Attachment 2

# Revised Environmental Noise Assessment

# Stoddard Lane Lot Split Project

City of Citrus Heights, California

Job # 2013-191

Prepared For:

**Altus Hybrid Growth Fund, LP**

PO Box 6787
Santa Rosa, California 95406

Attn: Ms. Ali Negus

Prepared By:


**j.c. brennan & associates, Inc.**

Luke Saxelby, INCE Bd. Cert.
Senior Consultant


June 5, 2015

j.c. brennan & associates
consultants in acoustics


P.O. Box 6748 -1287 High Street - Auburn, California 95603 -p: (530) 823-0960 -f: (530) 823-0961


PM 13-02

## INTRODUCTION

The Stoddard Lane Lot Split project consists of dividing an existing residential parcels to create a total of two residential parcels. The project is located adjacent to Sylvan Road, south of Stoddard Lane in the City of Citrus Heights, California.

Figure 1 shows an aerial photo of the project site. Figure 2 shows the project site plan.

The purpose of this study is to determine whether noise levels from the adjacent Sylvan Road could exceed the City of Citrus Heights exterior or interior noise level standards at the proposed residential lots. Predicted noise levels will be compared to the noise level standards of the City of Citrus Heights General Plan Noise Element. If necessary, noise control measures will be recommended for the proposed project.

