

INITIAL STUDY – DIANA AVENUE – MANA RESIDENTIAL DEVELOPMENT

ATTACHMENT 3

NOISE ASSESSMENT STUDY FOR THE
PLANNED “MONTECITO ESTATES”
SINGLE-FAMILY DEVELOPMENT
DIANA AVENUE, MORGAN HILL

BY

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APRIL 28, 2019



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April 28, 2019
Project No. 51-017

Mr. Joey Dinh
Planning Department
City of Morgan Hill
17575 Peak Avenue
Morgan Hill, CA 95037

Subject: Noise Assessment Study for the Planned “Montecito” Single-Family Development, Diana Avenue, Morgan Hill

Dear Mr. Dinh:

This report presents the results of a noise assessment study for the planned “Montecito” single-family development along Diana Avenue in Morgan Hill, as shown on the Site Development Plan, Ref. (a). The noise exposures presented herein were evaluated against the standards of the City of Morgan Hill Noise Element, Ref. (b). An analysis of the on-site noise measurements indicates that the noise environment is created primarily by traffic sources on Diana Avenue and Highway 101. The results of this study reveal that the noise exposures at the site are within the limits of the City of Morgan Hill Noise Element standards. Noise mitigation measures will not be required. Construction of the project may produce temporary noise impacts to existing residences in the area. Construction noise control methods are included in this report.

Section I of this report contains a summary of our findings. Subsequent sections contain the site, traffic and project descriptions, analyses, evaluations and the construction noise control methods. Appendices A, B and C contains the list of references, definitions of the terminology, descriptions of the acoustical instrumentation used for the field survey, general building shell controls and the on-site noise measurement data and calculation tables.

I. Findings

A. Noise Standards - City of Morgan Hill Noise Element

The noise exposures presented herein were evaluated against the standards of the City of Morgan Hill Noise Element, which utilizes the Day-Night Level (DNL) 24-hour descriptor to define acceptable noise exposures for various land uses. The standards specify a limit of 60 decibels (dB) DNL at the exterior living areas of single-family developments.

Interior living spaces of residential developments are limited to 45 dB DNL. In addition, the Noise Element specifies that when the exterior noise exposure is greater than 60 dB DNL, the *maximum instantaneous* noise levels shall not exceed 50 dBA in bedrooms and 55 dBA in other living spaces. The noise exposures at the site are no higher than 60 dB DNL. Thus, the interior maximum noise limits are not applicable.

Municipal Code 8.28.D - Construction Noise Limits

The construction activity limitations outlined in the City of Morgan Hill Municipal Code, Ref. (c), are shown below:

Construction activities as limited below. "Construction activities" are defined as including but not limited to excavation, grading, paving, demolition, construction, alteration or repair of any building, site, street or highway, delivery or removal of construction material to a site, or movement of construction materials on a site. Construction activities are prohibited other than between the hours of seven a.m. and eight p.m., Monday through Friday and between the hours of nine a.m. to six p.m. on Saturday. Construction activities may not occur on Sundays or federal holidays. No third person, including but not limited to landowners, construction company owners, contractors, subcontractors, or employers, shall permit or allow any person working on construction activities which are under their ownership, control or direction to violate this provision. Construction activities may occur in the following cases without violation of this provision:

In the event of urgent necessity in the interests of the public health and safety, and then only with a permit from the chief building official, which permit may be granted for a period of not to exceed three days or less while the emergency continues and which permit may be renewed for periods of three days or less while the emergency continues.

If the chief building official determines that the public health and safety will not be impaired by the construction activities between the hours of eight p.m. and seven a.m., and that loss or inconvenience would result to any party in interest, the chief building official may grant permission for such work to be done between the hours of eight p.m. and seven a.m. upon an application being made at the time the permit for the work is issued or during the progress of the work.

The city council finds that construction by the resident of a single residence does not have the same magnitude or frequency of noise impacts as a larger construction project. Therefore, the resident of a single residence may perform construction activities on that home during the hours in this subsection, as well as on Sundays and federal holidays from nine a.m. to six p.m., provided that such activities are limited to the improvement or maintenance undertaken by the resident on a personal basis.

Public work projects are exempt from this section and the public works director shall determine the hours of construction for public works projects.

Municipal Code 18.76.130 - Vibration.

