Environmental Noise Assessment

Homewood Snowmaking

Placer County, California

Job # 2008-232

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INTRODUCTION

This section analyzes the existing noise environment associated with snowmaking operations at the Homewood Mountain Resort and Ski Area. Homewood Mountain Resort encompasses 1260 acres, utilized for downhill snow recreation in winter months, and full service event facilities year round. Figure 1 shows the project site.

The intent of this report is to establish the existing noise environment, general ambient background noise levels, and existing snowmaking noise levels on the project site. This section also discusses the applicable regional and local noise level criteria.

ACOUSTICAL TERMINOLOGY[1]

Fundamentals of Acoustics

Acoustics is the science of sound. Sound may be thought of as mechanical energy of a vibrating object transmitted by pressure waves through a medium to human (or animal) ears. If the pressure variations occur frequently enough (at least 20 times per second), then they can be heard and are called sound. The number of pressure variations per second is called the frequency of sound, and is expressed as cycles per second or Hertz (Hz).

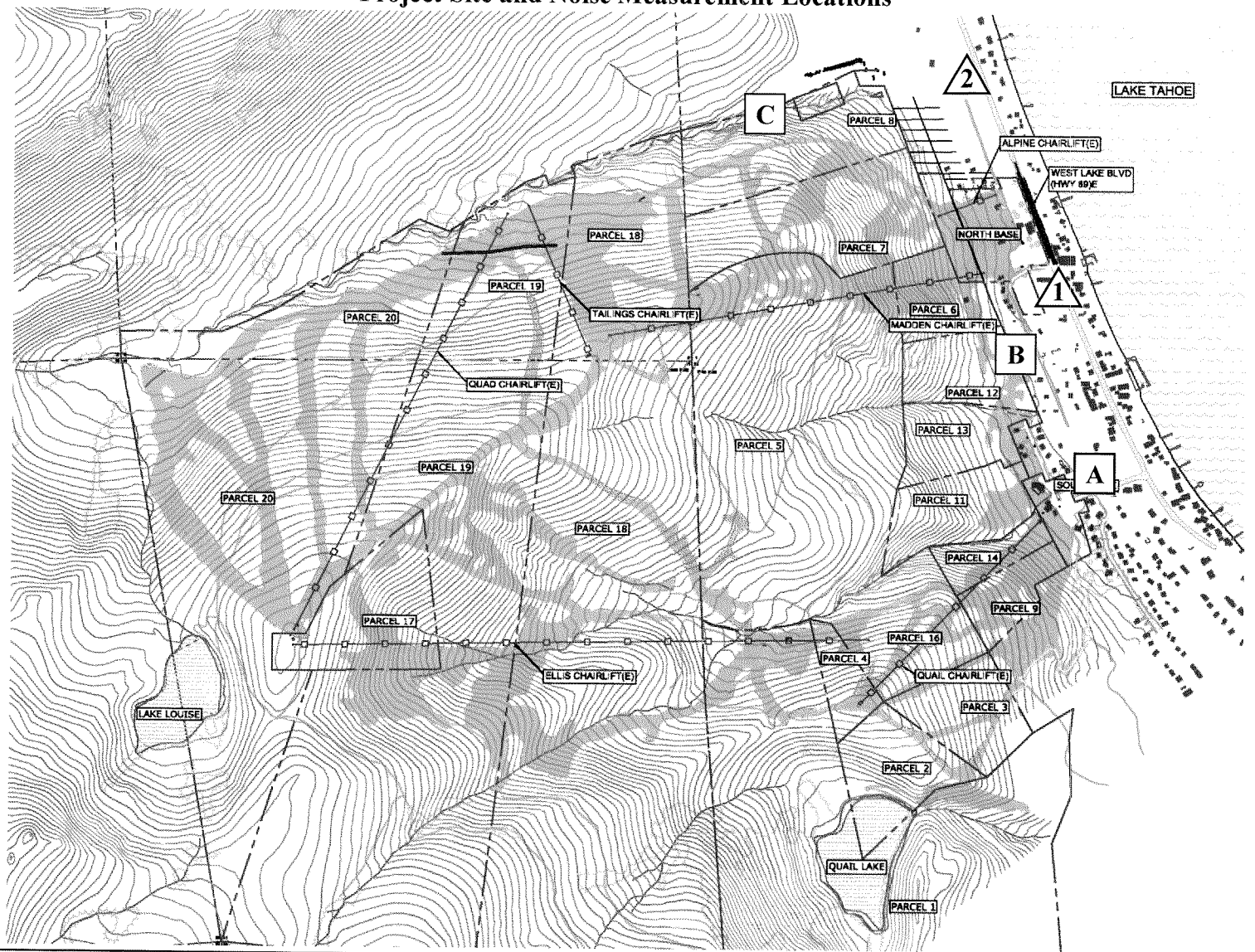
Noise is a subjective reaction to different types of sounds. Noise is typically defined as (airborne) sound that is loud, unpleasant, unexpected or undesired, and may therefore be classified as a more specific group of sounds. Perceptions of sound and noise are highly subjective: one person's music is another's headache.

Measuring sound directly in terms of pressure would require a very large and awkward range of numbers. To avoid this, the decibel scale was devised. The decibel scale uses the hearing threshold (20 micropascals), as a point of reference, defined as 0 dB. Other sound pressures are then compared to this reference pressure, and the logarithm is taken to keep the numbers in a practical range. The decibel scale allows a million-fold increase in pressure to be expressed as 120 dB, and changes in levels (dB) correspond closely to human perception of relative loudness.

The perceived loudness of sounds is dependent upon many factors, including sound pressure level and frequency content. However, within the usual range of environmental noise levels, perception of loudness is relatively predictable, and can be approximated by A-weighted sound levels. There is a strong correlation between A-weighted sound levels (expressed as dBA) and the way the human ear perceives sound. For this reason, the A-weighted sound level has become the standard tool of environmental noise assessment. All noise levels reported in this section are in terms of A-weighted levels, but are expressed as dB, unless otherwise noted.

[1] For an explanation of these terms, see Appendix A: "Acoustical Terminology"

Figure 1
Homewood Mountain Resort
Project Site and Noise Measurement Locations



△ : Short Term Noise Measurement Location

□ : Continuous Noise Measurement Location

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Community noise is commonly described in terms of the ambient noise level, which is defined as the all-encompassing noise level associated with a given environment. A common statistical tool to measure the ambient noise level is the average, or equivalent, sound level (L_{eq}), which corresponds to a steady-state A weighted sound level containing the same total energy as a time varying signal over a given time period (usually one hour). The L_{eq} is the foundation of the composite noise descriptor, L_{dn}, and shows very good correlation with community response to noise.

The Community Noise Equivalent Level (CNEL) descriptor is used by the TRPA for determining a significant noise impact. The CNEL is defined as the 24-hour average noise level with noise occurring during evening hours (7:00 p.m. – 10:00 p.m.) weighted by a factor of three, and nighttime hours (10:00 p.m. – 7:00 a.m.) weighted by a factor of 10, prior to the averaging.

Table 1 lists several examples of the noise levels associated with common situations. Appendix A provides a summary of acoustical terms used in this report.

Table 1
Typical A-Weighted Sound Levels of Common Noise Sources

Loudness Ratio Level	A-Weighted Sound Level (dBA)	
128	130	Threshold of pain
64	120	Jet aircraft take-off at 100 feet
32	110	Riveting machine at operators position
16	100	Shot-gun at 200 feet
8	90	Bulldozer at 50 feet
4	80	Diesel locomotive at 300 feet
2	70	Commercial jet aircraft interior during flight
1	60	Normal conversation speech at 5-10 feet
1/2	50	Open office background level
1/4	40	Background level within a residence
1/8	30	soft whisper at 2 feet
1/16	20	Interior of recording studio

REGULATORY SETTING

Tahoe Regional Planning Agency Criteria:

The Tahoe Regional Planning Agency (TRPA) has adopted environmental thresholds for the Lake Tahoe Region. The noise standards, or "Thresholds" as they are commonly referred to, are numerical CNEL values for various land use categories and transportation corridors.

As a form of zoning, the TRPA has divided the Lake Tahoe Region into more than 175 separate Plan Areas. Boundaries for each of the Plan Areas have been established based on similar land uses and the unique character of each geographic area. For each Plan Area, a "Statement" is made as to how that particular area should be regulated to achieve regional environmental and land use objectives. As a part of each Statement, an outdoor CNEL standard is established. The project site is located within Plan Area 157 (Homewood/Tahoe Ski Bowl). The project site is bordered to the south and east by Plan Area 156 (Chambers Landing) and to the north and northeast by Plan Area 160 (Homewood/Residential). The Plan Area Statement noise level criteria are shown in Table 2.

