Coastal Connections Conceptual Planning Study

APPENDIX F

MONTGOMERY AVENUE NOISE STUDY WAYSIDE HORN DEMONSTRATION REPORT

Montgomery Avenue Noise Study - Wayside Horn Demonstration Acoustic Monitoring Report

Montgomery Pedestrian Crossing Project

City of Encinitas, California

January 6, 2017

TABLE OF CONTENTS

List of Figures

List of Tables

Executive Summary

The purpose of the Montgomery Avenue (Ave.) Noise Study (Report) is to present the assessment of existing noise levels, and future noise associated with a proposed wayside horn near a proposed at-grade pedestrian crossing across the North County Transit District (NCTD) railroad tracks near Montgomery Ave. in the City of Encinitas, CA. Currently, pedestrians cannot legally cross the railroad at Montgomery Ave.

This study delineated a noise study area using Federal Transit Administration methods. HDR then measured outdoor noise levels continuously for 24 hours at four locations. HDR also measured noise levels associated with a demonstration of a stationary wayside horn. Three different stationary wayside horn options were evaluated in this demonstration. HDR measured noise levels throughout the study area during each of these demonstrations. Results of those measurements are presented in this report, and compared with each other in an effort to help readers understand how noise from each of the wayside horn options compares to existing noise levels in the study area.

Finally this report presents noise contour figures that are based on modeling. The figures depict how the directionality of each of the three stationary wayside horn options affects the way sound is dispersed throughout the study area.

Results of this study indicate that Option 1 introduces the highest levels of wayside horn noise into the study area. Stakeholders may consider this to be the most objectionable and intrusive option. Option 3 introduces the lowest levels of wayside horn noise into the study area, and may be the least intrusive and objectionable.

1. Introduction

Currently, pedestrians cannot legally cross the railroad track near Montgomery Ave. At this location pedestrians routinely trespass onto NCTD property and cross the track. The nearest legal pedestrian crossings are at Santa Fe Drive, 0.8 miles north, and at Chesterfield Drive, 0.5 miles south.

The July 2009 San Diego LOSSAN Corridor Project Prioritization Analysis prepared for the California Department of Transportation identifies several track-related and non-track-related projects to improve capacity, ridership, travel times, operational flexibility and reliability, and on-time performance for all passenger train services on the LOSSAN Corridor. The LOSSAN Project Prioritization identifies four Encinitas pedestrian grade separations to meet midterm 2025 goals.

Service levels are projected to increase from a 2012 base year of 50 trains to 79 trains in 2025 for midterm projections according to the LOSSAN Project Prioritization. The proposed pedestrian crossing at Montgomery Ave. will increase safety by providing another safe and legal railroad crossing which will be important as train volumes continue to increase. The crossing at Montgomery Ave. will provide a more direct route to beach access from the surrounding Cardiff community. The location, as shown in Figure 1-1, today experiences a large number of trespassers including over 90 pedestrians per hour crossing the tracks during the 2016 President's Day weekend.

Figure 1-1. Montgomery Ave. Pedestrian Crossing Location Existing Condition

2. Project Location

The proposed pedestrian crossing is located in the Cardiff By The Sea (Cardiff) community in the City of Encinitas. The project lies within and adjacent to North County Transit District (NCTD) right-of-way west of the intersection of Montgomery Ave. and San Elijo Ave. The proposed project will provide a new connection for pedestrians between the Cardiff community and beach areas to the west through the railroad ROW owned and operated by NCTD at Mile Post 239.36 of the San Diego Subdivision. The maps included as Figures 2-1 and 2-2 respectively identify the project location relative to the local street network and the regional rail network.

Figure 2-1. Montgomery Ave. Pedestrian Crossing Location Map

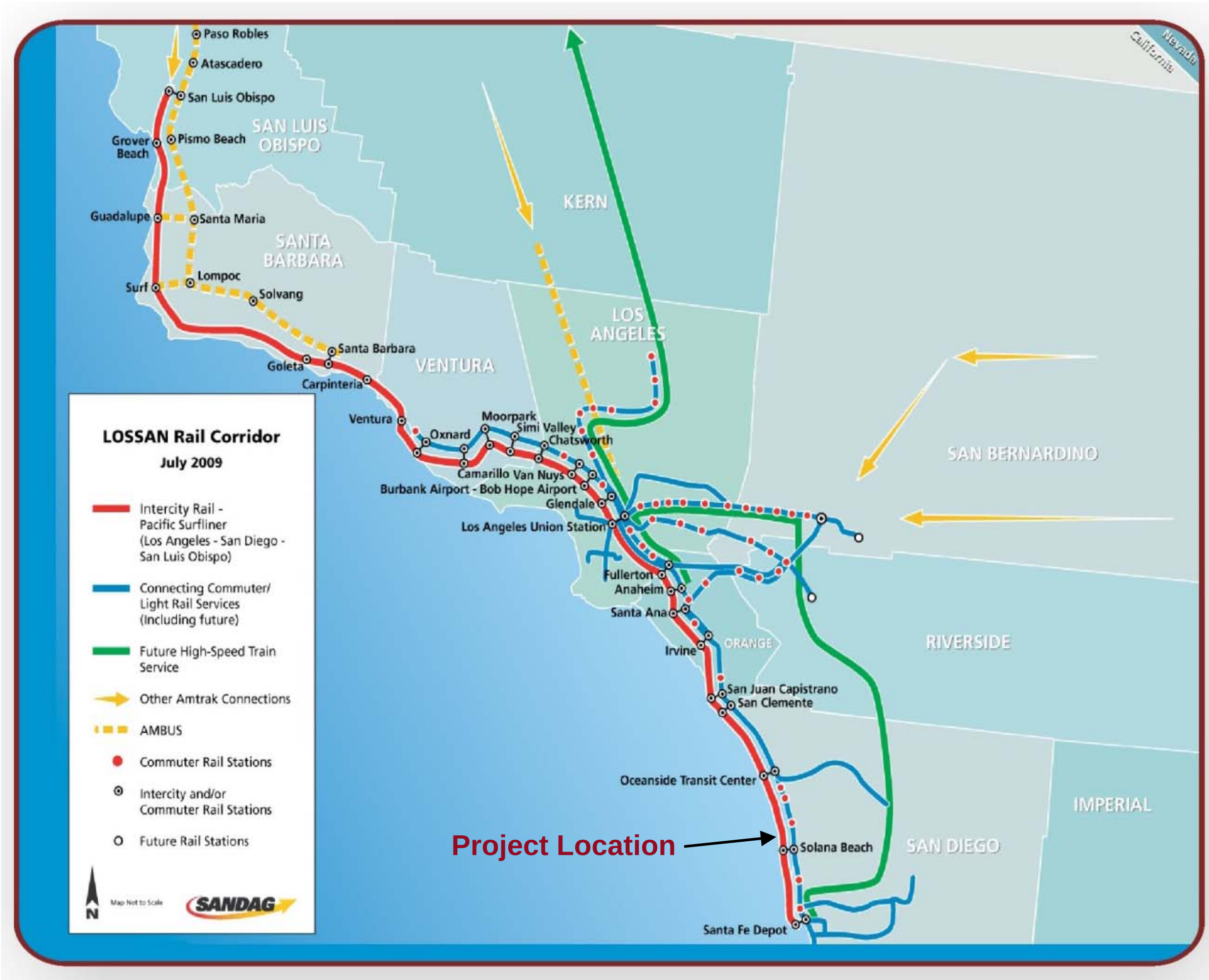

Figure 2-2. LOSSAN Rail Corridor

3. Background for Horn Use

The use of a horn for pedestrian crossings is standard practice required by CPUC and the FRA. In standard application, the locomotive will sound its112 decibel horn when approaching the grade crossing approximately 20 seconds before, or a minimum of ¼ mile away. If the City of Encinitas were to pursue a quiet zone, the locomotive would only sound its horn in emergency situations. Based on other pedestrian crossings in California quiet zones, the CPUC has required the installation of wayside horns at pedestrian only at-grade crossings. The current standards for wayside horns are applicable to roadway crossings and consist of 92 decibel horns. However, at similar pedestrian only quiet zone crossings in San Clemente California, the CPUC approved a modified wayside horn of 80 decibels.

