MD ACOUSTICS
Sound Solutions for Planning and Design

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September 28, 2018

McDowell Mountain Golf Club
10690 E. Sheena Drive
Scottsdale, AZ 85255
C/O Mr. Jim Hamilton, PGA
Mickelson Golf Properties

Subject: McDowell Mountain Golf Club "Special Event" Report– Noise Study and Recommendations – City of Scottsdale, AZ

Dear Mr. Hamilton:

MD Acoustics, LLC (MD) is pleased to provide this letter report as it relates to "special events" held at the McDowell Mountain Golf Club (MMGC) located at 10690 E. Sheena Drive, Scottsdale, AZ 85255. MD has completed a noise impact assessment. The project was assessed with regard to potential operational noise impacts generated by "special events" held at the site, such as weddings, corporate events, and other gatherings. For your reference, Appendix A contains a glossary of acoustical terms.

1.0 Assessment Overview

This assessment reviews the site plan and typical event layout to understand the Club's objectives and noise compliant issues from a noise compliance standpoint. MD traveled to the project site and performed several baseline measurements at various areas of the property boundary while no events occurred. MD utilized Type 1 sound level meters that meet ANSI S.4 engineering standards to record minute-by-minute data.

2.0 Local Acoustical Requirements

MD compared the results of the noise assessment to Section 19-26 of Ord. No. 3912, § 2, 9-28-10 of the Scottsdale, AZ, Code of Ordinances. The code states: "It shall be unlawful for a business that serves alcohol or provides live entertainment to create unreasonable noise that through its operations disturbs the peace or quiet of a residential district that contains dwellings" (Sec. 19-26 A). The phrase "unreasonable noise" is not rigorously defined in the Scottsdale, AZ, Code of Ordinances, but Section 19-26 (D) gives the following: "It shall be a rebuttal presumption under this article that noise levels over sixty-eight (68) dB(A) are considered unreasonable." Per these guidelines, MMGC is considered compliant as long as the noise level does not disturb its neighbors or does not exceed 68 dBA at the property line.

3.0 Study Method and Procedure

Real World Measurements

On September 6-7, 2018, MD performed a study of the baseline noise condition at MMGC. Appendix B contains the field data used to measure the community noise equivalent level (CNEL) for the 24-hour period. The CNEL measured at the project site was 53.1 dBA at the location indicated by the red pin on Figure 1. It should be noted that although the twenty-four hour average level was 53.1 dBA, levels as high as 68-72 dBA are reached from time to time due to background noise events, such as passing golf carts or lawn mowers.