Table 2
Project and Adjoining Plan Area Statement Noise Level Criteria

Plan Area #	Plan Area Name	TRPA Noise Level Criteria
157	Homewood/Tahoe Ski Bowl	55 dB CNEL for entire Plan Area
156	Chambers Landing	55 dB CNEL for entire Plan Area
160	Homewood/Residential	55 dB CNEL for entire Plan Area

Placer County General Plan

The Placer County General Plan Policies pertaining to noise are designed to protect County residents from the harmful and annoying effects of exposure to excessive noise. Those policies which would be applicable to this project are reproduced below:

1. *The County shall not allow development of new noise-sensitive uses where the noise level due to non-transportation noise sources will exceed the noise level standards of* Table 3 *(Table 9-1 of the Placer County General Plan Noise Element) as measured immediately within the property line of the new development, unless effective noise mitigation measures have been incorporated into the development design to achieve the standards specified in* Table 3.

2. *The County shall require that noise created by new non-transportation noise sources be mitigated so as not to exceed the noise level standards of* Table 3 *(Table 9-1 of the Placer County General Plan) as measured immediately within the property line of lands designated for noise-sensitive uses.*

3. *Impulsive noise produced by blasting should not be subject to the criteria listed in* Table 3 *(Table 9-1 of the Placer County General Plan). Single event impulsive noise levels produced by gunshots or blasting shall not exceed a peak linear overpressure of 122 dB, or a C-weighted Sound Exposure Level (SEL) of 98 dBC. The cumulative noise level from impulsive sounds such as gunshots and blasting shall not exceed 60 dB LCDN or CNEL on any given day. These standards shall be applied at the property line of a receiving land use.*

Table 3
(Table 9-1 of the Placer County General Plan)
Allowable Ldn Noise Levels Within Specified Zone Districts
Applicable to New Projects Affected by or Including Non-Transportation Noise Sources

Zone District of Receptor	Property Line of Receiving Use	Interior Space
Residential adjacent to industrial	60 dBA	45 dBA
Other Residential	50 dBA	45 dBA
Office/Professional	70 dBA	45 dBA
Neighborhood Commercial	70 dBA	45 dBA

Notes for Table 10-4:
1. Except where noted otherwise, noise exposures will be those which occur at the property line of the receiving use.
2. Interior spaces are defined as any locations where some degree of noise-sensitivity exists. Examples include all habitable rooms of residences, and areas where communication and speech intelligibility are essential, such as classrooms and offices.

EXISTING LAND USES IN THE PROJECT VICINITY

The Homewood Mountain Resort is located on the west shoreline of Lake Tahoe, six miles south of Tahoe City along Highway 89, in Placer County. Existing land uses in the immediate Project vicinity include limited commercial/retail areas to the east, and residential uses along the north, south and southeast. Highway 89 is directly adjacent to the North Lodge Building, on the Resort site.

EXISTING NOISE ENVIRONMENT IN THE PROJECT VICINITY

Snowmaking Operations

Snowmaking operations can be separated into two categories. The first is the air/water guns which consist of high pressure air and water which are mixed at the nozzle. These types of snowmaking guns can be fairly loud, with the primary noise source being the compressed air at the nozzle. In addition, this requires fairly large compressors and in some cases diesel generators. In the late 1980's and early 1990's, Homewood ski area used this type of snowmaking equipment. The air/water nozzle fleet was generally made up of Omichron and Ratnik brand air/water nozzles. Each nozzle has varying performance characteristics for snowmaking and noise emissions. Most of the nozzles are mounted to skids, and can be connected to any of the snowmaking hydrants on the mountain.

The other type of snowmaking equipment is characterized as fan-gun technology. The fan guns are electrically powered, with either compressors located in a main building or small compressors located on each fan gun. This technology is significantly quieter than the air/water nozzles. With the recent reconfiguration, the Homewood snowmaking fleet consists exclusively of fan guns, such as the Super Polecat, the Super Wizzard, and the Viking Snowtower. In general, fan gun snowmaking equipment is 10dB to 20dB quieter than the air/water nozzle equivalent.

Existing Ambient Noise Environment

To quantify existing snowmaking noise levels and background noise levels in the vicinity of the Ski Area, j.c. brennan & associates, Inc. conducted continuous noise monitoring for 4 consecutive days at three locations between the dates of December 18-21, 2008. Table 4 shows a summary of the continuous hourly noise monitoring results. Appendix B graphically shows the continuous 24-hour ambient noise measurement data.

Noise measurement equipment consisted of Larson Davis Laboratories (LDL) Model 820 precision integrating sound level meters. The measurement systems were calibrated using a LDL Model CAL200 acoustical calibrator before testing. The measurement equipment meets all of the pertinent requirements of the American National Standards Institute (ANSI) for Type 1 (precision) sound level meters.

Table 4
Existing Continuous Ambient and Snowmaking Noise Monitoring Results

				Average Measured Hourly Noise Levels, dBA								
				Daytime (7:00 am - 7:00 pm)			Evening (7:00 pm–10:00pm)			Nighttime (10:00 pm – 7:00 am)		
Site	Location	Date	CNEL/* (dBA)	Leq	L50	Lmax	Leq	L50	Lmax	Leq	L50	Lmax
A	Residential uses near South Base	December 18, 2008	65.1/60.0*	57.6	52.7	71.6	54.5	53.7	66.9	58.8	49.2	65.1
		December 19, 2008	65.8/62.7*	61.4	56.8	73.0	54.2	53.9	60.3	59.1	55.8	70.0
		December 20, 2008	65.4/59.9*	54.1	42.8	65.2	35.5	29.1	49.2	59.5	49.4	66.3
		December 21, 2008	58.6/**	51.0	42.1	65.7	44.1	42.5	60.3	52.4	30.6	55.7
B	Eastern Project Boundary	December 18, 2008	62.5/51.6*	56.6	43.9	78.5	60.4	48.0	87.2	54.9	42.1	67.5
		December 19, 2008	61.7/55.8*	55.9	47.4	75.7	45.0	41.8	64.4	55.3	48.6	72.1
		December 20, 2008	55.0/48.0*	55.2	38.3	71.2	36.9	28.4	49.4	45.9	40.0	61.5
		December 21, 2008	52.5/**	45.0	39.1	54.5	48.6	45.4	60.3	45.6	29.4	56.0
C	Northeastern Project Boundary	December 18, 2008	50.3/48.1*	42.5	36.0	59.2	47.4	45.0	64.1	43.1	33.1	48.1
		December 19, 2008	55.9/52.7*	54.2	42.2	66.9	32.2	30.0	49.8	48.4	43.5	59.8
		December 20, 2008	43.3/35.4*	44.7	33.5	58.6	36.3	29.0	49.9	31.2	29.3	46.4
		December 21, 2008	44.7/**	39.8	38.1	50.7	39.5	38.5	53.6	37.6	28.5	49.8

Appendix B graphically shows the continuous 24-hour ambient noise measurement results.
*Indicates the CNEL due to snowmaking operations.
**No Snowmaking occurred during this day
Source – j.c. brennan & associates, Inc. - 2008

The CNEL values shown in Table 4 show the overall ambient CNEL value as well as the CNEL value associated with snowmaking operations. Due to the fact that the measured noise levels included numerous noise sources, including snowmaking operations, roadway traffic, snowmobile operations, etc., the overall CNEL values associated with snowmaking were calculated using the measured L50 values. The hourly L50 values identify the steady-state noise associated with the snowmaking operations, while excluding the temporary and short-term noise events, such as snowmobile pass-bys and roadway traffic.

In conversations with Homewood Ski Resort, snowmaking was continuous from December 18th till 10:30 a.m. on December 20th. No snowmaking operations occurred on December 21st.

Short-Term Noise Monitoring

In addition to the continuous hourly noise level measurements, j.c. brennan & associates, Inc. conducted two sets of short-term noise measurements adjacent to the eastern boundary of the ski area, and S.R. 89 on December 22, 2008. The noise measurements were conducted while snowmaking operations occurred along the face of face of Homewood Ski Area. The noise measurement sites are shown on Figure 1.

Noise measurements were conducted using an LDL Model 824 precision integrating sound level meter, which was equipped with 1/3 Octave band filters. Table 5 shows the results of the short term noise measurements, and the predicted CNEL value based upon 24-hours of snowmaking operations.

