Veneklasen Associates
Consultants in Acoustics | Noise | Vibration | AV | IT

November 26, 2019

City Ventures
444 Spear Street, Suite 200
San Francisco, California 94105

Attention: Jason Bernstein and Samantha Hauser

Subject: **Morgan Hill 7**
Morgan Hill, California
Exterior Noise and Façade Acoustical Analysis
VA Project No. 4616-015

Dear Jason and Samantha:

Veneklasen Associates (Veneklasen) has completed our review of the exterior noise and vibration levels at the proposed Morgan Hill 7 development in Morgan Hill, California. This report represents the results of our findings. Veneklasen has utilized historical Veneklasen measurements and results from an acoustical noise and vibration survey from another engineering firm for this analysis (Appendix II). Veneklasen utilized the information to develop a computer model to assess noise levels and mitigation requirements. This report has been updated in response to the November 18, 2019 peer review comments provided by Bollard Acoustical Consultants (BAC).

1.0 INTRODUCTION

This study was conducted to determine the impact of the exterior noise and vibration sources on the Morgan Hill 7 project in Morgan Hill, California, and to determine the method, if any, required to satisfy the noise and vibration standards of the State of California and the City of Morgan Hill.

The project consists of 3-story townhouse-style condominium buildings. The project is bounded by Monterey Road to the west and north of the project boundary, Union Pacific Railroad (UPRR) to the east, and existing residential land uses to the south.

2.0 CRITERIA

LDN (Day-Night Noise 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-by's, 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.

VdB is a measurement of ground velocity relative to 10^{-6} inches per second.

2.1 Interior Noise Levels – Residential

The State of California Building Code (Section 1207, "Sound Transmission") 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 associated with exterior noise sources.

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.

2.2 Maximum Instantaneous Noise Levels – Residential

The City of Morgan Hill Noise Element (Goal 7, "Prevention of Noise from Interfering with Human Activities or Causing Health Problems") states that noise levels in new residential development exposed to an exterior

LDN 60 dBA or greater should be limited to a maximum instantaneous noise level in bedrooms of 50 dBA and 55 dBA in all other habitable rooms. VA utilized the L1 metric "instantaneous noise level" for train pass-by's.

2.3 Exterior Noise Levels – Residential

The City of Morgan Hill Noise sets an exterior noise level LDN goal of 60 dBA in residential areas where outdoor use is a major consideration. Where the City determines that providing an LDN of 60 dBA or lower cannot be achieved after the application of reasonable and feasible mitigation, an LDN of 65 dBA may be permitted. Also, the maximum outdoor noise level for new residences near the railroad shall be 70 dBA LDN.

Per the BAC report, private exterior areas (balconies, patios) do not fall under this criterion.

2.4 Vibration Criteria – Residential

There are no regulatory requirements for vibration levels.

The "Transit Noise and Vibration Impact Assessment Manual" from the Federal Transit Administration, U.S. Department of Transportation, dated September 2018 ("FTA Report No. 0123") is used as a guideline. The criterion presented in Table 6-3 of that report for infrequent events (defined as fewer than 30 per day) in residences is that the vibration levels not exceed 80 VdB.

3.0 EXTERIOR NOISE AND VIBRATION ENVIRONMENT

3.1 Noise and Vibration Measurements

Railroad operations from UPRR and traffic from Monterey Road are the primary sources of noise affecting the site.

Veneklasen utilized historical measurements from a project just to the south, at Monterey Road and Granada Street. The subject project site has exposure from the same environmental sources (train line and Monterey Road) at similar distances. 24-hour measurements were performed from April 7-8, 2014, using a Bruel & Kjaer type 2260 sound level meter along with recent measurements performed by other engineering firms. The microphone was mounted at approximately five feet above the ground. Ground vibration levels were measured using an accelerometer mounted to a stake driven into the dirt and similarly logged using a Bruel & Kjaer 2260 analyzer. Both noise and vibration measurements were taken at a distance of 25 feet from the railroad track. Short-term measurements were also completed along Monterey Road, approximately 10 feet from the edge of the road. Table 1 shows a summary of Veneklasen's noise and vibration measurements.

Table 1 – Veneklasen Measured Sound Levels, April 2014

Measurement	Vibration Velocity Level, VdB	Train Pass-by Events, L1 dBA	LDN
Noise, Train	-	82-92	74
Noise, Road	-	-	67[1]
Vibration, Train	78-82	-	-

Veneklasen's historical measurements were supplemented with site-specific reported levels from another engineering firm (Appendix II). The measured onsite levels per the report were consistent with Veneklasen's historical measurements. The number of trains captured during the two surveys were also mutually consistent and therefore the measurements are expected to represent a typical condition at the site. The BAC report questions why only short-term measurements were completed; this interpretation of Veneklasen's report is inaccurate. Veneklasen conducted 24-hour measurements at a nearby site and another consultant

[1] BAC report questions how the level can be 67 LDN at a distance of 40' from the centerline and 10' from the edge of the road. These distances have different reference points and therefore experience approximately the same level. The difference is less than 1 dB LDN.

report conducted 24-hour measurements at the project site. LDN levels were calculated in accordance with Veneklasen's statistical data model[2]. Refer to Appendix II for measurement locations and results. Therefore, measurements, in our professional opinion, satisfy the question raised as 2 sites were used and both had 24-hour data. Veneklasen believes this is a suitable data set for evaluation.

