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August 6, 2016
Project No. 48-001-R

Mr. Andrew Warner
City Ventures
444 Spear Street
Suite 200
San Francisco, CA 94105

Subject: Noise and Vibration Assessment Study for the Planned Mixed-Use Development, "Milpitas 1", 260 South Main Street, Milpitas

Dear Mr. Warner:

This report presents the results of a noise and vibration assessment study for the planned mixed-use development at 260 South Main Street in Milpitas, as shown on the Site Plan, Ref. (a). The noise exposures at the site were evaluated against the standards of the City of Milpitas Noise Element, Ref. (b), and the State of California Code of Regulations, Title 24, Ref. (c), which applies to all new multi-family housing. The railroad induced ground vibration levels were evaluated against guidelines established by the Federal Transit Administration (FTA), Ref. (d). The analysis of the on-site sound level measurements indicates that the existing noise environment at the site is due primarily to traffic sources on South Main Street and operations on the Union Pacific Railroad (UPRR) line with minor contributions from Duran & Venables general contracting facility across the railroad tracks and the Acclaim Auto Repair facility adjacent to the south. The results of the study indicate that the exterior exposures are within the limits of the standards. However, interior noise exposure excesses will occur and mitigation measures will be required. The study also reveals that ground-borne vibration levels within the planned structures due to UPRR operations will be within the criteria established by the FTA.

Sections I and II of this report contain a summary of our findings and recommendations, respectively. Subsequent sections contain the site, traffic, rail and project descriptions, analyses, and evaluations. Attached hereto are Appendices A, B, and C, which include the list of references, descriptions of the applicable standards, definitions of the terminology, descriptions of the acoustical instrumentation used for the field survey, and the on-site noise measurement data and calculation tables.

I. Summary of Findings

The noise assessment results presented in the findings were evaluated against the standards of the City of Milpitas Noise Element, which utilizes the Day-Night Level (DNL) descriptor. The standards specify a limit of 65 decibels (dB) DNL at multi-family common areas, such as common open spaces.

The noise standards are not applied to small, limited use private areas such as balconies. Policy 6-I-4 states, “Where actual or projected rear yard and exterior common open space noise exposure exceeds the ‘normally acceptable’ level for new single-family and multifamily residential projects, use mitigation measure to reduce sound levels in those areas to acceptable levels.”

The City of Milpitas Noise Element limits interior living spaces to 45 dB DNL.

The Title 24 standards, applicable only to multi-family housing, also use the DNL descriptor and specify a criterion of 60 dB DNL for the requirement of a noise analysis. When the exterior noise at the building façade exceeds 60 dB DNL, a noise analysis is required that provided the noise mitigation measures necessary to limit the interior noise exposures to 45 dB DNL or lower. Title 24 does not impose exterior noise limits.

The Title 24 standards also specify minimum sound insulation ratings for common partitions separating different dwelling units and dwelling units from interior common spaces. The standards specify that common walls and floor/ceiling assemblies must have a design Sound Transmission Class (STC) rating of 50 or higher. In addition, the floor/ceiling assemblies must achieve a minimum Impact Insulation Class (IIC) rating of 50 or higher. As design details for the interior partitions of the project were not available at the time of this study, an evaluation of the interior partitions has not been made.

The vibration levels shown in the findings are expressed in units of dB re: 1×10^{-6} in/sec (peak velocity). The human response to vibration can vary within wide limits, as it depends on the position and inherent motion of the person perceiving the vibration, as well as the physical and psychological makeup of the particular person.

The City of Milpitas Noise Element currently does not contain quantifiable standards for vibration in residential areas. The vibration analysis presented in this report uses the criteria established by the Federal Transit Administration (FTA). For residences near rail lines that carry fewer than 70 trains per day, which is considered infrequent, the FTA recommends a limit of 80 decibels of vibration (VdB) inside the dwelling. The FTA guidelines provide adjustment methodologies to vacant site vibration levels to determine the approximate vibration levels in various floor elevations of residential structures.

The noise and vibration levels shown below are without the application of mitigation measures and represent the noise and vibration environment for existing site and project conditions.

A. Exterior Noise Exposures

- The existing exterior noise exposure at the most impacted planned building setback from South Main Street, 37 ft. from the centerline of the road, is 65 dB DNL. Under future traffic conditions, the noise exposure is estimated to increase to 66 dB DNL. Thus, the noise exposures will be up to 6 dB in excess of the Title 24 criterion.
- The existing exterior noise exposures at the most impacted building setback from the UPRR tracks, 42 ft. from the centerline of the tracks, were 60 and 61 dB DNL on the two day of measurements. The noise exposures due to rail operations only were 46 dB DNL on the first day and 50 dB DNL on the second day. Under future traffic conditions, the noise exposures are estimated to remain at up to 61 dB DNL. Thus, the noise environment along the easterly side of the project is due to noise from the Duran & Venables facility, aircraft flyovers and other background noise sources. Note that the Duran & Venables company will be moving in the near future so noise currently being generated on that site is temporary. Thus, the noise exposures are up to 1 dB in excess of the Title 24 criterion.