Table 5
Short-term Snowmaking Operations Noise Measurement Results and Predicted CNEL Values

Site	Site Description	Measured Leq	Predicted CNEL*
1	Adjacent to S.R. 89, & East of Madden Chairlift	58 dB	64.6 dB
2	Adjacent to S.R. 89, & at North Boundary of Homewood	60 dB	66.6 dB

Source: j.c. brennan & associates, Inc. 2009
* CNEL is calculated based upon 24-hours of operations.

Individual Noise Measurements of Snowmaking Equipment

The staff of j.c. brennan & associates, Inc. have conducted noise measurements of the snowmaking equipment used at the Homewood Ski Area. Noise level data was collected at 3 locations. The locations were at 50 feet in front, side and rear of the equipment. Table 6 shows the results of the noise level data associated with the snowmaking equipment.

Table 6
Snowmaking Equipment Noise Levels

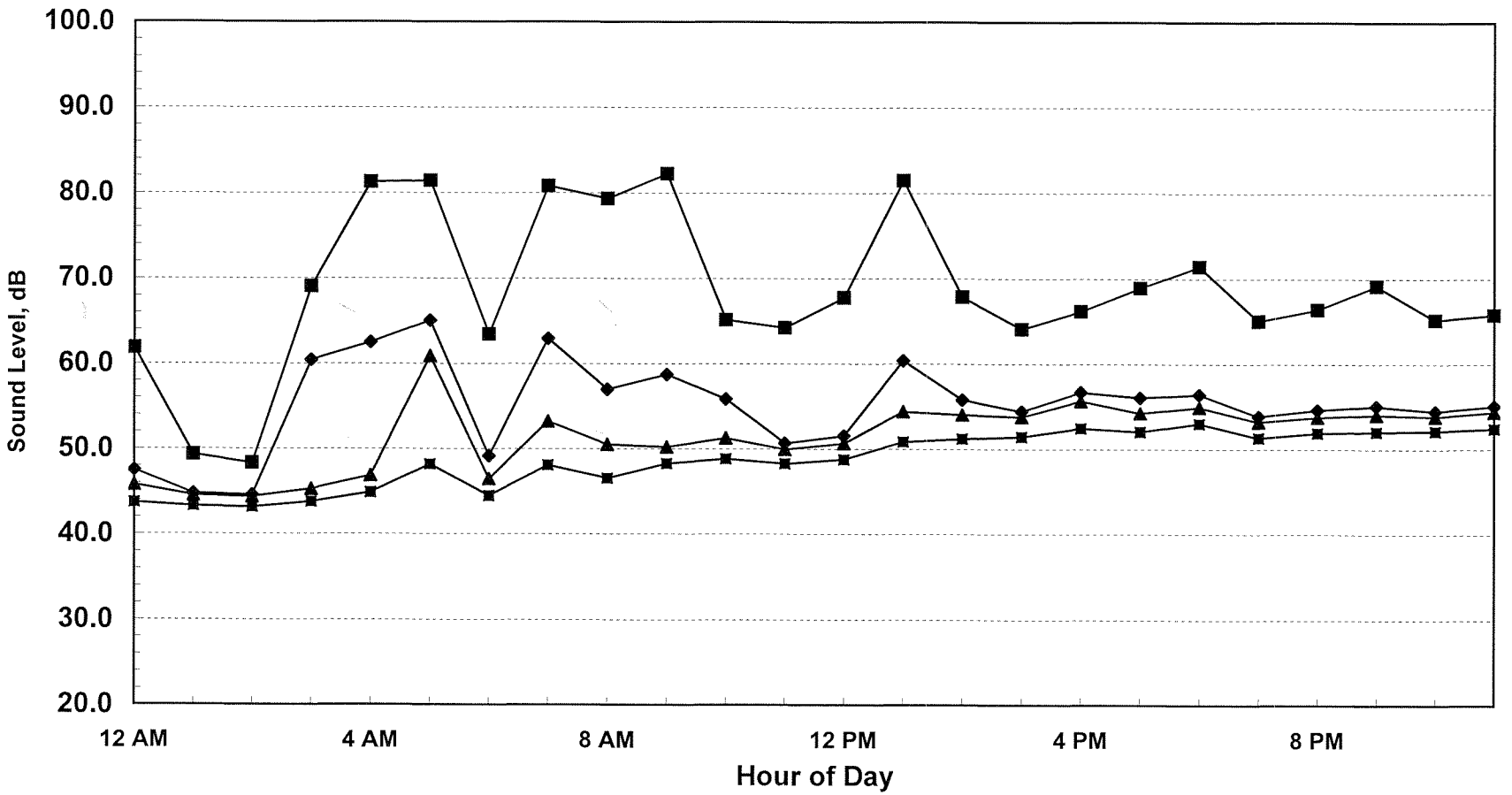
Snowmaking Equipment	Type	Noise Levels at Position		
		Front @ 50'	Side @ 50'	Rear @ 50'
Super Polecat 25 HP	Fan Gun	75 dBA	71 dBA	77 dBA
Super Wizzard 25 HP	Fan Gun	76 dBA	70 dBA	76 dBA
Viking Snowtower	Fan Gun	78 dBA	70 dBA	65 dBA

Appendix A

Acoustical Terminology

Acoustics	The science of sound.
Ambient Noise	The distinctive acoustical characteristics of a given space consisting of all noise sources audible at that location. In many cases, the term ambient is used to describe an existing or pre-project condition such as the setting in an environmental noise study.
Attenuation	The reduction of an acoustic signal.
A-Weighting	A frequency-response adjustment of a sound level meter that conditions the output signal to approximate human response.
Decibel or dB	Fundamental unit of sound, A Bell is defined as the logarithm of the ratio of the sound pressure squared over the reference pressure squared. A Decibel is one-tenth of a Bell.
CNEL	Community Noise Equivalent Level. Defined as the 24-hour average noise level with noise occurring during evening hours (7 - 10 p.m.) weighted by a factor of three and nighttime hours weighted by a factor of 10 prior to averaging.
Frequency	The measure of the rapidity of alterations of a periodic signal, expressed in cycles per second or hertz.
Ldn	Day/Night Average Sound Level. Similar to CNEL but with no evening weighting.
Leq	Equivalent or energy-averaged sound level.
Lmax	The highest root-mean-square (RMS) sound level measured over a given period of time.
L(n)	The sound level exceeded a described percentile over a measurement period. For instance, an hourly L50 is the sound level exceeded 50% of the time during the one hour period.
Loudness	A subjective term for the sensation of the magnitude of sound.
Noise	Unwanted sound.
Peak Noise	The level corresponding to the highest (not RMS) sound pressure measured over a given period of time. This term is often confused with the "Maximum" level, which is the highest RMS level.
RT_{60}	The time it takes reverberant sound to decay by 60 dB once the source has been removed.
Sabin	The unit of sound absorption. One square foot of material absorbing 100% of incident sound has an absorption of 1 sabin.
Threshold of Hearing	The lowest sound that can be perceived by the human auditory system, generally considered to be 0 dB for persons with perfect hearing.
Threshold of Pain	Approximately 120 dB above the threshold of hearing.
Impulsive	Sound of short duration, usually less than one second, with an abrupt onset and rapid decay.
Simple Tone	Any sound which can be judged as audible as a single pitch or set of single pitches.

Appendix B
Homewood Snowmaking Monitoring
Continous 24 Hr Monitoring, Site A
December 18, 2008