**Figure 1**
Stoddard Lane Lot Split – City of Citrus Heights, California
Project Site and Noise Measurement Location

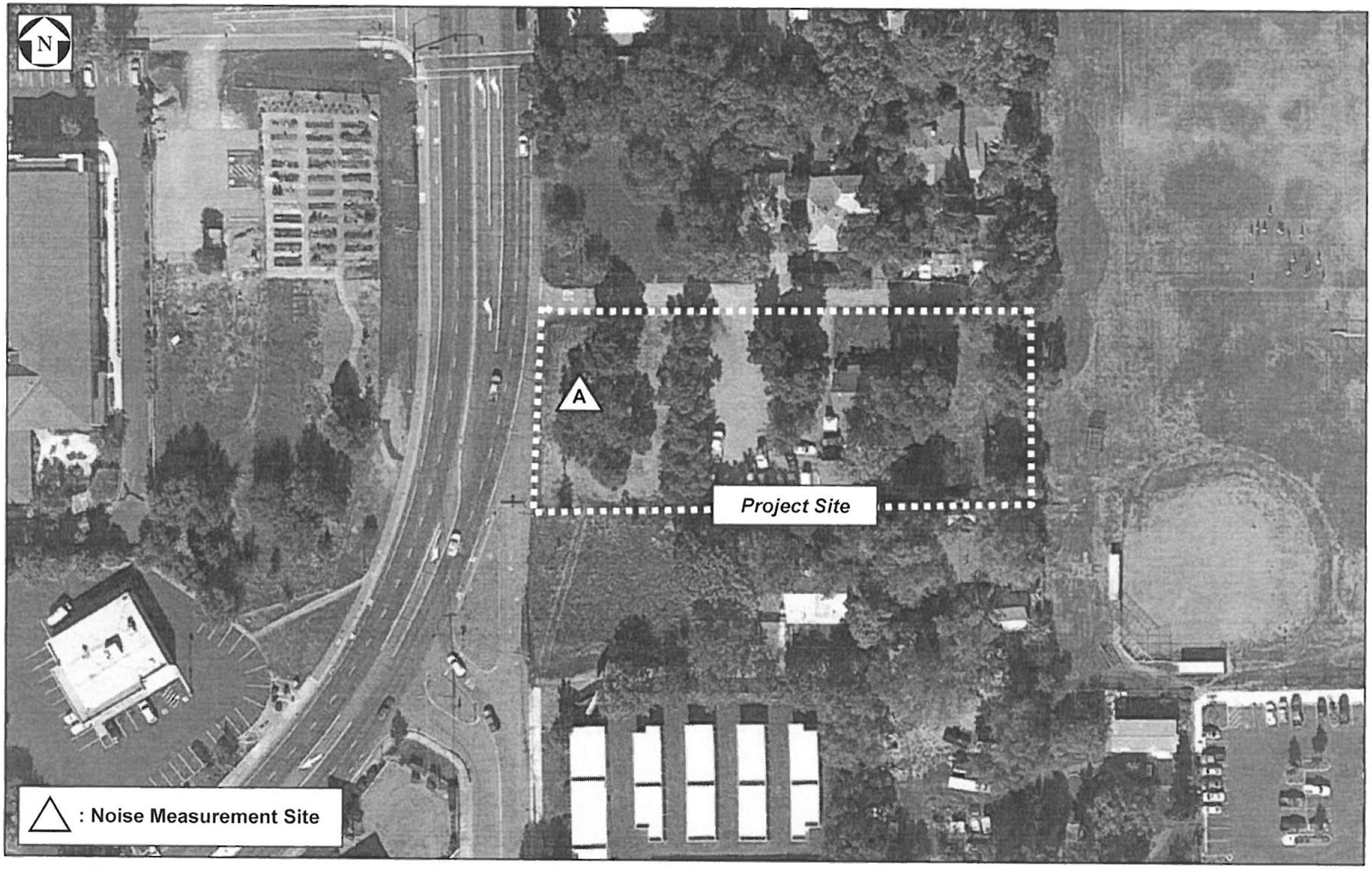


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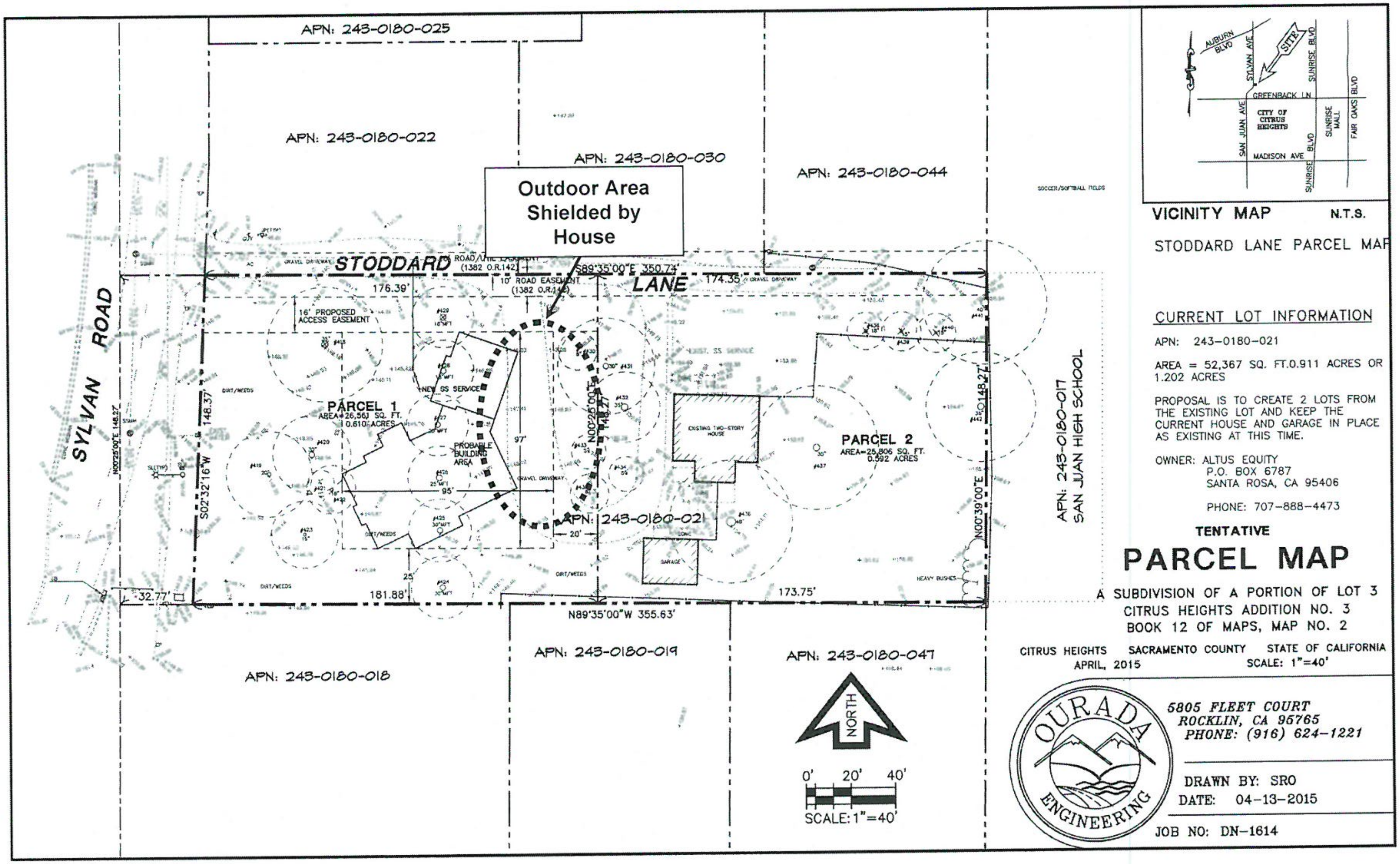
**Figure 2**

