aci Acoustical Consultants Inc.
5031 – 210 Street
Edmonton, Alberta, Canada T6M 0A8
Phone: (587) 290-3613
www.aciacoustical.com

Environmental Noise Impact Assessment
For

Northeast Anthony Henday Drive in Edmonton, AB

Prepared for:
ISL Engineering and Land Services Ltd.

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

PROFESSIONAL LICENSEE (ENGINEERING) ALBERTA
PATRICK FROMENT
01/29/2018

aci Project #: 17-022
January 29, 2018

Executive Summary

aci Acoustical Consultants Inc., of Edmonton AB, was retained by ISL Engineering and Land Services Ltd. (ISL) to conduct an environmental noise impact assessment for the Northeast section of Anthony Henday Drive (NEAHD) in Edmonton, Alberta. The purpose of the work was to conduct a 24-hour environmental noise monitoring at various locations adjacent to the roadway. These results were used to create a computer noise model of the study area under current, future and long-term traffic conditions which were then be compared to the Alberta Transportation noise guidelines. Site work was conducted for aci in June and July 2017 by P. Froment, B.Sc., B.Ed., P.L.(Eng.).

The results of the Current Conditions noise monitoring indicated noise levels ranging from 52.5 dBA to 68.9 dBA L_{eq}24[1]. All locations showed the typical trend of noise associated with traffic. These results confirmed that the noise levels being measured by the noise monitors were largely attributed to NEAHD in addition to the other major roadways.

The noise modeling results for Current Conditions matched well with the noise measurement results for most locations. The Current Conditions modeled noise levels at the existing residential receptor locations ranged from 53.2 – 62.6 dBA and thus were below Alberta Transportation's (AT) limit of 65 dBA L_{eq}24 at all the residential outdoor receptor locations.

The noise modeling results of all residential receptor locations for the Future Conditions (with projected traffic volumes representative of 2041 and a 1.6M population) indicated noise levels ranging from 54.2 – 63.6 dBA which is below the limit of 65 dBA L_{eq}24. A sensitivity analysis of the Future Conditions traffic volumes, traffic speeds, and % heavy trucks indicated that only with significant increases in all three, would the noise levels be above the AT limit of 65 dBA L_{eq}24 at two residential receptor locations were located southwest of the Whitemud Drive interchange where a new subdivision is being developed.

The noise modeling results for the Long-term Conditions (2.5M population) indicated noise levels which were below the AT limit of 65 dBA L_{eq}24 at all but two residential receptor locations. The two receptor

[1] The term L_{eq} represents the energy equivalent sound level. This is a measure of the equivalent sound level for a specified period of time accounting for fluctuations.

locations were located southwest of the Whitemud Drive interchange where a new subdivision is being developed.

As stated in the province's noise attenuation guideline, "*In areas where a residential subdivision is constructed adjacent to a designated highway that has been constructed, Alberta Transportation will request that the development proponent and approving authority address future noise concerns consistent with these guidelines.*" Therefore, it is noted that if future noise levels exceed 65 dBA within new residential development areas, additional noise mitigation will be the responsibility of the land developers.

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1.0 Introduction

aci Acoustical Consultants Inc., of Edmonton AB, was retained by ISL Engineering and Land Services Ltd. (ISL) to conduct an environmental noise impact assessment for the Northeast section of Anthony Henday Drive (NEAHD) in Edmonton, Alberta. The purpose of the work was to conduct a 24-hour environmental noise monitoring at various locations adjacent to the roadway. These results were used to create a computer noise model of the study area under current, future and long-term traffic conditions which were then be compared to the Alberta Transportation noise guidelines. Site work was conducted for aci in June and July 2017 by P. Froment, B.Sc., B.Ed., P.L.(Eng.).

2.0 Location Description

2.1. Roadways

Starting in the north, the study area for NEAHD spans from Manning Drive on the northeast end of Edmonton and continues to the south of Whitemud Drive, as indicated in Figures 1a – 1h. In addition, this study includes Highway 16 (Yellowhead Trail/Highway) from the east of the North Saskatchewan River (NSR) to Sherwood Drive. This study also includes Sherwood Park Freeway from just west of 17 Street NW to east of NEAHD. Throughout the entire span (approximately 21 km), NEAHD is a twinned road with at least 3-lanes in each direction. The posted speed limit throughout is 100 km/hr. Currently, there are grade separated interchanges at the following locations:

- Manning Drive (grade separated interchange)
- 153 Avenue NW (grade separated interchange)
- Aurum Road (grade separated interchange)
- Yellowhead Highway (grade separated interchange)
- Broadmoor Boulevard (grade separated interchange)
- Sherwood Drive (grade separated interchange)
- Baseline Road (grade separated interchange)
- Sherwood Park Freeway (grade separated interchange)
- 17 Street NW (grade separated interchange)
- Whitemud Drive (grade separated interchange)

2.2. Adjacent Development

Starting in the northern-most portion of the study area, the adjacent development between Manning Drive and 153 Avenue NW consists of a variety of land uses. To the north of NEAHD is the Alberta Hospital, open fields and residential dwellings. The dwellings within approximately 500 m of the Transportation Utility Corridor (TUC) are small acreage style residential properties and thus none of the locations would be determined as being in an "urban" area. To the south of NEAHD are small business properties, the Evergreen Funeral Home & Cemetery, open fields and small acreage style residential properties. The residential dwellings within proximity to the (TUC) would not be determined as being in an "urban" area.

South of 153 Avenue NW, west of NEAHD and north of NSR is a new residential area that is currently still being developed. The dwellings within this area that back onto NEAHD are single family residential structures. The residents along 152 Avenue do not have direct line-of-sight to NEAHD or 153 Avenue NW from their backyard spaces due to the topography of the land (lower than the roads) and to the existing noise fence. There is an existing partial noise fence along Fraser Vista NW however it has yet to be completed. Additionally, it has not been fully developed. It is anticipated that once fully developed the noise barrier will continue south and wrap around to the west. East of NEAHD and north of NSR is a single residential dwelling on an acreage lot. Otherwise, this area is comprised of open fields.

From the south of the NSR to the Highway 16 (on the east and west sides of NEAHD) development is primarily industrial and commercial. A few examples are; an aggregate facility, a compost facility, a recycling yard, etc. As a result, there are no residential dwellings within this portion of the study area.

Continuing east on the Highway 16 to Sherwood Drive (eastern border of the study area) the development is industrial and commercial. Land uses within this portion of the study area vary and include; storage facilities, small commercial buildings, car dealerships, etc. As a result, there are no residential dwellings within this portion of the study area.

South of Highway 16 to Baseline Road and west of NEAHD are primarily large industrial facilities. Many of these facilities are within proximity of NEAHD. On the east side of NEAHD there are industrial facilities however they are farther away (+600 m) from the NEAHD TUC when comparing to the west side. Neither side has residential dwellings.

On the west side of NEAHD and south of Baseline Road to Sherwood Park Freeway are large, open industrial yards with no residential development.

South of Baseline Road and east of NEAHD, extending approximately 700 m south, is commercial development. Beyond this point and continuing south to Sherwood Park Freeway, are single family residential developments with residential dwellings that back on to the NEAHD TUC. The distance to NEAHD (north and southbound lanes) from the rear property lines varies from approximately 700 m to 800 m. The majority of the back fences of the properties adjacent to the NEAHD TUC are composed of either chain-link or single slat wood boards. As a result, the fences do not provide a significant amount of noise attenuation. In the southeast corner of this portion of the study area there are commercial properties that are directly adjacent to Fir Street and Wye Road.

West of NEAHD, adjacent to Sherwood Park Freeway to 17 Street NW are industrial yards on the north and south sides of Sherwood Park Freeway. This portion of the study does not have residential development.

West of NEAHD and south of Sherwood Park Freeway is a mix of industrial yards, open fields, a cemetery and acreage style residential development. The northern most residential dwellings within this portion of the study area are approximately 1.0 km south of Sherwood Park Freeway while the southern most dwellings are approximately 500 m north of Whitemud Drive. All residential properties within this area are not dense enough to be considered as being “urban”.

Immediately south of Sherwood Park Freeway and east of NEAHD is a small commercial development. Further south (approximately 240 m) are acreage style residential properties. These properties extend south approximately 800 m before there are single family residential dwellings that are more densely populated. The single-family properties have wrought-iron fences along their rear property line, which is approximately 730 m east of NEAHD. Therefore, there is currently no noise mitigation between the properties and NEAHD. Approximately 1,200 m north of Whitemud Drive and continuing south 400 m, is an open field. The remaining 800 m of the southeastern portion of this study area are acreage style residential properties. These properties are not dense enough to be considered as being “urban”.

Directly southwest of the interchange at NEAHD and Whitemud Drive is a relatively new development of single-family residential lots. At the nearest location, the back-property line of these lots is approximately 90 m from Whitemud Drive to NEAHD southbound off-ramp. All residential properties directly adjacent to Whitemud Drive and/or NEAHD have an existing 1.83 m noise barrier along their back-property lines. Beyond 765 m south of Whitemud Drive to 34 Avenue NW are open fields.

Apart from a single acreage/farm property to the southeast of the interchange at NEAHD and Whitemud Drive the lands east and south of Whitemud Drive are open fields.

2.3. Topography

Topographically, the land surrounding NEAHD between Manning Drive and the NSR is generally flat with only small hills between the roadway and the residential structures. The ground is covered with field grasses and small patches of trees and bushes. As NEAHD approaches the NSR, there is a decrease in the road elevation. NEAHD continues to gradually decrease in elevation as it crosses over the NSR. Apart from a small section immediately southeast of the NSR crossing, NEAHD, south of the NSR, is also generally flat and covered with field grasses and small patches of trees and bushes. This is consistent for the remaining southern portion of the study area. Once again, there are relatively small changes in elevation throughout, however they are not significant enough to impact the noise propagation from NEAHD.

3.0 Measurement & Modeling Methods

3.1. Environmental Noise Monitoring

As part of the study, a 24-hour environmental noise monitoring was conducted at a total of fifteen (15) different locations within the study area. The noise monitoring locations, as indicated in Figures 1a – 1h were selected based on their proximity to NEAHD, major roadways, interchanges, etc. in addition to existing residential receptors (if applicable).

The noise measurements were conducted collecting broadband A-weighted as well as 1/3 octave band sound levels. This enabled a detailed analysis of the noise climate. The noise monitorings were conducted on weekdays under "typical" traffic conditions. In particular, measurements avoided any holidays, major construction activity that would re-route traffic nearby, and other occurrences which would affect the normal traffic on the road. In addition, the monitorings were conducted in summer-like conditions (i.e. no snow cover) with dry road surfaces, no precipitation, and low wind-speeds. The monitorings were accompanied by a 24-hour digital audio recording for more detailed post process analysis. Finally, a portable weather monitor was used within the study area to obtain local weather conditions for all noise monitoring periods.

All noise measurement instrumentation was calibrated at the start of the measurements and then checked afterwards to ensure that there had been no calibration drift over the duration of the measurements. Refer to Appendix I for a detailed description of the measurement equipment used, Appendix II for a description of the acoustical terminology, and Appendix III for a list of common noise sources. All noise measurement instrumentation was calibrated at the start of the measurements and then checked afterwards to ensure that there had been negligible calibration drift over the duration of the measurements.

3.1.1. Noise Monitoring Location Description

Noise Monitor 1

Noise Monitor 1 was located on public land approximately 45 m west of NEAHD and 870 m north of 34 Avenue NW and was the southernmost noise monitoring location as shown in Figure 1a and Figure 2. At this location, the monitor was placed immediately west of a small access road which had very minimal local traffic. The noise monitor had direct line-of-sight to both northbound and southbound lanes of NEAHD. The noise monitoring data for this location was taken from Tuesday June 6, 2017 (entire 24-hour period).

Noise Monitor 2

Noise Monitor 2 was located on public land approximately 20 m west of the Whitemud Drive to NEAHD SB off-ramp and 290 m south of Whitemud Drive EB as shown in Figure 1a and Figure 3. At this location, the monitor was placed at the northern most portion of a small access road which had very minimal local traffic. The noise monitor had direct line-of-sight to both northbound and southbound lanes of NEAHD in addition to Whitemud Drive. The noise monitoring data for this location was taken from Tuesday June 6, 2017 (entire 24-hour period).

Noise Monitor 3

Noise Monitor 3 was located on public land approximately 640 m east of NEAHD and immediately south of Fountain Creek Boulevard as shown in Figure 1b and Figure 4. The noise monitor had direct line-of-sight to NEAHD though at an increased distance. The noise monitoring data for this location was taken from Tuesday July 25, 2017 (entire 24-hour period).

Noise Monitor 4

Noise Monitor 4 was located on public land approximately 700 m east of NEAHD, 30 m west of Ordze Crescent Road and 650 m south of Wye Road as shown in Figure 1b and Figure 5. Due to the increased distance to NEAHD, the vegetation and topography of the area, the monitor did not have direct line-of-sight to NEAHD. The noise monitoring data for this location was taken from Tuesday July 25, 2017 (entire 24-hour period).

Noise Monitor 5

Noise Monitor 5 was located on public land approximately 40 m north of Sherwood Park Freeway WB and 340 m east of 17 Street NW shown in Figure 1b and Figure 6. The monitor was placed at the top of a small hill north of Sherwood Park Freeway and as a result, had direct line-of-sight to both lanes of traffic for Sherwood Park Freeway and partial views to 17 Street NW. The noise monitoring data for this location was taken from Monday June 19, 2017 (entire 24-hour period).

Noise Monitor 6

Noise Monitor 6 was located on public land approximately 730 m east of NEAHD NB, 120 m north of Fir Street and 300 m north of Wye Road as shown in Figure 1b and Figure 7. The monitor at this location had direct line-of-sight to various on and off-ramps associated with the NEAHD and the Sherwood Park Freeway Interchange. The noise monitoring data for this location was taken from Tuesday July 25, 2017 (entire 24-hour period).

Noise Monitor 7

Noise Monitor 7 was located on public land approximately 740 m east of NEAHD NB, 50 m west of Woodstock Drive and approximately 1.0 km south of Baseline Road as shown in Figure 1c and Figure 8. The noise monitor had direct line-of-sight to NEAHD. The noise monitoring data for this location was taken from Tuesday July 25, 2017 (entire 24-hour period).

Noise Monitor 8

Noise Monitor 8 was located on public land approximately 700 m east of NEAHD, 10 m west of Strathmoor Way and approximately 400 m north of Petroleum Way as shown in Figure 1d and Figure 9. The noise monitor had direct line-of-sight to NEAHD in addition to Strathmoor Way. In addition, there were significant contributions from the facility 500 m northeast of the noise monitor and facilities 1.0 km to the southwest. The noise monitoring from this location was conducted from July 24, 2017 to July 26, 2017, however in that time there were no periods in which the noise contributions from the adjacent industrial facilities were not strongly audible in the audio recording. This was also verified in the 1/3 octave band L_{eq} sound levels. Due the industrial facilities, it was not possible to differentiate between the contributions of NEAHD and those from the industrial facilities. Therefore, data from this monitoring period will not be presented and were not utilized during the calibration of the noise model.

Noise Monitor 9

Noise Monitor 9 was located on public land approximately 55 m south of Highway 16 EB and 630 m west of Sherwood Drive as shown in Figure 1e and Figure 10. The noise monitor had direct line-of-sight to Highway 16. The noise monitoring data for this location was taken from Wednesday June 14, 2017 (entire 24-hour period).

Noise Monitor 10

Noise Monitor 10 was located on public land approximately 30 m south of Highway 16 EB and 910 m east of Sherwood Drive as shown in Figure 1e and Figure 11. The noise monitor had direct line-of-sight to Highway 16. In addition, the noise monitor was placed immediately north of parking lot of a major retailer. However, due to the dominance of Highway 16, there were no apparent contributions from the retailer or activities typically associated with the retailer (e.g. patron noise) observed in the audio recording. The noise monitoring data for this location was taken from Wednesday June 14, 2017 (entire 24-hour period).

Noise Monitor 11

Noise Monitor 11 was located on public land approximately 70 m west of NEAHD SB and 430 m southeast of the NSR as shown in Figure 1g and Figure 12. At this location, the monitor was at a lowered elevation comparatively to NEAHD and as a result it only had directly direct line-of-sight to the southbound lanes of NEAHD. The noise monitoring data for this location was taken from Tuesday June 6, 2017 (entire 24-hour period).

Noise Monitor 12

Noise Monitor 12 was located on public land approximately 120 m west of NEAHD SB and 600 m southeast of the 153 Avenue NW as shown in Figure 1g and Figure 13. At this location, the monitor was at the top of a relatively significant hill and thus was elevated well above NEAHD. Therefore, the noise monitor had direct line-of-sight to all lanes of NEAHD in addition to the NEAHD and 153 Avenue NW Interchange. The noise monitoring data for this location was taken from Wednesday June 14, 2017 (entire 24-hour period).

Noise Monitor 13

Noise Monitor 13 was located on public land approximately 75 m west of NEAHD SB and 17 m east of 18 Street NW as shown in Figure 1g and Figure 14. At this location, the monitor was slightly below the height of NEAHD SB and as a result it only had direct line-of-sight to the southbound lanes of NEAHD. The noise monitoring data for this location was taken from Tuesday June 6, 2017 (entire 24-hour period).

Noise Monitor 14

Noise Monitor 14 was located on public land approximately 270 m north of NEAHD NB and 60 m west of Fort Road NW as shown in Figure 1h and Figure 15. At this location, the monitor was well below the height of NEAHD NB and as a result it only had direct line-of-sight to the northbound lanes of NEAHD. The noise monitoring data for this location was taken from Monday June 19, 2017 (entire 24-hour period).

Noise Monitor 15

Noise Monitor 15 was located on public land approximately 260 m south of NEAHD NB and 600 m west of Manning Drive as shown in Figure 1h and Figure 16. Due to the topography of the area (relatively flat), the monitor had direct line-of-sight to both lanes of NEAHD in addition to several off/on-ramps of the NEAHD and Manning Drive Interchange. The noise monitoring data for this location was taken from Tuesday June 13, 2017 (entire 24-hour period).

3.2. Computer Noise Modeling

The computer noise modeling was conducted using the CADNA/A (version 2017, build: 157.4702) software package. CADNA/A allows for the modeling of various noise sources such as road, rail, and various stationary sources. In addition, topographical features such as land contours, vegetation, and bodies of water can be included. Finally, meteorological conditions such as temperature, relative humidity, wind-speed and wind-direction can be included in the calculations.

The default calculation method for traffic noise in CADNA/A follows the German Standard RLS-90. It is aci's experience that this calculation method is accurate under the conditions present for this study, with a tendency to slightly over-predict potential noise levels (i.e. resulting in conservative values). The calculation method used for noise propagation follows the ISO standard 9613-2. All receiver locations were assumed as being downwind from the source(s). As stated in Section 5 of the ISO document:

> *"Downwind propagation conditions for the method specified in this part of IS0 9613 are as specified in 5.4.3.3 of IS0 1996-2:1987, namely*
>
> - *wind direction within an angle of ± 45^0 of the direction connecting the centre of the dominant sound source and the centre of the specified receiver region, with the wind blowing from source to receiver, and*
> - *wind speed between approximately 1 m/s and 5 m/s, measured at a height of 3 m to 11 m above the ground.*
>
> *The equations for calculating the average downwind sound pressure level LAT(DW) in this part of IS0 9613, including the equations for attenuation given in clause 7, are the average for meteorological conditions within these limits. The term average here means the average over a short time interval, as defined in 3.1.*
>
> *These equations also hold, equivalently, for average propagation under a well-developed moderate ground-based temperature inversion, such as commonly occurs on clear, calm nights".*

3.2.1. Noise Modeling Scenarios

As part of the study, various scenarios were modeled including:

1) Current conditions with existing road configurations and traffic volumes present during the noise monitoring (June & July 2017). The baseline noise monitoring was used as a calibration method for the model.

2) Future conditions (2041 Traffic Projections[1]) with final road configurations and interchanges and projected traffic volumes.

3) Future conditions (as in item #2) with a sensitivity analysis on the traffic parameters listed below. This involved modification of the various parameters to determine their effect on noise levels.
   a. Traffic counts
   b. Traffic speeds
   c. Traffic composition (i.e. % heavy vehicles)
   d. Combination of a. – c.

4) Long-term conditions with long-term population projections[2] with final road configurations and interchanges and projected traffic volumes.

[1] Assumes a 1.6M population.
[2] Assumes a 2.5M population.

3.2.2. Noise Modeling Parameters

Throughout the study area, the ground was given an absorption coefficient of 0.6. Trees and field grasses were added where appropriate to match existing conditions in addition to providing a calibration of the modeled results compared to the measured results at the various noise monitoring locations. Therefore, all sound level propagation calculations are considered conservatively representative of summertime conditions for all surrounding residents.

Buildings were included in the model for only the first row of buildings (in relation to the major roadways) since these are the ones which will have the highest sound levels and will result in the greatest impact and level of shielding for structures further in.

Receptors were placed in the first rows of existing perimeter development. In addition, Receptors were only placed in residential locations that could be considered in an "Urban" setting. Though, the color noise contours can be referenced for other residential locations found within the study area.

The computer noise modeling results were calculated in two ways. First, sound levels were calculated at specific receptor locations (i.e. typical residential outdoor amenity spaces). This was done at a height of 1.2 m (from the ground) and at an offset from the back-property line of 2 m for all locations. The projected noise levels at the receptor locations provide a more representative indication of the typical noise levels experienced by residents in their private backyard spaces (i.e. not directly adjacent to the rear property line).

Secondly, color noise contours were calculated using a 5 m x 5 m grid over the entire study area at a height of 1.2 m. This was performed for easier visualization of the results.

Refer to Appendix IV for a list of the noise modeling parameters.

4.0 Permissible Sound Levels

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

The criterion used to evaluate the road noise in the study area is the Alberta Transportation document entitled, "*Noise Attenuation Guidelines for Provincial Highways Under Provincial Jurisdiction Within Cities and Urban Areas (2002),*". The following is taken directly from the document:

Definition:

Noise is defined as the sounds generated by vehicles operating on the highway. It includes but is not limited to engine/exhaust sounds and road contact sounds.

Guidelines:

- *For construction or improvements of highways through cities and other urban areas, Alberta Transportation will adopt a noise level of 65 dBA Leq24 measured 1.2 metres above ground level and 2 metres inside the property line (outside the highway right-of-way). The measurements should be adjusted to the 10-year planning horizon value, as a threshold to consider noise mitigation measures.*
- *The mitigation of noise issues could include constructing noise walls and/or berms. The decision to implement noise mitigation must consider whether mitigation is cost-effective, technically practical, broadly supported by the affected residents, and fits into overall provincial priorities.*
- *Any accepted noise mitigation measures consistent with this guideline will be the responsibility of Alberta Transportation. Where established local noise mitigation policies are more stringent than this guideline, the local policy may be considered on a shared responsibility basis.*
- *Alberta Transportation will be responsible for noise attenuation, in accordance with this guideline, in areas where Alberta Transportation is undertaking widening (by at least one lane width) or major realignment of an existing road or constructing a new road adjacent to an existing residential development.*
- *In areas where a residential subdivision is constructed adjacent to an existing roadway, the development proponent will be responsible for noise attenuation consistent with these guidelines.*
- *In areas where a residential subdivision is constructed adjacent to a designated highway that has not been constructed, Alberta Transportation will request that the development proponent and approving authority address future noise concerns consistent with these guidelines.*

In summary, the criterion sets a threshold of **65 dBA Leq24** measured 1.2 m above ground level and 2.0 m inside the property line.

5.0 Noise Monitoring Results

5.1. Noise Monitoring

The results obtained from the environmental noise monitoring are provided in Table 1 and Figures 17 – 44 (broadband A-weighted L_{eq} sound levels and 1/3 octave band L_{eq} sound levels provided). It should be noted that the data have been adjusted by the removal of non-typical noise events such as loud aircraft flyovers (the noise modeling does not account for aircraft), pedestrians, dogs making noise nearby, abnormally loud vehicle passages, etc. A list of all non-typical noise events removed from each of the 15 noise monitoring locations can be found in Appendix V.

Table 1. 2017 Noise Monitoring Results

Monitoring Location	Leq24 (dBA)	LeqDay (dBA)	LeqNight (dBA)
M1	68.9	70.0	66.1
M2	64.9	66.0	62.2
M3	54.7	53.6	56.1
M4	54.1	53.0	55.4
M5	63.6	64.6	61.4
M6	55.0	53.0	57.1
M7	56.2	55.3	57.3
M8	N/A	N/A	N/A
M9	67.0	68.4	62.8
M10	68.0	71.4	65.5
M11	60.0	61.0	57.4
M12	59.6	60.9	56.0
M13	62.3	63.4	59.7
M14	52.5	52.7	52.2
M15	60.5	61.5	58.1

The results from the noise monitoring indicate $L_{eq}24$ noise levels ranging from 52.5 dBA to 68.9 dBA. Apart from Noise Monitoring Location 8, the noise climate was dominated by NEAHD or by other major roadways (Highway 16, Sherwood Park Freeway, etc.). As previously mentioned, the noise climate at Noise Monitoring Location 8 also included strong contributions from the surrounding industrial facilities. Due the industrial facilities, it was not possible to differentiate between the contributions of NEAHD and those from the industrial facilities. This was verified in the audio recording in addition to the 1/3 octave band L_{eq} spectral data. As a result, data from this monitoring period has not been provided.

At all other locations, the resultant 1/3 octave band L_{eq} sound levels were very similar with the typical trend of low frequency noise (near 63 – 80 Hz) resulting from engines and exhaust, as well as mid-high frequency noise (near 1,000 Hz) resulting from tire noise. These results confirm that the noise levels being measured by the noise monitors were largely attributed to either NEAHD or other major roadways within proximity to the noise monitors.

Lastly, certain receptor locations (3, 7, 11 & 14) had elevated levels in the higher frequencies (8 – 12.5 kHz) which could be attributed to the contributions from crickets, grasshoppers, etc. and not from the nearby roadways.

5.2. Weather Conditions

As previously mentioned, a local weather monitoring station was used throughout the entire noise monitoring period to obtain the wind speed, wind direction, temperature & relative humidity data in 1-minute sampling periods. All weather data are presented in Appendix VI.

The weather conditions for Noise Monitors 1, 2, 11 and 13 (June 6, 2017) had a wind that primarily was from the southeast to south for the entirety of the 24-hour period resulting in downwind/crosswind conditions for all locations. The wind was essentially calm through the morning period which increased to moderate/high in the early afternoon before calming again in the evening. No data had to be removed due to the wind conditions during this monitoring period. The temperature ranged from 6°C to 24°C and the relative humidity ranged from approximately 23% - 84%.

The weather conditions for Noise Monitor 15 (June 13, 2017) had a wind that was primarily from the north (including northwest and northeast) for the entirety of the 24-hour period thus resulting in downwind conditions for the noise monitor. Apart from short durations, the wind was moderate to high throughout the entire monitoring period however no data had to be removed due to the wind conditions during this monitoring period. The temperature ranged from 13°C to 19°C and the relative humidity ranged from approximately 40% - 82%.

The weather conditions for Noise Monitors 9, 10, 12 (June 14, 2017) had a wind that was primarily calm apart from short durations during the daytime and then again in the late afternoon. When the wind increased (between 8 km/hr to 15 km/hr) it was the northeast to the northwest thus resulting in downwind/crosswind conditions for all locations. No data had to be removed due to the wind conditions during this monitoring period. The temperature was very consistent ranged from 13°C to 15°C and the relative humidity ranged from approximately 68% - 88%.

The weather conditions for Noise Monitors 5 and 14 (June 19, 2017) had wind speeds that were relatively low (below 5 – 10 km/hr). Due to the low wind speeds[1] the wind varied throughout the entire noise monitoring period. The temperature ranged from 8°C to 22°C and the relative humidity ranged from approximately 23% - 73%.

The weather conditions for Noise Monitors 3, 4, 6 – 8 (July 25, 2017) had a wind that was primarily low to moderate, apart from short duration during the early afternoon, for the 24-hour monitoring period. The wind was from the west to southwest thus resulting in downwind conditions for all noise monitors. The temperature ranged from 8°C to 24°C and the relative humidity ranged from approximately 32% - 87%.

[1] The wind direction fluctuates more greatly when wind speeds are below 5 km/hr and are essentially calm. In these instances, the wind direction has a minimal influence of the propagation of the sound.

6.0 Noise Modelling Results

6.1. Current Conditions

6.1.1. Monitoring Locations

The L_{eq}24 sound levels from the noise modeling under current conditions at the noise monitoring locations are presented in Table 2. In addition, the difference relative to the monitoring results at each location has been provided. Apart from M2 and M14, the modeled sound levels compare very well with the monitored results at each location.

Based on the results of the model and monitoring for M1, the monitored noise levels from Monitor M2 are much lower than anticipated, particularly when considering its proximity to the Whitemud Drive/NEAHD interchange and on the 2017 traffic volumes for roadways within proximity to this monitoring location. As a result, the modeling values are considered representative of the current noise levels of the noise climate of this area.

The discrepancy between the model and monitoring results for Monitor M14 can be attributed primarily to the distance between the noise monitor and NEAHD[1] and the wind conditions during the monitoring. As described in Section 5.2, the wind speeds were relatively low (below 5 – 10 km/hr) and from various directions throughout. Typically, low wind speeds varying in direction have a minimal influence on the monitoring results because the noise monitor is close enough to the roadway that atmospheric and meteorological effects have minimal influence[2]. However, as the distance increases these effects are more pronounced. This would not be reflected in the noise model, as it assumes that the receptor locations are downwind from the source. As a result, the modeling values are considered representative of the current noise levels of the noise climate of this area under downwind conditions, which is considered conservative.

All other noise monitoring locations resulted in a difference less than ±1.0 dBA which is accurate.

[1] The noise monitor was placed at this distance due to accessibility and topographical restrictions.
[2] Apart from high wind speeds that can cause issues as they pass along the top of the microphone.

Table 2. Noise Modeling Results Under Current Conditions at Monitor Locations

Monitor	Monitoring Results Leq24 (dBA)	Modeling Results Leq24 (dBA)	Difference Relative to Monitor Results $L_{eq}24$ (dBA)
M1	68.9	69.0	0.1
M2	64.9	69.4	4.5
M3	54.7	54.9	0.2
M4	54.1	54.7	0.6
M5	63.6	64.3	0.7
M6	55.0	55.9	0.9
M7	56.2	55.5	-0.7
M8	N/A	59.4	-N/A
M9	67.0	66.7	-0.3
M10	68.0	68.1	0.1
M11	60.0	60.7	0.7
M12	59.6	60.1	0.5
M13	62.3	62.8	0.5
M14	52.5	56.0	3.5
M15	60.5	60.1	-0.4

6.1.2. Residential Receptor Locations

The results of the Current Conditions noise modeling at the various residential property locations are presented in Tables 3a – 3e. The study area was divided into separate groups for easier reference. In addition to the information presented in Tables 3a – 3e, the $L_{eq}24$ color noise contours for the entire study area are shown in Figures 45a – 45i. The color noise contours provide a very good representation of where the "hot" spots are (in terms of elevated noise levels) and the relative contribution from each of the nearby roadways for the various receptor locations. In the event of a discrepancy between the results indicated in the color contours and the Tables, the Tables will be considered as correct because the calculation locations in the Tables are at exact coordinates while the color contours are calculated on a 5m x 5m grid and the results elsewhere are interpolated.

The current noise levels at all receptor locations are under the limit of 65 dBA $L_{eq}24$.

Table 3a. Current Conditions Noise Modeling Results for Receptors South of Whitemud Drive

Receptor	L_{eq}24 (dBA)
R-01	56.9
R-02	56.0
R-03	55.0
R-04	53.6
R-05	53.6
R-06	55.0
R-07	55.7
R-08	62.5
R-09	62.6
R-10	60.1
R-11	61.0
R-12	61.0
R-13	60.5

Table 3b. Current Conditions Noise Modeling Results for Receptors South of Sherwood Park Freeway

Receptor	L_{eq}24 (dBA)
R-14	53.7
R-15	53.7
R-16	53.8
R-17	53.6
R-18	53.6
R-19	53.6
R-20	53.4
R-21	53.6
R-22	53.6
R-23	53.6

Table 3c. Current Conditions Noise Modeling Results for Residents South of Baseline Road

Receptor	L_{eq}24 (dBA)	Receptor	L_{eq}24 (dBA)
R-24	56.4	R-37	55.0
R-25	55.7	R-38	54.9
R-26	55.6	R-39	54.9
R-27	55.5	R-40	54.9
R-28	55.4	R-41	54.9
R-29	55.4	R-42	55.0
R-30	55.3	R-43	55.1
R-31	55.3	R-44	55.2
R-32	55.2	R-45	55.4
R-33	55.2	R-46	55.4
R-34	55.1	R-47	55.4
R-35	55.1	R-48	55.6
R-36	55.0		

Table 3d. Current Conditions Noise Modeling Results for Residents South of 153 Avenue NW

Receptor	L_{eq}24 (dBA)
R-49	57.6
R-50	54.2
R-51	54.2
R-52	55.1
R-53	55.3
R-54	55.2
R-55	55.0
R-56	53.9
R-57	54.7
R-58	55.4
R-59	55.2

Table 3e. Current Conditions Noise Modeling Results for Residents West of Manning Drive

Receptor	$L_{eq}24$ (dBA)
R-60	53.2
R-61	54.0
R-62	54.4
R-63	55.4
R-64	56.5
R-65	57.7
R-66	57.9
R-67	58.5
R-68	58.8

6.2. Future Conditions

The results of the noise modeling under future conditions (Year 2041) at the residential receptor locations are presented in Tables 4a – 4e and shown in Figures 46a – 46i. The L_{eq}24 sound levels are presented in the Tables along with the relative increase compared to the L_{eq}24 Current conditions. As with the Current Conditions, in the event of a discrepancy between the results indicated in the color contours and the Tables, the Tables will be considered as correct. Below each Table is a summary discussion of the results for that specific area.

Table 4a. Future Conditions Noise Modeling Results for Receptors South of Whitemud Drive

Receptor	L_{eq}24 (dBA)	L_{eq}24 Increase Relative to Current Conditions (dBA)
R-01	57.6	0.7
R-02	56.8	0.8
R-03	55.7	0.7
R-04	54.4	0.8
R-05	54.5	0.9
R-06	55.9	0.9
R-07	56.6	0.9
R-08	63.4	0.9
R-09	63.6	1.0
R-10	61.4	1.3
R-11	62.4	1.4
R-12	62.5	1.5
R-13	62.0	1.5

The Future Conditions noise modeling results for Residents south of Whitemud Drive indicated noise levels ranging from 54.4 dBA – 63.6 dBA L_{eq}24 at all locations. The increases relative to the Current Conditions ranged from +0.7 to +1.5 dBA which were primarily due to the projected increases in traffic volumes on NEAHD and Whitemud Drive (for Receptors R10 – R13).

Table 4b. Future Conditions Noise Modeling Results for Receptors South of Sherwood Park Freeway

Receptor	$L_{eq}24$ (dBA)	$L_{eq}24$ Increase Relative to Current Conditions (dBA)
R-14	54.5	0.8
R-15	54.5	0.8
R-16	54.6	0.8
R-17	54.4	0.8
R-18	54.4	0.8
R-19	54.4	0.8
R-20	54.2	0.8
R-21	54.4	0.8
R-22	54.4	0.8
R-23	54.5	0.9

The Future Conditions noise modeling results for Residents south of Sherwood Park Freeway indicated noise levels ranging from 54.2 dBA – 54.6 dBA $L_{eq}24$ at all locations. The increases relative to the Current Conditions ranged from +0.8 to +0.9 dBA which were due to the projected increases in traffic volumes on NEAHD and adjacent City Roads.

Table 4c. Future Conditions Noise Modeling Results for Residents South of Baseline Road

Receptor	$L_{eq}24$ (dBA)	$L_{eq}24$ Increase Relative to Current Conditions (dBA)		Receptor	$L_{eq}24$ (dBA)	$L_{eq}24$ Increase Relative to Current Conditions (dBA)
R-24	57.5	1.1		R-37	55.9	0.9
R-25	56.8	1.1		R-38	55.9	1.0
R-26	56.6	1.0		R-39	55.9	1.0
R-27	56.5	1.0		R-40	55.9	1.0
R-28	56.4	1.0		R-41	55.9	1.0
R-29	56.4	1.0		R-42	56.0	1.0
R-30	56.3	1.0		R-43	56.1	1.0
R-31	56.2	0.9		R-44	56.3	1.1
R-32	56.2	1.0		R-45	56.5	1.1
R-33	56.1	0.9		R-46	56.4	1.0
R-34	56.0	0.9		R-47	56.5	1.1
R-35	56.0	0.9		R-48	56.7	1.1
R-36	56.0	1.0				

The Future Conditions noise modeling results for Residents south of Baseline Road indicated noise levels ranging from 55.9 dBA – 57.5 dBA $L_{eq}24$ at all locations. The increases relative to the Current Conditions ranged from +0.9 to +1.1 dBA which were due to the projected increases in traffic volumes on NEAHD and adjacent City Roads.

Table 4d. Future Conditions Noise Modeling Results for Residents South of 153 Avenue NW

Receptor	L_{eq}24 (dBA)	L_{eq}24 Increase Relative to Current Conditions (dBA)
R-49	61.6	4.0
R-50	58.2	4.0
R-51	57.4	3.2
R-52	59.1	4.0
R-53	59.3	4.0
R-54	59.1	3.9
R-55	58.7	3.7
R-56	57.6	3.7
R-57	58.3	3.6
R-58	58.9	3.5
R-59	58.6	3.4

The Future Conditions noise modeling results for Residents south of 153 Avenue NW indicated noise levels ranging from 57.4 dBA – 61.6 dBA L_{eq}24 at all locations. The increases relative to the Current Conditions ranged from +3.2 to +4.0 dBA. In comparison to the receptor locations south of the NSR (R-01 to R-48), the receptors north of the NSR have a larger increase under Future Conditions. This can be attributed primarily to a more significant increase in traffic volumes in this area which is consistent with the anticipated future residential developments in this area (e.g. Horsehill Development).

Table 4e. Future Conditions Noise Modeling Results for Residents West of Manning Drive

Receptor	L_{eq}24 (dBA)	L_{eq}24 Increase Relative to Current Conditions (dBA)
R-60	56.1	2.9
R-61	56.9	2.9
R-62	57.2	2.8
R-63	58.2	2.8
R-64	59.3	2.8
R-65	60.5	2.8
R-66	60.7	2.8
R-67	61.3	2.8
R-68	61.6	2.8

The Future Conditions noise modeling results for Residents west of Manning Drive NW indicated noise levels ranging from 56.1 dBA – 61.6 dBA L_{eq}24 at all locations. The increases relative to the Current Conditions ranged from +2.8 to +2.9 dBA which were due primarily to the projected increases in traffic volumes on NEAHD and Manning Drive. Similarly to Receptors R-49 to R-59, the relative increase in noise levels under Future Conditions is more significant than for Receptors south of the NSR. This can be attributed to a more significant increase in traffic volumes in this area which is consistent with the anticipated future residential developments in the area (e.g. Horsehill Development).

6.3. Future Conditions Sensitivity Analysis

As part of the study, a sensitivity analysis was performed for the main future (2041) traffic parameters associated with NEAHD. These included the overall traffic volumes, the traffic speeds, and the % heavy trucks. Each was evaluated individually with an increase and a decrease relative to the future conditions modeled. In addition, the cumulative impact of an increase in all three variables was assessed.

6.3.1. Traffic Volume Analysis

As with any noise source, the relative change in noise level with changing quantity is a simple logarithmic function as indicated below:

$$\Delta SPL = 10\log_{10}\left(relative\ change\right)$$

This means that if the traffic volumes, for example, are doubled, there will be a 3.0 dBA increase. **If there is a relative increase in traffic volumes of 25% (possible error in long term planning horizon), there will be a relative maximum 1.0 dBA increase for locations in which the noise climate is entirely dominated by NEAHD (i.e. relative to other City Roadways). Conversely, there is a maximum relative decrease of -1.3 dBA for a relative reduction in traffic volumes of 25%.** At locations in which the noise climate has a greater influence by City Roadways, changes in traffic volumes on NEAHD will have less of an impact. Tables 5a – 5e show the $L_{eq}24$ results for the ± 25% vehicles per day conditions as well as the relative change in noise levels at all modeled receptor locations.

As an aside, typical traffic volumes on typical urban roads only vary a few percent from day-to-day. This means that changes in noise levels from day-to-day are almost entirely dictated by environmental and meteorological conditions, and not by varying traffic volumes.

Table 5a. Effects of Changing NEAHD Traffic Volumes for Receptors South of Whitemud Drive

Receptor	L_{eq}24 with +25% Vehicles Per Day (dBA)	Increase Compared to Future Vehicles Per Day (dBA)		L_{eq}24 with -25% Vehicles Per Day (dBA)	Decrease Compared to Future Vehicles Per Day (dBA)
R-01	58.2	0.6		56.2	-1.3
R-02	57.3	0.5		55.4	-1.3
R-03	56.4	0.7		54.4	-1.3
R-04	55.2	0.8		53.3	-1.1
R-05	55.2	0.7		53.4	-1.1
R-06	56.7	0.8		54.7	-1.2
R-07	57.4	0.8		55.6	-1.0
R-08	64.2	0.8		62.3	-1.1
R-09	64.4	0.8		62.6	-1.0
R-10	61.9	0.5		60.8	-0.6
R-11	62.6	0.2		62.1	-0.3
R-12	62.6	0.1		62.4	-0.1
R-13	62.1	0.1		61.9	-0.1

Table 5b. Effects of Changing NEAHD Traffic Volumes for Receptors South of Sherwood Park Freeway

Receptor	L_{eq}24 with +25% Vehicles Per Day (dBA)	Increase Compared to Future Vehicles Per Day (dBA)		L_{eq}24 with -25% Vehicles Per Day (dBA)	Decrease Compared to Future Vehicles Per Day (dBA)
R-14	55.4	0.9		53.4	-1.1
R-15	55.4	0.9		53.4	-1.1
R-16	55.5	0.9		53.5	-1.1
R-17	55.3	0.9		53.2	-1.2
R-18	55.4	1.0		53.3	-1.1
R-19	55.3	0.9		53.2	-1.2
R-20	55.2	1.0		53.1	-1.1
R-21	55.3	0.9		53.3	-1.1
R-22	55.3	0.9		53.3	-1.1
R-23	55.4	0.9		53.4	-1.1

Table 5c. Effects of Changing NEAHD Traffic Volumes for Receptors South of Baseline Road

Receptor	L_{eq}24 with +25% Vehicles Per Day (dBA)	Increase Compared to Future Vehicles Per Day (dBA)		L_{eq}24 with -25% Vehicles Per Day (dBA)	Decrease Compared to Future Vehicles Per Day (dBA)
R-24	58.1	0.6		56.8	-0.7
R-25	57.4	0.6		56.0	-0.8
R-26	57.3	0.7		55.7	-0.9
R-27	57.2	0.7		55.6	-0.9
R-28	57.2	0.8		55.5	-0.9
R-29	57.2	0.8		55.4	-1.0
R-30	57.1	0.8		55.3	-1.0
R-31	57.1	0.9		55.2	-1.0
R-32	57.1	0.9		55.1	-1.1
R-33	57.0	0.9		55.0	-1.1
R-34	56.9	0.9		54.9	-1.1
R-35	56.9	0.9		54.9	-1.1
R-36	56.9	0.9		54.8	-1.2
R-37	56.8	0.9		54.8	-1.1
R-38	56.8	0.9		54.7	-1.2
R-39	56.8	0.9		54.7	-1.2
R-40	56.8	0.9		54.7	-1.2
R-41	56.8	0.9		54.7	-1.2
R-42	56.9	0.9		54.8	-1.2
R-43	57.0	0.9		54.9	-1.2
R-44	57.2	0.9		55.1	-1.2
R-45	57.3	0.8		55.4	-1.1
R-46	57.3	0.9		55.3	-1.1
R-47	57.4	0.9		55.4	-1.1
R-48	57.5	0.8		55.6	-1.1

Table 5d. Effects of Changing NEAHD Traffic Volumes for Receptors South of 153 Avenue NW

Receptor	L_{eq}24 with +25% Vehicles Per Day (dBA)	Increase Compared to Future Vehicles Per Day (dBA)		L_{eq}24 with -25% Vehicles Per Day (dBA)	Decrease Compared to Future Vehicles Per Day (dBA)
R-49	62.5	0.9		60.4	-1.2
R-50	59.0	0.8		57.1	-1.1
R-51	58.1	0.7		56.5	-0.9
R-52	59.9	0.8		58.0	-1.1
R-53	60.1	0.8		58.3	-1.0
R-54	59.9	0.8		58.2	-0.9
R-55	59.3	0.6		58.0	-0.7
R-56	58.1	0.5		57.0	-0.6
R-57	58.7	0.4		57.8	-0.5
R-58	59.2	0.3		58.5	-0.4
R-59	58.9	0.3		58.3	-0.3

Table 5e. Effects of Changing NEAHD Traffic Volumes for Receptors West of Manning Drive

Receptor	L_{eq}24 with +25% Vehicles Per Day (dBA)	Increase Compared to Future Vehicles Per Day (dBA)		L_{eq}24 with -25% Vehicles Per Day (dBA)	Decrease Compared to Future Vehicles Per Day (dBA)
R-60	56.6	0.5		55.5	-0.6
R-61	57.5	0.6		56.2	-0.7
R-62	57.9	0.7		56.4	-0.8
R-63	59.0	0.8		57.3	-0.9
R-64	60.1	0.8		58.3	-1.0
R-65	61.3	0.8		59.4	-1.1
R-66	61.6	0.9		59.6	-1.1
R-67	62.2	0.9		60.2	-1.1
R-68	62.5	0.9		60.4	-1.2

6.3.2. Traffic Speed Analysis

To determine the effect of different traffic speeds, two scenarios were modeled. The Future Conditions included a speed of 100 km/hr on NEAHD throughout the entire study area. This speed was increased to 110 km/hr and then decreased to 90 km/hr to determine the relative change compared to 100 km/hr. It is unlikely that the posted traffic speeds will fall outside of this range. Tables 6a – 6e show the $L_{eq}24$ results for both the 110 km/hr and 90 km/hr conditions as well as the change in noise levels (relative to 100 km/hr) at all modeled receptor locations. **When increasing the speed to 110 km/hr, the noise levels increased by 0.0 – 0.9 dBA. When reducing the speed to 90 km/hr, the noise levels decreased by 0.0 – 0.8 dBA.** As with the traffic volumes assessment, the largest changes were at locations where the noise climate was completely dominated by the noise from NEAHD. The locations with the lowest changes were those where the noise climate was dominated by City Roads/Freeways (e.g. Whitemud Drive for R-12). The relative increase in noise levels with a speed increase to 110 km/hr will not result in any locations along NEAHD to have noise levels at or above 65 dBA $L_{eq}24$. Given that a minimum 2.0 – 3.0 dBA change is required before most people start to notice a change, changing the traffic speeds will not significantly impact the perceived noise climate.

Table 6a. Effects of Changing NEAHD Traffic Speed for Receptors South of Whitemud Drive

Receptor	L_{eq}24 with 110 km/hr on NEAHD (dBA)	Increase Compared to 100 km/hr (dBA)		L_{eq}24 with 90 km/hr on NEAHD (dBA)	Decrease Compared to 100 km/hr (dBA)
R-01	57.7	0.1		56.9	-0.7
R-02	56.9	0.1		56.0	-0.8
R-03	56.0	0.3		55.1	-0.6
R-04	54.8	0.4		54.0	-0.4
R-05	54.8	0.3		54.0	-0.5
R-06	56.2	0.3		55.4	-0.5
R-07	57.0	0.4		56.2	-0.4
R-08	63.8	0.4		63.0	-0.4
R-09	64.0	0.4		63.2	-0.4
R-10	61.6	0.2		61.2	-0.2
R-11	62.5	0.1		62.3	-0.1
R-12	62.5	0.0		62.5	0.0
R-13	62.0	0.0		61.9	-0.1

Table 6b. Effects of Changing NEAHD Traffic Speed for Receptors South of Sherwood Park Freeway

Receptor	L_{eq}24 with 110 km/hr on NEAHD (dBA)	Increase Compared to 100 km/hr (dBA)		L_{eq}24 with 90 km/hr on NEAHD (dBA)	Decrease Compared to 100 km/hr (dBA)
R-14	55.0	0.5		54.0	-0.5
R-15	55.0	0.5		54.1	-0.4
R-16	55.1	0.5		54.2	-0.4
R-17	54.9	0.5		53.9	-0.5
R-18	54.9	0.5		54.0	-0.4
R-19	54.9	0.5		53.9	-0.5
R-20	54.8	0.6		53.8	-0.4
R-21	54.9	0.5		54.0	-0.4
R-22	54.9	0.5		54.0	-0.4
R-23	55.0	0.5		54.1	-0.4

Table 6c. Effects of Changing NEAHD Traffic Speed for Receptors South of Baseline Road

Receptor	L_{eq}24 with 110 km/hr on NEAHD (dBA)	Increase Compared to 100 km/hr (dBA)		L_{eq}24 with 90 km/hr on NEAHD (dBA)	Decrease Compared to 100 km/hr (dBA)
R-24	57.8	0.3		57.2	-0.3
R-25	57.2	0.4		56.4	-0.4
R-26	57.0	0.4		56.2	-0.4
R-27	56.9	0.4		56.1	-0.4
R-28	56.9	0.5		56.0	-0.4
R-29	56.8	0.4		55.9	-0.5
R-30	56.8	0.5		55.8	-0.5
R-31	56.8	0.6		55.8	-0.4
R-32	56.7	0.5		55.7	-0.5
R-33	56.7	0.6		55.6	-0.5
R-34	56.6	0.6		55.5	-0.5
R-35	56.6	0.6		55.5	-0.5
R-36	56.5	0.5		55.4	-0.6
R-37	56.5	0.6		55.4	-0.5
R-38	56.5	0.6		55.4	-0.5
R-39	56.4	0.5		55.3	-0.6
R-40	56.4	0.5		55.3	-0.6
R-41	56.4	0.5		55.3	-0.6
R-42	56.6	0.6		55.5	-0.5
R-43	56.7	0.6		55.6	-0.5
R-44	56.8	0.5		55.7	-0.6
R-45	57.0	0.5		56.0	-0.5
R-46	57.0	0.6		55.9	-0.5
R-47	57.0	0.5		56.0	-0.5
R-48	57.2	0.5		56.2	-0.5

Table 6d. Effects of Changing NEAHD Traffic Speed for Receptors South of 153 Avenue NW

Receptor	L_{eq}24 with 110 km/hr on NEAHD (dBA)	Increase Compared to 100 km/hr (dBA)		L_{eq}24 with 90 km/hr on NEAHD (dBA)	Decrease Compared to 100 km/hr (dBA)
R-49	62.2	0.6		61.0	-0.6
R-50	58.7	0.5		57.6	-0.6
R-51	57.9	0.5		56.9	-0.5
R-52	59.6	0.5		58.5	-0.6
R-53	59.8	0.5		58.8	-0.5
R-54	59.6	0.5		58.7	-0.4
R-55	59.1	0.4		58.4	-0.3
R-56	57.9	0.3		57.3	-0.3
R-57	58.6	0.3		58.1	-0.2
R-58	59.1	0.2		58.7	-0.2
R-59	58.8	0.2		58.4	-0.2

Table 6e. Effects of Changing NEAHD Traffic Speed for Receptors West of Manning Drive

Receptor	L_{eq}24 with 110 km/hr on NEAHD (dBA)	Increase Compared to 100 km/hr (dBA)		L_{eq}24 with 90 km/hr on NEAHD (dBA)	Decrease Compared to 100 km/hr (dBA)
R-60	56.6	0.5		55.8	-0.3
R-61	57.5	0.6		56.5	-0.4
R-62	57.9	0.7		56.8	-0.4
R-63	59.0	0.8		57.8	-0.4
R-64	60.1	0.8		58.8	-0.5
R-65	61.3	0.8		60.0	-0.5
R-66	61.6	0.9		60.2	-0.5
R-67	62.2	0.9		60.7	-0.6
R-68	62.5	0.9		61.0	-0.6

6.3.3. % Heavy Trucks Analysis

To determine the effect of varying % heavy trucks, two scenarios were modeled. The future conditions were increased by 5% and then decreased by 5% to determine a relative range of values. It is unlikely that the % heavy trucks will fall outside of this range. The results are shown in Tables 7a – 7e. T**he relative sound level increase with a relative increase of 5% heavy trucks is approximately 0.1 – 0.9 dBA. The relative sound level decrease with a relative decrease of 5% heavy trucks is approximately 0.1 – 1.2 dBA.** As with the traffic volumes and traffic speeds assessments, the largest changes were at locations where the noise climate was completely dominated by the noise from NEAHD. The locations with the lowest changes were those where the noise climate was dominated by City Roads/Freeways. The relative increase in noise levels with a relative increase of 5% heavy trucks will not result in any locations along NEAHD to have noise levels at or above 65 dBA L_{eq}24. Again, given that a minimum 2.0 – 3.0 dBA change is required before most people start to notice a change, it will take a significant change to the % heavy trucks before most people will notice the difference.

In general, the effect of changing the % heavy trucks is inversely logarithmic. For example, the difference between 0% and 1% is significant (approximately 0.7 dBA) while the difference between 10% and 11% is much less (approximately 0.2 dBA). Since the % heavy trucks is above 8% along the entire NEAHD, small % changes in heavy trucks will not have a significant impact.

Table 7a. Effects of Changing NEAHD AHD % Heavy Trucks for Receptors South of Whitemud Drive

Receptor	L_{eq}24 with 5% Greater Heavy Trucks on NEAHD (dBA)	Increase Compared to Future Conditions (dBA)		L_{eq}24 with 5% Fewer Heavy Trucks on NEAHD (dBA)	Decrease Compared to Future Conditions (dBA)
R-01	58.0	0.4		56.5	-1.1
R-02	57.1	0.3		55.6	-1.2
R-03	56.2	0.5		54.7	-1.0
R-04	55.1	0.7		53.5	-0.9
R-05	55.0	0.5		53.6	-0.9
R-06	56.5	0.6		55.0	-0.9
R-07	57.2	0.6		55.8	-0.8
R-08	64.0	0.6		62.5	-0.9
R-09	64.2	0.6		62.8	-0.8
R-10	61.8	0.4		60.9	-0.5
R-11	62.6	0.2		62.2	-0.2
R-12	62.6	0.1		62.4	-0.1
R-13	62.0	0.0		61.9	-0.1

Table 7b. Effects of Changing NEAHD % Heavy Trucks for Receptors South of Sherwood Park Freeway

Receptor	L_{eq}24 with 5% Greater Heavy Trucks on NEAHD (dBA)	Increase Compared to Future Conditions (dBA)		L_{eq}24 with 5% Fewer Heavy Trucks on NEAHD (dBA)	Decrease Compared to Future Conditions (dBA)
R-14	55.3	0.8		53.6	-0.9
R-15	55.3	0.8		53.6	-0.9
R-16	55.4	0.8		53.7	-0.9
R-17	55.2	0.8		53.5	-0.9
R-18	55.2	0.8		53.5	-0.9
R-19	55.2	0.8		53.5	-0.9
R-20	55.0	0.8		53.3	-0.9
R-21	55.2	0.8		53.5	-0.9
R-22	55.2	0.8		53.5	-0.9
R-23	55.3	0.8		53.6	-0.9

Table 7c. Effects of Changing NEAHD % Heavy Trucks for Receptors South of Baseline Road

Receptor	L_{eq}24 with 5% Greater Heavy Trucks on NEAHD (dBA)	Increase Compared to Future Conditions (dBA)		L_{eq}24 with 5% Fewer Heavy Trucks on NEAHD (dBA)	Decrease Compared to Future Conditions (dBA)
R-24	58.0	0.5		56.9	-0.6
R-25	57.4	0.6		56.1	-0.7
R-26	57.3	0.7		55.8	-0.8
R-27	57.2	0.7		55.6	-0.9
R-28	57.2	0.8		55.6	-0.8
R-29	57.1	0.7		55.5	-0.9
R-30	57.1	0.8		55.4	-0.9
R-31	57.0	0.8		55.3	-0.9
R-32	57.0	0.8		55.2	-1.0
R-33	56.9	0.8		55.1	-1.0
R-34	56.9	0.9		55.0	-1.0
R-35	56.9	0.9		55.0	-1.0
R-36	56.8	0.8		54.9	-1.1
R-37	56.8	0.9		54.9	-1.0
R-38	56.7	0.8		54.8	-1.1
R-39	56.7	0.8		54.8	-1.1
R-40	56.7	0.8		54.8	-1.1
R-41	56.7	0.8		54.8	-1.1
R-42	56.8	0.8		54.9	-1.1
R-43	56.9	0.8		55.0	-1.1
R-44	57.1	0.8		55.2	-1.1
R-45	57.3	0.8		55.5	-1.0
R-46	57.2	0.8		55.4	-1.0
R-47	57.3	0.8		55.5	-1.0
R-48	57.5	0.8		55.7	-1.0

Table 7d. Effects of Changing NEAHD % Heavy Trucks for Receptors South of 153 Avenue NW

Receptor	L_{eq}24 with 5% Greater Heavy Trucks on NEAHD (dBA)	Increase Compared to Future Conditions (dBA)		L_{eq}24 with 5% Fewer Heavy Trucks on NEAHD (dBA)	Decrease Compared to Future Conditions (dBA)
R-49	62.5	0.9		60.5	-1.1
R-50	59.0	0.8		57.1	-1.1
R-51	58.1	0.7		56.5	-0.9
R-52	59.9	0.8		58.1	-1.0
R-53	60.1	0.8		58.3	-1.0
R-54	59.9	0.8		58.2	-0.9
R-55	59.3	0.6		58.0	-0.7
R-56	58.1	0.5		57.0	-0.6
R-57	58.7	0.4		57.8	-0.5
R-58	59.2	0.3		58.5	-0.4
R-59	58.9	0.3		58.3	-0.3

Table 7e. Effects of Changing NEAHD % Heavy Trucks for Receptors West of Manning Drive

Receptor	L_{eq}24 with 5% Greater Heavy Trucks on NEAHD (dBA)	Increase Compared to Future Conditions (dBA)		L_{eq}24 with 5% Fewer Heavy Trucks on NEAHD (dBA)	Decrease Compared to Future Conditions (dBA)
R-60	56.6	0.5		55.5	-0.6
R-61	57.4	0.5		56.2	-0.7
R-62	57.9	0.7		56.4	-0.8
R-63	59.0	0.8		57.3	-0.9
R-64	60.1	0.8		58.3	-1.0
R-65	61.3	0.8		59.5	-1.0
R-66	61.6	0.9		59.7	-1.0
R-67	62.1	0.8		60.2	-1.1
R-68	62.5	0.9		60.5	-1.1

6.3.4. Cumulative Sensitivity Analysis

With the information provided by the sensitivity analysis for each of the three main traffic parameters, it is possible to determine a cumulative effect if all three are taken into account simultaneously. The results are presented in in Tables 8a – 8e. Relative increases for locations which are most directly impacted by NEAHD are as high as 2.3 dBA. At locations in which the noise climate is most directly impacted by City Roads/Freeways, the increases are as low as 0.2 dBA. The relative increase in noise levels with a relative increase of 25% traffic volumes, 5% heavy trucks and a speed of 110 km/hr will result $L_{eq}24$ noise levels ranging from 56.2 to 65.4 dBA. There is anticipated to be one area having projected noise levels above 65 dBA $L_{eq}24$, otherwise all other locations along NEAHD will have noise levels below 65 dBA $L_{eq}24$.

As indicated in Table 8a, the projected noise levels for Receptors R-08 & R-09 are projected to exceed 65 dBA $L_{eq}24$. The elevated noise levels at this location can be attributed to the proximity of the residential development to both NEAHD and Whitemud Drive, in addition to the topography of the area which, currently[1], reduces the effectiveness of the existing noise barrier. As stated in the AT Criteria, (discussed in Section 4.0), "*Alberta Transportation will request that the development proponent and approving authority address future noise concerns consistent with these guidelines*". Therefore, if the future noise levels exceed 65 dBA $L_{eq}24$, additional noise mitigation will the responsibility of the City of Edmonton and/or the residential land developer.

[1] It should be noted that the residential development southwest of the Whitemud Drive & NEAHD has not yet been completed. Therefore, it is possible that there will be topographical changes once it complete, which could influence the noise climate of the area.

