APPENDIX 5.4-1

Atmospheric Sound Baseline Study

October 1, 2014

WOODFIBRE LNG

Atmospheric Sound Baseline Study

Submitted to:
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REPORT

Report Number: 1314220006-035-R-Rev0

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1.0 INTRODUCTION

Woodfibre LNG Limited (WLNG) is proposing to construct and operate a liquefied natural gas (LNG) production, storage, and marine carrier transfer facility (project) for the export of LNG. The project will be located approximately seven kilometres west-southwest of Squamish, British Columbia (BC) on the west side of Howe Sound. The project is undergoing a provincial and federal environmental assessment (EA) led by the BC Environmental Assessment Office (EAO).

Golder Associates Ltd. (Golder) has been retained by WLNG to conduct baseline studies to support an Environmental Assessment Certificate (EAC) application for the project. The EAC application will include an assessment of the change in atmospheric sound due to the project.

To appropriately assess the effect of atmospheric sound from the project, it is necessary to characterize the existing acoustic environment in the project area (i.e., the current sound levels in the area as a result of natural sound sources, human activities, and existing industrial sound sources). This report presents the results of an atmospheric sound baseline study conducted during spring 2014 for the purpose of characterizing the existing acoustic environment.

The atmospheric sound baseline study for the project was conducted in accordance with the British Columbia Oil and Gas Commission's (OGC) *British Columbia Noise Control Best Practices Guideline* (OGC 2009); hereafter referred to as the OGC Guideline. Additional guidance for conducting the atmospheric sound baseline study and processing the data was obtained from the Alberta Energy and Utilities Board document *Directive 038: Noise Control* (EUB 2007); hereafter referred to as Directive 038. Further guidance on the processing of baseline data was taken from the Health Canada (HC) document *Useful Information for Environmental Assessments* (Health Canada 2010); hereafter referred to as the HC Guidance.

The focus of the atmospheric sound assessment is to determine project-related changes to the existing or baseline sound levels in the project area. Both the predicted change in sound levels as a result of the project, and the absolute cumulative sound levels predicted during construction and operation are typically compared to relevant assessment criteria specified in the OGC Guideline and in the HC Guidance. Both the OGC Guideline and HC Guidance assess atmospheric sound from a receptor perspective and recommend assessing sound levels at locations where humans are likely to be exposed. The OGC 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 1.5km 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. The OGC Guideline and HC Guidance were considered when selecting receptors for baseline sound monitoring.

The objective of the atmospheric sound baseline study is to establish the existing acoustic environment at human receptors within the project area. Sound monitoring did not occur on site, where sound effects on wildlife is a concern, as the OGC Guideline prescribes ambient sound levels for rural areas and does not require baseline sound measurements. Later, as part of the EAC application, this baseline information can be used as input to predict project-related changes in sound levels and the absolute cumulative sound levels during construction and operation phases of the project.

2.0 STUDY AREA

The project site is located approximately seven kilometres west-southwest of Squamish, BC with the Universal Transverse Mercator (UTM) coordinates 481759 m Easting and 5501600 m Northing. The site is zoned for industrial use, and has been home to a pulp and paper mill for about 100 years. WLNG is purchasing the 86 hectare site from Western Forest Products, who decommissioned the Woodfibre pulp mill in 2006.

The Local Assessment Area (LAA) for assessment of atmospheric sound from the project extends 1.5 km in all directions from the project area boundary (Figure 2-1), consistent with the OGC Guideline. The Regional Assessment Area (RAA) for the assessment of atmospheric sound extends 8km in all directions from the project area fence line or boundary, including the area from which project direct or cumulative effects from the project could potentially be observed. Beyond the 8 km area, sound from the project is expected to be attenuated to such a level that it cannot be discerned from the ambient sound that is already in an area.

The atmospheric sound RAA is described as a recreation area used for boating, hunting, fishing, camping and rock climbing. Logging operations are ongoing immediately to the southwest of project site. On the opposite side of Howe Sound east of the project site, there are several communities, including Britannia Beach and Darrel Bay, both approximately 6 km away. As such, they are outside of the atmospheric sound LAA but still within the RAA. There is an operational quarry at Watts Point within Murrin Park, approximately 3 km east from the project boundary, located on Squamish First Nations land.

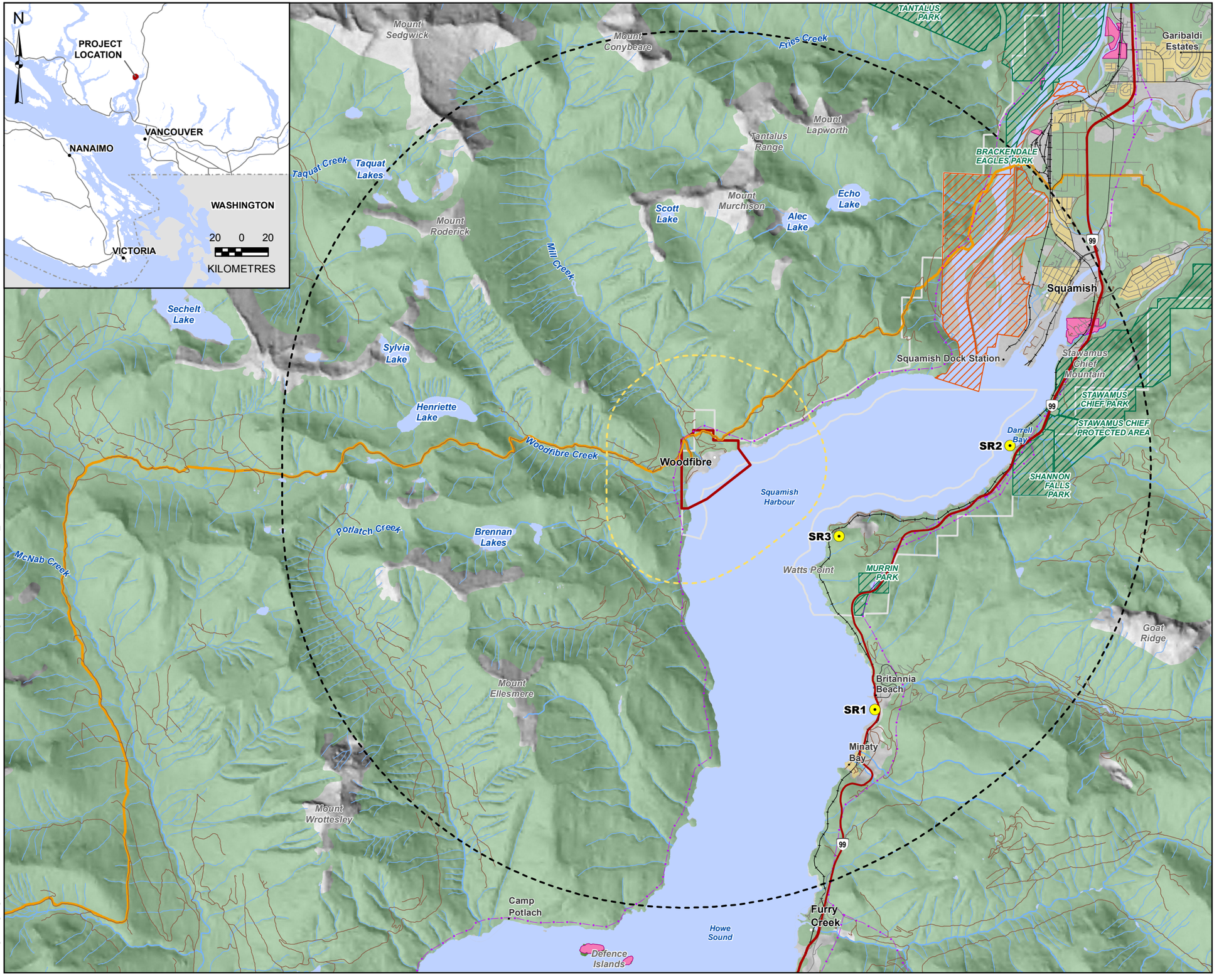
The communities on the opposite side of Howe Sound are greater than 1.5 km from the project area boundary, and are therefore not considered relevant sound sensitive receptors for the project under the OGC Guideline. However, in the interest of characterizing existing sound levels across the entire RAA, as well as considering the HC Guidance, baseline monitoring was conducted at three receptor locations (see Figure 2-1) including:

- **SR1 (Britannia Beach)** - located across the Howe Sound channel, within the atmospheric sound RAA. SR1 was located approximately 5.8 km from the project area boundary on the EPCOR pumphouse site in Britannia Beach. It was selected to characterize baseline sound levels in the residential community of Britannia Beach. Baseline sound levels at SR1 are mainly influenced by highway traffic and passing trains. The pumphouse itself did not produce any noticeable noise;
- **SR2 (Darrell Bay)** - an occupied location approximately 5.5km south-southeast of the project area boundary, within the atmospheric sound RAA. SR2 is a residence directly on the water across from the project site in Darrell Bay. It was selected to characterize baseline sound levels in Darrell Bay, a community that includes a residence and the Klahanie Campground. Baseline sound levels at SR2 are mainly influenced by natural sounds due to wildlife, wind and waves, and man-made sounds such as trains, boats and planes; and
- **SR3 (Watts Point)** - located near a First Nations site located 2.8 km southeast of the project area boundary within the atmospheric sound RAA. It is within the Watts Point quarry site in Murrin Park and; therefore, baseline sound levels are mainly influenced by the quarry, as well as natural sounds due to wind and waves, and man-made sounds such as boats and planes.