4. Noise Study

This noise study incorporated elements of train and transit noise assessment methods published by the Federal Transit Administration (FTA) and the Federal Railroad Administration

(FRA). The noise study area was determined using FTA noise screening assessment procedures. Existing noise levels were measured using FTA methods. Additional measurements occurred during a wayside horn demonstration in which there were three different versions of the wayside horn used. This report presents and compares results of both sets of measurements. This report also presents noise contour figures depicting how propagation of sound from the wayside horn demonstration compares to sound propagating through the study area when locomotive horns are used. These noise contour figures are based on modeling results, not measurements.

4.1 Fundamentals of Sound

Noise is usually defined as sound that is undesirable because it interferes with speech communication and hearing, or is otherwise annoying. Under certain conditions, noise may cause hearing loss, interfere with human activities, and in various ways may affect people's health and well-being.

The decibel (dB) is the accepted standard unit for measuring the amplitude of sound because it accounts for the large variations in sound pressure amplitude. When describing sound and its effect on a human population, A-weighted (dBA) sound pressure levels are typically used to account for the response of the human ear to different frequencies. The term "A-weighted" refers to a filtering of the noise signal in a manner corresponding to the way the human ear perceives sound. The A-weighted noise level has been found to correlate well with people's judgments of the noisiness of different sounds and has been used for many years as a measure of community noise. Figure 4-1 illustrates typical A-weighted sound pressure levels for various noise sources.

Decibels are a logarithmic unit, and therefore combining two noise levels is not a simple arithmetic function. When two noise levels are added together, the resulting noise level is not the arithmetic sum of the two. When two identical noise levels are added together, the result is a three dB increase. If the two noise levels being added together are not identical, the incremental increase will be less than three dB. As the difference between the two noise levels increases, the resulting incremental change decreases. If the difference between the two noise levels is 10 dB or more, there is no incremental change (the resulting noise level is the louder of the two noise levels being combined). For example, when two noise levels differ by 0 to 1 dB and you combine them, you add 3 dB to higher value. When two noise levels differ by 2 to 3 dB, you add 2 dB to the higher noise level. If the difference is 4 to 9 dB, you add 1 dB. And if the difference is 10 dB or more, there is no incremental increase.

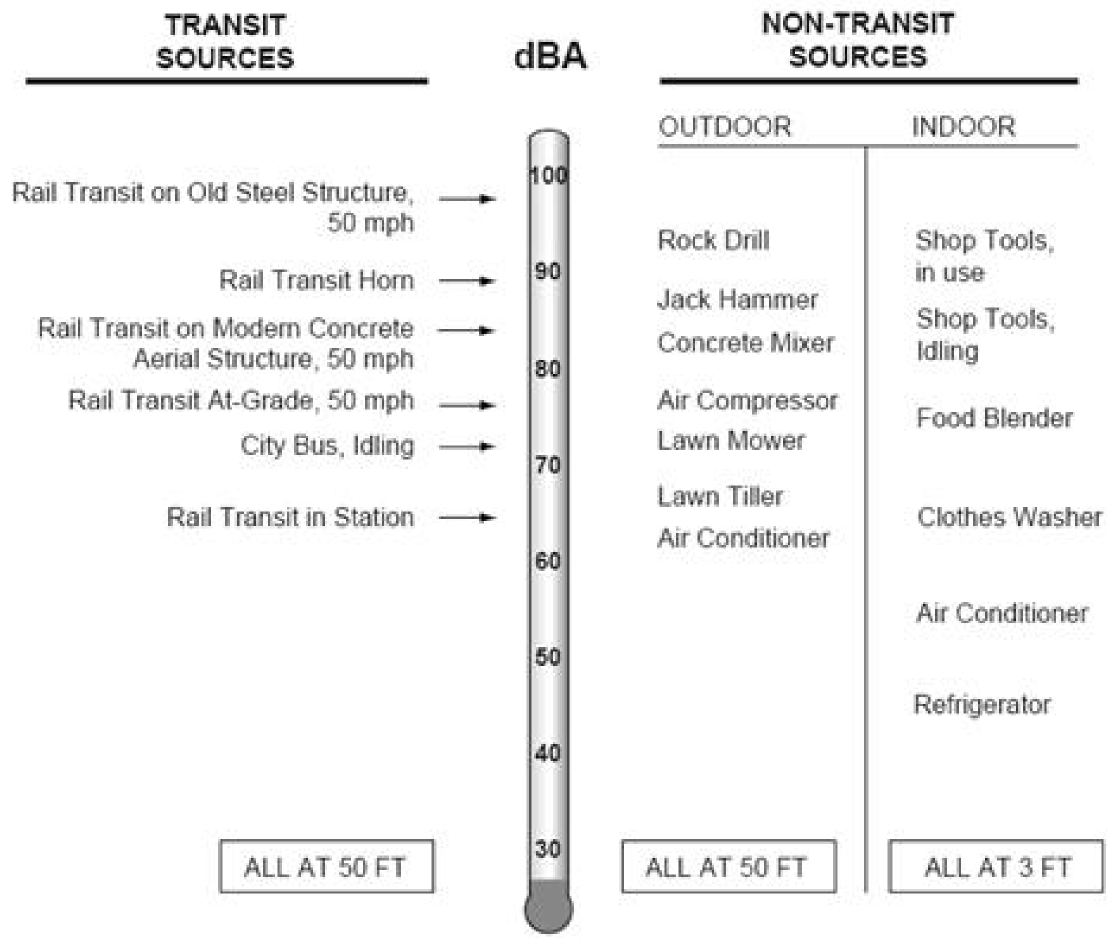

Figure 4-1. Typical Noise Levels

Source: FTA 2006

Community noise levels usually change continuously during the day. The equivalent continuous A-weighted sound pressure level (L_{eq}) is normally used to describe community noise. The L_{eq} is the equivalent steady-state A-weighted sound pressure level that would contain the same acoustical energy as the time-varying A-weighted sound pressure level during the same time interval. The maximum sound pressure level (L_{max}) is the greatest instantaneous sound pressure level observed during a single noise measurement interval.

4.2 Noise Study Area

The boundaries of the noise study area were determined using screening assessment methods published by FTA (FTA, 2006). Based on FTA guidance, a screening distance of 1,200 feet (from the location of the proposed pedestrian crossing) was used to delineate the noise study area. Figure 4-2 shows the noise study area and where noise measurements occurred (those measurements are discussed in the following sections).

