Environmental Noise Assessment

Topgolf Project

Roseville, CA

BAC Job # 2014-195

Prepared For:

Arco Murray

Attn: Ted Heilbron
3110 Woodcreek Drive
Downers Grove, IL 60515

Prepared By:

Bollard Acoustical Consultants, Inc.

Paul Bollard, President

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3551 Bankhead Road < Loomis, CA 95650 < Phone: (916) 663-0500 < Fax: (916) 663-0501 < BACNOISE.COM

Introduction

The Topgolf project (project) is proposed within the southern portion of the Parcel 49 development site located at Highway 65 and Washington Boulevard in the City of Roseville, California. The Topgolf project is a golf entertainment complex planned on the 12.52-acre parcel in the east portion of the site plan. Topgolf is a 64,232 square foot, three-story, facility with 102 climate-controlled hitting bays, an outdoor outfield enclosed by netting, full-service restaurant, bar, lounges and corporate/event meeting space and family entertainment area with games. The project site location is shown on Figure 1. This noise study was prepared to assess potential noise impacts associated with the Topgolf operations at the existing residential community to the immediate west of the project site.

Acoustical Fundamentals and Terminology

Noise is often described as unwanted sound. Sound is defined as any pressure variation in air that the human ear can detect. If the pressure variations occur frequently enough (at least 20 times per second), they can be heard and are designated as sound. The number of pressure variations per second is called the frequency of sound and is expressed as cycles per second, or Hertz (Hz). Definitions of acoustical terminology are provided in Appendix A.

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 filtering the frequency response of a sound level meter by means of the standardized A-weighting network. There is a strong correlation between A-weighted sound levels (expressed as dBA) and community response to noise. 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.

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 noise environment. A common statistical tool to measure the ambient noise level is the average, or equivalent, sound level (L_{eq}). The L_{eq} is the foundation of the day/night average noise descriptor, L_{dn}, and shows very good correlation with community response to noise. The day/night average sound level (L_{dn}) is based on the average noise level over a 24-hour day, with a +10 decibel weighting applied to noise occurring during nighttime (10:00 PM to 7:00 AM) hours. The nighttime penalty is based on the assumption that people react to nighttime noise exposures as though they were twice as loud as daytime exposures. Because L_{dn} represents a 24-hour average, it tends to disguise short-term variations in the noise environment. For this reason, the City of Roseville utilizes performance standards for non-transportation noise sources. Specifically, performance standards in terms of instantaneous maximum levels (L_{max}) and hourly average levels (L_{eq}), are used to assess noise generated on the project site.

Figure 1

Top Golf - Roseville, California

Site Plan and Noise Measurement Locations

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Scale (feet)

0 400 800

Existing Ambient Noise Environment

The ambient noise environment in the immediate project vicinity is defined primarily by noise from State Highway 65 traffic. To generally quantify existing ambient noise levels in the project vicinity, three continuous (24-hour) ambient noise surveys were conducted on December 9-10, 2010, at the three locations shown in Figure 1. The noise measurement sites were selected to represent the nearest potentially affected residential land uses to the Topgolf project site. The results of the continuous measurements are provided in Table 1.