Vibration transmitted through the ground that is discernible without instruments at the lot line of the establishment or use is prohibited. Vibrations from temporary construction, demolition, and vehicles that enter and leave the lot (e.g., construction equipment, trains, trucks, etc.) are exempt from this standard.

B. Exterior Noise Exposures

The noise exposures shown below are without the application of noise control measures and represent the noise environment for existing site and project conditions.

- The existing exterior noise exposure at the most impacted rear and side yard and the minimum planned building setback from Diana Avenue, 53 ft. from the centerline of Diana Avenue and 1,258 ft. from the centerline of Highway 101, is 59 dB DNL. Of this 59 dB, 54 dB is due to Diana Avenue traffic and 57 dB is due to Highway 101 traffic. Under future traffic conditions, the noise exposure is estimated to increase to 60 dB DNL, with 54 dB due to Diana Avenue traffic and 59 dB due to Highway 101 traffic. Thus, the noise exposures will be within the 60 dB DNL limit of the City of Morgan Hill Noise Element standards.

The existing exterior noise exposure at the most impacted rear and side yard and planned minimum building setback of homes at the rear of the site is 57 dB DNL. Under future traffic conditions, the noise exposure is estimated to increase to 59 dB DNL. The noise environment at the rear of the site is due primarily to traffic sources on Highway 101. The noise exposures will be within the 60 dB DNL limit of the City of Morgan Hill Noise Element standards.

As the exterior noise exposures over the site and in the exterior living areas of the project are within the limits of the standards, noise control measures will not be required.

C. Interior Noise Exposures

- The interior noise exposure in the most impacted living spaces closest to Diana Avenue will be up to 34 dB DNL. Under future traffic conditions, the noise exposure is estimated to increase to 35 dB DNL. Thus, the noise exposures will be within the 45 dB DNL limit of the City of Morgan Hill Noise Element standards.
- The existing exterior noise exposure at the most impacted living spaces of homes at the rear of the site will be up to 32 dB DNL. Under future traffic conditions, the noise exposure is estimated to increase to 34 dB DNL. The noise exposures will be within the 45 dB DNL limit of the City of Morgan Hill Noise Element standards.

As the interior noise exposures in project living spaces will be within the limits of the City of Morgan Hill Noise Element standards, noise control measures will not be required.

D. Project-Generated Construction Noise

Short-term noise impacts may be created during construction of the project. Demolition and construction equipment are typically similar, with the exception of paving equipment and pile drivers (impact hammers). However, pile driving is not expected on this project. The noise levels generated by the two phases will be similar over the course of entire process. With the exception of pile driving, blasting, vibratory compacting or rolling, construction equipment expected to be used on the site generates groundborne vibration level lower than 0.02 in/sec. peak particle velocity (ppv) at distances greater than 13 ft. The nearest homes are greater than 13 ft. from the project site where construction will occur.

A table of construction equipment (mostly earthwork equipment, which is usually the noisiest) taken from the Federal Transit Administration Noise and Vibration Impact Assessment, Ref. (d), is provided on page 7. The noise levels for each item of equipment, not all of which will be used on this project, are reported for a standard distance of 50 ft. From the information provided in the Table, demolition/construction equipment noise levels range from 76 to 85 dBA at a 50 ft. distance from the source. The residences to the west (building setback) are as close as 38 ft. from the project and the residences to the north and west (building setback) is as close as 5 ft. from the project.

Since construction is carried out in several reasonably discrete phases, each will have its own mix of equipment and consequently, its own noise characteristics. Generally, the site preparation requires the use of heavy equipment such as bulldozers, loaders, graders, concrete trucks and diesel trucks. Construction of the building includes haul trucks, cranes, forklifts, pumps, air compressors and powered and manual hand tools (saws, nail guns, sprayers). Once the shell of the building is completed with the windows installed, much of the construction noise will be contained inside the building.

Table I on page 8 of this study provides the list of equipment likely to be used on this project, the reference sound levels at 50 ft., the sound levels calculated at a distance of 25 ft., the hourly sound level assuming the use of the equipment 40% of time, the average distance from the item of equipment to the receptors and the sound levels at the receptors. Note that the average distances are acoustical averages not arithmetic averages. Also shown are the expected project-generated noise exposures at the most impacted residences.

As shown, the project construction noise exposures will cause increases in the existing noise environment by more than 3 decibels on the worst-case days. Noise control methods to minimize construction noise impacts to the neighbors are provided in Section V of this report.