- The existing noise exposure from the adjacent Acclaim Auto Repair facility is 52 dB DNL. Short term noise levels from repair operations, air-tools, compressed air, etc., range from 61-78 dBA.
- The existing exterior noise exposure at the most impacted Open Space 1 is 57 dB DNL, with 56 dB due to South Main Street traffic and 51 dB due to rail and other sources from the east. Under future traffic conditions, the noise exposure is estimated to increase to 58 dB DNL. Thus, the noise exposures will be within the 65 dB DNL limit of the City of Milpitas Noise Element standards.
- The existing exterior noise exposure at the most impacted Open Space 2 is 63 dB DNL, with 54 dB due to South Main Street traffic and 62 dB due to rail and other sources from the east. Under future traffic conditions, the noise exposure is estimated to remain at 63 58 dB DNL. Thus, the noise exposures will be within the 65 dB DNL limit of the City of Milpitas Noise Element standards.
- The existing exterior noise exposure at the most impacted Open Space 2 is 57 dB DNL, with 56 dB due to South Main Street traffic and 52 dB due to rail and other sources from the east. Under future traffic conditions, the noise exposure is estimated to increase to 58 dB DNL. Thus, the noise exposures will be within the 65 dB DNL limit of the City of Milpitas Noise Element standards.

The exterior noise exposures will exceed the 60 dB DNL criterion of Title 24. An acoustical analysis is required by the State Building Code. This study is intended to satisfy that requirement.

The exterior noise exposures at the common open spaces areas of the project will be within the limits of the standards. Noise mitigation measures for the exterior areas will not be required.

B. Interior Noise Exposures

- The interior noise exposures at the most impacted planned living spaces closest to South Main Street will be up to 50 and 51 dB DNL under existing and future conditions, respectively. Thus, the noise exposures will be up to 6 dB in excess of the 45 dB DNL limits of the City of Milpitas Noise Element and Title 24 standards.
- The interior noise exposures at the most impacted planned living spaces closest to the UPRR tracks will be up to 46 dB DNL under existing and future conditions. Thus, the noise exposures will be up to 1 dB in excess of the 45 dB DNL limits of the City of Milpitas Noise Element and Title 24 standards.

C. Ground-Borne Vibration

- The railroad induced ground-borne vibration levels at the most impacted planned building setback, 42 ft. from the centerline of the railroad tracks, are up to 58 VdB. Using the adjustment methodologies of the FTA, the vibration levels at the first floor elevation were calculated to be up to 59 VdB. At the 2nd floor elevation the vibration level was calculated to be up to 57 VdB. At the 3rd floor, the vibration level was calculated to be up to 55 VdB. Thus, the vibration levels will be within the 80 VdB criterion established by the FTA for infrequent rail operations.

II. Recommendations

A. Interior Noise Control

To achieve compliance with the 45 dB DNL interior standards of the City of Milpitas Noise Element and Title 24, the following mitigation measures are recommended:

- Maintain closed at all times all windows and glass doors of all living spaces within 90 ft. of the centerline of South Main Street and with a direct or side view of the roadway. Install windows and glass doors rated minimum Sound Transmission Class (STC) 28.

When windows are maintained closed for noise control, some type of mechanical ventilation to assure a habitable environment must be provided, per the Mechanical Code. The windows specified to be maintained closed are to be operable, as the requirement does not imply a “fixed” condition. All other windows of the project and all bathroom windows may have any type of glazing and may be kept opened as desired unless the bathroom is an integral part of a living space without a closeable door.

In addition to the required STC ratings, the windows and doors shall be installed in an acoustically-effective manner. To achieve an acoustically-effective window construction, the sliding window panels must form an air-tight seal when in the closed position and the window frames must be caulked to the wall opening around their entire perimeter with a non-hardening caulking compound to prevent sound infiltration. Exterior doors must seal air-tight around the full perimeter when in the closed position.

Please be aware that many dual-pane window and glass door assemblies have inherent noise reduction problems in the traffic and rail noise frequency spectra due to resonance that occurs within the air space between the window lites, and the noise reduction capabilities vary from manufacturer to manufacturer. Therefore, the acoustical test report of all sound rated windows and doors should be reviewed by a qualified acoustician to ensure that the chosen windows and doors will adequately reduce traffic and rail noise to acceptable levels.