Table 1
Ambient Noise Monitoring Results – December 9–10, 2010

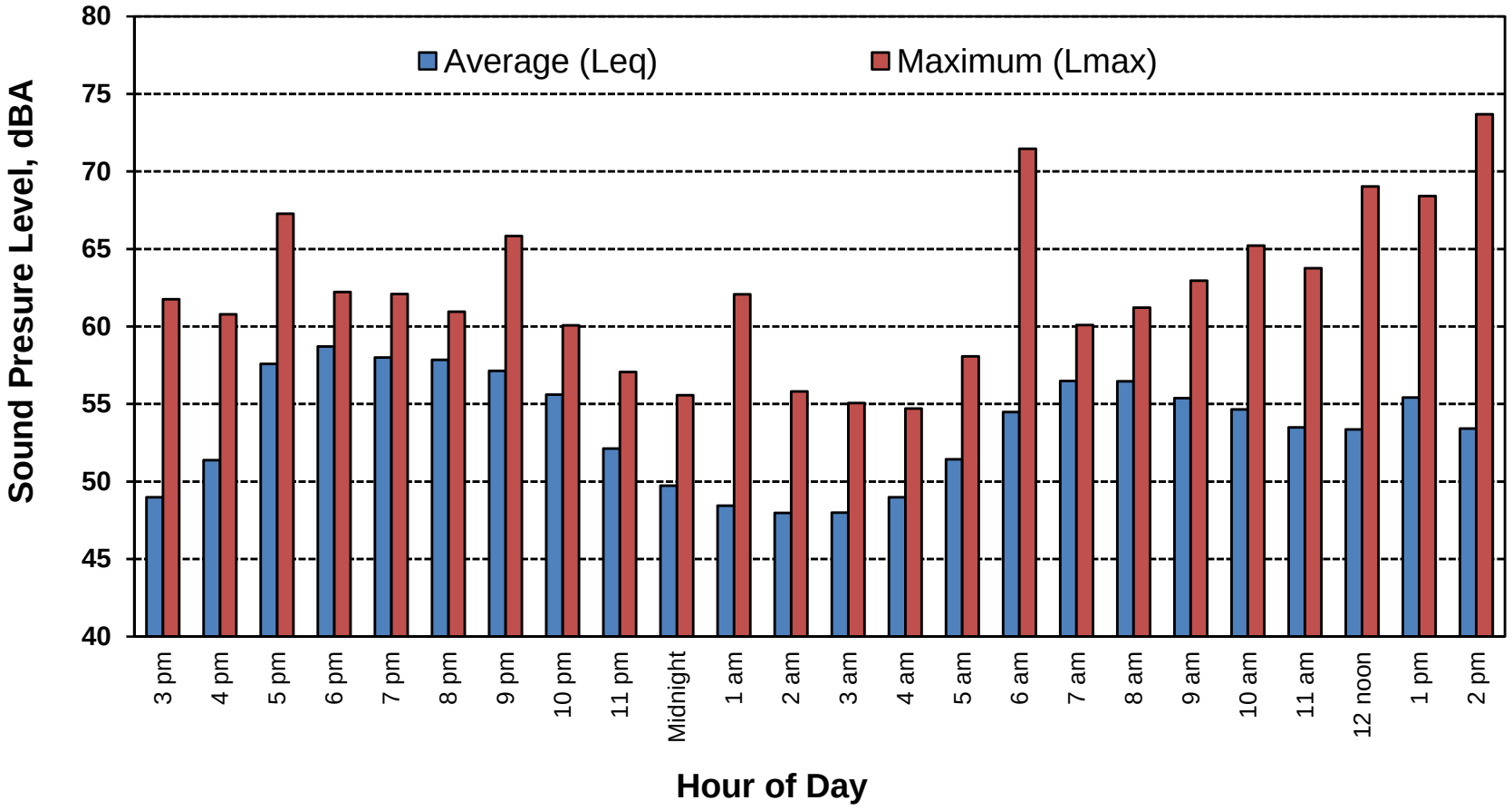
Site	Description	L_{dn}	Average Measured Hourly Noise Levels, dBA			
			Daytime (7 AM to 10 PM)		Nighttime (10 PM to 7 AM)	
			L_{eq}	L_{max}	L_{eq}	L_{max}
1	Southwest corner of project site	59	56	60–74	52	55–72
2	Near center of southern border	60	59	56–73	51	53–63
3	Southeast corner of project site	60	57	59–74	52	57–62

Source: Bollard Acoustical Consultants, Inc., December 2010

While the summaries provided in Table 1 are useful in characterizing overall ambient noise conditions at the project site, the hour-by-hour results of the ambient noise surveys are important because the Topgolf project proposes operations during some nighttime hours (until 2 am). Figures 2-4 shows the hourly results of the ambient noise surveys at each of the three measurement locations.

The nearest residences to the proposed Topgolf project are represented by noise measurement sites 2 & 3, shown on Figure 1. According to Figures 3 and 4, the hours during which the lowest hourly average noise levels were measured were 10 pm to 2 am. During those hours, average hourly noise levels at sites 2 and 3 ranged from 47 to 52 dB Leq. During those same hours, measured maximum noise levels ranged from 53 to 61 dB Lmax.

Figure 2
Hourly Noise Survey Results at Nearest Residences to Topgolf Project - Site 1
December 9-10, 2010