Table 7-1 Construction Equipment Noise Emission Levels *

Equipment	Typical Noise Level 50 ft. from Source, dBA
Air Compressor	80
Backhoe	80
Ballast Equalizer	82
Ballast Tamper	83
Compactor	82
Concrete Mixer	85
Concrete Pump	82
Concrete Vibrator	76
Crane, Derrick	88
Crane, Mobile	83
Dozer	85
Generator	82
Grader	85
Impact Wrench	85
Jack Hammer	88
Loader	80
Paver	85
Pile-driver (Impact)	101
Pile-driver (Sonic)	95
Pneumatic Tool	85
Pump	77
Rail Saw	90
Rock Drill	95
Roller	85
Saw	76
Scarifier	83
Scraper	85
Shovel	82
Spike Driver	77
Tie Cutter	84
Tie Handler	80
Tie Inserter	85
Truck	84

**This Table is copied from the FTA Transit Noise and Vibration Impact Assessment Manual, pg. 176.

TABLE I
Project-Generated Construction Noise Levels, dBA

Equipment	Reference Level	Dist., ft.	Sound Level 25 ft.	40% usage Leq(h) @ 25 ft.	Residence to West			Residence to North			Residence to East		
					Avg. Dist.	Sound Level	Sound Level	Avg. Dist.	Sound Level	Sound Level	Avg. Dist.	Sound Level	Sound Level
Paving Machine	85	50	91	73	93	62	71	64	24	74			
Water Truck	84	50	90	72	93	61	71	63	24	73			
Compactive Rollers	85	50	91	73	93	62	71	64	24	74			
Scrapers	85	50	91	73	93	62	71	64	24	74			
Graders	83	50	89	71	93	60	71	62	24	72			
Wheel Loader	80	50	86	68	93	57	71	59	24	69			
Track Loader	85	50	91	73	93	62	71	64	24	74			
Backhoe	80	50	86	68	93	57	71	59	24	69			
Bulldozer	85	50	91	73	93	62	71	64	24	74			
Haul Trucks	84	50	90	72	93	61	71	63	24	73			
Crane	83	50	89	71	93	60	71	62	24	72			
Excavator	85	50	91	73	93	62	71	64	24	74			
Air Compressor	80	50	86	68	93	57	71	59	24	69			
Generator	82	50	88	70	93	59	71	61	24	71			
Jackhammer	88	50	94	76	93	64	71	67	24	76			
Air Tools	78	85	89	71	93	59	71	62	24	71			
Pumps	77	50	83	65	93	54	71	56	24	66			
Nail Gun	81	50	87	69	DNL	67	DNL	69	DNL	79			

II. Site, Traffic and Project Descriptions

The planned project site is located along Diana Avenue, west of Highway 101 in Morgan Hill and currently contains one single-family residence. The site is flat and approximately at-grade with surrounding roadways and land uses. Surrounding land uses include single-family residential adjacent to the west, north, east and south.

The on-site noise environment is controlled primarily by traffic sources on Highway 101 and Diana Avenue. Highway 101 carries an Average Daily Traffic (ADT) volume of 136,500 vehicles in 2017, Ref. (e). Traffic volume data for Diana Avenue were not available at the time of this study. Diana Avenue terminates as it approaches Highway 101. There are few residential streets off of Diana Avenue east of the site.

The planned project includes the construction of 24 single-family homes. Ingress and egress to the project will be by way of project driveways off of Diana Avenue, new public streets off of Diana Avenue and an extension of Weichert Drive. The Site Development Plan is shown on Figure 1, below.

