October 31, 2022

AMG & Associates
16633 Ventura Boulevard, Suite 1014
Encino, California 91436

Attention: Matthew Ramos | Project Developer

Subject: **17910-17920 Monterey Rd.**
Morgan Hill, California
Exterior Noise and Exterior Facade Acoustical Analysis
Veneklasen Project No. 6425-008

Dear Matthew:

Veneklasen Associates, Inc. (Veneklasen) has completed our review of the 17910-17920 Monterey Rd. project located in Morgan Hill, California. This report predicts the exterior noise level at the site using measurements and computer modeling. Using this information, interior noise levels were calculated based on the exterior noise exposure and the construction types proposed. From this, the exterior facade design was determined. This report represents the results of our findings.

1.0 INTRODUCTION

This study was conducted to determine the impact of the exterior noise sources on the 17910-17920 Monterey Rd. project in Morgan Hill, California. Veneklasen's scope of work included calculating the exterior noise levels impacting the site and determining the method, if any, required to reduce the interior and exterior sound levels to meet the applicable code requirements of the State of California and the City of Morgan Hill.

The project consists of two 6-story Type III over raised podium structure buildings with 199 multifamily residential units. The project is bounded by Monterey Road to the southwest, the Caltrain rail line to the northeast, existing mixed-use residential to the southeast, and existing public facilities to the northwest.

2.0 NOISE CRITERIA

LDN (Day-Night Level) is the 24-hour equivalent (average) sound pressure level in which the nighttime (10 pm – 7 am) noise is weighted by adding 10 dB to the hourly level. Since this is a 24-hour metric, short-duration noise events (truck pass-bys, buses, trains, etc.) are not as prominent in the analysis.

Leq (equivalent continuous sound level) is defined as the steady sound pressure level which, over a given period of time, has the same total energy as the actual fluctuating noise.

All reported noise levels are A-weighted.

2.1 Interior Noise Levels – Residential

The State of California Building Code (Section 1207.4) and the City of Morgan Hill Noise Element state that interior LDN values for residential land uses are not to exceed 45 LDN in any habitable room.

If the windows must be closed to meet an interior level of 45 LDN, then a mechanical ventilating system or other means of natural ventilation may be required.

The City of Morgan Hill also limits noise levels in new residential development exposed to an exterior LDN 60 dB or greater to maximum instantaneous noise levels (e.g., trucks on busy streets, train noise) of 50 dB in bedrooms and 55 dB in other habitable rooms.

2.2 Exterior Noise Levels – Residential

The City of Morgan Hill Noise Element states that exterior LDN values are not to exceed 60 dB in residential areas where outdoor use is a major consideration (e.g., recreation areas in multi-family housing projects). The maximum instantaneous noise level for new residences near the railroad shall be LDN 70 dB, recognizing that train noise is characterized by relatively few loud events.

2.3 CALGreen – Non-residential

The California Green Building Standards Code (Section 5.507.4.2) stipulates that for buildings exposed to a noise level of 65 dB or more when measured as a 1-hour Equivalent Sound Level (Leq), the building facade, including walls, windows, and roofs, shall provide enough sound insulation so that the interior sound level from exterior sources does not exceed 50 dB during any hour of operation. This applies to non-residential spaces such as retail space, leasing, and amenities.

3.0 EXTERIOR NOISE ENVIRONMENT

3.1 Noise Measurements

Traffic on Monterey Road and trains were the primary sources of noise affecting the site. Veneklasen visited the site on Tuesday, October 11, 2022 and placed meters at the front and back of the site to capture the hourly sound levels on the site for a 24-hour period. Veneklasen also completed short-term noise measurements. Table 1 and Figure 1 show the location and summary of the noise measurements.

Table 1 – Measured Sound Levels

Location	Measured Level (dB)	LDN (dB)	Event Level (dB)	Loudest Daytime Hour (dB)
L1	66	71	77	71
L2	64	70	98	69
S1	47	-	-	-
S2	61	-	-	-

Figure 1 – Aerial View of Project Site Showing Measurement Locations

3.2 Caltrain Line

Caltrain runs parallel to Monterey Road at the northeast side of the project site. The schedule indicates that the trains run three times between 6 and 7 am and three times between 5 and 7 pm. Freight trains were also recorded. Using the measured sound levels at location L2, the calculated future noise event levels at the façade facing the railroad are going to be approximately 75 – 90 dB. Veneklasen utilized 87 dB as the noise event level at units facing the Caltrain Line.