Stoddard Lane Lot Split – City of Citrus Heights, California

Project Site Plan

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## ENVIRONMENTAL SETTING

### *Fundamentals of Acoustics*

Acoustics is the science of sound. Sound may be thought of as mechanical energy of a vibrating object transmitted by pressure waves through a medium to human (or animal) ears. If the pressure variations occur frequently enough (at least 20 times per second), then they can be heard and are called sound. The number of pressure variations per second is called the frequency of sound, and is expressed as cycles per second or Hertz (Hz).

Noise is a subjective reaction to different types of sounds. Noise is typically defined as (airborne) sound that is loud, unpleasant, unexpected or undesired, and may therefore be classified as a more specific group of sounds. Perceptions of sound and noise are highly subjective from person to person.

Measuring sound directly in terms of pressure would require a very large and awkward range of numbers. To avoid this, the decibel scale was devised. The decibel scale uses the hearing threshold (20 micropascals), as a point of reference, defined as 0 dB. Other sound pressures are then compared to this reference pressure, and the logarithm is taken to keep the numbers in a practical range. The decibel scale allows a million-fold increase in pressure to be expressed as 120 dB, and changes in levels (dB) correspond closely to human perception of relative loudness.

The perceived loudness of sounds is dependent upon many factors, including sound pressure level and frequency content. However, within the usual range of environmental noise levels, perception of loudness is relatively predictable, and can be approximated by A-weighted sound levels. There is a strong correlation between A-weighted sound levels (expressed as dBA) and the way the human ear perceives sound. For this reason, the A-weighted sound level has become the standard tool of environmental noise assessment. All noise levels reported in this section are in terms of A-weighted levels, unless otherwise noted.

The decibel scale is logarithmic, not linear. In other words, two sound levels 10 dB apart differ in acoustic energy by a factor of 10. When the standard logarithmic decibel is A-weighted, an increase of 10 dBA is generally perceived as a doubling in loudness. For example, a 70 dBA sound is half as loud as an 80 dBA sound, and twice as loud as a 60 dBA sound.

Community noise is commonly described in terms of the ambient noise level, which is defined as the all-encompassing noise level associated with a given environment. A common statistical tool is the average, or equivalent, sound level ($L_{eq}$), which corresponds to a steady-state A weighted sound level containing the same total energy as a time varying signal over a given time period (usually one hour). The $L_{eq}$ is the foundation of the composite noise descriptor, $L_{dn}$, and shows very good correlation with community response to noise.

