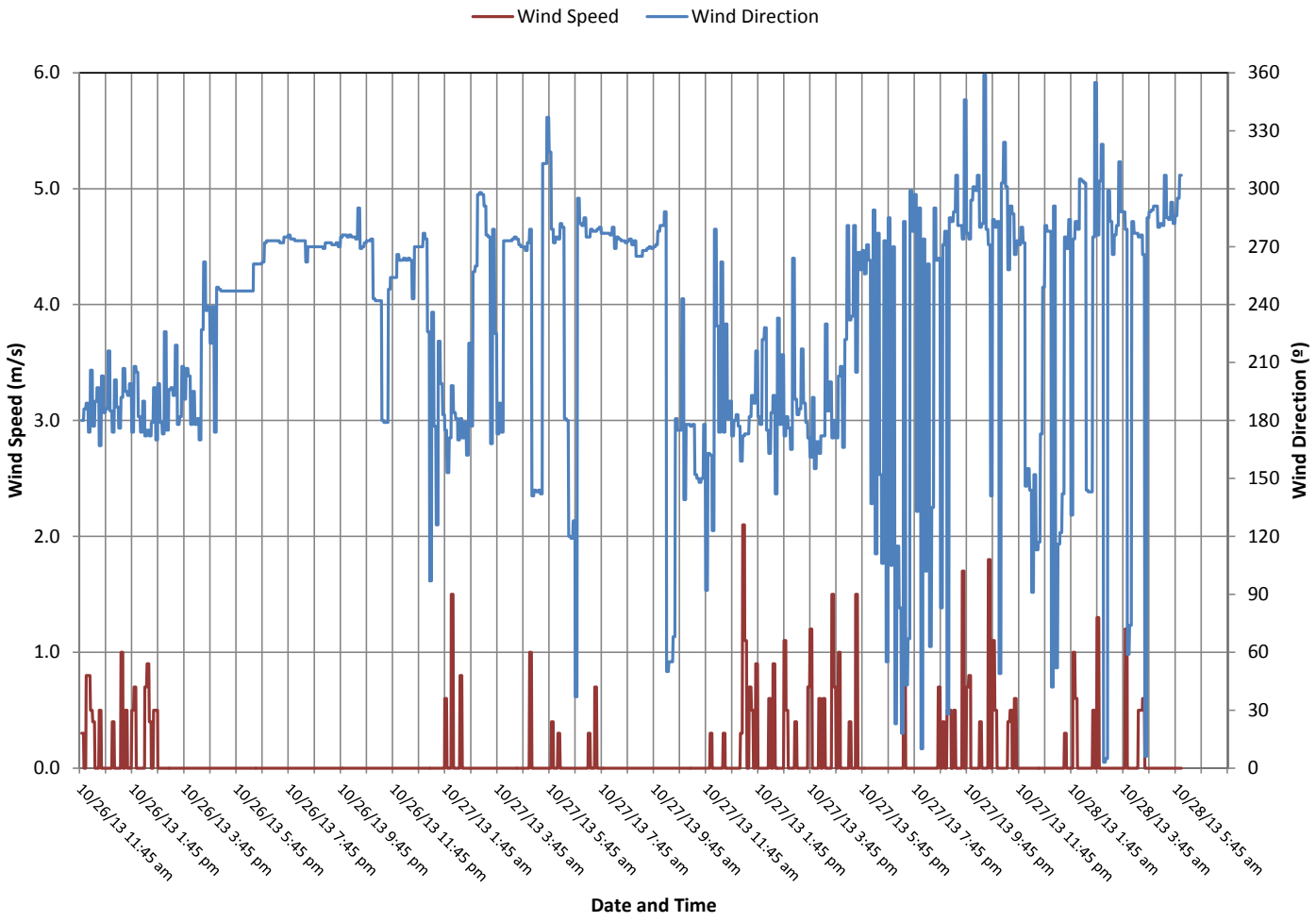



*Figure 19: Weather Information (Wind Speed and Direction) for NR5 (without logging)*

### 4.6.2 Low Frequency Noise Results

Table 14 presents the result of LFN analysis conducted using the 1/3 octave band spectra corresponding to valid one-minute noise samples for NR5.

**Table 14: Low Frequency Noise Analysis at Monitoring Location NR5 – without logging**

| Period | dBC – dBA | Number of tones below 250 Hz | LFN issue? |
|---|---|---|---|
| Daytime (7:00 AM – 10:00 PM) | 11.8 | 0 | no |
| Nighttime (10:00 PM – 7:00 AM) | 3.5 | 0 | no |

Table 14 indicates that the difference between the A-weighted and C-weighted noise levels is always less than 20 dB and that there are no tones present below 250 Hz. Therefore, there was no LFN issue during the daytime or nighttime periods of the NR5 survey.