Table 8a. Results of Cumulative Effects for Receptors South of Whitemud Drive

Receptor	L_{eq}24 with 25% Additional Vehicles, Speed of 110 km/hr, 5% Greater Heavy Trucks on NEAHD (dBA)	Increase Compared to Future Conditions (dBA)
R-01	59.2	1.6
R-02	58.4	1.6
R-03	57.5	1.8
R-04	56.3	1.9
R-05	56.2	1.7
R-06	57.7	1.8
R-07	58.4	1.8
R-08	65.2	1.8
R-09	65.4	1.8
R-10	62.5	1.1
R-11	63.0	0.6
R-12	62.8	0.3
R-13	62.2	0.2

Table 8b. Results of Cumulative Effects for Receptors South of Sherwood Park Freeway

Receptor	L_{eq}24 with 25% Additional Vehicles, Speed of 110 km/hr, 5% Greater Heavy Trucks on NEAHD (dBA)	Increase Compared to Future Conditions (dBA)
R-14	56.6	2.1
R-15	56.6	2.1
R-16	56.7	2.1
R-17	56.6	2.2
R-18	56.6	2.2
R-19	56.5	2.1
R-20	56.4	2.2
R-21	56.5	2.1
R-22	56.5	2.1
R-23	56.6	2.1

Table 8c. Results of Cumulative Effects for Receptors South of Baseline Road

Receptor	L_{eq}24 with 25% Additional Vehicles, Speed of 110 km/hr, 5% Greater Heavy Trucks on NEAHD (dBA)	Increase Compared to Future Conditions (dBA)		Receptor	L_{eq}24 with 25% Additional Vehicles, Speed of 110 km/hr, 5% Greater Heavy Trucks on NEAHD (dBA)	Increase Compared to Future Conditions (dBA)
R-24	58.9	1.4		R-37	58.1	2.2
R-25	58.5	1.7		R-38	58.1	2.2
R-26	58.4	1.8		R-39	58.1	2.2
R-27	58.4	1.9		R-40	58.1	2.2
R-28	58.4	2.0		R-41	58.1	2.2
R-29	58.3	1.9		R-42	58.2	2.2
R-30	58.3	2.0		R-43	58.3	2.2
R-31	58.3	2.1		R-44	58.4	2.1
R-32	58.3	2.1		R-45	58.6	2.1
R-33	58.2	2.1		R-46	58.6	2.2
R-34	58.2	2.2		R-47	58.6	2.1
R-35	58.2	2.2		R-48	58.8	2.1
R-36	58.2	2.2				

Table 8d. Results of Cumulative Effects for Receptors South of 153 Avenue NW

Receptor	L_{eq}24 with 25% Additional Vehicles, Speed of 110 km/hr, 5% Greater Heavy Trucks on NEAHD (dBA)	Increase Compared to Future Conditions (dBA)
R-49	63.9	2.3
R-50	60.4	2.2
R-51	59.3	1.9
R-52	61.1	2.0
R-53	61.3	2.0
R-54	61.1	2.0
R-55	60.3	1.6
R-56	59.0	1.4
R-57	59.5	1.2
R-58	59.8	0.9
R-59	59.5	0.9

Table 8e. Results of Cumulative Effects for Receptors West of Manning Drive

Receptor	L_{eq}24 with 25% Additional Vehicles, Speed of 110 km/hr, 5% Greater Heavy Trucks on NEAHD (dBA)	Increase Compared to Future Conditions (dBA)
R-60	57.4	1.3
R-61	58.4	1.5
R-62	59.0	1.8
R-63	60.2	2.0
R-64	61.4	2.1
R-65	62.6	2.1
R-66	63.0	2.3
R-67	63.5	2.2
R-68	63.9	2.3

6.4. Long-term Conditions

The results of the noise modeling under Long-term conditions (2.5M population) at the residential receptor locations are presented in Tables 9a – 9e and shown in Figures 47a – 47i. The $L_{eq}24$ sound levels are presented in the Tables along with the relative increase compared to the $L_{eq}24$current conditions. As with the Current Conditions, in the event of a discrepancy between the results indicated in the color contours and the Tables, the Tables will be considered as correct. Below each Table is a summary discussion of the results for that specific area.

Table 9a. Long-term Conditions Noise Modeling Results for Receptors South of Whitemud Drive

Receptor	Long-Term $L_{eq}24$ (dBA)	$L_{eq}24$ Increase Relative to Current Conditions (dBA)
R-01	59.5	2.6
R-02	58.7	2.7
R-03	57.7	2.7
R-04	56.6	3.0
R-05	56.8	3.2
R-06	58.0	3.0
R-07	58.8	3.1
R-08	65.4	2.9
R-09	65.7	3.1
R-10	63.7	3.6
R-11	65.0	4.0
R-12	65.2	4.2
R-13	64.9	4.4

The Long-term Conditions noise modeling results for Residents south of Sherwood Park Freeway indicated noise levels ranging from 56.6 dBA – 65.7 dBA $L_{eq}24$ at all locations. The increases relative to the Current Conditions ranged from +2.6 to +4.4 dBA which are due to the projected increases in traffic volumes on NEAHD, Whitemud Drive and adjacent City Roads. The noise levels for Receptors R-08 & R-09 are projected to exceed 65 dBA $L_{eq}24$, which are the only exceedances of all the Receptor locations (R-01 to R-68). The elevated noise levels for this area (as shown in Figure 47b) can be attributed to the proximity of the residential development to both NEAHD and Whitemud Drive, in addition to the topography of the area which, currently[1], reduces the effectiveness of the existing noise barrier.

[1] It should be noted that the residential development southwest of the Whitemud Drive & NEAHD has not yet been completed. Therefore, it is possible that there will be topographical changes once it complete, which could influence the noise climate of the area.

As stated in the AT Criteria, (discussed in Section 4.0), "*Alberta Transportation will request that the development proponent and approving authority address future noise concerns consistent with these guidelines*". Therefore, if the future noise levels exceed 65 dBA $L_{eq}24$, additional noise mitigation will the responsibility of the City of Edmonton and/or the residential land developer.

Table 9b. Long-term Conditions Noise Modeling Results for Receptors South of Sherwood Park Freeway

Receptor	Long-Term $L_{eq}24$ (dBA)	$L_{eq}24$ Increase Relative to Current Conditions (dBA)
R-14	56.8	3.1
R-15	56.8	3.1
R-16	56.8	3.0
R-17	56.7	3.1
R-18	56.7	3.1
R-19	56.7	3.1
R-20	56.5	3.1
R-21	56.6	3.0
R-22	56.6	3.0
R-23	56.7	3.1

The Long-term Conditions noise modeling results for Residents south of Sherwood Park Freeway indicated noise levels ranging from 56.5 dBA – 56.8 dBA $L_{eq}24$ at all locations. The increases relative to the Current Conditions ranged from +3.0 to +3.1 dBA which were due to the projected increases in traffic volumes on NEAHD.

Table 9c. Long-term Conditions Noise Modeling Results for Residents South of Baseline Road

Receptor	Long-Term L_{eq}24 (dBA)	L_{eq}24 Increase Relative to Current Conditions (dBA)	Receptor	Long-Term L_{eq}24 (dBA)	L_{eq}24 Increase Relative to Current Conditions (dBA)
R-24	58.9	2.5	R-37	57.7	2.7
R-25	58.3	2.6	R-38	57.7	2.8
R-26	58.2	2.6	R-39	57.7	2.8
R-27	58.1	2.6	R-40	57.7	2.8
R-28	58.1	2.7	R-41	57.7	2.8
R-29	58.1	2.7	R-42	57.8	2.8
R-30	58.0	2.7	R-43	57.9	2.8
R-31	58.0	2.7	R-44	58.1	2.9
R-32	58.0	2.8	R-45	58.2	2.8
R-33	57.9	2.7	R-46	58.2	2.8
R-34	57.8	2.7	R-47	58.3	2.9
R-35	57.8	2.7	R-48	58.4	2.8
R-36	57.8	2.8			

The Long-term Conditions noise modeling results for Residents south of Baseline Road indicated noise levels ranging from 57.7 dBA – 58.9 dBA L_{eq}24 at all locations. The increases relative to the Current Conditions ranged from +2.5 to +2.9 dBA which were due to the projected increases in traffic volumes on NEAHD and adjacent City Roads.

Table 9d. Long-term Conditions Noise Modeling Results for Residents South of 153 Avenue NW

Receptor	Long-Term L_{eq}24 (dBA)	L_{eq}24 Increase Relative to Current Conditions (dBA)
R-49	63.8	6.2
R-50	60.3	6.1
R-51	59.2	5.0
R-52	61.0	5.9
R-53	61.2	5.9
R-54	61.0	5.8
R-55	60.2	5.2
R-56	58.8	4.9
R-57	59.2	4.5
R-58	59.4	4.0
R-59	59.0	3.8

The Long-term Conditions noise modeling results for Residents south of 153 Avenue NW indicated noise levels ranging from 58.8 dBA – 63.8 dBA $L_{eq}24$ at all locations. The increases relative to the Current Conditions ranged from +3.8 to +6.2 dBA. Similarly to the Future Case scenario, the receptors north of the NSR have a larger increase under the Long-term Conditions when compared to the receptor locations south of the NSR (R-01 to R-48). This can be attributed primarily to a more significant increase in traffic volumes in this area which is consistent with the anticipated future residential developments (e.g. Horsehill Development).

Table 9e. Long-term Conditions Noise Modeling Results for Residents West of Manning Drive

Receptor	Long-Term $L_{eq}24$ (dBA)	$L_{eq}24$ Increase Relative to Current Conditions (dBA)
R-60	58.4	5.2
R-61	59.1	5.1
R-62	59.3	4.9
R-63	60.3	4.9
R-64	61.2	4.7
R-65	62.5	4.8
R-66	62.7	4.8
R-67	63.2	4.7
R-68	63.5	4.7

The Long-term Conditions noise modeling results for Residents west of Manning Drive NW indicated noise levels ranging from 58.4 dBA – 63.5 dBA $L_{eq}24$ at all locations. The increases relative to the Current Conditions ranged from +4.7 to +5.2 dBA which were due to the projected increases in traffic volumes on NEAHD, Manning Drive and adjacent City Roads. Similarly to Receptors R-49 to R-59, the relative increase in noise levels under Long-term Conditions is more significant than for Receptors south of the NSR. This can be attributed primarily to a more significant increase in traffic volumes in this area which is consistent with the anticipated future residential developments (e.g. Horsehill Development).

7.0 Conclusion

The results of the Current Conditions noise monitoring indicated noise levels ranging from 52.5 dBA to 68.9 dBA L_{eq}24. All locations showed the typical trend of noise associated with traffic. These results confirmed that the noise levels being measured by the noise monitors were largely attributed to NEAHD in addition to the other major roadways.

The noise modeling results for Current Conditions matched well with the noise measurement results for most locations. The Current Conditions modeled noise levels at the existing residential receptor locations ranged from 53.2 – 62.6 dBA and thus were below Alberta Transportation's (AT) limit of 65 dBA L_{eq}24 at all the residential outdoor receptor locations.

The noise modeling results of all residential receptor locations for the Future Conditions (with projected traffic volumes representative of 2041 and a 1.6M population) indicated noise levels ranging from 54.2 – 63.6 dBA which is below the limit of 65 dBA L_{eq}24. A sensitivity analysis of the Future Conditions traffic volumes, traffic speeds, and % heavy trucks indicated that only with significant increases in all three, would the noise levels be above the AT limit of 65 dBA L_{eq}24 at two residential receptor locations were located southwest of the Whitemud Drive interchange where a new subdivision is being developed.

The noise modeling results for the Long-term Conditions (2.5M population) indicated noise levels which were below the AT limit of 65 dBA L_{eq}24 at all but two residential receptor locations. The two receptor locations were located southwest of the Whitemud Drive interchange where a new subdivision is being developed.

As stated in the province's noise attenuation guideline, "*In areas where a residential subdivision is constructed adjacent to a designated highway that has been constructed, Alberta Transportation will request that the development proponent and approving authority address future noise concerns consistent with these guidelines.*" Therefore, it is noted that if future noise levels exceed 65 dBA within new residential development areas, additional noise mitigation will be the responsibility of the land developers.

8.0 References

- *"Noise Attenuation Guidelines for Provincial Highways Under Provincial Jurisdiction Within Cities and Urban Areas"*, by Alberta Transportation. October 2002
- International Organization for Standardization (ISO), *Standard 1996-1, Acoustics – Description, measurement and assessment of environmental noise – Part 1: Basic quantities and assessment procedures, 2003*, Geneva Switzerland.
- International Organization for Standardization (ISO), *Standard 9613-1, Acoustics – Attenuation of sound during propagation outdoors – Part 1: Calculation of absorption of sound by the atmosphere, 1993*, Geneva Switzerland.
- International Organization for Standardization (ISO), *Standard 9613-2, Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation, 1996*, Geneva Switzerland.

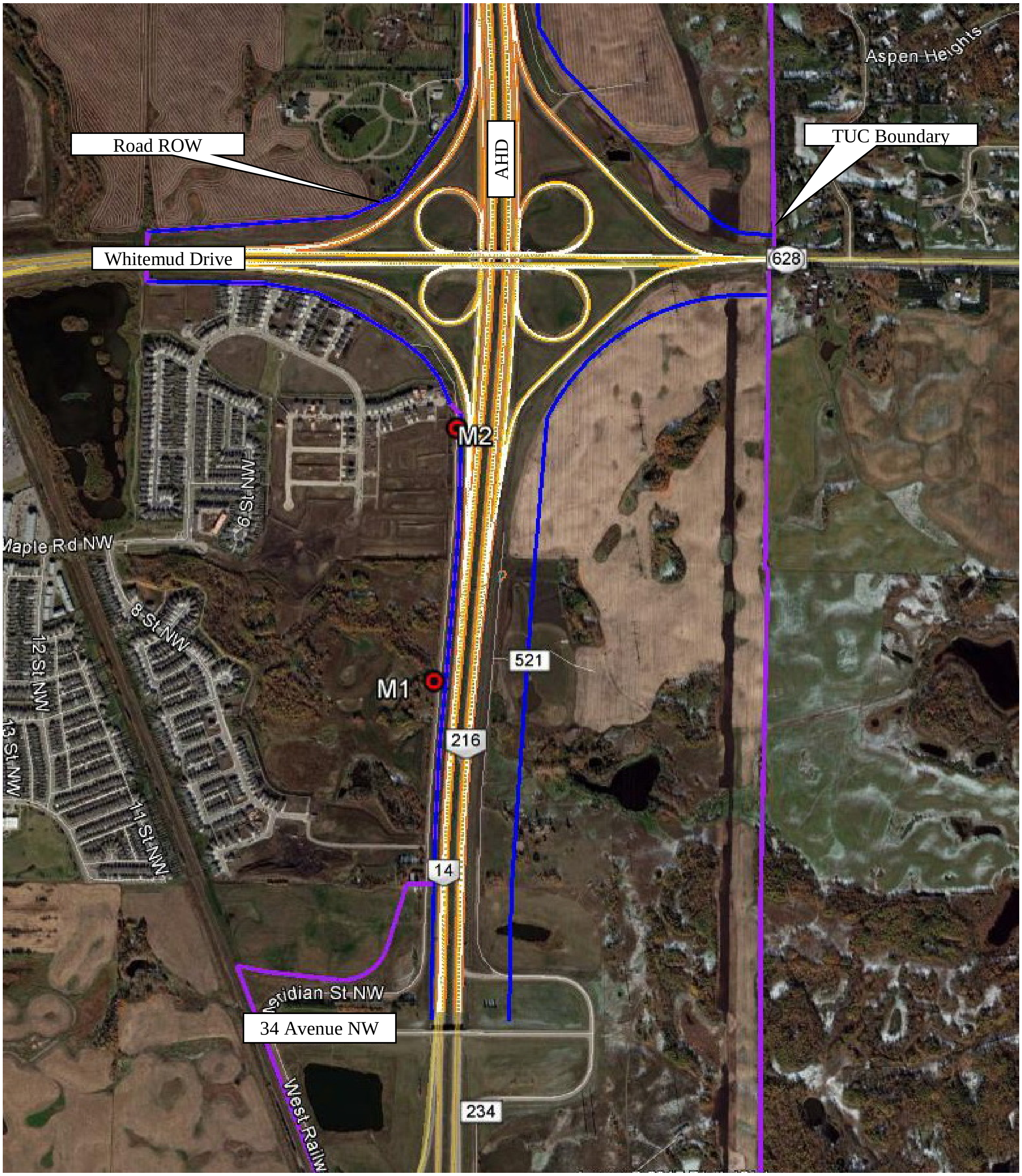

Figure 1a. Study Area (34 Avenue NW to Whitemud Drive – Southern Limit)[1]

[1] The Purple line in the following figures indicates the Transportation and Utility Corridor Boundary
The Blue line indicates the Road Right-of-Way
Red Circles indicate noise monitoring locations.

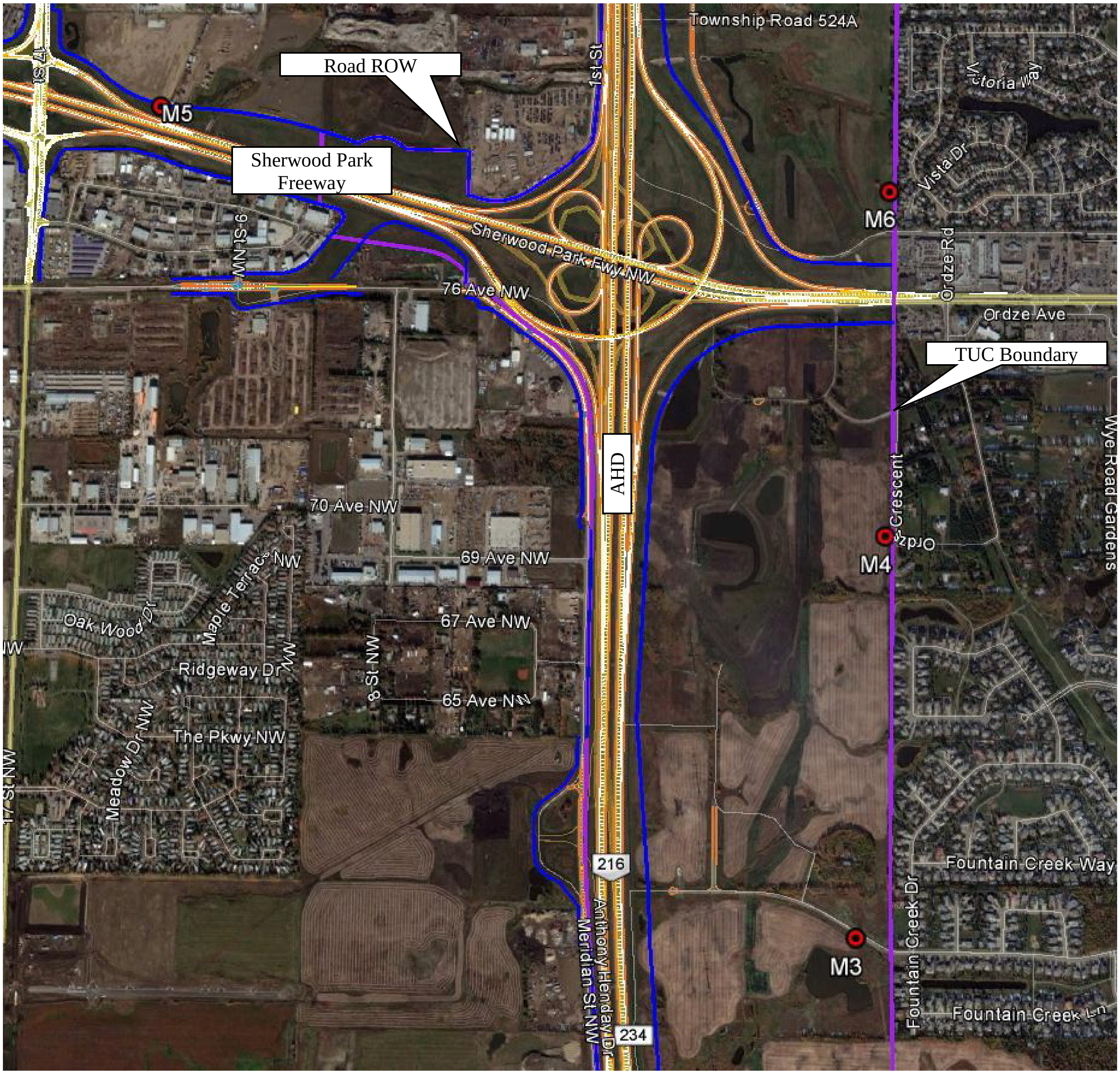

Figure 1b. Study Area (Whitemud Drive to Sherwood Park Freeway) [1]

[1] The Purple line in the following figures indicates the Transportation and Utility Corridor Boundary
The Blue line indicates the Road Right-of-Way
Red Circles indicate noise monitoring locations.

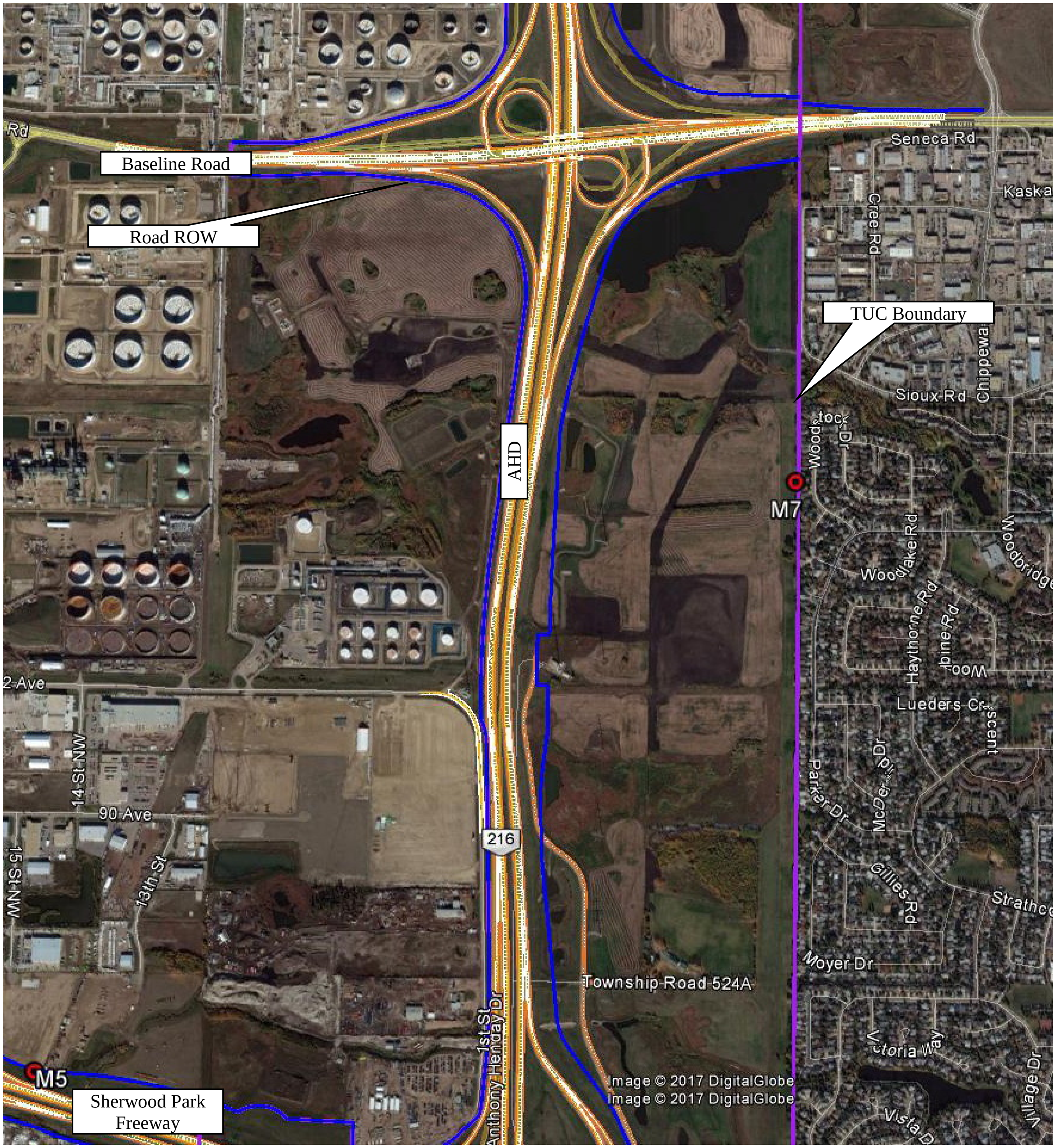

Figure 1c. Study Area (Sherwood Park Freeway to Baseline Road) [1]

[1] The Purple line in the following figures indicates the Transportation and Utility Corridor Boundary
The Blue line indicates the Road Right-of-Way
Red Circles indicate noise monitoring locations.

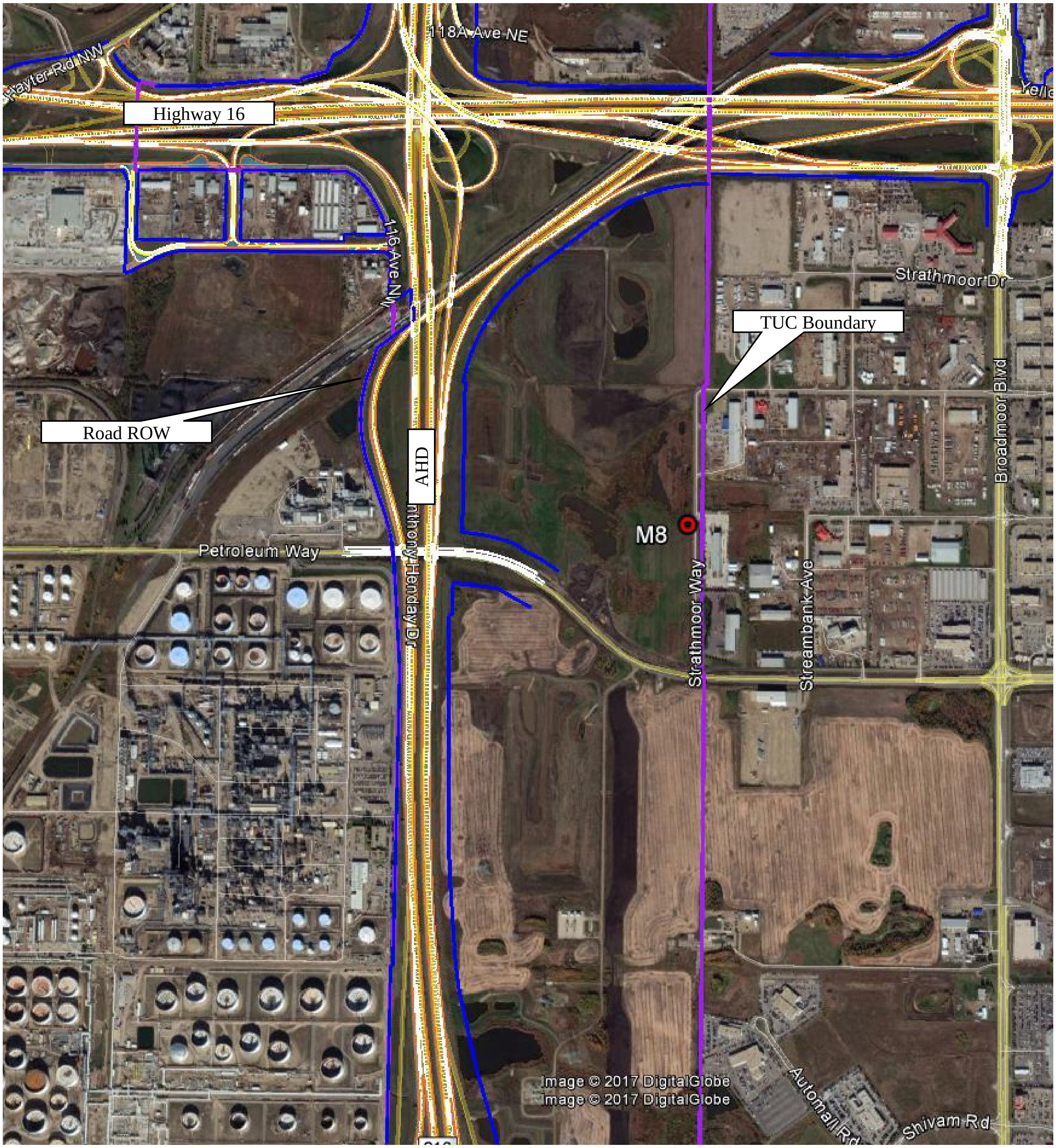

Figure 1d. Study Area (Baseline Road to Highway 16) [1]

[1] The Purple line in the following figures indicates the Transportation and Utility Corridor Boundary
The Blue line indicates the Road Right-of-Way
Red Circles indicate noise monitoring locations.

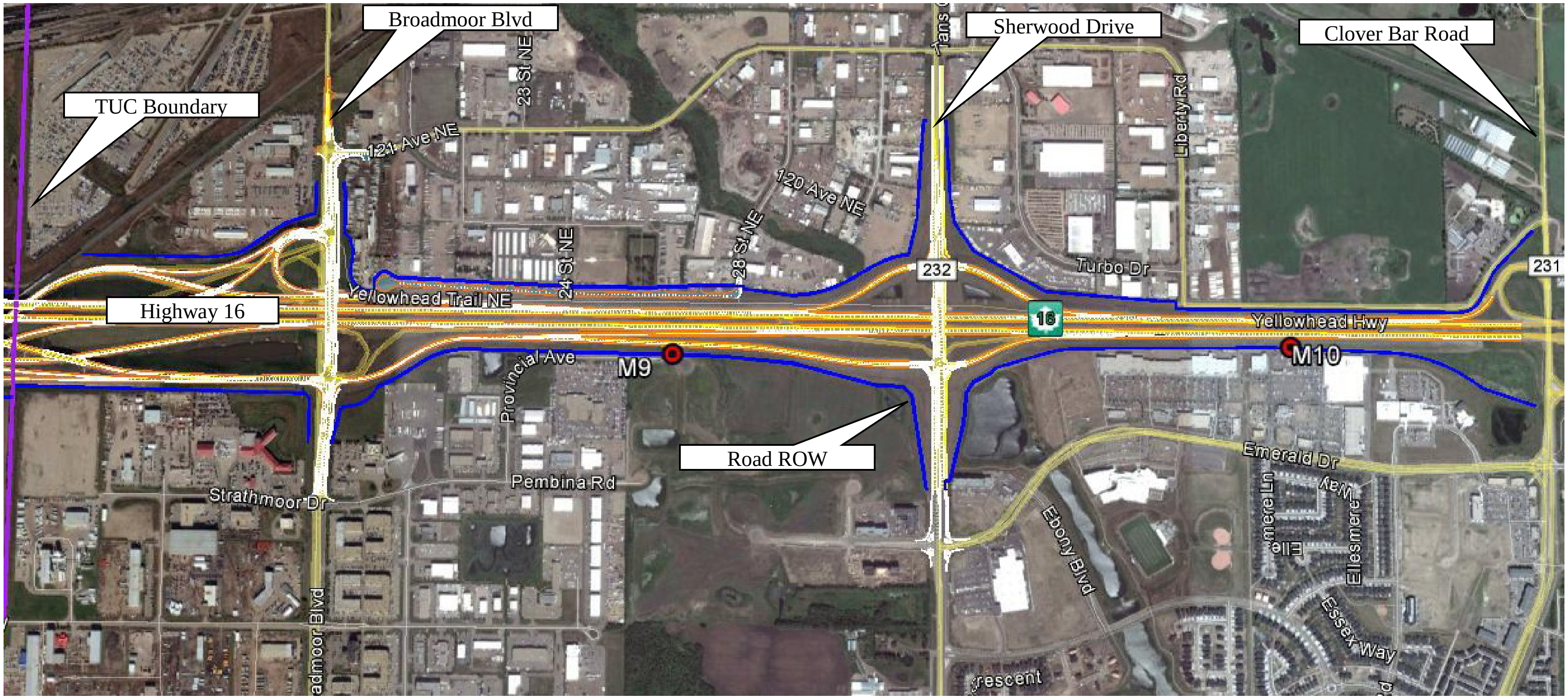

Figure 1e. Study Area (NEAHD to Clover Bar Road – East limit) [1]

[1] The Purple line in the following figures indicates the Transportation and Utility Corridor Boundary
The Blue line indicates the Road Right-of-Way
Red Circles indicate noise monitoring locations.

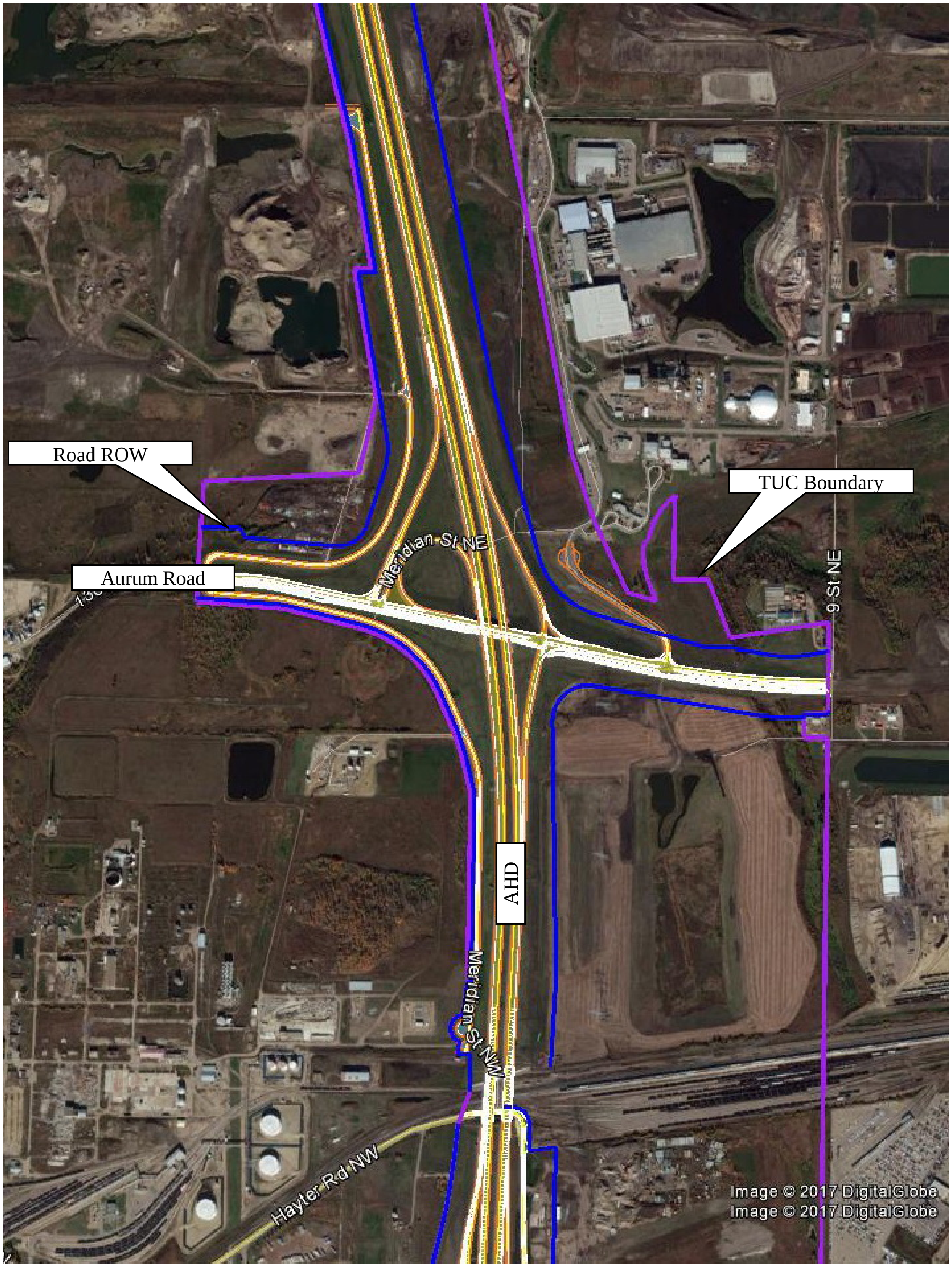

Figure 1f. Study Area (Highway 16 to Aurum Road) [1]

[1] The Purple line in the following figures indicates the Transportation and Utility Corridor Boundary
The Blue line indicates the Road Right-of-Way
Red Circles indicate noise monitoring locations.

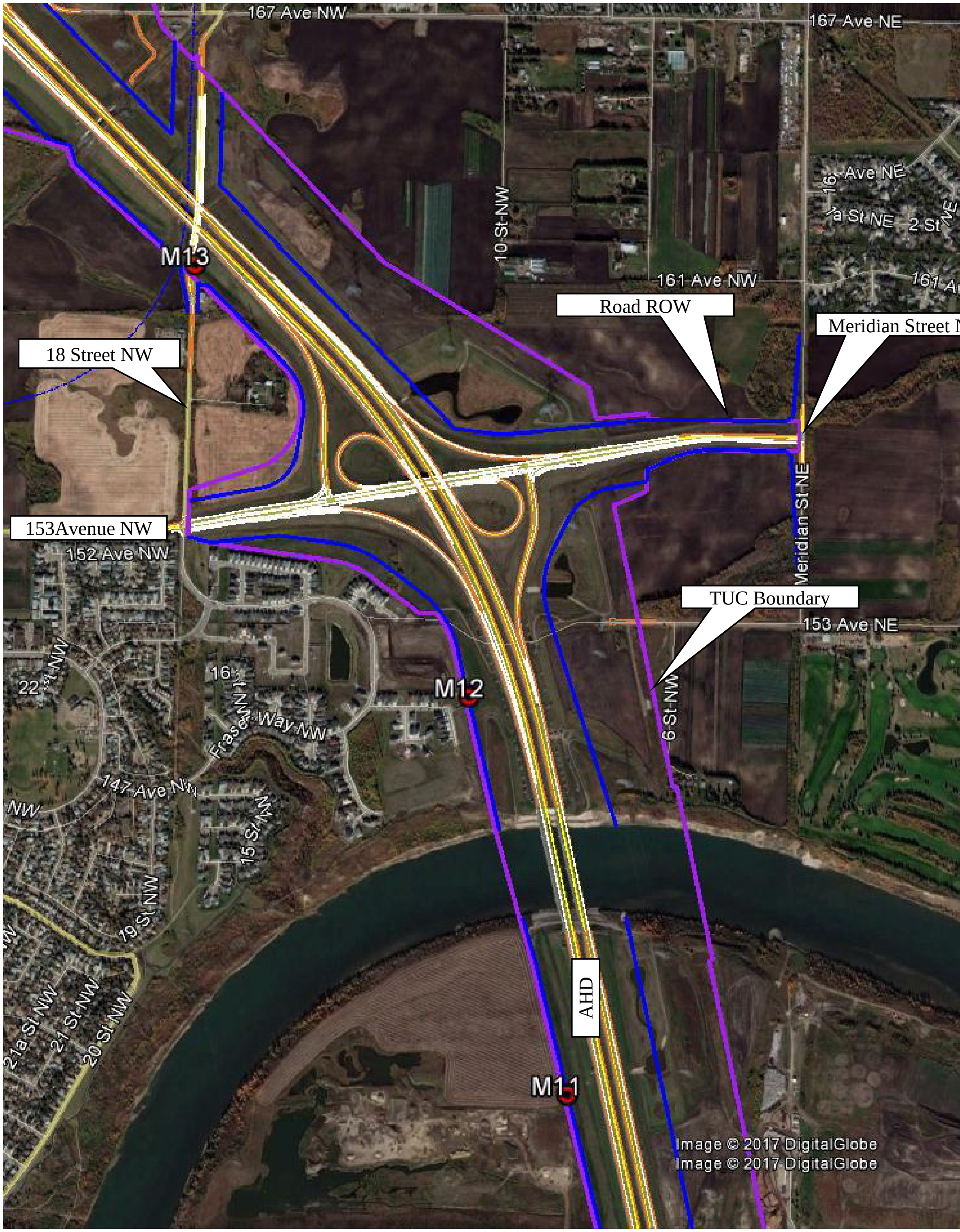

Figure 1g. Study Area (Aurum Road to 153 Avenue NW) [1]

[1] The Purple line in the following figures indicates the Transportation and Utility Corridor Boundary
The Blue line indicates the Road Right-of-Way
Red Circles indicate noise monitoring locations.

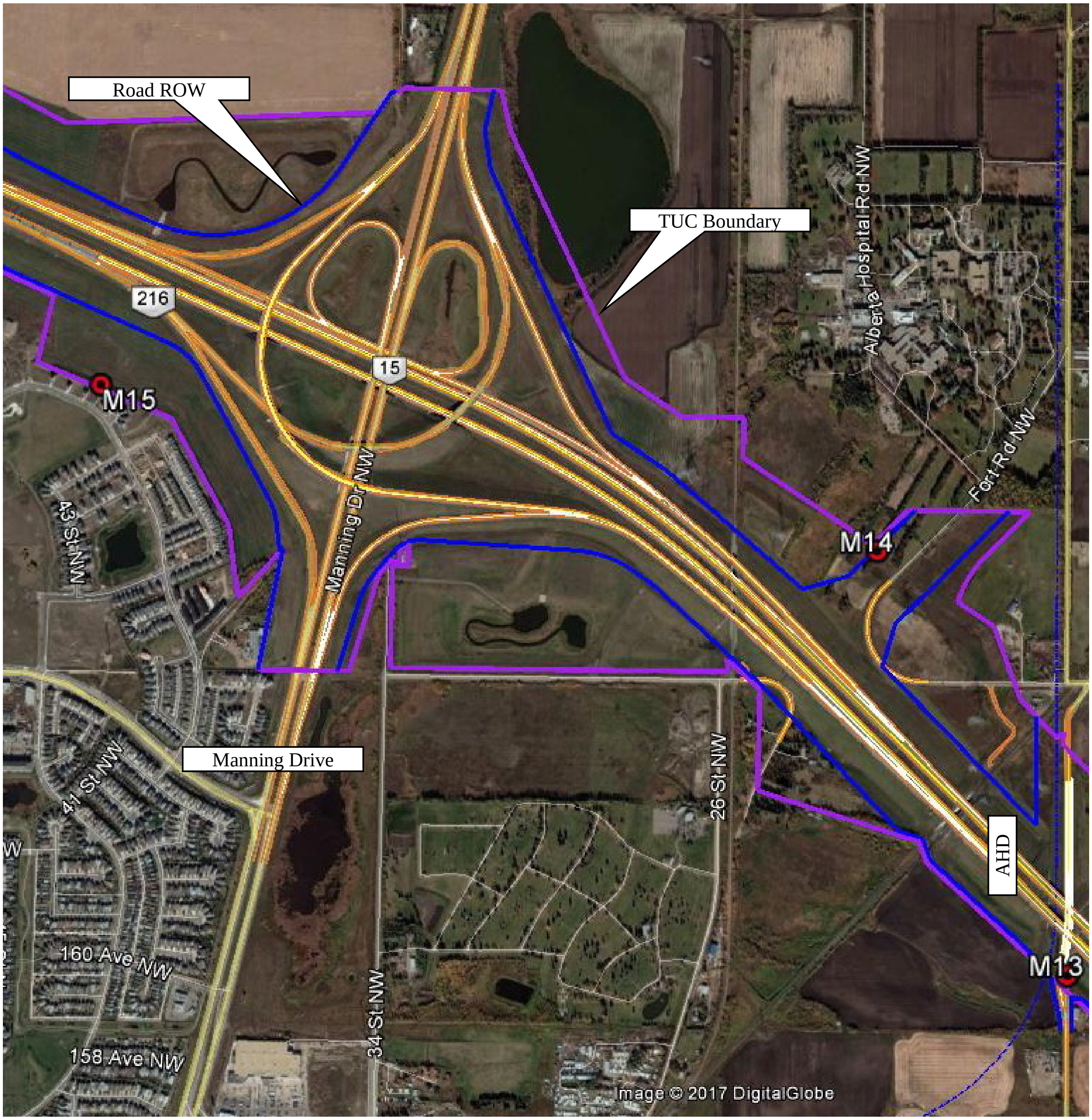

Figure 1h. Study Area (153 Avenue NW to Manning Drive) [1]

[1] The Purple line in the following figures indicates the Transportation and Utility Corridor Boundary
The Blue line indicates the Road Right-of-Way
Red Circles indicate noise monitoring locations.

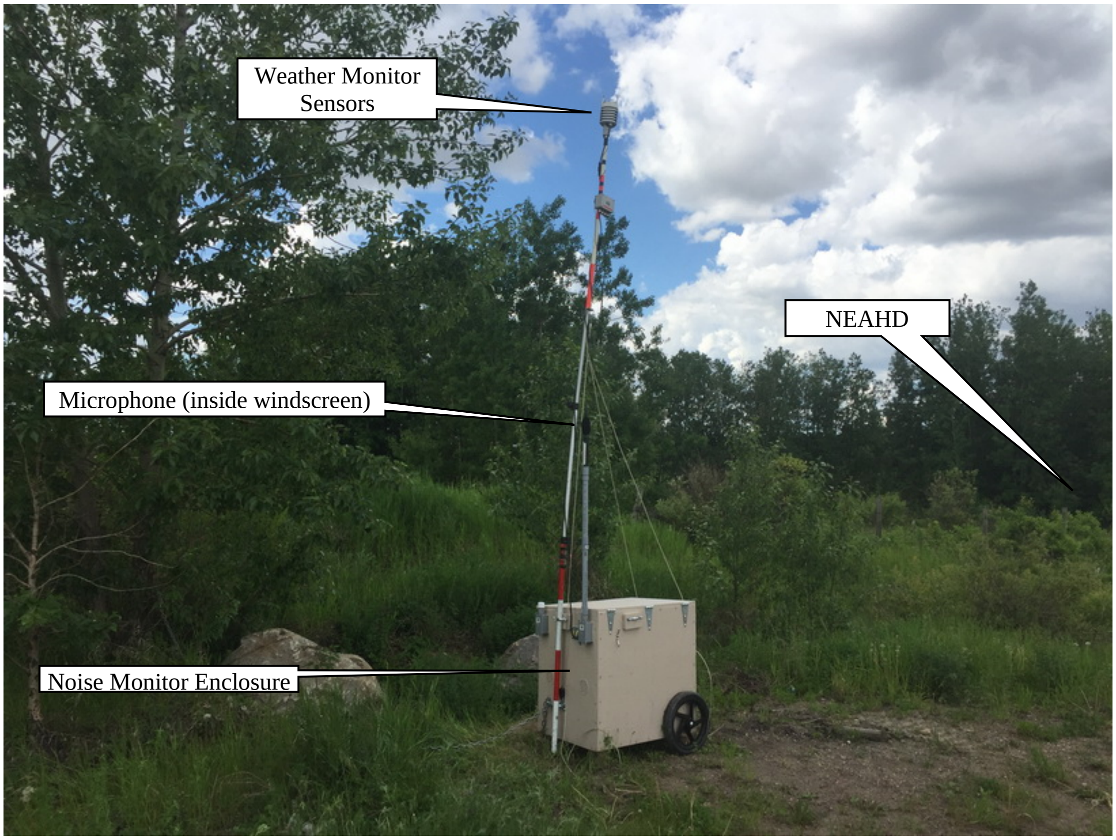

Figure 2. Noise Monitor at Location 1 (and Weather Monitor)