Table 2-1 provides the UTM coordinates for the selected monitoring locations (SR1 – SR3). Figure 2-1 shows the location of the sound monitoring sites relative to the project area boundary. Photographs taken at the monitoring locations are presented in Photographs 2-1 to 2-3.

Table 2-1: Coordinates for Selected Baseline Sound Monitoring Sites

Monitoring Location	UTM (NAD83, Zone 10)	
	Easting (m)	Northing (m)
SR1	485085	5496597
SR2	487794	5501885
SR3	484372	5500071



PATH: \\golder.gds\gal\Vancouver\CAD-GIS\VAN\2013\13-1422\13-1422-0006 - WoodfibreMapping\MXD\NoiseWOODFIBRE_ATMOSPHERIC_SOUND_FIGURE_2_1.mxd Date: 10/1/2014 Time: 11:03:49 AM

LEGEND

- PROJECT AREA
- ATMOSPHERIC SOUND LOCAL ASSESSMENT AREA (LAA)
- ATMOSPHERIC SOUND REGIONAL ASSESSMENT AREA (RAA)
- PARK / PROTECTED AREA (NAME)
- SKEWLWIL'EM SQUAMISH ESTUARY
- FOREST AREA
- URBAN AREA
- INDIAN RESERVE
- MUNICIPALITY
- HIGHWAY
- ARTERIAL ROAD
- LOCAL ROAD
- LIMITED ACCESS ROAD
- RAILWAY
- TRANSMISSION LINE (ELECTRIC)
- FORTISBC GAS PIPELINE
- WATERCOURSE
- SOUND RECEPTOR (SR#)

REFERENCE

PARKS/PROTECTED AREAS AND MUNICIPALITIES FROM GEOBC. GAS PIPELINE FROM ICIS. BASE DATA FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. HILLSHADE PROVIDED BY GOVERNMENT OF BRITISH COLUMBIA.
PROJECTION: UTM ZONE 10 DATUM: NAD 83

SCALE

2 0 2
KILOMETRES

PROJECT
WOODFIBRE LNG LIMITED
WOODFIBRE, HOWE SOUND, B.C.

TITLE
BASELINE ATMOSPHERIC SOUND MEASUREMENT LOCATIONS

Golder Associates

PROJECT NO. 13-1422-0006			PHASE No. 5000	
DESIGN	SD	20 May 2014	SCALE 1:75,000	REV. 1
GIS	RH	01 Oct. 2014		
CHECK	SD	30 Sep. 2014		
REVIEW	AF	30 Sep. 2014		

FIGURE 2-1

Photograph 2-1: Sound Monitor at SR1

Photograph 2-2: Sound Monitor at SR2

Photograph 2-3: Sound Monitor at SR3

3.0 METHODS

3.1 Monitoring Method

One survey of three (3) to four (4) days duration was completed at each of the three sound monitoring locations. The measurements were conducted at SR2 between April 26 and April 29, 2014 (Saturday to Tuesday) and at SR1 and SR3 between May 9 and May 13, 2014 (Friday to Tuesday). Surveys of this type and duration provide information on daily variability in sound levels, including the difference between a weekday and a weekend day, 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 sound measurements and audio recordings. This type of meter logs sound levels and records audio data over intervals selected by the user. Data variables 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 (dBZ); 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 variance was within 0.5 decibels (dB). The calibrator has an estimated uncertainty for sound pressure level of ±0.12dB at a 99% confidence level. The calibration data were logged by the meter and calibration results were also described in field notes.

Directive 038 indicates baseline sound monitoring should be conducted under favourable summertime conditions (i.e., in the absence of snow, water, or ice ground cover, and in the absence of steady precipitation). Directive 038 also specifies baseline sound monitoring should 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 sound 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 sound 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 sound 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 sound sources from the audio recordings and, in accordance with Directive 038, to filter out invalid data, such as sound associated with the following sources:

- Technician activities;
- Vehicular traffic near the monitoring location;
- Airplane flyovers;

- Wind;
- Rain;
- Thunder; and
- Birds, insects and other animal activities very near the monitoring location.

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

All three monitoring locations were very close to active train tracks. Train passes are discrete sound sources that had a substantial effect on the existing sound environment. Two sets of results are presented here based on the inclusion and exclusion of data measured during train passes.

During analysis of the data, sound sources were identified mainly from the audio recordings. Other indicators used to identify sources of sound 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 OGC Guideline and HC Guidance. The OGC 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 dBA for the sound monitoring locations SR1, SR2 and SR3 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 defined by the OGC Guideline, Directive 038 indicates that LFN may be an issue even when the broadband sound level is otherwise acceptable. Directive 038 lays out specific criteria for determining if LFN is an issue during a baseline sound survey. Directive 038 considers an LFN condition to exist if:

- The difference between the C-weighted (dBC) and dBA sound levels is greater than 20dB; 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 10dB 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 5dB in level bandwidths on the opposite side.

An overview of the valid minutes of baseline sound data for each monitoring location is shown in Table 3-1. Directive 038 requires a minimum of three hours (180 minutes) 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 3-1: Overview of Valid Minutes of Baseline Sound 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]
SR1 – including trains	2,420	925	2,028	132	4,448	1,087
SR1 – excluding trains	2,404	971	2,002	158	4,406	1,129
SR2 – including trains	1,524	841	1,394	226	2,918	1,067
SR2 – excluding trains	1,510	855	1,380	240	2,890	1,095
SR3 – including trains	2,133	1,242	1,488	672	3,621	1,914
SR3 – excluding trains	2,120	1,255	1,472	688	3,592	1,943

4.0 MEASURED BASELINE SOUND LEVELS

4.1 Monitoring Location SR1

4.1.1 Broadband Sound Results

The baseline sound levels at SR1 were found to be influenced primarily by constant sound associated with the traffic along the Sea-to-Sky Highway and train passes. As traffic volume increases during the daytime, daytime sound levels were found to be higher than nighttime levels at SR1. SR1 is believed to be representative of the residences within the community of Britannia Beach that are close to the highway and the active train tracks. There was little difference between daytime and nighttime measurements taken on a weekday versus a weekend. Weeknight sound levels were slightly higher due to increased traffic in the early morning hours.

Filtered $L_{eq,1hr}$ values that include train sound as well as $L_{eq,day}$, $L_{eq.night}$ and $L_{eq,dn}$ values for both the inclusion and exclusion of train sound at this monitoring location are presented in Table 4-1. Hours that contain a train pass have been indicated. Unfiltered $L_{eq.1min}$ values recorded at SR1 are shown in Figure 4-1. High wind speeds were the cause of the majority of the invalid data. Weather data, recorded near the SR1 monitoring site are presented in Figures 4-2 and 4-3.

Table 4-1: Filtered Hourly Sound Levels at SR1

Date	Start Hour	$L_{eq, 1hr}$ [dBA]
05/09/14	2:00 PM	53
05/09/14	3:00 PM	54
05/09/14	4:00 PM	54
05/09/14	5:00 PM	55
05/09/14	6:00 PM	54
05/09/14	7:00 PM	54
05/09/14	8:00 PM	53
05/09/14	9:00 PM	50
05/09/14	10:00 PM	48
05/09/14	11:00 PM	47
05/10/14	12:00 AM	44
05/10/14	1:00 AM	42
05/10/14	2:00 AM	65[(a)]
05/10/14	3:00 AM	44
05/10/14	4:00 AM	44
05/10/14	5:00 AM	49
05/10/14	6:00 AM	49
05/10/14	7:00 AM	52
05/10/14	8:00 AM	65[(a)]
05/10/14	9:00 AM	54
05/10/14	10:00 AM	53
05/10/14	11:00 AM	54
05/10/14	12:00 PM	Not Valid[(b)]
05/10/14	1:00 PM	Not Valid[(b)]
05/10/14	2:00 PM	Not Valid[(b)]