3.3 Computer Modeling

Veneklasen has utilized the Traffic Noise Model computer software program developed by the FHWA (Federal Highway Administration TNM 2.5) in order to predict vehicular noise levels at various locations. The primary purpose of the computer model was to determine how the noise environment will change due to traffic and site changes.

3.4 Overall Exterior Exposure

Based on the computer model and measurements, Veneklasen calculated the noise level at different locations across the project site. To simplify the presentation of the exterior noise levels, Veneklasen has separated the site into locations based on the sound exposure and required mitigation. The predicted sound levels at each zone, shown in Figure 2, are listed in Table 2 below.

Table 2 – Exterior Noise Levels

Location	Exterior LDN (dB)	Event Level (dB)	Exterior Loudest Daytime Hour (dB)
Zone A	71	77 (facing Monterey Rd) 87 (facing train line)	-
Zone B	65	79	-
Zone C	64	77	-
Zone D	-	-	71
Zone E	-	-	71
Remaining Units	≤ 60	< 75	< 65

Figure 2 – Noise Zones (Building A, Levels 1 - 2)

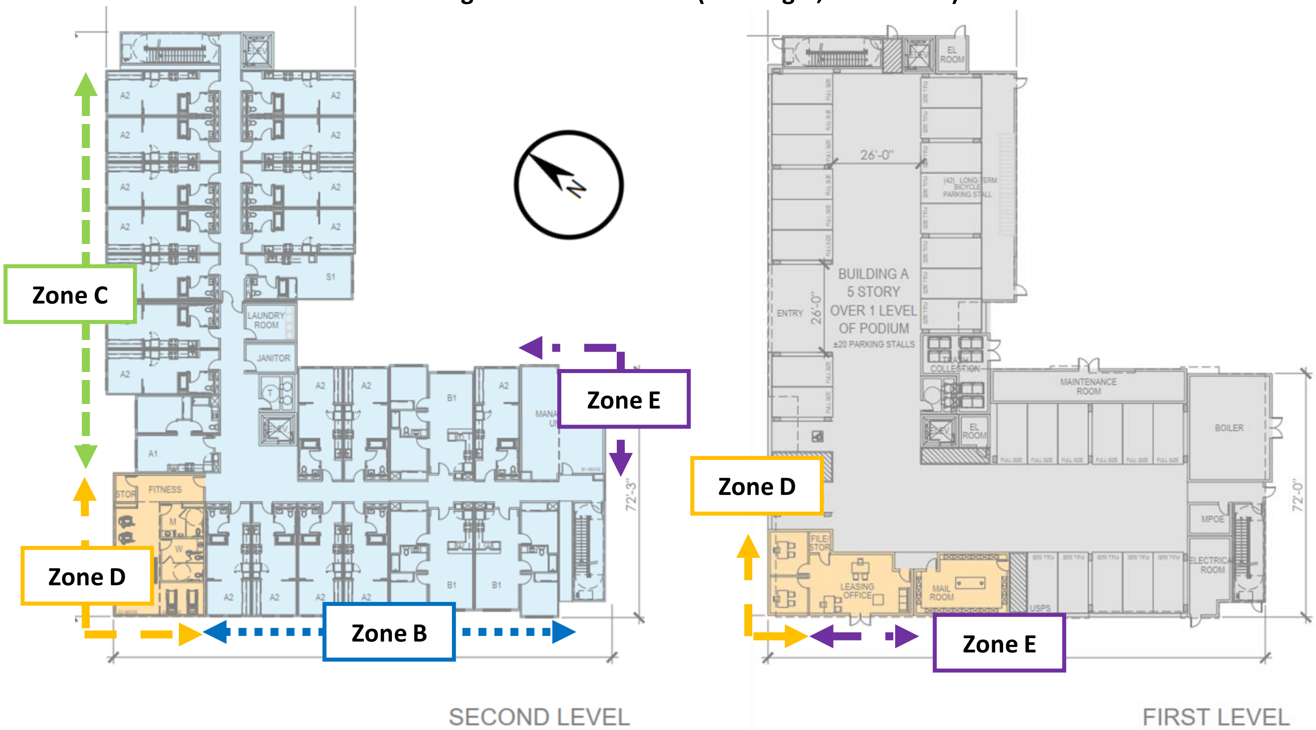
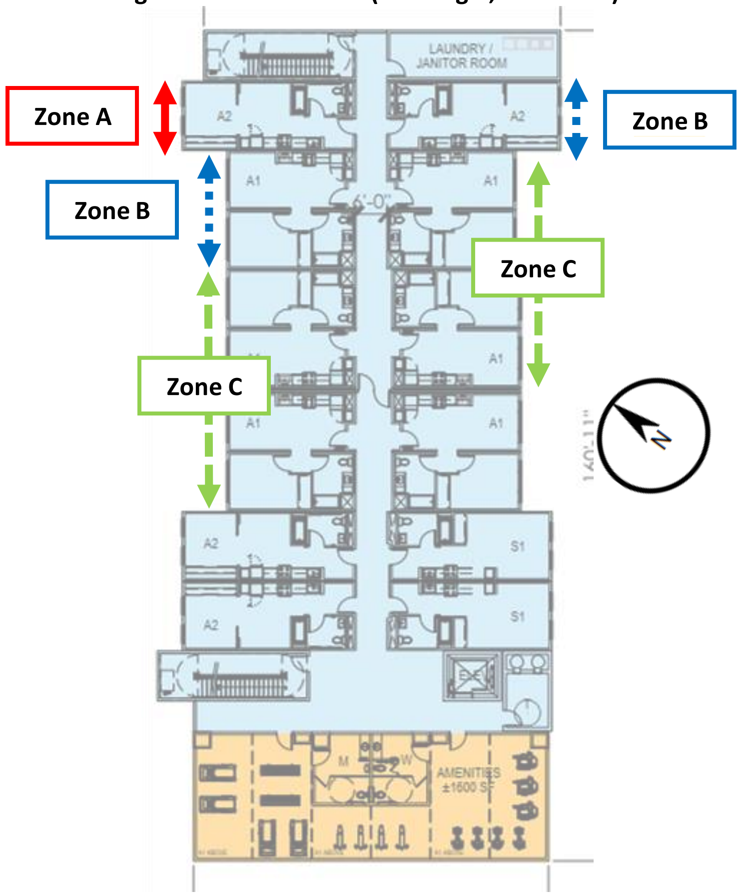