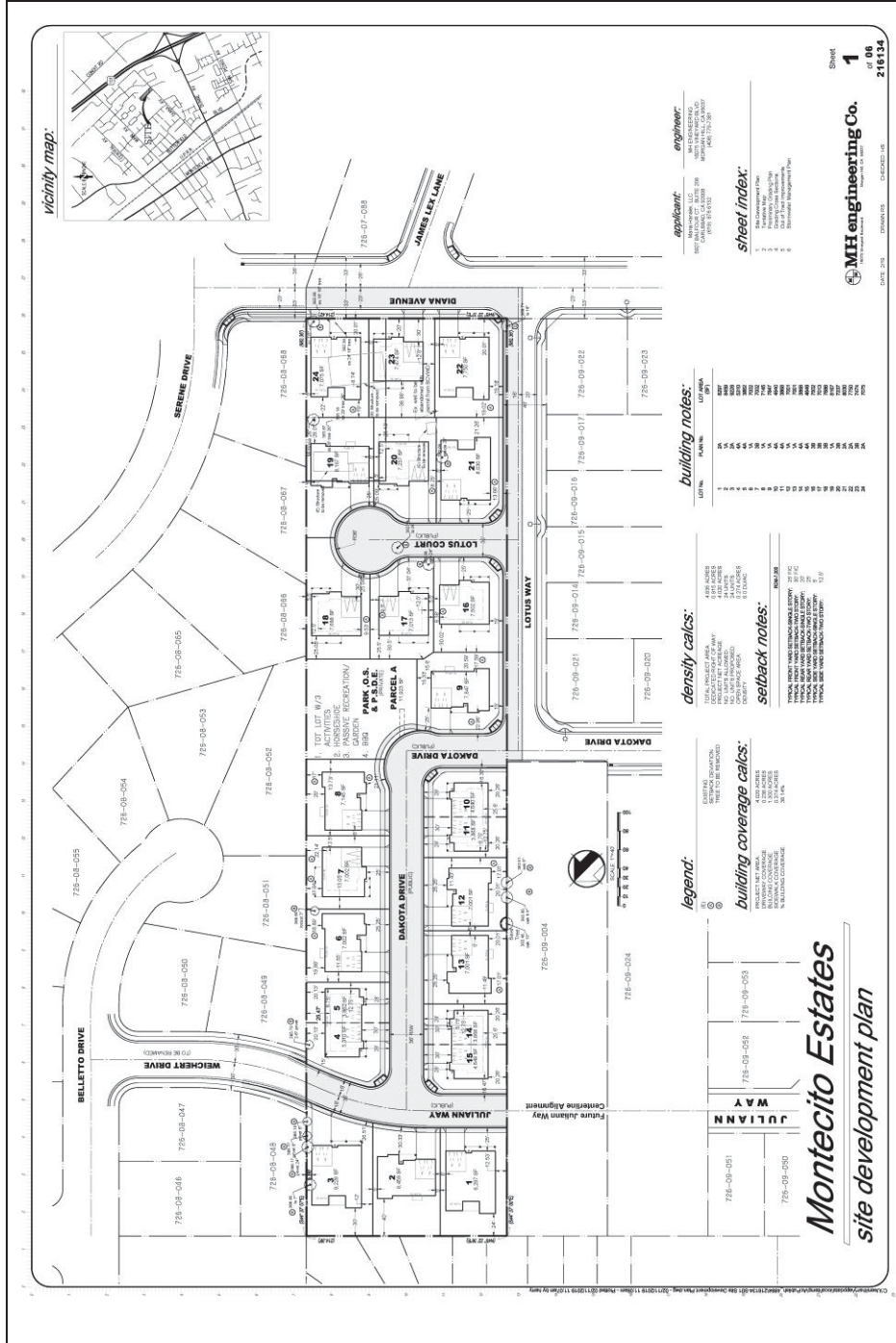


FIGURE 1 – Site Development Plan

III. 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 33 ft. from the centerline of Diana Avenue, corresponding to the front property line of the site contiguous with Diana Avenue. The sound meter was attached to a power pole at an elevation of 15 ft. above the ground. Location 2 was 15 ft. from the east property line near the terminus of Weichert Drive, 1,320 ft. from the centerline of Highway 101. The sound meter was placed on a mast 15 ft. above the site grade. This location corresponds to the planned setback of the homes near the back of the site most noise impacted by Highway 101 traffic sources. The noise level measurement locations are shown in Figure 2 on page 12.

The noise level measurements were made on April 16-17, 2019 using Larson-Davis 812 Precision Integrating Sound Level Meters. 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 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, 34 ft. from the centerline of Diana Avenue and 1,258 ft. from the centerline of Highway 101, ranged from 56.0 to 61.4 dBA during the daytime and from 46.9 to 54.7 dBA at night.

The L_{eq} 's at measurement Location 2, 1,320 ft. from the centerline of Highway 101, ranged from 48.4 to 55.5 dBA during the daytime and from 43.9 to 55.1 dBA at night.

