



**Aggregate Extraction and Processing Operation
Predicted Sound Levels and
Ambient Sound Level Measurements**

Yellowhead Aggregates
Proposed Pit 31 Turnbull (Onoway)

Prepared For

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FFA File 108 – 1883 - 01

Executive Summary

Yellowhead Aggregates retained FFA Consultants in Acoustics and Noise Control Ltd. (FFA) to predict the sound levels of their proposed aggregate extraction and processing operations at Pit 31 Turnbull (Onoway) to the surrounding community. It was also requested that ambient sound survey be conducted to determine the existing sound levels in the area. Pit 31 would be located in Section 6-55-1 W5M.

Sound pressure level measurements of the actual aggregate processing and extraction equipment that would be used at Pit 31 were undertaken at an existing Yellowhead Aggregates operating pit on June 4, 2008. A sound monitoring survey was also taken at two locations at the site to document the existing sound levels and nature of the sound environment at the site.

The measured equipment sound level data was used to determine sound power levels for the significant noise sources associated with the aggregate extraction and processing operation. These calculations followed accepted acoustical engineering practices for the determination of sound power levels from sound pressure levels for large machinery. The sound power levels were then incorporated into ENM, an environmental noise propagation model. The ENM model was used to predict the facility sound level to four of the residences located nearest to Pit 31. The results of the modelling are presented in the following table.

**Yellowhead Aggregates
Pit 31 Turnbull (Onoway)
Predicted Sound Levels**

Residence	Predicted Operational Sound Level (dBA)
1	42.9
2	48.7
3	36.6
4	34.6

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Ambient sound level measurements were undertaken at two locations at the Pit 31 site to establish the existing sound environment at the site. Measurement location 1 was located at the southwest corner of the site and location 2 was located at the east side of the site. The sound survey ran continuously and encompassed 3 nighttime periods. The daytime sound levels ranged from 36.5 to 45.6 dBA Leq and the nighttime sound levels ranged from 34.9 to 37.9 dBA Leq. The sounds of vehicle traffic on Highway 37 was clearly evident along with the typical rural sounds of vehicles on local roads, the sound of aircraft and rail traffic and the sound of birds and coyotes.

The noise propagation model results indicate that the operation of aggregate extraction and processing equipment at the proposed Yellowhead Aggregates Pit 31 Turnbull would range from 34.6 to 48.7 dBA at the surrounding residences. Noise control measures for this site will consist of strategically placed stockpile berms and backup warning devices that decrease in volume when the surrounding background noise is lower. In addition to noise control, Yellowhead Aggregates is also advised to continue with the development of a community relations program that would consider both the needs of the community and Yellowhead Aggregate's objectives for this gravel extraction operation.

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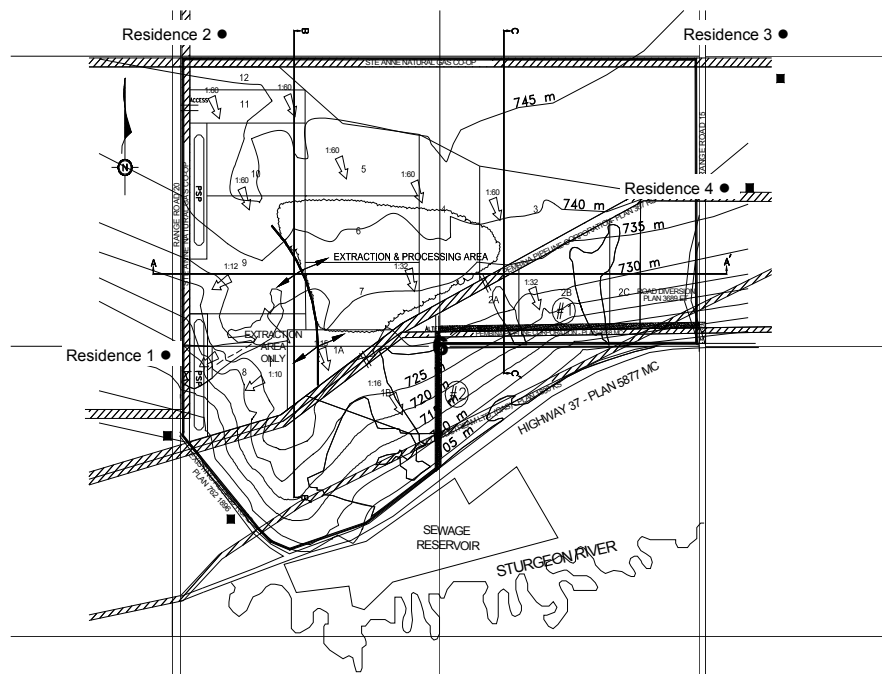
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Background and Scope

Yellowhead Aggregates desired to determine the operational sound levels that would be present at the residences surrounding their proposed Pit 31 Turnbull (Onoway) aggregate extraction and processing operations. The results of this assessment will be compared to the applicable noise criteria for the area, the County of Lac Ste. Anne No. 28 Noise Bylaw No. 14-85 and will also be used in discussions with the community. The results of the assessment may also be used to develop noise control measures for the aggregate extraction and processing operations. This may include noise control measures to pieces of equipment, operational noise control measures and/or the strategic use of topsoil stockpiles and product stockpiles as noise barriers. Yellowhead Aggregates retained the services of FFA Consultants in Acoustics and Noise Control Ltd. (FFA) to complete this evaluation.

Site Description & Residence Locations

The proposed Yellowhead Aggregates Pit 31 Turnbull aggregate extraction and processing operations are to be located in portions of Section 6-55-1 W5M. This site is located approximately 3.0 kilometres east of Onoway, Alberta along Provincial Highway 37. Bordering Section 6 to the east is Hillview Estates a country residential development. North of the NW ¼ of Section 6 is one residence. Bordering Section 6 to the west are three residences located west of the grid road. The terrain in the area is described as hilly with mixed agricultural use areas and areas of parkland forest. The residence locations are indicated in the following drawing.



Aggregate Extraction and Processing Equipment

Yellowhead Aggregates proposes to move a portable aggregate processing facility to the site. This equipment includes a loader, twin screener, two cone crushers, product surge bin, conveyers, portable power generating equipment and dump trucks. This equipment will be situated at various locations in the central area of the pit as aggregate extraction progresses. It is proposed to operate the pit continuously for 24 hours a day, 7 days a week until the mining areas is depleted.

Approach

FFA Consultants in Acoustics and Noise Control Ltd. (FFA) conducted sound pressure level measurements of a Yellowhead Aggregates extraction and processing operation similar to that proposed for Pit 31. This information was used to calculate sound power levels for the significant noise sources associated with the operation. Data regarding the topography and vegetation of the area surrounding the site along with the location of the residences with respect to the site was noted during a site visit. Additional geographic information was obtained from Yellowhead Aggregates and commercial sources. This information was used as input parameters for an environmental noise propagation computer model to calculate the aggregate extraction and processing sound level at the residences of interest.

The modelled results are presented as individual source sound levels at selected residences and as the overall operations sound level for all residences. The results may then be compared to the applicable community noise criteria. The results are also reviewed and comments are provided on the potential community noise impact. The results may also be used to develop and evaluate noise control measures for the most significant noise sources and the expected change in sound level can be predicted at the residence of interest.

A continuous sound monitoring survey to determine existing ambient sound levels and nature of the sound environment present at the site was also undertaken. Two locations at the site, one at the southwest corner and one at the east side of the site were chosen.

Criteria

The County of Lac Ste. Anne Noise Bylaw is the applicable noise regulation for the proposed Yellowhead Aggregates Pit 31 development. The regulation may be summarized as a general prohibition noise regulation. The regulation does permit activities that are associated with an approved development permit. The regulation restricts construction noises between the hours of 10 PM and 7 AM where the point of reception is in a residential subdivision. There are no specific allowable sound levels that must be met or adhered to indicated in the regulation

Sound Pressure Level Measurements and Sound Monitoring Survey

Sound pressure level measurements were undertaken on June 4, 2008, of the significant noise sources associated with a Yellowhead Aggregates extraction and processing operation that was the same equipment and layout that would be used at the proposed site. The sound pressure level measurements were conducted with a Brüel & Kjær Model 2260 Real Time Frequency Analyzer. The sound measurement system was field calibrated with a Brüel & Kjær Model 4231 calibrator at the start of the measurements and then checked at the completion. The Brüel & Kjær Model 2260 measures the 1/3 octave band sound pressure level and the overall 'A' weighted sound level in real time.

A sound monitoring survey was undertaken at two locations on the Pit 031 site from July 23 to July 26, 2008 and encompassed three nighttime periods. One location was at the southwest corner of the site beside range road 20 and the other location was at the east side of the site adjacent to range road 15 just south of the cement barriers that do not allow through traffic on this range road. The sound monitoring survey followed standard procedures for environmental sound level measurements. Brüel & Kjær Model 2250 Real Time Frequency Analyzers instrumentation was used for the sound monitoring survey. The analyzers were set to undertake continuous 1 minute sound level measurements and also stored continuous audio data. The audio recordings provide a time-referenced audible record of the noise events that occurred at the monitoring locations and provide an audible record of the nature of the sound level environment at the measurement location. The sound measurement system was field calibrated with a Brüel & Kjær Model 4231 calibrator at the start of the sound monitoring survey and then checked at the completion.

The monitored one-minute L_{eq} , L_{10} and L_{90} sound levels recorded during the monitoring survey are presented graphically in a time history format in Appendix A, Figures 1.1 to 1.7, Figures 2.1 to 2.6 for the two monitoring locations. The one-minute L_{eq} values were used to calculate 15 hour daytime and 9 hour nighttime L_{eq} values that are commonly used for environmental noise assessments. Table 1 presents the measured daytime and nighttime sound levels.

Sound Pressure Level Measurements and Sound Monitoring Survey (cont.)

Table 1
Yellowhead Aggregates
Pit 31 Turnbull (Onoway)
Daytime and Nighttime L_{eq} Values

Date	Daytime or Nighttime	Measured Sound Level (dBA L _{eq})	Time Period (Hours)
Southwest Monitoring Location Range Road 20			
July 23, 2008	Day	41.6	12.4
July 23 -24, 2008	Night	36.4	9.0
July 24, 2008	Day	40.5	15.0
July 24-25, 2008	Night	37.7	9.0
July 25, 2008	Day	45.6	15.0
July 25-26, 2008	Night	36.9	9.0
July 26, 2008	Day	36.5	0.6
East Monitoring Location Range Road 15			
July 23, 2008	Day	39.3	11.5
July 23 -24, 2008	Night	34.9	9.0
July 24, 2008	Day	41.3	15.0
July 24-25, 2008	Night	35.2	9.0
July 25, 2008	Day	41.1	15.0
July 25-26, 2008	Night	37.9	9.0
July 26, 2008	Day	38.9	1.6

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Sound Power Level Calculations

Sound power levels of the significant noise sources associated with the aggregate extraction and processing operation were calculated from the sound pressure level measurements. The calculations followed accepted acoustical engineering evaluation methods for the determination of sound power levels from sound pressure levels for large machinery. The calculated sound power levels of the equipment are presented in the following table, order ranked from highest to lowest overall dBA sound power level.

Sound Power Level Calculations (cont.)

Table 2
Yellowhead Aggregates
Pit 31 Turnbull (Onoway)
Source Sound Power Levels

Description	Sound Power Level (dB re: 10 ⁻¹² W)									Sum (dBA)
	Octave Band Centre Frequency (Hz)									
	31.5	63	125	250	500	1000	2000	4000	8000	
Twin Screener	97.0	99.7	106.8	110.3	114.5	111.4	112.2	108.5	105.1	118.0
Generator Set Engine Exhaust	112.3	113.5	111.0	109.8	110.9	106.8	107.8	105.3	103.2	114.2
First Cone	98.0	100.5	103.6	105.4	106.7	106.0	107.1	105.1	99.3	112.6
First Screener	100.9	101.4	105.4	106.3	106.6	105.8	106.5	105.1	99.2	112.4
Finishing Cone	95.6	100.0	104.2	109.9	107.7	107.8	103.6	99.6	97.1	111.7
Finishing Screener	98.6	101.3	99.9	105.7	106.3	103.0	104.2	103.0	97.9	110.5
Generator Trailer Side Vent (R)	89.6	95.4	102.4	104.0	101.9	104.3	101.8	97.3	95.1	108.3
Generator Trailer Open Side Door	91.6	98.8	106.3	102.4	101.1	103.6	102.2	97.7	96.9	108.2
Generator Trailer Side Vent (L)	87.6	96.4	101.9	103.1	103.6	102.3	101.2	97.1	93.7	107.6
Generator Set Trailer	97.7	105.7	109.0	106.3	102.3	99.0	96.7	91.7	84.2	105.1
Generator Set Radiator Outlet	89.3	96.8	109.1	103.4	100.3	100.2	96.3	91.5	86.6	104.5

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The presented sound power levels were calculated from the sound pressure level measurements. The order ranked sound pressure levels at the point of reception may differ from the order ranked site sound power levels. This can occur for a number of reasons including the frequency composition of each noise source, the physical height of the noise source above the ground, acoustical shielding at the site or due to the topography between the site and the receiver.