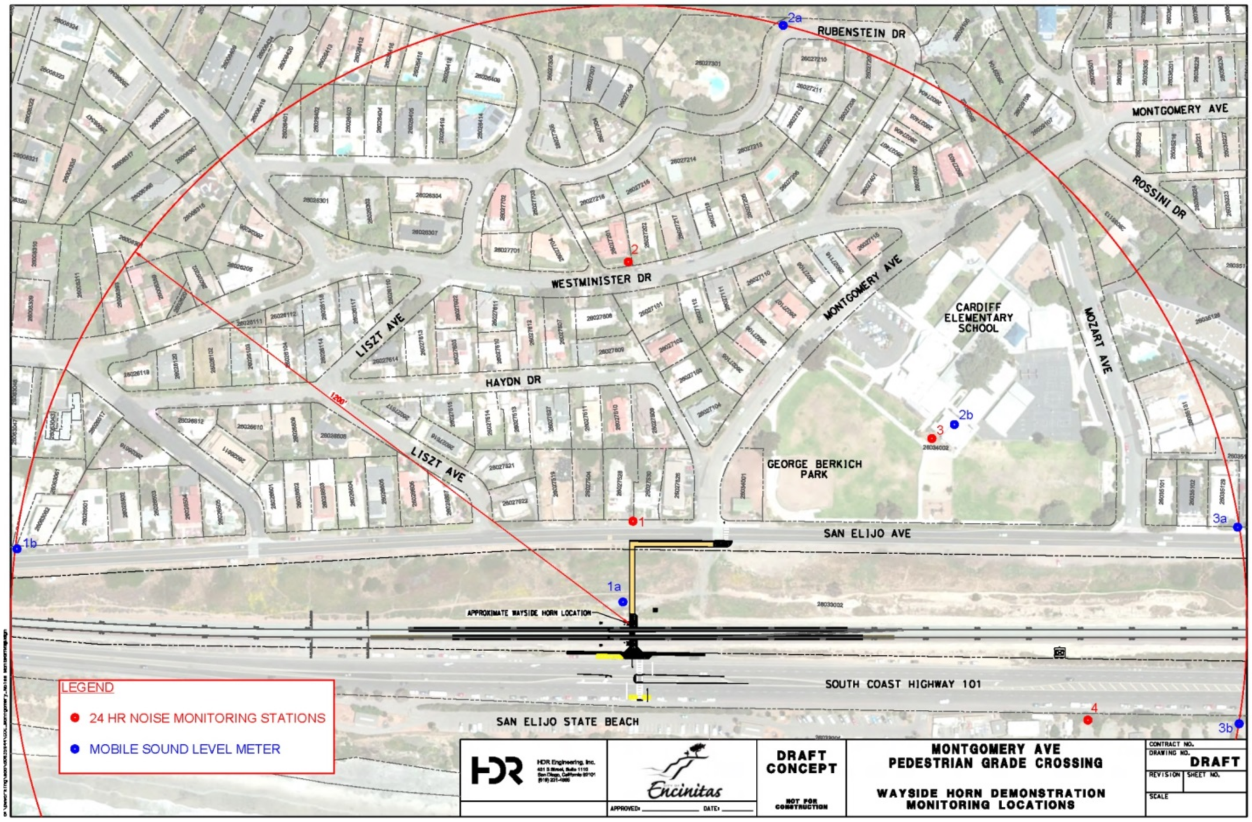

Figure 4-2. Noise Study Area

4.3 Existing Noise Measurements

In accordance with FRA and FTA noise assessment methodologies, existing noise levels were measured for a continuous 24-hour period at four locations. Table 4-1 presents the locations where the 24-hour noise measurements occurred.

Table 4-1. 24-hour Noise Measurement Locations

ID	LOCATION
1	1729 San Elijo Avenue
2	1805 Westminster Drive
3	Cardiff Elementary School
4	San Elijo State Beach Campground

Results of the 24-hour noise measurements are discussed below.

Table 4-2 presents the results of the 24-hour and 1-hour noise measurements. The table shows the measured L_{eq} at each long term (24-hour) measurement location (LT1, etc.). The L_{eq} is a type of average noise level.

Table 4-2. Comparison of Measured Hourly Leq

HOUR	HOURLY LEQ (DBA)			
	LT1	LT2	LT3	LT4
0:00	65	57	50	60
1:00	51	50	43	58
2:00	50	46	42	49
3:00	52	46	43	44
4:00	55	47	46	50
5:00	60	55	53	57
6:00	63	61	54	65
7:00	67	58	56	68
8:00	67	57	56	69
9:00	65	54	58	67
10:00	65	58	58	66
11:00	66	54	60	66
12:00	66	56	58	67
13:00	65	55	59	67
14:00	64	57	58	67
15:00	66	59	56	67
16:00	65	61	55	68
17:00	66	61	57	69
18:00	64	60	56	68
19:00	65	54	53	67
20:00	63	54	50	64
21:00	63	54	53	62
22:00	62	61	53	62
23:00	60	56	52	58

Figure 4-3 shows a graphical comparison of the measured Leq values, allowing readers to observe how average hourly noise levels change at each measurement location.

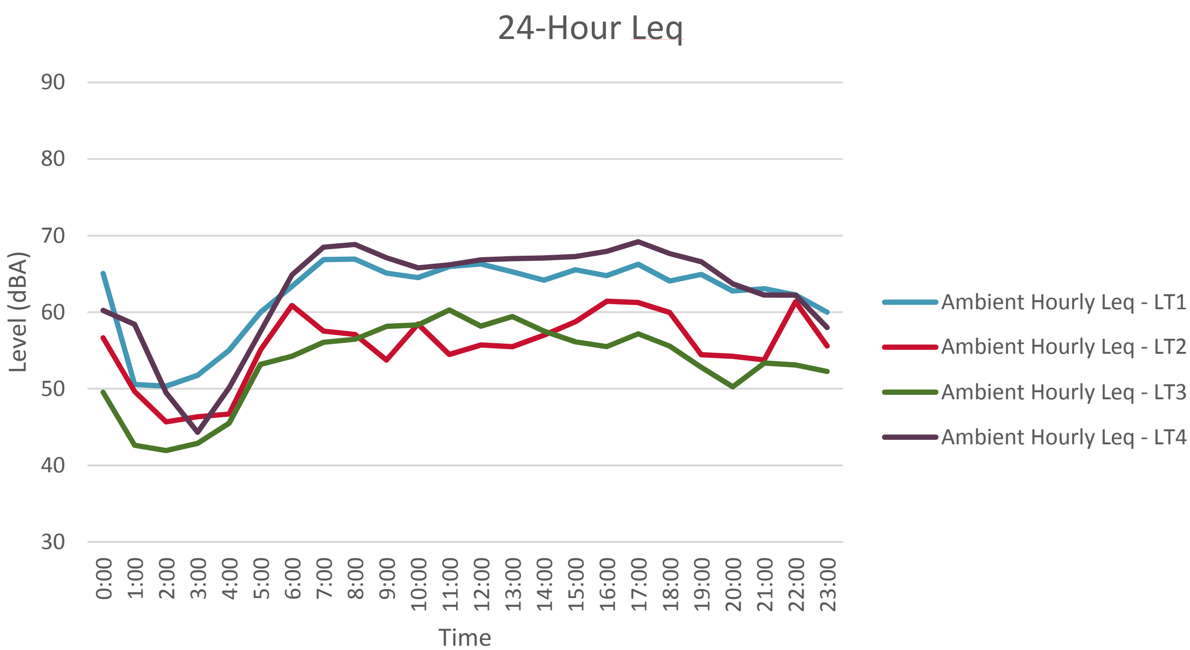

Figure 4-3. Graphical Comparison of Hourly Leq Values

Figure 4-3 above shows that the quietest nighttime hours are between 1:00 am and 4:00 am.

Table 4-3 presents the maximum noise level (Lmax) measured each hour during the 24-hour measurements.

Table 4-3. Comparison of Measured Hourly Lmax

HOUR	MAXIMUM HOURLY LMAX (DBA)			
	LT1	LT2	LT3	LT4
0:00	95	80	72	80
1:00	71	68	54	81
2:00	74	57	63	74
3:00	67	53	61	69
4:00	79	60	58	75
5:00	85	75	74	78
6:00	82	90	76	84
7:00	83	75	77	85
8:00	84	77	78	83
9:00	87	74	76	82
10:00	88	86	81	82
11:00	93	73	82	82
12:00	95	76	76	85
13:00	86	76	77	89
14:00	80	76	74	87
15:00	89	78	71	83
16:00	82	78	72	82
17:00	92	77	79	89
18:00	84	78	77	88
19:00	91	74	68	91
20:00	81	77	66	79
21:00	90	77	78	79
22:00	85	80	75	85
23:00	86	78	80	77

Figure 4-4 shows a graphical comparison of the measured Lmax values, allowing readers to observe how maximum hourly noise levels change at each measurement location.