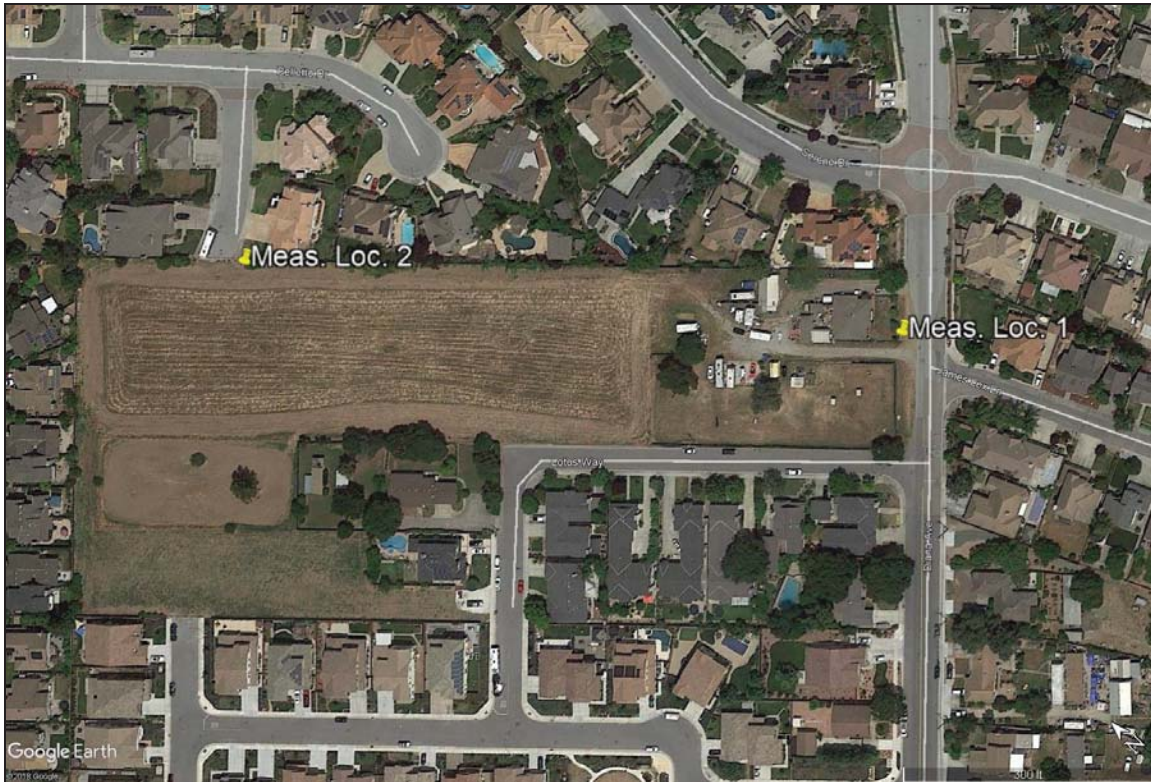


FIGURE 2 – Noise Measurement Locations

B. Future Noise Levels

Future traffic volume data for Highway 101 were not available from CalTrans. Therefore, a future projection was made based on traffic growth from historical data. The 1997 traffic volume was reported to be 88,000 vehicles ADT, Ref. (f). The 2017 volume was 136,500 vehicles ADT. Over the past 20 years, the annual average growth rate was calculated to be 2.2% per year. Applying this growth rate to the future 20 years, the 2037 traffic volume was calculated to be 211,730 vehicles ADT. This increase in traffic volume yields a 2 dB increase in the Highway 101 traffic noise levels.

Future traffic volume data for Diana Avenue are not available. Due to the buildout of the area, the future volumes are expected to be lower than a 15% increase, which is the minimum increase necessary to increase the noise environment by 1 decibel.

IV. Evaluation of the Noise Exposures

A. Exterior Noise Exposures

To evaluate the noise exposures against the City of Morgan Hill Noise Element standards, 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, Ref. (g).

The results of the calculations reveal that the noise exposure at measurement Location 1, 33 ft. from the centerline of Diana Avenue, is 60 dB DNL. At the planned minimum building setback, side yard and rear yard, 53 ft. from the centerline of Diana Avenue and 1,258 ft. from the centerline of Highway 101, the noise exposure is 59 dB DNL. Under future traffic conditions, the noise exposure is expected to increase to 60 dB DNL. Thus, the noise exposures are within the 60 dB DNL limit of the City of Morgan Hill Noise Element standards.