CNEL = 65.1 dB

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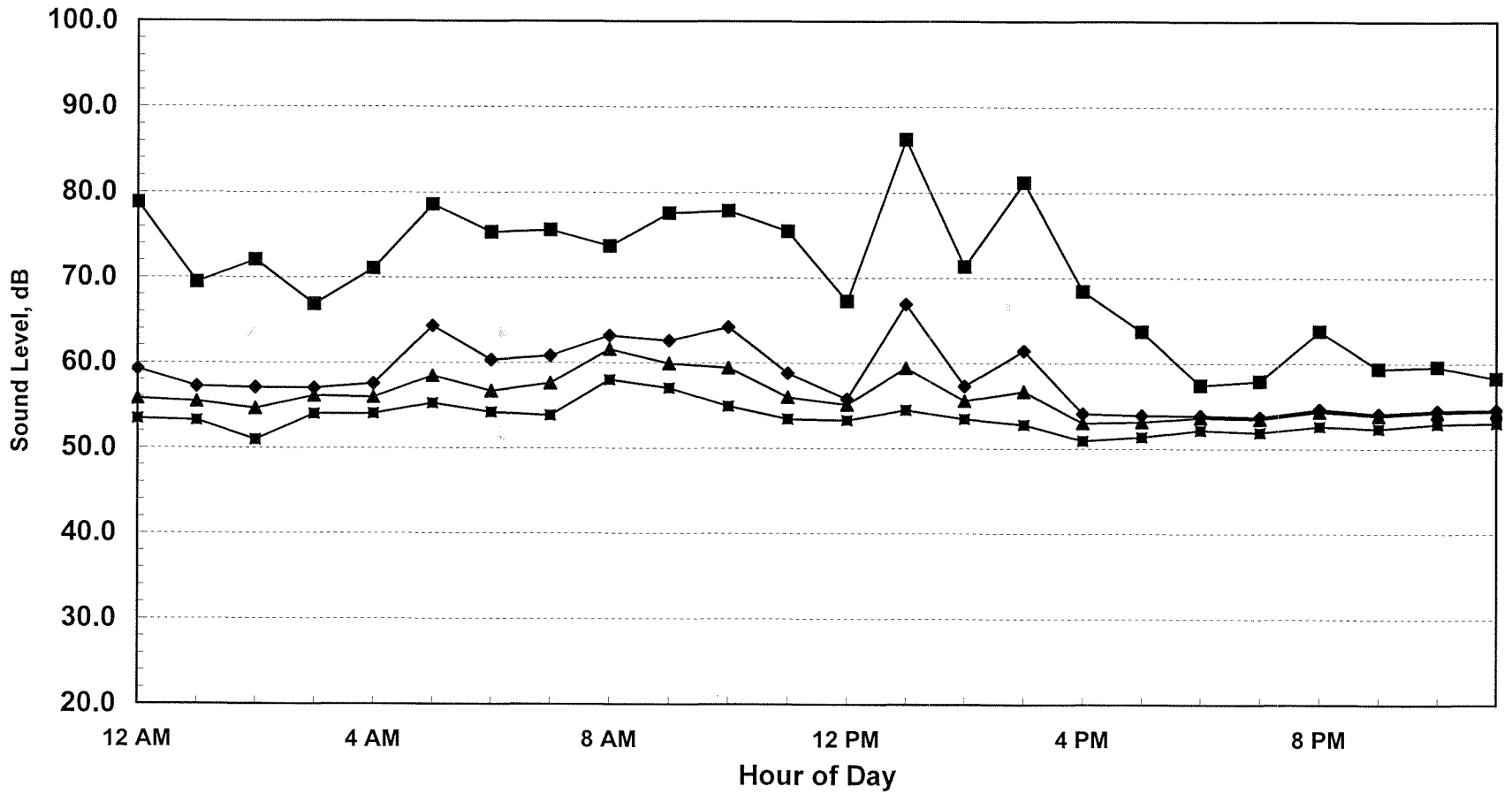
Appendix B
Homewood Snowmaking Monitoring
Continous 24 Hr Monitoring, Site A
December 19, 2008



CNEL = 65.8 dB

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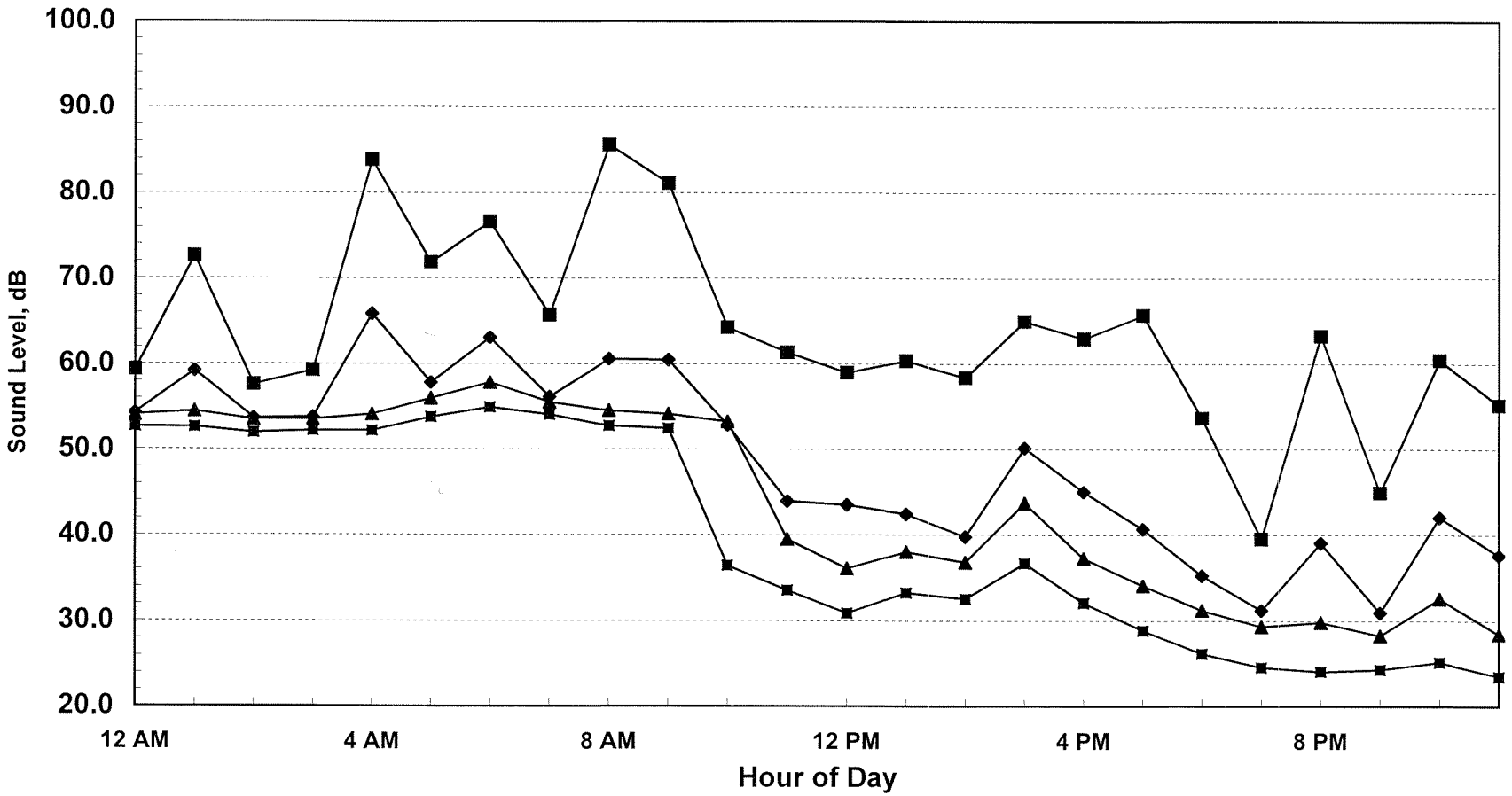
Appendix B
Homewood Snowmaking Monitoring
Continous 24 Hr Monitoring, Site A
December 20, 2008



