# *ENVIRONMENTAL NOISE ASSESSMENT*
# *RESIDENTIAL DEVELOPMENT AT CORONA STATION*
# *NORTH MC DOWELL AT CORONA ROAD*
# *PETALUMA, CALIFORNIA*

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# INTRODUCTION AND SUMMARY

This report presents the results of an environmental noise assessment completed for the proposed residential development at Corona Station located south of the SMART rail tracks at the northeast corner of North Mc Dowell Blvd and Corona Road (see Figure 1). The purpose for this noise assessment is to evaluate the compatibility of the development with respect to the environmental noise levels at the project site and evaluate noise impacts upon sensitive receptors in the area. The Setting Section of this report presents the fundamentals of environmental noise and vibration, describes regulatory criteria that are applicable in the project's assessment, and summarizes the results of a survey of the existing noise environment at the project site and vicinity.

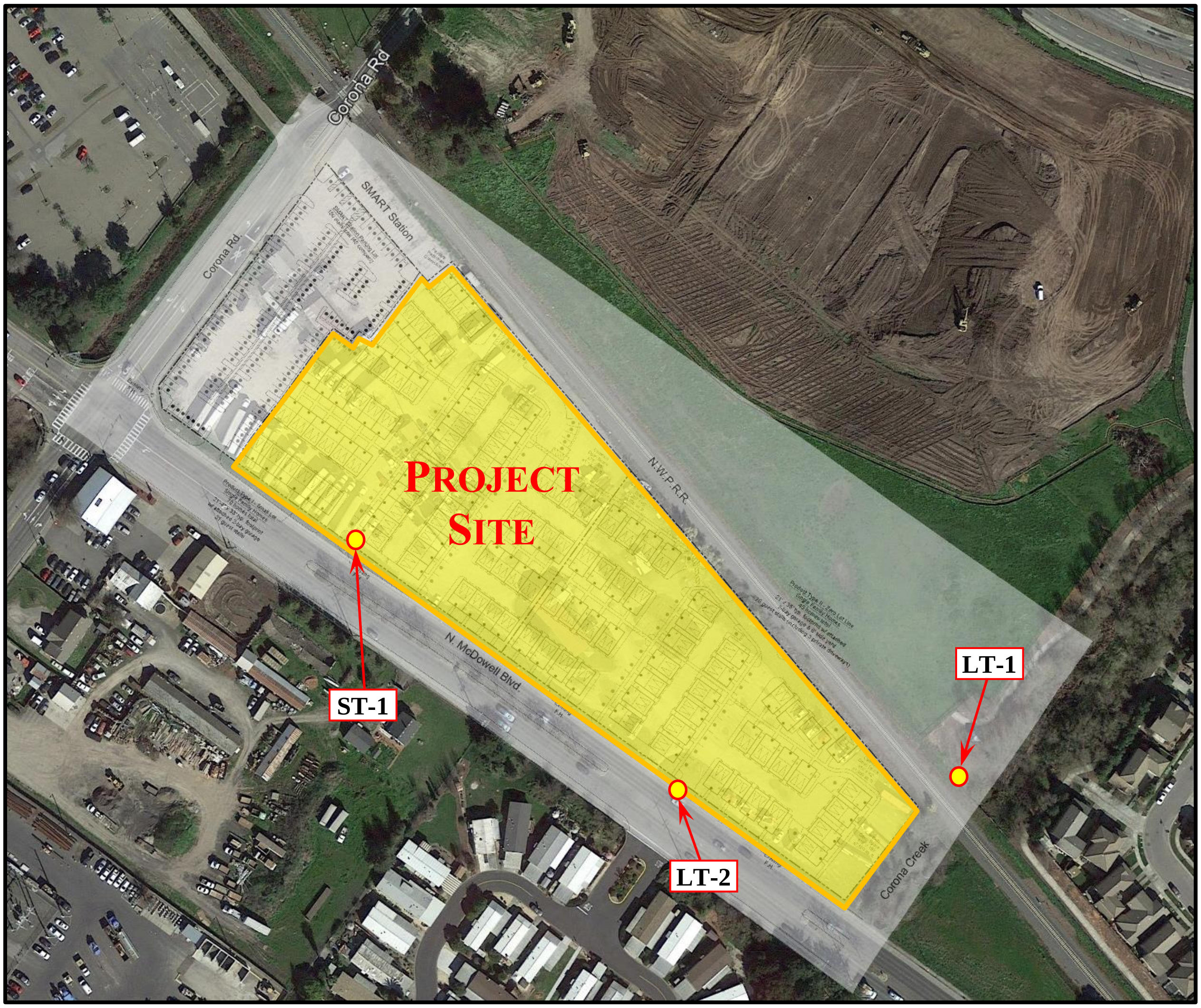



**Figure 1: Project Site, Vicinity and Noise Measurement Locations**

The Impacts and Mitigation Measures Section describes the significance criteria used to evaluate project impacts, provides a discussion of each project impact, and presents mitigation measures, where necessary, allow the development to be compatible with surrounding land uses and to comply with applicable regulatory criteria.

# SETTING

## FUNDAMENTALS OF ENVIRONMENTAL ACOUSTICS

Noise may be defined as unwanted sound. Noise is usually objectionable because it is disturbing or annoying. The objectionable nature of sound could be caused by its *pitch* or its loudness. *Pitch* is the height or depth of a tone or sound, depending on the relative rapidity (frequency) of the vibrations by which it is produced. Higher pitched signals sound louder to humans than sounds with a lower pitch. *Loudness* is intensity of sound waves combined with the reception characteristics of the ear. Intensity may be compared with the height of an ocean wave in that it is a measure of the amplitude of the sound wave.

In addition to the concepts of pitch and loudness, there are several noise measurement scales, which are used to describe noise in a particular location. *A decibel (dB)* is a unit of measurement, which indicates the relative amplitude of a sound. The zero on the decibel scale is based on the lowest sound level that the healthy, unimpaired human ear can detect. Sound levels in decibels are calculated on a logarithmic basis. An increase of 10 decibels represents a ten-fold increase in acoustic energy, while 20 decibels is 100 times more intense, 30 decibels is 1,000 times more intense, etc. There is a relationship between the subjective noisiness or loudness of a sound and its intensity. Each 10-decibel increase in sound level is perceived as approximately a doubling of loudness over a fairly wide range of intensities. Technical terms are defined in Table 1.

There are several methods of characterizing sound. The most common in California is the *A-weighted sound level or dBA.* This scale gives greater weight to the frequencies of sound to which the human ear is most sensitive. Representative outdoor and indoor noise levels in units of dBA are shown in Table 2.

Because sound levels can vary markedly over a short period of time, a method for describing either the average character of the sound or the statistical behavior of the variations must be utilized. Most commonly, environmental sounds are described in terms of an average level that has the same acoustical energy as the summation of all the time-varying events. This energy-equivalent sound/noise descriptor is called $L_{eq}$. The most common averaging period is hourly, but $L_{eq}$ can describe any series of noise events of arbitrary duration.

The scientific instrument used to measure noise is the sound level meter. Sound level meters can accurately measure environmental noise levels to within about plus or minus 1 dBA. Various computer models are used to predict environmental noise levels from sources, such as roadways and airports. The accuracy of the predicted models depends upon the distance the receptor is from the noise source. Close to the noise source, the models are accurate to within about plus or minus 1 to 2 dBA.