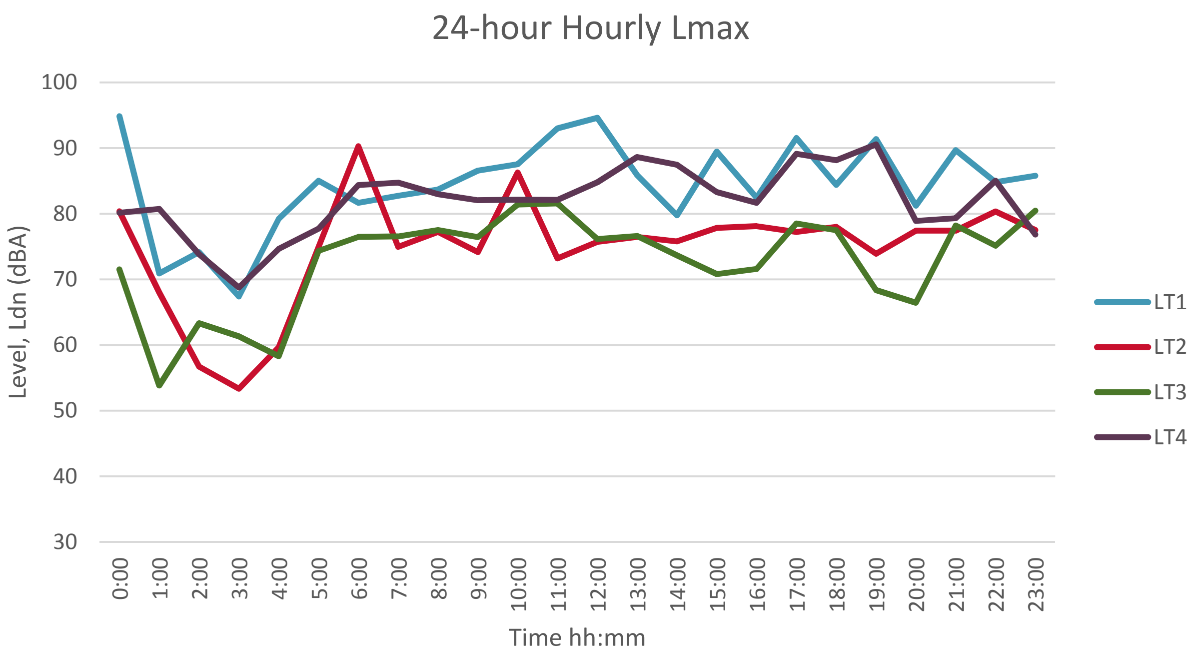

Figure 4-4. Graphical Comparison of Hourly Lmax Values

Figure 4-4 above shows that maximum noise levels fluctuate throughout the day, and during some hours the Lmax is quite loud (above 80 dBA). The Lmax represents the loudest instantaneous noise level each hour, and could have a very short duration.

4.4 Wayside Horn Demonstration

During the demonstration, wayside horns were placed on both sides of the RR tracks using a "cherry picker" or bucket truck on each side of the tracks. The wayside horn demonstration utilized three types of wayside horns. They included:

- Option 1: Conventional Horn

  Wayside horns will be sounded at a level of 92 dB(A) at a distance of 100 feet measured from the centerline of the near track. Horns are aimed away from the tracks towards the proposed walkway approaches.

- Option 2: Horn Towards Tracks

  Wayside horns will be sounded at a level of 92 dB(A) measured directly above the tracks. Horns are aimed down towards the tracks.

- Option 3: Modified Pedestrian Horn

  Option three will be to simulate pedestrian horns that will provide a sound level of 80 dB(A) measured approximately 20 feet from the proposed crossing gates. Noise is emitted from the bollard on each side of the proposed crossing.

Figure 4-5 shows the two bucket trucks used during the wayside horn demonstration.

Figure 4-5. Photograph of Wayside Horn Demonstration

4.5 Wayside Horn Noise Measurements

HDR measured noise from the 3 types of wayside horns used during the demonstration. The duration of each measurement was short and lasted as long as a wayside horn event. The measurements occurred at 10 locations in the study area. Brief ambient noise measurements were performed either before or after each wayside horn simulation, at each measurement location.

Figure 4-6 shows the maximum noise levels (Lmax) measured at ML3a during the wayside horn measurements. It also shows results of an ambient noise measurement performed at that location, without any wayside horn noise present. This facilitates a comparison of wayside horn noise with background noise at this location.

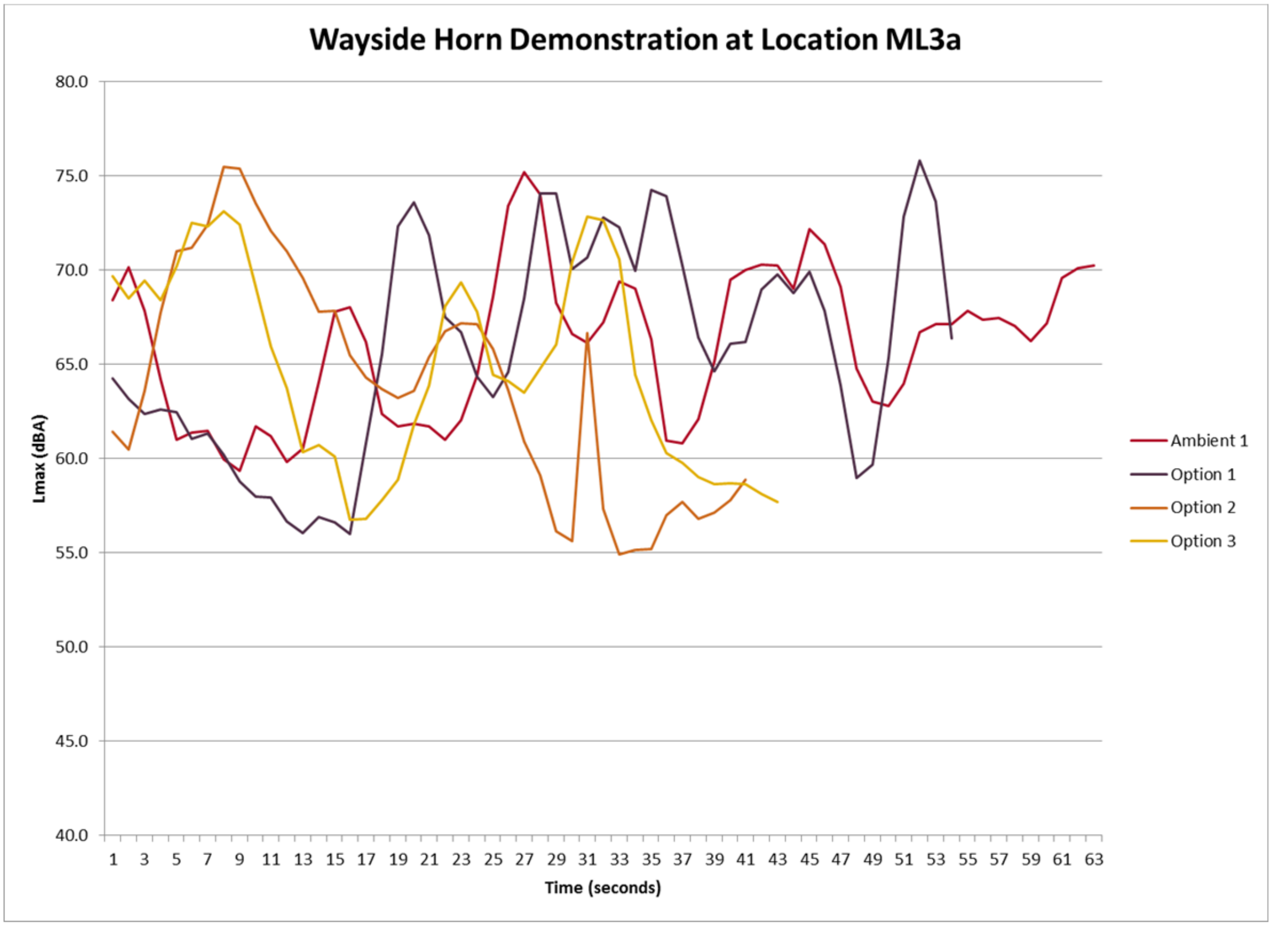

Figure 4-6. Wayside Horn Lmax at ML3a

The individual horn events appear as spikes in the measurement results shown in the graph above; the ambient noise measurement also exhibits spikes that are unrelated to the horn demonstration. Note that maximum noise levels among the data above are fairly comparable.

Figure 4-7 presents the wayside horn noise (Lmax) measured at LT1. It also shows results of an ambient noise measurements performed at that location, without any wayside horn noise present. This facilitates a comparison of wayside horn noise with background noise at this location.