Ldn: 59 dB

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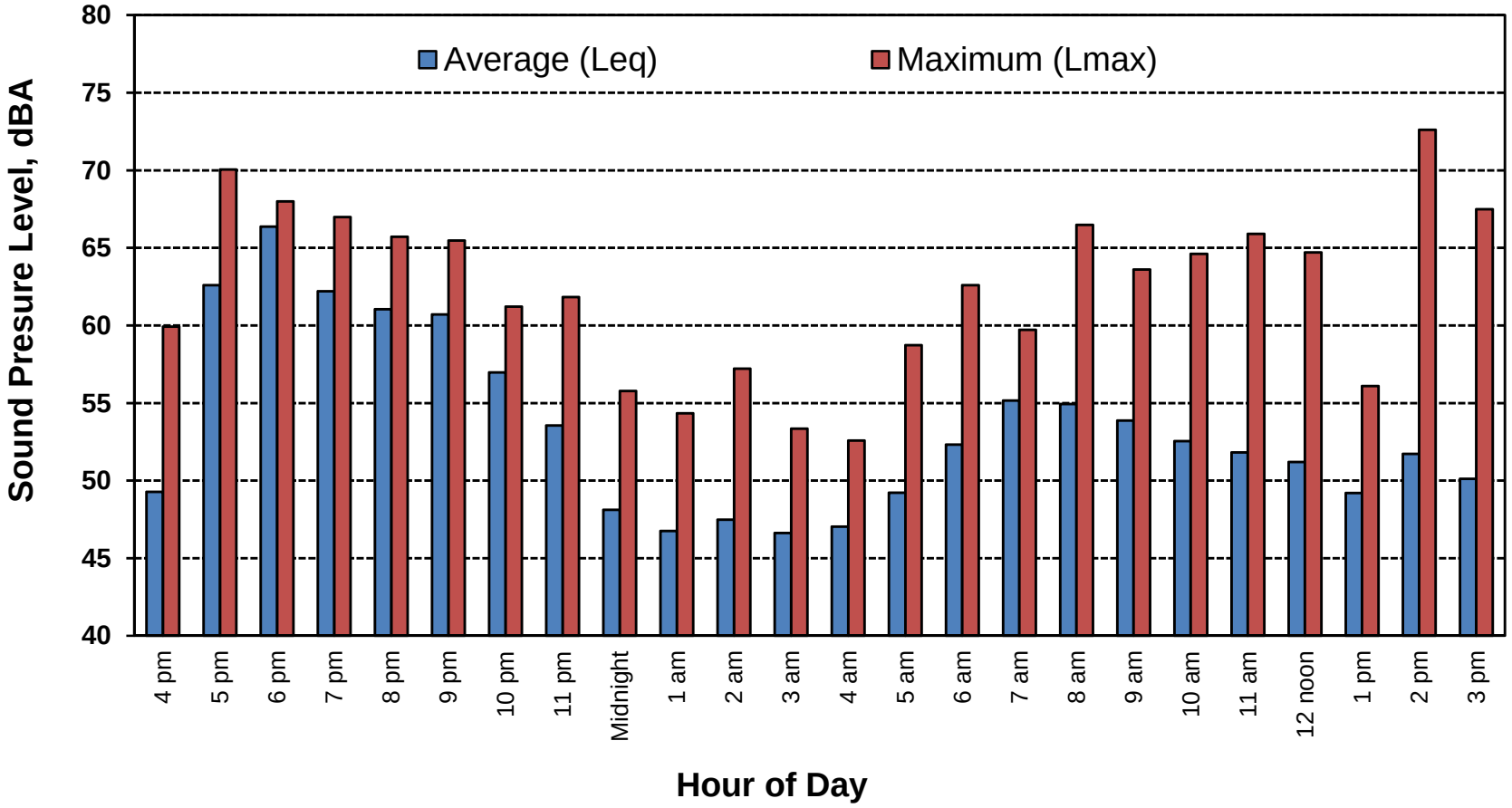
Figure 3
Hourly Noise Survey Results at Nearest Residences to Topgolf Project - Site 2
December 9-10, 2010



Ldn: 60 dB

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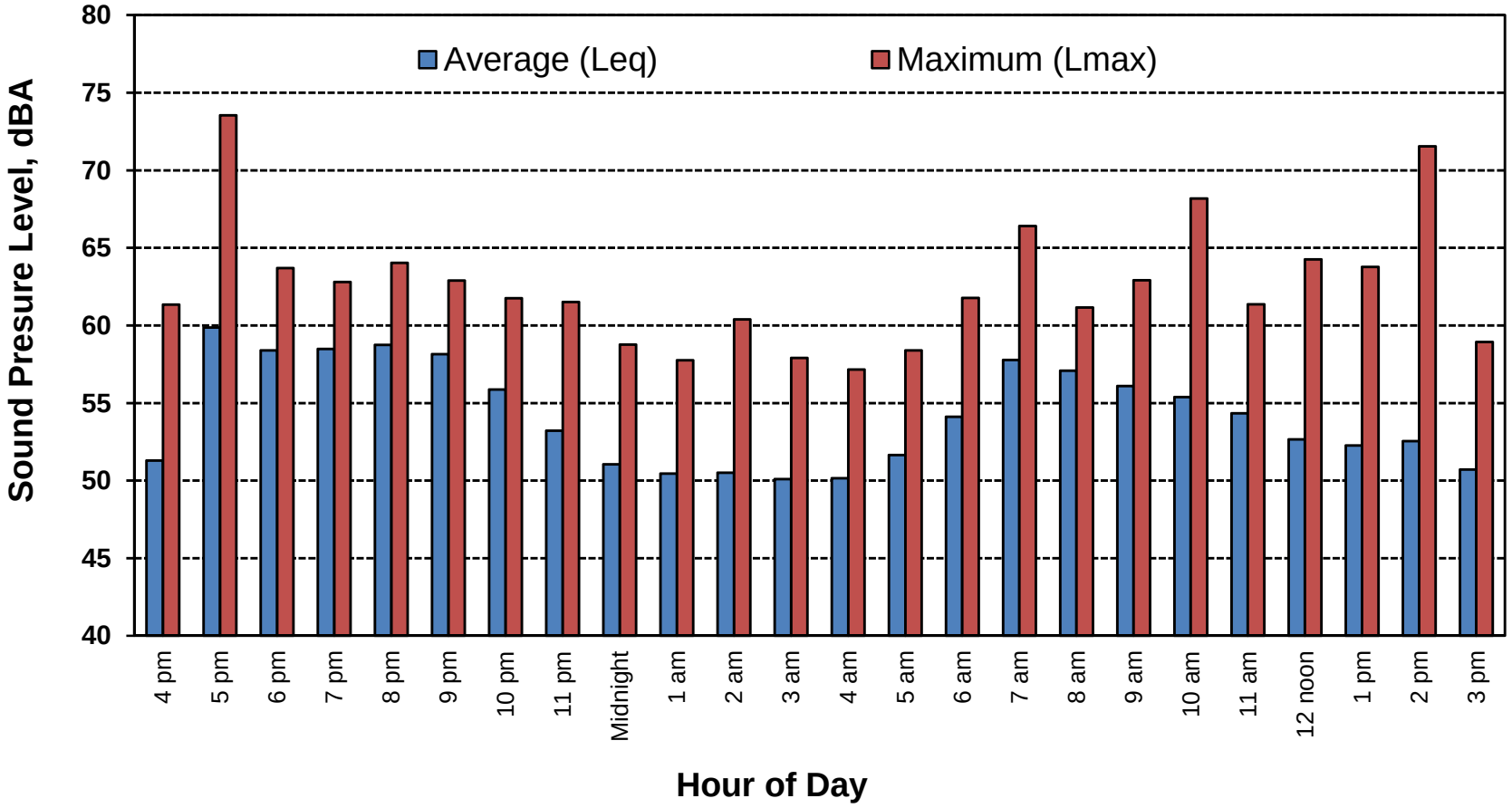
Figure 4
Hourly Noise Survey Results at Nearest Residences to Topgolf Project - Site 3
December 9-10, 2010