Figure 3 – Noise Zones (Building A, Levels 3-6)

Figure 4 – Noise Zones (Building B, Levels 2-6)



4.0 INTERIOR NOISE CALCULATION

4.1 Exterior Facade Construction

Calculations were based on the plans dated June 24, 2022. The plans do not show the exterior wall construction, but Veneklasen assumes a performance equivalent to 3-coat stucco over sheathing on wood studs with a single layer of gypsum board on the interior and batt insulation in the cavity.

Veneklasen's calculations included the roof path, but this was insignificant in the interior noise level calculated.

Veneklasen utilized the glazing ratings (glass, frame and seals) shown in Appendix I.

4.2 Interior Average Noise Level (LDN) and Short-duration Noise Event – Residential

Veneklasen calculated the interior level within the residential units given the measured noise environment and the exterior facade construction described above. In a similar manner Veneklasen calculated the interior noise levels from the single-event noise sources such as trains and heavy truck pass-bys. Table 3 show the predicted interior LDN and Event Level based on the windows and doors with STC ratings as shown and glazing construction as described in Appendix I. Note that the STC ratings indicated in the table do not completely specify the building element performance, as the building element must also meet the octave band transmission loss across the frequency spectrum as specified in Appendix I.

Table 3 – Calculated Interior LDN and Event Level

Location	Exterior LDN (dB)	Exterior Event Level (dB)	Window/ Door Rating[1]	Interior LDN (dB)	Interior Event Level (dB)
Zone A	71	77 (facing Monterey Rd) 87 (facing train line)	STC 40	< 45	Bedroom: < 50 Living Room: < 55
Zone B	65	79	STC 37	< 45	Bedroom: < 50
Zone C	64	77	STC 33	< 45	Bedroom: < 50 Living Room: < 55
Remaining Units	≤ 60	< 75	No STC requirement STC 30 recommended		

Where the noise level does not exceed 60, sound-rated assemblies are not required. However, Veneklasen recommends specifying a window with a minimum rating of STC 30 to maintain a consistent level of acoustical quality.