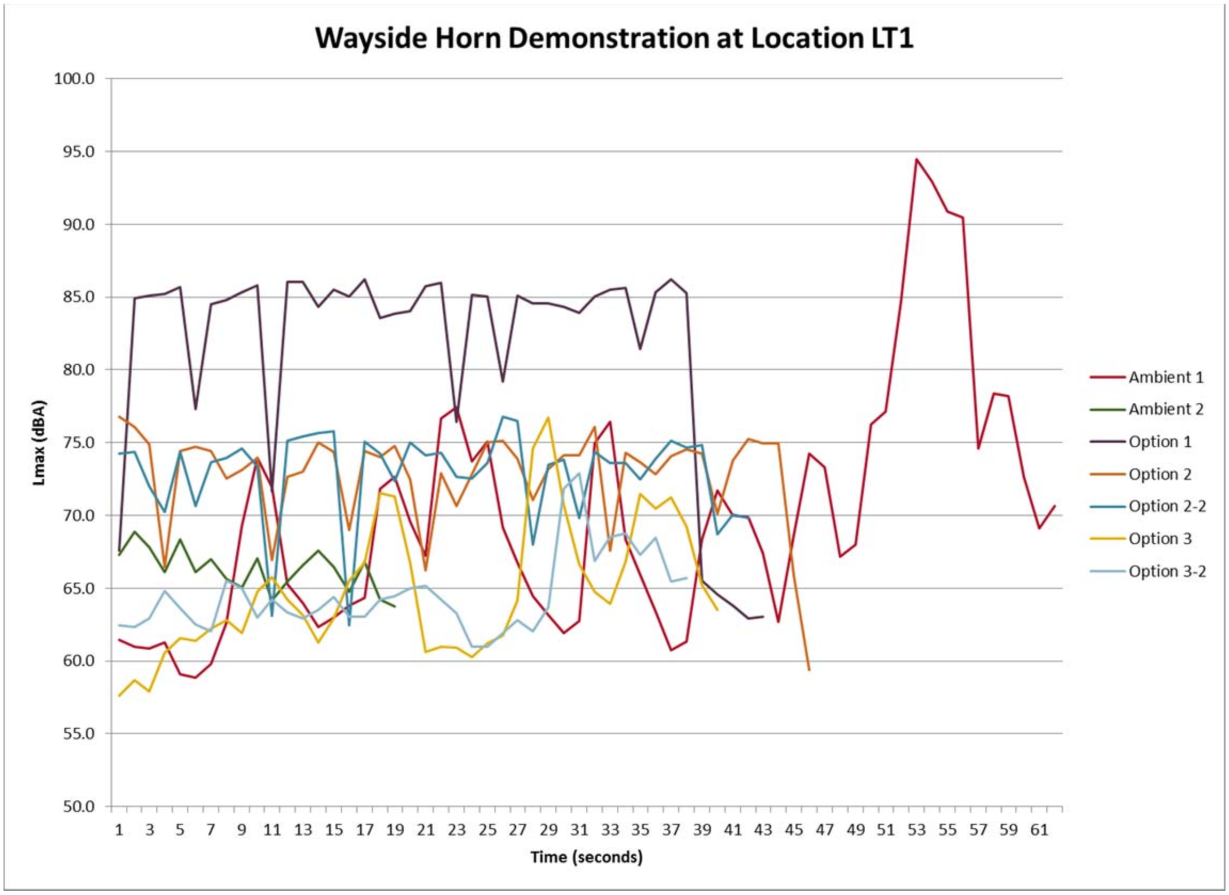

Figure 4-7. Wayside Horn Lmax at LT1

This data shows that wayside horn type 1 is dramatically louder than the other two horn types when measured at this location. This data shows that the horns themselves are calibrated to a fairly constant sound pressure level when they are actuated. This data also shows that horn Types 2 and 3 (Options 2 and 3) are understandably quieter at this location (because they are not pointed directly at the walkway, towards the nearest homes).

4.6 Comparison of Wayside Horn vs. Ambient Noise Measurements

In this section the Lmax from wayside horn demonstrations is compared with the average hourly noise level (Leq) measured in the project area. These figures also show the Lmax associated with locomotive horn use during train pass-by events. The purpose of this comparison is to show how wayside horn noise will be different from the ambient or background noise throughout the day at each of the 24-hour measurement locations.

Figure 4-8 compares the wayside horn Lmax and hourly Leq measured at LT1.

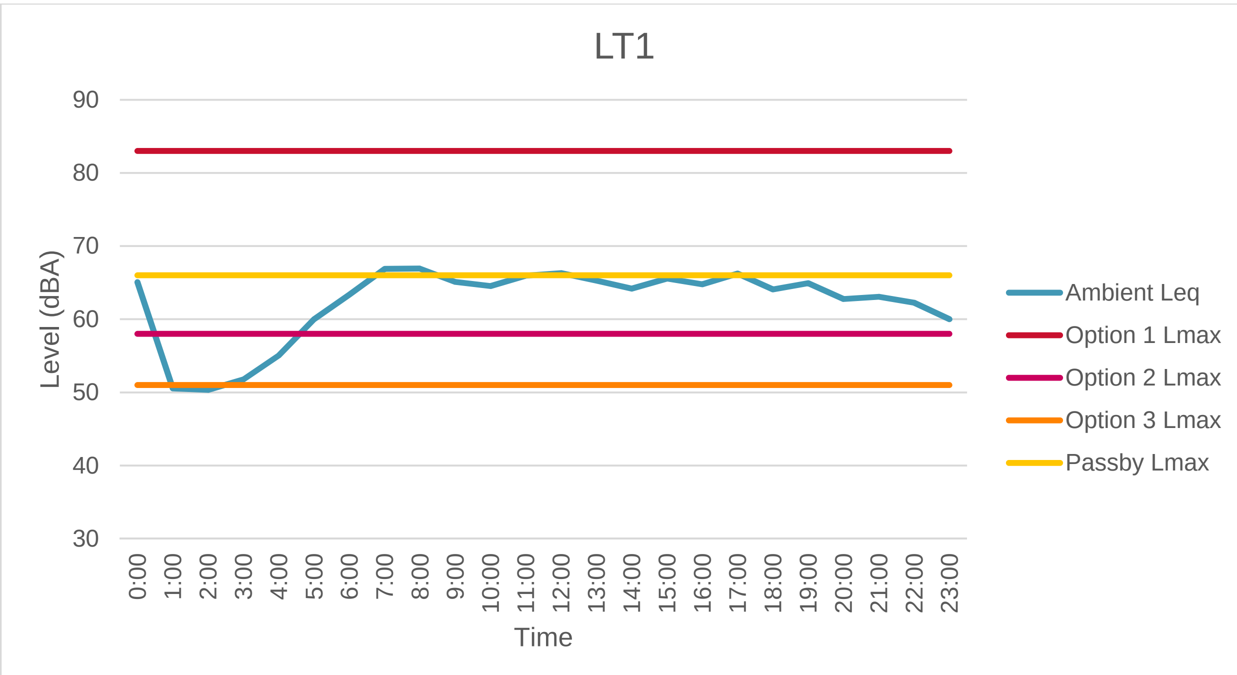

Figure 4-8. Comparison of Wayside Horns Lmax and Ambient Leq at LT1

In this and subsequent graphs, the 24 hourly Leq values appear as the fluctuating line in the graphs. The measured Lmax value associated with each wayside horn option appear as fixed lines. These graphs illustrate how the maximum noise level associated with each wayside horn option compares to the ambient noise level measured throughout the day at each location; it's intended to provide insight on how loud the wayside horns will be in the ambient acoustic environment at each measurement location.

Data in this graph shows that wayside horn Option 1 is dramatically louder than the other two wayside horns at LT1. It also shows that horns 2 and 3 are quieter than hourly Leq values for most of the day and night (except for the quietest hours of the night). Note that the Lmax from train passby events is comparable to the ambient Leq for most of the day.

Figure 4-9 compares the wayside horn Lmax and hourly Leq measured at LT2.