Veneklasen utilizes statistical methodologies[2] for establishing design levels for a project as statistical methods provide a more reliable understanding of site environmental noise. This has been found useful for shorter environmental data sets, which are typical of this site.

3.2 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. Onsite measurement results were used to validate the TNM model.

Traffic counts for Monterey Road were obtained from the City of Morgan Hill Public Works Department. The Average Daily Traffic (ADT) volume on Monterey Road is approximately 14,000 (2015 count). The engineering report utilizes a 2.76% growth in traffic per year based on the City of Morgan Hill Traffic Impact Analysis report and traffic counts from 2009. This approximation yields a 2015 ADT of 15,000. Given the traffic counts conducted in 2015 indicated an actual ADT of 14,000 at the project site, the 2.76% growth rate appears to be higher than reality. Using this approximation is anticipated to result in levels that are higher than actual.

Using the 17,000 ADT for 2018, the calculated sound level at a distance of 40 feet from the centerline of the road is 67 LDN. This corresponds with the levels measured for Monterey Road at Granada Street in 2014. With a traffic level increase of 2.76% per year, over 10 years that results in an increase in sound level of 1 dB LDN.

The site plans include a current building setback of 60 feet, minimum, between the noise source and the buildings. Therefore, Veneklasen has utilized an LDN of 66 for Monterey Road at a distance of 60 feet.

3.3 Overall Exterior Exposure

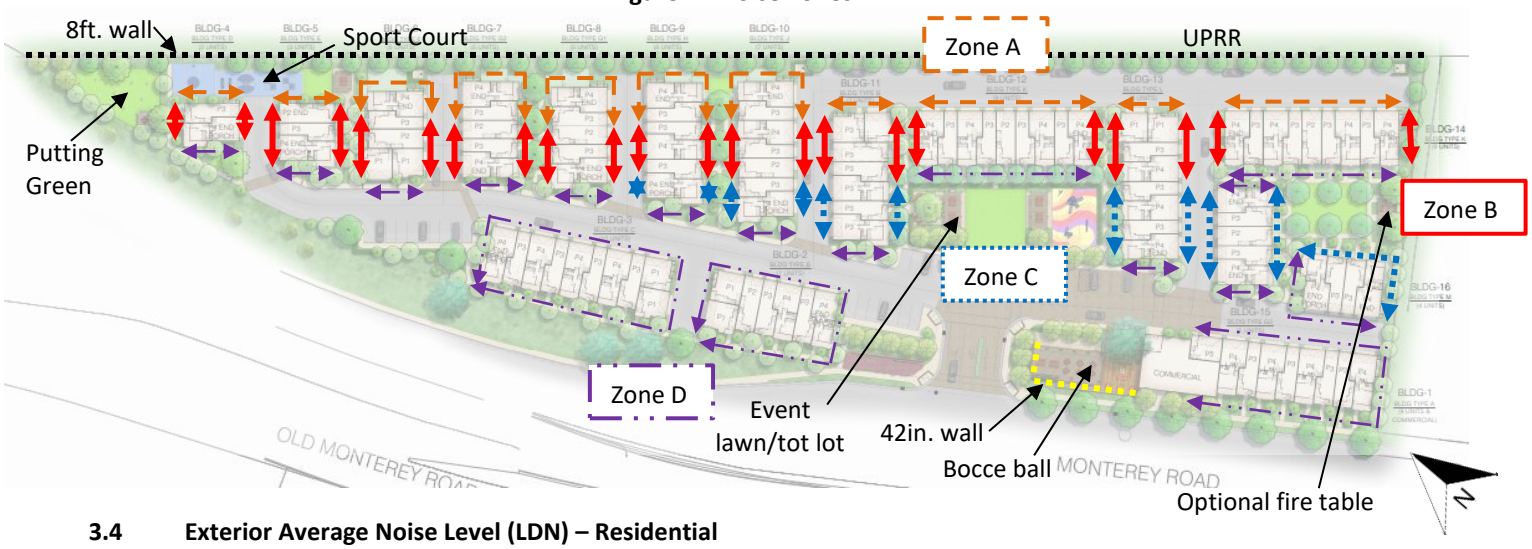
Based on the computer model and measurements, Veneklasen calculated the noise level at different locations across the project site. To simplify the presentation of the exterior noise levels, Veneklasen has separated the site into locations based on the sound exposure and required mitigation. The predicted sound levels at each zone, shown in Figure 1, are listed in Table 2 below.

Table 2 - Exterior Noise Levels

Location	Floor	Exterior Noise Level, LDN	Train Pass-by Level, L1 dBA
Zone A	All	68-71	75-80
Zone B	All	63-66	70-75
Zone C	All	58-61	65-70
Zone D	All	60-67	< 65

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

Figure 1 - Noise Zones



3.4 Exterior Average Noise Level (LDN) – Residential

From Table 2, it can be seen that the City General Plan requirement of 70 LDN for all residential buildings is met for all buildings except those in Zone A.