4.3 Mechanical Ventilation – Residential

Because the windows and doors must be kept closed to meet the noise requirements, mechanical or other means of ventilation may be required for units in Zones A through C. The ventilation system shall not compromise the sound insulation capability of the exterior facade assembly.

4.4 CALGreen – Non-Residential

In a similar manner, Veneklasen calculated the noise level within non-residential spaces. CALGreen is based on the loudest hourly Leq. Veneklasen utilized a statistical methodology to determine this level from the measurements[2]. The results are shown in Table 4 below. Hourly noise level summaries and sample calculations are included in the appendices.

Table 4 – Calculated Interior Average Noise Levels at Non-Residential Areas

Location	Exterior Loudest Daytime Hour (dB)	Minimum Glazing	Interior Loudest Daytime Hour (dB)
Zone D	71	STC 33	< 50
Zone E	71	STC 30	< 50
Remaining Areas	< 65	CALGreen analysis not required STC 30 recommended	

5.0 EXTERIOR NOISE CALCULATION

5.1 Exterior Average Noise Level (LDN) – Residential

Based on Landscape sheet L1, a recreation area consisting of picnic space, community garden boxes, and playground is planned between Building A and an existing building. The predicted exterior LDN for this recreation area is below LDN 60 dB. Therefore, no additional mitigation is necessary.

A fenced dog park is planned by Building B and the Caltrain line. The predicted exterior LDN due to train activity is 68 dB. No additional mitigation is necessary.

6.0 SUMMARY

The following summarizes the acoustical items required to satisfy the noise criteria as described in this report.

[1] STC rating does not fully specify the building element performance. Refer to Appendix I.

[2] LoVerde, John; Dong, Wayland; Rawlings, Samantha. “Noise Prediction of Traffic on Freeways and Arterials from Measured Data.” Noise-Con 2014. Fort Lauderdale, Florida.

Residential

- Exterior wall assembly is acceptable as anticipated in Section 4.1.
- The roof assembly was included in our calculations and is not a significant path of sound and can remain as designed.
- Windows and glass doors as shown in Table 3 with Transmission Loss values and STC ratings defined in Appendix I are required. Appendix I shall be the acoustical specification for all exterior windows and doors.
- Residential mechanical ventilation, or other means of natural ventilation, may be required for units in Zones A through C.

Non-Residential

- At amenity and other non-residential spaces, windows and glass doors as shown in Table 4 with Transmission Loss values and STC ratings defined in Appendix I are required to meet the CALGreen interior noise criterion.

Exterior Use Areas

- No mitigation is necessary for the exterior recreational areas.

Various noise mitigation methods may be utilized to satisfy the noise criteria described in this report. Alteration of mitigation methods that deviate from requirements should be reviewed by the acoustical consultant.

If you have any questions or comments regarding this report, please do not hesitate to contact us.

Sincerely,
Veneklasen Associates, Inc.

Elias Montoya
Associate

Winter Saeedi
Associate

APPENDIX I – GLAZING REQUIREMENTS

In order to meet the predicted interior noise levels described in Section 4.0, the glazing shall meet the following requirements:

Table 5 – Acoustical Glazing Requirements: Minimum Octave Band Transmission Loss and STC Rating

Nominal Thickness	Minimum Transmission Loss Octave Band Center Frequency (Hz)						Min. STC Rating
	125	250	500	1000	2000	4000	
1” dual	21	19	28	34	37	33	**30**
1” dual	23	22	30	36	37	36	**33**
1” dual	24	27	35	39	40	42	**37**
Storm (triple glazed)	24	30	36	44	49	45	**40**

The transmission loss values in the table above can likely be met with the following glazing assemblies:

1. STC 30: 1/8” monolithic – 3/4” airspace – 1/8” monolithic
2. STC 33: 3/16” monolithic – 11/16” airspace – 1/8” monolithic
3. STC 37: 7/16" laminated – 3/8” airspace – 3/16” monolithic
4. STC 40: 1/8" monolithic – 1/2” airspace – 1/8” monolithic – 2” airspace – 3/16” storm

An assembly’s frame and seals may limit the performance of the overall system. Therefore, the window and door systems selected for the project shall not be selected on the basis of the STC rating of the glass alone, but on the entire assembly including frame and seals. Additionally, the assemblies given above are provided as a basis of design, but regardless of construction, the octave band Transmission Loss (TL) and STC value of the system selected must meet the minimum values in Table 5 above.