CNEL = 65.4 dB

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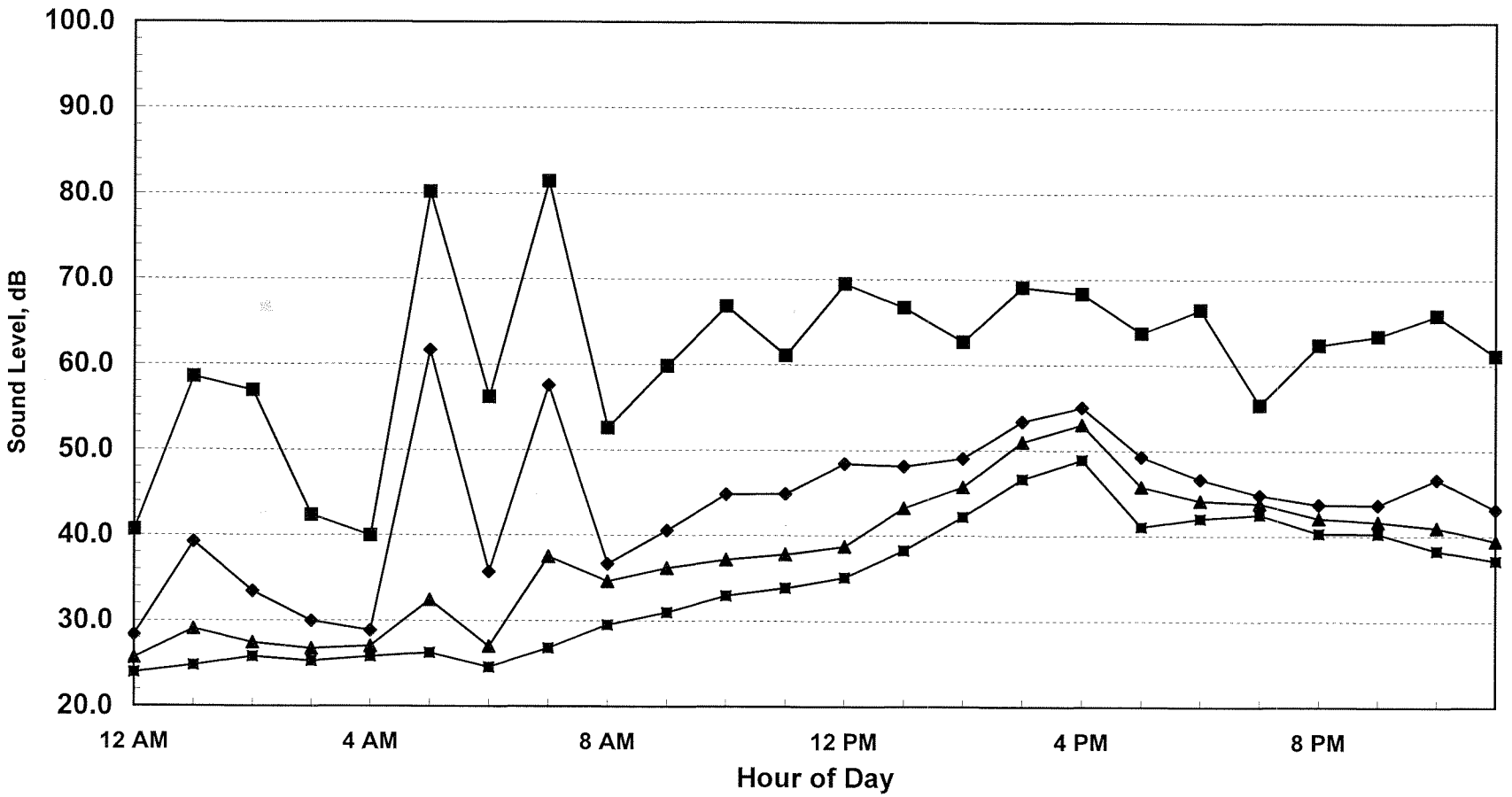
Appendix B
Homewood Snowmaking Monitoring
Continous 24 Hr Monitoring, Site A
December 21, 2008



CNEL = 58.6 dB

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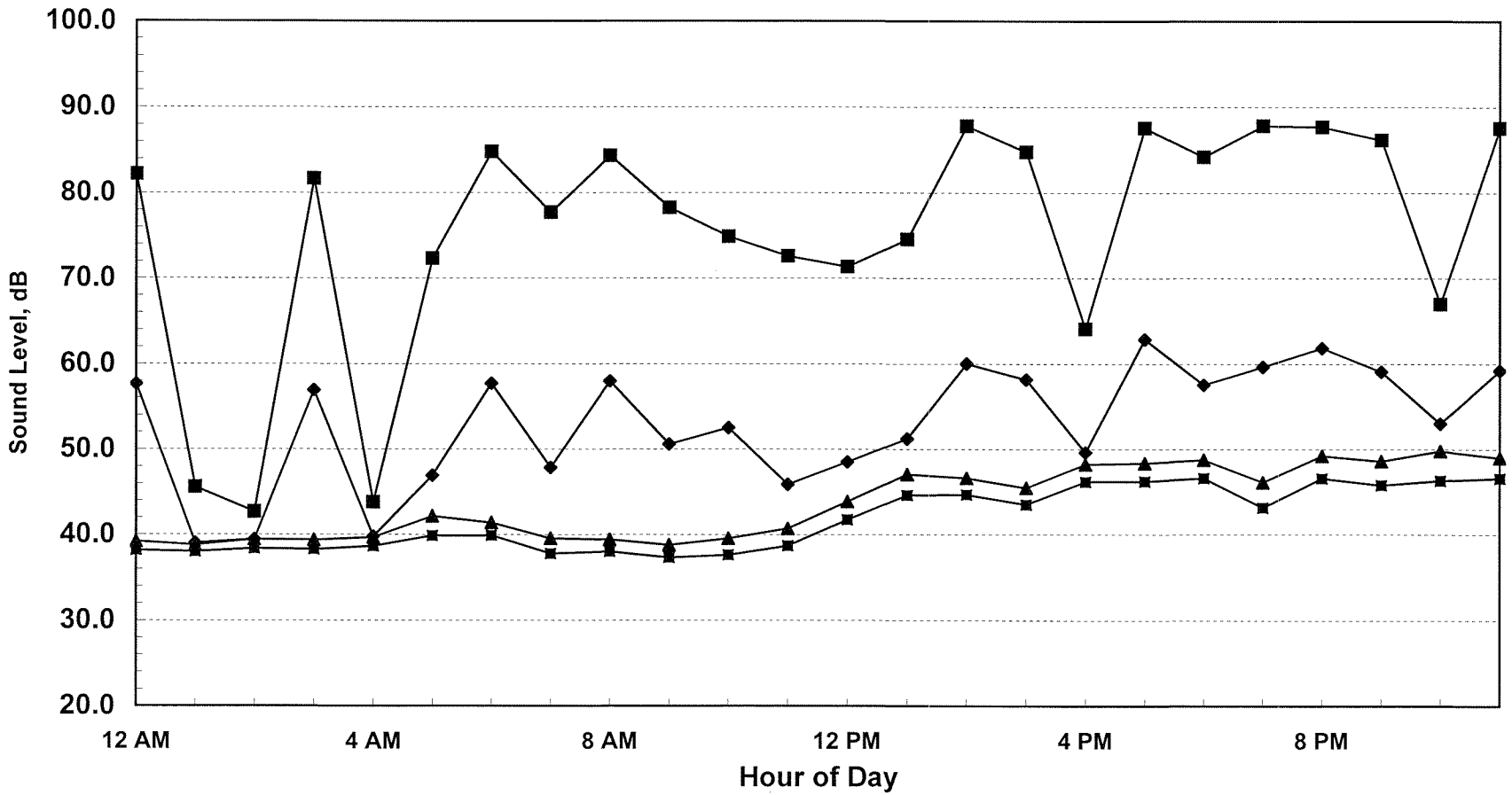
Appendix B
Homewood Snowmaking Monitoring
Continous 24 Hr Monitoring, Site B
December 18, 2008



CNEL = 62.5 dB

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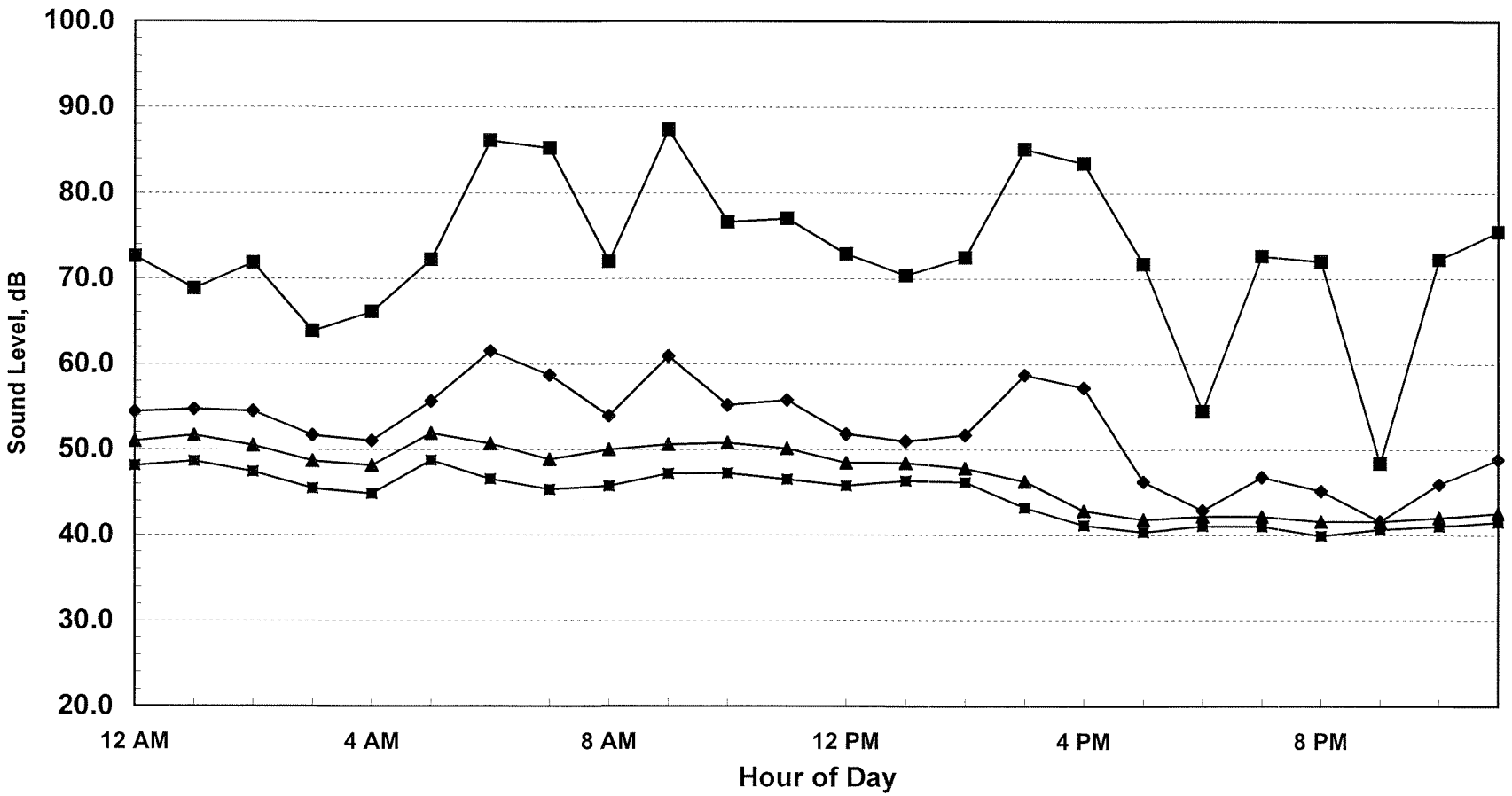
Appendix B
Homewood Snowmaking Monitoring
Continous 24 Hr Monitoring, Site B
December 19, 2008