Date	Start Hour	$L_{eq, 1hr}$ [dBA]
05/10/14	3:00 PM	Not Valid[(b)]
05/10/14	4:00 PM	Not Valid[(b)]
05/10/14	5:00 PM	Not Valid[(b)]
05/10/14	6:00 PM	Not Valid[(b)]
05/10/14	7:00 PM	54
05/10/14	8:00 PM	51
05/10/14	9:00 PM	49
05/10/14	10:00 PM	48
05/10/14	11:00 PM	50
05/11/14	12:00 AM	44
05/11/14	1:00 AM	43
05/11/14	2:00 AM	41
05/11/14	3:00 AM	64[(a)]
05/11/14	4:00 AM	43
05/11/14	5:00 AM	44
05/11/14	6:00 AM	47
05/11/14	7:00 AM	49
05/11/14	8:00 AM	58[(a)]
05/11/14	9:00 AM	53
05/11/14	10:00 AM	53
05/11/14	11:00 AM	54
05/11/14	12:00 PM	Not Valid[(b)]
05/11/14	1:00 PM	Not Valid[(b)]
05/11/14	2:00 PM	Not Valid[(b)]
05/11/14	3:00 PM	Not Valid[(b)]
05/11/14	4:00 PM	Not Valid[(b)]
05/11/14	5:00 PM	Not Valid[(b)]
05/11/14	6:00 PM	54
05/11/14	7:00 PM	54
05/11/14	8:00 PM	53
05/11/14	9:00 PM	52
05/11/14	10:00 PM	49
05/11/14	11:00 PM	47
05/12/14	12:00 AM	44
05/12/14	1:00 AM	41
05/12/14	2:00 AM	65[(a)]
05/12/14	3:00 AM	40
05/12/14	4:00 AM	45
05/12/14	5:00 AM	50
05/12/14	6:00 AM	53
05/12/14	7:00 AM	54
05/12/14	8:00 AM	60[(a)]

Date	Start Hour	$L_{eq,\ 1hr}$ [dBA]
05/12/14	9:00 AM	53
05/12/14	10:00 AM	53
05/12/14	11:00 AM	53
05/12/14	12:00 PM	52
05/12/14	1:00 PM	52
05/12/14	2:00 PM	53
05/12/14	3:00 PM	54
05/12/14	4:00 PM	54
05/12/14	5:00 PM	54
05/12/14	6:00 PM	53
05/12/14	7:00 PM	53
05/12/14	8:00 PM	52
05/12/14	9:00 PM	49
05/12/14	10:00 PM	48
05/12/14	11:00 PM	47
05/13/14	12:00 AM	44
05/13/14	1:00 AM	42
05/13/14	2:00 AM	65[(a)]
05/13/14	3:00 AM	45
05/13/14	4:00 AM	45
05/13/14	5:00 AM	51
05/13/14	6:00 AM	53
05/13/14	7:00 AM	54
05/13/14	8:00 AM	63[(a)]
05/13/14	9:00 AM	54
Including Trains		
Daytime Average($L_{eq,day}$)	**7:00 AM to 10:00 PM**	**55**
Nighttime Average ($L_{eq,night}$)	**10:00 PM to 7:00 AM**	**57**
Day-Nighttime Average ($L_{eq,dn}$)		**63**
Excluding Trains		
Weekday Average ($L_{eq,day}$)	*7:00 AM to 10:00 PM*	*53*
Weeknight Average ($L_{eq,night}$)	*10:00 PM to 7:00 AM*	*48*
Weekend Day Average ($L_{eq,day}$)	*7:00 AM to 10:00 PM*	*53*
Weekend Night Average ($L_{eq,night}$)	*10:00 PM to 7:00 AM*	*46*
Daytime Average ($L_{eq,day}$)	**7:00 AM to 10:00 PM**	**53**
Nighttime Average ($L_{eq,night}$)	**10:00 PM to 7:00 AM**	**47**
Day-Nighttime Average ($L_{eq,dn}$)		**55**

(a) This hour contained a train pass
(b) This hour contained less than 30 minutes of valid data due to high winds and/or train passes