Since the sensitivity to noise increases during the evening and at night -- because excessive noise interferes with the ability to sleep -- 24-hour descriptors have been developed that incorporate artificial noise penalties added to quiet-time noise events. The *Community Noise Equivalent Level, CNEL,* is a measure of the cumulative noise exposure in a community, with a 5 dB penalty added to evening (7:00 pm - 10:00 pm) and a 10 dB addition to nocturnal (10:00 pm - 7:00 am) noise levels. The *Day/Night Average Sound Level, DNL or* $L_{dn}$, is essentially the same as CNEL, with the exception that the evening time period is dropped and all occurrences during this three-hour period are grouped into the daytime period.

**TABLE 1: Definitions of Acoustical Terms Used in this Report**

| Term | Definitions |
|---|---|
| Decibel, dB | A unit describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure. The reference pressure for air is 20. |
| Sound Pressure Level | Sound pressure is the sound force per unit area, usually expressed in micro Pascals (or 20 micro Newtons per square meter), where 1 Pascal is the pressure resulting from a force of 1 Newton exerted over an area of 1 square meter. The sound pressure level is expressed in decibels as 20 times the logarithm to the base 10 of the ratio between the pressures exerted by the sound to a reference sound pressure (e.g., 20 micro Pascals). Sound pressure level is the quantity that is directly measured by a sound level meter. |
| Frequency, Hz | The number of complete pressure fluctuations per second above and below atmospheric pressure. Normal human hearing is between 20 Hz and 20,000 Hz. Infrasonic sound are below 20 Hz and Ultrasonic sounds are above 20,000 Hz. |
| A-Weighted Sound Level, dBA | The sound pressure level in decibels as measured on a sound level meter using the A-weighting filter network. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise. |
| Equivalent Noise Level, $L_{eq}$ | The average A-weighted noise level during the measurement period. The hourly Leq used for this report is denoted as dBA $L_{eq[h]}$. |
| Day-Night Level, $L_{dn}$ | The equivalent noise level for a continuous 24-hour period with a 10-decibel penalty imposed during nighttime and morning hours (10:00 pm to 7:00 am). |
| Community Noise Exposure Level, CNEL | CNEL is the equivalent noise level for a continuous 24-hour period with a 5-decibel penalty imposed in the evening (7:00 pm to 10:00 pm) and a 10-decibel penalty imposed during nighttime and morning hours (10:00 pm to 7:00am) |
| $L_1$, $L_{10}$, $L_{50}$, $L_{90}$ | The A-weighted noise levels that are exceeded 1%, 10%, 50%, and 90% of the time during the measurement period. |
| Ambient Noise Level | The composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location. |
| Intrusive | That noise which intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, and time of occurrence and tonal or informational content as well as the prevailing ambient noise level. |

Source: Handbook of Acoustical Measurements and Noise Control, Harris, 1998.

**TABLE 2: Typical Noise Levels in the Environment**

| Common Outdoor Noise Source | Noise Level (dBA) | Common Indoor Noise Source |
|---|---|---|
| | 110 dBA | Rock band |
| Jet fly-over at 1,000 feet | | |
| | 100 dBA | |
| Gas lawn mower at 3 feet | | |
| | 90 dBA | |
| Diesel truck at 50 feet at 50 mph | | Food blender at 3 feet |
| | 80 dBA | Garbage disposal at 3 feet |
| Noisy urban area, daytime | | |
| Gas lawn mower, 100 feet | 70 dBA | Vacuum cleaner at 10 feet |
| Commercial area | | Normal speech at 3 feet |
| Heavy traffic at 300 feet | 60 dBA | |
| | | Large business office |
| Quiet urban daytime | 50 dBA | Dishwasher in next room |
| Quiet urban nighttime | 40 dBA | Theater, large conference room |
| Quiet suburban nighttime | | |
| | 30 dBA | Library |
| Quiet rural nighttime | | Bedroom at night, concert hall (background) |
| | 20 dBA | |
| | | Broadcast/recording studio |
| | 10 dBA | |
| | 0 dBA | |

Source: Technical Noise Supplement (TeNS), Caltrans, November 2009.

## FUNDAMENTALS OF GROUNDBORNE VIBRATION

Ground vibration consists of rapidly fluctuating motions or waves with an average motion of zero. Several different methods are typically used to quantify vibration amplitude. One is the Peak Particle Velocity (PPV) and another is the Root Mean Square (RMS) velocity. The PPV is defined as the maximum instantaneous positive or negative peak of the vibration wave. The RMS velocity is defined as the average of the squared amplitude of the signal. The PPV and RMS vibration velocity amplitudes are used to evaluate human response to vibration. In this section, a PPV descriptor with units of mm/sec or in/sec is used to evaluate construction generated vibration for building damage and human complaints. Table 3 displays the reactions of people and the effects on buildings that continuous vibration levels produce. The annoyance levels shown in Table 3 should be interpreted with care since vibration may be found to be annoying at much lower levels than those shown, depending on the level of activity or the sensitivity of the individual. To sensitive individuals, vibrations approaching the threshold of perception can be annoying.

Low-level vibrations frequently cause irritating secondary vibration, such as a slight rattling of windows, doors or stacked dishes. The rattling sound can give rise to exaggerated vibration complaints, even though there is very little risk of actual structural damage. In high noise environments, which are more prevalent where groundborne vibration approaches perceptible levels, this rattling phenomenon may also be produced by loud airborne environmental noise causing induced vibration in exterior doors and windows.

**TABLE 3: Reaction of People and Damage to Buildings for Continuous Vibration Levels**

| Vibration Level, PPV (in/sec) | Human Reaction | Effect on Buildings |
|---|---|---|
| 0.006 to 0.019 | Threshold of perception, Possibility of intrusion | Vibration unlikely to cause damage of any type |
| 0.08 | Vibrations readily perceptible | Recommended upper level of the vibration for ruins and ancient monuments |
| 0.10 | Level at which continuous vibrations begin to annoy people | Virtually no risk of “architectural” damage to normal buildings |
| 0.20 | Vibrations annoying to people in buildings | Threshold at which there is a risk of “architectural” damage to normal dwellings |
| 0.4 to 0.6 | Considered unpleasant by people subjected to continuous vibrations | Vibration at this level would cause “architectural” damage and possibly minor structural damage. |

Source: Transportation Related Earthborne Vibrations (Caltrans Experiences), Technical Advisory, Vibration TAV-02-01-R9601, California Department of Transportation, February 20, 2002.

Construction activities can cause vibration that varies in intensity depending on several factors. The use of pile driving and vibratory compaction equipment typically generate the highest construction related ground-borne vibration levels. Because of the impulsive nature of such activities, the use of the peak particle velocity descriptor (PPV) has been routinely used to measure and assess ground-borne vibration and almost exclusively to assess the potential of vibration to induce structural damage and the degree of annoyance for humans.

The two primary concerns with construction-induced vibration, the potential to damage a structure and the potential to interfere with the enjoyment of life are evaluated against different vibration limits. Studies have shown that the threshold of perception for average persons is in the range of 0.008 to 0.012 in/sec PPV. Human perception to vibration varies with the individual and is a function of physical setting and the type of vibration. Persons exposed to elevated ambient vibration levels such those in urban environments may tolerate a higher vibration level.