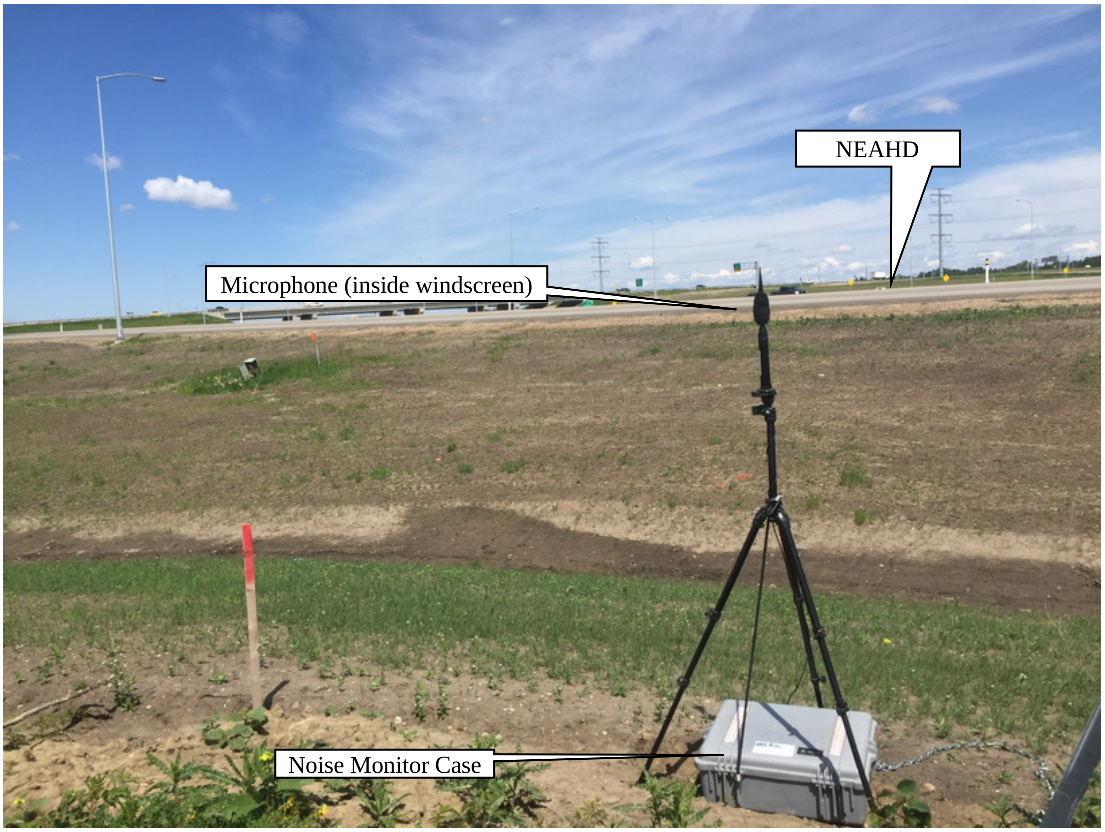

Figure 3. Noise Monitor at Location 2

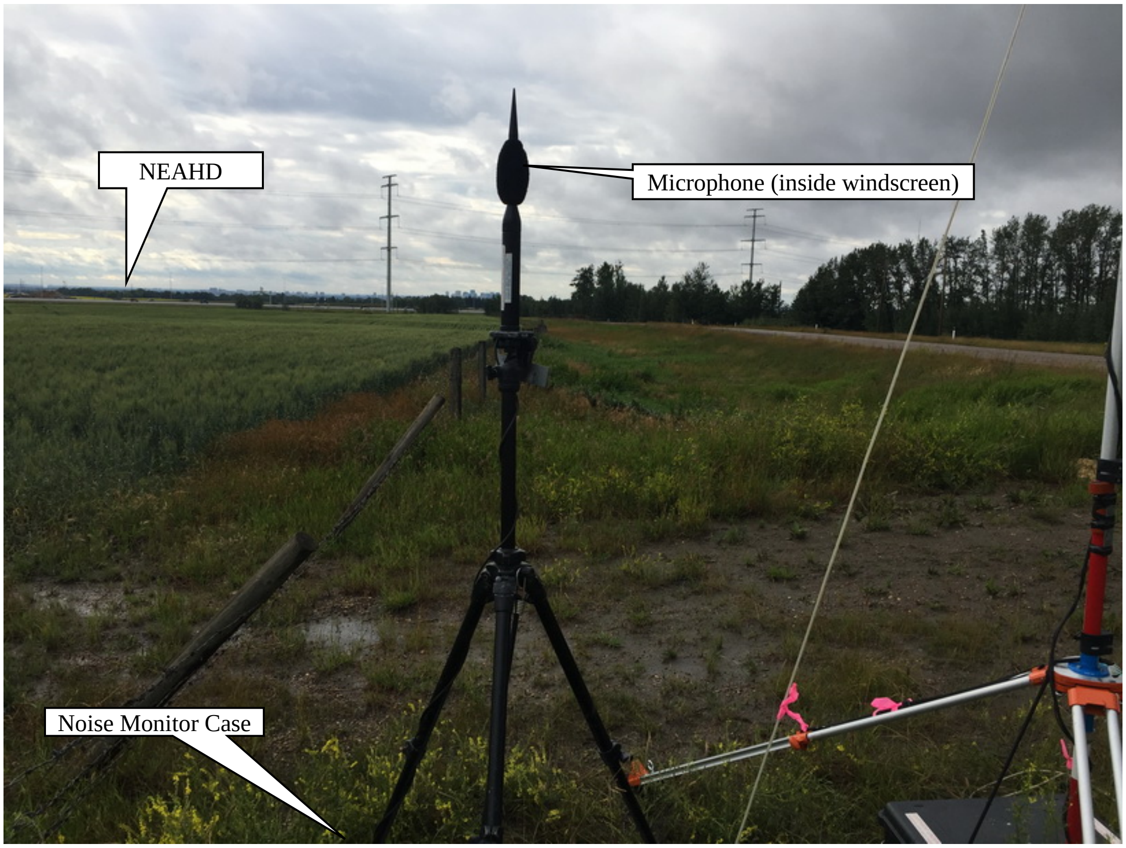

Figure 4. Noise Monitor at Location 3

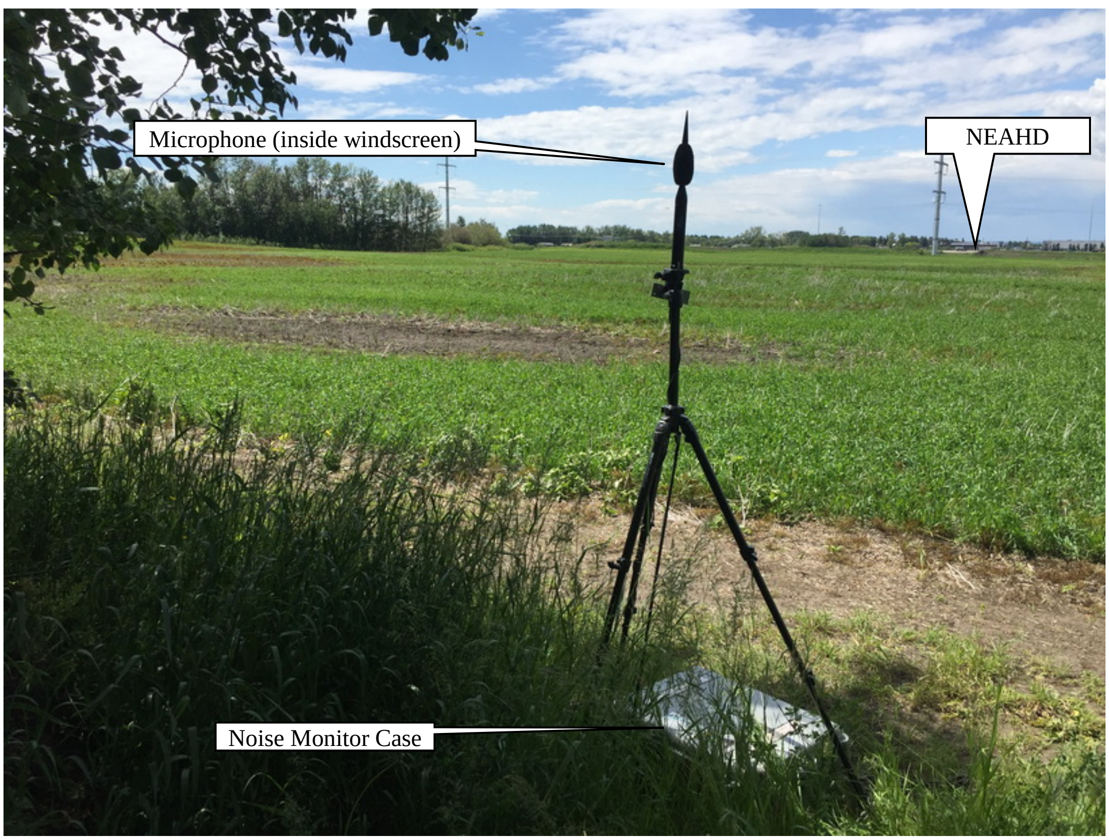

Figure 5. Noise Monitor at Location 4

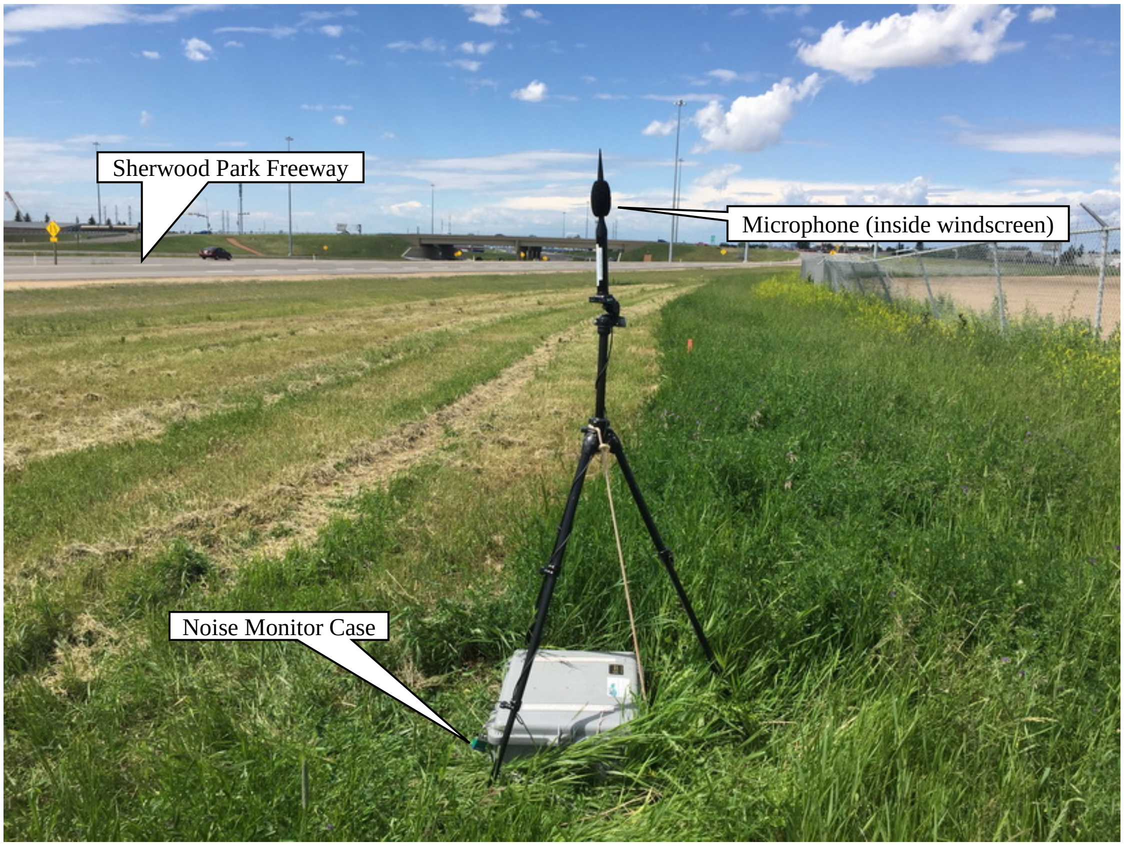

Figure 6. Noise Monitor at Location 5

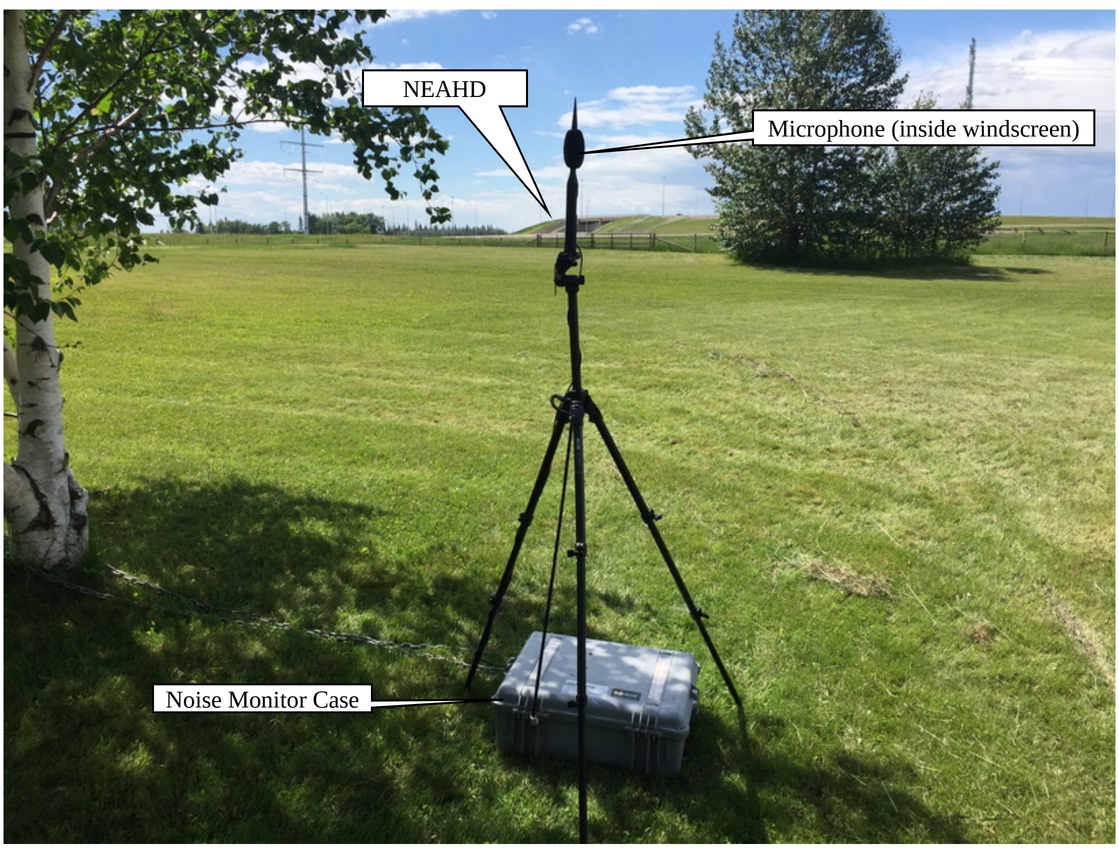

Figure 7. Noise Monitor at Location 6

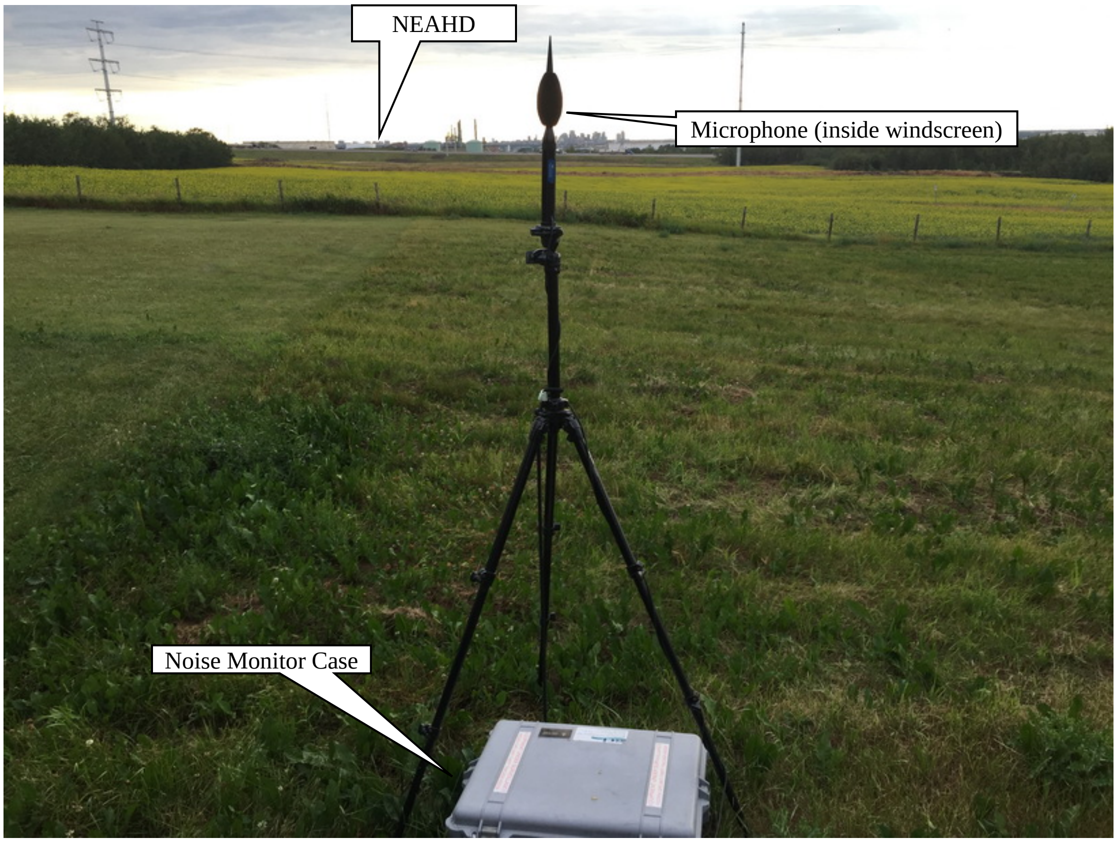

Figure 8. Noise Monitor at Location 7

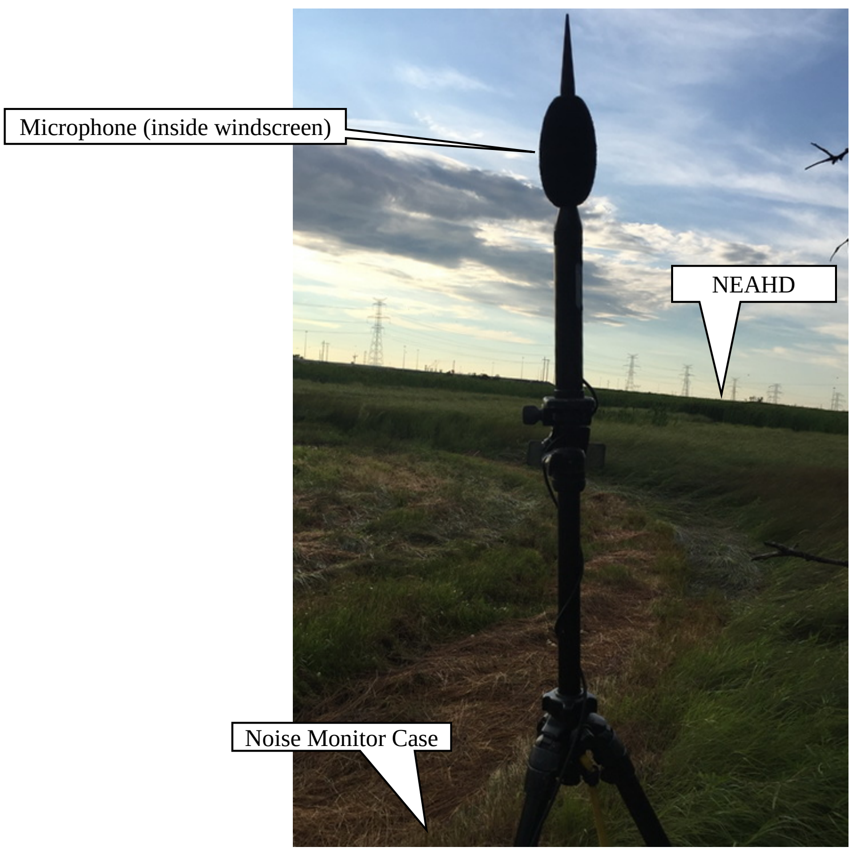

Figure 9. Noise Monitor at Location 8

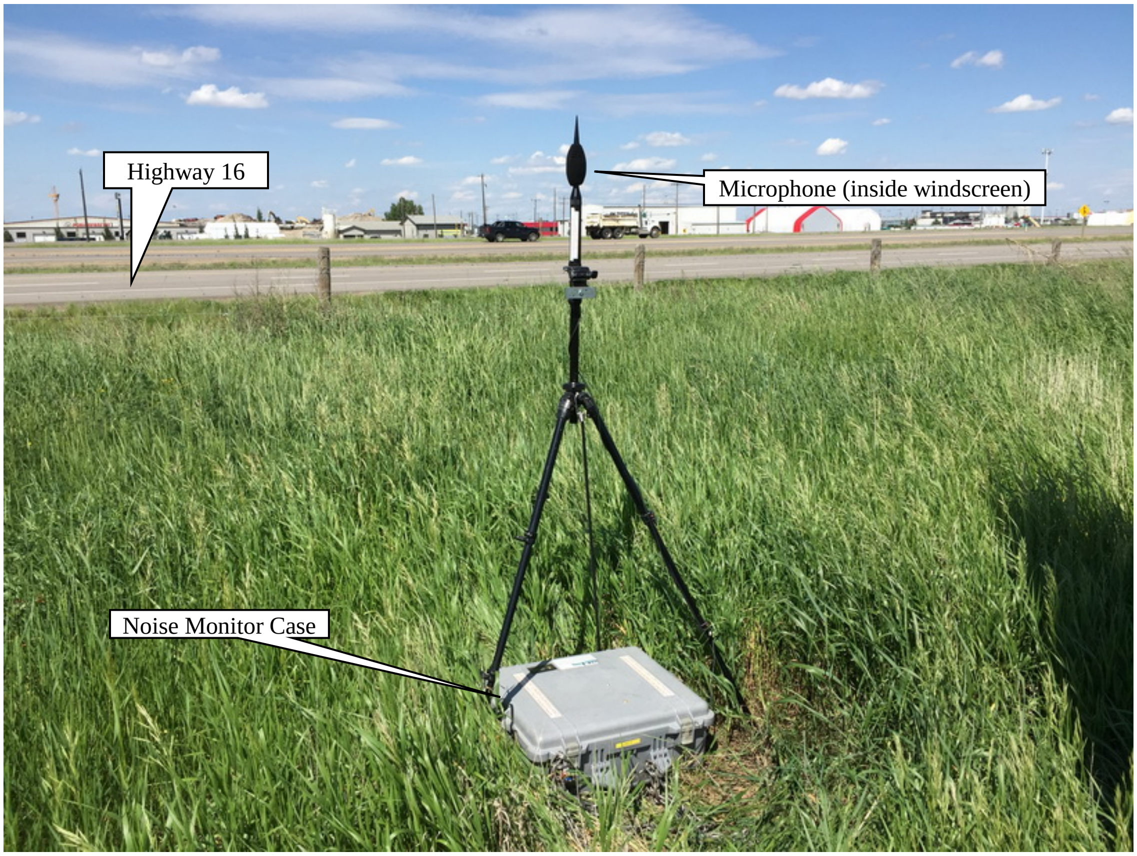

Figure 10. Noise Monitor at Location 9

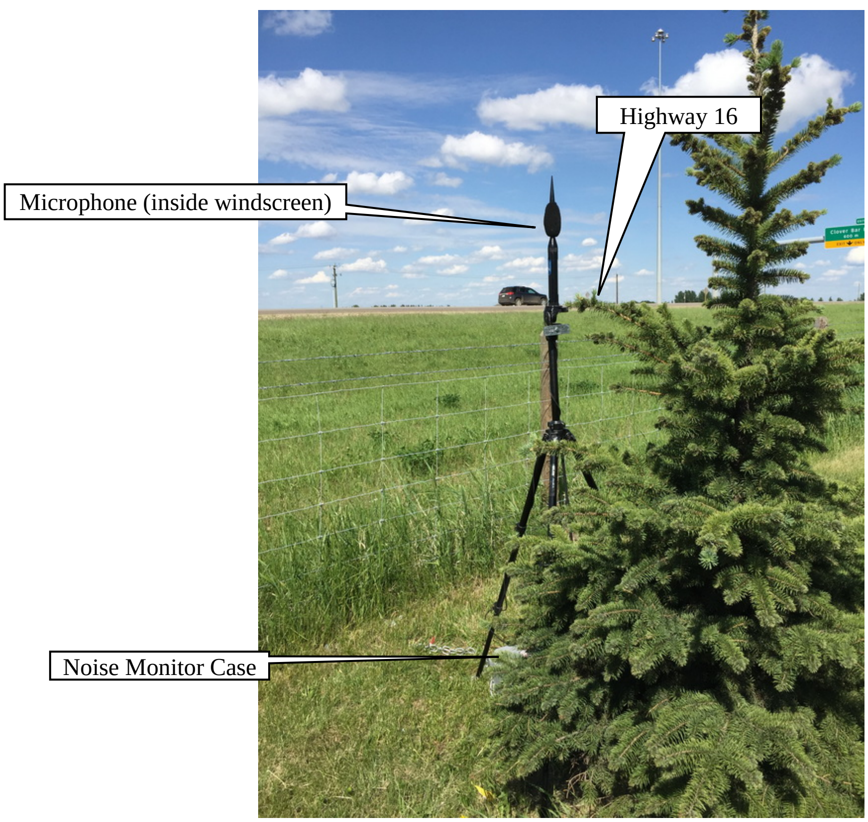

Figure 11. Noise Monitor at Location 10

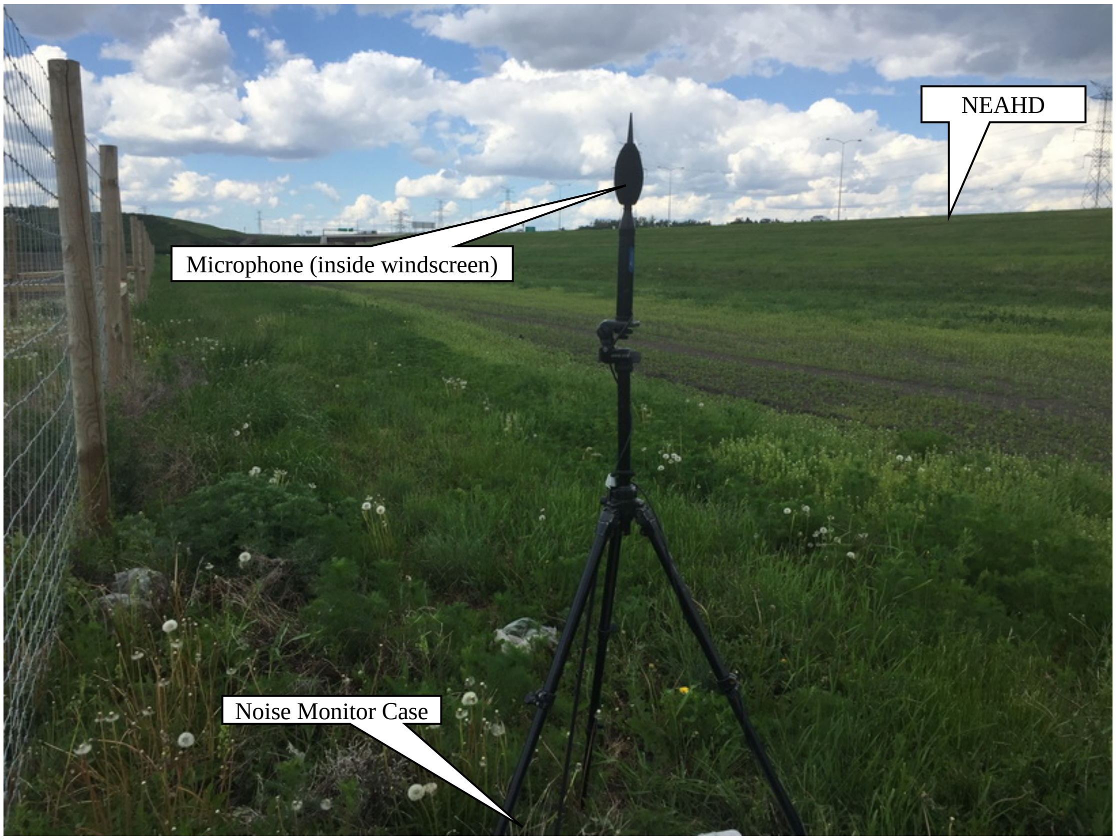

Figure 12. Noise Monitor at Location 11

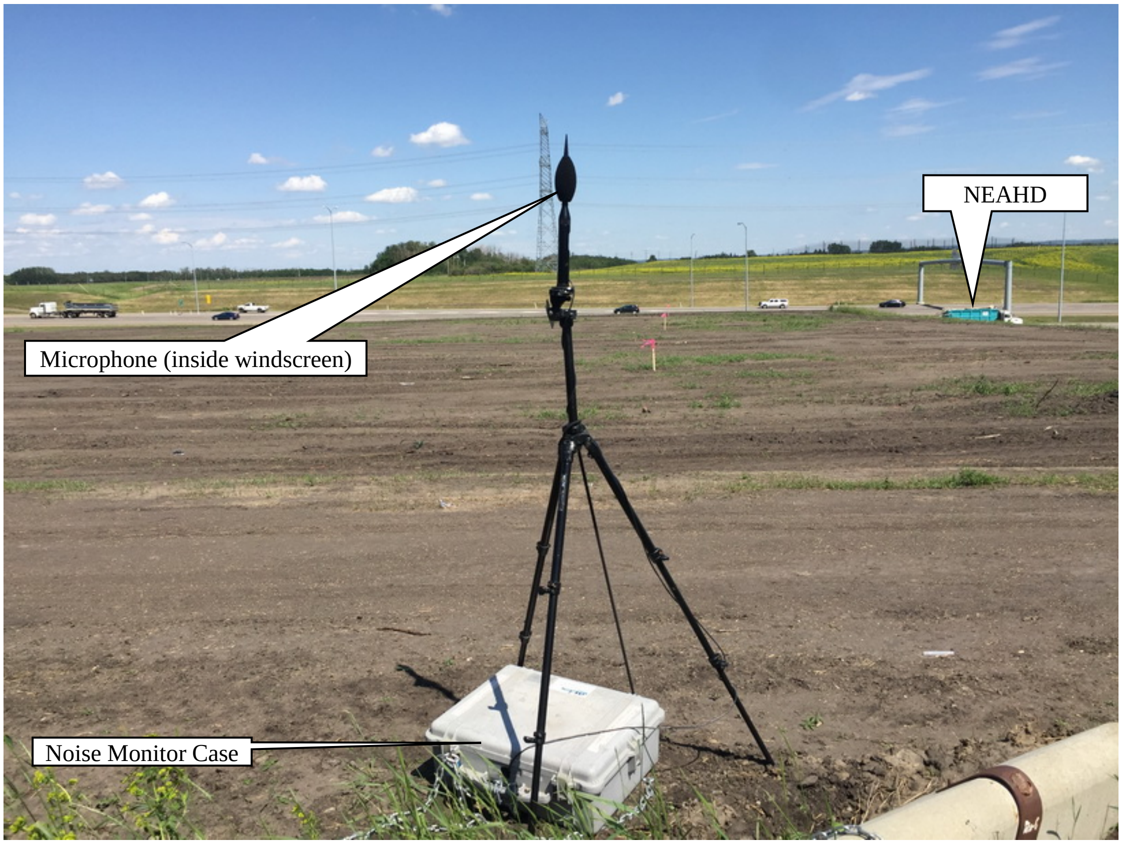

Figure 13. Noise Monitor at Location 12

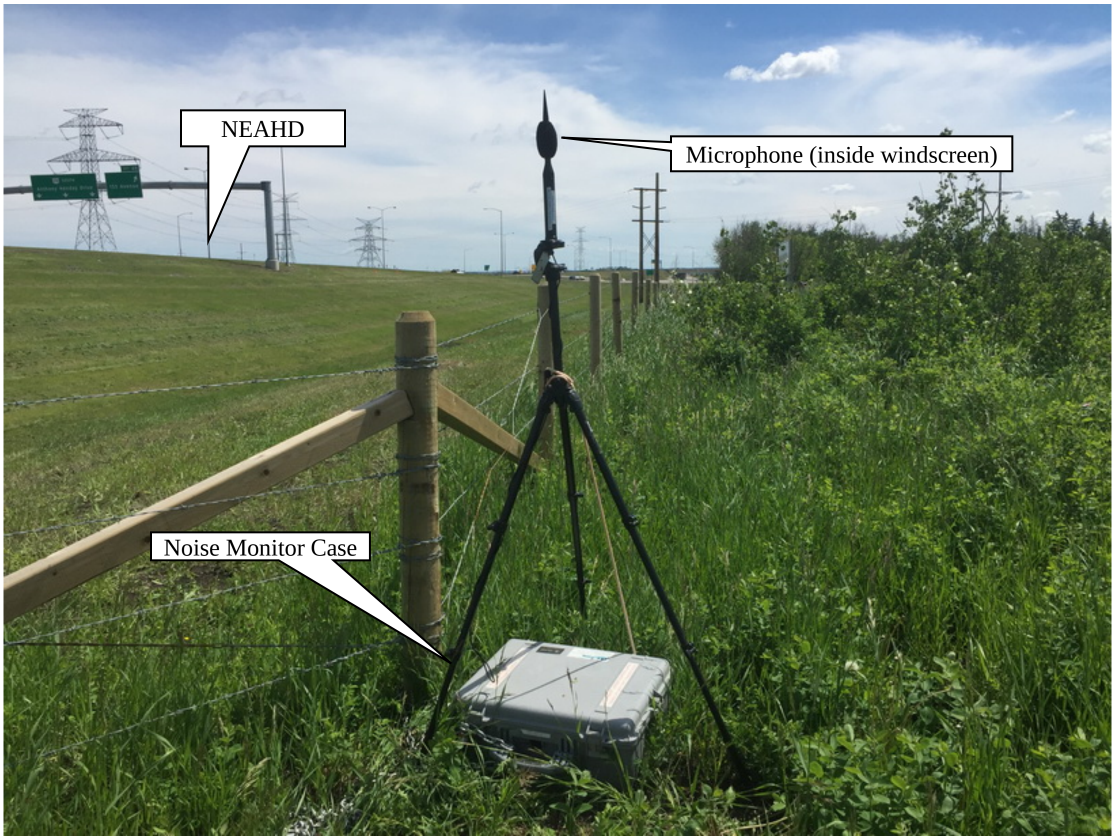

Figure 14. Noise Monitor at Location 13

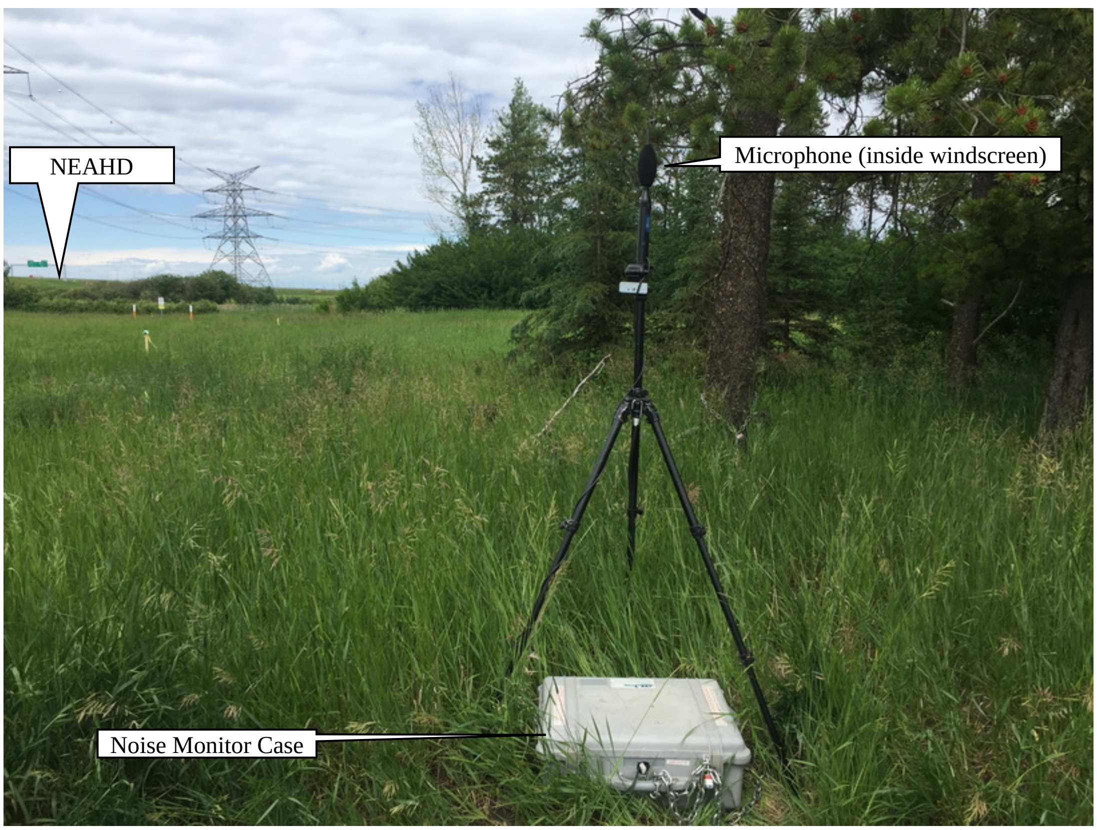

Figure 15. Noise Monitor at Location 14

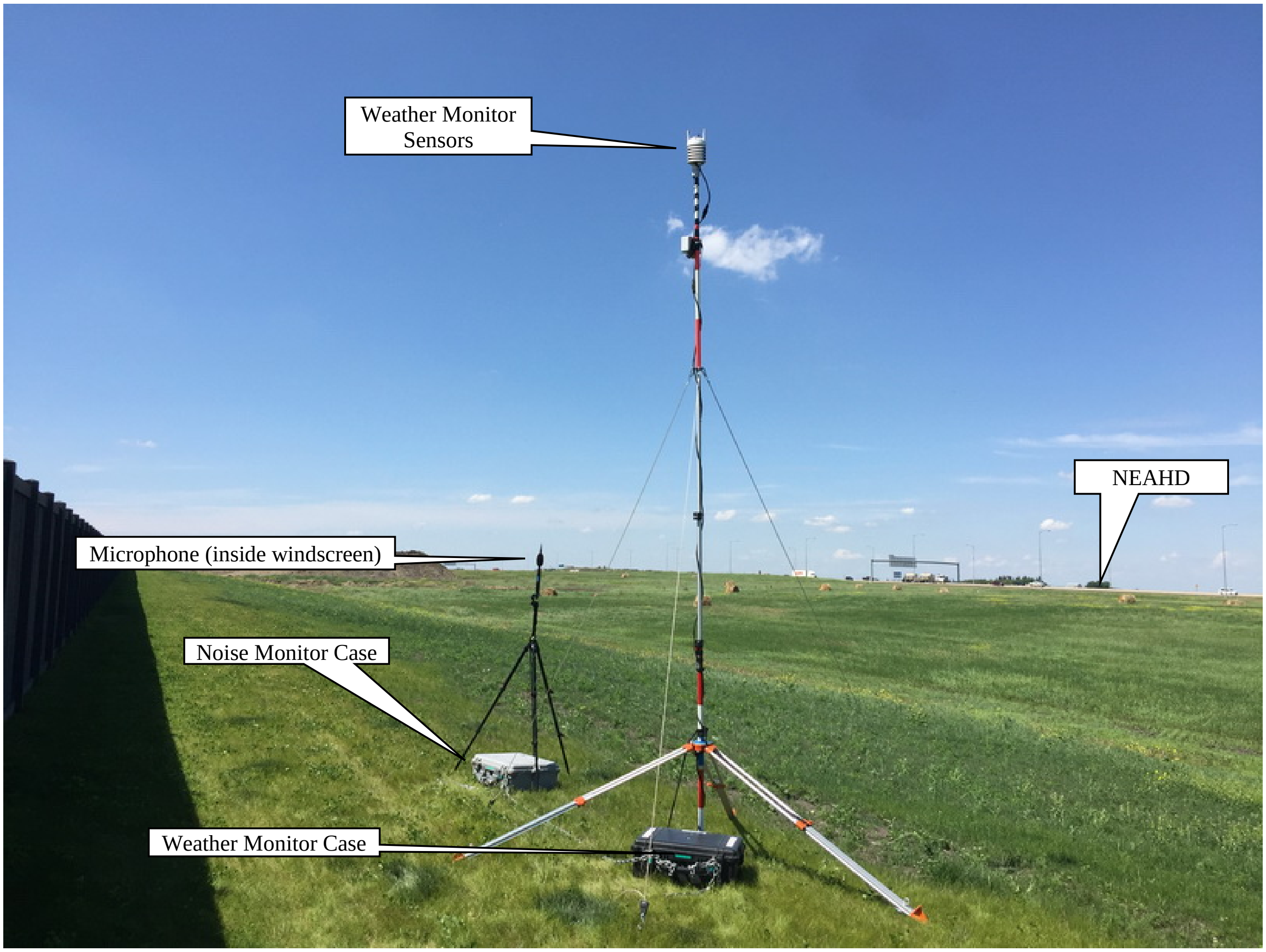

Figure 16. Noise Monitor at Location 15

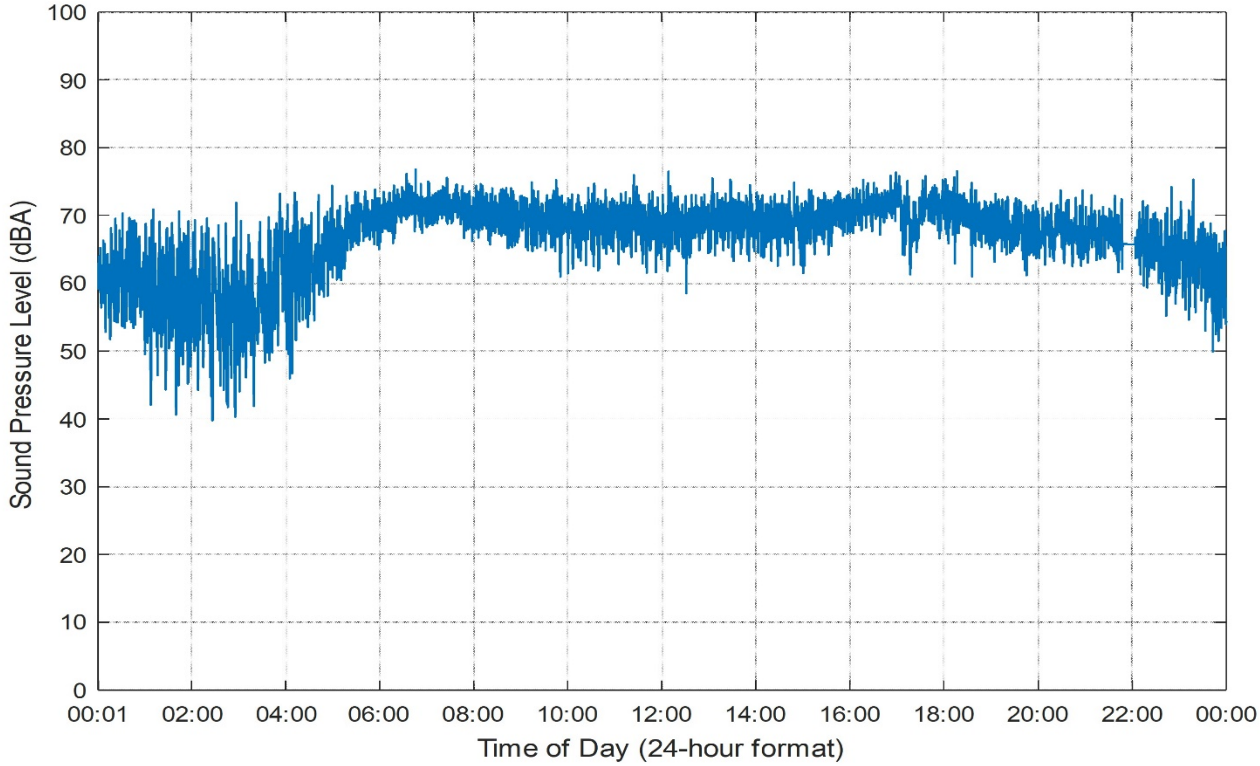

Figure 17. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Monitor Location 1

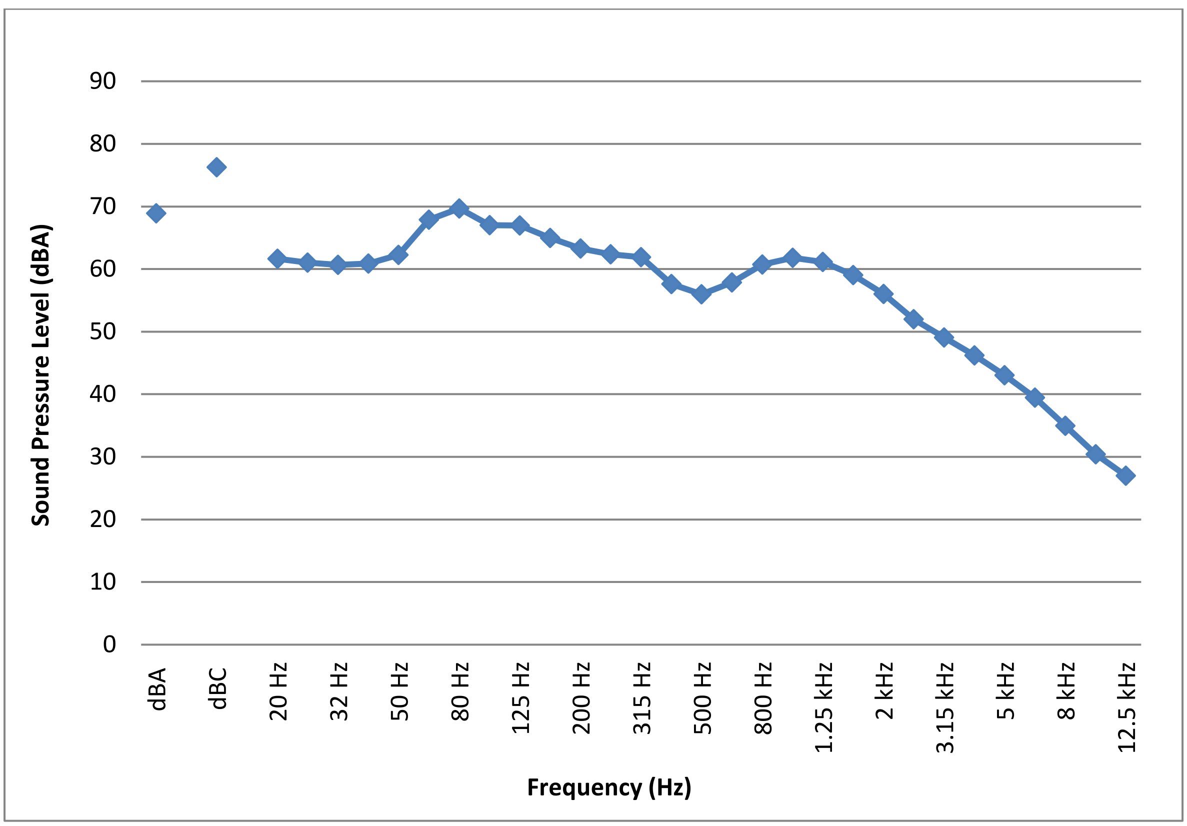

Figure 18. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location 1

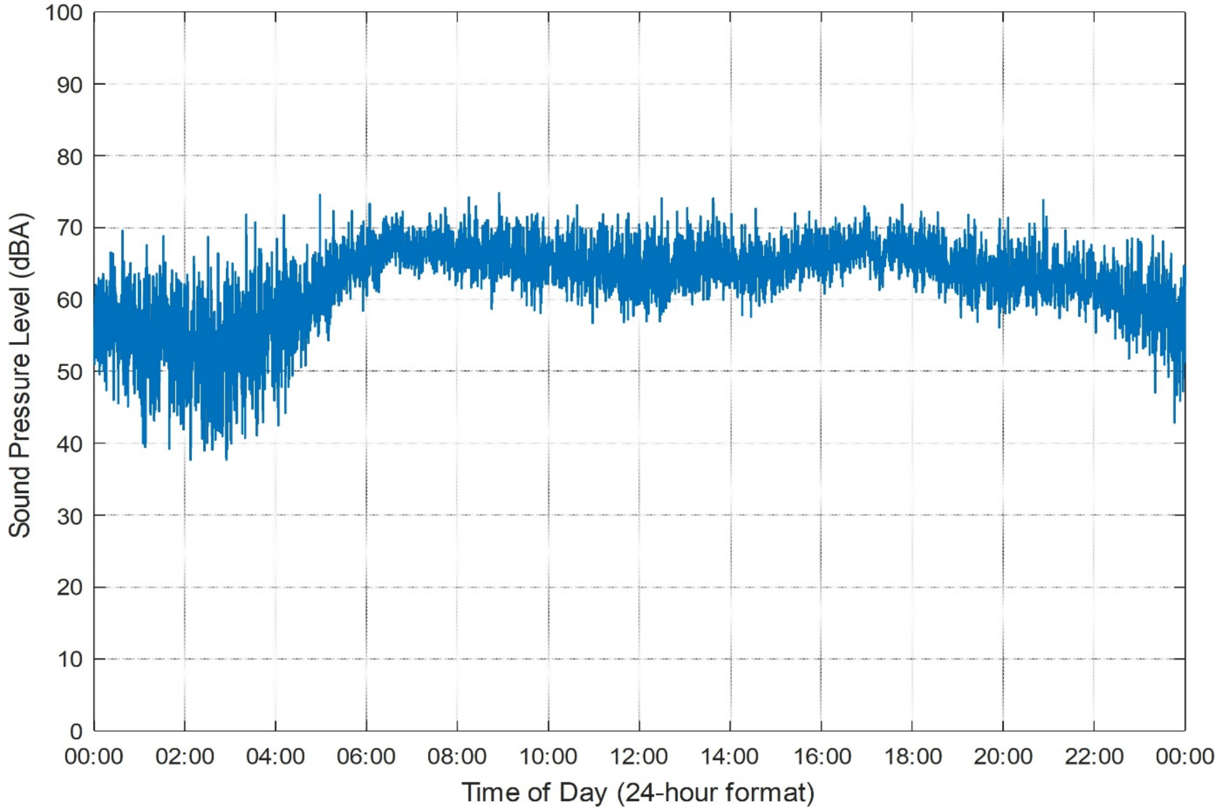

Figure 19. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Monitor Location 2

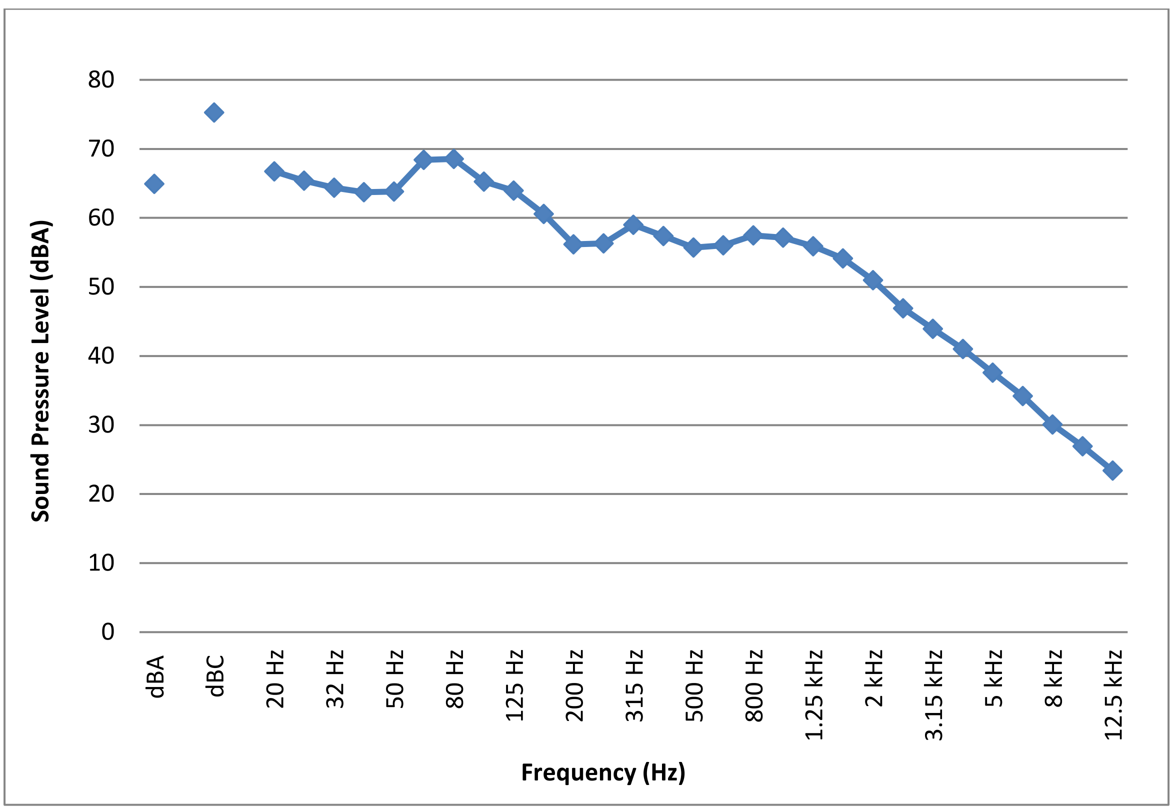

Figure 20. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location 2

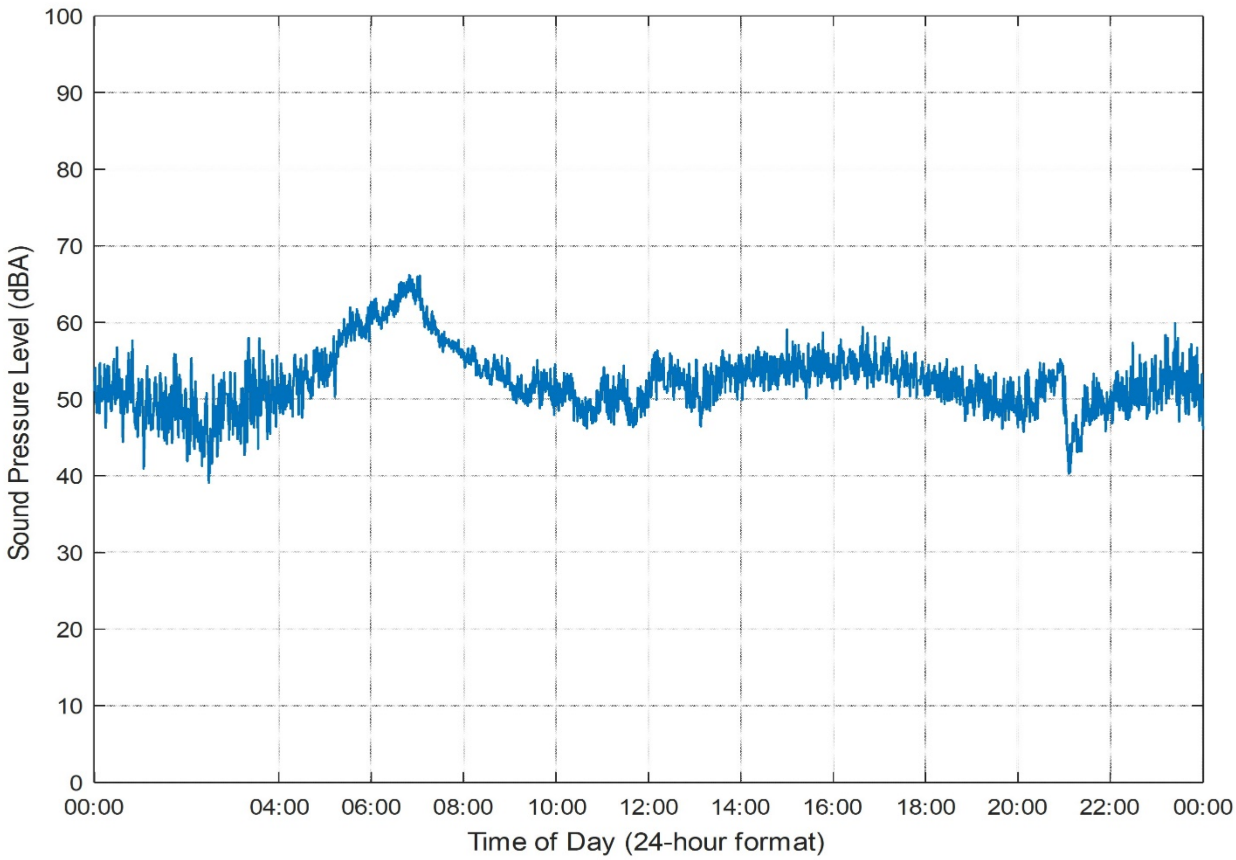

Figure 21. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Monitor Location 3

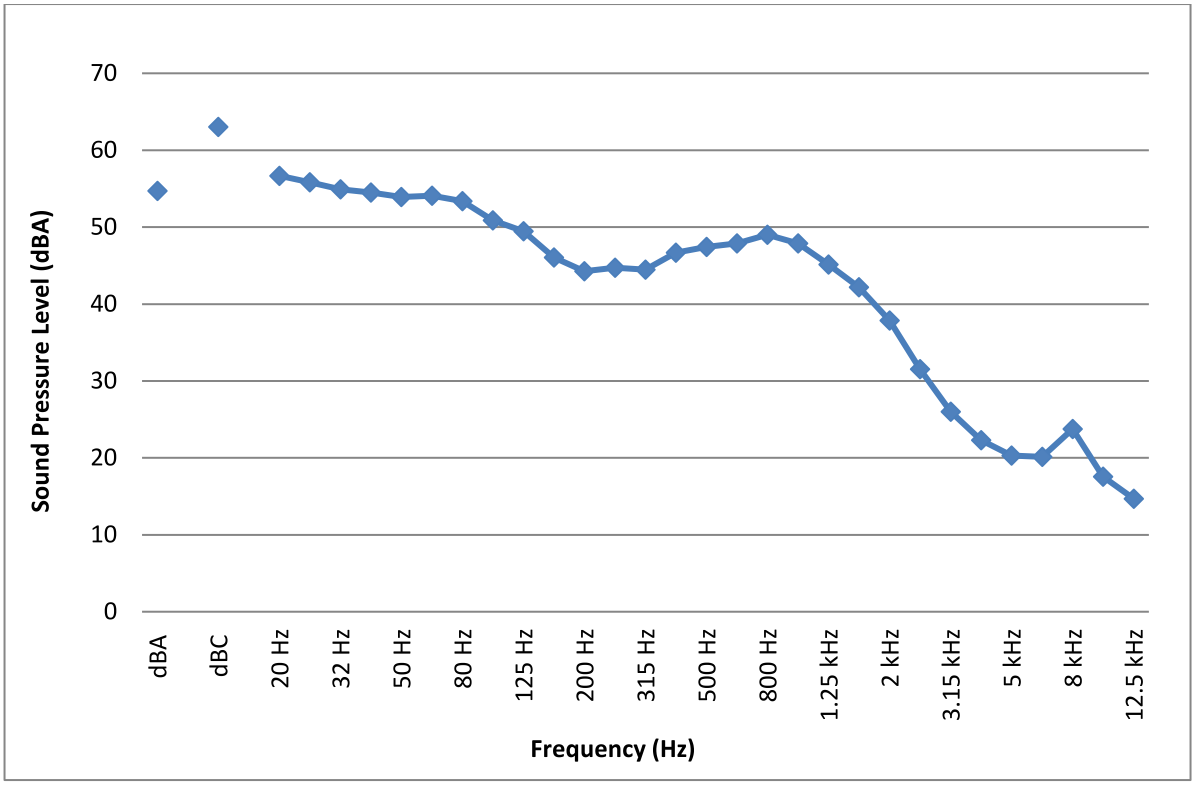

Figure 22. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location 3

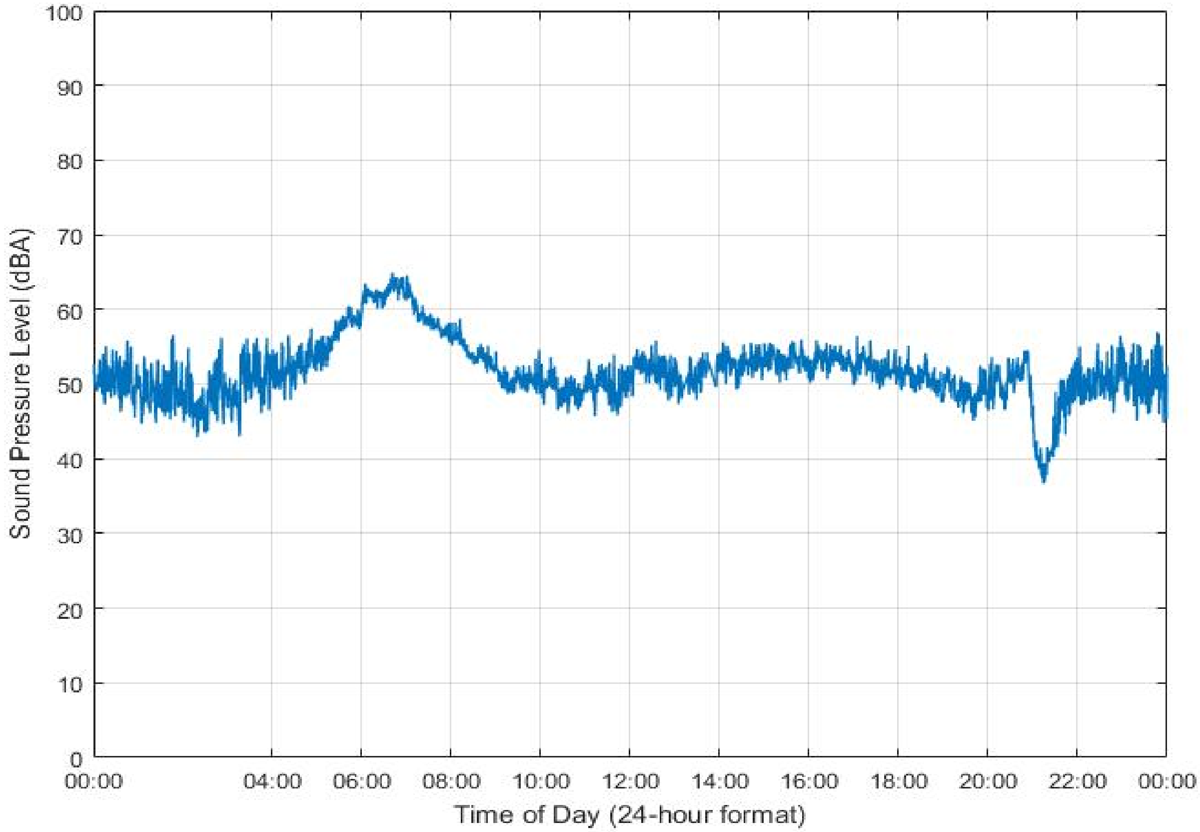

Figure 23. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Monitor Location 4

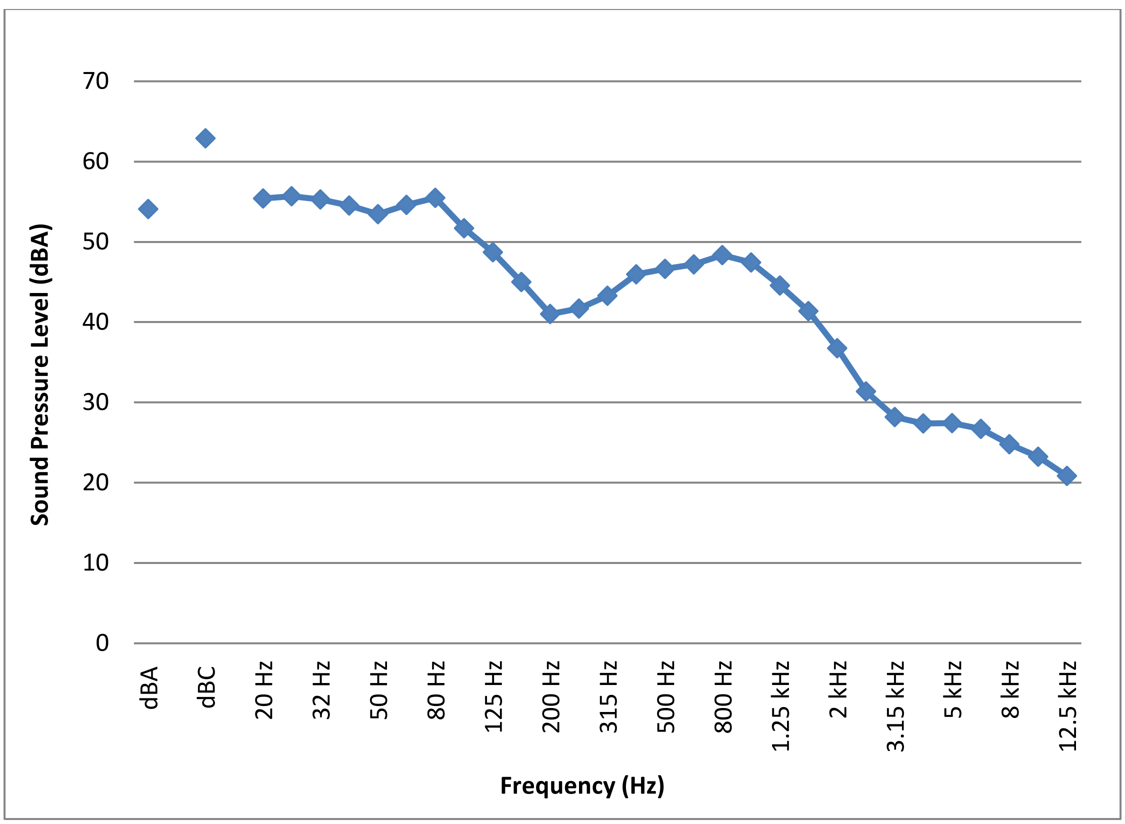

Figure 24. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location 4

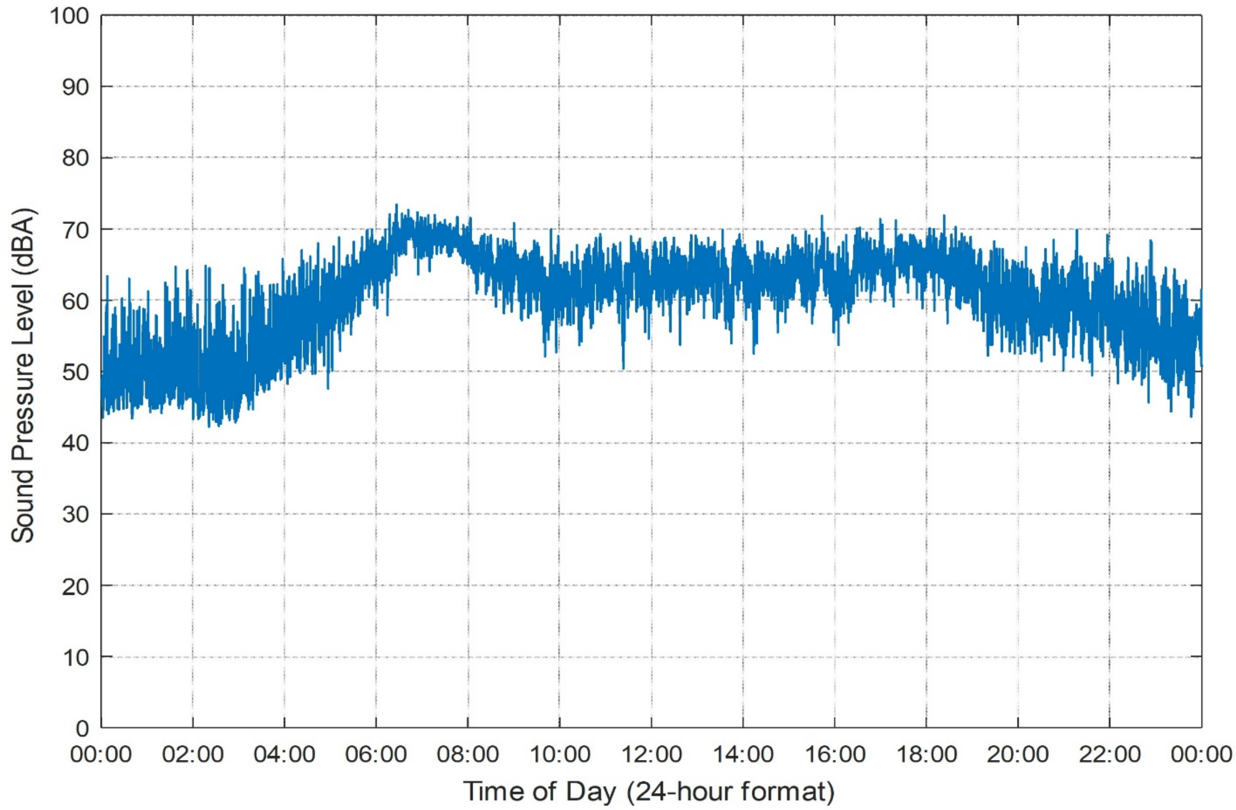

Figure 25. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Monitor Location 5

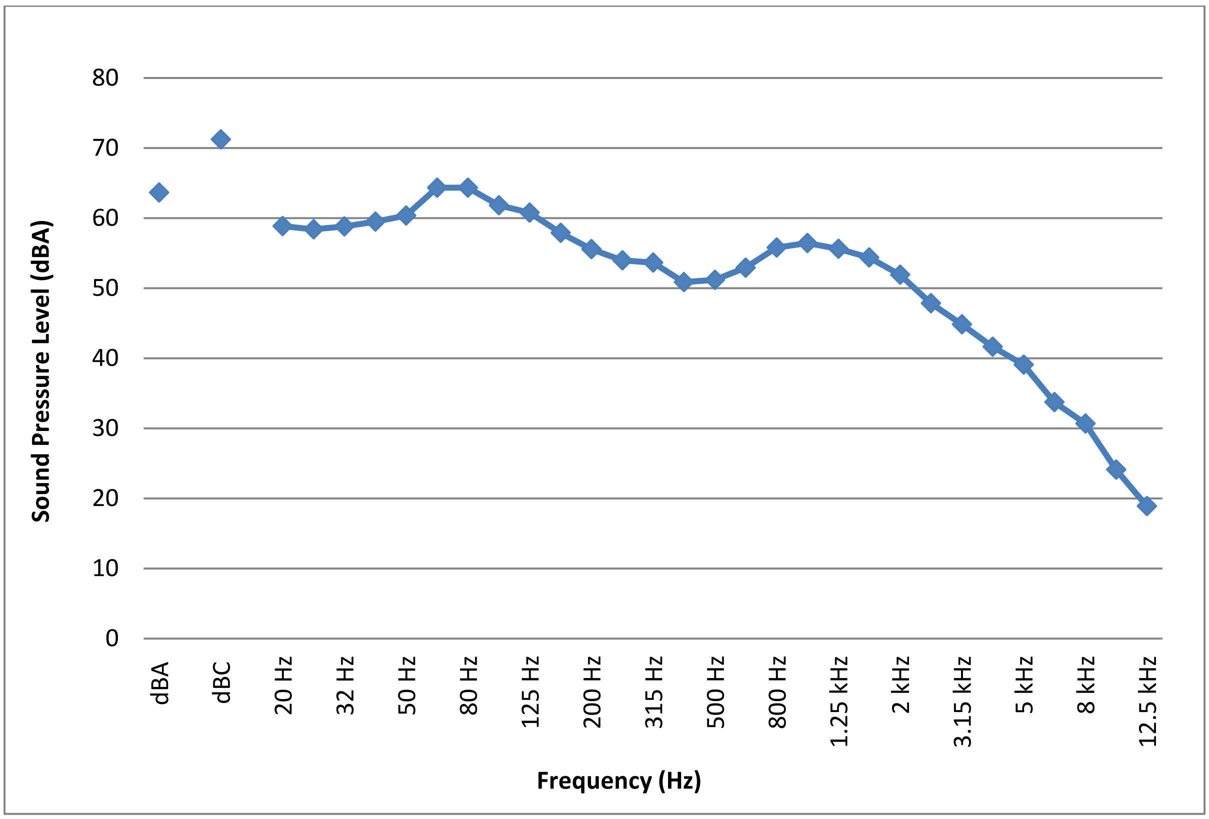

Figure 26. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location 5

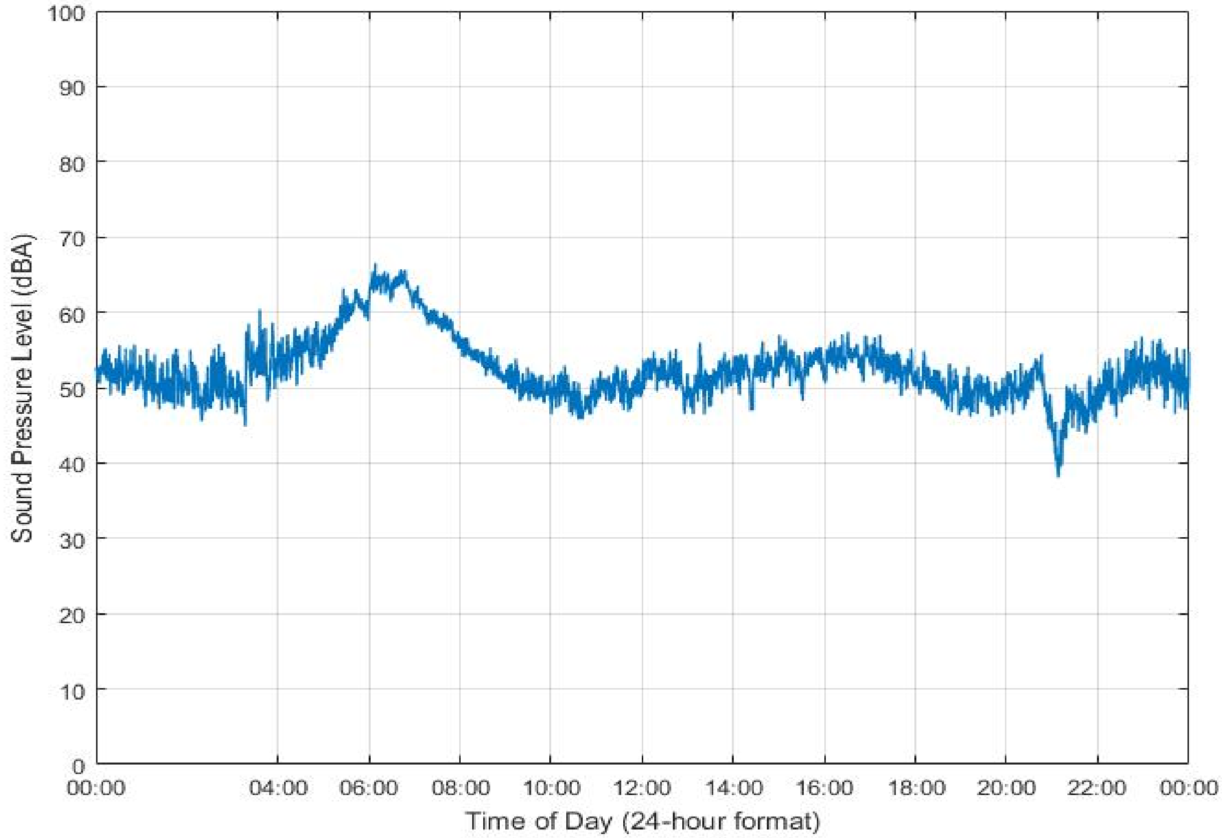

Figure 27. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Monitor Location 6