The day/night average level ($L_{dn}$) is based upon the average noise level over a 24-hour day, with a +10 decibel weighing applied to noise occurring during nighttime (10:00 p.m. to 7:00 a.m.) hours. The nighttime penalty is based upon the assumption that people react to nighttime noise exposures as though they were twice as loud as daytime exposures. Because $L_{dn}$ represents a 24-hour average, it tends to disguise short-term variations in the noise environment.

Table 1 lists several examples of the noise levels associated with common situations. Appendix A provides a summary of acoustical terms used in this report.

**TABLE 1**
**TYPICAL NOISE LEVELS**

| Common Outdoor Activities | Noise Level (dBA) | Common Indoor Activities |
|---|---|---|
| | --110-- | Rock Band |
| Jet Fly-over at 300 m (1,000 ft) | --100-- | |
| Gas Lawn Mower at 1 m (3 ft) | --90-- | |
| Diesel Truck at 15 m (50 ft), at 80 km/hr (50 mph) | --80-- | Food Blender at 1 m (3 ft)<br>Garbage Disposal at 1 m (3 ft) |
| Noisy Urban Area, Daytime<br>Gas Lawn Mower, 30 m (100 ft) | --70-- | Vacuum Cleaner at 3 m (10 ft) |
| Commercial Area<br>Heavy Traffic at 90 m (300 ft) | --60-- | Normal Speech at 1 m (3 ft) |
| Quiet Urban Daytime | --50-- | Large Business Office<br>Dishwasher in Next Room |
| Quiet Urban Nighttime | --40-- | Theater, Large Conference Room (Background) |
| Quiet Suburban Nighttime | --30-- | Library |
| Quiet Rural Nighttime | --20-- | Bedroom at Night, Concert Hall (Background) |
| | --10-- | Broadcast/Recording Studio |
| Lowest Threshold of Human Hearing | --0-- | Lowest Threshold of Human Hearing |

Source: Caltrans, Technical Noise Supplement, Traffic Noise Analysis Protocol. November, 2009.

### *Effects of Noise on People*

The effects of noise on people can be placed in three categories:

- Subjective effects of annoyance, nuisance, and dissatisfaction
- Interference with activities such as speech, sleep, and learning
- Physiological effects such as hearing loss or sudden startling

Environmental noise typically produces effects in the first two categories. Workers in industrial plants can experience noise in the last category. There is no completely satisfactory way to measure the subjective effects of noise or the corresponding reactions of annoyance and dissatisfaction. A wide variation in individual thresholds of annoyance exists and different tolerances to noise tend to develop based on an individual's past experiences with noise.

Thus, an important way of predicting a human reaction to a new noise environment is the way it compares to the existing environment to which one has adapted: the so-called ambient noise level. In general, the more a new noise exceeds the previously existing ambient noise level, the less acceptable the new noise will be judged by those hearing it.

With regard to increases in A-weighted noise level, the following relationships occur:

- Except in carefully controlled laboratory experiments, a change of 1 dBA cannot be perceived;
- Outside of the laboratory, a 3 dBA change is considered a just-perceivable difference;
- A change in level of at least 5 dBA is required before any noticeable change in human response would be expected; and
- A 10 dBA change is subjectively heard as approximately a doubling in loudness, and can cause an adverse response.

Stationary point sources of noise – including stationary mobile sources such as idling vehicles – attenuate (lessen) at a rate of approximately 6 dB per doubling of distance from the source, depending on environmental conditions (i.e. atmospheric conditions and either vegetative or manufactured noise barriers, etc.). Widely distributed noises, such as a large industrial facility spread over many acres, or a street with moving vehicles, would typically attenuate at a lower rate.

## REGULATORY CONTEXT

### FEDERAL

There are no federal regulations related to noise that apply to the Proposed Project.

### STATE

There are no state regulations related to noise that apply to the Proposed Project.

### LOCAL

***City of Citrus Heights General Plan Noise Element***

**Goal 51:** Protect City residents from the harmful and annoying effects of exposure to excessive noise through noise reduction and suppression techniques and appropriate land use policies

**Policies:**

**51.1** Review proposed development projects for compliance with the standards in Table 10 (Figure 3 of this report): Acceptable Noise Levels. If it appears that a project may exceed the limits of Table 10 (Figure 3 of this report), require an acoustical analysis to identify potential noise levels and attenuation methods.