Noise Model

ENM, an environmental noise propagation model, was used for this assessment. ENM is an environmental noise assessment software package from RTA Technology Pty. Ltd. The calculated source sound power levels complete with the physical information regarding the site layout and location of the residences of interest were input into the model. The meteorological conditions selected favoured the transmission of sound from the site to each point of reception and thus emulate a period during which the operation may experience noise complaints. A noise contour for a calm wind condition was also generated with the ENM software. The model inputs and results are reviewed by FFA during the modelling process and where warranted, additional calculations are completed outside of the model to verify the ENM results.

Results

The modelling was first undertaken with the equipment placed in the centre of the pit development area. The following table presents the results of the modelling for the four nearest residences under a light wind condition.

Table 3
Yellowhead Aggregates
Pit 31 Turnbull (Onway)
Predicted Sound Levels

Residence	Predicted Operational Sound Level (dBA)
1	42.9
2	48.7
3	36.6
4	34.6

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These overall predicted operational sound levels may be further examined to determine what noise sources provide the largest contribution to the overall predicted sound level at each residence location. This result is provided in the following table for Residence 2.

Table 4
Yellowhead Aggregates
Pit 31 Turnbull (Onway)
Residence 2 (NW corner)
Order Ranked Sound Pressure Levels

Source	Source Sound Level Contribution (dBA)
Twin Screener	43.8
Generator Set Engine Exhaust	41.2
First Cone	39.5
First Screener	39.0
Finishing Cone	37.9
Finishing Screener	35.9
Generator Trailer Open Side Door	34.3
Generator Trailer Side Vent (R)	34.3
Generator Trailer Side Vent (L)	33.1
Generator Set Trailer	31.2
Generator Set Radiator Outlet	30.2
Generator Trailer Side Vent (small)	12.3
Sum	48.7

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Discussion of Results

The results indicate overall predicted sound levels to the residences of 34.6 to 48.7 dBA. The presented results have considered wind that would favour the transmission of sound from the equipment locations to any of the residence locations.

The County of Lac Ste. Anne Noise Bylaw being a general prohibition bylaw without fixed permissible sound levels for this type of development would be controversial if applied to an approved development.

The results of the sound monitoring survey indicate that the daytime sound levels ranged from 36.5 to 45.6 dBA Leq at location 1 and from 38.9 to 41.3 dBA Leq at location 2. Nighttime sound levels ranged from 36.4 to 37.7 dBA Leq at location 1 and from 34.9 to 37.9 dBA Leq at location 2. It can be seen from the graphs that the sound of vehicles on Provincial Highway 37 set the higher sound levels with lower sound levels measured between the sound of passing cars in the nighttime period. As is typical the daytime sound levels are louder than the nighttime sound levels because of higher volumes of vehicle traffic on Highway 37. It can be seen on the graphs that the sound levels decrease during the nighttime and then increase in the morning from both increased human activities and noise attributed to natural sources such as birds. The sounds of aircraft and train traffic were also present.

Based on the measured background sound levels at the site, the increase in the ambient sound levels from the sounds generated at the aggregate pit operations would range from 0 to 12 dBA during the nighttime period at surrounding residences and would be audible depending on environmental conditions present.

Recommendations

FFA recommends that Yellowhead Aggregates consider noise control measures and operational measures that would reduce the audible aggregate operational sounds heard in the community. These measures, incorporated with an effective community relations program that considers and balances the concerns of the community with those of Yellowhead Aggregates may result in fewer noise related concerns from the community.

The first consideration would be to strategically situate equipment behind top soil stockpiles and gravel stockpiles so that they act as noise barriers to provide the maximum benefit to the community. Calculations were undertaken to determine the potential noise reduction that may be realized. It was found the placing a 5 m high topsoil stockpile between the equipment in the pit and the SW and NW residences resulted in a 2 to 3 dBA reduction at those residences. Higher stockpiles may result in greater noise reductions.

Recommendations (cont.)

An operating practices review should include the use of strobe warning devices where and when possible in substitution of backup beepers as well as some newer backup alarms that are less annoying to the surrounding community. We understand that backup beepers that automatically adjust to the existing ambient sound level at the worksite are under trial at other Yellowhead Aggregate operations. These warning beepers automatically lower the alarm volume when the background sound level at the site is lower.

Yellowhead Aggregates should also consider installing engine exhaust mufflers with higher levels of attenuation on the genset. Further noise reductions to the genset trailer to minimize radiator and engine casing noise could also be considered.

Conclusion

The noise propagation model results indicate that the operation of aggregate extraction and processing equipment at the proposed Yellowhead Aggregates Pit 31 Turnbull would range from 36.4 to 48.7 dBA at nearby residences. Based on the measured nighttime ambient sound levels and the predicted aggregate operation sound levels would result in pit operations being audible to the surrounding community depending on the location of the equipment in the pit, the location of the residences with respect to the equipment and the environmental conditions. Some noise control measures have been discussed that could be implemented to help reduce the aggregate operations sounds heard in the surrounding community. In addition to the implementation of noise control measures, Yellowhead Aggregates is also advised to continue with the development of a community relations program that would consider both the needs of the community and Yellowhead Aggregate's objectives for this gravel extraction operation.



Appendix A

Graphic Presentation of Sound Monitoring Survey Results

Figure 1.1
Yellowhead Aggregates Ambient Sound Survey
Site 1
July 23, 2008; 07:00 - 14:29

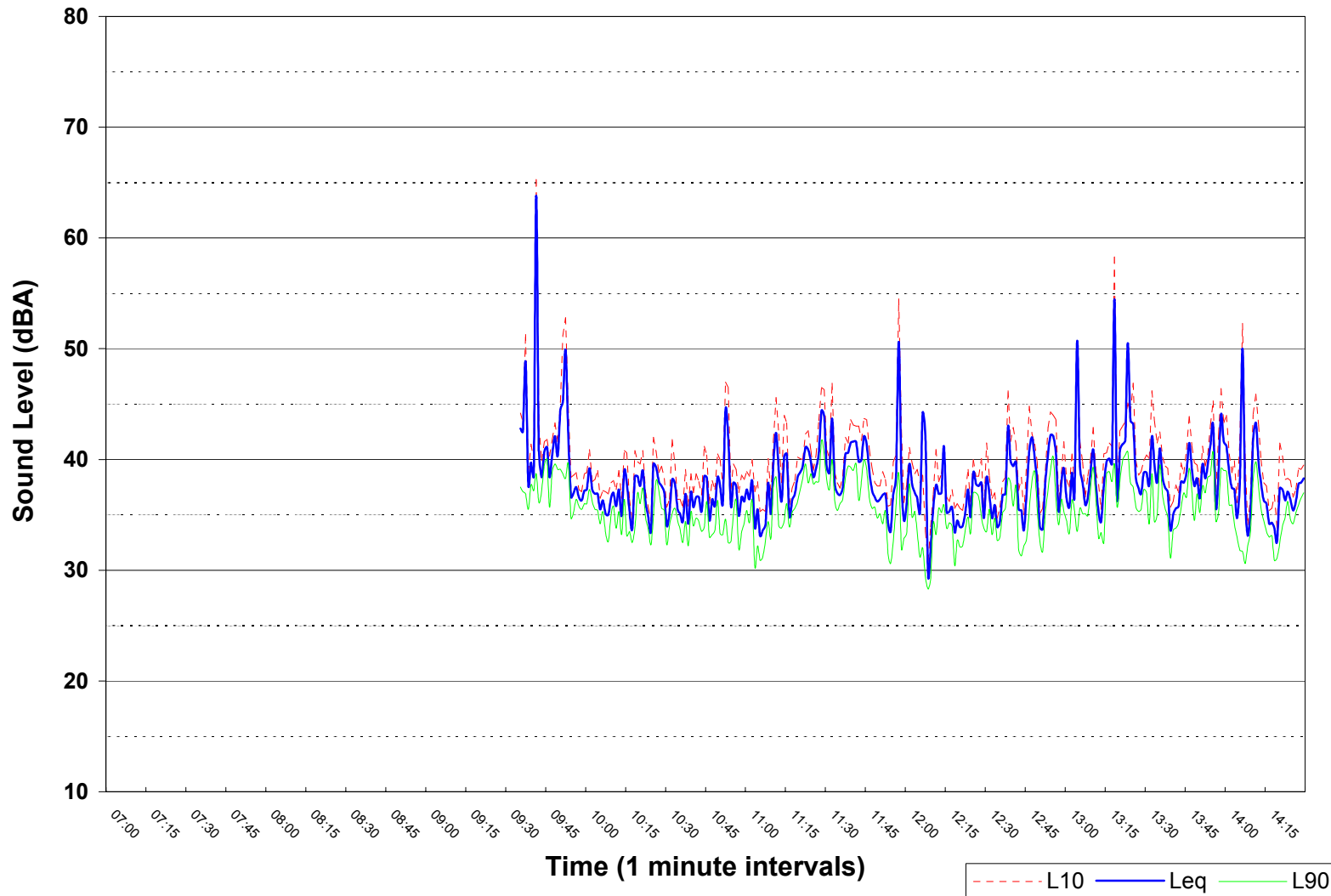


Figure 1.2
Yellowhead Aggregates Ambient Sound Survey
Site 1
July 23, 2008; 14:30 - 21:59

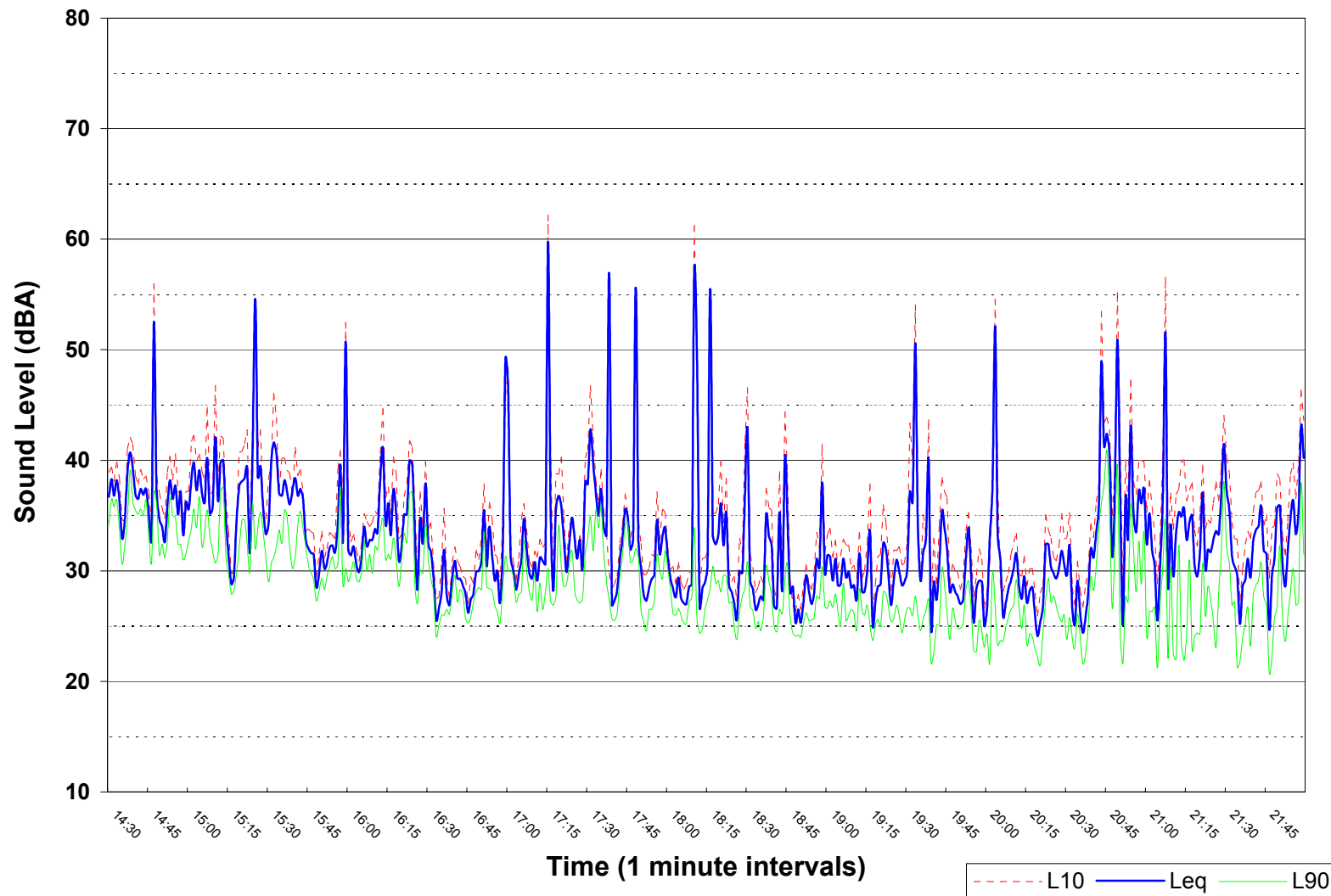


Figure 1.3
Yellowhead Aggregates Ambient Sound Survey
Site 1
July 23 - 24, 2008; 22:00 - 06:59