Structural damage can be classified as cosmetic only, such as minor cracking of building elements, or may threaten the integrity of the building. Safe vibration limits that can be applied to assess the potential for damaging a structure vary by researcher and there is no general consensus as to what amount of vibration may pose a threat for structural damage to the building. Construction-induced vibration that can be detrimental to the building is very rare and has only been observed in instances where the structure is at a high state of disrepair and the construction activity occurs immediately adjacent to the structure.

## REGULATORY BACKGROUND

The proposed project would be subject to noise-related regulations, plans, and policies established within documents prepared by the State of California and the City of Petaluma. These planning documents are implemented during the environmental review process to limit noise exposure at existing and proposed noise sensitive land uses. Applicable planning documents include: The California Environmental Quality Act (CEQA) Guidelines, Appendix G, and the Health and Safety Element of the Petaluma 2025 General Plan. Regulations, plans, and policies presented within these documents form the basis of the significance criteria used to assess project impacts.

### *State CEQA Guidelines.*

CEQA requires an evaluation of the significance of potential project noise impacts. Potential noise effects from a project are considered to cause a significant environmental impact if any of the following occur:

a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies;
b) Exposure of persons to or generation of excessive ground-borne vibration or ground-borne noise levels;
c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project;
d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project;
e) For a project located within an airport land use plan or where such a plan has not been adopted within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels;
f) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?

The project is located more than 2 miles of a general aviation airport, thus items e) and f ) above will not be carried forward in this analysis.

CEQA does not define what noise level increase would be considered substantial. Typically, project-generated noise level increases of 3 dBA $L_{dn}$/CNEL or greater would be considered significant where exterior noise levels would exceed the normally acceptable noise level standard. Where noise levels would remain at or below the normally acceptable noise level standard with the project, noise level increases of 5 dBA $L_{dn}$/CNEL or greater would be considered significant.

### *City of Petaluma General Plan 2025*

Section 10.2 of the City of Petaluma's Health and Safety Element includes objectives and policies applicable to the proposed residential project. The City's objective is to, "Protect public health and welfare by eliminating or minimizing the effects of existing noise problems, and by minimizing the increase of noise levels in the future." Single-family and duplex residential land uses are considered "normally acceptable" up to 60 dBA $L_{dn}$ or CNEL while multi-family residential land uses are considered "normally acceptable" up to 65 dBA $L_{dn}$ or CNEL. Single-family, duplex and multi-family residential land are all considered "conditionally acceptable" up to 70 dBA $L_{dn}$ or CNEL, "normally unacceptable" between 70 and 75 dBA $L_{dn}$ or CNEL, and "clearly unacceptable" above 75 dBA $L_{dn}$ or CNEL. The following General Plan policies are applicable to the proposed residential project.

Policy A: Continue efforts to incorporate noise considerations into land use planning decisions, and guide the locations and design of transportation facilities to minimize the effects of noise on adjacent land uses.

Policy B: Discourage location of new noise-sensitive uses, primarily homes, in areas with projected noise levels greater than 65 dBA CNEL. Where such uses are permitted, require incorporation of mitigation measures to ensure that interior noise levels do not exceed 45 dB CNEL.

Policy C: Ensure that the City's Noise Ordinance and other regulations:

- Require that applicants for new noise-sensitive development in areas subject to noise levels greater than 65 dB CNEL obtain the services of a professional acoustical engineer to provide a technical analysis and design of mitigation measures.
- Require placement of fixed equipment, such as air conditioning units and condensers, inside or in the walls of new buildings or on roof-tops of central units in order to reduce noise impacts on any nearby sensitive receptors.

Policy D: Continue to require control of noise or mitigation measures for any noise-emitting construction equipment or activity. The City's Noise Ordinance establishes controls on construction-related noise.

Policy E: As part of development review, use Figure 10-2: Land Use Compatibility Standards to determine acceptable uses and installation requirements in noise-impacted areas.

Policy F: Discourage the use of sound walls anywhere except along Highway 101 and/or along the NWPRA corridor without findings that such walls will not be detrimental to community character. When sound walls are deemed necessary, integrate them into the streetscape.

Policy G: In making a determination of impact under the California Environmental Quality Act (CEQA) consider an increase of four or more dBA to be "significant" if the resulting noise level would exceed that described as normally acceptable for the affected use in Figure 10-3: Land Use Compatibility for Community Noise Environments.

***Petaluma Noise Ordinance.***

The Noise Ordinance, in Municipal Code Section 22-301, establishes quantitative noise limits for stationary noise sources such as machinery and commercial activities to protect the public from disturbance caused by unnecessary or excessive noise. The basic noise limit is a level of 60 dBA $L_{eq}$ measured on a receiving property. Noise generating construction activities are prohibited between 10 PM and 7 AM.

***Groundborne Vibration***

The City of Petaluma has not identified quantifiable vibration limits that can be used to evaluate the compatibility of land uses with the expected vibration environment, however the Federal Transit Administration (FTA) has established vibration impact criteria to evaluate the land use compatibility along railroad lines. The FTA[1] vibration impact criteria has been developed to assess vibration impacts associated with rapid transit projects based on maximum overall levels for a single event. The criteria for groundborne vibration impact are shown in Table 4. Note that there are criteria for frequent events (more than 70 events per day), occasional (between 30 and 70 events per day) and infrequent events (less than 30 events per day).

**Table 4: Groundborne Vibration Impact Criteria**

| Land Use Category | Vibration Impact Limits (VdB re: 1 µin./sec, RMS) | | |
|---|---|---|---|
| | Frequent Events[1] | Occasional Events[2] | Infrequent Events [3] |
| **Category 1:** Buildings where low ambient is essential for interior operations | 65 VdB[4] | 65 VdB[4] | 65 VdB[4] |
| **Category 2:** Residences and buildings where people normally sleep | 72 VdB | 75 VdB | 80 VdB |
| **Category 3:** Institutional land uses with primarily daytime use | 75 VdB | 78 VdB | 83 VdB |

Notes:
1. "Frequent Events" is defined as more than 70 vibration events per day. Most rapid transit projects fall into this category.
2. "Occasional Events" is defined as between 30 and 70 vibration events of the same source per day. Most commuter trunk lines have this many operations.
3. "Infrequent Events" is defined as fewer than 30 vibration events per day. This category includes most commuter rail systems.
4. This limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes.

***Supplemental Sleep Disturbance Criteria***

Though the City, and State noise criteria are typically sufficient to achieve an acceptable interior noise environment with common environmental noise source, when dealing with loud intermittent noise sources, such as the sounding of train horns near railroad tracks, achieving a CNEL/ $L_{dn}$ of 45 dBA within homes may still result in maximum noise levels within interiors great enough to result in significant sleep disturbance. Studies have been undertaken to determine the effect of short term maximum noise levels on sleep disturbance. The conclusions of these studies typically give a probability of sleep disturbance related to the maximum noise level of the event at the sleep location and the duration of the event. A review of sleep disturbance study data shows that limiting maximum noise levels to 55 dBA within sleeping rooms will limit the probability of waking residents at the subject project when trains pass the site to less than five percent per occurrence[2]. Therefore, though this is not a City or State requirement, I&R recommends the adoption of additional interior sound level criteria limiting maximum noise levels to 55 dBA within bedrooms of the homes adjacent to rail lines. To limit annoyance and disturbance of non-sleeping residents, we recommend limiting maximum noise levels to 60 dBA in other residential living areas of these homes.