**51.2** New residential development projects shall be designed and constructed to meet acceptable exterior noise level standards shown in Table 10 (Figure 3 of this report), as follows:

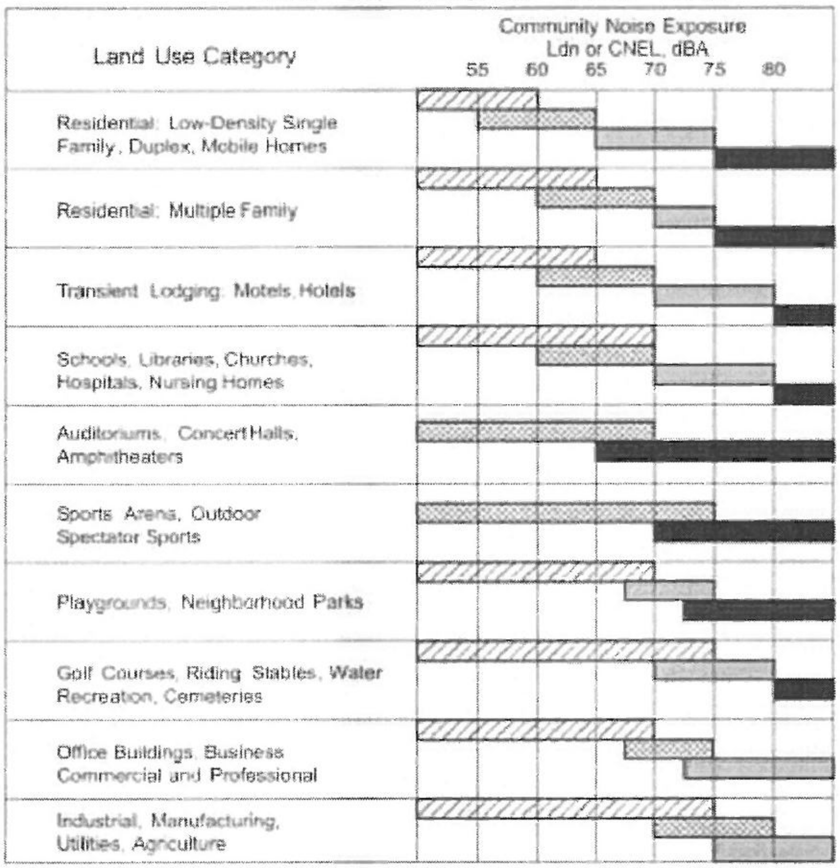
- The maximum exterior noise level of 60 dBA $L_{dn}$ shall be applied in residential areas where outdoor use is a major consideration (such as backyards in single family housing developments and recreation areas in multi-family housing projects). Where the City determines that providing a $L_{dn}$ of 60 dBA or lower is not feasible, the noise level in outdoor areas shall be reduced to as close to the standard as feasible through project design.

- Indoor noise levels shall not exceed a $L_{dn}$ 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 shall be limited to a maximum instantaneous noise level (e.g., trucks on busy streets, train warning whistles) in bedrooms of 50 dBA. Maximum instantaneous noise levels in all other habitable rooms shall not exceed 55 dBA.

## Figure 3
Acceptable Noise Levels
Table 10 of the City of Citrus Heights General Plan Noise Element

**Table 10. Acceptable Noise Levels**




INTERPRETATION

NORMALLY ACCEPTABLE

Specified land use is satisfactory, based upon the assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements.

CONDITIONALLY ACCEPTABLE

New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning will normally suffice.

NORMALLY UNACCEPTABLE

New construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise insulation features included in the design.

CLEARLY UNACCEPTABLE

New construction or development should generally not be undertaken.