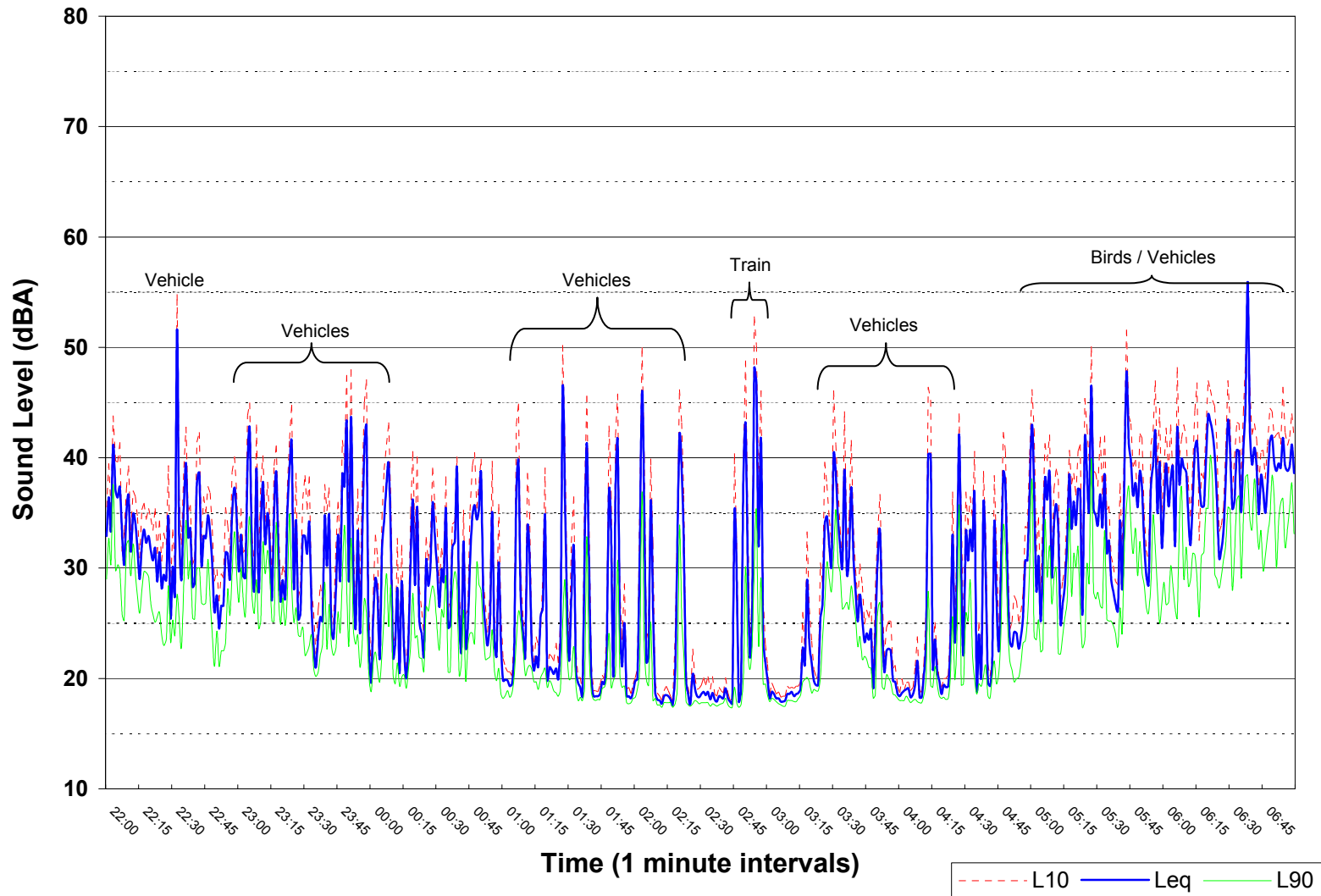


Figure 1.4
Yellowhead Aggregates Ambient Sound Survey
Site 1
July 24, 2008; 07:00 - 14:29

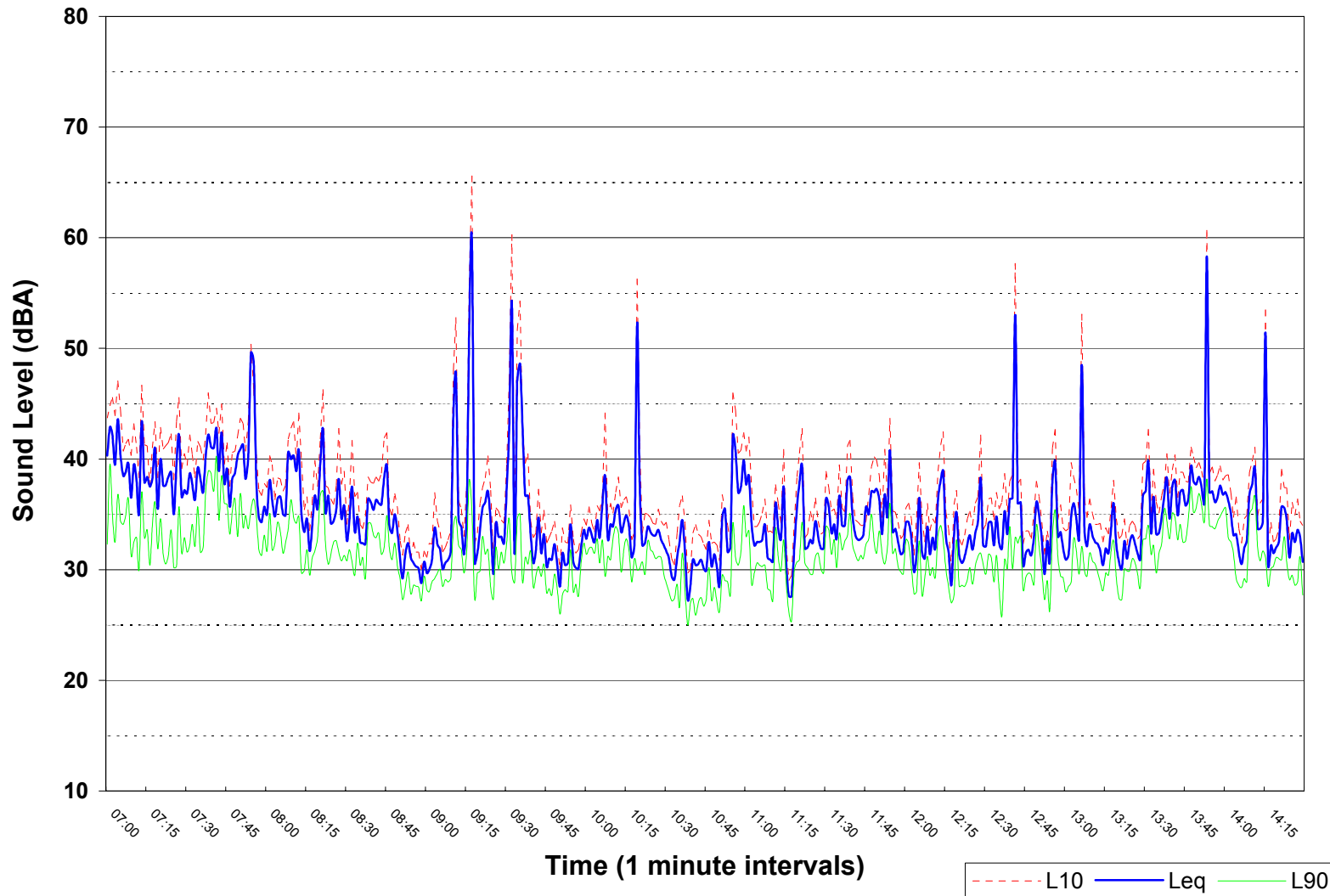


Figure 1.5
Yellowhead Aggregates Ambient Sound Survey
Site 1
July 24, 2008; 14:30 - 21:59

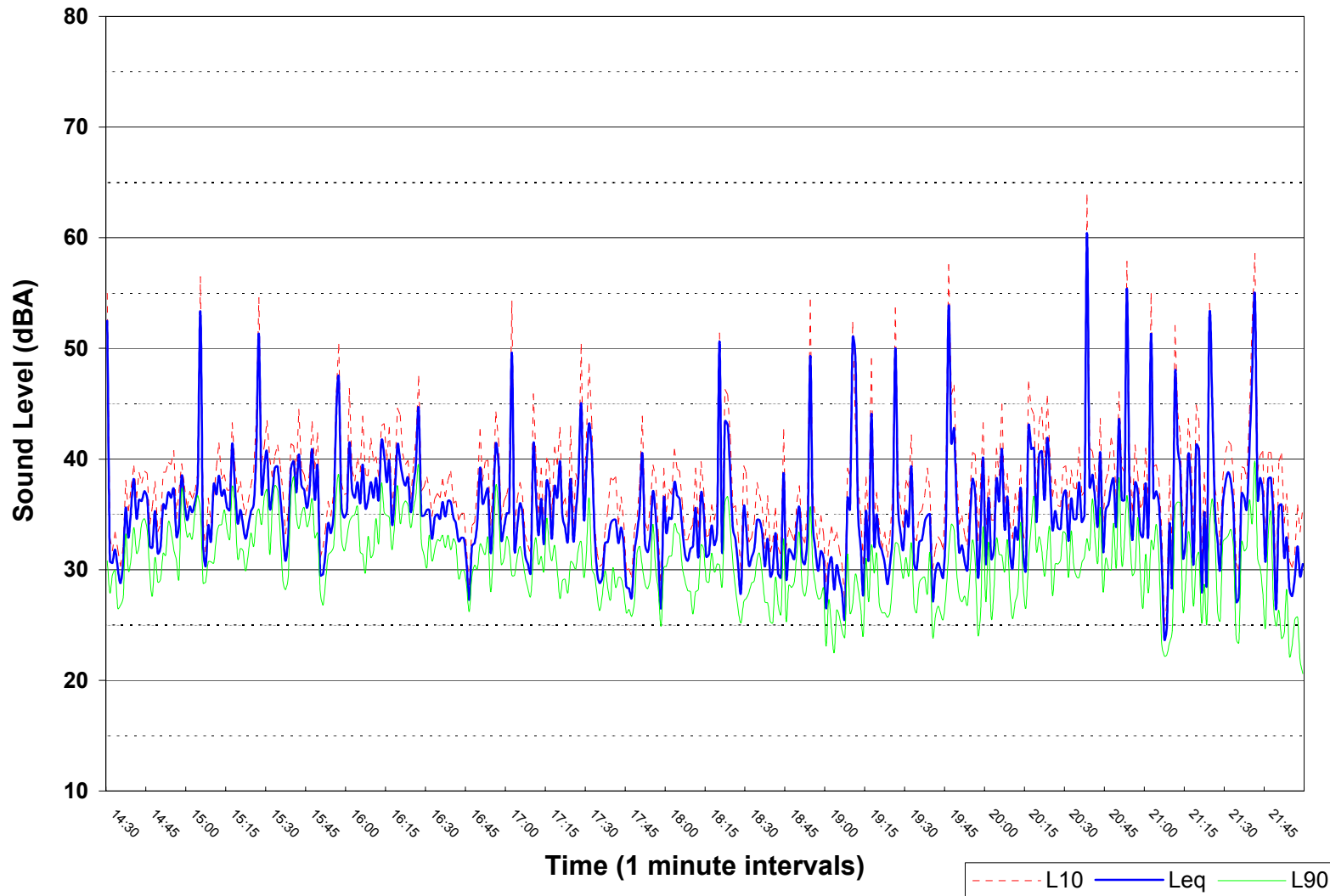


Figure 1.6
Yellowhead Aggregates Ambient Sound Survey
Site 1
July 24 - 25, 2008; 22:00 - 06:59