CNEL = 61.7 dB

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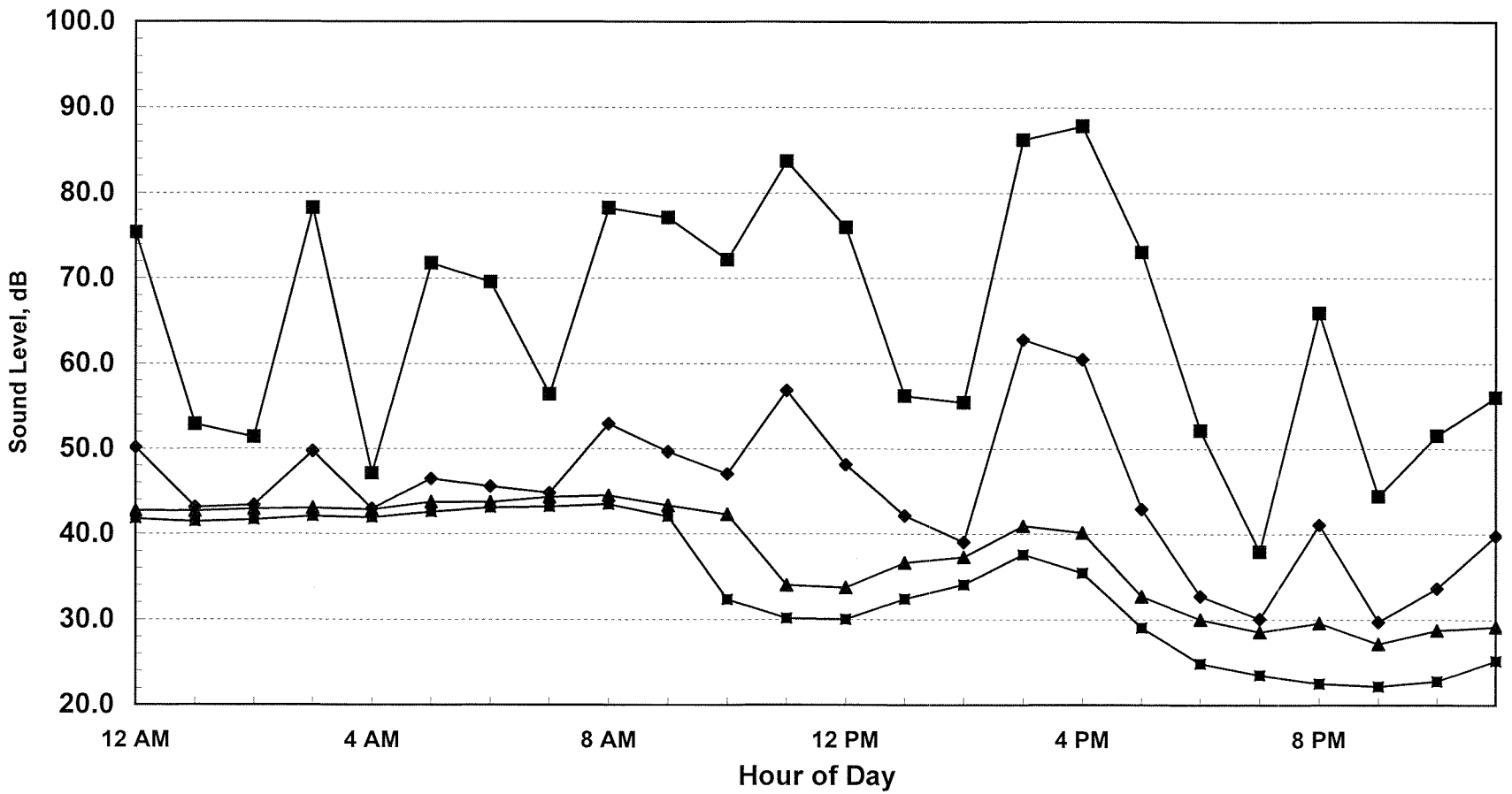
Appendix B
Homewood Snowmaking Monitoring
Continous 24 Hr Monitoring, Site B
December 20, 2008



CNEL = 55.0 dB

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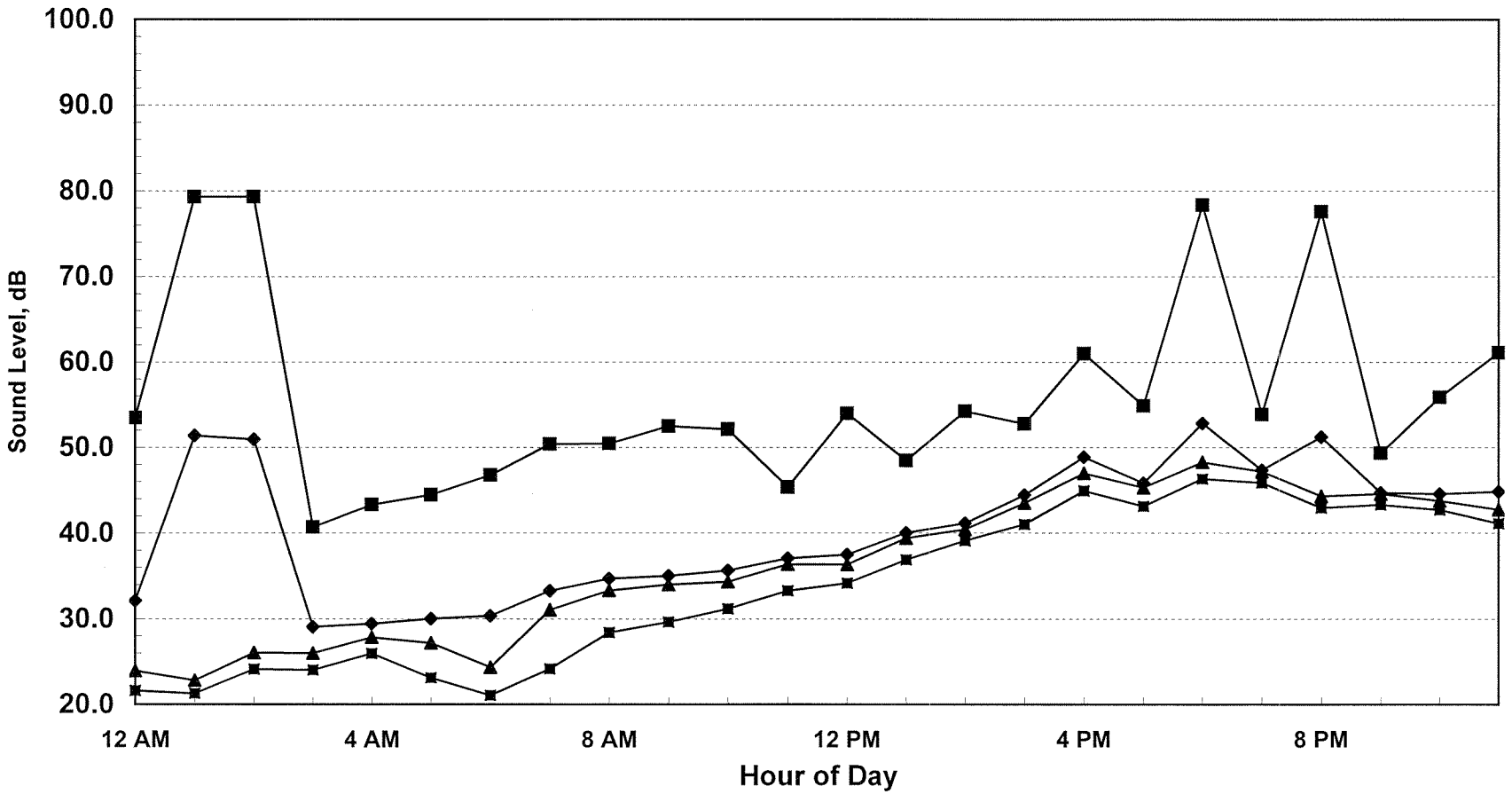
Appendix B
Homewood Snowmaking Monitoring
Continous 24 Hr Monitoring, Site B
December 21, 2008