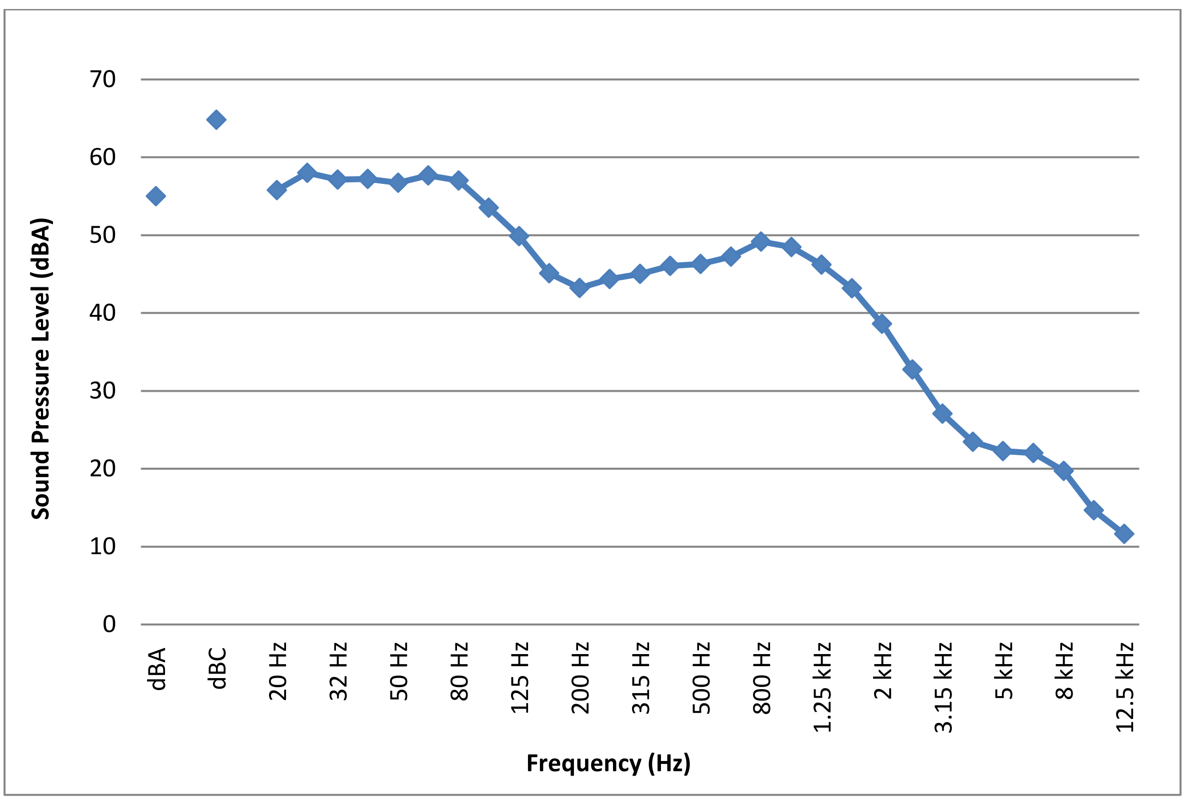

Figure 28. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location 6

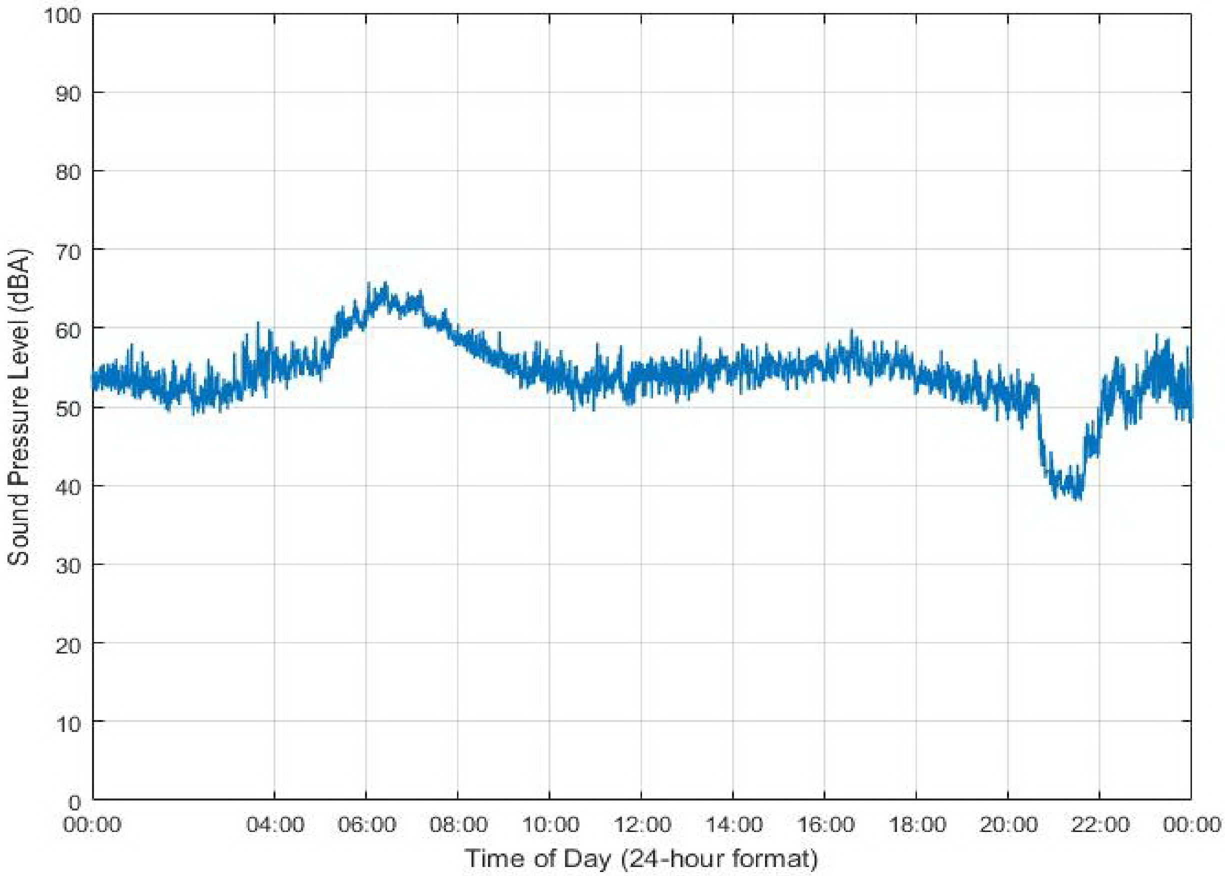

Figure 29. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Monitor Location 7

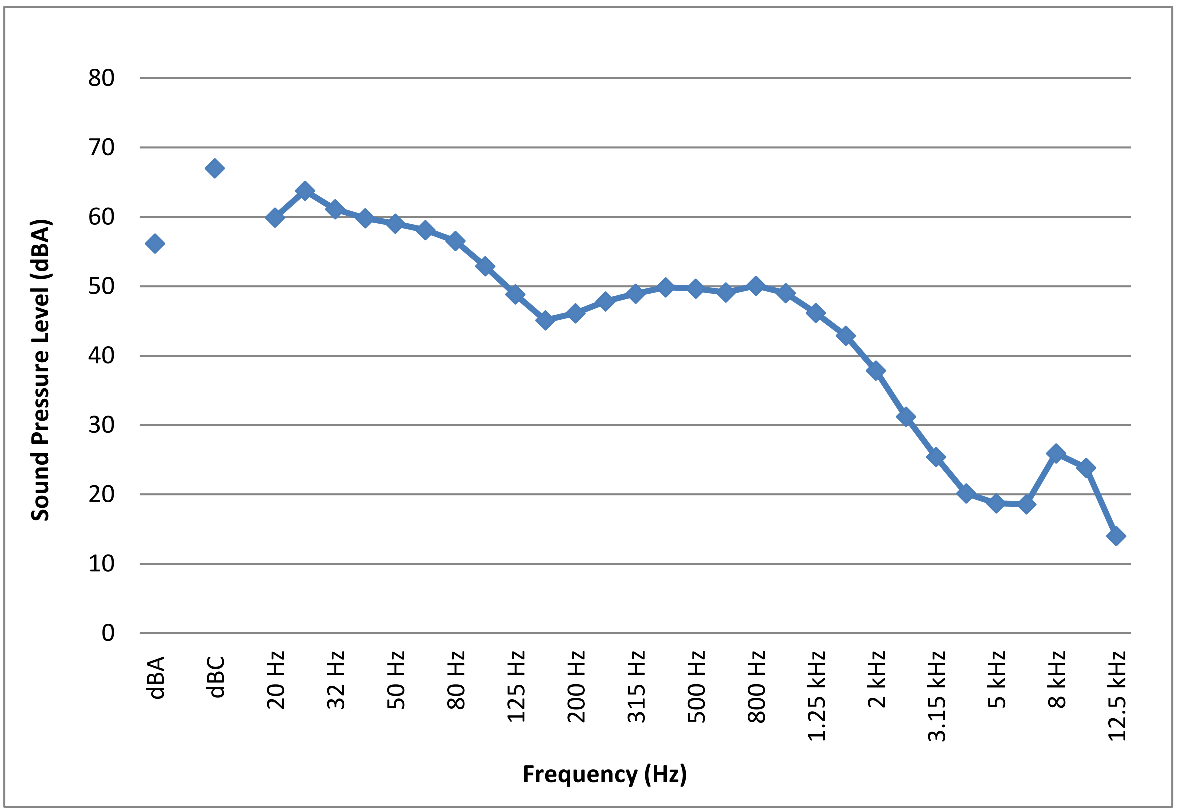

Figure 30. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location 7

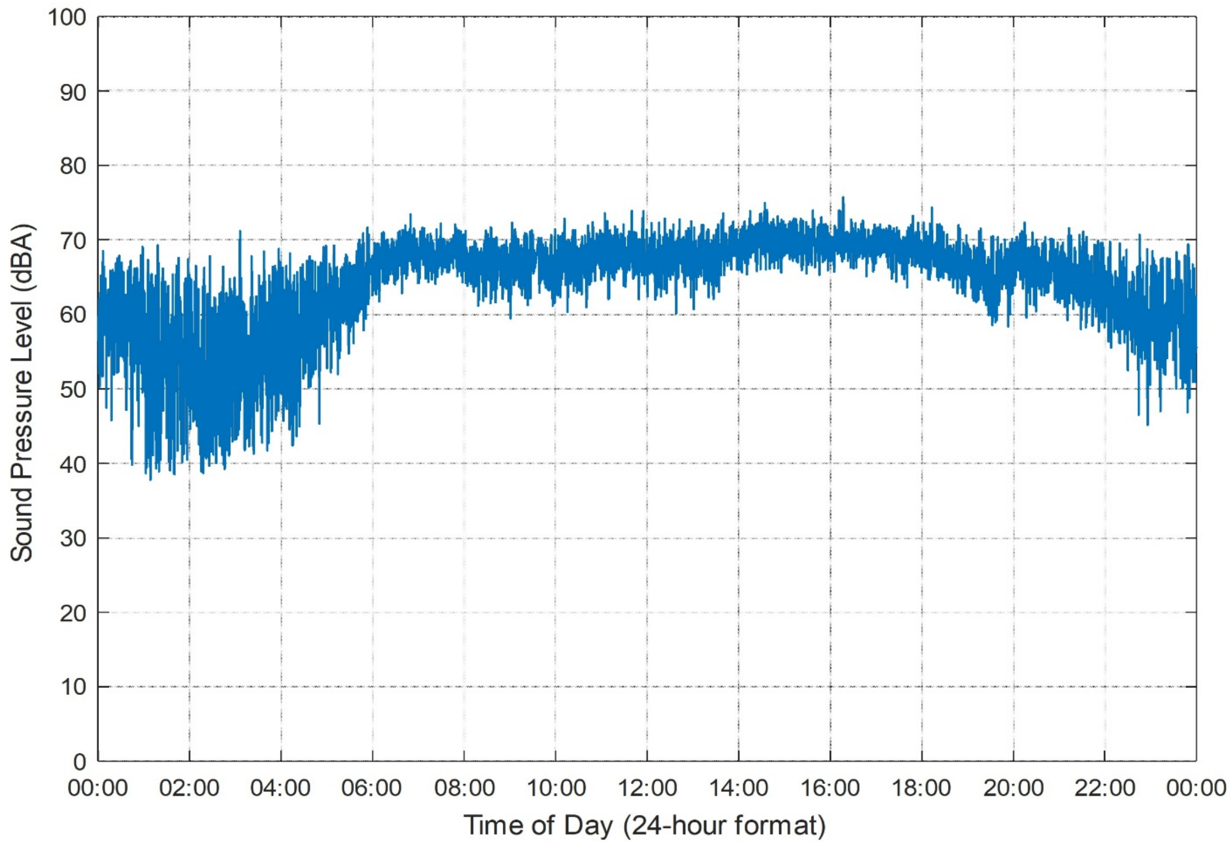

Figure 31. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Monitor Location 9

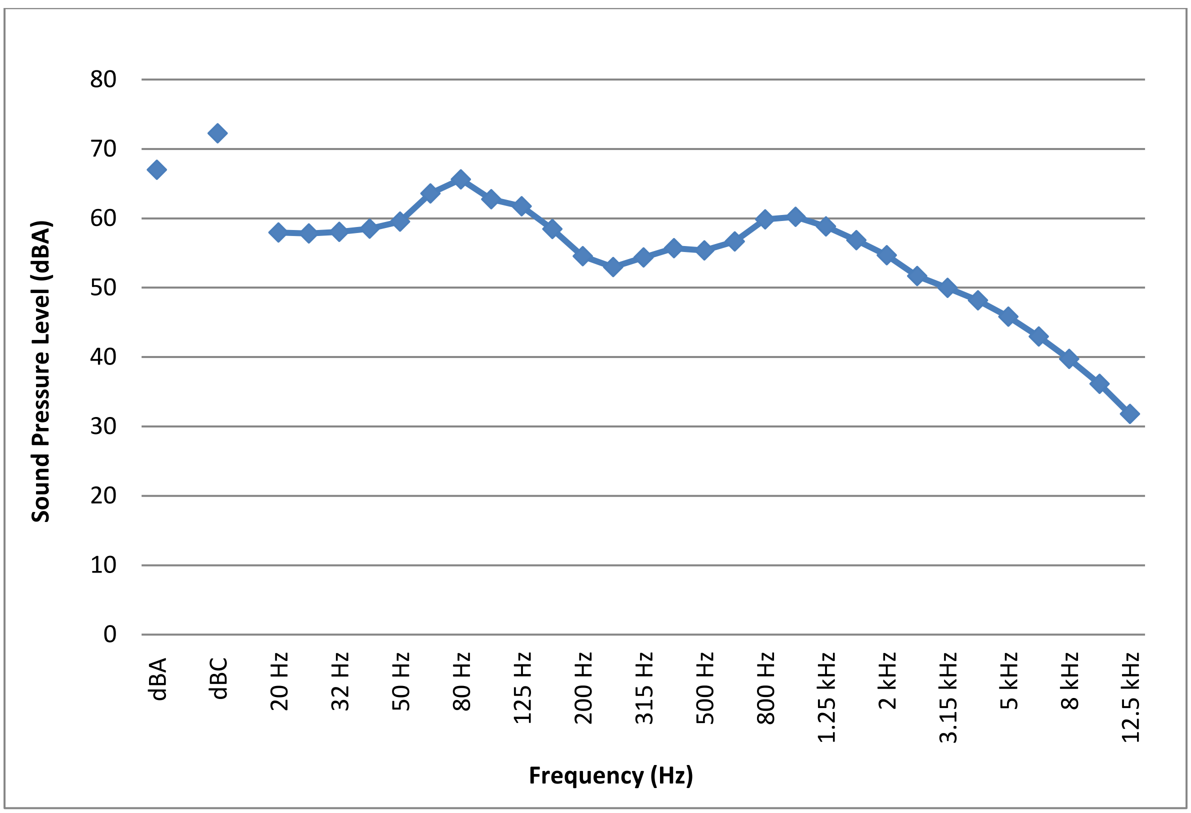

Figure 32. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location 9

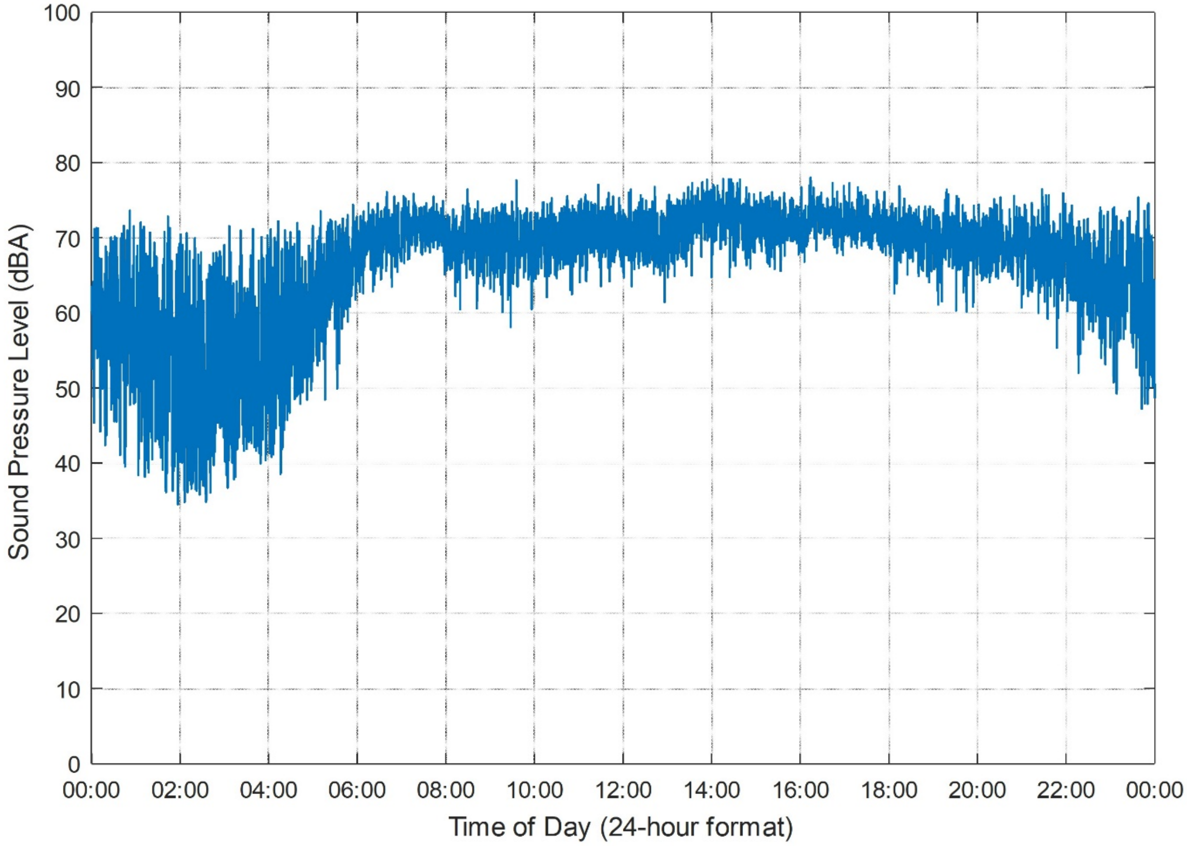

Figure 33. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Monitor Location 10

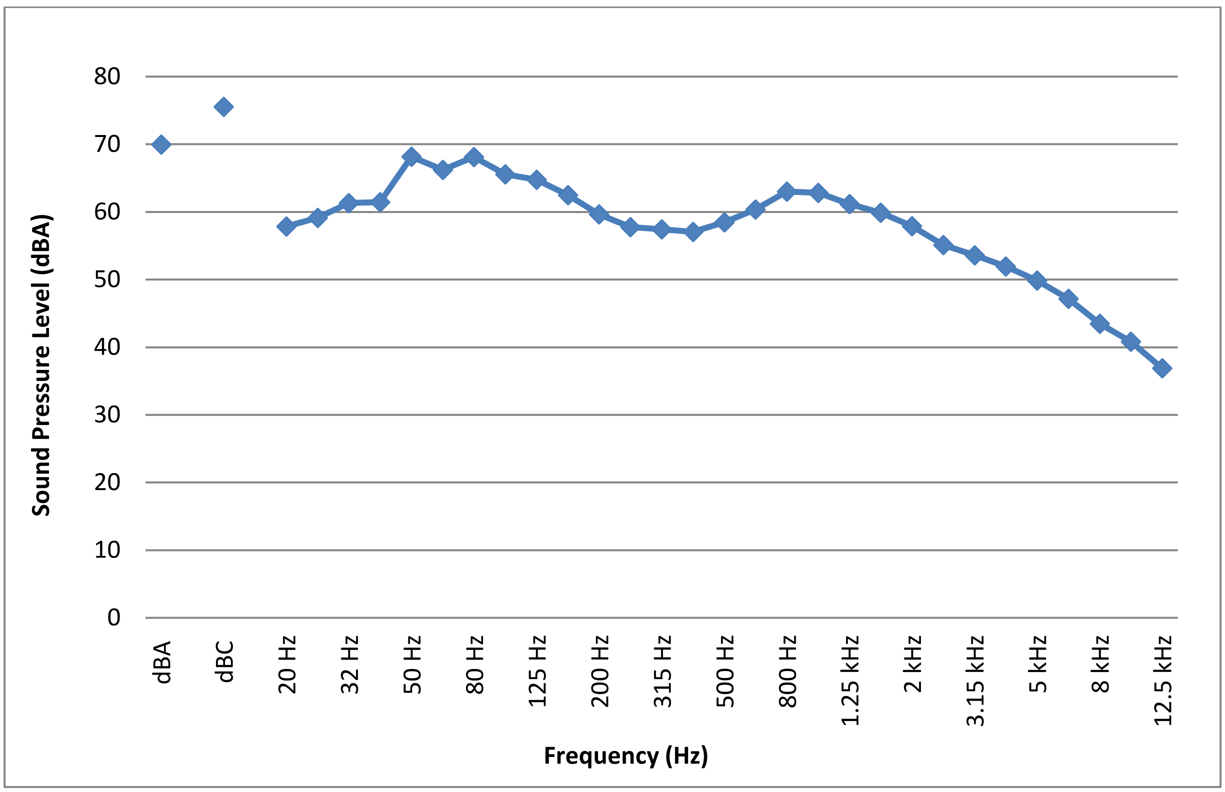

Figure 34. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location 10

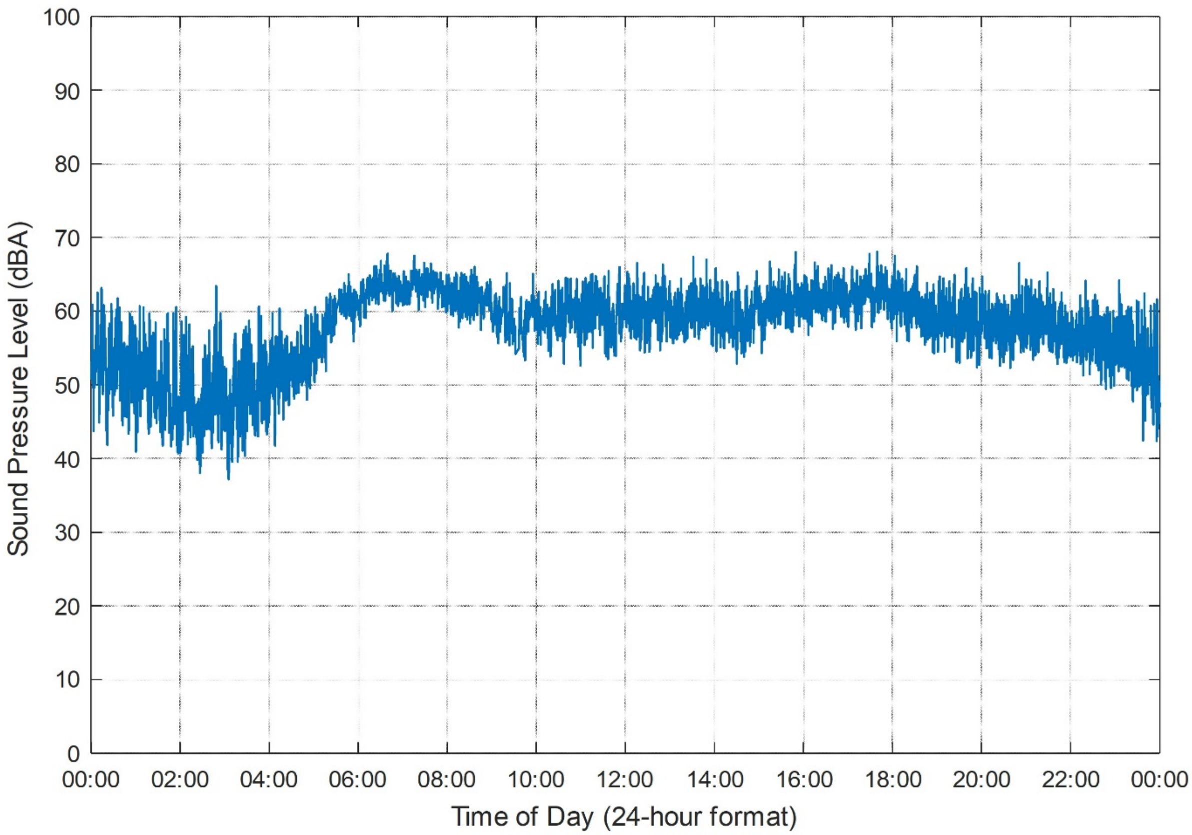

Figure 35. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Monitor Location 11

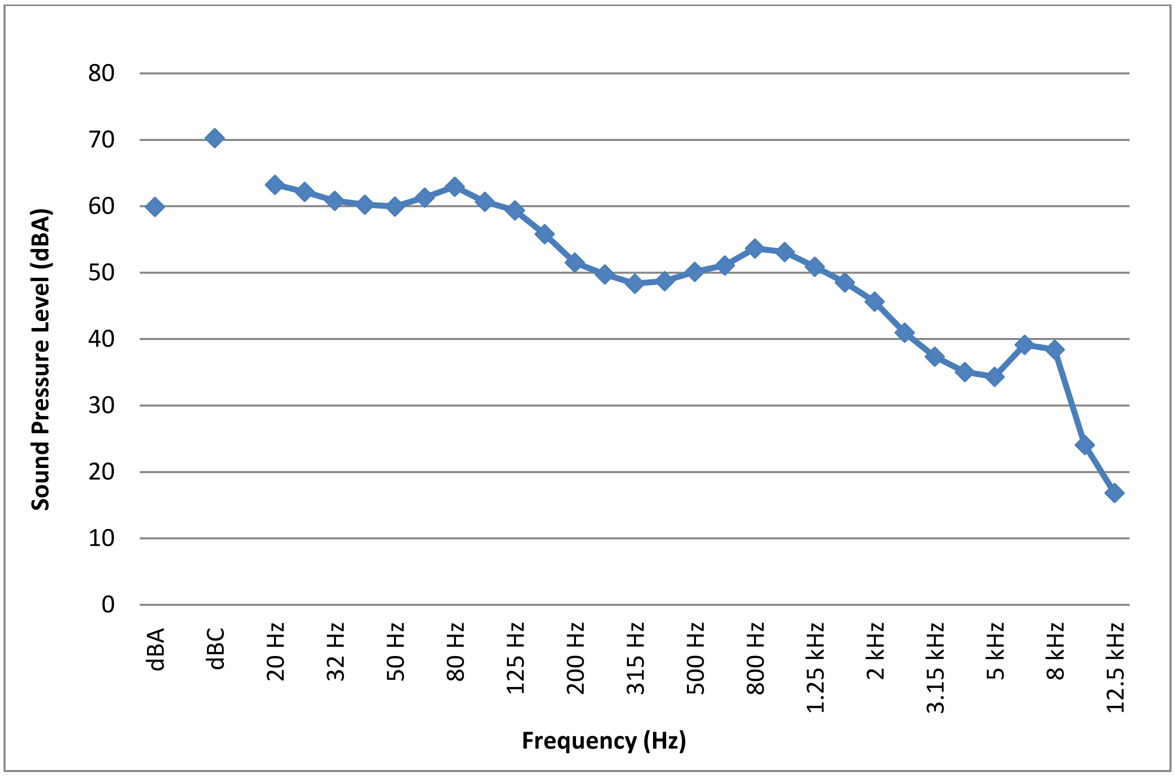

Figure 36. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location 11

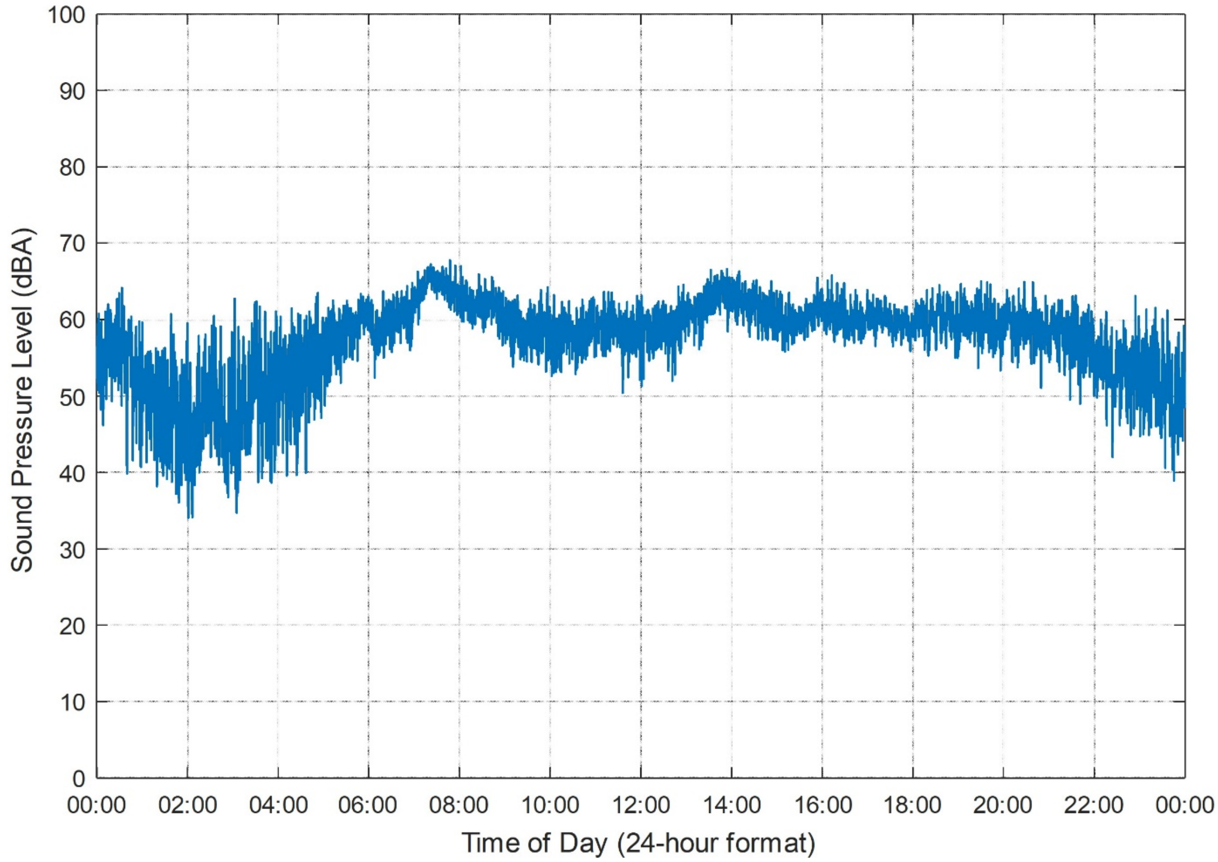

Figure 37. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Monitor Location 12

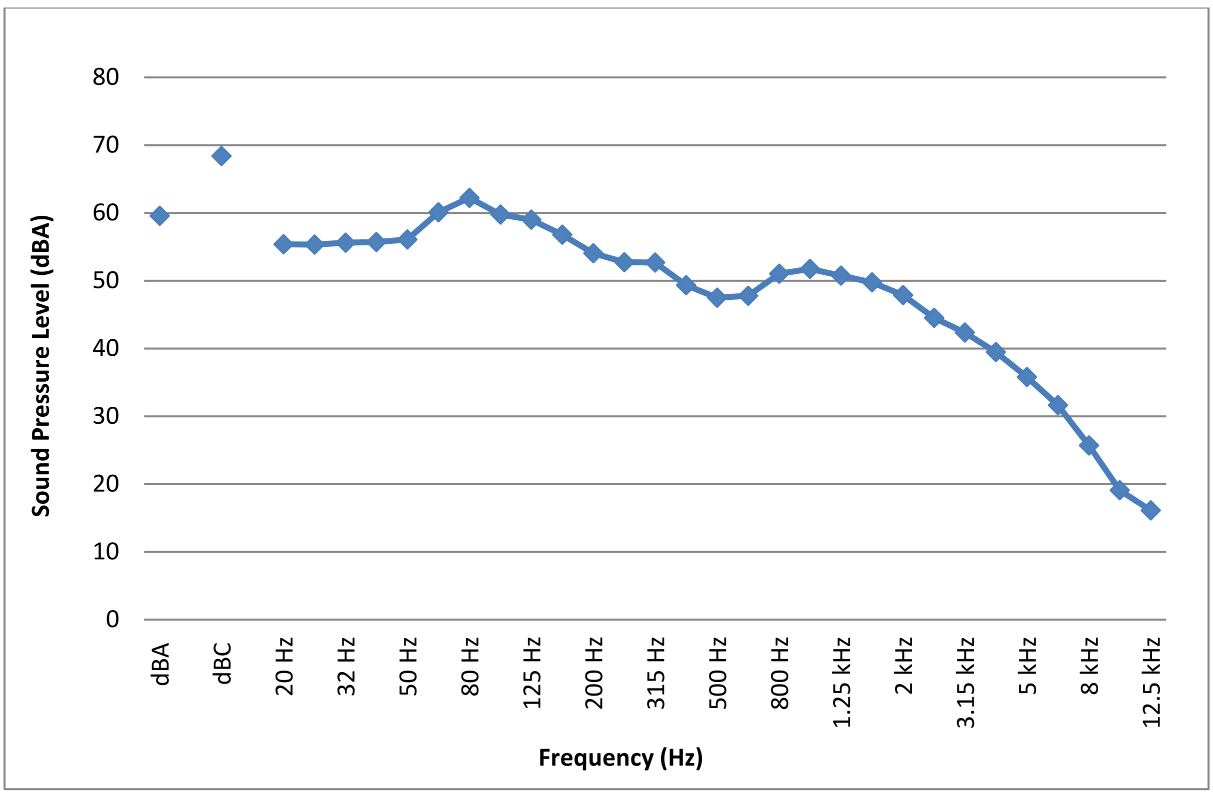

Figure 38. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location 12

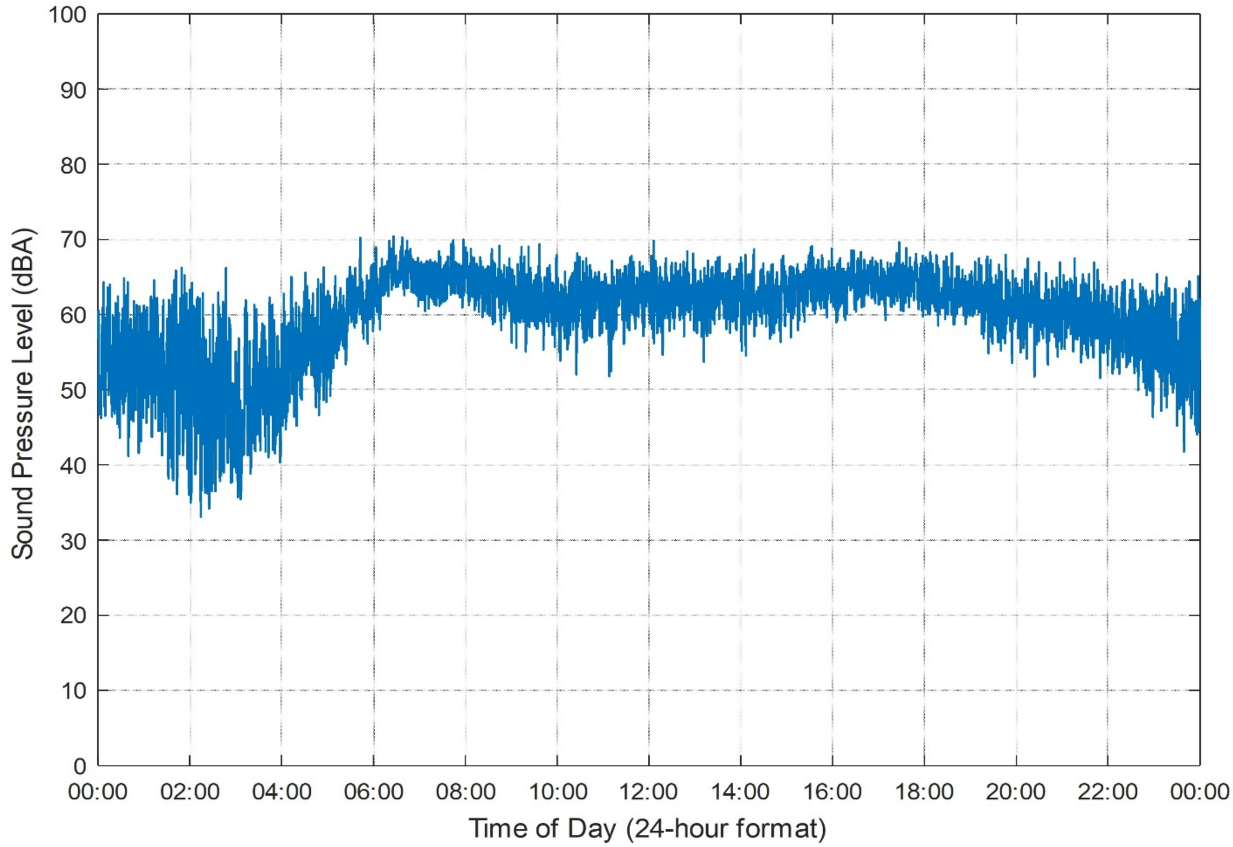

Figure 39. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Monitor Location 13

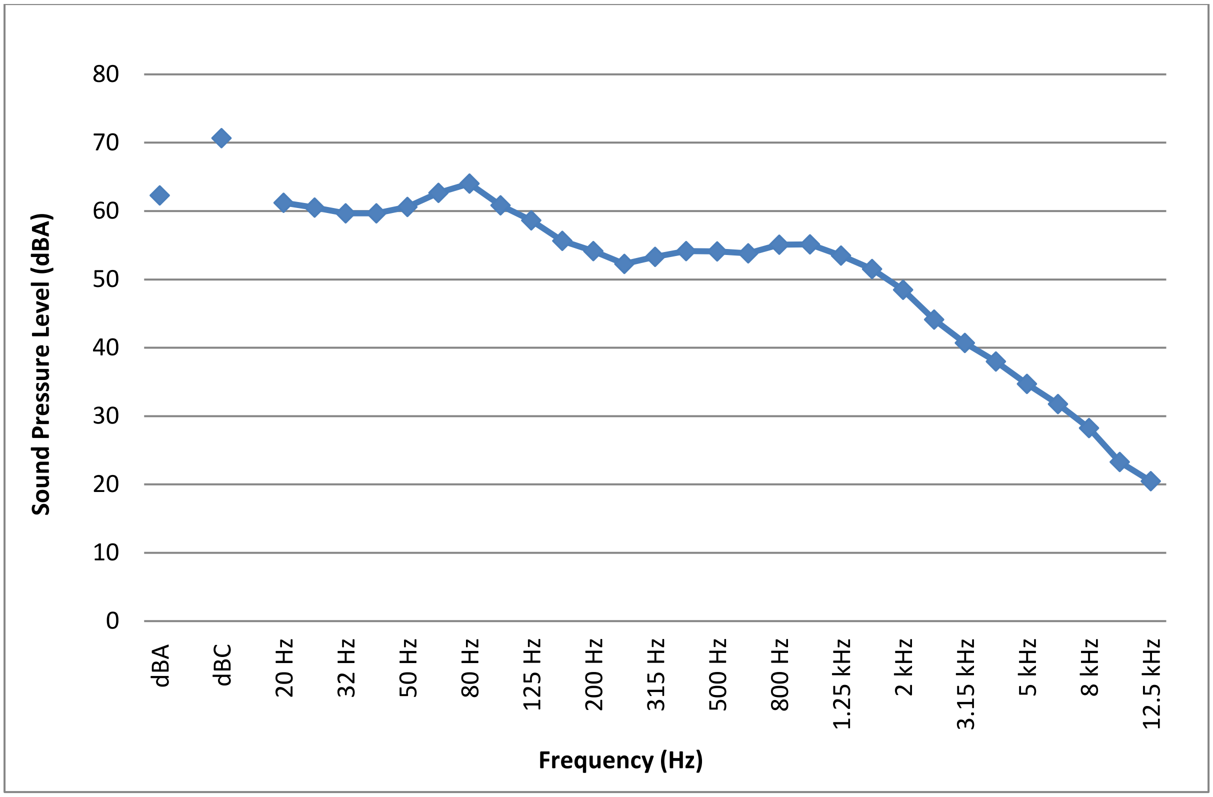

Figure 40. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location 13

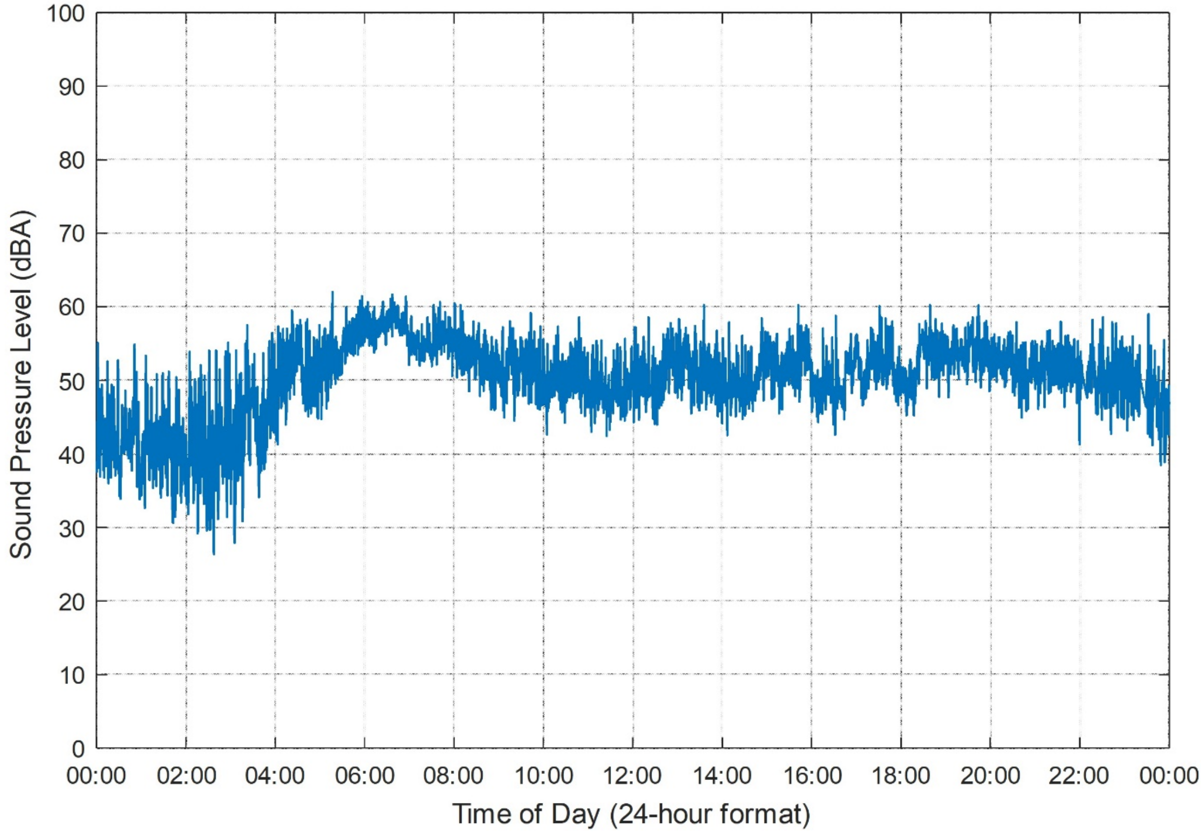

Figure 41. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Monitor Location 14

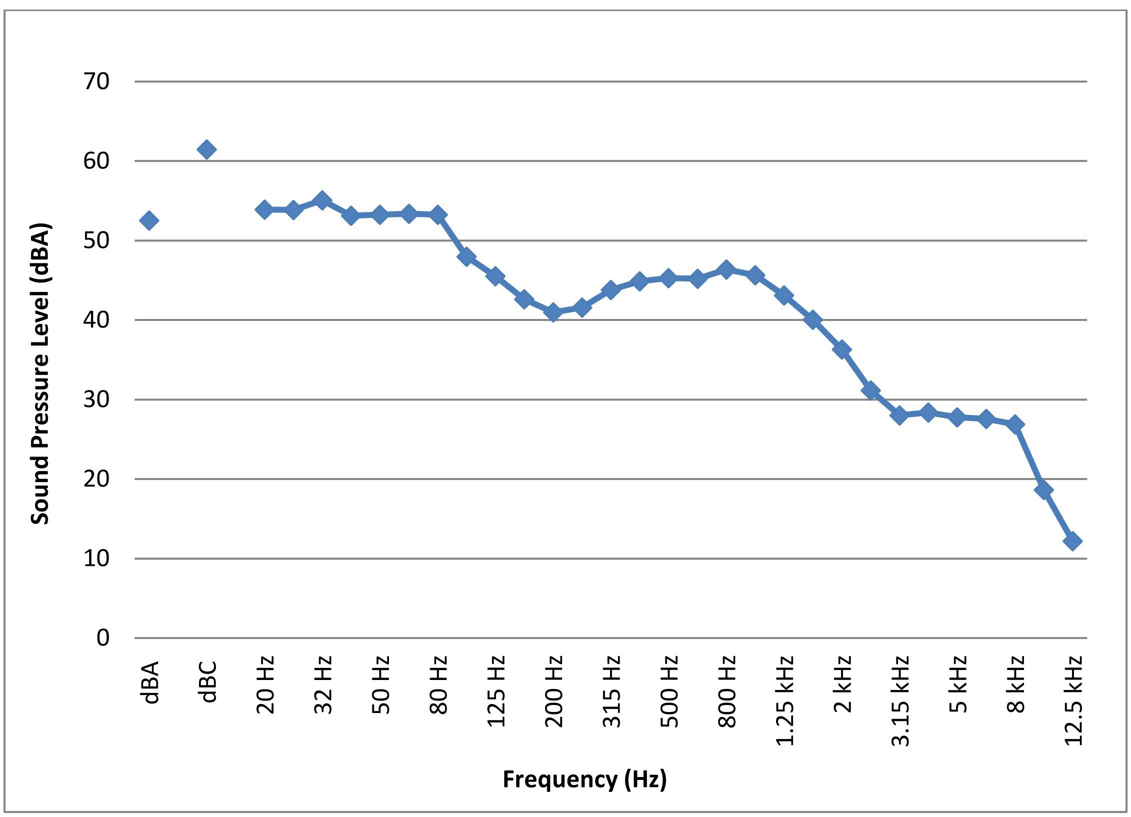

Figure 42. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location 14

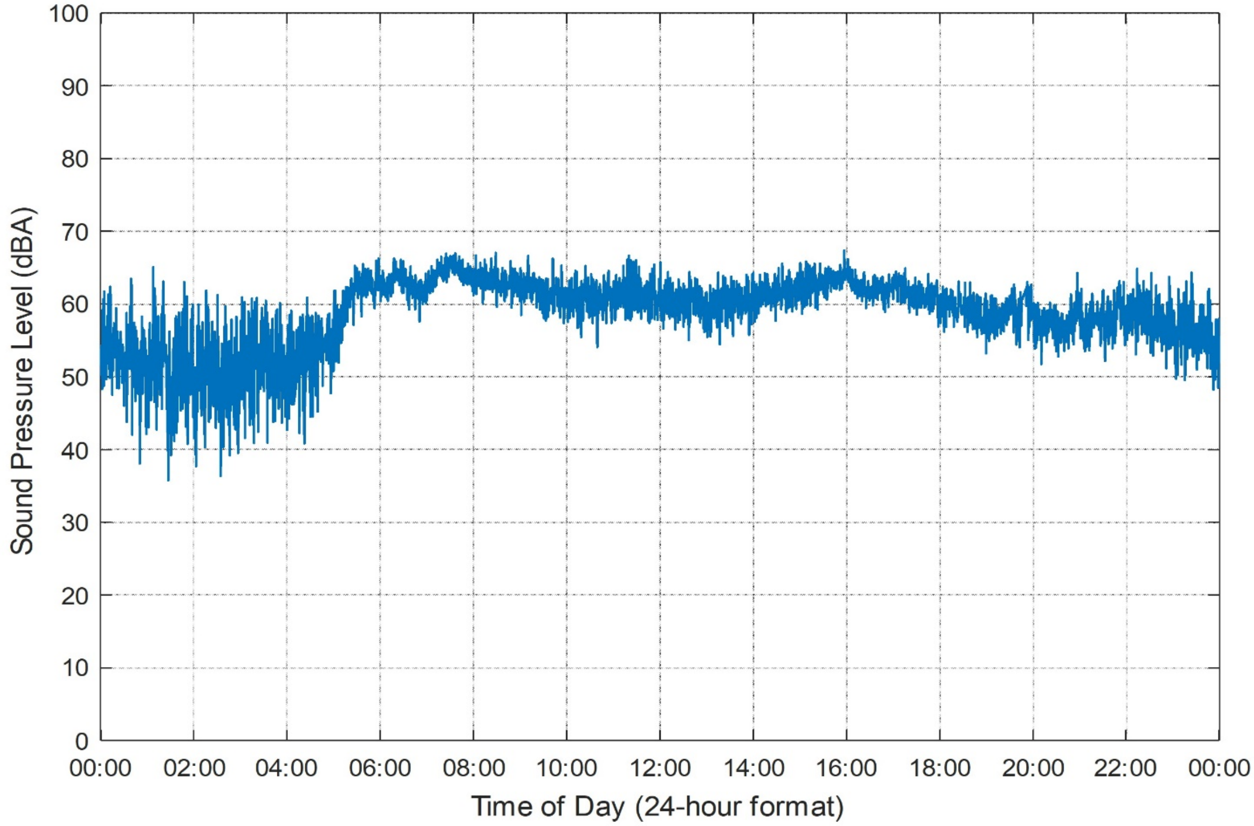

Figure 43. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Monitor Location 15

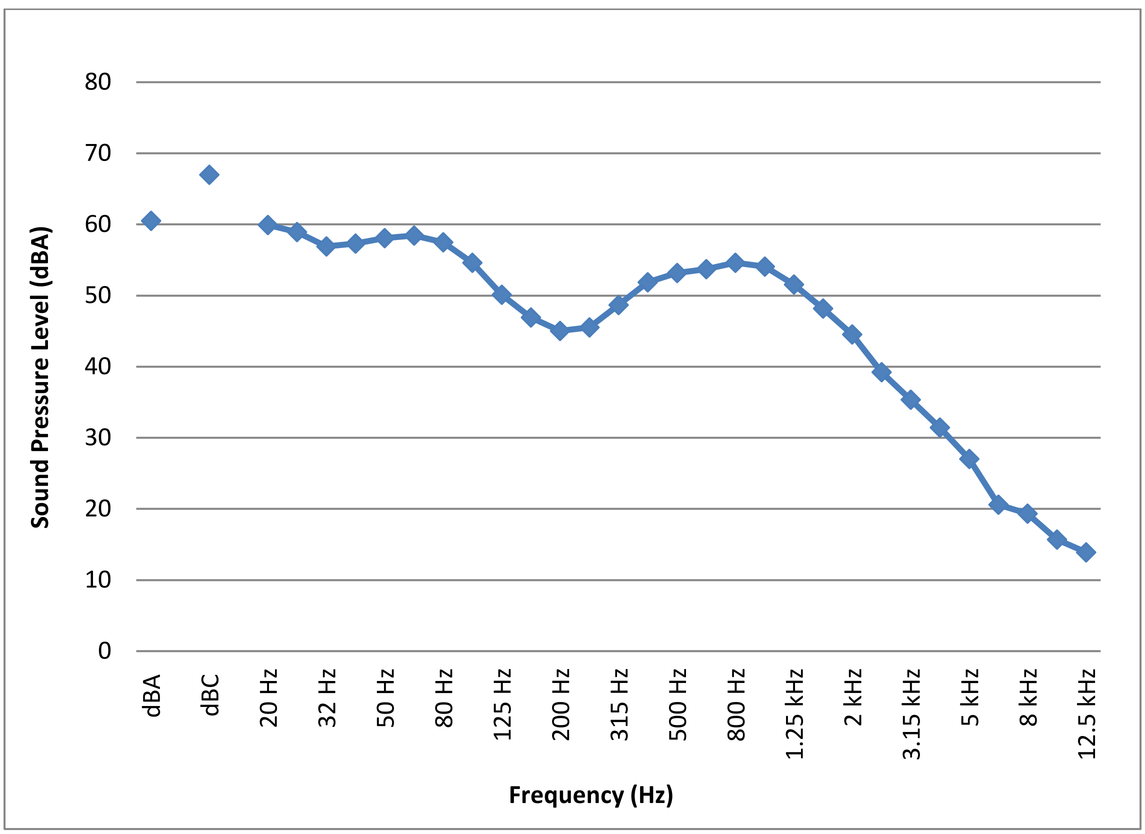

Figure 44. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location 15

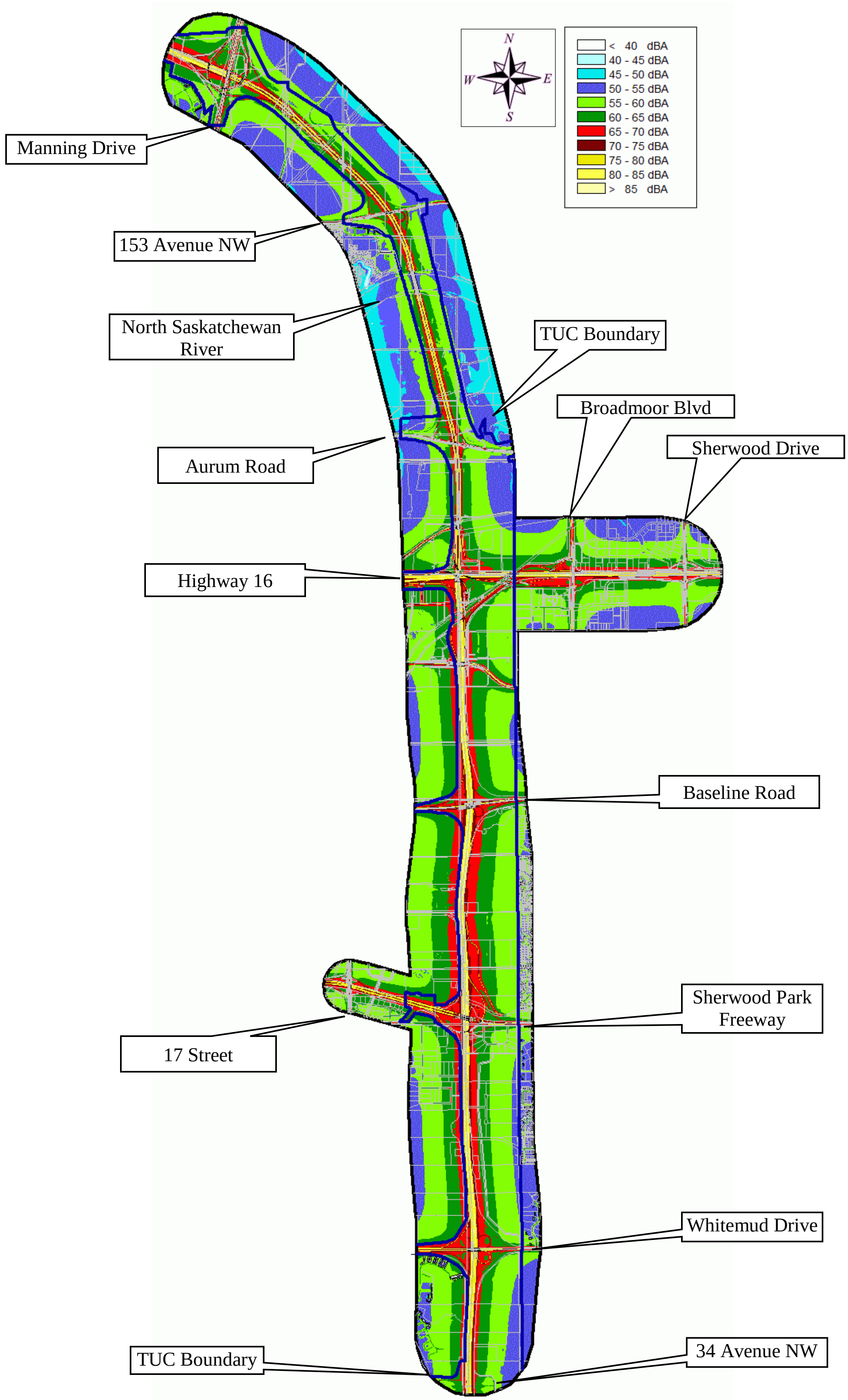

Figure 45a. Current Conditions L_{eq}24 Sound Levels for Entire Study Area

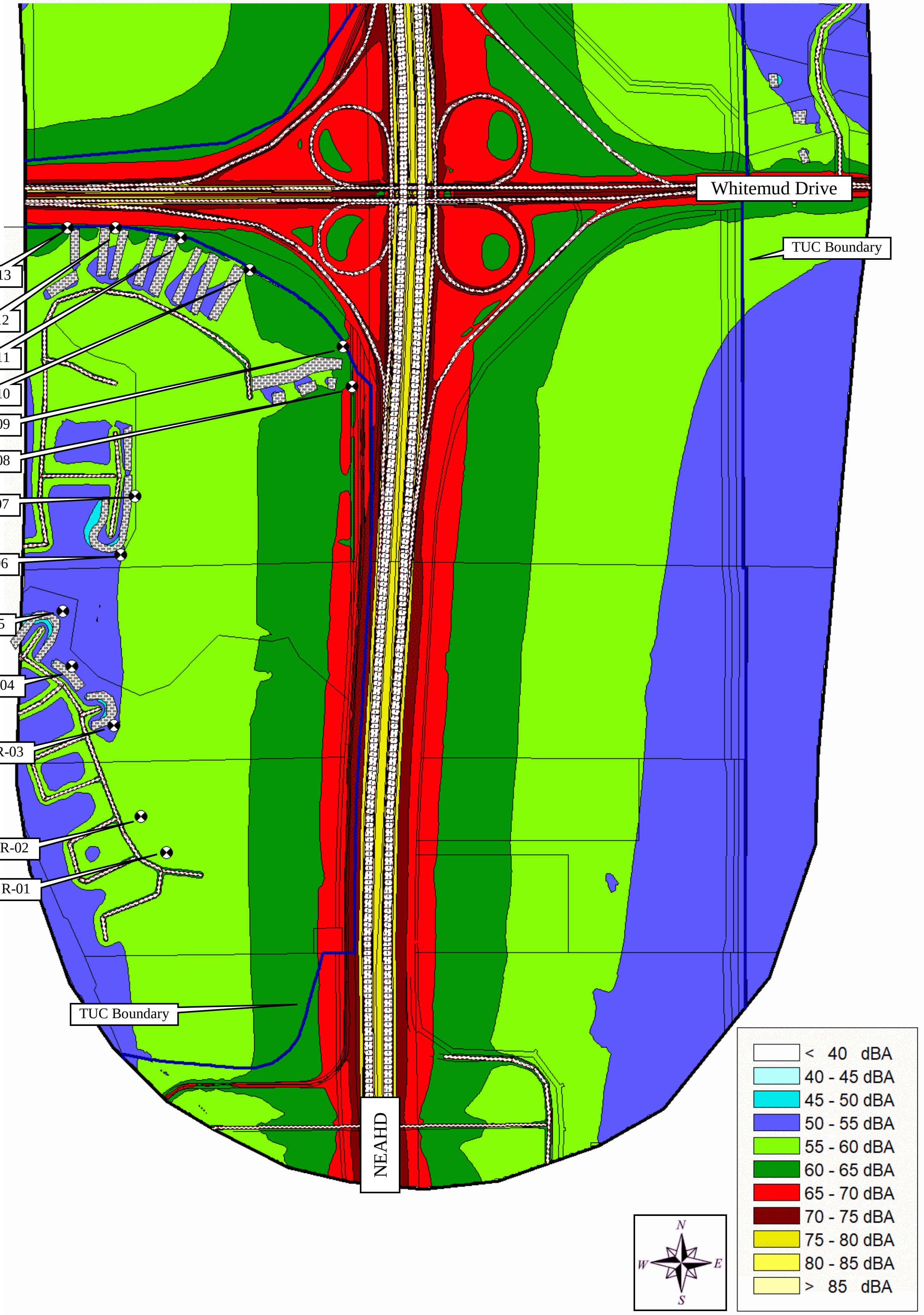

Figure 45b. Current Conditions L_{eq}24 Sound Levels (34 Avenue NW to Whitemud Drive)

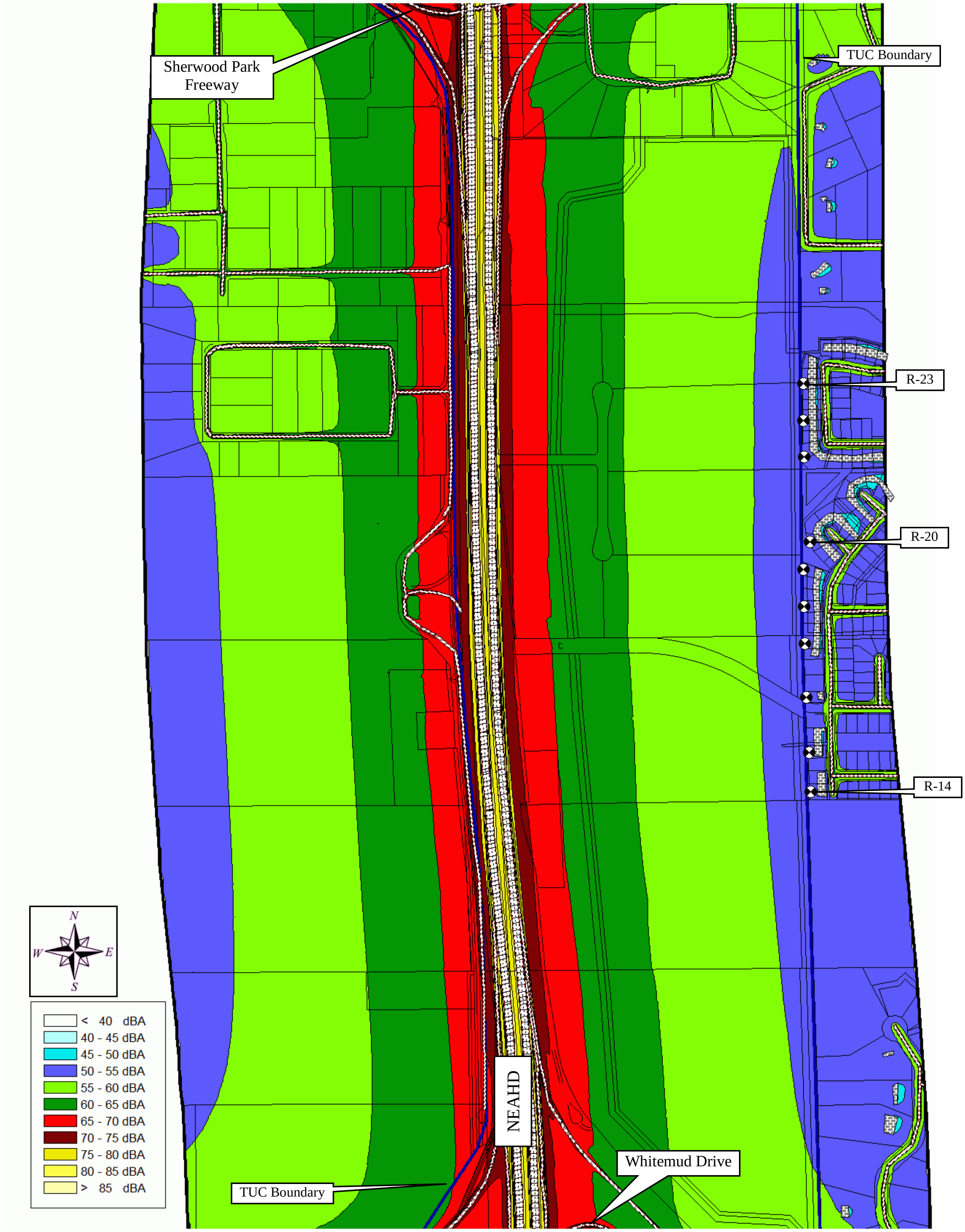

Figure 45c. Current Conditions L_{eq}24 Sound Levels (Whitemud Drive to Sherwood Park Freeway)