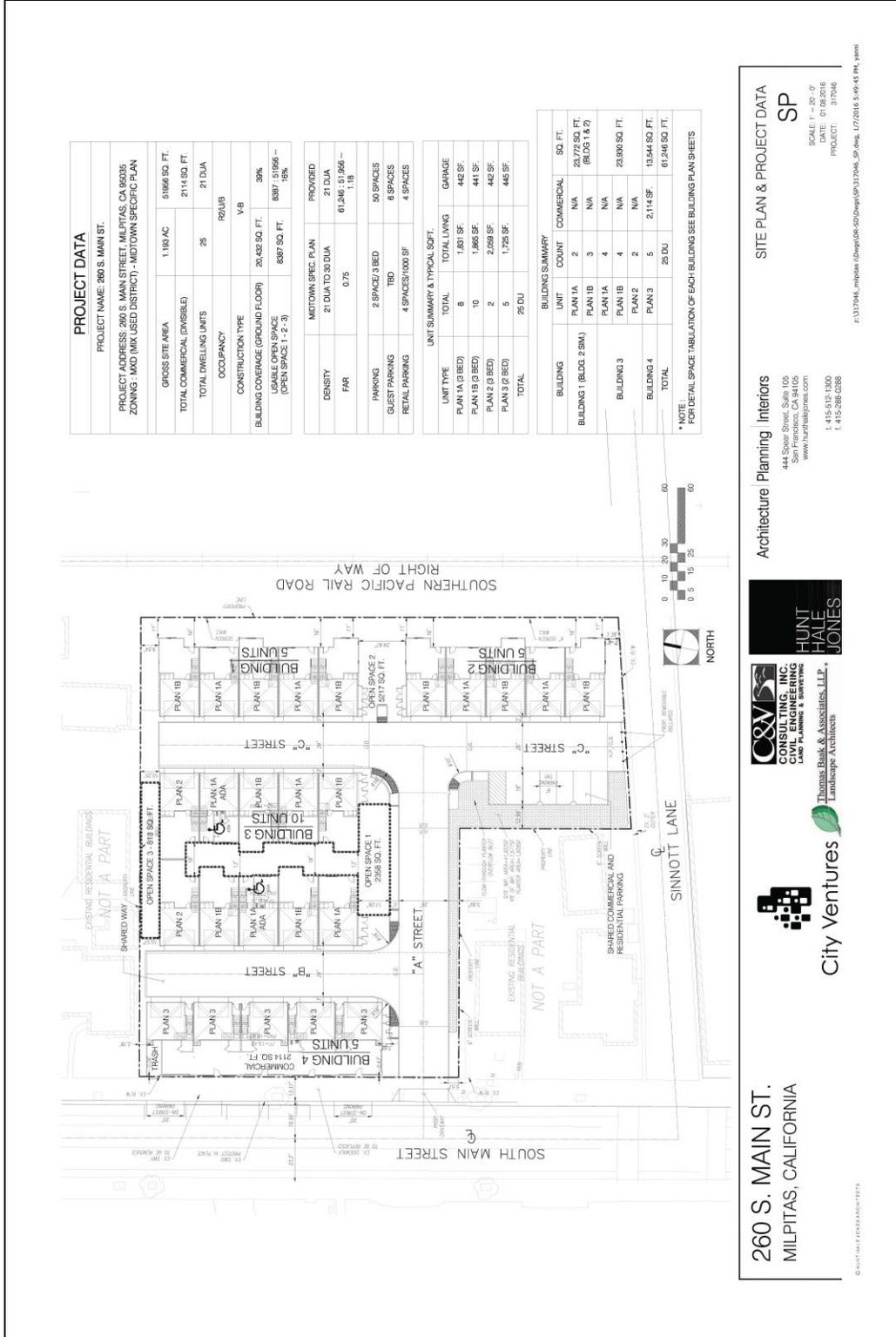
The implementation of the above recommended measures will reduce excess noise exposures for compliance with the 45 dB DNL interior noise exposure standards of the City of Milpitas Noise Element and Title 24.

III. Site, Traffic, Railroad and Project Descriptions

The planned project site is located along South Main Street between and Calaveras Boulevard in Milpitas. The site is relatively flat and at-grade with South Main Street and the Union Pacific Railroad tracks. The site currently contains one vacant building and one currently occupied single –family home. Surrounding land uses include single-family residential adjacent to the north, the Duran & Venables facility across the UPRR tracks to the east, the Acclaim Auto Repair facility adjacent to the south and a vacant lot and the St. John’s Catholic Church across South Main Street to the west.

The primary sources of noise in the site vicinity are traffic on South Main Street and noise from the Duran & Venables facility and other background sources. Noise from the UPRR is audible at the site and is included in the noise data acquired at the east property boundary, but does not add significantly to the background noise environment. Noise from the Acclaim Auto Repair facility is also audible at the site. UPRR operations occur three to four times per day. Traffic volume data for South Main Street are not available from the City of Milpitas.

The planned project includes the construction of 25 townhouse style condominium units in 4 three-story buildings. Three common open space areas will be provided for the residents. Open Space 1 and Open Space 3 will be located at the south and north ends of Building 3, respectively. Open Space 2 will be situated along the east property line between Buildings 1 and 2. A commercial space will be located on the first floor of the building facing South Main Street. Ingress and egress to the project are by way of projects access streets off of South Main Street and Sinnott Lane. The Site Plan is shown on Figure 1 on page 8.