**EXISTING NOISE ENVIRONMENT**

The proposed project is located south of the North-West Pacific Railroad (NWPRR) line and northeast of the intersection of Corona Road and South McDowell Boulevard. The project site is bordered by existing residential uses across N. McDowell and to the north east across the rail line and a creek greenway. Future residential uses will also be located to the north opposite the rail line and an open space area. Other area uses are industrial and commercial in nature. The existing noise environment at the project site results primarily from vehicular traffic on South McDowell Blvd and Sonoma Marin Area Rapid Transit (SMART) railcar passbys on the BWPRR tracks to the north. Other sources of noise in the area include residential and park uses, South McDowell Blvd traffic, distant construction traffic at the future Brody Ranch residential

[1]U.S. Department of Transportation, Federal Transit Administration, Transit Noise and Vibration Impact Assessment, May 2006, FTA-VA-90-1003-06.

2 Kryter Karl D., The effects of Noise on Man, Second Edition, Academic Press, Inc. London, 1985, p.444-446

development north of the rail line, and overhead noise from general aviation aircraft using the Petaluma Airport. The SMART rail operations on the NWPRR tracks have a "quiet zone" designation such that passing rail cars do not sound there horn when passing the site.

A noise monitoring survey was conducted between 11 am on Friday July 13th, 2018 and 2 pm on Monday July 16th, 2018 to quantify the existing noise environment on the project site. The noise monitoring survey included two long-term (75-hour duration) noise measurements as indicated as LT-1, and LT-2 in Figure 1 and one short term measurement indicated as ST-1 in Figure 1. All noise measurements were conducted with Larson Davis Laboratories (LDL) Type I Model 820 Sound Level Meter fitted with a ½-inch pre-polarized condenser microphone and windscreen. The meters were calibrated with a Larson Davis Model CA250 precision acoustic calibrator prior to and following the measurement survey.

The first long-term noise measurement, LT-1, was located on the opposite side of the NWPRR tracks from the site, at a height of approximately 10 feet above ground in a tree beyond the end of a greenway path at approximately 35 feet from the NWPRR track centerline, and 250 feet from the centerline of North McDowell Blvd. This measurement served the primary purpose of documenting maximum noise levels produced by passing SMART rail trains at the closed proposed residential setback from the NWPRR line on the site. During week day periods background noise from distant earthmoving and grading activities at the future Brody Ranch residential development to the north and west. However, though sound produced by these activities was distinct and different from traffic noise produced by vehicles on North McDowell the average noise levels produced by these sources were found to be approximately equal. The measured noise levels at this location, including the energy equivalent noise level ($L_{eq}$), maximum ($L_{max}$), minimum ($L_{min}$), and the noise levels exceeded 1, 10, 50, and 90 percent of the time (indicated as $L_{01}$, $L_{10}$, $L_{50}$ and $L_{90}$) are shown on Chart 1.

A review of Chart 1 indicates that the noise levels at site LT-1 follow a diurnal pattern characteristic of traffic noise, with the average daytime noise levels ranging from 52 to 63 dBA $L_{eq}$ and the average hourly nighttime noise levels ranging from 47 to 58 dBA $L_{eq}$. The overall Community Noise Equivalent Level (CNEL) for the 75-hour measurement period at position LT-1 was 61 dBA, with the average weekday CNEL at 62 dBA and the average weekend CNEL at 60 dBA.

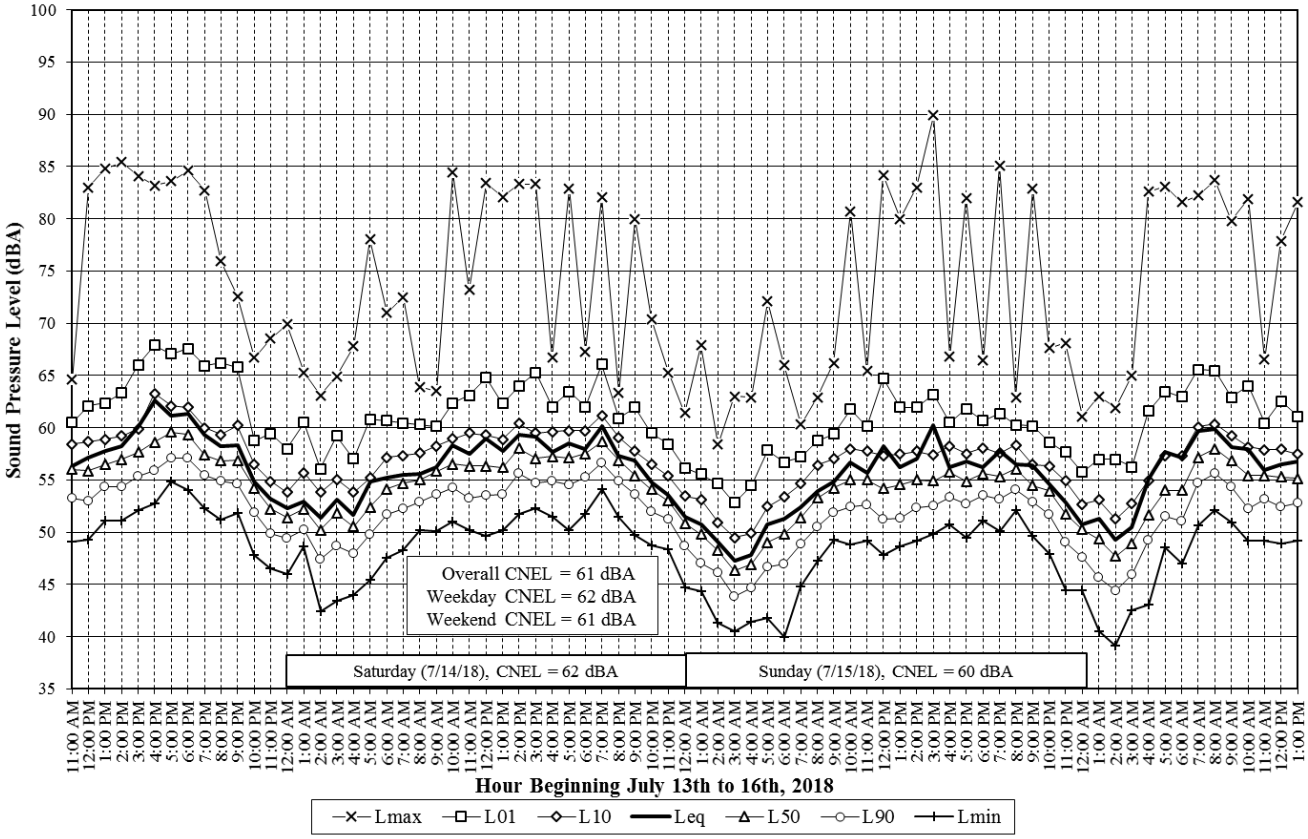
During the 75-hour measurement period 38 weekday and 20 weekend SMART rail passbys occurred[3], producing a recurring maximum noise ($L_{max30}$)[4] levels of 81 dBA for weekday passbys and $L_{max30}$ levels of 82 dBA for weekend passbys. The overall recurring $L_{max30}$ level from SMART operations over the 75-hr. measurement period was found to be 81 dBA. Calculations based the sound exposure levels (SEL)[5] produced by SMART rail car passbys and the time of day these passbys occurred indicates that the overall CNEL at the measurement site due to SMART rail passbys only was 53 dBA, with respective weekday and weekend CNEL due only to SMART rail passbys were 56 dBA and 50 dBA respectively. Considering this finding, the effective CNEL on this site due to environmental noise sources other than SMART rail operations (primarily S. McDowell Blvd. traffic) has been calculated at CNEL of 61 dBA on weekdays and a CNEL of 60 dBA on weekends.