Adapted from: Office of Planning and Research, State of California General Plan Guidelines, Appendix A: Guidelines for the Preparation and Content of the Noise Element of the General Plan, 1990.

## EVALUATION OF FUTURE TRAFFIC NOISE LEVELS AT THE PROJECT SITE

### Traffic Noise Prediction Methodology

j.c. brennan & associates, Inc., utilizes the Federal Highway Administration (FHWA) Highway Traffic Noise Prediction Model (FHWA RD-77-108) for the prediction of traffic noise levels. The model is based upon the CALVENO noise emission factors for automobiles, medium trucks and heavy trucks, with consideration given to vehicle volume, speed, roadway configuration, distance to the receiver, and the acoustical characteristics of the site.

On October 17, 2013 j.c. brennan & associates, Inc. j.c. brennan & associates, Inc., staff conducted short-term noise level measurements and concurrent counts of traffic on Sylvan Road at the project site. The purpose of the short-term traffic noise level measurements is to determine the accuracy of the FHWA model in describing the existing noise environment on the project site, while accounting for shielding from existing intervening structures, actual travel speeds, and roadway grade. Noise measurement results were compared to the FHWA model results by entering the observed traffic volume, speed, and distance as inputs to the FHWA model. See Figure 1 for noise measurement locations.

Instrumentation used for the measurement was a Larson Davis Laboratories (LDL) Model 820 precision integrating sound level meter which was calibrated in the field before use with an LDL CAL200 acoustical calibrator. A complete listing of FHWA Model inputs and results are shown in Appendix B. Table 2 shows the results of the traffic noise calibration.

**TABLE 2**
**COMPARISON OF FHWA MODEL TO MEASURED TRAFFIC**

| Vehicles | | | | Speed (mph) | Dist. (Feet)* | Measured Leq, dB | Modeled Leq, dB** | Difference |
|---|---|---|---|---|---|---|---|---|
| Site | Autos | Med. Trk. | Hvy.Trk. | | | | | |
| ***Sylvan Road*** | | | | | | | | |
| 1 | 209 | 3 | 2 | 45 | 100 | 64.6 | 63.7 | -0.9 dB |

*The noise measurement location is from the roadway centerline.
**Acoustically "soft" site assumed

Based upon the calibration results, the FHWA Model was found to accurately-predict Sylvan Road traffic noise levels within 1 dB at the proposed single family residential lot nearest to the roadway. Therefore, no offsets were added to the FHWA model for predicted future traffic noise levels.

## Future Traffic Noise Levels

To determine the future traffic noise levels on the project site, j.c. brennan & associates, Inc., utilized 2035 traffic predictions from the City of Citrus Heights General Plan Update FEIR (Table 4.2-10).

Table 3 shows the predicted future traffic noise levels at the proposed residential Lot closest to Sylvan Road. A complete listing of the FHWA Traffic Noise Prediction Model inputs is provided in Appendix C.

**TABLE 3**
**PREDICTED FUTURE TRAFFIC NOISE LEVELS**

| Location | Distance | Predicted Traffic Noise Levels, $L_{dn}$ |
|---|---|---|
| ***Sylvan Road – Greenback Ln. to Auburn Blvd. ADT - 31,400*** | | |
| Lot 1 Backyard | 200 (Assumes backyards shielded by house) | 58 dB |
| Lot 1 – 1st Floor Facade | 125 | 67 dB |
| Lot 1 – 2nd Floor Facade | 125 | 70 dB |
| Sources: j.c. brennan & associates, Inc., Citrus Heights GP Update FEIR, and FHWA RD-77-108 | | |

Based upon the predicted future traffic noise levels shown in Table 3, the residential lot located adjacent to Sylvan Road will be exposed to future traffic noise levels that comply the City of Citrus Heights General Plan exterior noise level standard of 60 dB $L_{dn}$. It should be noted that this conclusion assumes that the backyard (outdoor activity area) would be shielded by the residential building in a manner similar to that shown on Figure 2.

