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Environmental Noise Computer Modelling
For

Northwest Anthony Henday Drive in Edmonton, AB

Prepared for:

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Executive Summary

aci Acoustical Consultants Inc., of Edmonton AB, was retained by ISL Engineering and Land Services Ltd. (ISL) to conduct an environmental noise assessment along the northwest section of Anthony Henday Drive (NWAHD) in Edmonton, Alberta. The purpose of the work was to conduct 24-hour environmental noise monitorings at various locations adjacent to the roadway and generate a computer noise model with current and future traffic conditions and compare the results to the AT noise guidelines. The results of the noise monitorings are provided in the report entitled "*Environmental Noise Monitoring for Northwest Anthony Henday Drive in Edmonton, AB,* prepared for ISL Engineering and Land Services Ltd., by aci Acoustical Consultants Inc., November 02, 2012" This report details the computer noise modeling portion of the work for NWAHD.

The results of the Current Conditions noise monitoring indicated noise levels which were below 65 dBA $L_{eq}24$[1]. at most locations. At most of the noise monitoring locations, traffic noise on NWAHD was the dominant noise source. There were some locations at which the adjacent City of Edmonton or City of St. Alberta road was the dominant noise source due to the relative distances from the noise monitor to the City road and to NWAHD. Note that the noise monitorings within the City of St. Albert were conducted within residential backyard locations and can be compared directly to the criteria of 65 dBA $L_{eq}24$ (all seven of them resulted in noise levels below 65 dBA $L_{eq}24$). All other locations, however, were conducted on public land within the TUC or at the TUC boundary and cannot be directly compared to the criteria of 65 dBA $L_{eq}24$.

The noise modeling results for Current Conditions matched well with the measurement results. The modeled noise levels were below the limit of 65 dBA $L_{eq}24$ at all of the residential outdoor receptor locations with the exception of those directly north of Yellowhead Trail and east of NWAHD. For those locations, the dominant noise source was vehicle traffic on Yellowhead Trail.

The noise modeling results for the Future Conditions (with projected traffic volumes for the Year 2040) indicated noise levels which were still below the limit of 65 dBA $L_{eq}24$ at most locations. The model indicated that, other than the residents immediately north of Yellowhead Trail, there will be two residential receptors between 170 Street and St. Albert Trail with noise levels at 65 dBA $L_{eq}24$ and

[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.

several neighboring locations with noise levels very near 65 dBA L_{eq}24. It is important to note that none of the residential properties in this area have fences which provide any acoustical shielding.

A sensitivity analysis of the traffic volumes, traffic speeds, and % heavy trucks indicated that significant individual increases to each parameter or significant increases to all three combined, would result in additional locations with noise levels at or above 65 dBA L_{eq}24. All of these additional locations were located between 170 Street and St. Albert Trail, adjacent to those which were already modeled to exceed 65 dBA Leq24 with the Future conditions.

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1.0 Introduction

aci Acoustical Consultants Inc., of Edmonton AB, was retained by ISL Engineering and Land Services Ltd. (ISL) to conduct an environmental noise assessment along the northwest section of Anthony Henday Drive (NWAHD) in Edmonton, Alberta. The purpose of the work was to conduct 24-hour environmental noise monitorings at various locations adjacent to the roadway and generate a computer noise model with current and future traffic conditions and compare the results to the Alberta Transportation noise guidelines. The results of the noise monitorings are provided in the report entitled "*Environmental Noise Monitoring for Northwest Anthony Henday Drive in Edmonton, AB,* prepared for ISL Engineering and Land Services Ltd., by aci Acoustical Consultants Inc., November 02, 2012" This report details the computer noise modeling portion of the work for NWAHD.

2.0 Location Description

2.1. Roadways

The study area for NWAHD spans from Highway 16 on the southwest end around to Manning Drive on the northeast end, as indicated in Figures 1a and 1b. Throughout the entire span (approximately 21.5 km), NWAHD is a twinned road with at least 2-lanes in each direction and some sections with 3-lanes in each direction. The posted speed limit throughout is 100 km/hr. Currently, there are grade separated interchanges or fly-over's at the following locations:

- Highway 16 (grade separated interchange)
- 184 Street / Ray Gibbon Drive (grade separated interchange, not fully complete)
- CN Rail Line (fly-over)
- 137 Avenue (fly-over, 137 Avenue not open to traffic at time of study)
- 170 Street (fly-over)
- Mark Messier Trail / St. Albert Trail (grade separated interchange)
- Campbell Road (grade separated interchange)
- 142 Street and CN Rail Line (fly-over)
- 127 Street (grade separated interchange)
- 97 Street (grade separated interchange)
- 82 Street (fly-over)
- 66 Street (grade separated interchange, not fully operational)
- Manning Drive (grade separated interchange, not fully complete)

For the future case noise modeling scenario the following interchanges have been upgraded to their final design or added as new locations:

- 184 Street / Ray Gibbon Drive (completion of interchange by adding ramp for northbound NWAHD to northbound Ray Gibbon Drive
- 137 Avenue (new grade separated interchange)
- 112 Street (new fly-over)
- 66 Street (completion of interchange by extending 66 Street north and south of interchange)
- 50 Street (new grade separated interchange)
- Manning Drive (completion of interchange and extending AHD towards the southeast as part of the northeast AHD project)

2.2. Adjacent Development

Starting from the southwest portion of the study area, there are two residential receptors located adjacent to the southwest of the interchange between Highway 16 and NWAHD, within Edmonton. Further to the southwest and to the southeast is commercial and industrial development within Edmonton. To the northeast of the interchange are single family residential acreage-style lots which back onto Highway 16 with commercial and industrial development further northeast within Edmonton. To the northwest of the interchange is a golf course with acreage-style residential development and more densely packed single-family residential development further to the northwest within Edmonton.

Adjacent to the interchange between 184 Street and NWAHD, there is open land and industrial development to the south and east within Edmonton. To the north is pending residential development partially within Edmonton and then within the City of St. Albert further north. To the northwest there is a new residential subdivision already under construction, adjacent to Ray Gibbon Drive, primarily consisting of single family detached houses, within Edmonton.

Further to the northeast, between the interchange at 137 Avenue and Campbell Road is residential development within St. Albert. Along this span are single family detached houses which back directly onto the Transportation and Utility Corridor (TUC) and onto NWAHD. Along this span, to the south of NWAHD is commercial and industrial development within Edmonton.

North of NWAHD and east of Campbell Road (west of 142 Street), within St. Albert, is commercial and industrial development.

Between 142 Street and 127 Street, south of NWAHD is a new residential subdivision within Edmonton that is currently under construction, consisting primarily of single family detached houses that back onto the TUC and NWAHD. To the north of NWAHD is a pending residential subdivision within Edmonton.

Between 127 Street and 112 Street, south of NWAHD is pending residential development within Edmonton with existing residential development further south. To the north is the new Edmonton Remand center (currently under construction), surrounded on all sides by undeveloped land.

Between 112 Street and 82 Street, south of NWAHD is residential development within Edmonton comprising of single family detached houses that back directly onto the TUC and NWAHD. To the north, within Edmonton, is a golf course (immediately east of 112 Street) and undeveloped land further to the east.

Between 82 Street and Manning Drive, south of NWAHD is pending residential development within Edmonton which will eventually extend all the way to the TUC with existing residential development further south. To the north is undeveloped land which is used primarily for agricultural purposes.

2.3. Topography

Topographically, the land in between NWAHD and the adjacent residential receptors varies with location. Some residential receptors have direct line-of-sight to NWAHD while others do not due to earth berms in between or sections of NWAHD which have been depressed relative to the adjacent grade. Elevation contours containing all of the recent interchanges and roadway elevations have been included in the noise model for more accurate modeling results. The vegetation in the areas between the residential locations and NWAHD consists mainly of field grasses with some small sections of bushes and trees for residents within St. Albert. Although the trees will provide a minimal level of noise attenuation, they have not been included in the model in an effort to make the model more conservative.

3.0 Measurement & Modeling Methods

3.1. Environmental Noise Monitoring

As part of the study a total of seventeen (17) 24-hour environmental noise monitorings were conducted throughout the study area. The noise monitoring locations, as indicated in Figures 1a and 1b, were selected based on their proximity to NWAHD and adjacent interchanges as well as adjacent residential receptors. Seven of the locations were conducted in residential backyards within St. Albert.

The measurements were conducted collecting broadband A-weighted as well as 1/3 octave band sound levels. This enabled a detailed analysis of the noise climate. The 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 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 area to obtain local weather conditions. 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 the report entitled "*Environmental Noise Monitoring for Northwest Anthony Henday Drive in Edmonton, AB,* prepared for ISL Engineering and Land Services Ltd., by aci Acoustical Consultants Inc., November 02, 2012" for more detailed information on the measurement locations, start/stop times, and the equipment used.

3.2. Computer Noise Modeling

The computer noise modeling was conducted using the CADNA/A (version 4.2.140) 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). In particular, 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".*

Throughout the study area, the ground was given an absorption coefficient of 0.5. 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.

Note that not every commercial building and house in the area was modeled. Only the first row of buildings (in relation to the major roadways) were included, 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.

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

1) Current conditions: This included existing road configurations and traffic volumes present during the noise monitoring traffic volumes. The baseline noise monitoring was used as a calibration method for the model.
2) Future conditions (Year 2040): This included final road configurations and interchanges with projected traffic volumes.
3) Future conditions (as in item #2) with a sensitivity analysis: This involved modification of various traffic parameters (listed below) to determine their effect on noise levels.
    a. Traffic counts
    b. Traffic speeds
    c. Traffic composition (i.e. % heavy vehicles)

The computer noise modeling results were calculated in two ways. First, sound levels were calculated at specific receiver locations. This included the noise monitor locations as well as numerous representative residential locations. Next, the sound levels were calculated using a 5 m x 5 m grid over the entire study area for the Current and Future conditions. This provided color noise contours for easier visualization of the results.

Refer to Appendix I for a list of the computer noise modeling parameters, to Appendix II for a description of the acoustical terminology and to Appendix III for a list of common noise sources.

4.0 Permissible Sound Levels

Environmental noise levels from road traffic 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 based on the document entitled *"Noise Attenuation Guidelines for Provincial Highways Under Provincial Jurisdiction Within Cities and Urban Areas"* by Alberta Transportation. The document specifies:

> *"For construction or improvements of highways through cities and other urban areas, Alberta Transportation will adopt a noise level of 65 dBA L_{eq}24 measured 1.2 m above ground level and 2 meters inside the property line (outside the highway right-of-way). The measurements should be adjusted to the 10-year planning horizon, as a threshold to consider noise mitigation measures"*

As such, the criterion used to assess the noise levels in the computer noise model will be **65 dBA L_{eq}24** for all current dwellings at a height of 1.2 m above grade. For typical residential lots that back or "side" onto the provincial roadway, the assessment will be taken at 2 m inside the residential property line in the back-yard amenity space. For typical residential lots that "front" onto the provincial highway, noise levels will be assessed at 2 m inside the residential property line in the front yard. Note also that the criteria state that a 10-year planning horizon should be used for the *future* conditions. Normally, this would mean using traffic data for year 2022 which was not available. Using traffic data for the year 2040 exceeds the requirements of Alberta Transportation and provides a more conservative estimate of the future noise levels.

5.0 Monitoring Results

The noise monitoring results at all 17 measurement locations are shown in Table 1. The information shows the broadband A-weighted $L_{eq}24$, $L_{eq}Day$ and $L_{eq}Night$ sound levels. At most of the noise monitoring locations, traffic noise on NWAHD was the dominant noise source. There were some locations at which the adjacent City of Edmonton or City of St. Alberta roads were the dominant noise sources due to the relative distances from the noise monitor to the City roads and to NWAHD. Note that, the results for monitors M3 - M9 were conducted within residential backyard locations (at a height of 1.2 m and at 2.0 m from the rear property line) and can be compared directly to the Alberta Transportation criteria. These 7 noise monitoring locations within residential property, resulted in noise levels below 65 dBA $L_{eq}24$. All other locations, however, were conducted on public land within the TUC or at the TUC boundary and cannot be directly compared to the criteria of 65 dBA $L_{eq}24$. Further comparisons to the criteria should be done with the modeled results at the residential locations presented in Section 6.

More detailed information for the noise monitorings can be found in the report entitled "*Environmental Noise Monitoring for Northwest Anthony Henday Drive in Edmonton, AB,* prepared for ISL Engineering and Land Services Ltd., by aci Acoustical Consultants Inc., November 02, 2012"

Table 1. Summary of Noise Monitoring Results

Monitor	$L_{eq}24$ (dBA)	$L_{eq}Day$ (dBA)	$L_{eq}Night$ (dBA)
M1	71.2	72.3	68.4
M2	55.8	56.6	53.9
M3	54.2	54.9	52.8
M4	55.4	56.3	53.3
M5	49.7	49.9	49.3
M6	61.8	62.8	59.5
M7	50.7	50.8	50.6
M8	53.9	54.4	52.9
M9	51.8	52.3	50.6
M10	58.4	59.6	55.1
M11	51.2	52.3	48.3
M12	57.5	58.3	55.7
M13	56.2	56.7	55.0
M14	56.9	58.0	53.8
M15	64.6	65.8	61.1
M16	65.4	66.5	62.9
M17	60.9	61.8	58.6

6.0 Modelling Results

6.1. Current Conditions

The results of the noise modeling under current conditions at the noise monitoring locations are presented in Table 2. The $L_{eq}24$, $L_{eq}Day$ and $L_{eq}Night$ sound levels are presented as well as the difference in the $L_{eq}24$ sound levels relative to the monitor results at each location. It can be seen that the modeled sound levels compare very well with the monitored results at each location. At all but one location (M11), the model calibration was such that the model gave slightly higher $L_{eq}24$ sound levels than the monitored results. The reason for the negative difference at M11 is because of the nearby earth-moving construction work that impacted the noise monitoring results but was not accounted for in the noise model. At M2, the modeled noise levels were 0.9 dBA higher than the monitored results because there were reduced traffic speeds on Ray Gibbon Drive / 184 Street at the time of the noise monitoring due to road construction work (resulting in monitored noise levels that were lower than "typical"). Similarly, at M5, the modeled noise levels were 1.0 dBA higher than the monitored results because there were reduced traffic speeds and volumes on 170 Street at the time of the noise monitoring due to road construction work (resulting in monitored noise levels that were lower than "typical"). As such, all noise modeling results are considered conservative (i.e. slightly higher than actual).

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

Monitor	$L_{eq}24$ (dBA)	Difference Relative to Monitor Results $L_{eq}24$ (dBA)	$L_{eq}Day$ (dBA)	$L_{eq}Night$ (dBA)
M1	71.3	0.1	72.2	69.2
M2	56.6	0.9	57.4	54.5
M3	54.5	0.3	55.4	52.4
M4	56.0	0.6	56.8	53.9
M5	50.6	1.0	51.5	48.5
M6	61.8	0.0	62.7	59.8
M7	51.3	0.6	52.1	49.2
M8	53.9	0.0	54.8	51.9
M9	52.6	0.9	53.4	50.5
M10	58.9	0.5	59.7	56.8
M11	50.8	-0.4	51.6	48.7
M12	57.9	0.4	58.8	55.9
M13	56.9	0.7	57.8	54.9
M14	57.6	0.7	58.5	55.5
M15	64.8	0.2	65.7	62.8
M16	65.6	0.2	66.4	63.5
M17	61.1	0.2	61.9	59.0

The results of the Current Conditions noise modeling at the various residential property locations are presented in Tables 3a - 3g. The study area was divided into 7 separate sections, with roadway interchanges as the dividers for each section. In addition to the information presented in Tables 3a - 3g, the L_{eq}24 color noise contours for the entire study area are shown in Figures 2a – 2h. The color contours provide a very good representation of where the "hot" spots are 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 and the color contours are calculated on a 5m x 5m grid and the results are interpolated.

The current noise levels at residential property locations are under the limit of 65 dBA L_{eq}24 at most locations. The exceptions include the residential area immediately north of Yellowhead Trail and east of NWAHD (R_001 to R_003). For this residential area, the dominant noise source is vehicle traffic on Yellowhead Trail.

Table 3a. Noise Modeling Results Under Current Conditions for Region 1

Receptor	L_{eq}24 (dBA)	L_{eq}Day (dBA)	L_{eq}Night (dBA)
R_001	65.8	66.7	63.8
R_002	66.8	67.6	64.7
R_003	70.1	71.0	68.1
R_004	63.4	64.3	61.4
R_005	60.2	61.1	58.1
R_006	58.9	59.8	56.9
R_007	61.4	62.3	59.4
R_008	59.2	60.0	57.1
R_009	53.9	54.8	51.8
R_010	52.5	53.4	50.5
R_011	50.1	51.0	48.1
R_012	48.5	49.4	46.4
R_013	49.6	50.5	47.6
R_014	49.9	50.7	47.8
R_015	49.4	50.3	47.4
R_016	49.1	50.0	47.0
R_017	48.7	49.6	46.7
R_018	48.2	49.0	46.1
R_019	47.5	48.4	45.5
R_020	46.9	47.8	44.9
R_021	46.4	47.3	44.4
R_022	45.8	46.7	43.7
R_023	55.0	55.8	52.9
R_024	54.7	55.6	52.7
R_025	54.8	55.7	52.7
R_026	56.9	57.7	54.8
R_027	58.4	59.2	56.3
R_028	58.6	59.5	56.6
R_029	57.4	58.2	55.3
R_030	58.8	59.6	56.7

Table 3b. Noise Modeling Results Under Current Conditions for Region 2

Receptor	L_{eq}24 (dBA)	L_{eq}Day (dBA)	L_{eq}Night (dBA)		Receptor	L_{eq}24 (dBA)	L_{eq}Day (dBA)	L_{eq}Night (dBA)
R_031	46.3	47.2	44.3		R_072	55.1	55.9	53.0
R_032	52.5	53.4	50.4		R_073	55.4	56.3	53.4
R_033	52.5	53.4	50.5		R_074	55.6	56.5	53.6
R_034	47.3	48.1	45.2		R_075	56.1	57.0	54.1
R_035	47.4	48.3	45.4		R_076	56.4	57.3	54.4
R_036	48.7	49.5	46.6		R_077	57.2	58.1	55.2
R_037	48.3	49.2	46.3		R_078	58.1	59.0	56.1
R_038	48.1	49.0	46.0		R_079	58.2	59.1	56.2
R_039	48.6	49.5	46.6		R_080	58.0	58.9	56.0
R_040	49.0	49.9	47.0		R_081	58.2	59.1	56.2
R_041	50.3	51.2	48.3		R_082	58.8	59.7	56.8
R_042	51.2	52.1	49.2		R_083	59.2	60.1	57.2
R_043	52.4	53.2	50.3		R_084	57.2	58.1	55.2
R_044	53.2	54.0	51.1		R_085	56.8	57.7	54.8
R_045	53.7	54.5	51.6		R_086	57.0	57.8	54.9
R_046	54.2	55.1	52.1		R_087	57.4	58.3	55.3
R_047	55.5	56.4	53.5		R_088	57.9	58.8	55.9
R_048	55.4	56.2	53.3		R_089	58.6	59.4	56.5
R_049	56.1	57.0	54.1		R_090	59.3	60.2	57.3
R_050	55.2	56.1	53.2		R_091	60.5	61.3	58.4
R_051	55.8	56.7	53.8		R_092	61.5	62.4	59.5
R_052	55.5	56.4	53.5		R_093	61.2	62.1	59.2
R_053	55.8	56.7	53.8		R_094	60.8	61.7	58.8
R_054	56.3	57.2	54.3		R_095	60.2	61.1	58.2
R_055	56.5	57.4	54.5		R_096	59.6	60.4	57.5
R_056	56.8	57.7	54.7		R_097	59.1	60.0	57.0
R_057	56.9	57.7	54.8		R_098	58.8	59.7	56.8
R_058	56.8	57.6	54.7		R_099	58.2	59.1	56.2
R_059	56.5	57.4	54.5		R_100	56.5	57.3	54.4
R_060	56.4	57.3	54.4		R_101	54.7	55.6	52.7
R_061	55.8	56.7	53.8		R_102	53.4	54.2	51.3
R_062	56.1	57.0	54.1		R_103	54.0	54.9	52.0
R_063	55.7	56.6	53.7		R_104	55.1	56.0	53.1
R_064	55.6	56.5	53.6		R_105	55.2	56.1	53.2
R_065	55.0	55.9	53.0		R_106	54.7	55.5	52.6
R_066	55.4	56.3	53.4		R_107	54.4	55.3	52.4
R_067	53.9	54.8	51.9		R_108	55.0	55.8	52.9
R_068	53.8	54.6	51.7		R_109	55.6	56.5	53.6
R_069	50.4	51.3	48.4		R_110	56.2	57.1	54.2
R_070	49.6	50.5	47.6		R_111	56.0	56.9	54.0
R_071	51.1	52.0	49.1					

Table 3c. Noise Modeling Results Under Current Conditions for Region 3

Receptor	L_{eq}24 (dBA)	L_{eq}Day (dBA)	L_{eq}Night (dBA)		Receptor	L_{eq}24 (dBA)	L_{eq}Day (dBA)	L_{eq}Night (dBA)
R_112	53.0	53.9	51.0		R_147	52.3	53.2	50.3
R_113	52.4	53.3	50.4		R_148	52.0	52.9	49.9
R_114	53.7	54.6	51.7		R_149	51.7	52.6	49.7
R_115	52.1	53.0	50.1		R_150	51.9	52.8	49.9
R_116	51.2	52.1	49.2		R_151	53.3	54.2	51.3
R_117	51.3	52.1	49.2		R_152	55.3	56.2	53.3
R_118	51.1	52.0	49.1		R_153	54.1	54.9	52.0
R_119	52.3	53.2	50.3		R_154	53.5	54.4	51.5
R_120	53.2	54.1	51.2		R_155	53.5	54.4	51.5
R_121	53.4	54.3	51.3		R_156	53.3	54.2	51.3
R_122	53.6	54.5	51.5		R_157	53.1	53.9	51.0
R_123	54.2	55.1	52.2		R_158	52.8	53.7	50.8
R_124	54.4	55.3	52.3		R_159	52.6	53.5	50.6
R_125	54.3	55.1	52.2		R_160	52.6	53.4	50.5
R_126	54.3	55.2	52.3		R_161	52.4	53.3	50.4
R_127	54.5	55.4	52.5		R_162	52.4	53.2	50.3
R_128	54.0	54.9	52.0		R_163	52.8	53.7	50.8
R_129	54.3	55.2	52.3		R_164	52.9	53.8	50.9
R_130	53.4	54.3	51.4		R_165	53.3	54.2	51.3
R_131	53.9	54.8	51.9		R_166	54.2	55.0	52.1
R_132	54.3	55.2	52.3		R_167	54.0	54.9	52.0
R_133	54.0	54.9	52.0		R_168	54.3	55.2	52.3
R_134	54.2	55.1	52.2		R_169	54.4	55.3	52.4
R_135	54.0	54.9	52.0		R_170	54.3	55.2	52.3
R_136	53.6	54.5	51.6		R_171	54.4	55.3	52.4
R_137	53.5	54.4	51.5		R_172	52.1	53.0	50.0
R_138	53.9	54.8	51.9		R_173	50.6	51.5	48.6
R_139	54.1	55.0	52.1		R_174	51.3	52.2	49.3
R_140	54.2	55.1	52.1		R_175	51.4	52.3	49.4
R_141	54.4	55.3	52.4		R_176	51.1	51.9	49.0
R_142	54.6	55.5	52.6		R_177	53.6	54.4	51.5
R_143	54.3	55.2	52.3		R_178	55.2	56.1	53.2
R_144	55.4	56.3	53.4		R_179	55.7	56.5	53.6
R_145	52.8	53.7	50.8		R_180	56.7	57.5	54.6
R_146	52.6	53.5	50.6					

Table 3d. Noise Modeling Results Under Current Conditions for Region 4

Receptor	L_{eq}24 (dBA)	L_{eq}Day (dBA)	L_{eq}Night (dBA)
R_181	48.9	49.8	46.9
R_182	49.9	50.8	47.9
R_183	61.0	61.9	59.0
R_184	57.2	58.1	55.2
R_185	56.2	57.0	54.1
R_186	55.7	56.6	53.7
R_187	55.6	56.5	53.6
R_188	55.7	56.6	53.7
R_189	55.9	56.8	53.9
R_190	55.8	56.7	53.8
R_191	55.8	56.6	53.7
R_192	55.7	56.6	53.7
R_193	55.6	56.5	53.6
R_194	55.6	56.5	53.6
R_195	59.3	60.2	57.3
R_196	57.9	58.7	55.8
R_197	56.9	57.8	54.9
R_198	56.0	56.9	54.0
R_199	54.4	55.3	52.4
R_200	53.5	54.4	51.5
R_201	52.9	53.8	50.9
R_202	52.4	53.2	50.3
R_203	52.1	53.0	50.1
R_204	51.9	52.8	49.9
R_205	51.7	52.6	49.7
R_206	51.6	52.5	49.6
R_207	48.2	49.1	46.2
R_208	46.8	47.7	44.8
R_209	47.0	47.9	45.0
R_210	47.3	48.2	45.3
R_211	48.1	49.0	46.1
R_212	48.2	49.0	46.1
R_213	47.9	48.8	45.9
R_214	47.9	48.7	45.8
R_215	47.5	48.4	45.5
R_216	47.4	48.3	45.4
R_217	47.4	48.3	45.4
R_218	48.5	49.4	46.5

Table 3e. Noise Modeling Results Under Current Conditions for Region 5

Receptor	L_{eq}24 (dBA)	L_{eq}Day (dBA)	L_{eq}Night (dBA)		Receptor	L_{eq}24 (dBA)	L_{eq}Day (dBA)	L_{eq}Night (dBA)
R_219	56.4	57.3	54.4		R_249	54.5	55.4	52.5
R_220	54.3	55.1	52.2		R_250	53.7	54.6	51.7
R_221	53.3	54.2	51.3		R_251	53.6	54.5	51.6
R_222	52.8	53.7	50.8		R_252	54.8	55.7	52.8
R_223	52.8	53.7	50.8		R_253	54.5	55.4	52.5
R_224	50.8	51.7	48.8		R_254	53.4	54.3	51.4
R_225	50.4	51.3	48.4		R_255	54.4	55.3	52.4
R_226	50.3	51.1	48.2		R_256	57.0	57.9	55.0
R_227	50.8	51.6	48.7		R_257	56.9	57.8	54.9
R_228	50.1	51.0	48.1		R_258	54.7	55.6	52.7
R_229	51.5	52.4	49.5		R_259	53.1	54.0	51.1
R_230	52.0	52.8	49.9		R_260	53.2	54.0	51.1
R_231	53.1	53.9	51.0		R_261	53.6	54.4	51.5
R_232	54.2	55.1	52.2		R_262	54.1	55.0	52.1
R_233	54.0	54.8	51.9		R_263	54.7	55.6	52.7
R_234	53.9	54.8	51.9		R_264	54.0	54.9	52.0
R_235	54.0	54.9	52.0		R_265	54.2	55.1	52.2
R_236	53.3	54.2	51.3		R_266	54.2	55.1	52.2
R_237	53.9	54.8	51.9		R_267	52.9	53.8	50.9
R_238	54.6	55.5	52.6		R_268	52.7	53.6	50.7
R_239	54.9	55.8	52.8		R_269	51.7	52.6	49.7
R_240	55.0	55.8	52.9		R_270	51.1	52.0	49.1
R_241	54.5	55.4	52.5		R_271	50.6	51.5	48.6
R_242	54.8	55.7	52.8		R_272	50.8	51.6	48.7
R_243	54.7	55.6	52.7		R_273	51.1	52.0	49.1
R_244	54.9	55.7	52.8		R_274	52.4	53.2	50.3
R_245	55.1	56.0	53.1		R_275	55.1	56.0	53.0
R_246	54.7	55.5	52.6		R_276	56.5	57.3	54.4
R_247	55.2	56.0	53.1		R_277	56.8	57.7	54.8
R_248	55.2	56.1	53.2		R_278	56.8	57.7	54.8

Table 3f. Noise Modeling Results Under Current Conditions for Region 6

Receptor	L_{eq}24 (dBA)	L_{eq}Day (dBA)	L_{eq}Night (dBA)		Receptor	L_{eq}24 (dBA)	L_{eq}Day (dBA)	L_{eq}Night (dBA)
R_279	57.0	57.8	54.9		R_304	50.3	51.2	48.3
R_280	56.8	57.7	54.7		R_305	50.0	50.8	47.9
R_281	56.5	57.4	54.5		R_306	49.9	50.8	47.9
R_282	54.3	55.2	52.3		R_307	51.7	52.6	49.7
R_283	52.1	53.0	50.1		R_308	49.7	50.6	47.7
R_284	51.3	52.2	49.3		R_309	49.5	50.3	47.4
R_285	51.6	52.5	49.6		R_310	49.6	50.5	47.6
R_286	50.7	51.6	48.6		R_311	49.6	50.5	47.6
R_287	50.8	51.7	48.8		R_312	49.5	50.4	47.5
R_288	50.6	51.4	48.5		R_313	49.5	50.4	47.5
R_289	50.9	51.8	48.9		R_314	49.9	50.8	47.9
R_290	50.8	51.7	48.7		R_315	50.0	50.8	47.9
R_291	51.5	52.4	49.5		R_316	49.7	50.6	47.7
R_292	50.7	51.5	48.6		R_317	50.1	50.9	48.0
R_293	51.5	52.4	49.5		R_318	49.7	50.5	47.6
R_294	50.3	51.2	48.3		R_319	49.4	50.2	47.3
R_295	50.1	51.0	48.1		R_320	50.4	51.2	48.3
R_296	50.0	50.9	48.0		R_321	50.8	51.7	48.8
R_297	50.1	51.0	48.1		R_322	53.2	54.1	51.2
R_298	50.1	51.0	48.1		R_323	53.7	54.6	51.7
R_299	49.9	50.8	47.9		R_324	55.4	56.3	53.4
R_300	50.1	50.9	48.0		R_325	55.3	56.2	53.3
R_301	50.3	51.1	48.2		R_326	55.0	55.9	53.0
R_302	50.4	51.3	48.4		R_327	52.9	53.8	50.9
R_303	50.7	51.6	48.7					

Table 3g. Noise Modeling Results Under Current Conditions for Region 7

Receptor	L_{eq}24 (dBA)	L_{eq}Day (dBA)	L_{eq}Night (dBA)
R_328	52.3	53.2	50.3
R_329	51.2	52.0	49.1
R_330	49.6	50.5	47.6
R_331	53.4	54.3	51.4
R_332	56.9	57.8	54.9
R_333	49.9	50.8	47.9
R_334	49.1	50.0	47.1
R_335	59.4	60.3	57.4

6.2. Future Conditions

The results of the noise modeling under future conditions (Year 2040) at the residential receptor locations are presented in Tables 4a - 4g and shown in Figures 3a – 3h. The L_{eq}24, L_{eq}Day and L_{eq}Night sound levels are presented in the Tables along with the relative increase in the L_{eq}24 compared to 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 because the calculation locations in the Tables are at exact coordinates and the color contours are calculated on a 5m x 5m grid and the results are interpolated. Below each Table is a summary discussion of the results for that particular Region.

Table 4a. Noise Modeling Results Under Future Conditions for Region 1

Receptor	$L_{eq}24$ (dBA)	$L_{eq}24$ Increase Relative to Current Conditions (dBA)	$L_{eq}Day$ (dBA)	$L_{eq}Night$ (dBA)
R_001	66.9	1.1	67.7	64.8
R_002	67.9	1.1	68.8	65.8
R_003	71.5	1.4	72.4	69.5
R_004	64.9	1.5	65.7	62.8
R_005	61.9	1.7	62.8	59.9
R_006	61.0	2.1	61.9	59.0
R_007	64.1	2.7	65.0	62.1
R_008	61.8	2.6	62.6	59.7
R_009	58.0	4.1	58.9	56.0
R_010	56.8	4.3	57.6	54.7
R_011	54.3	4.2	55.2	52.3
R_012	52.9	4.4	53.8	50.9
R_013	53.7	4.1	54.6	51.7
R_014	54.1	4.2	54.9	52.0
R_015	53.7	4.3	54.5	51.6
R_016	53.3	4.2	54.2	51.3
R_017	53.0	4.3	53.9	51.0
R_018	52.5	4.3	53.4	50.5
R_019	52.0	4.5	52.8	49.9
R_020	51.5	4.6	52.4	49.5
R_021	51.1	4.7	52.0	49.1
R_022	50.6	4.8	51.5	48.6
R_023	57.5	2.5	58.4	55.5
R_024	58.5	3.8	59.4	56.4
R_025	58.8	4.0	59.7	56.8
R_026	60.8	3.9	61.7	58.8
R_027	62.3	3.9	63.2	60.3
R_028	63.0	4.4	63.9	61.0
R_029	61.9	4.5	62.8	59.9
R_030	62.4	3.6	63.3	60.4

The Future Conditions noise modeling for Region 1 indicated noise levels below 65 dBA $L_{eq}24$ at all locations with the exception of R_001 to R_003. As mentioned previously, the noise climate for these receptors is dominated by vehicle traffic on Yellowhead Trail. It is also important to note that the residential lots to the west of Ray Gibbon Drive (R_023 to R_030) currently do not have a fence, but will in the near future at the rear property line as the houses backing onto Ray Gibbon Drive are built. As such, a 1.83 m (6 ft) solid screen wood fence was included in the noise model at this location for all Future conditions. The increases relative to the Current Conditions for Region 1 ranged from +1.1 to +4.8 dBA. At essentially all locations, these increases were mostly due to the projected increases in traffic volumes on NWAHD and Ray Gibbon Drive with a lesser projected increase on Yellowhead Trail.

Table 4b. Noise Modeling Results Under Future Conditions for Region 2

Receptor	$L_{eq}24$ (dBA)	$L_{eq}24$ Increase Relative to Current Conditions (dBA)	$L_{eq}Day$ (dBA)	$L_{eq}Night$ (dBA)		Receptor	$L_{eq}24$ (dBA)	$L_{eq}24$ Increase Relative to Current Conditions (dBA)	$L_{eq}Day$ (dBA)	$L_{eq}Night$ (dBA)
R_031	53.8	7.5	54.7	51.8		R_072	58.1	3.0	59.0	56.1
R_032	54.6	2.1	55.5	52.6		R_073	58.5	3.1	59.3	56.4
R_033	55.4	2.9	56.3	53.4		R_074	58.6	3.0	59.5	56.6
R_034	53.0	5.7	53.9	51.0		R_075	58.8	2.7	59.7	56.8
R_035	53.1	5.7	54.0	51.1		R_076	58.9	2.5	59.8	56.9
R_036	53.2	4.5	54.0	51.1		R_077	59.3	2.1	60.1	57.2
R_037	54.0	5.7	54.9	52.0		R_078	59.8	1.7	60.7	57.8
R_038	53.7	5.6	54.6	51.6		R_079	59.8	1.6	60.7	57.8
R_039	54.4	5.8	55.3	52.4		R_080	59.4	1.4	60.3	57.4
R_040	54.8	5.8	55.6	52.7		R_081	59.6	1.4	60.5	57.6
R_041	55.7	5.4	56.6	53.7		R_082	60.3	1.5	61.1	58.2
R_042	56.3	5.1	57.2	54.3		R_083	61.1	1.9	62.0	59.1
R_043	57.3	4.9	58.2	55.3		R_084	60.2	3.0	61.1	58.2
R_044	58.3	5.1	59.1	56.2		R_085	60.3	3.5	61.2	58.3
R_045	58.7	5.0	59.6	56.7		R_086	60.6	3.6	61.5	58.6
R_046	59.3	5.1	60.1	57.2		R_087	61.2	3.8	62.1	59.2
R_047	60.5	5.0	61.4	58.5		R_088	61.8	3.9	62.7	59.8
R_048	60.2	4.8	61.1	58.2		R_089	62.6	4.0	63.4	60.5
R_049	61.0	4.9	61.9	58.9		R_090	63.4	4.1	64.2	61.3
R_050	60.0	4.8	60.8	57.9		R_091	64.5	4.0	65.4	62.5
R_051	60.5	4.7	61.4	58.5		R_092	65.6	4.1	66.5	63.5
R_052	60.2	4.7	61.0	58.1		R_093	65.3	4.1	66.2	63.3
R_053	60.4	4.6	61.3	58.4		R_094	64.9	4.1	65.8	62.9
R_054	60.9	4.6	61.7	58.8		R_095	64.3	4.1	65.2	62.3
R_055	61.1	4.6	61.9	59.0		R_096	63.6	4.0	64.5	61.6
R_056	61.3	4.5	62.2	59.3		R_097	63.1	4.0	63.9	61.0
R_057	61.3	4.4	62.2	59.3		R_098	62.7	3.9	63.5	60.6
R_058	61.2	4.4	62.1	59.2		R_099	61.9	3.7	62.8	59.9
R_059	60.9	4.4	61.8	58.9		R_100	59.8	3.3	60.7	57.8
R_060	60.8	4.4	61.6	58.7		R_101	57.6	2.9	58.5	55.6
R_061	60.2	4.4	61.0	58.1		R_102	56.4	3.0	57.2	54.3
R_062	60.3	4.2	61.1	58.2		R_103	57.2	3.2	58.1	55.1
R_063	59.9	4.2	60.8	57.9		R_104	58.0	2.9	58.9	56.0
R_064	59.6	4.0	60.5	57.6		R_105	57.6	2.4	58.4	55.5
R_065	59.0	4.0	59.9	57.0		R_106	56.9	2.2	57.8	54.9
R_066	59.2	3.8	60.0	57.1		R_107	57.5	3.1	58.4	55.5
R_067	57.7	3.8	58.5	55.6		R_108	58.0	3.0	58.8	55.9
R_068	57.3	3.5	58.2	55.3		R_109	58.6	3.0	59.4	56.5
R_069	53.8	3.4	54.7	51.8		R_110	58.9	2.7	59.8	56.9
R_070	53.0	3.4	53.8	50.9		R_111	58.5	2.5	59.3	56.4
R_071	54.3	3.2	55.2	52.3						

The Future Conditions noise modeling for Region 2 indicated noise levels below 65 dBA $L_{eq}24$ at all but two locations. These two locations (R_092 & R_093) and the neighboring properties (also with noise levels very near 65 dBA $L_{eq}24$) are the residential properties which are physically the closest to NWAHD throughout the entire study area. The site visit indicated that the properties in this area have no fences which provide any acoustical shielding. The increases relative to the Current Conditions ranged from +1.4 to +7.5 dBA. At most locations, these increases were mostly due to the projected increases in traffic volumes on NWAHD. Locations at which the noise climate had a greater influence from intersecting City roads (i.e. 170 Street & St. Albert Trail with lower projected increases in traffic volumes), had lower a relative increase in noise level. The exceptions to this are the residents nearest to 137 Avenue which will see the largest projected increases because of the future introduction of a road and an interchange that is not currently operational.

Table 4c. Noise Modeling Results Under Future Conditions for Region 3

Receptor	$L_{eq}24$ (dBA)	$L_{eq}24$ Increase Relative to Current Conditions (dBA)	$L_{eq}Day$ (dBA)	$L_{eq}Night$ (dBA)		Receptor	$L_{eq}24$ (dBA)	$L_{eq}24$ Increase Relative to Current Conditions (dBA)	$L_{eq}Day$ (dBA)	$L_{eq}Night$ (dBA)
R_112	55.2	2.2	56.0	53.1		R_147	55.8	3.5	56.7	53.8
R_113	54.4	2.0	55.3	52.4		R_148	55.6	3.6	56.5	53.6
R_114	55.6	1.9	56.4	53.5		R_149	55.4	3.7	56.3	53.4
R_115	54.2	2.1	55.1	52.2		R_150	55.7	3.8	56.5	53.6
R_116	53.7	2.5	54.5	51.6		R_151	57.0	3.7	57.8	54.9
R_117	53.9	2.6	54.8	51.9		R_152	59.2	3.9	60.0	57.1
R_118	54.0	2.9	54.9	52.0		R_153	57.8	3.7	58.7	55.7
R_119	55.0	2.7	55.8	52.9		R_154	57.4	3.9	58.2	55.3
R_120	56.5	3.3	57.3	54.4		R_155	57.4	3.9	58.3	55.4
R_121	57.0	3.6	57.9	55.0		R_156	57.1	3.8	58.0	55.1
R_122	57.2	3.6	58.1	55.2		R_157	56.9	3.8	57.8	54.9
R_123	57.7	3.5	58.6	55.7		R_158	56.6	3.8	57.5	54.6
R_124	57.9	3.5	58.7	55.8		R_159	56.4	3.8	57.3	54.4
R_125	57.9	3.6	58.8	55.9		R_160	56.3	3.7	57.1	54.2
R_126	57.9	3.6	58.8	55.8		R_161	56.0	3.6	56.9	54.0
R_127	58.1	3.6	58.9	56.0		R_162	55.9	3.5	56.8	53.9
R_128	57.4	3.4	58.3	55.4		R_163	56.2	3.4	57.1	54.2
R_129	58.0	3.7	58.9	56.0		R_164	56.2	3.3	57.1	54.2
R_130	57.2	3.8	58.1	55.2		R_165	56.4	3.1	57.3	54.4
R_131	57.7	3.8	58.6	55.7		R_166	57.0	2.8	57.9	55.0
R_132	58.0	3.7	58.9	56.0		R_167	56.7	2.7	57.6	54.7
R_133	57.7	3.7	58.6	55.7		R_168	57.1	2.8	58.0	55.1
R_134	58.1	3.9	59.0	56.1		R_169	57.0	2.6	57.9	55.0
R_135	57.9	3.9	58.8	55.9		R_170	56.7	2.4	57.6	54.7
R_136	57.5	3.9	58.4	55.5		R_171	56.6	2.2	57.5	54.6
R_137	57.4	3.9	58.3	55.4		R_172	54.1	2.0	55.0	52.1
R_138	57.8	3.9	58.6	55.7		R_173	53.0	2.4	53.9	50.9
R_139	58.0	3.9	58.9	56.0		R_174	53.5	2.2	54.3	51.4
R_140	58.1	3.9	59.0	56.0		R_175	53.4	2.0	54.3	51.4
R_141	58.3	3.9	59.2	56.3		R_176	53.2	2.1	54.0	51.1
R_142	58.5	3.9	59.4	56.5		R_177	55.1	1.5	55.9	53.0
R_143	58.1	3.8	59.0	56.1		R_178	56.7	1.5	57.6	54.7
R_144	59.3	3.9	60.1	57.2		R_179	56.9	1.2	57.7	54.8
R_145	56.2	3.4	57.1	54.2		R_180	57.5	0.8	58.3	55.4
R_146	55.5	2.9	56.4	53.5						

The Future Conditions noise modeling for Region 3 indicated noise levels below 65 dBA $L_{eq}24$ at all locations. The increases relative to the Current Conditions ranged from +0.8 to +3.9 dBA. At most locations, these increases were due to the projected increases in traffic volumes on NWAHD. Locations at which the noise climate had a greater influence from intersecting City roads (i.e. St. Albert Trial & Campbell Road with lower projected increases in traffic volumes), had a lower relative increase in noise levels.

Table 4d. Noise Modeling Results Under Future Conditions for Region 4

Receptor	$L_{eq}24$ (dBA)	$L_{eq}24$ Increase Relative to Current Conditions (dBA)	$L_{eq}Day$ (dBA)	$L_{eq}Night$ (dBA)
R_181	52.0	3.1	52.9	50.0
R_182	52.9	3.0	53.8	50.9
R_183	62.7	1.7	63.6	60.7
R_184	59.6	2.4	60.4	57.5
R_185	58.9	2.7	59.8	56.9
R_186	58.7	3.0	59.6	56.7
R_187	58.8	3.2	59.6	56.7
R_188	59.0	3.3	59.9	57.0
R_189	59.4	3.5	60.2	57.3
R_190	59.3	3.5	60.2	57.3
R_191	59.2	3.4	60.1	57.2
R_192	59.2	3.5	60.1	57.2
R_193	59.2	3.6	60.0	57.1
R_194	59.1	3.5	60.0	57.1
R_195	61.3	2.0	62.2	59.3
R_196	60.0	2.1	60.9	58.0
R_197	59.2	2.3	60.1	57.2
R_198	58.6	2.6	59.4	56.5
R_199	57.3	2.9	58.2	55.3
R_200	56.7	3.2	57.5	54.6
R_201	56.2	3.3	57.1	54.2
R_202	55.9	3.5	56.8	53.9
R_203	55.8	3.7	56.7	53.8
R_204	55.7	3.8	56.6	53.7
R_205	55.7	4.0	56.6	53.7
R_206	55.7	4.1	56.6	53.7
R_207	51.8	3.6	52.6	49.7
R_208	51.2	4.4	52.0	49.1
R_209	51.5	4.5	52.4	49.5
R_210	51.9	4.6	52.7	49.8
R_211	52.6	4.5	53.5	50.6
R_212	52.9	4.7	53.8	50.9
R_213	52.7	4.8	53.6	50.7
R_214	52.6	4.7	53.5	50.6
R_215	52.3	4.8	53.1	50.2
R_216	52.1	4.7	53.0	50.1
R_217	52.0	4.6	52.9	50.0
R_218	52.5	4.0	53.4	50.5

The Future Conditions noise modeling for Region 4 indicated noise levels below 65 dBA $L_{eq}24$ at all locations. The increases relative to the Current Conditions ranged from +1.7 to +4.8 dBA. At most locations, these increases were due to the projected increases in traffic volumes on NWAHD. Locations at which the noise climate had a greater influence from intersecting City roads (i.e. Campbell Road, 142 Street, 167 Avenue, and 127 Street with lower projected increases in traffic volumes), had a lower relative increase in noise levels.

Table 4e. Noise Modeling Results Under Future Conditions for Region 5

Receptor	$L_{eq}24$ (dBA)	$L_{eq}24$ Increase Relative to Current Conditions (dBA)	$L_{eq}Day$ (dBA)	$L_{eq}Night$ (dBA)		Receptor	$L_{eq}24$ (dBA)	$L_{eq}24$ Increase Relative to Current Conditions (dBA)	$L_{eq}Day$ (dBA)	$L_{eq}Night$ (dBA)
R_219	59.8	3.4	60.6	57.7		R_249	59.1	4.6	60.0	57.1
R_220	59.4	5.1	60.3	57.4		R_250	58.4	4.7	59.3	56.3
R_221	59.1	5.8	59.9	57.0		R_251	58.0	4.4	58.9	56.0
R_222	59.4	6.6	60.3	57.4		R_252	59.6	4.8	60.5	57.6
R_223	61.5	8.7	62.4	59.5		R_253	59.3	4.8	60.2	57.3
R_224	56.2	5.4	57.1	54.2		R_254	58.3	4.9	59.2	56.3
R_225	58.4	8.0	59.3	56.4		R_255	59.4	5.0	60.3	57.4
R_226	57.7	7.4	58.6	55.7		R_256	62.0	5.0	62.9	59.9
R_227	56.9	6.1	57.8	54.9		R_257	61.9	5.0	62.8	59.9
R_228	55.6	5.5	56.5	53.5		R_258	59.6	4.9	60.5	57.6
R_229	56.2	4.7	57.1	54.2		R_259	57.8	4.7	58.7	55.8
R_230	56.3	4.3	57.2	54.3		R_260	57.9	4.7	58.8	55.9
R_231	57.7	4.6	58.6	55.7		R_261	58.1	4.5	59.0	56.1
R_232	59.3	5.1	60.2	57.3		R_262	58.7	4.6	59.6	56.7
R_233	59.0	5.0	59.9	57.0		R_263	59.5	4.8	60.3	57.4
R_234	59.0	5.1	59.9	57.0		R_264	58.7	4.7	59.6	56.6
R_235	59.1	5.1	60.0	57.0		R_265	58.8	4.6	59.7	56.7
R_236	58.4	5.1	59.2	56.3		R_266	58.7	4.5	59.6	56.7
R_237	58.9	5.0	59.8	56.9		R_267	57.2	4.3	58.0	55.1
R_238	59.7	5.1	60.5	57.6		R_268	56.8	4.1	57.7	54.8
R_239	59.7	4.8	60.6	57.7		R_269	55.8	4.1	56.7	53.7
R_240	59.8	4.8	60.6	57.7		R_270	54.9	3.8	55.8	52.9
R_241	59.5	5.0	60.3	57.4		R_271	54.5	3.9	55.3	52.4
R_242	59.8	5.0	60.7	57.8		R_272	54.5	3.7	55.3	52.4
R_243	59.7	5.0	60.6	57.7		R_273	54.6	3.5	55.5	52.6
R_244	59.8	4.9	60.7	57.8		R_274	55.6	3.2	56.4	53.5
R_245	59.9	4.8	60.8	57.9		R_275	57.5	2.4	58.4	55.5
R_246	59.6	4.9	60.5	57.6		R_276	58.2	1.7	59.0	56.1
R_247	60.0	4.8	60.9	58.0		R_277	59.5	2.7	60.4	57.5
R_248	59.9	4.7	60.8	57.9		R_278	59.5	2.7	60.3	57.4

The Future Conditions noise modeling for Region 5 indicated noise levels below 65 dBA $L_{eq}24$ at all locations. The increases relative to the Current Conditions ranged from +1.7 to +8.7 dBA. At most locations, these increases were due to the projected increases in traffic volumes on NWAHD. Locations at which the noise climate had a greater influence from intersecting City roads (i.e. 97 Street with lower projected increases in traffic volumes), had a lower relative increase in noise levels. The exceptions to this are the residents nearest to 112 Street which will see the largest projected increases because of the future introduction of a road that is not currently operational.

Table 4f. Noise Modeling Results Under Future Conditions for Region 6

Receptor	$L_{eq}24$ (dBA)	$L_{eq}24$ Increase Relative to Current Conditions (dBA)	L_{eq}Day (dBA)	L_{eq}Night (dBA)
R_279	59.9	2.9	60.8	57.9
R_280	59.9	3.1	60.8	57.9
R_281	60.2	3.7	61.1	58.2
R_282	58.1	3.8	59.0	56.1
R_283	56.6	4.5	57.5	54.6
R_284	56.1	4.8	57.0	54.1
R_285	56.6	5.0	57.5	54.6
R_286	56.1	5.4	57.0	54.1
R_287	56.5	5.7	57.4	54.5
R_288	56.3	5.7	57.2	54.3
R_289	56.8	5.9	57.7	54.8
R_290	56.5	5.7	57.4	54.5
R_291	57.1	5.6	58.0	55.1
R_292	56.5	5.8	57.4	54.5
R_293	57.4	5.9	58.2	55.3
R_294	56.5	6.2	57.4	54.5
R_295	56.5	6.4	57.4	54.4
R_296	56.3	6.3	57.2	54.3
R_297	56.5	6.4	57.4	54.5
R_298	56.6	6.5	57.5	54.5
R_299	56.4	6.5	57.3	54.3
R_300	56.6	6.5	57.4	54.5
R_301	56.6	6.3	57.5	54.6
R_302	56.8	6.4	57.6	54.7
R_303	56.8	6.1	57.7	54.8
R_304	56.7	6.4	57.6	54.7
R_305	56.5	6.5	57.4	54.5
R_306	56.4	6.5	57.3	54.4
R_307	58.5	6.8	59.4	56.5
R_308	56.1	6.4	57.0	54.1
R_309	55.9	6.4	56.8	53.8
R_310	56.2	6.6	57.1	54.2
R_311	56.2	6.6	57.1	54.2
R_312	56.1	6.6	57.0	54.1
R_313	56.1	6.6	57.0	54.1
R_314	56.1	6.2	57.0	54.1
R_315	56.2	6.2	57.1	54.2
R_316	56.0	6.3	56.9	54.0
R_317	55.9	5.8	56.8	53.9
R_318	55.8	6.1	56.7	53.8
R_319	55.5	6.1	56.4	53.5
R_320	56.3	5.9	57.2	54.3
R_321	56.4	5.6	57.2	54.3
R_322	56.3	3.1	57.2	54.3
R_323	56.8	3.1	57.6	54.7
R_324	58.4	3.0	59.3	56.3
R_325	57.4	2.1	58.2	55.3
R_326	57.0	2.0	57.9	55.0
R_327	59.2	6.3	60.1	57.2

The Future Conditions noise modeling for Region 6 indicated noise levels below 65 dBA $L_{eq}24$ at all locations. The increases relative to the Current Conditions ranged from +2.0 to +6.8 dBA. At most locations, these increases were due to the projected increases in traffic volumes on NWAHD. Locations at which the noise climate had a greater influence from intersecting City roads (i.e. 97 Street & 82 Street with lower projected increases in traffic volumes), had a lower relative increase in noise levels.

Table 4g. Noise Modeling Results Under Future Conditions for Region 7

Receptor	$L_{eq}24$ (dBA)	$L_{eq}24$ Increase Relative to Current Conditions (dBA)	$L_{eq}Day$ (dBA)	$L_{eq}Night$ (dBA)
R_328	60.8	8.5	61.7	58.8
R_329	54.7	3.5	55.6	52.7
R_330	58.8	9.2	59.7	56.8
R_331	55.9	2.5	56.7	53.8
R_332	59.6	2.7	60.4	57.5
R_333	57.4	7.5	58.3	55.4
R_334	57.6	8.5	58.5	55.6
R_335	64.6	5.2	65.5	62.5

The Future Conditions noise modeling for Region 7 indicated noise levels below 65 dBA $L_{eq}24$ at all locations. The increases relative to the Current Conditions ranged from +2.5 to +9.2 dBA. At most locations, these increases were due to the projected increases in traffic volumes on NWAHD. Locations at which the noise climate had a greater influence from intersecting City roads (i.e. 66 Street, 50 Street, and Manning Drive with lower projected increases in traffic volumes), had a lower relative increase in noise levels. The exceptions to this are the residents nearest to 50 Street which will see the largest projected increases because of the future introduction of a road that is not currently operational.

6.3. Future Conditions Sensitivity Analysis

As part of the study, a sensitivity analysis was performed for the main traffic parameters associated with NWAHD. These included the overall traffic volumes, the traffic speeds, and the % heavy trucks. Each was evaluated 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 NWAHD (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 NWAHD will have less of an impact. Tables 5a – 5g 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. The relative increase in noise levels with a relative increase of 25% in traffic volumes would result in a small number of additional locations along NWAHD to have noise levels at or above 65 dBA L_{eq}24, all of them located between 170 Street and St. Albert Trail on the north side of NWAHD.