[3] This level of activity was found to directly correlate with the weekday and weekend SMART schedule, which has 17 scheduled northbound and 17 scheduled southbound trains passing the site on weekdays between ~4:50 am and ~9:15pm and 5 scheduled northbound and 5 scheduled southbound trains passing the site on weekends between ~10:40 am and ~9:25pm.

[4] Greene, Rob, "Max Level Intrusive Noise Limit", 1982 National Conference on Environmental and Occupational Noise. The $L_{max30}$ is obtained by logarithmically averaging the loudest 30% of maximum levels of rail passbys over a given time period.

[5] The Sound exposure level (SEL) is a measure of energy that takes into account both received sound level and duration of exposure of the receiver to this level of noise

**Chart 1: Measured Noise Levels at LT-1**




The second long-term noise measurement, LT-2, was located on the project site on an existing light standard on the north side of North McDowell Blvd, at a height of approximately 12 feet above road grade and approximately 40 feet from the roadway centerline. The measured noise levels at this location, including the energy equivalent noise level ($L_{eq}$), maximum ($L_{max}$), minimum ($L_{min}$), and the noise levels exceeded 10, 50 and 90 percent of the time (indicated as $L_{10}$, $L_{50}$ and $L_{90}$) are shown on Chart 2.

A review of Chart 2 indicates that the noise levels at site LT-2 also followed a diurnal pattern characteristic of traffic noise, with the average daytime noise levels ranging from 67 to 75 dBA $L_{eq}$ and the average hourly nighttime noise levels ranging from 59 to 71 dBA $L_{eq}$. The overall Community Noise Equivalent Level (CNEL) for the 75-hr. measurement period at position LT-2 was 74 dBA, with a weekday CNEL at 75 dBA and a weekend CNEL at 74 dBA.

The short term (10-minute duration) noise measurement (ST-1) was made between 1:50 and 2:00 p.m. on Monday, July 16$^{th}$, 2018 on the project site at 65 feet from the centerline of North Mc Dowell Boulevard. This measurement location represents the setback of the proposed residential facades closest to this roadway. The measurement was conducted simultaneously with measurements at LT-1 and LT-2 to determine the noise exposure at the closest residential use to North Mc Dowell Boulevard. The results of the simultaneous measurements at long-term sites LT-1 and LT-2 and the short-term site ST-1 are shown in Table 5, following. A review of the data in Table 5 indicates that the noise exposure at the closest residential use to N. Mc Dowell Boulevard is characterized by a CNEL of 70 dBA.

## Chart 2: Measured Noise Levels at LT-2

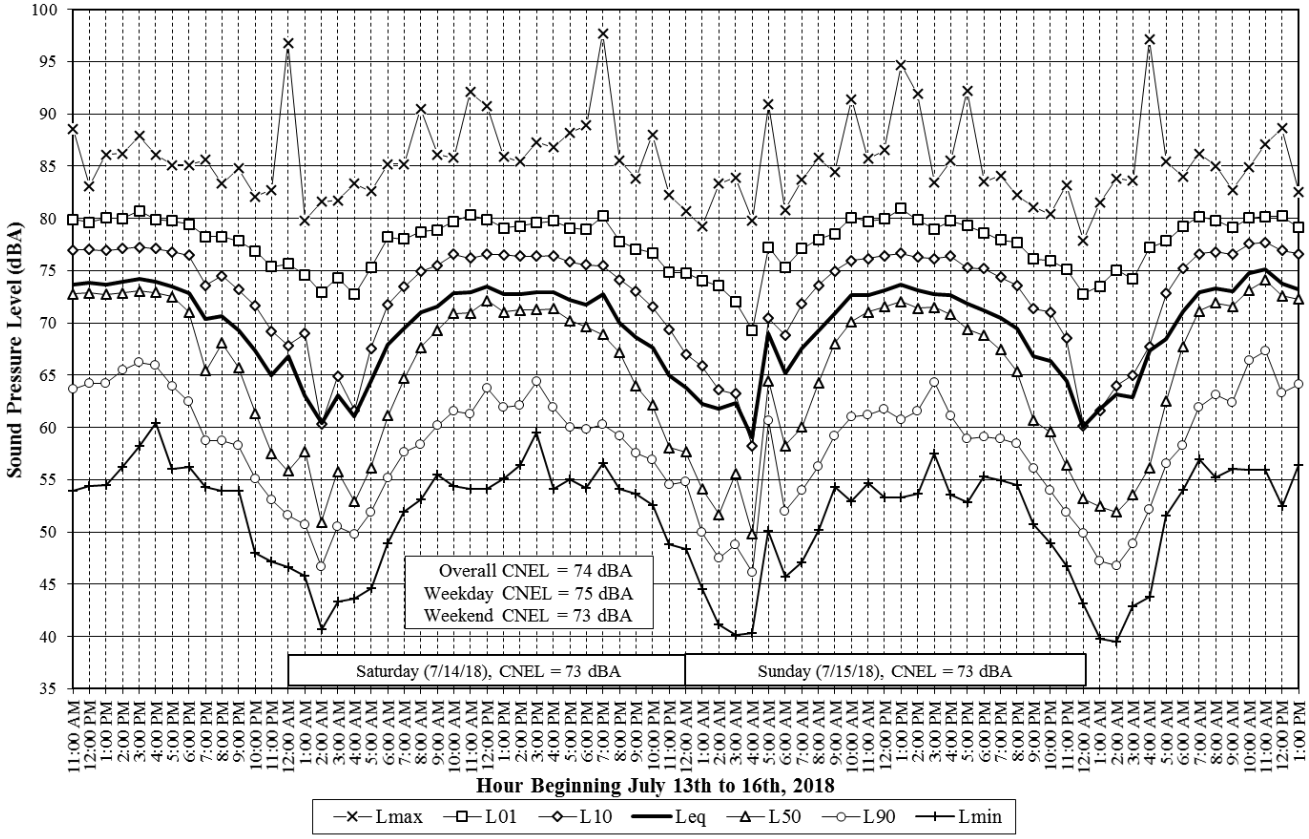



**Table 5: Summary of Short-Term Noise Measurement Data, dBA**

| Noise Measurement Location | $L_{max}$ | $L_{(1)}$ | $L_{(10)}$ | $L_{(50)}$ | $L_{(90)}$ | $L_{eq}$ | CNEL |
|---|---|---|---|---|---|---|---|
| ST-1: Approx. 65 feet from the centerline of N. McDowell Blvd. | 74 | 72 | 70 | 66 | 60 | 67 | **70**[1] |
| LT-1: Approx. 250 feet from the centerline of N. McDowell Blvd. | 60 | 59 | 58 | 56 | 54 | 56 | **61** |
| LT-2: Approx. 40 feet from the centerline of N. McDowell Blvd. | 81 | 79 | 76 | 72 | 65 | 73 | **74** |

[1] The $L_{dn}$ at ST-1 is approximated by correlation to the corresponding measurement at LT-1 and LT-2

## Future Noise and Vibration Environment

### Roadway Traffic Noise

The future noise environment on the roadway frontages would continue to result from traffic along the adjacent roadways. To assess the future noise environment, we have assumed that future traffic volumes along North McDowell Blvd. would increase by about 1-2% per year as a result of general growth throughout the City. Based on this traffic volume estimate, the future noise environment would be approximately 1 decibel higher than existing noise levels. Thus, exterior noise levels due to roadway traffic under future conditions would be 71 dBA CNEL at the residential facades closest to North McDowell Blvd.