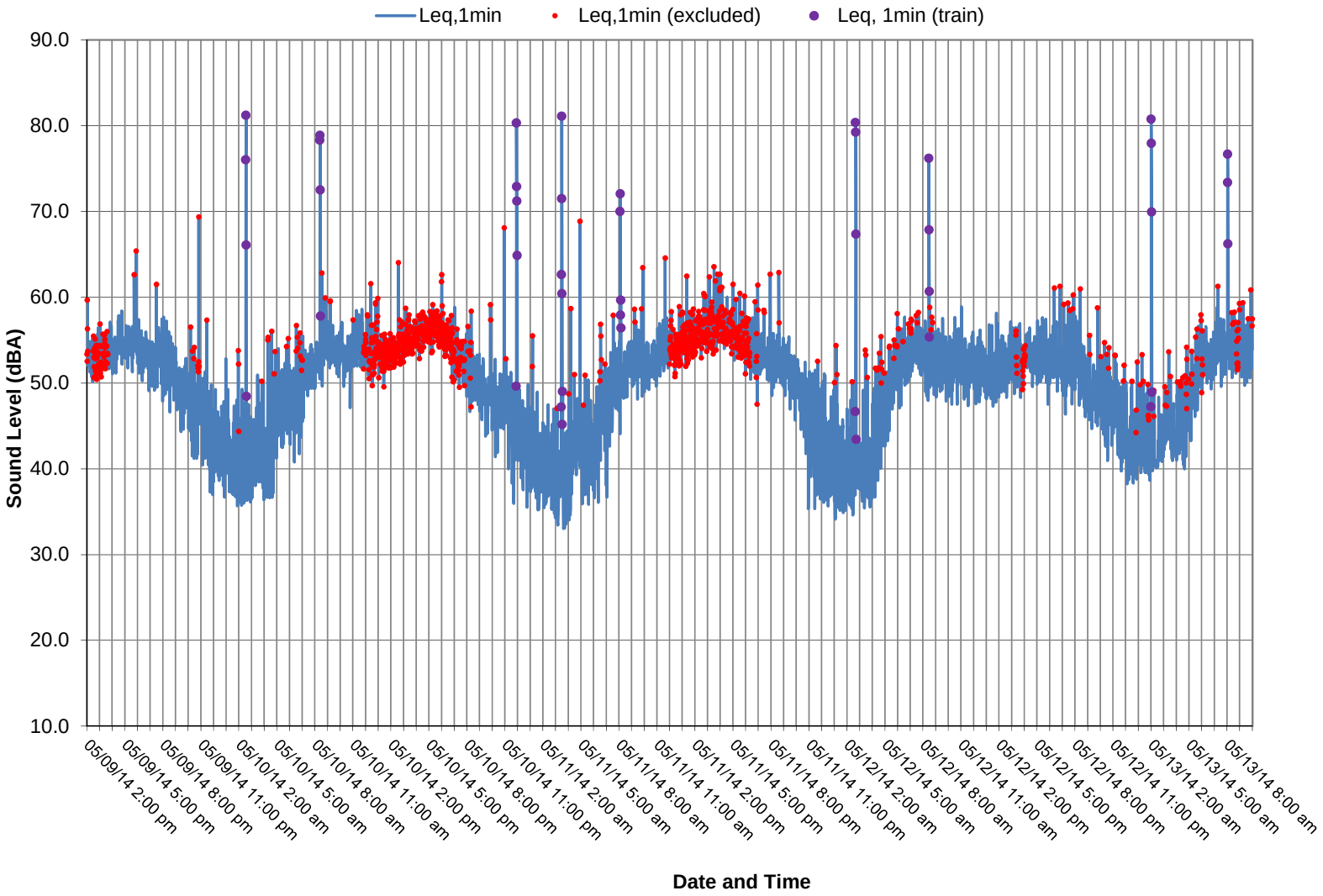


Figure 4-1: Unfiltered One-Minute Sound Levels at SR1

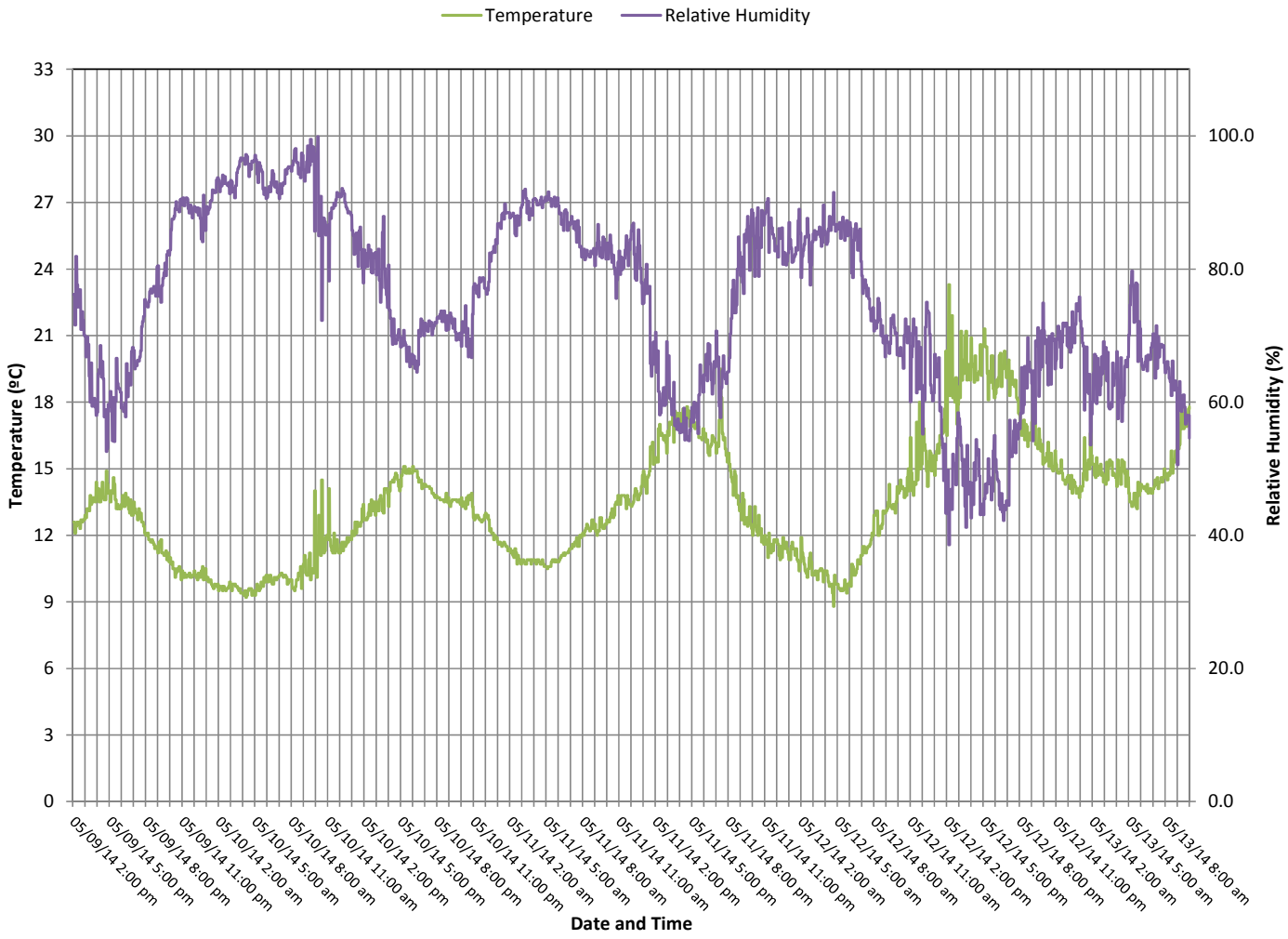


Figure 4-2: Weather Information (Temperature and Humidity) for SR1

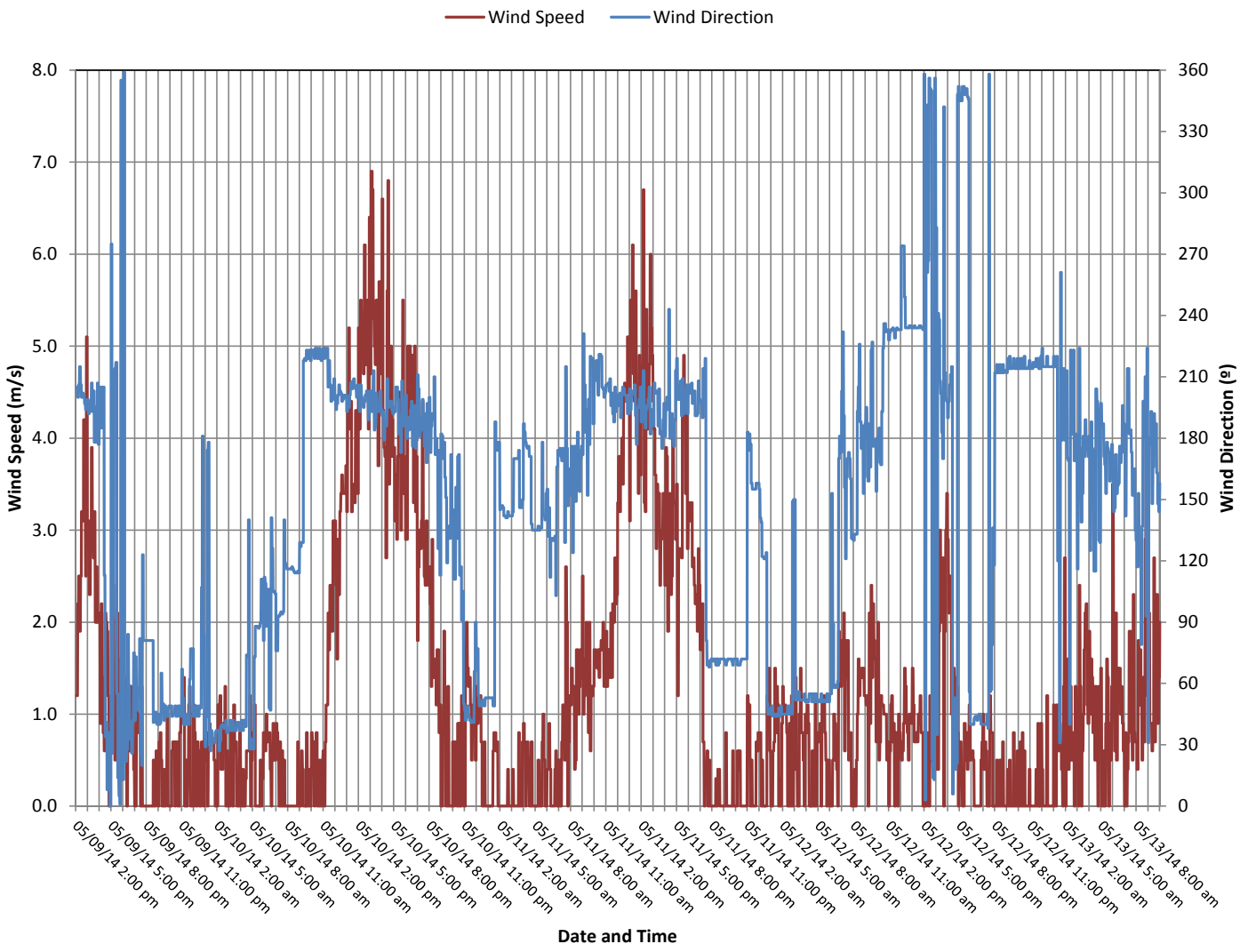


Figure 4-3: Weather Information (Wind Speed and Direction) for SR1

4.1.2 Low Frequency Noise (LFN) Results

Table 4-2 presents the result of LFN analysis conducted using the 1/3 octave band spectra corresponding to valid one-minute sound samples for SR1.

Table 4-2: Low Frequency Noise Analysis at Monitoring Location SR1

Period	dBC – dBA	Number of tones below 250 Hz	LFN issue?
Daytime (7:00 am – 10:00 pm) – trains included	9.6	0	no
Nighttime (10:00 pm – 7:00 am) – trains included	7.3	0	no
Daytime (7:00 am – 10:00 pm) – trains excluded	10.5	0	no
Nighttime (10:00 pm – 7:00 am) – trains excluded	9.7	0	no

Table 4-2 indicates that the difference between the A-weighted and C-weighted sound levels is always less than 20dB and that no tones are present below 250 Hz. Therefore, there was no LFN issue during the daytime or nighttime periods of the SR1 survey.

4.2 Monitoring Location SR2

4.2.1 Broadband Sound Results

SR2 is a residence located on the water in Darrell Bay within the atmospheric sound RAA. The baseline sound levels at SR2 were found to be primarily influenced by natural sound from birds and the waves of the water, as well as man-made sounds such as cars, trains, boats and airplanes. Since most of these man-made sounds are more likely to be active during the daytime period, baseline sound levels at SR2 were found to be higher during the daytime. There was very little difference between daytime and nighttime measurements taken on a weekday versus a weekend. Weeknight sound levels are slightly higher due to increased traffic in the early morning hours. SR2 is believed to be representative of the camp site and residences in Darrell Bay.

Filtered $L_{eq,1hr}$ values that include train sound as well as $L_{eq,day}$, $L_{eq,night}$ and $L_{eq,dn}$ values for both the inclusion and exclusion of train sound at this monitoring location are presented in Table 4-3. Hours that contain a train pass have been indicated. Unfiltered $L_{eq,1min}$ values recorded at SR2 are shown in Figure 4-4. Rain was the cause of the invalid data for the hours from 12:00 AM to 3:00 AM of April 27, 2014 and high wind speeds were the cause of the remaining hours of invalid data. Weather data recorded near the SR2 monitoring site are presented in Figures 4-5 and 4-6.