The noise exposure at measurement Location 2 at the planned minimum setback of homes closest to Highway 101 at the back of the site, 1320 ft. from the Highway 101 centerline, the noise exposure is 57 dB DNL. Under future traffic conditions, the noise exposure is expected to increase to 59 dB DNL.

B. Interior Noise Exposures

To determine the interior noise exposures, a 25 dB reduction was applied to the exterior noise exposures at the building setback locations to represent the attenuation provided by a typical building shell under a closed window condition. The closed window condition allows the residents to keep the windows closed at all times for noise control as supplementary mechanical ventilation will be required per the State of California Mechanical Code.

The interior noise exposures in the living spaces closest to Diana Avenue were calculated to be 34 and 35 dB DNL under existing and future traffic conditions, respectively. Thus, the noise exposures will be within the 45 dB DNL limit of the City of Morgan Hill Noise Element and Title 24 standards.

The interior noise exposures in the most impacted living spaces closest to Highway 101 at the back of the site will be up to 32 and 34 dB DNL under existing and future traffic conditions, respectively. Thus, the noise exposures will be within the 45 dB DNL limit of the City of Morgan Hill Noise Element and Title 24 standards.

As shown by the above evaluations, the exterior exposures and the interior noise exposures will be within the limits of the City of Morgan Hill Noise Element standards. Noise mitigation measures for the project will not be required.

V. Construction Noise Reduction Methods

Reduction of the demolition/construction phase noise at the site can be accomplished by using quiet or "new technology" equipment. The greatest potential for noise abatement of current equipment should be the quieting of exhaust noises by use of improved mufflers. It is recommended that all internal combustion engines used at the project site be equipped with a type of muffler recommended by the vehicle manufacturer. In addition, all equipment should be in good mechanical condition so as to minimize noise created by faulty or poorly maintained engine, drive-train and other components. Demolition and construction noise can also be mitigated by the following:

OPERATIONAL AND SITUATIONAL CONTROLS

- All work on site shall be restricted to 7:00 AM to 8:00 PM Weekdays, 9:00 AM to 6:00 PM, Saturdays and no work allowed on Sundays and Federal Holidays to comply with the City of Morgan Hill Municipal Code standards.
- All construction noise control measures currently imposed on the project shall be maintained unless the measures outlined herein are more restrictive.
- No material deliveries are allowed on Sundays or Federal Holidays.
- Cranes shall be located at least 100 ft. from any neighboring residential property line with the exception of cranes or lifts necessary to dismantle scaffolding.
- Minimize material movement along the west, north and east sides of the site.
- Locate stockpiles adjacent to residential neighbors as much as possible to help shield residences from on-site noise generation.
- Music shall not be audible off site.

- Dirt berming and stockpiling materials whenever possible can also help reduce noise to sensitive receptor locations.
- Place long-term stationary equipment as far away from the residential areas as possible.
- Keep mobile equipment (haul trucks, concrete trucks, etc.) off of local streets near residences as much as possible.
- Keep vehicle paths graded smooth as rough roads and paths can cause significant noise and vibration from trucks (particularly empty trucks) rolling over rough surfaces. Loud bangs and ground-borne vibration can occur.
- Limit the extent of heavy diesel engine equipment work to less than 10 consecutive days when working within 40 ft. of residential property lines.

INTERIOR WORK

- For interior work, the windows of the interior spaces facing neighboring residences where work is being performed shall be kept closed while work is proceeding.
- Noise generating equipment indoors should be located within the building to utilize building elements as noise screens.

EQUIPMENT

- Earth Removal: Use scrapers as much as possible for earth removal, rather than the noisier loaders and hauling trucks.
- Backfilling: Use a backhoe for backfilling, as it is less costly and quieter than either dozers or loaders.

- Ground Preparation: Use a motor grader rather than a bulldozer for final grading. Wheeled heavy equipment is less noisy than track equipment. Utilize wheeled equipment rather than track equipment whenever possible.
- Building Construction: Nail guns should be used where possible as they are less noisy than manual hammering.
- Generators and Compressors: Use generators, compressors and pumps that are housed in acoustical enclosures rather than weather enclosures or none at all.
- Utilize temporary power service from the utility company in lieu of generators wherever possible.
- Circular saws, miter/chop saws and radial arm saws shall be used no closer than 50 ft. from any residential property line unless the saw is screened from view by any and all residences using an air-tight screen material of at least 2.0 lbs./sq. ft. surface weight, such as 3/4" plywood.
- Use electrically powered tools rather than pneumatic tools whenever possible.
- Mitigation of the construction phase noise at the site can be accomplished by using quiet or "new technology" equipment.
- The greatest potential for noise abatement of current equipment should be the quieting of exhaust noises by use of improved mufflers.
- It is recommended that all internal combustion engines used at the project site be equipped with a type of muffler recommended by the vehicle manufacturer.