Figure 1: Source and Receiver Locations for Simulated Special Events

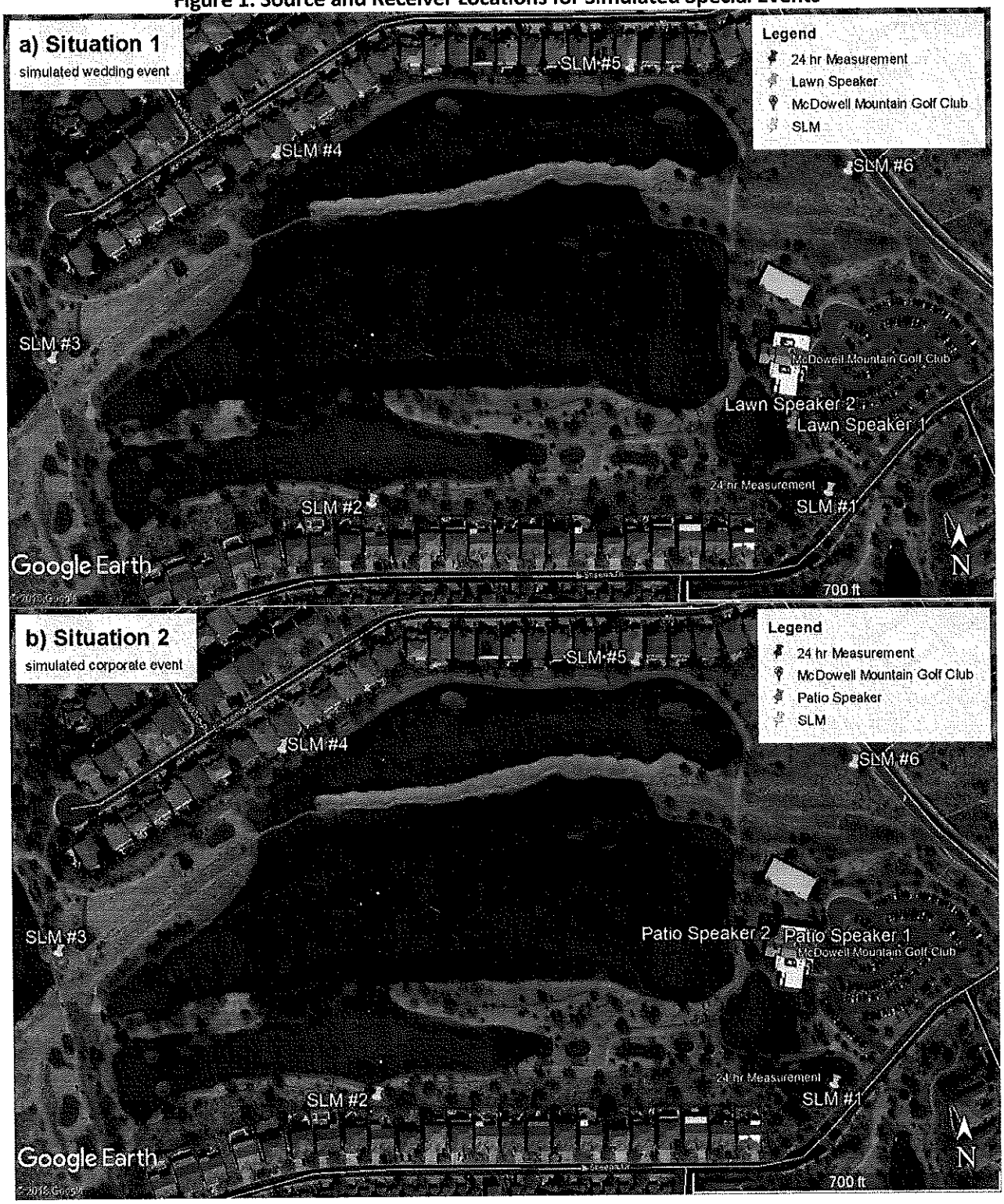

Figure 1-a shows source and receiver locations for Situation 1. Figure 1-b shows source and receiver locations for Situation 2. Five-minute baseline measurements were performed at each location indicated by a yellow pin while all speakers were turned off. A twenty-four hour baseline measurement was performed at the location indicated by the red pin.

MD also cooperated with MMGC to simulate two (2) different event situations by placing loudspeakers in two (2) different configurations and measuring the sound level at various points around the property. After interviewing golf club personnel, MD found that events at the golf club include music typical of wedding receptions. In order to capture the spectral content of such events held at MMGC, MD used two (2) 15-inch THUMP15 speakers to play the top three songs that are most frequently included on wedding playlists in the United States (as published by *The Washington Post* on Sept. 20, 2017).

Minute-by-minute data was logged at five-minute intervals at each location, including a baseline measurement with no music playing. Figure 1 shows the experimental configuration for each situation, with source locations indicated by green pins and receiver locations indicated by yellow and red pins. In Situation 1, a wedding event was simulated with speakers placed at the locations used by the sound mixer, indicated by Lawn Speaker 1 and Lawn Speaker 2 (see Figure 1-a). Type 1 sound level meters (SLM) were used to measure the noise at six (6) locations around the property with the music running. In Situation 2 (Figure 1-b), a corporate event was simulated by placing two (2) speakers on the patio, facing the building, as is typical for such events. The sound level was then measured at the same six (6) monitoring locations around the property with music playing from the loudspeakers.

Stationary Noise Level Prediction

SoundPlan Acoustic Modeling Software (SP) was utilized to model the operational noise levels from the project site. SP acoustical modeling software is capable of evaluating stationary noise sources (e.g., loudspeakers for live events, parking lots, crowds, etc.) and much more. SP's software utilizes algorithms (based on inverse square law) to calculate noise level projections. The software allows the user to input specific noise sources, spectral content, sound barriers, building placement, topography, and sensitive receptor locations. In addition, SP can model the noise sources as point sources, line sources, and area sources. Noise level output data is located in Appendix C.

MD modeled the operational noise levels for Situation 1 and Situation 2. MD calibrated the model with the data collected from the real world measurements. The loudspeakers were modeled as point sources and were assigned reference noise levels equal to the values measured near the source for each scenario. For Situation 1, this level was measured to be 89.2 dBA at a distance of 12' from the speakers; for Situation 2, this was 92.7 dBA at a distance of 7' from the speakers (within a 3 dB tolerance). The model illustrates how the sound propagates from the site to the adjacent residences.