Table 4-3: Filtered Hourly Sound Levels at SR2

Date	Start Hour	$L_{eq, 1hr}$ [dBA]
04/26/14	3:00 PM	Not Valid[(b)]
04/26/14	4:00 PM	53
04/26/14	5:00 PM	50
04/26/14	6:00 PM	49
04/26/14	7:00 PM	43
04/26/14	8:00 PM	41
04/26/14	9:00 PM	40
04/26/14	10:00 PM	39
04/26/14	11:00 PM	40
04/27/14	12:00 AM	Not Valid[(b)]
04/27/14	1:00 AM	Not Valid[(b)]
04/27/14	2:00 AM	Not Valid[(b)]
04/27/14	3:00 AM	Not Valid[(b)]
04/27/14	4:00 AM	40
04/27/14	5:00 AM	40
04/27/14	6:00 AM	40
04/27/14	7:00 AM	56[(a)]
04/27/14	8:00 AM	48
04/27/14	9:00 AM	Not Valid[(b)]
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04/27/14	1:00 PM	Not Valid[(b)]
04/27/14	2:00 PM	Not Valid[(b)]
04/27/14	3:00 PM	Not Valid[(b)]
04/27/14	4:00 PM	Not Valid[(b)]
04/27/14	5:00 PM	Not Valid[(b)]
04/27/14	6:00 PM	Not Valid[(b)]
04/27/14	7:00 PM	48
04/27/14	8:00 PM	46
04/27/14	9:00 PM	42
04/27/14	10:00 PM	42
04/27/14	11:00 PM	39
04/28/14	12:00 AM	39
04/28/14	1:00 AM	38
04/28/14	2:00 AM	52[(a)]
04/28/14	3:00 AM	38
04/28/14	4:00 AM	40
04/28/14	5:00 AM	42
04/28/14	6:00 AM	54[(a)]
04/28/14	7:00 AM	46
04/28/14	8:00 AM	47

Date	Start Hour	$L_{eq,\ 1hr}$ [dBA]
04/28/14	9:00 AM	47
04/28/14	10:00 AM	51
04/28/14	11:00 AM	Not Valid(b)
04/28/14	12:00 PM	Not Valid(b)
04/28/14	1:00 PM	47
04/28/14	2:00 PM	47
04/28/14	3:00 PM	46
04/28/14	4:00 PM	46
04/28/14	5:00 PM	50
04/28/14	6:00 PM	Not Valid(b)
04/28/14	7:00 PM	52
04/28/14	8:00 PM	48
04/28/14	9:00 PM	45
04/28/14	10:00 PM	41
04/28/14	11:00 PM	40
04/29/14	12:00 AM	39
04/29/14	1:00 AM	40
04/29/14	2:00 AM	52(a)
04/29/14	3:00 AM	44
04/29/14	4:00 AM	44
04/29/14	5:00 AM	45
04/29/14	6:00 AM	47
04/29/14	7:00 AM	58(a)
04/29/14	8:00 AM	46
Including Trains		
Daytime Average($L_{eq,day}$)	**7:00 AM to 10:00 PM**	**50**
Nighttime Average ($L_{eq,night}$)	**10:00 PM to 7:00 AM**	**46**
Day-Nighttime Average ($L_{eq,dn}$)		**53**
Excluding Trains		
Weekday Average ($L_{eq,day}$)	*7:00 AM to 10:00 PM*	*48*
Weeknight Average ($L_{eq,night}$)	*10:00 PM to 7:00 AM*	*43*
Weekend Day Average ($L_{eq,day}$)	*7:00 AM to 10:00 PM*	*48*
Weekend Night Average ($L_{eq,night}$)	*10:00 PM to 7:00 AM*	*41*
Daytime Average ($L_{eq,day}$)	**7:00 AM to 10:00 PM**	**48**
Nighttime Average ($L_{eq,night}$)	**10:00 PM to 7:00 AM**	**42**
Day-Nighttime Average ($L_{eq,dn}$)		**50**

(a) This hour contained a train pass
(b) This hour contained less than 30 minutes of valid data due to high winds and/or train passes