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Landscape Planning & Services

HUNT-HALE-JONES

SITE PLAN & PROJECT DATA
SP

SCALE: 1" = 20' - 0"
DATE: 01/08/2016
PROJECT: 317046

X:\317046_milpitas\04days\04days\317046_SP.dwg, 1/7/2016 5:46:45 PM, yjones

FIGURE 1 – Site Plan

IV. 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 three locations, as shown on Figure 2. Location 1 was 45 ft. from the centerline of South Main Street. This location was chosen for security of the sound measuring instrument. Location 2 was 42 ft. from the centerline of the tracks corresponding to the planned minimum setback of the buildings from the railroad. Location 3 was 10 ft. from the property line along Sinnott Lane directly across from the auto service bays at Acclaim Auto Repair. The measurements at Locations 1 and 2 were made on for continuous 48 hour periods each location on April 15-18, 2015, and included representative hours during the daytime and nighttime periods of the DNL index. The measurements at Location 3 were made on April 18, 2016 from 11:00 AM to 3:00 PM.

The noise level data were acquired using Larson-Davis Model 812 Precision Integrating Sound Level Meters. The meters yield, by direct readout, a series of descriptors of the sound levels versus time. These descriptors are commonly used to describe community noise, as defined in Appendix B. The measured descriptors include the L_1 , L_{10} , L_{50} , and L_{90} , i.e., those levels 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's. The results of the measurements are shown in the data table in Appendix C.

The results of the field survey reveal that the L_{eq} 's at Location 1 on the first day of measurements, 45 ft. from the centerline of South Main Street, ranged from 58.7 to 65.3 dBA during the daytime and from 48.1 to 62.3 dBA at night. On Day 2, the L_{eq} 's ranged from 59.0 to 65.7 dBA during the daytime and from 48.4 to 61.9 dBA at night.

The L_{eq} 's at Location 2, 42 ft. from the UPRR tracks, ranged from 51.1 to 59.1 dBA during the daytime and from 47.5 to 56.1 dBA at night. On Day 2, the L_{eq} 's ranged from 53.0 to 59.3 dBA during the daytime and from 48.9 to 57.0 dBA at night. Rail passbys occurred during the 7:00 AM, 9:00 AM and 6:00 PM hours on the first day and during the 7:00 AM, 10:00 AM, 2:00 PM and 12:00 AM hours on Day 2.

The L_{eq} 's at Location 3 ranged from 55.1 to 57.0 dBA. The average hourly L_{eq} at this location was approximately 56.0 dBA.



FIGURE 2 – Noise Measurement Locations

Traffic and rail noise dissipate at the rate of 3 to 6 dB for each doubling of the distance from the source (centerline of the roadway/tracks) to the receiver. Therefore, other locations on the site at greater distances from the roadway or railroad tracks will have lower noise levels.

Vehicular traffic and railroad noise contain wide spectra of frequency components (from 63 to 10,000 Hertz), which are associated with engine, tire, drive-train, wheel/rail interaction, exhaust and other sources. The frequency components are centered primarily in the 100, 250 and 500 Hz octave bands and were used in determining the noise control measures recommended for this project.

B. Future Noise Levels

Future traffic volume data for South Main Street are not available. Therefore, we are estimating that the average annual growth rate for South Main Street traffic is approximately 1% per year. Over a 20 year horizon, a 1% per year growth is equivalent to a 22% increase in the traffic volumes. This increase in traffic volume yields a 1 dB increase in the traffic noise levels.

There are no data for future operations for the Union Pacific Railroad. Therefore, we are assuming that the future operations will be similar to present levels.

C. Ground-Borne Vibration

To determine the levels of railroad induced ground vibration, on site vibration level measurements were made at the planned minimum setback of the planned building at 42 ft. from the centerline of the railroad tracks. The measurements were made on April 16, 2017 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: 1×10^{-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. Table I, below, provides the measured vibration levels for the measured train passby.

TABLE I												
Measured Ground Vibration Levels, VdB @ 42 ft. From The Track Centerline												
Freq. (Hz)	8	10	12.5	16	20	25	31.5	40	50	63	80	Total
Freight	31.3	41.2	38.3	44.4	47.3	50.1	50.0	49.5	51.1	50.7	41.0	58

V. Evaluations of the Noise Exposures and Vibration Levels

A. Exterior Noise Exposures

To evaluate the on-site noise exposures against the City of Milpitas standards and the Title 24 criterion, 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 made to the measured noise levels at Location 1 to account for the difference in the distance between the measurement location and the building setback using methods established by the Highway Research Board, Ref. (e). The noise exposure calculations are shown in greater detail in Appendix C.

The results of the calculations indicate that the total exterior noise exposure at measurement Location 1, 45 ft. from the centerline of South Main Street, was 64 dB DNL on each of the two days of measurements under existing conditions.

At the planned minimum building setback of 37 ft. from the centerline of the road, the noise exposure is 65 dB DNL. Under future traffic conditions, the noise exposure is expected to increase to 66 dB DNL. Thus, the noise exposures will be up to 6 dB in excess of the Title 24 criterion.

The noise exposures at measurement Location 2, 42 ft. from the centerline of the railroad tracks, were calculated to be 60 and 61 dB DNL on Day 1 and Day 2, respectively. The noise exposures due to rail operations were calculated to be 46 dB DNL on the first day and 50 dB DNL on the second day. As the rail operational noise is 10 dB or more lower than the background noise exposure, the rail noise does not add to the background noise.