The exterior recreational areas near Monterey Road (putting green, bocce ball court) are within exterior noise zones in excess of 65 LDN due to vehicular traffic from Monterey Road. The calculated sound level at the bocce ball court is 67 LDN; the sound level at the putting green is 62 LDN. In order to achieve the project goal of community connectivity, use of barriers along Monterey Road has been minimized. The sound levels at the bocce ball court can be reduced to 62 LDN with a 42-inch high barrier. Both areas are therefore in compliance with the City standard of 65 LDN.

With the revised site plan and recommended barriers, all of the recreational areas are below the City General Plan 65 LDN threshold from vehicular sources and 70 LDN threshold from rail sources.

3.5 Project Impact on Existing Noise Environment

The BAC report requests comment on the project's anticipated impact on the future noise environment for existing occupancies near the project. Per the BAC report, the project is anticipated to generate an additional 1034 daily trips. This number of trips represents a 6% increase in traffic over the 2018 ADT for Monterey Road, resulting in a net change of 0.3 dB. This change will be imperceptible to a human ear and therefore does not represent a significant impact[3].

4.0 INTERIOR NOISE

4.1 Exterior Facade Construction

Veneklasen understands the project will utilize a typical standard exterior construction which consists of 3-coat stucco over sheathing on wood studs with a single layer of gypsum board on the interior and batt insulation in the cavity.

4.2 Interior Average Noise Level (LDN) – Residential

Veneklasen calculated the interior level within the residential units given the measured noise environment and the exterior facade construction described above. Based on Veneklasen's analysis, the interior LDN criteria can be met with exterior constructions as indicated in Table 3 below. Veneklasen utilized the glazing ratings (glass, frame and seals) shown in Appendix I.

[3] Significant impacts defined as an increase of 3 dBA or more when exterior level is 60 LDN or more. Policy SSI-8.5, 2035 General Plan, City of Morgan Hill.

4.3 Interior Train Pass-by Event Noise Level (dBA) – Residential

In a similar manner, Veneklasen calculated the interior noise levels as a result of the train pass-by's. As described in Section 2.2, event noise level criterion is 50 or 55 dBA for bedroom and living rooms, respectively.

As described above, Veneklasen utilizes statistical methodologies for establishing event levels. The train pass-by events were composed of two elements: the locomotive pass-by and the rolling stock. The locomotive events are significantly louder (30 dBA on average) than the rolling stock sound level. Therefore, Veneklasen assessed the two sources independently; the glazing design for train pass-by events was controlled by the locomotive pass-by.

Veneklasen's analysis indicates that the STC ratings will be required to be higher than for the LDN criteria with ratings of STC 36-42 in Zone A. These are required to comply with City General Plan requirements. Veneklasen utilized the glazing ratings (glass, frame and seals) shown in Appendix I.

4.4 Mitigation Options – Interior Sound Levels

Veneklasen investigated a number of options for mitigation of exterior and interior sound levels to comply with requirements. These options included:

- Increased building setback from train line; (not enough benefit)
- Increased building setback from Monterey Road; (not enough benefit)
- Use of sound barriers along train line and Monterey Road; (benefit and detail provided)
- Use of vegetation as an acoustical barrier; (not effective)
- Upgraded window/door assemblies; (benefit and various presented)
- Upgraded exterior wall assemblies; (benefit and various presented)
- Change in grade level for exterior recreational areas; (discussed)
- Change in orientation, type and building functionality; (benefit and detail provided)
- Relocation of buildings on the site related to exterior recreational areas.

The most recent site plan reflects Veneklasen's recommendations in order to mitigate level by orienting and locating buildings, adjusting recreational areas, and incorporating a sound wall.

In selecting a mitigation option to recommend, Veneklasen balanced the requirements for the exterior and interior mitigation, design goals for access to the project, and the efficiency of the different options. Veneklasen presents below our recommendation as a balance among all these factors.

4.5 Recommended Mitigation

The recommended mitigation strategy includes construction of an 8-foot-tall sound wall along the train line at the project property line. The barrier would extend along the entire project boundary on the railroad side. A barrier is also required for the seating area and bocce ball court near the project entry between the recreational area and Monterey Road. This barrier shall be 42 inches in height, minimum (refer to Figure 1). The BAC report questions why the barrier is not taller to provide shielding for standing players utilizing the bocce ball court. This is to balance the project's goals of community connectivity with the City's acoustical requirements. The predicted sound level at the bocce ball court is 64-65 LDN with the 42-inch barrier. This level is not expected to have an adverse effect on bocce ball players.

For units in Zone A, provide solid balcony railings that are a minimum of 46 inches tall.

With this mitigation, the sound levels at all exterior recreational areas are reduced below the 65/70 LDN (vehicular sources/rail sources) threshold required by the City. In addition, the 8-foot wall provides reduction in exterior level at the northern building facades that face the train line, such that the glazing STC ratings can be reduced on the first floor as indicated in Table 3, and balcony railings are recommended to provide acoustical shielding for balcony doors, where used, since acoustical ratings are more limited for door assemblies than window assemblies.

Table 3 below shows the glazing and exterior wall construction requirements with the inclusion of the sound walls. The sound wall may be constructed from any solid material with a minimum surface weight of 2.5 psf.

Refer to Appendix IV for sample calculations.