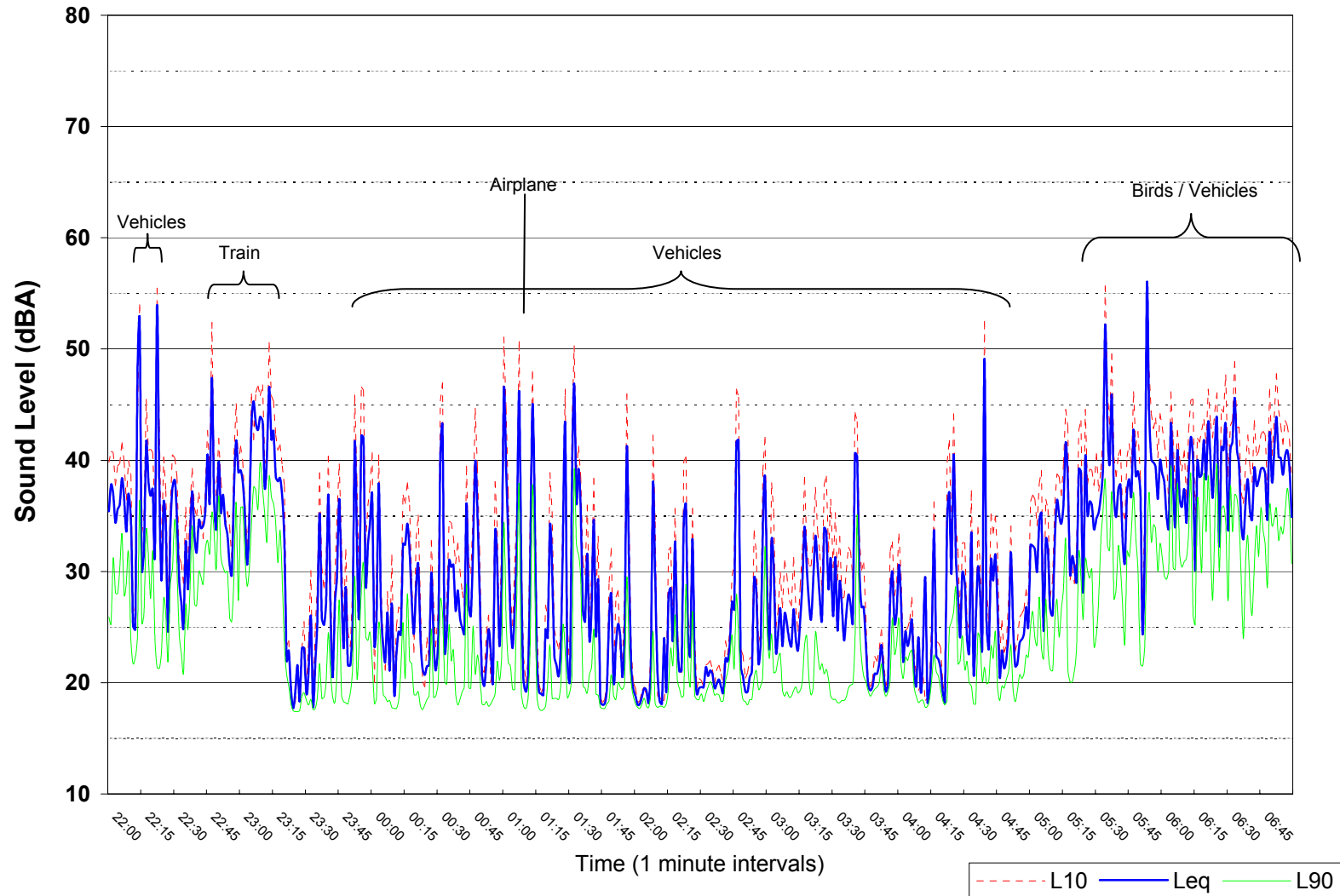


Figure 1.7
Yellowhead Aggregates Ambient Sound Survey
Site 1
July 25, 2008; 07:00 - 14:29

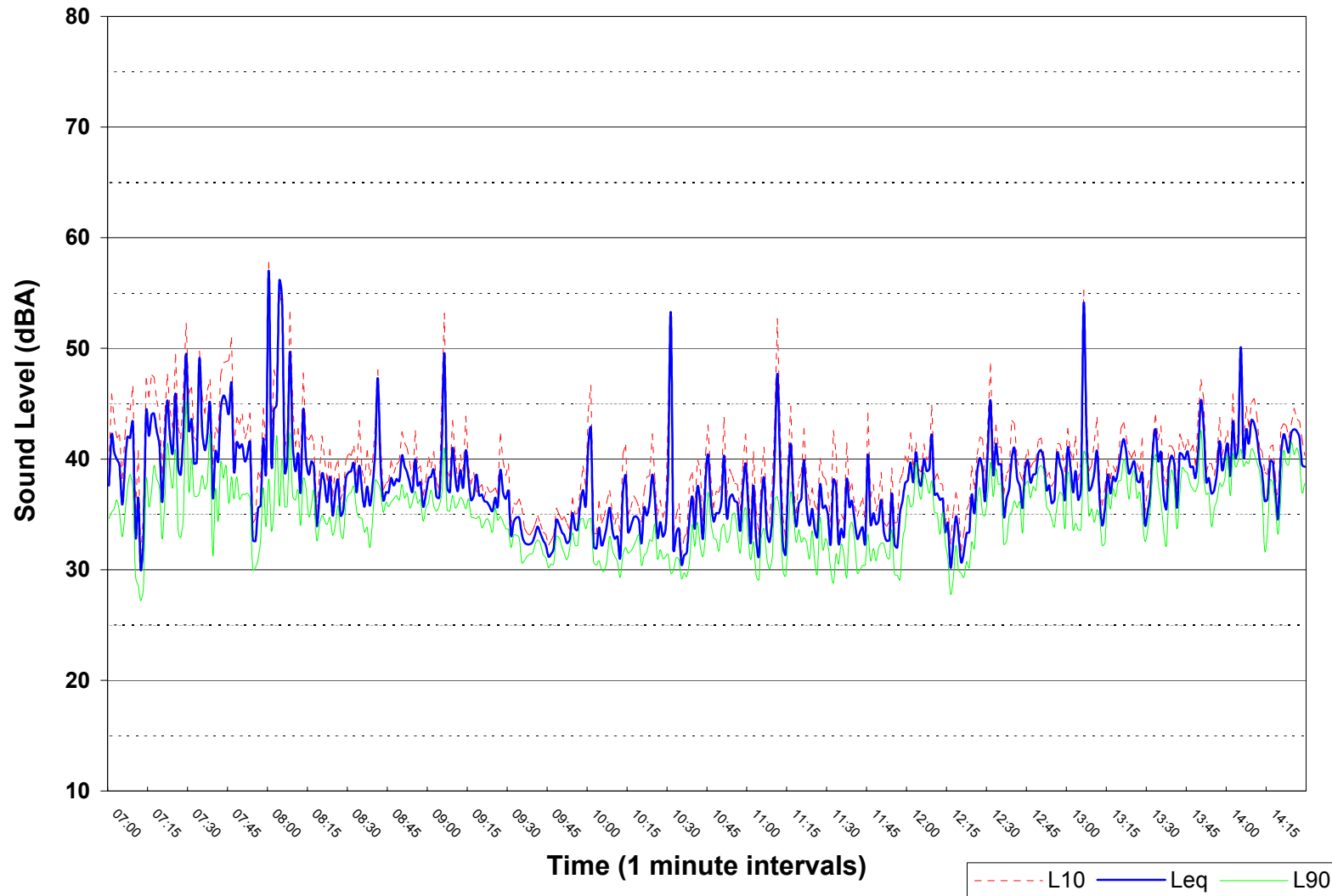


Figure 1.8
Yellowhead Aggregates Ambient Sound Survey
Site 1
July 25, 2008; 14:30 - 21:59

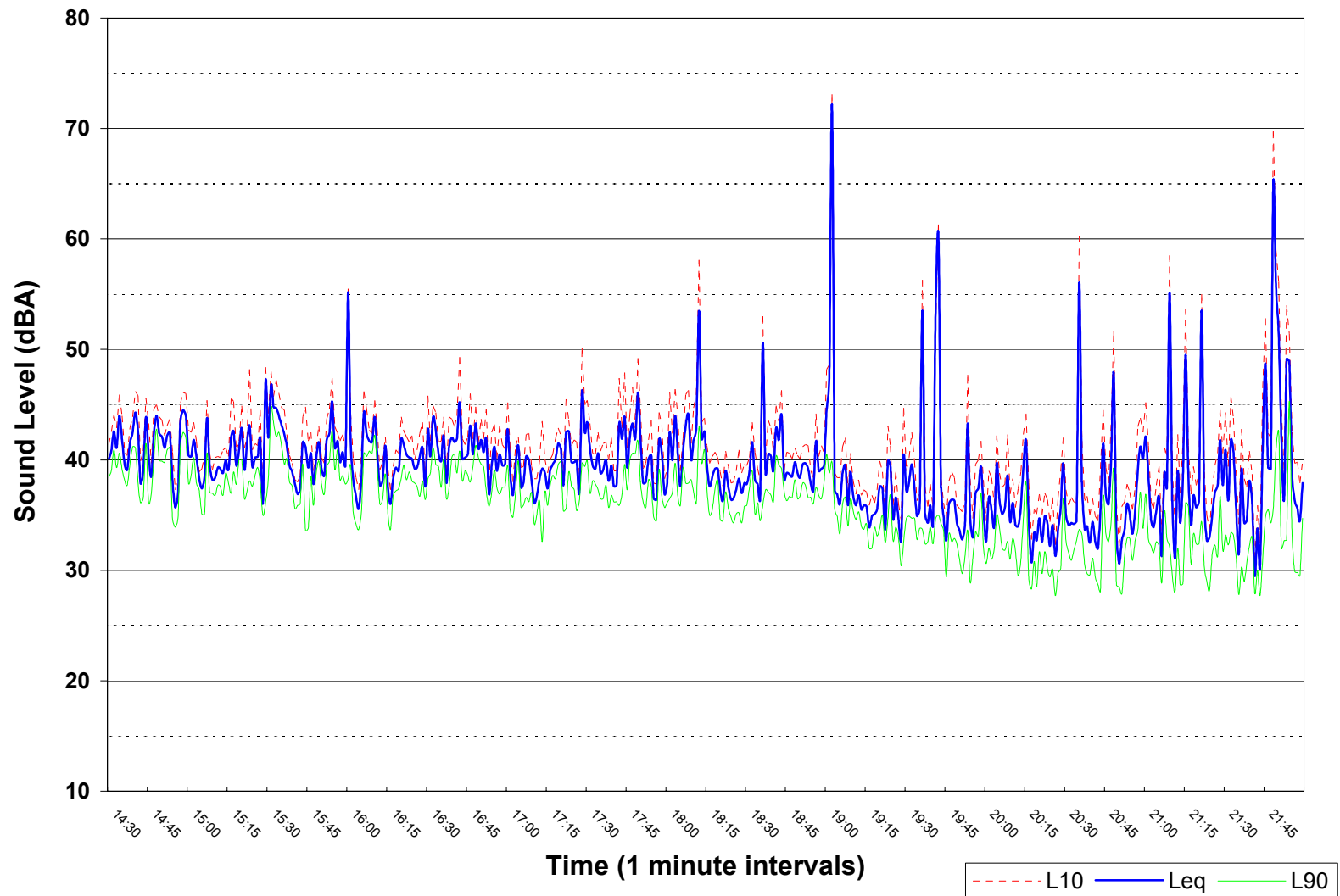


Figure 1.9
Yellowhead Aggregates Ambient Sound Survey
Site 1
July 25 - 26, 2008; 22:00 - 06:59