Ldn: 60 dB

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Criteria for Acceptable Noise Exposure

The City of Roseville General Plan Noise Element establishes acceptable noise level criteria for non-transportation noise sources, such as noise generated by parking lot movements, music, and patrons at the proposed Topgolf facility. The City's Noise Element criteria are provided below in Table 2.

Table 2
City of Roseville General Plan Noise Level Performance Standards
New Projects Affected by or Including Non-Transportation Projects

Noise Level Descriptor	Daytime (7 AM to 10 PM)	Nighttime (10 PM to 7 AM)
Hourly Average Level – L_{eq}, dBA	50	45
Maximum Level – L_{max}, dBA	70	65

Source: City of Roseville
Note: Each of the noise levels specified above shall be lowered by 5 dB for simple tone noises, noises consisting primarily of speech or music, or for recurring impulsive noises. Noise level standards are as measured at the property line of lands designated for noise-sensitive uses.

For this project, the City of Roseville Planning Department staff has recognized that the nearest residences are currently exposed to noise from traffic on Highway 65 which exceeds the noise standards identified in Table 2 during the hours of proposed Topgolf operations. As a result, the City has directed this analysis to address an exterior noise level standard equal to measured existing ambient noise levels along the property lines of the nearest residences to the west. Based on this direction, and the ambient noise level data shown in Figures 2-4, the following specific noise level standards have been applied to the Topgolf project, as indicated in Table 3.

Table 3
Noise Level Standards Applied to the Topgolf Facility by the City of Roseville

Hour of Day	Hourly Average Level – L_{eq}, dBA	Maximum Level – L_{max}, dBA
Facility opening to 8 pm	60	65
8 pm – 9 pm	59	64
9 pm – 10 pm:	56	61
10 pm – 11 pm:	53	60
11 pm – Midnight:	50	57
Midnight – 1 am	49	56
1 am – 2 am:	47	55

Source: City of Roseville

The noise targets for this project, as shown in Table 3, reflect the fact that ambient noise levels at the nearest residences to the project site decrease during the late night and early morning hours. This condition is expected as the ambient noise environment at the nearest residences is defined primarily by distant Highway 65 traffic noise levels and traffic on that major roadway is considerably lighter during the late night and evening hours.

Analysis of Project Noise Generation

Topgolf Operations

As noted previously, Topgolf is a proposed golf entertainment complex planned on the 12.52-acre parcel in the east portion of the site plan. Topgolf is a 64,232 square foot three-story facility with 102 climate-controlled hitting bays, an outdoor outfield enclosed by netting, full-service restaurant, bar, lounges and corporate/event meeting space and family entertainment area with games.

Players play in individual hitting bays. Each hitting bay can accommodate up to six players at a time but it's not unusual for one or two players in some bays. Hitting bays include seating, television screens to monitor sporting events and track Topgolf scoring. The Topgolf facility will offer food and beverage service delivered restaurant-style to the hitting bays. The Topgolf facility will also feature a full sports bar.

Topgolf players use golf clubs to hit balls embedded with a RFID (radio frequency identification) microchip into a 240-yard outfield which features eleven targets at various distances. Microchips in the balls track each player's shot in real time, giving points for accuracy or luck and making the driving range experience competitive and social. Different games are simulated to appeal to players of varying skill levels.

The facility has been located on the site so that the tee line is facing east, away from the afternoon sun. The facility includes the following features:

- **Lower Level**. The lower level features 34 hitting bays including bays designated for golf instruction and team practice. The lower level features a family lounge area. This level is at grade on the tee line.

- **Main Level.** The entrance to the building is on the main level. The main level features 34 hitting bays, a full-service bar/restaurant, a 2,900-square foot corporate and event meeting space and lobby area.

- **Upper Level.** The upper level features 34 hitting bays and an open-air rooftop terrace. The rooftop terrace will be furnished with tables, couches and fire pits. Restaurant food service is available on the roof top terrace. The terrace can accommodate live music for events with a small stage on the southern end of the terrace which faces toward the freeway. When live music is offered for events, music will end by 10 pm. The rooftop terrace is enclosed by a four-foot parapet with a three-foot tall plexiglass barrier, which creates a barrier of seven feet to screen noise from adjacent uses.