CNEL = 52.5 dB

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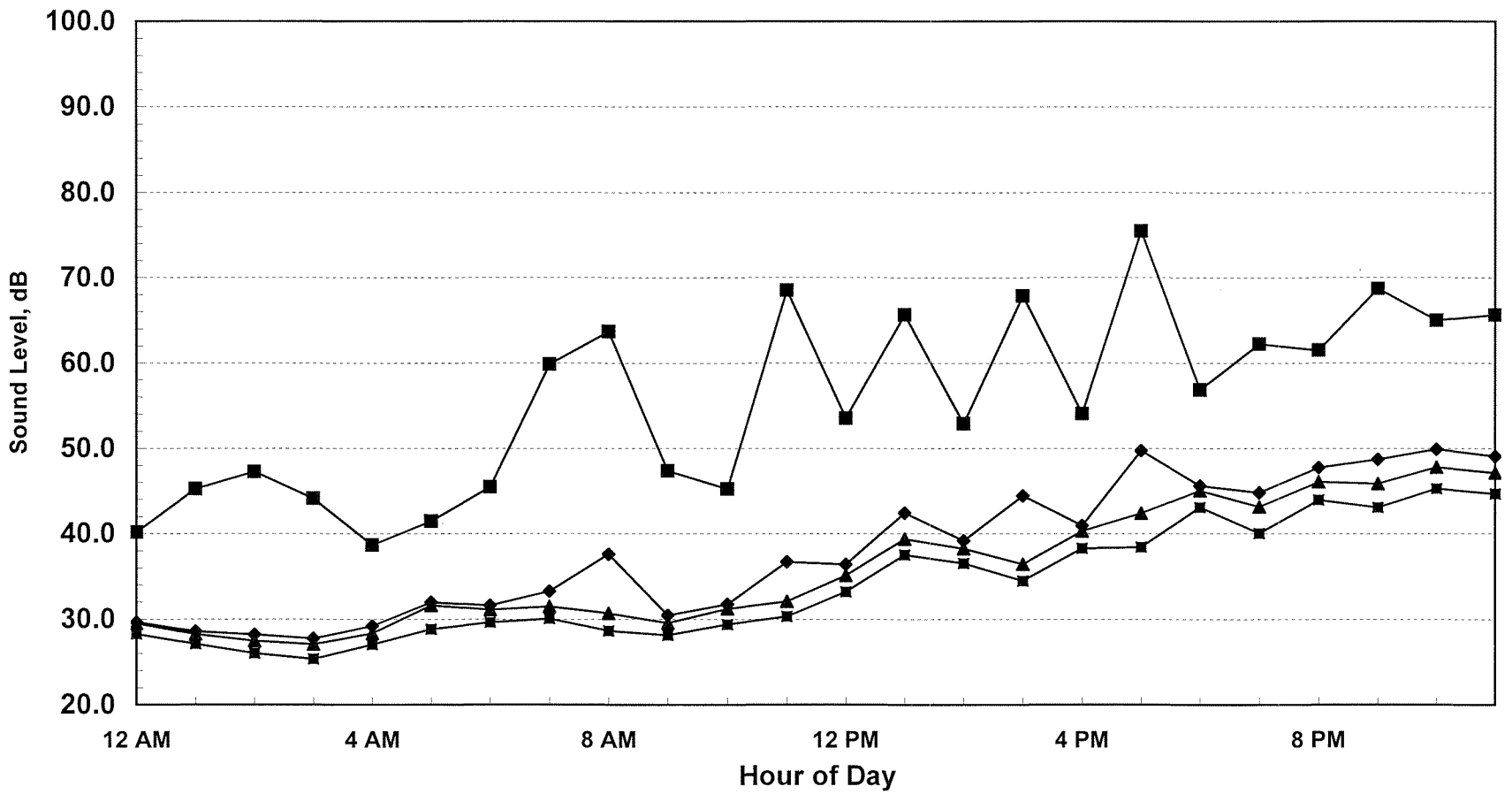
Appendix B
Homewood Snowmaking Monitoring
Continous 24 Hr Monitoring, Site C
December 18, 2008



CNEL = 50.3 dB

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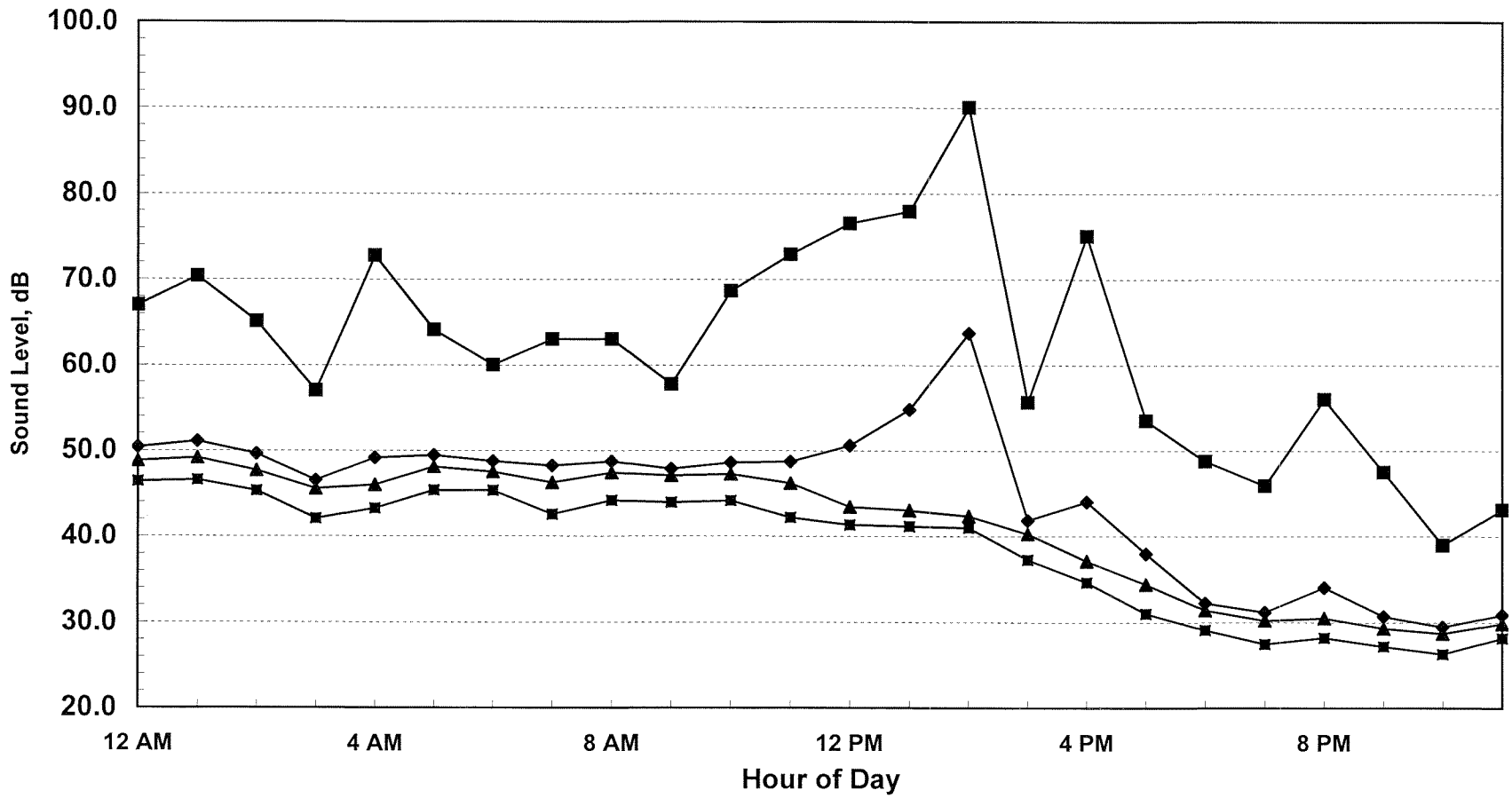
Appendix B
Homewood Snowmaking Monitoring
Continous 24 Hr Monitoring, Site C
December 19, 2008