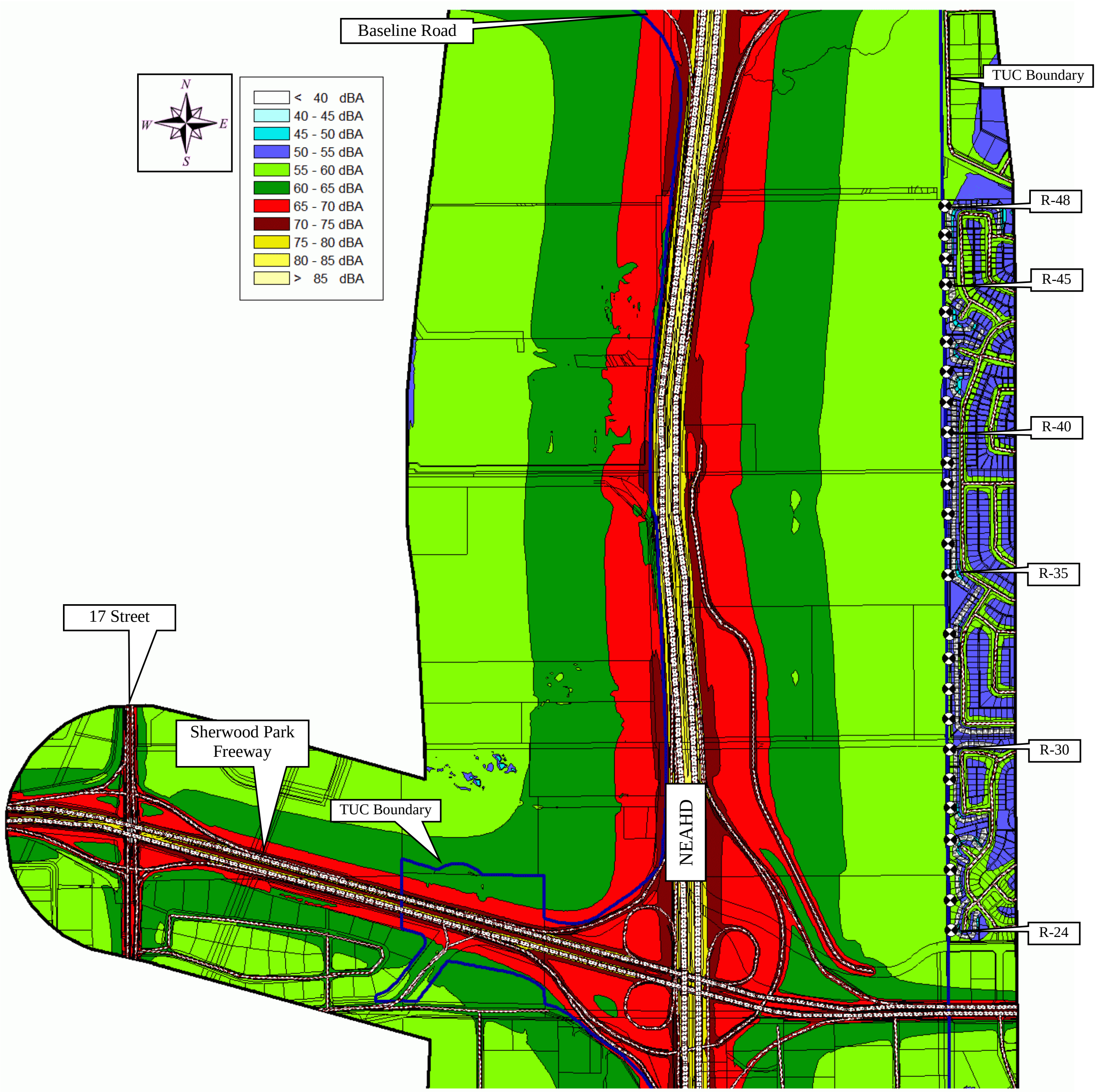

Figure 45d. Current Conditions L_{eq}24 Sound Levels (Sherwood Park Freeway to Baseline Road)

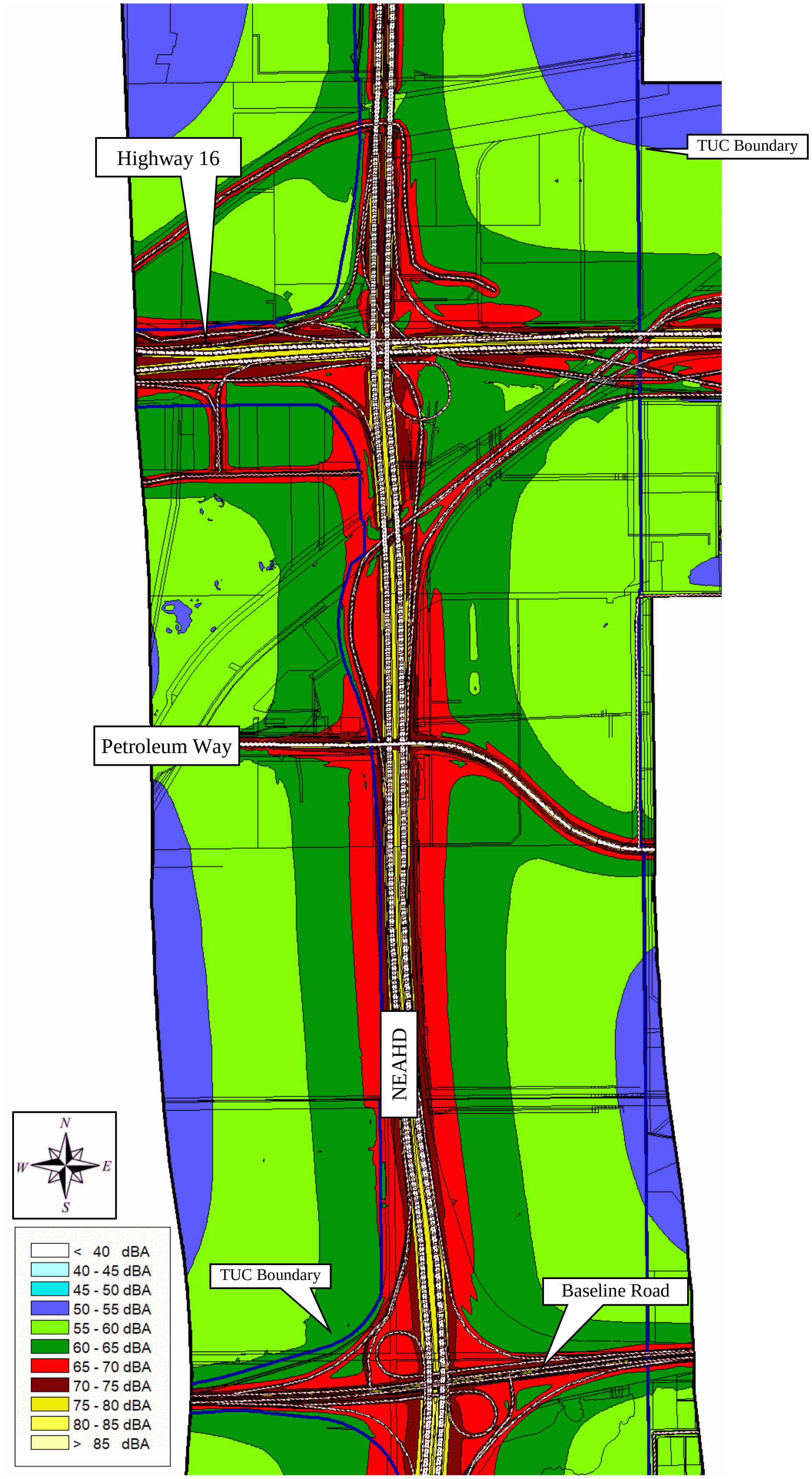

Figure 45e. Current Conditions L_{eq}24 Sound Levels (Baseline Road to Highway 16)

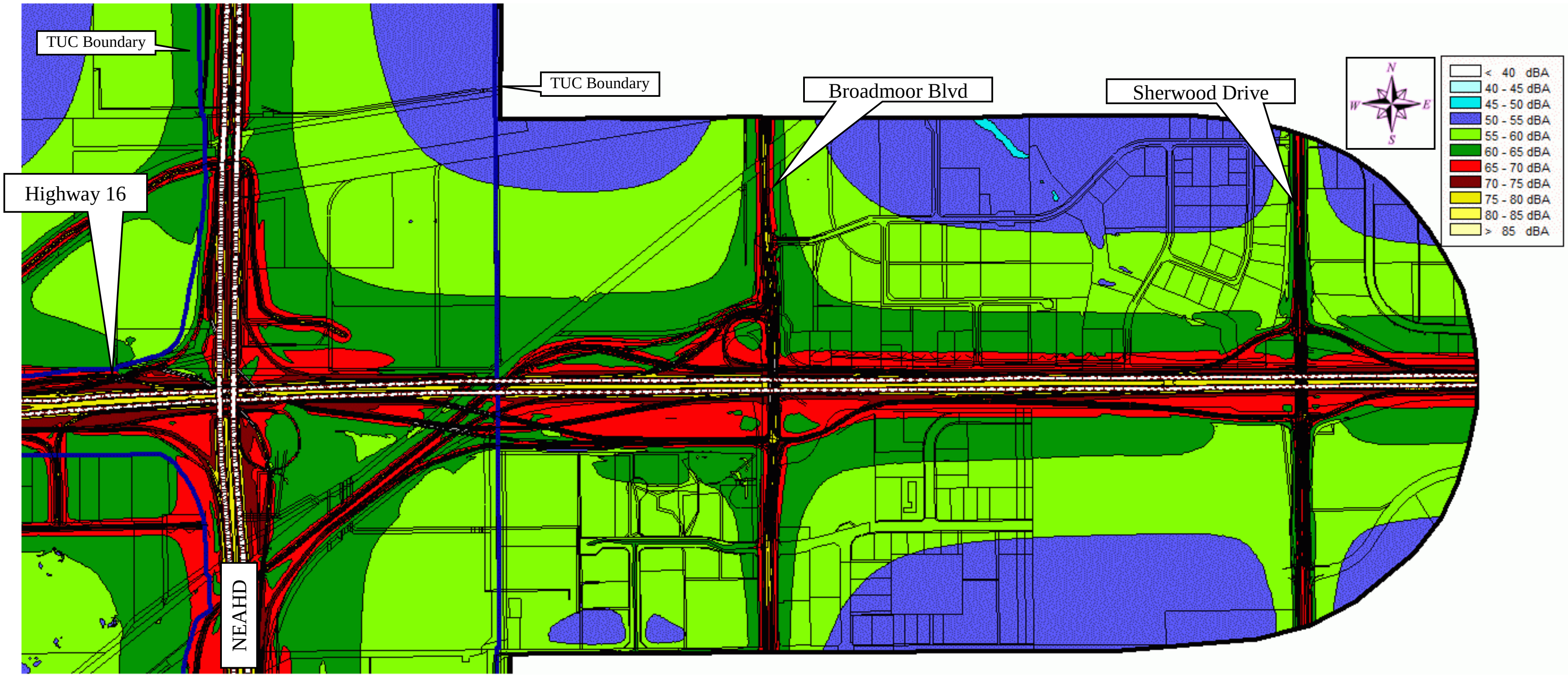

Figure 45f. Current Conditions L_{eq}24 Sound Levels (Highway 16 – Broadmoor Blvd to Sherwood Drive)

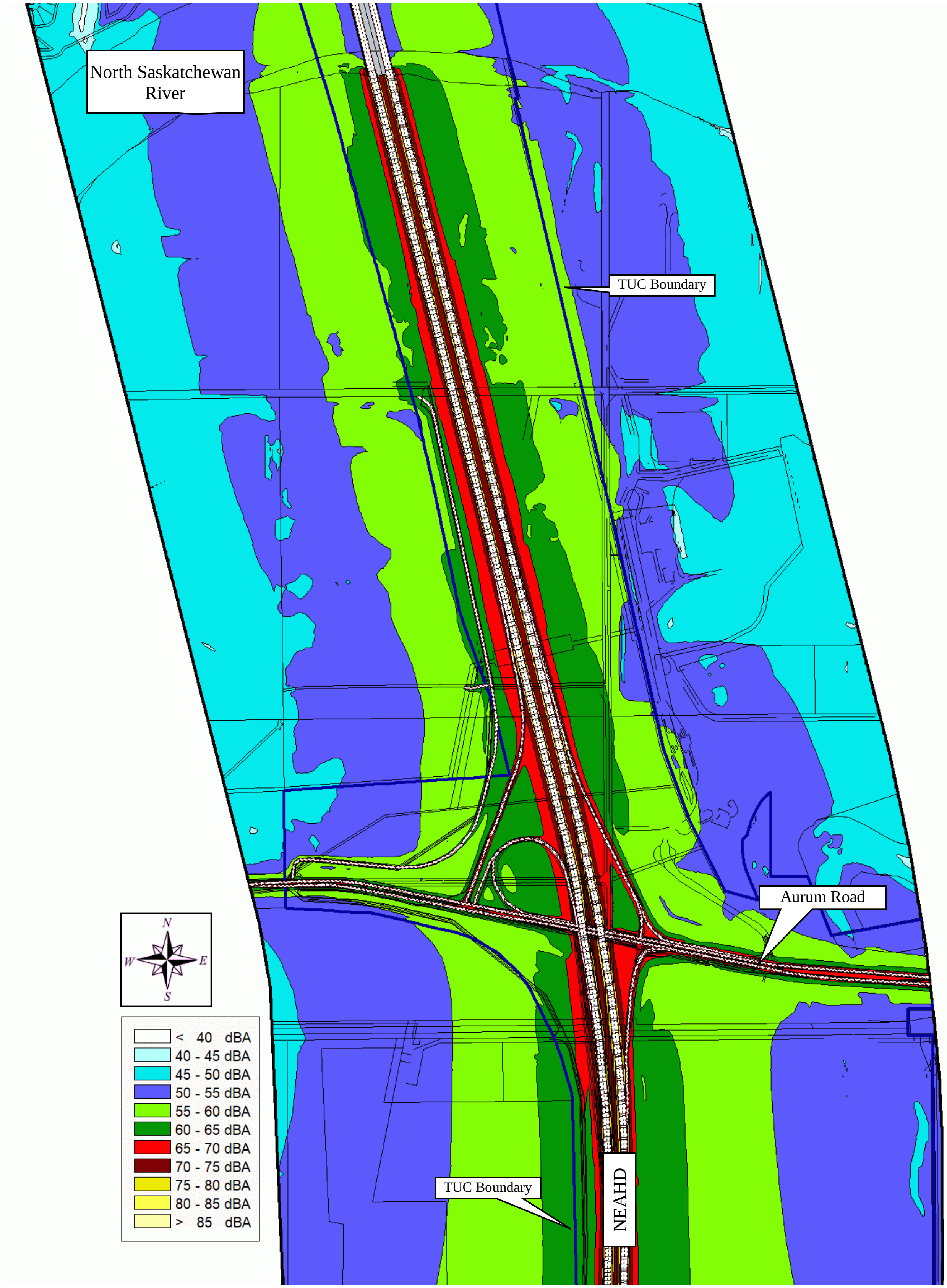

Figure 45g. Current Conditions L_{eq}24 Sound Levels (Highway 16 to Aurum Road to NSR)

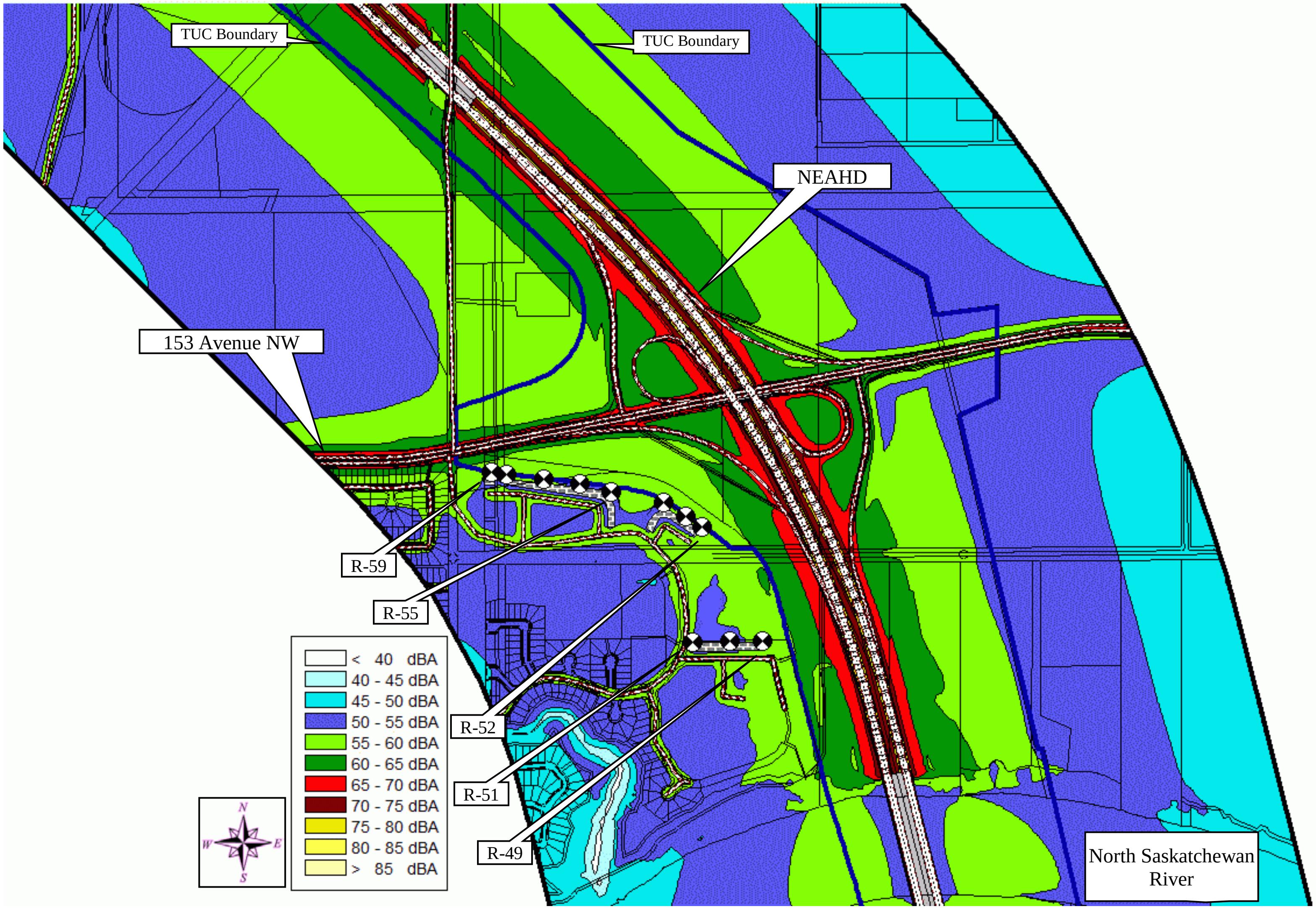

Figure 45h. Current Conditions L_{eq}24 Sound Levels (NSR to 153 Avenue)

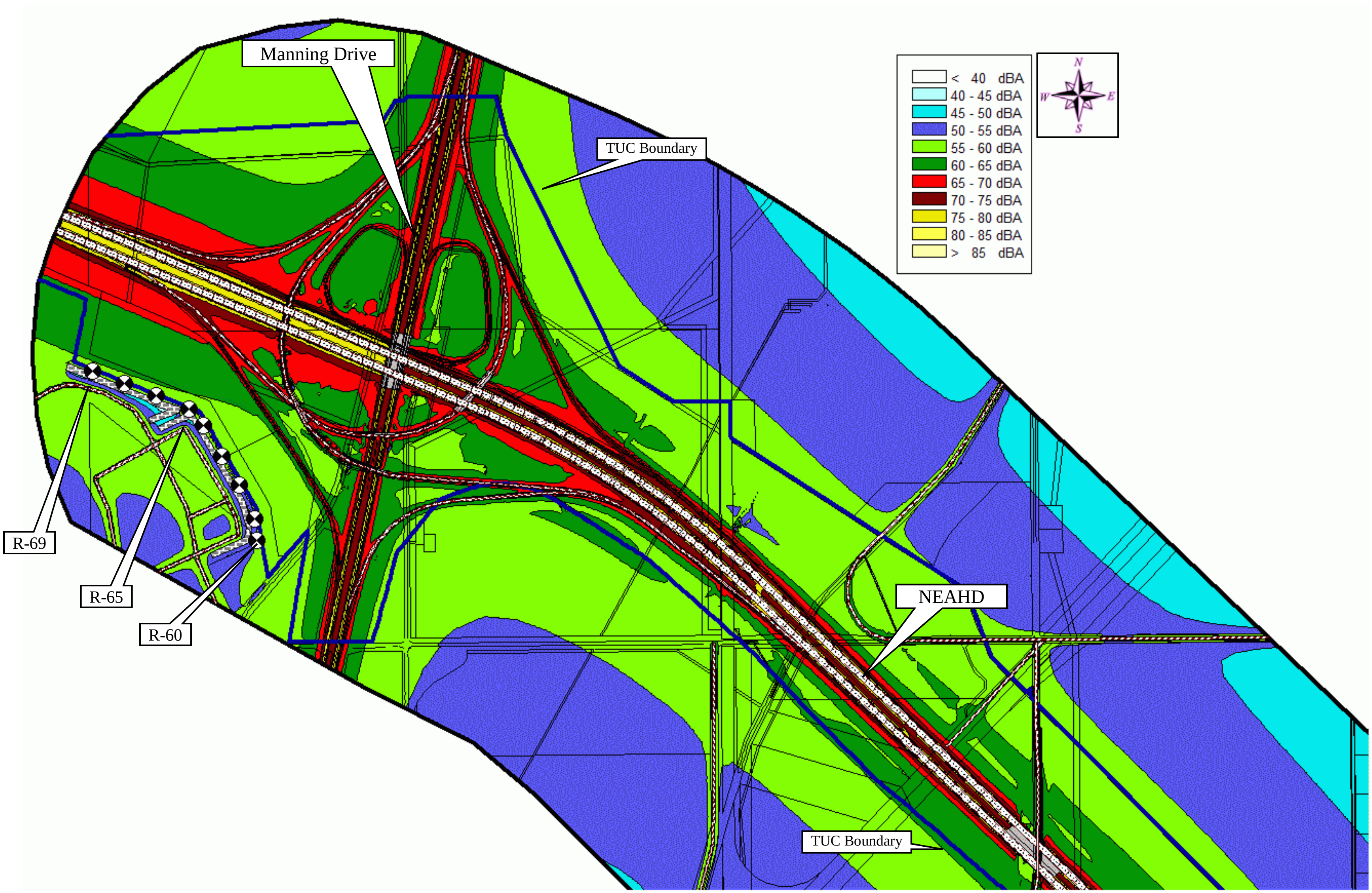

Figure 45i. Current Conditions L_{eq}24 Sound Levels (153 Avenue to Manning Drive)

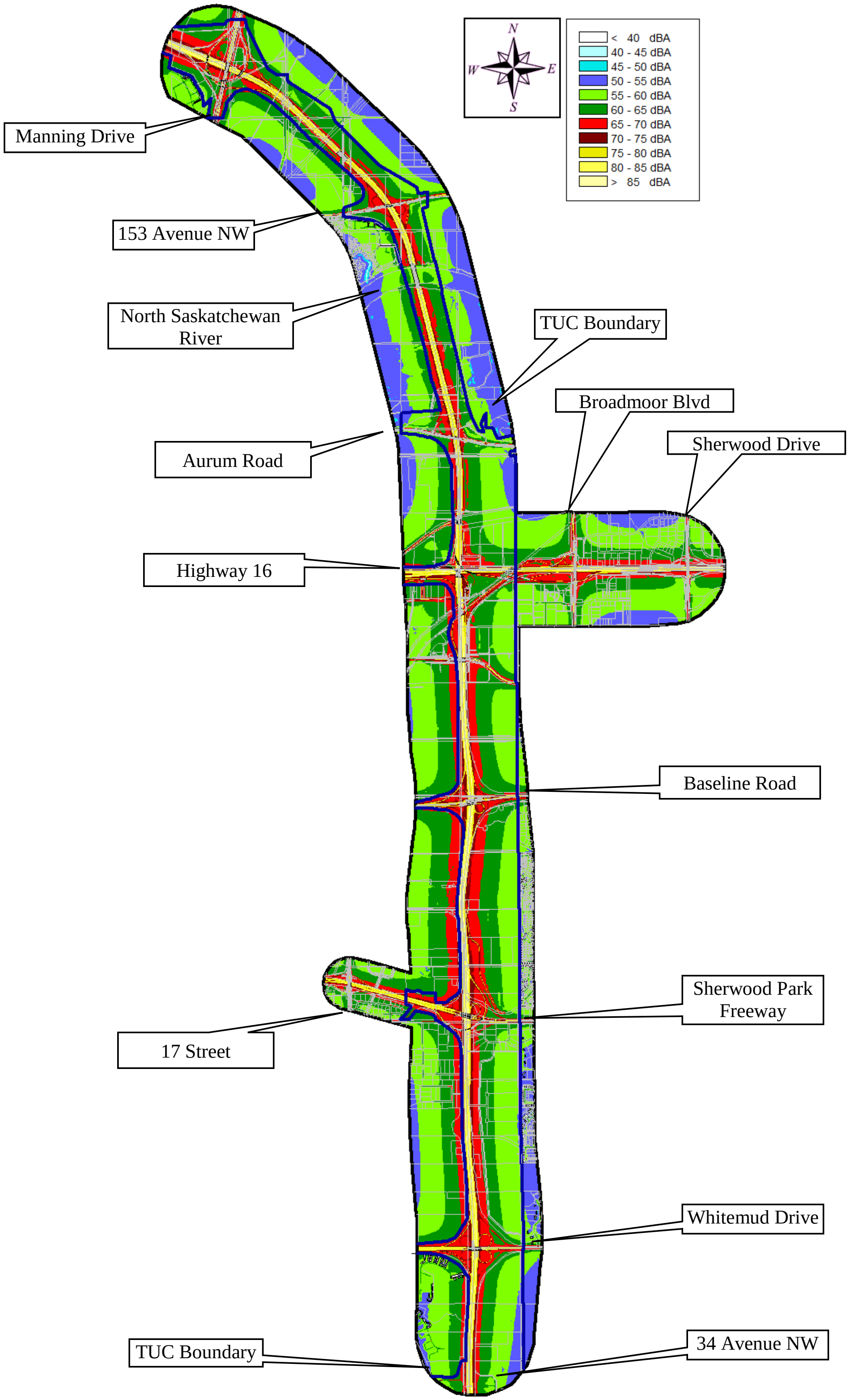

Figure 46a. Future Conditions L_{eq}24 Sound Levels for Entire Study Area

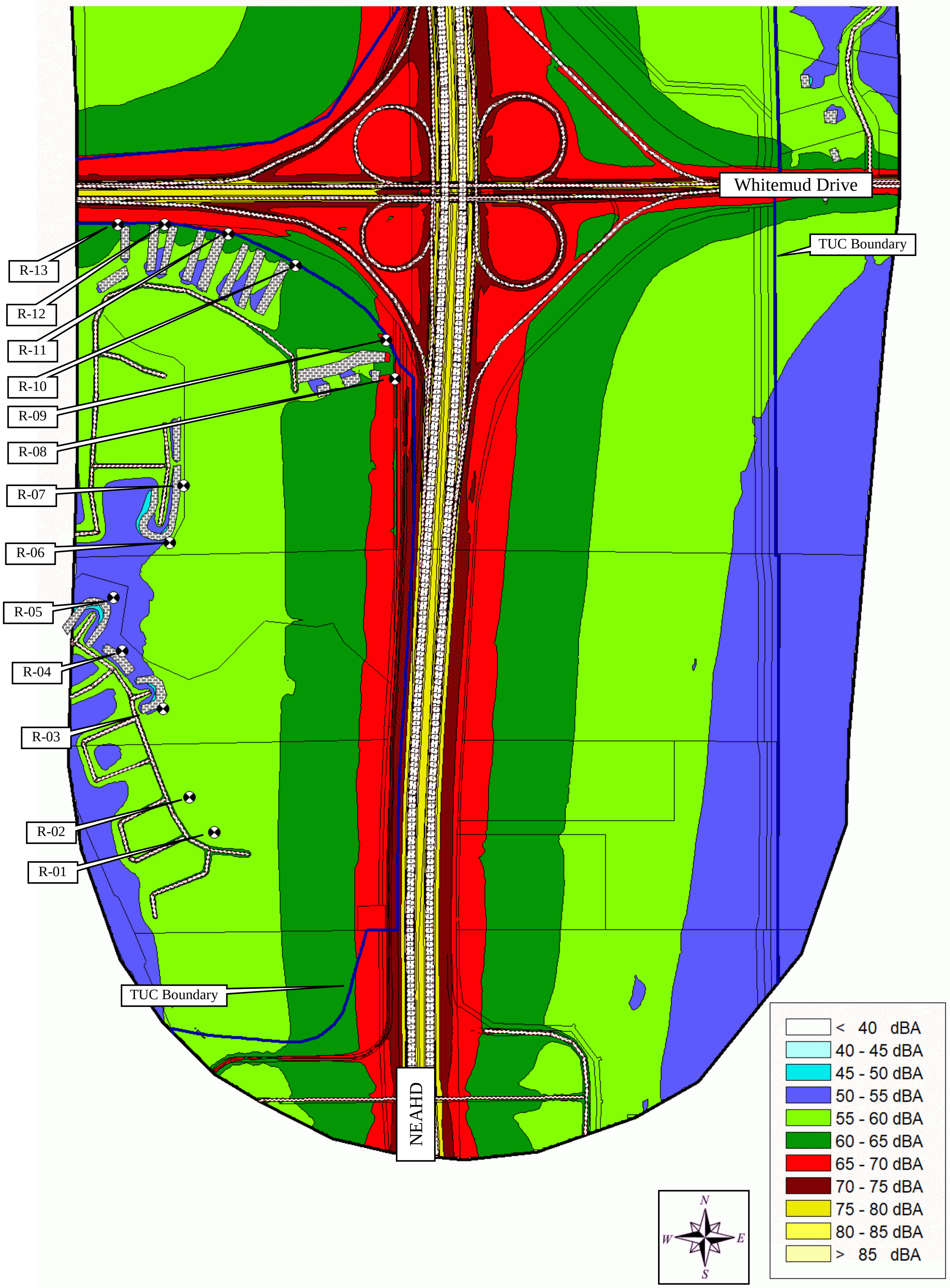

Figure 46b. Future Conditions L_{eq}24 Sound Levels (34 Avenue NW to Whitemud Drive)

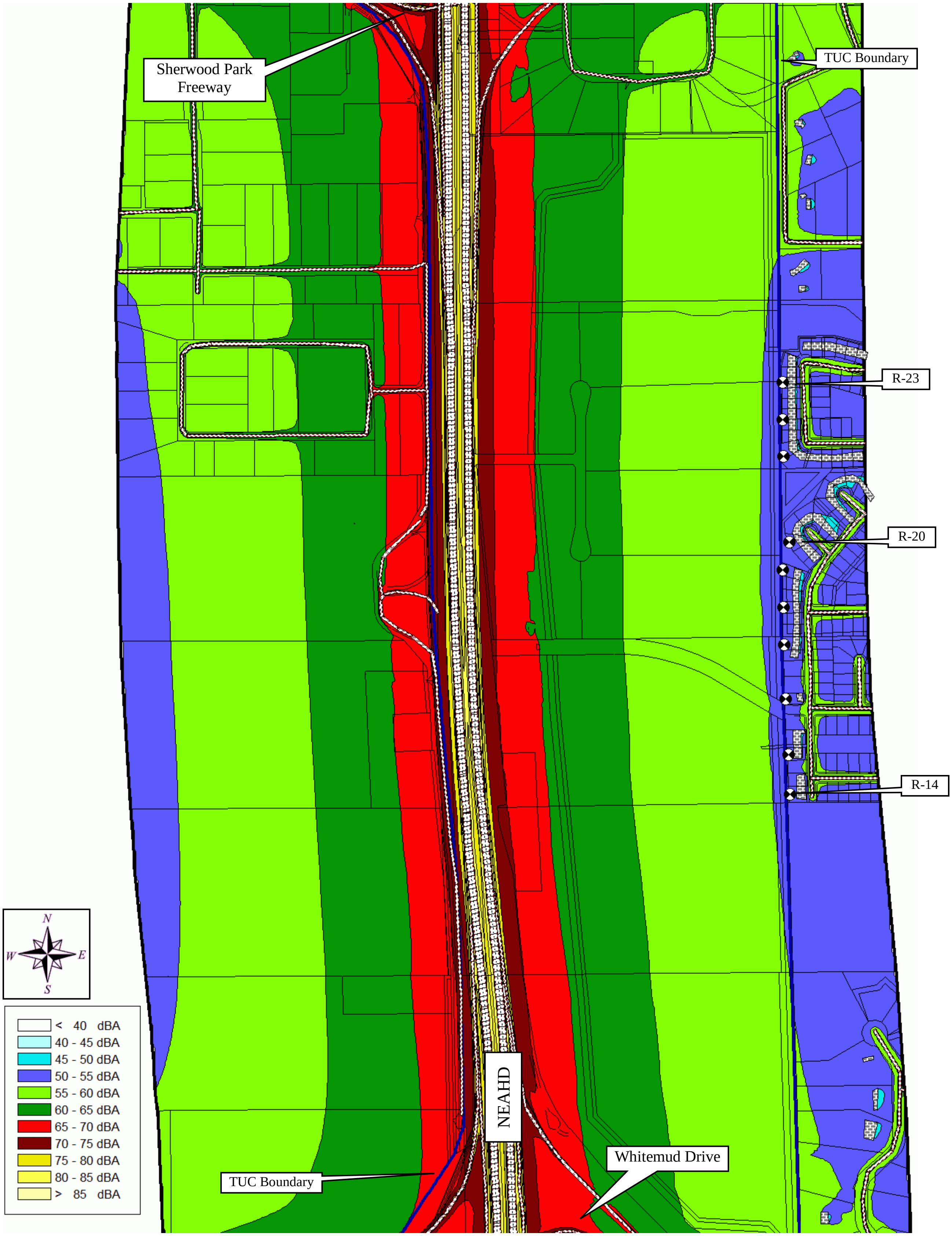

Figure 46c. Future Conditions L_{eq}24 Sound Levels (Whitemud Drive to Sherwood Park Freeway)

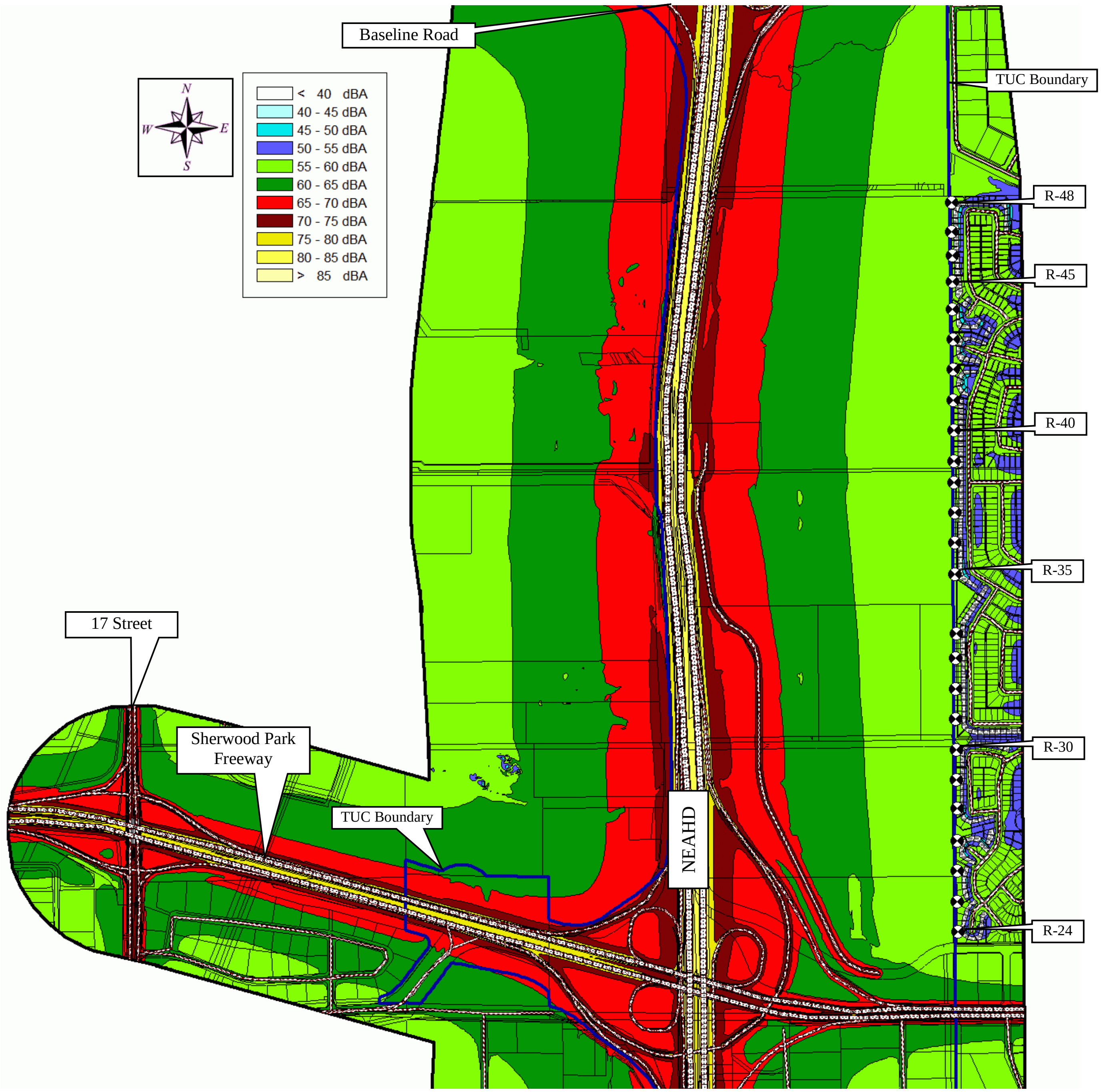

Figure 46d. Future Conditions L_{eq}24 Sound Levels (Sherwood Park Freeway to Baseline Road)

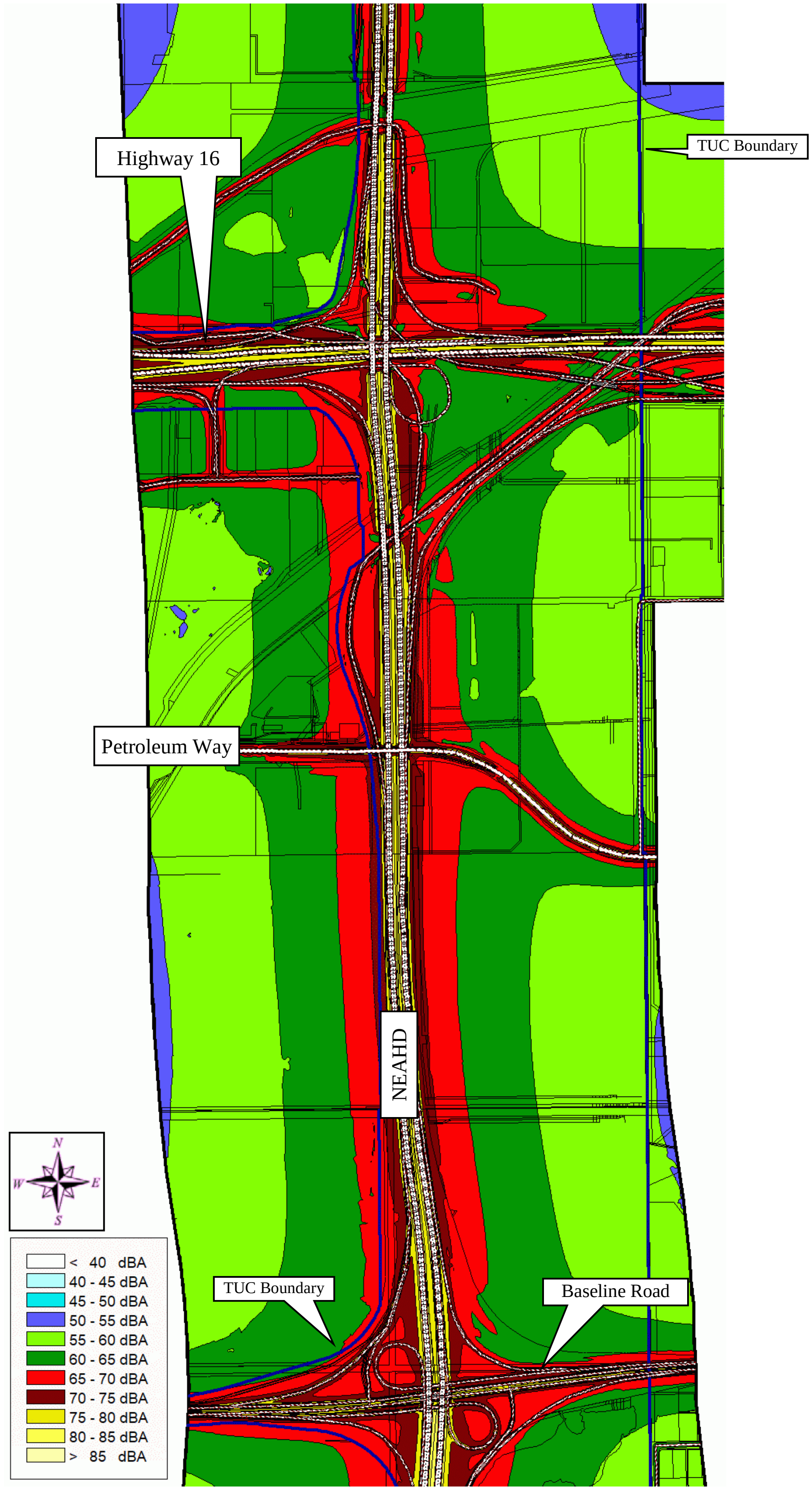

Figure 46e. Future Conditions L_{eq}24 Sound Levels (Baseline Road to Highway 16)

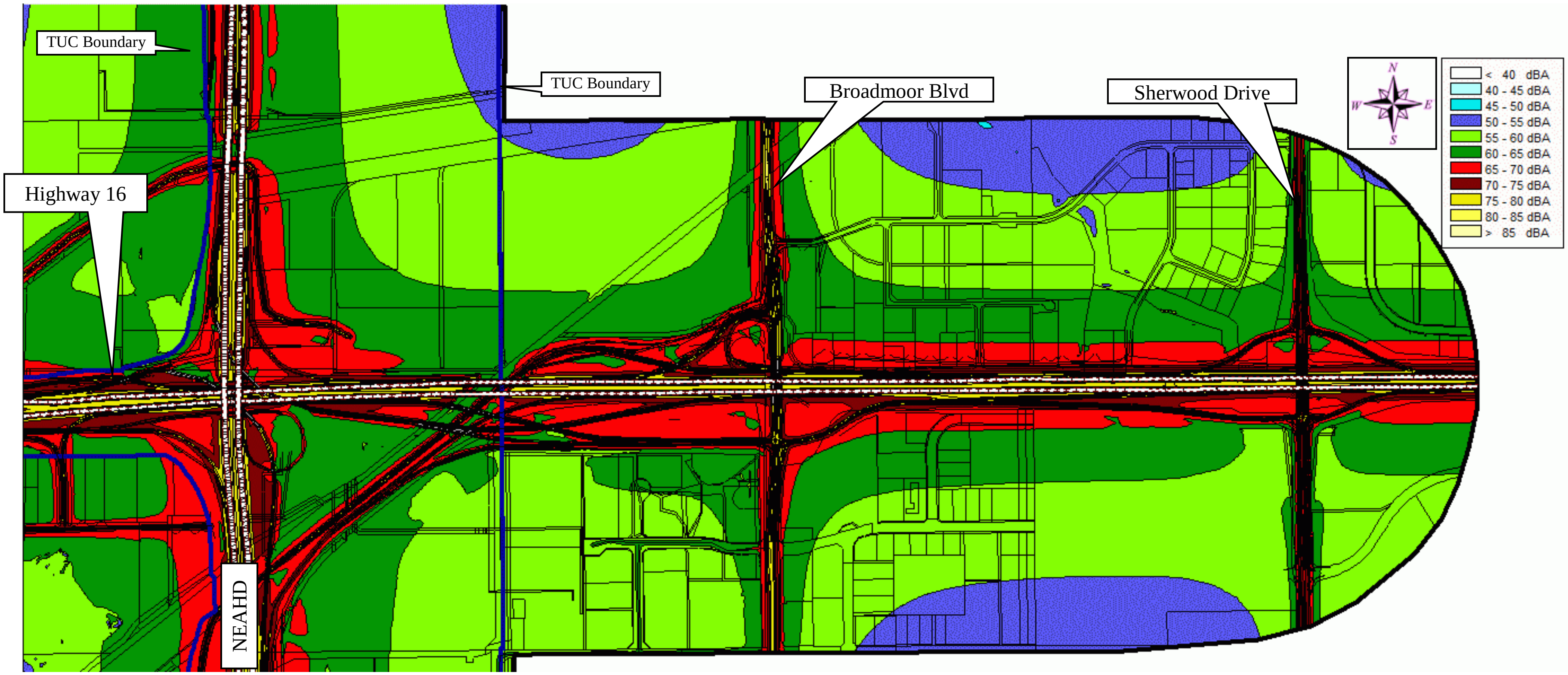

Figure 46f. Future Conditions L_{eq}24 Sound Levels (Highway 16 – Broadmoor Blvd to Sherwood Drive)

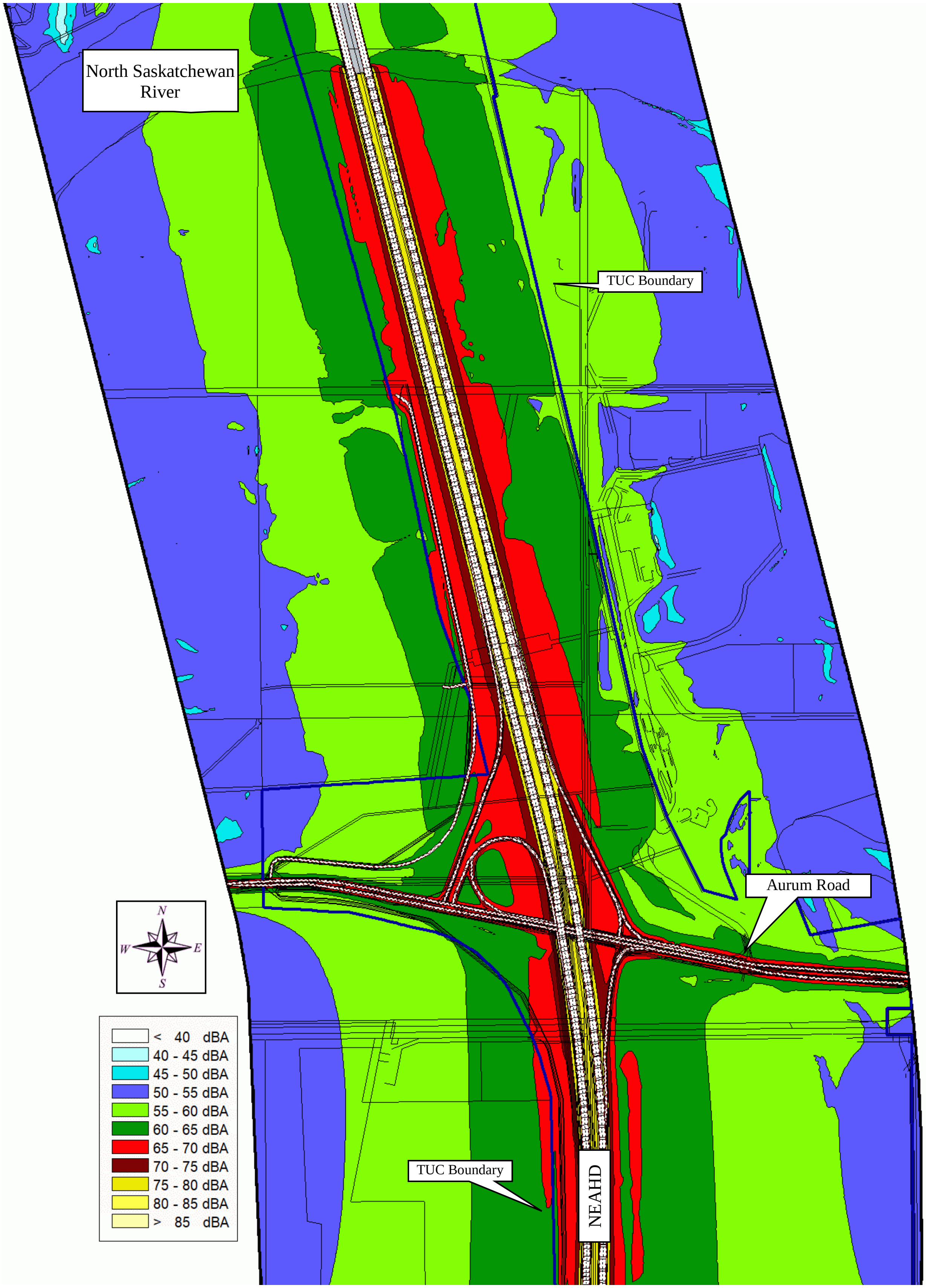

Figure 46g. Future Conditions L_{eq}24 Sound Levels (Highway 16 to Aurum Road to NSR)

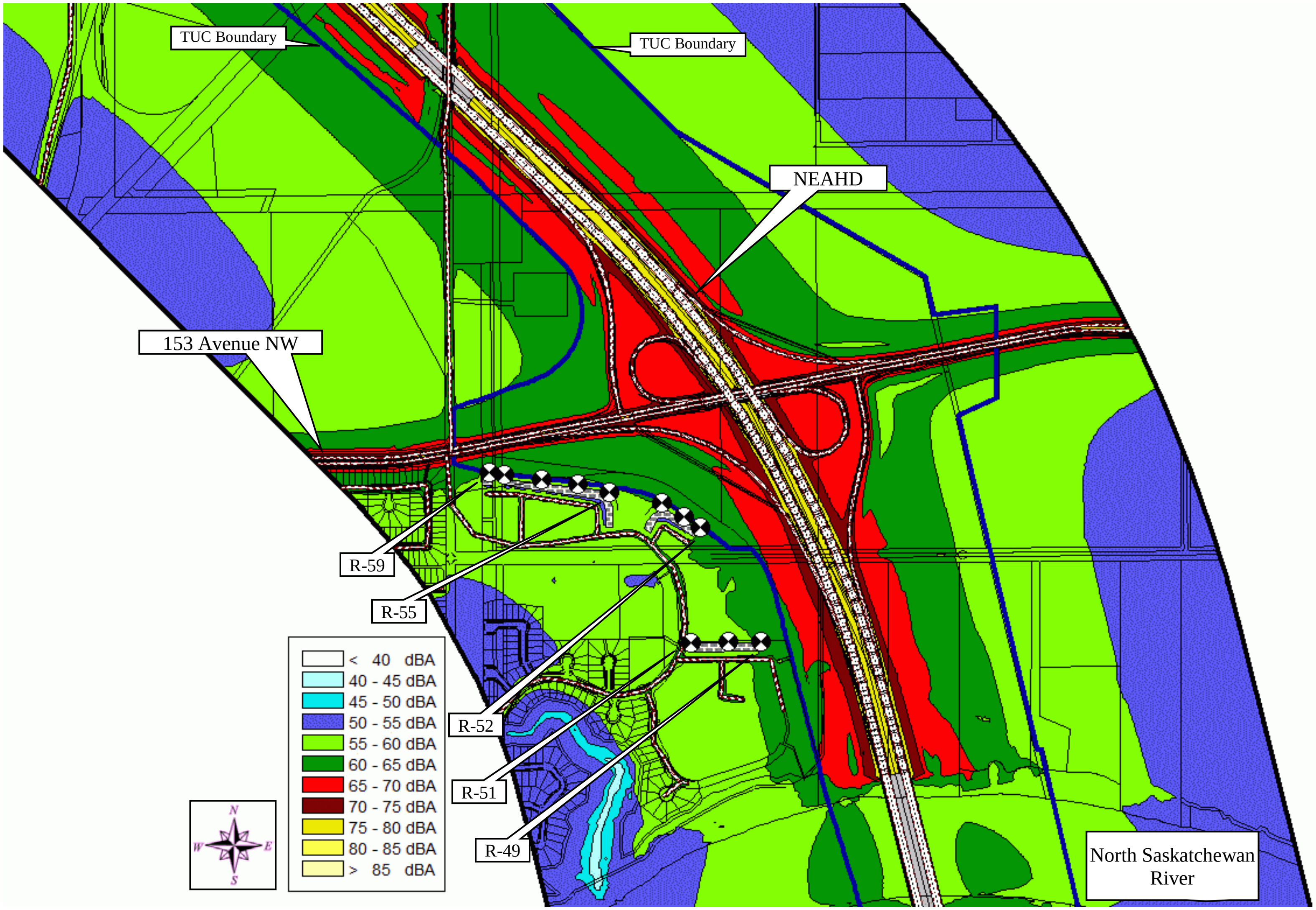

Figure 46h. Future Conditions L_{eq}24 Sound Levels (NSR to 153 Avenue)

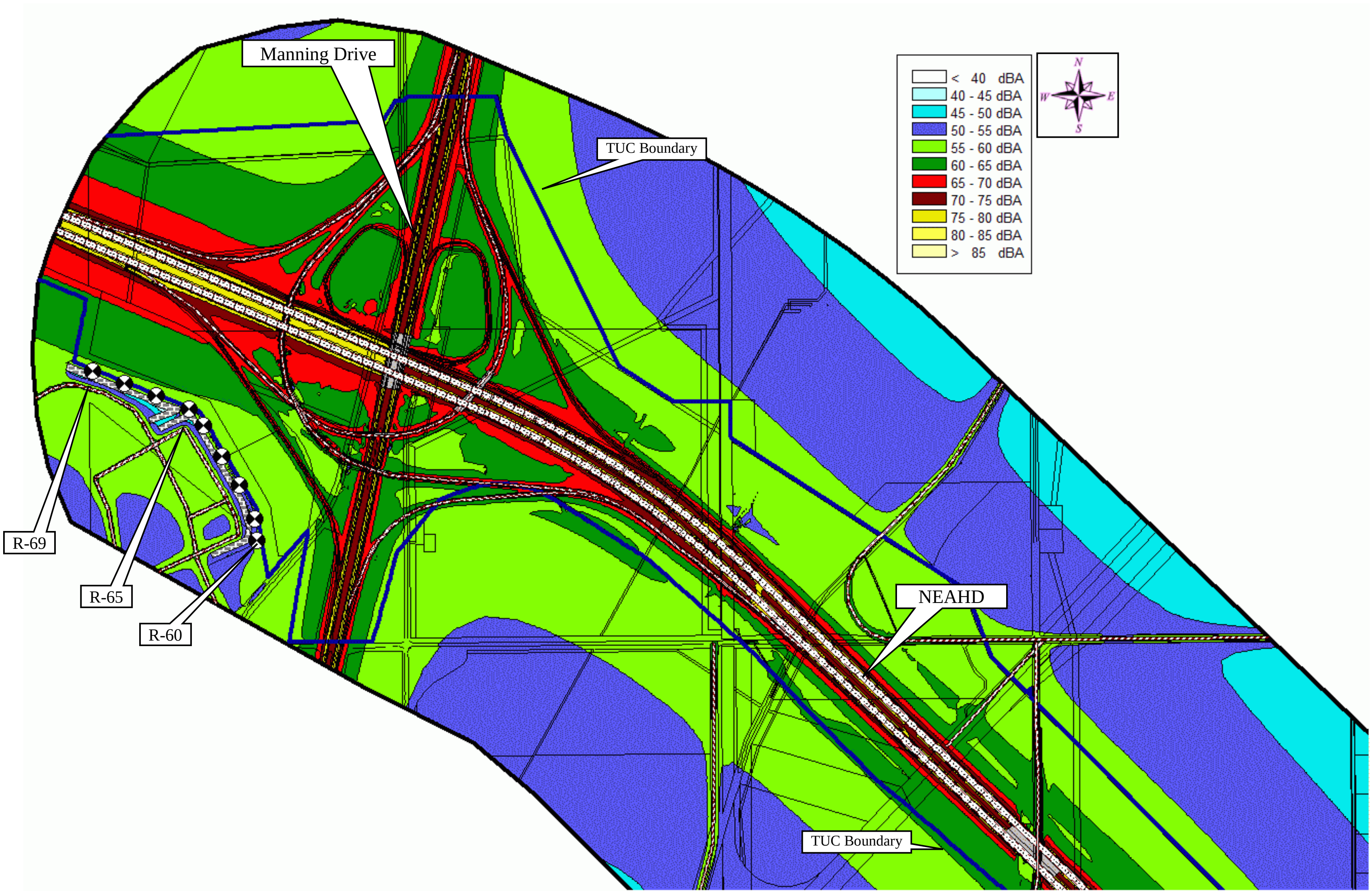

Figure 46i. Future Conditions L_{eq}24 Sound Levels (153 Avenue to Manning Drive)

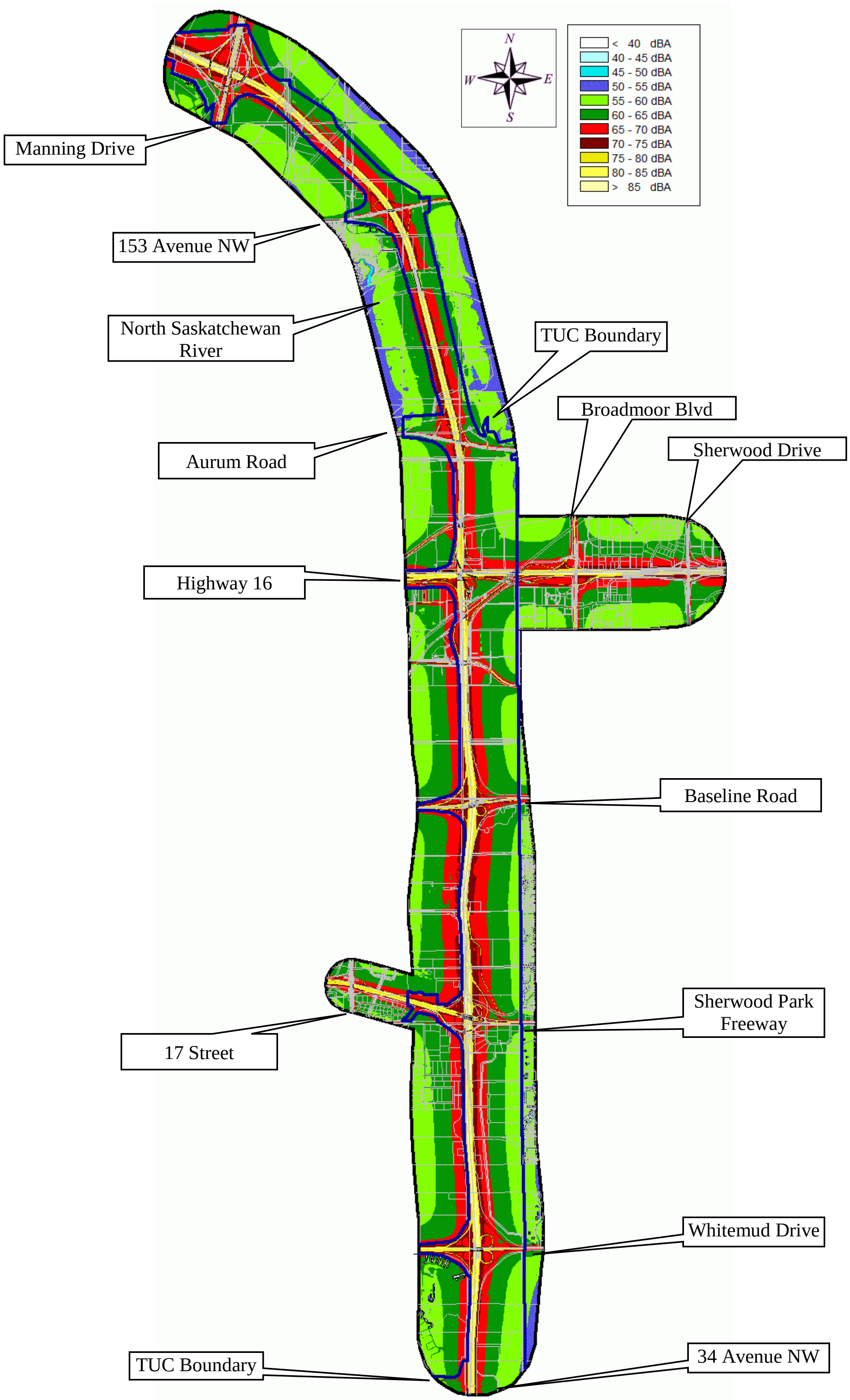

Figure 47a. Long-term Conditions L_{eq}24 Sound Levels for Entire Study Area

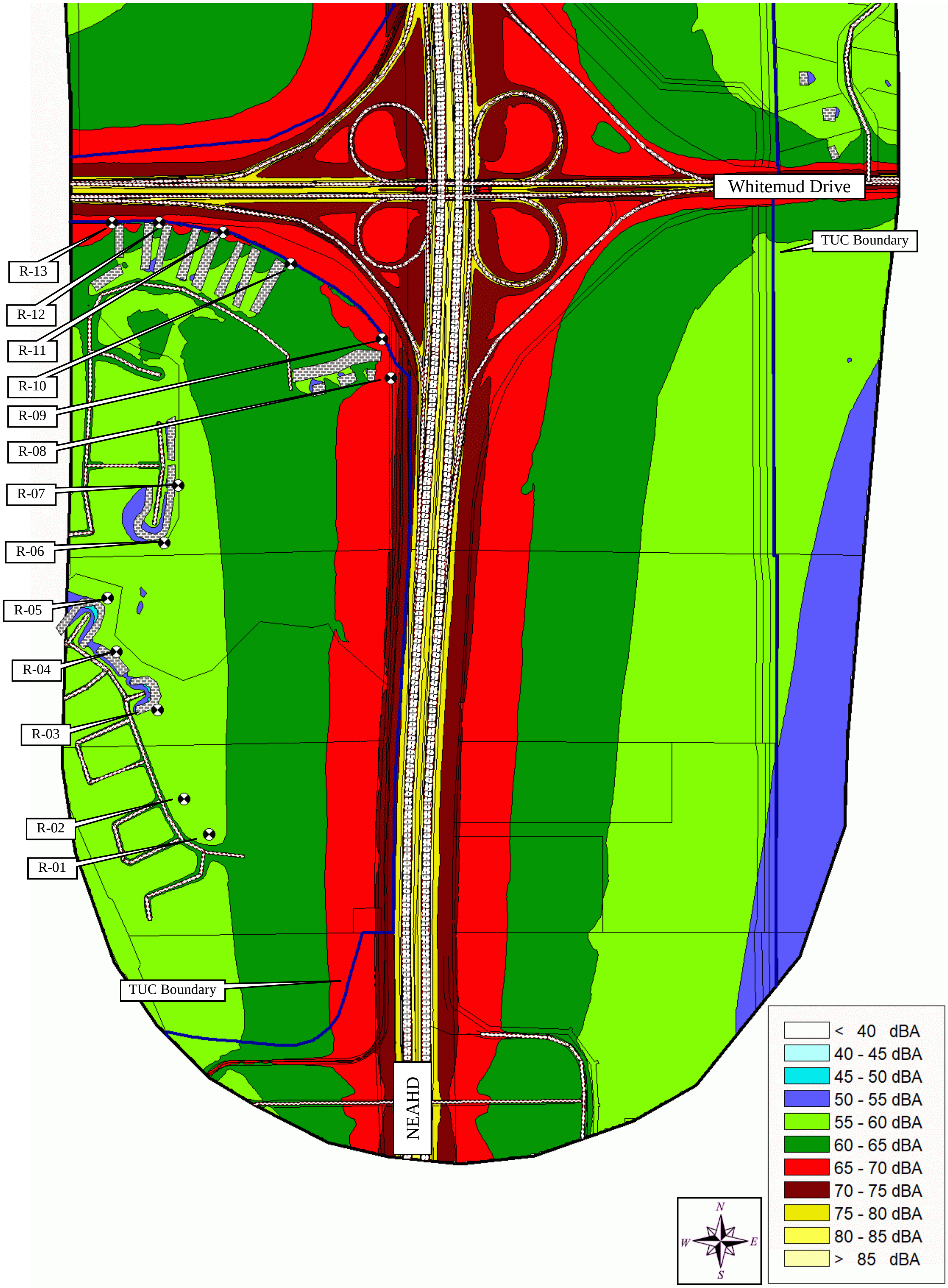

Figure 47b. Long-term Conditions L_{eq}24 Sound Levels (34 Avenue NW to Whitemud Drive)