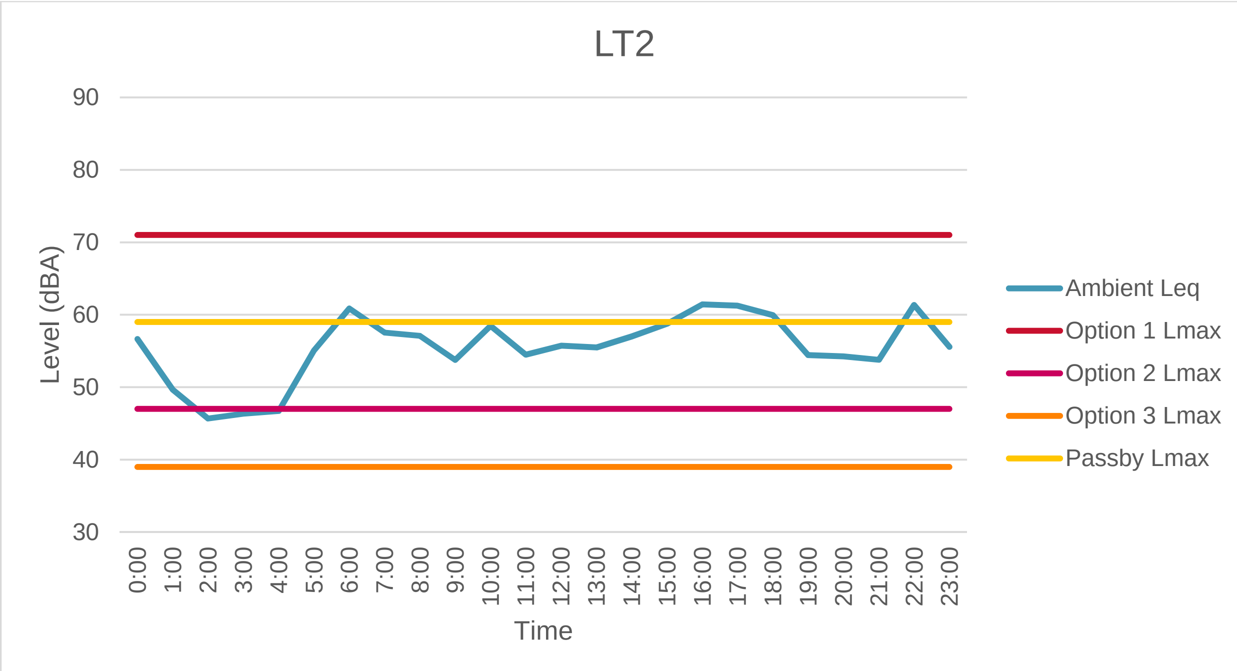

Figure 4-9. Comparison of Wayside Horns Lmax and Ambient Leq at LT2

Data in this graph also shows that wayside horn Option 1 is dramatically louder than the other two wayside horns at LT2. It also shows that horns 2 and 3 are quieter than hourly Leq values for most of the day and night (except for the quietest hours of the night). Again, the Lmax from train passby events is comparable to the ambient Leq for most of the day.

Figure 4-10 compares the wayside horn Lmax and hourly Leq measured at LT2.

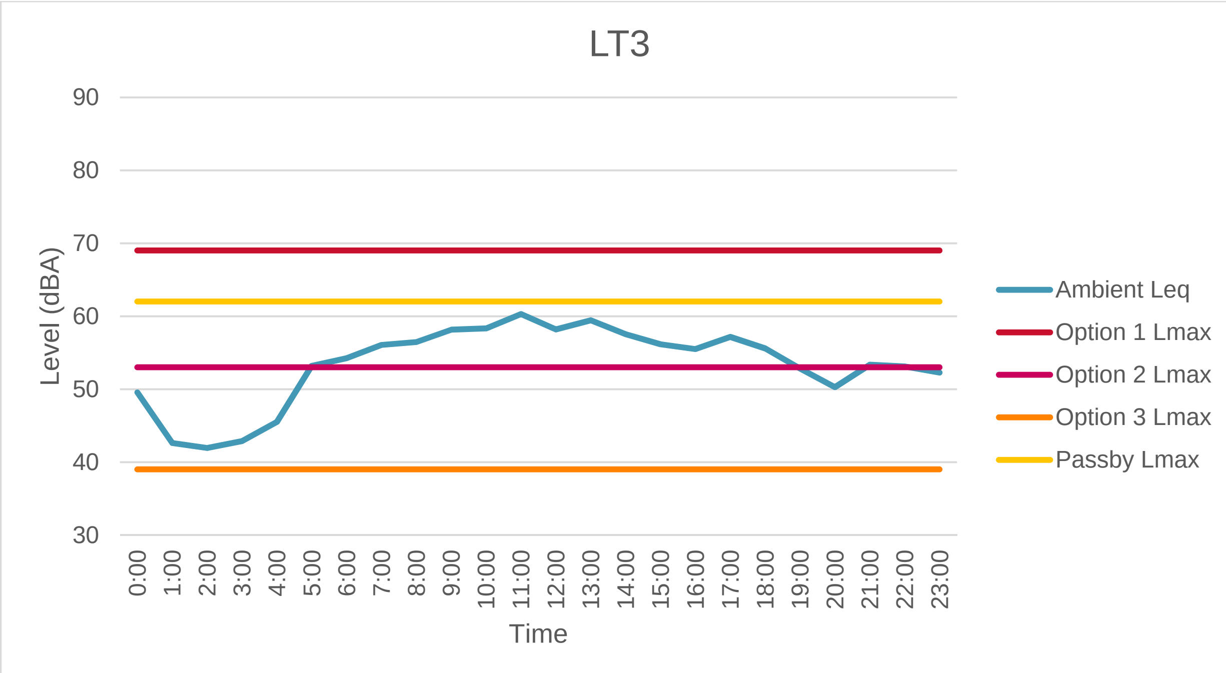

Figure 4-10. Comparison of Wayside Horns Lmax and Ambient Leq at LT3

Data in this graph also shows that wayside horn Option 1 is dramatically louder than the other two wayside horns at LT3. It also shows that horns 2 and 3 are quieter than hourly Leq values for most of the day and night, with a few exceptions. However, the Lmax from train passby events is louder than the ambient Leq for most of the day. The figure shows that ambient Leq values are above Option 3 Lmax values at this location for daytime and nighttime hours. The figure also shows that Option 2 Lmax values are closest to the ambient Leq values at this location.

Figure 4-11 compares the wayside horn Lmax and hourly Leq measured at LT4.

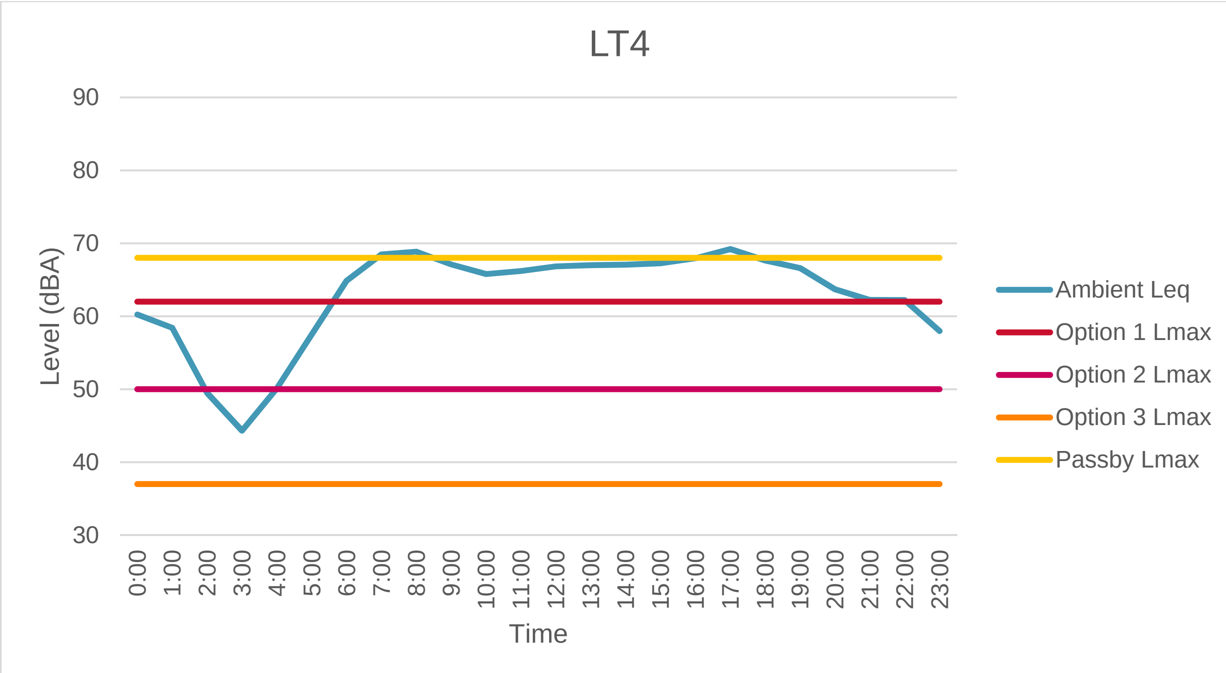

Figure 4-11. Comparison of Wayside Horns Lmax and Ambient Leq at LT4

Data in this graph shows that the Lmax from train passby events is louder than the ambient Leq for most of the day; it is also louder than wayside horn Option 1. Ambient Leq is louder than wayside horns 2 and 3 for most of the day.