Independent laboratory acoustical test reports should be submitted for review by the design team to ensure compliance with glazing acoustical performance requirements. Laboratories shall be accredited by the Department of Commerce National Voluntary Laboratory Accreditation Program (NVLAP). Labs shall be pre-approved by Veneklasen Associates. Tests shall be required to be performed in North America. Lab tests and lab reports shall be in compliance with ASTM standard E90 and be no more than 10 years old from the date of submission for this project.

If test reports are not available for a proposed assembly, the assembly, including frame, seals and hardware, shall be tested at an independent pre-approved NVLAP-accredited laboratory to demonstrate compliance with the requirements of this report. Veneklasen shall be invited to witness acoustical testing completed and reserves the right to exclude test reports from laboratories that are not pre-approved by Veneklasen.

APPENDIX II – MEASURED HOURLY NOISE LEVELS

Location	Start Time	Duration	LAeq	LAFmax
L1	10:00 am	1:00:00	66	87
	11:00 am	1:00:00	65	82
	12:00 pm	1:00:00	66	83
	1:00 pm	1:00:00	66	92
	2:00 pm	1:00:00	67	90
	3:00 pm	1:00:00	67	86
	4:00 pm	1:00:00	69	93
	5:00 pm	1:00:00	68	89
	6:00 pm	1:00:00	66	86
	7:00 pm	1:00:00	65	86
	8:00 pm	1:00:00	65	94
	9:00 pm	1:00:00	63	83
	10:00 pm	1:00:00	61	83
	11:00 pm	1:00:00	59	79
	12:00 am	1:00:00	54	78
	1:00 am	1:00:00	53	79
	2:00 am	1:00:00	54	79
	3:00 am	1:00:00	54	74
	4:00 am	1:00:00	60	79
	5:00 am	1:00:00	67	88
	6:00 am	1:00:00	71	98
	7:00 am	1:00:00	70	88
	8:00 am	1:00:00	68	85
	9:00 am	1:00:00	68	89
L2	10:00 am	1:00:00	63	96
	11:00 am	1:00:00	49	74
	12:00 pm	1:00:00	46	68
	1:00 pm	1:00:00	47	64
	2:00 pm	1:00:00	55	86
	3:00 pm	1:00:00	46	71
	4:00 pm	1:00:00	49	65
	5:00 pm	1:00:00	61	92
	6:00 pm	1:00:00	57	90
	7:00 pm	1:00:00	66	101
	8:00 pm	1:00:00	72	99
	9:00 pm	1:00:00	45	60
	10:00 pm	1:00:00	43	67
	11:00 pm	1:00:00	41	54
	12:00 am	1:00:00	38	58

Location	Start Time	Duration	LAeq	LAFmax
	1:00 am	1:00:00	34	60
	2:00 am	1:00:00	72	98
	3:00 am	1:00:00	36	58
	4:00 am	1:00:00	68	97
	5:00 am	1:00:00	45	59
	6:00 am	1:00:00	63	97
	7:00 am	1:00:00	69	98
	8:00 am	1:00:00	48	65
	9:00 am	1:00:00	48	75
S1	9:40 am	0:15:00	47	60
S2	10:00 am	0:15:00	61	78