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 AHD Traffic Volumes for Region 1

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_001	66.9	0.0		66.8	-0.1
R_002	67.9	0.0		67.9	0.0
R_003	71.5	0.0		71.5	0.0
R_004	64.9	0.0		64.8	-0.1
R_005	62.1	0.2		61.8	-0.1
R_006	61.2	0.2		60.8	-0.2
R_007	64.3	0.2		64.0	-0.1
R_008	61.9	0.1		61.6	-0.2
R_009	58.7	0.7		57.2	-0.8
R_010	57.5	0.7		55.9	-0.9
R_011	55.0	0.7		53.5	-0.8
R_012	53.6	0.7		52.1	-0.8
R_013	54.3	0.6		52.9	-0.8
R_014	54.7	0.6		53.3	-0.8
R_015	54.3	0.6		52.9	-0.8
R_016	54.0	0.7		52.5	-0.8
R_017	53.6	0.6		52.2	-0.8
R_018	53.2	0.7		51.7	-0.8
R_019	52.6	0.6		51.2	-0.8
R_020	52.2	0.7		50.7	-0.8
R_021	51.8	0.7		50.3	-0.8
R_022	51.3	0.7		49.9	-0.7
R_023	58.0	0.5		57.0	-0.5
R_024	58.8	0.3		58.1	-0.4
R_025	58.9	0.1		58.6	-0.2
R_026	60.9	0.1		60.7	-0.1
R_027	62.4	0.1		62.2	-0.1
R_028	63.1	0.1		63.0	0.0
R_029	61.9	0.0		61.9	0.0
R_030	62.5	0.1		62.4	0.0

Table 5b. Effects of Changing AHD Traffic Volumes for Region 2

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)		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_031	54.0	0.2		53.5	-0.3		R_072	58.9	0.8		57.2	-0.9
R_032	54.8	0.2		54.4	-0.2		R_073	59.2	0.7		57.5	-1.0
R_033	55.7	0.3		55.1	-0.3		R_074	59.3	0.7		57.7	-0.9
R_034	53.5	0.5		52.5	-0.5		R_075	59.5	0.7		57.9	-0.9
R_035	53.6	0.5		52.6	-0.5		R_076	59.6	0.7		58.1	-0.8
R_036	53.6	0.4		52.7	-0.5		R_077	59.9	0.6		58.6	-0.7
R_037	54.6	0.6		53.4	-0.6		R_078	60.3	0.5		59.2	-0.6
R_038	54.2	0.5		53.1	-0.6		R_079	60.3	0.5		59.2	-0.6
R_039	55.0	0.6		53.7	-0.7		R_080	59.9	0.5		58.9	-0.5
R_040	55.4	0.6		54.0	-0.8		R_081	60.1	0.5		59.1	-0.5
R_041	56.4	0.7		54.9	-0.8		R_082	60.7	0.4		59.8	-0.5
R_042	57.0	0.7		55.5	-0.8		R_083	61.7	0.6		60.5	-0.6
R_043	58.0	0.7		56.4	-0.9		R_084	61.0	0.8		59.3	-0.9
R_044	59.1	0.8		57.3	-1.0		R_085	61.1	0.8		59.3	-1.0
R_045	59.5	0.8		57.7	-1.0		R_086	61.5	0.9		59.6	-1.0
R_046	60.1	0.8		58.3	-1.0		R_087	62.1	0.9		60.1	-1.1
R_047	61.3	0.8		59.5	-1.0		R_088	62.7	0.9		60.8	-1.0
R_048	61.1	0.9		59.2	-1.0		R_089	63.4	0.8		61.5	-1.1
R_049	61.8	0.8		59.9	-1.1		R_090	64.3	0.9		62.3	-1.1
R_050	60.8	0.8		58.9	-1.1		R_091	65.4	0.9		63.4	-1.1
R_051	61.4	0.9		59.4	-1.1		R_092	66.5	0.9		64.5	-1.1
R_052	61.0	0.8		59.1	-1.1		R_093	66.2	0.9		64.2	-1.1
R_053	61.3	0.9		59.3	-1.1		R_094	65.8	0.9		63.8	-1.1
R_054	61.7	0.8		59.8	-1.1		R_095	65.2	0.9		63.2	-1.1
R_055	61.9	0.8		59.9	-1.2		R_096	64.5	0.9		62.5	-1.1
R_056	62.2	0.9		60.2	-1.1		R_097	63.9	0.8		62.0	-1.1
R_057	62.2	0.9		60.2	-1.1		R_098	63.5	0.8		61.6	-1.1
R_058	62.1	0.9		60.1	-1.1		R_099	62.7	0.8		60.9	-1.0
R_059	61.8	0.9		59.8	-1.1		R_100	60.6	0.8		58.8	-1.0
R_060	61.7	0.9		59.7	-1.1		R_101	58.3	0.7		56.7	-0.9
R_061	61.1	0.9		59.0	-1.2		R_102	57.1	0.7		55.5	-0.9
R_062	61.1	0.8		59.2	-1.1		R_103	57.9	0.7		56.3	-0.9
R_063	60.8	0.9		58.8	-1.1		R_104	58.7	0.7		57.2	-0.8
R_064	60.5	0.9		58.5	-1.1		R_105	58.2	0.6		56.8	-0.8
R_065	59.9	0.9		57.9	-1.1		R_106	57.5	0.6		56.3	-0.6
R_066	60.0	0.8		58.1	-1.1		R_107	58.2	0.7		56.6	-0.9
R_067	58.5	0.8		56.6	-1.1		R_108	58.7	0.7		57.1	-0.9
R_068	58.2	0.9		56.3	-1.0		R_109	59.3	0.7		57.7	-0.9
R_069	54.6	0.8		52.9	-0.9		R_110	59.6	0.7		58.1	-0.8
R_070	53.7	0.7		52.0	-1.0		R_111	59.1	0.6		57.7	-0.8
R_071	55.1	0.8		53.4	-0.9							

Table 5c. Effects of Changing AHD Traffic Volumes for Region 3

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)	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_112	55.7	0.5	54.5	-0.7	R_147	56.6	0.8	54.9	-0.9
R_113	54.9	0.5	53.8	-0.6	R_148	56.4	0.8	54.6	-1.0
R_114	56.1	0.5	55.0	-0.6	R_149	56.2	0.8	54.4	-1.0
R_115	54.8	0.6	53.6	-0.6	R_150	56.5	0.8	54.6	-1.1
R_116	54.3	0.6	52.9	-0.8	R_151	57.8	0.8	55.9	-1.1
R_117	54.6	0.7	53.1	-0.8	R_152	60.0	0.8	58.1	-1.1
R_118	54.7	0.7	53.1	-0.9	R_153	58.6	0.8	56.8	-1.0
R_119	55.7	0.7	54.1	-0.9	R_154	58.2	0.8	56.3	-1.1
R_120	57.2	0.7	55.5	-1.0	R_155	58.2	0.8	56.4	-1.0
R_121	57.9	0.9	56.0	-1.0	R_156	57.9	0.8	56.1	-1.0
R_122	58.0	0.8	56.2	-1.0	R_157	57.7	0.8	55.9	-1.0
R_123	58.6	0.9	56.7	-1.0	R_158	57.4	0.8	55.6	-1.0
R_124	58.7	0.8	56.9	-1.0	R_159	57.2	0.8	55.5	-0.9
R_125	58.8	0.9	56.9	-1.0	R_160	57.0	0.7	55.3	-1.0
R_126	58.7	0.8	56.9	-1.0	R_161	56.8	0.8	55.1	-0.9
R_127	58.9	0.8	57.0	-1.1	R_162	56.6	0.7	55.0	-0.9
R_128	58.3	0.9	56.4	-1.0	R_163	56.9	0.7	55.4	-0.8
R_129	58.8	0.8	56.9	-1.1	R_164	56.9	0.7	55.4	-0.8
R_130	58.1	0.9	56.2	-1.0	R_165	57.1	0.7	55.7	-0.7
R_131	58.6	0.9	56.7	-1.0	R_166	57.6	0.6	56.3	-0.7
R_132	58.9	0.9	57.0	-1.0	R_167	57.3	0.6	56.1	-0.6
R_133	58.5	0.8	56.6	-1.1	R_168	57.7	0.6	56.5	-0.6
R_134	59.0	0.9	57.0	-1.1	R_169	57.6	0.6	56.4	-0.6
R_135	58.8	0.9	56.8	-1.1	R_170	57.2	0.5	56.2	-0.5
R_136	58.3	0.8	56.4	-1.1	R_171	57.1	0.5	56.1	-0.5
R_137	58.3	0.9	56.3	-1.1	R_172	54.6	0.5	53.6	-0.5
R_138	58.6	0.8	56.7	-1.1	R_173	53.5	0.5	52.4	-0.6
R_139	58.9	0.9	56.9	-1.1	R_174	53.9	0.4	52.9	-0.6
R_140	58.9	0.8	57.0	-1.1	R_175	53.9	0.5	52.8	-0.6
R_141	59.2	0.9	57.2	-1.1	R_176	53.7	0.5	52.6	-0.6
R_142	59.4	0.9	57.4	-1.1	R_177	55.4	0.3	54.7	-0.4
R_143	59.0	0.9	57.1	-1.0	R_178	57.1	0.4	56.4	-0.3
R_144	60.1	0.8	58.2	-1.1	R_179	57.1	0.2	56.6	-0.3
R_145	57.0	0.8	55.2	-1.0	R_180	57.7	0.2	57.2	-0.3
R_146	56.2	0.7	54.7	-0.8					

Table 5d. Effects of Changing AHD Traffic Volumes for Region 4

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_181	52.6	0.6		51.4	-0.6
R_182	53.5	0.6		52.2	-0.7
R_183	63.0	0.3		62.5	-0.2
R_184	60.0	0.4		59.0	-0.6
R_185	59.5	0.6		58.2	-0.7
R_186	59.4	0.7		57.9	-0.8
R_187	59.5	0.7		57.8	-1.0
R_188	59.8	0.8		58.0	-1.0
R_189	60.2	0.8		58.3	-1.1
R_190	60.2	0.9		58.2	-1.1
R_191	60.1	0.9		58.1	-1.1
R_192	60.1	0.9		58.1	-1.1
R_193	60.0	0.8		58.0	-1.2
R_194	60.0	0.9		58.0	-1.1
R_195	61.4	0.1		61.2	-0.1
R_196	60.2	0.2		59.9	-0.1
R_197	59.5	0.3		59.0	-0.2
R_198	58.9	0.3		58.3	-0.3
R_199	57.7	0.4		56.9	-0.4
R_200	57.1	0.4		56.1	-0.6
R_201	56.8	0.6		55.6	-0.6
R_202	56.5	0.6		55.2	-0.7
R_203	56.4	0.6		55.0	-0.8
R_204	56.4	0.7		54.9	-0.8
R_205	56.4	0.7		54.8	-0.9
R_206	56.4	0.7		54.8	-0.9
R_207	52.5	0.7		50.9	-0.9
R_208	52.0	0.8		50.2	-1.0
R_209	52.3	0.8		50.5	-1.0
R_210	52.7	0.8		50.8	-1.1
R_211	53.4	0.8		51.5	-1.1
R_212	53.8	0.9		51.9	-1.0
R_213	53.6	0.9		51.7	-1.0
R_214	53.5	0.9		51.6	-1.0
R_215	53.1	0.8		51.2	-1.1
R_216	52.9	0.8		51.0	-1.1
R_217	52.9	0.9		51.0	-1.0
R_218	53.3	0.8		51.6	-0.9

Table 5e. Effects of Changing AHD Traffic Volumes for Region 5

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)	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_219	60.0	0.2	59.6	-0.2	R_249	60.0	0.9	58.0	-1.1
R_220	59.6	0.2	59.2	-0.2	R_250	59.3	0.9	57.3	-1.1
R_221	59.3	0.2	58.8	-0.3	R_251	58.9	0.9	56.9	-1.1
R_222	59.7	0.3	59.1	-0.3	R_252	60.5	0.9	58.5	-1.1
R_223	61.8	0.3	61.3	-0.2	R_253	60.2	0.9	58.2	-1.1
R_224	56.6	0.4	55.9	-0.3	R_254	59.2	0.9	57.2	-1.1
R_225	58.8	0.4	58.0	-0.4	R_255	60.3	0.9	58.3	-1.1
R_226	58.2	0.5	57.2	-0.5	R_256	62.9	0.9	60.8	-1.2
R_227	57.7	0.8	56.1	-0.8	R_257	62.8	0.9	60.8	-1.1
R_228	56.4	0.8	54.6	-1.0	R_258	60.5	0.9	58.5	-1.1
R_229	57.1	0.9	55.2	-1.0	R_259	58.7	0.9	56.8	-1.0
R_230	57.1	0.8	55.3	-1.0	R_260	58.8	0.9	56.9	-1.0
R_231	58.6	0.9	56.6	-1.1	R_261	58.9	0.8	57.1	-1.0
R_232	60.2	0.9	58.1	-1.2	R_262	59.6	0.9	57.7	-1.0
R_233	60.0	1.0	57.9	-1.1	R_263	60.3	0.8	58.4	-1.1
R_234	60.0	1.0	57.8	-1.2	R_264	59.5	0.8	57.7	-1.0
R_235	60.0	0.9	57.9	-1.2	R_265	59.6	0.8	57.8	-1.0
R_236	59.3	0.9	57.2	-1.2	R_266	59.5	0.8	57.7	-1.0
R_237	59.9	1.0	57.8	-1.1	R_267	57.9	0.7	56.3	-0.9
R_238	60.6	0.9	58.5	-1.2	R_268	57.6	0.8	56.0	-0.8
R_239	60.7	1.0	58.6	-1.1	R_269	56.5	0.7	54.9	-0.9
R_240	60.7	0.9	58.6	-1.2	R_270	55.6	0.7	54.2	-0.7
R_241	60.4	0.9	58.3	-1.2	R_271	55.1	0.6	53.7	-0.8
R_242	60.7	0.9	58.6	-1.2	R_272	55.0	0.5	53.8	-0.7
R_243	60.6	0.9	58.5	-1.2	R_273	55.1	0.5	54.0	-0.6
R_244	60.7	0.9	58.7	-1.1	R_274	56.0	0.4	55.0	-0.6
R_245	60.8	0.9	58.7	-1.2	R_275	57.8	0.3	57.1	-0.4
R_246	60.5	0.9	58.5	-1.1	R_276	58.4	0.2	57.9	-0.3
R_247	60.9	0.9	58.9	-1.1	R_277	59.9	0.4	59.1	-0.4
R_248	60.8	0.9	58.8	-1.1	R_278	59.8	0.3	59.1	-0.4

Table 5f. Effects of Changing AHD Traffic Volumes for Region 6

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)		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_279	60.2	0.3		59.6	-0.3		R_304	57.6	0.9		55.6	-1.1
R_280	60.3	0.4		59.6	-0.3		R_305	57.4	0.9		55.4	-1.1
R_281	60.6	0.4		59.8	-0.4		R_306	57.3	0.9		55.3	-1.1
R_282	58.6	0.5		57.6	-0.5		R_307	59.4	0.9		57.3	-1.2
R_283	57.2	0.6		55.9	-0.7		R_308	57.0	0.9		55.0	-1.1
R_284	56.8	0.7		55.3	-0.8		R_309	56.8	0.9		54.7	-1.2
R_285	57.3	0.7		55.8	-0.8		R_310	57.1	0.9		55.0	-1.2
R_286	56.9	0.8		55.2	-0.9		R_311	57.1	0.9		55.1	-1.1
R_287	57.3	0.8		55.5	-1.0		R_312	57.0	0.9		55.0	-1.1
R_288	57.1	0.8		55.4	-0.9		R_313	57.0	0.9		55.0	-1.1
R_289	57.6	0.8		55.8	-1.0		R_314	57.0	0.9		55.0	-1.1
R_290	57.3	0.8		55.5	-1.0		R_315	57.1	0.9		55.1	-1.1
R_291	57.9	0.8		56.1	-1.0		R_316	56.9	0.9		54.9	-1.1
R_292	57.3	0.8		55.5	-1.0		R_317	56.8	0.9		54.8	-1.1
R_293	58.2	0.8		56.3	-1.1		R_318	56.7	0.9		54.7	-1.1
R_294	57.4	0.9		55.5	-1.0		R_319	56.4	0.9		54.3	-1.2
R_295	57.3	0.8		55.4	-1.1		R_320	57.2	0.9		55.2	-1.1
R_296	57.2	0.9		55.3	-1.0		R_321	57.3	0.9		55.2	-1.2
R_297	57.4	0.9		55.4	-1.1		R_322	57.1	0.8		55.4	-0.9
R_298	57.5	0.9		55.5	-1.1		R_323	57.5	0.7		55.8	-1.0
R_299	57.3	0.9		55.3	-1.1		R_324	59.2	0.8		57.4	-1.0
R_300	57.5	0.9		55.5	-1.1		R_325	58.1	0.7		56.5	-0.9
R_301	57.5	0.9		55.5	-1.1		R_326	57.7	0.7		56.2	-0.8
R_302	57.6	0.8		55.7	-1.1		R_327	60.2	1.0		58.1	-1.1
R_303	57.7	0.9		55.7	-1.1							

Table 5g. Effects of Changing AHD Traffic Volumes for Region 7

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_328	61.5	0.7		59.9	-0.9
R_329	55.3	0.6		54.1	-0.6
R_330	59.3	0.5		58.3	-0.5
R_331	56.2	0.3		55.5	-0.4
R_332	59.8	0.2		59.4	-0.2
R_333	58.2	0.8		56.4	-1.0
R_334	58.2	0.6		56.8	-0.8
R_335	64.6	0.0		64.5	-0.1

6.3.2. Traffic Speed Analysis

In order to determine the effect of different traffic speeds, two scenarios were modeled. The baseline future conditions case included a speed of 100 km/hr on NWAHD 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 – 6g 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 – 0.7 dBA. When reducing the speed to 90 km/hr, the noise levels decreased by 0.0 – 0.7 dBA.** As with the traffic volumes assessment, the largest changes were at locations where the noise climate was completely dominated by the noise from NWAHD. The locations with the lowest changes were those where the noise climate was dominated by City Roads. The relative increase in noise levels with a speed increase to 110 km/hr would result in a small number of additional locations along NWAHD to have noise levels at or above 65 dBA $L_{eq}24$, all of them located between 170 Street and St. Albert Trail on the north side of NWAHD. 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 AHD Traffic Speed for Region 1

Receptor	L_{eq}24 with 110 km/hr on AHD (dBA)	Increase Compared to 100 km/hr (dBA)		L_{eq}24 with 90 km/hr on AHD (dBA)	Decrease Compared to 100 km/hr (dBA)
R_001	66.9	0.0		66.8	-0.1
R_002	67.9	0.0		67.9	0.0
R_003	71.5	0.0		71.5	0.0
R_004	64.9	0.0		64.8	-0.1
R_005	62.0	0.1		61.9	0.0
R_006	61.1	0.1		60.9	-0.1
R_007	64.2	0.1		64.0	-0.1
R_008	61.8	0.0		61.7	-0.1
R_009	58.5	0.5		57.7	-0.3
R_010	57.2	0.4		56.4	-0.4
R_011	54.8	0.5		53.9	-0.4
R_012	53.3	0.4		52.5	-0.4
R_013	54.1	0.4		53.3	-0.4
R_014	54.5	0.4		53.7	-0.4
R_015	54.1	0.4		53.3	-0.4
R_016	53.8	0.5		53.0	-0.3
R_017	53.4	0.4		52.6	-0.4
R_018	52.9	0.4		52.1	-0.4
R_019	52.4	0.4		51.6	-0.4
R_020	51.9	0.4		51.1	-0.4
R_021	51.5	0.4		50.7	-0.4
R_022	51.1	0.5		50.3	-0.3
R_023	57.8	0.3		57.2	-0.3
R_024	58.7	0.2		58.3	-0.2
R_025	58.9	0.1		58.7	-0.1
R_026	60.9	0.1		60.8	0.0
R_027	62.3	0.0		62.3	0.0
R_028	63.0	0.0		63.0	0.0
R_029	61.9	0.0		61.9	0.0
R_030	62.4	0.0		62.4	0.0

Table 6b. Effects of Changing AHD Traffic Speed for Region 2

Receptor	L_{eq}24 with 110 km/hr on AHD (dBA)	Increase Compared to 100 km/hr (dBA)		L_{eq}24 with 90 km/hr on AHD (dBA)	Decrease Compared to 100 km/hr (dBA)		Receptor	L_{eq}24 with 110 km/hr on AHD (dBA)	Increase Compared to 100 km/hr (dBA)		L_{eq}24 with 90 km/hr on AHD (dBA)	Decrease Compared to 100 km/hr (dBA)
R_031	54.0	0.2		53.6	-0.2		R_072	58.7	0.6		57.6	-0.5
R_032	54.7	0.1		54.5	-0.1		R_073	59.0	0.5		57.9	-0.6
R_033	55.6	0.2		55.3	-0.1		R_074	59.1	0.5		58.1	-0.5
R_034	53.4	0.4		52.8	-0.2		R_075	59.3	0.5		58.3	-0.5
R_035	53.5	0.4		52.8	-0.3		R_076	59.4	0.5		58.5	-0.4
R_036	53.5	0.3		52.9	-0.3		R_077	59.7	0.4		58.9	-0.4
R_037	54.5	0.5		53.7	-0.3		R_078	60.2	0.4		59.5	-0.3
R_038	54.1	0.4		53.3	-0.4		R_079	60.2	0.4		59.5	-0.3
R_039	54.8	0.4		54.0	-0.4		R_080	59.8	0.4		59.1	-0.3
R_040	55.2	0.4		54.4	-0.4		R_081	59.9	0.3		59.3	-0.3
R_041	56.2	0.5		55.3	-0.4		R_082	60.6	0.3		60.0	-0.3
R_042	56.8	0.5		55.8	-0.5		R_083	61.5	0.4		60.8	-0.3
R_043	57.8	0.5		56.8	-0.5		R_084	60.8	0.6		59.7	-0.5
R_044	58.9	0.6		57.7	-0.6		R_085	60.9	0.6		59.7	-0.6
R_045	59.3	0.6		58.2	-0.5		R_086	61.3	0.7		60.1	-0.5
R_046	59.8	0.5		58.7	-0.6		R_087	61.8	0.6		60.6	-0.6
R_047	61.1	0.6		59.9	-0.6		R_088	62.5	0.7		61.2	-0.6
R_048	60.9	0.7		59.7	-0.5		R_089	63.2	0.6		62.0	-0.6
R_049	61.6	0.6		60.4	-0.6		R_090	64.0	0.6		62.7	-0.7
R_050	60.6	0.6		59.4	-0.6		R_091	65.2	0.7		63.9	-0.6
R_051	61.1	0.6		59.9	-0.6		R_092	66.2	0.6		65.0	-0.6
R_052	60.8	0.6		59.6	-0.6		R_093	66.0	0.7		64.7	-0.6
R_053	61.0	0.6		59.8	-0.6		R_094	65.6	0.7		64.3	-0.6
R_054	61.5	0.6		60.3	-0.6		R_095	65.0	0.7		63.7	-0.6
R_055	61.7	0.6		60.4	-0.7		R_096	64.3	0.7		63.0	-0.6
R_056	61.9	0.6		60.7	-0.6		R_097	63.7	0.6		62.5	-0.6
R_057	62.0	0.7		60.7	-0.6		R_098	63.3	0.6		62.1	-0.6
R_058	61.9	0.7		60.6	-0.6		R_099	62.5	0.6		61.3	-0.6
R_059	61.6	0.7		60.3	-0.6		R_100	60.3	0.5		59.3	-0.5
R_060	61.4	0.6		60.2	-0.6		R_101	58.1	0.5		57.1	-0.5
R_061	60.8	0.6		59.5	-0.7		R_102	56.9	0.5		55.9	-0.5
R_062	60.9	0.6		59.7	-0.6		R_103	57.7	0.5		56.7	-0.5
R_063	60.5	0.6		59.3	-0.6		R_104	58.5	0.5		57.6	-0.4
R_064	60.2	0.6		59.0	-0.6		R_105	58.0	0.4		57.2	-0.4
R_065	59.7	0.7		58.4	-0.6		R_106	57.4	0.5		56.6	-0.3
R_066	59.8	0.6		58.6	-0.6		R_107	58.0	0.5		57.0	-0.5
R_067	58.3	0.6		57.1	-0.6		R_108	58.5	0.5		57.5	-0.5
R_068	57.9	0.6		56.8	-0.5		R_109	59.1	0.5		58.1	-0.5
R_069	54.4	0.6		53.3	-0.5		R_110	59.4	0.5		58.5	-0.4
R_070	53.5	0.5		52.4	-0.6		R_111	58.9	0.4		58.0	-0.5
R_071	54.9	0.6		53.8	-0.5							

Table 6c. Effects of Changing AHD Traffic Speed for Region 3

Receptor	L_{eq}24 with 110 km/hr on AHD (dBA)	Increase Compared to 100 km/hr (dBA)		L_{eq}24 with 90 km/hr on AHD (dBA)	Decrease Compared to 100 km/hr (dBA)		Receptor	L_{eq}24 with 110 km/hr on AHD (dBA)	Increase Compared to 100 km/hr (dBA)		L_{eq}24 with 90 km/hr on AHD (dBA)	Decrease Compared to 100 km/hr (dBA)
R_112	55.5	0.3		54.8	-0.4		R_147	56.4	0.6		55.3	-0.5
R_113	54.7	0.3		54.1	-0.3		R_148	56.1	0.5		55.1	-0.5
R_114	55.9	0.3		55.2	-0.4		R_149	55.9	0.5		54.9	-0.5
R_115	54.6	0.4		53.9	-0.3		R_150	56.2	0.5		55.1	-0.6
R_116	54.1	0.4		53.3	-0.4		R_151	57.5	0.5		56.4	-0.6
R_117	54.3	0.4		53.5	-0.4		R_152	59.7	0.5		58.6	-0.6
R_118	54.5	0.5		53.6	-0.4		R_153	58.3	0.5		57.3	-0.5
R_119	55.4	0.4		54.5	-0.5		R_154	57.9	0.5		56.9	-0.5
R_120	57.0	0.5		56.0	-0.5		R_155	57.9	0.5		56.9	-0.5
R_121	57.6	0.6		56.5	-0.5		R_156	57.7	0.6		56.6	-0.5
R_122	57.8	0.6		56.7	-0.5		R_157	57.4	0.5		56.4	-0.5
R_123	58.3	0.6		57.2	-0.5		R_158	57.1	0.5		56.1	-0.5
R_124	58.4	0.5		57.4	-0.5		R_159	56.9	0.5		55.9	-0.5
R_125	58.5	0.6		57.4	-0.5		R_160	56.8	0.5		55.8	-0.5
R_126	58.4	0.5		57.4	-0.5		R_161	56.5	0.5		55.6	-0.4
R_127	58.6	0.5		57.5	-0.6		R_162	56.4	0.5		55.4	-0.5
R_128	58.0	0.6		56.9	-0.5		R_163	56.7	0.5		55.8	-0.4
R_129	58.6	0.6		57.5	-0.5		R_164	56.6	0.4		55.8	-0.4
R_130	57.8	0.6		56.7	-0.5		R_165	56.9	0.5		56.0	-0.4
R_131	58.3	0.6		57.2	-0.5		R_166	57.4	0.4		56.7	-0.3
R_132	58.6	0.6		57.5	-0.5		R_167	57.1	0.4		56.4	-0.3
R_133	58.3	0.6		57.2	-0.5		R_168	57.5	0.4		56.8	-0.3
R_134	58.7	0.6		57.5	-0.6		R_169	57.4	0.4		56.7	-0.3
R_135	58.5	0.6		57.3	-0.6		R_170	57.1	0.4		56.5	-0.2
R_136	58.1	0.6		56.9	-0.6		R_171	57.0	0.4		56.4	-0.2
R_137	58.0	0.6		56.9	-0.5		R_172	54.5	0.4		53.8	-0.3
R_138	58.4	0.6		57.2	-0.6		R_173	53.3	0.3		52.7	-0.3
R_139	58.6	0.6		57.5	-0.5		R_174	53.8	0.3		53.2	-0.3
R_140	58.7	0.6		57.5	-0.6		R_175	53.8	0.4		53.1	-0.3
R_141	58.9	0.6		57.8	-0.5		R_176	53.5	0.3		52.9	-0.3
R_142	59.1	0.6		58.0	-0.5		R_177	55.3	0.2		54.9	-0.2
R_143	58.7	0.6		57.6	-0.5		R_178	56.9	0.2		56.5	-0.2
R_144	59.9	0.6		58.7	-0.6		R_179	57.0	0.1		56.7	-0.2
R_145	56.7	0.5		55.7	-0.5		R_180	57.6	0.1		57.3	-0.2
R_146	56.0	0.5		55.1	-0.4							

Table 6d. Effects of Changing AHD Traffic Speed for Region 4

Receptor	L_{eq}24 with 110 km/hr on AHD (dBA)	Increase Compared to 100 km/hr (dBA)		L_{eq}24 with 90 km/hr on AHD (dBA)	Decrease Compared to 100 km/hr (dBA)
R_181	52.4	0.4		51.7	-0.3
R_182	53.3	0.4		52.6	-0.3
R_183	62.9	0.2		62.6	-0.1
R_184	59.9	0.3		59.3	-0.3
R_185	59.3	0.4		58.5	-0.4
R_186	59.2	0.5		58.3	-0.4
R_187	59.3	0.5		58.3	-0.5
R_188	59.6	0.6		58.5	-0.5
R_189	59.9	0.5		58.8	-0.6
R_190	59.9	0.6		58.8	-0.5
R_191	59.8	0.6		58.7	-0.5
R_192	59.8	0.6		58.6	-0.6
R_193	59.7	0.5		58.6	-0.6
R_194	59.7	0.6		58.6	-0.5
R_195	61.4	0.1		61.3	0.0
R_196	60.1	0.1		59.9	-0.1
R_197	59.4	0.2		59.1	-0.1
R_198	58.8	0.2		58.4	-0.2
R_199	57.6	0.3		57.1	-0.2
R_200	57.0	0.3		56.4	-0.3
R_201	56.6	0.4		55.9	-0.3
R_202	56.3	0.4		55.6	-0.3
R_203	56.2	0.4		55.4	-0.4
R_204	56.2	0.5		55.3	-0.4
R_205	56.2	0.5		55.3	-0.4
R_206	56.2	0.5		55.3	-0.4
R_207	52.2	0.4		51.3	-0.5
R_208	51.7	0.5		50.7	-0.5
R_209	52.1	0.6		51.0	-0.5
R_210	52.4	0.5		51.3	-0.6
R_211	53.1	0.5		52.1	-0.5
R_212	53.5	0.6		52.4	-0.5
R_213	53.3	0.6		52.2	-0.5
R_214	53.2	0.6		52.1	-0.5
R_215	52.8	0.5		51.7	-0.6
R_216	52.7	0.6		51.6	-0.5
R_217	52.6	0.6		51.5	-0.5
R_218	53.0	0.5		52.1	-0.4

Table 6e. Effects of Changing AHD Traffic Speed for Region 5

Receptor	$L_{eq}24$ with 110 km/hr on AHD (dBA)	Increase Compared to 100 km/hr (dBA)	$L_{eq}24$ with 90 km/hr on AHD (dBA)	Decrease Compared to 100 km/hr (dBA)	Receptor	$L_{eq}24$ with 110 km/hr on AHD (dBA)	Increase Compared to 100 km/hr (dBA)	$L_{eq}24$ with 90 km/hr on AHD (dBA)	Decrease Compared to 100 km/hr (dBA)
R_219	59.9	0.1	59.7	-0.1	R_249	59.7	0.6	58.6	-0.5
R_220	59.6	0.2	59.3	-0.1	R_250	59.0	0.6	57.8	-0.6
R_221	59.2	0.1	58.9	-0.2	R_251	58.6	0.6	57.5	-0.5
R_222	59.6	0.2	59.3	-0.1	R_252	60.2	0.6	59.1	-0.5
R_223	61.7	0.2	61.4	-0.1	R_253	59.9	0.6	58.8	-0.5
R_224	56.4	0.2	56.1	-0.1	R_254	58.9	0.6	57.8	-0.5
R_225	58.6	0.2	58.2	-0.2	R_255	60.0	0.6	58.8	-0.6
R_226	58.0	0.3	57.5	-0.2	R_256	62.6	0.6	61.4	-0.6
R_227	57.4	0.5	56.5	-0.4	R_257	62.5	0.6	61.4	-0.5
R_228	56.1	0.5	55.1	-0.5	R_258	60.2	0.6	59.1	-0.5
R_229	56.8	0.6	55.7	-0.5	R_259	58.4	0.6	57.3	-0.5
R_230	56.8	0.5	55.8	-0.5	R_260	58.5	0.6	57.4	-0.5
R_231	58.3	0.6	57.2	-0.5	R_261	58.6	0.5	57.6	-0.5
R_232	59.9	0.6	58.7	-0.6	R_262	59.3	0.6	58.2	-0.5
R_233	59.7	0.7	58.5	-0.5	R_263	60.0	0.5	58.9	-0.6
R_234	59.6	0.6	58.4	-0.6	R_264	59.2	0.5	58.2	-0.5
R_235	59.7	0.6	58.5	-0.6	R_265	59.3	0.5	58.3	-0.5
R_236	59.0	0.6	57.8	-0.6	R_266	59.3	0.6	58.2	-0.5
R_237	59.6	0.7	58.4	-0.5	R_267	57.7	0.5	56.7	-0.5
R_238	60.3	0.6	59.1	-0.6	R_268	57.3	0.5	56.4	-0.4
R_239	60.4	0.7	59.2	-0.5	R_269	56.2	0.4	55.4	-0.4
R_240	60.4	0.6	59.2	-0.6	R_270	55.4	0.5	54.6	-0.3
R_241	60.1	0.6	58.9	-0.6	R_271	54.9	0.4	54.1	-0.4
R_242	60.4	0.6	59.2	-0.6	R_272	54.8	0.3	54.1	-0.4
R_243	60.3	0.6	59.1	-0.6	R_273	55.0	0.4	54.3	-0.3
R_244	60.4	0.6	59.2	-0.6	R_274	55.9	0.3	55.3	-0.3
R_245	60.5	0.6	59.3	-0.6	R_275	57.7	0.2	57.3	-0.2
R_246	60.2	0.6	59.0	-0.6	R_276	58.3	0.1	58.0	-0.2
R_247	60.6	0.6	59.4	-0.6	R_277	59.7	0.2	59.3	-0.2
R_248	60.5	0.6	59.4	-0.5	R_278	59.7	0.2	59.3	-0.2

Table 6f. Effects of Changing AHD Traffic Speed for Region 6

Receptor	L_{eq}24 with 110 km/hr on AHD (dBA)	Increase Compared to 100 km/hr (dBA)	L_{eq}24 with 90 km/hr on AHD (dBA)	Decrease Compared to 100 km/hr (dBA)
R_279	60.1	0.2	59.8	-0.1
R_280	60.1	0.2	59.8	-0.1
R_281	60.5	0.3	60.0	-0.2
R_282	58.4	0.3	57.9	-0.2
R_283	57.0	0.4	56.3	-0.3
R_284	56.5	0.4	55.8	-0.3
R_285	57.1	0.5	56.3	-0.3
R_286	56.6	0.5	55.7	-0.4
R_287	57.0	0.5	56.1	-0.4
R_288	56.8	0.5	55.9	-0.4
R_289	57.3	0.5	56.4	-0.4
R_290	57.0	0.5	56.1	-0.4
R_291	57.6	0.5	56.7	-0.4
R_292	57.0	0.5	56.1	-0.4
R_293	57.9	0.5	56.9	-0.5
R_294	57.1	0.6	56.1	-0.4
R_295	57.0	0.5	56.0	-0.5
R_296	56.9	0.6	55.9	-0.4
R_297	57.0	0.5	56.0	-0.5
R_298	57.1	0.5	56.1	-0.5
R_299	56.9	0.5	55.9	-0.5
R_300	57.1	0.5	56.1	-0.5
R_301	57.1	0.5	56.1	-0.5
R_302	57.3	0.5	56.3	-0.5
R_303	57.3	0.5	56.3	-0.5
R_304	57.3	0.6	56.3	-0.4
R_305	57.0	0.5	56.0	-0.5
R_306	57.0	0.6	55.9	-0.5
R_307	59.0	0.5	58.0	-0.5
R_308	56.7	0.6	55.6	-0.5
R_309	56.4	0.5	55.4	-0.5
R_310	56.7	0.5	55.7	-0.5
R_311	56.8	0.6	55.7	-0.5
R_312	56.7	0.6	55.6	-0.5
R_313	56.7	0.6	55.6	-0.5
R_314	56.6	0.5	55.6	-0.5
R_315	56.7	0.5	55.7	-0.5
R_316	56.6	0.6	55.5	-0.5
R_317	56.4	0.5	55.4	-0.5
R_318	56.3	0.5	55.3	-0.5
R_319	56.0	0.5	55.0	-0.5
R_320	56.8	0.5	55.8	-0.5
R_321	56.9	0.5	55.9	-0.5
R_322	56.8	0.5	55.9	-0.4
R_323	57.2	0.4	56.3	-0.5
R_324	58.8	0.4	57.9	-0.5
R_325	57.8	0.4	57.0	-0.4
R_326	57.4	0.4	56.7	-0.3
R_327	59.8	0.6	58.7	-0.5

Table 6g. Effects of Changing AHD Traffic Speed for Region 7

Receptor	L_{eq}24 with 110 km/hr on AHD (dBA)	Increase Compared to 100 km/hr (dBA)	L_{eq}24 with 90 km/hr on AHD (dBA)	Decrease Compared to 100 km/hr (dBA)
R_328	61.2	0.4	60.4	-0.4
R_329	55.0	0.3	54.4	-0.3
R_330	59.1	0.3	58.6	-0.2
R_331	56.0	0.1	55.7	-0.2
R_332	59.7	0.1	59.5	-0.1
R_333	57.9	0.5	57.0	-0.4
R_334	58.0	0.4	57.2	-0.4
R_335	64.6	0.0	64.5	-0.1

6.3.3. % Heavy Trucks Analysis

In order 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 – 7g. It can be seen that **the relative sound level increase with a relative increase of 5% heavy trucks is approximately 0.0 – 1.0 dBA. The relative sound level decrease with a relative decrease of 5% heavy trucks is approximately 0.0 – 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 NWAHD. The locations with the lowest changes were those where the noise climate was dominated by City Roads. The relative increase in noise levels with a relative increase of 5% heavy trucks would result in a small number of additional locations along NWAHD to have noise levels at or above 65 dBA L_{eq}24, all of them located between 170 Street and St. Albert Trail on the north side of NWAHD. 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 logarithmic. 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 at least 6% during the day-time along the entire NWAHD, small % changes will not have a significant impact.

Table 7a. Effects of Changing AHD % Heavy Trucks for Region 1

Receptor	L_{eq}24 with 5% Greater Heavy Trucks on AHD (dBA)	Increase Compared to Future Conditions (dBA)		L_{eq}24 with 5% Fewer Heavy Trucks on AHD (dBA)	Decrease Compared to Future Conditions (dBA)
R_001	66.9	0.0		66.8	-0.1
R_002	67.9	0.0		67.9	0.0
R_003	71.5	0.0		71.5	0.0
R_004	64.9	0.0		64.8	-0.1
R_005	62.1	0.2		61.8	-0.1
R_006	61.2	0.2		60.8	-0.2
R_007	64.2	0.1		64.0	-0.1
R_008	61.9	0.1		61.6	-0.2
R_009	58.7	0.7		57.3	-0.7
R_010	57.4	0.6		56.0	-0.8
R_011	55.0	0.7		53.6	-0.7
R_012	53.5	0.6		52.1	-0.8
R_013	54.3	0.6		53.0	-0.7
R_014	54.7	0.6		53.3	-0.8
R_015	54.3	0.6		52.9	-0.8
R_016	54.0	0.7		52.6	-0.7
R_017	53.6	0.6		52.2	-0.8
R_018	53.2	0.7		51.8	-0.7
R_019	52.6	0.6		51.2	-0.8
R_020	52.1	0.6		50.8	-0.7
R_021	51.7	0.6		50.4	-0.7
R_022	51.3	0.7		49.9	-0.7
R_023	58.0	0.5		57.0	-0.5
R_024	58.8	0.3		58.1	-0.4
R_025	58.9	0.1		58.7	-0.1
R_026	60.9	0.1		60.7	-0.1
R_027	62.4	0.1		62.2	-0.1
R_028	63.1	0.1		63.0	0.0
R_029	61.9	0.0		61.9	0.0
R_030	62.5	0.1		62.4	0.0

Table 7b. Effects of Changing AHD % Heavy Trucks for Region 2

Receptor	L_{eq}24 with 5% Greater Heavy Trucks on AHD (dBA)	Increase Compared to Future Conditions (dBA)		L_{eq}24 with 5% Fewer Heavy Trucks on AHD (dBA)	Decrease Compared to Future Conditions (dBA)		Receptor	L_{eq}24 with 5% Greater Heavy Trucks on AHD (dBA)	Increase Compared to Future Conditions (dBA)		L_{eq}24 with 5% Fewer Heavy Trucks on AHD (dBA)	Decrease Compared to Future Conditions (dBA)
R_031	54.0	0.2		53.5	-0.3		R_072	58.9	0.8		57.1	-1.0
R_032	54.8	0.2		54.4	-0.2		R_073	59.3	0.8		57.5	-1.0
R_033	55.7	0.3		55.1	-0.3		R_074	59.4	0.8		57.6	-1.0
R_034	53.5	0.5		52.5	-0.5		R_075	59.6	0.8		57.9	-0.9
R_035	53.7	0.6		52.5	-0.6		R_076	59.6	0.7		58.0	-0.9
R_036	53.7	0.5		52.6	-0.6		R_077	59.9	0.6		58.5	-0.8
R_037	54.7	0.7		53.3	-0.7		R_078	60.4	0.6		59.2	-0.6
R_038	54.3	0.6		53.0	-0.7		R_079	60.4	0.6		59.2	-0.6
R_039	55.0	0.6		53.6	-0.8		R_080	59.9	0.5		58.9	-0.5
R_040	55.4	0.6		54.0	-0.8		R_081	60.1	0.5		59.1	-0.5
R_041	56.4	0.7		54.9	-0.8		R_082	60.7	0.4		59.7	-0.6
R_042	57.0	0.7		55.4	-0.9		R_083	61.7	0.6		60.4	-0.7
R_043	58.1	0.8		56.3	-1.0		R_084	61.0	0.8		59.3	-0.9
R_044	59.1	0.8		57.2	-1.1		R_085	61.1	0.8		59.2	-1.1
R_045	59.6	0.9		57.6	-1.1		R_086	61.5	0.9		59.5	-1.1
R_046	60.1	0.8		58.2	-1.1		R_087	62.1	0.9		60.0	-1.2
R_047	61.4	0.9		59.4	-1.1		R_088	62.8	1.0		60.7	-1.1
R_048	61.1	0.9		59.1	-1.1		R_089	63.5	0.9		61.4	-1.2
R_049	61.9	0.9		59.8	-1.2		R_090	64.3	0.9		62.2	-1.2
R_050	60.9	0.9		58.8	-1.2		R_091	65.5	1.0		63.3	-1.2
R_051	61.4	0.9		59.3	-1.2		R_092	66.5	0.9		64.4	-1.2
R_052	61.1	0.9		59.0	-1.2		R_093	66.3	1.0		64.1	-1.2
R_053	61.3	0.9		59.2	-1.2		R_094	65.9	1.0		63.7	-1.2
R_054	61.8	0.9		59.7	-1.2		R_095	65.3	1.0		63.1	-1.2
R_055	62.0	0.9		59.9	-1.2		R_096	64.5	0.9		62.4	-1.2
R_056	62.2	0.9		60.1	-1.2		R_097	64.0	0.9		61.9	-1.2
R_057	62.2	0.9		60.1	-1.2		R_098	63.6	0.9		61.5	-1.2
R_058	62.2	1.0		60.0	-1.2		R_099	62.8	0.9		60.8	-1.1
R_059	61.9	1.0		59.7	-1.2		R_100	60.6	0.8		58.8	-1.0
R_060	61.7	0.9		59.6	-1.2		R_101	58.3	0.7		56.7	-0.9
R_061	61.1	0.9		59.0	-1.2		R_102	57.1	0.7		55.5	-0.9
R_062	61.2	0.9		59.1	-1.2		R_103	57.9	0.7		56.2	-1.0
R_063	60.8	0.9		58.7	-1.2		R_104	58.8	0.8		57.1	-0.9
R_064	60.5	0.9		58.5	-1.1		R_105	58.2	0.6		56.8	-0.8
R_065	59.9	0.9		57.9	-1.1		R_106	57.6	0.7		56.2	-0.7
R_066	60.1	0.9		58.1	-1.1		R_107	58.3	0.8		56.6	-0.9
R_067	58.5	0.8		56.5	-1.2		R_108	58.7	0.7		57.1	-0.9
R_068	58.2	0.9		56.3	-1.0		R_109	59.3	0.7		57.7	-0.9
R_069	54.7	0.9		52.8	-1.0		R_110	59.6	0.7		58.1	-0.8
R_070	53.8	0.8		52.0	-1.0		R_111	59.1	0.6		57.7	-0.8
R_071	55.1	0.8		53.3	-1.0							

Table 7c. Effects of Changing AHD % Heavy Trucks for Region 3

Receptor	L_{eq}24 with 5% Greater Heavy Trucks on AHD (dBA)	Increase Compared to Future Conditions (dBA)	L_{eq}24 with 5% Fewer Heavy Trucks on AHD (dBA)	Decrease Compared to Future Conditions (dBA)	Receptor	L_{eq}24 with 5% Greater Heavy Trucks on AHD (dBA)	Increase Compared to Future Conditions (dBA)	L_{eq}24 with 5% Fewer Heavy Trucks on AHD (dBA)	Decrease Compared to Future Conditions (dBA)
R_112	55.7	0.5	54.5	-0.7	R_147	56.6	0.8	54.9	-0.9
R_113	54.9	0.5	53.8	-0.6	R_148	56.4	0.8	54.6	-1.0
R_114	56.1	0.5	55.0	-0.6	R_149	56.2	0.8	54.4	-1.0
R_115	54.8	0.6	53.6	-0.6	R_150	56.5	0.8	54.6	-1.1
R_116	54.3	0.6	52.9	-0.8	R_151	57.8	0.8	55.9	-1.1
R_117	54.6	0.7	53.1	-0.8	R_152	60.0	0.8	58.1	-1.1
R_118	54.7	0.7	53.1	-0.9	R_153	58.6	0.8	56.8	-1.0
R_119	55.7	0.7	54.1	-0.9	R_154	58.2	0.8	56.4	-1.0
R_120	57.2	0.7	55.5	-1.0	R_155	58.2	0.8	56.4	-1.0
R_121	57.9	0.9	56.0	-1.0	R_156	57.9	0.8	56.1	-1.0
R_122	58.0	0.8	56.2	-1.0	R_157	57.7	0.8	55.9	-1.0
R_123	58.5	0.8	56.7	-1.0	R_158	57.4	0.8	55.7	-0.9
R_124	58.7	0.8	56.9	-1.0	R_159	57.2	0.8	55.5	-0.9
R_125	58.8	0.9	56.9	-1.0	R_160	57.0	0.7	55.4	-0.9
R_126	58.7	0.8	56.9	-1.0	R_161	56.8	0.8	55.1	-0.9
R_127	58.9	0.8	57.1	-1.0	R_162	56.6	0.7	55.0	-0.9
R_128	58.3	0.9	56.4	-1.0	R_163	56.9	0.7	55.4	-0.8
R_129	58.8	0.8	57.0	-1.0	R_164	56.9	0.7	55.4	-0.8
R_130	58.1	0.9	56.2	-1.0	R_165	57.1	0.7	55.7	-0.7
R_131	58.6	0.9	56.7	-1.0	R_166	57.6	0.6	56.3	-0.7
R_132	58.9	0.9	57.0	-1.0	R_167	57.3	0.6	56.1	-0.6
R_133	58.5	0.8	56.6	-1.1	R_168	57.7	0.6	56.5	-0.6
R_134	58.9	0.8	57.0	-1.1	R_169	57.5	0.5	56.4	-0.6
R_135	58.7	0.8	56.8	-1.1	R_170	57.2	0.5	56.2	-0.5
R_136	58.3	0.8	56.4	-1.1	R_171	57.1	0.5	56.1	-0.5
R_137	58.3	0.9	56.3	-1.1	R_172	54.6	0.5	53.6	-0.5
R_138	58.6	0.8	56.7	-1.1	R_173	53.5	0.5	52.4	-0.6
R_139	58.9	0.9	56.9	-1.1	R_174	53.9	0.4	52.9	-0.6
R_140	58.9	0.8	57.0	-1.1	R_175	53.9	0.5	52.8	-0.6
R_141	59.2	0.9	57.2	-1.1	R_176	53.7	0.5	52.6	-0.6
R_142	59.4	0.9	57.4	-1.1	R_177	55.4	0.3	54.7	-0.4
R_143	59.0	0.9	57.1	-1.0	R_178	57.1	0.4	56.4	-0.3
R_144	60.1	0.8	58.2	-1.1	R_179	57.1	0.2	56.6	-0.3
R_145	57.0	0.8	55.3	-0.9	R_180	57.7	0.2	57.2	-0.3
R_146	56.2	0.7	54.7	-0.8					

Table 7d. Effects of Changing AHD % Heavy Trucks for Region 4

Receptor	L_{eq}24 with 5% Greater Heavy Trucks on AHD (dBA)	Increase Compared to Future Conditions (dBA)		L_{eq}24 with 5% Fewer Heavy Trucks on AHD (dBA)	Decrease Compared to Future Conditions (dBA)
R_181	52.6	0.6		51.4	-0.6
R_182	53.5	0.6		52.2	-0.7
R_183	63.0	0.3		62.5	-0.2
R_184	60.0	0.4		59.0	-0.6
R_185	59.5	0.6		58.2	-0.7
R_186	59.4	0.7		57.9	-0.8
R_187	59.5	0.7		57.9	-0.9
R_188	59.8	0.8		58.0	-1.0
R_189	60.2	0.8		58.3	-1.1
R_190	60.2	0.9		58.2	-1.1
R_191	60.1	0.9		58.2	-1.0
R_192	60.1	0.9		58.1	-1.1
R_193	60.0	0.8		58.1	-1.1
R_194	60.0	0.9		58.0	-1.1
R_195	61.4	0.1		61.2	-0.1
R_196	60.2	0.2		59.9	-0.1
R_197	59.5	0.3		59.0	-0.2
R_198	58.9	0.3		58.3	-0.3
R_199	57.7	0.4		56.9	-0.4
R_200	57.1	0.4		56.1	-0.6
R_201	56.8	0.6		55.6	-0.6
R_202	56.5	0.6		55.2	-0.7
R_203	56.4	0.6		55.1	-0.7
R_204	56.4	0.7		54.9	-0.8
R_205	56.4	0.7		54.9	-0.8
R_206	56.4	0.7		54.8	-0.9
R_207	52.4	0.6		51.0	-0.8
R_208	52.0	0.8		50.2	-1.0
R_209	52.3	0.8		50.5	-1.0
R_210	52.7	0.8		50.8	-1.1
R_211	53.4	0.8		51.6	-1.0
R_212	53.8	0.9		51.9	-1.0
R_213	53.6	0.9		51.7	-1.0
R_214	53.5	0.9		51.6	-1.0
R_215	53.1	0.8		51.2	-1.1
R_216	52.9	0.8		51.1	-1.0
R_217	52.9	0.9		51.0	-1.0
R_218	53.3	0.8		51.6	-0.9

Table 7e. Effects of Changing AHD % Heavy Trucks for Region 5

Receptor	L_{eq}24 with 5% Greater Heavy Trucks on AHD (dBA)	Increase Compared to Future Conditions (dBA)		L_{eq}24 with 5% Fewer Heavy Trucks on AHD (dBA)	Decrease Compared to Future Conditions (dBA)		Receptor	L_{eq}24 with 5% Greater Heavy Trucks on AHD (dBA)	Increase Compared to Future Conditions (dBA)		L_{eq}24 with 5% Fewer Heavy Trucks on AHD (dBA)	Decrease Compared to Future Conditions (dBA)
R_219	60.0	0.2		59.6	-0.2		R_249	60.0	0.9		58.0	-1.1
R_220	59.6	0.2		59.2	-0.2		R_250	59.3	0.9		57.3	-1.1
R_221	59.3	0.2		58.8	-0.3		R_251	58.9	0.9		57.0	-1.0
R_222	59.7	0.3		59.1	-0.3		R_252	60.5	0.9		58.5	-1.1
R_223	61.8	0.3		61.3	-0.2		R_253	60.2	0.9		58.2	-1.1
R_224	56.6	0.4		55.9	-0.3		R_254	59.2	0.9		57.2	-1.1
R_225	58.8	0.4		58.0	-0.4		R_255	60.3	0.9		58.3	-1.1
R_226	58.2	0.5		57.2	-0.5		R_256	62.9	0.9		60.8	-1.2
R_227	57.6	0.7		56.1	-0.8		R_257	62.8	0.9		60.8	-1.1
R_228	56.4	0.8		54.6	-1.0		R_258	60.5	0.9		58.6	-1.0
R_229	57.0	0.8		55.2	-1.0		R_259	58.7	0.9		56.8	-1.0
R_230	57.1	0.8		55.4	-0.9		R_260	58.8	0.9		56.9	-1.0
R_231	58.6	0.9		56.6	-1.1		R_261	58.9	0.8		57.1	-1.0
R_232	60.2	0.9		58.2	-1.1		R_262	59.5	0.8		57.7	-1.0
R_233	60.0	1.0		57.9	-1.1		R_263	60.3	0.8		58.4	-1.1
R_234	59.9	0.9		57.9	-1.1		R_264	59.5	0.8		57.7	-1.0
R_235	60.0	0.9		57.9	-1.2		R_265	59.6	0.8		57.8	-1.0
R_236	59.3	0.9		57.2	-1.2		R_266	59.5	0.8		57.8	-0.9
R_237	59.9	1.0		57.8	-1.1		R_267	57.9	0.7		56.3	-0.9
R_238	60.6	0.9		58.5	-1.2		R_268	57.5	0.7		56.0	-0.8
R_239	60.6	0.9		58.6	-1.1		R_269	56.5	0.7		55.0	-0.8
R_240	60.7	0.9		58.6	-1.2		R_270	55.6	0.7		54.2	-0.7
R_241	60.4	0.9		58.3	-1.2		R_271	55.1	0.6		53.7	-0.8
R_242	60.7	0.9		58.6	-1.2		R_272	55.0	0.5		53.8	-0.7
R_243	60.6	0.9		58.5	-1.2		R_273	55.1	0.5		54.0	-0.6
R_244	60.7	0.9		58.7	-1.1		R_274	56.0	0.4		55.1	-0.5
R_245	60.8	0.9		58.8	-1.1		R_275	57.8	0.3		57.2	-0.3
R_246	60.5	0.9		58.5	-1.1		R_276	58.4	0.2		57.9	-0.3
R_247	60.9	0.9		58.9	-1.1		R_277	59.9	0.4		59.1	-0.4
R_248	60.8	0.9		58.8	-1.1		R_278	59.8	0.3		59.1	-0.4

Table 7f. Effects of Changing AHD % Heavy Trucks for Region 6

Receptor	L_{eq}24 with 5% Greater Heavy Trucks on AHD (dBA)	Increase Compared to Future Conditions (dBA)		L_{eq}24 with 5% Fewer Heavy Trucks on AHD (dBA)	Decrease Compared to Future Conditions (dBA)		Receptor	L_{eq}24 with 5% Greater Heavy Trucks on AHD (dBA)	Increase Compared to Future Conditions (dBA)		L_{eq}24 with 5% Fewer Heavy Trucks on AHD (dBA)	Decrease Compared to Future Conditions (dBA)
R_279	60.2	0.3		59.6	-0.3		R_304	57.6	0.9		55.8	-0.9
R_280	60.2	0.3		59.6	-0.3		R_305	57.3	0.8		55.5	-1.0
R_281	60.6	0.4		59.8	-0.4		R_306	57.3	0.9		55.4	-1.0
R_282	58.6	0.5		57.6	-0.5		R_307	59.3	0.8		57.5	-1.0
R_283	57.2	0.6		56.0	-0.6		R_308	56.9	0.8		55.1	-1.0
R_284	56.7	0.6		55.4	-0.7		R_309	56.7	0.8		54.9	-1.0
R_285	57.3	0.7		55.9	-0.7		R_310	57.0	0.8		55.2	-1.0
R_286	56.8	0.7		55.3	-0.8		R_311	57.0	0.8		55.2	-1.0
R_287	57.2	0.7		55.6	-0.9		R_312	57.0	0.9		55.1	-1.0
R_288	57.1	0.8		55.5	-0.8		R_313	57.0	0.9		55.1	-1.0
R_289	57.5	0.7		55.9	-0.9		R_314	56.9	0.8		55.1	-1.0
R_290	57.3	0.8		55.6	-0.9		R_315	57.0	0.8		55.2	-1.0
R_291	57.8	0.7		56.2	-0.9		R_316	56.9	0.9		55.0	-1.0
R_292	57.3	0.8		55.6	-0.9		R_317	56.7	0.8		54.9	-1.0
R_293	58.1	0.7		56.5	-0.9		R_318	56.6	0.8		54.8	-1.0
R_294	57.3	0.8		55.6	-0.9		R_319	56.3	0.8		54.5	-1.0
R_295	57.3	0.8		55.5	-1.0		R_320	57.1	0.8		55.3	-1.0
R_296	57.1	0.8		55.4	-0.9		R_321	57.2	0.8		55.4	-1.0
R_297	57.3	0.8		55.6	-0.9		R_322	57.0	0.7		55.5	-0.8
R_298	57.4	0.8		55.6	-1.0		R_323	57.5	0.7		55.9	-0.9
R_299	57.2	0.8		55.4	-1.0		R_324	59.1	0.7		57.5	-0.9
R_300	57.4	0.8		55.6	-1.0		R_325	58.0	0.6		56.6	-0.8
R_301	57.4	0.8		55.6	-1.0		R_326	57.6	0.6		56.3	-0.7
R_302	57.6	0.8		55.8	-1.0		R_327	60.1	0.9		58.2	-1.0
R_303	57.6	0.8		55.8	-1.0							

Table 7g. Effects of Changing AHD % Heavy Trucks for Region 7

Receptor	L_{eq}24 with 5% Greater Heavy Trucks on AHD (dBA)	Increase Compared to Future Conditions (dBA)		L_{eq}24 with 5% Fewer Heavy Trucks on AHD (dBA)	Decrease Compared to Future Conditions (dBA)
R_328	61.4	0.6		60.0	-0.8
R_329	55.2	0.5		54.2	-0.5
R_330	59.2	0.4		58.3	-0.5
R_331	56.1	0.2		55.6	-0.3
R_332	59.7	0.1		59.4	-0.2
R_333	58.2	0.8		56.5	-0.9
R_334	58.2	0.6		56.9	-0.7
R_335	64.6	0.0		64.5	-0.1

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 Tables 8a – 8g. Relative increases for locations which are most directly impacted by NWAHD are as high as 2.4 dBA. At locations in which the noise climate is most directly impacted by City roadways, the increases are as low as 0.0 dBA. The relative increase in noise levels associated with a relative increase of 25% traffic volumes, 5% heavy trucks and a speed of 110 km/hr would result in a small number of additional locations along NWAHD to have noise levels at or above 65 dBA L_{eq}24, all of them located between 170 Street and St. Albert Trail on the north side of NWAHD.

Table 8a. Effects of Cumulative Effects on Noise Levels For Region 1

Receptor	L_{eq}24 with 25% Additional Vehicles, Speed of 110 km/hr, 5% Greater Heavy Trucks on AHD (dBA)	Increase Compared to Future Conditions (dBA)
R_001	66.9	0.0
R_002	67.9	0.0
R_003	71.6	0.1
R_004	65.1	0.2
R_005	62.4	0.5
R_006	61.6	0.6
R_007	64.5	0.4
R_008	62.1	0.3
R_009	59.8	1.8
R_010	58.5	1.7
R_011	56.1	1.8
R_012	54.6	1.7
R_013	55.3	1.6
R_014	55.8	1.7
R_015	55.4	1.7
R_016	55.0	1.7
R_017	54.7	1.7
R_018	54.2	1.7
R_019	53.7	1.7
R_020	53.2	1.7
R_021	52.8	1.7
R_022	52.3	1.7
R_023	58.8	1.3
R_024	59.4	0.9
R_025	59.2	0.4
R_026	61.1	0.3
R_027	62.5	0.2
R_028	63.2	0.2
R_029	62.0	0.1
R_030	62.6	0.2

Table 8b. Effects of Cumulative Effects on Noise Levels For Region 2

Receptor	Leq24 with 25% Additional Vehicles, Speed of 110 km/hr, 5% Greater Heavy Trucks on AHD (dBA)	Increase Compared to Future Conditions (dBA)		Receptor	Leq24 with 25% Additional Vehicles, Speed of 110 km/hr, 5% Greater Heavy Trucks on AHD (dBA)	Increase Compared to Future Conditions (dBA)
R_031	54.5	0.7		R_072	60.2	2.1
R_032	55.1	0.5		R_073	60.6	2.1
R_033	56.2	0.8		R_074	60.6	2.0
R_034	54.4	1.4		R_075	60.8	2.0
R_035	54.5	1.4		R_076	60.8	1.9
R_036	54.5	1.3		R_077	61.0	1.7
R_037	55.7	1.7		R_078	61.3	1.5
R_038	55.2	1.5		R_079	61.3	1.5
R_039	56.1	1.7		R_080	60.8	1.4
R_040	56.5	1.7		R_081	60.9	1.3
R_041	57.5	1.8		R_082	61.5	1.2
R_042	58.1	1.8		R_083	62.7	1.6
R_043	59.3	2.0		R_084	62.3	2.1
R_044	60.4	2.1		R_085	62.5	2.2
R_045	60.9	2.2		R_086	62.9	2.3
R_046	61.4	2.1		R_087	63.5	2.3
R_047	62.7	2.2		R_088	64.2	2.4
R_048	62.5	2.3		R_089	64.9	2.3
R_049	63.2	2.2		R_090	65.7	2.3
R_050	62.2	2.2		R_091	66.9	2.4
R_051	62.8	2.3		R_092	67.9	2.3
R_052	62.5	2.3		R_093	67.7	2.4
R_053	62.7	2.3		R_094	67.3	2.4
R_054	63.2	2.3		R_095	66.7	2.4
R_055	63.4	2.3		R_096	66.0	2.4
R_056	63.7	2.4		R_097	65.4	2.3
R_057	63.7	2.4		R_098	64.9	2.2
R_058	63.6	2.4		R_099	64.1	2.2
R_059	63.3	2.4		R_100	61.9	2.1
R_060	63.1	2.3		R_101	59.5	1.9
R_061	62.5	2.3		R_102	58.3	1.9
R_062	62.6	2.3		R_103	59.2	2.0
R_063	62.2	2.3		R_104	59.9	1.9
R_064	61.9	2.3		R_105	59.3	1.7
R_065	61.3	2.3		R_106	58.6	1.7
R_066	61.4	2.2		R_107	59.5	2.0
R_067	59.9	2.2		R_108	59.9	1.9
R_068	59.5	2.2		R_109	60.5	1.9
R_069	56.0	2.2		R_110	60.7	1.8
R_070	55.1	2.1		R_111	60.2	1.7
R_071	56.4	2.1				

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Table 8c. Effects of Cumulative Effects on Noise Levels For Region 3

Receptor	Leq24 with 25% Additional Vehicles, Speed of 110 km/hr, 5% Greater Heavy Trucks on AHD (dBA)	Increase Compared to Future Conditions (dBA)		Receptor	Leq24 with 25% Additional Vehicles, Speed of 110 km/hr, 5% Greater Heavy Trucks on AHD (dBA)	Increase Compared to Future Conditions (dBA)
R_112	56.7	1.5		R_147	57.9	2.1
R_113	55.8	1.4		R_148	57.7	2.1
R_114	57.0	1.4		R_149	57.5	2.1
R_115	55.8	1.6		R_150	57.8	2.1
R_116	55.3	1.6		R_151	59.1	2.1
R_117	55.7	1.8		R_152	61.3	2.1
R_118	55.9	1.9		R_153	59.9	2.1
R_119	56.8	1.8		R_154	59.5	2.1
R_120	58.5	2.0		R_155	59.5	2.1
R_121	59.2	2.2		R_156	59.2	2.1
R_122	59.3	2.1		R_157	59.0	2.1
R_123	59.8	2.1		R_158	58.6	2.0
R_124	60.0	2.1		R_159	58.4	2.0
R_125	60.1	2.2		R_160	58.2	1.9
R_126	60.0	2.1		R_161	57.9	1.9
R_127	60.2	2.1		R_162	57.8	1.9
R_128	59.6	2.2		R_163	58.1	1.9
R_129	60.2	2.2		R_164	58.0	1.8
R_130	59.4	2.2		R_165	58.1	1.7
R_131	59.9	2.2		R_166	58.6	1.6
R_132	60.2	2.2		R_167	58.2	1.5
R_133	59.9	2.2		R_168	58.6	1.5
R_134	60.3	2.2		R_169	58.4	1.4
R_135	60.1	2.2		R_170	58.1	1.4
R_136	59.7	2.2		R_171	57.9	1.3
R_137	59.6	2.2		R_172	55.5	1.4
R_138	60.0	2.2		R_173	54.5	1.5
R_139	60.2	2.2		R_174	54.8	1.3
R_140	60.3	2.2		R_175	54.8	1.4
R_141	60.5	2.2		R_176	54.6	1.4
R_142	60.7	2.2		R_177	56.1	1.0
R_143	60.3	2.2		R_178	57.7	1.0
R_144	61.5	2.2		R_179	57.6	0.7
R_145	58.3	2.1		R_180	58.1	0.6
R_146	57.4	1.9				

Table 8d. Effects of Cumulative Effects on Noise Levels For Region 4

Receptor	$L_{eq}24$ with 25% Additional Vehicles, Speed of 110 km/hr, 5% Greater Heavy Trucks on AHD (dBA)	Increase Compared to Future Conditions (dBA)
R_181	53.5	1.5
R_182	54.5	1.6
R_183	63.4	0.7
R_184	60.9	1.3
R_185	60.5	1.6
R_186	60.5	1.8
R_187	60.7	1.9
R_188	61.1	2.1
R_189	61.5	2.1
R_190	61.5	2.2
R_191	61.5	2.3
R_192	61.4	2.2
R_193	61.4	2.2
R_194	61.4	2.3
R_195	61.6	0.3
R_196	60.5	0.5
R_197	59.9	0.7
R_198	59.4	0.8
R_199	58.4	1.1
R_200	57.9	1.2
R_201	57.7	1.5
R_202	57.5	1.6
R_203	57.5	1.7
R_204	57.5	1.8
R_205	57.5	1.8
R_206	57.6	1.9
R_207	53.6	1.8
R_208	53.3	2.1
R_209	53.6	2.1
R_210	54.0	2.1
R_211	54.7	2.1
R_212	55.1	2.2
R_213	55.0	2.3
R_214	54.8	2.2
R_215	54.4	2.1
R_216	54.3	2.2
R_217	54.2	2.2
R_218	54.5	2.0

Table 8e. Effects of Cumulative Effects on Noise Levels For Region 5

Receptor	Leq24 with 25% Additional Vehicles, Speed of 110 km/hr, 5% Greater Heavy Trucks on AHD (dBA)	Increase Compared to Future Conditions (dBA)		Receptor	Leq24 with 25% Additional Vehicles, Speed of 110 km/hr, 5% Greater Heavy Trucks on AHD (dBA)	Increase Compared to Future Conditions (dBA)
R_219	60.3	0.5		R_249	61.3	2.2
R_220	60.1	0.7		R_250	60.6	2.2
R_221	59.8	0.7		R_251	60.2	2.2
R_222	60.3	0.9		R_252	61.9	2.3
R_223	62.2	0.7		R_253	61.6	2.3
R_224	57.1	0.9		R_254	60.6	2.3
R_225	59.4	1.0		R_255	61.7	2.3
R_226	59.0	1.3		R_256	64.3	2.3
R_227	58.8	1.9		R_257	64.2	2.3
R_228	57.7	2.1		R_258	61.9	2.3
R_229	58.3	2.1		R_259	60.0	2.2
R_230	58.3	2.0		R_260	60.1	2.2
R_231	60.0	2.3		R_261	60.2	2.1
R_232	61.6	2.3		R_262	60.8	2.1
R_233	61.4	2.4		R_263	61.6	2.1
R_234	61.4	2.4		R_264	60.8	2.1
R_235	61.4	2.3		R_265	60.9	2.1
R_236	60.7	2.3		R_266	60.8	2.1
R_237	61.3	2.4		R_267	59.1	1.9
R_238	62.0	2.3		R_268	58.7	1.9
R_239	62.1	2.4		R_269	57.6	1.8
R_240	62.1	2.3		R_270	56.6	1.7
R_241	61.8	2.3		R_271	56.2	1.7
R_242	62.1	2.3		R_272	56.0	1.5
R_243	62.0	2.3		R_273	56.0	1.4
R_244	62.1	2.3		R_274	56.8	1.2
R_245	62.2	2.3		R_275	58.3	0.8
R_246	61.9	2.3		R_276	58.8	0.6
R_247	62.3	2.3		R_277	60.5	1.0
R_248	62.2	2.3		R_278	60.4	0.9

Table 8f. Effects of Cumulative Effects on Noise Levels For Region 6

Receptor	Leq24 with 25% Additional Vehicles, Speed of 110 km/hr, 5% Greater Heavy Trucks on AHD (dBA)	Increase Compared to Future Conditions (dBA)		Receptor	Leq24 with 25% Additional Vehicles, Speed of 110 km/hr, 5% Greater Heavy Trucks on AHD (dBA)	Increase Compared to Future Conditions (dBA)
R_279	60.7	0.8		R_304	58.9	2.2
R_280	60.8	0.9		R_305	58.7	2.2
R_281	61.3	1.1		R_306	58.6	2.2
R_282	59.4	1.3		R_307	60.7	2.2
R_283	58.1	1.5		R_308	58.3	2.2
R_284	57.8	1.7		R_309	58.0	2.1
R_285	58.4	1.8		R_310	58.4	2.2
R_286	58.0	1.9		R_311	58.4	2.2
R_287	58.4	1.9		R_312	58.3	2.2
R_288	58.3	2.0		R_313	58.3	2.2
R_289	58.8	2.0		R_314	58.2	2.1
R_290	58.5	2.0		R_315	58.4	2.2
R_291	59.1	2.0		R_316	58.2	2.2
R_292	58.5	2.0		R_317	58.0	2.1
R_293	59.4	2.0		R_318	58.0	2.2
R_294	58.6	2.1		R_319	57.7	2.2
R_295	58.6	2.1		R_320	58.5	2.2
R_296	58.4	2.1		R_321	58.5	2.1
R_297	58.6	2.1		R_322	58.2	1.9
R_298	58.7	2.1		R_323	58.7	1.9
R_299	58.5	2.1		R_324	60.3	1.9
R_300	58.7	2.1		R_325	59.1	1.7
R_301	58.7	2.1		R_326	58.7	1.7
R_302	58.9	2.1		R_327	61.5	2.3
R_303	58.9	2.1				

Table 8g. Effects of Cumulative Effects on Noise Levels For Region 7

Receptor	L_{eq}24 with 25% Additional Vehicles, Speed of 110 km/hr, 5% Greater Heavy Trucks on AHD (dBA)	Increase Compared to Future Conditions (dBA)
R_328	62.5	1.7
R_329	56.1	1.4
R_330	60.0	1.2
R_331	56.7	0.8
R_332	60.1	0.5
R_333	59.4	2.0
R_334	59.2	1.6
R_335	64.7	0.1

7.0 Conclusion

The results of the Current Conditions noise monitoring indicated noise levels which were below 65 dBA L_{eq}24 at most locations. At most of the noise monitoring locations, traffic noise on NWAHD was the dominant noise source. There were some locations at which the adjacent City of Edmonton or City of St. Alberta road was the dominant noise source due to the relative distances from the noise monitor to the City road and to NWAHD. Note that the noise monitorings within the City of St. Albert were conducted within residential backyard locations and can be compared directly to the criteria of 65 dBA L_{eq}24 (all seven of them resulted in noise levels below 65 dBA L_{eq}24). All other locations, however, were conducted on public land within the TUC or at the TUC boundary and cannot be directly compared to the criteria of 65 dBA L_{eq}24.