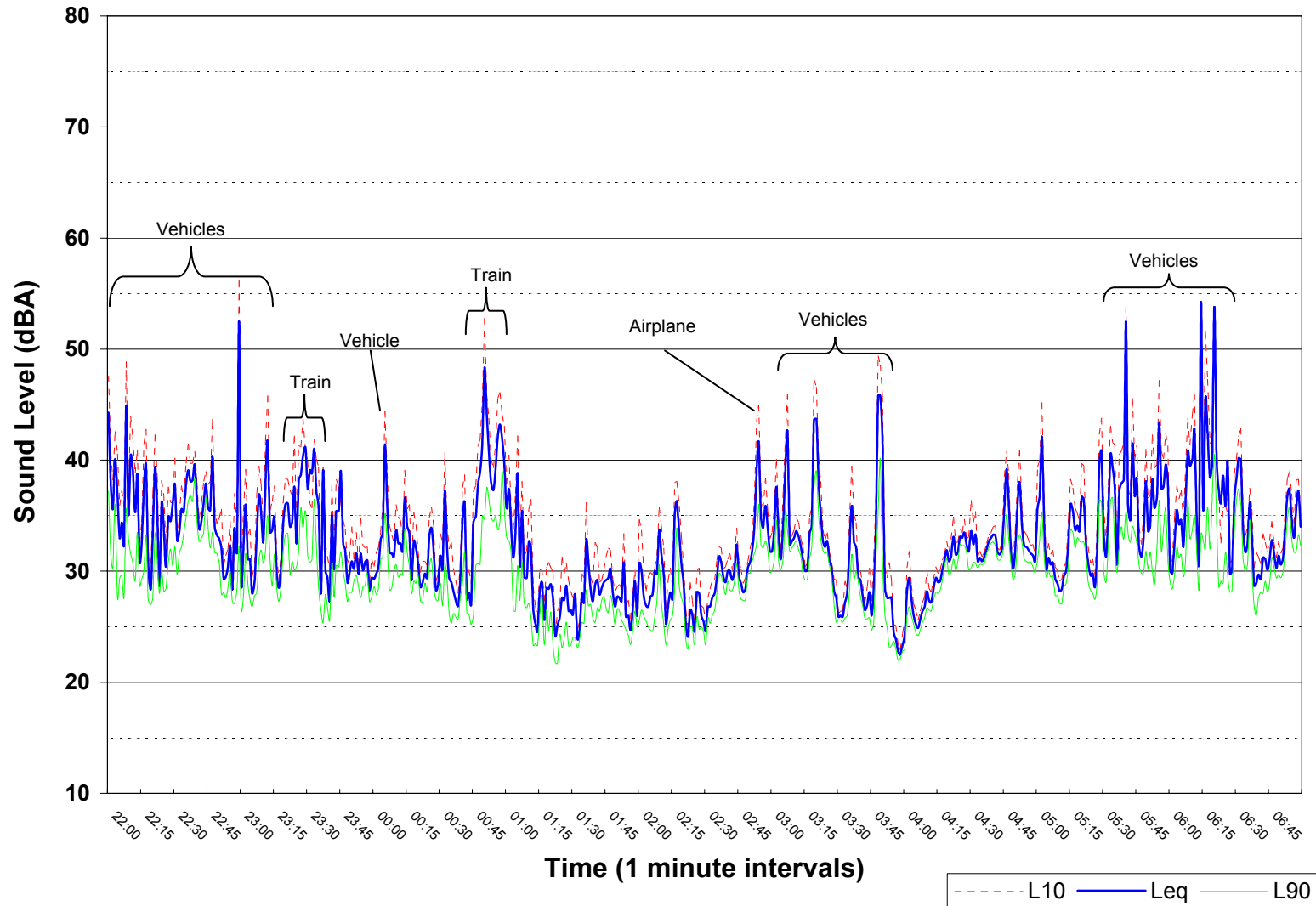


Figure 1.10
Yellowhead Aggregates Ambient Sound Survey
Site 1
July 26, 2008; 07:00 - 14:29

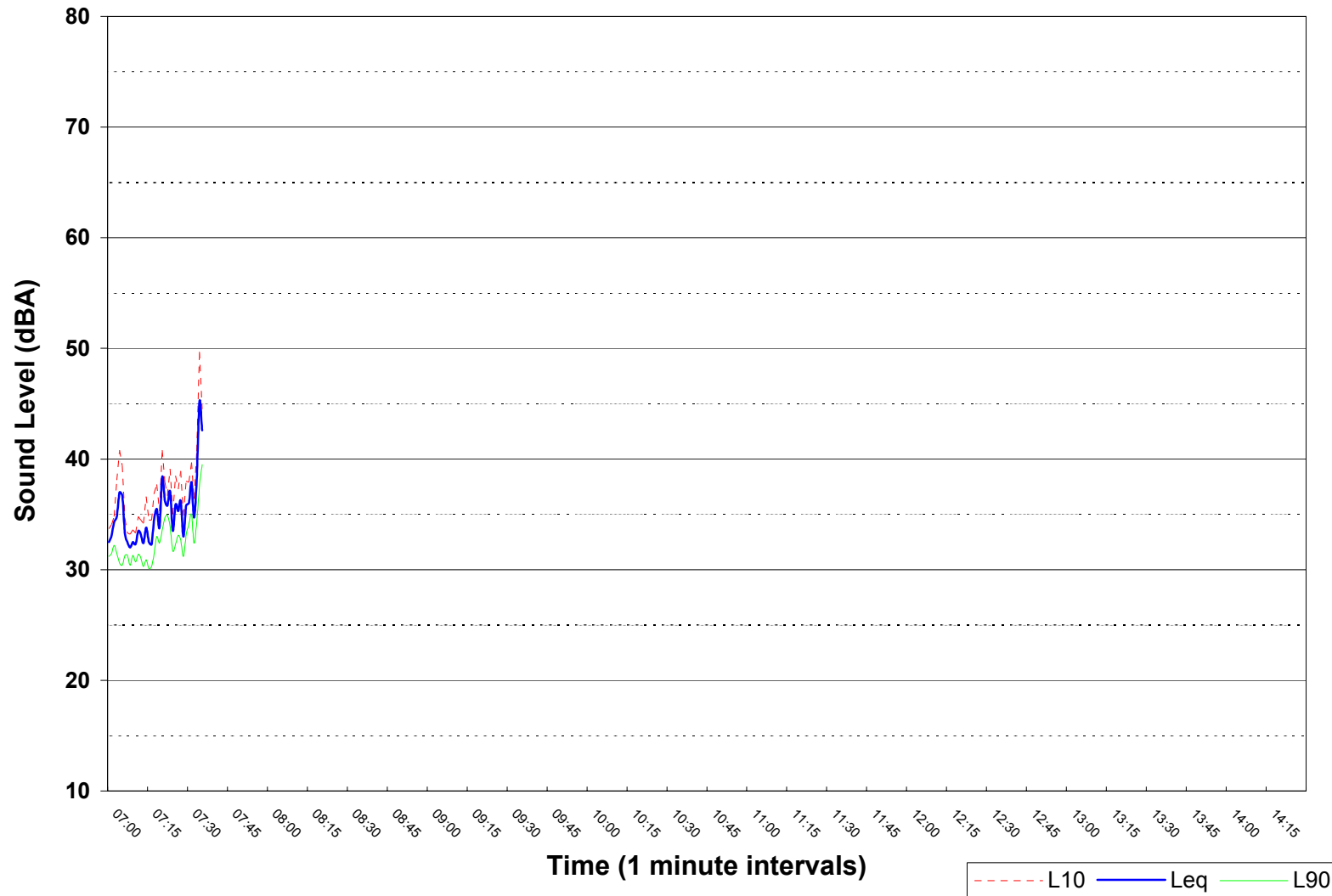


Figure 2.1
Yellowhead Aggregates Ambient Sound Survey
Site 2
July 23, 2008; 07:00 - 14:29

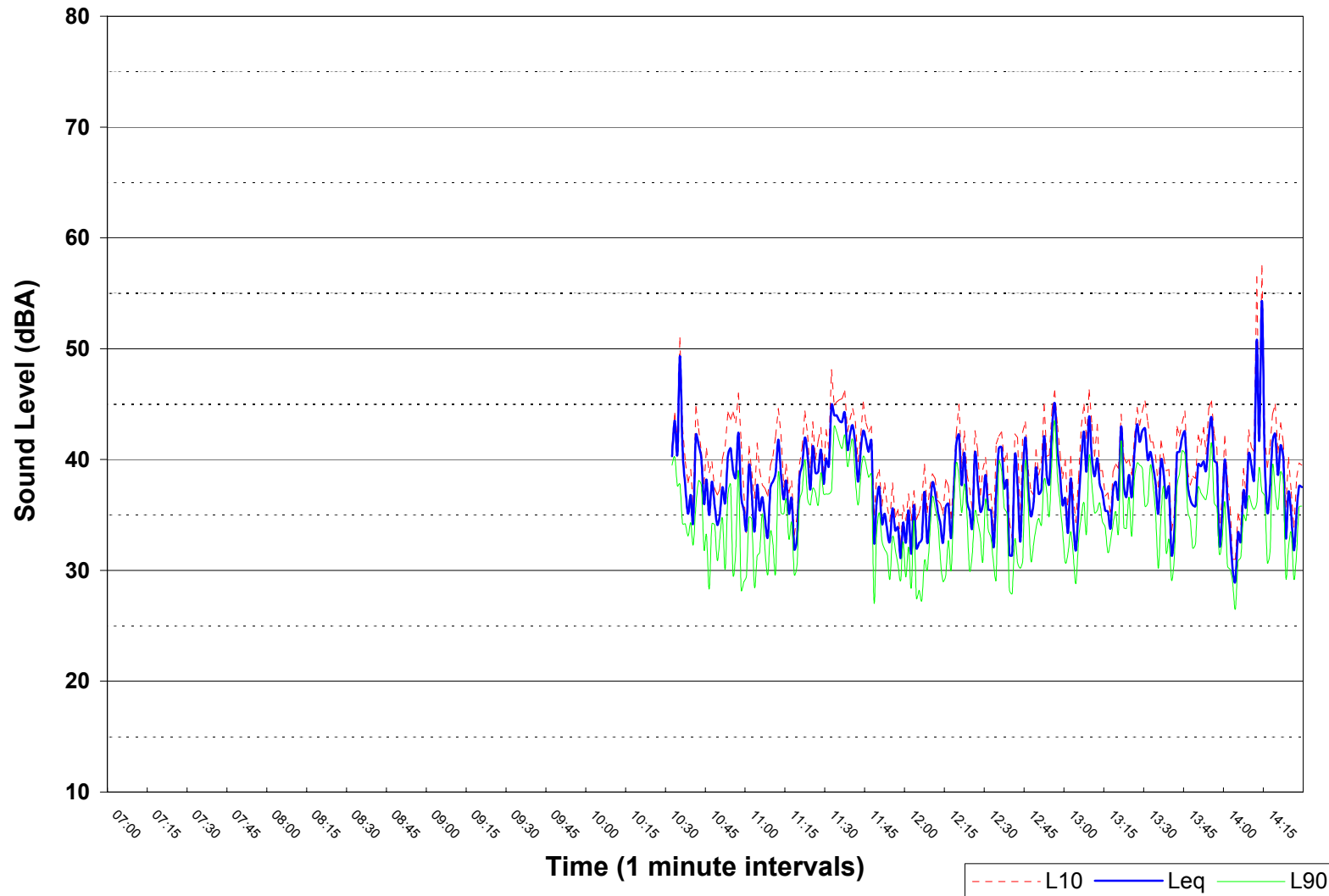


Figure 2.2
Yellowhead Aggregates Ambient Sound Survey
Site 2
July 23, 2008; 14:30 - 21:59