Palo Verde Room

The Palo Verde Room is a room used for receptions or parties at the golf club. Located on the south side of the main building, the Palo Verde Room opens onto the lawn and putting green commonly used to stage outdoor events. MD evaluated the transmission loss achieved by the doors of the Palo Verde room by placing two (2) 15 inch THUMP15 speakers in the room and recording the sound level in three (3) locations as music was playing: at the center of the room, four inches from the door interior, and four inches from the door exterior.

4.0 Findings and Recommendations

Outdoor Measurement Results

Table 1 shows the results of the experimental measurements for Situation 1 and Situation 2 and compares them with the baseline condition, as measured at the same six (6) monitoring locations for five-minute

intervals. The baseline condition measures the time-weighted equivalent noise level, or LAeq, at the project site. The baseline LAeq ranges from 47.5 dBA to 56.5 dBA, with an average level of 53.3 dBA, which is within 0.2 dB of the twenty-four hour CNEL. The LASmin and LASmax give the lowest and highest instantaneous value at each measurement location, respectively. At Location 1 for the baseline condition, for example, the measured LAeq is 47.5 dBA, and ranges from 40.5 dBA to 58.2 dBA.

For Situation 1, the highest (loudest) time-averaged level occurs at Location 1, which is the closest to the sound source (see Figure 1-a). At 58.6 dBA, this value is about 9.5 dBA below the City's specified 68 dBA limit provided by the City's code as unreasonable and is only about 5 dBA above the baseline noise level (53.3 dBA). In addition, this value is about 5 dBA lower than the value predicted by SP (see Appendix C), which validates the conservative nature of our model for Situation 1. This means that a sound mixer could increase the volume by nearly 10 dB and still be within compliance.

For Situation 2, the highest measured value occurs at Location 4 (see Figure 1-b). At 57.4 dBA, this value is more than 10 dBA below the value provided by the City's code as unreasonable and is only about 4 dBA above the baseline noise level. In other words, this noise level does not create a significant impact and is not considered unreasonable.

Table 1: Outdoor Experimental Results

Measurement Location	Baseline			Situation 1 - speakers driven at 89.2 dBA as measured 12' away			Situation 2 - speakers driven at 92.7 dBA as measured 7' away		
	LAeq (dBA)	LASmin	LASmax	LAeq (dBA)	LASmin	LASmax	LAeq (dBA)	LASmin	LASmax
1	47.5	40.5	58.2	58.6	41.9	64.0	46.0	39.8	53.7
2	56.5	44.0	64.7	47.1	36.9	52.8	46.5	34.2	75.0
3	52.8	37.2	62.9	54.9	37.8	73.5	44.1	37.8	55.2
4	53.5	36.8	67.8	46.6	38.2	55.9	57.4	45.5	69.9
5	53.7	35.7	70.3	45.5	34.5	53.3	46.7	38.1	54.9
6	51.6	40.0	65.8	50.4	37.2	60.9	50.9	40.5	59.4
Average	**53.3**	--	--	--	--	--	--	--	--

Table 2 summarizes the results of the outdoor measurement experiments and compares the difference between the sound level measured during the baseline condition and during each scenario. For example, at Location 4, the LAeq measured during Situation 1 was 46.6 dBA, which is 6.9 dB lower than the level measured at that location during the baseline condition (53.5 dBA). This indicates that the typical noise fluctuation due to the ambient conditions was greater at Location 4 than noise introduced by the Lawn Speakers in Situation 1. Considering the distance from Location 4 to the Lawn Speakers is a little over 1300 feet, this makes perfect sense. Similarly, during Situation 2, the measured equivalent level (LAeq) at Location 4 was 3.9 dB higher than during the baseline condition. For the configuration in Situation 2, the speakers were closer by about 100 feet to Location 4 than during Situation 1 and were driven louder. Therefore, the noise introduced by the loudspeakers was nearly 4 dB louder than the baseline condition, as indicated in the delta (Δ) column.

Table 2: Summary of Outdoor Results

Measurement Location	Baseline LAeq (dBA)	Situation 1 LAeq (dBA)	Δ (dB)	Baseline LAeq (dBA)	Situation 2 LAeq (dBA)	Δ (dB)
1	47.5	58.6	11.1	47.5	46.0	-1.5
2	56.5	47.1	-9.4	56.5	46.5	-10.0
3	52.8	54.9	2.1	52.8	44.1	-8.7
4	53.5	46.6	-6.9	53.5	57.4	3.9
5	53.7	45.5	-8.2	53.7	46.7	-7.0
6	51.6	50.4	-1.2	51.6	50.9	-0.7

Sensitive receptors that may be affected by special events at MMGC include existing residences to the north, south, and east of the project site. A total of nine (9) receptors were modeled using SP to accurately evaluate the noise impact of special events at MMGC, including a receptor near the source to indicate the sound level produced in the near field. The models were calibrated (within a 3 dB tolerance) to the sound level measured near each source. A receptor is indicated by yellow dot. All yellow dots represent either a property line or a sensitive receptor such as an outdoor sensitive area (e.g. backyard, etc).