APPENDIX III – GLOSSARY OF ACOUSTICAL TERMS

Term	Definition
Absorption	A property of material referring to how much sound it absorbs (as opposed to reflecting). In the context of this report, absorption refers to the total quantity of absorption within the receiving space. Absorption is measure in sabins.
A-weighting (dB)	The sound pressure level in decibels as measured in an A-weighting filter network. The A-weighting de-emphasizes the low frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise.
Decibel (dB)	A unit describing the amplitude of sound equivalent to 20 times the logarithm, to the base 10, of the ratio of the pressure of the sound to the reference pressure of 20 μPa. Used to quantify sound pressure levels.
Equivalent Sound Level (Leq)	The time-weighted average noise level during the stated measurement period.
Sabin	A unit used to describe absorption within a space. One sabin is equal to the absorption of a one-square-foot open window.
Sound Pressure Level (SPL)	The amplitude of sound when compared to the reference sound pressure level of 20 μPa. SPL is measured in dB.
Sound Transmission Class (STC)	A single-number metric used to describe the transmission loss performance of a material or assembly across the frequency spectrum. It is intended for use primarily when speech is the noise source.
Transmission Loss (TL)	A measure of the reduction in sound level as a sound wave passes through a material. The higher the transmission loss, the better the material's sound insulating properties.

APPENDIX IV – ACOUSTICAL CALCULATION METHODS

Decibel Addition

Decibels are based on a logarithmic scale; defined as the logarithmic ratio between a measured sound pressure level and a reference sound pressure level. When decibels are added, they are not combined arithmetically, but logarithmically. Decibels are added according to the following equation.

$$SPL_{tot} = 10log\left(10^{\left(SPL_1/10\right)}\right) + 10log\left(10^{\left(SPL_2/10\right)}\right)$$

Where:
SPL_{tot} = Total Sound Pressure Level (dB or dB)
SPL_1, SPL_2 = Sound Pressure Level 1, 2 (dB or dB)

A-Weighting

A-weighting a spectrum is completed by applying standardized weighting factors to a frequency spectrum, either in octave bands or third-octave bands. These resultant A-weighted levels are summed using decibel addition to generate the overall A-weighted level, noted as dB. In a report, spectral data is typically presented un-weighted, and the overall level is presented with A-weighting.

The octave band A-weighting correction factors are shown in the table below:

	Octave Band Center Frequency (Hz)							
	63	125	250	500	1000	2000	4000	8000
A-weighting Correction Factor (dB)	-26	-16	-9	-3	0	+1	+1	-1

Acoustical Shielding

The presence of adjacent buildings or facades, changes in terrain, parapets, and other similar barriers provide acoustical shielding, reducing the sound level incident on the exterior facades. Common locations where acoustical shielding occurs include, but are not limited to, the roof, the back, and sides of the building that are not directly facing the noise source.

Acoustical shielding due to building geometry can be separated into two categories: reduction due to reduced area of exposure (side of a building), and shielding from barriers (such as a parapet or sound wall).

Reduction as a result of reduced area of exposure is calculated according to the following equation:

$$\Delta SPL = 10\log_{10}\left(\frac{\theta_{exp}}{180}\right)$$

Where:
ΔSPL = Change in Sound Pressure Level (dB)
θ_{exp} = Angle of exposure (degrees)

Acoustical Attenuation due to Distance

Sound pressure level reduction due to distance is calculated according to the following equation:

$$SPL_2 = SPL_1 + C_S \log\left(\frac{r_1}{r_2}\right)$$

Where:
SPL_1 = Sound Pressure Level at Location 1 (dB or dB)
SPL_2 = Sound Pressure Level at Location 2 (dB or dB)
C_S = Source Coefficient; 20 for point source, 10 for a line source
r_1 = Location 1 distance from source (ft.)
r_2 = Location 2 distance from source (ft.)

In some situations, the C_S value is between 10 and 20; selection of this number is an engineering judgment based on the relationship between the source and receiver as well as the type of source.

Interior Noise Calculation

The interior noise calculation takes into account the exterior noise level, the transmission loss of the glazing (including glass, frame, and seals), wall, and roof/ceiling systems, the finishes within the space, and noise exposure due to building geometry and acoustic shielding. The interior sound level is calculated using the equation:

$$SPL_I = SPL_E + 10\, log_{10}(A) - 10 log_{10}(R) - TL + 6$$

Where:
SPL_I = the Interior Sound Pressure Level (dB or dB)
SPL_E = Exterior Sound Pressure Level (dB or dB)
A = Surface Area exposed to Exterior Noise (sq.ft.)
R = Room Absorption Coefficient (sabins)
TL = Sound Transmission Loss of Exterior Facade Assembly (dB)

This calculation is performed for each exposed facade individually. The total interior sound level is found by using decibel addition to sum the sound level from all exposed facades.