Table 3 - Calculated Interior Maximum Noise Levels with 8-foot Sound Wall

Location	Floor	Exterior Sound Level		Glazing Rating LR/BR*	Exterior Glass Door Rating LR/BR*	Interior Sound Level	
		LDN	Event Level, dBA			LDN	Event Level, dBA LR/BR*
Zone A	2-3	68-71	75-80	STC 40/STC 42	STC 36/STC 36	<45	55/50
	1	62-65	69-74	NA/STC 40	NA/STC 33	<45	NA/49
Zone B	2-3	63-66	70-75	STC 40/STC 40	STC 33/STC 33	<45	55/49
	1	< 60	64-69	NA/STC 33	NA/STC 30	<45	NA/48
Zone C	2-3	58-61	65-70	STC 30/STC 30	STC 30/STC 30	<45	48/49
	1	< 60	62-66	NA/STC 30	NA/STC 30	<45	NA/<45
Zone D	All	60-67	<75	STC 30/STC 30	STC 30	<45	<55/<50

* LR/BR means Living Room/Bedroom

5.0 INTERIOR VIBRATION LEVELS (VDB)

The vibration survey report cites measured levels in the ground of 61-70 VdB at a distance of 40 feet from the tracks. With the revised site plan, the closest buildings are now approximately 60 feet from the tracks. Veneklasen's measurements at a nearby site yielded higher results, at a shorter distance to the source. It is unknown if soil conditions between the two sites are similar enough to yield a comparison. The BAC report questions why Veneklasen used the other engineering firm's reported vibration levels instead of the higher levels measured by Veneklasen. Veneklasen utilized the other engineering firm's measured levels for two reasons: first, they were conducted on the site and represent site-specific conditions; secondly, the measured levels are mutually consistent. Veneklasen's measured levels are expected to be higher as they were measured at a location closer to the source.

Veneklasen evaluated the site based on the reported vibration levels at the site and has concluded that railroad-induced vibration levels would be below the 80 VdB guideline for acceptability.

It should be noted that compliance with the FTA guidelines does not indicate that vibration will not be perceptible. Events that occur at that vibration threshold would be noticeable and may cause secondary events such as rattling of objects.

There are no regulatory requirements related to vibration from the train line, therefore there are no mitigation requirements for this project.

Since the anticipated interior vibration levels are compliant with the FTA acceptability criteria, there is no significant impact from rail vibration to occupants of the site.

6.0 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 all units. The ventilation system shall not compromise the sound insulation capability of the exterior facade assembly.

7.0 SUMMARY

Veneklasen has assessed the exterior noise environment based on the updated plans and current project drawings. Veneklasen's conclusions are summarized below.

- All buildings comply with the residential building criteria of 70 LDN except those in Zone A.
- All recreational areas comply with the criteria of 65 LDN from traffic sources and 70 LDN from rail sources with inclusion of the recommended barriers along the railroad and Monterey Road.
- Provide an 8-foot-tall sound wall between the railroad and the project.
- Provide a 42-inch-tall sound wall at the bocce ball recreation area along Monterey Road.
- Provide solid balcony barriers, 46-inch-tall, at balconies within Zone A.
- Provide window assemblies with minimum ratings as indicated in Table 3 and Figure 1. See Appendix I for full requirements.
- Locate balcony access in Zone A where preferred per section 4.5, as feasible.
- Refer to Appendix I for the glazing acoustical ratings (glass, frame and seals). This is the specification of the windows and doors for the project and includes the required specified acoustical STC and Transmission Loss specified for all exterior windows and doors. This is required to be satisfied.
- The vibration levels inside of the residential buildings are predicted to be less than the 80 VdB threshold recommended by FTA based on the number of events. There are no regulatory requirements and therefore no mitigation is required.

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

Sincerely,
Veneklasen Associates, Inc.

John LoVerde, *FASA*
Principal

APPENDIX I – GLAZING REQUIREMENTS

In order to meet the predicted interior noise levels described in Section 3.4, the glazing shall meet the following requirements:

Table 4– 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	23	22	32	37	38	38	**35**
Storm (triple glazed)	24	30	36	44	49	45	**40**
Storm (triple glazed)	27	32	37	45	49	51	**42**
Balcony/Patio Door	18	16	28	34	36	37	**30**
Balcony/Patio Door	21	22	29	35	37	39	**33**
Balcony/Patio Door	24	28	35	36	37	42	**36**

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 35: 1/4" monolithic – 1/2" airspace – 1/4" monolithic
4. STC 36: 1/4" monolithic – 1/2" airspace – 1/4" laminated
5. STC 40: 1/8" monolithic – 1/2" airspace – 1/8" monolithic – airspace – storm
6. STC 42: 3/16" monolithic – 7/16" airspace – 1/8" monolithic – airspace - storm

An assembly's frame and seals may limit the performance of the overall system. The window systems selected for the project shall not be selected on the basis of STC rating alone but must meet the system STC rating provided in Table 4 above. Additionally, the assemblies given above are provided as a basis of design, but regardless of construction, the octave band Transmission Loss (TL) of the particular system selected must meet the minimum values in Table 4 above. Therefore, systems selected must meet the minimum Transmission Loss values and STC ratings provided in Table 4.