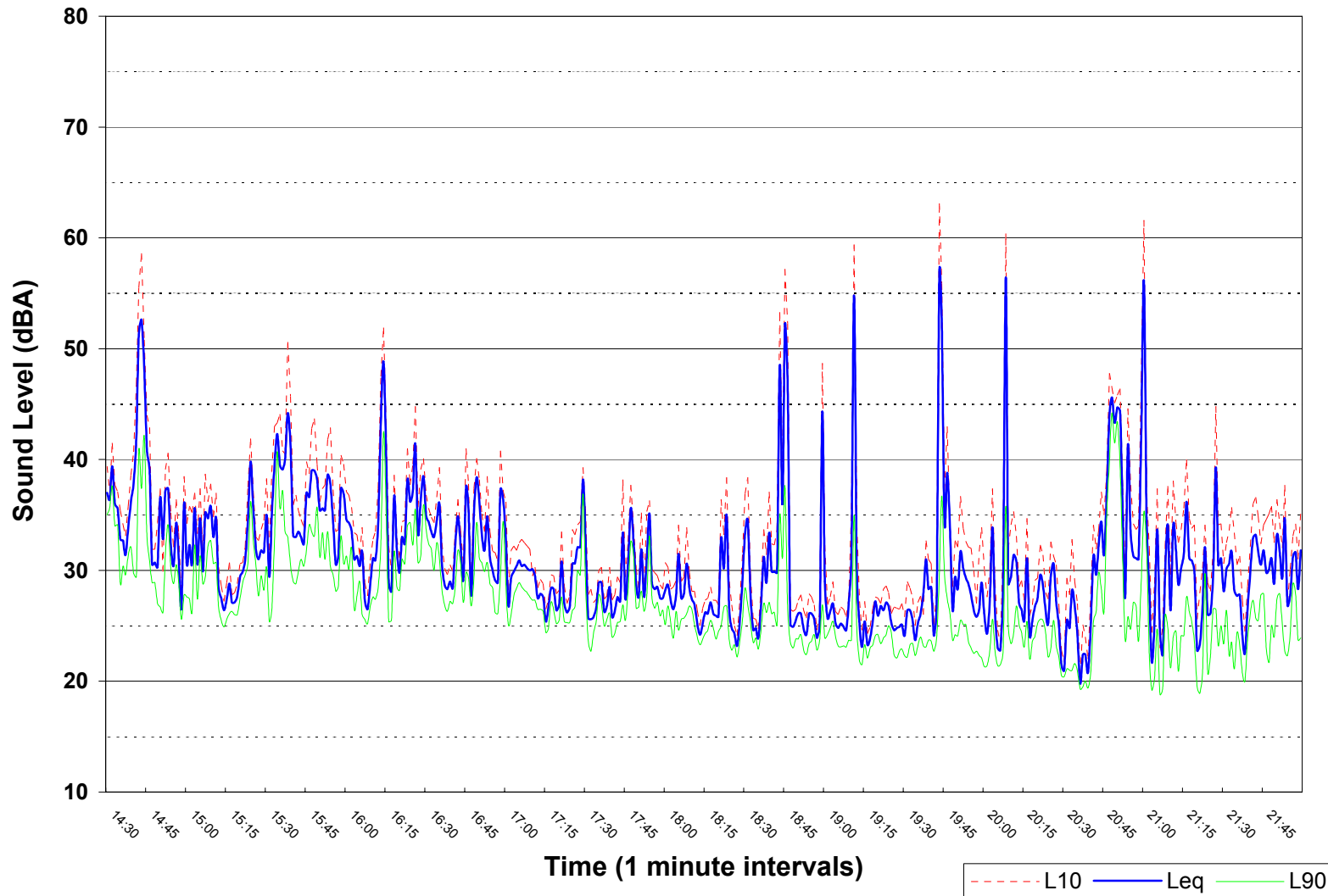


Figure 2.3
Yellowhead Aggregates Ambient Sound Survey
Site 2
July 23 - 24, 2008; 22:00 - 06:59

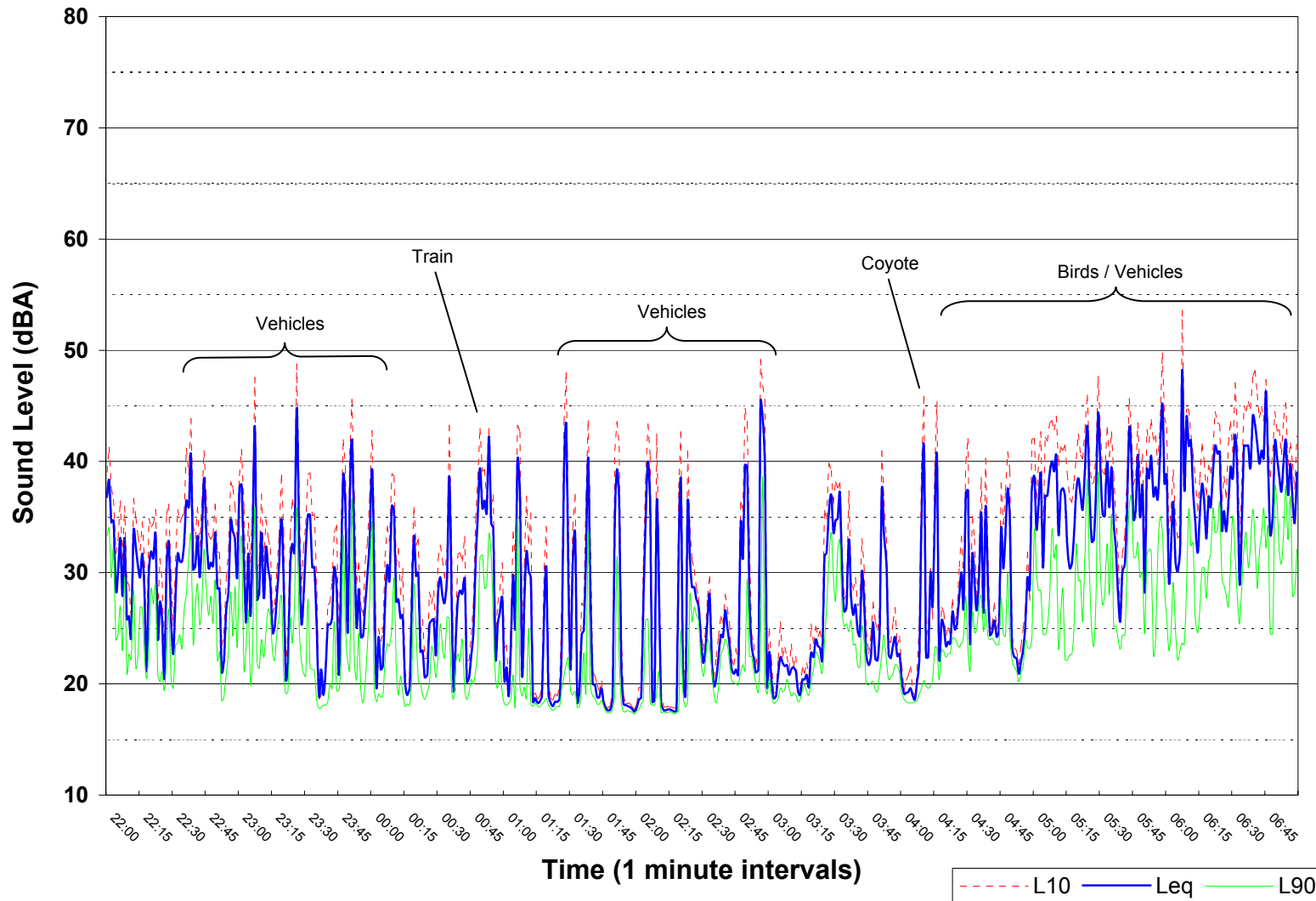


Figure 2.4
Yellowhead Aggregates Ambient Sound Survey
Site 2
July 24, 2008; 07:00 - 14:29

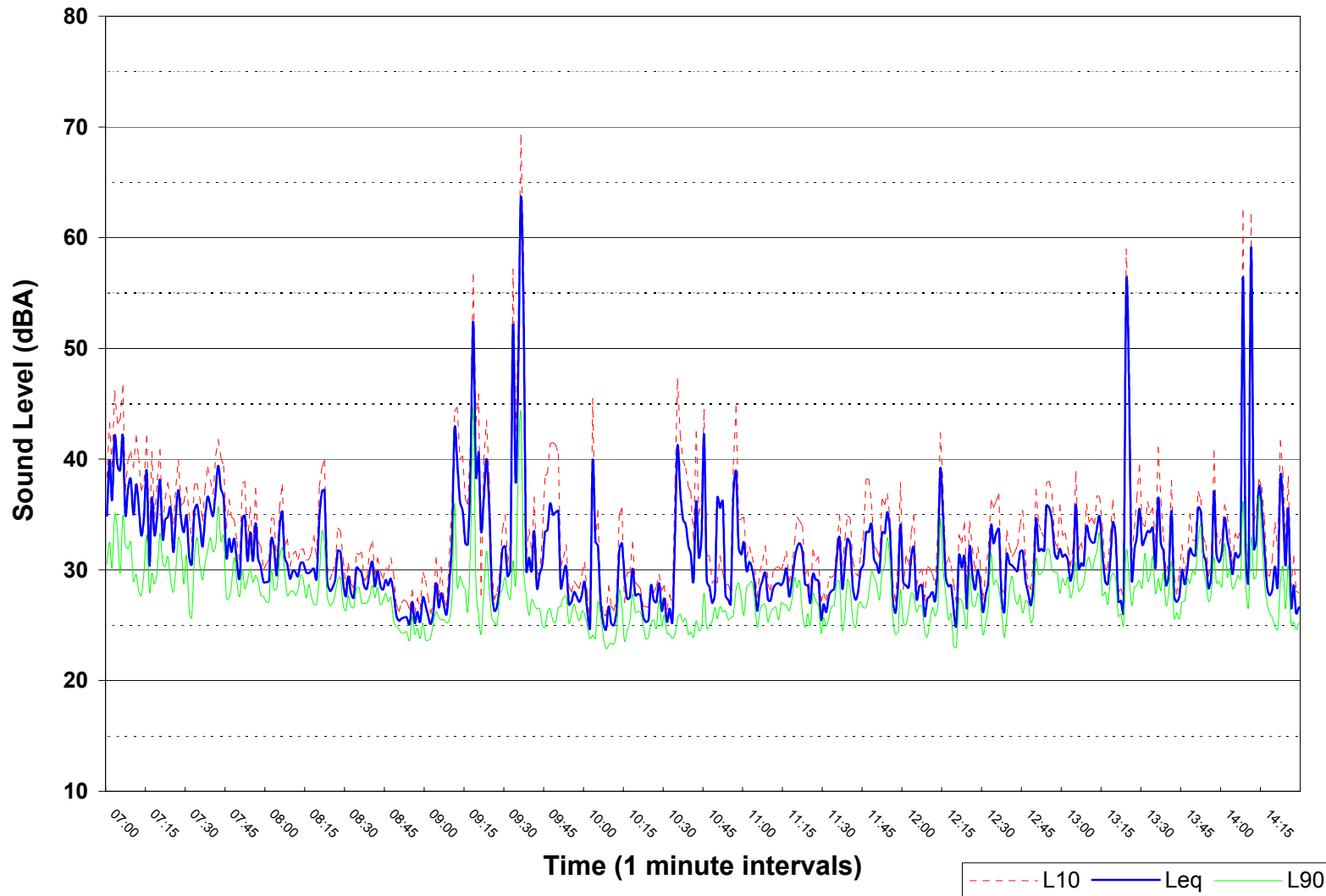


Figure 2.5
Yellowhead Aggregates Ambient Sound Survey
Site 2
July 24, 2008; 14:30 - 21:59

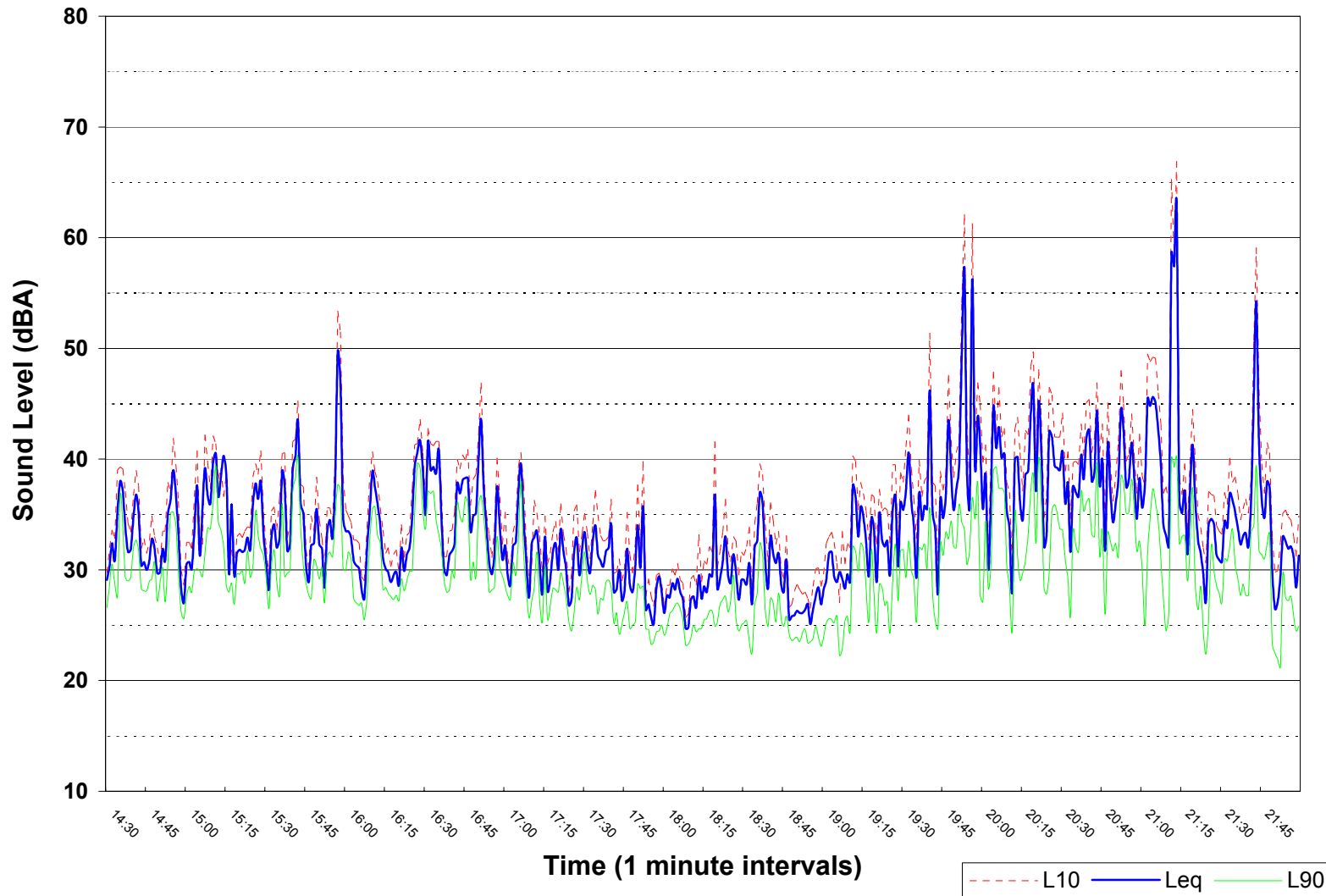


Figure 2.6
Yellowhead Aggregates Ambient Sound Survey
Site 2
July 24 - 25, 2008; 22:00 - 06:59