- **Outfield.** The outfield is approximately four acres and 240 yards from the tee line to the net line. The outfield features eleven illuminated round targets located 20 to 240 yards away from the tee line. The targets are internally illuminated with colored LED lighting.

  The outfield perimeter is completely enclosed by a transparent stainless steel mesh net approximately 150 feet high secured by galvanized steel poles. The net is 93% transparent. Net poles range from 90 feet in height near the building and crest to 150 feet at the end of the outfield. The poles are made of high-grade steel painted gray/blue

to blend with the color of the sky. The poles on the corners of the outfield are secured by guy wires. Inside the nets, the surface of the outfield consists of synthetic grass surface. Outside the nets, the landscape consists of plant materials.

Stairs lead from the parking lot to the front door. A separate handicapped accessible door is located at grade on the north side of the building. A trash enclosure and a delivery door/dock are located on the south side of the front of the building. Fire access is available to the tee line from the sides of the building, between the building and the netting.

- **Parking.** The Topgolf parcel includes 477 parking spaces. The parking demand for Topgolf is estimated to be 439 spaces based on Zoning Code Parking Standards. Based on parking usage and customer counts at other locations, Topgolf estimates its parking demand to be approximately 427 spaces.

- **Architecture**. The Topgolf building combines modern design within a natural materials and color scheme. The building is proposed to be constructed of stone, wood and concrete. The building façade consists of multiple overlapping rectilinear lines with a variety of building material accents including synthetic stucco, metal mesh, stained wood, board-formed concrete and stone. The exterior colors are natural colors in the light beige and dark brown tones. Glazing and decorative features are on all four sides of the building. These materials provide a variety of texture and color.

- **Operations.** Operating hours are Sunday through Thursday from 9 am to 1 am and Friday and Saturday from 9 am to 2 am. Live and DJ-generated music on the outdoor terrace on the third level stops at 10 pm, seven days a week. Security will be provided with on-site indoor and outdoor cameras and on-site staff security during operating hours.

Major Noise Sources Evaluated in this Study

The major noise-producing components of the proposed Topgolf project consist of on-site parking lot movements associated with vehicles arriving and departing the site (car doors, engines starting, etc.), house music played in the driving range hitting bays (drive bays), live entertainment and DJ music generated on the terrace, and voice sound generated by Topgolf customers. Each of these noise sources is evaluated below.

Parking Lot Activity Noise Generation

As a means of determining the noise levels due to parking lot activities, BAC utilized noise level data collected at various parking lots in the Sacramento region over the years. That data indicate that a typical SEL due to automobile arrivals/departures, including car doors slamming and people conversing is approximately 72 dB, at a distance of 50 feet. The maximum noise level associated with parking lot activity typically did not exceed 65 dB Lmax at the same reference distance.

Because cars entering and leaving the proposed parking areas will, individually, result in brief periods of noise generation, impacts associated with parking lot movements are assessed relative to the City's maximum noise level standards shown in Table 2. In addition, because of the large number of parking spaces proposed in the area adjacent to the existing residences is

fairly large, the potential for ongoing parking lot noise generation will be present. As a result, noise impacts associated with parking lot usage are also assessed in this study relative to the City's average noise level standards shown in Table 2.

Human nature is such that Topgolf patrons will utilize the closest parking spaces to the main entrance, utilizing parking spaces further away (closer to existing residences to the west) only when no closer parking is available. The closest parking spaces to be developed as part of the Phase 1 Parcel 49 development (Topgolf) would be located approximately 200 feet from the nearest residential property line to the west. At that distance, maximum noise levels generated by parking lot activities are predicted to be approximately 53 dB Lmax or less. This range is considered satisfactory relative to the noise level criteria identified in Table 3.

To compute hourly average noise levels generated by parking lot activities, the approximate number of hourly operations in any given area and distance to the effective noise center of those activities is required. According to the project traffic study, approximately 312 peak hour trips would be generated during the busiest hour of Topgolf operations. The hourly average noise level generated by parking lot movements is computed for a reference distance of 50 feet using the following formula:

$$\text{Hourly Leq} = 72 + 10\log(N) - 36,$$

Where 72 is the mean Sound Exposure Level (SEL) for an automobile parking lot arrival or departure, N is the number of parking lot operations in a given hour, and 36 is 10 times the logarithm of the number of seconds in an hour. Assuming that 312 parking lot movements could occur during the peak hour, the computed Leq using this formula is 61 dB Leq at 50 feet. At the nearest residential property line, located 200 feet from the nearest Phase 1 parking area, the predicted level would be 12 dB lower (6 dB decrease per doubling of distance), or approximately 49 dB Leq. Because peak hour conditions are expected to occur prior to midnight, the predicted level of 49 dB Leq would be satisfactory relative to City of Roseville recommended noise standards for this project.

Music and Patron Activity Noise Generation

The design of the Topgolf facilities is such that music is played above the individual drive bays, as well as on the third level terrace. In addition to this music, sound is also generated at the Topgolf facilities by patrons conversing, sometimes in raised voices.