The noise modeling results for Current Conditions matched well with the measurement results. The modeled noise levels were below the limit of 65 dBA L_{eq}24 at all of the residential outdoor receptor locations with the exception of those directly north of Yellowhead Trail and east of NWAHD. For those locations, the dominant noise source was vehicle traffic on Yellowhead Trail.

The noise modeling results for the Future Conditions (with projected traffic volumes for the Year 2040) indicated noise levels which were still below the limit of 65 dBA L_{eq}24 at most locations. The model indicated that, other than the residents immediately north of Yellowhead Trail, there will be two residential receptors between 170 Street and St. Albert Trail with noise levels at 65 dBA L_{eq}24 and several neighboring locations with noise levels very near 65 dBA L_{eq}24. It is important to note that none of the residential properties in this area have fences which provide any acoustical shielding.

A sensitivity analysis of the traffic volumes, traffic speeds, and % heavy trucks indicated that significant individual increases to each parameter or significant increases to all three combined, would result in additional locations with noise levels at or above 65 dBA L_{eq}24. All of these additional locations were located between 170 Street and St. Albert Trail, adjacent to those which were already modeled to exceed 65 dBA Leq24 with the Future conditions.

8.0 References

- *"Noise Attenuation Guidelines for Provincial Highways Under Provincial Jurisdiction Within Cities and Urban Areas"*, by Alberta Transportation. October, 2002
- *"Environmental Noise Monitoring for Northwest Anthony Henday Drive in Edmonton, AB"*. Prepared for ISL Engineering and Land Services Ltd. by aci Acoustical Consultants Inc. November 02, 2012.
- City of Edmonton Urban Traffic Noise Policy (C506), 2004
- 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.

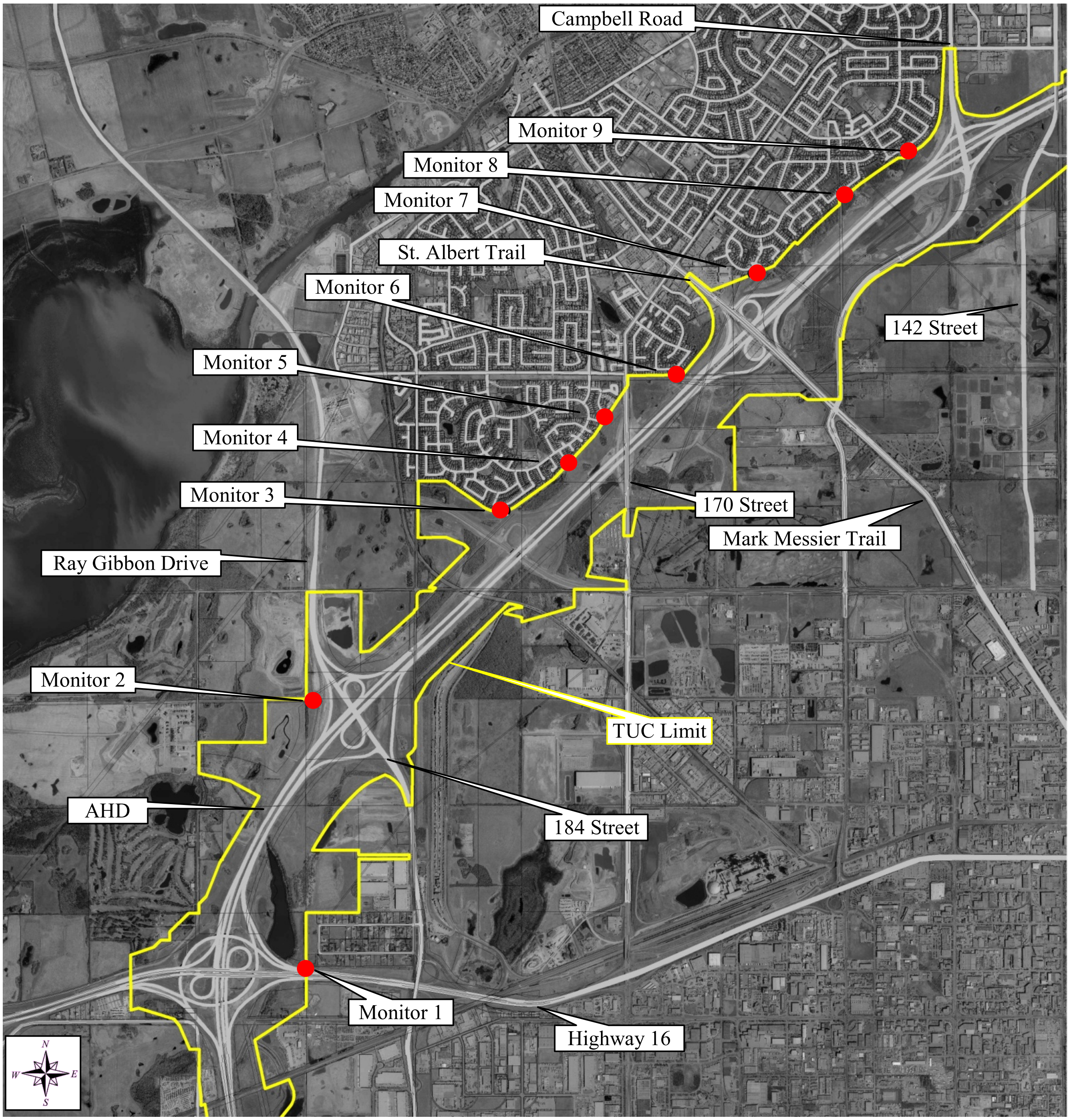

Figure 1a. Study Area West

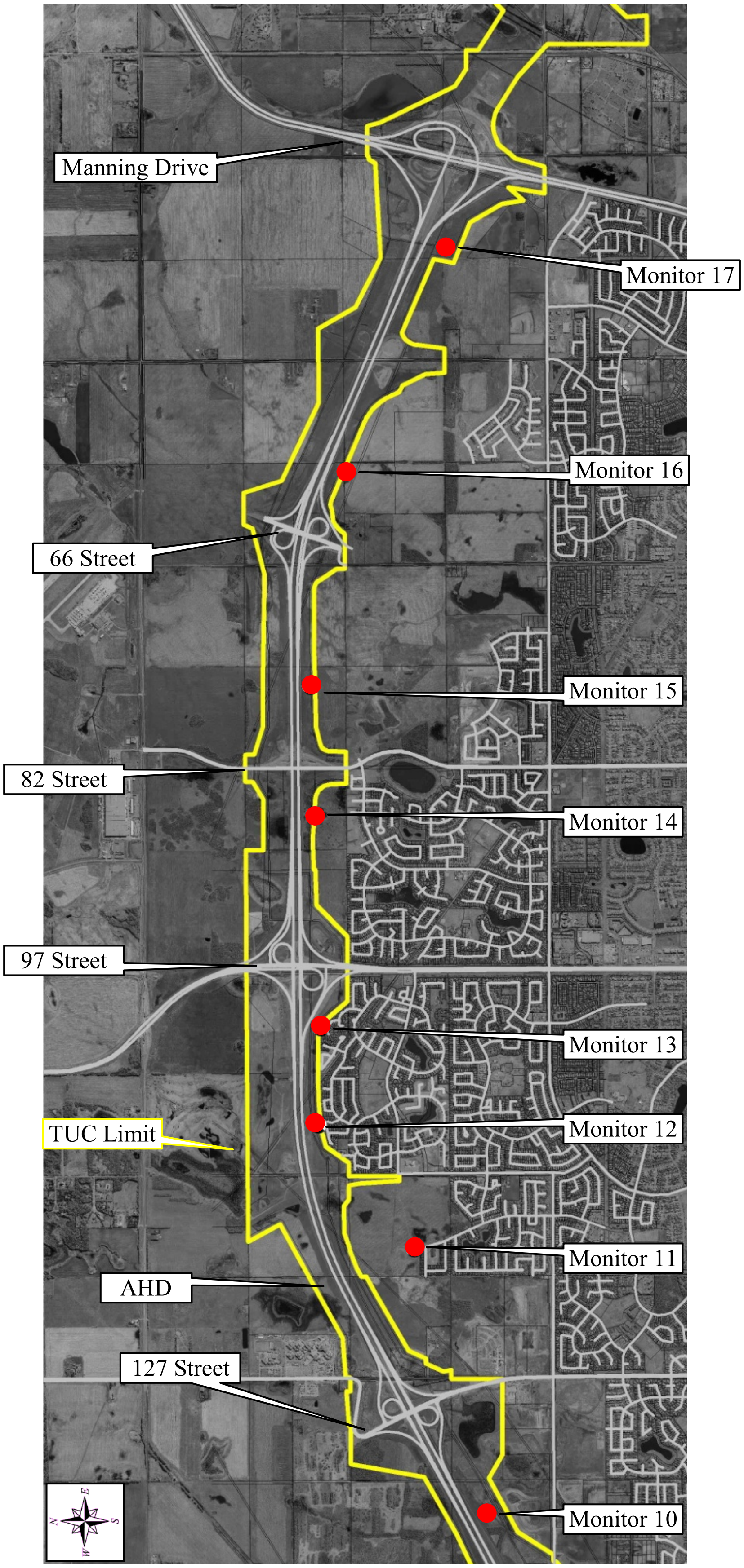

Figure 1b. Study Area East

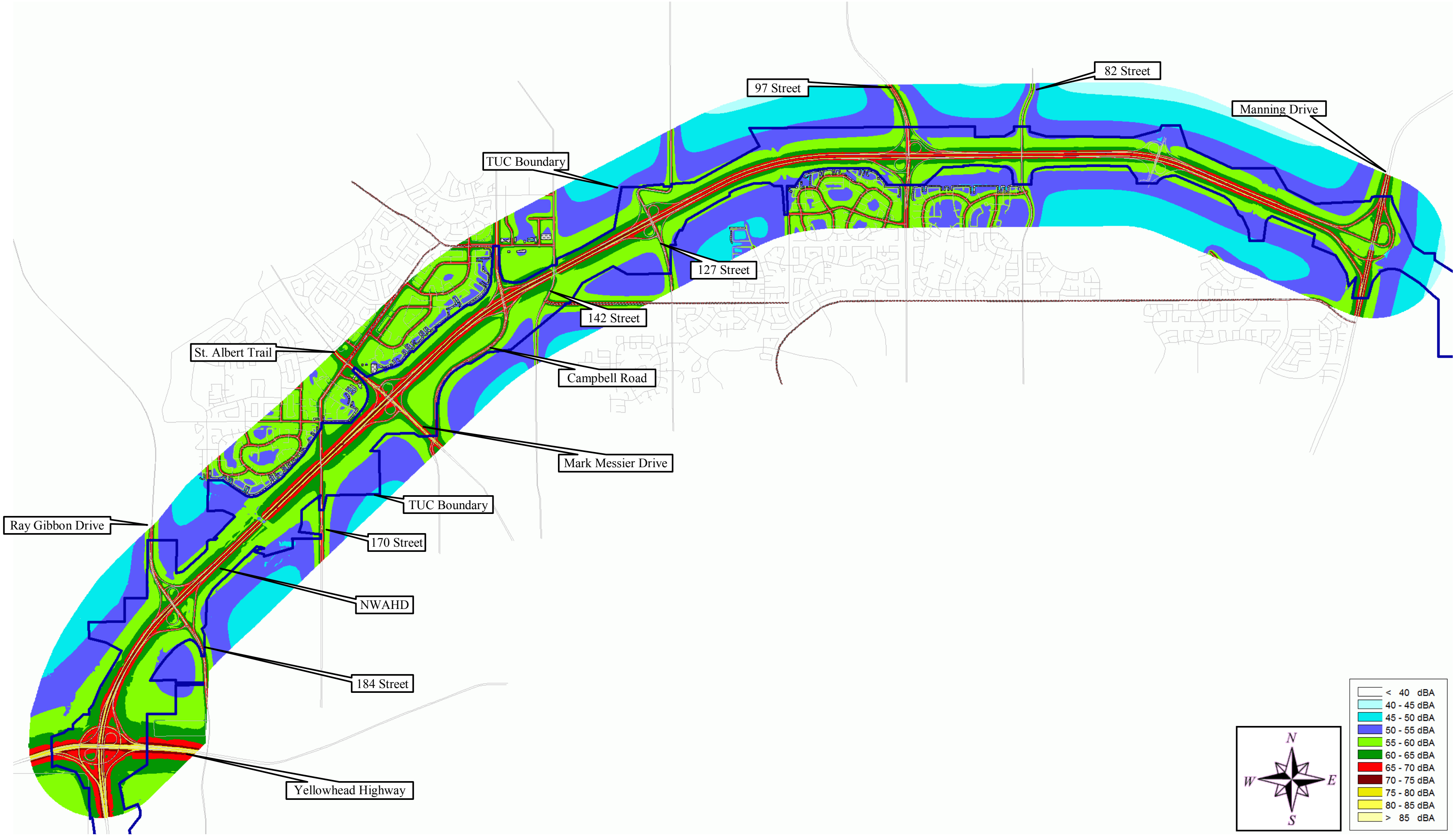

Figure 2a. Current Conditions L_{eq}24 Sound Levels for Entire Study Area

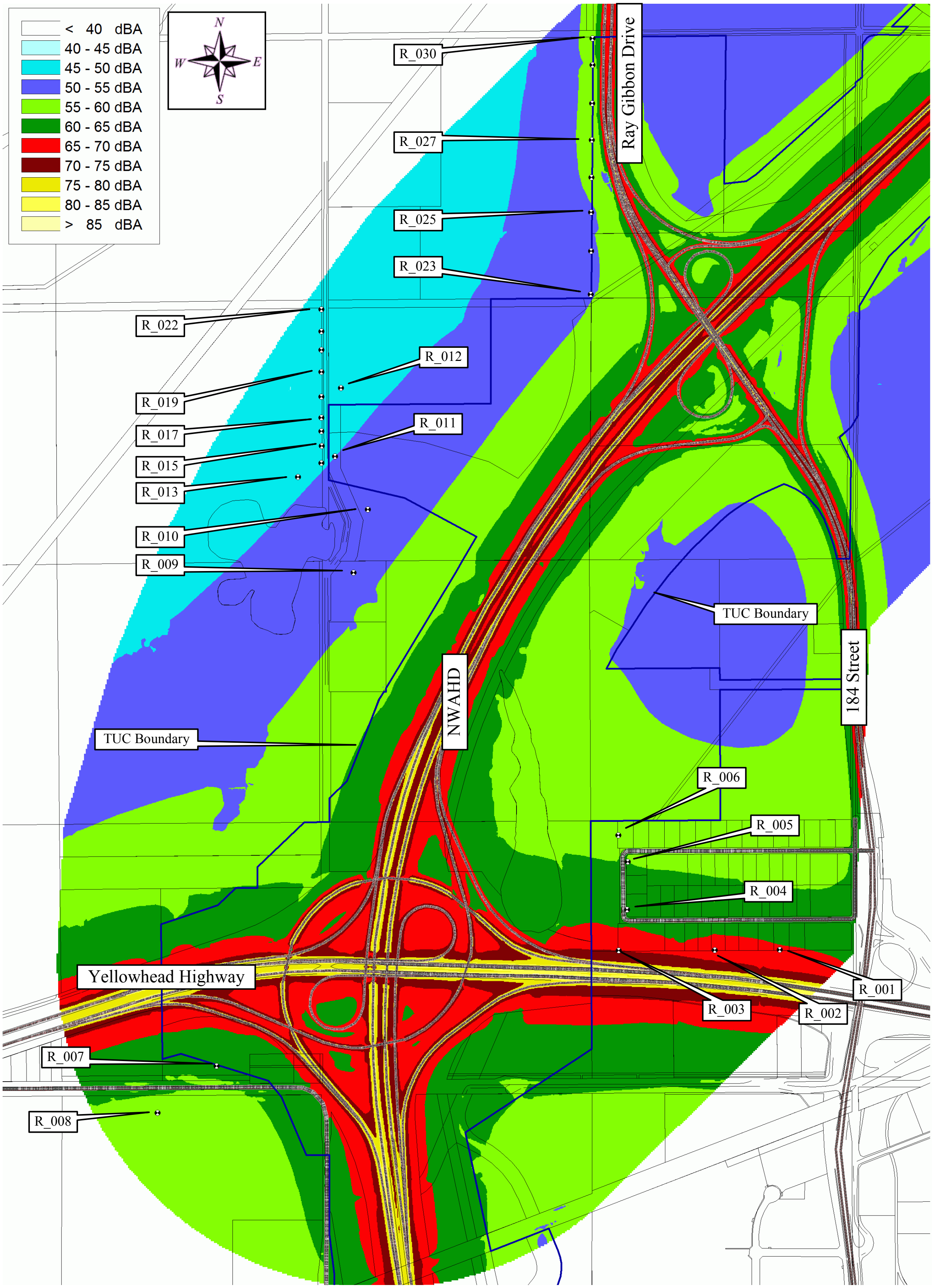

Figure 2b. Current Conditions L_{eq}24 Sound Levels for Region 1

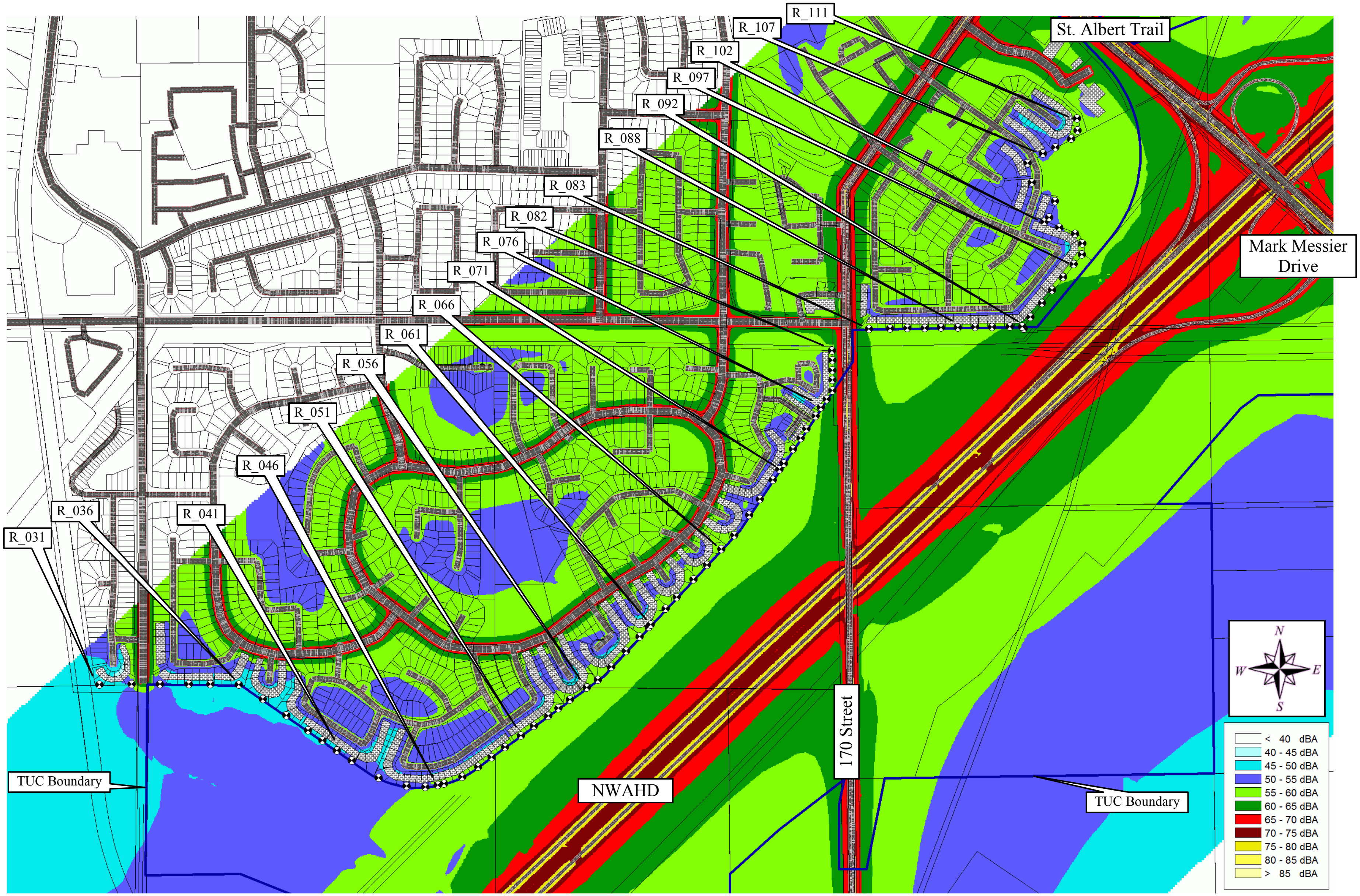

Figure 2c. Current Conditions L_{eq}24 Sound Levels for Region 2

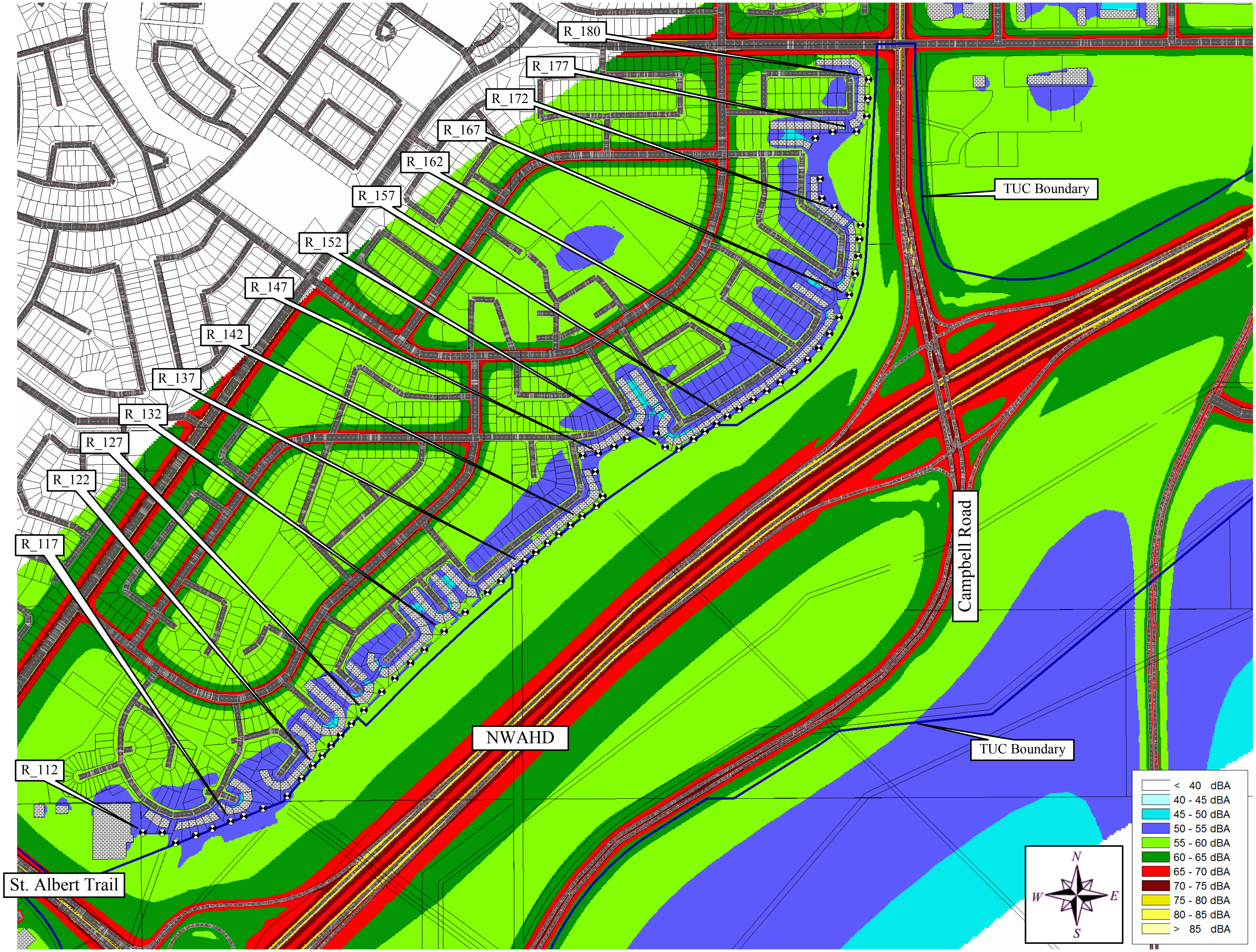

Figure 2d. Current Conditions L_{eq}24 Sound Levels for Region 3

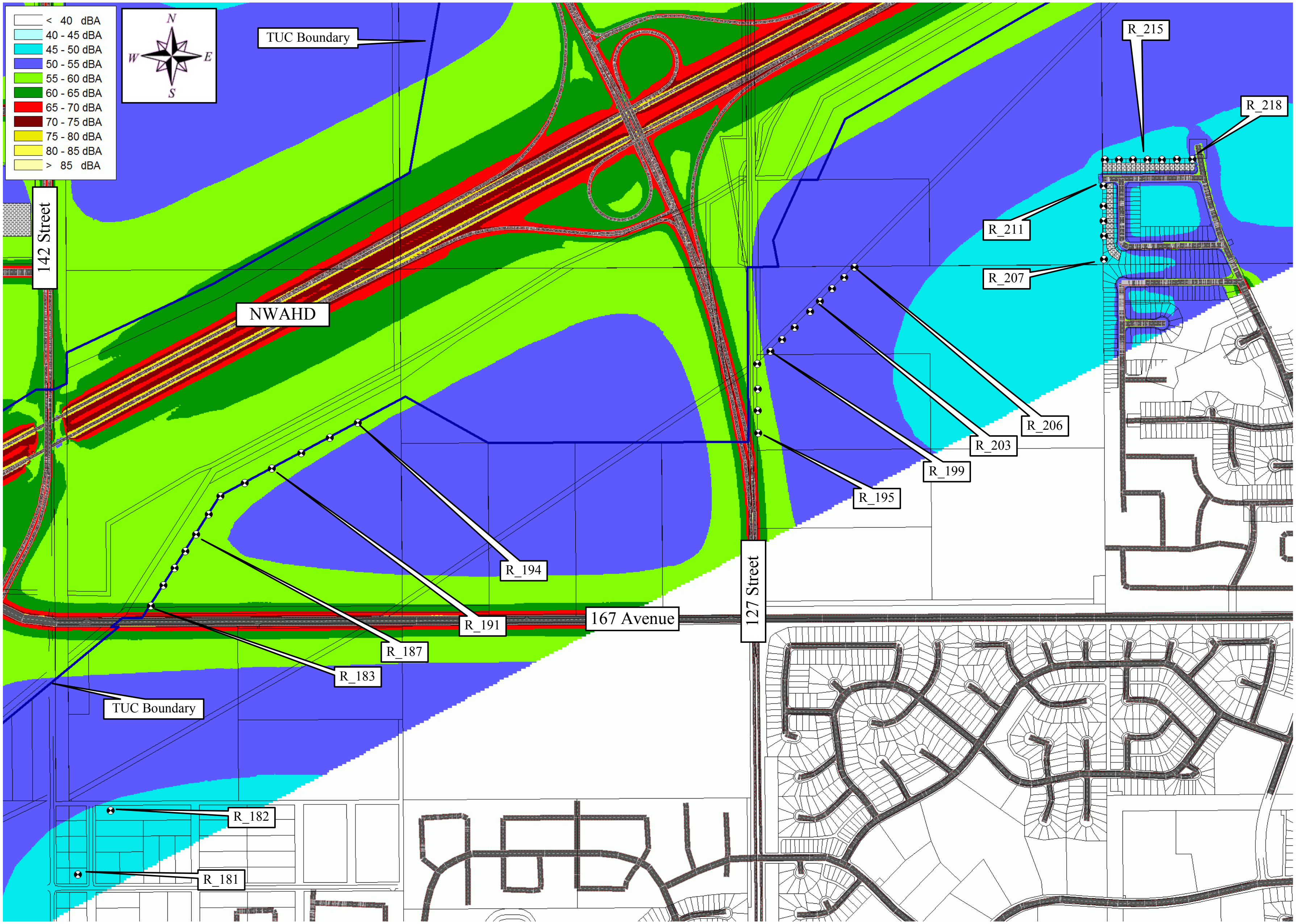

Figure 2e. Current Conditions L_{eq}24 Sound Levels for Region 4

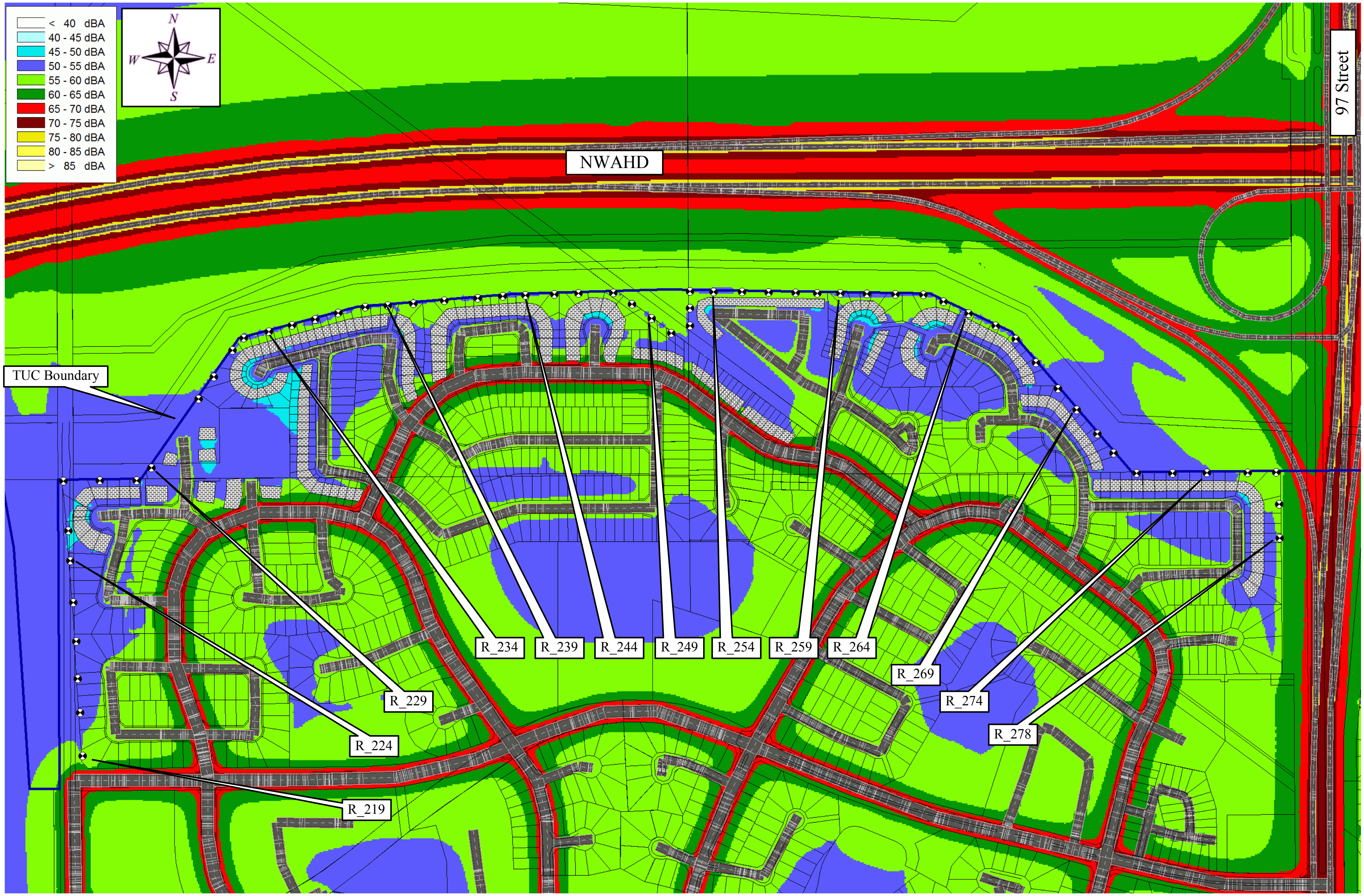

Figure 2f. Current Conditions L_{eq}24 Sound Levels for Region 5

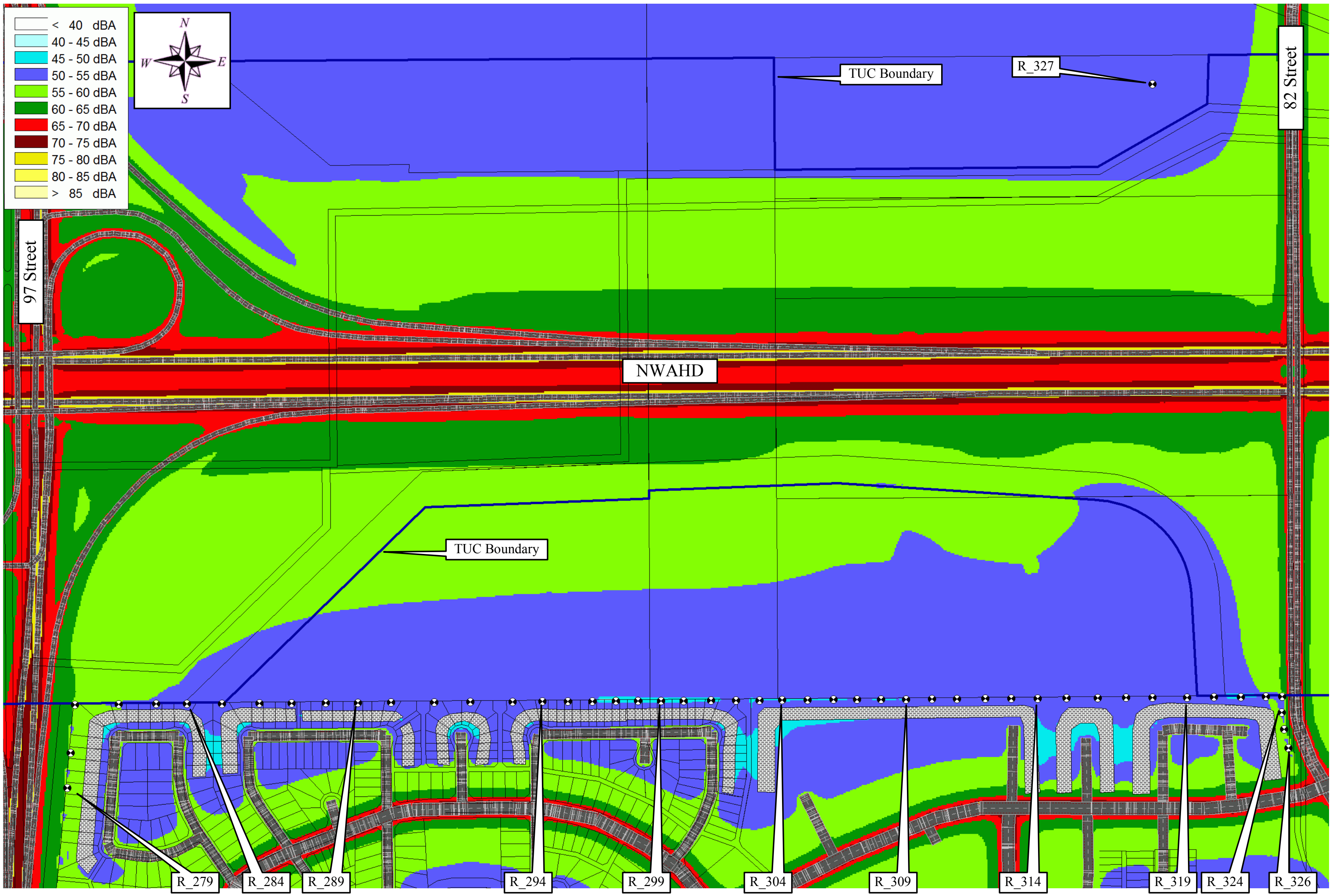

Figure 2g. Current Conditions L_{eq}24 Sound Levels for Region 6

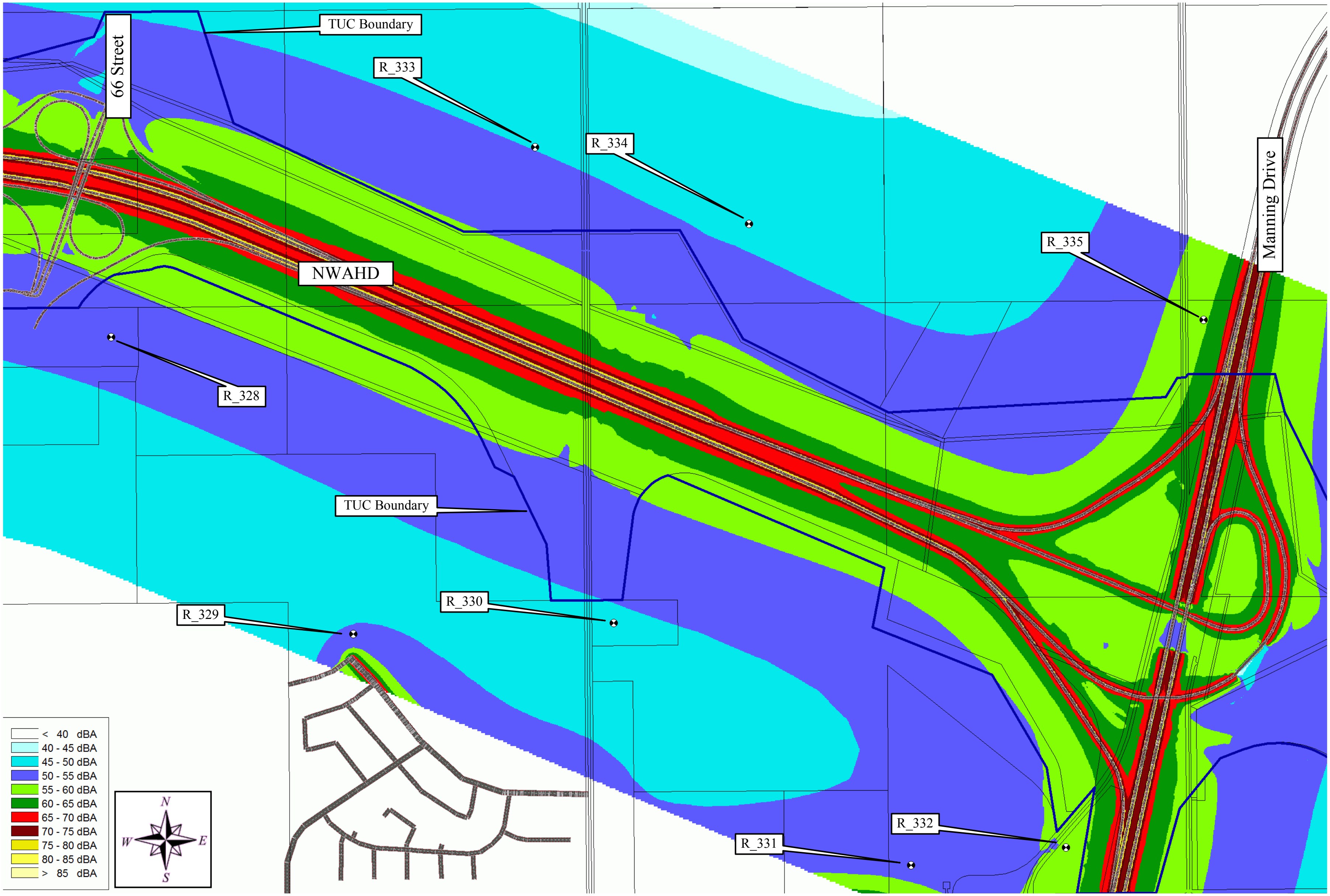

Figure 2h. Current Conditions L_{eq}24 Sound Levels for Region 7

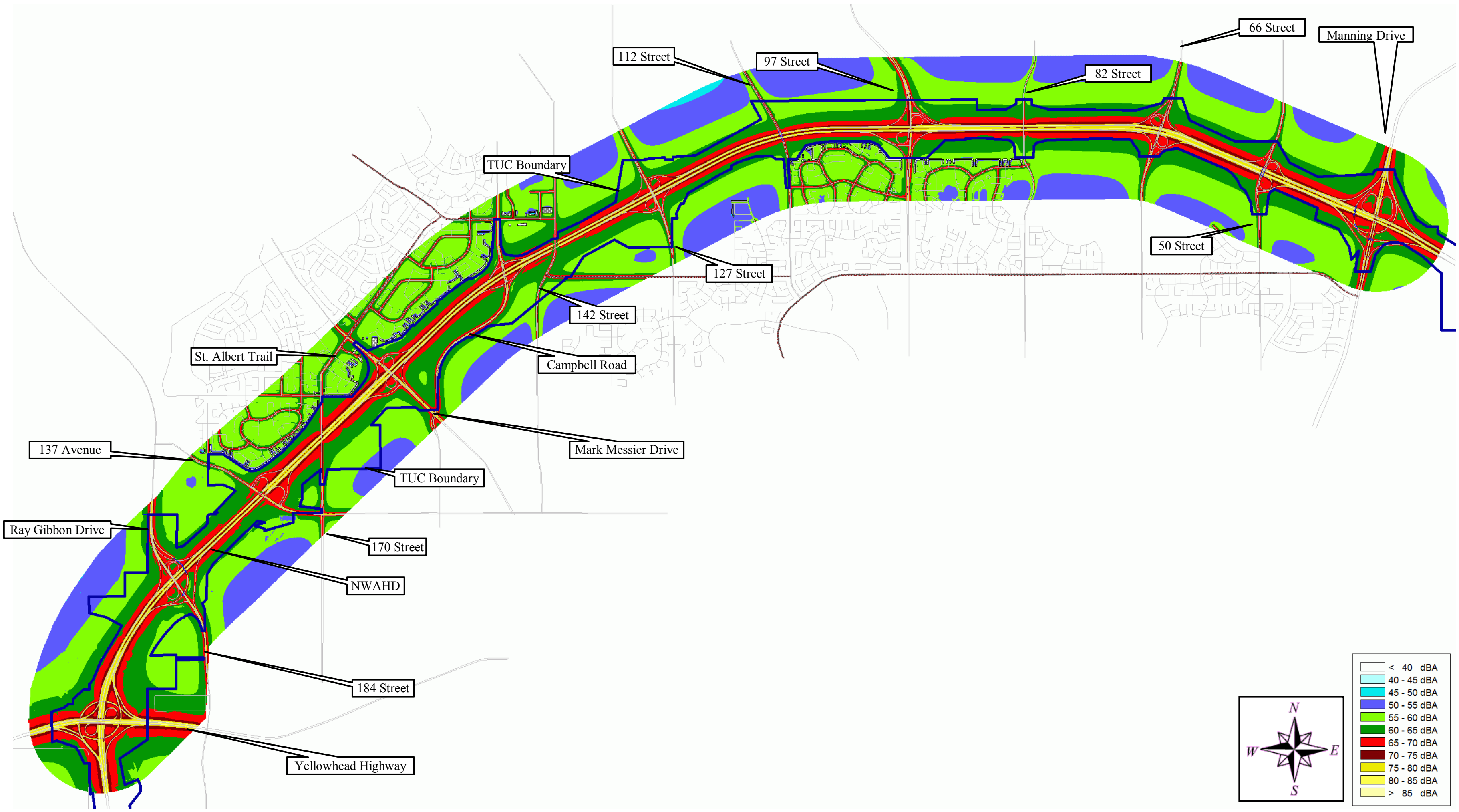

Figure 3a. Future Conditions (Year 2040) L_{eq}24 Sound Levels for Entire Study Area

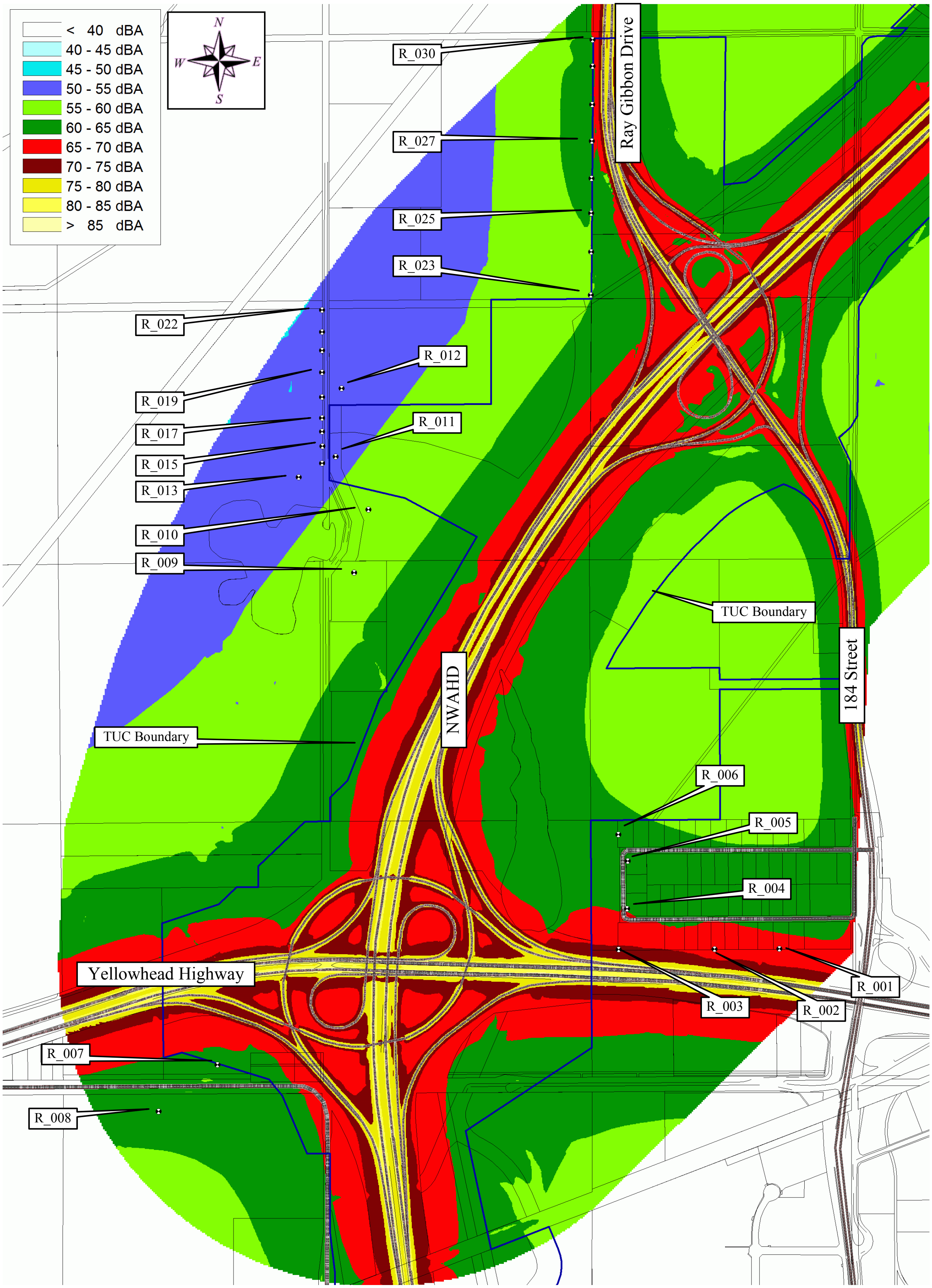

Figure 3b. Future Conditions (Year 2040) L_{eq}24 Sound Levels for Region 1

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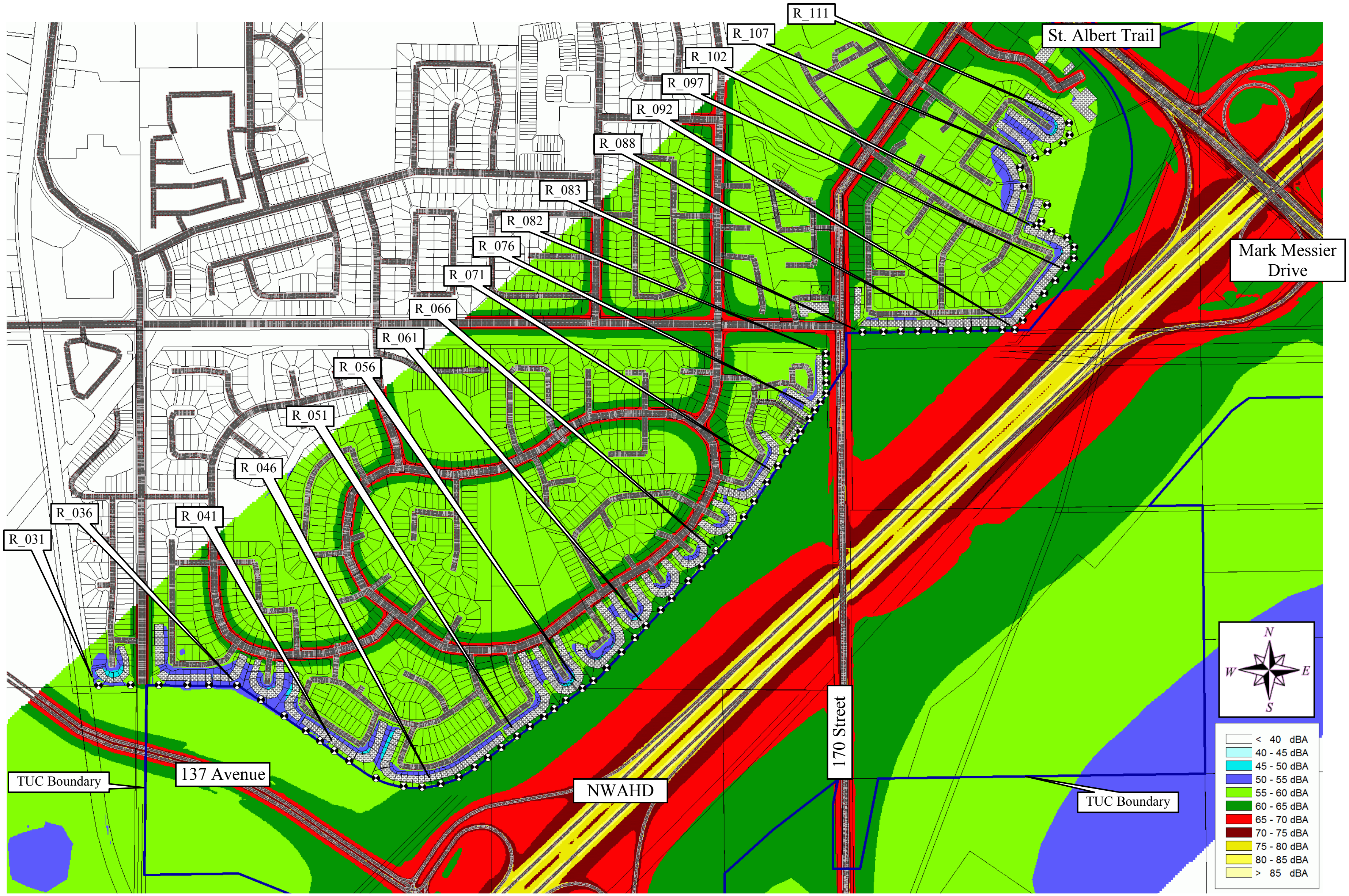