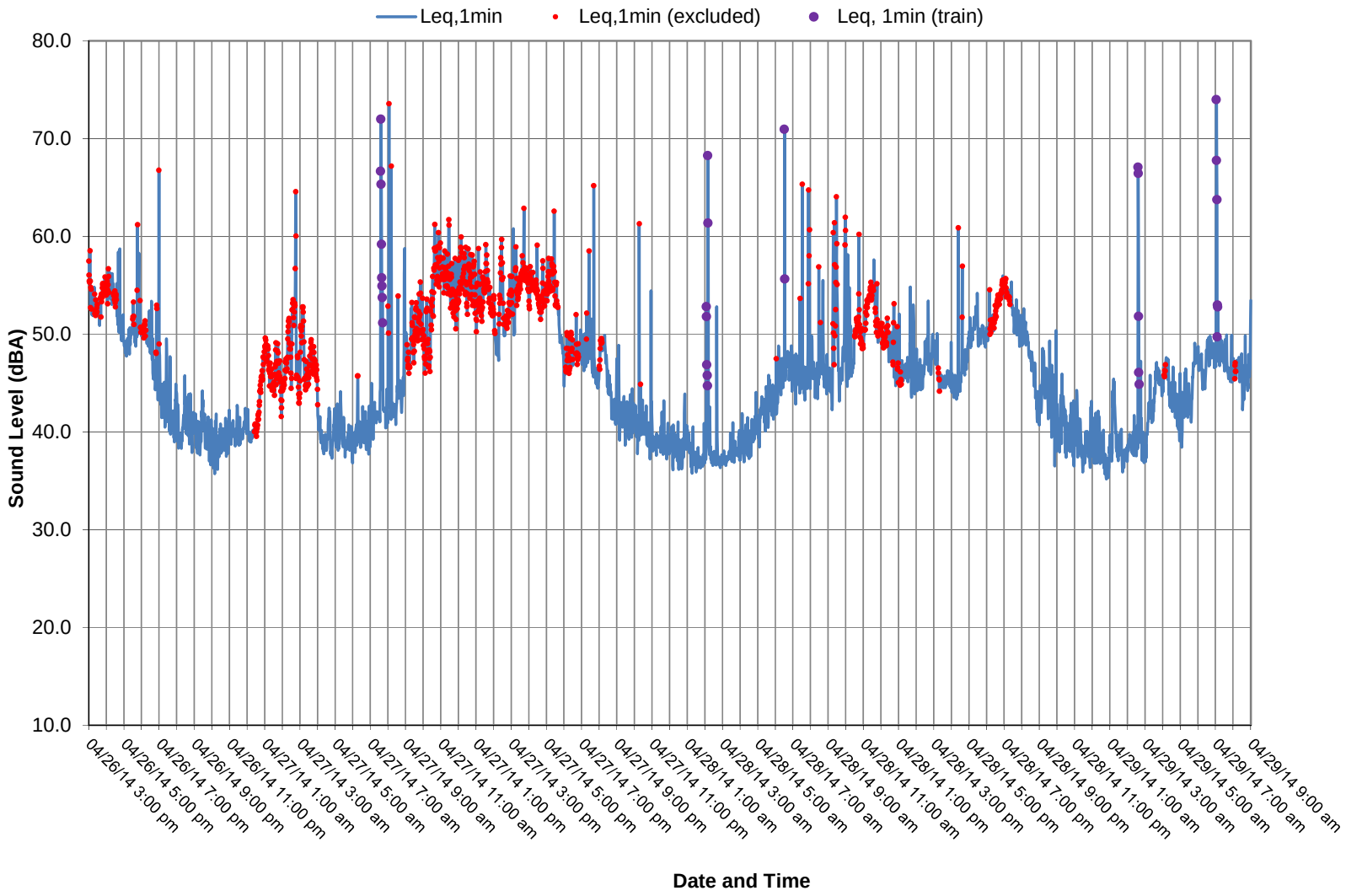

Figure 4-4: Unfiltered One-Minute Sound Levels at SR2

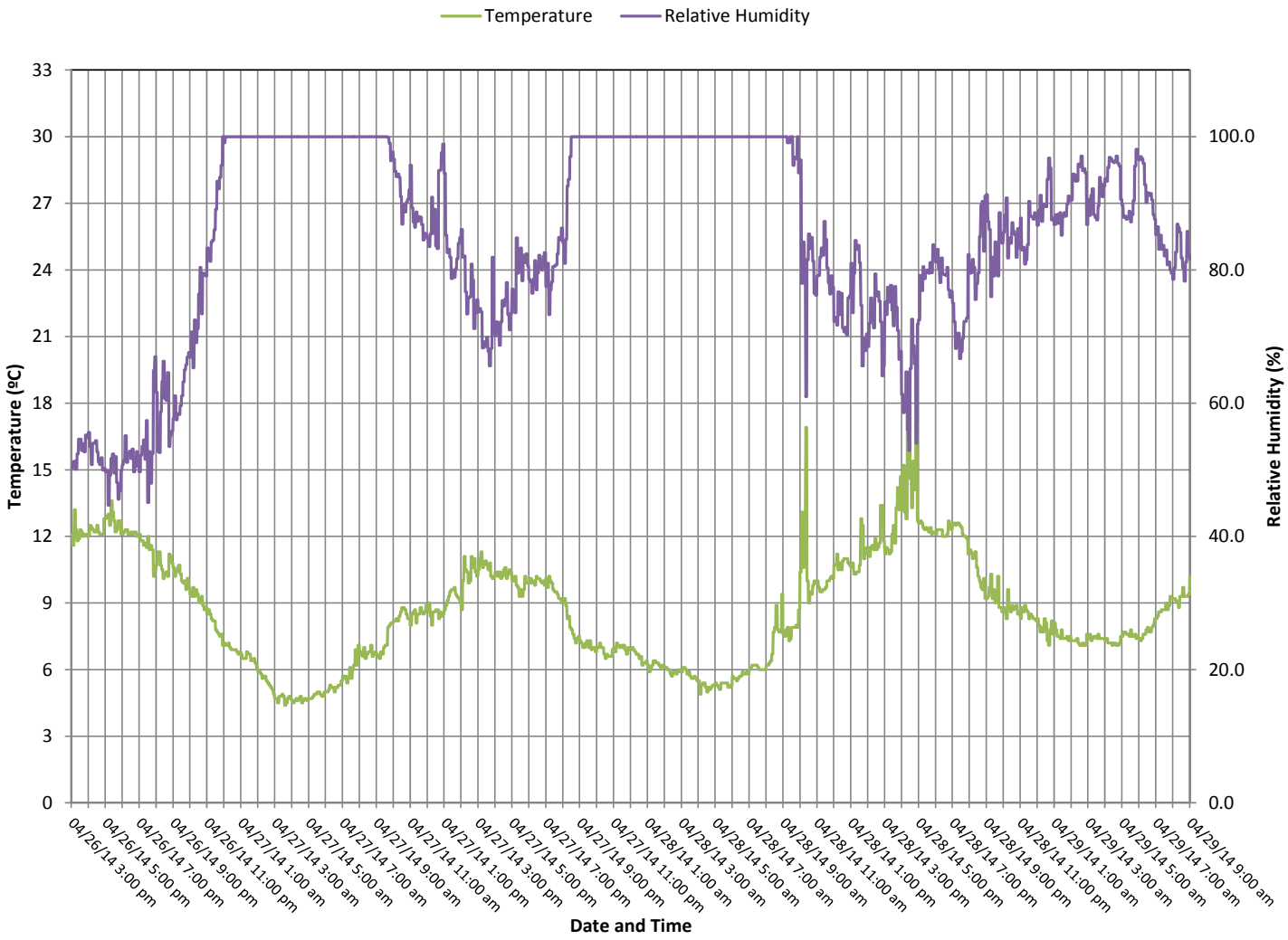

Figure 4-5: Weather Information (Temperature and Humidity) for SR2

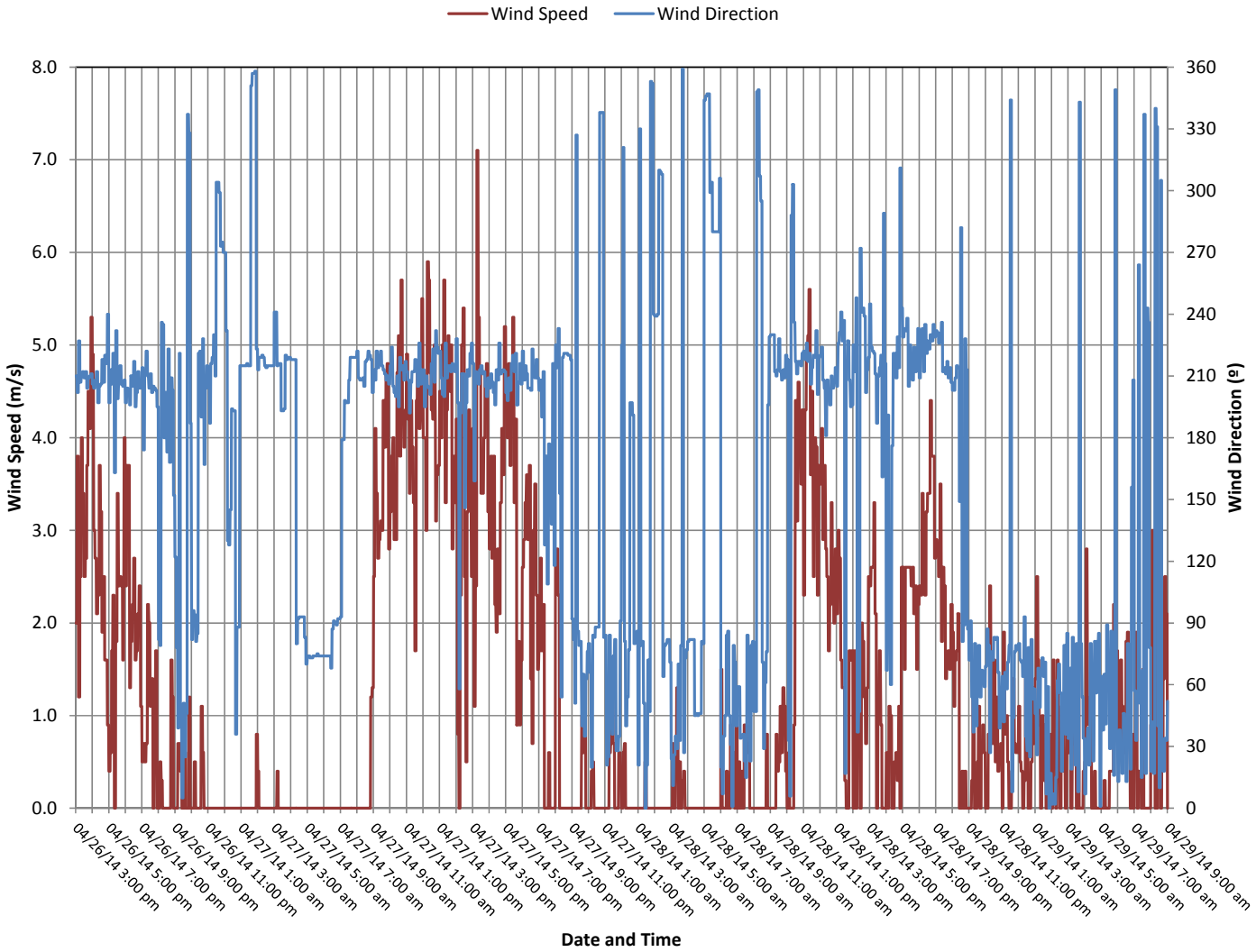

Figure 4-6: Weather Information (Wind Speed and Direction) for SR2

4.2.2 Low Frequency Noise Results

Table 4-4 presents the result of LFN analysis conducted using the 1/3 octave band spectra corresponding to valid one-minute sound samples for SR2.

Table 4-4: Low Frequency Noise Analysis at Monitoring Location SR2

Period	dBC – dBA	Number of tones below 250 Hz	LFN issue?
Daytime (7:00 am – 10:00 pm) – trains included	9.4	0	no
Nighttime (10:00 pm – 7:00 am) – trains included	9.3	0	no
Daytime (7:00 am – 10:00 pm) – trains excluded	10.3	0	no
Nighttime (10:00 pm – 7:00 am) – trains excluded	10.9	0	no

Table 4-4 indicates that the difference between the A-weighted and C-weighted sound levels is always less than 20dB and that there are no tones present below 250 Hz. Therefore, there was no LFN issue during the daytime or nighttime periods of SR2 survey.

4.3 Monitoring Location SR3

4.3.1 Broadband Sound Results

The baseline sound levels at SR3 were mainly influenced by man-made sources such as boats and planes, and natural sounds, such as birds, wind, and waves. During the weekdays, the Watts Point quarry activities were the main contributors. SR3 is believed to be representative of the area within Murrin Park near Watts Point. As the quarry is only active during the week, weekend sound levels were measured to be lower than sound levels during the week. Quarry activities began at 6:00 AM, influencing nighttime sound levels as well as daytime levels.

Filtered $L_{eq,1hr}$ values that include train sound as well as $L_{eq,day}$, $L_{eq.night}$ and $L_{eq,dn}$ values for both the inclusion and exclusion of train sound at this monitoring location are presented in Table 4-5. Hours that contain a train pass have been indicated. Unfiltered $L_{eq,1min}$ values recorded at SR3 are shown in Figure 4-7. High wind speeds were the cause of the invalid data. Weather data, recorded near the SR3 monitoring site are presented in Figures 4-8 and 4-9.

Table 4-5: Filtered Hourly Sound Levels at SR3

Date	Start Hour	$L_{eq, 1hr}$ [dBA]
05/09/14	1:00 PM	Not Valid[(a)]
05/09/14	2:00 PM	Not Valid[(a)]
05/09/14	3:00 PM	42
05/09/14	4:00 PM	43
05/09/14	5:00 PM	39
05/09/14	6:00 PM	37
05/09/14	7:00 PM	35
05/09/14	8:00 PM	35
05/09/14	9:00 PM	34
05/09/14	10:00 PM	32
05/09/14	11:00 PM	32
05/10/14	12:00 AM	31
05/10/14	1:00 AM	31
05/10/14	2:00 AM	36[(a)]
05/10/14	3:00 AM	30
05/10/14	4:00 AM	31
05/10/14	5:00 AM	32
05/10/14	6:00 AM	32
05/10/14	7:00 AM	31
05/10/14	8:00 AM	42[(a)]
05/10/14	9:00 AM	36
05/10/14	10:00 AM	36
05/10/14	11:00 AM	38
05/10/14	12:00 PM	40
05/10/14	1:00 PM	Not Valid[(b)]
05/10/14	2:00 PM	Not Valid[(b)]
05/10/14	3:00 PM	Not Valid[(b)]
05/10/14	4:00 PM	Not Valid[(b)]
05/10/14	5:00 PM	Not Valid[(b)]
05/10/14	6:00 PM	Not Valid[(b)]
05/10/14	7:00 PM	Not Valid[(b)]
05/10/14	8:00 PM	Not Valid[(b)]
05/10/14	9:00 PM	Not Valid[(b)]
05/10/14	10:00 PM	32
05/10/14	11:00 PM	40
05/11/14	12:00 AM	31
05/11/14	1:00 AM	33
05/11/14	2:00 AM	33
05/11/14	3:00 AM	37[(a)]
05/11/14	4:00 AM	34
05/11/14	5:00 AM	35
05/11/14	6:00 AM	37
05/11/14	7:00 AM	40[(a)]