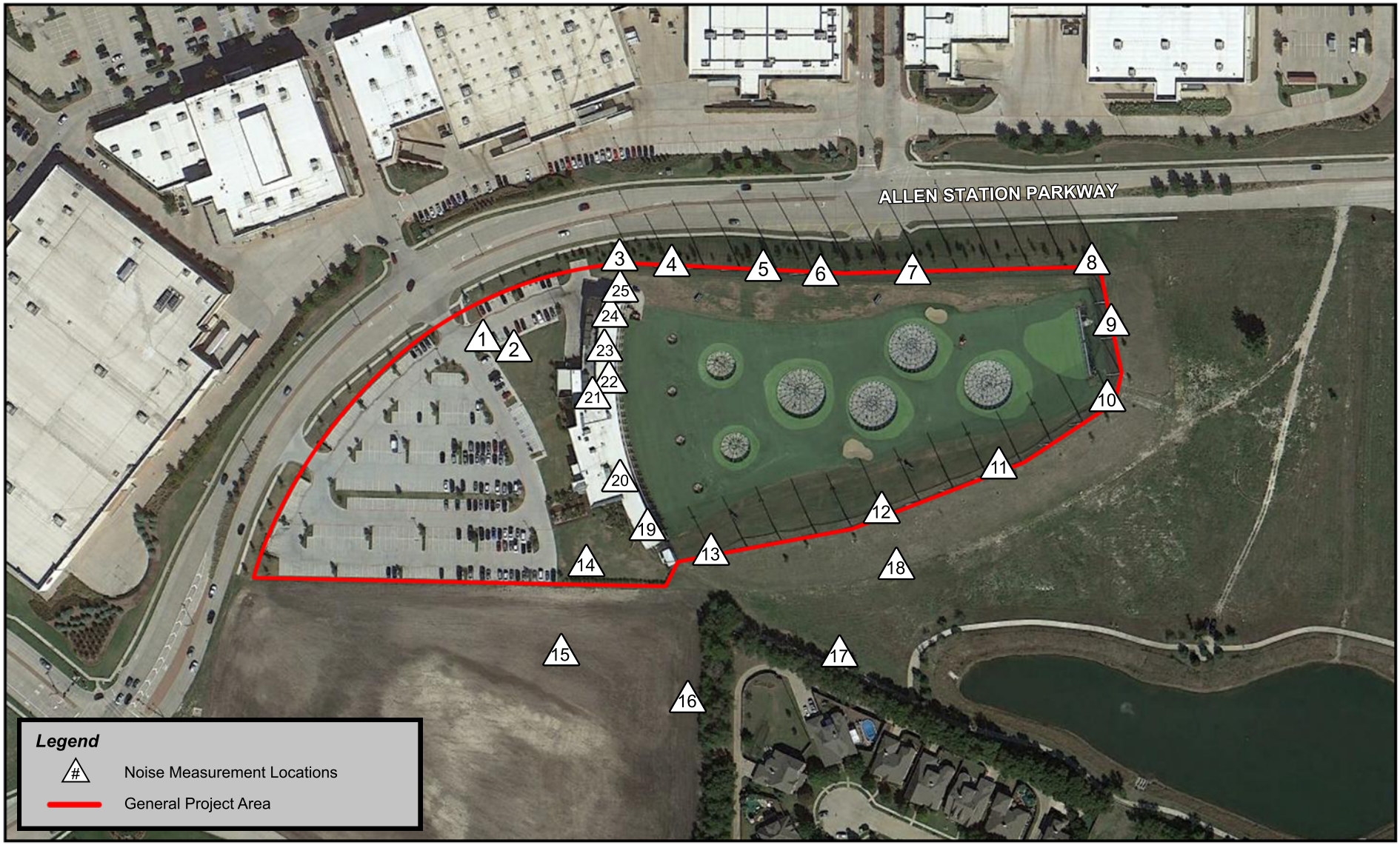
To evaluate the noise generation of the proposed facility, an extensive sound level survey was conducted at the Topgolf facility in Allen Texas. The surveys were conducted on the evenings of Thursday September 4 and Friday September 5, 2014, by Daly-Standlee & Associates of Beaverton, Oregon. The survey consisted of sound level measurements at 25 locations in and around the Topgolf facility. According to Topgolf representatives, the noise generation of the proposed Topgolf Roseville facility would be comparable to that of the Allen facility where the sound level surveys were conducted. Figure 5 shows an aerial image of the Allen Texas Topgolf facility with the sound level measurement locations superimposed.

During the Friday, September 5th measurements at the Allen Texas facility, the facility was reportedly very crowded during the evening hours and a band was playing on the terrace. As a result, the data collected on that evening is expected to represent the reasonably worst-case conditions at the proposed Roseville facility. Figure 6 shows the results of the Allen Texas Topgolf noise survey at each of the measurement locations.