Figure 3c. Future Conditions (Year 2040) L_{eq}24 Sound Levels for Region 2

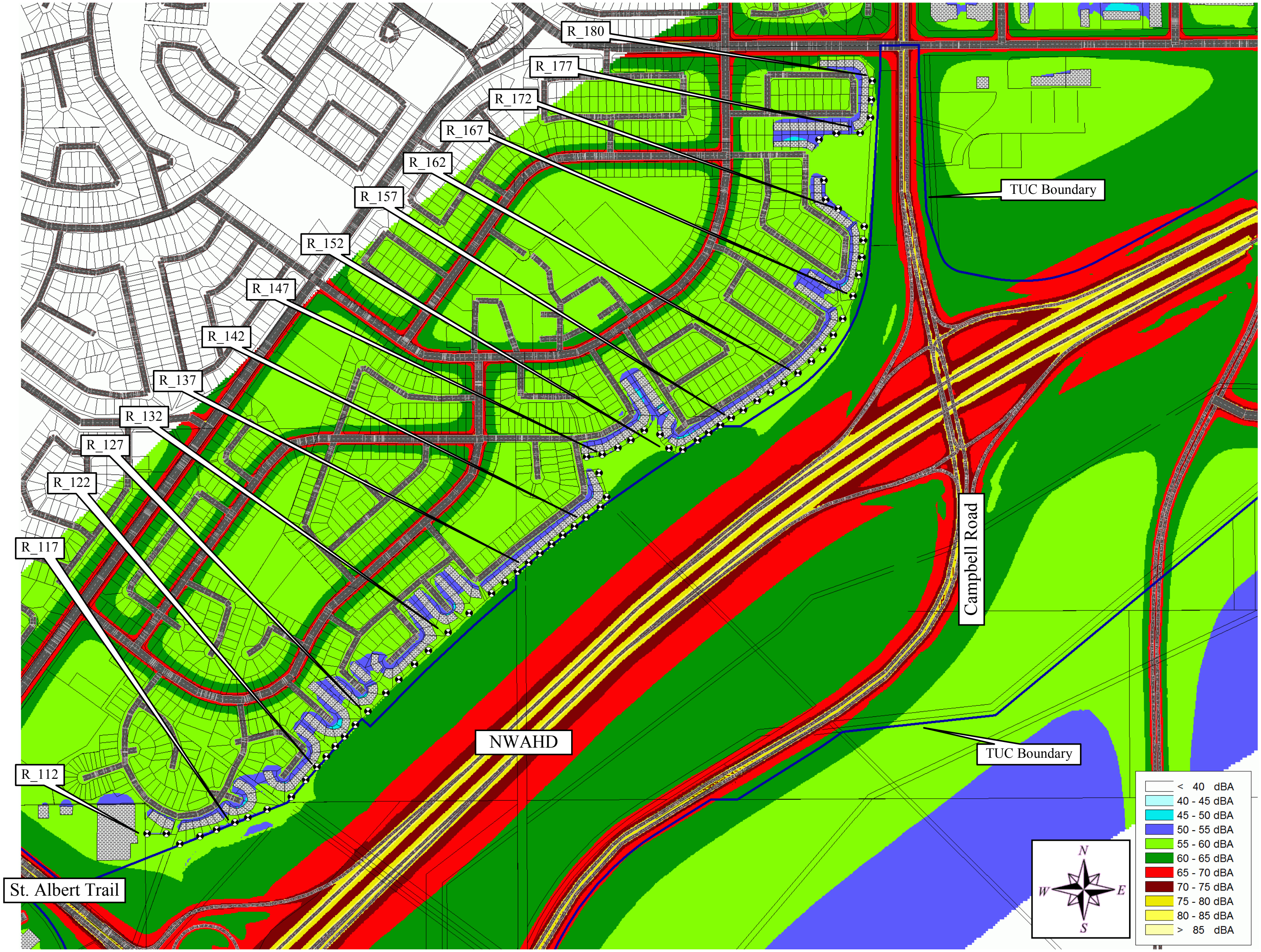


Figure 3d. Future Conditions (Year 2040) L_{eq}24 Sound Levels for Region 3

Figure 3e. Future Conditions (Year 2040) L_{eq}24 Sound Levels for Region 4

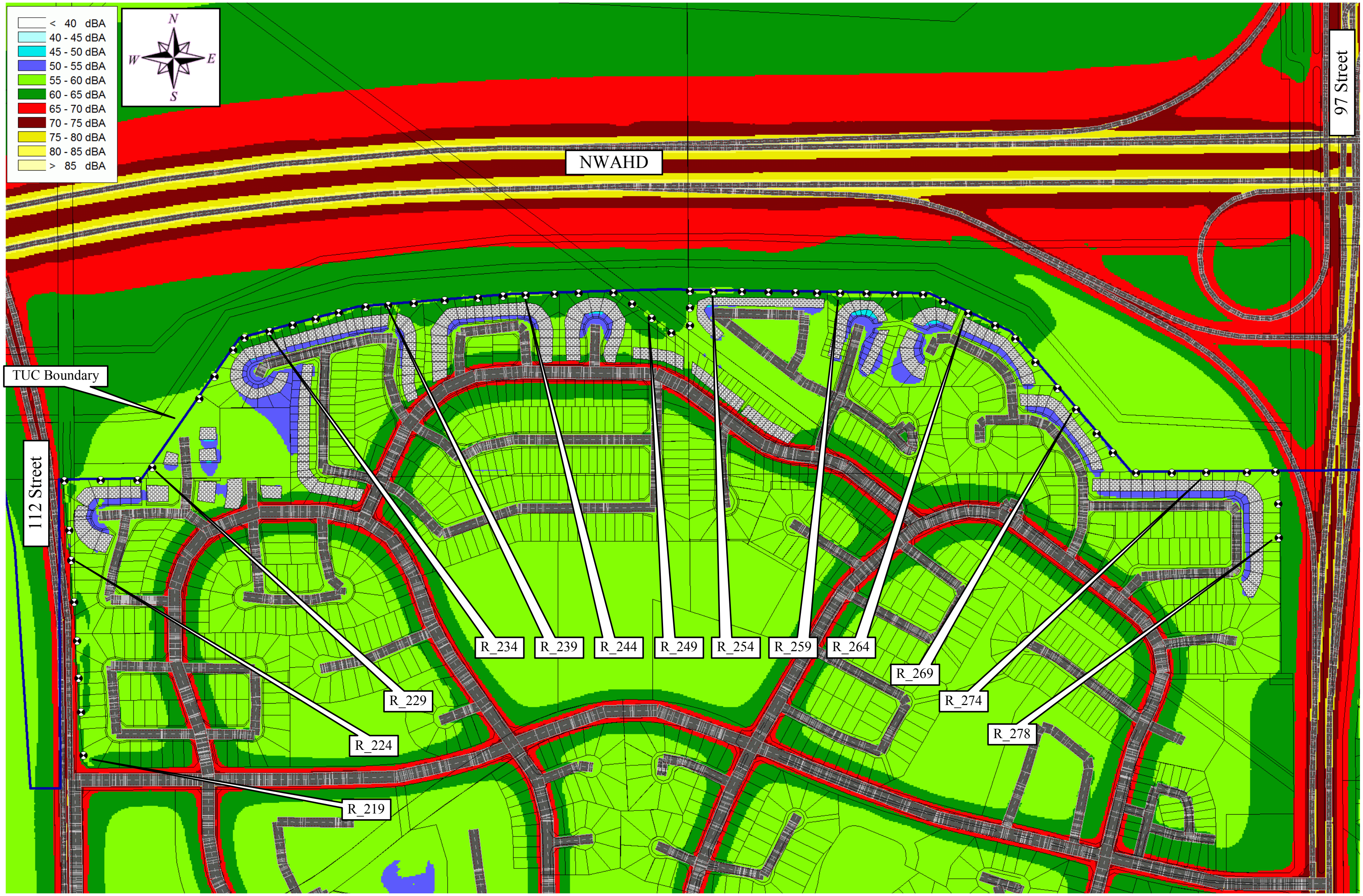


Figure 3f. Future Conditions (Year 2040) L_{eq}24 Sound Levels for Region 5

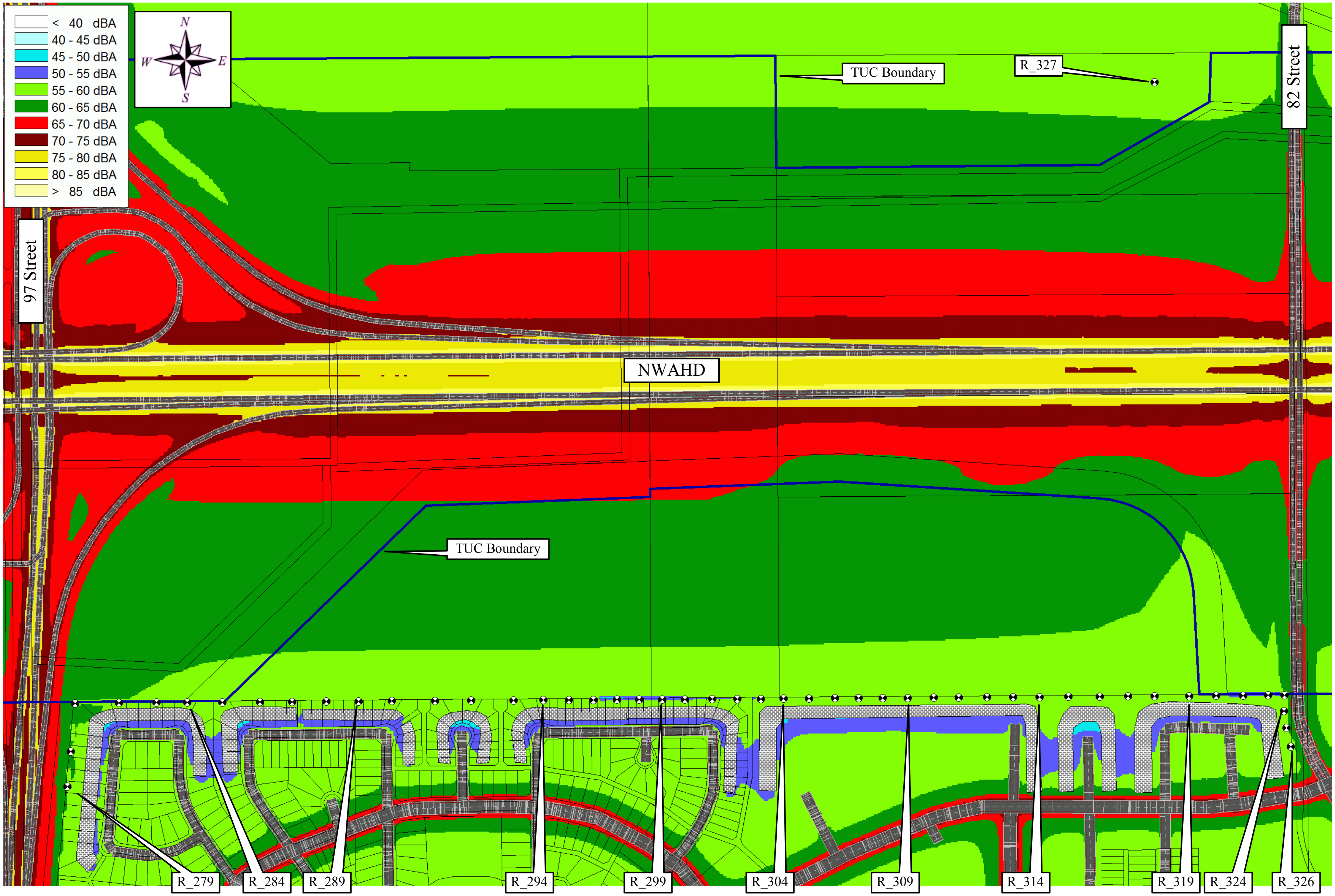


Figure 3g. Future Conditions (Year 2040) L_{eq}24 Sound Levels for Region 6

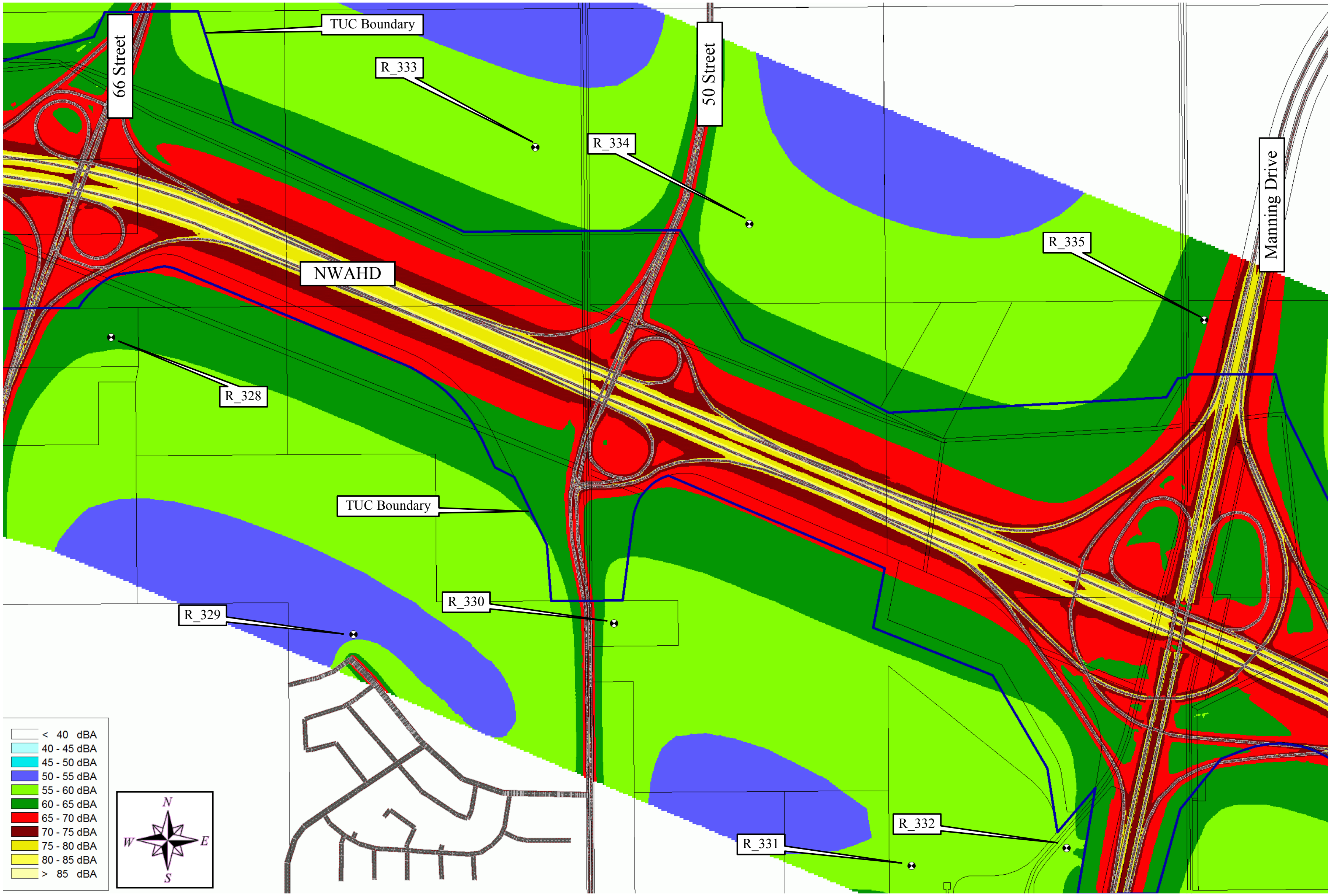
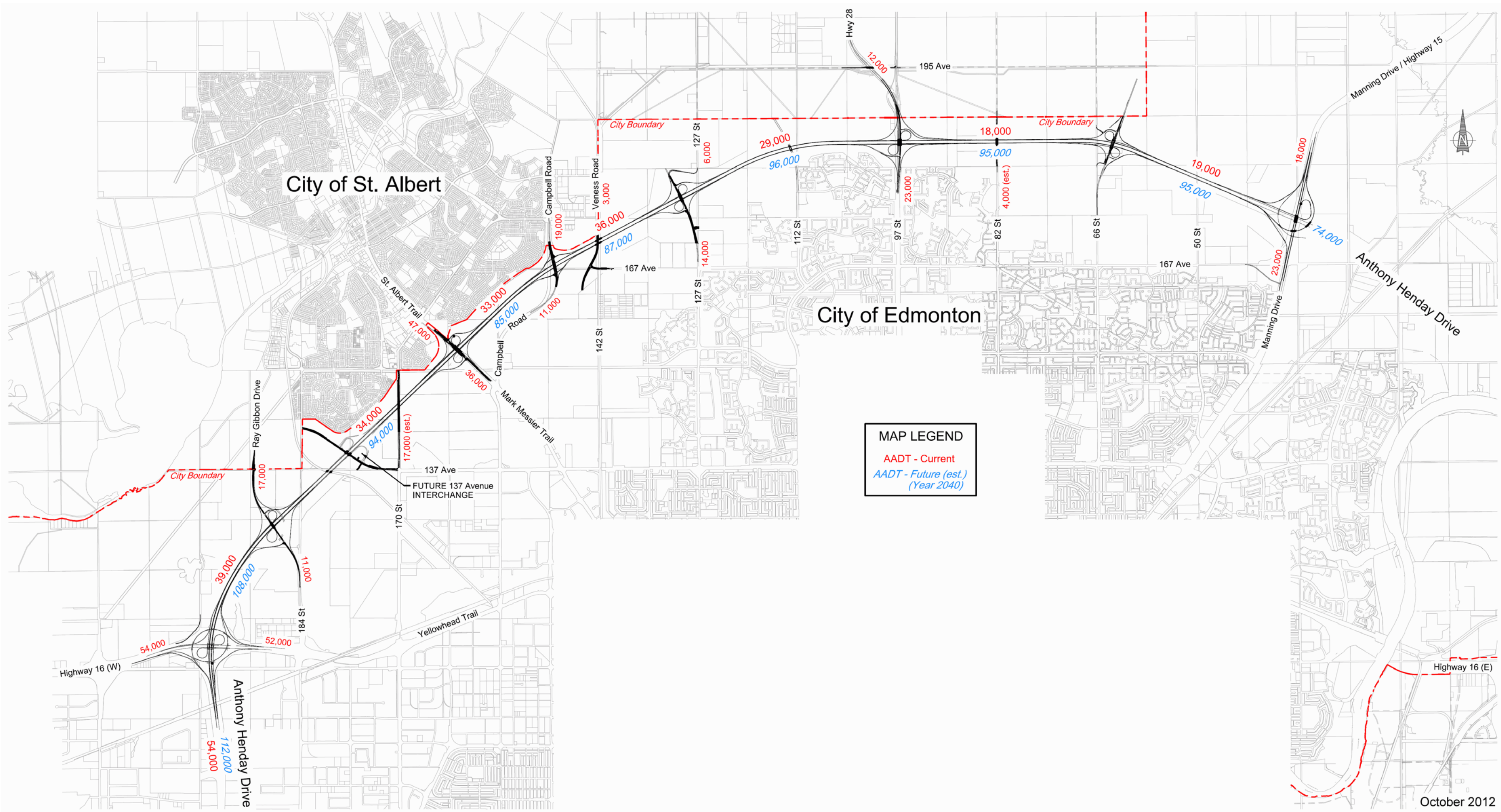


Figure 3h. Future Conditions (Year 2040) L_{eq}24 Sound Levels for Region 7

Appendix I NOISE MODELLING PARAMETERS



NW Anthony Henday Drive
Hwy 16 (W) to Manning Drive

Appendix I

Noise Modelling Parameters

Traffic Volumes
Current and Future AADT

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Current Conditions

Road	Day (Vehicles Per Hour)	Day % Heavy Vehicles	Night (Vehicles Per Hour)	Night % Heavy Vehicles	Speed (km/hr)	Total Volume (vehicles per day)
AHD South of Yellowhead Trail NB	1383	13.9	708	13.9	100	27110
AHD South of Yellowhead Trail SB	1382	14.0	708	14.0	100	27100
AHD North of Yellowhead Trail NB	989	9.1	507	9.1	100	19400
AHD North of Yellowhead Trail SB	989	8.4	507	8.4	100	19400
AHD East of 184 Street EB	876	6.6	449	6.6	100	17180
AHD East of 184 Street WB	876	6.4	449	6.4	100	17180
AHD East of 137 Avenue EB	876	6.6	449	6.6	100	17180
AHD East of 137 Avenue WB	876	6.4	449	6.4	100	17180
AHD East of Mark Messier Trail EB	842	8.4	431	8.4	100	16510
AHD East of Mark Messier Trail WB	842	7.7	431	7.7	100	16510
AHD East of Campbell Road EB	929	8.2	476	8.2	100	18220
AHD East of Campbell Road WB	930	7.6	476	7.6	100	18230
AHD East of 127 Street EB	744	7.9	381	7.9	100	14580
AHD East of 127 Street WB	744	8.4	381	8.4	100	14590
AHD East of 97 Street EB	455	10.7	233	10.7	100	8930
AHD East of 97 Street WB	455	9.4	233	9.4	100	8930
AHD East of 66 Street EB	495	11.0	253	11.0	100	9700
AHD East of 66 Street WB	495	9.9	254	9.9	100	9710
AHD East of 50 Street EB	495	11.0	253	11.0	90	9700
AHD East of 50 Street WB	495	9.9	254	9.9	100	9710
Yellowhead Trail West of AHD EB	1383	19.1	708	19.1	100	27120
Yellowhead Trail West of AHD WB	1383	18.7	708	18.7	100	27120
Yellowhead Trail East of AHD EB	1320	20.7	676	20.7	100	25880
Yellowhead Trail East of AHD WB	1319	20.8	675	20.8	100	25870
AHD NB to Yellowhead Trail EB Ramp	385	23.1	197	23.1	80	7550
AHD NB to Yellowhead Trail WB Ramp	260	20.4	133	20.4	50	5100
Yellowhead Trail WB to AHD NB Ramp	32	19.5	16	19.5	80	620
Yellowhead Trail WB to AHD SB Ramp	385	23.7	197	23.7	80	7550
AHD SB to Yellowhead Trail WB Ramp	220	13.3	113	13.3	80	4320
AHD SB to Yellowhead Trail EB Ramp	32	15.6	16	15.6	50	620
Yellowhead Trail EB to AHD SB Ramp	260	20.4	133	20.4	80	5090
Yellowhead Trail EB to AHD NB Ramp	220	14.8	113	14.8	80	4320
184 Street South of AHD NB	268	9.4	137	9.4	70	5260
184 Street South of AHD SB	268	8.6	137	8.6	70	5260
184 Street North of AHD NB	440	6.4	225	6.4	60	8620
184 Street North of AHD SB	440	6.7	225	6.7	60	8620
AHD EB to 184 Street SB Ramp	13	20.8	7	20.8	80	260
AHD EB to 184 Street NB Ramp	257	5.9	132	5.9	70	5040
184 Street NB to AHD EB Ramp	115	10.2	59	10.2	80	2250
184 Street NB to AHD WB Ramp	13	33.1	7	33.1	40	260
AHD WB to 184 Street NB Ramp	42	9.0	22	9.0	80	830
AHD WB to 184 Strreet SB Ramp	115	8.1	59	8.1	60	2250
184 Street SB to AHD WB Ramp	257	5.3	132	5.3	60	5040
184 Street SB to AHD EB Ramp	42	11.3	22	11.3	50	830
170 Street NB	423	4.0	217	4.0	70	8300
170 Street SB	423	4.0	217	4.0	70	8300
Mark Messier Trail NB	934	4.7	478	4.7	70	18310
Mark Messier Trail SB	923	4.9	473	4.9	70	18100
St. Albert Trail NB	1207	4.6	618	4.6	60	23670
St. Albert Trail SB	1198	4.9	613	4.9	60	23490

Current Conditions (Cont.)

Road	Day (Vehicles Per Hour)	Day % Heavy Vehicles	Night (Vehicles Per Hour)	Night % Heavy Vehicles	Speed (km/hr)	Total Volume (vehicles per day)
AHD EB to Mark Messier Trail SB Ramp	36	8.9	18	8.9	70	700
AHD EB to Mark Messier Trail NB Ramp	209	6.0	107	6.0	70	4100
Mark Messier Trail NB to AHD EB Ramp	55	10.7	28	10.7	80	1070
Mark Messier Trail NB to AHD WB Ramp	36	6.4	18	6.4	50	700
AHD WB to Mark Messier Trail NB Ramp	155	4.4	79	4.4	80	3030
AHD WB to Mark Messier Trail SB Ramp	55	10.2	28	10.2	70	1070
St. Albert Trail SB to AHD WB Ramp	209	7.0	107	7.0	80	4100
St. Albert Trail SB to AHD EB Ramp	156	4.6	80	4.6	50	3060
Campbell Road South of AHD NB	282	9.6	144	9.6	60	5520
Campbell Road South of AHD SB	281	12.7	144	12.7	60	5510
Campbell Road North of AHD NB	494	7.0	253	7.0	60	9690
Campbell Road North of AHD SB	493	8.5	252	8.5	60	9660
AHD EB to Campbell Road SB Ramp	4	3.8	2	3.8	70	80
AHD EB to Campbell Road NB Ramp	110	7.3	56	7.3	70	2150
Campbell Road NB to AHD EB Ramp	47	15.2	24	15.2	70	930
Campbell Road NB to AHD WB Ramp	4	3.8	2	3.8	70	80
AHD WB to Campbell Road NB Ramp	155	4.5	79	4.5	70	3030
AHD WB to Campbell Road SB Ramp	47	21.0	24	21.0	70	930
Campbell Road SB to AHD WB Ramp	109	8.6	56	8.6	70	2140
Campbell Road SB to AHD EB Ramp	154	4.5	79	4.5	70	3020
142 Street NB	69	5.0	35	5.0	70	1350
142 Street SB	69	5.0	35	5.0	70	1350
127 Street South of AHD NB	351	4.0	180	4.0	60	6890
127 Street South of AHD SB	352	3.3	180	3.3	60	6910
127 Street North of AHD NB	159	5.1	81	5.1	70	3110
127 Street North of AHD SB	159	4.1	81	4.1	70	3110
AHD EB to 127 Street SB Ramp	206	3.4	105	3.4	70	4040
AHD EB to 127 Street NB Ramp	44	5.9	22	5.9	70	860
127 Street NB to AHD EB Ramp	47	5.2	24	5.2	70	930
127 Street NB to AHD WB Ramp	206	3.5	105	3.5	70	4030
AHD WB to 127 Street NB Ramp	16	7.5	8	7.5	70	320
AHD WB to 127 Street SB Ramp	48	5.2	25	5.2	70	940
127 Street SB to AHD WB Ramp	44	7.1	22	7.1	70	860
127 Street SB to AHD EB Ramp	16	7.5	8	7.5	70	320
97 Street South of AHD NB	579	4.3	297	4.3	80	11360
97 Street South of AHD SB	580	4.3	297	4.3	80	11370
97 Street North of AHD NB	313	7.1	160	7.1	80	6130
97 Street North of AHD SB	313	7.0	160	7.0	80	6130
AHD EB to 97 Street SB Ramp	309	4.6	158	4.6	80	6050
AHD EB to 97 Street NB Ramp	63	5.0	32	5.0	70	1240
97 Street NB to AHD EB Ramp	53	4.6	27	4.6	80	1030
97 Street NB to AHD WB Ramp	308	4.4	158	4.4	50	6040
AHD WB to 97 Street NB Ramp	31	7.0	16	7.0	80	600
AHD WB to 97 Street SB Ramp	53	3.7	27	3.7	70	1030
97 Street SB to AHD WB Ramp	63	7.0	32	7.0	80	1240
97 Street SB to AHD EB Ramp	31	7.0	16	7.0	50	600
82 Street NB	110	5.0	56	5.0	70	2150
82 Street SB	110	5.0	56	5.0	70	2150
66 Street South of AHD NB	0	0.0	0	0.0	60	0
66 Street South of AHD SB	0	0.0	0	0.0	60	0
66 Street North of AHD NB	0	0.0	0	0.0	60	0
66 Street North of AHD SB	0	0.0	0	0.0	60	0
AHD EB to 66 Street SB Ramp	0	0.0	0	0.0	80	0
AHD EB to 66 Street NB Ramp	0	0.0	0	0.0	70	0
66 Street NB to AHD EB Ramp	0	0.0	0	0.0	80	0
66 Street NB to AHD WB Ramp	0	0.0	0	0.0	60	0
AHD WB to 66 Street NB Ramp	0	0.0	0	0.0	80	0
AHD WB to 66 Street SB Ramp	0	0.0	0	0.0	60	0

Current Conditions (Cont.)

Road	Day (Vehicles Per Hour)	Day % Heavy Vehicles	Night (Vehicles Per Hour)	Night % Heavy Vehicles	Speed (km/hr)	Total Volume (vehicles per day)
Manning Drive South of AHD NB	598	6.8	306	6.8	90	11720
Manning Drive South of AHD SB	598	7.1	306	7.1	90	11720
Manning Drive North of AHD NB	466	9.4	239	9.4	90	9140
Manning Drive North of AHD SB	467	8.6	239	8.6	90	9150
AHD EB to Manning Drive SB Ramp	313	8.5	160	8.5	90	6140
AHD EB to Manning Drive NB Ramp	182	15.3	93	15.3	80	3560
Manning Drive NB to AHD WB Ramp	313	7.8	160	7.8	60	6140
Manning Drive SB to AHD WB Ramp	182	13.4	93	13.4	90	3570
Levasseur Road	281	4.0	144	4.0	60	5500
Hebert Road	1581	5.0	809	5.0	60	31000
Boudreau Road	1173	5.0	601	5.0	60	23000
167 Avenue East of 142 Street	842	5.0	431	5.0	60	16500
167 Avenue West of Manning Drive	561	5.0	287	5.0	60	11000
Collector Roads	408	3.0	209	3.0	60	8000
Residential Streets	10	3.0	5	3.0	50	200

Future Conditions (Year 2040)

Road	Day (Vehicles Per Hour)	Day % Heavy Vehicles	Night (Vehicles Per Hour)	Night % Heavy Vehicles	Speed (km/hr)	Total Volume (vehicles per day)
AHD South of Yellowhead Trail NB	2741	13.9	1403	13.9	100	53750
AHD South of Yellowhead Trail SB	2978	14.0	1525	14.0	100	58400
AHD North of Yellowhead Trail NB	2802	9.1	1435	9.1	100	54950
AHD North of Yellowhead Trail SB	2711	8.4	1388	8.4	100	53150
AHD East of 184 Street EB	2392	6.6	1225	6.6	100	46900
AHD East of 184 Street WB	2407	6.4	1232	6.4	100	47200
AHD East of 137 Avenue EB	2438	6.6	1248	6.6	100	47800
AHD East of 137 Avenue WB	2318	6.4	1187	6.4	100	45450
AHD East of Mark Messier Trail EB	2196	8.4	1124	8.4	100	43050
AHD East of Mark Messier Trail WB	2117	7.7	1084	7.7	100	41500
AHD East of Campbell Road EB	2241	8.2	1148	8.2	100	43950
AHD East of Campbell Road WB	2183	7.6	1118	7.6	100	42800
AHD East of 127 Street EB	2486	7.9	1273	7.9	100	48750
AHD East of 127 Street WB	2394	8.4	1226	8.4	100	46950
AHD East of 97 Street EB	2502	10.7	1281	10.7	100	49050
AHD East of 97 Street WB	2341	9.4	1199	9.4	100	45900
AHD East of 66 Street EB	2522	11.0	1291	11.0	100	49450
AHD East of 66 Street WB	2321	9.9	1188	9.9	100	45500
AHD East of 50 Street EB	2081	11.0	1065	11.0	100	40800
AHD East of 50 Street WB	1930	9.9	988	9.9	100	37850
AHD East of Manning Drive EB	1969	11.0	1008	11.0	100	38600
AHD East of Manning Drive WB	1821	9.9	932	9.9	100	35700
Yellowhead Trail West of AHD EB	2619	19.1	1341	19.1	100	51350
Yellowhead Trail West of AHD WB	2058	18.7	1054	18.7	100	40350
Yellowhead Trail East of AHD EB	1744	20.7	893	20.7	100	34200
Yellowhead Trail East of AHD WB	1507	20.8	772	20.8	100	29550
AHD NB to Yellowhead Trail EB Ramp	324	23.1	166	23.1	80	6350
AHD NB to Yellowhead Trail WB Ramp	421	20.4	215	20.4	50	8250
Yellowhead Trail WB to AHD NB Ramp	477	19.5	244	19.5	80	9350
Yellowhead Trail WB to AHD SB Ramp	477	23.7	244	23.7	80	9350
AHD SB to Yellowhead Trail WB Ramp	607	13.3	311	13.3	80	11900
AHD SB to Yellowhead Trail EB Ramp	408	15.6	209	15.6	50	8000
Yellowhead Trail EB to AHD SB Ramp	395	20.4	202	20.4	80	7750
Yellowhead Trail EB to AHD NB Ramp	803	14.8	411	14.8	80	15750
184 Street South of AHD NB	750	9.4	384	9.4	70	14700
184 Street South of AHD SB	836	8.6	428	8.6	70	16400
184 Street North of AHD NB	1153	6.4	590	6.4	100	22600
184 Street North of AHD SB	1109	6.7	568	6.7	100	21750
AHD EB to 184 Street SB Ramp	64	20.8	33	20.8	80	1250
AHD EB to 184 Street NB Ramp	584	5.9	299	5.9	80	11450
184 Street NB to AHD EB Ramp	212	10.2	108	10.2	80	4150
184 Street NB to AHD WB Ramp	36	33.1	18	33.1	50	700
AHD WB to 184 Street NB Ramp	71	9.0	37	9.0	80	1400
AHD WB to 184 Strreet SB Ramp	252	8.1	129	8.1	60	4950
184 Street SB to AHD WB Ramp	602	5.3	308	5.3	80	11800
184 Street SB to AHD EB Ramp	26	11.3	13	11.3	50	500
137 Avenue West of AHD EB	513	5.0	262	5.0	60	10050
137 Avenue West of AHD WB	311	5.0	159	5.0	60	6100
137 Avenue East of AHD EB	834	5.0	427	5.0	70	16350
137 Avenue East of AHD WB	768	5.0	393	5.0	70	15050

Future Conditions (Year 2040) (Cont.)

Road	Day (Vehicles Per Hour)	Day % Heavy Vehicles	Night (Vehicles Per Hour)	Night % Heavy Vehicles	Speed (km/hr)	Total Volume (vehicles per day)
AHD EB to 137 Avenue EB Ramp	301	6.0	154	6.0	70	5900
AHD EB to 137 Avenue WB Ramp	84	6.0	43	6.0	70	1650
137 Avenue WB to AHD EB Ramp	275	6.0	141	6.0	70	5400
137 Avenue WB to AHD WB Ramp	321	6.0	165	6.0	70	6300
AHD WB to 137 Avenue WB Ramp	56	6.0	29	6.0	70	1100
AHD WB to 137 Avenue EB Ramp	263	6.0	134	6.0	70	5150
137 Avenue EB to AHD WB Ramp	87	6.0	44	6.0	70	1700
137 Avenue EB to AHD EB Ramp	156	6.0	80	6.0	70	3050
170 Street NB	383	4.0	196	4.0	70	7500
170 Street SB	408	4.0	209	4.0	70	8000
Mark Messier Trail NB	908	4.7	465	4.7	70	17800
Mark Messier Trail SB	1285	4.9	658	4.9	70	25200
St. Albert Trail NB	1035	4.6	530	4.6	60	20300
St. Albert Trail SB	1372	4.9	702	4.9	60	26900
AHD EB to Mark Messier Trail SB Ramp	326	8.9	167	8.9	70	6400
AHD EB to Mark Messier Trail NB Ramp	227	6.0	116	6.0	70	4450
Mark Messier Trail NB to AHD EB Ramp	217	10.7	111	10.7	80	4250
Mark Messier Trail NB to AHD WB Ramp	120	6.4	61	6.4	50	2350
AHD WB to Mark Messier Trail NB Ramp	237	4.4	121	4.4	80	4650
AHD WB to Mark Messier Trail SB Ramp	33	10.2	17	10.2	70	650
St. Albert Trail SB to AHD WB Ramp	352	7.0	180	7.0	80	6900
St. Albert Trail SB to AHD EB Ramp	99	4.6	51	4.6	50	1950
Campbell Road South of AHD NB	569	9.6	291	9.6	60	11150
Campbell Road South of AHD SB	727	12.7	372	12.7	60	14250
Campbell Road North of AHD NB	492	7.0	252	7.0	60	9650
Campbell Road North of AHD SB	630	8.5	322	8.5	60	12350
AHD EB to Campbell Road SB Ramp	156	3.8	80	3.8	70	3050
AHD EB to Campbell Road NB Ramp	161	7.3	82	7.3	70	3150
Campbell Road NB to AHD EB Ramp	112	15.2	57	15.2	70	2200
Campbell Road NB to AHD WB Ramp	263	3.8	134	3.8	70	5150
AHD WB to Campbell Road NB Ramp	138	4.5	71	4.5	70	2700
AHD WB to Campbell Road SB Ramp	332	21.0	170	21.0	70	6500
Campbell Road SB to AHD WB Ramp	140	8.6	72	8.6	70	2750
Campbell Road SB to AHD EB Ramp	250	4.5	128	4.5	70	4900
142 Street NB	153	5.0	78	5.0	70	3000
142 Street SB	179	5.0	91	5.0	70	3500
127 Street South of AHD NB	528	4.0	270	4.0	60	10350
127 Street South of AHD SB	558	3.3	286	3.3	60	10950
127 Street North of AHD NB	418	5.1	214	5.1	70	8200
127 Street North of AHD SB	482	4.1	247	4.1	70	9450
AHD EB to 127 Street SB Ramp	252	3.4	129	3.4	70	4950
AHD EB to 127 Street NB Ramp	28	5.9	14	5.9	70	550
127 Street NB to AHD EB Ramp	258	5.2	132	5.2	70	5050
127 Street NB to AHD WB Ramp	161	3.5	82	3.5	70	3150
AHD WB to 127 Street NB Ramp	281	7.5	144	7.5	70	5500
AHD WB to 127 Street SB Ramp	184	5.2	94	5.2	70	3600
127 Street SB to AHD WB Ramp	92	7.1	47	7.1	70	1800
127 Street SB to AHD EB Ramp	268	7.5	137	7.5	70	5250
112 Street NB	224	5.0	115	5.0	70	4400
112 Street SB	242	5.0	124	5.0	70	4750
97 Street South of AHD NB	836	4.3	428	4.3	80	16400
97 Street South of AHD SB	834	4.3	427	4.3	80	16350
97 Street North of AHD NB	671	7.1	343	7.1	80	13150
97 Street North of AHD SB	742	7.0	380	7.0	80	14550
AHD EB to 97 Street SB Ramp	301	4.6	154	4.6	80	5900
AHD EB to 97 Street NB Ramp	263	5.0	134	5.0	70	5150
97 Street NB to AHD EB Ramp	342	4.6	175	4.6	80	6700
97 Street NB to AHD WB Ramp	298	4.4	153	4.4	50	5850

Future Conditions (Year 2040) (Cont.)

Road	Day (Vehicles Per Hour)	Day % Heavy Vehicles	Night (Vehicles Per Hour)	Night % Heavy Vehicles	Speed (km/hr)	Total Volume (vehicles per day)
AHD WB to 97 Street NB Ramp	217	7.0	111	7.0	80	4250
AHD WB to 97 Street SB Ramp	301	3.7	154	3.7	70	5900
97 Street SB to AHD WB Ramp	273	7.0	140	7.0	80	5350
97 Street SB to AHD EB Ramp	237	7.0	121	7.0	50	4650
82 Street NB	51	5.0	26	5.0	70	1000
82 Street SB	51	5.0	26	5.0	70	1000
66 Street South of AHD NB	686	5.0	351	5.0	60	13450
66 Street South of AHD SB	520	5.0	266	5.0	60	10200
66 Street North of AHD NB	428	5.0	219	5.0	60	8400
66 Street North of AHD SB	303	5.0	155	5.0	60	5950
AHD EB to 66 Street SB Ramp	250	10.0	128	10.0	80	4900
AHD EB to 66 Street NB Ramp	161	10.0	82	10.0	70	3150
66 Street NB to AHD EB Ramp	357	10.0	183	10.0	80	7000
66 Street NB to AHD WB Ramp	227	10.0	116	10.0	60	4450
AHD WB to 66 Street NB Ramp	166	10.0	85	10.0	80	3250
AHD WB to 66 Street SB Ramp	194	10.0	99	10.0	60	3800
66 Street SB to AHD WB Ramp	153	10.0	78	10.0	80	3000
66 Street SB to AHD EB Ramp	74	10.0	38	10.0	70	1450
50 Street South of AHD NB	326	5.0	167	5.0	60	6400
50 Street South of AHD SB	349	5.0	179	5.0	60	6850
50 Street North of AHD NB	408	5.0	209	5.0	60	8000
50 Street North of AHD SB	431	5.0	221	5.0	60	8450
AHD EB to 50 Street SB Ramp	143	10.0	73	10.0	60	2800
AHD EB to 50 Street NB Ramp	298	10.0	153	10.0	60	5850
50 Street NB to AHD EB Ramp	390	10.0	200	10.0	60	7650
50 Street NB to AHD WB Ramp	390	10.0	200	10.0	60	7650
AHD WB to 50 Street NB Ramp	224	10.0	115	10.0	60	4400
AHD WB to 50 Street SB Ramp	224	10.0	115	10.0	60	4400
50 Street SB to AHD WB Ramp	224	10.0	115	10.0	60	4400
50 Street SB to AHD EB Ramp	224	10.0	115	10.0	60	4400
Manning Drive South of AHD NB	854	6.8	437	6.8	90	16750
Manning Drive South of AHD SB	959	7.1	491	7.1	90	18800
Manning Drive North of AHD NB	1290	9.4	661	9.4	90	25300
Manning Drive North of AHD SB	1400	8.6	717	8.6	90	27450
AHD EB to Manning Drive SB Ramp	237	8.5	121	8.5	90	4650
AHD EB to Manning Drive NB Ramp	434	15.3	222	15.3	80	8500
Manning Drive NB to AHD EB Ramp	173	11.0	89	11.0	90	3400
Manning Drive NB to AHD WB Ramp	140	9.9	72	9.9	60	2750
AHD WB to Manning Drive NB Ramp	324	9.9	166	9.9	90	6350
AHD WB to Manning Drive SB Ramp	171	9.9	87	9.9	80	3350
Manning Drive SB to AHD WB Ramp	464	13.4	238	13.4	90	9100
Manning Drive SB to AHD EB Ramp	385	11.0	197	11.0	60	7550
Levasseur Road	523	4.0	268	4.0	60	10250
Hebert Road	765	5.0	392	5.0	60	15000
Boudreau Road	893	5.0	457	5.0	60	17500
167 Avenue East of 142 Street	1122	5.0	574	5.0	60	22000
167 Avenue West of Manning Drive	536	5.0	274	5.0	60	10500
Collector Roads	408	3.0	209	3.0	60	8000
Residential Streets	10	3.0	5	3.0	50	200

Appendix II THE ASSESSMENT OF ENVIRONMENTAL NOISE (GENERAL)

Sound Pressure Level

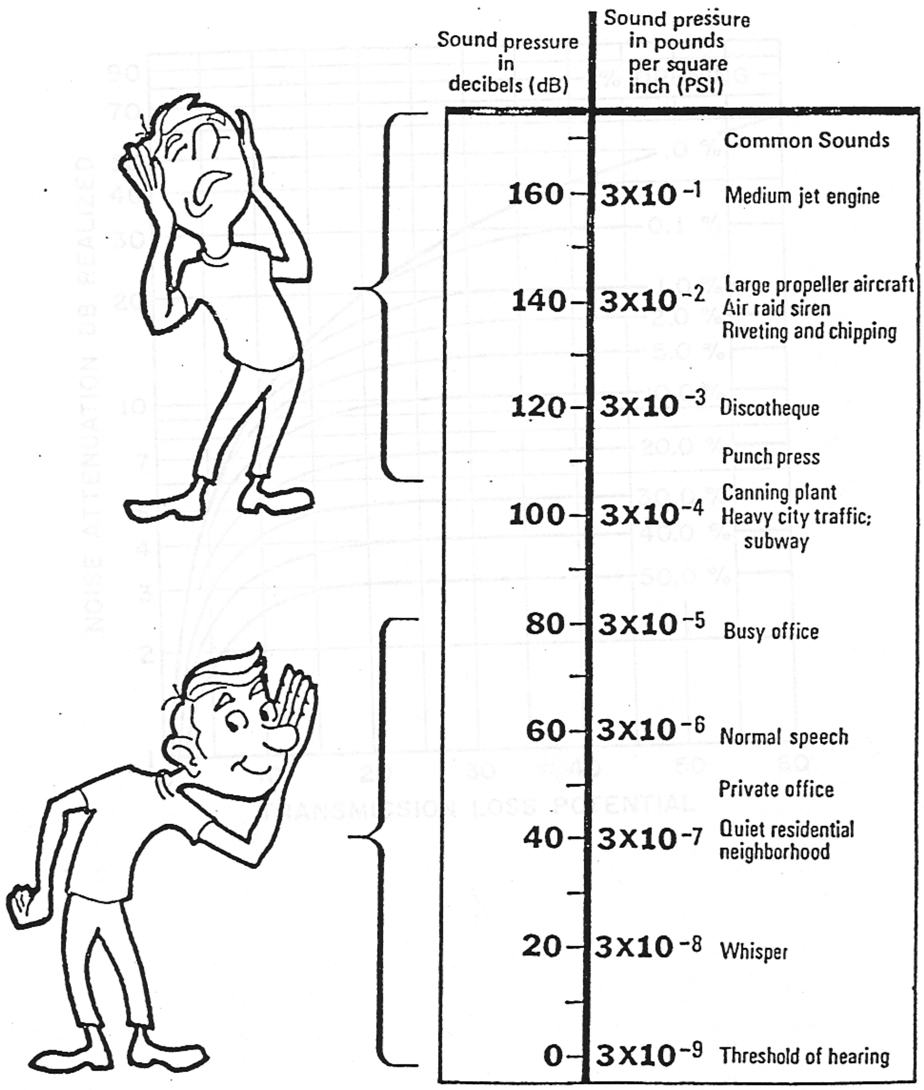
Sound pressure is initially measured in Pascal's (Pa). Humans can hear several orders of magnitude in sound pressure levels, so a more convenient scale is used. This scale is known as the decibel (dB) scale, named after Alexander Graham Bell (telephone guy). It is a base 10 logarithmic scale. When we 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 ($P_{ref} = 2x10^{-5}$ 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!


Sound pressure in decibels (dB)
Sound pressure in pounds per square inch (PSI)
Common Sounds
160 3X10 -1 Medium jet engine
140 3X10 -2 Large propeller aircraft
Air raid siren
Riveting and chipping
120 3X10 -3 Discotheque
Punch press
Canning plant
100 3X10 -4 Heavy city traffic; subway
80 3X10 -5 Busy office
60 3X10 -6 Normal speech
Private office
40 3X10 -7 Quiet residential neighborhood
20 3X10 -8 Whisper
0 3X10 -9 Threshold of hearing

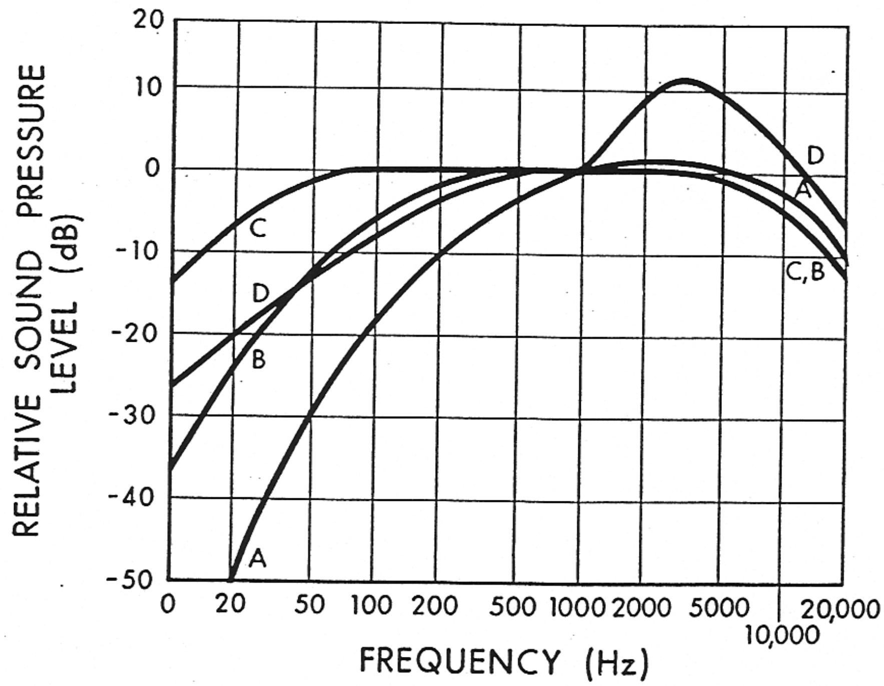
Frequency

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:

Lower Band Limit	Whole Octave Center Frequency	Upper Band Limit	Lower Band Limit	1/3 Octave 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.

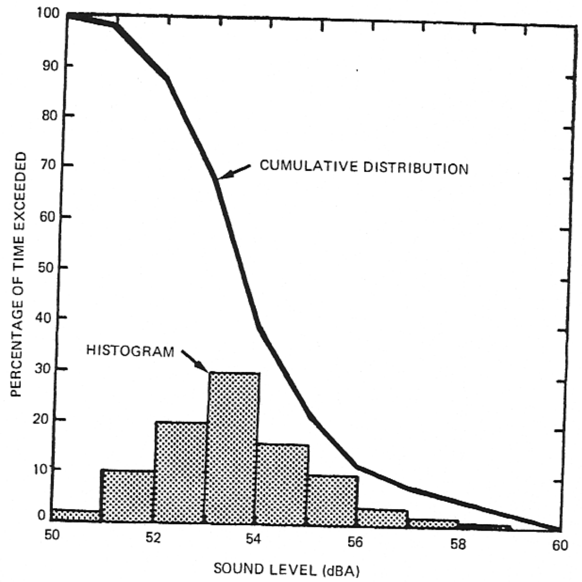


Figure 16.6 Statistically processed community noise showing histogram and cumulative distribution of A weighted sound levels.

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

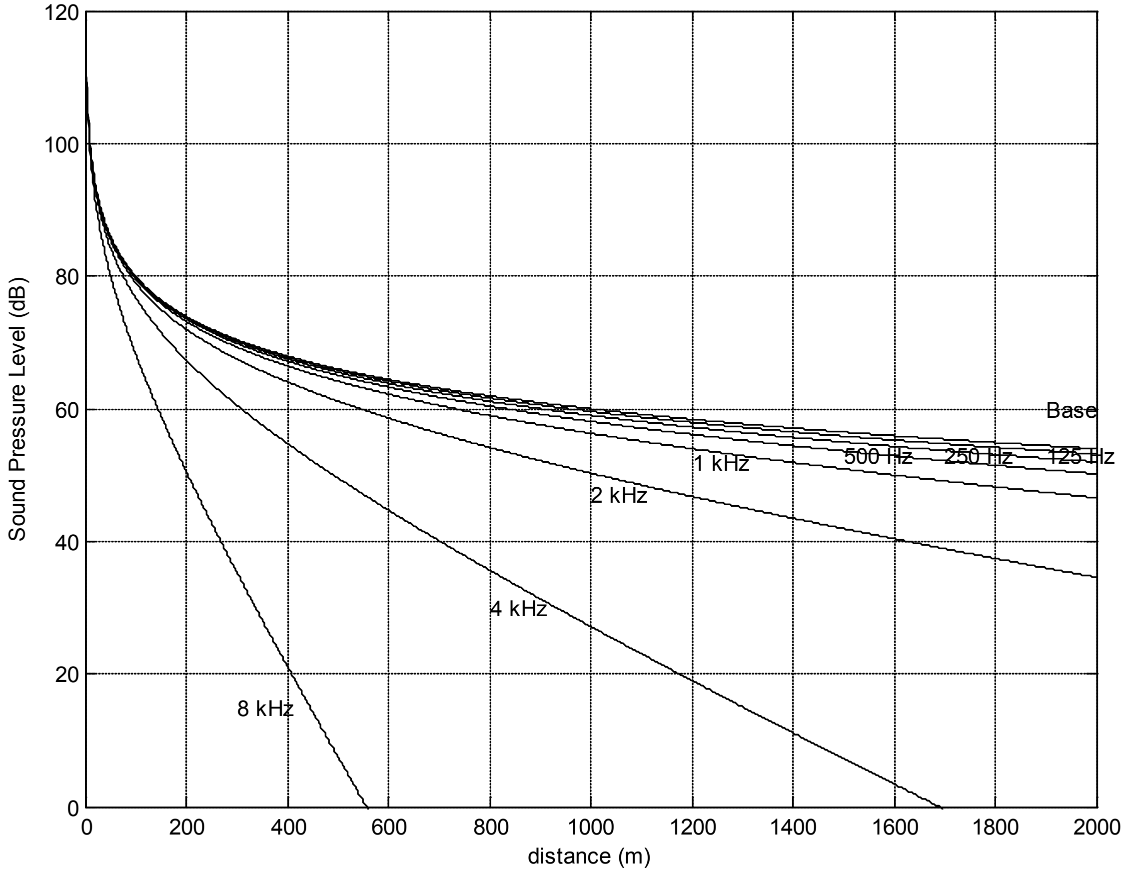
As sound transmits through a medium, there is an attenuation (or dissipation of acoustic energy) which can be attributed to three mechanisms:

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 10^{o}C 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.

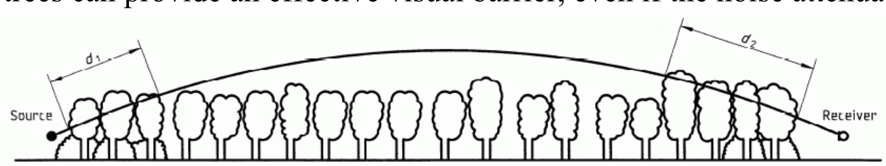
Topography
- One of the most important factors in sound propagation.
- Can provide a natural barrier between source and receiver (i.e. if berm or hill in between).
- Can provide a natural amplifier between source and receiver (i.e. large valley in between or hard reflective surface in between).
- Must 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).

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Environmental Noise Monitoring

For

Northwest Anthony Henday Drive in Edmonton, AB

Prepared for:

ISL Engineering and Land Services Ltd.

Prepared by:
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aci Acoustical Consultants Inc.
Edmonton, Alberta
APEGGA Permit to Practice #P7735

aci Project #: 12-017
November 02, 2012

Executive Summary

aci Acoustical Consultants Inc., of Edmonton AB, was retained by ISL Engineering and Land Services Ltd. (ISL) to conduct a environmental noise monitorings along the northwest section of Anthony Henday Drive (NWAHD)in Edmonton, Alberta. The purpose of this work was to conduct 24-hour noise monitorings at a total of 17 locations along NWAHD to be used as a calibration tool for a computer noise model of the study area. The site work was conducted for aci in May - July, 2012 by S. Bilawchuk, M.Sc., P.Eng., and P. Froment, B.Sc., B.Ed., CET.

The results of the baseline noise monitoring indicated sound levels ranging from 49.7 – 71.2 dBA $L_{eq}24$[1]. At all locations, the noise climate was dominated by NWAHD or by local traffic on the adjacent roads. The monitoring indicated the noise climate was generally broadband in nature with no tonal components and no dominant stationary sources.

[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.

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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 assessment along the northwest section of Anthony Henday Drive (NWAHD) in Edmonton, Alberta. The purpose of the work was to conduct 24-hour environmental noise monitorings at various locations adjacent to the roadway and generate a computer noise model with current and future traffic conditions and compare the results to the Alberta Transportation noise guidelines. The information contained within this report pertains to the noise monitoring at 17 locations along NWAHD. The site work was conducted for aci in May - July, 2012 by S. Bilawchuk, M.Sc., P.Eng., and P. Froment, B.Sc., B.Ed., CET.

2.0 Location Description

2.1. Roadways

The study area for NWAHD spans from Highway 16 on the southwest end around to Manning Drive on the northeast end, as indicated in Figures 1a and 1b. Throughout the entire span (approximately 21.5 km), NWAHD is a twinned road with at least 2-lanes in each direction and some sections with 3-lanes in each direction. The posted speed limit throughout is 100 km/hr. Currently, there are grade separated interchanges or fly-over's at the following locations:

- Highway 16 (grade separated interchange)
- 184 Street / Ray Gibbon Drive (grade separated interchange, not fully complete)
- CN Rail Line (fly-over)
- 137 Avenue (fly-over, 137 Avenue not open to traffic at time of study)
- 170 Street (fly-over)
- Mark Messier Trail / St. Albert Trail (grade separated interchange)
- Campbell Road (grade separated interchange)
- 142 Street and CN Rail Line (fly-over)
- 127 Street (grade separated interchange)
- 97 Street (grade separated interchange)
- 82 Street (fly-over)
- 66 Street (grade separated interchange, not fully operational)
- Manning Drive (grade separated interchange, not fully complete)

For the future case noise modeling scenario the following interchanges have been upgraded to their final design or added as new locations:

- 184 Street / Ray Gibbon Drive (completion of interchange by adding ramp for northbound NWAHD to northbound Ray Gibbon Drive
- 137 Avenue (new grade separated interchange)

- 112 Street (new fly-over)
- 66 Street (completion of interchange by extending 66 Street north and south of interchange)
- 50 Street (new grade separated interchange)
- Manning Drive (completion of interchange and extending AHD towards the southeast as part of the northeast AHD project)

2.2. Adjacent Development

Starting from the southwest portion of the study area, there are two residential receptors located adjacent to the southwest of the interchange between Highway 16 and NWAHD, within Edmonton. Further to the southwest and to the southeast is commercial and industrial development within Edmonton. To the northeast of the interchange are single family residential acreage-style lots which back onto Highway 16 with commercial and industrial development further northeast within Edmonton. To the northwest of the interchange is a golf course with acreage-style residential development and more densely packed single-family residential development further to the northwest within Edmonton.

Adjacent to the interchange between 184 Street and NWAHD, there is open land and industrial development to the south and east within Edmonton. To the north is pending residential development partially within Edmonton and then within the City of St. Albert further north. To the northwest there is a new residential subdivision already under construction, adjacent to Ray Gibbon Drive, primarily consisting of single family detached houses, within Edmonton.

Further to the northeast, between the interchange at 137 Avenue and Campbell Road is residential development within St. Albert. Along this span are single family detached houses which back directly onto the Transportation and Utility Corridor (TUC) and onto NWAHD. Along this span, to the south of NWAHD is commercial and industrial development within Edmonton.

North of NWAHD and east of Campbell Road (west of 142 Street), within St. Albert, is commercial and industrial development.

Between 142 Street and 127 Street, south of NWAHD is a new residential subdivision within Edmonton that is currently under construction, consisting primarily of single family detached houses that back onto the TUC and NWAHD. To the north of NWAHD is a pending residential subdivision within Edmonton.

Between 127 Street and 112 Street, south of NWAHD is pending residential development within Edmonton with existing residential development further south. To the north is the new Edmonton Remand center (currently under construction), surrounded on all sides by undeveloped land.

Between 112 Street and 82 Street, south of NWAHD is residential development within Edmonton comprising of single family detached houses that back directly onto the TUC and NWAHD. To the north, within Edmonton, is a golf course (immediately east of 112 Street) and undeveloped land further to the east.

Between 82 Street and Manning Drive, south of NWAHD is pending residential development within Edmonton which will eventually extend all the way to the TUC with existing residential development further south. To the north is undeveloped land which is used primarily for agricultural purposes.

2.3. Topography

Topographically, the land in between NWAHD and the adjacent residential receptors varies with location. Some residential receptors have direct line-of-sight to NWAHD while others do not due to earth berms in between or sections of NWAHD which have been depressed relative to the adjacent grade. Elevation contours containing all of the recent interchanges and roadway elevations have been included in the noise model for more accurate modeling results. The vegetation in the areas between the residential locations and NWAHD consists mainly of field grasses with some small sections of bushes and trees for residents within St. Albert. Although the trees will provide a minimal level of noise attenuation, they have not been included in the model in an effort to make the model more conservative.

3.0 Measurement Methods

As part of the study a total of seventeen (17) 24-hour environmental noise monitorings were conducted throughout the study area. The noise monitoring locations, as indicated in Figures 1a and 1b, were selected based on their proximity to NWAHD and adjacent interchanges as well as adjacent residential receptors. Seven of the locations were conducted in residential backyards within St. Albert. A detailed description of each location is provided below. 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.

Noise Monitor 1

Noise Monitor 1 was located approximately 50 m north of the westbound lanes for Highway 16 and 600 m east of the northbound lanes for NWAHD as shown in Figure 1a and Figure 2. The noise monitor was placed at the TUC fence-line with the microphone at a height of 1.2 m above ground. At this location, there was direct line-of-sight to Highway 16, NWAHD, and the interchange between the two. There was no significant vegetation between the noise monitor and the roads. The noise monitor was started at 08:00 on Thursday May 31, 2012 and ran for 24-hours until 08:00 on Friday June 01, 2012.

Noise Monitor 2

Noise Monitor 2 was located approximately 185 m west of the southbound lanes for Ray Gibbon Drive and 240 m north of the southbound lanes for NWAHD as shown in Figure 1a and Figure 3. The noise monitor was placed at the existing fence-line with the microphone at a height of 1.2 m above ground. At this location, there was direct line-of-sight to Ray Gibbon Drive, and the interchange and partial line-of-sight to NWAHD. There was no significant vegetation between the noise monitor and the roads. The noise monitor was started at 10:00 on Thursday June 07, 2012 and ran for 24-hours until 10:00 on Friday June 07, 2012.

Noise Monitor 3

Noise Monitor 3 was located in the backyard of the residence at 31 Hamilton Crescent in St. Albert, approximately 285 m northwest of the westbound lanes for NWAHD and 220 m northeast of 137 Avenue, as shown in Figure 1a and Figure 4. The noise monitor was placed 2 m in from the rear property line with the microphone at a height of 1.2 m above ground. At this location, there was no line-of-sight to NWAHD because of the fence, however, there was line-of-sight to NWAHD over the fence. There was no significant vegetation between the noise monitor and the roads other than field grasses. The noise monitor was started at 13:00 on Thursday June 21, 2012 and ran for 24-hours until 13:00 on Friday June 22, 2012.

Noise Monitor 4

Noise Monitor 4 was located in the backyard of the residence at 08 Hayden Place in St. Albert, approximately 210 m northwest of the westbound lanes for NWAHD and 440 m west of 170 Street, as shown in Figure 1a and Figure 5. The noise monitor was placed 2 m in from the rear property line with the microphone at a height of 1.2 m above ground. At this location, there was no line-of-sight to NWAHD because of the fence, however, there was line-of-sight to NWAHD over the fence. There was no significant vegetation between the noise monitor and the roads other than field grasses. The noise monitor was started at 13:30 on Thursday June 21, 2012 and ran for 24-hours until 13:30 on Friday June 22, 2012.

Noise Monitor 5

Noise Monitor 5 was located in the backyard of the residence at 33 Hunchak Way in St. Albert, approximately 260 m northwest of the westbound lanes for NWAHD and 145 m west of 170 Street, as shown in Figure 1a and Figure 6. The noise monitor was placed 2 m in from the rear property line with the microphone at a height of 1.2 m above ground. At this location, there was no line-of-sight to NWAHD because of the retaining wall and fence. There was no significant vegetation between the noise monitor and the roads other than field grasses. The noise monitor was started at 13:45 on Thursday June 21, 2012 and ran for 24-hours until 13:45 on Friday June 22, 2012.

Noise Monitor 6

Noise Monitor 6 was located in the backyard of the residence at 70 Goodridge Drive in St. Albert, approximately 110 m northwest of the westbound lanes for NWAHD and 380 m east of 170 Street, as shown in Figure 1a and Figure 7. The noise monitor was placed approximately 2 m in from the rear property line with the microphone at a height of 1.2 m above ground. At this location, there was direct line-of-sight to NWAHD because there was no fence at the rear property line. There was no significant vegetation between the noise monitor and the roads other than field grasses. The noise monitor was started at 14:15 on Thursday June 21, 2012 and ran for 24-hours until 14:15 on Friday June 22, 2012.

Noise Monitor 7

Noise Monitor 7 was located in the backyard of the residence at 19 Arcand Drive in St. Albert, approximately 280 m northwest of the westbound lanes for NWAHD and 330 m northeast of St. Albert Trail, as shown in Figure 1a and Figure 8. The noise monitor was placed approximately 2 m in from the rear property line with the microphone at a height of 1.2 m above ground. At this location, there was no line-of-sight to NWAHD because of the fence and the earth berm to the south. There was no significant vegetation between the noise monitor and the roads other than field grasses. The noise monitor was started at 14:40 on Thursday June 21, 2012 and ran for 23-hours and 20-minutes until 14:00 on Friday June 22, 2012. The noise monitor was stopped early due to an afternoon thundershower on June 22, which started affecting the noise levels at approximately 14:00.

Noise Monitor 8

Noise Monitor 8 was located in the backyard of the residence at 35 Alderwood Blvd in St. Albert, approximately 230 m northwest of the westbound lanes for NWAHD and 1220 m northeast of St. Albert Trail, as shown in Figure 1a and Figure 9. The noise monitor was placed approximately 2 m in from the rear property line with the microphone at a height of 1.2 m above ground. At this location, there was no line-of-sight to NWAHD because of the fence and the trees to the southeast. There were groups of trees between the residential property and AHD, however, the quantity and density was not sufficient for significant noise reduction. The noise monitor was started at 15:00 on Thursday June 21, 2012 and ran for 23-hours until 14:00 on Friday June 22, 2012. The noise monitor was stopped early due to an afternoon thundershower on June 22, which started affecting the noise levels at approximately 14:00.

Noise Monitor 9

Noise Monitor 9 was located in the backyard of the residence at 57 Arbor Crescent in St. Albert, approximately 190 m northwest of the westbound lanes for NWAHD and 390 m west of Campbell Road, as shown in Figure 1a and Figure 10. The noise monitor was placed approximately 2 m in from the rear property line with the microphone at a height of 1.2 m above ground. At this location, there was no line-of-sight to NWAHD because of the fence, the earth berm to the east, and the trees to the south. There was a small group of trees between the residential property and AHD to the south, however, the quantity and density was not sufficient for significant noise reduction. The noise monitor was started at 15:20 on Thursday June 21, 2012 and ran for 22-hours and 40-minutes until 14:00 on Friday June 22, 2012. The noise monitor was stopped early due to an afternoon thundershower on June 22, which started affecting the noise levels at approximately 14:00.

Noise Monitor 10

Noise Monitor 10 was located in an open field area approximately 140 m southeast of the eastbound lanes for NWAHD and 550 m east of 142 Street, as shown in Figure 1b and Figure 11. This placed the noise monitor well within the TUC. It would have been preferable to locate the noise monitor at the TUC boundary, however, nearby residential construction and road paving to the south was generating too much noise to locate the noise monitor at the TUC boundary. A location closer to NWAHD was selected to ensure the NWAHD would be the dominant noise source. This is suitable for the purposes of calibration for the computer noise model. The microphone was set at a height of 1.2 m above ground. At this location, there was direct line-of-sight to NWAHD. There was no significant vegetation between the noise monitor and NWAHD. The noise monitor was started at 20:00 on Tuesday June 19, 2012 and ran for 24-hours until 20:00 on Wednesday June 20, 2012.

Noise Monitor 11

Noise Monitor 11 was located at the north end of 115 Street (just north of a bus turn-around) in an open field area approximately 610 m southeast of the eastbound lanes for NWAHD, as shown in Figure 1b and Figure 12. The closest residential receptor to the noise monitor was 11504 - 175 Avenue. The microphone was set at a height of 1.2 m above ground. At this location, there was direct line-of-sight to NWAHD. There was no significant vegetation between the noise monitor and NWAHD. The noise monitor was started at 20:00 on Tuesday June 19, 2012 and ran for 24-hours until 20:00 on Wednesday June 20, 2012.

Noise Monitor 12

Noise Monitor 12 was located within the TUC, approximately 20 m north of the rear property line for the residence at 10720 - 183 Avenue. This placed the noise monitor approximately 125 m south of the eastbound lanes for NWAHD and 1260 m west of 97 Street, as shown in Figure 1b and Figure 13. The noise monitor was chained to a metal TUC sign and the microphone was set at a height of 1.2 m above ground. At this location, there was direct line-of-sight to NWAHD. There was no significant vegetation between the noise monitor and NWAHD. The noise monitor was started at 20:00 on Tuesday June 19, 2012 and ran for 24-hours until 20:00 on Wednesday June 20, 2012.

Noise Monitor 13

Noise Monitor 13 was located within the TUC, approximately 3 m north of the rear property line for the residence at 18247 - 103 Street. This placed the noise monitor approximately 160 m south of the eastbound lanes for NWAHD and 490 m west of 97 Street, as shown in Figure 1b and Figure 14. The microphone was set at a height of 1.2 m above ground. At this location, there was direct line-of-sight to NWAHD and to the off ramp for eastbound NWAHD. There was no significant vegetation between the noise monitor and NWAHD. The noise monitor was started at 20:00 on Tuesday June 19, 2012 and ran for 24-hours until 20:00 on Wednesday June 20, 2012.

Noise Monitor 14

Noise Monitor 14 was located at the TUC boundary, approximately 120 m south of the eastbound lanes for NWAHD and 370 m west of 82 Street, as shown in Figure 1b and Figure 15. It would have been preferable to locate the noise monitor further south (closer to the existing residential development), however, nearby residential development construction to the south was generating too much noise and a location closer to NWAHD was selected to ensure the NWAHD would be the dominant noise source. This is suitable for the purposes of calibration for the computer noise model. The microphone was set at a height of 1.2 m above ground. At this location, there was direct line-of-sight to NWAHD. There was no significant vegetation between the noise monitor and NWAHD. The noise monitor was started at 20:00 on Tuesday June 19, 2012 and ran for 24-hours until 20:00 on Wednesday June 20, 2012.

Noise Monitor 15

Noise Monitor 15 was located at the TUC boundary, approximately 37 m south of the eastbound lanes for NWAHD and 660 m east of 82 Street, as shown in Figure 1b and Figure 16. The closest current residential development was approximately another 1,200 m to the south, so this location was selected to ensure the NWAHD would be the dominant noise source. This is suitable for the purposes of calibration for the computer noise model. The microphone was set at a height of 1.2 m above ground. At this location, there was direct line-of-sight to NWAHD. There was no significant vegetation between the noise monitor and NWAHD. The noise monitor was started at 20:00 on Tuesday June 19, 2012 and ran for 24-hours until 20:00 on Wednesday June 20, 2012.

Noise Monitor 16

Noise Monitor 16 was located at the NWAHD road fence-line, approximately 34 m south of the eastbound lanes for NWAHD and 800 m east of 66 Street, as shown in Figure 1b and Figure 17. The closest current residential development was approximately another 850 m to the south, so this location was selected to ensure the NWAHD would be the dominant noise source. This is suitable for the purposes of calibration for the computer noise model. The microphone was set at a height of 1.2 m above ground. At this location, there was direct line-of-sight to NWAHD. There was no significant vegetation between the noise monitor and NWAHD. The noise monitor was started at 13:00 on Thursday July 12, 2012 and ran for 24-hours until 13:00 on Friday July 13, 2012.