Appendix C demonstrates how the sound propagates from the site to the adjacent uses and shows the calculated noise levels at the property lines at any nearby sensitive receptors. Operational noise levels are anticipated to range from 38 dBA to 64 dBA at the property line in the case of Situation 1 and from 30 dBA to 50 dBA in the case of Situation 2. The noise level projections will not exceed the City's exterior noise standard.

Indoor Measurement Results

Table 3 summarizes the results of the Palo Verde room measurement. When music was played at an average level of 73.7 dBA within the room, the doors provided a transmission loss (noise reduction) of 19.5 dB. This can be improved by upgrading the seals around the edges of the doors with weather stripping to remove air gaps.

Table 3: Palo Verde Room Doors

Room Level	Door Interior	Door Exterior	TL
73.7 dBA	73.0 dBA	53.5 dBA	19.5 dB

Although special events at the golf course will not generate a significant noise impact, the following provides additional noise abatement measures to further ensure noise reduction.

- Where feasible, loudspeakers shall be positioned in a direction away from the nearest sensitive receptor, such that the noise projects away from nearby residencies.
- MMGC has agreed that no music shall be played after 10 pm.
- Sound level meters may be used to ensure levels are below 68 dBA near the closest property lines.

- For events held in the Palo Verde room, guests may be invited to use an alternative exit to prevent noise from escaping through the doors facing the main lawn.

- MMGC is in the process of updating the seals on the doors for the Palo Verde room to provide higher transmission loss through the doors. MD estimates an additional 3-5 dBA reduction when the door seals are upgraded to remove air gaps.

5.0 Conclusions

Special events held at McDowell Mountain Golf Club will meet the City's noise standards (outlined above). MD is pleased to provide McDowell Mountain Golf Club with this noise assessment and recommendations. If you have any questions regarding this analysis or need further review, please call our office at (602) 774-1950.

Sincerely,
MD Acoustics, LLC

Mike Dickerson, INCE
Principal

Samuel Hord, M.S.
Consultant

Appendix A
Glossary of Acoustical Terms

Glossary of Terms

A-Weighted Sound Level: The sound pressure level in decibels as measured on a sound level meter using the A-weighted filter network. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the response of the human ear. A numerical method of rating human judgment of loudness.

Ambient Noise Level: The composite of noise from all sources, near and far. In this context, the ambient noise level constitutes the normal or existing level of environmental noise at a given location.

C-Weighted Sound Level: The sound pressure level in decibels as measured on a sound level meter using the C-weighted filter network. The C-weighting filter greatly de-emphasizes very high frequency components of the sound and slightly de-emphasizes the very low frequency components. A numerical method of rating human judgment of loudness.

Community Noise Equivalent Level (CNEL): The average equivalent A-weighted sound level during a 24-hour day, obtained after addition of five (5) decibels to sound levels in the evening from 7:00 to 10:00 PM and after addition of ten (10) decibels to sound levels in the night before 7:00 AM and after 10:00 PM.

Decibel (dB): A unit for measuring the amplitude of a sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure, which is 20 micro-pascals.

dB(A): A-weighted sound level (see definition above).

dB(C): C-weighted sound level (see definition above).

dB(Z): Z-weighted sound level (see definition of dB above).

Equivalent Sound Level (LEQ): The sound level corresponding to a steady noise level over a given sample period with the same amount of acoustic energy as the actual time varying noise level. The energy average noise level during the sample period.

Habitable Room: Any room meeting the requirements of the Uniform Building Code or other applicable regulations which is intended to be used for sleeping, living, cooking or dining purposes, excluding such enclosed spaces as closets, pantries, bath or toilet rooms, service rooms, connecting corridors, laundries, unfinished attics, foyers, storage spaces, cellars, utility rooms and similar spaces.

Human Sensitivity to Sound: In general, the healthy human ear can hear between 20 Hz to 20,000 Hz. Frequencies below 125 Hz are typically associated with low frequencies or bass. Frequencies between 125 Hz and 5,000 Hz are typically associated with mid-range tones. Finally, frequencies between 5,000 and 20,000Hz are typically associated with higher range tones.

The human ear is sensitive to changes in noise levels, depending on the frequency. Generally speaking, the healthy human ear is most sensitive to sounds between 1,000 Hz and 5,000 Hz (A-weighted scale) and perceives a sound within that range as being more intense than a sound with a higher or lower frequency with the same magnitude. At lower and higher frequencies, the ear can become less sensitive depending on a number of factors. Table 1 provides a brief summary of how humans perceive changes in noise levels.