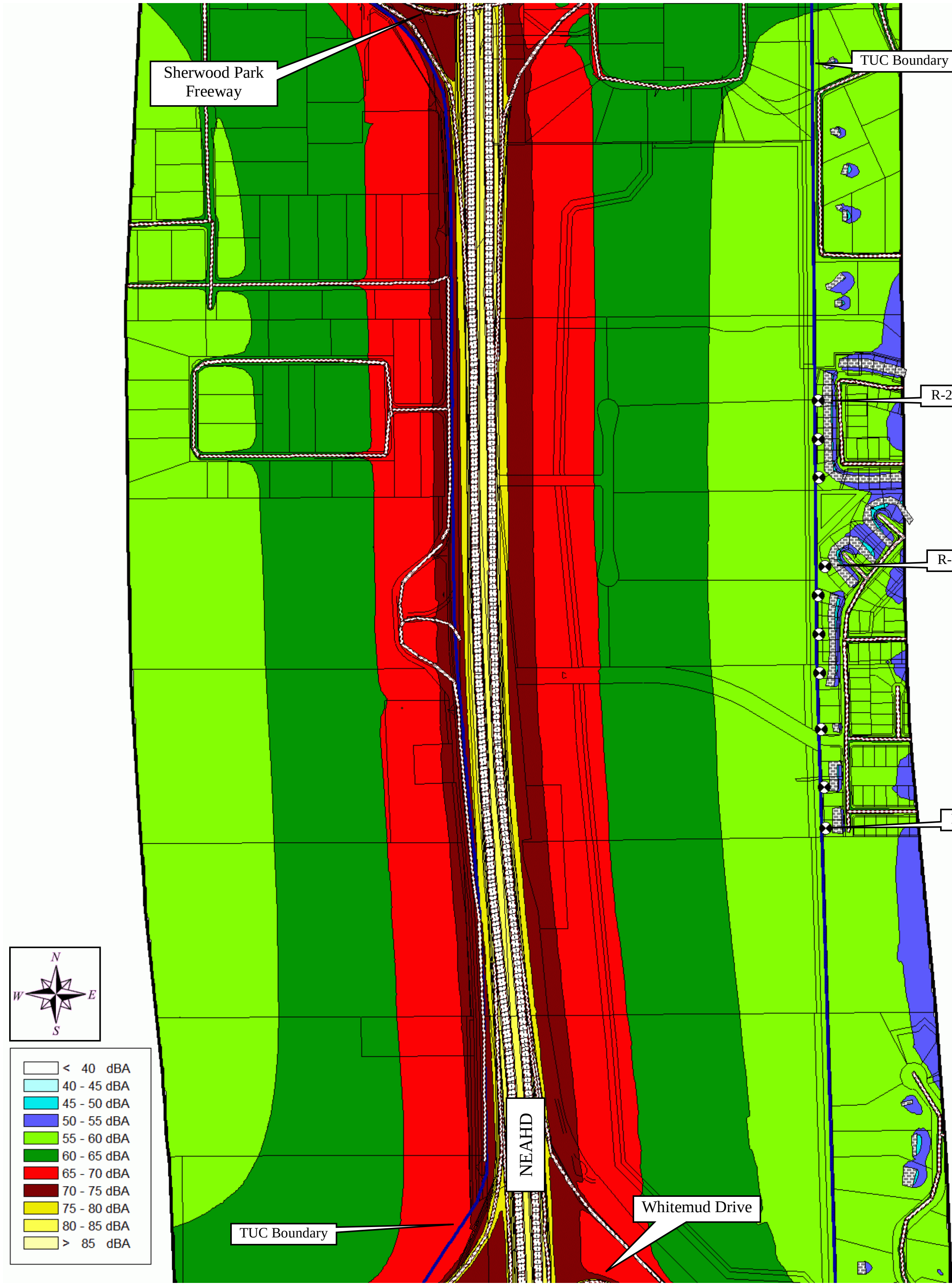

Figure 47c. Long-term Conditions L_{eq}24 Sound Levels (Whitemud Drive to Sherwood Park Freeway)

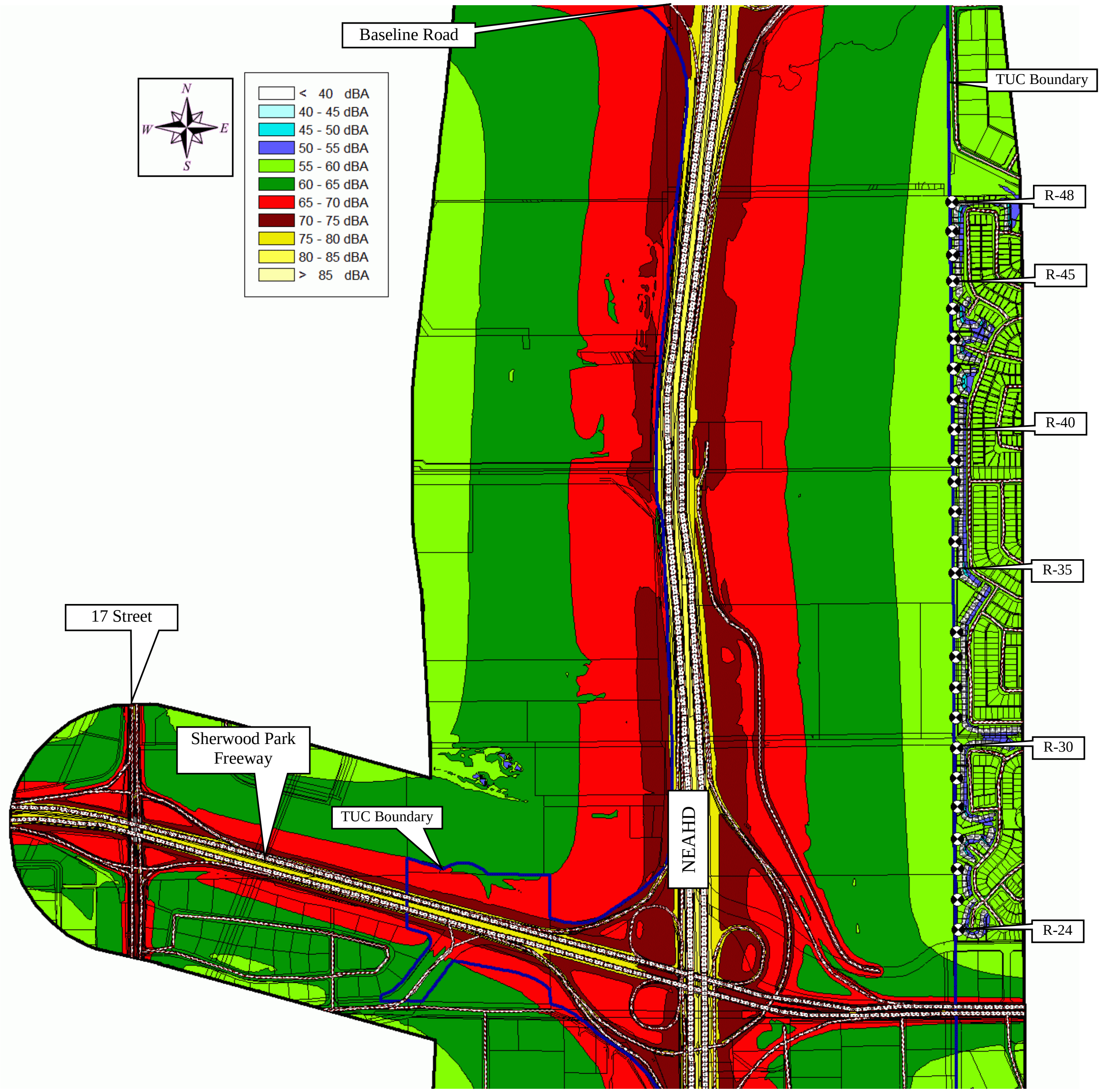

Figure 47d. Long-term Conditions L_{eq}24 Sound Levels (Sherwood Park Freeway to Baseline Road)

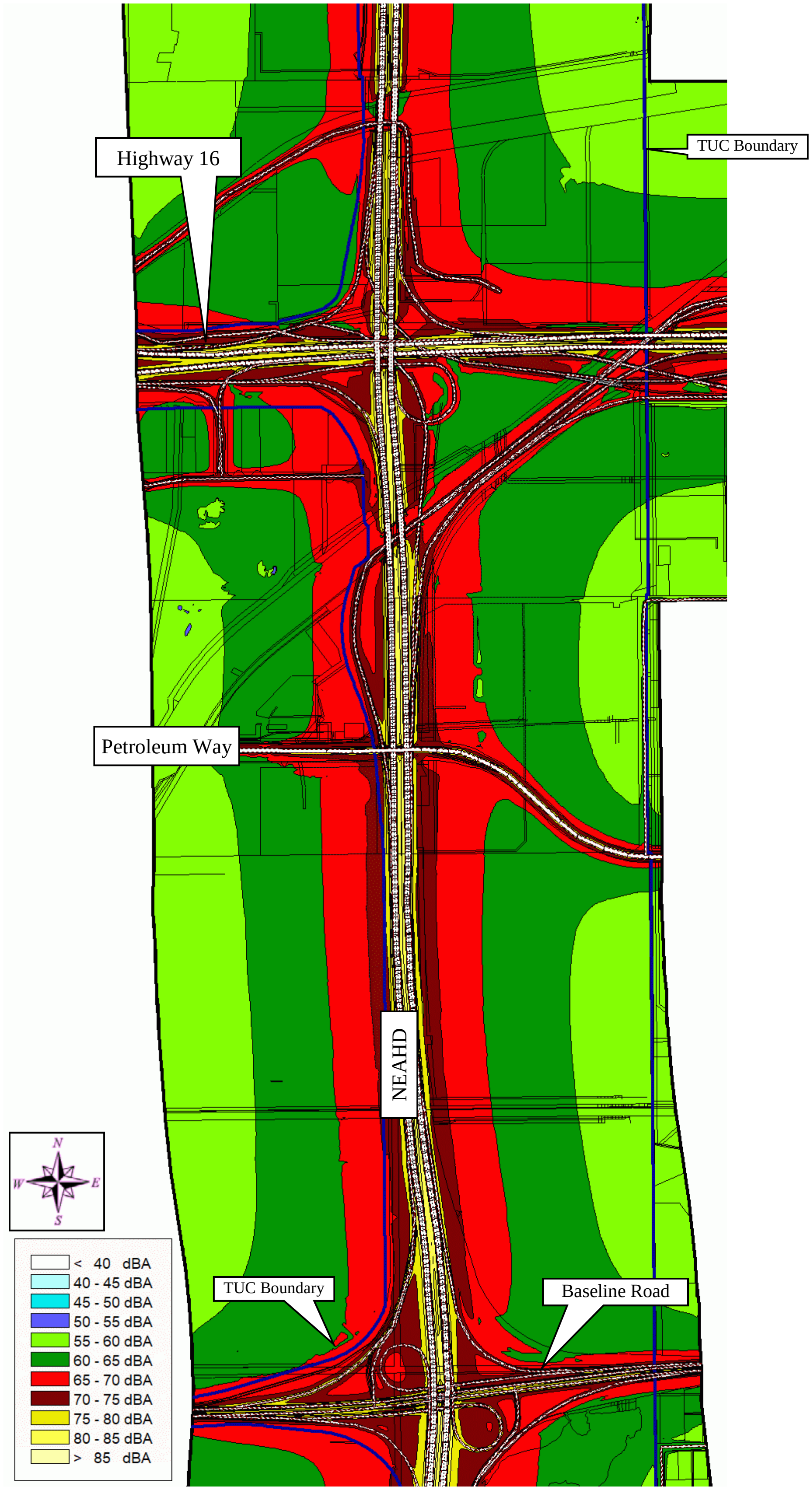

Figure 47e. Long-term Conditions L_{eq}24 Sound Levels (Baseline Road to Highway 16)

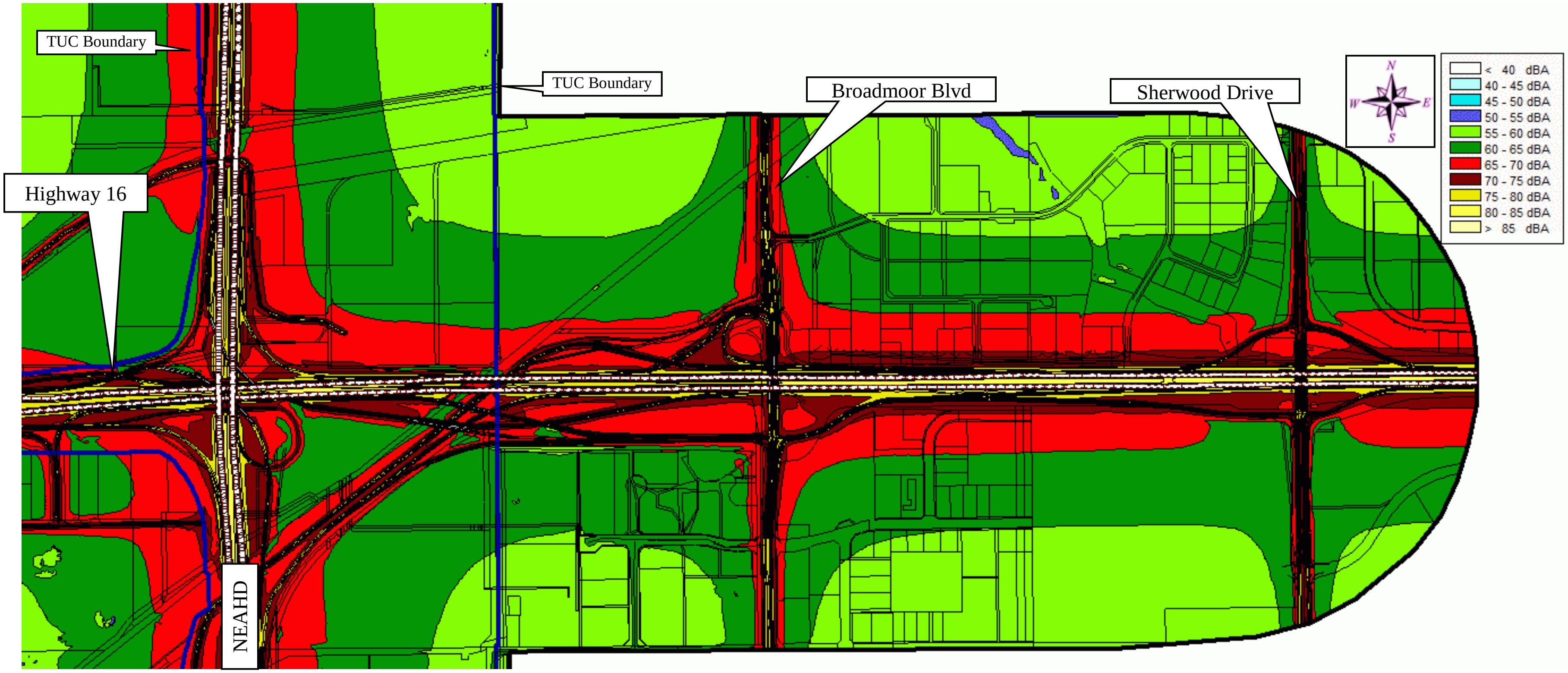

Figure 47f. Long-term Conditions L_{eq}24 Sound Levels (Highway 16 – Broadmoor Blvd to Sherwood Drive)

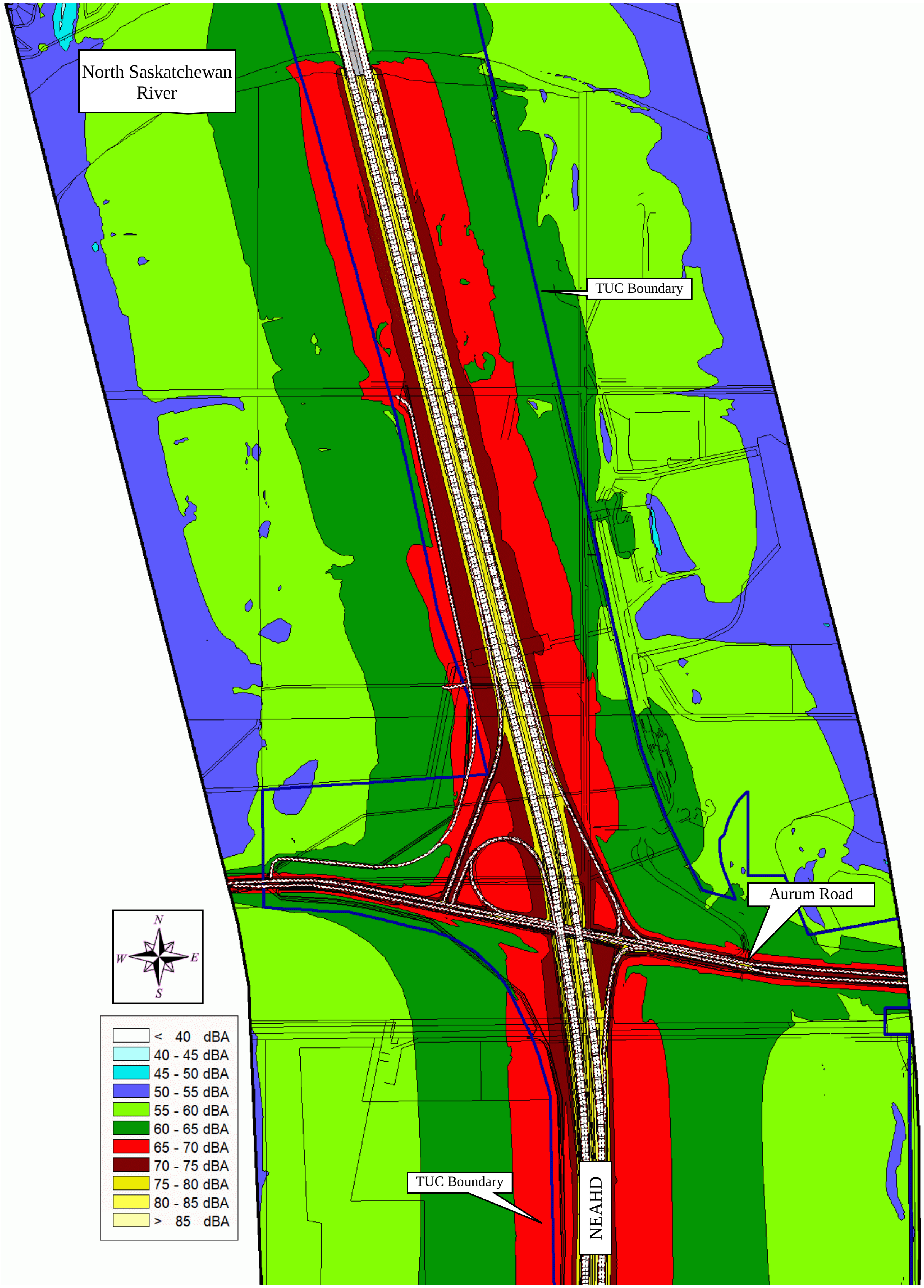

Figure 47g. Long-term Conditions L_{eq}24 Sound Levels (Highway 16 to Aurum Road to NSR)

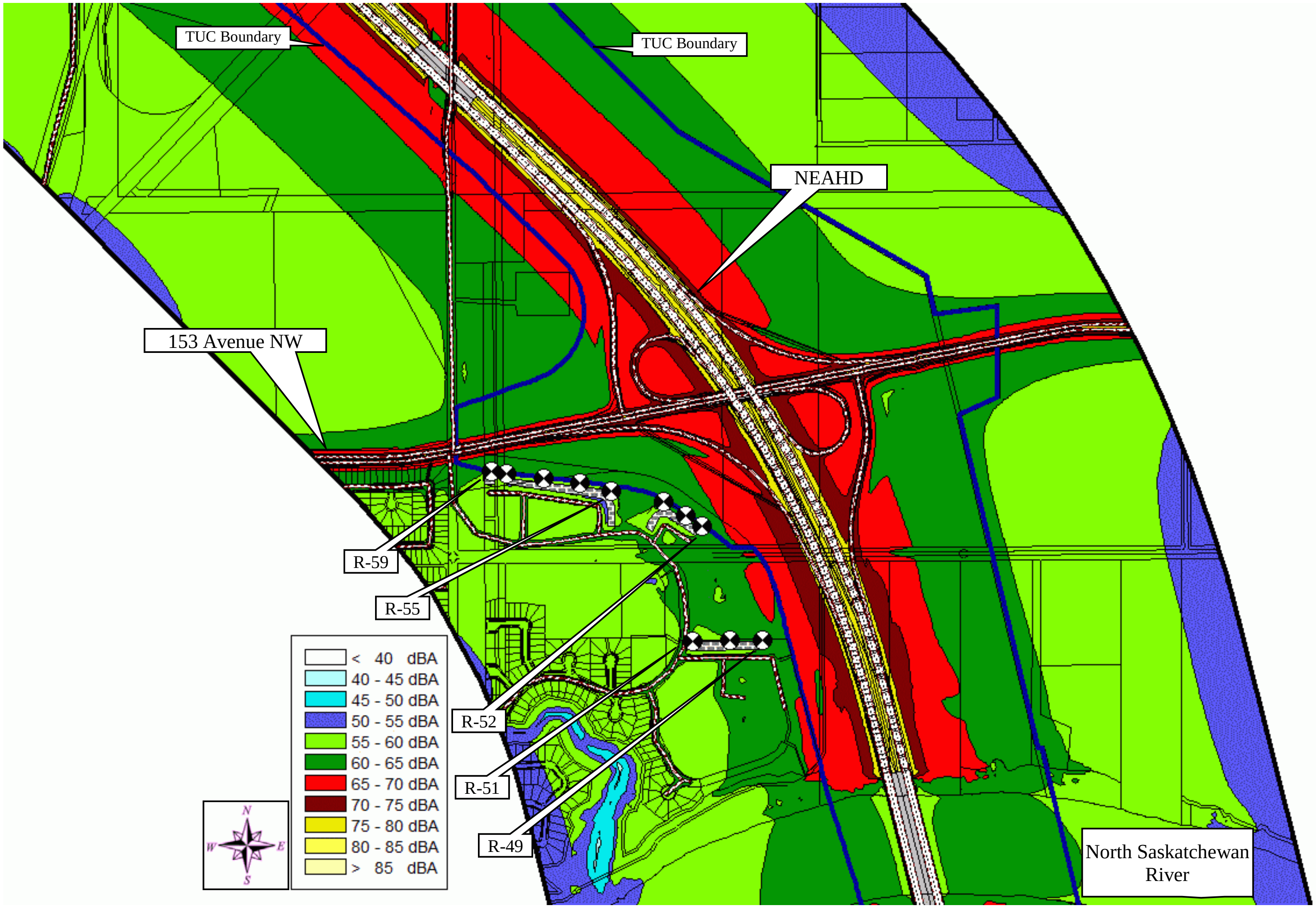

Figure 47h. Long-term Conditions L_{eq}24 Sound Levels (NSR to 153 Avenue)

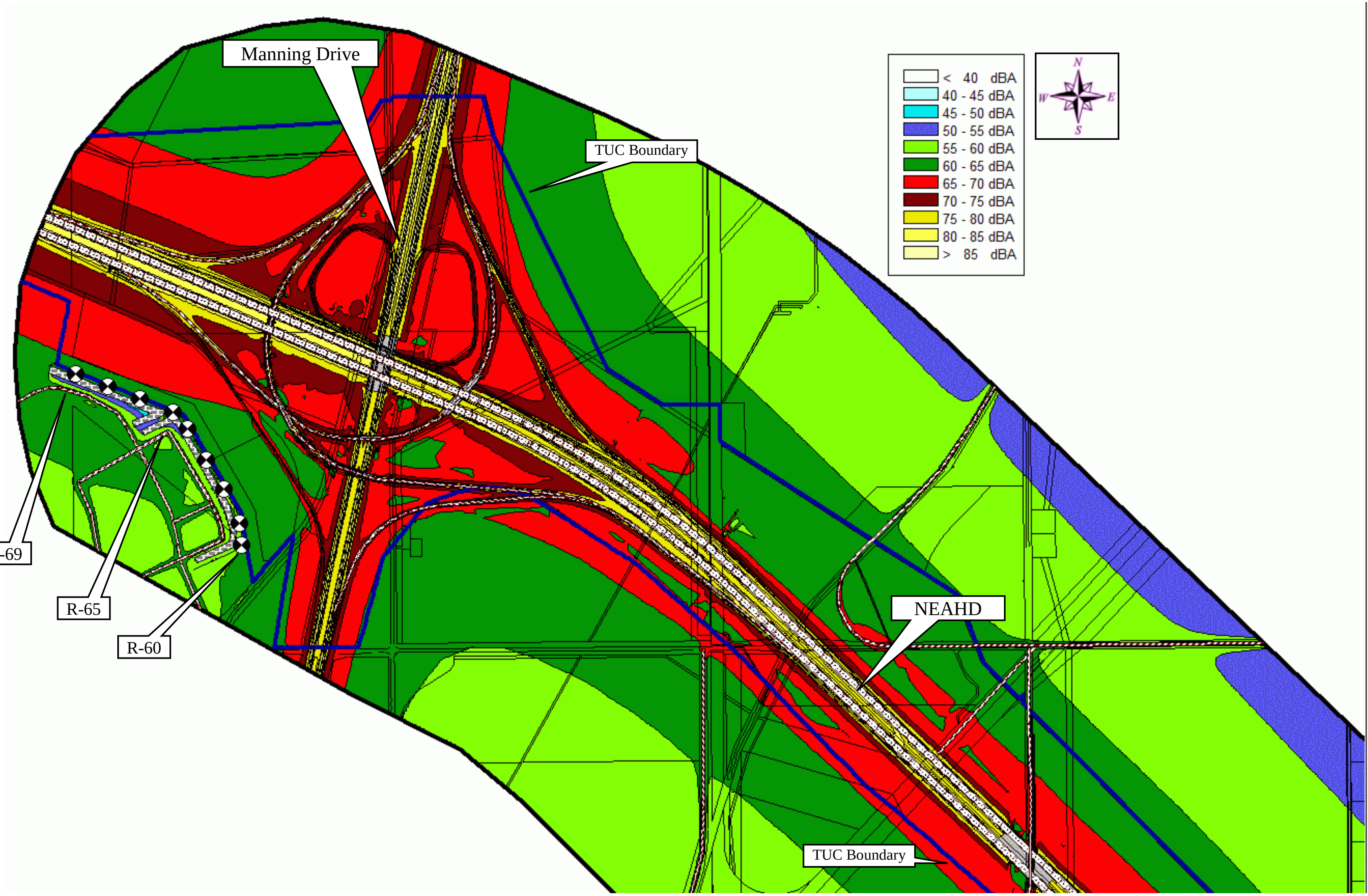

Figure 47i. Long-term Conditions L_{eq}24 Sound Levels (153 Avenue to Manning Drive)

Appendix I MEASUREMENT EQUIPMENT USED

Brüel and Kjær 2250/2270

The environmental noise monitoring equipment used consisted of a Brüel and Kjær Type 2250/2270 Precision Integrating Sound Level Meter enclosed in an environmental case, a tripod, a weather protective microphone hood. The system acquired data in 15-second L_{eq} samples using 1/3 octave band frequency analysis and overall A-weighted and C-weighted sound levels. The sound level meter conforms to Type 1, ANSI S1.4, ANSI S1.43, IEC 61672-1, IEC 60651, IEC 60804 and DIN 45657. The 1/3 octave filters conform to S1.11 – Type 0-C, and IEC 61260 – Class 0. The calibrator conforms to IEC 942 and ANSI S1.40. The sound level meter, pre-amplifier and microphone were certified on May 09, 2017 / January 19, 2017 / November 14, 2016 / November 11, 2016 / November 10, 2016 / November 11, 2016 and the calibrator (type B&K 4231) was certified on / January 18, 2017 by a NIST NVLAP Accredited Calibration Laboratory for all requirements of ISO 17025: 1999 and relevant requirements of ISO 9002:1994, ISO 9001:2000 and ANSI/NCSL Z540: 1994 Part 1. Simultaneous digital audio was recorded directly on the sound level meter using a 8 kHz sample rate for more detailed post-processing analysis. Refer to the next section in the Appendix for a detailed description of the various acoustical descriptive terms used.

Weather Monitor

The weather monitoring equipment used for the study consisted of a NovaLynx 110-WS-16D data acquisition box, with a 200-WS-02E wind-speed and wind-direction sensor, a 110-WS-16TH temperature and relative humidity sensor and a 110-WS-16THS solar radiation shield. The data acquisition box and a battery were located in a weather protective case. The sensors were mounted on a tripod at approximately 4.5m above ground. The system was set up to record data in 5-minute averages obtaining average wind-speed, peak wind-speed, wind-direction, temperature and relative humidity.

Record of Calibration Results

Description	Date	Time	Pre / Post	Calibration Level	Calibrator Model	Serial Number
Monitor Location #1	June 5, 2017	15:15	Pre	93.9 dBA	B&K 4231	2656414
Monitor Location #1	June 7, 2017	11:10	Post	93.9 dBA	B&K 4231	2656414
Monitor Location #2	June 5, 2017	14:20	Pre	93.9 dBA	B&K 4231	2656414
Monitor Location #2	June 7, 2017	11:40	Post	93.8 dBA	B&K 4231	2656414
Monitor Location #3	July 24, 2017	18:20	Pre	93.9 dBA	B&K 4231	2656414
Monitor Location #3	July 26, 2017	09:35	Post	93.8 dBA	B&K 4231	2656414
Monitor Location #4	July 24, 2017	18:45	Pre	93.9 dBA	B&K 4231	2656414
Monitor Location #4	July 26, 2017	09:05	Post	93.9 dBA	B&K 4231	2656414
Monitor Location #5	June 18, 2017	13:00	Pre	93.9 dBA	B&K 4231	2656414
Monitor Location #5	June 20, 2017	11:00	Post	93.8 dBA	B&K 4231	2656414
Monitor Location #6	July 24, 2017	19:00	Pre	93.9 dBA	B&K 4231	2656414
Monitor Location #6	July 26, 2017	08:45	Post	93.8 dBA	B&K 4231	2656414
Monitor Location #7	July 24, 2017	19:40	Pre	93.9 dBA	B&K 4231	2656414
Monitor Location #7	July 26, 2017	08:30	Post	93.8 dBA	B&K 4231	2656414
Monitor Location #8	July 24, 2017	20:05	Pre	93.9 dBA	B&K 4231	2656414
Monitor Location #8	July 26, 2017	08:15	Post	93.8 dBA	B&K 4231	2656414
Monitor Location #9	June 12, 2017	15:20	Pre	93.9 dBA	B&K 4231	2656414
Monitor Location #9	June 15, 2017	10:00	Post	93.8 dBA	B&K 4231	2656414
Monitor Location #10	June 6, 2017	15:37	Pre	93.9 dBA	B&K 4231	2656414
Monitor Location #10	June 8, 2017	09:45	Post	93.8 dBA	B&K 4231	2656414
Monitor Location #11	June 5, 2017	16:00	Pre	93.9 dBA	B&K 4231	2656414
Monitor Location #11	June 7, 2017	10:30	Post	93.9 dBA	B&K 4231	2656414
Monitor Location #12	June 12, 2017	15:20	Pre	93.9 dBA	B&K 4231	2656414
Monitor Location #12	June 15, 2017	10:20	Post	93.8 dBA	B&K 4231	2656414
Monitor Location #13	June 5, 2017	13:20	Pre	93.9 dBA	B&K 4231	2656414
Monitor Location #13	June 7, 2017	12:10	Post	93.8 dBA	B&K 4231	2656414
Monitor Location #14	June 18, 2017	12:10	Pre	93.9 dBA	B&K 4231	2656414
Monitor Location #14	June 20, 2017	10:40	Post	93.9 dBA	B&K 4231	2656414
Monitor Location #15	June 12, 2017	14:20	Pre	93.9 dBA	B&K 4231	2656414
Monitor Location #15	June 14, 2017	08:05	Post	93.8 dBA	B&K 4231	2656414

B&K 2250 Unit #1 SLM Calibration Certificate

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

NVLAP® CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.38467

Instrument:	**Sound Level Meter**	*Date Calibrated:* **5/9/2017** *Cal Due:*		
Model:	**2250**	*Status:*	**Received**	**Sent**
Manufacturer:	**Brüel and Kjær**	*In tolerance:*	X	X
Serial number:	**2488495**	*Out of tolerance:*		
Tested with:	**Microphone 4189 s/n 2471133** **Preamplifier ZC0032 s/n 3271**	*See comments:*		

Contains non-accredited tests: __ **Yes** _X_ **No**
Calibration service: __ **Basic** _X_ **Standard**

Type (class): **1**
Customer: **ACI Acoustical Consultants Inc.**
Tel/Fax: **780-414-6373 / 780-414-6376**
Address: **5031 - 210 Street, Edmonton, Alberta, CANADA T6M 0A8**

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

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

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

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

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
23.0	100.11	41.8

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

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This Calibration Certificate or Test Reports shall not be used to claim product certification, approval or endorsement by NVLAP, NIST, or any agency of the federal government.
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B&K 2250 Unit #1 Microphone Calibration Certificate

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

NVLAP® CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.38468

Instrument: **Microphone**
Model: **4189**
Manufacturer: **Brüel & Kjær**
Serial number: **2471133**
Composed of:

Date Calibrated: **5/8/2017** *Cal Due:*

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

Contains non-accredited tests: __Yes _X_ No

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

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

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

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

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

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

Calibration Certificates or Test Reports shall not be reproduced, except in full, without written approval of the laboratory.
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B&K 2270 Unit #2 SLM Calibration Certificate

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

NVLAP®
CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.37710

Instrument:	**Sound Level Meter**	*Date Calibrated:* **1/19/2017** *Cal Due:*		
Model:	**2270**	*Status:*	**Received**	**Sent**
Manufacturer:	**Brüel and Kjær**	*In tolerance:*	X	X
Serial number:	**3002718**	*Out of tolerance:*		
Tested with:	**Microphone 4189 s/n 2850742** **Preamplifier ZC0032 s/n 18754**	*See comments:*		

Contains non-accredited tests: __Yes X No
Calibration service: __ Basic X Standard

Type (class):	**1**
Customer:	**ACI Acoustical Consultants Inc.**
Tel/Fax:	**780-414-6373 / -6376**
Address:	**5031 - 210 Street, Edmonton, Alberta, CANADA T6M 0A8**

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

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

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

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

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
22.8	100.31	40.2

Calibrated by:	Jeremy Gotwalt	**Authorized signatory:**	Steven E. Marshall
Signature	[signature]	Signature	[signature]
Date	1/19/17	Date	1/20/2017

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This Calibration Certificate or Test Reports shall not be used to claim product certification, approval or endorsement by NVLAP, NIST, or any agency of the federal government.
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B&K 2270 Unit #2 Microphone Calibration Certificate

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

NVLAP® CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.37711

Instrument: **Microphone**
Model: **4189**
Manufacturer: **Brüel & Kjær**
Serial number: **2850742**
Composed of:

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

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

Contains non-accredited tests: __Yes _X_ No

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

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

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

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31061	Jul 27, 2016	Scantek, Inc./ NVLAP	Jul 27, 2017
DS-360-SRS	Function Generator	88077	Sep 15, 2016	ACR Env./ A2LA	Sep 15, 2018
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Sep 15, 2016	ACR Env./ A2LA	Sep 15, 2017
HM30-Thommen	Meteo Station	1040170/39633	Nov 1, 2016	ACR Env./ A2LA	Nov 1, 2017
PC Program 1017 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1253-Norsonic	Calibrator	22909	Nov 10, 2016	Scantek, Inc./ NVLAP	Nov 10, 2017
1203-Norsonic	Preamplifier	92268	Oct 17, 2016	Scantek, Inc./ NVLAP	Oct 17, 2017
4180-Brüel&Kjær	Microphone	2246115	Oct 26, 2015	NPL-UK / UKAS	Oct 26, 2017

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

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

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B&K 2270 Unit #4 SLM Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY

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

NVLAP® CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.37319

Instrument: **Sound Level Meter**
Model: **2270**
Manufacturer: **Brüel and Kjær**
Serial number: **2644639**
Tested with: **Microphone 4189 s/n 2643219**
Preamplifier ZC0032 s/n 8255
Type (class): **1**
Customer: **ACI Acoustical Consultants Inc.**
Tel/Fax: **780-414-6373 / -6376**

Date Calibrated: **11/14/2016** *Cal Due:*

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

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

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

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

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

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

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
21.5	100.29	38.8

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

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B&K 2270 Unit #4 Microphone Calibration Certificate

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

NVLAP® CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.37320

Instrument: **Microphone**
Model: **4189**
Manufacturer: **Brüel & Kjær**
Serial number: **2643219**
Composed of:

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

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

Contains non-accredited tests: __Yes _X_ No

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

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

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

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

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

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

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B&K 2250 Unit #5 SLM Calibration Certificate

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

NVLAP® CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.37315

Instrument: **Sound Level Meter**
Model: **2250**
Manufacturer: **Brüel and Kjær**
Serial number: **2722894**
Tested with: **Microphone 4189 s/n 2719777**
Preamplifier ZC0032 s/n 13895
Type (class): **1**
Customer: **ACI Acoustical Consultants Inc.**
Tel/Fax: **780-414-6373 / -6376**

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

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

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

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

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

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

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

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
23.6	99.58	30.5

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

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B&K 2250 Unit #5 Microphone Calibration Certificate

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NVLAP Lab Code: 200625-0

Calibration Certificate No.37316

Instrument: **Microphone**
Model: **4189**
Manufacturer: **Brüel & Kjær**
Serial number: **2719777**
Composed of:

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

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

Contains non-accredited tests: __ **Yes** _X_ **No**

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

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

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

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

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

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

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B&K 2250 Unit #6 SLM Calibration Certificate

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NVLAP® CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.37313

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

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

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

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

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

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

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

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

Environmental conditions:

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

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

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NVLAP Lab Code: 200625-0

Calibration Certificate No.37314

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

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

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

Contains non-accredited tests: __Yes _X_ No

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

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

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

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

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

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

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B&K 4231 Unit #6 Calibrator Calibration Certificate

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NVLAP® CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.37705

Instrument: **Acoustical Calibrator**
Model: **4231**
Manufacturer: **Brüel and Kjær**
Serial number: **2656414**
Class (IEC 60942): **1**
Barometer type:
Barometer s/n:

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

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

Contains non-accredited tests: __Yes _X_ No

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

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

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

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

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

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

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B&K 2250 Unit #7 SLM Calibration Certificate

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NVLAP® CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.37317

Instrument:	**Sound Level Meter**	*Date Calibrated:* **11/11/2016** *Cal Due:*	
Model:	**2250**	*Status:*	**Received** / **Sent**
Manufacturer:	**Brüel and Kjær**	*In tolerance:*	X / X
Serial number:	**2722859**	*Out of tolerance:*	
Tested with:	**Microphone 4189 s/n 2710791** **Preamplifier ZC0032 s/n 13398**	*See comments:*	
		Contains non-accredited tests: __Yes _X_ No	
Type (class):	**1**	*Calibration service:* __ Basic _X_ Standard	
Customer:	**ACI Acoustical Consultants Inc.**	*Address:*	**5031 - 210 Street** **Edmonton, Alberta, CANADA** **T6M 0A8**
Tel/Fax:	**780-414-6373 / -6376**		

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

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

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

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

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
22.9	99.83	33.4

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

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NVLAP CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.37318

Instrument: **Microphone**
Model: **4189**
Manufacturer: **Brüel & Kjær**
Serial number: **2710791**
Composed of:

Customer: **ACI Acoustical Consultants Inc.**
Tel/Fax: **780-414-6373/-6376**

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

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

Contains non-accredited tests: __Yes _X_ No

Address: **5031 - 210 Street**
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Tested in accordance with the following procedures and standards:
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Instrumentation used for calibration: N-1504 Norsonic Test System:

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

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

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

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Appendix II THE ASSESSMENT OF ENVIRONMENTAL NOISE (GENERAL)

Sound Pressure Level

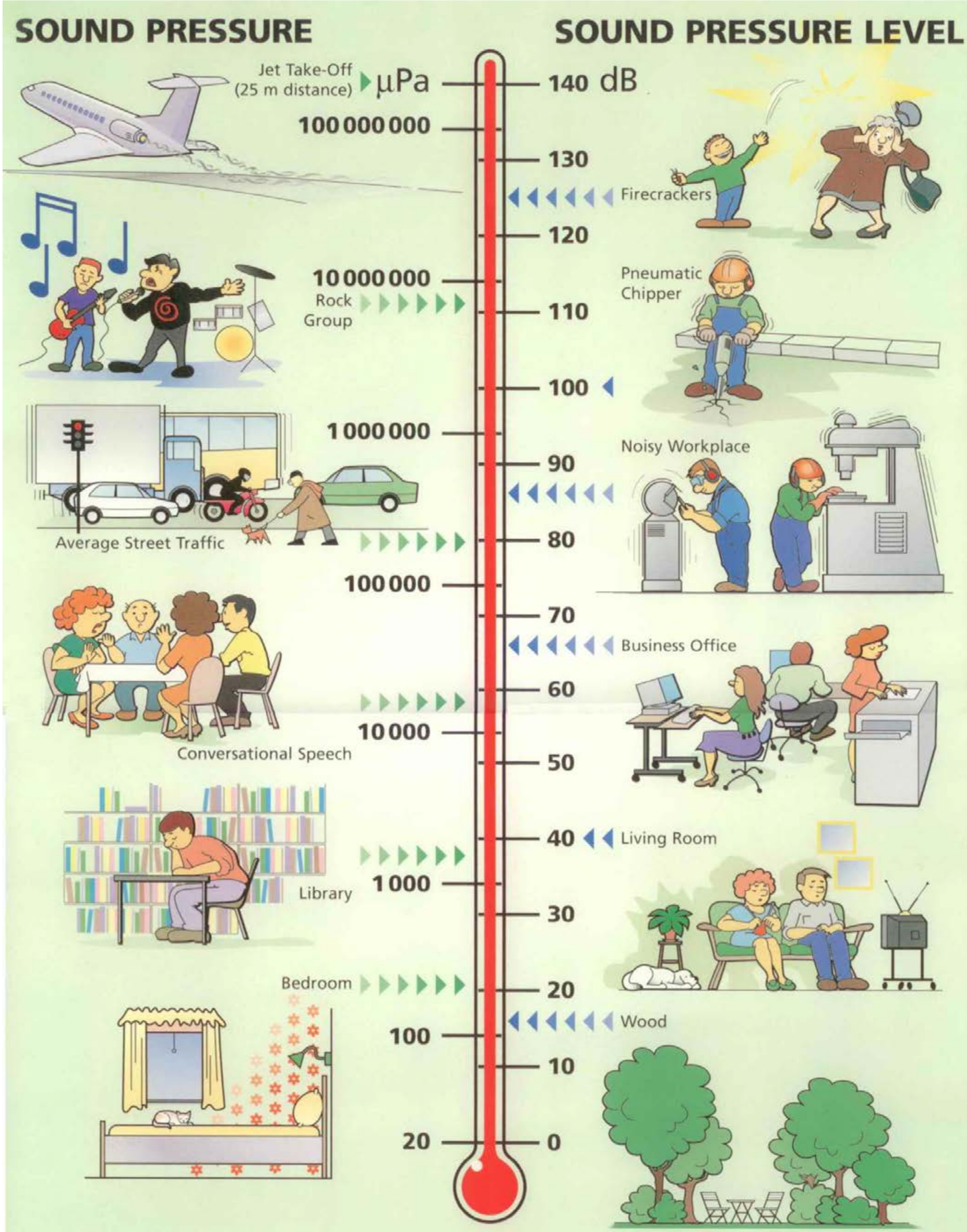
Sound pressure is initially measured in Pascal's (Pa). Humans can hear several orders of magnitude in sound pressure levels, so a more convenient scale is used. This scale is known as the decibel (dB) scale, named after Alexander Graham Bell (telephone guy). It is a base 10 logarithmic scale. When we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

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

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

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

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



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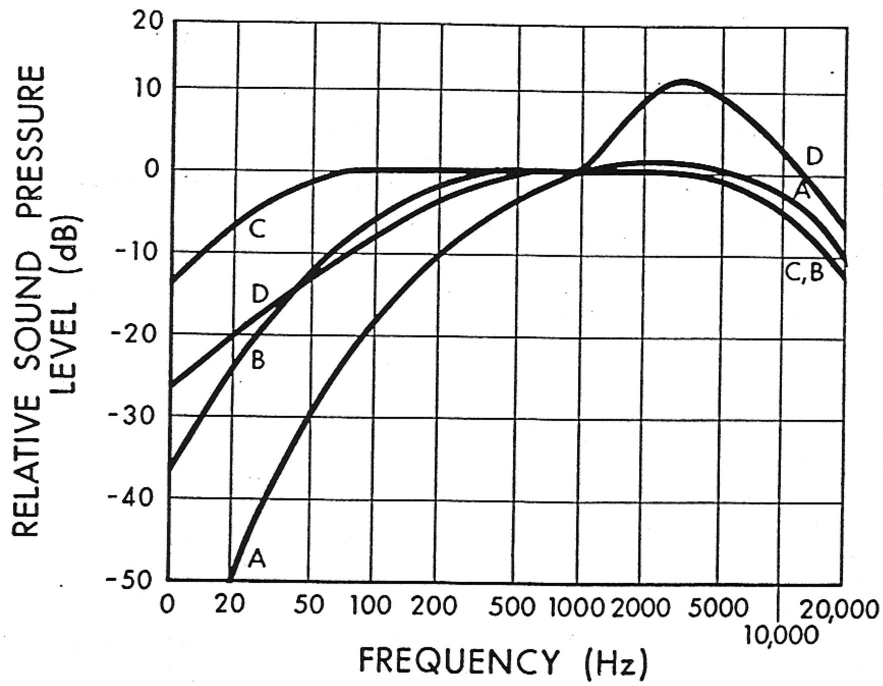
Frequency

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

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

	Whole Octave			1/3 Octave	
Lower Band Limit	Center Frequency	Upper Band Limit	Lower Band Limit	Center Frequency	Upper Band Limit
11	**16**	22	14.1	**16**	17.8
			17.8	**20**	22.4
			22.4	**25**	28.2
22	**31.5**	44	28.2	**31.5**	35.5
			35.5	**40**	44.7
			44.7	**50**	56.2
44	**63**	88	56.2	**63**	70.8
			70.8	**80**	89.1
			89.1	**100**	112
88	**125**	177	112	**125**	141
			141	**160**	178
			178	**200**	224
177	**250**	355	224	**250**	282
			282	**315**	355
			355	**400**	447
355	**500**	710	447	**500**	562
			562	**630**	708
			708	**800**	891
710	**1000**	1420	891	**1000**	1122
			1122	**1250**	1413
			1413	**1600**	1778
1420	**2000**	2840	1778	**2000**	2239
			2239	**2500**	2818
			2818	**3150**	3548
2840	**4000**	5680	3548	**4000**	4467
			4467	**5000**	5623
			5623	**6300**	7079
5680	**8000**	11360	7079	**8000**	8913
			8913	**10000**	11220
			11220	**12500**	14130
11360	**16000**	22720	14130	**16000**	17780
			17780	**20000**	22390

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



Combination of Sounds

When combining multiple sound sources the general equation is:

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

Examples:

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

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

Sound Level Measurements

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

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

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

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

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

Statistical Descriptor

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

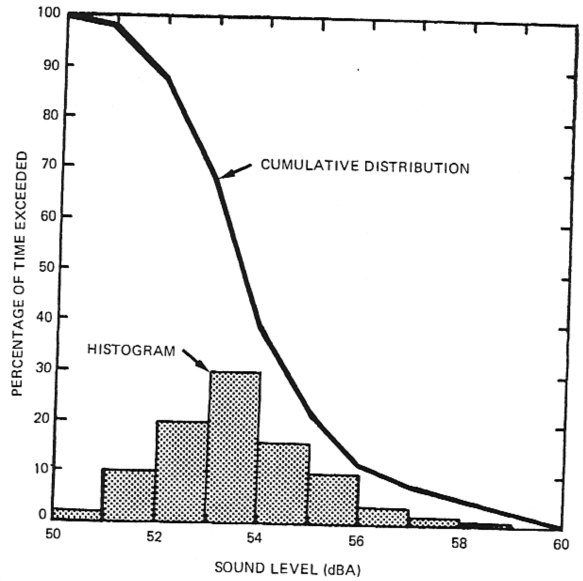


Figure 16.6 Statistically processed community noise showing histogram and cumulative distribution of A weighted sound levels.

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

The most common statistical descriptors are:

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

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

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

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

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

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

Sound Propagation

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

Point Source

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

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

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

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

Examples (note no atmospheric absorption):

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

Line Source

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

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

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

Examples (note no atmospheric absorption):

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

Atmospheric Absorption

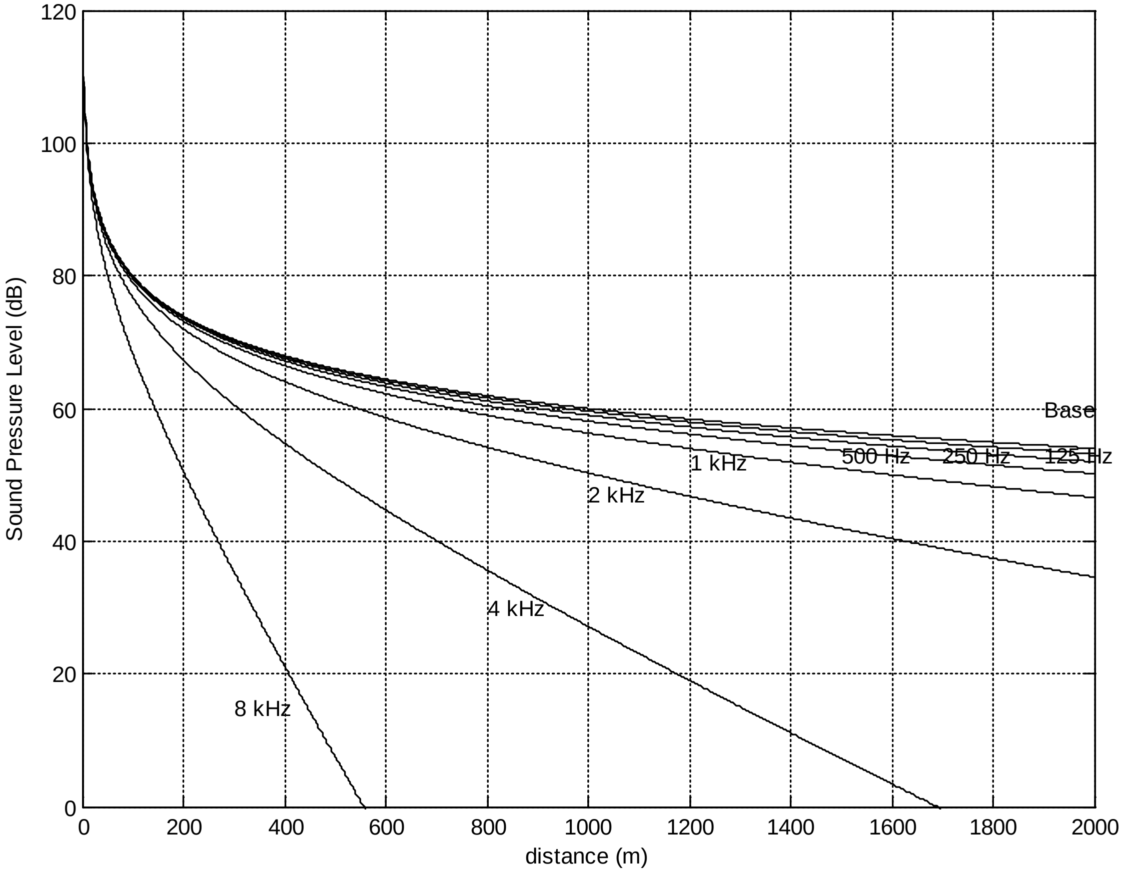
As sound transmits through a medium, there is an attenuation (or dissipation of acoustic energy) which can be attributed to three mechanisms:

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

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

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

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



Atmospheric Absorption at 10ºC and 70% RH

Meteorological Effects

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

Wind

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

Temperature

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

Rain

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

Summary

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

Topographical Effects

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

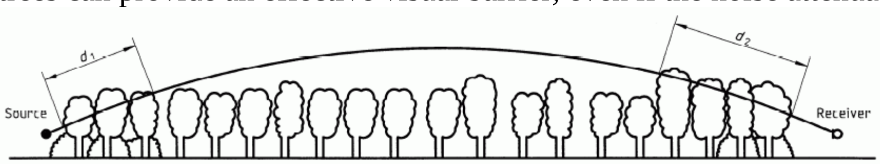
Topography
- One of the most important factors in sound propagation.
- Can provide a natural barrier between source and receiver (i.e. if berm or hill in between).
- Can provide a natural amplifier between source and receiver (i.e. large valley in between or hard reflective surface in between).
- Must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

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

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

Where: A_g is the absorption amount

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



NOTE — $d_f = d_1 + d_2$

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

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

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

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

Tree/Foliage attenuation from ISO 9613-2:1996

Bodies of Water

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

Snow

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

Appendix III SOUND LEVELS OF FAMILIAR NOISE SOURCES

Used with Permission Obtained from ERCB Directive 038 (2007)

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

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

SOUND LEVELS GENERATED BY COMMON APPLIANCES

Used with Permission Obtained from ERCB Directive 038 (2007)

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

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

Appendix IV NOISE MODELLING PARAMETERS

Current Conditions (Year 2017)

Road	Day (Vehicles Per Hour)	Day % Heavy Vehicles	Night (Vehicles Per Hour)	Night % Heavy Vehicles	Speed (km/hr)	Total Volume (vehicles per day)
NEAHD West of Manning Dr. WB	1404	8	260	8	100	23400
NEAHD West of Manning Dr. EB	1404	8	260	8	100	23400
NEAHD West of 153 Ave WB	1188	10	220	10	100	19800
NEAHD West of 153 Ave EB	1188	10	220	10	100	19800
NEAHD North of 130 Avenue NB	1223	8	227	8	100	20390
NEAHD North of 130 Avenue SB	1217	8	225	8	100	20280
NEAHD North of Yellowhead Trail NB	1366	10	253	9	100	22764
NEAHD North of Yellowhead Trail SB	1467	10	272	9	100	24452
NEAHD North of Baseline Road NB	2758	14	511	13	100	45961
NEAHD North of Baseline Road SB	2846	14	527	13	100	47430
NEAHD North of Sherwood Park Freeway NB	2917	9	540	9	100	48617
NEAHD North of Sherwood Park Freeway SB	2906	9	538	9	100	48432
NEAHD North of Whitemud Drive NB	2568	12	476	11	100	42797
NEAHD North of Whitemud Drive SB	2909	12	539	11	100	48477
NEAHD South of Whitemud Drive NB	2248	13	416	12	100	37471
NEAHD South of Whitemud Drive SB	2636	13	488	12	100	43925
Manning Drive N of NEAHD NB	727	8	135	8	100	12120
Manning Drive N of NEAHD SB	727	8	135	8	100	12110
Manning Drive S of NEAHD NB	653	2	121	2	100	10880
Manning Drive S of NEAHD SB	652	3	121	3	100	10870
Manning Dr. NW Off-Ramp (Man Dr to NEAHD - WB)	286	9	53	8	60	4770
Manning Dr. NW Off-Ramp (Man Dr to NEAHD - EB)	160	18	30	17	60	2670
Manning Dr. SW Off-Ramp (NEAHD to Man Dr - NB)	286	9	53	8	60	4770
Manning Dr. SW Off-Ramp (NEAHD to Man Dr - SB)	231	3	43	3	60	3850
Manning Dr. SE Off-Ramp (Man Dr to NEAHD - WB)	231	3	43	3	60	3850
Manning Dr. SE Off-Ramp (Man Dr to NEAHD - EB)	141	4	26	4	60	2350
Manning Dr. NE Off-Ramp (NEAHD to Man Dr - NB)	160	16	30	15	60	2670
Manning Dr. NE Off-Ramp (NEAHD to Man Dr - SB)	141	2	26	2	60	2350
153 Ave West of NEAHD WB	416	6	77	5	60	6930
153 Ave West of NEAHD EB	410	6	76	5	60	6830
153 Ave East of NEAHD WB	121	3	22	5	60	2020
153 Ave East of NEAHD EB	121	3	22	5	60	2010
153 Ave NW Off-ramp (NEAHD to 153 Ave - NB & SB)	209	2	39	2	60	3490
153 Ave SW Off-ramp (153 Ave to NEAHD - NB)	190	20	35	18	60	3170
153 Ave SW Off-ramp (153 Ave to NEAHD - SB)	179	2	33	2	60	2980
153 Ave SE Off-ramp (NEAHD to 153 Ave - NB & SB)	245	2	45	2	60	4090
153 Ave NE Off-ramp (153 Ave to NEAHD - NB)	20	5	4	5	60	340
153 Ave NE Off-ramp (153 Ave to NEAHD - SB)	60	2	11	2	60	1000
18 Street	444	5	82	5	60	7400
130 Avenue West of NEAHD WB	43	20	8	10	60	711
130 Avenue West of NEAHD EB	43	20	8	10	60	711
130 Avenue East of NEAHD WB	121	20	22	10	60	2016
130 Avenue East of NEAHD EB	100	20	18	10	60	1660
130 Avenue NW Off-ramp (NEAHD to 130 Ave - EB & WB)	85	20	16	10	60	1423
130 Avenue NW Off-ramp (130 Ave EB to NEAHD - SB)	14	20	3	10	60	237
130 Avenue NW Off-ramp (130 Ave WB to NEAHD - SB)	28	20	5	10	60	474
130 Avenue SE Off-ramp (NEAHD NB to 130 Ave - EB & WB)	57	20	11	10	60	949
130 Avenue NE Off-ramp (130 Ave EB to NEAHD - NB)	28	20	5	10	60	474
130 Avenue NE Off-ramp (130 Ave WB to NEAHD - NB)	92	20	17	10	60	1541
Yellowhead Trail West of NEAHD WB	1902	12	352	12	100	31706
Yellowhead Trail West of NEAHD EB	1964	12	364	12	100	32735
Yellowhead Trail East of NEAHD WB	1852	14	343	12	100	30868
Yellowhead Trail East of NEAHD EB	1912	14	354	12	100	31869
Yellowhead Trail East of Broadmoor Blvd. WB	1349	11	250	11	100	22484
Yellowhead Trail East of Broadmoor Blvd. EB	1394	11	258	11	100	23225
Yellowhead Trail East of Sherwood Drive WB	1291	12	239	11	100	21515
Yellowhead Trail East of Sherwood Drive EB	1093	12	202	11	100	18210

Current Conditions (Year 2017) (Cont.)