Noise Monitor 17

Noise Monitor 17 was located at the NWAHD Road fence-line, approximately 62 m south of the eastbound lanes for NWAHD and 720 m west of Manning Drive, as shown in Figure 1b and Figure 18. The closest current residential development was approximately another 700 m to the south, so this location was selected to ensure the NWAHD would be the dominant noise source. This is suitable for the purposes of calibration for the computer noise model. The microphone was set at a height of 1.2 m above ground. At this location, there was direct line-of-sight to NWAHD. There was no significant vegetation between the noise monitor and NWAHD. The noise monitor was started at 13:00 on Thursday July 12, 2012 and ran for 24-hours until 13:00 on Friday July 13, 2012.

4.0 Results and Discussion

4.1. Noise Monitoring

The results obtained from the environmental noise monitorings are shown in Table 1 and Figures. 19–52 (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 and dogs making noise nearby, abnormally loud vehicle passages, etc. At all locations, the resultant 1/3 octave band L_{eq} sound levels were very similar. All locations show the typical trend of low frequency noise (near 63 – 80 Hz) resulting from engines and exhaust, as well as mid-high frequency noise (near 1,000 Hz) resulting from tire noise. These results confirm that the noise levels being measured by the noise monitors were largely attributed to NWAHD in addition to the other major roadways. Some locations also show elevated peaks near 8 kHz which are related to bird chirping nearby.

Table 1. Baseline Noise Monitoring Results

Monitor	L_{eq}24 (dBA)	L_{eq}Day (dBA)	L_{eq}Night (dBA)
M1	71.2	72.3	68.4
M2	55.8	56.6	53.9
M3	54.2	54.9	52.8
M4	55.4	56.3	53.3
M5	49.7	49.9	49.3
M6	61.8	62.8	59.5
M7	50.7	50.8	50.6
M8	53.9	54.4	52.9
M9	51.8	52.3	50.6
M10	58.4	59.6	55.1
M11	51.2	52.3	48.3
M12	57.5	58.3	55.7
M13	56.2	56.7	55.0
M14	56.9	58.0	53.8
M15	64.6	65.8	61.1
M16	65.4	66.5	62.9
M17	60.9	61.8	58.6

The noise levels at noise monitor 1 were dominated by traffic on Highway 16.

The noise levels at noise monitor 2 were dominated by traffic on Ray Gibbon Drive and the ramp from Ray Gibbon Drive southbound to NWAHD southbound as well as lesser noise from NWAHD itself. Note that there were construction signs posted in the area, resulting in lower-than-normal traffic speeds on the adjacent roads, likely resulting in a slightly lower than normal noise monitoring result.

The noise levels at noise monitor 3 were dominated by traffic on NWAHD. Bird chirping noise was audible in the morning starting by approximately 03:45, however, NWAHD was still dominant.

The noise levels at noise monitor 4 were dominated by traffic on NWAHD. Data were removed from approximately 20:02 - 20:25 due to a lawnmower operating nearby and near approximately 15:35 due to a back-up beeper operating nearby. There were also crickets chirping nearby in the late evening and early morning, however, NWAHD was still dominant.

The noise levels at noise monitor 5 were dominated by traffic on NWAHD and there was also a notable influence from traffic on 170 Street. Data were removed from approximately 16:16 - 16:46 due to a lawnmower operating nearby. In addition, there was road construction activity on 170 Street which was audible starting at approximately 06:00. The loudest construction related spikes were removed from the data. In general, the noise levels during the morning of June 22 are slightly louder than they may have otherwise been without the construction activity, thus the data during this period is slightly conservative. At other times, however, the noise levels are likely slightly lower than normal because of the lower traffic speeds on 170 Street resulting from the construction activity. Relative to the other locations, the noise levels at noise monitor 5 are lower due to the significant shielding caused by the retaining wall and fence at the rear property line. This effectively resulted in a noise barrier of approximately 3 m in height.

The noise levels at noise monitor 6 were dominated by traffic on NWAHD. At this location, there was direct line-of-sight to NWAHD with the residential property elevated above the roadway by approximately 7 m.

The noise levels at noise monitor 7 were dominated by traffic on NWAHD with notable influence from traffic on St. Albert Trail and the interchange between St. Albert Trail and NWAHD. It was observed that the earth berm to the south of the residential property provided a significant level of noise shielding relative to the adjacent roadways. Note that the data past 14:00 on June 22 were removed due to the noise from the high winds and thunder from a local thundershower. This removed 40-minutes from the 24-hour data at a time period in the afternoon when traffic noise is generally lower than the morning rush and afternoon rush periods. As such, the removal of this data did not have a significant impact on the overall day-time or 24-hour results.

The noise levels at noise monitor 8 were dominated by traffic on NWAHD. Note that the data past 14:00 on June 22 were removed due to the noise from the high winds and thunder from a local thundershower. This removed 60-minutes from the 24-hour data at a time period in the afternoon when traffic noise is generally lower than the morning rush and afternoon rush periods. As such, the removal of this data did not have a significant impact on the overall day-time or 24-hour results.

The noise levels at noise monitor 9 were dominated by traffic on NWAHD and were also influenced by traffic on Campbell Road and the interchange between Campbell Road and NWAHD. Data were removed from approximately 16:30 - 17:00 due to a lawnmower operating nearby. There were also several short-term dog barking events (just a few seconds each) that were removed from the data. Data were removed between 22:10 - 23:14 because of music and talking nearby as well as a tone near 125 Hz as well as other unidentified loud banging noises. Given that the morning rush for traffic was the dominant factor in the night-time noise levels, removal of the data between 22:10 - 23:14 will have had a minor impact on the night-time and 24-hour broadband dBA noise monitoring results. In addition, the tone at 125 Hz (likely attributed to the nearby hot tub) was present throughout much of the night. During the quietest periods (i.e. when there was a lull in traffic), this tone dominated the overall noise levels at about 40 dBA at the microphone. These time periods were few and far between. At all other times when traffic noise was present, traffic noise dominated. As such, although almost always present, the tone at 125 Hz was not sufficient to affect the broadband dBA day-time, night-time, or 24-hour noise monitoring results. Note also that the data past 14:00 on June 22 were removed due to the noise from the high winds and thunder from a local thundershower. This removed 80-minutes from the 24-hour data at a time period in the afternoon when traffic noise is generally lower than the morning rush and afternoon rush periods. As such, the removal of this data did not have a significant impact on the overall day-time or 24-hour results.

The noise levels at noise monitor 10 were dominated by traffic on NWAHD. The construction noise and road paving noise to the south did not have a significant impact on the noise monitoring results. There were periods when bird chirping noise resulted in elevated spikes (in particular near 8 kHz). The loudest of these (i.e. events which dominated the broadband dBA sound levels) were removed to minimize the impact on the monitored noise levels.

The noise levels at noise monitor 11 were dominated by traffic on NWAHD. There was also some minor contribution from earth-moving equipment operating to the northwest of the noise monitor, resulting in noise levels during the day-time that were slightly higher than typical. Data were removed during each bus pass-by that occurred in the adjacent bus turn-around.

The noise levels at noise monitor 12 were dominated by traffic on NWAHD. There were periods when bird chirping noise resulted in elevated spikes (in particular near 8 kHz). The loudest of these (i.e. events which dominated the broadband dBA sound levels) were removed to minimize the impact on the monitored noise levels.

The noise levels at noise monitor 13 were dominated by traffic on NWAHD. There were significant periods when bird chirping noise resulted in elevated spikes (in particular near 8 kHz). The loudest of these (i.e. events which dominated the broadband dBA sound levels) were removed to minimize the impact on the monitored noise levels.

The noise levels at noise monitor 14 were dominated by traffic on NWAHD. There were significant periods when bird chirping noise resulted in elevated spikes (in particular near 8 kHz). The loudest of these (i.e. events which dominated the broadband dBA sound levels) were removed to minimize the impact on the monitored noise levels.

The noise levels at noise monitor 15 were dominated by traffic on NWAHD. There were only a few minor sections of data removed due to loud birdsong, etc.

The noise levels at noise monitor 16 were dominated by traffic on NWAHD. There were only a few minor sections of data removed due to loud vehicles, etc.

The noise levels at noise monitor 17 were dominated by traffic on NWAHD. During the noise monitoring period there was construction activity underway at the nearby interchange between NWAHD and Manning Drive. In particular, there was impact pile driving noise. During the first day, the noise was audible but not sufficient to impact the noise monitoring results. During the second day, however, there were three specific periods of approximately 30-minutes each where the noise from the pile driving was sufficient to adversely impact the noise monitoring results, so the data were removed. Beyond that, there were only a few minor sections of data removed due to loud birdsong, etc.

4.2. Weather Conditions

The weather conditions for noise monitor 1 had a generally west to southwest wind that was less than 20 km/hr throughout. This resulted in favourable conditions for noise from the adjacent Highway 16 and NWAHD towards the noise monitor.

The weather conditions for noise monitor 2 had a generally south to southeast wind that was less than 15 km/hr throughout. This resulted in favourable conditions for noise from the adjacent sections of NWAHD, Ray Gibbon Drive, and 184 Street towards the noise monitor.

The weather conditions for noise monitors 3 - 9 had a generally south to southeast to east wind that was less than 15 km/hr throughout. This resulted in favourable conditions for noise from the adjacent sections of NWAHD towards the noise monitors. As mentioned previously, a localized thunderstorm rolled through the area and resulted in high winds and rain and thunder starting at approximately 14:00. For some locations, this caused higher than normal noise levels and necessitated removal of some of the noise measurement data.

The weather conditions for noise monitors 10 - 15 had a generally northerly wind that was less than 15 km/hr throughout. This resulted in favourable conditions for noise from the adjacent sections of NWAHD towards the noise monitors.

The weather conditions for noise monitors 16 & 17 had a generally northerly wind that was less than 15 km/hr throughout. This resulted in favourable conditions for noise from the adjacent sections of NWAHD towards the noise monitors.

Weather data for the duration of the environmental noise monitorings is presented in Appendix IV.

5.0 Conclusion

The results of the baseline noise monitoring indicated sound levels ranging from 49.7 – 71.2 dBA L_{eq}24. At all locations, the noise climate was dominated by NWAHD or by local traffic on the adjacent roads. The monitoring indicated the noise climate was generally broadband in nature with no tonal components and no dominant stationary sources.

6.0 References

- 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.

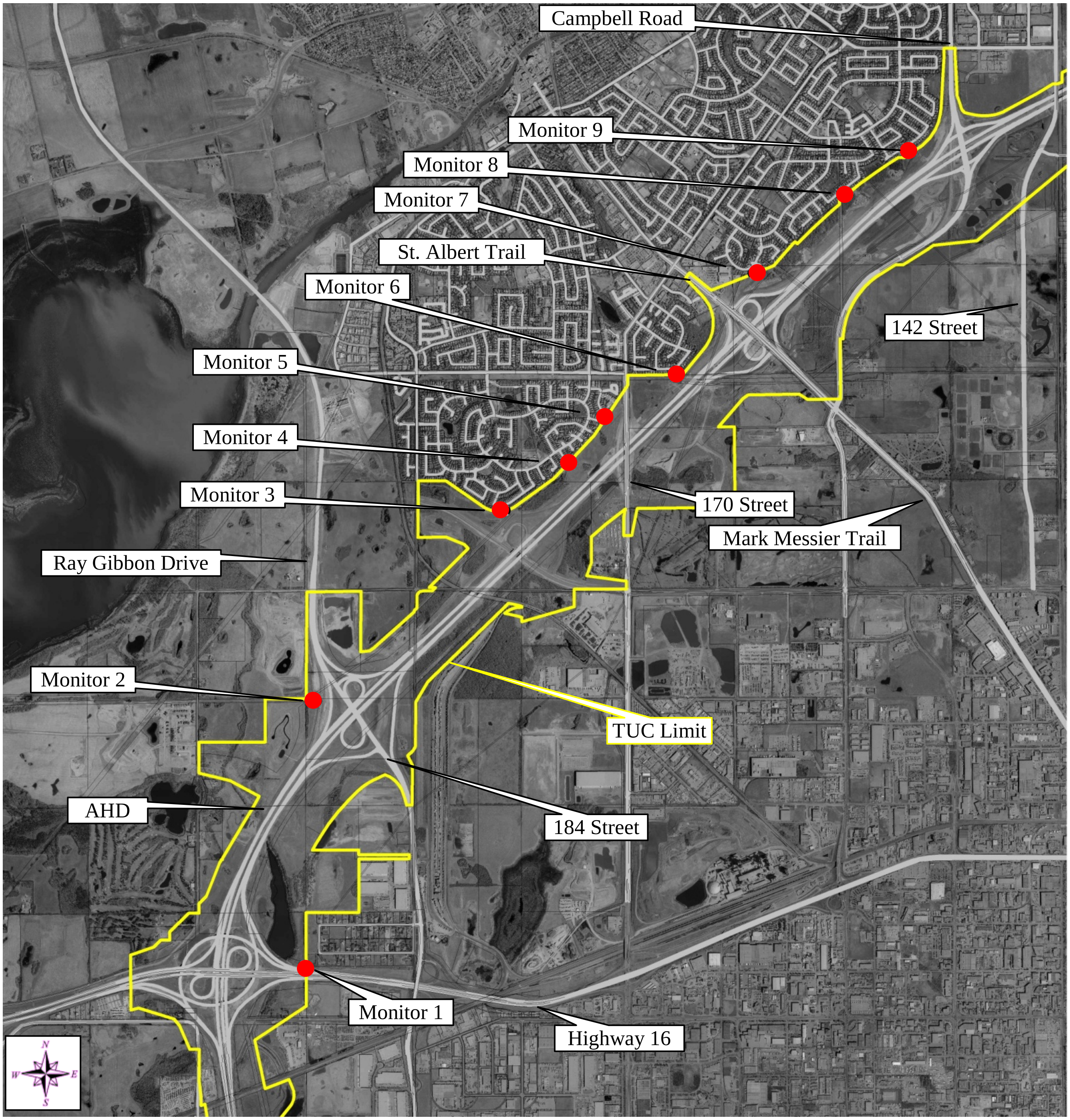

Figure 1a. Study Area West

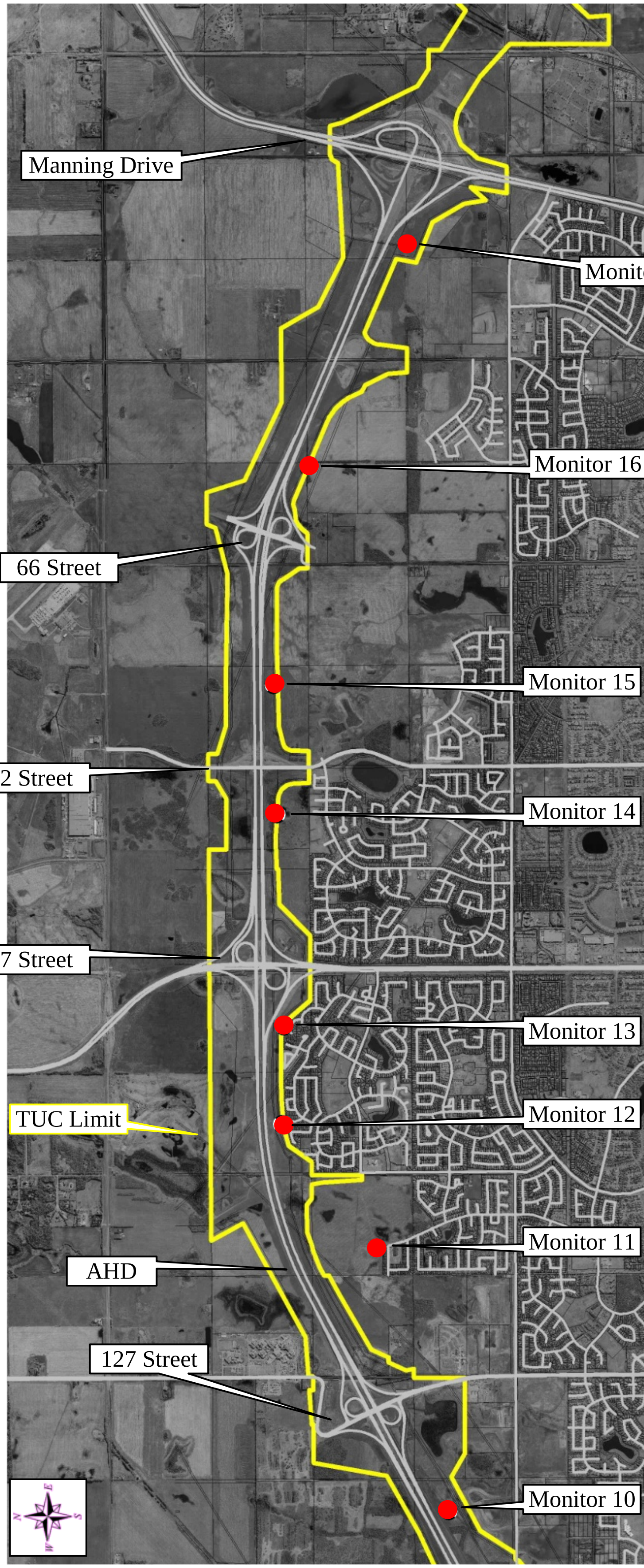

Figure 1b. Study Area East

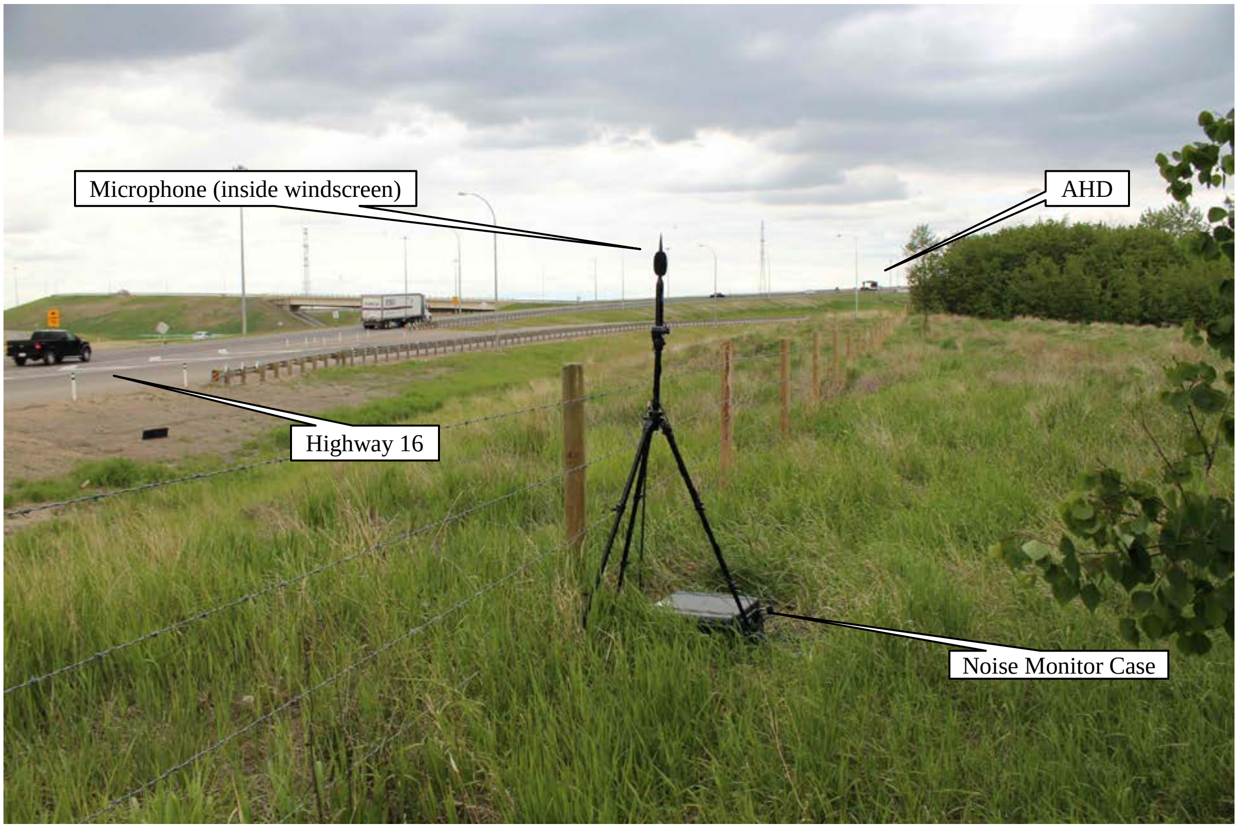

Figure 2. Noise Monitor at Location 1

Figure 3. Noise Monitor at Location 2

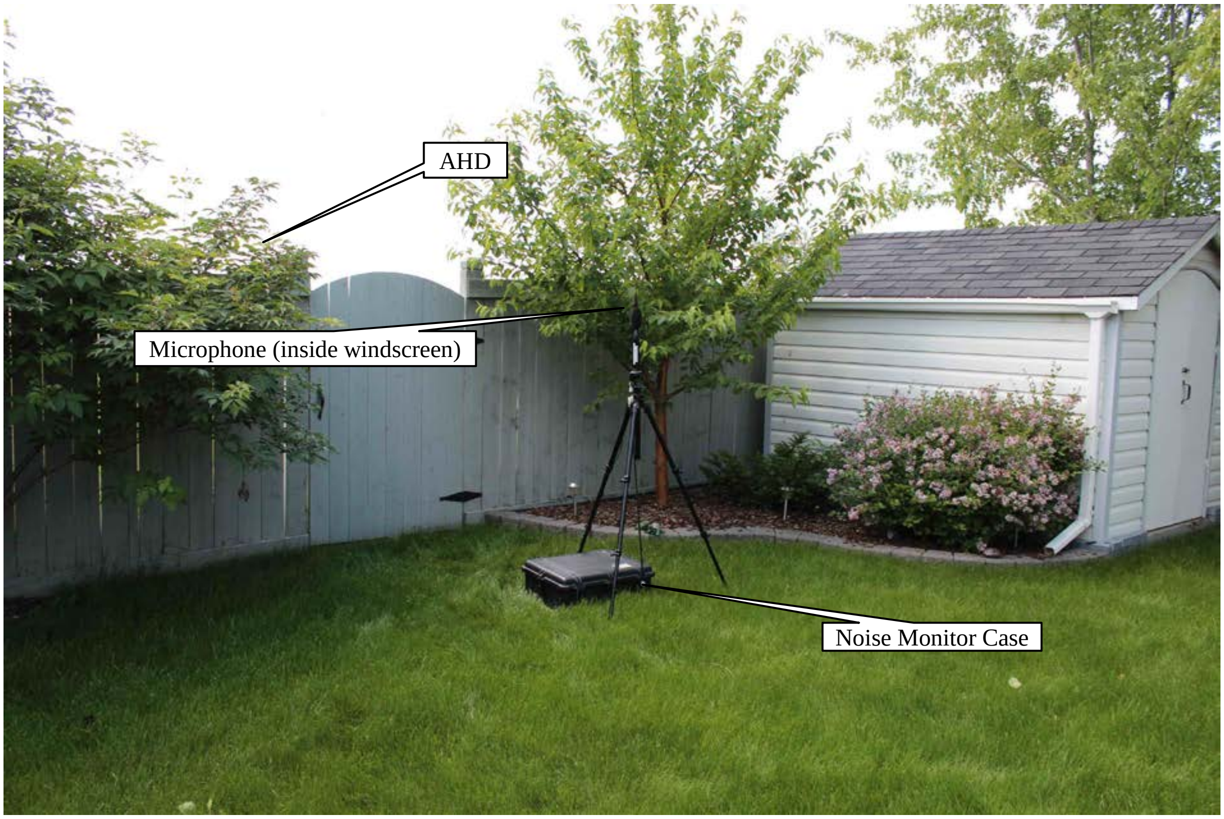

Figure 4. Noise Monitor at Location 3

Figure 5. Noise Monitor at Location 4

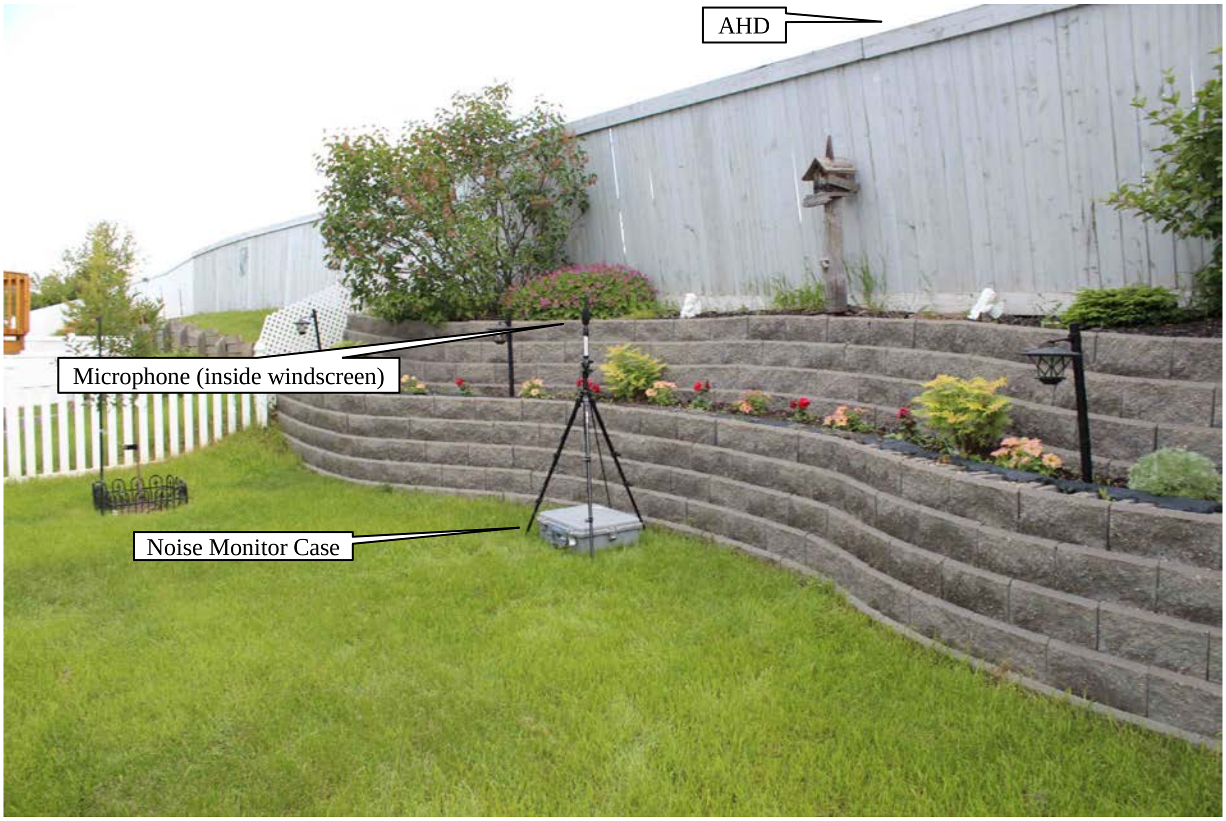

Figure 6. Noise Monitor at Location 5

Figure 7. Noise Monitor at Location 6

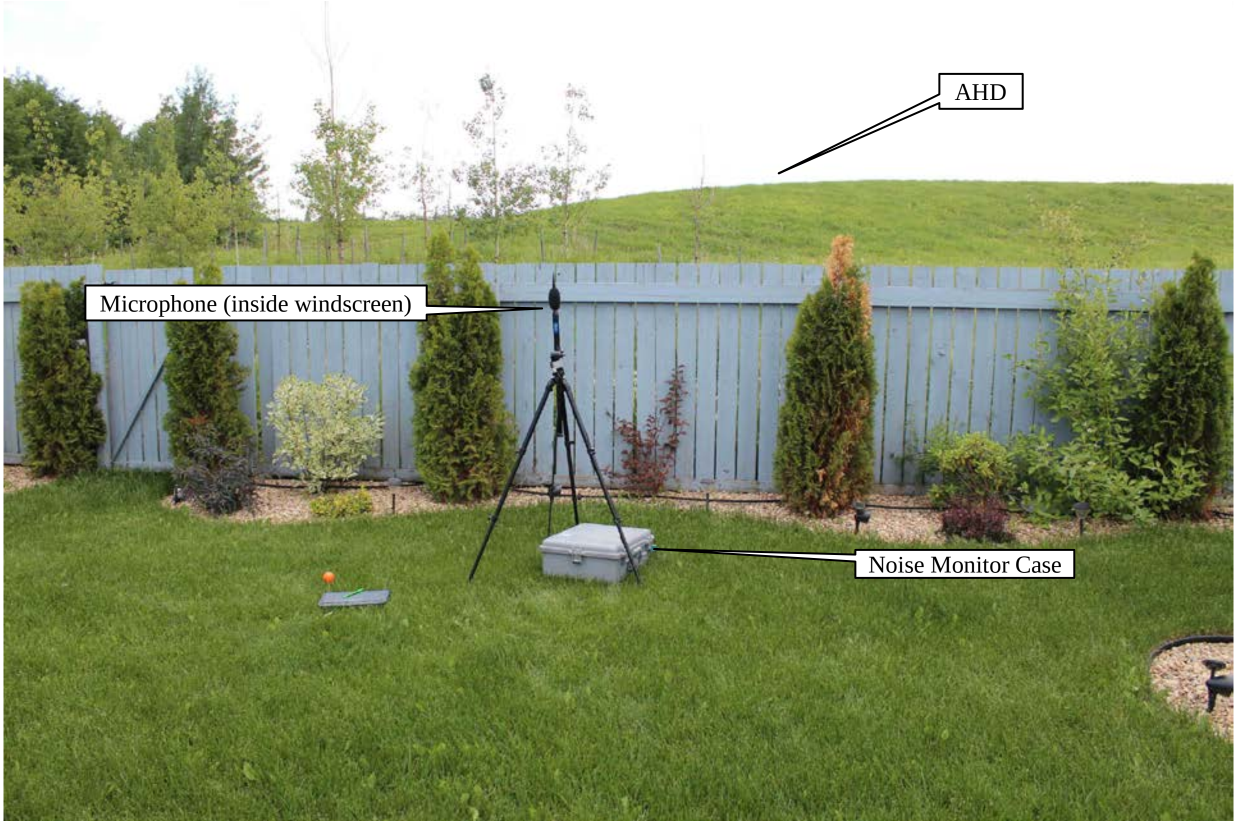

Figure 8. Noise Monitor at Location 7

Figure 9. Noise Monitor at Location 8

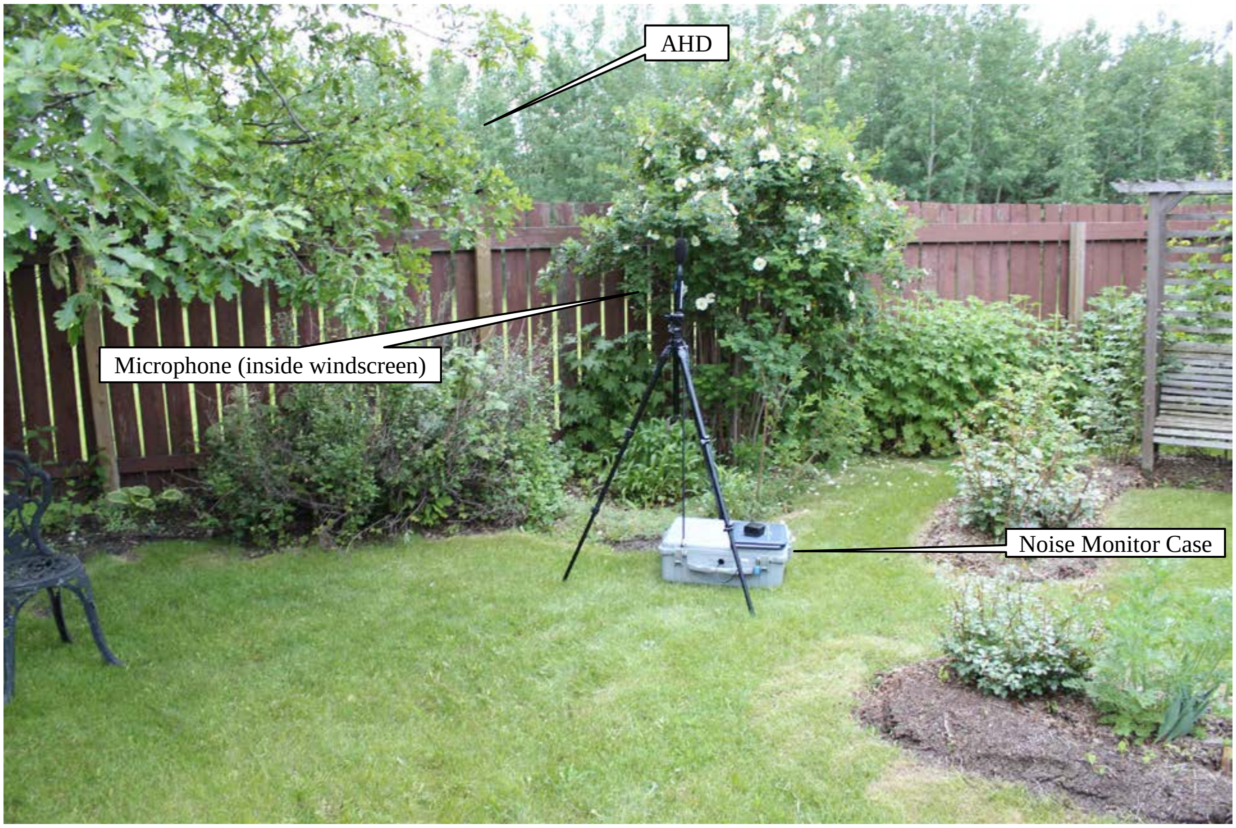

Figure 10. Noise Monitor at Location 9

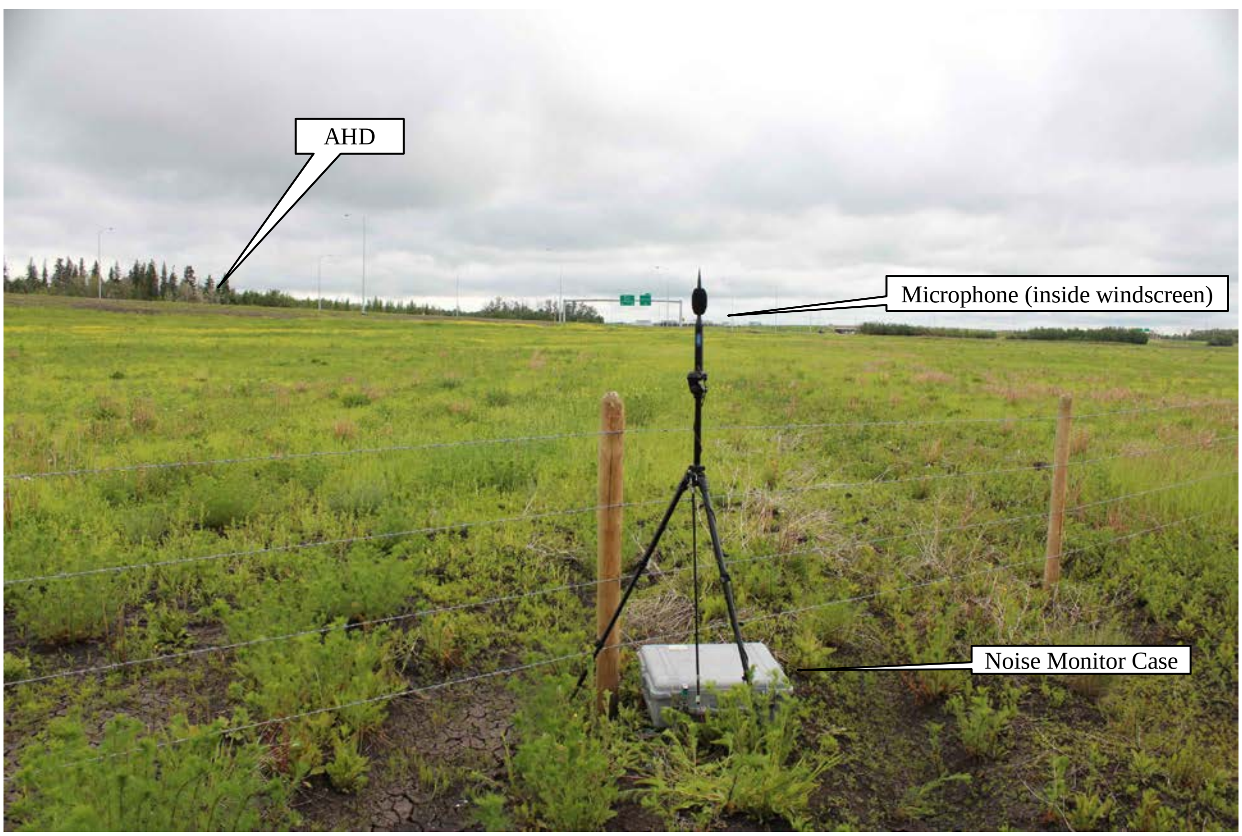

Figure 11. Noise Monitor at Location 10

Figure 12. Noise Monitor at Location 11

Figure 13. Noise Monitor at Location 12

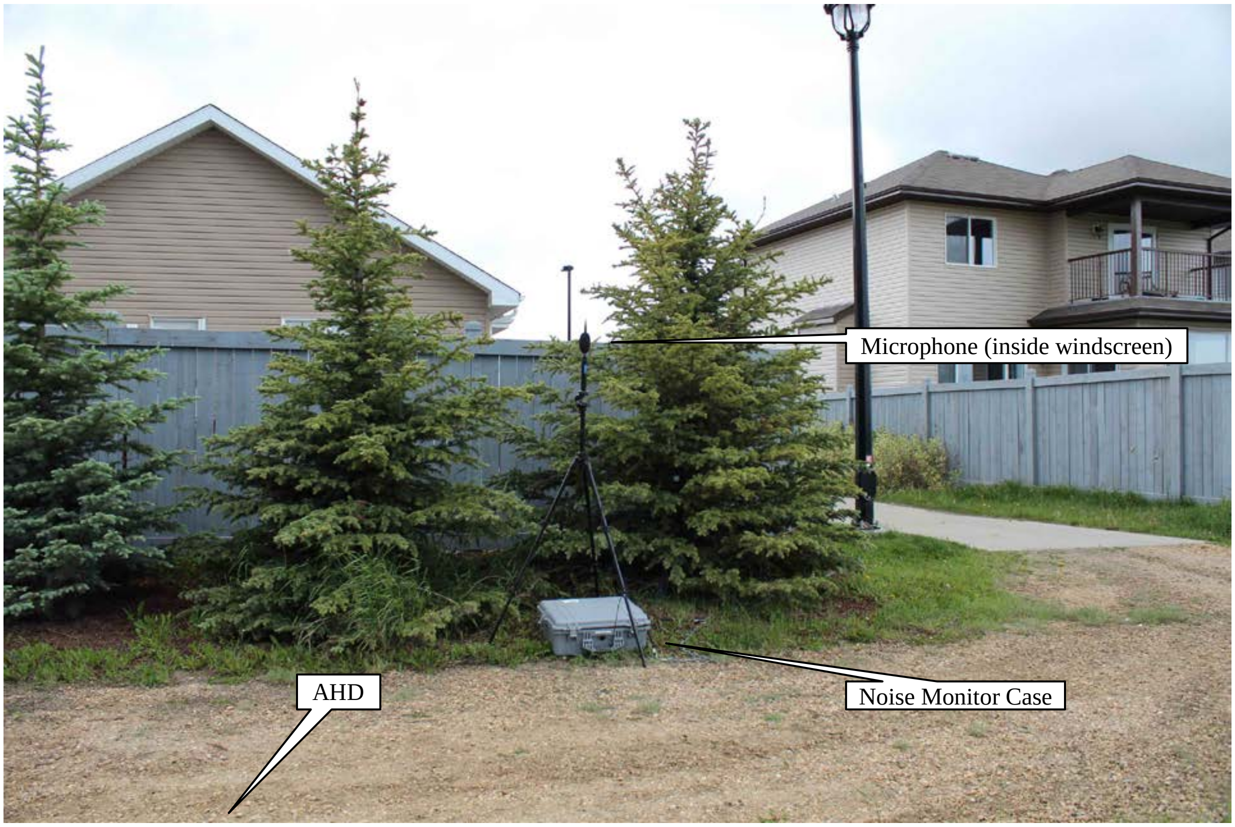

Figure 14. Noise Monitor at Location 13

Figure 15. Noise Monitor at Location 14

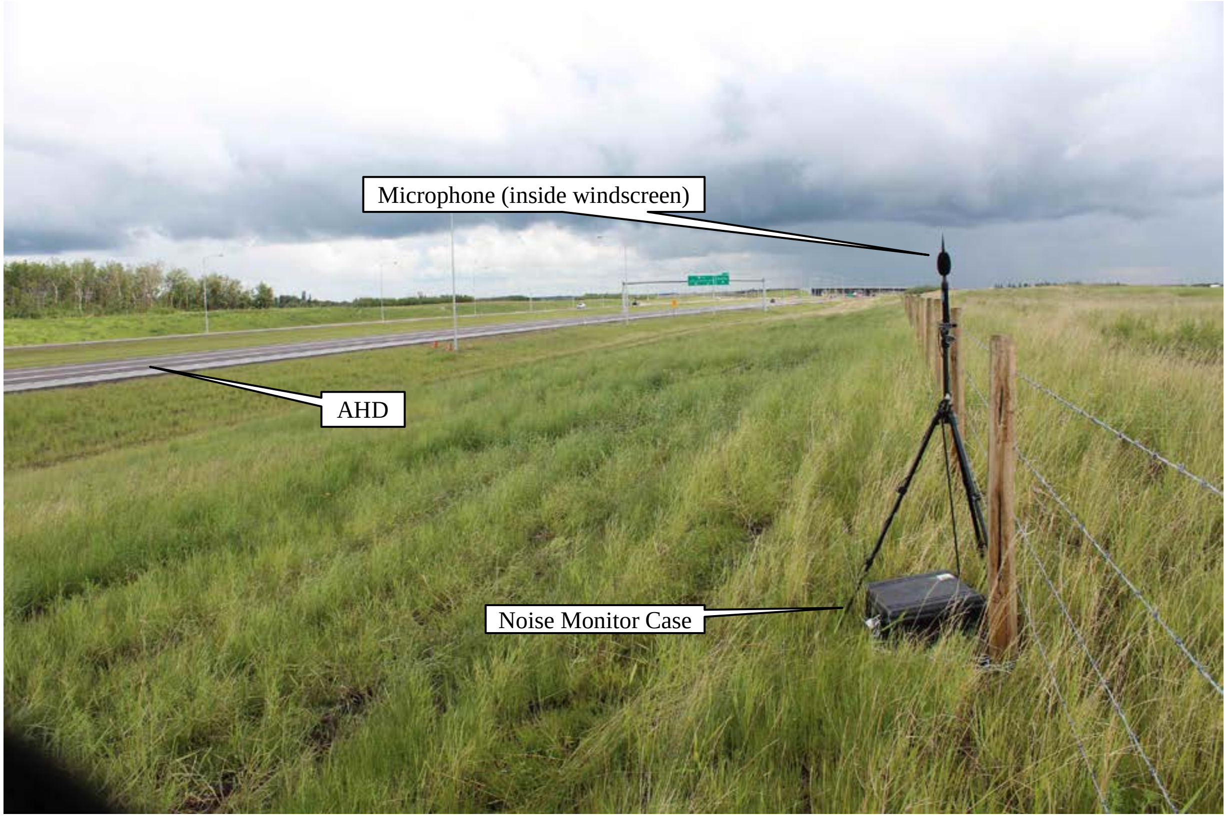

Figure 16. Noise Monitor at Location 15

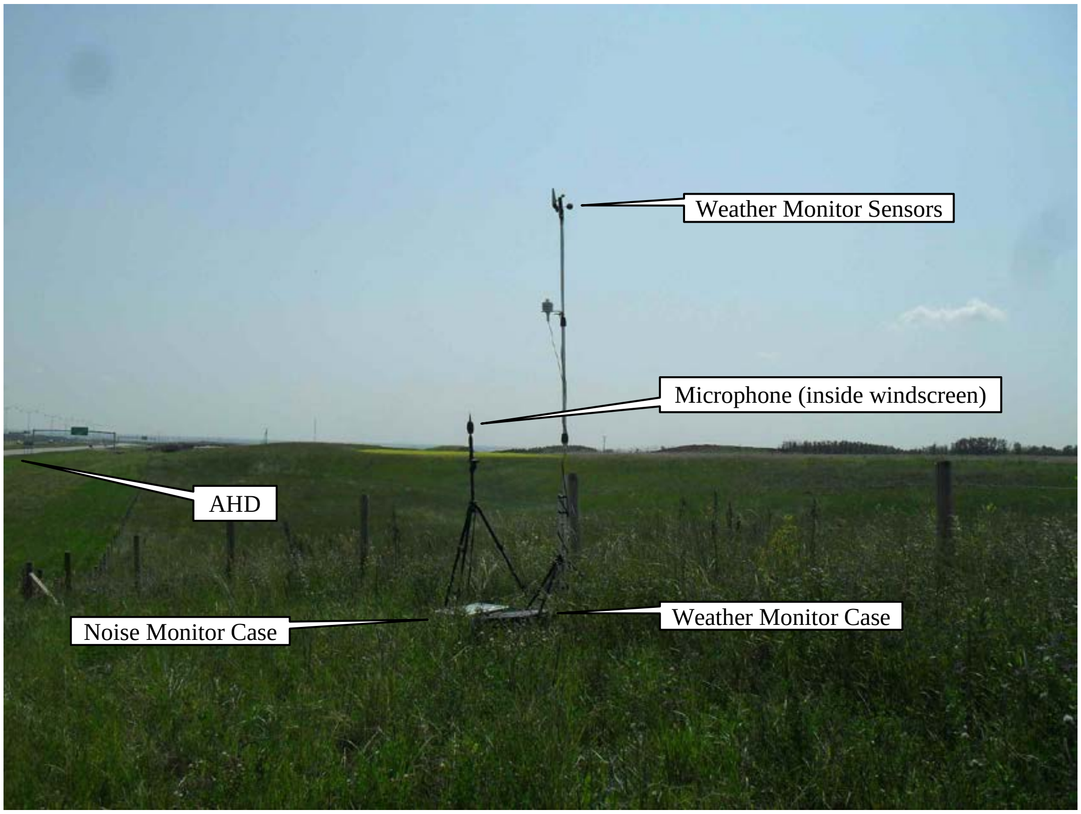

Figure 17. Noise Monitor at Location 16

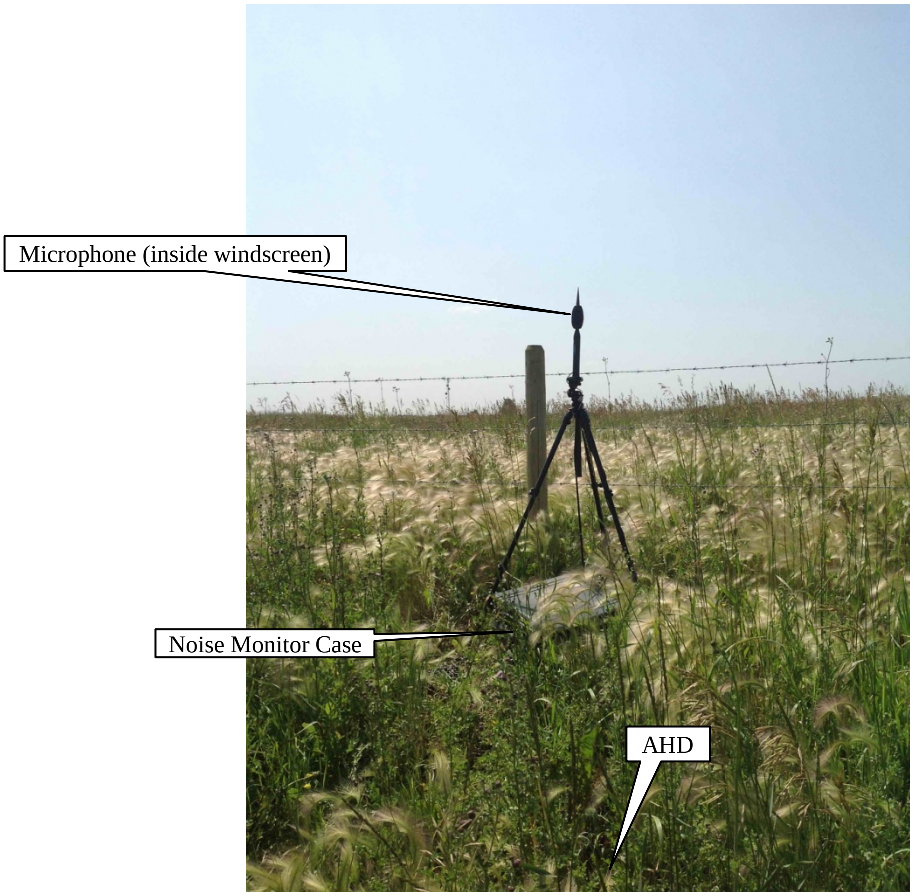

Figure 18. Noise Monitor at Location 17

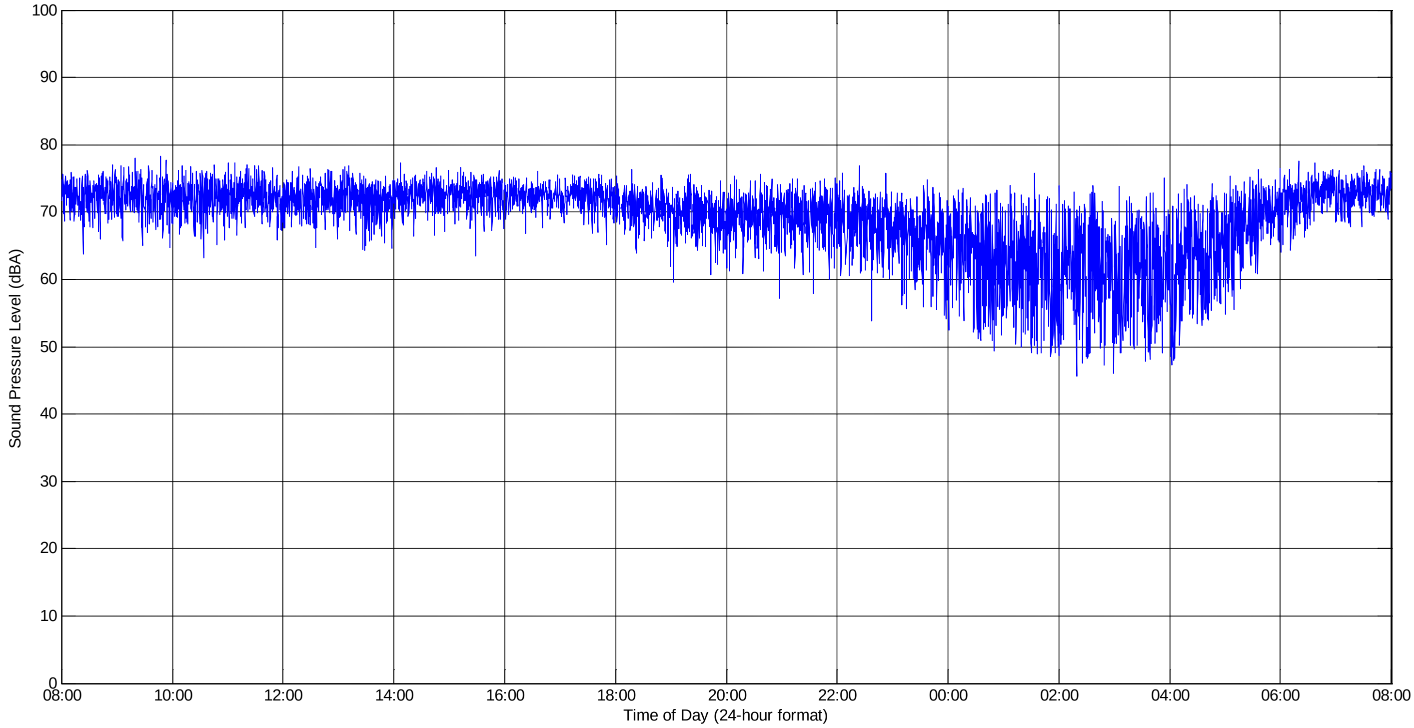

Figure 19. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Monitor Location 1

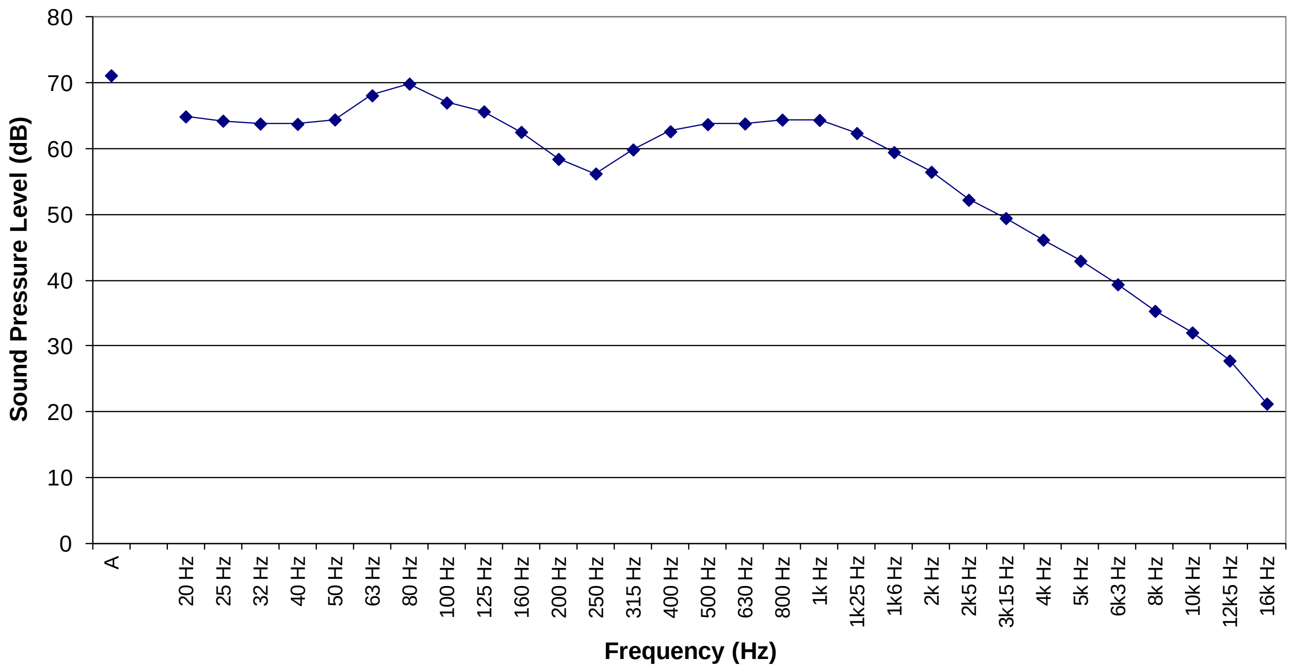

Figure 20. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location 1

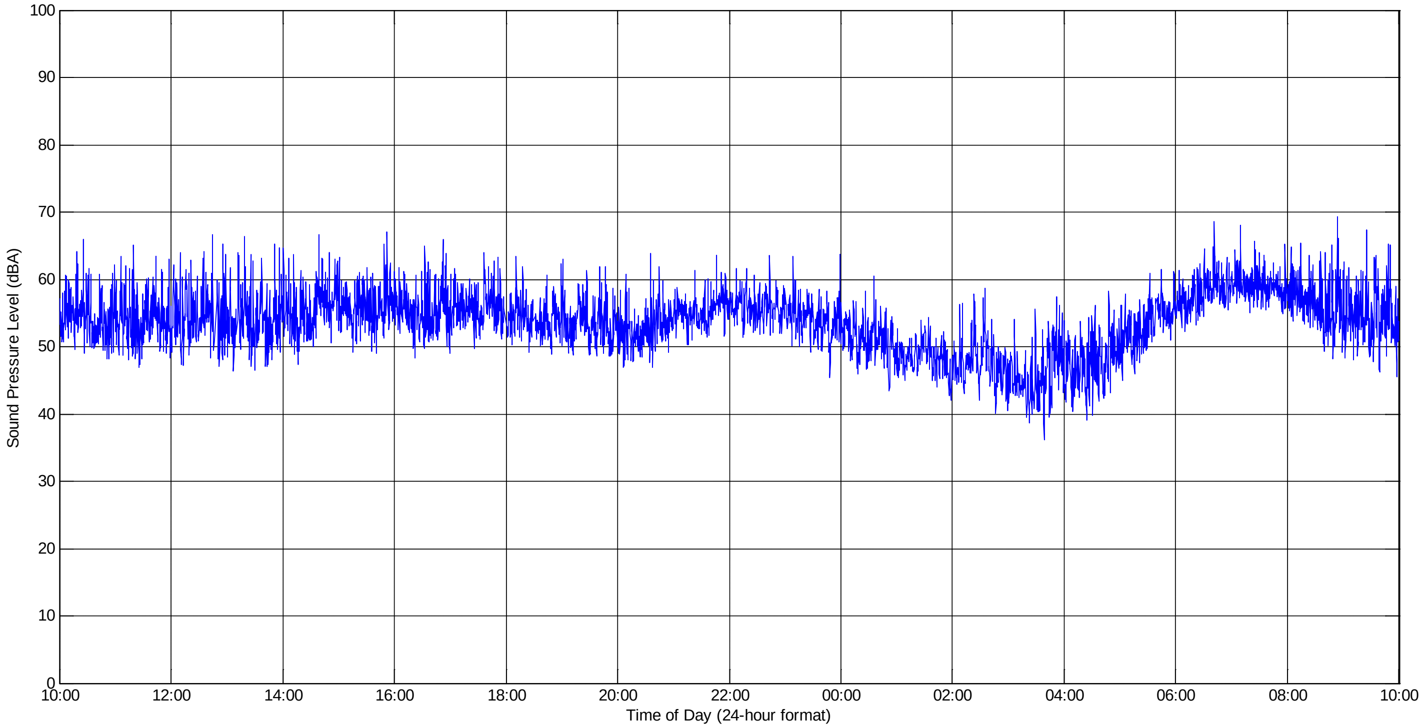

Figure 21. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Monitor Location 2

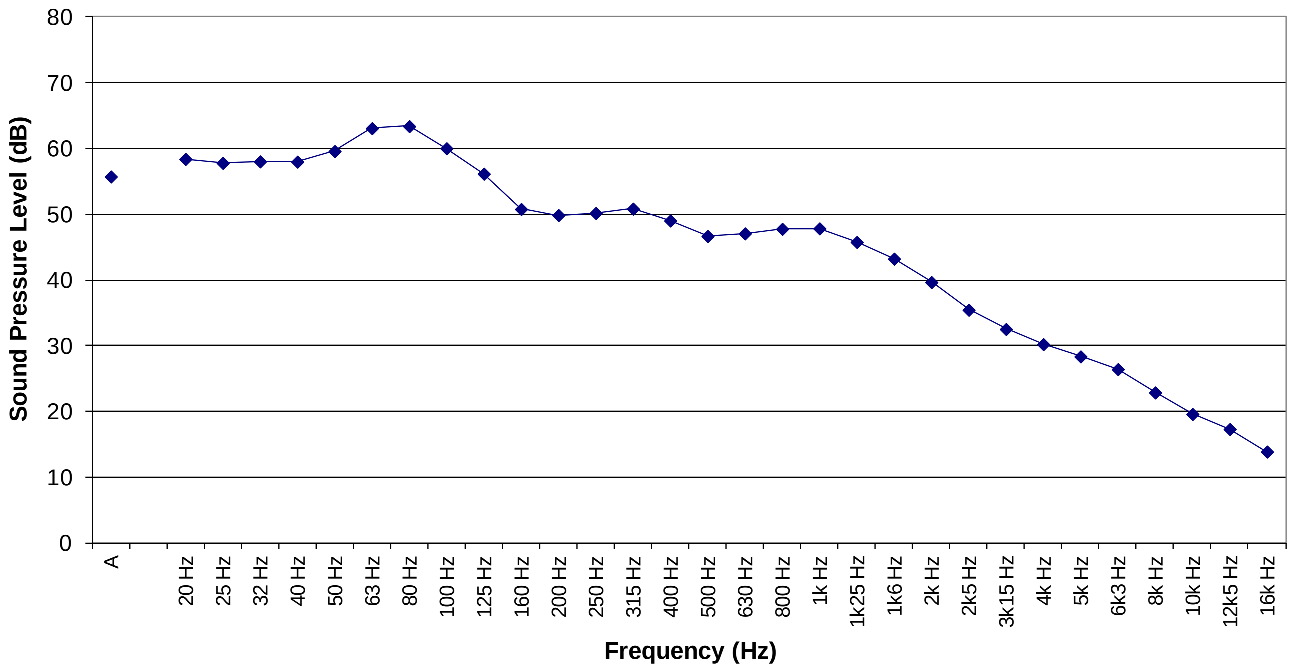

Figure 22. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location 2

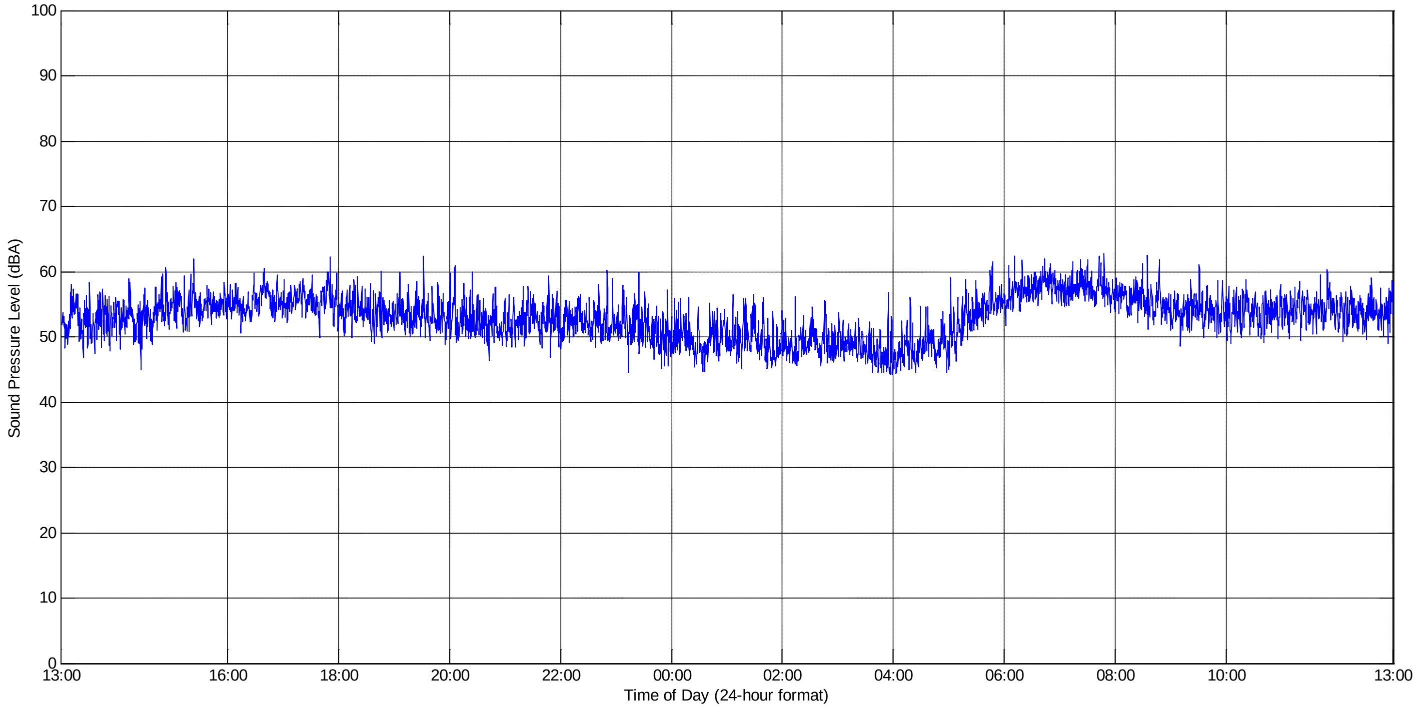

Figure 23. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Monitor Location 3