Open Space 1 is 120 ft. from the centerline of South Main Street and 130 ft. from the railroad tracks. This open space is partially shielded by Building 3. The noise exposure from South Main Street traffic was calculated to be 56 dB DNL. The noise exposure from the railroad and other background sources emanating from the east was calculated to be 49 dB DNL. The combined noise exposure was calculated to be 56 dB DNL. Under future conditions, the noise exposure from South Main Street traffic is expected to increase to 57 dB DNL and the railroad noise exposure is expected to remain at 49 dB DNL with a combined noise exposure of 57 dB DNL. Thus, the noise exposures will be within the 65 dB DNL limit of the City of Milpitas Noise Element standards.

Open Space 2 is 220 ft. from the centerline of South Main Street and 30 ft. from the railroad tracks. This open spaces is partially shielded from South Main Street traffic by Building 3. The noise exposure from South Main Street traffic was calculated to be 54 dB DNL. The noise exposure from the railroad and other background sources emanating from the east was calculated to be 62 dB DNL. The combined noise exposure was calculated to be 63 dB DNL. Under future conditions, the noise exposure from South Main Street traffic is expected to increase to 55 dB DNL and the railroad noise exposure is expected to remain at 62 dB DNL with a combined noise exposure of 63 dB DNL. Thus, the noise exposures will be within the 65 dB DNL limit of the City of Milpitas Noise Element standards.

Open Space 3 is 116 ft. from the centerline of South Main Street and 120 ft. from the railroad tracks. This open space is partially shielded by Building 3. The noise exposure from South Main Street traffic was calculated to be 56 dB DNL. The noise exposure from the railroad and other background sources emanating from the east was calculated to be 50 dB DNL. The combined noise exposure was calculated to be 57 dB DNL. Under future conditions, the noise exposure from South Main Street traffic is expected to increase to 57 dB DNL and the railroad noise exposure is expected to remain at 50 dB DNL with a combined noise exposure of 58 dB DNL. Thus, the noise exposures will be within the 65 dB DNL limit of the City of Milpitas Noise Element standards.

B. Interior Noise Exposures

To evaluate the interior noise exposures in project living spaces, a 15 dB reduction was applied to the exterior noise exposure to represent the attenuation provided by the building shell under *annual-average* conditions. The *annual-average* condition assumes that windows have standard dual-pane thermal insulating glass and are kept open up to 50 % of the time for natural ventilation. Thus, the interior noise exposures in living spaces closest to South Main Street will be up to 50 and 51 dB DNL under existing and future traffic conditions, respectively. Thus, the noise exposures will be up to 6 dB in excess of the City of Milpitas Noise Element and Title 24 standards.

The interior noise exposures in the most impacted living spaces closest to the UPRR tracks will be up to 46 dB DNL. Thus, noise exposures will be up to 1 dB in excess of the 45 dB DNL limits of the of the City of Milpitas Noise Element and Title 24 standards.

As the interior noise exposures will exceed the limits of the standards, mitigation measures will be required. The recommended measures are described in Section II of this report.

C. Vibration Levels

To determine the levels of vibration in the project structures, the FTA methodologies uses factors for coupling loss or the way the house or structure is tied to the ground, how the floors resonate and the small amounts of vibrational energy that are lost as it travels through the building.

Lightweight structures on a large concrete slab foundation have a 5 VdB downward adjustment for coupling loss. A 6 VdB increase is added for floor resonances and a 2 VdB reduction per floor elevation is subtracted. Therefore, the ground vibration level caused by a freight train passby of up to 58 VdB on the bare ground, the vibration levels in the most impacted dwelling units will be up to 59 VdB at the first floor, 57 VdB at the 2nd floor, 55 VdB at the 3rd floor. Thus, the vibration levels in dwelling units will be within the 80 VdB criterion established by the FTA for infrequent rail operations.

The vibration levels will be within the limits established by the Federal Transit Administration. Vibration mitigation measures will not be required.

In conclusion, the exterior noise exposures at the building setbacks will exceed the 60 dB DNL criterion of Title 24 for the requirement of an acoustical analysis. The exterior noise exposures at the common open space areas will be within the limits of the City of Milpitas Noise Element standards. Noise mitigation for the exterior areas will not be required.

Interior noise exposure excesses in relation to Title 24 and the City of Milpitas Noise Element will occur and mitigation measures for the interior living spaces will be required. The recommended measures are described in Section II of this report.

This report presents the results of a noise and vibration assessment study for the planned “Milpitas 1” mixed-use development at 260 South Main Street in Milpitas. The study findings and recommendations are based on field measurements and other data and are correct to the best of our knowledge. However, significant changes in the predicted traffic volumes, UPRR operations, speed limits, motor vehicle or rail technology, noise regulations, or other future changes beyond our control may produce long-range noise results different from our estimates.

If you have any questions or would like an elaboration on this report, please call me.

Sincerely,

EDWARD L. PACK ASSOC., INC.

A handwritten signature in blue ink, reading "Jeffrey K. Pack", is written over a horizontal line.