Figure 5

Top Golf - Allen, Texas

Noise Measurement Locations - September 4-5, 2014



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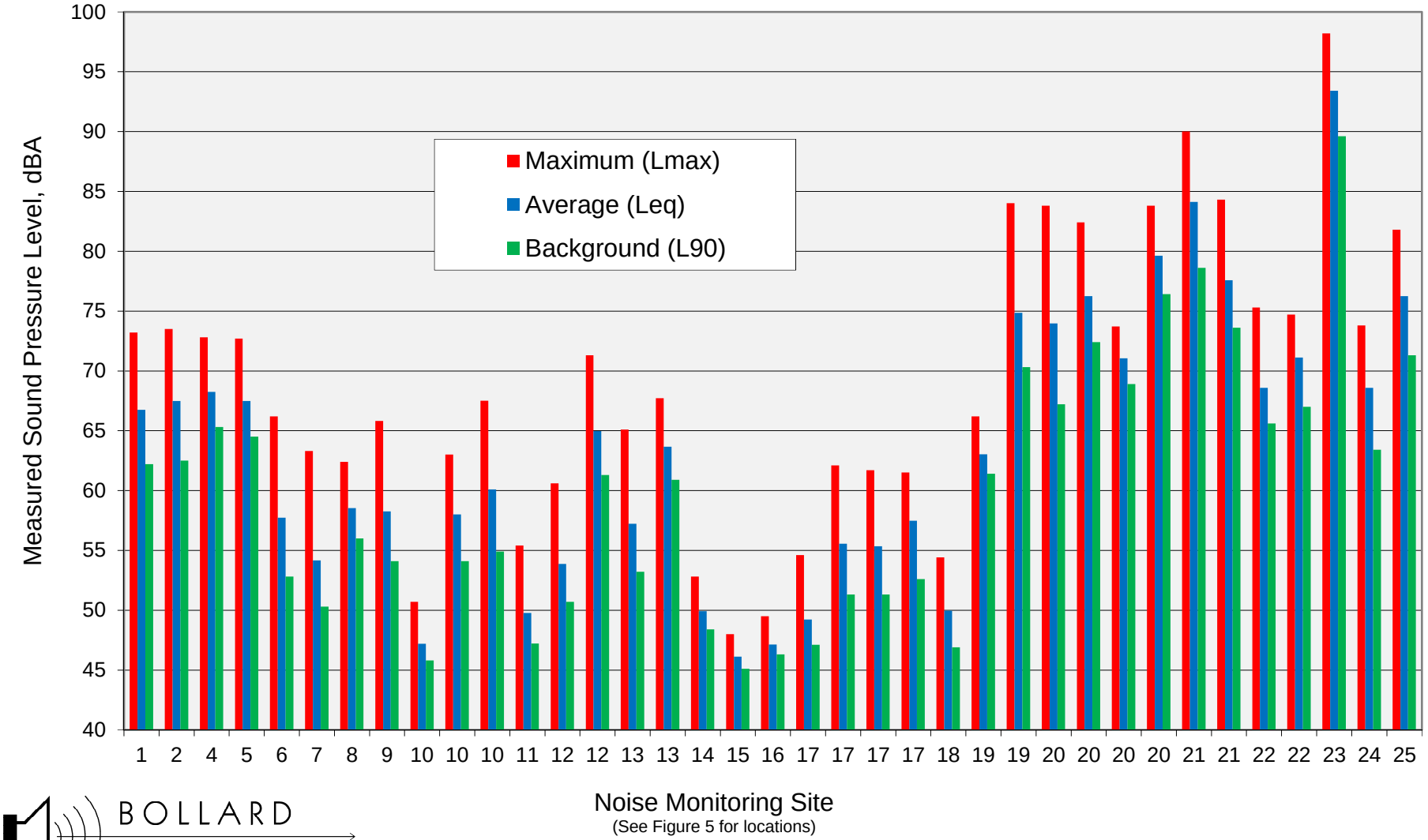
Scale (feet)

0 150 300

Figure 6
Topgolf Allen Texas Noise Measurement Results
September 4-5, 2014



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Data collected by Daly-Standlee Associates, Inc.

Figure 6 indicates the measured maximum (L_{max}), average (L_{eq}), and background (L_{90}), at each of the noise measurement sites. As indicated by Figure 6, some of the measurement locations were monitored multiple times during the survey.

The Allen Texas Topgolf facility measurement site which is most pertinent to this analysis of potential impacts at the proposed Roseville facility is Site 17. That site was approximately 340 feet from the corner of the Topgolf Allen site, which is almost exactly the same orientation and distance to the nearest residences at the proposed Roseville location.

Figure 6 shows that, while noise levels measured within the drive bays and terrace area of the Topgolf facility (Sites 19-25), varied, ranging from 73-98 dB Lmax, the noise levels measured at Site 17 were considerably lower. Figure 6 shows that there were four noise readings conducted at Site 17. The first of the four was on Thursday evening, when no band was playing and the facility was less crowded. The middle two samples for Site 17 were collected on Friday evening during busier conditions, and the final sample at Site 17 was also Friday night during busy conditions, but with the band playing on the terrace.

The Site 17 data was used to predict future noise levels at the nearest residences to the proposed Roseville Topgolf facility. Table 4 shows a summary of the predicted Topgolf Roseville noise levels predicted at the nearest residences for a variety of operating conditions.

Table 4
Predicted Topgolf Roseville Noise Levels at Nearest Residences

Condition	Average Level (L_{eq}, dBA)	Maximum Level (L_{max}, dBA)
Typical Weeknight – House music but no live music on terrace	50-55	55-60
Busier Weekend – House music but no live music on terrace	55	60-65
Busier Weekend – Live or DJ Music on Terrace	58	65

Source: Bollard Acoustical Consultants with data from Daly-Standlee Associates.