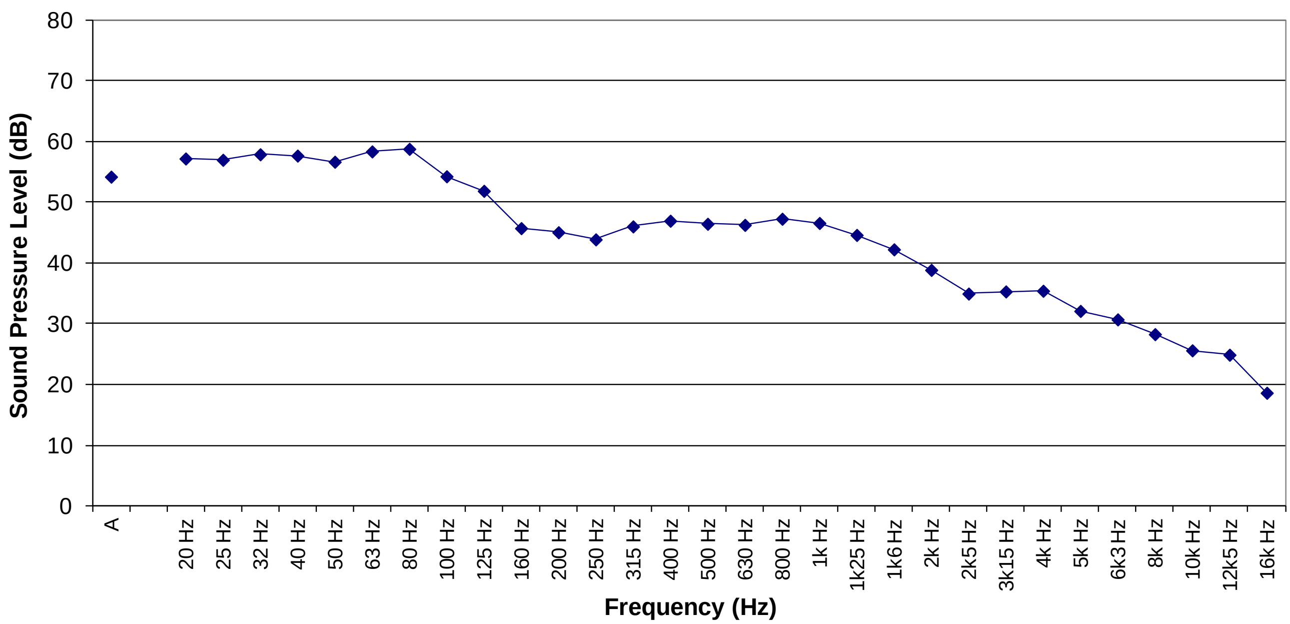

Figure 24. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location 3

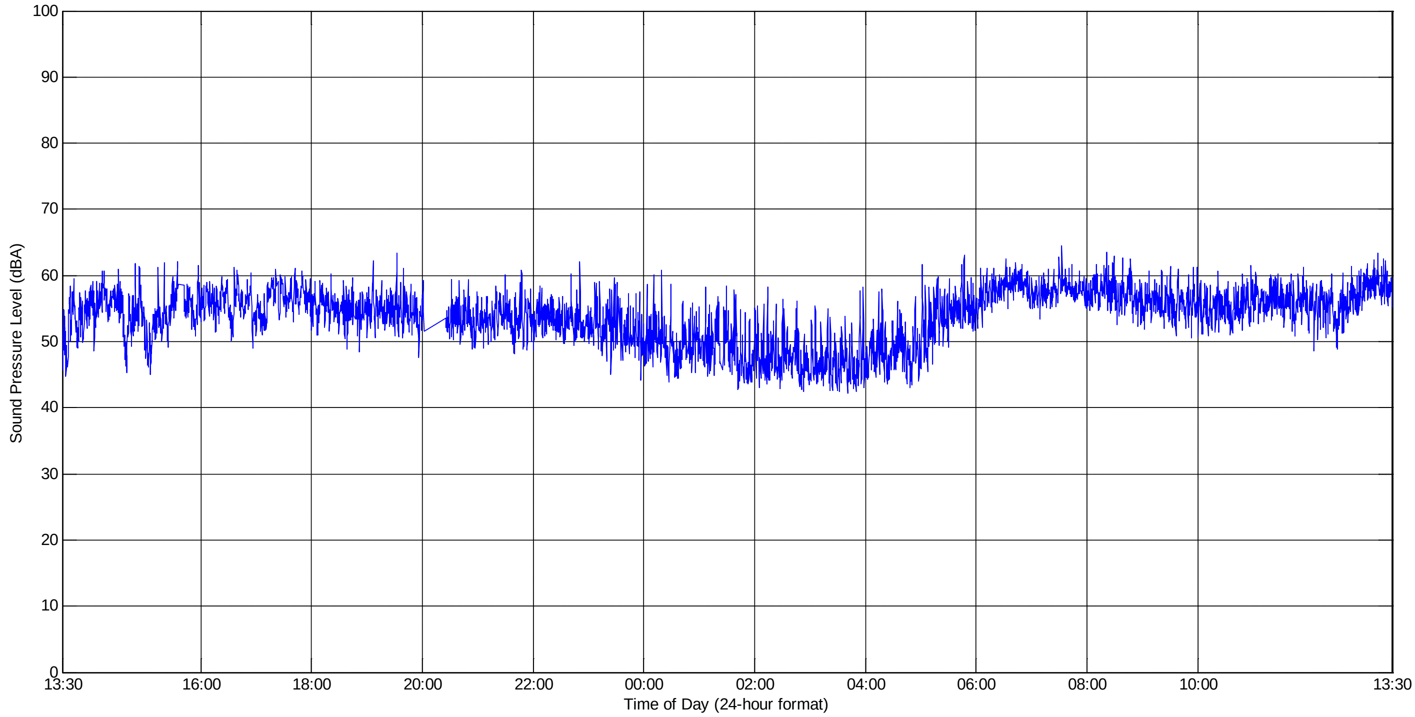

Figure 25. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Monitor Location 4

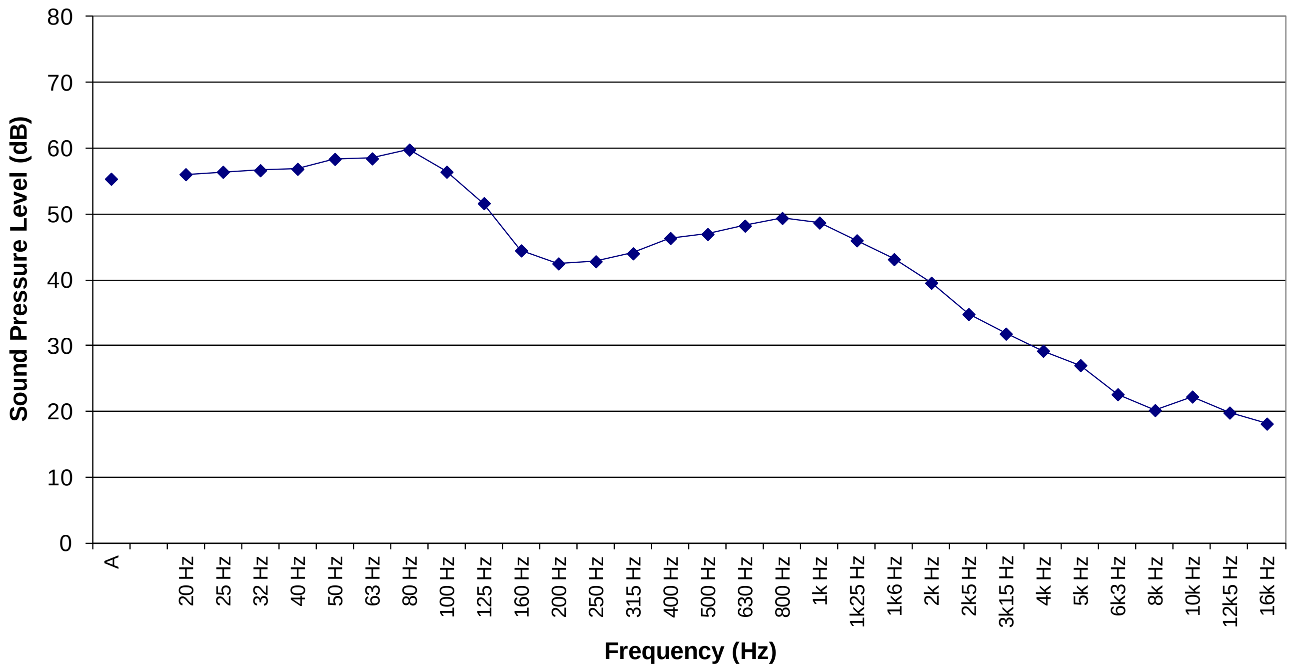

Figure 26. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location 4

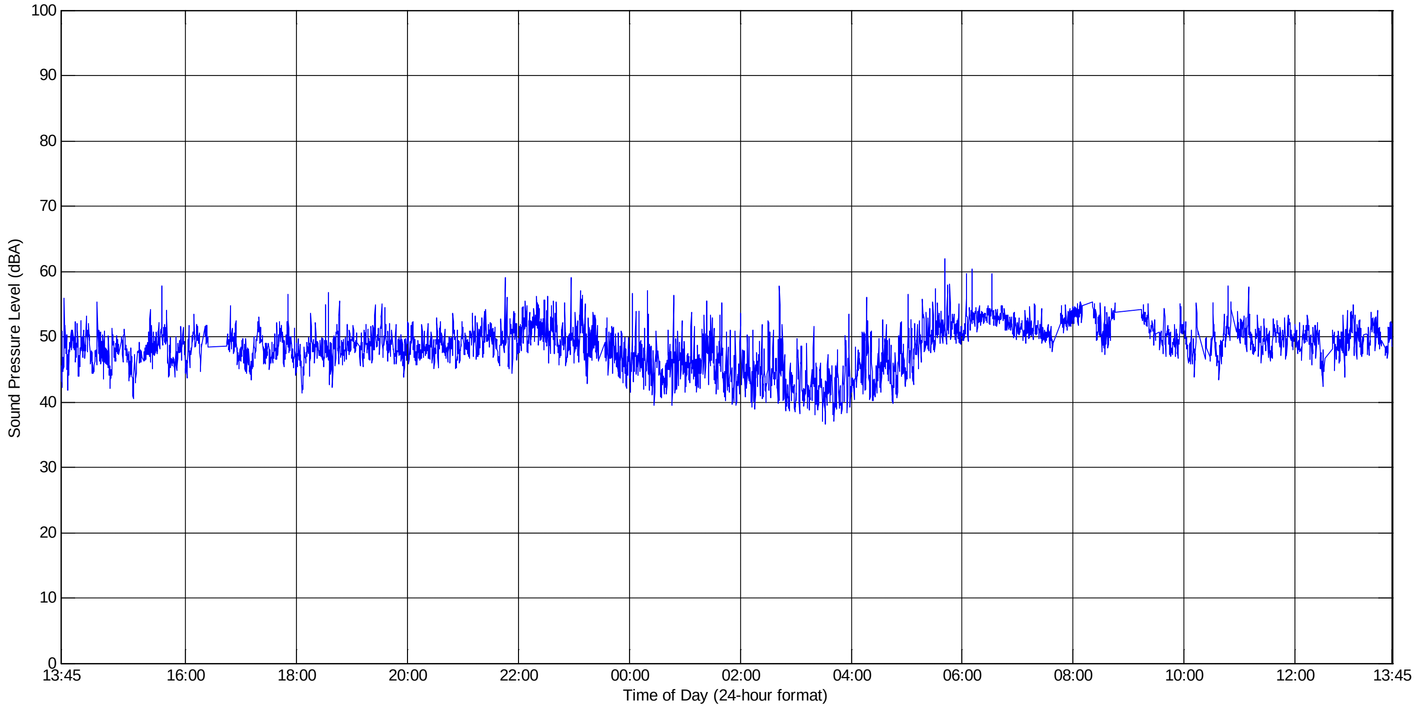

Figure 27. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Monitor Location 5

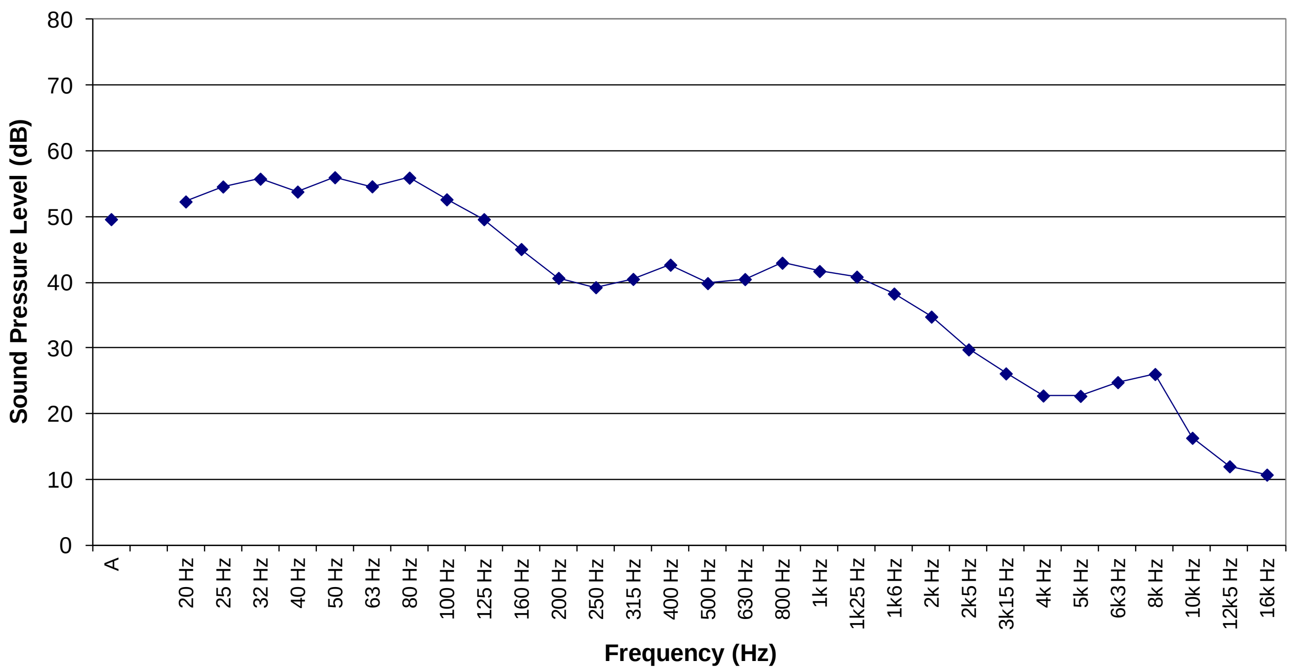

Figure 28. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location 5

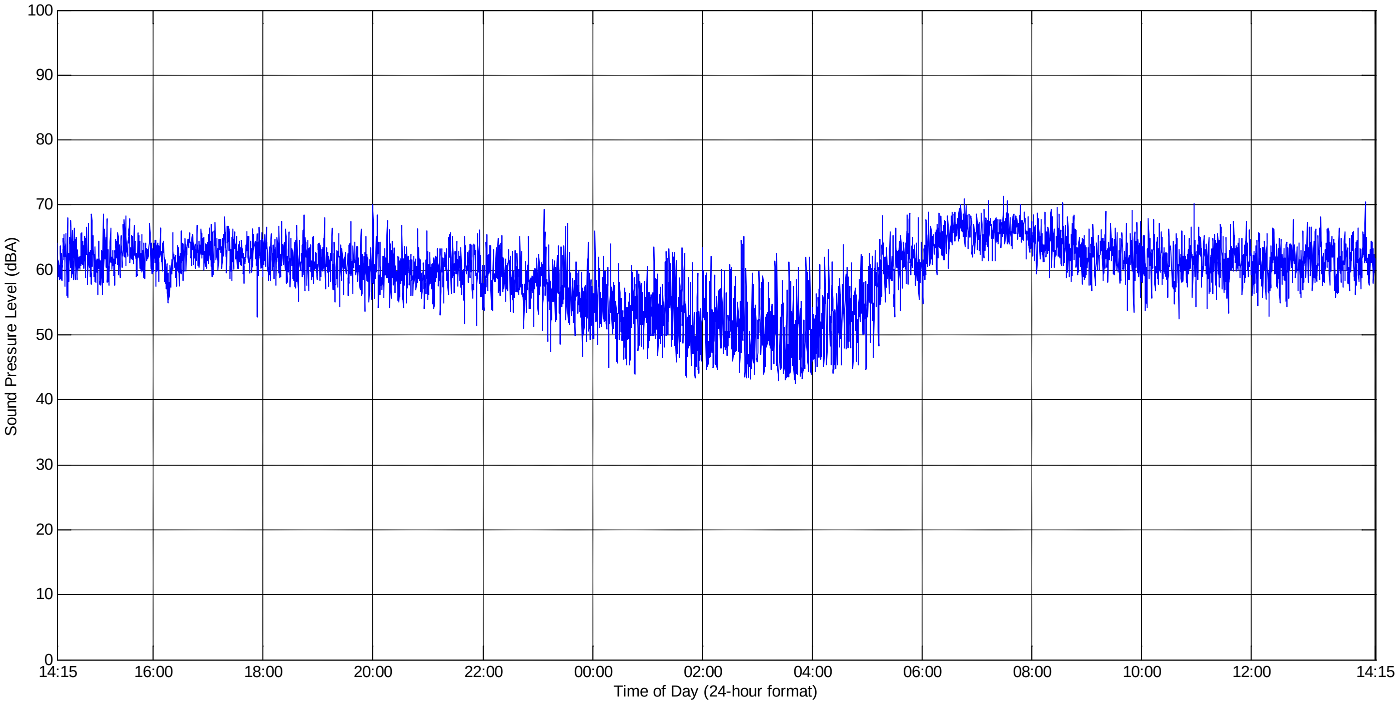

Figure 29. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Monitor Location 6

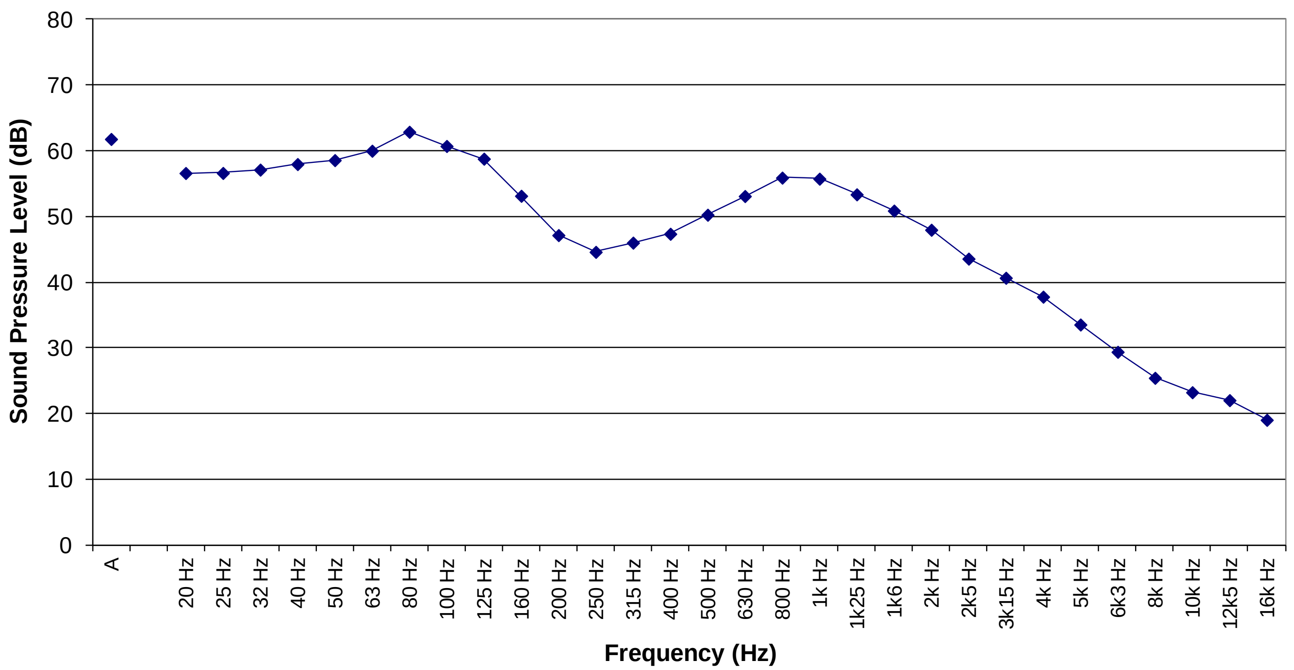

Figure 30. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location 6

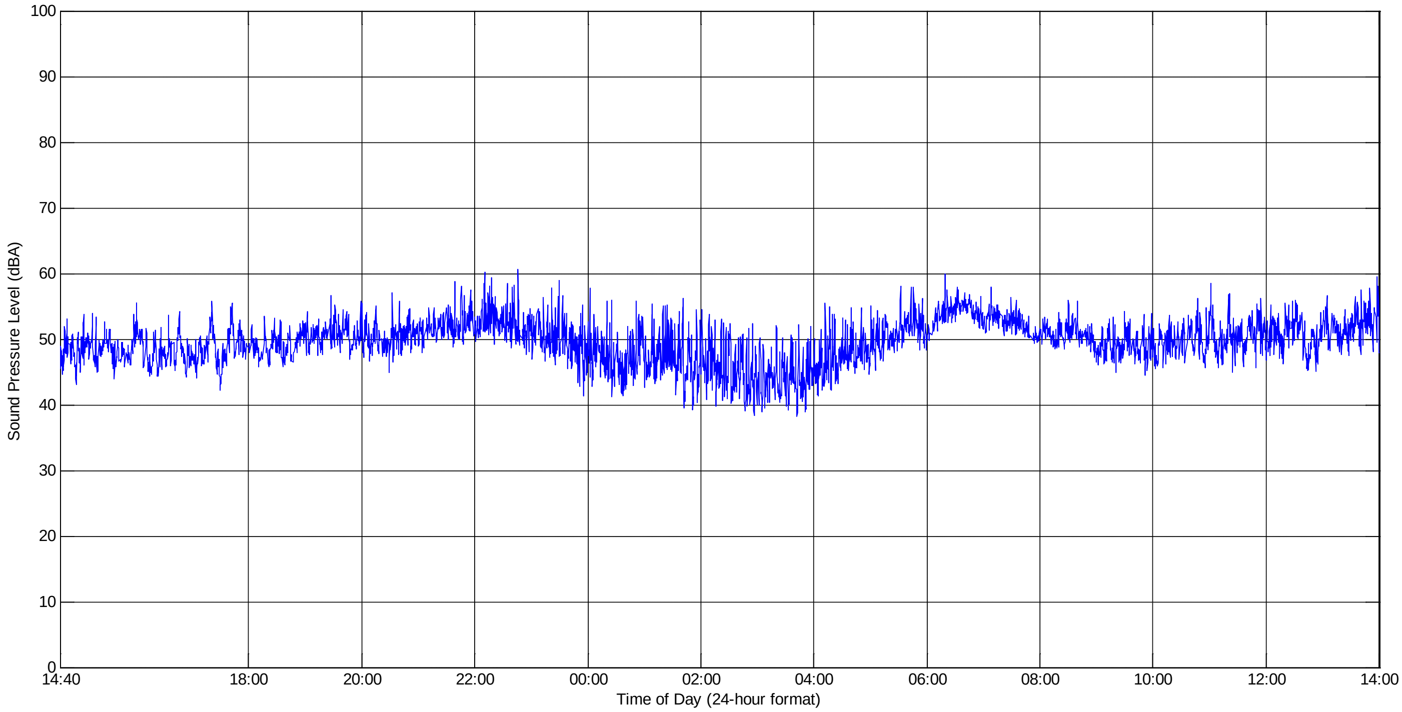

Figure 31. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Monitor Location 7

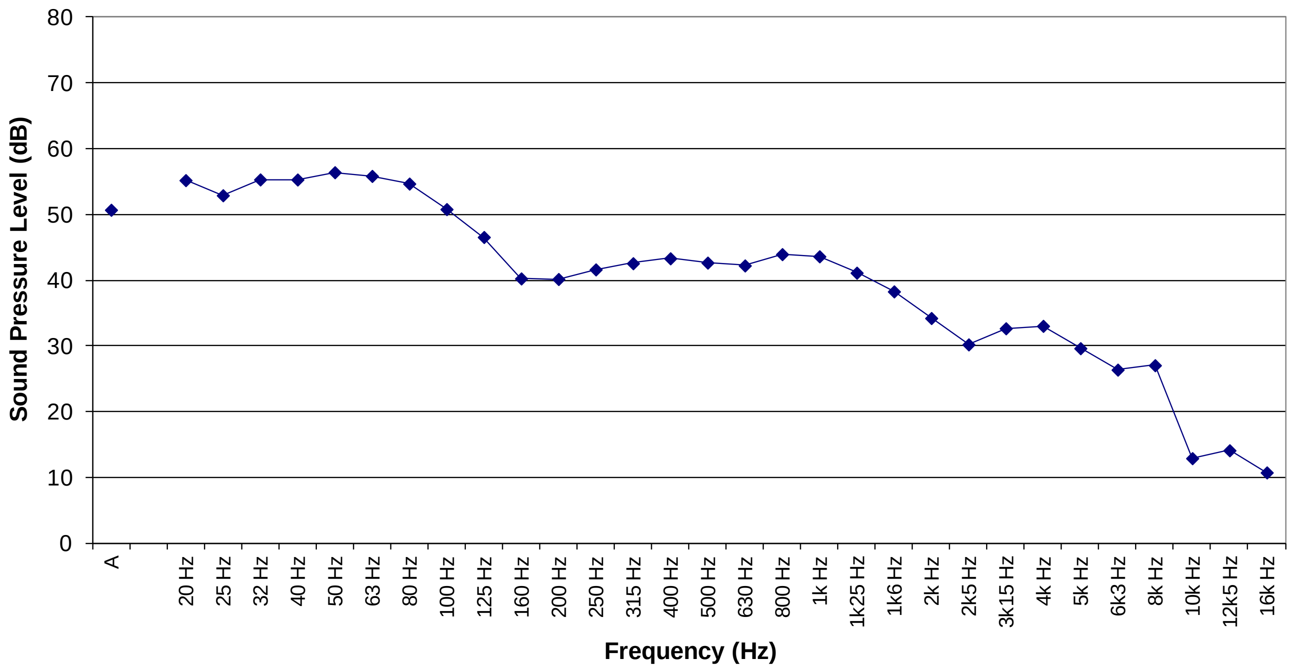

Figure 32. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location 7

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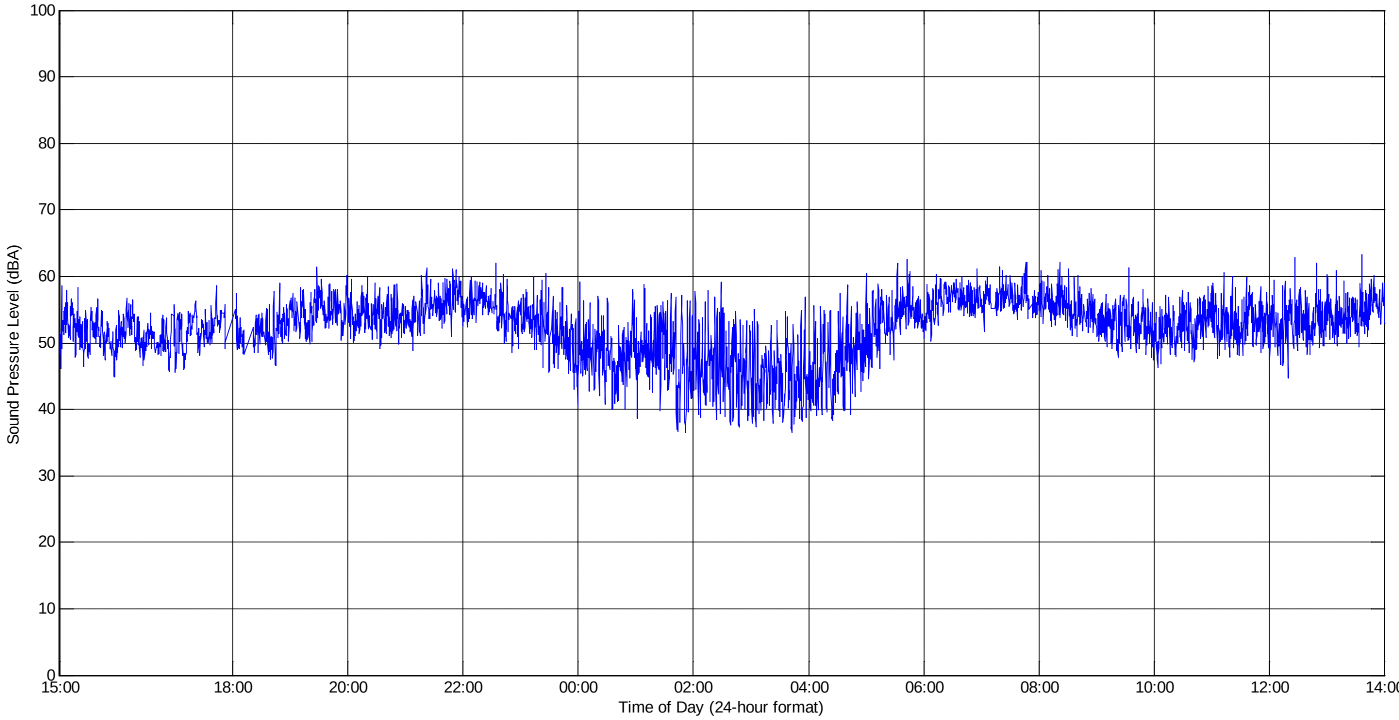

Figure 33. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Monitor Location 8

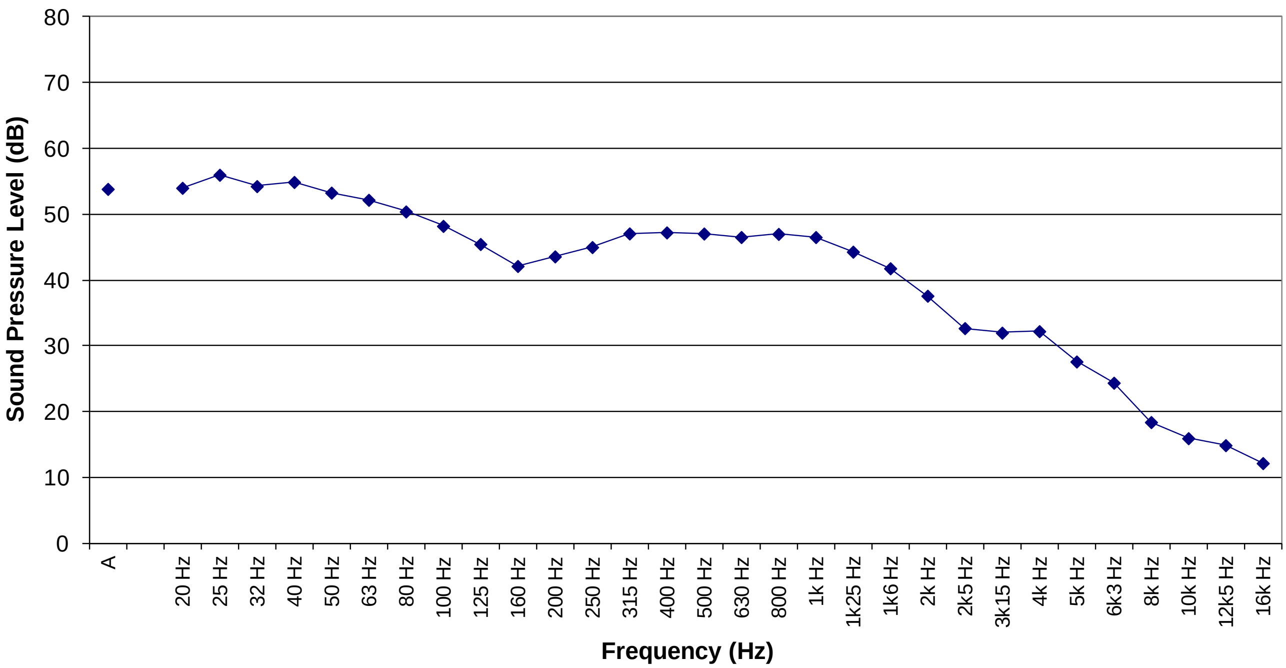

Figure 34. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location 8

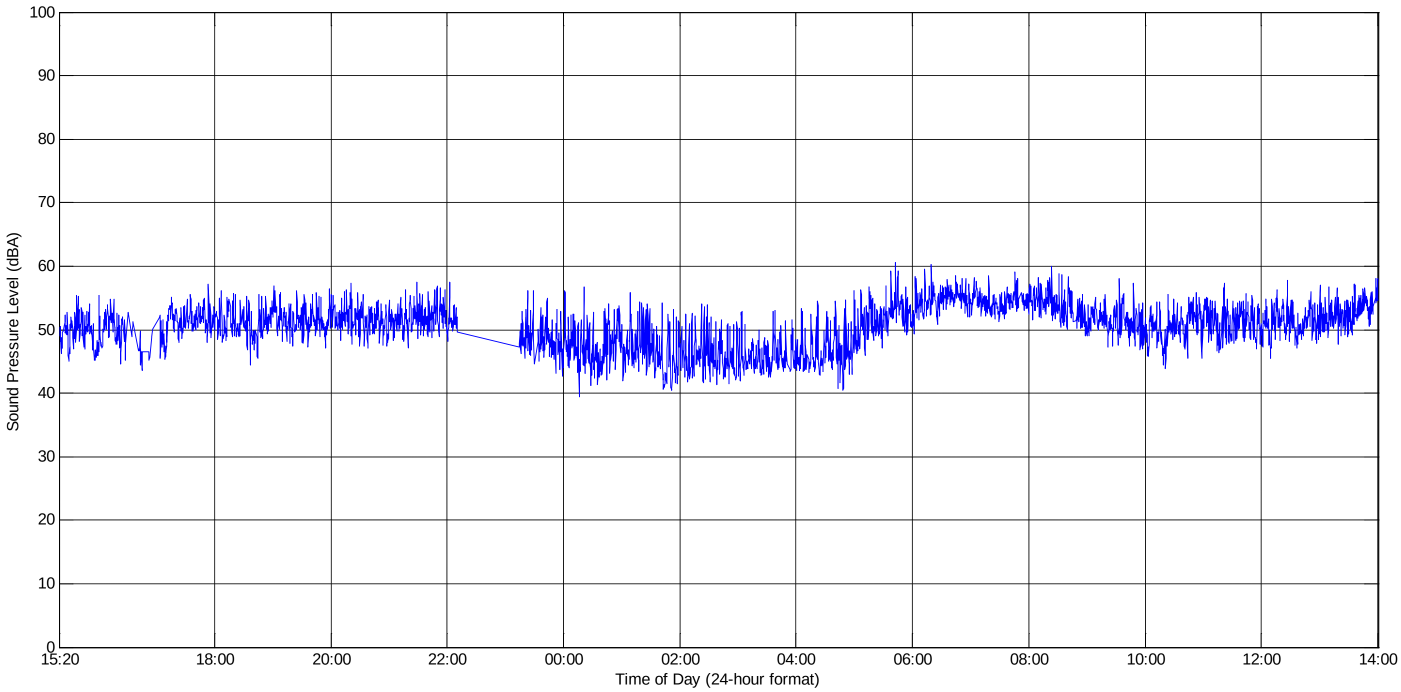

Figure 35. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Monitor Location 9

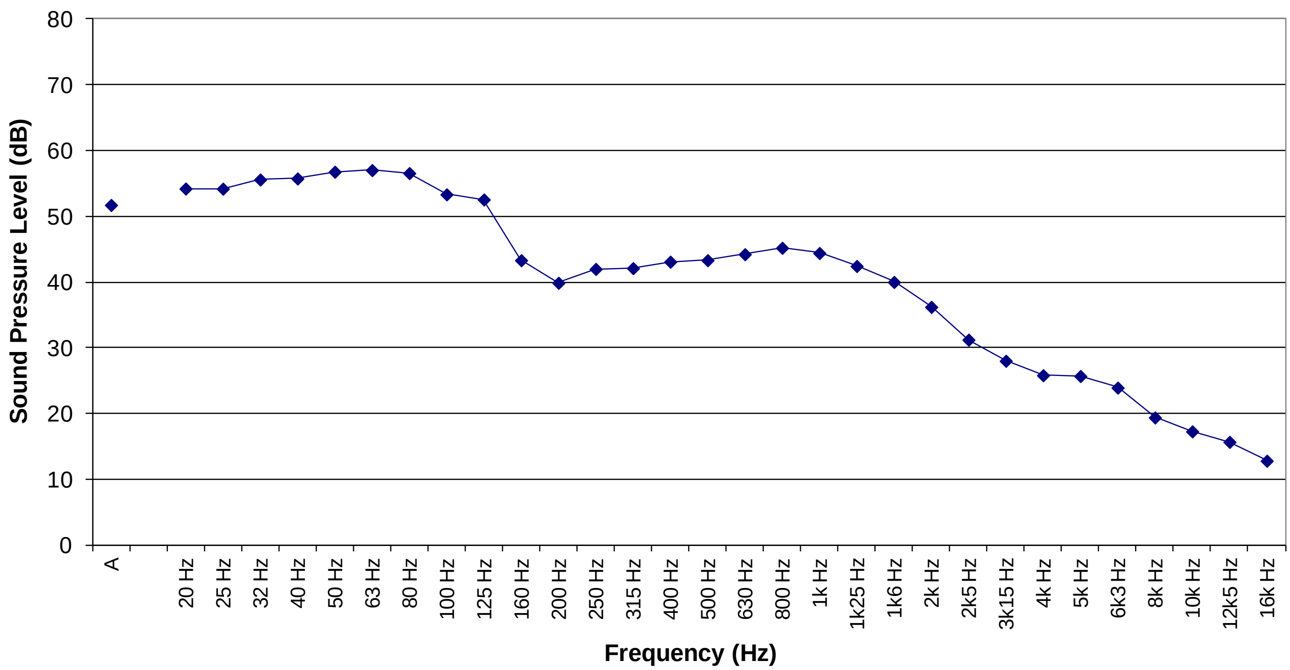

Figure 36. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location 9

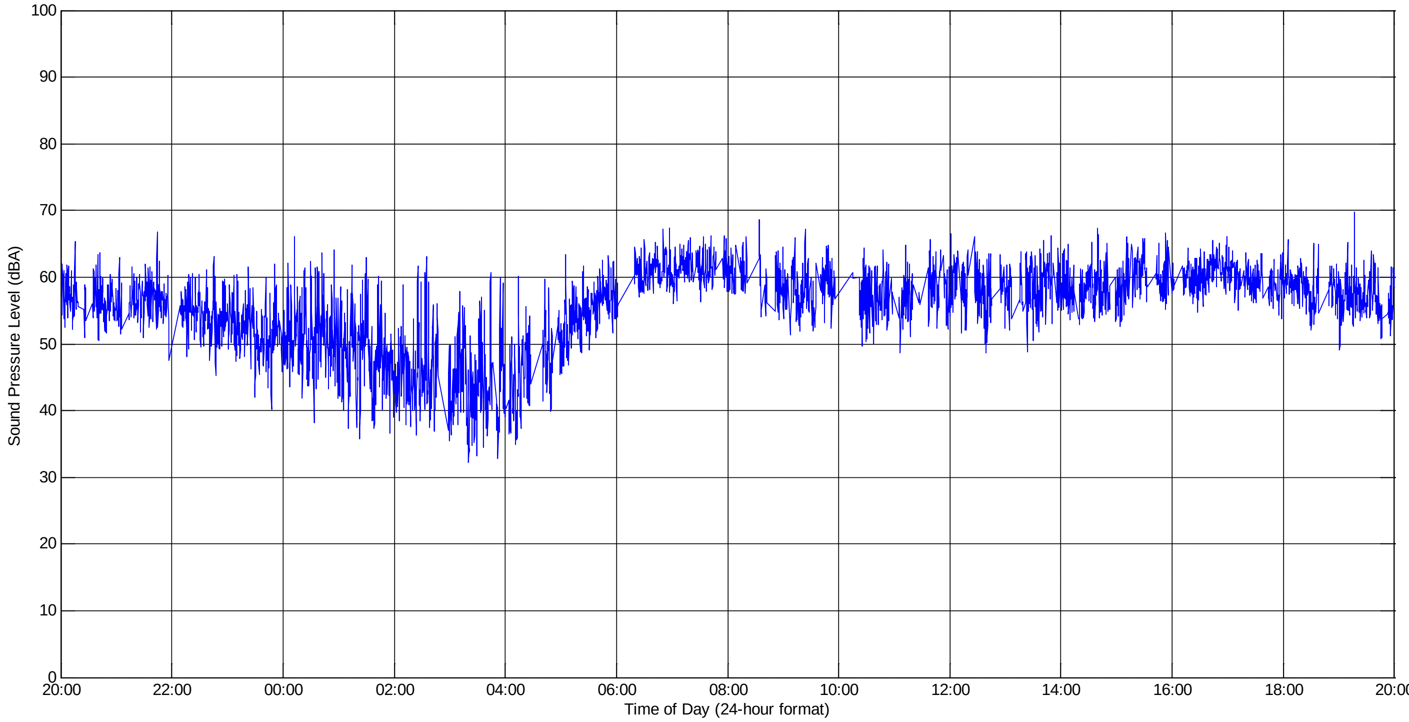

Figure 37. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Monitor Location 10

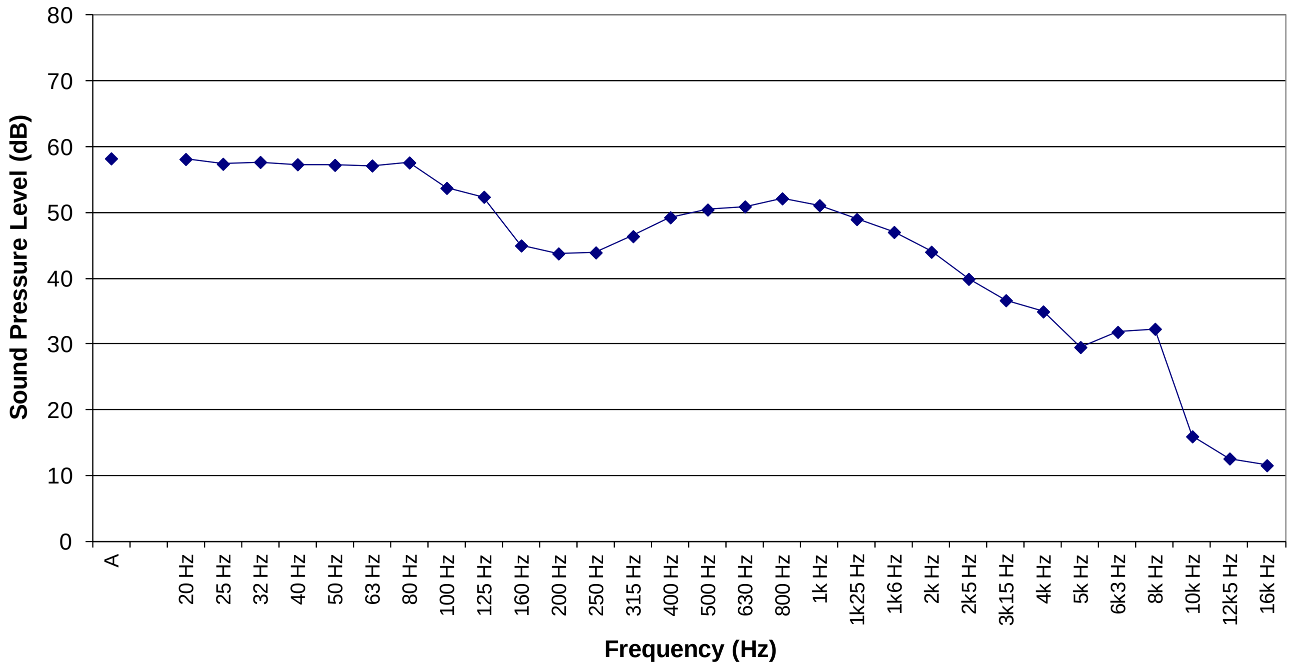

Figure 38. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location 10

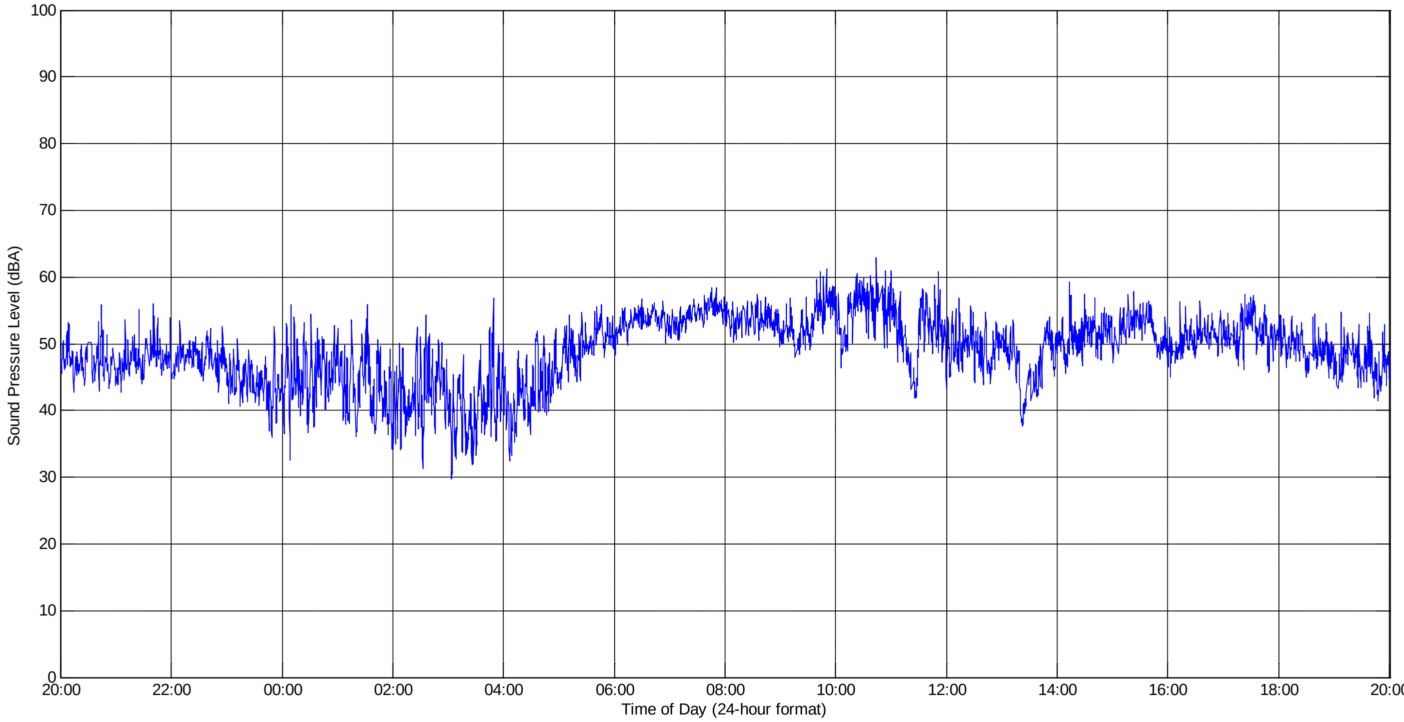

Figure 39. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Monitor Location 11

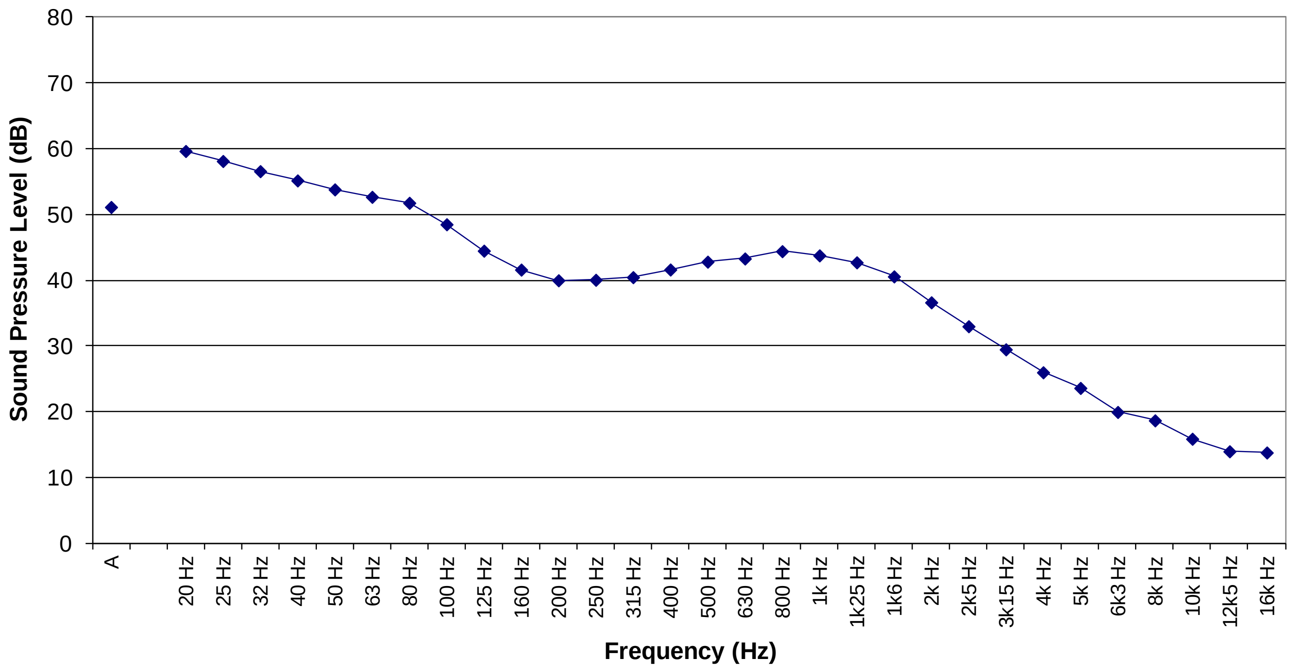

Figure 40. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location 11

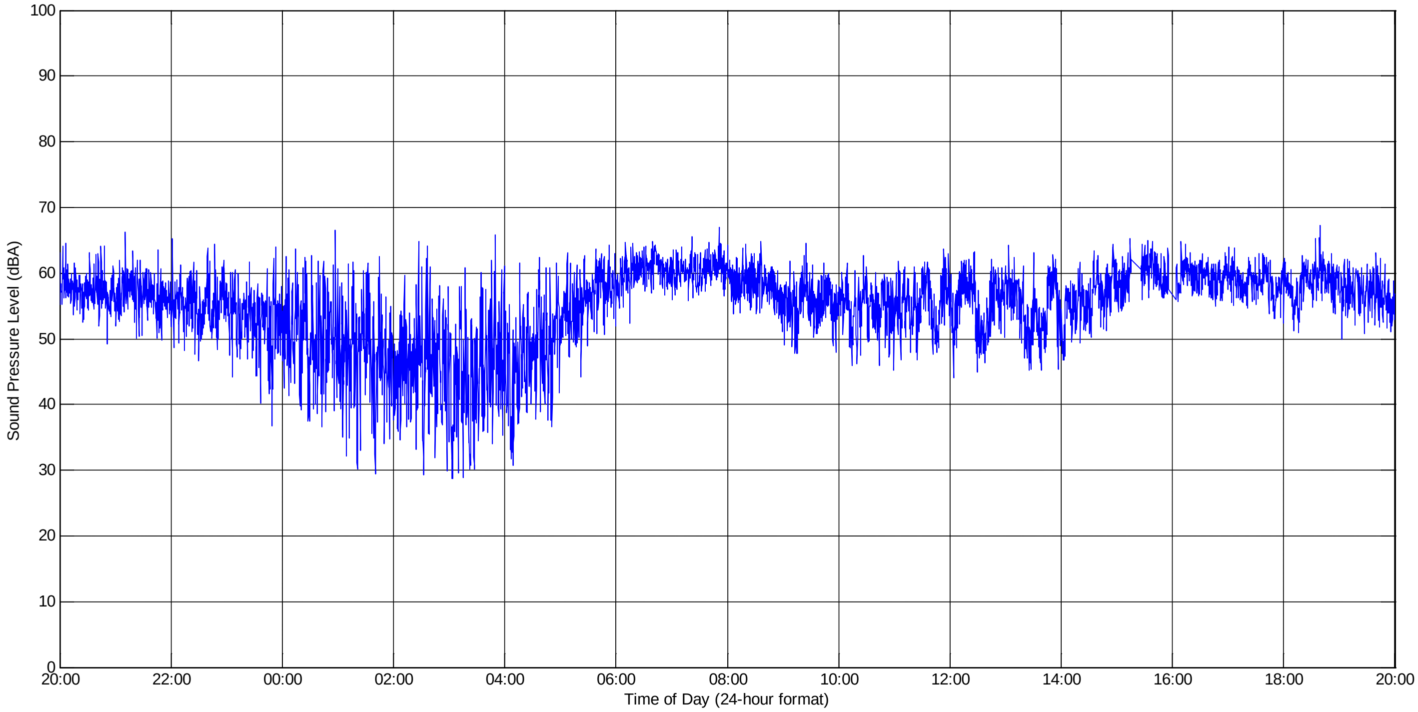

Figure 41. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Monitor Location 12

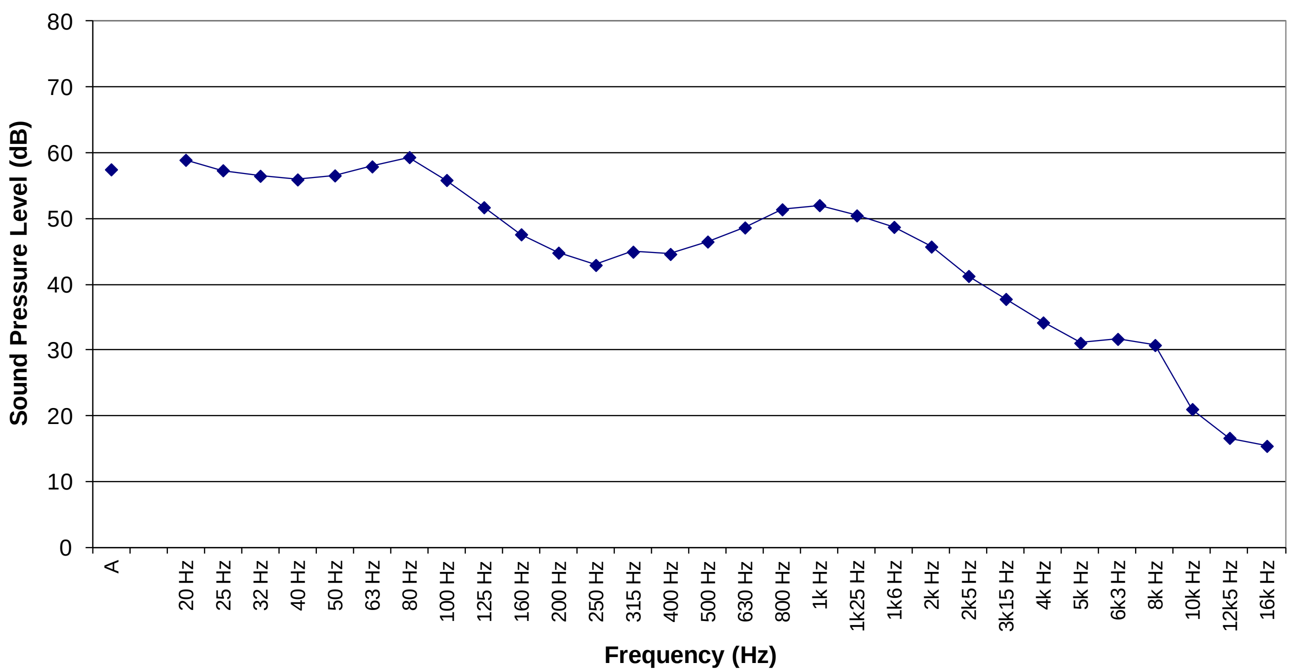

Figure 42. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location 12

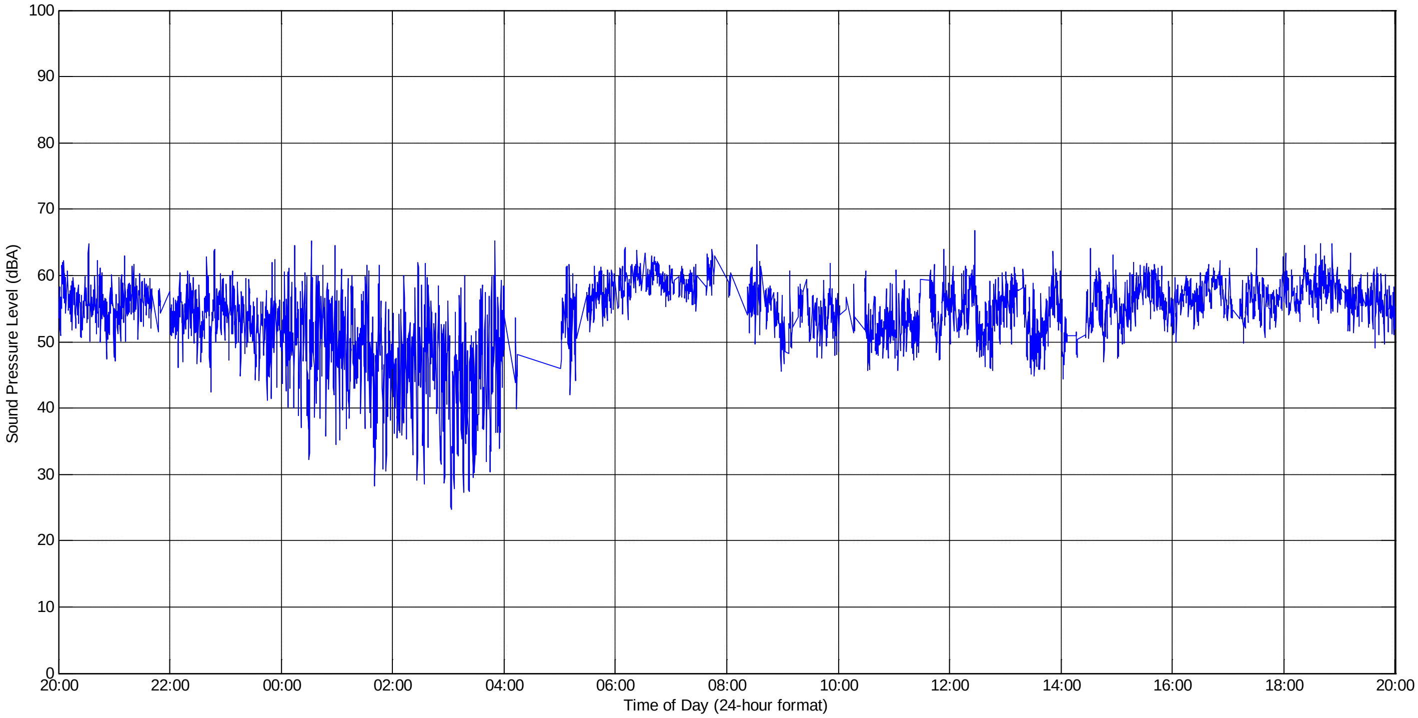

Figure 43. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Monitor Location 13