Jeffrey K. Pack
President

Attachments: Appendices A, B, and C

APPENDIX A

References

- (a) Site Plan, 260 South Main Street, by Hunt, hale, Jones Architects, January 8, 2016
- (b) Noise Element of the General Plan, City of Milpitas, March 2002
- (c) California Code of Regulations, Title 24, Chapter 2, Section 1207 “Sound Transmission”, Subsection 1207.4 (Allowable Interior Noise Levels), Revised 2013
- (d) FTA Guidance Manual, Transit Noise and Vibration Impact Assessment, Sections 8 and 11, Prepared by Harris, Miller, Miller & Hanson, Inc., 1995 - www.hmmh.com/rail05.html
- (e) Highway Research Board, “Highway Noise – A Design Guide for Highway Engineers”, Report 117, 1971

APPENDIX B

Noise Standards, Terminology, Instrumentation and Building Shell Controls

1. Noise Standards

A. City of Milpitas Noise Element Standards

The noise standards of the City of Milpitas Noise Element of the General Plan, updated March 19, 2002, employ the Day-Night Level (DNL) noise descriptor, which is a 24-hour average noise descriptor that penalizes noise created between 10:00 p.m. and 7:00 a.m. by 10 decibels. The “Normally Acceptable” noise exposure for single-family land-use is 60 dB DNL. For multi-family land-use, the “Normally Acceptable” limit is 65 dB DNL. Schools, libraries, churches, nursing homes, hospitals, playgrounds, parks, auditoriums, amphitheaters, office buildings, and other commercial or professional business uses are acceptable up to 70 dB DNL. Sports arenas, industrial, manufacturing, golf courses, riding stables, water recreation and cemeteries are acceptable up to 75 dB DNL.

Interior noise exposures in all residences are limited to 45 dB DNL.

B. Title 24 Noise Standards

The California Code of Regulations, 1, Title 24, Chapter 2, Section 1207, "Sound Transmission", applies to all new multi-family dwellings including condominiums, apartments, hotels, motels and dormitories. The standards, which utilize either the Day-Night Level (DNL) descriptor or the Community Noise Equivalent Level (CNEL), whichever is consistent with the local jurisdictional standards, specify that interior noise exposures from exterior sources shall not exceed 45 dB DNL/CNEL in any habitable room.

The Title 24 standards also establish minimum sound insulation requirements for interior partitions separating different dwelling units from each other and dwelling units from common spaces such as garages, corridors, equipment rooms, etc. The common interior walls and floor/ceiling assemblies regulated by the California Building Code (apartments, condominiums, hotels, etc.) must achieve a minimum Sound Transmission Class (STC) rating of 50 for airborne noise. Common floor/ceiling assemblies must achieve an Impact Insulation Class (IIC) rating of 50 for impact noise. These ratings are based on laboratory tested partitions. Field tested partitions must achieve ratings of NIC and FIIC 45. Attached dwellings regulated by the California Residential Code (townhouses under 3 stories in height) must achieve minimum STC 45 for the common partition.

2. Terminology

A. Statistical Noise Levels

Due to the fluctuating character of urban traffic noise, statistical procedures are needed to provide an adequate description of the environment. A series of statistical descriptors have been developed which represent the noise levels exceeded a given percentage of the time. These descriptors are obtained by direct readout of the Sound Level Meters. Some of the statistical levels used to describe community noise are defined as follows:

- L_1 - A noise level exceeded for 1% of the time.
- L_{10} - A noise level exceeded for 10% of the time, considered to be an "intrusive" level.
- L_{50} - The noise level exceeded 50% of the time representing an "average" sound level.
- L_{90} - The noise level exceeded 90 % of the time, designated as a "background" noise level.
- L_{eq} - The continuous equivalent-energy level is that level of a steady-state noise having the same sound energy as a given time-varying noise. The L_{eq} represents the decibel level of the time-averaged value of sound energy or sound pressure squared and is used to calculate the DNL and CNEL.

B. Day-Night Level (DNL)

Noise levels utilized in the standards are described in terms of the Day-Night Level (DNL). The DNL rating is determined by the cumulative noise exposures occurring over a 24-hour day in terms of A-Weighted sound energy. The 24-hour day is divided into two subperiods for the DNL index, i.e., the daytime period from 7:00 a.m. to 10:00 p.m., and the nighttime period from 10:00 p.m. to 7:00 a.m. A 10 dB weighting factor is applied (added) to the noise levels occurring during the nighttime period to account for the greater sensitivity of people to noise during these hours. The DNL is calculated from the measured L_{eq} in accordance with the following mathematical formula:

$$DNL = \left[\left[(10 \log_{10}(10^{\sum L_{eq}(7-10)})) \times 15 \right] + \left[\left((10 \log_{10}(10^{\sum L_{eq}(10-7)}) + 10) \right) \times 9 \right] \right] / 24$$

C. A-Weighted Sound Level

The decibel measure of the sound level utilizing the "A" weighted network of a sound level meter is referred to as "dBA". The "A" weighting is the accepted standard weighting system used when noise is measured and recorded for the purpose of determining total noise levels and conducting statistical analyses of the environment so that the output correlates well with the response of the human ear.