## Interior Traffic Noise Levels:

Standard construction practices, consistent with the uniform building code typically provides an exterior-to-interior noise level reduction of approximately 25 dB, assuming that air conditioning is included for each unit, which allows residents to close windows for the required acoustical isolation. Therefore, as long as exterior noise levels at the building facades do not exceed 70 dB $L_{dn}$, the interior noise levels will typically comply with the interior noise level standard of 45 dB $L_{dn}$.

First floor noise exposure at Lot 1 is predicted to be 67 dB Ldn and the second floor façade is predicted to be 70 dB $L_{dn}$, as shown in Table 3. Based upon a typical exterior-to-interior noise level reduction of 25 dB, interior noise levels are predicted to be 45 dB $L_{dn}$, with windows closed. This would comply with the City standard of 45 dB $L_{dn}$. Therefore, no additional interior noise reduction measures would be required, assuming that mechanical ventilation would allow for windows to remain closed for acoustic isolation.

## CONCLUSIONS

The proposed project is predicted to be exposed to transportation noise levels in compliance with the City of Citrus Heights exterior and interior noise level standards, assuming the following:

- The backyard (outdoor recreation area) is shielded by the residential structure, similar to that shown on Figure 2.
- Mechanical ventilation should be included to allow occupants to close doors and windows as desired for acoustical isolation.

# Appendix A
## Acoustical Terminology

| | |
|---|---|
| **Acoustics** | The science of sound. |
| **Ambient Noise** | The distinctive acoustical characteristics of a given space consisting of all noise sources audible at that location. In many cases, the term ambient is used to describe an existing or pre-project condition such as the setting in an environmental noise study. |
| **Attenuation** | The reduction of an acoustic signal. |
| **A-Weighting** | A frequency-response adjustment of a sound level meter that conditions the output signal to approximate human response. |
| **Decibel or dB** | Fundamental unit of sound, A Bell is defined as the logarithm of the ratio of the sound pressure squared over the reference pressure squared. A Decibel is one-tenth of a Bell. |
| **CNEL** | Community Noise Equivalent Level. Defined as the 24-hour average noise level with noise occurring during evening hours (7 - 10 p.m.) weighted by a factor of three and nighttime hours weighted by a factor of 10 prior to averaging. |
| **Frequency** | The measure of the rapidity of alterations of a periodic signal, expressed in cycles per second or hertz (Hz). |
| **$L_{dn}$** | Day/Night Average Sound Level. Similar to CNEL but with no evening weighting. |
| **Leq** | Equivalent or energy-averaged sound level. |
| **$L_{max}$** | The highest root-mean-square (RMS) sound level measured over a given period of time. |
| **$L_{(n)}$** | The sound level exceeded a described percentile over a measurement period. For instance, an hourly $L_{50}$ is the sound level exceeded 50% of the time during the one hour period. |
| **Loudness** | A subjective term for the sensation of the magnitude of sound. |
| **Noise** | Unwanted sound. |
| **NRC** | Noise Reduction Coefficient. NRC is a single-number rating of the sound-absorption of a material equal to the arithmetic mean of the sound-absorption coefficients in the 250, 500, 1000, and 2,000 Hz octave frequency bands rounded to the nearest multiple of 0.05. It is a representation of the amount of sound energy absorbed upon striking a particular surface. An NRC of 0 indicates perfect reflection; an NRC of 1 indicates perfect absorption. |
| **Peak Noise** | The level corresponding to the highest (not RMS) sound pressure measured over a given period of time. This term is often confused with the "Maximum" level, which is the highest RMS level. |
| **$RT_{60}$** | The time it takes reverberant sound to decay by 60 dB once the source has been removed. |
| **Sabin** | The unit of sound absorption. One square foot of material absorbing 100% of incident sound has an absorption of 1 Sabin. |
| **SEL** | Sound Exposure Level. SEL is s rating, in decibels, of a discrete event, such as an aircraft flyover or train passby, that compresses the total sound energy into a one-second event. |
| **STC** | Sound Transmission Class. STC is an integer rating of how well a building partition attenuates airborne sound. It is widely used to rate interior partitions, ceilings/floors, doors, windows and exterior wall configurations. |
| **Threshold of Hearing** | The lowest sound that can be perceived by the human auditory system, generally considered to be 0 dB for persons with perfect hearing. |
| **Threshold of Pain** | Approximately 120 dB above the threshold of hearing. |
| **Impulsive** | Sound of short duration, usually less than one second, with an abrupt onset and rapid decay. |
| **Simple Tone** | Any sound which can be judged as audible as a single pitch or set of single pitches. |