Date	Start Hour	$L_{eq, 1hr}$ [dBA]
05/11/14	8:00 AM	36
05/11/14	9:00 AM	37
05/11/14	10:00 AM	34
05/11/14	11:00 AM	41
05/11/14	12:00 PM	Not Valid[(b)]
05/11/14	1:00 PM	Not Valid[(b)]
05/11/14	2:00 PM	Not Valid[(b)]
05/11/14	3:00 PM	Not Valid[(b)]
05/11/14	4:00 PM	Not Valid[(b)]
05/11/14	5:00 PM	Not Valid[(b)]
05/11/14	6:00 PM	34
05/11/14	7:00 PM	33
05/11/14	8:00 PM	32
05/11/14	9:00 PM	33
05/11/14	10:00 PM	33
05/11/14	11:00 PM	Not Valid[(b)]
05/12/14	12:00 AM	Not Valid[(b)]
05/12/14	1:00 AM	36
05/12/14	2:00 AM	39[(a)]
05/12/14	3:00 AM	Not Valid[(b)]
05/12/14	4:00 AM	38
05/12/14	5:00 AM	Not Valid[(b)]
05/12/14	6:00 AM	43
05/12/14	7:00 AM	45
05/12/14	8:00 AM	47
05/12/14	9:00 AM	48
05/12/14	10:00 AM	45
05/12/14	11:00 AM	44
05/12/14	12:00 PM	40
05/12/14	1:00 PM	40
05/12/14	2:00 PM	40
05/12/14	3:00 PM	40
05/12/14	4:00 PM	37
05/12/14	5:00 PM	38
05/12/14	6:00 PM	37
05/12/14	7:00 PM	36
05/12/14	8:00 PM	35
05/12/14	9:00 PM	34
05/12/14	10:00 PM	36
05/12/14	11:00 PM	36
05/13/14	12:00 AM	Not Valid[(b)]
05/13/14	1:00 AM	Not Valid[(b)]
05/13/14	2:00 AM	Not Valid[(b)]

Date	Start Hour	$L_{eq,\ 1hr}$ [dBA]
05/13/14	3:00 AM	Not Valid(b)
05/13/14	4:00 AM	Not Valid(b)
05/13/14	5:00 AM	Not Valid(b)
05/13/14	6:00 AM	Not Valid(b)
05/13/14	7:00 AM	Not Valid(b)
05/13/14	8:00 AM	Not Valid(b)
05/13/14	9:00 AM	Not Valid(b)
Including Trains		
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**
Excluding Trains		
Weekday Average ($L_{eq,day}$)	*7:00 AM to 10:00 PM*	*42*
Weeknight Average ($L_{eq,night}$)	*10:00 PM to 7:00 AM*	*38*
Weekend Day Average ($L_{eq,day}$)	*7:00 AM to 10:00 PM*	*36*
Weekend Night Average ($L_{eq,night}$)	*10:00 PM to 7:00 AM*	*33*
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**	**35**
Day-Nighttime Average ($L_{eq,dn}$)		**43**

(a) This hour contained a train pass
(b) This hour contained less than 30 minutes of valid data due to high winds and/or train passes