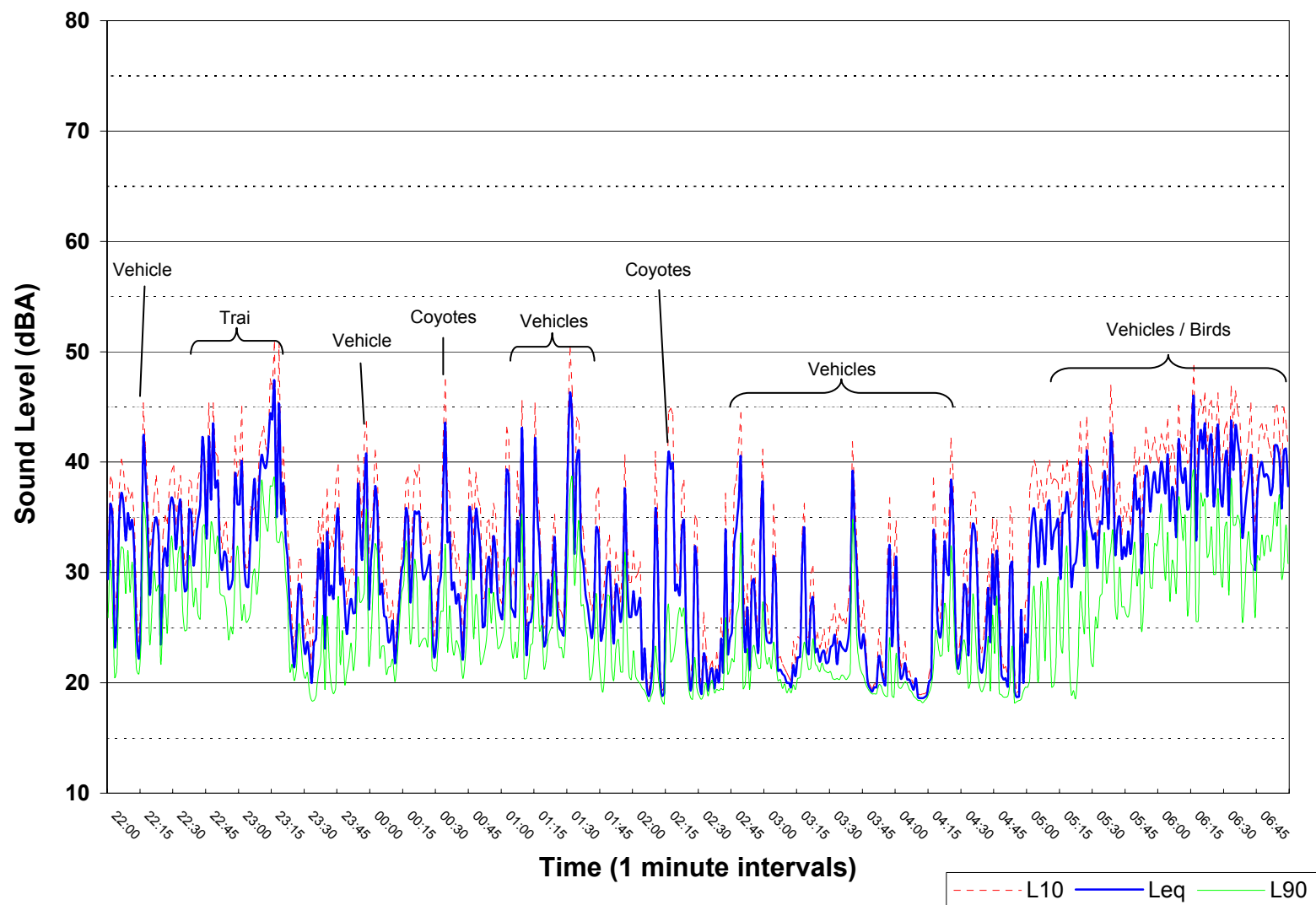


Figure 2.7
Yellowhead Aggregates Ambient Sound Survey
Site 2
July 25, 2008; 07:00 - 14:29

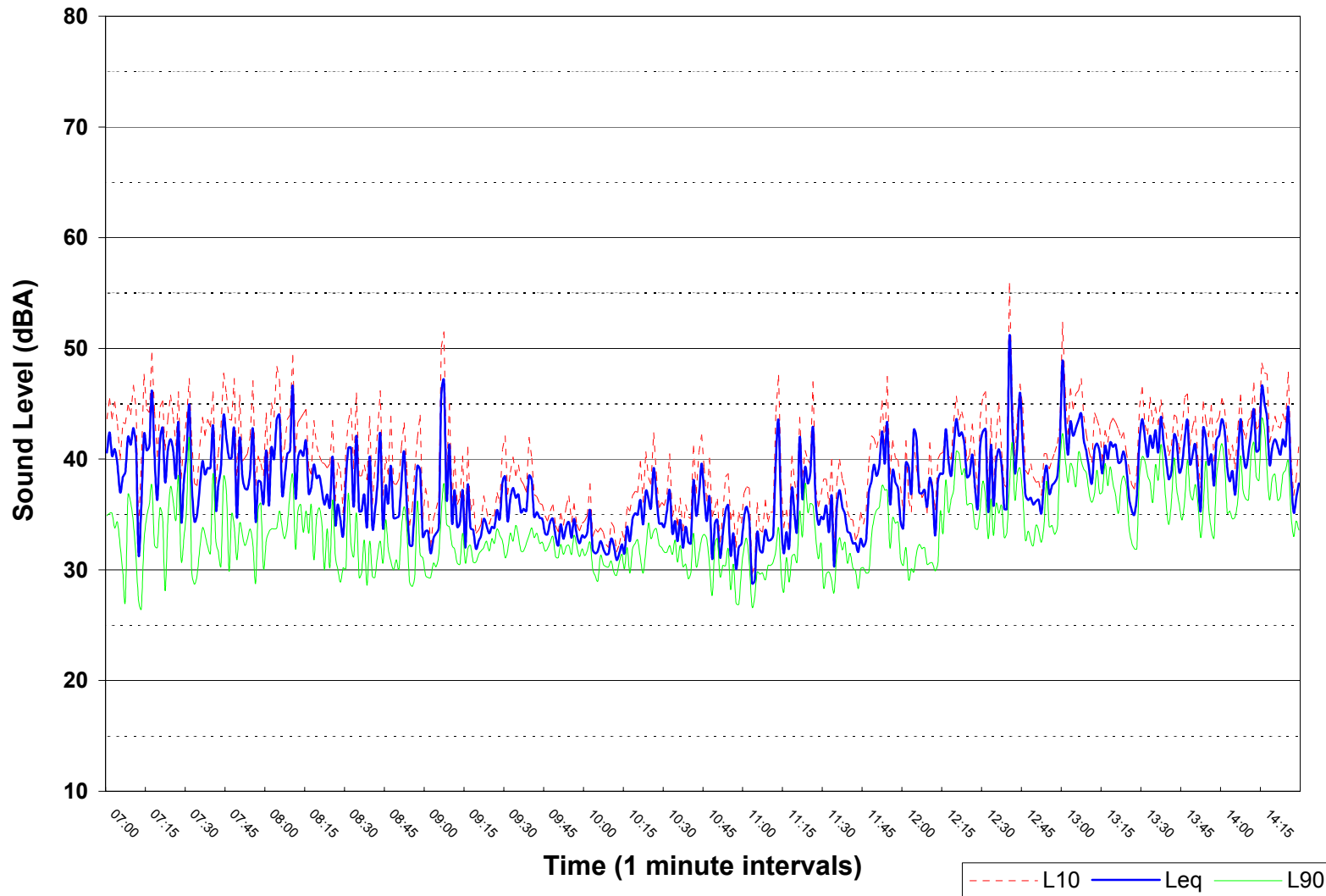


Figure 2.8
Yellowhead Aggregates Ambient Sound Survey
Site 2
July 25, 2008; 14:30 - 21:59

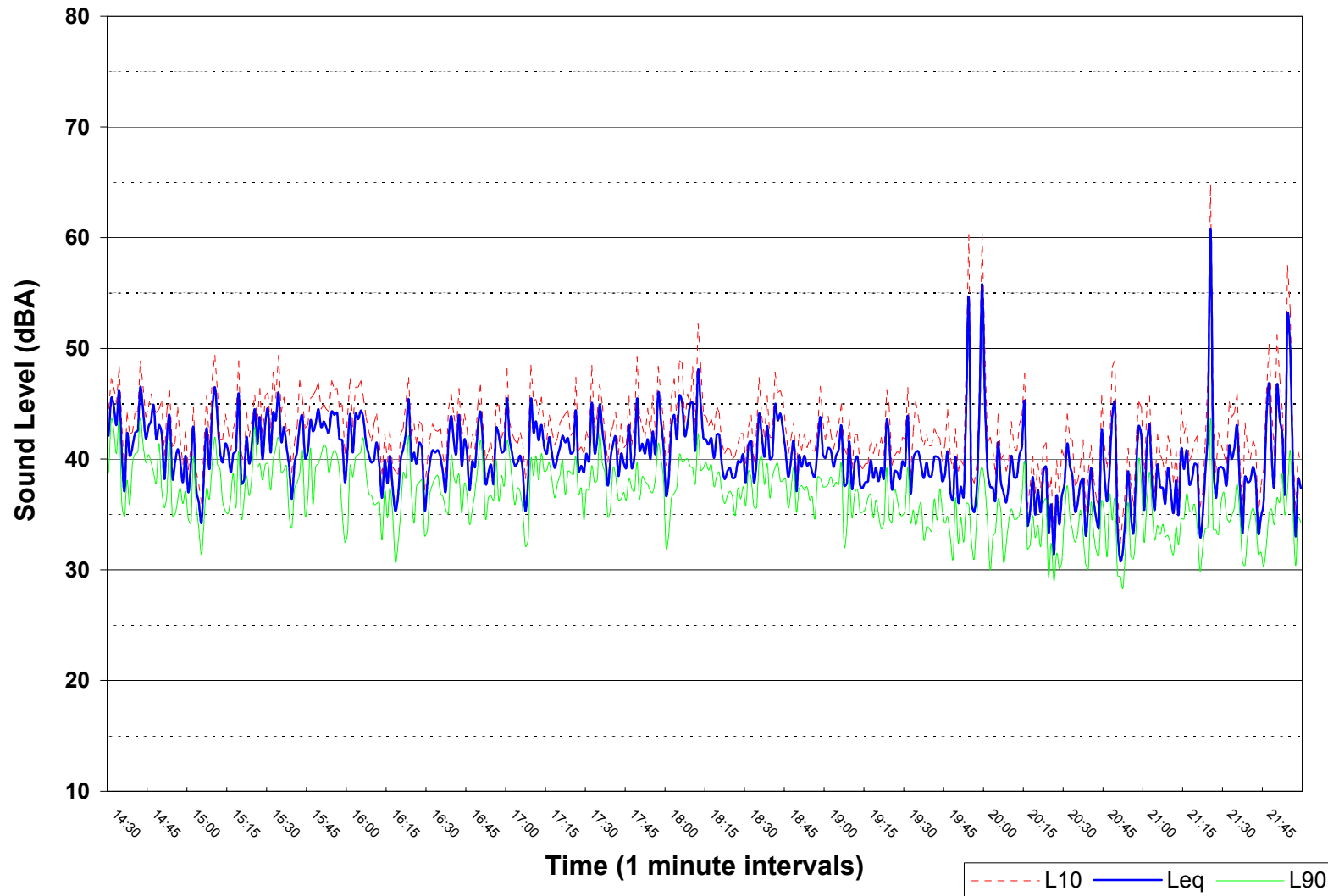


Figure 2.9
Yellowhead Aggregates Ambient Sound Survey
Site 2
July 25 - 26, 2008; 22:00 - 06:59