Independent laboratory acoustical test reports should be provided for review by the design team to ensure compliance with glazing acoustical performance requirements. Lab shall be a current member of the National Voluntary Laboratory Accreditation Program (NVLAP) under the National Institute for Standards and Technology (NIST) for accreditation and shall be pre-approved by Veneklasen Associates, Inc. Tests are required to be completed in North America. Lab reports shall be in compliance with ASTM standard E90 and be no more than 10 years old (from date of submission on specific project). VA requires invitation to witness acoustical testing completed to demonstrate compliance with the requirements of this report and reserves the right to exclude test reports from laboratories that are not pre-approved by Veneklasen Associates, Inc. for the specific test standard. The tests shall be performed on the entire assembly, including frame and seals and hardware, if applicable to be used for the project. If test reports are not available for the assembly, VA would require that the assembly be tested at a third-party independent lab accredited through NVLAP for the ASTM E90.

The BAC report questioned the purpose for these requirements regarding review of the laboratory test reports. Veneklasen has adopted these standards as a result of variation between laboratory testing agencies. Adoption of this process improves consistency and minimizes risk to a project developer, design/construction team, glazing manufacturers, the City, and future project residents.

APPENDIX II – REFERENCE HISTORICAL ACOUSTICAL STUDIES, MEASUREMENT EXCERPTS

Figure 2 - Edward L. Pack Associates Report, June 2018

V. Analysis of the Noise Levels

A. Existing Noise Levels

To determine the existing noise environment at the site, continuous recordings of the sound levels were made at two locations. Location 1 was 37 from the centerline of the UPRR/CalTrain/Amtrak tracks. Location 2 was 40 from the centerline of Monterey Road, corresponding to the property line along the roadway. The noise level measurement locations are shown in Figure 2 on page 12.

The measurements were made on May 9-10, 2018 using a Larson-Davis 831 Precision Integrating Sound Level Meter location 1 and a Larson Davis LDL 812 Precision Integrating Sound Level Meter at Location 2. The meters yield, by direct readout, a series of descriptors of the sound levels versus time, as described in Appendix B. The measured descriptors included the L_1, L_{10}, L_{50}, and L_{90}, i.e., those levels that are exceeded 1%, 10%, 50%, and 90% of the time. Also measured were the maximum and minimum levels, and the continuous equivalent-energy levels (L_{eq}), which are used to calculate the DNL. The sound level meter used for the railroad measurements also provides narrow band frequency data of the train passbys.

The measurements were made for a total period of 24 continuous hours and included recordings of the noise levels during representative hours of the daytime and nighttime periods of the DNL index. The results of the measurements are shown in data tables in Appendix C.

As shown in the tables, the L_{eq}'s at measurement Location 1, 37 ft. from the centerline of the UPRR/CalTrain tracks, ranged from 47.3 to 70.5 dBA during the daytime and from 37.9 to 73.1 dBA at night. The L_1 values ranged from 55.3 to 89.9 dBA during the daytime and from 48.0 to 64.2 dBA at night.

Figure 3 - Edward L. Pack Associates Report, June 2018

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The L_{eq}'s at measurement Location 2, 40 ft. from the centerline of Monterey Road, ranged from 64.2 to 74.3 dBA during the daytime and from 52.4 to 70.4 dBA at night. The L_1 values ranged from 74.9 to 77.7 dBA during the daytime and 65.5 to 78.9 dBA at night.

FIGURE 2 – Noise and Vibration Measurement Locations

Figure 4 - Edward L. Pack Associates Report, June 2018

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Table I provides the passby times, types of trains, passby average noise levels, the hourly L_1 values and the hourly L_{eq} values during the trains passbys.

TABLE I

Railroad Passby Times and Sound Levels, 37 ft. from UPRR Tracks

Time	Train Type	Passby L_{eq}	Hourly Leq	Hourly L1
6:51 PM.	CalTrain	89.5	60.9	60.2
7:33 PM	CalTrain	91.1	65.9	65.0
7:48 PM	Amtrak	98.8		
8:25 PM	Freight	91.3	68.9	66.4
8:58 PM	Freight	86.5		
9:15 PM	Freight	81.5	72.5	89.9
9:53 PM	Freight	88.9		
10:54 PM	Freight	94.5	72.9	64.2
3:15 AM	Freight	90.0	64.9	56.5
6:25 AM	CalTrain	88.4	63.5	63.1
6:46 AM	CalTrain	90.3		
7:30 AM	CalTrain	87.5	58.9	58.4
10:50 AM	Amtrak	93.1	64.5	63.2
1:03 PM	Freight	90.0	67.5	85.4

Figure 5 - Edward L. Pack Associates Report, June 2018

Traffic and railroad noise dissipates at the rate of 3 to 6 dB for each doubling of the distance from the source to the receiver. Therefore, other locations on the site at greater distances from the roadway or railroad will have lower noise levels. Additional noise shielding will be provided by interposed buildings of the project.

B. Future Noise Levels

Future traffic volume data for Monterey Road were provided in the General Plan TIA. The future 2030 traffic volume is predicted to increase to 23,500 vehicles ADT. As the existing traffic volume is estimated to be 16,955 vehicles ADT, the predicted increase in traffic volume yields a 1 dB increase in the traffic noise levels.