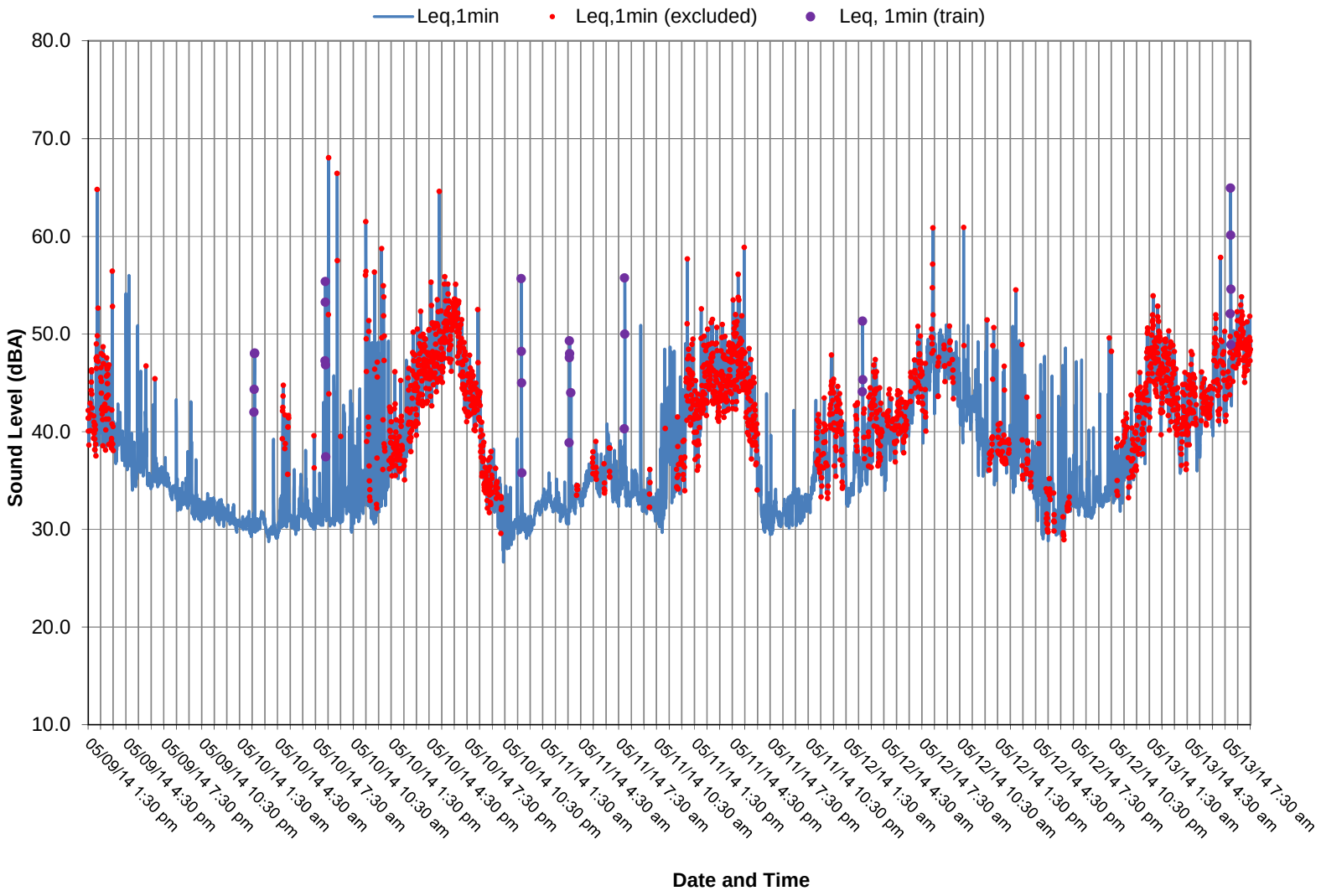

Figure 4-7: Unfiltered One-Minute Sound Levels at SR3

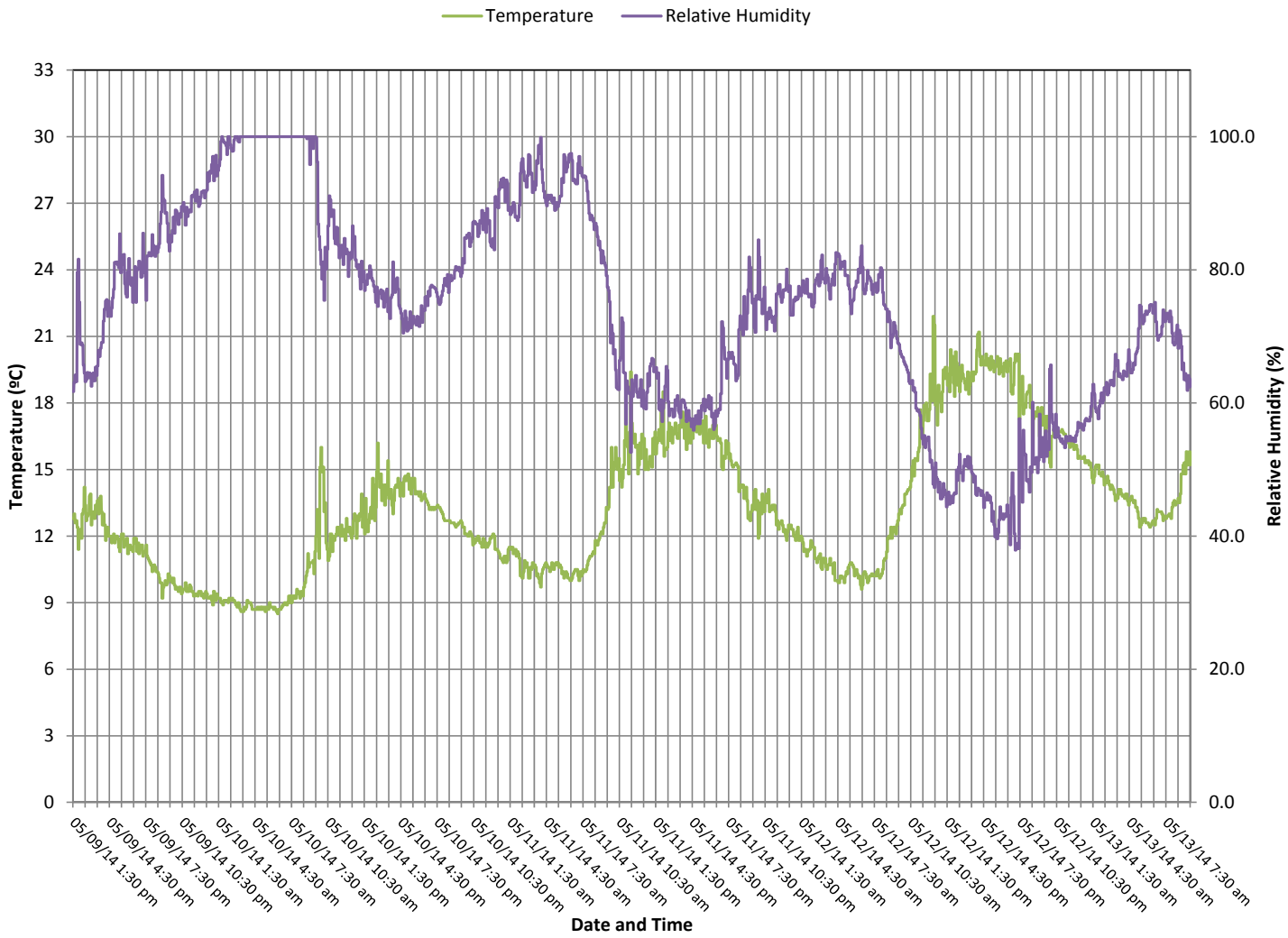

Figure 4-8: Weather Information (Temperature and Humidity) for SR3

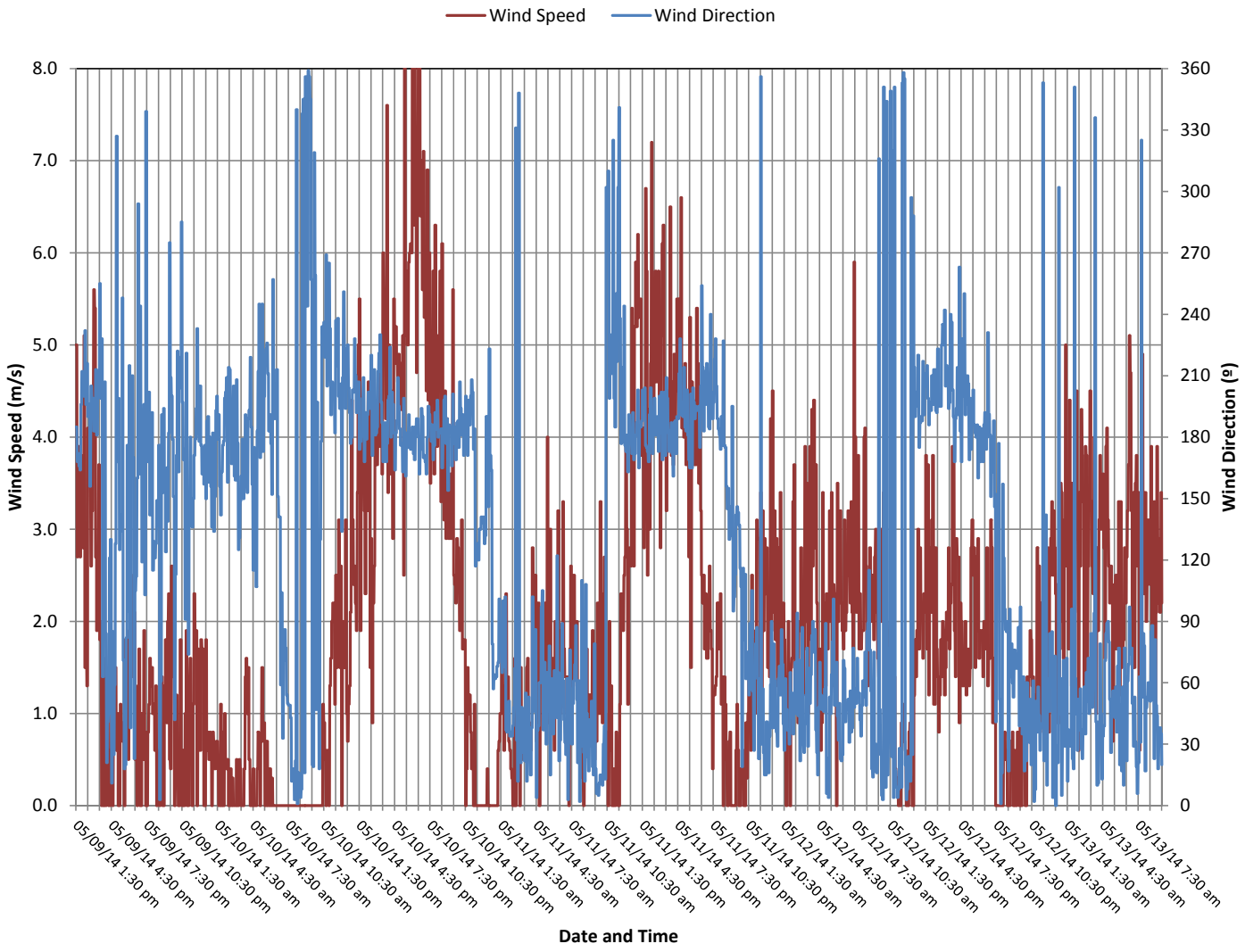

Figure 4-9: Weather Information (Wind Speed and Direction) for SR3

4.3.2 Low Frequency Noise Results

Table 4-6 presents the result of LFN analysis conducted using the 1/3 octave band spectra corresponding to valid one-minute sound samples for SR3.

Table 4-6: Low Frequency Noise Analysis at Monitoring Location SR3

Period	dBC – dBA	Number of tones below 250 Hz	LFN issue?
Daytime (7:00 am – 10:00 pm) – trains included	16.5	0	no
Nighttime (10:00 pm – 7:00 am) – trains included	20.8	0	no
Daytime (7:00 am – 10:00 pm) – trains excluded	16.5	0	no
Nighttime (10:00 pm – 7:00 am) – trains excluded	21.3	0	no

Table 4-6 indicates that the difference between the A-weighted and C-weighted sound levels is greater than 20dB during the nighttime. However, as there are no tones present below 250 Hz, there was no LFN issue during the daytime or nighttime periods of SR3 survey.

5.0 SUMMARY

The results of the sound baseline surveys at three monitoring locations are summarized in Table 5-1. The period averages were based on the hourly data filtered to exclude extraneous sound events and weather conditions.

Table 5-1: Baseline Sound Survey Results at Monitoring Locations

Monitoring Location	Baseline Sound Levels (dBA)			
	Train Included		Train Excluded	
	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
SR1 – Britannia Beach	55	57	53	47
SR2 – Darrell Bay	50	46	48	42
SR3 – Watts Point	40	36	40	35

The three monitoring locations used for the baseline sound survey were selected to be representative of baseline sound levels throughout the atmospheric sound RAA: SR1 represents sound levels in the RAA in the community of Britannia Beach; SR2 represents sound levels in the RAA in Darrell Bay; and SR3 represents sound levels in the RAA at the First Nations area at Watts Point in Murrin Park.

The baseline sound levels at SR1 were mainly influenced by constant sound associated with the traffic along the Sea-to-Sky Highway and infrequent sound from the passing trains.

The baseline sound levels at SR2 were mainly influenced by natural sounds from birds, wind and waves, and man-made sources such as trains, boats, airplanes and traffic.

The baseline sound levels at SR3 were mainly influenced by sound from the active quarry, as well as natural sound from wind and waves and man-made sound from boats and airplanes.

The results presented in Table 5-1, excluding train noise, are similar to prescribed ambient sound levels (ASL) required in the OGC Guideline. The OGC Guideline considers housing density and proximity to heavily used roads and rail lines to determine a representative ASL. Based on the OGC Guideline, Britannia Beach would have a daytime ASL of 53dBA and a nighttime ASL of 43dBA. Darrell Bay and Watts Point would have a daytime ASL of 50dBA and a nighttime ASL of 40dBA.

6.0 CLOSURE

We trust the information contained in this report is sufficient for your present needs. Should you have any additional questions regarding the project, please do not hesitate to contact the undersigned.

GOLDER ASSOCIATES LTD.

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7.0 REFERENCES

OGC, (2009); *British Columbia Noise Control Best Practices Guideline.* British Columbia Oil and Gas Commission. March 2009.

EUB, (2007); *Directive 038: Noise Control.* Alberta Energy and Utilities Board. Revised February 2007.

Health Canada, (2010); *Useful Information for Environmental Assessments. H128-1/10-599E.* 2010.

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