CNEL = 55.9 dB

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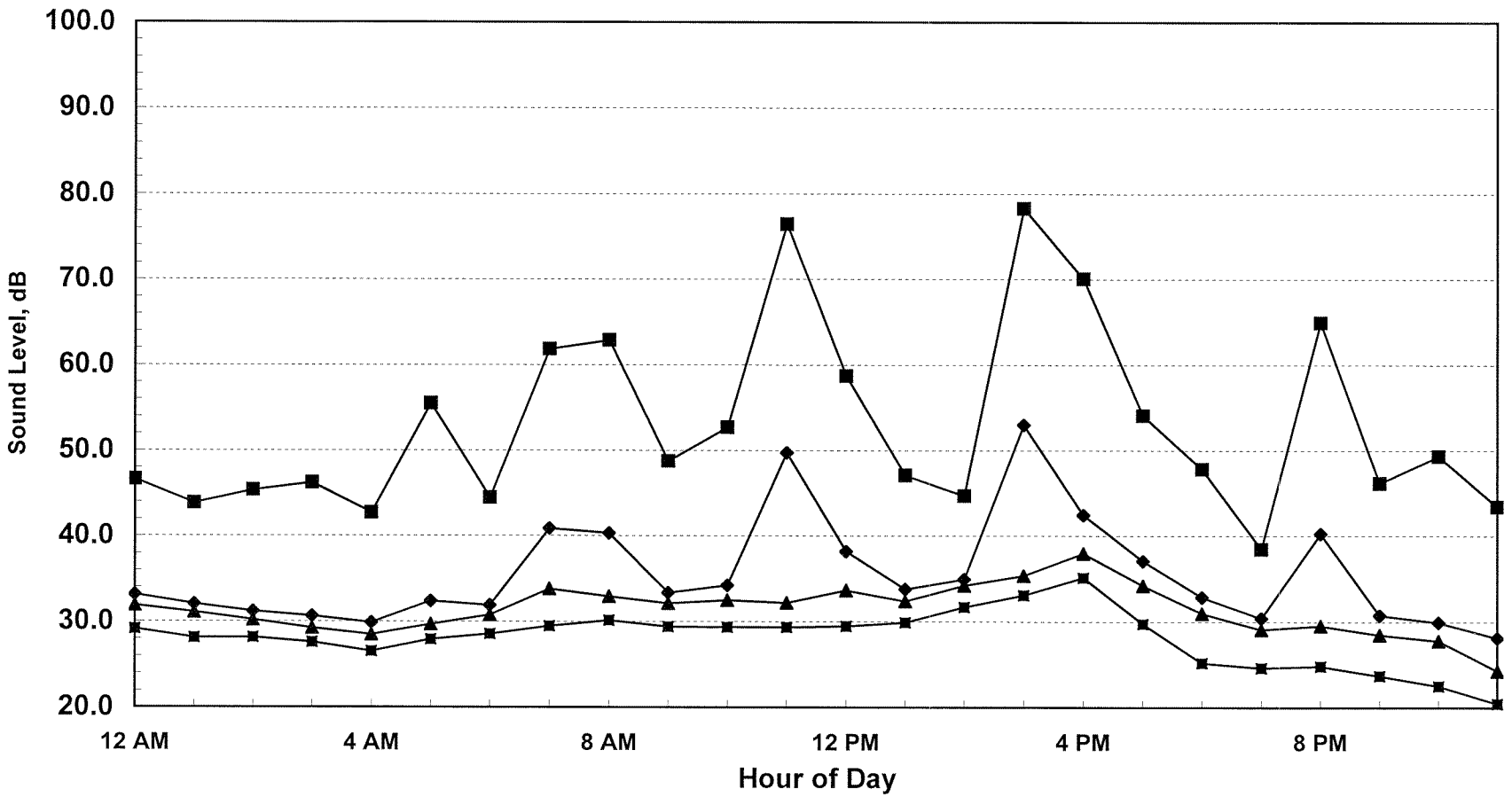
Appendix B
Homewood Snowmaking Monitoring
Continous 24 Hr Monitoring, Site C
December 20, 2008



CNEL = 43.3 dB

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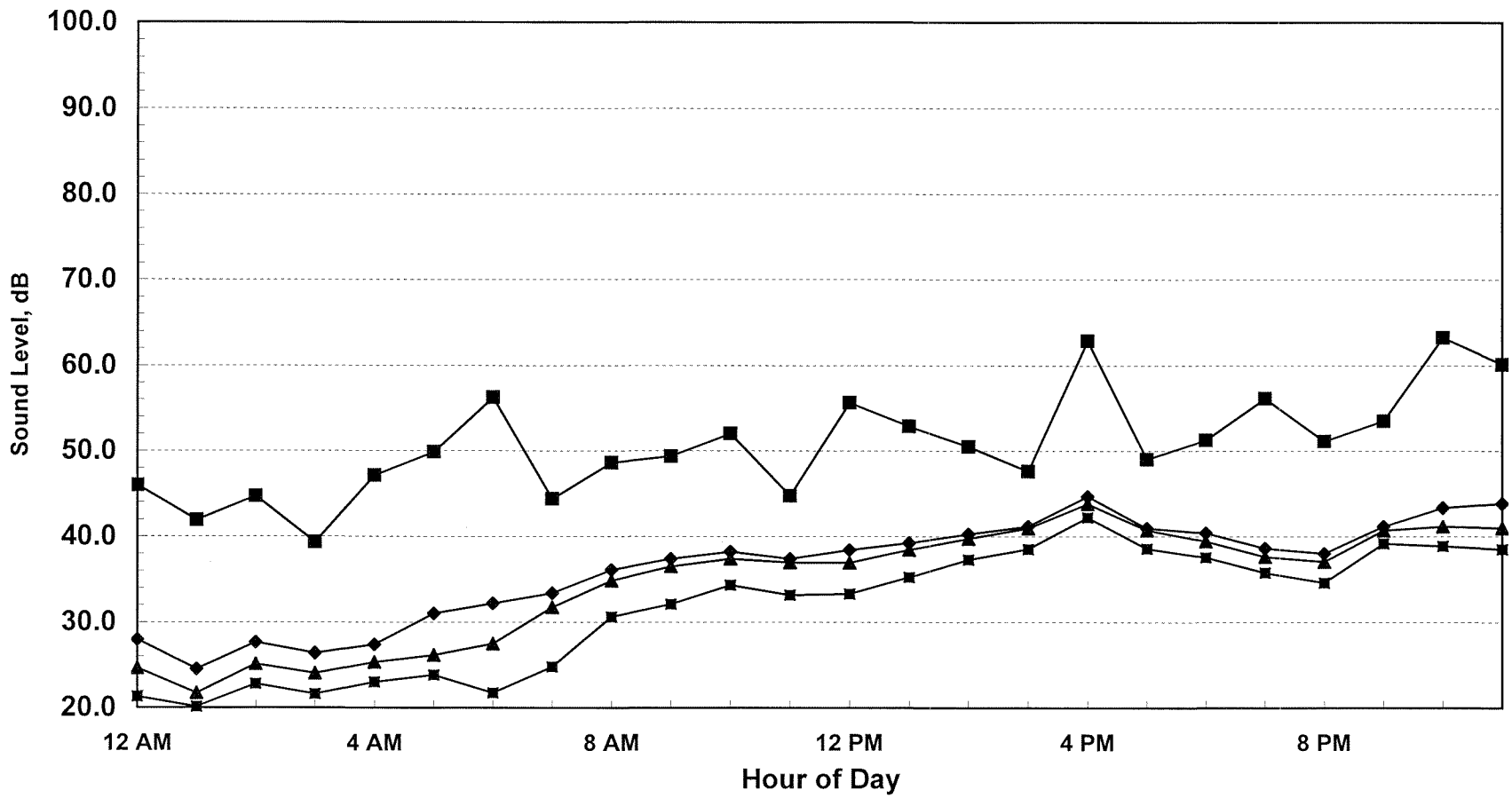
Appendix B
Homewood Snowmaking Monitoring
Continous 24 Hr Monitoring, Site C
December 21, 2008



CNEL = 44.7 dB

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