Information on future rail operations is not available. Therefore, we are assuming the future operations will be similar to current levels.

C. Noise Exposures

The DNL's for the survey locations were calculated by decibel averaging of the L_{eq}'s as they apply to the daily time periods of the DNL index. The DNL is a 24-hour noise descriptor that uses the measured L_{eq} values to calculate a 24-hour time-weighted average noise exposure. The formula used to calculate the DNL is described in Appendix B. Adjustments were applied to the measured noise levels to account for the various setback distances from the measurement locations using methods established by the Highway Research Board and Wyle Laboratories. The results of the calculations are shown in the data tables in Appendix C.

The results of the calculations reveal that the noise exposures at measurement Location 1, 37 ft. from the centerline of the railroad tracks is 71 dB DNL. Under future traffic conditions, the noise exposures are expected to remain at 71 dB DNL.

Figure 6 - Edward L. Pack Associates Report, June 2018

The noise exposures at measurement Location 2, 40 ft. from the centerline of Monterey Road is 71 dB DNL. Under future traffic conditions, the noise exposures are expected to increase to 72 dB DNL.

D. Ground-Borne Vibration

To determine the levels of railroad induced ground vibration, vibration level measurements were made near Location 2, 40 ft. from the centerline of the railroad tracks. The measurements were made on May 10, 2018 using a PCB Piezotronics 393A03 accelerometer and a Larson Davis 2900 Dual Channel Real Time analyzer. The analyzer measured real time 1/3-octave band vibration levels, in dB re: 1 x 10^{-6} in./sec. over the frequency range of 0.8 to 10 kHz. The vibration levels from 8 Hz to 80 Hz were used to assess the impact of ground borne vibration on homes of the project.

The bare ground railroad vibration levels of two measured CalTrain passbys were 61 and 62 VdB between 8 Hz and 80 Hz.

The bare ground railroad vibration level of one Amtrak train passby was 63 VdB between 8 Hz and 80 Hz.

The bare ground railroad vibration level of two measured freight passbys were 64 and 70 VdB between 8 Hz and 80 Hz.

E. Interior Noise Exposures

To determine the interior noise exposures, a 15 dB reduction was applied to the exterior noise exposures at various building setback locations to represent the attenuation provided by a typical building shell under an *annual-average* condition. The annual-average condition assumes the installation of standard dual-pane, thermal insulating windows and glass doors that are kept open up to 50% of time for natural ventilation.

Expected interior noise exposures are shown in the cross section tables.

Figure 7 - Veneklasen Report Excerpt (Gipetti Hill, Morgan Hill), April 2014

3.0 EXTERIOR NOISE AND VIBRATION MEASUREMENTS

The primary noise and vibration source impacting the site is railroad operations. Vehicular movement on Monterey Road is a secondary noise source. VA performed 24-hour noise measurements at the site from the morning of April 7, 2014 to the morning of April 8, 2014. Noise and vibration measurements were taken at a distance of 20 feet from the railroad track. A short-term noise measurement was also taken at the site on the morning of April 8, approximately 10 feet from Monterey Road.

Noise measurements were performed using a Bruel&Kjaer type 2260 sound level meter which logged the average and maximum noise levels. The microphone was mounted at approximately five feet above the ground. Ground vibration levels were measured using an accelerometer mounted to a stake driven into the dirt and similarly logged using a Bruel&Kjaer 2260 analyzer.

A total of 12 trains passed the site during the day of measurement, with 6 during nighttime hours (10 pm – 7 am). At least 6 of the pass-bys were commuter trains, either Caltrain or Amtrak, and at least 2 were freight trains. The noise and vibration levels from the freight trains were not significantly different from the commuter trains, although the pass-bys are longer in duration.