- All equipment should be in good mechanical condition so as to minimize noise created by faulty or poorly maintained engines, drive-trains and other components. Worn, loose or unbalanced parts or components shall be maintained or replaced to minimize noise and vibration.
- Utilize wheeled equipment rather than tracked equipment whenever possible.
- Diesel vibrating compaction equipment shall not be used within 100 ft. of a residential structure.

NOISE COMPLAINT MANAGEMENT

- Designate a noise complaint officer. The officer shall be available at all times during construction hours via both telephone and email. Signs shall be posted at site entries. A sample is shown below.

<p style="text-align: center;">NOISE COMPLAINTS</p> <p style="text-align: center;">FOR CONCERNS REGARDING CONSTRUCTION NOISE PLEASE CONTACT:</p> <p style="text-align: center;">“CONSTRUCTION OFFICER”</p> <p style="text-align: center;">Conoff@jobsite.com</p> <p style="text-align: center;">OPERATIONS MANAGEMENT ENGINEER</p> <p style="text-align: center;">CALL CENTER: (111) 111-1111</p>
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- Notify, in writing, all residents within 300 ft. of the site of construction. The notification shall contain the name, phone number and email address of the noise complaint officer. A flyer may be placed at the doors of the residences.
- A log of all complaints shall be maintained. The logs shall contain the name and address of the complainant, the date and time of the complaint, the nature/description of the noise source, a description of the remediation attempt or the reason remediation could not be attempted.

The above report presents a noise assessment study for the planned “Montecito” single-family development along Diana Avenue in Morgan Hill. The study findings for present conditions are based on field measurements and other data and are correct to the best of our knowledge. Future noise exposures were based on information provided by CalTrans. However, significant deviations in the future traffic volumes, or changes in motor vehicle technology, speed limits, noise regulations, or other future changes beyond our control may produce long-range noise results different from our estimates.

If you need any additional information 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

Attachment: Appendices A, B and C

APPENDIX A

References:

- (a) Site Development Plan, “Montecito”, by MH Engineering, February 2019
- (b) City of Morgan Hill General Plan, Health and Safety Element, “Noise”, July 2001
- (c) City of Morgan Hill Code of Ordinances, Title 8 – Health and Safety, Chapter 8.28 –Noise, Subsection 8.28.040 – Enumeration of unlawful noises, March 28, 2019.
- (d) Federal Transit Administration, Transit Noise and Vibration Impact Assessment Manual, FTA Report No. 0123, by John A Volpe National Transportation Systems Center, September 2018
- (e) State of California Department of Transportation, Division of Traffic Operations, <http://www.dot.ca.gov/trafficops/census/volumes2017/Route101.html>
- (f) 1997 Traffic Volumes on California State Highways, State of California Department of Transportation, Division of Traffic Operations, June 1998
- (g) Highway Research Board, “Highway Noise – A Design Guide for Highway Engineers”, Report 117, 1971

APPENDIX B

Noise Standards, Terminology, Instrumentation and General Building Shell Controls

1. Noise Standards

A. City of Morgan Hill Noise Element Standards

The Public Health and Safety (Noise) Element of the City of Morgan Hill General Plan, adopted July, 2001, contains land use compatibility standards for various land uses.

The maximum exterior noise level of 60 dBA L_{dn} shall be applied in residential areas where outdoor use is a major consideration (e.g., backyards in single family housing developments and recreation areas in multi-family housing projects). Where the City determines that providing an L_{dn} of 60 dBA or lower cannot be achieved after the application of reasonable and feasible mitigation, an L_{dn} of 65 dBA maybe permitted.

- *Indoor noise levels should not exceed an L_{dn} of 45 dBA in new residential housing units.*

- *Noise levels in new residential development exposed to an exterior L_{dn} of 60 dBA or greater should be limited to a maximum instantaneous noise level(e.g., trucks on busy streets, train warning whistles) in bedrooms of 50dBA. Maximum instantaneous noise levels in all other habitable rooms should not exceed 55 dBA.*

The maximum outdoor noise level for new residences near the railroad shall be 70 dBA L_{dn} , recognizing that train noise is characterized by relatively few loud events.