Table 1: Change in Noise Level Characteristics[1]

Changes in Intensity Level, dBA	Changes in Apparent Loudness
1	Not perceptible
3	Just perceptible
5	Clearly noticeable
10	Twice (or half) as loud

https://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/polguide/polguide02.cfm

L(n): The A-weighted sound level exceeded during a certain percentage of the sample time. For example, L10 in the sound level exceeded 10 percent of the sample time. Similarly, L50, L90 and L99, etc.

Noise: Any unwanted sound or sound which is undesirable because it interferes with speech and hearing, or is intense enough to damage hearing, or is otherwise annoying. The State Noise Control Act defines noise as "...excessive undesirable sound...".

Percent Noise Levels: See L(n).

Sound Level (Noise Level): The weighted sound pressure level obtained by use of a sound level meter having a standard frequency-filter for attenuating part of the sound spectrum.

Sound Level Meter: An instrument, including a microphone, an amplifier, an output meter, and frequency weighting networks for the measurement and determination of noise and sound levels.

Single Event Noise Exposure Level (SENEL): The dB(A) level which, if it lasted for one second, would produce the same A-weighted sound energy as the actual event.

Appendix B

24 Hour Baseline Measurement

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Simi Valley, CA 93065

24-Hour Continuous Noise Measurement Datasheet

Project: McDowell Golf Course
Site Address/Location: 10690 E. Sheena Drive, Scottsdale AZ
Date: 9/6/2018 to 9/7/2018
Field Tech/Engineer: Mike Dickerson, INCE

Site Observations: Clear weather. Measurement location is at a somewhat lower elevation than the clubhouse.

General Location:
Sound Meter: LD 831 **SN:** 10421
Settings: A-weighted, slow, 1-sec, 1-hour interval, 24-hour duration
Meteorological Con.: 100 degrees F,
Site ID: LT-1

Site Topo: Flat
Ground Type: Soft site, w/ street surface hard

Noise Source(s) w/ Distance:

Figure 1: LT-1 Monitoring Location

Figure 2: LT-1 Photo

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24-Hour Continuous Noise Measurement Datasheet - Cont.

Project: McDowell Golf Course **Day:** 1 of 1

Site Address/Location: 10690 E. Sheena Drive, Scottsdale AZ

Site ID: LT-1

Date	Start	Stop	Leq	Lmax	Lmin	L2	L8	L25	L50	L90
9/6/2018	9:00 AM	10:00 AM	53.5	65.6	34.6	60.4	59.7	52.7	44.9	38.8
9/6/2018	10:00 AM	11:00 AM	50.7	64.7	32.9	56.6	55.6	52.1	47.4	38.7
9/6/2018	11:00 AM	12:00 PM	43.0	58.9	33.8	50.5	47.1	42.8	39.3	36.3
9/6/2018	12:00 PM	1:00 PM	44.8	62.7	32.7	53.3	48.4	44.1	40.1	35.9
9/6/2018	1:00 PM	2:00 PM	47.5	59.8	32.5	53.9	51.5	49.4	44.6	35.7
9/6/2018	2:00 PM	3:00 PM	46.0	67.4	32.3	54.0	49.3	43.8	38.5	34.5
9/6/2018	3:00 PM	4:00 PM	46.0	61.2	34.3	54.8	49.4	46.1	43.0	37.4
9/6/2018	4:00 PM	5:00 PM	42.7	56.3	33.6	49.1	47.8	43.2	38.7	36.4
9/6/2018	5:00 PM	6:00 PM	41.2	61.5	33.3	48.4	44.3	40.7	39.0	36.8
9/6/2018	6:00 PM	7:00 PM	44.7	64.4	35.3	52.2	48.2	43.1	39.1	36.9
9/6/2018	7:00 PM	8:00 PM	47.1	67.7	36.9	53.1	49.7	47.5	41.1	38.6
9/6/2018	8:00 PM	9:00 PM	41.1	53.0	35.5	47.0	43.2	41.0	40.0	38.2
9/6/2018	9:00 PM	10:00 PM	39.7	60.8	36.0	43.3	41.3	39.9	39.0	37.4
9/6/2018	10:00 PM	11:00 PM	40.5	58.5	33.7	46.7	42.0	39.7	38.7	37.0
9/6/2018	11:00 PM	12:00 AM	39.9	51.9	33.8	46.7	42.0	40.1	38.6	35.3
9/7/2018	12:00 AM	1:00 AM	39.5	60.6	32.2	44.0	38.5	37.5	36.0	33.4
9/7/2018	1:00 AM	2:00 AM	37.1	48.9	32.9	40.4	38.8	37.9	36.4	34.9
9/7/2018	2:00 AM	3:00 AM	36.2	40.6	32.2	38.6	37.9	37.2	35.8	34.1
9/7/2018	3:00 AM	4:00 AM	36.8	48.6	33.3	39.3	38.1	37.2	36.5	34.9
9/7/2018	4:00 AM	5:00 AM	39.5	60.4	32.3	42.7	39.2	37.8	36.8	34.4
9/7/2018	5:00 AM	6:00 AM	51.0	63.5	33.6	59.6	56.1	51.7	45.0	38.1
9/7/2018	6:00 AM	7:00 AM	52.9	70.5	37.4	62.4	56.6	51.3	48.2	40.8
9/7/2018	7:00 AM	8:00 AM	54.6	66.2	39.0	62.2	59.8	55.3	50.1	43.7
9/7/2018	8:00 AM	9:00 AM	48.1	61.2	38.0	54.6	51.5	48.7	46.3	41.8