Figure 8 - 2014 Measurement Locations

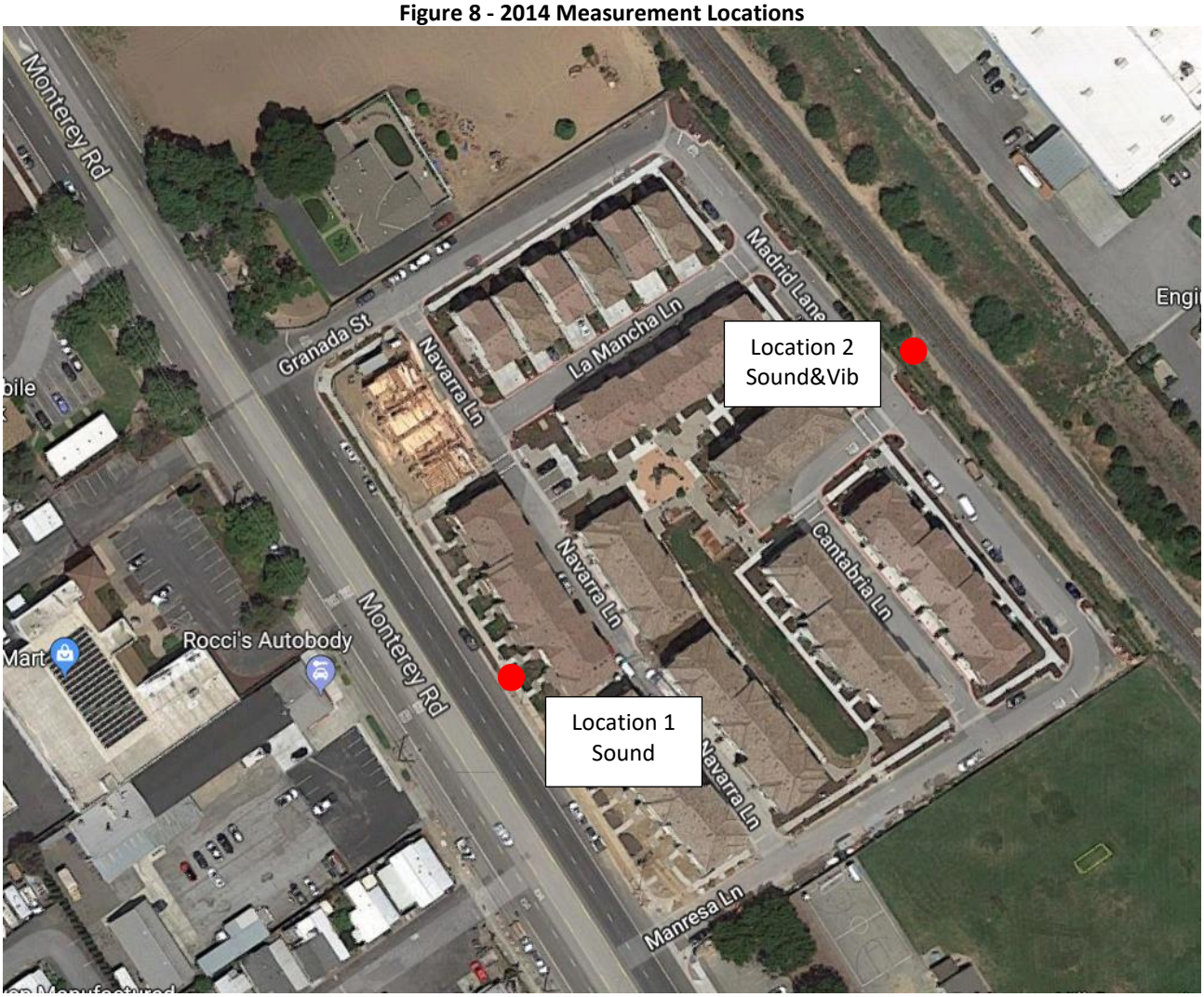

Table 5 - Summary of Train Events, 20-foot Distance, April 2014

Start Time	Description	Passby Time	L1 (dBA)	VdB
4/7/14 10 AM	Commuter	10:27	55	72
4/7/14 11 AM	Commuter	-	59	-
4/7/14 12 PM	Commuter	12:15	54	72
4/7/14 1 PM	Commuter	-	58	-
4/7/14 2 PM	Commuter	-	54	-
4/7/14 3 PM	Commuter	-	54	-
4/7/14 4 PM	Commuter	-	55	-
4/7/14 5 PM	Commuter	5:07	56	81
4/7/14 6 PM	Commuter	6:47	56	67
4/7/14 7 PM	Commuter	-	55	-
4/7/14 8 PM	Commuter	8:27	60	69
4/7/14 9 PM	Commuter	-	55	-
4/7/14 10 PM	Commuter	10:22	86	70
	Freight	10:32		76
4/7/14 11 PM	Commuter	11:58	51	76
4/8/14 12 AM	Freight	12:53	70	74
4/8/14 1 AM	Commuter	-	45	-
4/8/14 2 AM	Commuter	-	46	-
4/8/14 3 AM	Commuter	-	50	-
4/8/14 4 AM	Commuter	-	51	-
4/8/14 5 AM	Commuter	-	54	-
4/8/14 6 AM	Commuter	6:24	62	NA[4]
	Commuter	6:45		
4/8/14 7 AM	Commuter	7:22	58	
4/8/14 8 AM	Commuter	-	52	

[4] Monitor terminated at midnight on 4/8/14; no levels captured.

APPENDIX III – SUMMARY OF CALCULATION INPUT

Table 6 - Summary of Source Levels, Frequency Content (Level per Measurement Location)

Source	Distance from Source	Sound Pressure Level Octave Band Center Frequency (Hz)						
		63	125	250	500	1000	2000	4000
Monterey Road	10 ft.	67	69	64	61	64	60	52
Train Locomotive	20 ft.	95	90	90	88	88	85	81