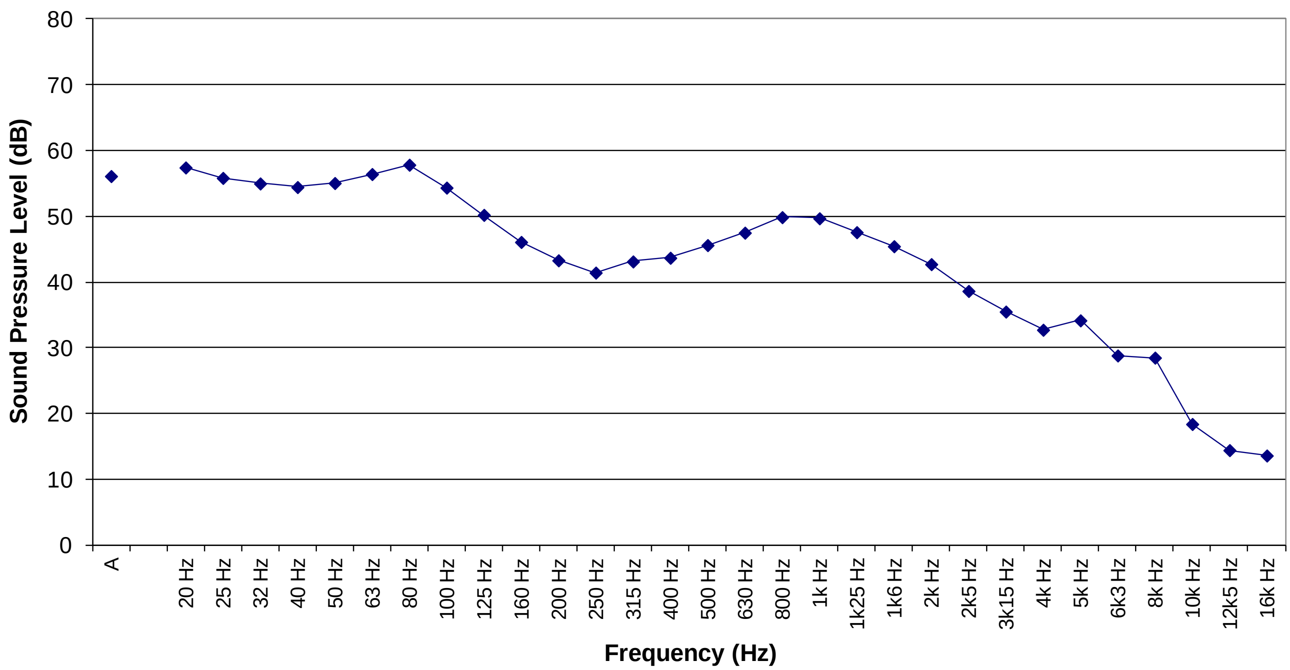

Figure 44. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location 13

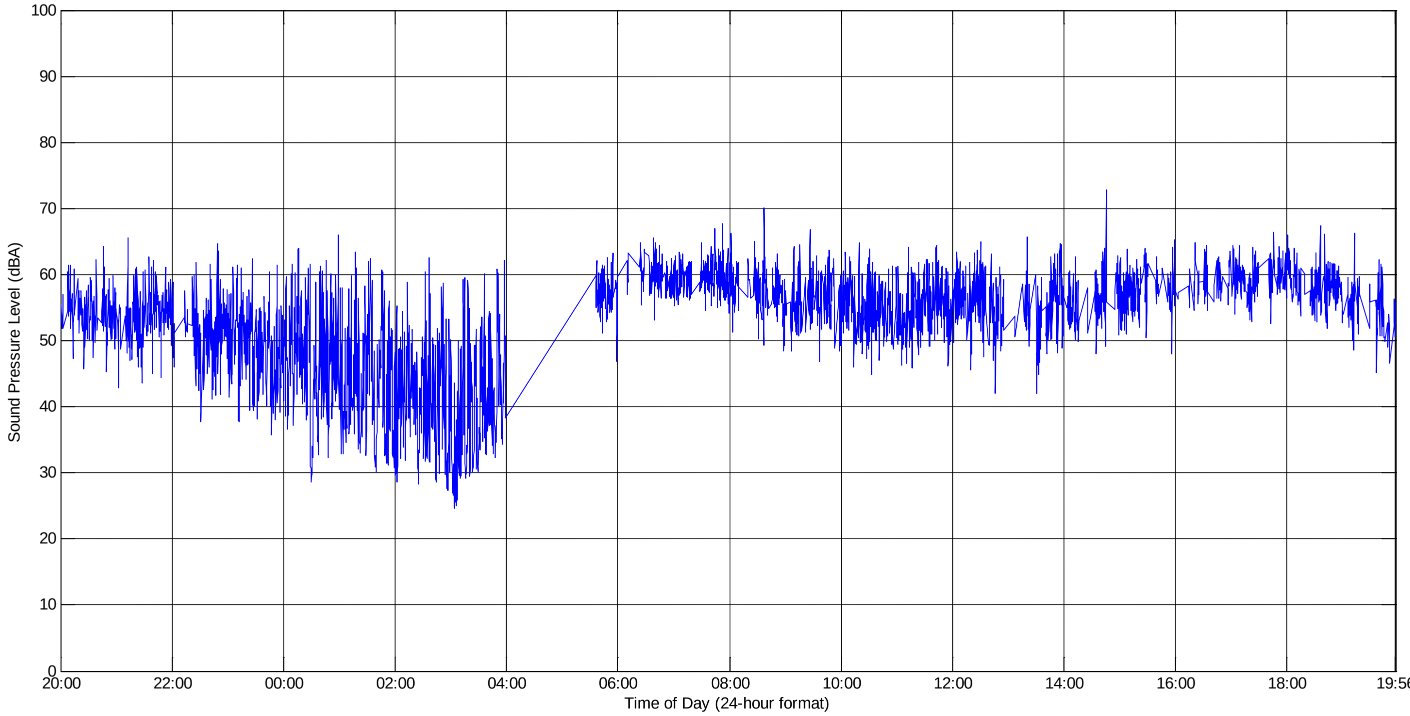

Figure 45. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Monitor Location 14

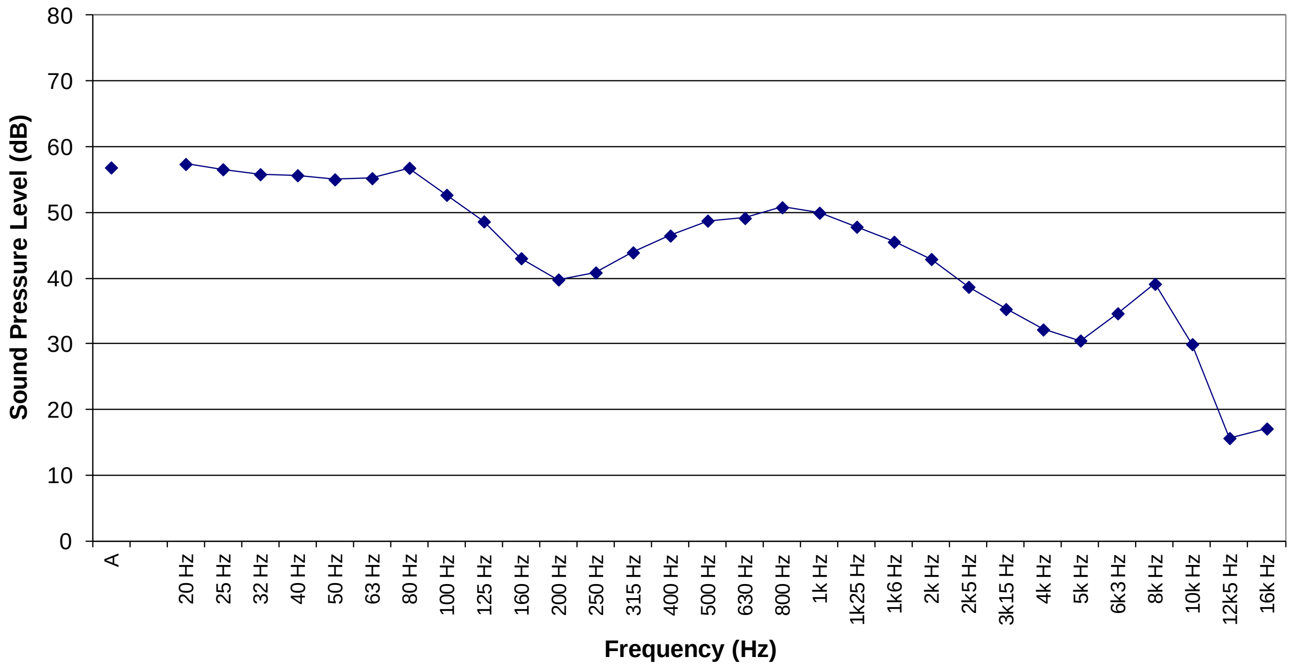

Figure 46. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location 14

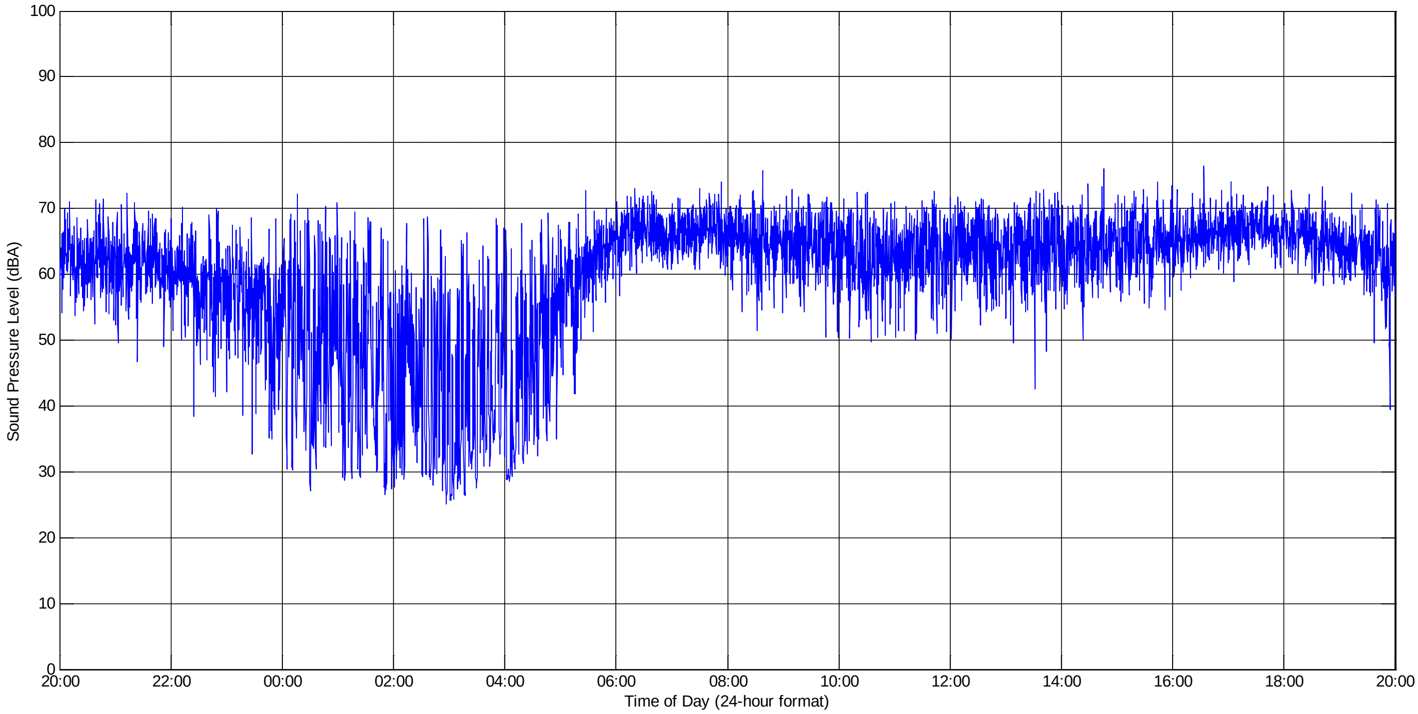

Figure 47. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Monitor Location 15

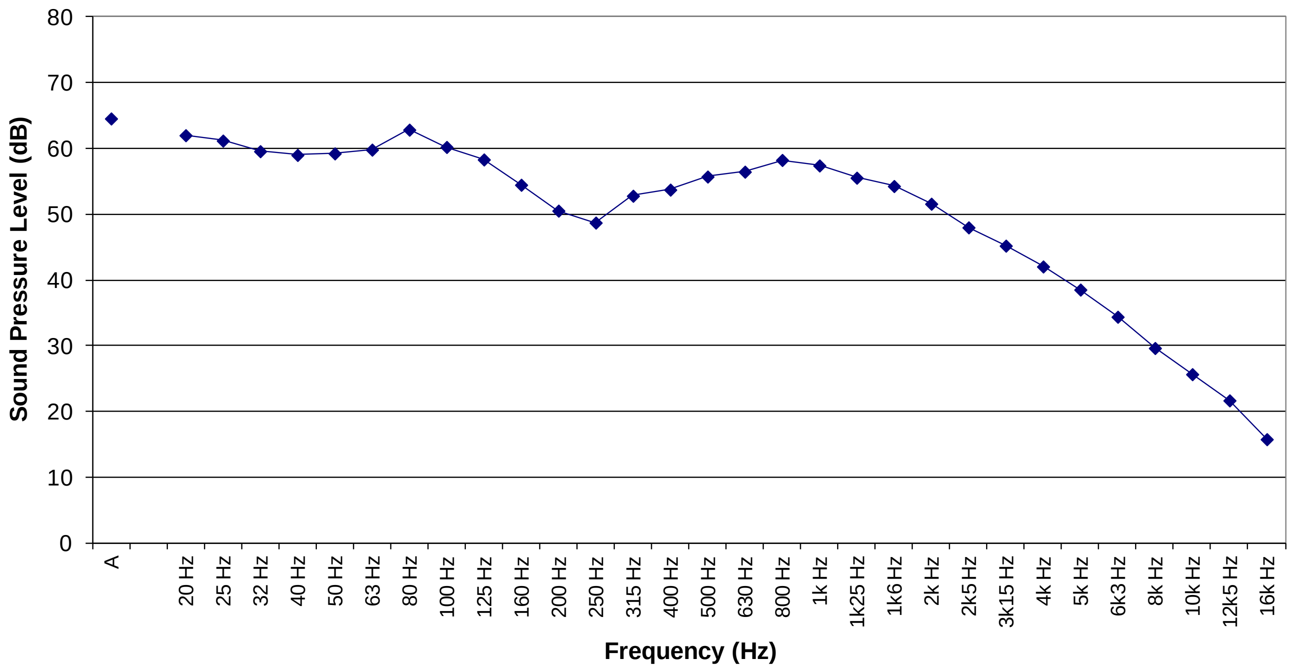

Figure 48. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location 15

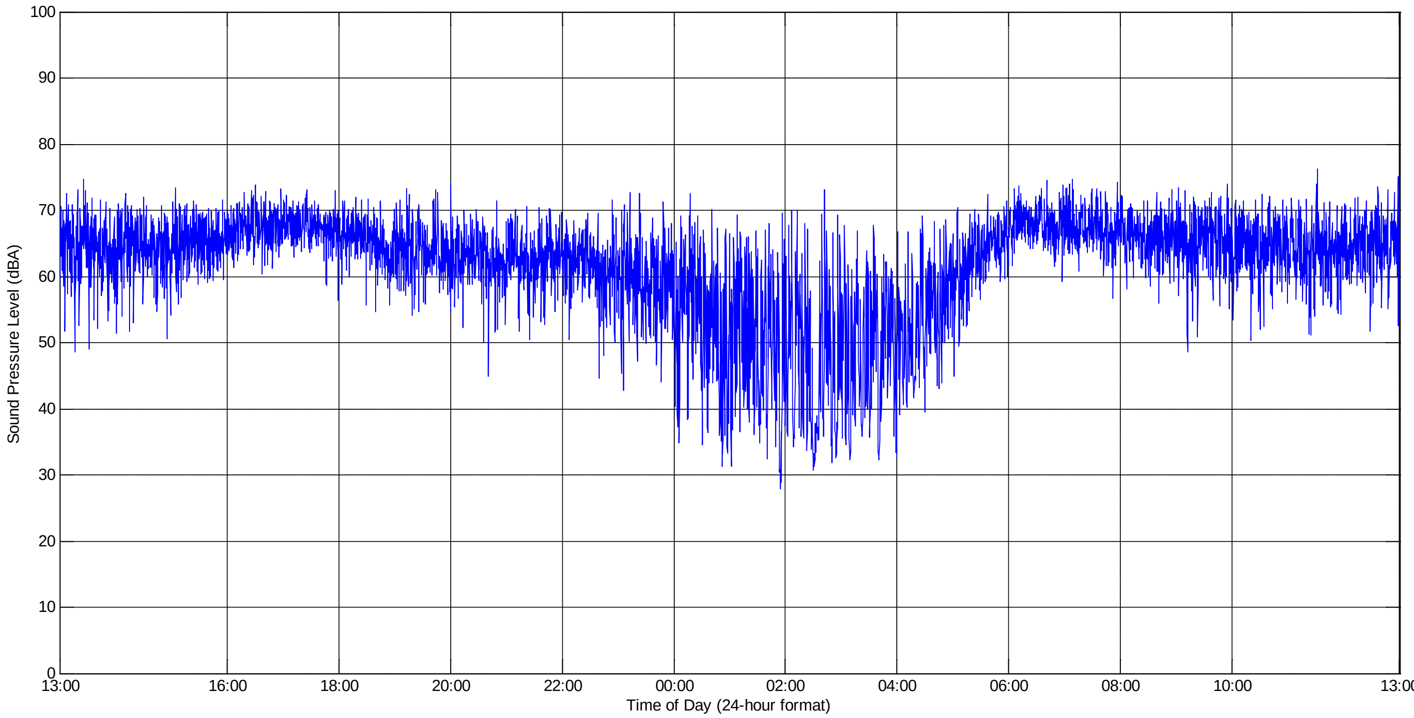

Figure 49. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Monitor Location 16

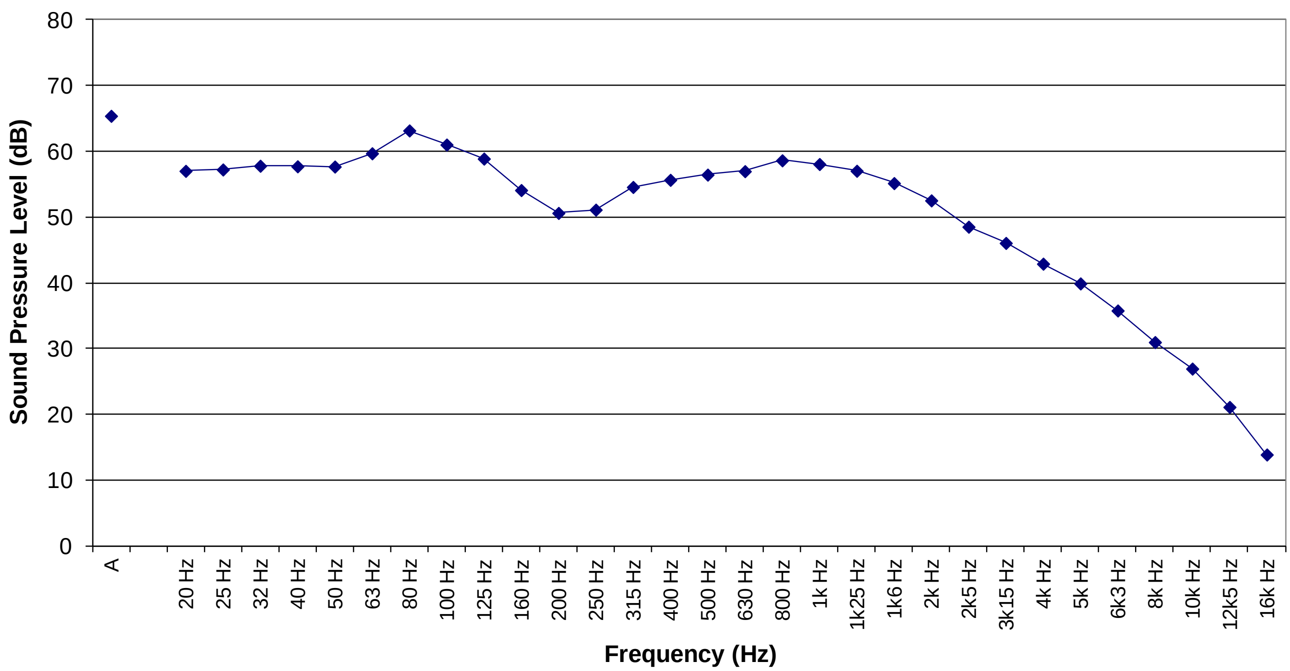

Figure 50. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location 16

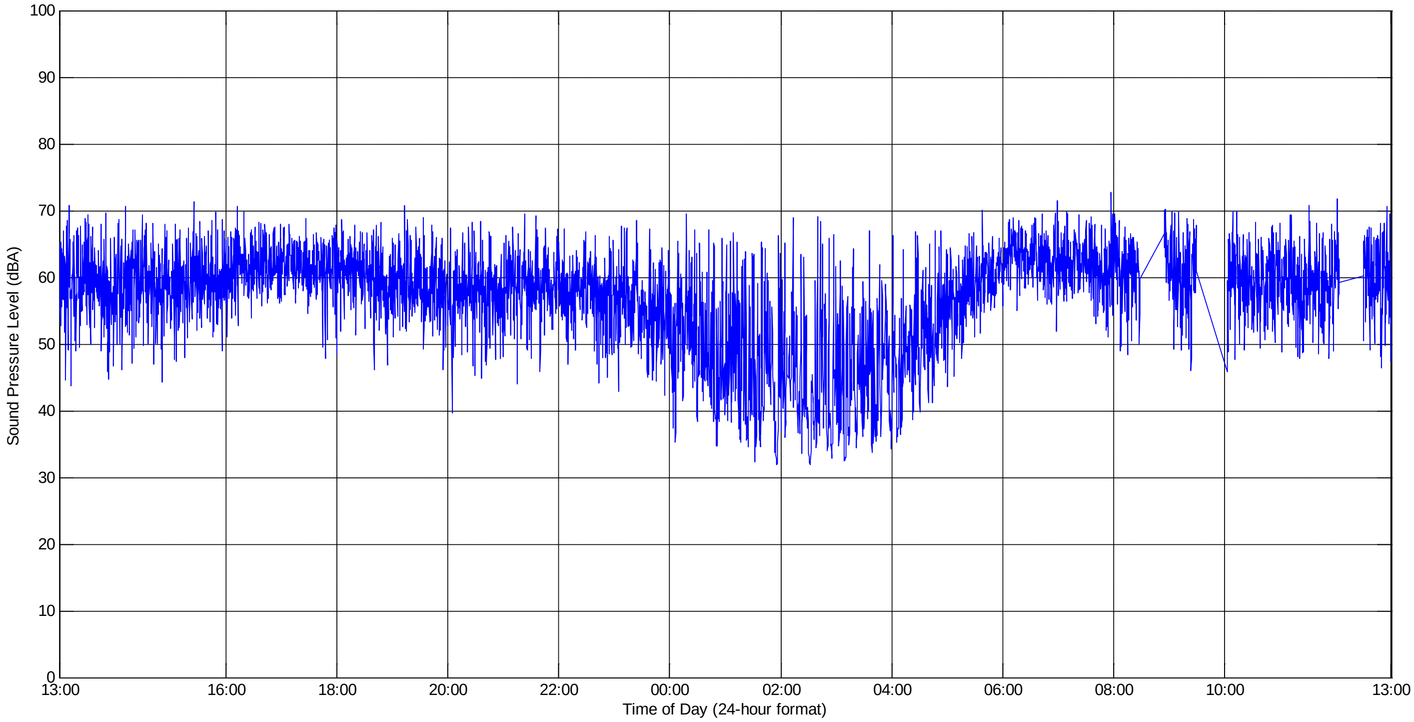

Figure 51. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Monitor Location 17

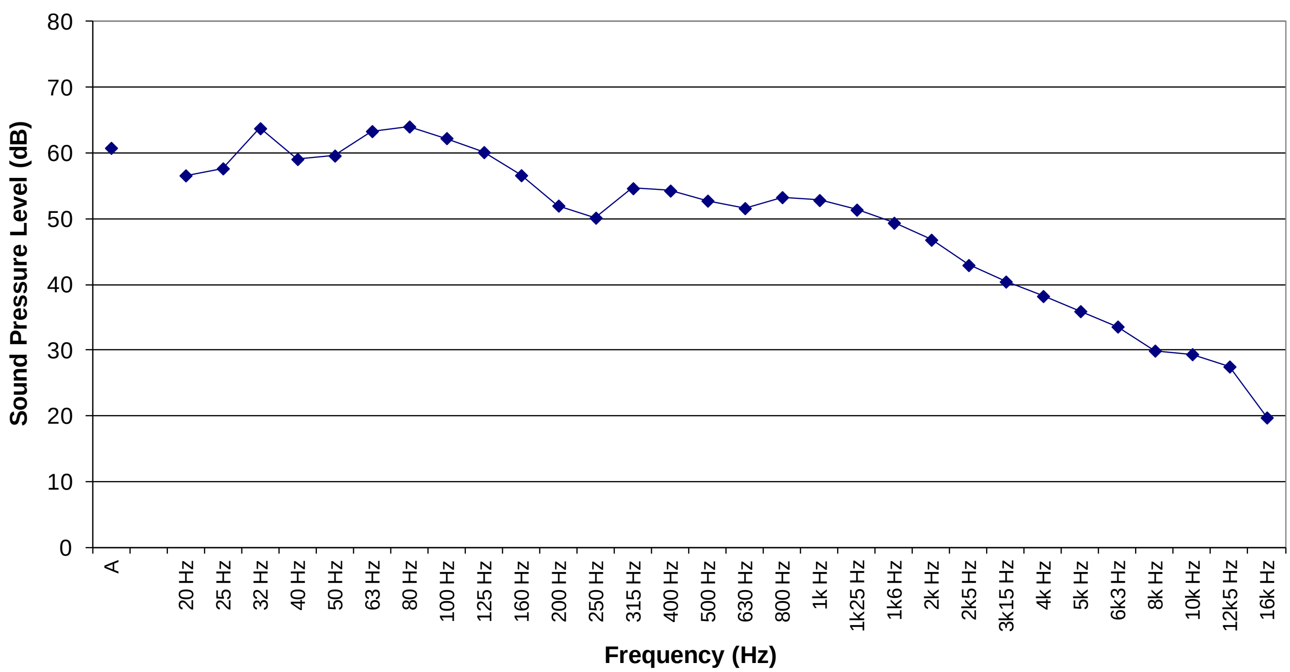

Figure 52. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Monitor Location 17

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Appendix I. MEASUREMENT EQUIPMENT USED

Noise Monitors

The environmental noise monitoring equipment used consisted of a Brüel and Kjær Type 2250/2270 Precision Integrating Sound Level Meters enclosed in environmental cases, with tripods, and weather protective microphone hoods. The systems acquired data in 15-second L_{eq} samples using 1/3 octave band frequency analysis and overall A-weighted and C-weighted sound levels. The sound level meters conform to Type 1, ANSI S1.4, ANSI S1.43, IEC 61672-1, IEC 60651, IEC 60804 and DIN 45657. The 1/3 octave filters conform to S1.11 – Type 0-C, and IEC 61260 – Class 0. The calibrator conforms to IEC 942 and ANSI S1.40. The sound level meters, pre-amplifiers and microphones were certified on June 21, 2011 / June 21, 2011 / November 21, 2011 / November 4, 2010 / September 7 2010 / November 4, 2010 / June 29, 2010 and the calibrator (type B&K 4231) was certified on November 18, 2011 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
M1	May 30 2012	13:00	Pre	93.9 dBA	B&K 4231	2594693
M1	June 1 2012	9:00	Post	93.9 dBA	B&K 4231	2594693
M2	June 7 2012	9:00	Pre	93.9 dBA	B&K 4231	2594693
M2	June 8 2012	13:00	Post	93.8 dBA	B&K 4231	2594693
M3	June 21 2012	12:45	Pre	93.9 dBA	B&K 4231	2594693
M3	June 22 2012	15:00	Post	93.9 dBA	B&K 4231	2594693
M4	June 21 2012	13:15	Pre	93.9 dBA	B&K 4231	2594693
M4	June 22 2012	15:15	Post	93.8 dBA	B&K 4231	2594693
M5	June 21 2012	13:35	Pre	93.9 dBA	B&K 4231	2594693
M5	June 22 2012	15:30	Post	93.8 dBA	B&K 4231	2594693
M6	June 21 2012	14:00	Pre	93.9 dBA	B&K 4231	2594693
M6	June 22 2012	15:45	Post	93.8 dBA	B&K 4231	2594693
M7	June 21 2012	14:45	Pre	93.9 dBA	B&K 4231	2594693
M7	June 22 2012	16:00	Post	93.8 dBA	B&K 4231	2594693
M8	June 21 2012	15:00	Pre	93.9 dBA	B&K 4231	2594693
M8	June 22 2012	16:15	Post	93.9 dBA	B&K 4231	2594693
M9	June 21 2012	15:30	Pre	93.9 dBA	B&K 4231	2594693
M9	June 22 2012	16:30	Post	93.9 dBA	B&K 4231	2594693
M10	June 19 2012	10:00	Pre	93.9 dBA	B&K 4231	2594693
M10	June 21 2012	11:00	Post	93.9 dBA	B&K 4231	2594693
M11	June 19 2012	10:30	Pre	93.9 dBA	B&K 4231	2594693
M11	June 21 2012	11:15	Post	93.8 dBA	B&K 4231	2594693
M12	June 19 2012	11:00	Pre	93.9 dBA	B&K 4231	2594693
M12	June 21 2012	11:30	Post	93.9 dBA	B&K 4231	2594693
M13	June 19 2012	11:30	Pre	93.9 dBA	B&K 4231	2594693
M13	June 21 2012	11:45	Post	93.8 dBA	B&K 4231	2594693
M14	June 19 2012	12:15	Pre	93.9 dBA	B&K 4231	2594693
M14	June 21 2012	12:00	Post	93.8 dBA	B&K 4231	2594693
M15	June 19 2012	13:00	Pre	93.9 dBA	B&K 4231	2594693
M15	June 21 2012	12:15	Post	93.8 dBA	B&K 4231	2594693
M16	July 12 2012	12:20	Pre	93.9 dBA	B&K 4231	2594693
M16	July 13 2012	14:00	Post	93.9 dBA	B&K 4231	2594693
M17	July 12 2012	12:45	Pre	93.9 dBA	B&K 4231	2594693
M17	July 13 2012	14:20	Post	93.9 dBA	B&K 4231	2594693

B&K 2250/2270 Unit #1 SLM Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY

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

NVLAP
NVLAP Lab Code: 200625-0

Calibration Certificate No.24117

Instrument: **Sound Level Meter**
Model: **2250**
Manufacturer: **Brüel and Kjær**
Serial number: **2488495**
Tested with: **Microphone 4189 s/n 2471133**
Preamplifier ZC0032 s/n 3271
Type (class): **1**

Date Calibrated: **6/21/2011** *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

Customer: **Acoustical Consultants Inc.**
Tel/Fax: **780-414-6373 / 780-414-6376**
Address: **5031 - 210 Street Edmonton, Alberta, Canada T6M0A8**

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., 06/07/2005
SLM & Dosimeters – Acoustical Tests, Scantek Inc., 06/15/2005

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	31052	Sep 10, 2010	Scantek, Inc./NVLAP	Sep 10, 2011
DS-360-SRS	Function Generator	33584	Oct 5, 2009	ACR. Env / A2LA	Oct 5, 2011
34401A-Agilent Technologies	Digital Voltmeter	US36120731	Sep 3, 2010	ACR Env. / A2LA	Sep 3, 2011
HM30-Thommen	Meteo Station	1040170/39633	Jun 26, 2010	ACR Env. / A2LA	Dec 26, 2011
PC Program 1019 Norsonic	Calibration software	v.5.0	Validated July 2009	-	-
1251-Norsonic	Calibrator	30878	Dec 7, 2010	Scantek, Inc./ NVLAP	Dec 7, 2011

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 °C	99.96 kPa	69.9 %RH

Calibrated by	Kristen van Otterloo	**Checked by**	Mariana Buzduga
Signature	Kristen van Otterloo	Signature	[signature]
Date	6/22/2011	Date	6/22/2011

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B&K 2250/2270 Unit #1 Microphone Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY

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

NVLAP®

NVLAP Lab Code: 200625-0

Calibration Certificate No.24119

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

Date Calibrated: **6/17/2011** *Cal Due:*

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

Contains non-accredited tests: __Yes _X_ No

Customer: **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:
Procedure for Calibration of Measurement Microphones, Scantek Inc., 06/15/2005

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	25747	Jan 4, 2011	Scantek, Inc./ NVLAP	Jan 4, 2012
DS-360-SRS	Function Generator	61646	Nov 13, 2009	ACR Env. / A2LA	Nov 13, 2011
34401A-Agilent Technologies	Digital Multimeter	MY41022043	Nov 17, 2010	ACR Env. / A2LA	Nov 17, 2011
DPI 141-Druck	Pressure Indicator	790/00-04	Dec 13, 2010	ACR Env. / A2LA	Dec 13, 2012
HM30-Thommen	Meteo Station	1040170/39633	Jun 26, 2010	ACR Env./ A2LA	Dec 26, 2011
PC Program 1017 Norsonic	Calibration software	v.5.0	Validated July 2009	-	-
1253-Norsonic	Calibrator	28326	Dec 6, 2010	Scantek, Inc./ NVLAP	Dec 6, 2011
1203-Norsonic	Preamplifier	14059	Jan 5, 2011	Scantek, Inc./ NVLAP	Jan 5, 2012
4180-Brüel&Kjær	Microphone	2246115	Dec 14, 2009	NPL (UK) / UKAS	Dec 14, 2011

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

Calibrated by	Kristen van Otterloo	Checked by	Mariana Buzduga
Signature	[signature]	Signature	[signature]
Date	6/17/2011	Date	6/22/2011

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B&K 2250/2270 Unit #2 SLM Calibration Certificate

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

NVLAP
NVLAP Lab Code: 200625-0

Calibration Certificate No.24118

Instrument: **Sound Level Meter**
Model: **2250**
Manufacturer: **Brüel and Kjær**
Serial number: **2575774**
Tested with: **Microphone 4189 s/n 2573766**
Preamplifier ZC0032 s/n 5842
Type (class): **1**

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

Date Calibrated: **6/21/2011** *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 T6M0A8**

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., 06/07/2005
SLM & Dosimeters – Acoustical Tests, Scantek Inc., 06/15/2005

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	31052	Sep 10, 2010	Scantek, Inc./NVLAP	Sep 10, 2011
DS-360-SRS	Function Generator	33584	Oct 5, 2009	ACR. Env / A2LA	Oct 5, 2011
34401A-Agilent Technologies	Digital Voltmeter	US36120731	Sep 3, 2010	ACR Env. / A2LA	Sep 3, 2011
HM30-Thommen	Meteo Station	1040170/39633	Jun 26, 2010	ACR Env. / A2LA	Dec 26, 2011
PC Program 1019 Norsonic	Calibration software	v.5.0	Validated July 2009	-	-
1251-Norsonic	Calibrator	30878	Dec 7, 2010	Scantek, Inc./ NVLAP	Dec 7, 2011

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 °C	99.96 kPa	69.9 %RH

Calibrated by	Kristen van Otterloo	**Checked by**	Mariana Buzduga
Signature	*(signature)*	Signature	*(signature)*
Date	6/22/2011	Date	6/22/2011

Calibration Certificates or Test Reports shall not be reproduced, except in full, without written approval of the laboratory.
This Calibration Certificate or Test Reports shall not be used to claim product certification, approval or endorsement by NVLAP, NIST, or any agency of the federal government.
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B&K 2250/2270 Unit #2 Microphone Calibration Certificate

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

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.24120

Instrument: **Microphone**
Model: **4189**
Manufacturer: **Brüel & Kjær**
Serial number: **2573766**

Date Calibrated: **6/17/2011** *Cal Due:*

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

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

Customer: **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:
Procedure for Calibration of Measurement Microphones, Scantek Inc., 06/15/2005

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	25747	Jan 4, 2011	Scantek, Inc./ NVLAP	Jan 4, 2012
DS-360-SRS	Function Generator	61646	Nov 13, 2009	ACR Env. / A2LA	Nov 13, 2011
34401A-Agilent Technologies	Digital Multimeter	MY41022043	Nov 17, 2010	ACR Env. / A2LA	Nov 17, 2011
DPI 141-Druck	Pressure Indicator	790/00-04	Dec 13, 2010	ACR Env. / A2LA	Dec 13, 2012
HM30-Thommen	Meteo Station	1040170/39633	Jun 26, 2010	ACR Env./ A2LA	Dec 26, 2011
PC Program 1017 Norsonic	Calibration software	v.5.0	Validated July 2009	-	-
1253-Norsonic	Calibrator	28326	Dec 6, 2010	Scantek, Inc./ NVLAP	Dec 6, 2011
1203-Norsonic	Preamplifier	14059	Jan 5, 2011	Scantek, Inc./ NVLAP	Jan 5, 2012
4180-Brüel&Kjær	Microphone	2246115	Dec 14, 2009	NPL (UK) / UKAS	Dec 14, 2011

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

Calibrated by	Kristen van Otterloo	**Checked by**	Mariana Buzduga
Signature	Kvan Otterloo	Signature	[signature]
Date	6/17/2011	Date	6/22/2011

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B&K 2250/2270 Unit #3 SLM Calibration Certificate

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

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.25015

Instrument:	**Sound Level Meter**	*Date Calibrated:* **11/21/2011** *Cal Due:*		
Model:	**2250**	*Status:*	**Received**	**Sent**
Manufacturer:	**Brüel and Kjær**	*In tolerance:*	X	X
Serial number:	**2600498**	*Out of tolerance:*		
Tested with:	**Microphone 4189 s/n 2595637**	*See comments:*		
	Preamplifier ZC0032 s/n 6434	*Contains non-accredited tests:* __Yes X No		
Type (class):	**1**	*Calibration service:* __ Basic X Standard		
Customer:	**Acoustical Consultants Inc.**	*Address:* **5031 - 210 Street Edmonton, Alberta, Canada T6M0A8**		
Tel/Fax:	**780-414-6373 / 780-414-6376**			

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., Rev. 6/7/2005
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	31052	Sep 13, 2011	Scantek, Inc./ NVLAP	Sep 13, 2012
DS-360-SRS	Function Generator	33584	Sep 9, 2011	ACR Env./ A2LA	Sep 9, 2013
34401A-Agilent Technologies	Digital Voltmeter	US36120731	Sep 9, 2011	ACR Env. / A2LA	Sep 9, 2012
DPI 141-Druck	Pressure Indicator	790/00-04	Dec 13, 2010	ACR Env./ A2LA	Dec 13, 2012
HMP233-Vaisala Oyj	Humidity & Temp. Transmitter	V3820001	Jul 29, 2011	Vaisala / A2LA	Jul 29, 2012
PC Program 1019 Norsonic	Calibration software	v.5.2	Validated Mar 2011	Scantek, Inc.	-
1251-Norsonic	Calibrator	30878	Dec 7, 2010	Scantek, Inc./ NVLAP	Dec 7, 2011

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 °C	101.610 kPa	43.2 %RH

Calibrated by	Kristen van Otterloo	**Checked by**	Mariana Buzduga
Signature	*(signature)*	Signature	*(signature)*
Date	11/21/2011	Date	11/21/2011

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B&K 2250/2270 Unit #3 Microphone Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY

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

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.25016

Instrument:	**Microphone**	*Date Calibrated:*	**11/18/2011** *Cal Due:*	
Model:	**4189**	*Status:*	**Received**	**Sent**
Manufacturer:	**Brüel & Kjær**	*In tolerance:*	X	X
Serial number:	**2595637**	*Out of tolerance:*		
Composed of:		*See comments:*		

Contains non-accredited tests: __Yes _X_ No

Customer: **Acoustical Consultants Inc.**
Tel/Fax: **780-414-6373/780-414-6376**
Address: **5031 - 210 Street Edmonton, Alberta, Canada T6M0A8**

Tested in accordance with the following procedures and standards:
Calibration of Measurement Microphones, Scantek, Inc., Rev. 11/30/2010

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	31052	Sep 13, 2011	Scantek, Inc./ NVLAP	Sep 13, 2012
DS-360-SRS	Function Generator	33584	Sep 9, 2011	ACR Env./ A2LA	Sep 9, 2013
34401A-Agilent Technologies	Digital Voltmeter	US36120731	Sep 9, 2011	ACR Env. / A2LA	Sep 9, 2012
DPI 141-Druck	Pressure Indicator	790/00-04	Dec 13, 2010	ACR Env./ A2LA	Dec 13, 2012
HMP233-Vaisala Oyj	Humidity & Temp. Transmitter	V3820001	Jul 29, 2011	Vaisala / A2LA	Jul 29, 2012
PC Program 1017 Norsonic	Calibration software	v.5.2	Validated Mar 2011	Scantek, Inc.	-
1253-Norsonic	Calibrator	28326	Dec 6, 2010	Scantek, Inc./ NVLAP	Dec 6, 2011
1203-Norsonic	Preamplifier	92268	Dec 6, 2010	Scantek, Inc./ NVLAP	Dec 6, 2011
4180-Bruel&Kjaer	Microphone	2246115	Dec 14, 2009	NPL-UK / UKAS	Dec 14, 2011

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

Calibrated by	Kristen van Otterloo	Checked by	Mariana Buzduga
Signature	Kristen van Otterloo	Signature	[signature]
Date	11/18/2011	Date	11/21/2011

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B&K 2250/2270 Unit #3 Calibrator Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY

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

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.25017

Instrument:	**Acoustical Calibrator**	*Date Calibrated:* **11/18/2011** *Cal Due:*		
Model:	**4231**	*Status:*	**Received**	**Sent**
Manufacturer:	**Brüel and Kjær**	*In tolerance:*	X	X
Serial number:	**2594693**	*Out of tolerance:*		
Class (IEC 60942):	**1**	*See comments:*		
Barometer type:		*Contains non-accredited tests:* __Yes _X_ No		
Barometer s/n:				

Customer: **Acoustical Consultants Inc.**
Tel/Fax: **780-414-6373 / 780-414-6376**
Address: **5031 - 210 Street Edmonton, Alberta, Canada T6M0A8**

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	31052	Sep 13, 2011	Scantek, Inc./ NVLAP	Sep 13, 2012
DS-360-SRS	Function Generator	33584	Sep 9, 2011	ACR Env./ A2LA	Sep 9, 2013
34401A-Agilent Technologies	Digital Voltmeter	US36120731	Sep 9, 2011	ACR Env. / A2LA	Sep 9, 2012
DPI 141-Druck	Pressure Indicator	790/00-04	Dec 13, 2010	ACR Env./ A2LA	Dec 13, 2012
HMP233-Vaisala Oyj	Humidity & Temp. Transmitter	V3820001	Jul 29, 2011	Vaisala / A2LA	Jul 29, 2012
8903-HP	Audio Analyzer	2514A05691	Dec 1, 2010	ACR Env. / A2LA	Dec 1, 2013
PC Program 1018 Norsonic	Calibration software	v.5.2	Validated March 2011	Scantek, Inc.	-
4134-Bruel&Kjaer	Microphone	456196	Oct 18, 2011	Scantek, Inc. / NVLAP	Oct 18, 2012
1203-Norsonic	Preamplifier	92268	Dec 6, 2010	Scantek, Inc./ NVLAP	Dec 6, 2011

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

Calibrated by	Kristen van Otterloo	Checked by	Mariana Buzduga
Signature	*Kvan Otter*	Signature	*signature*
Date	11/18/2011	Date	11/21/2011

Calibration Certificates or Test Reports shall not be reproduced, except in full, without written approval of the laboratory.
This Calibration Certificate or Test Reports shall not be used to claim product certification, approval or endorsement by NVLAP, NIST, or any agency of the federal government.
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B&K 2250/2270 Unit #4 SLM Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY
ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1 and relevant requirements of ISO 9002:1994 ACCREDITED by NVLAP (an ILAC and APLAC signatory)

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.22803

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

Date Calibrated: **11/5/2010** *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., 06/07/2005
SLM & Dosimeters – Acoustical Tests, Scantek Inc., 06/15/2005

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	25747	Dec 24, 2009	Scantek, Inc./ NVLAP	Dec 24, 2010
DS-360-SRS	Function Generator	61646	Nov 13, 2009	ACR Env. / A2LA	Nov 13, 2011
34401A-Agilent Technologies	Digital Multimeter	MY41022043	Nov 12, 2009	ACR Env. / A2LA	Nov 12, 2010
DPI 141-Druck	Pressure Indicator	790/00-04	Nov 21, 2008	Transcat / NVLAP	Nov 21, 2010
HMP233-Vaisala Oyj	Humidity & Temp. Transmitter	V3820001	Nov 25, 2009	Transcat / NVLAP	May 25, 2011
PC Program 1019 Norsonic	Calibration software	v.5.0	Validated July 2009	-	-
1253-Norsonic	Calibrator	25726	Dec 7, 2009	Scantek, Inc./ NVLAP	Dec 7, 2010

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 °C	98.967 kPa	41.4 %RH

Calibrated by	Valentin Buzduga	**Checked by**	Mariana Buzduga
Signature	[signature]	Signature	[signature]
Date	11/05/2010	Date	11/5/2010

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B&K 2250/2270 Unit #4 Microphone Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY
ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
and relevant requirements of ISO 9002:1994
ACCREDITED by NVLAP (an ILAC and APLAC signatory)

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.22804

Instrument:	**Microphone**	*Date Calibrated:* **11/4/2010** *Cal Due:*		
Model:	**4189**	*Status:*	**Received**	**Sent**
Manufacturer:	**Brüel & Kjær**	*In tolerance:*	**X**	**X**
Serial number:	**2643219**	*Out of tolerance:*		
		See comments:		
		Contains non-accredited tests: __Yes _X_ No		
Customer:	**Acoustical Consultants Inc.**	*Address:*	**5031 - 210 Street, Edmonton, Alberta, CANADA T6M 0A8**	
Tel/Fax:	**780-414-6373/780-414-6376**			

Tested in accordance with the following procedures and standards:
Procedure for Calibration of Measurement Microphones, Scantek Inc., 06/15/2005

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	25747	Dec 24, 2009	Scantek, Inc./ NVLAP	Dec 24, 2010
DS-360-SRS	Function Generator	61646	Nov 13, 2009	ACR Env. / A2LA	Nov 13, 2011
34401A-Agilent Technologies	Digital Multimeter	MY41022043	Nov 12, 2009	ACR Env. / A2LA	Nov 12, 2010
DPI 141-Druck	Pressure Indicator	790/00-04	Nov 21, 2008	Transcat / NVLAP	Nov 21, 2010
HMP233-Vaisala Oyj	Humidity & Temp. Transmitter	V3820001	Nov 25, 2009	ACR Env./ A2LA	May 25, 2011
PC Program 1017 Norsonic	Calibration software	v.5.0	Validated July 2009	-	-
1253-Norsonic	Calibrator	28326	Dec 7, 2009	Scantek, Inc./ NVLAP	Dec 7, 2010
1203-Norsonic	Preamplifier	14059	Jan 4, 2010	Scantek, Inc./ NVLAP	Jan 4, 2011
4180-Brüel&Kjær	Microphone	2246115	Dec 14, 2009	NPL (UK) / UKAS	Dec 14, 2011

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

Calibrated by	Valentin Buzduga	Checked by	Mariana Buzduga
Signature		Signature	
Date	11/04/2010	Date	11/5/2010

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B&K 2250/2270 Unit #5 Calibration Certificate(s)

MANUFACTURER'S CERTIFICATE OF CONFORMANCE

We certify that Brüel & Kjær **-2250---** Serial No. **2722894** has been tested and passed all production tests, confirming compliance with the manufacturer's published specification at the date of the test.

The final test has been performed using calibrated equipment, traceable to National or International Standards or by ratio measurements.

Brüel & Kjær is certified under ISO 9001:2008 assuring that all test data is retained on file and is available for inspection upon request.

Nærum 07-sep-2010

Torben Bjørn
Vice President, Operations

Please note that this document is not a calibration certificate.
For information on our calibration services please contact your nearest Brüel & Kjær office.

BA 0238-17

HEADQUARTERS: Brüel & Kjær Sound & Vibration Measurement A/S · DK-2850 Nærum · Denmark
Telephone: +45 7741 2000 · Fax: +45 4580 1405 · www.bksv.com · info@bksv.com
Local representatives and service organisations worldwide

Brüel & Kjær
Incorporating LDS and Lochard

Bruel & Kjær

Prepolarized Free-field 1/2" Microphone Type 4189

Calibration Chart

Serial No: 2719777

Open-circuit Sensitivity*, S_0:	-25.4	dB re 1V/Pa
Equivalent to:	53.5	mV/Pa
Uncertainty, 95 % confidence level	0.2	dB
Capacitance:	12.9	pF
Valid At:		
Temperature:	23	°C
Ambient Static Pressure:	101.3	kPa
Relative Humidity:	50	%
Frequency:	251.2	Hz
Polarization Voltage, external:	0	V

Sensitivity Traceable To:
DPLA: Danish Primary Laboratory of Acoustics
NIST: National Institute of Standards and Technology, USA

IEC 61094-4: Type WS 2 F

Environmental Calibration Conditions:
99.0 kPa 23 °C 53 % RH

Procedure: 704215 **Date:** 24. Aug. 2010 **Signature:** BK

$^*K_0 = -26 - S_0$ Example: $K_0 = -26 - (-26.2) = +0.2$ dB

acoustical consultants inc

B&K 2250/2270 Unit #6 SLM Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY
ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1 and relevant requirements of ISO 9002:1994 ACCREDITED by NVLAP (an ILAC and APLAC signatory)

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.22805

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

Date Calibrated: **11/4/2010** *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., 06/07/2005
SLM & Dosimeters – Acoustical Tests, Scantek Inc., 06/15/2005

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	25747	Dec 24, 2009	Scantek, Inc./ NVLAP	Dec 24, 2010
DS-360-SRS	Function Generator	61646	Nov 13, 2009	ACR Env. / A2LA	Nov 13, 2011
34401A-Agilent Technologies	Digital Multimeter	MY41022043	Nov 12, 2009	ACR Env. / A2LA	Nov 12, 2010
DPI 141-Druck	Pressure Indicator	790/00-04	Nov 21, 2008	Transcat / NVLAP	Nov 21, 2010
HMP233-Vaisala Oyj	Humidity & Temp. Transmitter	V3820001	Nov 25, 2009	Transcat / NVLAP	May 25, 2011
PC Program 1019 Norsonic	Calibration software	v.5.0	Validated July 2009	-	-
1253-Norsonic	Calibrator	25726	Dec 7, 2009	Scantek, Inc./ NVLAP	Dec 7, 2010

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 (%)
21.9 °C	98.579 kPa	48.1 %RH

Calibrated by	Valentin Buzduga	**Checked by**	Mariana Buzduga
Signature	[signature]	Signature	[signature]
Date	11/04/2010	Date	11/5/2010

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B&K 2250/2270 Unit #6 Microphone Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
and relevant requirements of ISO 9002:1994
ACCREDITED by NVLAP (an ILAC and APLAC signatory)

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.22806

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

Date Calibrated: **11/4/2010** *Cal Due:*

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

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

Customer: **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:
Procedure for Calibration of Measurement Microphones, Scantek Inc., 06/15/2005

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	25747	Dec 24, 2009	Scantek, Inc./ NVLAP	Dec 24, 2010
DS-360-SRS	Function Generator	61646	Nov 13, 2009	ACR Env. / A2LA	Nov 13, 2011
34401A-Agilent Technologies	Digital Multimeter	MY41022043	Nov 12, 2009	ACR Env. / A2LA	Nov 12, 2010
DPI 141-Druck	Pressure Indicator	790/00-04	Nov 21, 2008	Transcat / NVLAP	Nov 21, 2010
HMP233-Vaisala Oyj	Humidity & Temp. Transmitter	V3820001	Nov 25, 2009	ACR Env./ A2LA	May 25, 2011
PC Program 1017 Norsonic	Calibration software	v.5.0	Validated July 2009	-	-
1253-Norsonic	Calibrator	28326	Dec 7, 2009	Scantek, Inc./ NVLAP	Dec 7, 2010
1203-Norsonic	Preamplifier	14059	Jan 4, 2010	Scantek, Inc./ NVLAP	Jan 4, 2011
4180-Brüel&Kjær	Microphone	2246115	Dec 14, 2009	NPL (UK) / UKAS	Dec 14, 2011

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

Calibrated by	Valentin Buzduga	Checked by	Mariana Buzduga
Signature	[signature]	Signature	[signature]
Date	11/04/2010	Date	11/5/2010

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B&K 2250/2270 Unit #7 Calibration Certificate

MANUFACTURER'S CERTIFICATE OF CONFORMANCE

We certify that Brüel & Kjær **-2250---** Serial No. **2722859** has been tested and passed all production tests, confirming compliance with the manufacturer's published specification at the date of the test.

The final test has been performed using calibrated equipment, traceable to National or International Standards or by ratio measurements.

Brüel & Kjær is certified under ISO 9001:2008 assuring that all test data is retained on file and is available for inspection upon request.

Nærum 29-jun-2010

Torben Bjørn
Vice President, Operations

Please note that this document is not a calibration certificate.
For information on our calibration services please contact your nearest Brüel & Kjær office.

BA 0238 – 17

HEADQUARTERS: Brüel & Kjær Sound & Vibration Measurement A/S · DK-2850 Nærum · Denmark
Telephone: +45 7741 2000 · Fax: +45 4580 1405 · www.bksv.com · info@bksv.com
Local representatives and service organisations worldwide

Brüel & Kjær
Incorporating LDS and Lochard

Bruel & Kjær

Prepolarized Free-field 1/2" Microphone Type 4189

Calibration Chart

Serial No: **2710791**

Open-circuit Sensitivity*, S_0:	***-26.1***	dB re 1V/Pa
Equivalent to:	***49.8***	mV/Pa
Uncertainty, 95 % confidence level	0.2	dB
Capacitance:	***12.8***	pF
Valid At:		
Temperature:	23	°C
Ambient Static Pressure:	101.3	kPa
Relative Humidity:	50	%
Frequency:	251.2	Hz
Polarization Voltage, external:	0	V

Sensitivity Traceable To:
DPLA: Danish Primary Laboratory of Acoustics
NIST: National Institute of Standards and Technology, USA

IEC 61094-4: Type WS 2 F

Environmental Calibration Conditions:
101.5 kPa 23 °C 52 % RH

Procedure: 704215 **Date:** 29. Jun. 2010 **Signature:** S.L

*$K_0 = -26 - S_0$ Example: $K_0 = -26 - (-26.2) = +0.2$ dB

Appendix II. THE ASSESSMENT OF ENVIRONMENTAL NOISE (GENERAL)

Sound Pressure Level

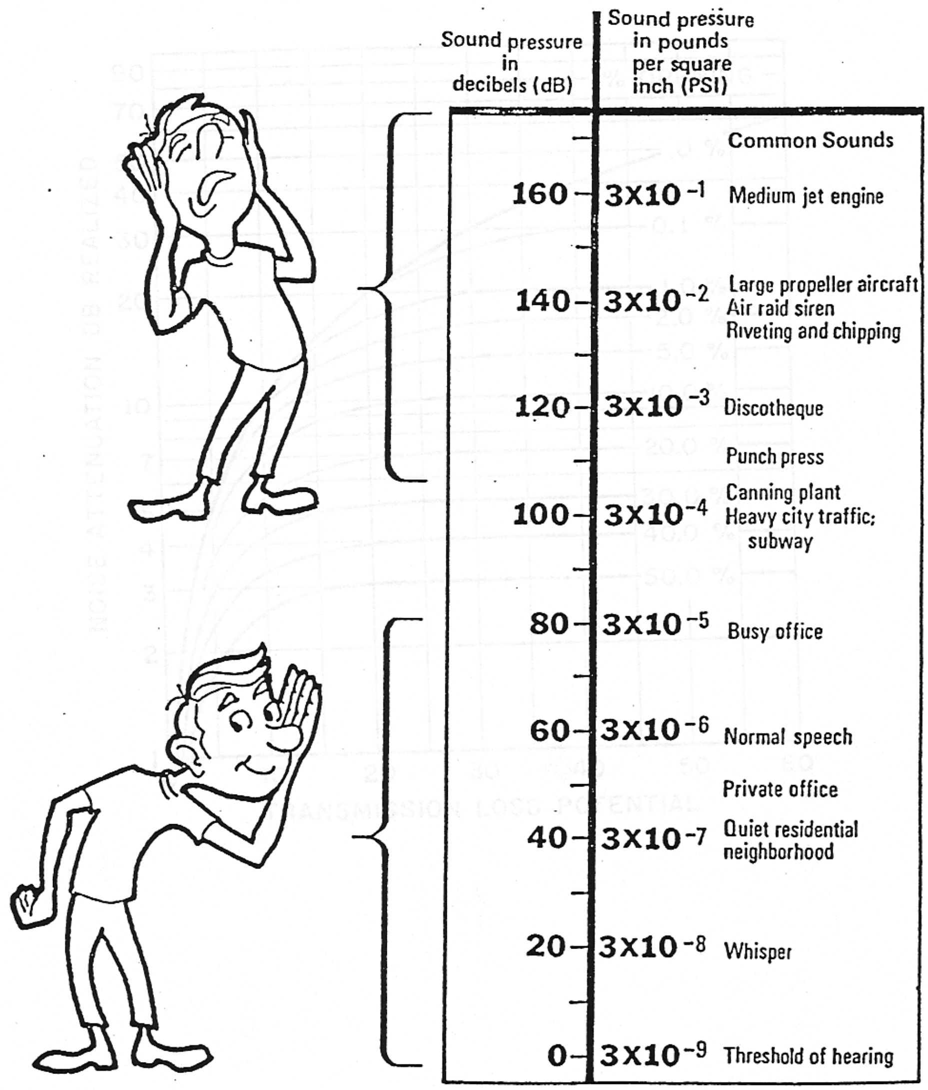
Sound pressure is initially measured in Pascal's (Pa). Humans can hear several orders of magnitude in sound pressure levels, so a more convenient scale is used. This scale is known as the decibel (dB) scale, named after Alexander Graham Bell (telephone guy). It is a base 10 logarithmic scale. When we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


Sound pressure in decibels (dB)
Sound pressure in pounds per square inch (PSI)
Common Sounds
160
3X10 -1
Medium jet engine
140
3X10 -2
Large propeller aircraft
Air raid siren
Riveting and chipping
120
3X10 -3
Discotheque
Punch press
100
3X10 -4
Canning plant
Heavy city traffic; subway
80
3X10 -5
Busy office
60
3X10 -6
Normal speech
Private office
40
3X10 -7
Quiet residential neighborhood
20
3X10 -8
Whisper
0
3X10 -9
Threshold of hearing

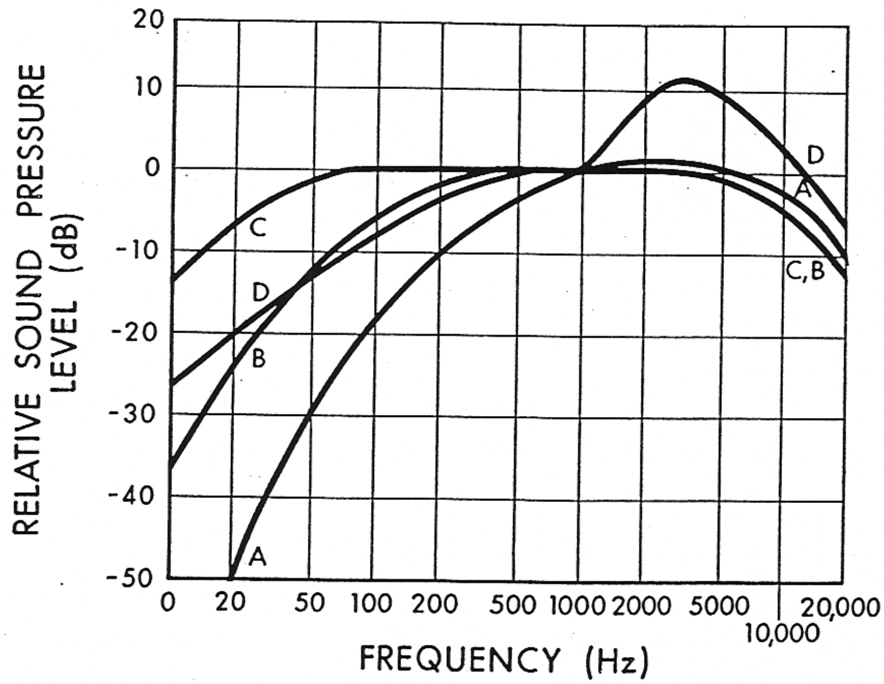
Frequency

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:

Lower Band Limit	Whole Octave Center Frequency	Upper Band Limit	Lower Band Limit	1/3 Octave 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.

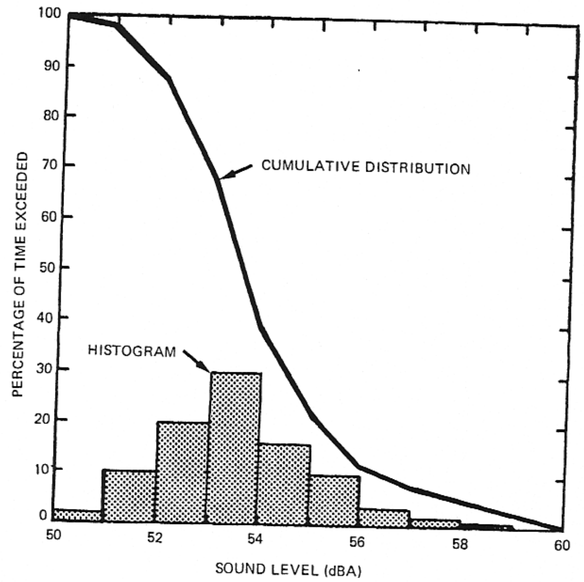


Figure 16.6 Statistically processed community noise showing histogram and cumulative distribution of A weighted sound levels.

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 34 dB at 400m.
- A line source measuring 50 dB at 100m will be 40 dB at 1000m.