## 4.7 Logging Correction

Logging activities began in 2013 and are planned to be ongoing for a significant portion of the Project lifespan, and therefore the baseline noise levels at each receptor position should include logging noise. Baseline measurements at NR1-NR4 occurred when no logging was present, and therefore noise levels do not reflect the current logging operations. Measurements at NR5, which were measured with and without logging activities, allow for corrections to be applied to the first four receptor locations to account for the logging noise. Table 15 shows the calculation of the logging correction at NR5 and Table 16 shows the calculation of the corrected baseline noise levels at receptor locations NR1-NR4.

**Table 15: Calculation of Logging Correction at NR5**

| Monitoring Location | Baseline Noise Measurements | | Distance from Logging (km) | Logging Correction[(a)] | | Corrected Baseline[(b)] | |
|---|---|---|---|---|---|---|---|
| | $L_{eq,\ day}$[dBA] | $L_{eq,\ night}$ [dBA] | | $L_{eq,\ day}$[dBA] | $L_{eq,\ night}$[dBA] | $L_{eq,\ day}$[dBA] | $L_{eq,\ night}$[dBA] |
| NR5 –without logging | 40 | 36 | 1.2 | 40 | 30 | 43 | 37 |
| NR5 – with logging | 43 | 37 | 1.2 | N/A | N/A | N/A | N/A |

(a) Logarithmic Difference between Baseline Noise Measurements of NR5 with and without logging

(b) Logarithmic Sum of Baseline Noise Measurements and Logging Correction

**Table 16: Calculation of Corrected Baseline Noise Levels at NR1-NR4**

| Monitoring Location | Baseline Noise Measurements | | Distance from Logging (km) | Distance Effect (dB) | Logging Correction[(a)] | | Corrected Baseline[(b)] | |
|---|---|---|---|---|---|---|---|---|
| | $L_{eq, day}$[dBA] | $L_{eq, night}$ [dBA] | | | $L_{eq, day}$[dBA] | $L_{eq, night}$[dBA] | $L_{eq, day}$[dBA] | $L_{eq, night}$[dBA] |
| NR1 | 36 | 36 | 1.1 | -1 | 41 | 31 | 42 | 37 |
| NR2 | 43 | 37 | 0.9 | -2 | 42 | 33 | 46 | 38 |
| NR3 | 42 | 41 | 3 | 8 | 32 | 22 | 42 | 41 |
| NR4 | 44 | 33 | 3.3 | 9 | 31 | 21 | 44 | 33 |

(a) NR5 Baseline Logging Correction plus Distance Effect

(b) Logarithmic Sum of Baseline Noise Measurements and Logging Correction

# 5.0 SUMMARY

The results of the acoustic environmental baseline surveys at five monitoring locations are summarized in Table 17. The period averages were based on the hourly data filtered to exclude extraneous sound events and weather conditions. Corrections were applied to NR1-NR4 to account for logging activities which were not present during the initial noise survey. Corrections were based on NR5 measurements, which occurred with and without logging activities. As the logging is planned to be ongoing for much of the lifespan of the Project, the Baseline Case for the Noise Impact Assessment will be with logging activities included.

**Table 17: Baseline Noise Survey Results at Monitoring Locations**

| Monitoring Location | Baseline Noise Levels – No Logging (dBA) | | Baseline Noise Levels – Logging (dBA) | |
|---|---|---|---|---|
| | Day-time, $L_{eq, day}$ | Night-time, $L_{eq, night}$ | Day-time, $L_{eq, day}$ | Night-time, $L_{eq, night}$ |
| | 7:00 AM to 10:00 PM | 10:00 PM to 7:00 AM | 7:00 AM to 10:00 PM | 10:00 PM to 7:00 AM |
| NR1 – BURNCO East | 36 | 36 | 42 | 37 |
| NR2 – BURNCO West | 43 | 37 | 46 | 38 |
| NR3 – BURNCO North | 42 | 41 | 42 | 41 |
| NR4 – BURNCO South | 44 | 33 | 44 | 33 |
| NR5 – McNab Strata Community | 40 | 36 | 43 | 37 |

The five monitoring locations used for the baseline noise survey were selected to be representative of baseline noise levels throughout the noise RSA. NR1 represents noise levels in the open areas near slow flowing water of McNab Creek; NR2 represents noise levels in the heavily forested area west of the Project fence line or boundary; NR3 represents noise levels in the heavily forested area nearby fast flowing water of McNab Creek; NR4 represents the noise levels in the recreation areas nearby the shore of Howe Sound; and NR5 represents the noise levels in the McNab Strata Community. The baseline noise levels at NR1 were mainly influenced by noise from a section of McNab Creek in which water was moving relatively slowly. Likewise the baseline noise levels at NR3 were mainly influenced by noise from a section of McNab Creek in which water was moving relatively quickly. The baseline noise levels at NR2 were mainly influenced by natural noise from birds and other wildlife. The baseline noise levels at NR4 were mainly influenced by recreational activities associated with summer camps and yacht clubs. The major sound sources contributing to the baseline noise levels at NR5 are logging, fast flowing water in McNab Creek, wave activity in Howe Sound, human activities including power generation in the community and on the beach, wildlife, birds and insects and wind in the trees.