APPENDIX IV – SAMPLE CALCULATION

Figure 9 - Sample Exterior-to-Interior Calculation

Project Name:	**Morgan Hill 7**												
Plan:	typical												
Floor:	3												
Room:	bed												
Receiving Room Absorption													
Length	10		Location	Material	Code	Area							
Width	11		Ceiling	1" Gypboard	22	110							
Height	9		Floor	Vinyl Tile	6	55							
			Walls	1" Gypboard	22	306							
Volume	990		Furnishings	King Bed	100	55							
F/C area	110		Glazing	1/8" Glass	47	72							
Wall area	378			Enter Code & Area									
				Enter Code & Area									
				Enter Code & Area									
				Enter Code & Area									
				Total Surface Area(ft^2) =		598							
Total Interior Level:			**38**										
(excluding 63 Hz):			37										
Maximum Level:			**50**										
					63	125	250	500	1000	2000	4000	8000	dBA
				Room Constant	178	139	104	90	74	80	79	79	
Exterior Noise Level													
			Level	Source type	63	125	250	500	1000	2000	4000	8000	dBA
			67	Railroad LDN	69.8	65.4	64.7	63.4	62.6	59.5	55.2	46.6	**67.0**
			40	Monterey Road	39.8	41.8	36.8	33.8	36.8	32.8	24.8	22.8	**40.0**
				<N/A>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
CNEL, LDN, or average:				**Total**	69.8	65.4	64.7	63.4	62.6	59.5	55.2	46.6	**67.0**
			Level	Source type	63	125	250	500	1000	2000	4000	8000	dBA
		Maximum:	80	Locomotive pass	82.5	77.4	77.3	75.9	75.6	72.9	68.9	60.0	**80.0**
Exterior Assemblies					**Average Interior Levels**								
	Area			Assembly Type	63	125	250	500	1000	2000	4000	8000	dBA
wall	66			VA Typical Wall (stucco,2x4ws,5/8gyp) wyle	51.5	38.2	31.7	23.0	18.1	10.7	3.4	-5.2	**29.5**
glazing	24			STC 42, Milgard 7420, 3/16 7/16 1/8 storm	47.1	36.8	32.3	26.6	20.7	11.3	5.0	-6.6	**29.2**
door	48			STC 36 Milgard Slid glass door(7/32lam 5/8 1/4)	49.1	41.8	39.4	31.2	30.5	26.6	17.4	6.4	**36.2**
				<N/A>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
				<N/A>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
				Total	**54.4**	**44.2**	**40.7**	**33.0**	**31.1**	**26.8**	**17.8**	**6.9**	**37.7**

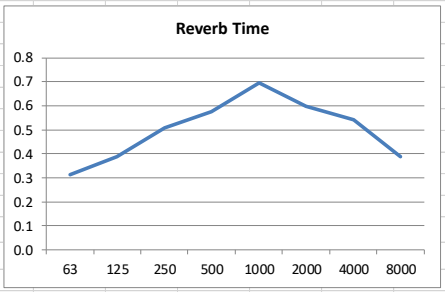

Figure 10 - Sample Barrier Insertion Loss Calculation

Barrier Insertion Loss for Point Source									
(Use same units as sound speed in cell M4)									
Source to barrier distance	30		**A**	30					
Source height	8		**B**	22.142					
Observer to barrier distance	22		**C**	52.06					
Observer height	5.5								
Barrier height	8								
Barrier: 0, Berm: 1	0								
Zone	Shadow								
Distance from Source	52								
Octave band (Hz)	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**dBA**
SPL at receiver (distance loss only)	82.5	77.4	77.3	75.9	75.6	72.9	68.9	60.0	80.0
Attenuation due to barrier (dB)	5	5	6	6	7	9	11	14	7.4
SPL at receiver with barrier	77	72	72	70	68	64	58	46	72.6

Veneklasen Associates
Consultants in Acoustics | Noise | Vibration | AV | IT

January 30, 2020

City Ventures
444 Spear Street, Suite 200
San Francisco, California 94105

Attention: Samantha Hauser | Senior Vice President of Development

Subject: **Morgan Hill 7**
Morgan Hill, California
Exterior Noise Analysis – Barrier Wall from Building 10 through Building 14
Veneklasen Project No. 4616-015

Dear Ms. Hauser:

Veneklasen Associates (Veneklasen) has completed our review of the exterior noise at the proposed Morgan Hill 7 development in Morgan Hill, California. This letter specifically addresses the City's request to reduce or remove the barrier that is located between Buildings 10 and 14. Further, the City indicated the requirement to retain meeting the requirements set forth in the California State Building Code as adopted by the City of Morgan Hill. Veneklasen has completed calculations and reviewed the conditions. The following summarizes our findings for the barrier location from Building 10 through Building 14:

1. Veneklasen reviewed reducing the barrier height while retaining compliance with the California State Building Code requirements as adopted by the City of Morgan Hill.
2. Removal of the barrier at this location is not possible. Removal of a solid barrier to an open system (like a wrought iron fence) would result in non-compliance with the California State Building Code as adopted by the City of Morgan Hill.
3. Calculations indicated that the minimum barrier height is 8 feet. Computer models of 7 foot barrier shows non-compliance. Therefore, the minimum barrier height for this noise exposure is 8 feet. City Ventures has indicated that they will construct this height.
4. The material for the barrier is not required to be concrete block or masonry. (Note that this applies to the entire barrier.)
5. The barrier should be continuous and have no gaps.
6. The barrier can be constructed from wood, concrete, masonry or other material. For instance, the barrier can be a gapless wood fence.
7. The barrier should have a minimum density of 2 lbs./square foot.

If the parameters that are described above are followed, then the parameters within the Veneklasen Exterior Noise and Exterior Façade Acoustical Analysis apply and show compliance with Building Code.

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

Sincerely,
Veneklasen Associates, Inc.

John LoVerde, *FASA*
Principal