CNEL: 53.1

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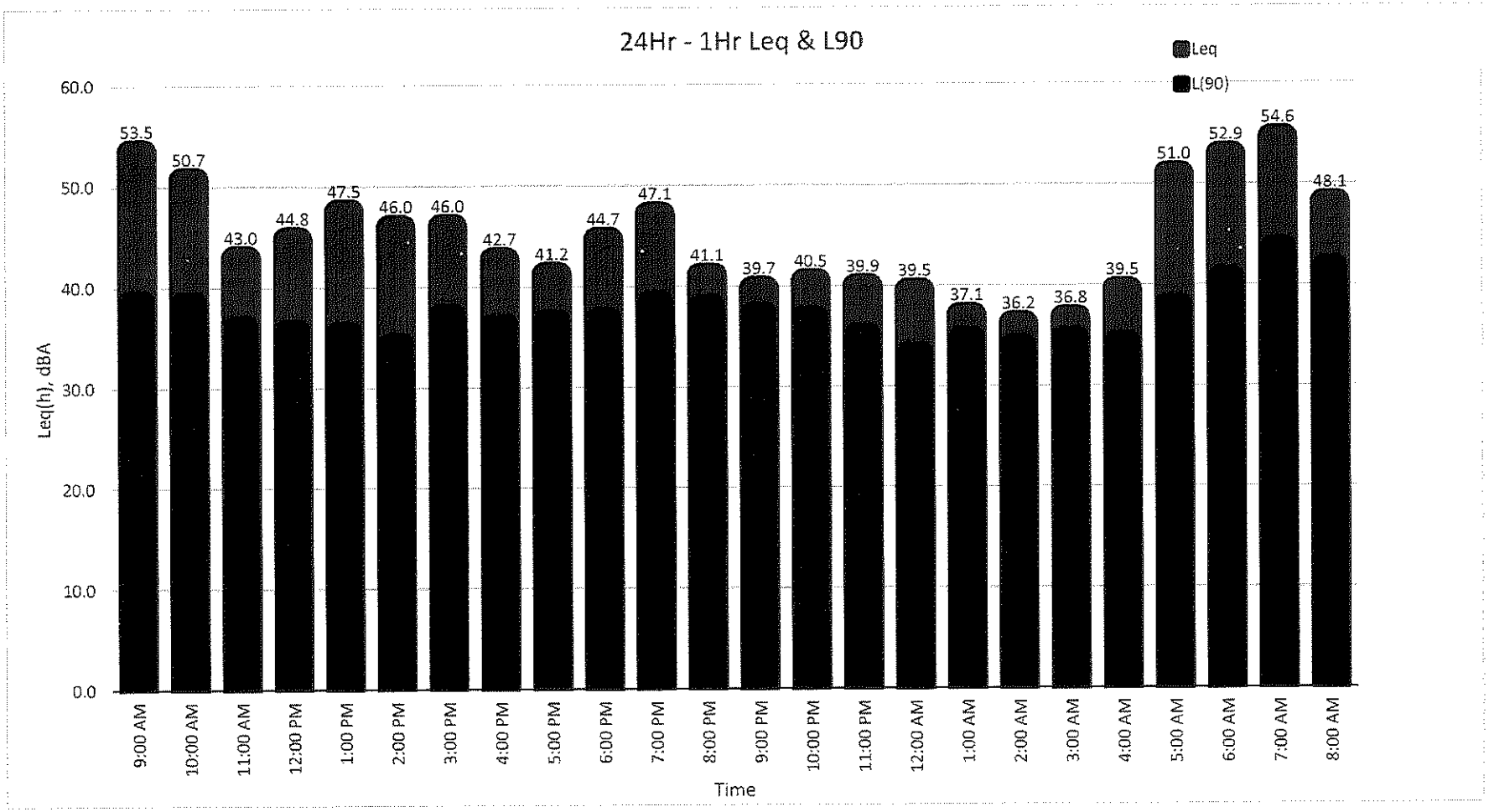
24-Hour Continuous Noise Measurement Datasheet - Cont.