## 6.0 CLOSING

We trust that the information contained in this report meets your current requirements. Please contact us if you require any further information.

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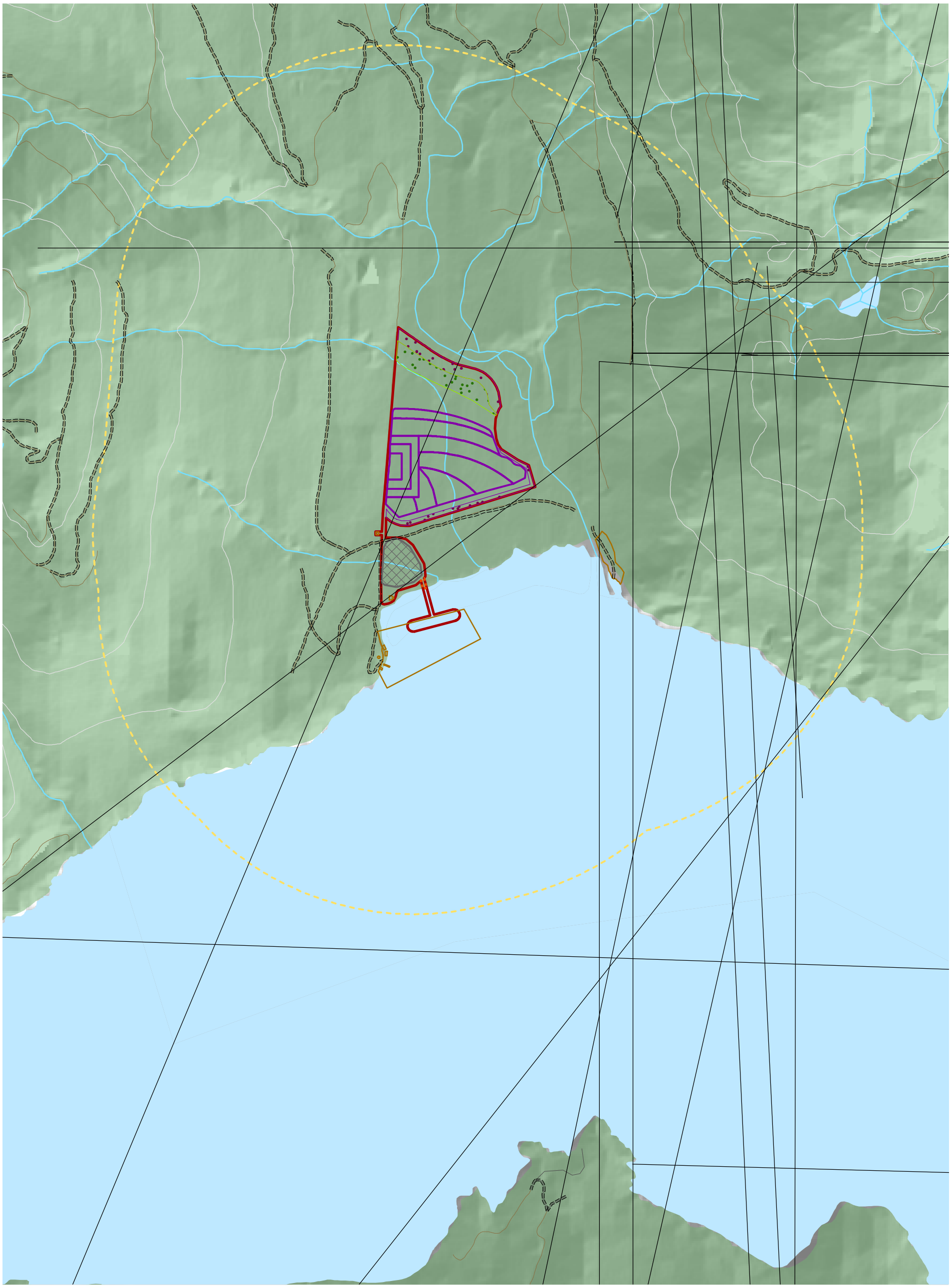

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