3. Instrumentation

The on-site field measurement data were acquired by the use of one or more of the precision acoustical instruments shown below. The acoustical instrumentation provides a direct readout of the L exceedance statistical levels including the equivalent-energy level (L_{eq}). Input to the meters was provided by a microphone extended to a height of 5 ft. above the ground. The meter conforms to ANSI S1.4 for Type 1 instruments. The "A" weighting network and the "Fast" response setting of the meter were used in conformance with the applicable ISO and IEC standards. All instrumentation was acoustically calibrated before and after field tests to assure accuracy.

Larson Davis 831 Precision Integrating Sound Level Meter

Larson Davis LDL 812 Precision Integrating Sound Level Meter

Larson Davis 2900 Real Time Analyzer

4. Building Shell Controls

The following additional precautionary measures are required to assure the greatest potential for exterior-to-interior noise attenuation by the recommended mitigation measures. These measures apply at those units where closed windows are required:

- Unshielded entry doors having a direct or side orientation toward the primary noise source must be 1-5/8" or 1-3/4" thick, insulated metal or solid-core wood construction with effective weather seals around the full perimeter.
- If any penetrations in the building shell are required for vents, piping, conduit, etc., sound leakage around these penetrations can be controlled by sealing all cracks and clearance spaces with a non-hardening caulking compound.
- Ventilation openings shall not compromise the acoustical integrity of the building shell.

APPENDIX C

Noise and Vibration Measurement Data and Calculation Tables

DNL CALCULATIONS

CLIENT: CITY VENTURES
 FILE: 48-001
 PROJECT: MILPITAS 1
 DATE: 3/14-16/2016
 SOURCE: S. MAIN ST., UPRR

TIME	Leq	10 [^] Leq/10		
LOCATION 1 S. Main St. Dist. To Source 45 ft.				
7:00 AM	65.3	3388441.6		
8:00 AM	63.5	2238721.1		
9:00 AM	64.4	2754228.7		
10:00 AM	62.1	1621810.1		
11:00 AM	63.2	2089296.1		
12:00 PM	63.8	2398832.9		
1:00 PM	63.9	2454708.9		
2:00 PM	63.7	2344228.8		
3:00 PM	63.2	2089296.1		
4:00 PM	63.0	1995262.3		
5:00 PM	65.2	3311311.2		
6:00 PM	64.2	2630268.0		
7:00 PM	61.8	1513561.2		
8:00 PM	59.6	912010.8		
9:00 PM	58.7	741310.2	SUM=	32483288
10:00 PM	57.6	575439.9	Ld=	75.1
11:00 PM	54.1	257039.6		
12:00 AM	52.4	173780.1		
1:00 AM	51.3	134896.3		
2:00 AM	49.2	83176.4		
3:00 AM	48.1	64565.4		
4:00 AM	51.4	138038.4		
5:00 AM	54.6	288403.2		
6:00 AM	62.3	1698243.7	SUM=	3413583
			Ln=	65.3
		Daytime Level=	75.1	
		Nighttime Level=	75.3	
		DNL=	64	
		24-Hour Leq=	61.7	

TIME	Leq	10 [^] Leq/10		
LOCATION 1 S. Main St. Dist. To Source 45 ft.				
7:00 AM	65.7	3715352.3		
8:00 AM	63.6	2290867.7		
9:00 AM	65.0	3162277.7		
10:00 AM	62.0	1584893.2		
11:00 AM	63.3	2137962.1		
12:00 PM	63.8	2398832.9		
1:00 PM	64.0	2511886.4		
2:00 PM	63.0	1995262.3		
3:00 PM	62.8	1905460.7		
4:00 PM	62.6	1819700.9		
5:00 PM	64.8	3019951.7		
6:00 PM	63.8	2398832.9		
7:00 PM	62.5	1778279.4		
8:00 PM	60.2	1047128.5		
9:00 PM	59.0	794328.2	SUM=	32561017
10:00 PM	57.1	512861.4	Ld=	75.1
11:00 PM	54.3	269153.5		
12:00 AM	52.8	190546.1		
1:00 AM	51.2	131825.7		
2:00 AM	49.4	87096.4		
3:00 AM	48.4	69183.1		
4:00 AM	51.6	144544.0		
5:00 AM	55.1	323593.7		
6:00 AM	61.9	1548816.6	SUM=	3277620
			Ln=	65.2
		Daytime Level=	75.1	
		Nighttime Level=	75.2	
		DNL=	64	
		24-Hour Leq=	61.7	