The Table 4 data indicate that average noise levels from the proposed Topgolf Roseville facility are predicted to range from approximately 50 to 58 dBA Leq during the busier weekday and weekend periods, with maximum noise levels ranging from approximately 55-65 dBA Lmax. Comparison of these predicted levels against the target project noise level criteria shown in Table 3 indicates that, up until 8 pm, no noise mitigation measures would be required of the project due to the elevated ambient noise conditions. However, as activities progress later into the evening, noise mitigation measures would be required of certain aspects of the Topgolf operation to satisfy the Table 3 noise standards. The following section describes the recommended noise mitigation measures for this project.

Noise Mitigation Measures

As noted in the preceding section, prior to 8 pm, no noise mitigation measures would be required of the project to achieve satisfaction with the Table 3 target noise level criteria. This is because the City of Roseville has stated that project-generated noise levels shall be no-greater than existing ambient conditions, and ambient conditions are still somewhat elevated prior to 8 pm. However, as activities progress later into the evening when ambient conditions decrease, noise mitigation measures would be required of certain aspects of the Topgolf operation to satisfy the Table 3 noise standards.

An evaluation of a wide range of noise mitigation measures was considered for this project. Such measures include the following:

- Reorienting drive-bay speaker's 45-degrees inward rather than straight down.
- Restricting live and DJ-generated music generated on the terrace to pre-10 pm.
- Gradually reducing house sound system output after 10 pm.
- Filter low-frequency sound.
- Installation of extensive sound absorbing materials in and around the drive bays (50% treatment of wall, column, and ceiling areas with NRC 0.8 materials).
- Install sound absorbing turf around the hitting mats from the front edge of the drive bay to the support columns.
- Increasing terrace wall height using glass barriers.
- Orientation of terrace live entertainment stage to face east toward Highway 65.
- Requirement that live bands utilize electric drum kits so sound output can be regulated.
- Installation of sound absorbing materials within the terrace area.

The project applicant (Topgolf) has stated that these measures are feasible and has agreed to implement all of the listed mitigation measures. BAC conducted an analysis of the noise reduction provided by these measures and the results of that analysis are presented in Table 5.

Table 5
Predicted Topgolf Nosie Mitigation Effectiveness

Mitigation Option	Predicted Noise Reduction, dBA		
	Hitting Bay Human Voice	House Music	Terrace Music
Angle hitting bay speakers 45 degrees away from opening	0	-3	0
Filter low frequency sound	0	0	0
Gradually lower speaker volume later into nighttime hours	-1 to -3	-1 to -3	0
Sound absorption in Hitting Bays	-2 to -3	-2 to -3	0
Sound absorption on Terrace	0	0	-2 to -3
Increase terrace wall heights using glass	0	0	-1 to -3
Require electric drum kits for bands	0	0	-2
Total Noise Reduction	-1 to -6 dBA	-1 to -9 dBA	-2 to -8 dBA

Source: Bollard Acoustical Consultants

The Table 5 data indicate that implementation of the recommended noise mitigation measures would result in varying degrees of sound attenuation of the identified major project noise sources. With terrace music ending at 10 pm, that source would be mitigated to a less than significant level through the measures cited above. In addition, implementation of the measures cited above, in conjunction with decreased facility outdoor activities in the very late hours, is also predicted to reduce project noise levels to a state of compliance with the Table 3 noise criteria.

To ensure that the project operations, after implementation of the above described mitigation measures, do not result in exceedance of the City's recommended noise standards for this project as set forth in Table 3, follow-up noise testing should be conducted upon commencement of facility operations to verify the assumptions of this analysis and to ensure the City's noise standards are being satisfied. In the event that those measurements indicate that additional noise controls are needed to satisfy those standards, the sources of noise responsible for those exceedances should be identified and additional sound control measures implemented as warranted.

Conclusions and Recommendations

Following implementation of the noise mitigation measures cited above, the Topgolf Roseville project noise generation is expected to satisfy the noise criteria established for this project by the City of Roseville at the existing residences to the immediate west of the project site. Nonetheless, given the sensitivity of the neighboring residences and the potential noise generation of the project, BAC recommends that follow-up noise testing be conducted to ensure compliance.

These conclusions are based on the project layout shown on Figure 1, on the ambient noise level data shown in Figures 2-4, on the noise level data collected at the Topgolf Allen Texas Facility by Daly-Standlee Associates, and on the assumptions cited herein. Any substantive revisions to the project site plans or deviations from these data or assumptions could cause actual noise levels to vary relative to those predicted herein. BAC is not responsible for such revisions or for the noise generation of individual patrons of the proposed Topgolf facility.

This concludes BAC's noise assessment for the proposed Topgolf project. Please contact BAC at (916) 663-0500 or paulb@bacnoise.com with any questions regarding this assessment.

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.
Loudness	A subjective term for the sensation of the magnitude of sound.
Masking	The amount (or the process) by which the threshold of audibility is for one sound is raised by the presence of another (masking) 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.
SEL	A rating, in decibels, of a discrete event, such as an aircraft flyover or train passby, that compresses the total sound energy of the event into a 1-s time period.
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.