Project: McDowell Golf Course **Day:** 1 of 1

Site Address/Location: 10690 E. Sheena Drive, Scottsdale AZ

Site ID: LT-1



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24-Hour Continuous Noise Measurement Datasheet - Cont.

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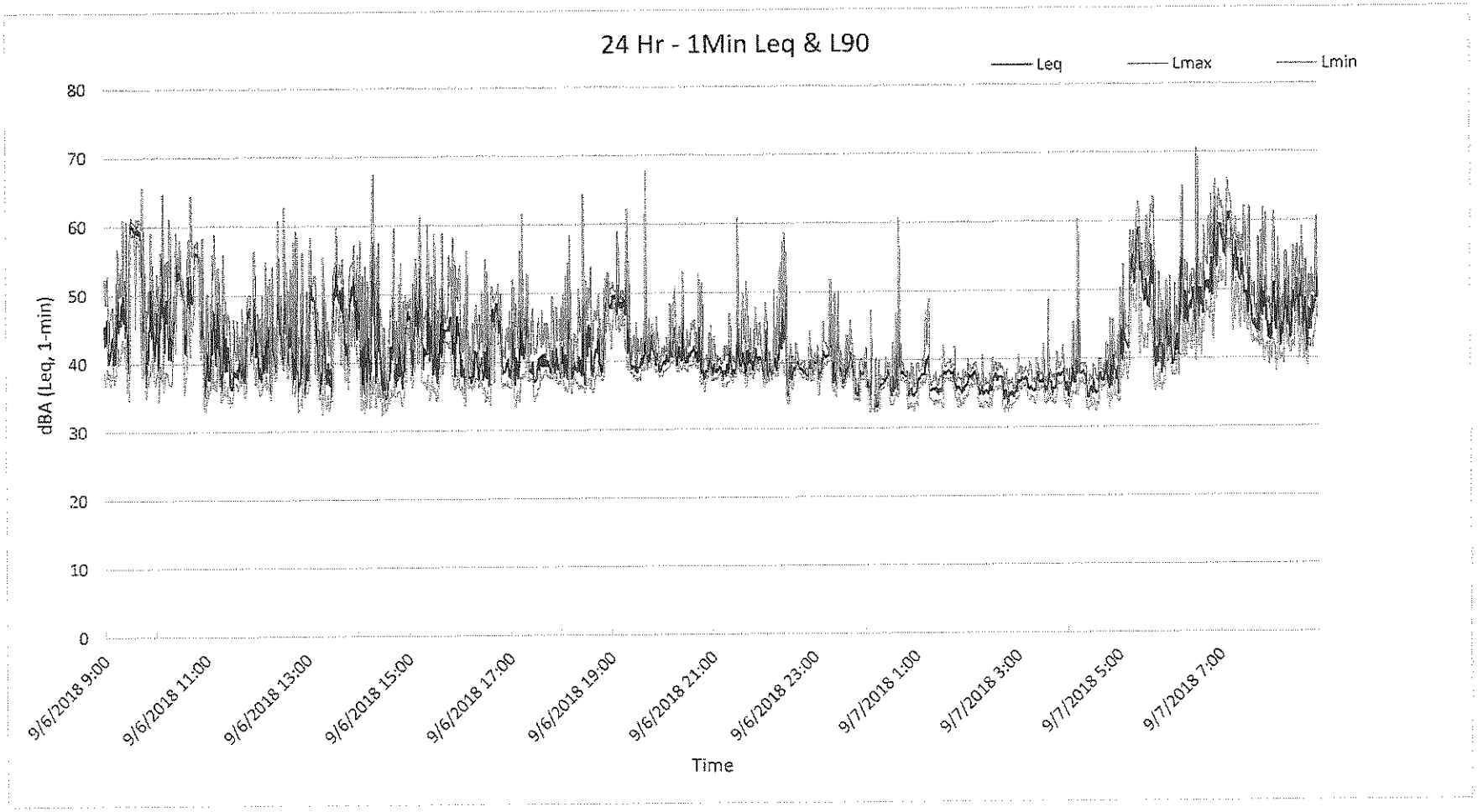
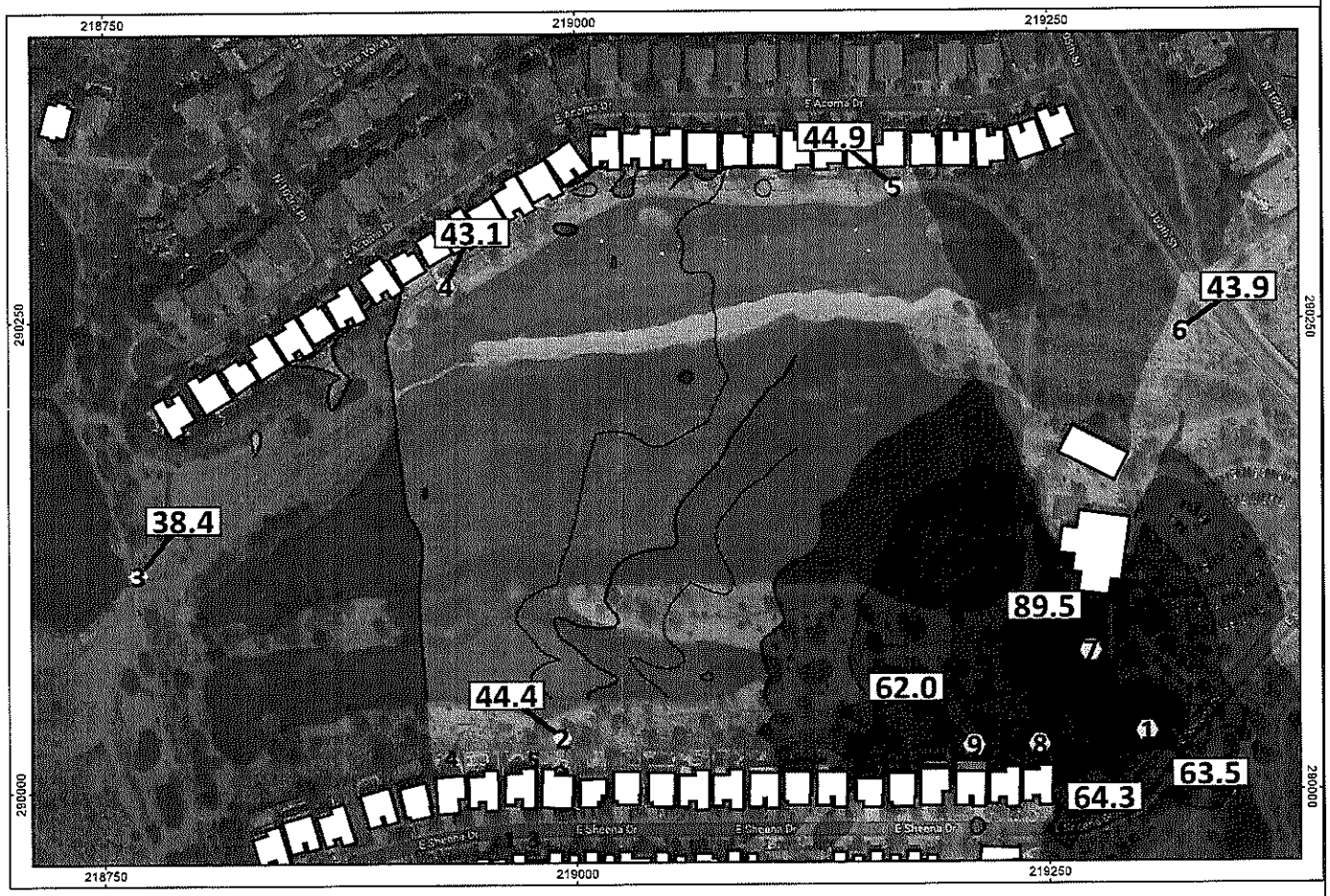


Appendix C

SoundPLAN Modelling Output

McDowell Mountain Golf Club Noise Level Contours: Situation 1



Levels in dB(A)

>=	65
60 -	65
55 -	60
50 -	55
45 -	50
<	45

Signs and symbols

- Onsite buildings
- Receiver
- Level table
- Wall

Length scale 1:200

0 100 200 400 600 feet

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McDowell Mountain Golf Club
Noise Level Contours:
Situation 2

Levels in dB(A)

>=	65
60 -	65
55 -	60
50 -	55
45 -	50
<	45

Signs and symbols

- Onsite buildings
- Receiver
- Level table

Length scale 1:200

0 100 200 400 600 feet

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