Atmospheric Absorption

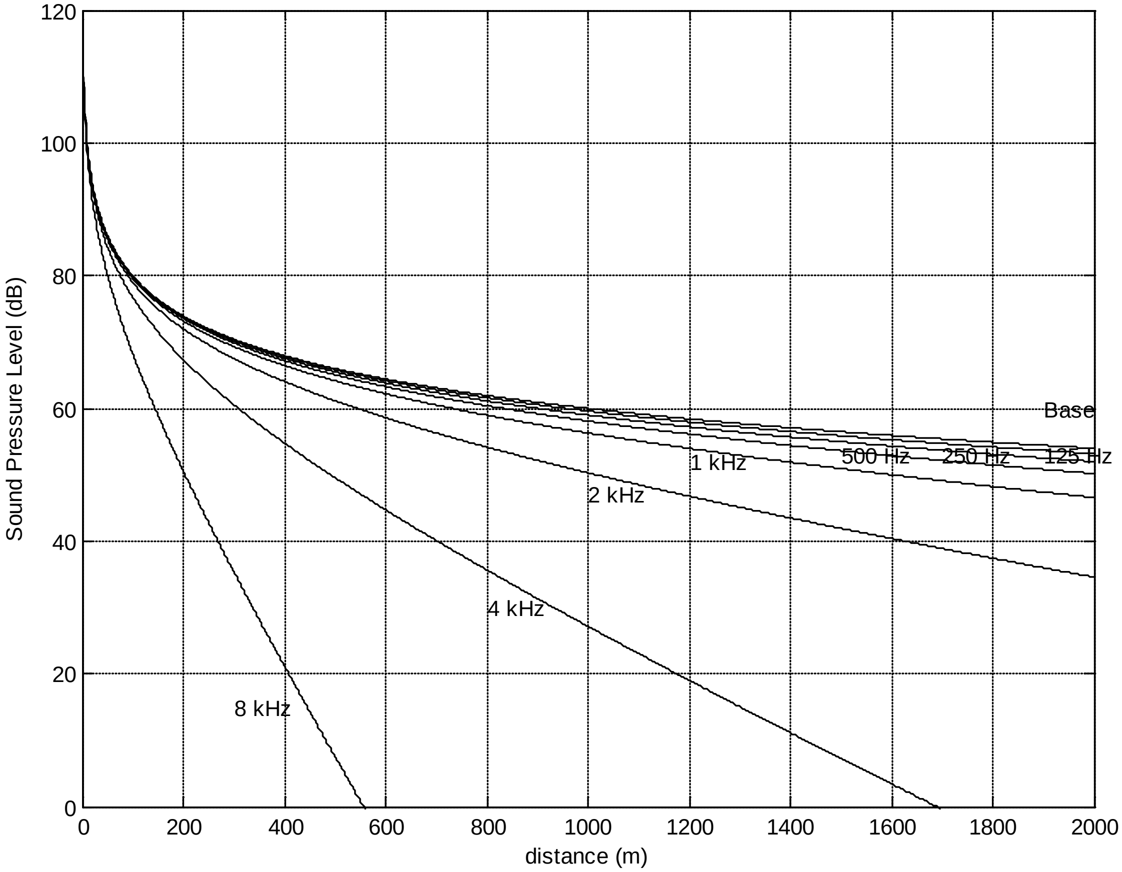
As sound transmits through a medium, there is an attenuation (or dissipation of acoustic energy) which can be attributed to three mechanisms:

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 increases
- As Relative Humidity increases, absorption decreases
- 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 10°C 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

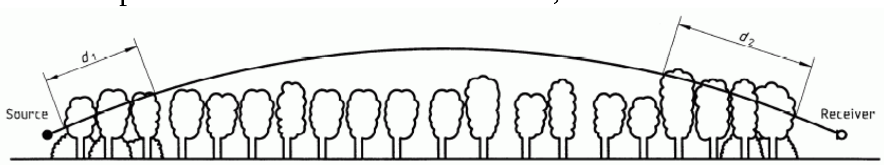
- Can be an effective absorber due to large area covered
- Only effective at low height above ground. Does not affect sound transmitted direct from source to receiver if there is line of sight.
- Typically less absorption than atmospheric absorption when there is line of sight.
- Approximate rule of 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
$10 \leq d_f \leq 20$	Attenuation, dB: 0	0	1	1	1	1	2	3
$20 \leq d_f \leq 200$	Attenuation, dB/m: 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 approximately 1/2 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).

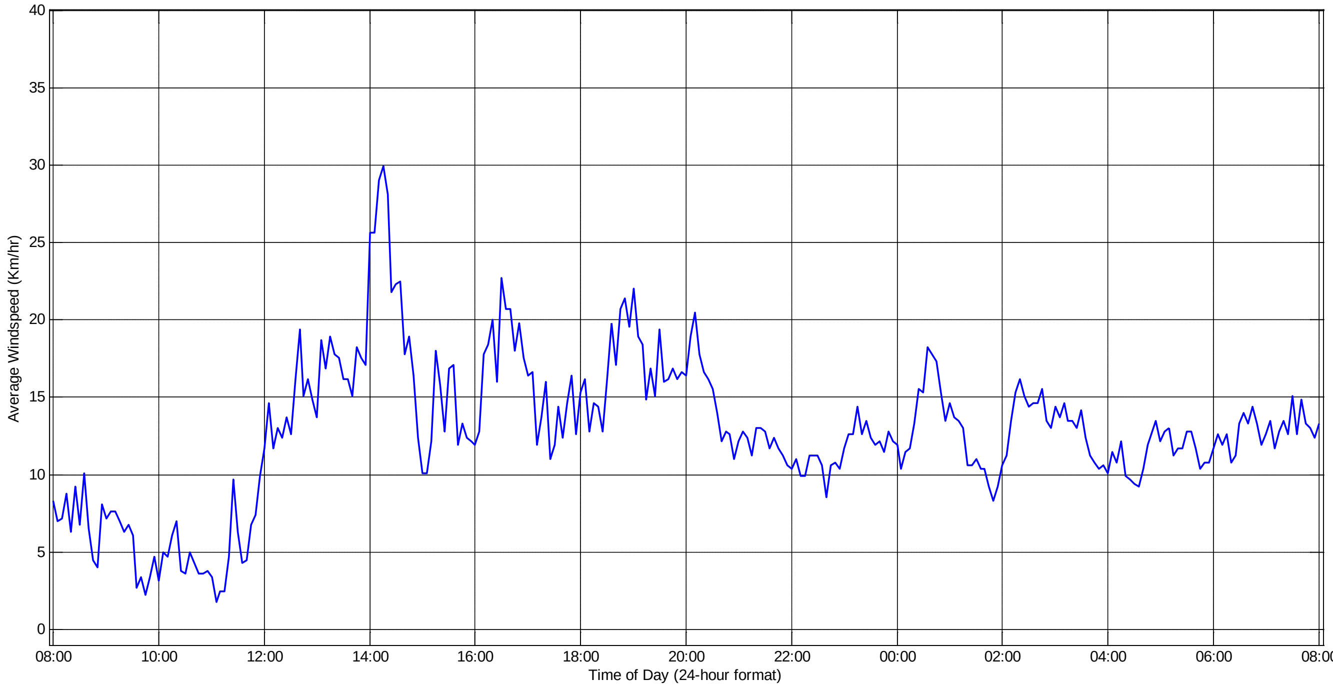
SOUND LEVELS GENERATED BY COMMON APPLIANCES

Used with Permission Obtained from ERCB Directive 038 (2007)

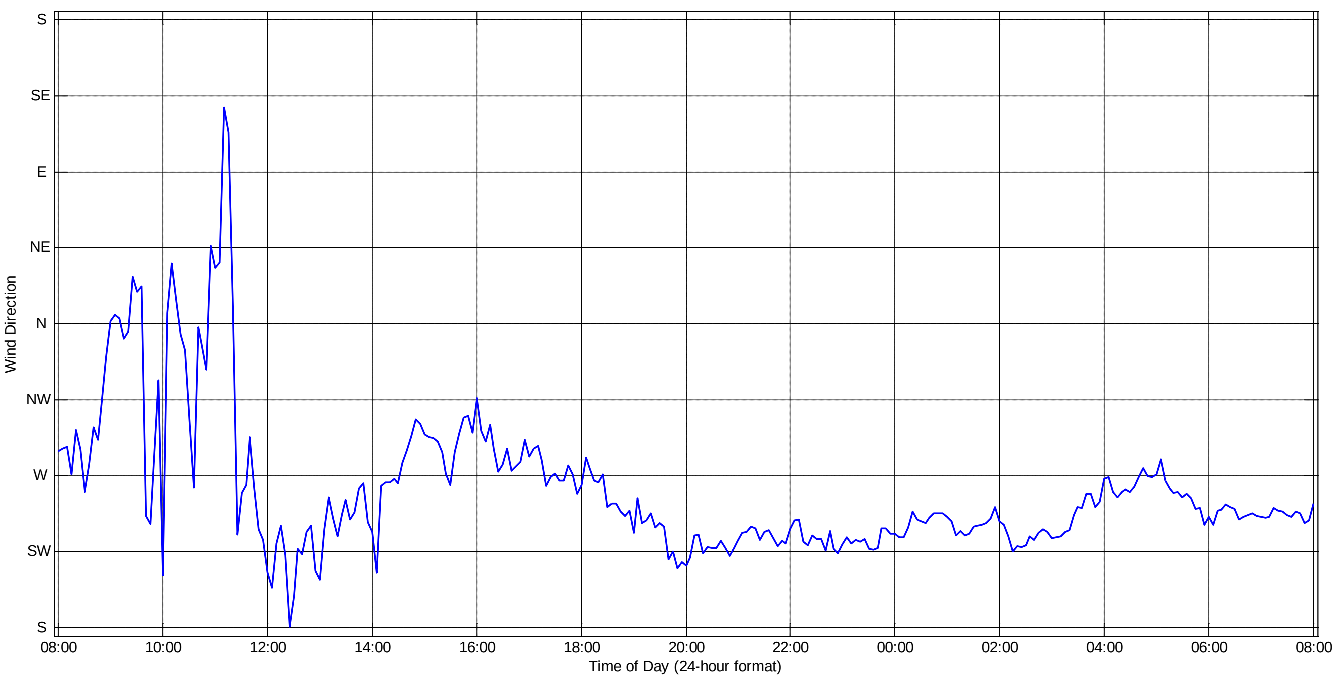
Source[1]	Sound level at 3 feet (dBA)
Freezer	38-45
Refrigerator	34-53
Electric heater	47
Hair clipper	50
Electric toothbrush	48-57
Humidifier	41-54
Clothes dryer	51-65
Air conditioner	50-67
Electric shaver	47-68
Water faucet	62
Hair dryer	58-64
Clothes washer	48-73
Dishwasher	59-71
Electric can opener	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).

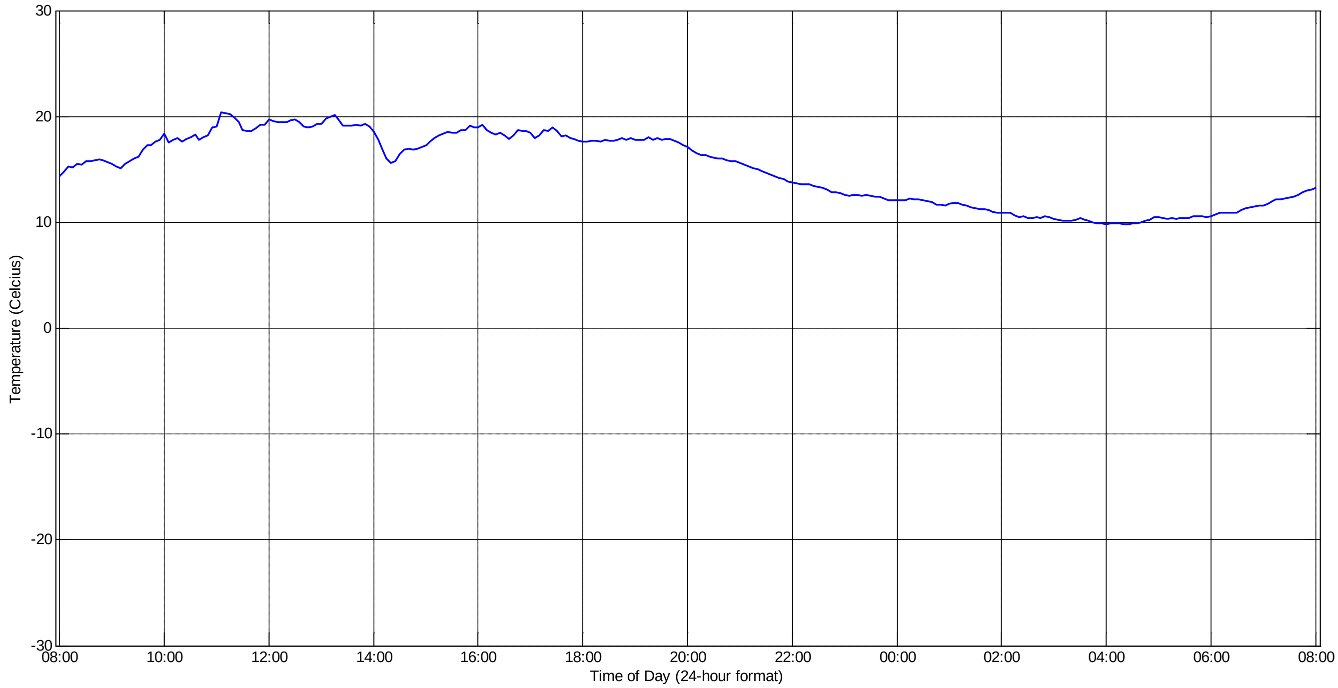
Appendix IV. WEATHER DATA



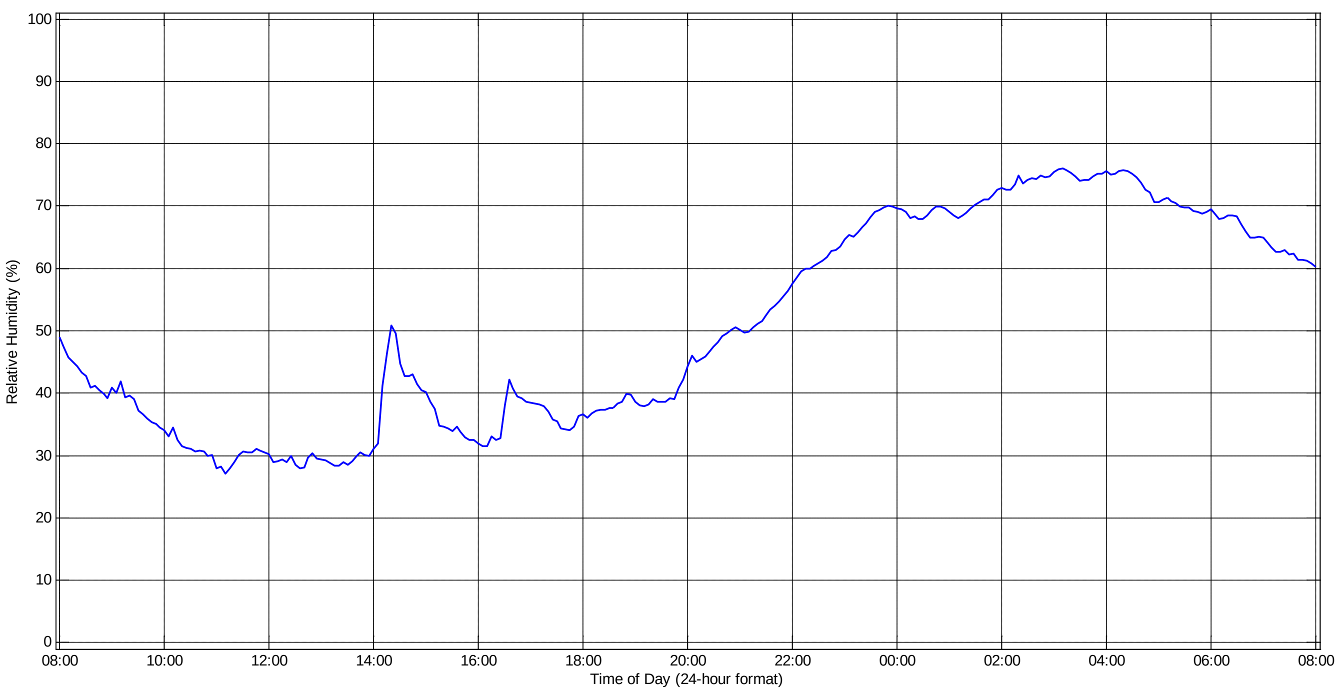
May 31 - June 01, 2012 Monitored Wind Speed



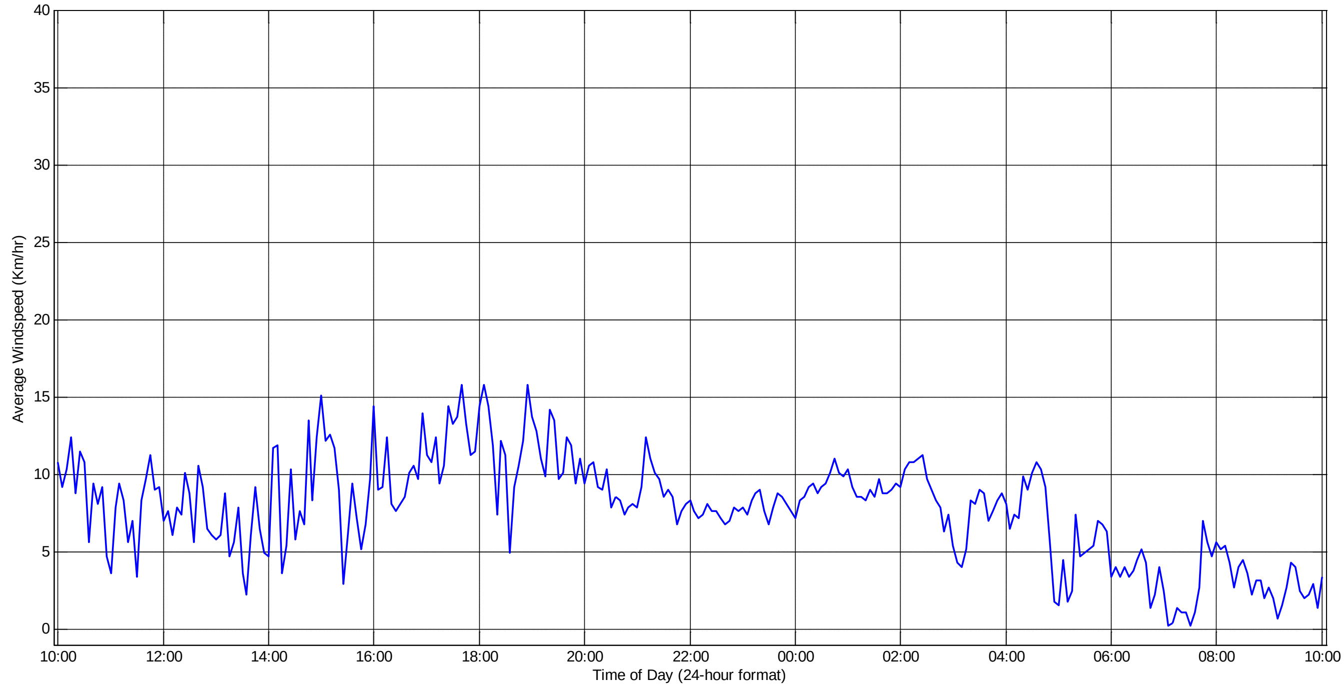
May 31 - June 01, 2012 Monitored Wind Direction



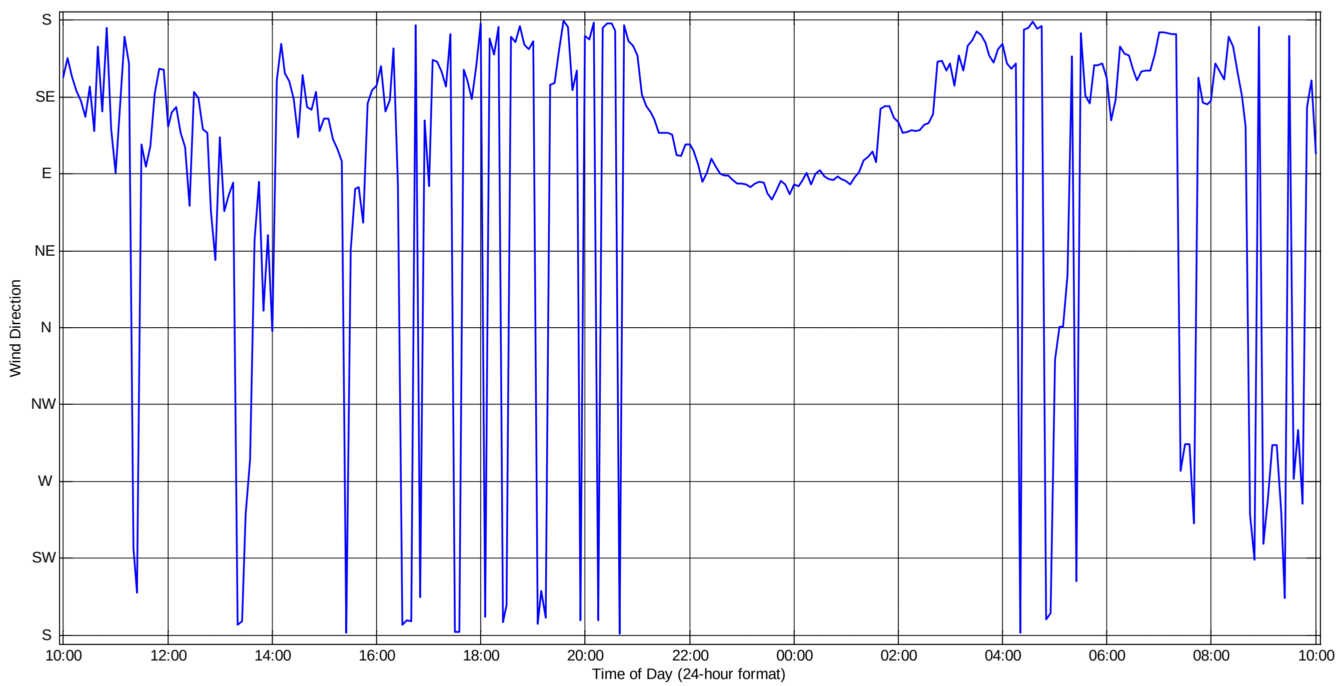
May 31 - June 01, 2012 Monitored Temperature



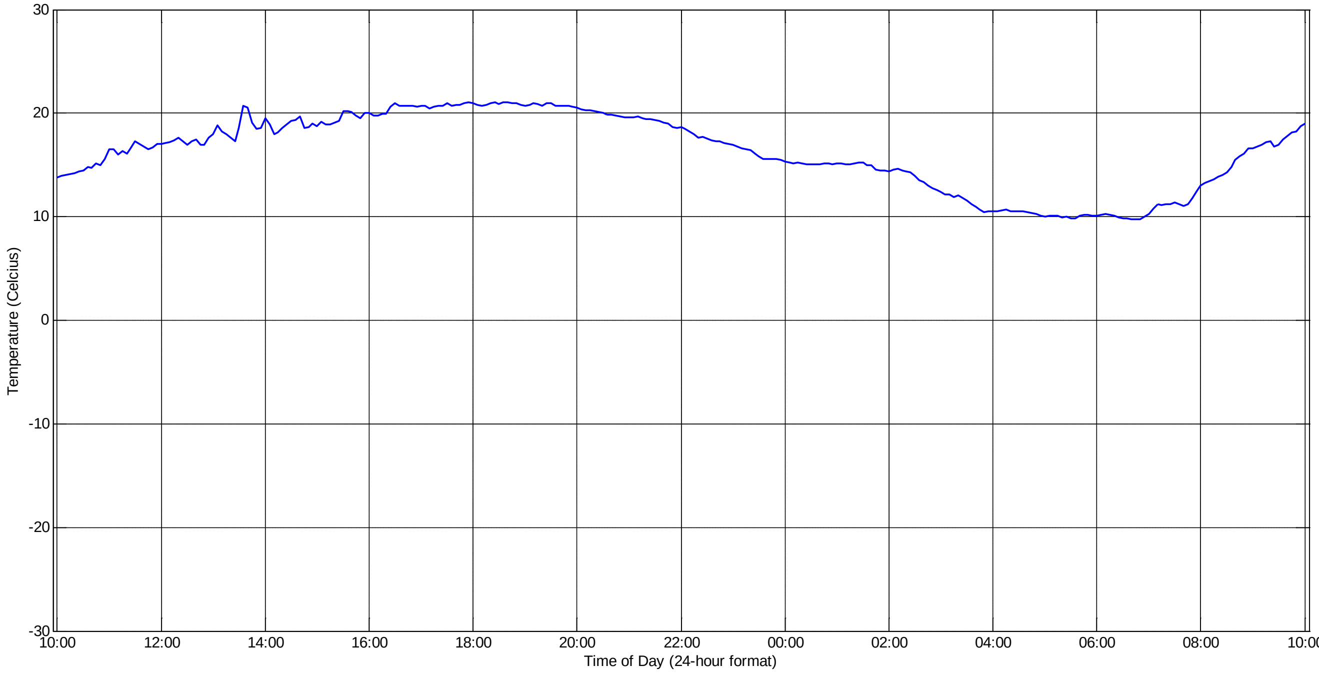
May 31 - June 01, 2012 Monitored Relative Humidity



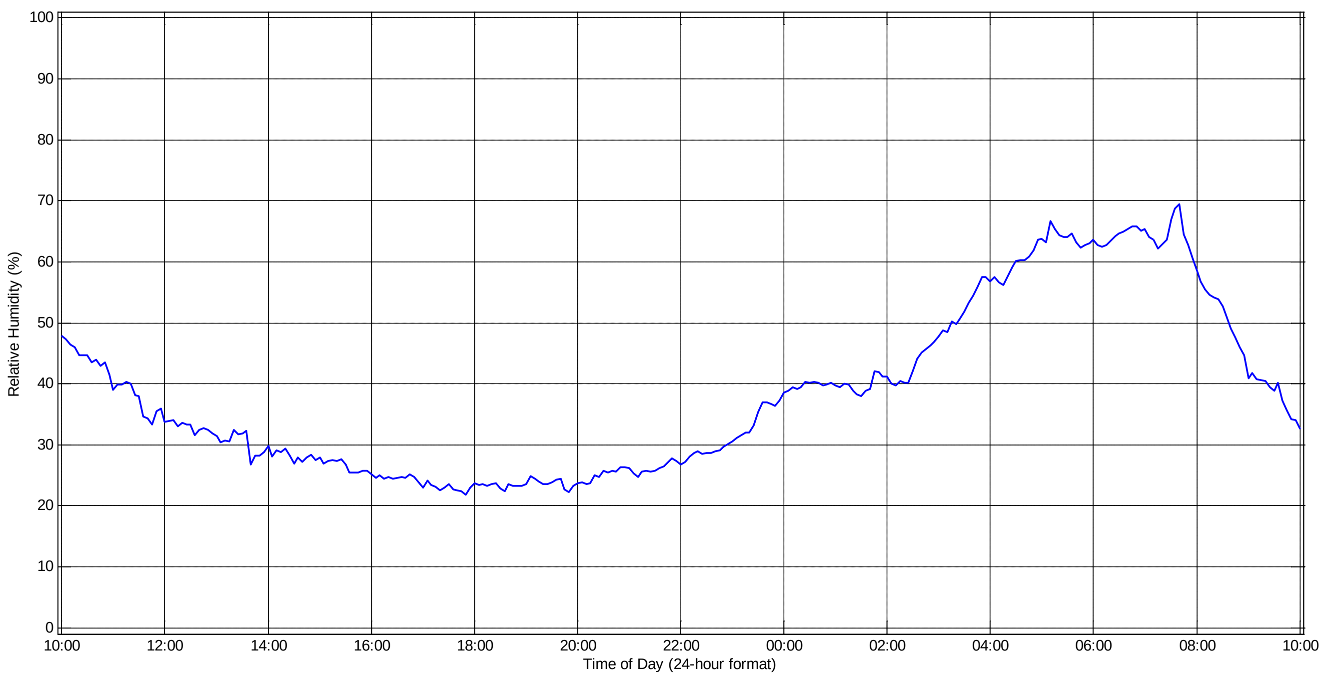
July 07 - 08, 2012 Monitored Wind Speed



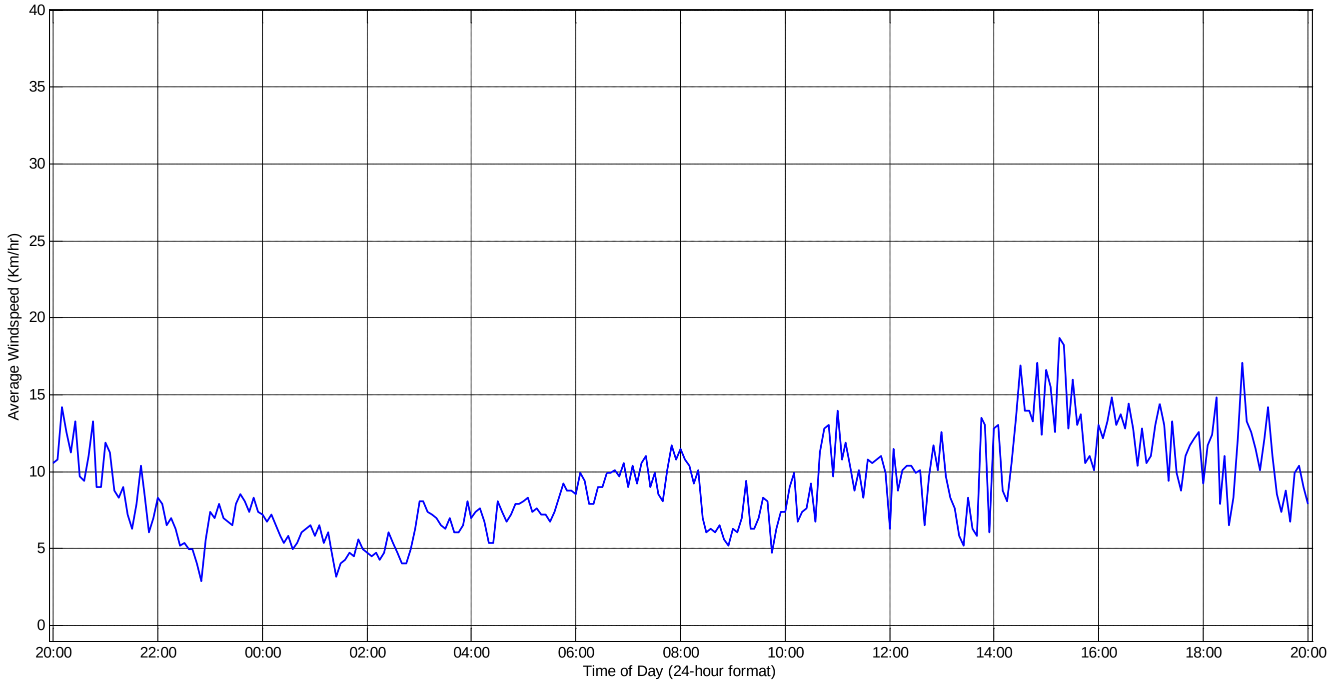
July 07 - 08, 2012 Monitored Wind Direction



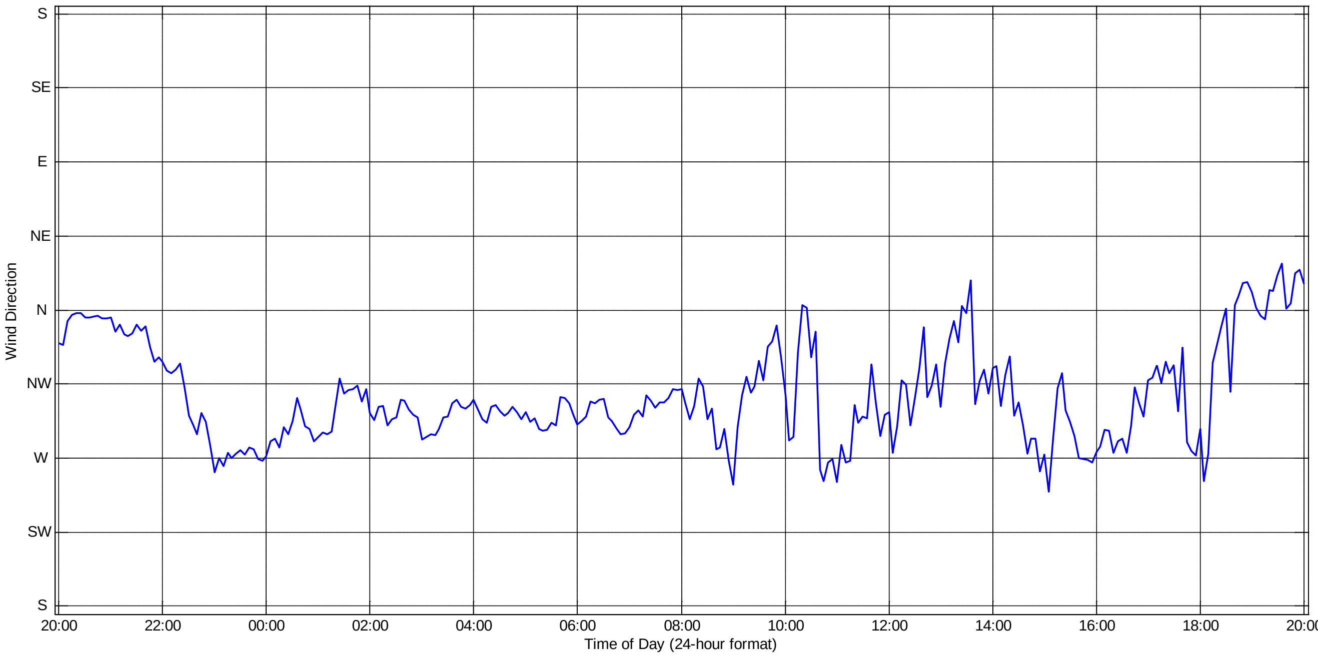
July 07 - 08, 2012 Monitored Temperature



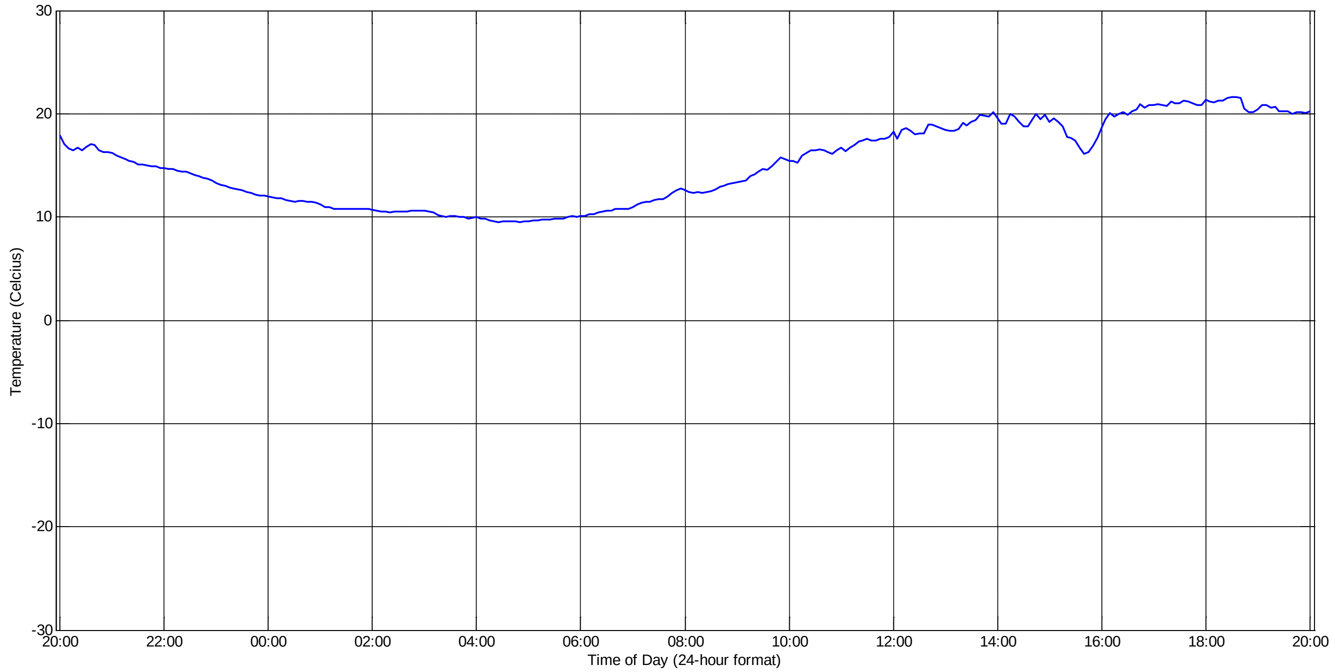
July 07 - 08, 2012 Monitored Relative Humidity



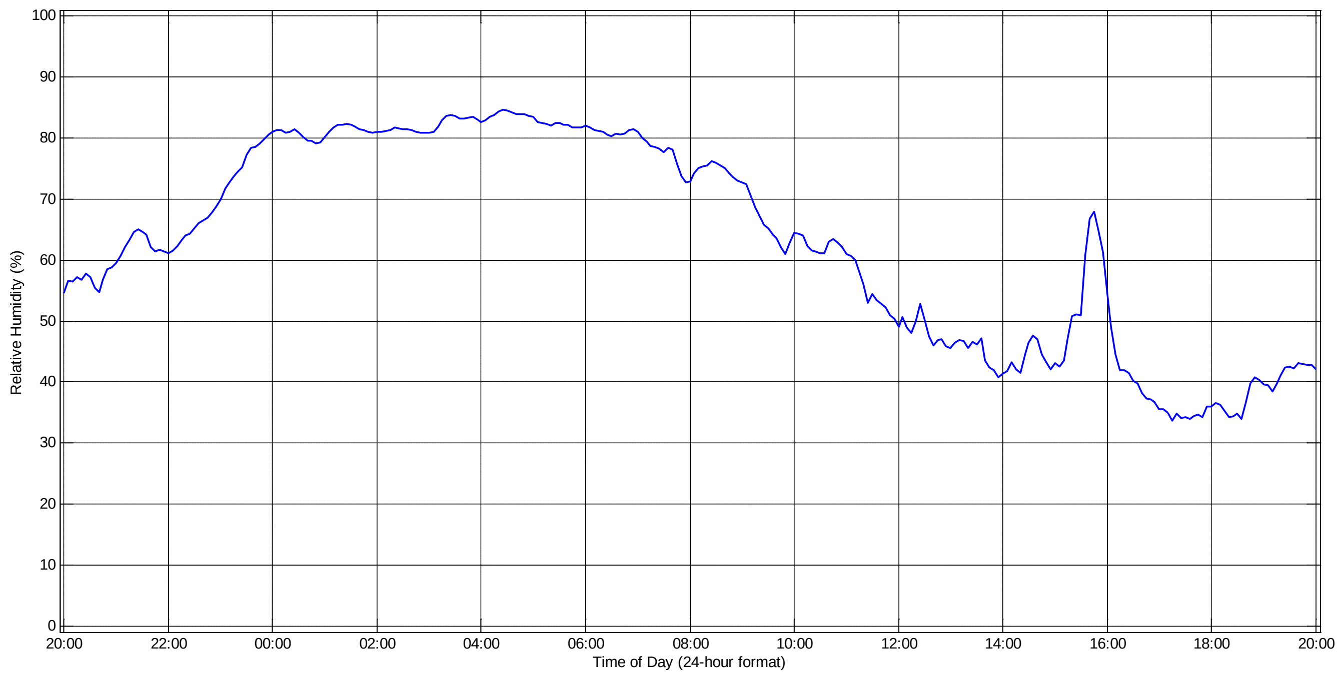
June 19 - 20, 2012 Monitored Wind Speed



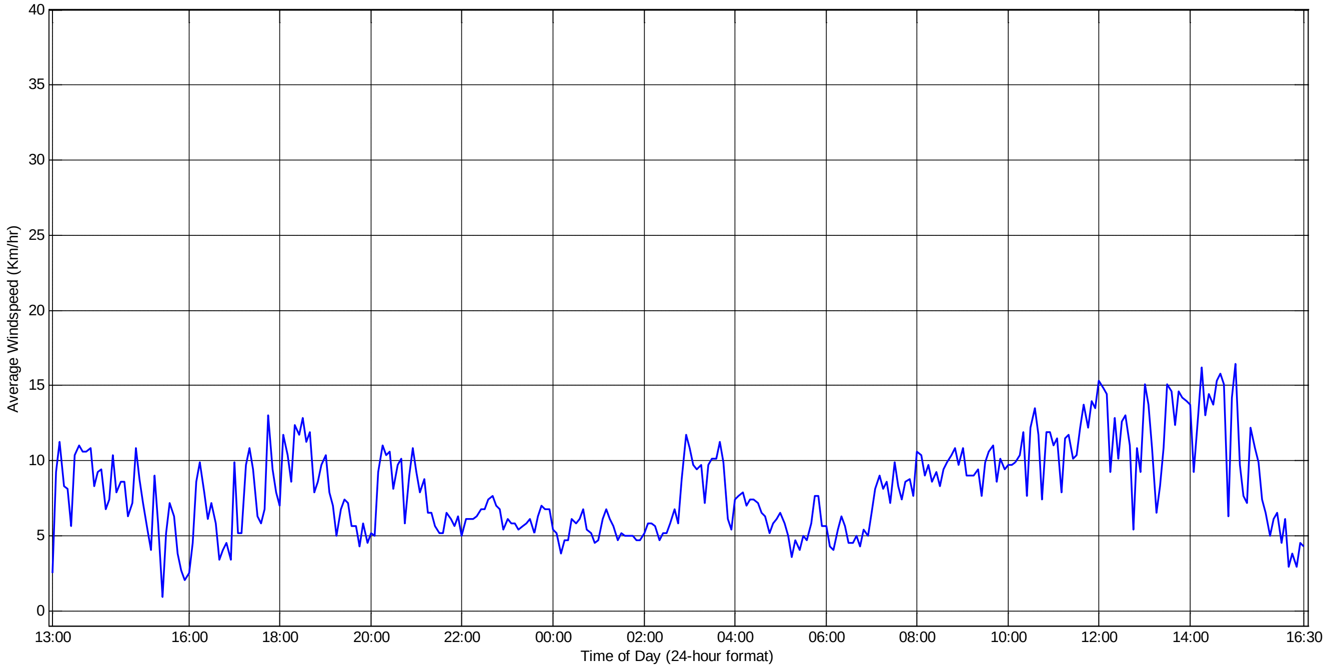
June 19 - 20, 2012 Monitored Wind Direction



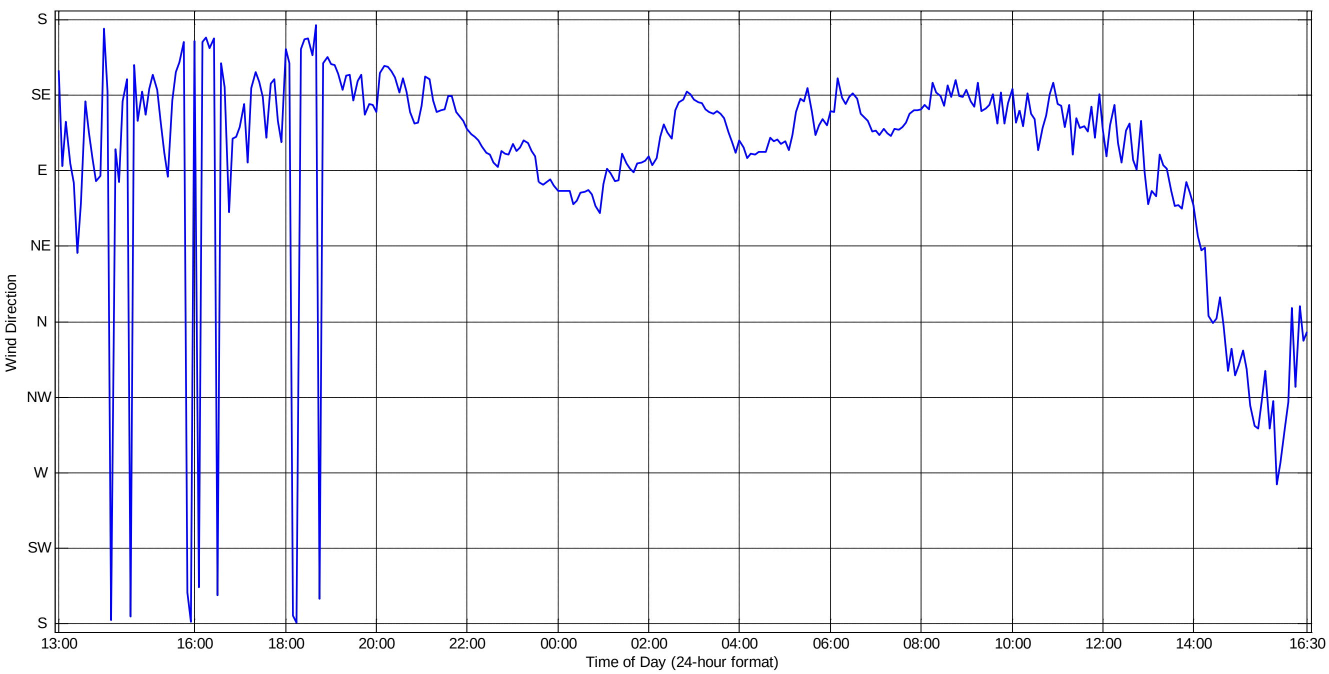
June 19 - 20, 2012 Monitored Temperature



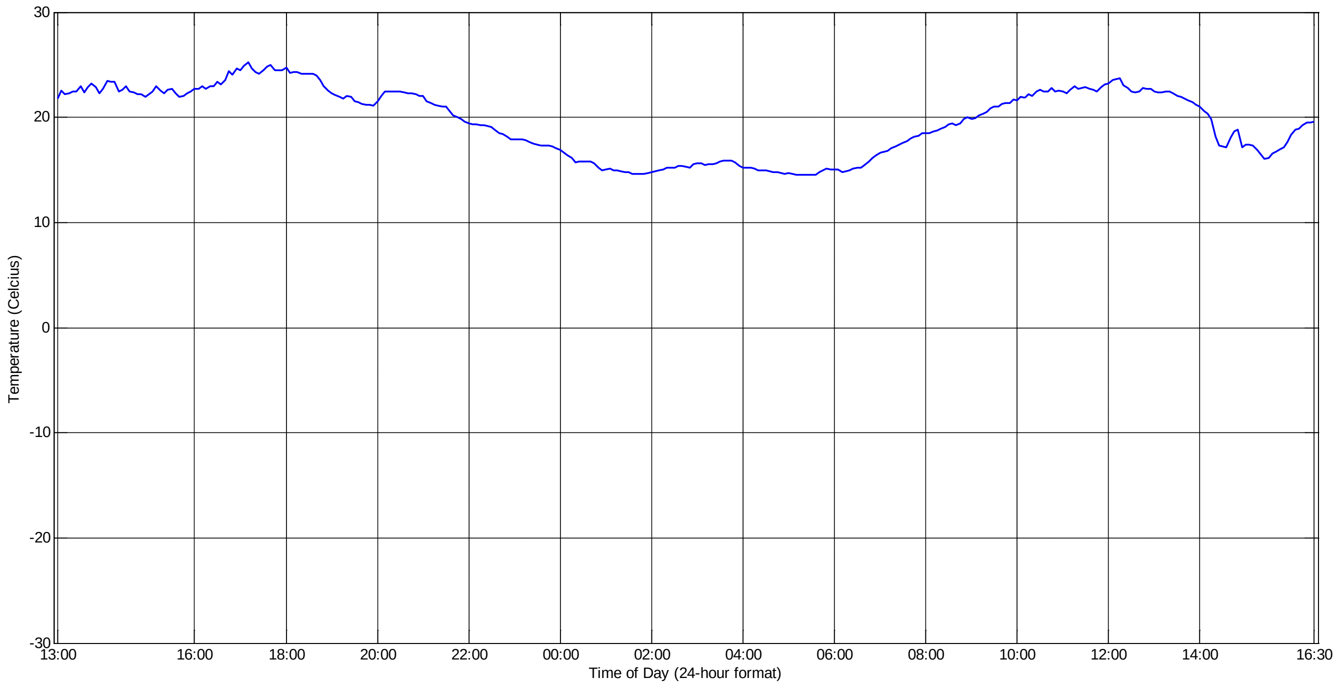
June 19 - 20, 2012 Monitored Relative Humidity



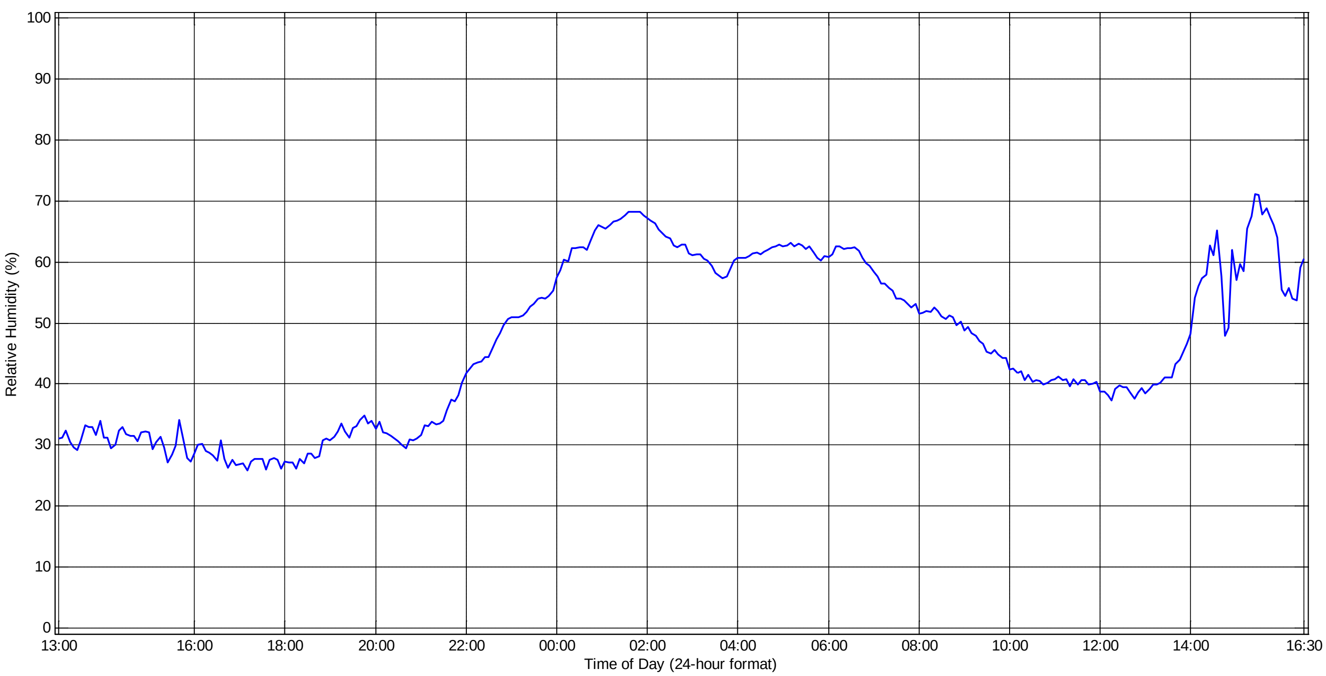
June 21 - 22, 2012 Monitored Wind Speed



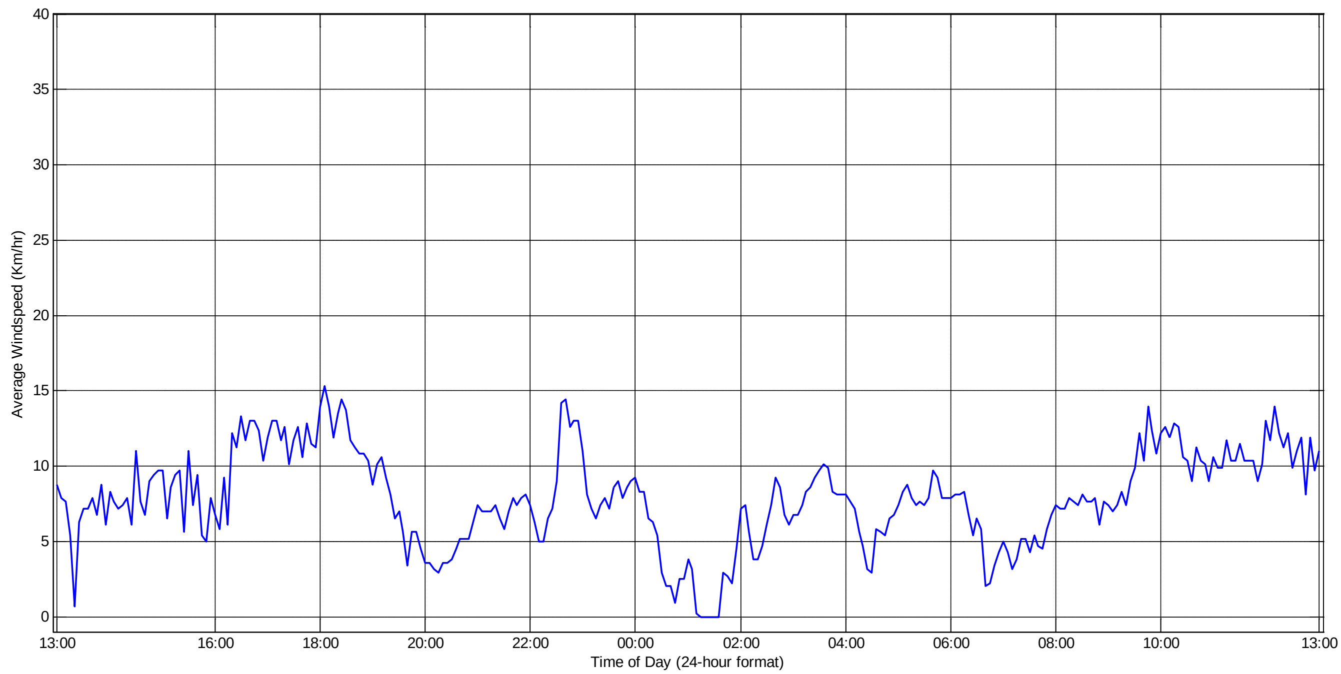
June 21 - 22, 2012 Monitored Wind Direction



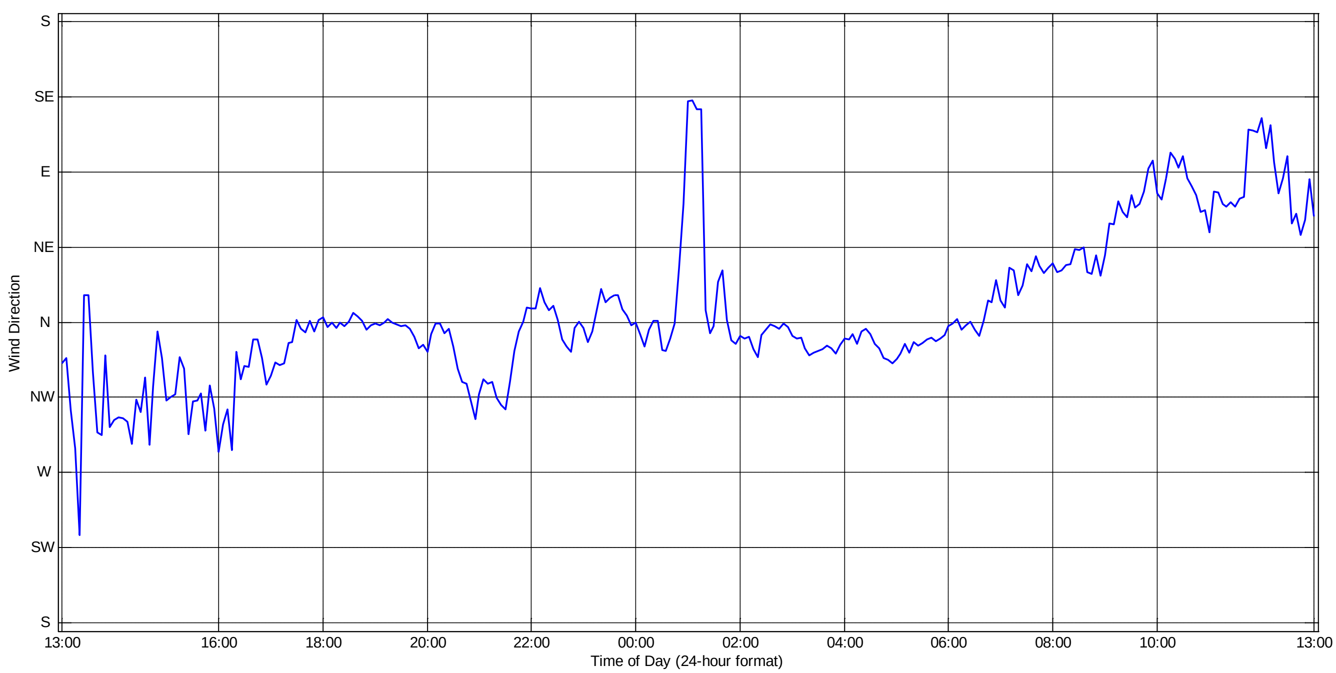
June 21 - 22, 2012 Monitored Temperature



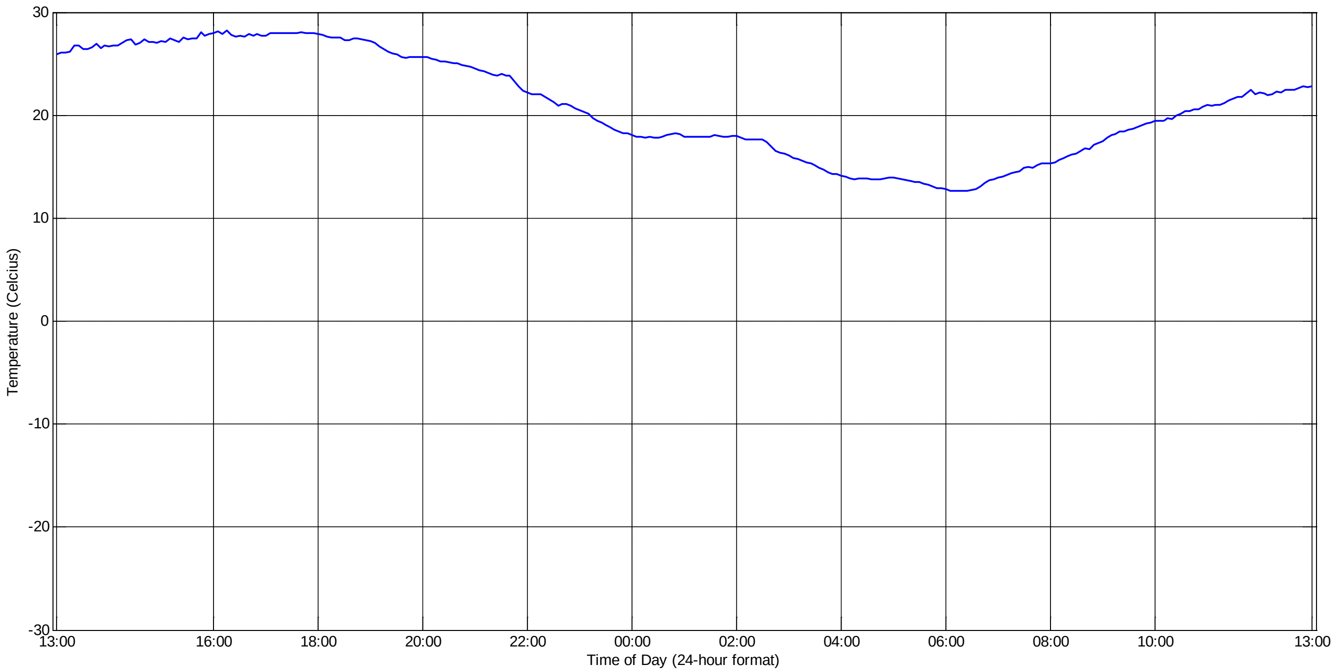
June 21 - 22, 2012 Monitored Relative Humidity



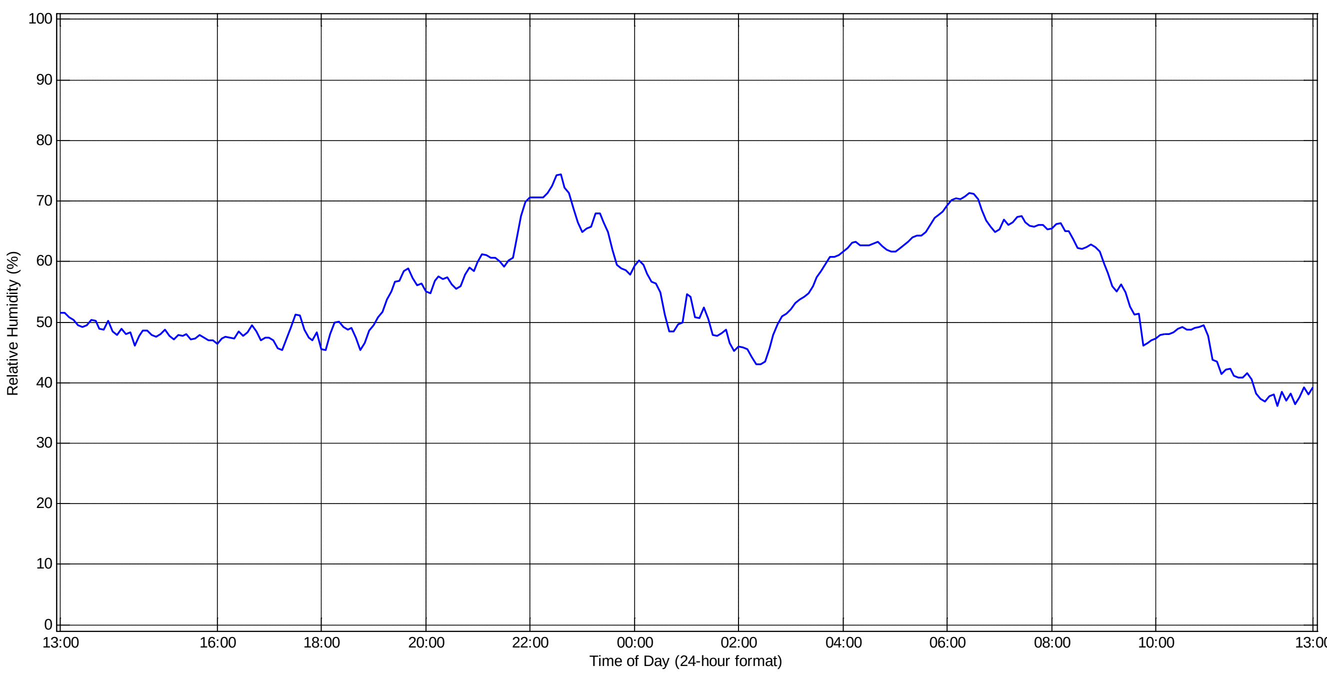
July 12 - 13, 2012 Monitored Wind Speed



July 12 - 13, 2012 Monitored Wind Direction



July 12 - 13, 2012 Monitored Temperature



July 12 - 13, 2012 Monitored Relative Humidity