### Railroad Noise

Though there are at-grade roadway crossings NWPRR rail line at Corona Road to the west of the site and at N. McDowell Blvd. to the east of the site, this portion of the NWPRR line has been designated as a Quiet Zone by the Federal Railroad Administration (FRA). As such, SMART commuter rail cars passing the site do not sound their horns. As noted above the current rail service on the SMART rail system includes 17 scheduled northbound and southbound trains on weekdays and 5 scheduled northbound and southbound trains passing the site on weekends with overall rail activity occurring on weekdays on the rail line adjacent to the site on weekdays between ~4:50 am and ~9:15pm on weekends between ~10:40 am and ~9:25pm. Under future conditions with a rail station at the site, the amount of time rail cars are in the site area may increase, however the speed of the rail cars passing the site, and the maximum noise level produced, would be expected to decrease. These two factors are expected to balance each other out, resulting in no net increase in average noise exposure of the site due to rail operations.

The closest residential facades will be located about 35 feet from the track centerline (see Figure 2). Considering the noise measurement results discussed above these closest residential facades will be exposed to maximum recurring noise levels ($L_{max30}$) of 81 to 82 dBA during SMART rail passbys and a weekday CNEL of 56 dBA due to SMART operations.

**Railroad Induced Vibration**

Information provided in the Draft EIR for the SMART project indicates that at distances between 20 and 100 feet from the tracks, vibration levels may be perceptible; however, they are expected to produce a RMS vibration velocity of less than 0.01 inches per second, which equates to a level of 68 VdB level, which is less than the applicable FTA impact significance criteria for residential uses.

## SIGNIFICANCE CRITERIA

Appendix G of the CEQA Guidelines states that a project would normally be considered to result in significant noise impacts if noise levels conflict with adopted environmental standards or plans or if noise generated by the project would substantially increase existing noise levels at sensitive receivers over a permanent or temporary basis. A significant impact would be identified for a proposed land use if it would be exposed to noise levels exceeding established guidelines or standards for noise and land use compatibility. A substantial permanent noise increase would occur if the noise level increase resulting from the project is 4 dBA CNEL as established by the Petaluma General Plan. A substantial temporary noise level increase would occur where noise from construction activities exceeds 60 dBA $L_{eq}$ and the ambient noise environment by at least 5 dBA $L_{eq}$ at adjacent land uses in the project vicinity for a period of one year or more. Vibration levels generated during demolition or construction activities would be significant if they cause cosmetic or structural damage to adjacent buildings.

## NOISE IMPACTS AND MITIGATION MEASURES

**Impact 1a:** **Exterior Residential Noise and Land Use Compatibility.** Residential uses developed at portions of the project site would be exposed to "conditionally acceptable" to "normally unacceptable" noise levels. **This is a potentially significant impact.**

The project includes two types of residential buildings, Product Type I is described as "Small Lot Single Family Homes" and Product Type II is described as "Zero Lot Line Single Family Homes". The Type I Small Lot homes are proposed on the eastern half of the project site (see Figure 2, attached), and are designed as attached homes situated in four and six-unit buildings. The rear of these homes back to access drives, with outdoor space at the home limited to small front yard areas. The Type II Zero Lot Line homes are proposed on the western half of the project site (see Figure 2, attached) and are designed as detached homes each with private 6' with side yards. The project also provides two common outdoor spaces on the northern portions of the site between the Type I and Type II residences and the NWPRR right of way.

A review of the project site plan indicates that the front yard areas of the Type I Small Lot homes directly adjacent to and/or perpendicular to North McDowell Blvd will be exposed to CNEL levels of up to 71 dBA, with these areas being considered "clearly unacceptable" for residential use by the City's General Plan noise standards. However, the two common outdoor spaces on the northern portion project site will be acoustically shielded by intervening project structures from roadway traffic noise such that sound levels in these areas are expected to be below 60 dBA CNEL. Such exterior noise levels are considered "normally acceptable" by the City of Petaluma General Plan Noise Element for residential use and will provide an acceptable outdoor use area for residents of the Type I homes directly adjacent to and/or perpendicular to North McDowell Blvd. A further review of the front yard areas of the Type I Small Lot homes which are not adjacent to and/or perpendicular to North McDowell Blvd will be acoustically shielded by intervening project structures from roadway traffic noise such that sound levels in these areas are expected to be at or below 60 dBA CNEL and are thus considered "normally acceptable" by the City of Petaluma General Plan Noise Element for residential use.

A review of the project site plan indicates that the private side yard areas of the four Type II Zero Lot Line homes facing North McDowell Blvd will be exposed to CNEL levels of up to 71 dBA, with these areas being considered "clearly unacceptable" for residential use by the City's General Plan noise standards. Though these residences can also use two common outdoor spaces on the northern portion project site to reduce noise levels in these private side yards we recommend the following mitigation measure be incorporated in the project design:

**Mitigation Measure 1a: Exterior Noise Reduction at Private Side Yards**
To reduce noise levels noise levels in the side yards of the eight Type II Zero Lot Line homes facing North McDowell Blvd to a CNEL of 60 dBA, a barrier with a minimum top of wall elevation of seven (7) feet above yard grade level on the side yard of the Zero Lot Line homes along North McDowell Blvd as shown in Figure 2 (attached) is recommended. To be effective as a barrier to noise, the noise barrier walls should be built without cracks or gaps in the face or large or continuous gaps at the base or where they adjoin the homes or each other. The walls should also have a minimum surface weight of 3.0 lbs. per sq. ft. Small, dispersed, gaps in the base of the walls for landscape irrigation or drainage which do not compose more than 0.5% of the wall area are acceptable.

**Impact 1b:** **Interior Residential Noise and Land Use Compatibility.** The interiors of residences on portions of the project site that would be exposed to "conditionally acceptable" to "normally unacceptable" noise levels may be exposed to interior noise levels exceeding the City required 45 dBA CNEL level and/or the recommended sleep disturbance/annoyance criterion of 55 dBA $L_{max}$. **This is a potentially significant impact.**

**Reduction of Average (CNEL) Interior Noise**
Homes on the project site adjacent to or with a clear view of North McDowell Blvd. traffic will be exposed to exterior noise levels of up to 71 dBA CNEL. The City of Petaluma requires that interior noise levels within new residential units not exceed 45 dBA CNEL. In buildings of typical construction, with the windows partially open, interior noise levels are approximately 15 dBA lower than exterior noise levels. With the windows closed, standard residential construction typically provides 20 to 25 decibels of exterior to interior noise reduction.

Where exterior day-night average noise levels are 65 dBA CNEL or less, interior noise levels can typically be maintained below City standards (45 dBA CNEL) with the incorporation of forced air mechanical ventilation systems in residential units. These systems allow the occupant the option of controlling noise by maintaining the windows shut. Where noise levels exceed 65 dBA CNEL, forced-air mechanical ventilation systems and sound-rated building elements are normally required.