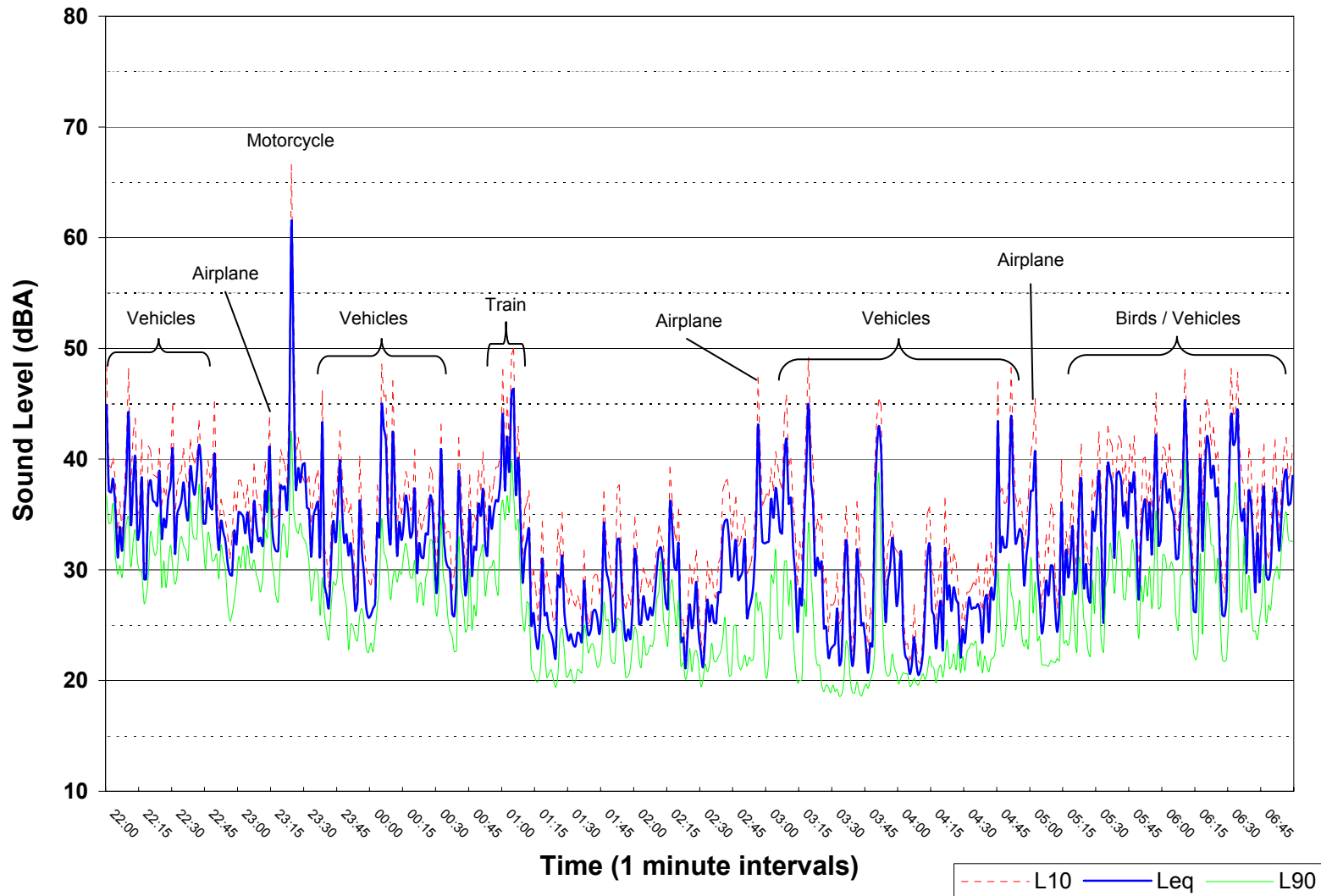
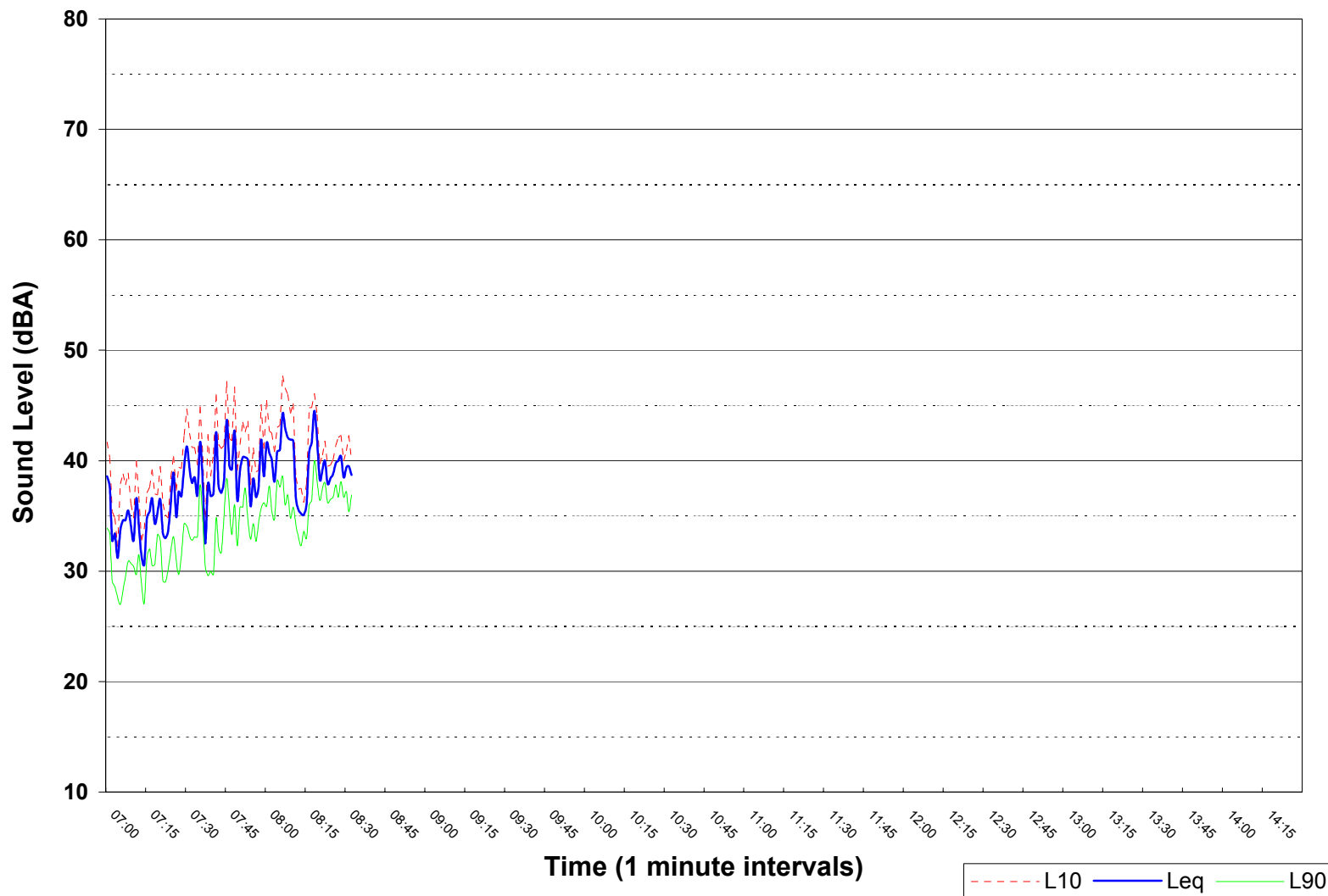
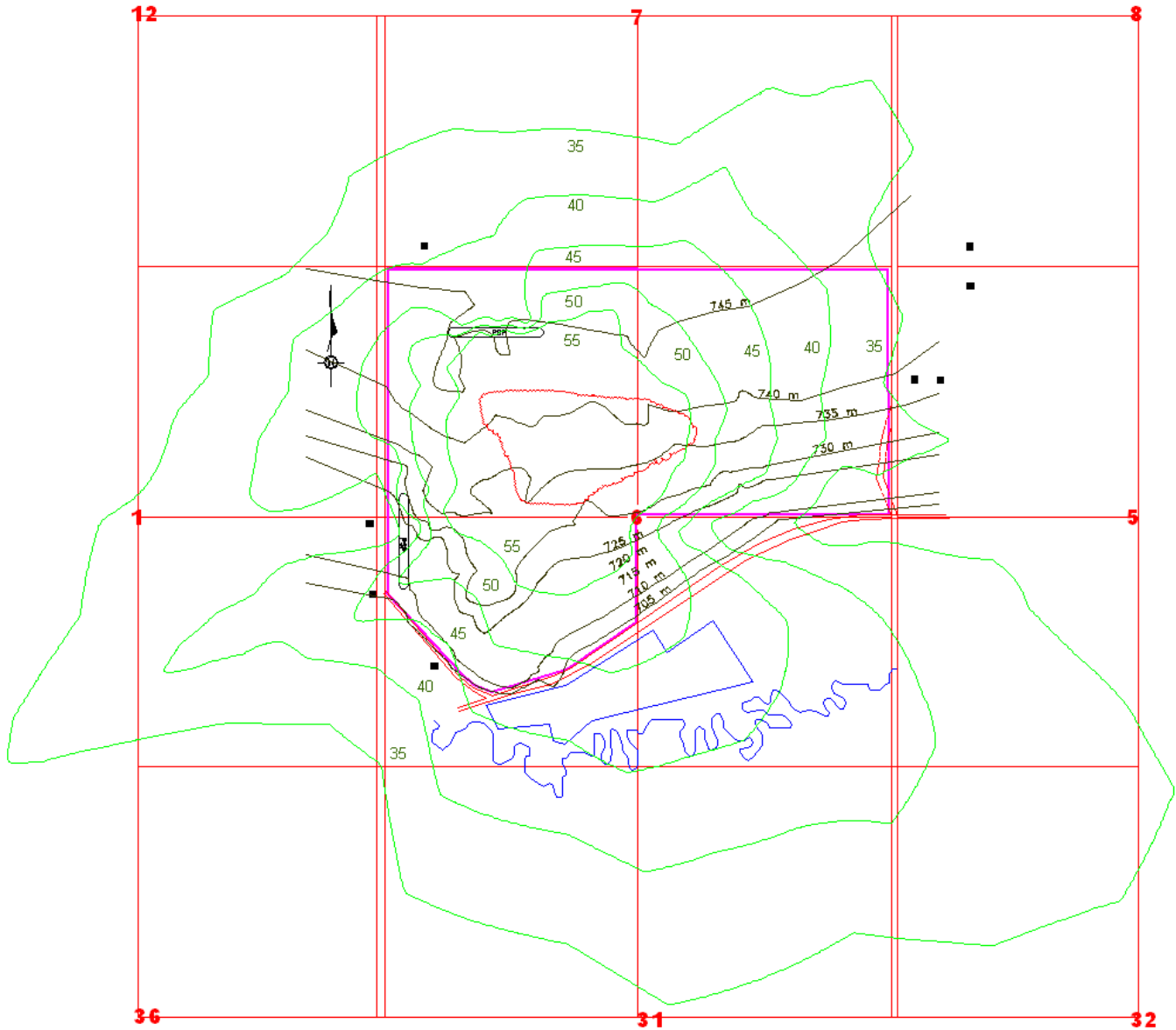


Figure 2.10
Yellowhead Aggregates Ambient Sound Survey
Site 2
July 26, 2008; 07:00 - 14:29



Appendix B

Noise Contour



**Yellowhead Aggregates
Pit 31 Turnbull (Onoway)
Modelled Noise Contour**