DNL CALCULATIONS

CLIENT: CITY VENTURES
 FILE: 48-001
 PROJECT: MILPITAS 1
 DATE: 3/14-16/2016
 SOURCE: S. MAIN ST., UPRR

LOCATION 2	UPRR		
Dist. To Source		42 ft.	
TIME	Leq	10 [^] Leq/10	
7:00 AM	57.4	549540.9	
8:00 AM	54.4	275422.9	
9:00 AM	57.7	588843.7	
10:00 AM	53.1	204173.8	
11:00 AM	51.1	128825.0	
12:00 PM	54.6	288403.2	
1:00 PM	54.2	263026.8	
2:00 PM	56.1	407380.3	
3:00 PM	55.9	389045.1	
4:00 PM	55.4	346736.9	
5:00 PM	55.3	338844.2	
6:00 PM	59.1	812830.5	
7:00 PM	56.4	436515.8	
8:00 PM	54.8	301995.2	
9:00 PM	51.8	151356.1	SUM= 5482940
10:00 PM	52.6	181970.1	Ld= 67.4
11:00 PM	54.3	269153.5	
12:00 AM	51.3	134896.3	
1:00 AM	47.5	56234.1	
2:00 AM	48.4	69183.1	
3:00 AM	51.6	144544.0	
4:00 AM	51.4	138038.4	
5:00 AM	53.4	218776.2	
6:00 AM	56.1	407380.3	SUM= 1620176
		1.0 Ln=	62.1
	Daytime Level=	67.4	
	Nighttime Level=	72.1	
	DNL=	60	
	24-Hour Leq=	54.7	

LOCATION 2	UPRR		
Dist. To Source		42 ft.	
TIME	Leq	10 [^] Leq/10	
7:00 AM	59.3	851138.0	
8:00 AM	55.1	323593.7	
9:00 AM	53.2	208929.6	
10:00 AM	58.8	758577.6	
11:00 AM	53.0	199526.2	
12:00 PM	54.1	257039.6	
1:00 PM	54.7	295120.9	
2:00 PM	58.5	707945.8	
3:00 PM	54.9	309029.5	
4:00 PM	54.6	288403.2	
5:00 PM	55.2	331131.1	
6:00 PM	54.3	269153.5	
7:00 PM	55.0	316227.8	
8:00 PM	54.9	309029.5	
9:00 PM	53.9	245470.9	SUM= 5670317
10:00 PM	53.6	229086.8	Ld= 67.5
11:00 PM	56.8	478630.1	
12:00 AM	55.1	323593.7	
1:00 AM	48.9	77624.7	
2:00 AM	50.8	120226.4	
3:00 AM	49.5	89125.1	
4:00 AM	52.0	158489.3	
5:00 AM	54.5	281838.3	
6:00 AM	57.0	501187.2	SUM= 2259802
		Ln=	63.5
	Daytime Level=	67.5	
	Nighttime Level=	73.5	
	DNL=	61	
	24-Hour Leq=	55.2	

Values shown in RED include rail passbys

DNL CALCULATIONS

CLIENT: CITY VENTURES
 FILE: 48-001
 PROJECT: MILPITAS 1
 DATE: 3/14-16/2016
 SOURCE: S. MAIN ST., UPRR

LOCATION 2 UPRR			
Dist. To Source 42 ft.			
TIME	Railroad Only		
	Leq	10 ⁿ Leq/10	
7:00 AM	49.8	95499.3	
8:00 AM		1.0	
9:00 AM	56.5	446683.6	
10:00 AM		1.0	
11:00 AM		1.0	
12:00 PM		1.0	
1:00 PM		1.0	
2:00 PM		1.0	
3:00 PM		1.0	
4:00 PM		1.0	
5:00 PM		1.0	
6:00 PM	56.0	398107.2	
7:00 PM		1.0	
8:00 PM		1.0	
9:00 PM		1.0	SUM= 940302
10:00 PM		1.0	Ld= 59.7
11:00 PM		1.0	
12:00 AM		1.0	
1:00 AM		1.0	
2:00 AM		1.0	
3:00 AM		1.0	
4:00 AM		1.0	
5:00 AM		1.0	
6:00 AM		1.0	SUM= 9
			Ln= 9.5
	Daytime Level=	59.7	
	Nighttime Level=	19.5	
	DNL=	46	
	24-Hour Leq=	45.9	

LOCATION 2 UPRR			
Dist. To Source 42 ft.			
TIME	Railroad Only		
	Leq	10 ⁿ Leq/10	
7:00 AM	51.3	134896.3	
8:00 AM		1.0	
9:00 AM		1.0	
10:00 AM	57.5	562341.3	
11:00 AM		1.0	
12:00 PM		1.0	
1:00 PM		1.0	
2:00 PM	56.9	489778.8	
3:00 PM		1.0	
4:00 PM		1.0	
5:00 PM		1.0	
6:00 PM		1.0	
7:00 PM		1.0	
8:00 PM		1.0	
9:00 PM		1.0	SUM= 1187028
10:00 PM		1.0	Ld= 60.7
11:00 PM		1.0	
12:00 AM	50.3	107151.9	
1:00 AM		1.0	
2:00 AM		1.0	
3:00 AM		1.0	
4:00 AM		1.0	
5:00 AM		1.0	
6:00 AM		1.0	SUM= 107160
			Ln= 50.3
	Daytime Level=	60.7	
	Nighttime Level=	60.3	
	DNL=	50	
	24-Hour Leq=	47.3	