The Noise Element references the Land Use Compatibility chart from the State of California Guidelines for the Preparation of a Noise Element. The “Normally Acceptable” standards for the land use categories are as follows:

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 the "mean" 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 sub-periods 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 dBA 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:

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

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 sound analyzer listed below. The instrumentation provides a direct readout of the L exceedance statistical levels including the equivalent-energy level (L_{eq}). Input to the meters were provided by microphones extended to a height of 5 ft. above the ground. The “A” weighting network and the “Fast” response setting of the meters were used in conformance with the applicable standards. The Larson-Davis meters were factory modified to conform to the Type 1 performance standards of ANSI S1.4. All instrumentation was acoustically calibrated before and after field tests to assure accuracy.

Bruel & Kjaer 2231 Precision Integrating Sound Level Meter

Larson Davis LDL 812 Precision Integrating Sound Level Meter

Larson Davis 2900 Real Time Analyzer

Larson Davis 831 Precision Integrating Sound Level Meter

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 devices shall not compromise the acoustical integrity of the building shell.

APPENDIX C

On-Site Noise Measurement Data and Calculation Tables

DNL CALCULATIONS

CLIENT: CITY OF MORGAN HILL
 FILE: 51-017
 PROJECT: MONTECITO
 DATE: APRIL 16-17/2019
 SOURCE: DIANA AVE., HIGHWAY 101

LOCATION 1 Diana Ave. Dist. To Source 33 ft.			
TIME	Leq	10 ⁿ Leq/10	
7:00 AM	58.0	630957.3	
8:00 AM	58.6	724436.0	
9:00 AM	58.4	691831.0	
10:00 AM	58.2	660693.4	
11:00 AM	58.2	660693.4	
12:00 PM	56.8	478630.1	
1:00 PM	60.2	1047128.5	
2:00 PM	60.1	1023293.0	
3:00 PM	59.6	918332.6	
4:00 PM	58.4	691831.0	
5:00 PM	61.2	1318256.7	
6:00 PM	58.8	758577.6	
7:00 PM	61.4	1380384.3	
8:00 PM	56.8	478630.1	
9:00 PM	56.0	398107.2	SUM= 11861782.2
10:00 PM	53.8	239883.3	Ld= 70.7
11:00 PM	51.6	144544.0	
12:00 AM	47.7	58884.4	
1:00 AM	47.6	57544.0	
2:00 AM	46.9	48977.9	
3:00 AM	48.1	64565.4	
4:00 AM	50.0	100000.0	
5:00 AM	54.1	257039.6	
6:00 AM	54.7	295120.9	SUM= 1266559.4
		Ln=	61.0
	Daytime Level=	70.7	
	Nighttime Level=	71.0	
	DNL=	60	
	24-Hour Leq=	57.4	

LOCATION 2 Northeast Area of Site, East PL Dist. To Source 1,320 ft.			
TIME	Leq	10 ⁿ Leq/10	
7:00 AM	49.1	81283.1	
8:00 AM	50.4	109647.8	
9:00 AM	50.1	102329.3	
10:00 AM	48.4	69183.1	
11:00 AM	48.8	75857.8	
12:00 PM	49.6	91833.3	
1:00 PM	49.6	91201.1	
2:00 PM	50.9	123026.9	
3:00 PM	52.2	165958.7	
4:00 PM	53.4	218776.2	
5:00 PM	53.7	234422.9	
6:00 PM	54.5	281838.3	
7:00 PM	55.5	354813.4	
8:00 PM	54.0	251188.6	
9:00 PM	52.2	165958.7	SUM= 2417319.0
10:00 PM	50.0	100000.0	Ld= 63.8
11:00 PM	48.8	75857.8	
12:00 AM	45.1	32359.4	
1:00 AM	47.6	57544.0	
2:00 AM	43.9	24547.1	
3:00 AM	48.0	63095.7	
4:00 AM	48.8	75857.8	
5:00 AM	49.6	91201.1	
6:00 AM	55.1	323593.7	SUM= 844056.4
		Ln=	59.3
	Daytime Level=	63.8	
	Nighttime Level=	69.3	
	DNL=	57	
	24-Hour Leq=	51.3	