Road	Day (Vehicles Per Hour)	Day % Heavy Vehicles	Night (Vehicles Per Hour)	Night % Heavy Vehicles	Speed (km/hr)	Total Volume (vehicles per day)
Yellowhead Trail NW Off-ramp (NEAHD SB to YH - WB)	46	5	9	5	60	773
Yellowhead Trail NW Off-ramp (NEAHD SB to YH - EB)	557	5	103	5	60	9280
Yellowhead Trail SW Off-ramp (YH EB to NEAHD - SB)	510	5	95	5	60	8506
Yellowhead Trail SW Off-ramp (YH EB to NEAHD - NB)	46	5	9	5	60	773
Yellowhead Trail SE Off-ramp (NEAHD NB to YH - EB)	246	5	46	5	60	4099
Yellowhead Trail SE Off-ramp (NEAHD NB to Broadmoor Blvd - EB)	183	5	34	5	60	3055
Yellowhead Trail SE Off-ramp (YH WB to NEAHD - SB)	496	5	92	5	60	8274
Yellowhead Trail SE Off-ramp (17 Street SB to NEAHD - SB)	142	5	26	5	60	2359
Yellowhead Trail SE Off-ramp (NEAHD NB to YH WB - WB)	777	5	144	5	60	12953
Yellowhead Trail SE Off-ramp (YH EB to Broadmoor Blvd - EB)	545	5	101	5	60	9086
Yellowhead Trail NE Off-ramp (YH WB to NEAHD - NB)	371	5	69	5	60	6187
Broadmoor Blvd North of Yellowhead Trail - NB	326	29	60	29	60	5430
Broadmoor Blvd North of Yellowhead Trail - SB	325	29	60	29	60	5420
Broadmoor Blvd South of Yellowhead Trail - NB	605	13	112	11	60	10080
Broadmoor Blvd South of Yellowhead Trail - SB	605	13	112	11	60	10080
Broadmoor Blvd NW Off-Ramp (BDMR to NEAHD - WB)	219	28	41	28	60	3650
Broadmoor Blvd NW Off-Ramp (NEAHD WB to BDMR - SB NB)	146	12	27	12	60	2430
Broadmoor Blvd SE Off-Ramp (BDMR NB to NEAHD - EB)	158	16	29	16	60	2640
Sherwood Drive North of NEAHD - NB	230	5	43	5	60	3833
Sherwood Drive North of NEAHD - SB	240	5	44	5	60	3993
Sherwood Drive South of NEAHD - NB	374	5	69	5	60	6229
Sherwood Drive South of NEAHD - SB	364	5	67	5	60	6069
Sherwood Drive NW Off-ramp (SRWD Dr to NEAHD - WB)	326	5	60	5	60	5430
Sherwood Drive SW Off-ramp (NEAHD to SRWD Dr - NB & SB)	316	5	59	5	60	5270
Sherwood Drive SE Off-ramp (SRWD Dr to NEAHD - EB)	163	5	30	5	60	2715
Sherwood Drive NE Off-ramp (NEAHD to SRWD Dr - NB & SB)	153	5	28	5	60	2555
Baseline Road West of NEAHD - WB	914	7	169	7	70	15240
Baseline Road West of NEAHD - EB	915	7	169	7	70	15250
Baseline Road East of NEAHD - WB	1196	4	222	4	70	19940
Baseline Road East of NEAHD - EB	1196	4	222	4	70	19940
Baseline Road NW Off-ramp (NEAHD to BSLN - WB)	145	23	27	23	60	2420
Baseline Road NW Off-ramp (NEAHD to BSLN - EB)	149	5	28	5	60	2480
Baseline Road NW Off-ramp (BSLN to NEAHD - SB)	344	5	64	5	60	5740
Baseline Road SW Off-ramp (BSLN to NEAHD - SB)	66	7	12	7	60	1100
Baseline Road SE Off-ramp (NEAHD to BSLN - WB)	66	7	12	7	60	1100
Baseline Road SE Off-ramp (NEAHD to BSLN - EB)	344	4	64	4	60	5740
Baseline Road SE Off-ramp (BSLN EB to NEAHD - NB)	146	22	27	22	60	2430
Baseline Road NE Off-ramp (BSLN WB to NEAHD - NB)	149	5	28	5	60	2480
Sherwood Park Freeway West of 17 Street - WB	1469	8	272	8	80	24476
Sherwood Park Freeway West of 17 Street - EB	1466	8	272	8	80	24440
Sherwood Park Freeway West of NEAHD - WB	1469	9	272	9	80	24476
Sherwood Park Freeway West of NEAHD - EB	1466	9	272	9	80	24440
Sherwood Park Freeway East of NEAHD - WB	1119	3	207	3	70	18646
Sherwood Park Freeway East of NEAHD - EB	1067	3	198	3	70	17786
17 Street North of Sherwood Park Freeway - NB	278	16	51	16	60	4630
17 Street North of Sherwood Park Freeway - SB	262	16	48	16	60	4360
17 Street South of Sherwood Park Freeway - NB	307	16	57	16	60	5110
17 Street South of Sherwood Park Freeway - SB	298	16	55	16	60	4960
17 Street NW Off-Ramp (17 Street SB to SRWD PRK FWY - WB)	97	10	18	10	60	1610
17 Street NW Off-Ramp (17 Street NB to SRWD PRK FWY - WB)	62	13	12	13	60	1040
17 Street SW Off-Ramp (SRWD PRK FWY EB to 17 Street - SB)	68	15	13	15	60	1130
17 Street SW Off-Ramp (SRWD PRK FWY EB to 17 Street - NB)	98	13	18	13	60	1640
17 Street SE Off-Ramp (17 Street SB to SRWD PRK FWY - EB)	87	12	16	12	60	1453
17 Street SE Off-Ramp (17 Street NB to SRWD PRK FWY - EB)	184	12	34	12	60	3067
17 Street SW Off-Ramp (SRWD PRK FWY EB to 17 Street - NB)	184	12	34	12	60	3067

Current Conditions (Year 2017) (Cont.)

Road	Day (Vehicles Per Hour)	Day % Heavy Vehicles	Night (Vehicles Per Hour)	Night % Heavy Vehicles	Speed (km/hr)	Total Volume (vehicles per day)
17 Street NE Off-Ramp (SRWD PRK FWY WB to 17 Street - NB)	107	12	20	12	60	1776
Sherwood Park Freeway NW Off-ramp (NEAHD SB to SWRD PRK FWY - WB)	505	15	94	15	60	8419
Sherwood Park Freeway NW Off-ramp (SWRD PRK FWY WB to NEAHD - SB)	207	3	38	3	60	3452
Sherwood Park Freeway SW Off-ramp (NEAHD SB to SWRD PRK FWY - EB)	191	7	35	7	60	3181
Sherwood Park Freeway SW Off-ramp (SWRD PRK FWY EB to NEAHD - NB)	506	14	94	14	60	8434
Sherwood Park Freeway SW Off-ramp (SWRD PRK FWY EB to NEAHD - SB)	203	20	38	20	60	3392
Sherwood Park Freeway SE Off-ramp (NEAHD NB to SWRD PRK FWY - EB)	207	3	38	3	60	3452
Sherwood Park Freeway NE Off-ramp (NEAHD NB to SWRD PRK FWY - WB)	203	18	38	18	60	3392
Sherwood Park Freeway NE Off-ramp (SWRD PRK FWY WB to NEAHD - NB)	191	4	35	4	60	3181
Whitemud Drive West of NEAHD - WB	1225	8	227	8	80	20420
Whitemud Drive West of NEAHD - EB	1225	8	227	8	80	20420
Whitemud Drive East of NEAHD - WB	736	3	136	3	80	12260
Whitemud Drive East of NEAHD - EB	736	3	136	3	80	12260
Whitemud Drive NW Off-ramp (NEAHD SB to WHTMD - WB)	515	11	95	11	60	8580
Whitemud Drive NW Off-ramp (WHTMD WB to NEAHD - SB)	127	2	24	2	60	2120
Whitemud Drive SW Off-ramp (NEAHD SB to WHTMD - EB)	36	17	7	17	60	600
Whitemud Drive SW Off-ramp (WHTMD EB to NEAHD - SB)	138	17	26	17	60	2300
Whitemud Drive SE Off-ramp (NEAHD NB to WHTMD - EB)	127	2	24	2	60	2120
Whitemud Drive SE Off-ramp (WHTMD EB to NEAHD - NB)	515	11	95	11	60	8580
Whitemud Drive NE Off-ramp (NEAHD NB to WHTMD - WB)	138	19	26	19	60	2300
Whitemud Drive NE Off-ramp (WHTMD WB to NEAHD - NB)	36	5	7	5	60	600
Collector Road	480	3	89	3	60	8000
Residential Streets	20	5	5	3	60	345

Future Conditions (Year 2041)

Road	Day (Vehicles Per Hour)	Day % Heavy Vehicles	Night (Vehicles Per Hour)	Night % Heavy Vehicles	Speed (km/hr)	Total Volume (vehicles per day)
NEAHD West of Manning Dr. WB	2625	8	486	8	100	43750
NEAHD West of Manning Dr. EB	2715	8	503	8	100	45250
NEAHD West of 153 Ave WB	2505	10	464	10	100	41750
NEAHD West of 153 Ave EB	2490	10	461	10	100	41500
NEAHD North of 130 Avenue NB	3015	8	558	8	100	50250
NEAHD North of 130 Avenue SB	3165	8	586	8	100	52750
NEAHD North of Yellowhead Trail NB	2880	10	533	9	100	48000
NEAHD North of Yellowhead Trail SB	3075	10	569	9	100	51250
NEAHD North of Baseline Road NB	3900	14	722	13	100	65000
NEAHD North of Baseline Road SB	3780	14	700	13	100	63000
NEAHD North of Sherwood Park Freeway NB	3675	9	681	9	100	61250
NEAHD North of Sherwood Park Freeway SB	3570	9	661	9	100	59500
NEAHD North of Whitemud Drive NB	3375	12	625	11	100	56250
NEAHD North of Whitemud Drive SB	3195	12	592	11	100	53250
NEAHD South of Whitemud Drive NB	2955	13	547	12	100	49250
NEAHD South of Whitemud Drive SB	2895	13	536	12	100	48250
Manning Drive N of NEAHD NB	1875	8	347	8	100	31250
Manning Drive N of NEAHD SB	1665	8	308	8	100	27750
Manning Drive S of NEAHD NB	1350	2	250	2	100	22500
Manning Drive S of NEAHD SB	1245	3	231	3	100	20750
Manning Dr. NW Off-Ramp (Man Dr to NEAHD - WB)	555	9	103	8	60	9250
Manning Dr. NW Off-Ramp (Man Dr to NEAHD - EB)	375	18	69	17	60	6250
Manning Dr. SW Off-Ramp (NEAHD to Man Dr - NB)	555	9	103	8	60	9250
Manning Dr. SW Off-Ramp (NEAHD to Man Dr - SB)	300	3	56	3	60	5000
Manning Dr. SE Off-Ramp (Man Dr to NEAHD - WB)	255	3	47	3	60	4250
Manning Dr. SE Off-Ramp (Man Dr to NEAHD - EB)	255	4	47	4	60	4250
Manning Dr. NE Off-Ramp (NEAHD to Man Dr - NB)	480	16	89	15	60	8000
Manning Dr. NE Off-Ramp (NEAHD to Man Dr - SB)	210	2	39	2	60	3500
153 Ave West of NEAHD WB	780	6	144	5	60	13000
153 Ave West of NEAHD EB	990	6	183	5	60	16500
153 Ave East of NEAHD WB	1095	3	203	5	60	18250
153 Ave East of NEAHD EB	1140	3	211	5	60	19000
153 Ave NW Off-ramp (NEAHD to 153 Ave - NB & SB)	480	2	89	2	60	8000
153 Ave SW Off-ramp (153 Ave to NEAHD - NB)	165	20	31	18	60	2750
153 Ave SW Off-ramp (153 Ave to NEAHD - SB)	555	2	103	2	60	9250
153 Ave SE Off-ramp (NEAHD to 153 Ave - NB & SB)	900	2	167	2	60	15000
153 Ave NE Off-ramp (153 Ave to NEAHD - NB)	225	5	42	5	60	3750
153 Ave NE Off-ramp (153 Ave to NEAHD - SB)	600	2	111	2	60	10000
130 Avenue West of NEAHD WB	90	20	17	5	60	1500
130 Avenue West of NEAHD EB	90	20	17	5	60	1500
130 Avenue East of NEAHD WB	255	20	47	10	60	4250
130 Avenue East of NEAHD EB	210	20	39	10	60	3500
130 Avenue NW Off-ramp (NEAHD to 130 Ave - EB & WB)	180	20	33	10	60	3000
130 Avenue NW Off-ramp (130 Ave EB to NEAHD - SB)	30	20	6	10	60	500
130 Avenue NW Off-ramp (130 Ave WB to NEAHD - SB)	60	20	11	10	60	1000
130 Avenue SE Off-ramp (NEAHD NB to 130 Ave - EB & WB)	120	20	22	10	60	2000
130 Avenue NE Off-ramp (130 Ave EB to NEAHD - NB)	60	20	11	10	60	1000
130 Avenue NE Off-ramp (130 Ave WB to NEAHD - NB)	195	20	36	10	60	3250
Yellowhead Trail West of NEAHD WB	2460	12	456	10	100	41000
Yellowhead Trail West of NEAHD EB	2370	12	439	10	100	39500
Yellowhead Trail East of NEAHD WB	1935	14	358	12	100	32250
Yellowhead Trail East of NEAHD EB	1470	14	272	12	100	24500
Yellowhead Trail East of Broadmoor Blvd. WB	2370	11	439	12	100	39500
Yellowhead Trail East of Broadmoor Blvd. EB	1500	11	278	12	100	25000
Yellowhead Trail East of Sherwood Drive WB	2100	12	389	11	100	35000
Yellowhead Trail East of Sherwood Drive EB	2100	12	389	11	100	35000

Future Conditions (Year 2041) (Cont.)

Road	Day (Vehicles Per Hour)	Day % Heavy Vehicles	Night (Vehicles Per Hour)	Night % Heavy Vehicles	Speed (km/hr)	Total Volume (vehicles per day)
Yellowhead Trail NW Off-ramp (NEAHD SB to YH - WB)	60	5	11	5	60	1000
Yellowhead Trail NW Off-ramp (NEAHD SB to YH - EB)	720	5	133	5	60	12000
Yellowhead Trail SW Off-ramp (YH EB to NEAHD - SB)	660	5	122	5	60	11000
Yellowhead Trail SW Off-ramp (YH EB to NEAHD - NB)	60	5	11	5	60	1000
Yellowhead Trail SE Off-ramp (NEAHD NB to YH - EB)	318	5	59	5	60	5300
Yellowhead Trail SE Off-ramp (NEAHD NB to Broadmoor Blvd - EB)	237	5	44	5	60	3950
Yellowhead Trail SE Off-ramp (YH WB to NEAHD - SB)	642	5	119	5	60	10700
Yellowhead Trail SE Off-ramp (17 Street SB to NEAHD - SB)	183	5	34	5	60	3050
Yellowhead Trail SE Off-ramp (NEAHD NB to YH WB - WB)	1005	5	186	5	60	16750
Yellowhead Trail SE Off-ramp (YH EB to Broadmoor Blvd - EB)	705	5	131	5	60	11750
Yellowhead Trail NE Off-ramp (YH WB to NEAHD - NB)	480	5	89	5	60	8000
Broadmoor Blvd North of Yellowhead Trail - NB	510	29	94	29	60	8500
Broadmoor Blvd North of Yellowhead Trail - SB	525	29	97	29	60	8750
Broadmoor Blvd South of Yellowhead Trail - NB	750	13	139	11	60	12500
Broadmoor Blvd South of Yellowhead Trail - SB	780	13	144	11	60	13000
Broadmoor Blvd NW Off-Ramp (BDMR to NEAHD - WB)	507	28	94	28	60	8450
Broadmoor Blvd NW Off-Ramp (NEAHD WB to BDMR - SB NB)	300	12	56	12	60	5000
Broadmoor Blvd SE Off-Ramp (BDMR NB to NEAHD - EB)	840	16	156	16	60	14000
Sherwood Drive North of NEAHD - NB	360	5	67	5	60	6000
Sherwood Drive North of NEAHD - SB	375	5	69	5	60	6250
Sherwood Drive South of NEAHD - NB	585	5	108	5	60	9750
Sherwood Drive South of NEAHD - SB	570	5	106	5	60	9500
Sherwood Drive NW Off-ramp (SRWD Dr to NEAHD - WB)	510	5	94	5	60	8500
Sherwood Drive SW Off-ramp (NEAHD to SRWD Dr - NB & SB)	495	5	92	5	60	8250
Sherwood Drive SE Off-ramp (SRWD Dr to NEAHD - EB)	255	5	47	5	60	4250
Sherwood Drive NE Off-ramp (NEAHD to SRWD Dr - NB & SB)	240	5	44	5	60	4000
Baseline Road West of NEAHD - WB	1920	7	356	7	70	32000
Baseline Road West of NEAHD - EB	1635	7	303	7	70	27250
Baseline Road East of NEAHD - WB	1860	4	344	4	70	31000
Baseline Road East of NEAHD - EB	1560	4	289	4	70	26000
Baseline Road NW Off-ramp (NEAHD to BSLN - WB)	630	23	117	23	60	10500
Baseline Road NW Off-ramp (NEAHD to BSLN - EB)	300	5	56	5	60	5000
Baseline Road NW Off-ramp (BSLN to NEAHD - SB)	480	5	89	5	60	8000
Baseline Road SW Off-ramp (BSLN to NEAHD - SB)	240	7	44	7	60	4000
Baseline Road SE Off-ramp (NEAHD to BSLN - WB)	300	7	56	7	60	5000
Baseline Road SE Off-ramp (NEAHD to BSLN - EB)	390	4	72	4	60	6500
Baseline Road SE Off-ramp (BSLN EB to NEAHD - NB)	525	22	97	22	60	8750
Baseline Road NE Off-ramp (BSLN WB to NEAHD - NB)	390	5	72	5	60	6500
Sherwood Park Freeway West of 17 Street - WB	2085	8	386	8	80	34750
Sherwood Park Freeway West of 17 Street - EB	1920	8	356	8	80	32000
Sherwood Park Freeway West of NEAHD - WB	2175	9	403	9	80	36250
Sherwood Park Freeway West of NEAHD - EB	2070	9	383	9	80	34500
Sherwood Park Freeway East of NEAHD - WB	1530	3	283	3	70	25500
Sherwood Park Freeway East of NEAHD - EB	1500	3	278	3	70	25000
17 Street North of Sherwood Park Freeway - NB	394	16	73	16	60	6573
17 Street North of Sherwood Park Freeway - SB	371	16	69	16	60	6190
17 Street South of Sherwood Park Freeway - NB	435	16	81	16	60	7255
17 Street South of Sherwood Park Freeway - SB	423	16	78	16	60	7042
17 Street NW Off-Ramp (17 Street SB to SRWD PRK FWY - WB)	180	10	33	10	60	3000
17 Street NW Off-Ramp (17 Street NB to SRWD PRK FWY - WB)	180	13	33	13	60	3000
17 Street SW Off-Ramp (SRWD PRK FWY EB to 17 Street - SB)	105	15	19	15	60	1750
17 Street SW Off-Ramp (SRWD PRK FWY EB to 17 Street - NB)	165	13	31	13	60	2750
17 Street SE Off-Ramp (17 Street SB to SRWD PRK FWY - EB)	135	12	25	12	60	2250
17 Street SE Off-Ramp (17 Street NB to SRWD PRK FWY - EB)	285	12	53	12	60	4750
17 Street SW Off-Ramp (SRWD PRK FWY EB to 17 Street - NB)	285	12	53	12	60	4750

Future Conditions (Year 2041) (Cont.)

Road	Day (Vehicles Per Hour)	Day % Heavy Vehicles	Night (Vehicles Per Hour)	Night % Heavy Vehicles	Speed (km/hr)	Total Volume (vehicles per day)
17 Street NE Off-Ramp (SRWD PRK FWY WB to 17 Street - NB)	165	12	31	12	60	2750
Sherwood Park Freeway NW Off-ramp (NEAHD SB to SWRD PRK FWY - WB)	735	15	136	15	60	12250
Sherwood Park Freeway NW Off-ramp (SWRD PRK FWY WB to NEAHD - SB)	240	3	44	3	60	4000
Sherwood Park Freeway SW Off-ramp (NEAHD SB to SWRD PRK FWY - EB)	210	7	39	7	60	3500
Sherwood Park Freeway SW Off-ramp (SWRD PRK FWY EB to NEAHD - NB)	780	14	144	14	60	13000
Sherwood Park Freeway SW Off-ramp (SWRD PRK FWY EB to NEAHD - SB)	330	20	61	20	60	5500
Sherwood Park Freeway SE Off-ramp (NEAHD NB to SWRD PRK FWY - EB)	330	3	61	3	60	5500
Sherwood Park Freeway NE Off-ramp (NEAHD NB to SWRD PRK FWY - WB)	420	18	78	18	60	7000
Sherwood Park Freeway NE Off-ramp (SWRD PRK FWY WB to NEAHD - NB)	270	4	50	4	60	4500
Whitemud Drive West of NEAHD - WB	2010	8	372	8	80	33500
Whitemud Drive West of NEAHD - EB	1485	8	275	8	80	24750
Whitemud Drive East of NEAHD - WB	1425	3	264	3	80	23750
Whitemud Drive East of NEAHD - EB	840	3	156	3	80	14000
Whitemud Drive NW Off-ramp (NEAHD SB to WHTMD - WB)	705	11	131	11	60	11750
Whitemud Drive NW Off-ramp (WHTMD WB to NEAHD - SB)	240	2	44	2	60	4000
Whitemud Drive SW Off-ramp (NEAHD SB to WHTMD - EB)	150	17	28	17	60	2500
Whitemud Drive SW Off-ramp (WHTMD EB to NEAHD - SB)	255	17	47	17	60	4250
Whitemud Drive SE Off-ramp (NEAHD NB to WHTMD - EB)	150	2	28	2	60	2500
Whitemud Drive SE Off-ramp (WHTMD EB to NEAHD - NB)	690	11	128	11	60	11500
Whitemud Drive NE Off-ramp (NEAHD NB to WHTMD - WB)	315	19	58	19	60	5250
Whitemud Drive NE Off-ramp (WHTMD WB to NEAHD - NB)	195	5	36	5	60	3250
Collector Road	480	3	89	3	60	8000
Residential Streets	20	3	5	3	60	345

Long-Term Conditions (2.5M population)

Road	Day (Vehicles Per Hour)	Day % Heavy Vehicles	Night (Vehicles Per Hour)	Night % Heavy Vehicles	Speed (km/hr)	Total Volume (vehicles per day)
NEAHD West of Manning Dr. WB	3972	8	736	8	100	66200
NEAHD West of Manning Dr. EB	4032	8	747	8	100	67200
NEAHD West of 153 Ave WB	4065	10	753	10	100	67750
NEAHD West of 153 Ave EB	4272	10	791	10	100	71200
NEAHD North of 130 Avenue NB	4947	8	916	8	100	82450
NEAHD North of 130 Avenue SB	5454	8	1010	8	100	90900
NEAHD North of Yellowhead Trail NB	5007	10	927	9	100	83450
NEAHD North of Yellowhead Trail SB	5178	10	959	9	100	86300
NEAHD North of Baseline Road NB	5754	14	1066	13	100	95900
NEAHD North of Baseline Road SB	5904	14	1093	13	100	98400
NEAHD North of Sherwood Park Freeway NB	5634	9	1043	9	100	93900
NEAHD North of Sherwood Park Freeway SB	5604	9	1038	9	100	93400
NEAHD North of Whitemud Drive NB	5691	12	1054	11	100	94850
NEAHD North of Whitemud Drive SB	5439	12	1007	11	100	90650
NEAHD South of Whitemud Drive NB	4980	13	922	12	100	83000
NEAHD South of Whitemud Drive SB	4416	13	818	12	100	73600
Manning Drive N of NEAHD NB	4116	8	762	8	100	68600
Manning Drive N of NEAHD SB	3954	8	732	8	100	65900
Manning Drive S of NEAHD NB	2535	2	469	2	100	42250
Manning Drive S of NEAHD SB	2226	3	412	3	100	37100
Manning Dr. NW Off-Ramp (Man Dr to NEAHD - WB)	1329	9	246	8	60	22150
Manning Dr. NW Off-Ramp (Man Dr to NEAHD - EB)	966	18	179	17	60	16100
Manning Dr. SW Off-Ramp (NEAHD to Man Dr - NB)	1143	9	212	8	60	19050
Manning Dr. SW Off-Ramp (NEAHD to Man Dr - SB)	198	3	37	3	60	3300
Manning Dr. SE Off-Ramp (Man Dr to NEAHD - WB)	237	3	44	3	60	3950
Manning Dr. SE Off-Ramp (Man Dr to NEAHD - EB)	615	4	114	4	60	10250
Manning Dr. NE Off-Ramp (NEAHD to Man Dr - NB)	1290	16	239	15	60	21500
Manning Dr. NE Off-Ramp (NEAHD to Man Dr - SB)	369	2	68	2	60	6150
153 Ave West of NEAHD WB	528	6	98	5	60	8800
153 Ave West of NEAHD EB	888	6	164	5	60	14800
153 Ave East of NEAHD WB	1485	3	275	5	60	24750
153 Ave East of NEAHD EB	1569	3	291	5	60	26150
153 Ave NW Off-ramp (NEAHD to 153 Ave - NB & SB)	537	2	99	2	60	8950
153 Ave SW Off-ramp (153 Ave to NEAHD - NB)	108	20	20	18	60	1800
153 Ave SW Off-ramp (153 Ave to NEAHD - SB)	687	2	127	2	60	11450
153 Ave SE Off-ramp (NEAHD to 153 Ave - NB & SB)	1332	2	247	2	60	22200
153 Ave NE Off-ramp (153 Ave to NEAHD - NB)	342	5	63	5	60	5700
153 Ave NE Off-ramp (153 Ave to NEAHD - SB)	1020	2	189	2	60	17000
130 Avenue West of NEAHD WB	426	20	79	10	60	7100
130 Avenue West of NEAHD EB	246	20	46	10	60	4100
130 Avenue East of NEAHD WB	450	20	83	10	60	7500
130 Avenue East of NEAHD EB	606	20	112	10	60	10100
130 Avenue NW Off-ramp (NEAHD to 130 Ave - EB & WB)	501	20	93	10	60	8350
130 Avenue NW Off-ramp (130 Ave EB to NEAHD - SB)	135	20	25	10	60	2250
130 Avenue NW Off-ramp (130 Ave WB to NEAHD - SB)	90	20	17	10	60	1500
130 Avenue SE Off-ramp (NEAHD NB to 130 Ave - EB & WB)	465	20	86	10	60	7750
130 Avenue NE Off-ramp (130 Ave EB to NEAHD - NB)	81	20	15	10	60	1350
130 Avenue NE Off-ramp (130 Ave WB to NEAHD - NB)	324	20	60	10	60	5400
Yellowhead Trail West of NEAHD WB	3516	12	651	12	100	58600
Yellowhead Trail West of NEAHD EB	2421	12	448	12	100	40350
Yellowhead Trail East of NEAHD WB	3645	14	675	12	100	60750
Yellowhead Trail East of NEAHD EB	2958	14	548	12	100	49300
Yellowhead Trail East of Broadmoor Blvd. WB	4401	11	815	11	100	73350
Yellowhead Trail East of Broadmoor Blvd. EB	3453	11	639	11	100	57550
Yellowhead Trail East of Sherwood Drive WB	4251	12	787	11	100	70850
Yellowhead Trail East of Sherwood Drive EB	4443	12	823	11	100	74050

Long-term Conditions (2.5M population) (Cont.)

Road	Day (Vehicles Per Hour)	Day % Heavy Vehicles	Night (Vehicles Per Hour)	Night % Heavy Vehicles	Speed (km/hr)	Total Volume (vehicles per day)
Yellowhead Trail NW Off-ramp (NEAHD SB to YH - WB)	228	5	42	5	60	3800
Yellowhead Trail NW Off-ramp (NEAHD SB to YH - EB)	1197	5	222	5	60	19950
Yellowhead Trail SW Off-ramp (YH EB to NEAHD - SB)	1011	5	187	5	60	16850
Yellowhead Trail SW Off-ramp (YH EB to NEAHD - NB)	408	5	76	5	60	6800
Yellowhead Trail SE Off-ramp (NEAHD NB to YH - EB)	771	5	143	5	60	12850
Yellowhead Trail SE Off-ramp (NEAHD NB to Broadmoor Blvd - EB)	270	5	50	5	60	4500
Yellowhead Trail SE Off-ramp (YH WB to NEAHD - SB)	930	5	172	5	60	15500
Yellowhead Trail SE Off-ramp (17 Street SB to NEAHD - SB)	210	5	39	5	60	3500
Yellowhead Trail SE Off-ramp (NEAHD NB to YH WB - WB)	990	5	183	5	60	16500
Yellowhead Trail SE Off-ramp (YH EB to Broadmoor Blvd - EB)	567	5	105	5	60	9450
Yellowhead Trail NE Off-ramp (YH WB to NEAHD - NB)	876	5	162	5	60	14600
Broadmoor Blvd North of Yellowhead Trail - NB	723	29	134	29	60	12050
Broadmoor Blvd North of Yellowhead Trail - SB	792	29	147	29	60	13200
Broadmoor Blvd South of Yellowhead Trail - NB	1050	13	194	11	60	17500
Broadmoor Blvd South of Yellowhead Trail - SB	1203	13	223	11	60	20050
Broadmoor Blvd NW Off-Ramp (BDMR to NEAHD - WB)	657	28	122	28	60	10950
Broadmoor Blvd NW Off-Ramp (NEAHD WB to BDMR - SB NB)	483	12	89	12	60	8050
Broadmoor Blvd SE Off-Ramp (BDMR NB to NEAHD - EB)	1275	16	236	16	60	21250
Sherwood Drive North of NEAHD - NB	570	5	106	5	60	9500
Sherwood Drive North of NEAHD - SB	555	5	103	5	60	9250
Sherwood Drive South of NEAHD - NB	930	5	172	5	60	15500
Sherwood Drive South of NEAHD - SB	1050	5	194	5	60	17500
Sherwood Drive NW Off-ramp (SRWD Dr to NEAHD - WB)	600	5	111	5	60	10000
Sherwood Drive SW Off-ramp (NEAHD to SRWD Dr - NB & SB)	750	5	139	5	60	12500
Sherwood Drive SE Off-ramp (SRWD Dr to NEAHD - EB)	465	5	86	5	60	7750
Sherwood Drive NE Off-ramp (NEAHD to SRWD Dr - NB & SB)	450	5	83	5	60	7500
Baseline Road West of NEAHD - WB	2280	7	422	7	70	38000
Baseline Road West of NEAHD - EB	1860	7	344	7	70	31000
Baseline Road East of NEAHD - WB	2010	4	372	4	70	33500
Baseline Road East of NEAHD - EB	1770	4	328	4	70	29500
Baseline Road NW Off-ramp (NEAHD to BSLN - WB)	810	23	150	23	60	13500
Baseline Road NW Off-ramp (NEAHD to BSLN - EB)	330	5	61	5	60	5500
Baseline Road NW Off-ramp (BSLN to NEAHD - SB)	540	5	100	5	60	9000
Baseline Road SW Off-ramp (BSLN to NEAHD - SB)	360	7	67	7	60	6000
Baseline Road SE Off-ramp (NEAHD to BSLN - WB)	390	7	72	7	60	6500
Baseline Road SE Off-ramp (NEAHD to BSLN - EB)	540	4	100	4	60	9000
Baseline Road SE Off-ramp (BSLN EB to NEAHD - NB)	600	22	111	22	60	10000
Baseline Road NE Off-ramp (BSLN WB to NEAHD - NB)	450	5	83	5	60	7500
Sherwood Park Freeway West of 17 Street - WB	2499	8	463	8	80	41650
Sherwood Park Freeway West of 17 Street - EB	2340	8	433	8	80	39000
Sherwood Park Freeway West of NEAHD - WB	2673	9	495	9	80	44550
Sherwood Park Freeway West of NEAHD - EB	2430	9	450	9	80	40500
Sherwood Park Freeway East of NEAHD - WB	1731	3	321	3	70	28850
Sherwood Park Freeway East of NEAHD - EB	1710	3	317	3	70	28500
17 Street North of Sherwood Park Freeway - NB	505	16	93	16	60	8414
17 Street North of Sherwood Park Freeway - SB	656	16	122	16	60	10938
17 Street South of Sherwood Park Freeway - NB	883	16	164	16	60	14725
17 Street South of Sherwood Park Freeway - SB	555	16	103	16	60	9256
17 Street NW Off-Ramp (17 Street SB to SRWD PRK FWY - WB)	99	10	18	10	60	1650
17 Street NW Off-Ramp (17 Street NB to SRWD PRK FWY - WB)	186	13	34	13	60	3100
17 Street SW Off-Ramp (SRWD PRK FWY EB to 17 Street - SB)	249	15	46	15	60	4150
17 Street SW Off-Ramp (SRWD PRK FWY EB to 17 Street - NB)	141	13	26	13	60	2350
17 Street SE Off-Ramp (17 Street SB to SRWD PRK FWY - EB)	93	12	17	12	60	1550
17 Street SE Off-Ramp (17 Street NB to SRWD PRK FWY - EB)	387	12	72	12	60	6450
17 Street SW Off-Ramp (SRWD PRK FWY EB to 17 Street - NB)	312	12	58	12	60	5200

Long-term Conditions (2.5M population) (Cont.)

Road	Day (Vehicles Per Hour)	Day % Heavy Vehicles	Night (Vehicles Per Hour)	Night % Heavy Vehicles	Speed (km/hr)	Total Volume (vehicles per day)
17 Street NE Off-Ramp (SRWD PRK FWY WB to 17 Street - NB)	147	12	27	12	60	2450
Sherwood Park Freeway NW Off-ramp (NEAHD SB to SWRD PRK FWY - WB)	855	15	158	15	60	14250
Sherwood Park Freeway NW Off-ramp (SWRD PRK FWY WB to NEAHD - SB)	360	3	67	3	60	6000
Sherwood Park Freeway SW Off-ramp (NEAHD SB to SWRD PRK FWY - EB)	240	7	44	7	60	4000
Sherwood Park Freeway SW Off-ramp (SWRD PRK FWY EB to NEAHD - NB)	810	14	150	14	60	13500
Sherwood Park Freeway SW Off-ramp (SWRD PRK FWY EB to NEAHD - SB)	570	20	106	20	60	9500
Sherwood Park Freeway SE Off-ramp (NEAHD NB to SWRD PRK FWY - EB)	420	3	78	3	60	7000
Sherwood Park Freeway NE Off-ramp (NEAHD NB to SWRD PRK FWY - WB)	717	18	133	18	60	11950
Sherwood Park Freeway NE Off-ramp (SWRD PRK FWY WB to NEAHD - NB)	270	4	50	4	60	4500
Whitemud Drive West of NEAHD - WB	3360	8	622	8	80	56000
Whitemud Drive West of NEAHD - EB	2700	8	500	8	80	45000
Whitemud Drive East of NEAHD - WB	1560	3	289	3	80	26000
Whitemud Drive East of NEAHD - EB	1212	3	224	3	80	20200
Whitemud Drive NW Off-ramp (NEAHD SB to WHTMD - WB)	1650	11	306	11	60	27500
Whitemud Drive NW Off-ramp (WHTMD WB to NEAHD - SB)	237	2	44	2	60	3950
Whitemud Drive SW Off-ramp (NEAHD SB to WHTMD - EB)	129	17	24	17	60	2150
Whitemud Drive SW Off-ramp (WHTMD EB to NEAHD - SB)	504	17	93	17	60	8400
Whitemud Drive SE Off-ramp (NEAHD NB to WHTMD - EB)	258	2	48	2	60	4300
Whitemud Drive SE Off-ramp (WHTMD EB to NEAHD - NB)	1371	11	254	11	60	22850
Whitemud Drive NE Off-ramp (NEAHD NB to WHTMD - WB)	642	19	119	19	60	10700
Whitemud Drive NE Off-ramp (WHTMD WB to NEAHD - NB)	240	5	44	5	60	4000
Collector Road	480	3	89	3	60	8000
Residential Streets	20	3	5	3	60	345

Appendix V DATA REMOVAL

Data Removal Noise Monitoring Location #1

Start Time	End Time	Duration (min)	Reason
6/06/17 08:28	6/06/17 08:28	0.5	Loud Vehicle Pass-by
6/06/17 09:10	6/06/17 09:11	0.8	Loud Vehicle Pass-by
6/06/17 11:49	6/06/17 11:50	0.5	Activity by Monitor
6/06/17 14:33	6/06/17 14:34	0.5	Activity by Monitor
6/06/17 16:15	6/06/17 16:16	1.3	Loud Vehicle Pass-by
6/06/17 16:19	6/06/17 16:19	0.8	Activity by Monitor
6/06/17 17:37	6/06/17 17:38	1.3	Activity by Monitor
6/06/17 18:21	6/06/17 18:21	0.8	Activity by Monitor
6/06/17 19:55	6/06/17 19:56	0.8	Loud Vehicle Pass-by
6/06/17 20:02	6/06/17 20:03	1.0	Activity by Monitor
6/06/17 20:07	6/06/17 20:07	0.8	Loud Vehicle Pass-by
6/06/17 20:42	6/06/17 20:42	0.0	Loud Vehicle Pass-by
6/06/17 20:57	6/06/17 20:58	0.3	Loud Vehicle Pass-by
6/06/17 21:06	6/06/17 21:06	0.8	Loud Vehicle Pass-by
	Total Data	**10**	

Data Removal Noise Monitoring Location #2

Start Time	End Time	Duration (min)	Reason
6/06/17 00:31	6/06/17 00:31	0.4	Loud Vehicle Pass-by
6/06/17 09:10	6/06/17 09:10	0.4	Loud Vehicle Pass-by
6/06/17 10:03	6/06/17 10:04	1.1	Non-typical Noise
6/06/17 11:23	6/06/17 11:23	0.9	Loud Vehicle Pass-by
6/06/17 13:33	6/06/17 13:33	0.1	Loud Vehicle Pass-by
6/06/17 16:14	6/06/17 16:15	0.9	Loud Vehicle Pass-by
6/06/17 17:37	6/06/17 17:37	0.6	Sirens
	Total Data	**4**	

Data Removal Noise Monitoring Location #3

Start Time	End Time	Duration (min)	Reason
6/19/17 06:51	6/19/17 06:53	1.8	Excessive Bird Noise
6/19/17 07:41	6/19/17 07:43	1.5	Loud Vehicle Pass-by
6/19/17 08:20	6/19/17 08:22	2.3	Aircraft Flyover
6/19/17 09:09	6/19/17 09:10	0.8	Excessive Bird Noise
6/19/17 09:12	6/19/17 09:15	3.5	Excessive Bird Noise
6/19/17 09:51	6/19/17 09:53	1.8	Loud Vehicle Pass-by
6/19/17 10:04	6/19/17 10:07	2.8	Excessive Bird Noise
6/19/17 10:12	6/19/17 10:14	2.3	Excessive Bird Noise
6/19/17 10:19	6/19/17 10:22	2.8	Excessive Bird Noise
6/19/17 11:29	6/19/17 11:31	2.5	Excessive Bird Noise
6/19/17 11:41	6/19/17 11:42	1.8	Loud Vehicle Pass-by
6/19/17 11:53	6/19/17 11:53	0.0	Excessive Bird Noise
6/19/17 11:53	6/19/17 11:54	1.5	Excessive Bird Noise
6/19/17 12:45	6/19/17 12:47	1.5	Loud Vehicle Pass-by
6/19/17 12:49	6/19/17 12:51	1.8	Aircraft Flyover
6/19/17 12:54	6/19/17 12:55	0.8	Loud Vehicle Pass-by
6/19/17 13:03	6/19/17 13:03	0.8	Loud Vehicle Pass-by
6/19/17 13:14	6/19/17 13:15	0.8	Aircraft Flyover
6/19/17 13:25	6/19/17 13:26	0.8	Loud Vehicle Pass-by
6/19/17 13:33	6/19/17 13:34	0.8	Loud Vehicle Pass-by
6/19/17 13:45	6/19/17 13:46	1.5	Loud Vehicle Pass-by
6/19/17 13:48	6/19/17 13:49	0.8	Loud Vehicle Pass-by
6/19/17 14:04	6/19/17 14:07	2.3	Aircraft Flyover
6/19/17 14:10	6/19/17 14:11	1.3	Aircraft Flyover
6/19/17 15:06	6/19/17 15:07	0.8	backup beeper
6/19/17 16:26	6/19/17 16:27	0.8	Loud Vehicle Pass-by
6/19/17 16:33	6/19/17 16:34	1.0	Loud Vehicle Pass-by
6/19/17 17:05	6/19/17 17:10	5.5	Excessive Bird Noise
6/19/17 17:19	6/19/17 17:20	0.8	Loud Vehicle Pass-by
6/19/17 17:42	6/19/17 17:43	1.3	Aircraft Flyover
6/19/17 18:06	6/19/17 18:07	1.0	Loud Vehicle Pass-by
6/19/17 18:26	6/19/17 18:27	0.8	Dog Barking
6/19/17 18:28	6/19/17 18:28	0.0	Dog Barking
6/19/17 18:28	6/19/17 18:29	1.3	Loud Vehicle Pass-by
6/19/17 18:34	6/19/17 18:35	0.8	Loud Vehicle Pass-by
6/19/17 18:37	6/19/17 18:38	1.0	Loud Vehicle Pass-by
6/19/17 18:41	6/19/17 18:43	2.0	Loud Vehicle Pass-by
6/19/17 18:45	6/19/17 18:46	0.8	Sirens
6/19/17 19:21	6/19/17 19:24	2.8	Excessive Bird Noise

Data Removal Noise Monitoring Location #3 (Cont.)

Start Time	End Time	Duration (min)	Reason
6/19/17 19:27	6/19/17 19:28	0.5	Loud Vehicle Pass-by
6/19/17 19:52	6/19/17 19:54	2.3	Excessive Bird Noise
6/19/17 20:01	6/19/17 20:05	3.5	Excessive Bird Noise
6/19/17 20:31	6/19/17 20:32	0.8	Loud Vehicle Pass-by
6/19/17 20:35	6/19/17 20:35	0.5	Loud Vehicle Pass-by
6/19/17 20:37	6/19/17 20:41	4.3	Loud Vehicle Pass-by
6/19/17 21:13	6/19/17 21:13	0.5	Loud Vehicle Pass-by
6/19/17 21:15	6/19/17 21:16	1.3	Loud Vehicle Pass-by
6/19/17 21:23	6/19/17 21:23	0.5	Excessive Bird Noise
6/19/17 21:41	6/19/17 21:41	0.5	Loud Vehicle Pass-by
6/19/17 22:29	6/19/17 22:30	0.8	Excessive Bird Noise
6/19/17 23:08	6/19/17 23:09	0.5	Loud Vehicle Pass-by
	Total Data	**75**	

Data Removal Noise Monitoring Location #4

Start Time	End Time	Duration (min)	Reason
7/25/17 08:02	7/25/17 08:04	2.4	Backup beeper
7/25/17 08:06	7/25/17 08:07	0.9	Tailgate Slap
7/25/17 08:08	7/25/17 08:09	1.4	Loud Vehicle Pass-by
7/25/17 08:25	7/25/17 08:26	1.4	Aircraft Flyover
7/25/17 08:55	7/25/17 08:56	0.9	Activity near monitor
7/25/17 09:02	7/25/17 09:02	0.7	Train Pass-by
7/25/17 10:43	7/25/17 10:43	0.9	Aircraft Flyover
7/25/17 11:29	7/25/17 11:31	1.9	Activity near monitor
7/25/17 12:01	7/25/17 12:02	1.4	Aircraft Flyover
7/25/17 12:06	7/25/17 12:07	1.9	Aircraft Flyover
7/25/17 12:22	7/25/17 12:24	2.4	Aircraft Flyover
7/25/17 13:10	7/25/17 13:17	6.9	Activity near monitor
7/25/17 13:44	7/25/17 13:55	10.7	Activity near monitor
7/25/17 14:11	7/25/17 14:11	0.7	Loud Vehicle Pass-by
7/25/17 14:54	7/25/17 14:55	1.2	Loud Vehicle Pass-by
7/25/17 17:13	7/25/17 17:15	2.7	Loud Vehicle Pass-by
7/25/17 17:50	7/25/17 17:52	2.9	Aircraft Flyover
7/25/17 19:13	7/25/17 19:14	1.2	Loud Vehicle Pass-by
7/25/17 19:17	7/25/17 19:18	1.7	Abnormal Noise
7/25/17 20:36	7/25/17 20:39	2.9	Loud Vehicle Pass-by
7/25/17 20:50	7/25/17 20:51	1.7	Loud Vehicle Pass-by
7/25/17 21:24	7/25/17 21:26	2.9	Loud Vehicle Pass-by
7/25/17 22:29	7/25/17 22:30	1.7	Loud Vehicle Pass-by
7/25/17 22:49	7/25/17 22:50	1.7	Loud Vehicle Pass-by
7/25/17 23:28	7/25/17 23:28	0.9	Aircraft Flyover
	Total Data	**56**	

Data Removal Noise Monitoring Location #5

Start Time	End Time	Duration (min)	Reason
6/19/17 09:01	6/19/17 09:04	2.7	Loud Vehicle Pass-by
6/19/17 10:58	6/19/17 11:00	2.0	Loud Vehicle Pass-by
6/19/17 11:59	6/19/17 12:00	1.2	Loud Vehicle Pass-by
6/19/17 12:23	6/19/17 12:24	1.2	Loud Vehicle Pass-by
6/19/17 14:22	6/19/17 14:22	0.7	Loud Vehicle Pass-by
6/19/17 14:34	6/19/17 14:34	0.7	Loud Vehicle Pass-by
6/19/17 15:59	6/19/17 16:00	1.2	Loud Vehicle Pass-by
6/19/17 20:25	6/19/17 20:26	1.0	Loud Vehicle Pass-by
6/19/17 21:28	6/19/17 21:29	1.5	Loud Vehicle Pass-by
	Total Data	**12**	

Data Removal Noise Monitoring Location #6

Start Time	End Time	Duration (min)	Reason
6/19/17 01:35	6/19/17 01:37	1.5	Aircraft Flyover
6/19/17 08:02	6/19/17 08:06	3.3	Excessive Bird Noise
6/19/17 08:54	6/19/17 08:56	2.5	Excessive Bird Noise
6/19/17 09:06	6/19/17 09:08	2.3	Excessive Bird Noise
6/19/17 09:10	6/19/17 09:12	1.5	Excessive Bird Noise
6/19/17 09:38	6/19/17 09:39	1.5	Aircraft Flyover
6/19/17 09:46	6/19/17 09:48	2.0	Excessive Bird Noise
6/19/17 09:52	6/19/17 09:54	2.5	Aircraft Flyover
6/19/17 10:08	6/19/17 10:11	3.3	Excessive Bird Noise
6/19/17 10:15	6/19/17 10:17	1.5	Excessive Bird Noise
6/19/17 10:21	6/19/17 10:23	1.8	Excessive Bird Noise
6/19/17 10:28	6/19/17 10:29	1.3	Excessive Bird Noise
6/19/17 10:40	6/19/17 10:51	11.5	Excessive Bird Noise
6/19/17 11:07	6/19/17 11:08	0.5	Excessive Bird Noise
6/19/17 12:26	6/19/17 12:27	0.8	Excessive Bird Noise
6/19/17 12:50	6/19/17 12:51	1.0	Aircraft Flyover
6/19/17 13:05	6/19/17 13:06	1.0	Excessive Bird Noise
6/19/17 13:47	6/19/17 13:50	2.3	Excessive Bird Noise
6/19/17 14:04	6/19/17 14:05	1.3	Aircraft Flyover
6/19/17 14:11	6/19/17 14:11	0.0	Aircraft Flyover
6/19/17 14:11	6/19/17 14:12	0.8	Aircraft Flyover
6/19/17 14:17	6/19/17 14:17	0.8	Excessive Bird Noise
6/19/17 14:23	6/19/17 14:23	0.5	Excessive Bird Noise
6/19/17 14:47	6/19/17 14:49	2.3	Excessive Bird Noise
6/19/17 14:50	6/19/17 14:51	1.8	Excessive Bird Noise
6/19/17 15:21	6/19/17 15:22	0.3	Excessive Bird Noise
6/19/17 15:44	6/19/17 15:46	1.3	Loud Vehicle Pass-by
6/19/17 16:04	6/19/17 16:06	2.0	Loud Vehicle Pass-by
6/19/17 16:30	6/19/17 16:33	3.3	Noise from resident
6/19/17 16:40	6/19/17 16:46	5.3	Noise from resident
6/19/17 16:50	6/19/17 16:51	0.5	Excessive Bird Noise
6/19/17 16:54	6/19/17 16:54	0.5	Noise from resident
6/19/17 17:03	6/19/17 17:06	3.5	Noise from resident
6/19/17 17:29	6/19/17 17:30	1.0	Aircraft Flyover
6/19/17 17:42	6/19/17 17:43	1.3	Loud Vehicle Pass-by
6/19/17 17:44	6/19/17 17:53	9.5	Resident cutting grass
6/19/17 18:29	6/19/17 18:30	1.3	Aircraft Flyover
6/19/17 19:36	6/19/17 19:37	1.0	Excessive Bird Noise
6/19/17 20:02	6/19/17 20:03	1.3	Loud Vehicle Pass-by

Data Removal Noise Monitoring Location #6 (Cont.)

Start Time	End Time	Duration (min)	Reason
6/19/17 20:06	6/19/17 20:07	1.3	Excessive Bird Noise
6/19/17 20:07	6/19/17 20:09	1.8	Excessive Bird Noise
6/19/17 20:10	6/19/17 20:12	1.5	Excessive Bird Noise
6/19/17 20:12	6/19/17 20:14	1.8	Excessive Bird Noise
6/19/17 20:28	6/19/17 20:30	2.5	Excessive Bird Noise
6/19/17 20:31	6/19/17 20:35	3.8	Excessive Bird Noise
6/19/17 20:47	6/19/17 20:58	11.3	Excessive Bird Noise
6/19/17 21:02	6/19/17 21:05	3.0	Excessive Bird Noise
6/19/17 21:08	6/19/17 21:09	1.5	Excessive Bird Noise
6/19/17 21:18	6/19/17 21:21	2.8	Excessive Bird Noise
6/19/17 21:46	6/19/17 21:47	1.0	Excessive Bird Noise
6/19/17 23:58	6/19/17 23:59	1.5	Excessive Bird Noise
	Total Data	**115**	

Data Removal Noise Monitoring Location #7

Start Time	End Time	Duration (min)	Reason
7/24/17 23:51	7/24/17 23:53	2.1	Loud Vehicle Pass-by
7/25/17 07:31	7/25/17 07:32	0.6	Train Pass-by
7/25/17 08:04	7/25/17 08:04	0.1	Train Pass-by
7/25/17 08:04	7/25/17 08:05	0.4	Train Pass-by
7/25/17 12:05	7/25/17 12:06	1.4	Aircraft Flyover
7/25/17 12:23	7/25/17 12:24	1.6	Aircraft Flyover
7/25/17 17:51	7/25/17 17:51	0.9	Aircraft Flyover
7/25/17 19:24	7/25/17 19:26	2.4	Resident banging a sign
7/25/17 20:34	7/25/17 20:36	2.4	Loud Vehicle Pass-by
7/25/17 20:49	7/25/17 20:54	4.6	Aircraft Flyover
7/25/17 21:05	7/25/17 21:08	2.4	Aircraft Flyover
7/25/17 21:09	7/25/17 21:11	1.6	Resident's Talking
7/25/17 22:25	7/25/17 22:26	1.1	Loud Vehicle Pass-by
7/25/17 22:41	7/25/17 22:42	1.9	Loud Vehicle Pass-by
7/25/17 22:50	7/25/17 22:52	1.4	Loud Vehicle Pass-by
	Total Data	**25**	

Data Removal Noise Monitoring Location #9

Start Time	End Time	Duration (min)	Reason
6/14/17 09:33	6/14/17 09:37	4.5	Loud Vehicle Pass-by
6/14/17 11:57	6/14/17 11:58	0.8	Sirens
6/14/17 13:55	6/14/17 13:56	0.8	Sirens
6/14/17 20:58	6/14/17 20:59	1.0	Loud Vehicle Pass-by
	Total Data	**7**	

Data Removal Noise Monitoring Location #10

Start Time	End Time	Duration (min)	Reason
6/14/17 06:56	6/14/17 06:59	2.9	Vehicle beside monitor
6/14/17 13:54	6/14/17 13:56	1.6	Sirens
	Total Data	**4**	

Data Removal Noise Monitoring Location #11

Start Time	End Time	Duration (min)	Reason
6/06/17 05:58	6/06/17 05:59	0.5	Loud Vehicle Pass-by
6/06/17 07:18	6/06/17 07:20	1.3	Activity near Monitor
6/06/17 08:42	6/06/17 08:44	1.8	Activity near Monitor
6/06/17 08:50	6/06/17 08:51	1.5	Activity near Monitor
6/06/17 09:00	6/06/17 09:01	1.0	Activity near Monitor
6/06/17 09:01	6/06/17 09:03	1.8	Activity near Monitor
6/06/17 09:12	6/06/17 09:15	2.5	Activity near Monitor
6/06/17 09:21	6/06/17 09:23	2.0	Activity near Monitor
6/06/17 09:32	6/06/17 09:36	4.5	Activity near Monitor
6/06/17 09:41	6/06/17 09:42	1.8	Activity near Monitor
6/06/17 09:50	6/06/17 09:53	2.5	Activity near Monitor
6/06/17 09:58	6/06/17 09:59	1.5	Activity near Monitor
6/06/17 10:06	6/06/17 10:08	1.8	Activity near Monitor
6/06/17 10:13	6/06/17 10:14	1.5	Activity near Monitor
6/06/17 10:22	6/06/17 10:24	1.3	Activity near Monitor
6/06/17 19:26	6/06/17 19:28	1.3	Loud Vehicle Pass-by
	Total Data	**29**	

Data Removal Noise Monitoring Location #12

Start Time	End Time	Duration (min)	Reason
6/14/17 07:16	6/14/17 07:17	1.2	Loud Vehicle Pass-by
6/14/17 07:18	6/14/17 07:20	2.5	Activity Near Monitor
6/14/17 09:13	6/14/17 09:14	1.2	Aircraft Flyover
6/14/17 09:52	6/14/17 09:53	1.2	Aircraft Flyover
6/14/17 10:27	6/14/17 10:28	1.2	Aircraft Flyover
6/14/17 12:06	6/14/17 12:06	1.0	Loud Vehicle Pass-by
6/14/17 12:43	6/14/17 12:44	1.0	Activity near Monitor
6/14/17 13:08	6/14/17 13:09	1.2	Excessive Bird Noise
6/14/17 17:20	6/14/17 17:21	1.2	Loud Vehicle Pass-by
6/14/17 19:33	6/14/17 19:34	0.7	Loud Vehicle Pass-by
6/14/17 20:08	6/14/17 20:09	0.7	Loud Vehicle Pass-by
6/14/17 20:53	6/14/17 20:54	1.2	Loud Vehicle Pass-by
6/14/17 20:54	6/14/17 20:54	0.2	Loud Vehicle Pass-by
	Total Data	**14**	

Data Removal Noise Monitoring Location #13

Start Time	End Time	Duration (min)	Reason
6/06/17 00:14	6/06/17 00:14	0.8	Loud Vehicle Pass-by
6/06/17 02:51	6/06/17 02:52	1.3	Loud Vehicle Pass-by
6/06/17 03:20	6/06/17 03:21	1.3	Loud Vehicle Pass-by
6/06/17 07:12	6/06/17 07:13	0.5	Loud Vehicle Pass-by
6/06/17 10:30	6/06/17 10:31	0.5	Loud Vehicle Pass-by
6/06/17 11:24	6/06/17 11:24	0.8	Loud Vehicle Pass-by
6/06/17 12:52	6/06/17 12:53	0.5	Loud Vehicle Pass-by
6/06/17 13:47	6/06/17 13:48	0.5	Loud Vehicle Pass-by
6/06/17 14:02	6/06/17 14:03	1.3	Loud Vehicle Pass-by
6/06/17 14:18	6/06/17 14:19	1.3	Loud Vehicle Pass-by
6/06/17 15:12	6/06/17 15:13	1.3	Loud Vehicle Pass-by
6/06/17 17:10	6/06/17 17:10	0.5	Loud Vehicle Pass-by
6/06/17 18:52	6/06/17 18:53	0.5	Loud Vehicle Pass-by
6/06/17 19:07	6/06/17 19:08	0.8	Loud Vehicle Pass-by
6/06/17 23:41	6/06/17 23:41	0.0	Loud Vehicle Pass-by
	Total Data	**12**	

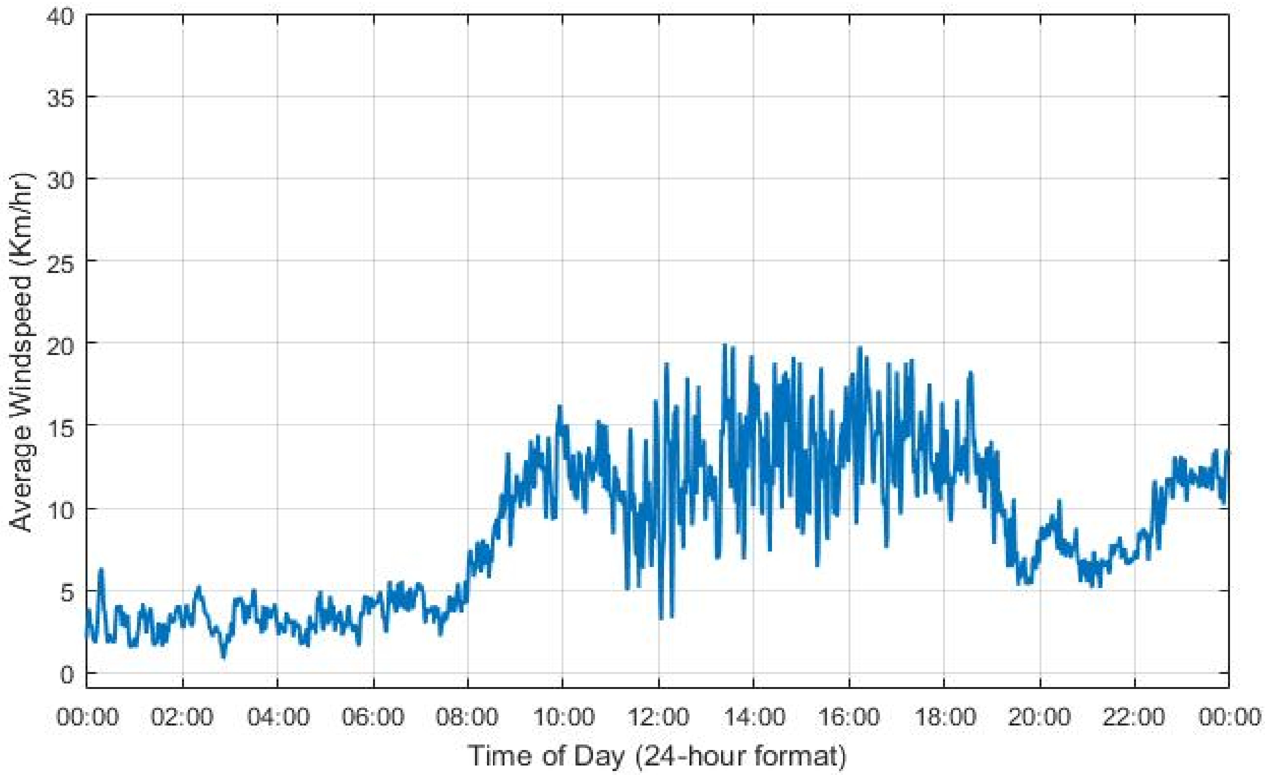
Data Removal Noise Monitoring Location #14

Start Time	End Time	Duration (min)	Reason
6/19/17 03:27	6/19/17 03:29	2.0	Abnormal Noise Event
6/19/17 05:25	6/19/17 05:26	0.7	Crickets
6/19/17 08:50	6/19/17 08:51	1.0	Activity near monitor
6/19/17 09:33	6/19/17 09:35	1.7	Abnormal Noise Event
6/19/17 10:12	6/19/17 10:13	1.5	Loud Vehicle Pass-by
6/19/17 11:54	6/19/17 11:55	1.2	Abnormal Noise Event
6/19/17 12:22	6/19/17 12:25	3.2	Aircraft Flyover
6/19/17 18:26	6/19/17 18:28	1.7	Excessive Bird Noise
6/19/17 22:03	6/19/17 22:09	6.0	Train Pass-by
6/19/17 23:21	6/19/17 23:28	7.2	Train Pass-by
	Total Data	**26**	

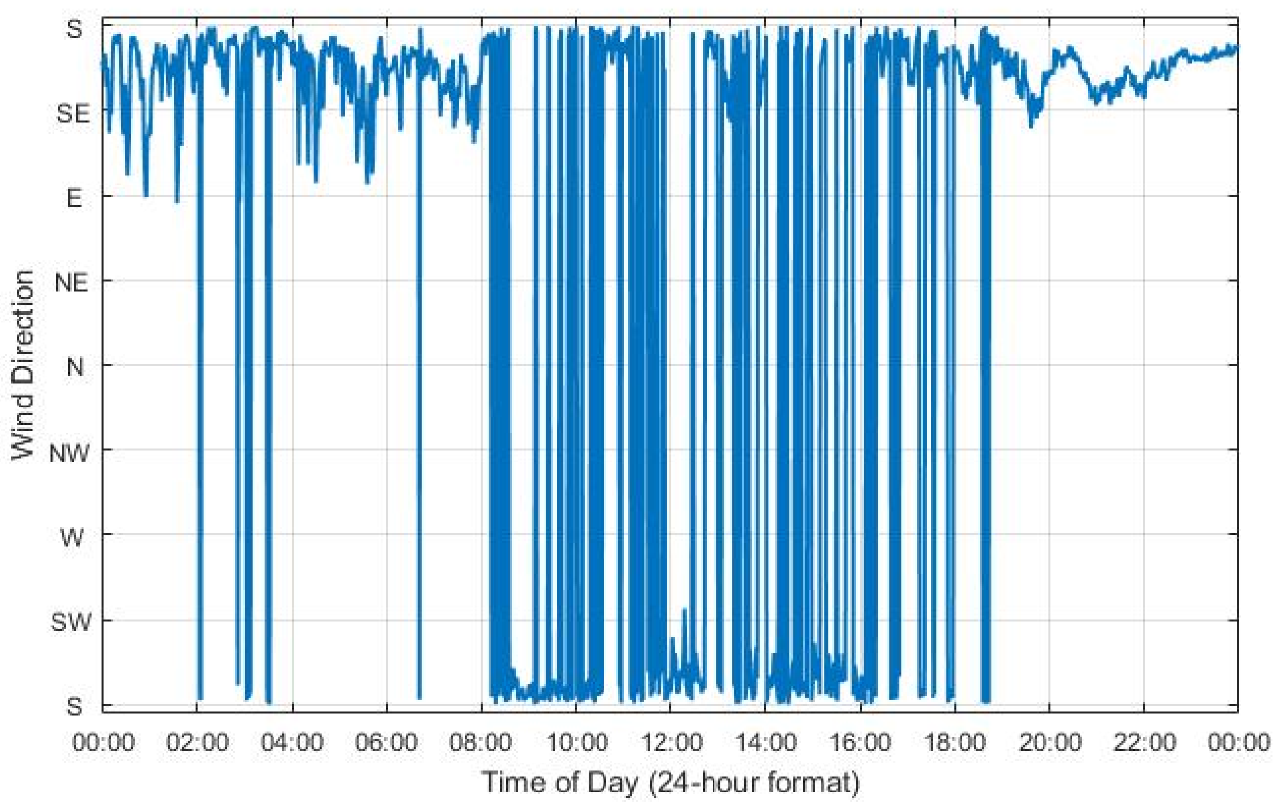
Data Removal Noise Monitoring Location #15