The next series of figures presents a comparison of the Lmax measured during each wayside horn option with the ambient hourly Leq; each figure shows data measured at all of the 24-hour measurement locations. The goal of these figures is to show how loud each wayside horn option is at all of the 24-hour measurement locations in a single figure. Readers will be able to understand the effects of each horn on the entire study area through these figures.

Figure 4-12 shows how the wayside horn Option 1 Lmax at each measurement location compares with the time-varying hourly Leq levels at each location.

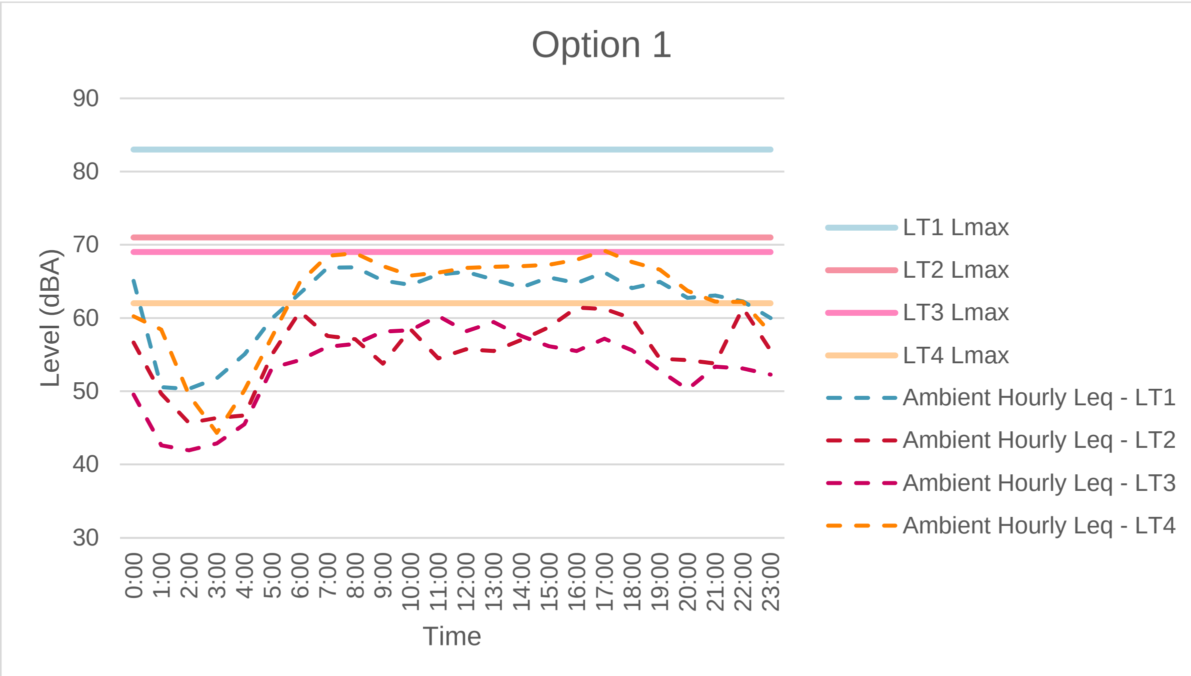

Figure 4-12. Option 1 Lmax vs. Leq at 24-hour Measurement Locations

As expected, Option 1 Lmax values are highest at the measurement locations closest to the proposed pedestrian crossing. This Lmax is also higher than ambient hourly Leq values at most locations. This option may be perceived as intrusive by stakeholders throughout the study area because it is louder than average noise levels at most of the measurement locations.

Figure 4-13 shows how the wayside horn Option 2 Lmax at each measurement location compares with the time-varying hourly Leq levels at each location.

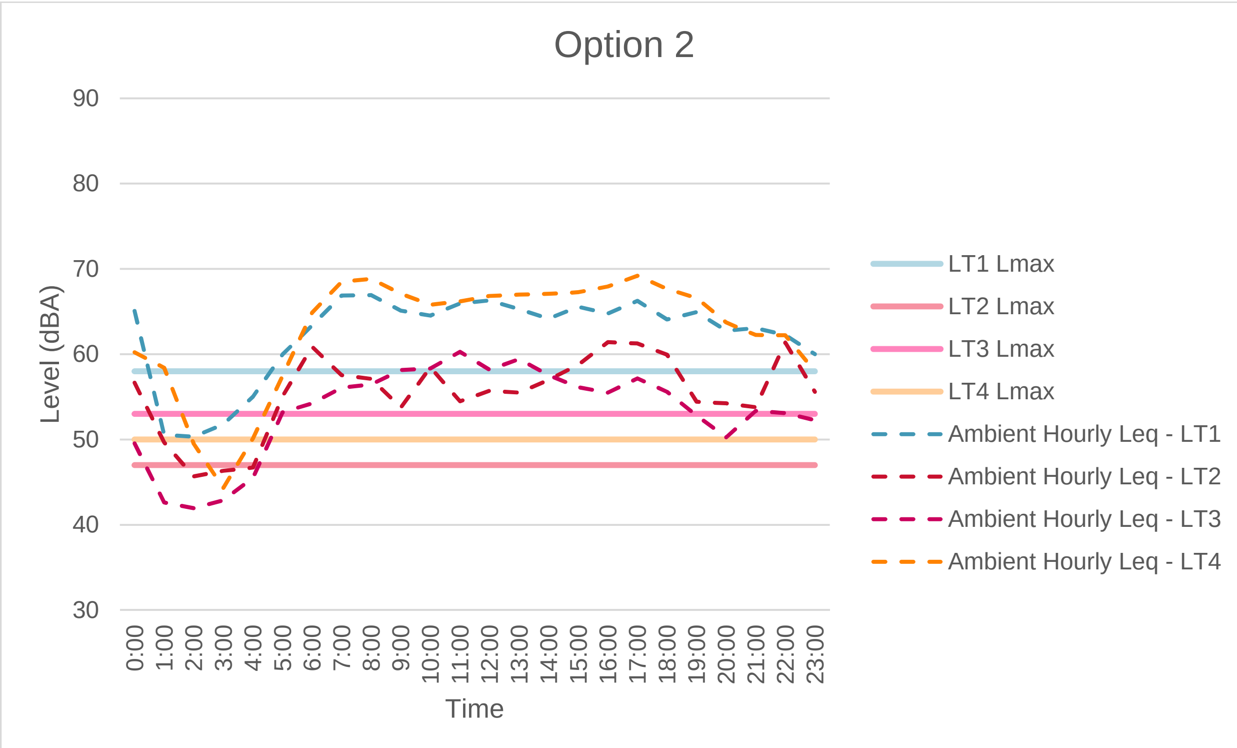

Figure 4-13. Option 2 Lmax vs. Leq at 24-hour Measurement Locations

As expected, Option 2 Lmax values are lower than Option 1 Lmax values throughout much of the study area. Option 2 Lmax values are also lower than ambient noise levels throughout much of the study area. This option may be less intrusive and less objectionable to stakeholders than Option 1.

Figure 4-14 shows how the wayside horn Option 3 Lmax at each measurement location compares with the time-varying hourly Leq levels at each location.