Appendix B

# FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)
## Calibration Worksheet

| | | |
|---|---|---|
| **Project Information:** | Job Number: | 2013-191 |
| | Project Name: | Stoddard Lane Lot Split |
| | Roadway Tested: | Sylvan Road |
| | Test Location: | 1 |
| | Test Date: | October 17, 2013 |
| **Weather Conditions:** | Temperature (Fahrenheit): | 50 |
| | Relative Humidity: | Moderate |
| | Wind Speed and Direction: | Calm |
| | Cloud Cover: | Clear |
| **Sound Level Meter:** | Sound Level Meter: | LDL Model 820 |
| | Calibrator: | LDL Model CAL200 |
| | Meter Calibrated: | Immediately before and after test |
| | Meter Settings: | A-weighted, slow response |
| **Microphone:** | Microphone Location: | On Project Site |
| | Distance to Centerline (feet): | 100 |
| | Microphone Height: | 5 feet above ground |
| | Intervening Ground (Hard or Soft): | **Soft** |
| | Elevation Relative to Road (feet): | 5 |
| **Roadway Condition:** | Pavement Type | AC |
| | Pavement Condition: | Good |
| | Number of Lanes: | 4 |
| | Posted Maximum Speed (mph): | 40 |
| **Test Parameters:** | Test Time: | 8:28 AM |
| | Test Duration (minutes): | 10 |
| | Observed Number Automobiles: | 209 |
| | Observed Number Medium Trucks: | 3 |
| | Observed Number Heavy Trucks: | 2 |
| | Observed Average Speed (mph): | 45 |
| **Model Calibration:** | Measured Average Level ($L_{eq}$): | 64.6 |
| | Level Predicted by FHWA Model: | 63.7 |
| | ***Difference:*** | ***-0.9 dB*** |

**Conclusions:**

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Appendix C

# FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)
## Noise Prediction Worksheet

**Project Information:**

| | |
|---|---|
| Job Number: | 2013-191 |
| Project Name: | Stoddard Lane Lot Split |
| Roadway Name: | Sylvan Road |

**Traffic Data:**

| | |
|---|---|
| Year: | Future |
| Average Daily Traffic Volume: | 31,400 |
| Percent Daytime Traffic: | 83 |
| Percent Nighttime Traffic: | 17 |
| Percent Medium Trucks (2 axle): | 2 |
| Percent Heavy Trucks (3+ axle): | 1 |
| Assumed Vehicle Speed (mph): | 45 |
| Intervening Ground Type (hard/soft): | **Soft** |

**Traffic Noise Levels:**

| | | | | $L_{dn}$, dB | | | |
|---|---|---|---|---|---|---|---|
| **Location:** | **Description** | **Distance** | **Offset (dB)** | **Autos** | **Medium Trucks** | **Heavy Trucks** | **Total** |
| 1 | Lot 1 Backyard | 200 | -5 | 57 | 49 | 50 | 58 |
| 2 | Lot 1 - First Floor Façade | 125 | 0 | 65 | 57 | 58 | 67 |
| 3 | Lot 1 - Second Floor Façade | 125 | 3 | 68 | 60 | 61 | 70 |

**Traffic Noise Contours (No Calibration Offset):**

| $L_{dn}$ Contour, dB | Distance from Centerline, (ft) |
|---|---|
| 75 | 34 |
| 70 | 74 |
| 65 | 159 |
| 60 | 342 |

**Notes:**

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