Start Time	End Time	Duration (min)	Reason
6/13/17 10:07	6/13/17 10:08	1.2	Loud Vehicle Pass-by
6/13/17 10:43	6/13/17 10:45	1.9	Aircraft Flyover
6/13/17 12:57	6/13/17 12:58	0.7	Loud Vehicle Pass-by
6/13/17 19:46	6/13/17 19:51	4.9	Loud Vehicle Pass-by
6/13/17 19:58	6/13/17 20:01	2.4	Loud Vehicle Pass-by
6/13/17 21:11	6/13/17 21:11	0.9	Loud Vehicle Pass-by
6/13/17 21:19	6/13/17 21:20	1.4	Loud Vehicle Pass-by
6/13/17 23:29	6/13/17 23:29	0.2	Loud Vehicle Pass-by
	Total Data	**14**	

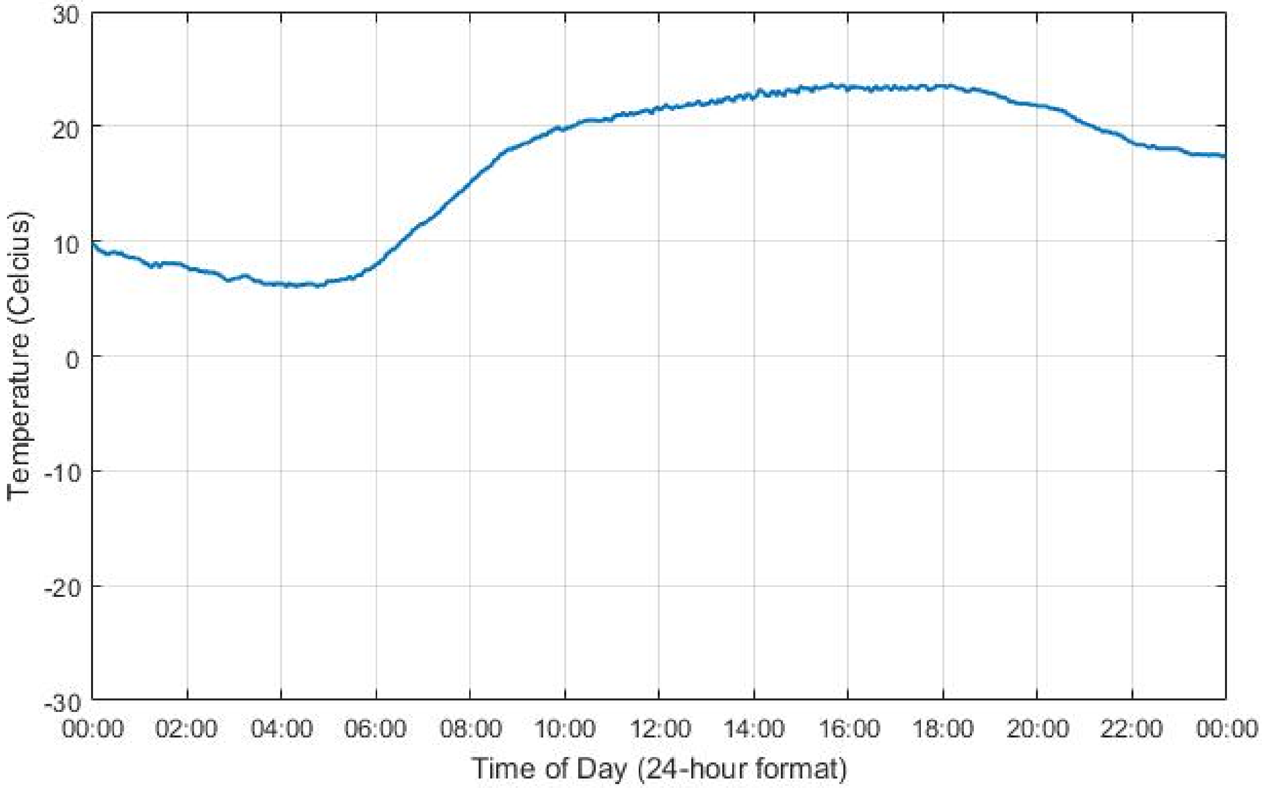
Appendix VI WEATHER DATA



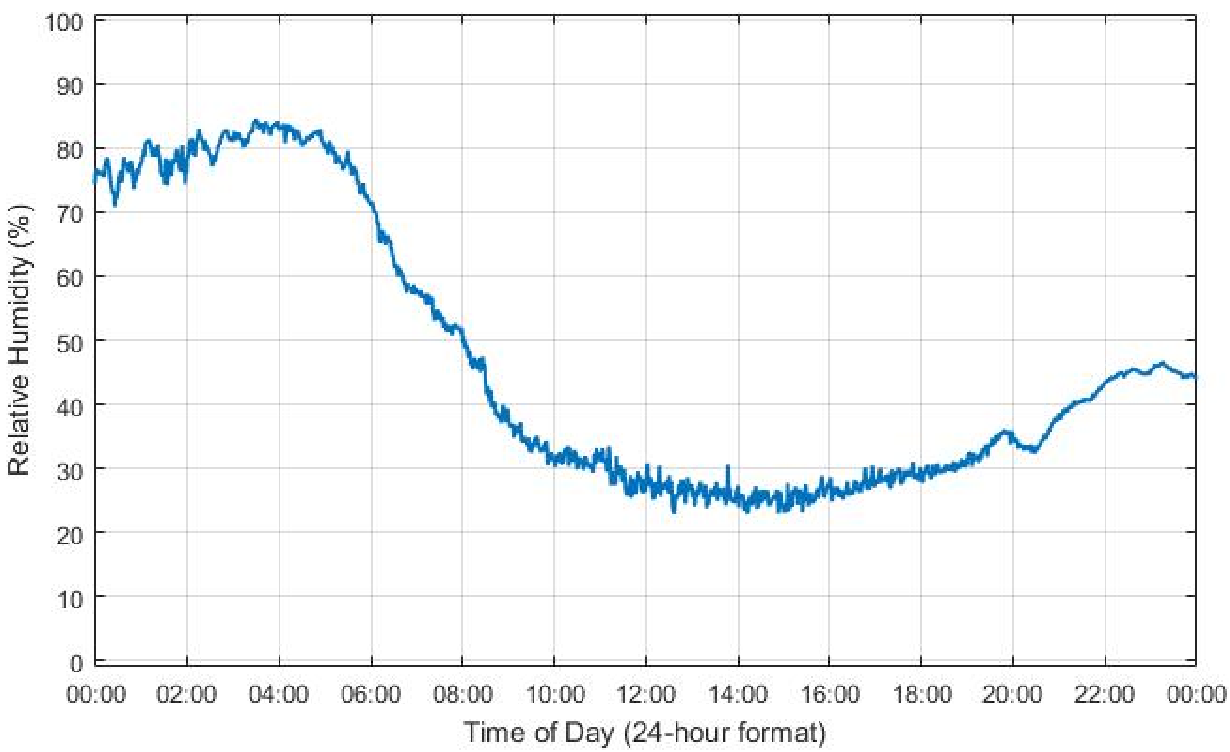
June 6, 2017 – Monitored Wind Speed



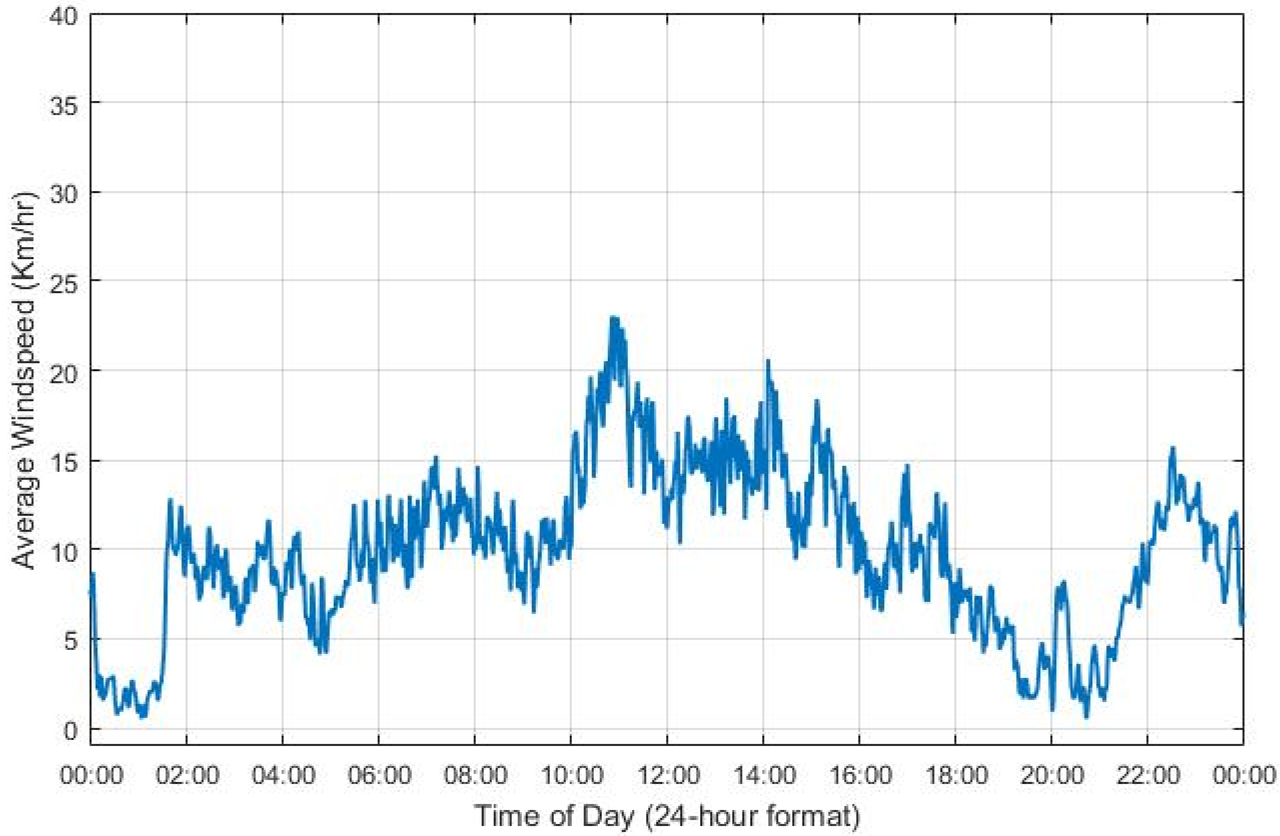
June 6, 2017 – Monitored Wind Direction



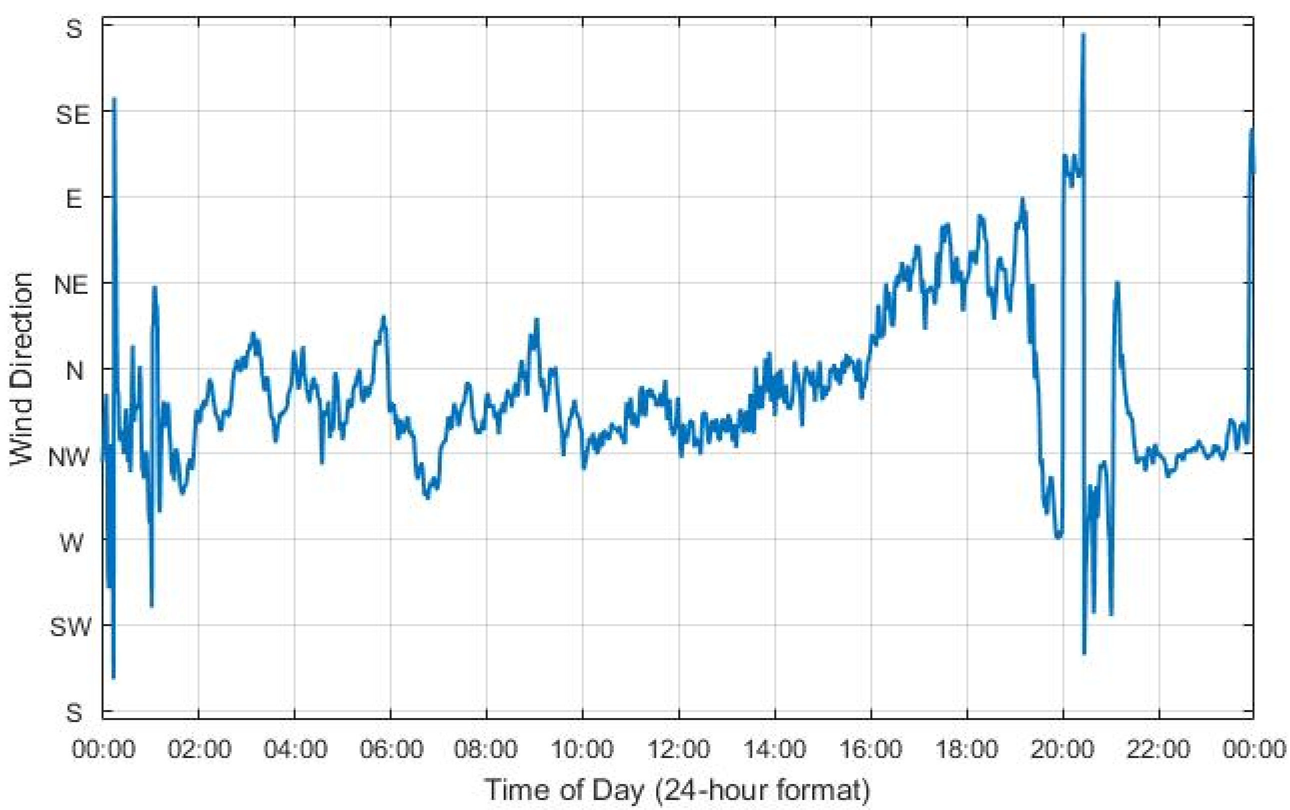
June 6, 2017 – Monitored Temperature



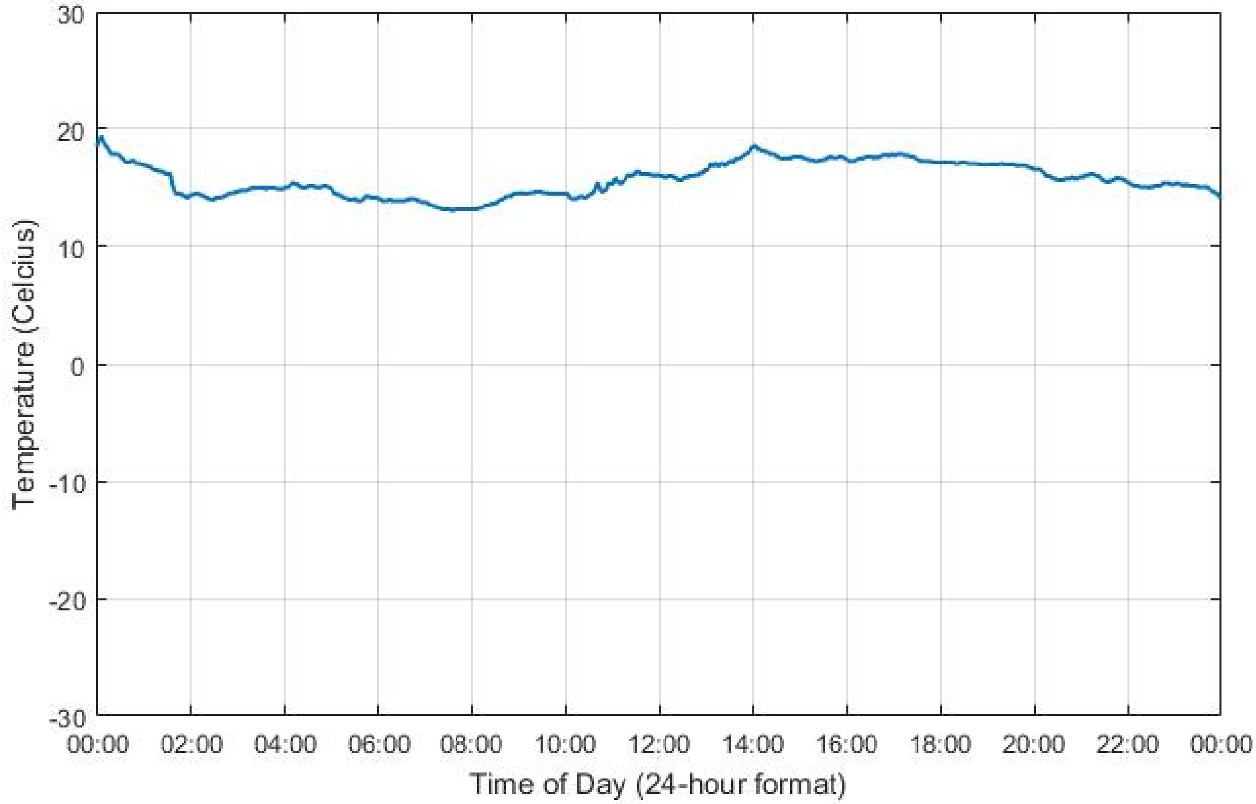
June 6, 2017 – Monitored Relative Humidity



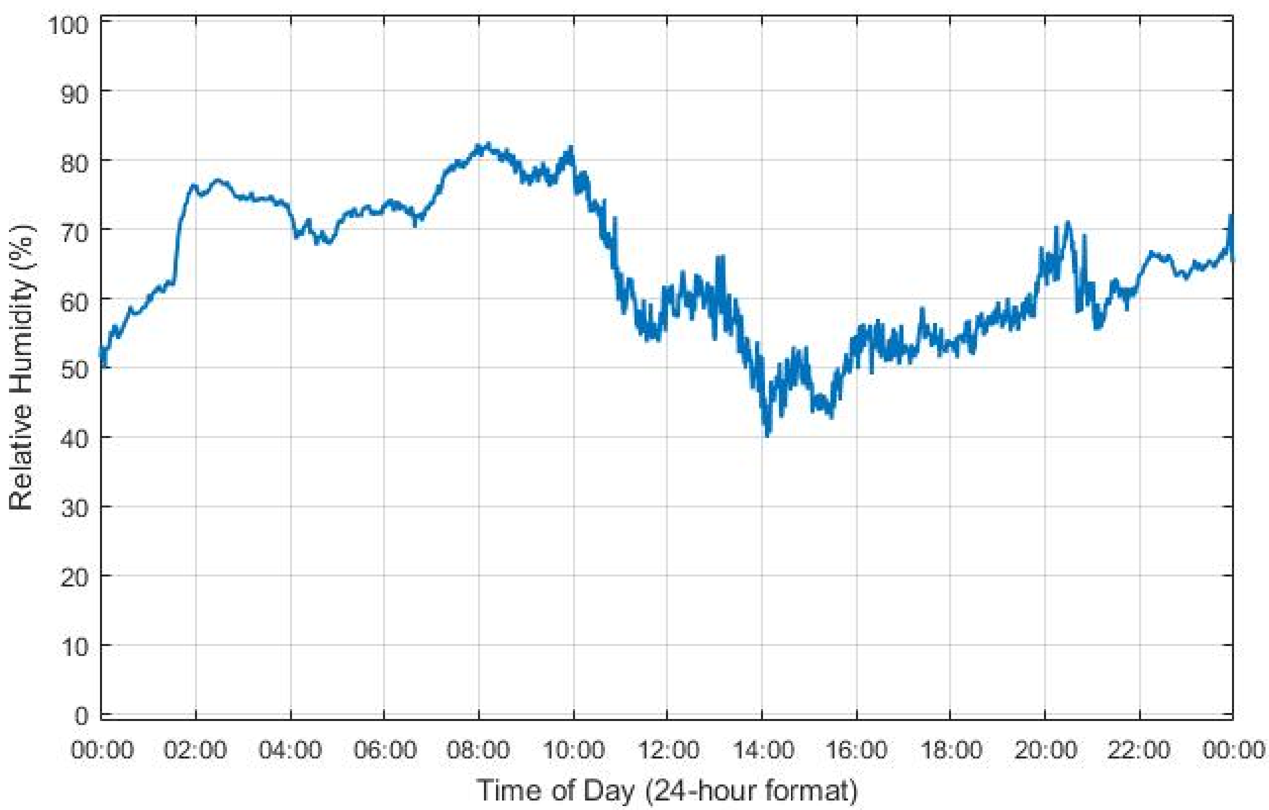
June 13, 2017 – Monitored Wind Speed



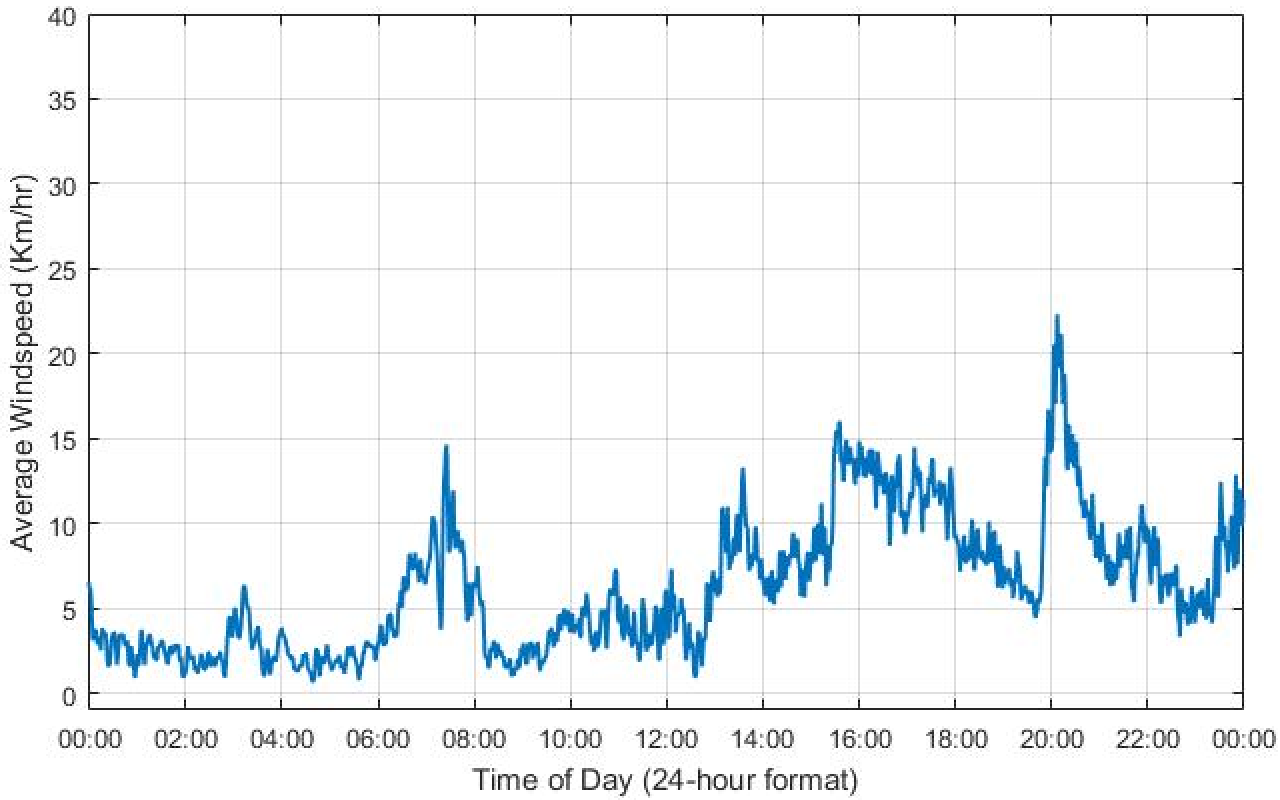
June 13, 2017 – Monitored Wind Direction



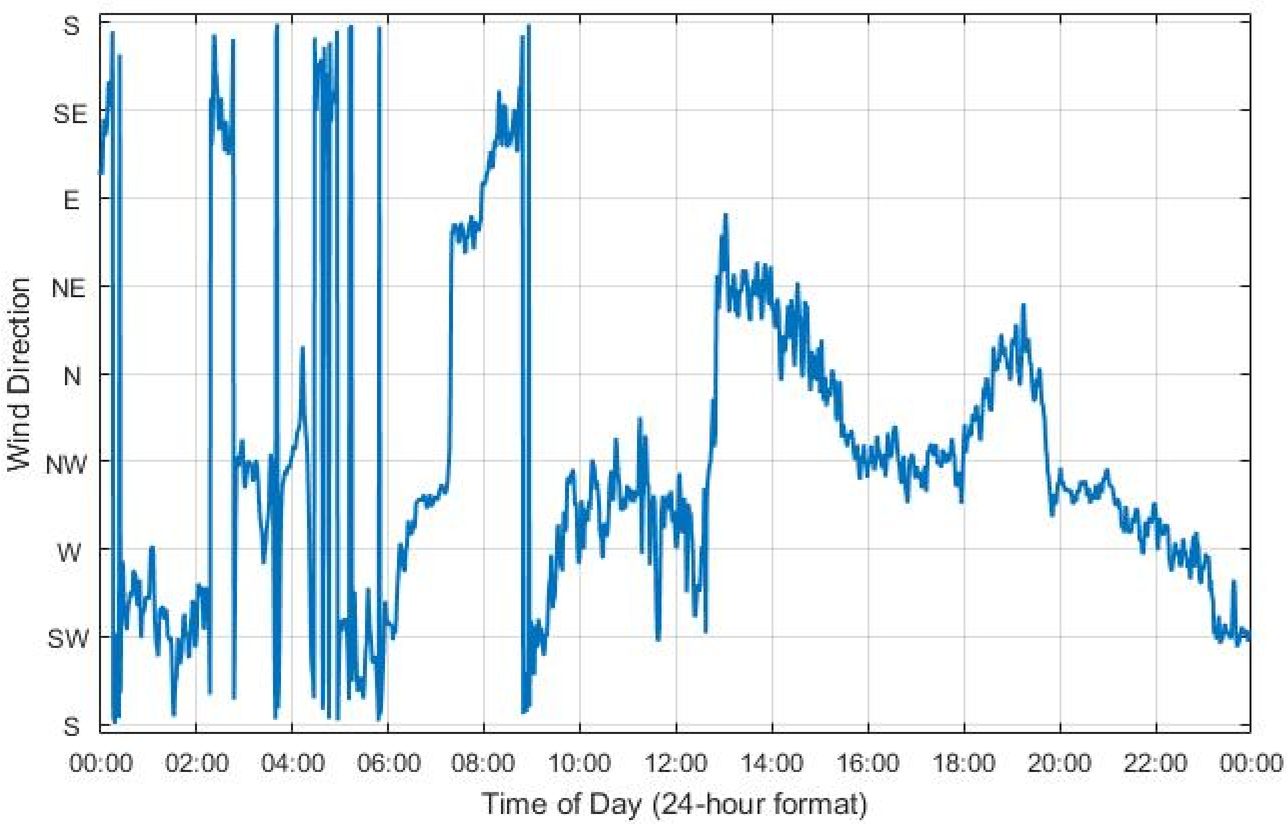
June 13, 2017 – Monitored Temperature



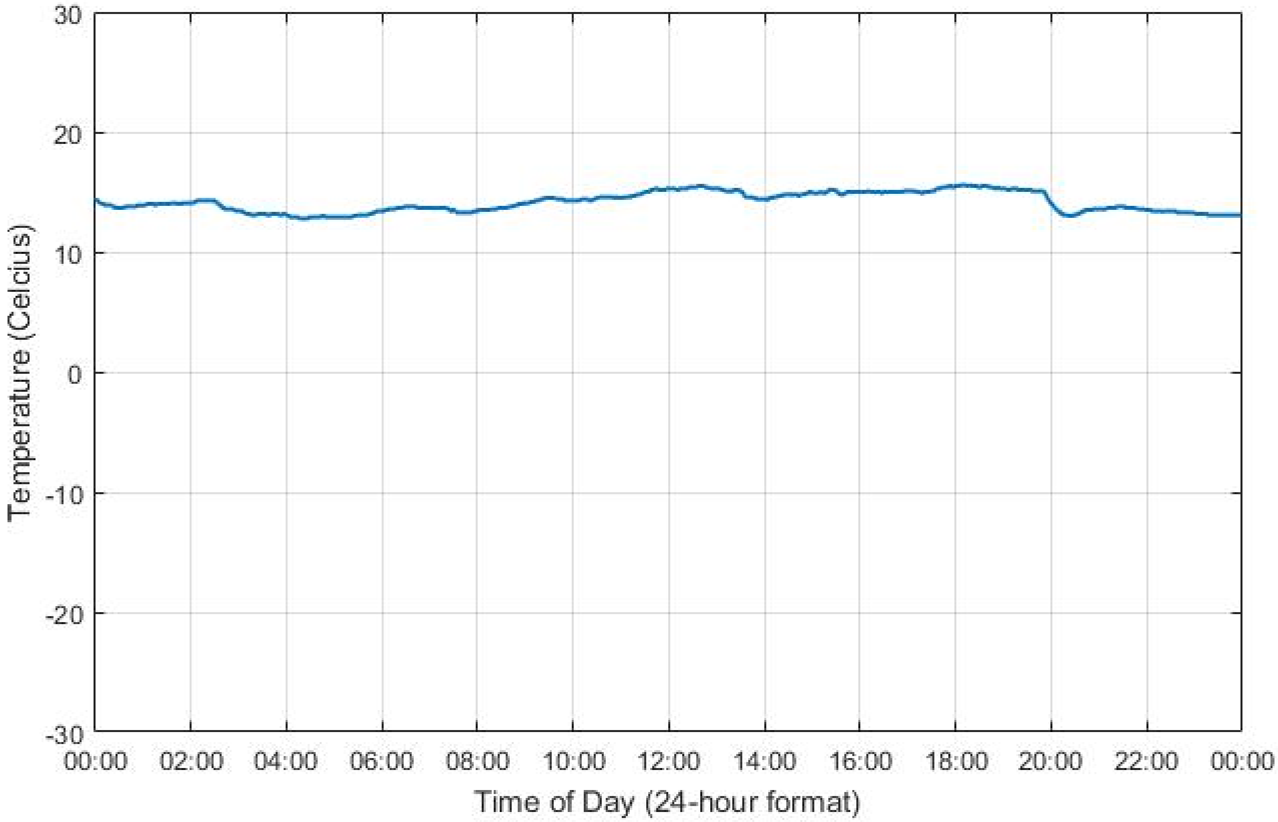
June 13, 2017 – Monitored Relative Humidity



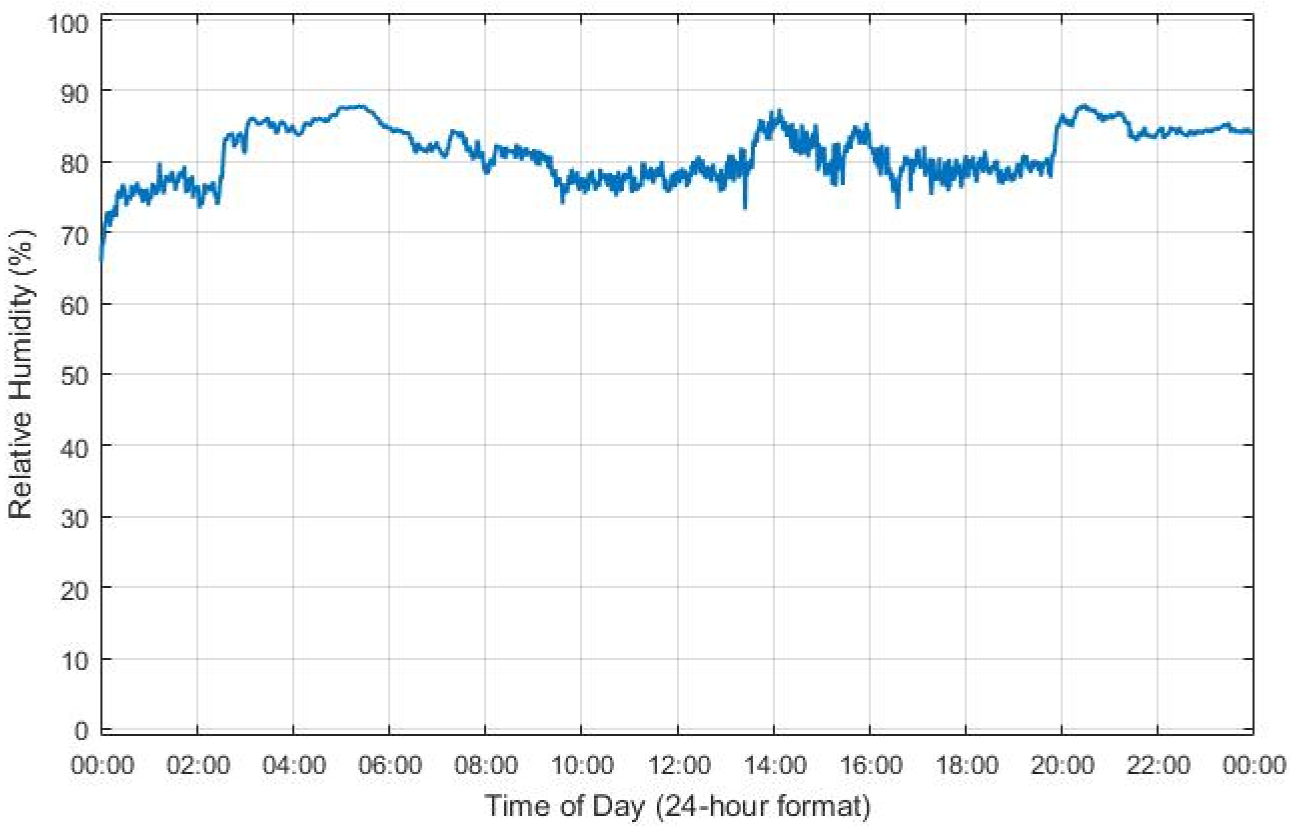
June 14, 2017 – Monitored Wind Speed



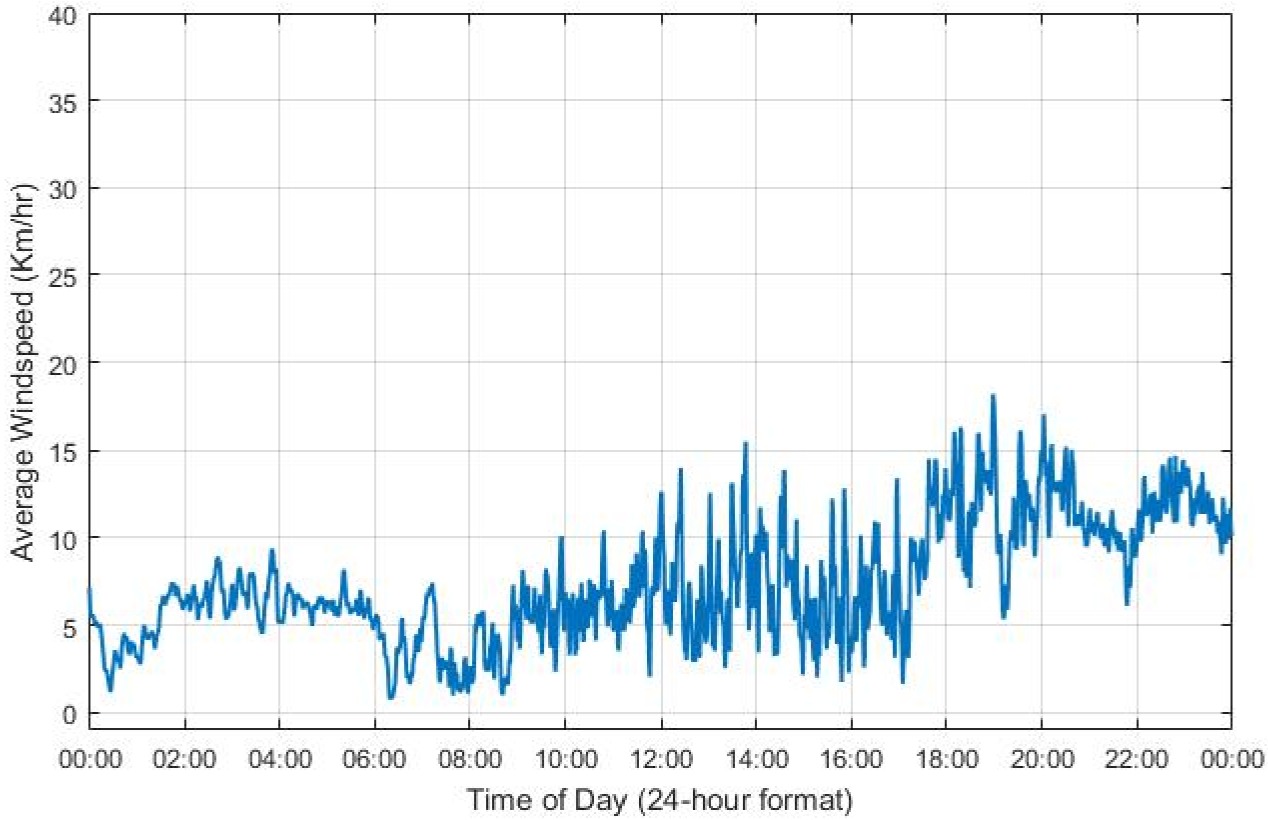
June 14, 2017 – Monitored Wind Direction



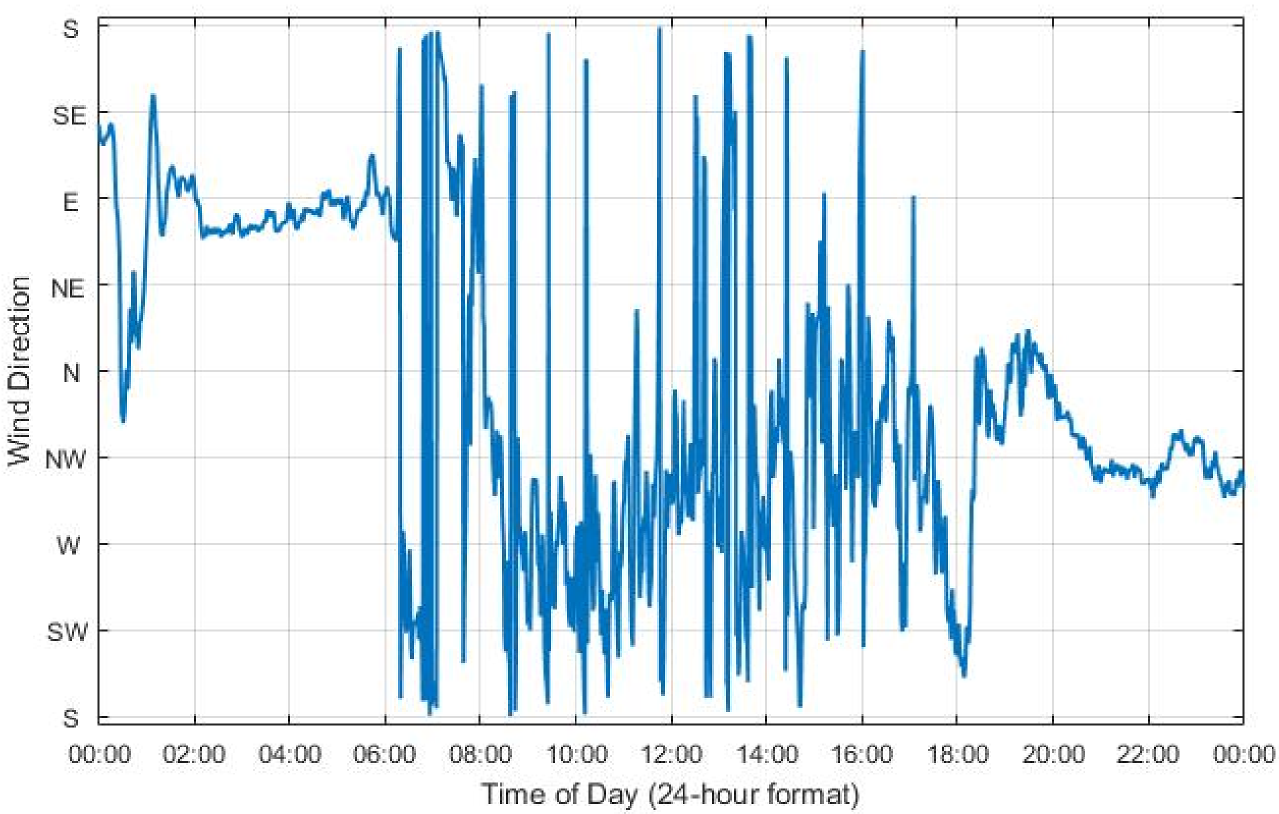
June 14, 2017 – Monitored Temperature



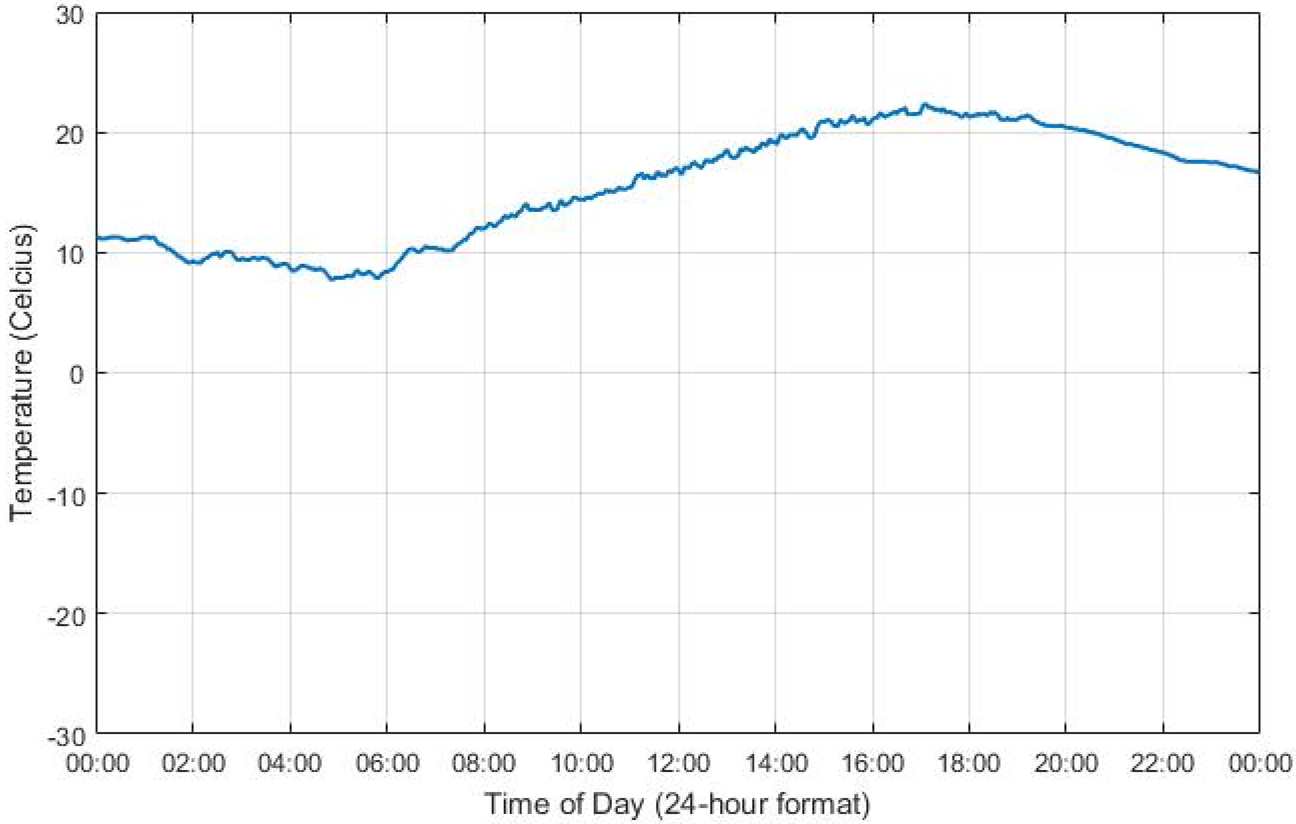
June 14, 2017 – Monitored Relative Humidity



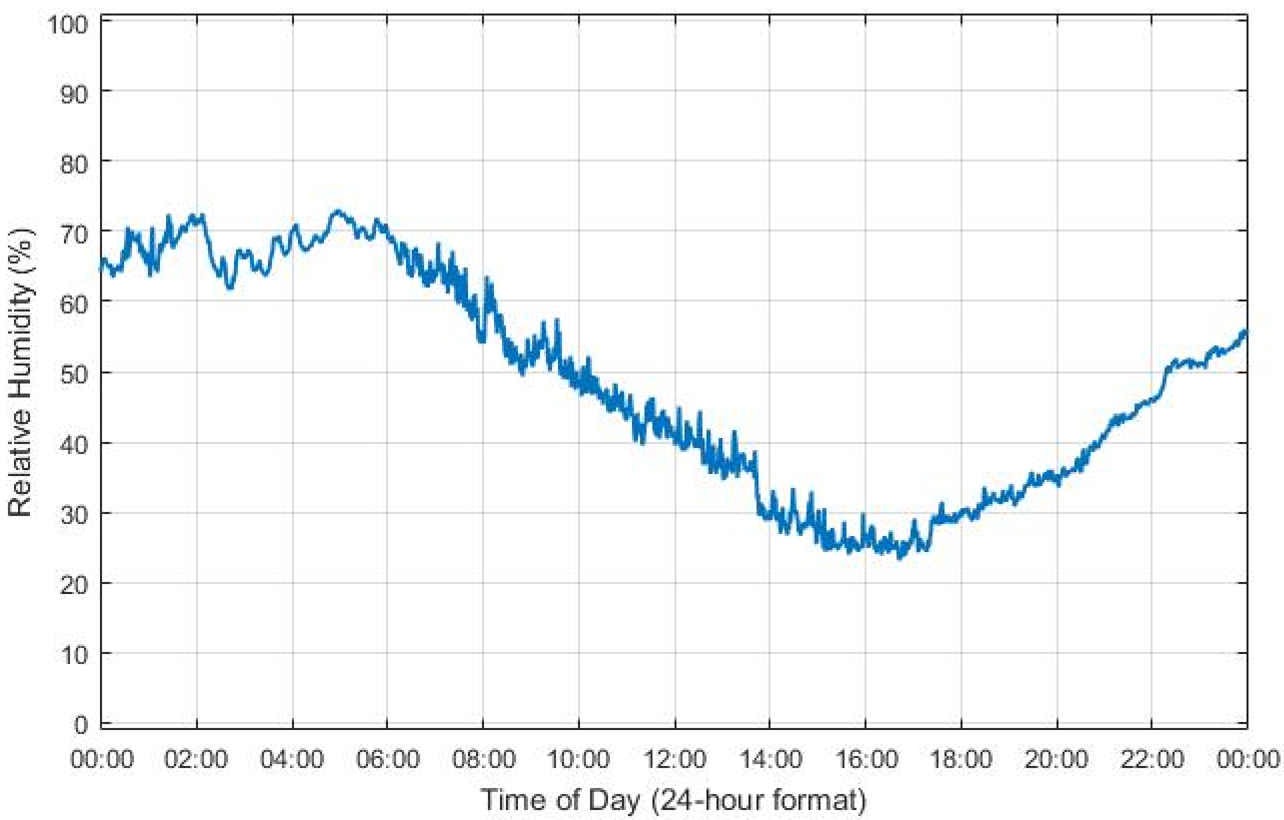
June 19, 2017 – Monitored Wind Speed



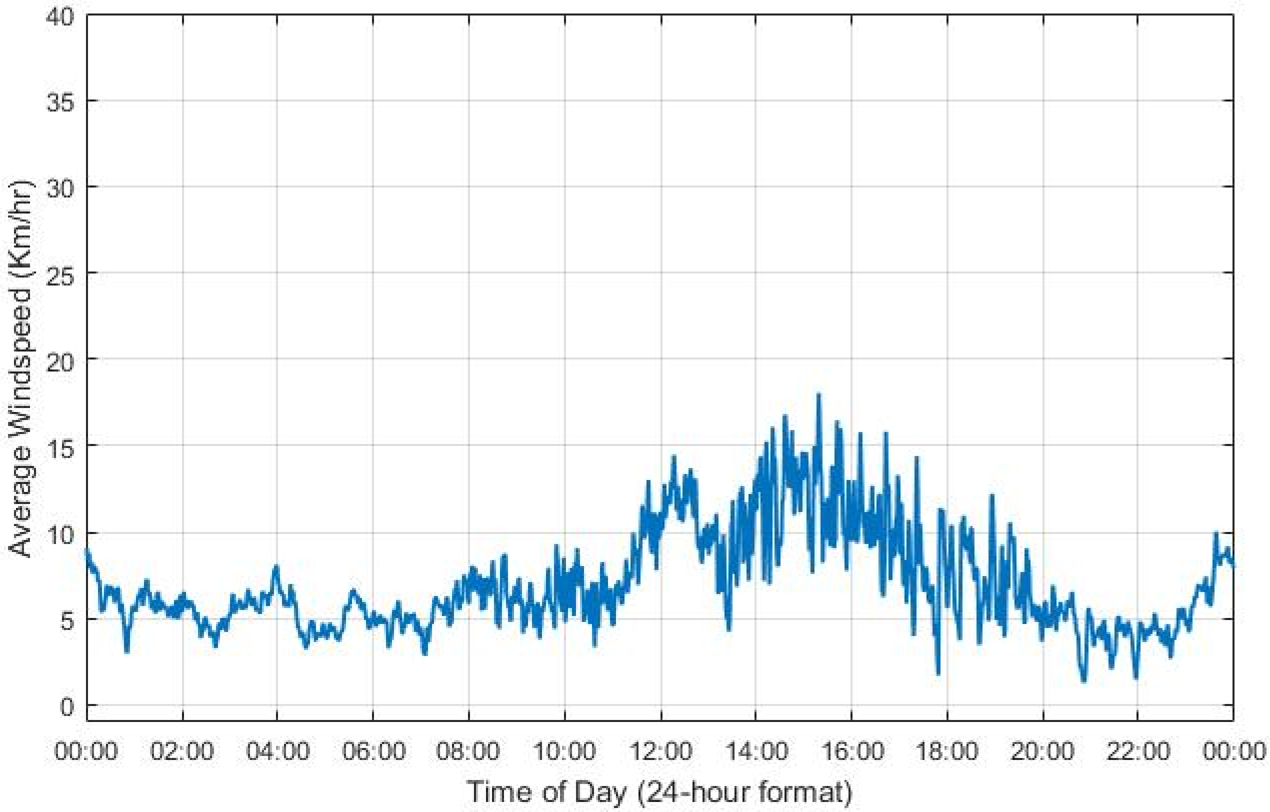
June 19, 2017 – Monitored Wind Direction



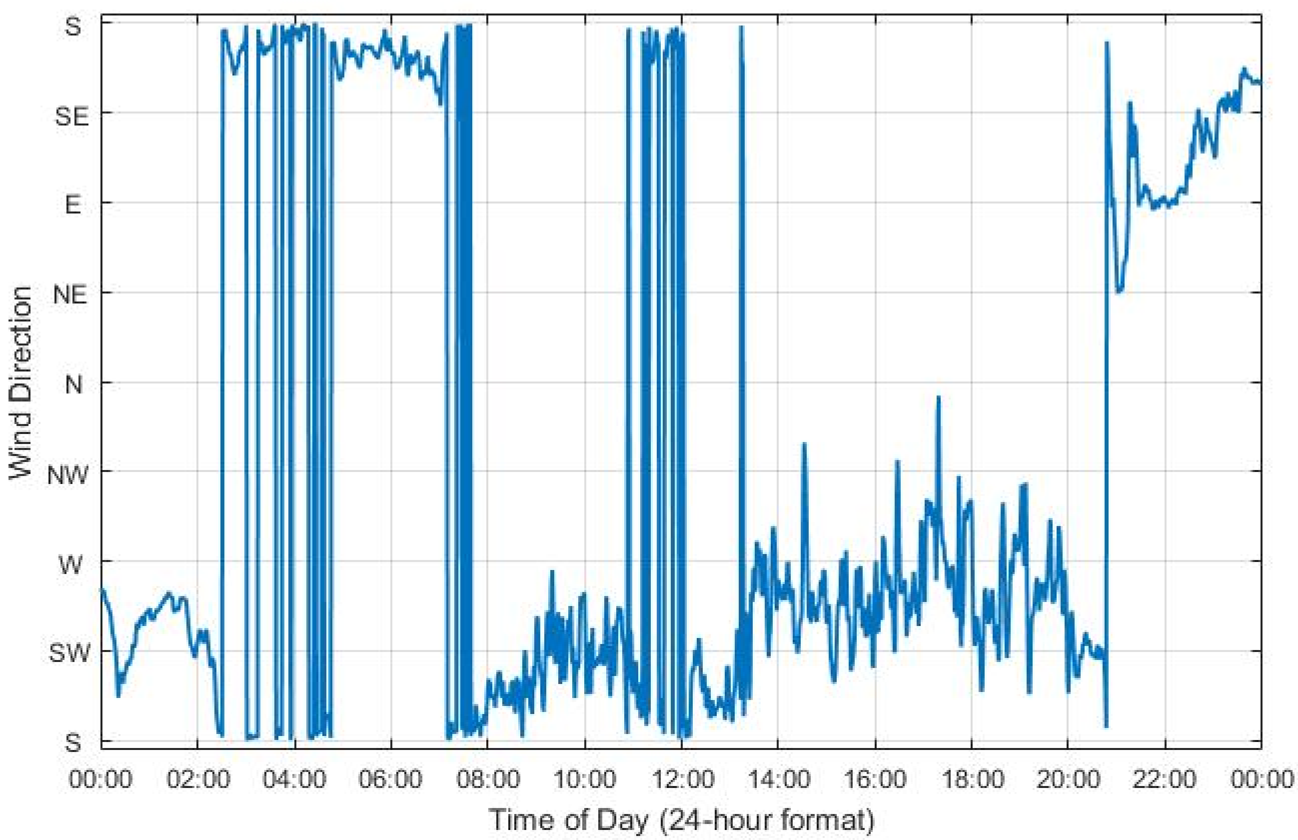
June 19, 2017 – Monitored Temperature



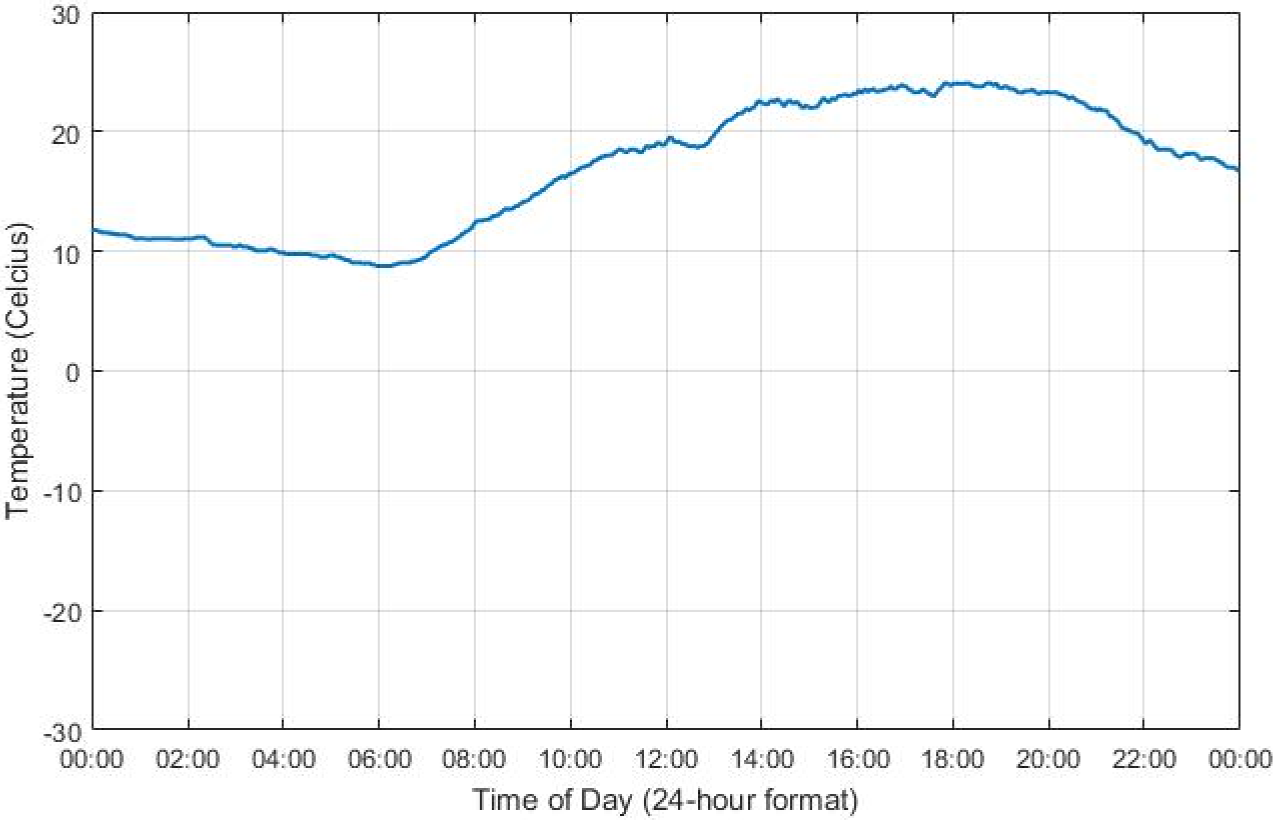
June 19, 2017 – Monitored Relative Humidity



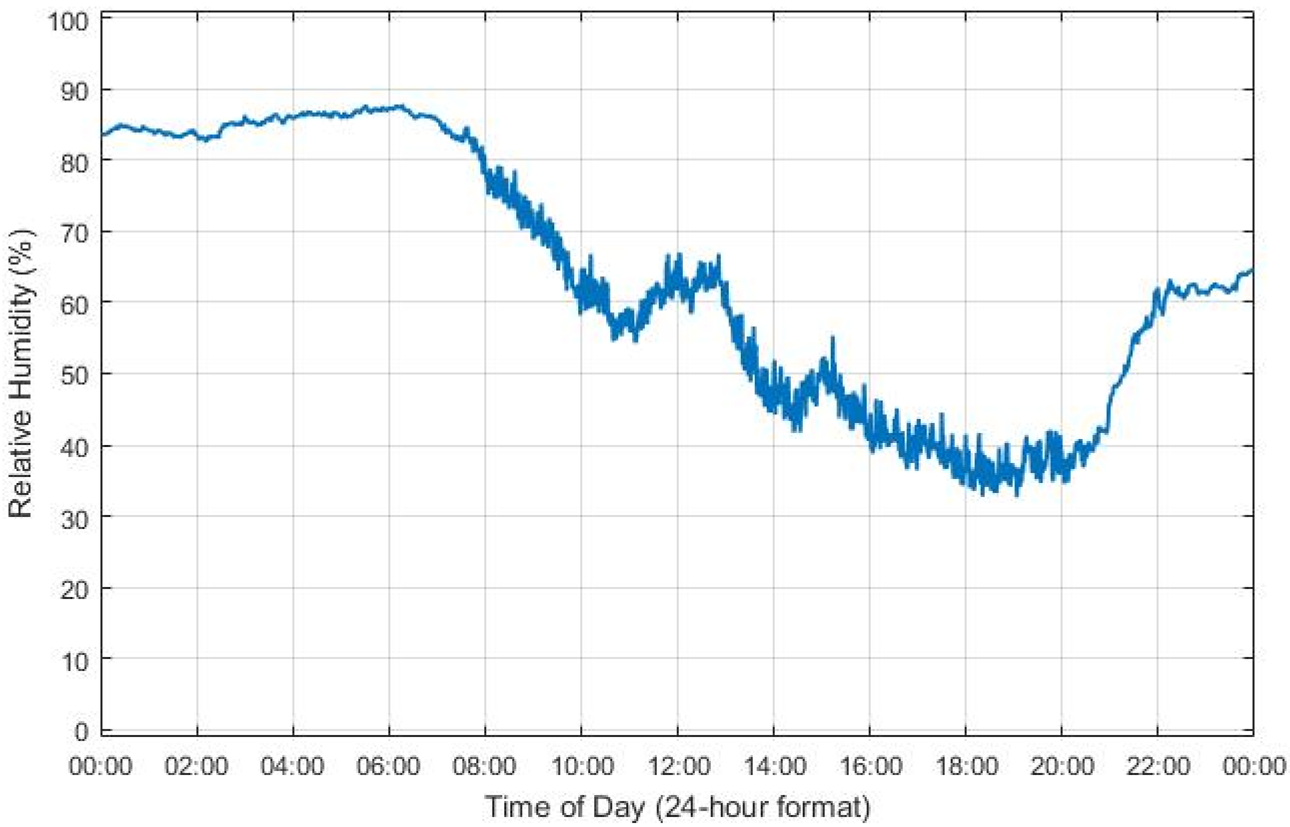
July 25, 2017 – Monitored Wind Speed



July 25, 2017 – Monitored Wind Direction



July 25, 2017 – Monitored Temperature



July 25, 2017 – Monitored Relative Humidity