**Mitigation 1b.1: Average (CNEL) Interior Noise**

a. To achieve the necessary noise reduction required to meet the requirements of the City General Plan standards, some form of forced air mechanical ventilation, satisfactory to the local building official, would be required in all residences with partial or full line of sight to North McDowell Blvd. traffic.
b. Given the anticipated exterior noise levels along North McDowell, it may also be necessary to provide sound-rated windows and doors at Type I and Type II residences facing or perpendicular to North McDowell Blvd. to maintain interior noise levels at or below 45 dBA CNEL. The degree of sound mitigation needed to achieve an interior CNEL of 45 dBA or less would vary depending on the final design of the building (relative window area to wall area) and the design of the exterior wall assemblies. However, based on the future exterior noise levels and typical residential construction, we would expect that windows and doors facing or with a view of North McDowell Blvd. may require STC ratings of between 28 and 30.
c. The specific determination of exterior wall assemblies and window/door STC ratings should be conducted on a unit-by-unit basis during the project design. The results of the analysis, including the description of the necessary noise control treatments, shall be submitted to the City along with the building plans and approved prior to issuance of a building permit.

**Reduction of Maximum (Rail-related) Interior Noise**

Residences adjacent to the NWPRR rail line may require a somewhat higher degree of sound rating for windows and doors to reduce interior maximum noise levels due to SMART rail passbys to levels considered acceptable for residential use.

**Mitigation 1b.2: Maximum (Rail-related) Interior Noise**

Though the percentage of exterior glazing and the exterior wall assemblies were not reviewed for this report windows with STC ratings of between 28 and 32 are likely be needed in the residences adjacent to the rail line to reduce interior maximum levels due to train engine noise to the recommended 55 dBA $L_{max30}$ interior levels.

**Impact 2:** **Project Operational Noise Generation** Noise due to the use and occupation of the project residences on adjacent noise sensitive uses is not expected to significantly increase or alter the existing noise environment at these uses. **This is a less-than-significant impact.**

The proposed project would place new residential uses approximately 130 feet across N. Mc Dowell from existing residential uses to the south and approximately 200 feet across the NWPRR and existing and future greenways from existing and future residential uses to the north and east The occupation and use of the proposed homes is expected to result in the typical noises associated with residential development, including voices of the new residents, home maintenance activities, barking dogs and children. Though the noise environment may change noticeably in some areas due to the occupation of the new residences, the noise associated with the proposed residences is not incompatible with the surrounding land uses and therefore is not judged to result in a noise impact.

**Mitigation 2: None Needed**

**Impact 3:** **Project-Generated Traffic Noise.** The proposed project would not substantially increase noise levels on a permanent basis at noise sensitive uses in the vicinity. **This is a less-than-significant impact.**

A significant impact would be identified if traffic generated by the project would substantially increase noise levels at sensitive receivers in the vicinity. A substantial increase would occur if the project traffic on area roadways where to result in a noise level increase of 4 dBA CNEL or greater. A traffic report for the development was not reviewed for this project, however, to cause a 4 dBA increase in noise along area roadway, the project would have to generate enough traffic to more than double current roadway volumes. Given the size of the project and the current amount of traffic on the area roadways, this is not considered possible.

**Mitigation 3: None Required.**

**Impact 4a:** **Exposure to Construction Generated Groundborne Vibration.** Residences in the vicinity of the project site are not expected to be exposed to perceptible vibration levels from construction activities. **This is a less-than-significant impact.**

Construction activities would include site preparation work such as grading and the installation of utilities, foundation work, and new building framing. Construction techniques that generate the highest vibration levels, such as impact or vibratory pile driving, are not expected at this project. Construction activities would generally occur at distances of 200 feet or more from the nearest residential units, but activities near the southern project perimeter could occur at distances of as close as 130 feet from existing residential units.

For structural damage, the California Department of Transportation uses a vibration limit of 0.5 in/sec, PPV for buildings structurally sound and designed to modern engineering standards and 0.2 in/sec, PPV for buildings that are found to be structurally sound but where structural damage is a major concern.

Project construction activities such as drilling, the use of jackhammers, rock drills and other high-power or vibratory tools, and rolling stock equipment (tracked vehicles, compactors, etc.) may generate substantial vibration in the immediate vicinity. Building framing, exterior and interior finishing, and landscaping activities are not anticipated to be sources of substantial vibration. Construction activities may extend over several construction seasons, but construction vibration would not be substantial for most of this time except during vibration generating activities (as discussed above).

Table 5 presents vibration source levels for typical construction equipment at a distance of 25 feet. Jackhammers typically generate vibration levels of 0.035 in/sec PPV, drilling typically generates vibration levels of 0.09 in/sec PPV, and vibratory rollers generate vibration levels of 0.21 in/sec PPV at a distance of 25 feet. Vibration levels would vary depending on soil conditions, construction methods, and equipment used. At distances of 100 feet or greater, construction activities would generally not generate vibration levels exceeding 0.05 in/sec PPV and would be well below the 0.50 in/sec PPV damage criteria.

In areas where vibration would not be expected to cause structural damage, vibration levels may still be perceptible. However, as with any type of construction, this would be anticipated and it would not be considered significant given the intermittent and short duration of the phases that have the highest potential of producing vibration (jackhammers and vibratory rollers). By use of administrative controls such as notifying adjacent land uses of scheduled construction activities and scheduling construction activities with the highest potential to produce perceptible vibration to hours with least potential to affect nearby residences, perceptible vibration can be kept to a minimum and as such would not result in a significant impact with respect to perception.

**TABLE 5 Vibration Source Levels for Construction Equipment**[6]

| Equipment | | PPV at 25 ft. (in/sec) |
|---|---|---|
| Clam shovel drop | | 0.202 |
| Hydromill (slurry wall) | in soil | 0.008 |
| | in rock | 0.017 |
| Vibratory Roller | | 0.210 |
| Hoe Ram | | 0.089 |
| Large bulldozer | | 0.089 |
| Caisson drilling | | 0.089 |
| Loaded trucks | | 0.076 |
| Jackhammer | | 0.035 |
| Small bulldozer | | 0.003 |

**Mitigation 4a: None Required**

**Impact 4b: Exposure to Railroad Related Groundborne Vibration.** Residences on the project site would not be exposed to rail related ground vibration levels in excess of the significance criteria established by the Federal Transit Administration (FTA). **This is a less-than-significant impact.**

As previously discussed, Information provided in the Draft EIR for the SMART project indicates that at distances between 20 and 100 feet from the tracks, rail vibration levels may be perceptible, but would be less than the applicable FTA impact significance criteria for residential uses. The closest residential units to the rail line would be located approximately 35 feet from the centerline of the NWPRR line. Considering the findings of the SMART Draft EIR rail vibration levels may be perceptible in these closest homes, but vibrations levla at these homes would exceed the FTA significance criteria.

**Mitigation 4b: None Required**

**Impact 5: Construction Noise.** Noise levels generated by project construction activities would temporarily elevate ambient noise levels at sensitive land uses in the vicinity. Major noise generating construction activities would be limited to less than one construction season or less. **This is a less-than-significant impact.**

The construction of the project would generate noise and would temporarily increase noise levels at adjacent residential receivers. Noise impacts resulting from construction depend on the noise generated by various pieces of construction equipment operating on site, the timing and duration of noise generating activities, and the distance between construction noise sources and noise sensitive receptors. Construction of the project would involve site improvements, such as the establishment of utilities, excavation of foundations, building erection, paving, and landscaping. The hauling of excavated material and construction materials would also generate truck trips on local roadways. Construction activities are typically carried out in stages. During each stage of construction, there would be a different mix of equipment operating. Construction noise levels would vary by stage and vary within stages based on the amount of equipment in operation and location where the equipment is

[6] Transit Noise and Vibration Impact Assessment, United States Department of Transportation, Office of Planning and Environment, Federal Transit Administration, May 2006.

operating.  Typical construction noise levels at a distance of 50 feet are shown in Table 6, which gives the average noise level ranges by construction phase.  Most demolition and construction noise is in the range of 80 to 90 dBA at a distance of 50 feet from the source.