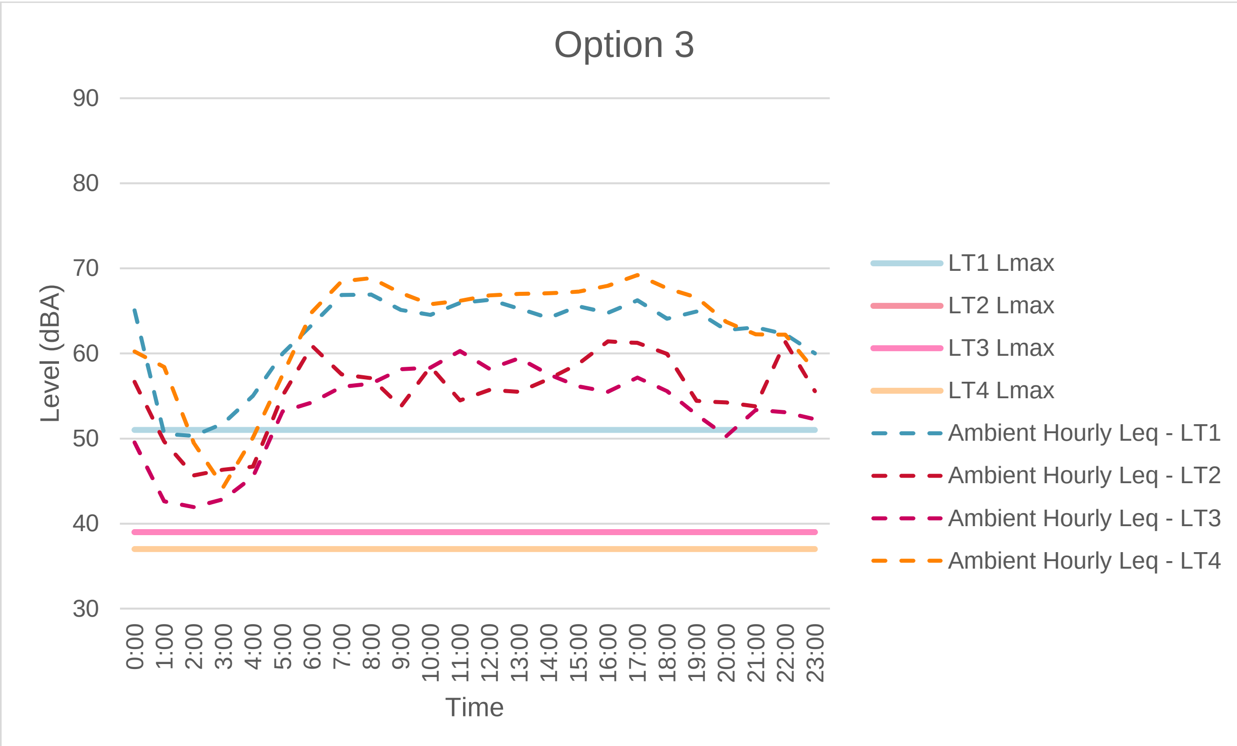

Figure 4-14. Option 3 Lmax vs. Leq at 24-hour Measurement Locations

Maximum noise levels associated with Option 3 are notably below ambient Leq levels at 24-hour measurement locations throughout the study area. Stakeholders may perceive this as the least intrusive wayside horn option.

Figure 4-15 shows how the locomotive horn Lmax at each measurement location compares with the time-varying hourly Leq levels at each location.

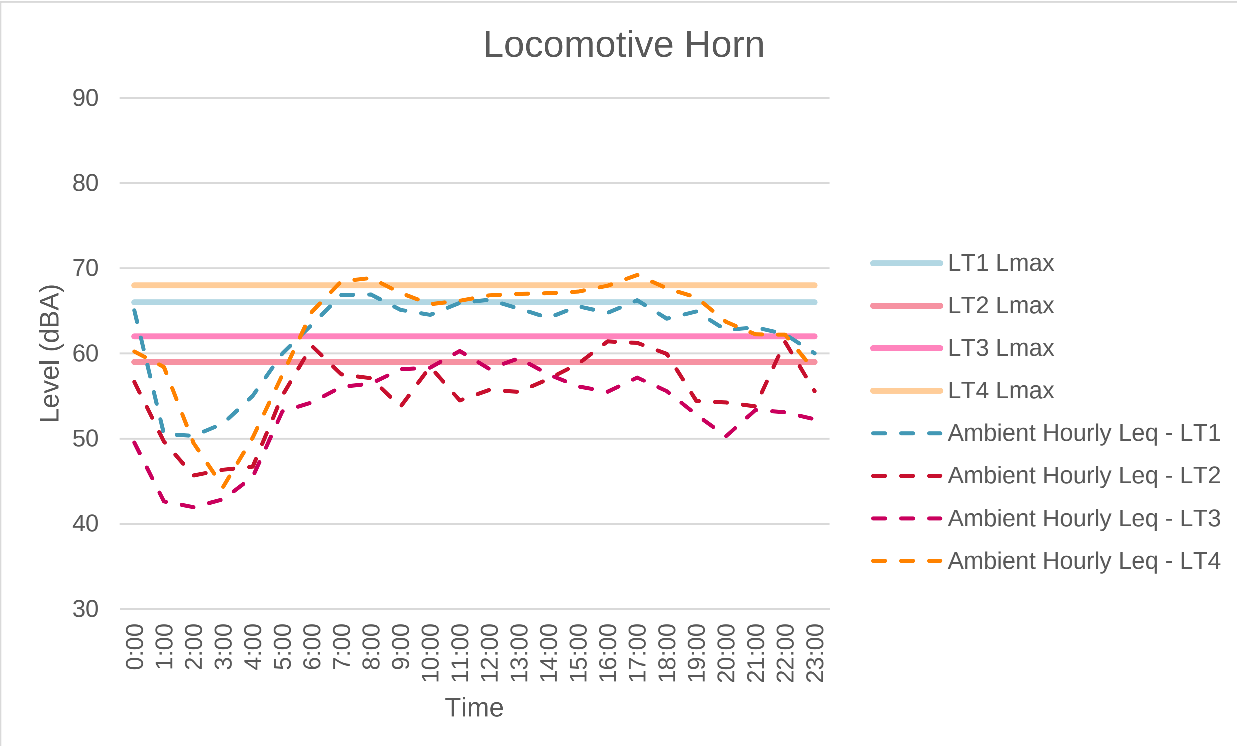

Figure 4-15. Locomotive Horn Lmax vs. Leq at 24-hour Measurement Locations

This figure shows that locomotive horn Lmax values are comparable to ambient Leq values throughout most of the study area.

4.7 Modeled Noise Contours

This section presents noise contour figures created using an acoustical modeling software called Cadna-A. Cadna is based on international acoustical standards including ISO 9613 (propagation of sound outdoors). The wayside horn options were each modeled a stationary noise sources using the sound pressure levels measured or reported by the manufacturer. If the option has any defined directivity, it was included in the model.

Figure 4-16 shows modeled noise contours associated with the Option 1 wayside horn configuration.

Figure 4-16. Option 1 Wayside Horn Noise Contours

The noise contours are somewhat polar-shaped (with two lobes) focused into and away from the study area. Note the contours closest to LT2 (70 dBA) and 2a (65 dBA). Also note that the 50 dBA contour lines are not visible in this figure. This option introduces the highest levels of wayside horn noise into the study area.

Figure 4-17 shows modeled noise contours associated with the Option 2 wayside horn configuration.

Figure 4-17. Option 2 Wayside Horn Noise Contours

The noise contours are somewhat polar-shaped (two lobes), however they are focused parallel to the rail line. Note the contours closest to LT2 (45 dBA) and 2a (40 dBA). Also note where the 50 dBA contour line is, for comparison with the other noise contour figures. This option introduces less noise into the study area than Option 1.

Figure 4-18 shows modeled noise contours associated with the Option 3 wayside horn configuration.

Figure 4-18. Option 3 Wayside Horn Noise Contours

The noise contours radiate outward equally in all directions (there is no directionality). Note the contours closest to LT2 (40 dBA) and 2a (35 dBA). For comparison purposes, note where the 50 dBA contour line is. Based on modeling results, this option introduces the least amount of noise into the study area.

Figure 4-19 shows modeled noise contours associated with locomotive horn use.

Figure 4-19. Locomotive Horn Noise Contours

Note that the noise contours radiate out into the study area throughout the length of the study area, exposing most of the study area to horn noise. LT2 is between the 55 and 60 dBA contour, and 2a is between the 50 and 55 dBA contours.

In summary, more homes are exposed to noise from horns on locomotives that are moving in both directions (N and S) on the train tracks. Use of a stationary post-mounted wayside horn device dramatically reduces the footprint of homes exposed to horn noise. Option 1 introduces the most noise into the study area; Option 3 introduces the least amount of noise into the study area.