**TABLE 6: Typical Ranges of $L_{eq}$ Construction Noise Levels at 50 Feet, dBA**

| Construction Stage | Domestic Housing | | Office Building, Hotel, Hospital, School, Public Works | | Public Works Roads & Highways, Sewers, and Trenches | |
|---|---|---|---|---|---|---|
| | **I** | **II** | **I** | **II** | **I** | **II** |
| Ground Clearing | 83 | 83 | 84 | 84 | 84 | 84 |
| Excavation | 88 | 75 | 89 | 79 | 88 | 78 |
| Foundations | 81 | 81 | 78 | 78 | 88 | 88 |
| Erection | 81 | 65 | 87 | 75 | 79 | 78 |
| Finishing | 88 | 72 | 89 | 75 | 84 | 84 |
| **I** - All pertinent equipment present at site, **II** - Minimum required equipment present at site. | | | | | | |

Source:  U.S.E.P.A., Legal Compilation on Noise, Vol. 1, p. 2-104, 1973.

The nearest noise sensitive uses will be 130 feet from the closest project construction activities.  Average noise levels at this distance of typical construction activity at this site would reach 79 dBA during busy construction periods.  These noise levels drop off at a rate of about 6 dBA per doubling of distance between the noise source and receptor.  The adjacent, existing, residences would, therefore be intermittently exposed to high levels of noise during periods of nearby construction.  Typically, significant noise impacts do not result when standard construction noise control measures are enforced at the project site and when the duration of the noise generating construction period is limited to one construction season (typically one year) or less.  Noise generated by major construction activities is not expected to result in noise levels exceeding 60 dBA $L_{eq}$ and the ambient noise environment by 5 dBA $L_{eq}$ for a period of greater than one year.

The following standard controls are assumed to be included in the project:

- Pursuant to the Municipal Code, restrict noise-generating activities at the construction site or in areas adjacent to the construction site to the hours between 7:00 a.m. and 10:00 p.m., Monday through Friday and 9:00 a.m. to 10:00 p.m. on Saturday, Sunday and State, Federal or Local Holidays.
- Equip all internal combustion engine driven equipment with intake and exhaust mufflers that are in good condition and appropriate for the equipment.
- Locate stationary noise generating equipment (e.g., compressors) as far as possible from adjacent residential receivers.
- Acoustically shield stationary equipment located near residential receivers with temporary noise barriers.
- Utilize "quiet" air compressors and other stationary noise sources where technology exists.
- Designate a "disturbance coordinator" responsible for responding to any complaints about construction noise.  The disturbance coordinator will determine the cause of the noise complaint (e.g., bad muffler, etc.) and will require that reasonable measures be implemented to correct the problem.

With the implementation of these controls, and the limited duration of the noise generating construction period, the substantial temporary increase in ambient noise levels associated with construction activities would be less-than-significant.

**Mitigation Measure 5:** **No additional measures required**

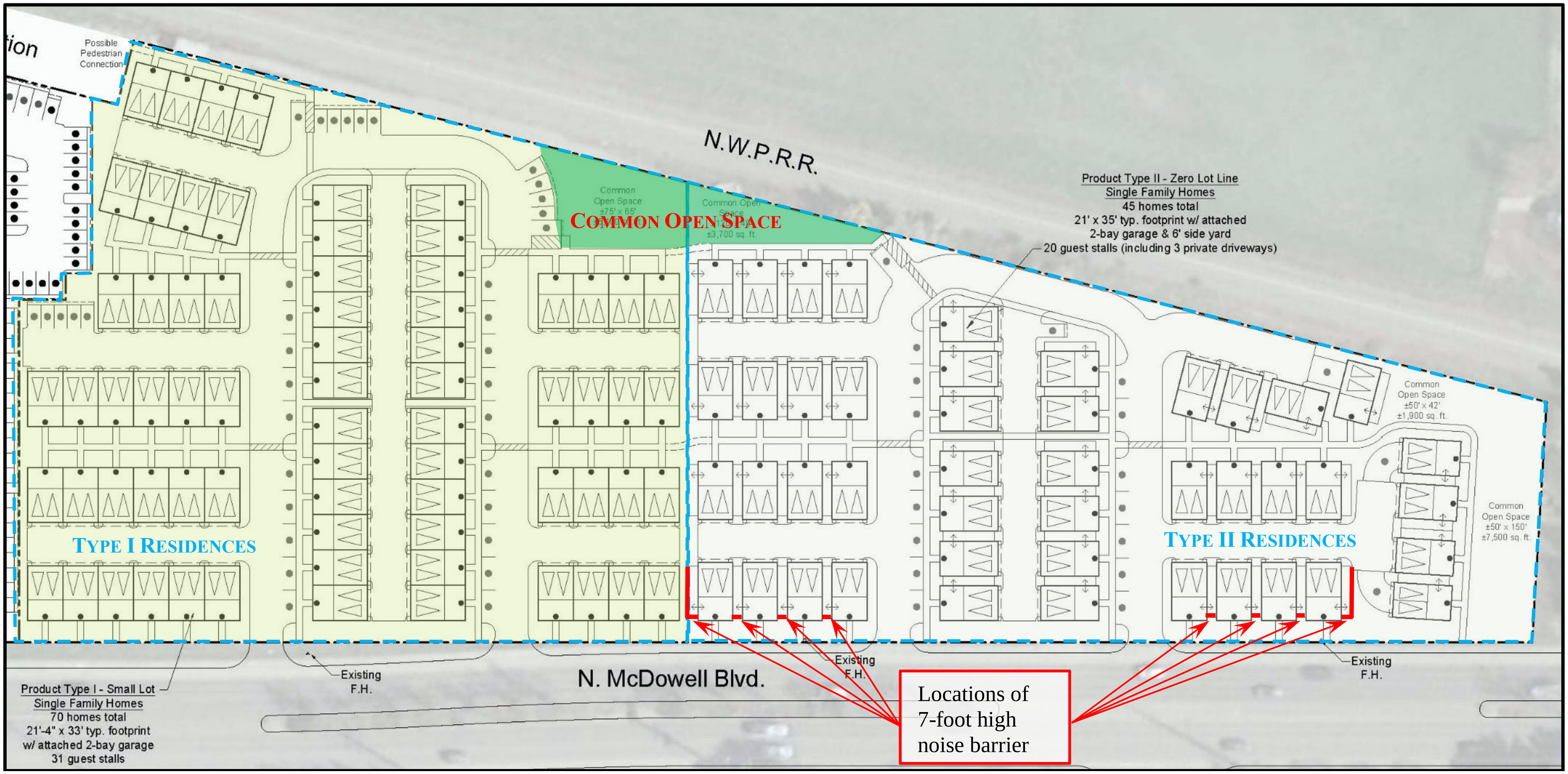



**Figure 2: Project Site Plan with Proposed Mitigation Measures**