SPIEKER SENIOR CONTINUING CARE COMMUNITY

ENVIRONMENTAL NOISE ASSESSMENT

Contra Costa County, California

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INTRODUCTION

The Project proposes the development of a self-contained continuing care retirement community, or CCRC, offering long-term continuing care contracts that provide for housing, residential services, and long-term nursing care, all on two existing parcels containing approximately 30.8-acres. The CCRC would include two main components: (a) independent living units, for residents capable of residing in the community without daily assistance; and (b) a Health Care Center, for residents requiring daily assistance or daily medical attention. In addition to 360 independent living residences / apartments and the 100 health care center units, the project also proposes a clubhouse, recreation building, maintenance buildings, and outdoor amenities to serve the needs of residents.

This report evaluates the project's potential to result in significant environmental noise impacts with respect to applicable California Environmental Quality Act (CEQA) guidelines. The report is divided into three sections: 1) the Setting Section provides a brief description of the fundamentals of environmental noise, summarizes applicable regulatory criteria, and discusses the results of the ambient noise monitoring survey completed to document existing noise conditions; 2) the General Plan Consistency section discusses noise land use compatibility utilizing policies in the Contra Costa County (County) and City of Walnut Creek (City) General Plan; and, 3) 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, to mitigate the impacts.

SETTING

Fundamentals of Environmental Noise

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 (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.

Effects of Noise

Sleep and Speech Interference

The thresholds for speech interference indoors are about 45 dBA if the noise is steady and above 55 dBA if the noise is fluctuating. Outdoors the thresholds are about 15 dBA higher. Steady noises of sufficient intensity (above 35 dBA) and fluctuating noise levels above about 45 dBA have been shown to affect sleep. Interior residential standards for multi-family dwellings are set by the State of California at 45 dBA L_{dn}. Typically, the highest steady traffic noise level during the daytime is about equal to the L_{dn} and nighttime levels are 10 dBA lower. The standard is designed for sleep and speech protection and most jurisdictions apply the same criterion for all residential uses. Typical structural attenuation is 12-17 dBA with open windows. With closed windows in good condition, the noise attenuation factor is around 20 dBA for an older structure and 25 dBA for a newer dwelling. Sleep and speech interference is therefore possible when exterior noise levels are about 57-62 dBA L_{dn} with open windows and 65-70 dBA L_{dn} if the windows are closed. Levels of 55-60 dBA are common along collector streets and secondary arterials, while 65-70 dBA is a typical value for a primary/major arterial. Levels of 75-80 dBA are normal noise levels at the first row of development outside a freeway right-of-way. In order to achieve an acceptable interior noise environment, bedrooms facing secondary roadways need to be able to have their windows closed, those facing major roadways and freeways typically need special glass windows.

Annoyance

Attitude surveys are used for measuring the annoyance felt in a community for noises intruding into homes or affecting outdoor activity areas. In these surveys, it was determined that the causes for annoyance include interference with speech, radio and television, house vibrations, and interference with sleep and rest. The L_{dn} as a measure of noise has been found to provide a valid correlation of noise level and the percentage of people annoyed. People have been asked to judge the annoyance caused by aircraft noise and ground transportation noise. There continues to be disagreement about the relative annoyance of these different sources. When measuring the percentage of the population highly annoyed, the threshold for ground vehicle noise is about 50 dBA L_{dn}. At a L_{dn} of about 60 dBA, approximately 12 percent of the population is highly annoyed. When the L_{dn} increases to 70 dBA, the percentage of the population highly annoyed increases to about 25-30 percent of the population. There is, therefore, an increase of about 2 percent per dBA between a L_{dn} of 60-70 dBA. Between a L_{dn} of 70-80 dBA, each additional decibel increases the percentage of the population highly annoyed by about 3 percent. People appear to respond more adversely to aircraft noise. When the L_{dn} is 60 dBA, approximately 30-35 percent of the population is believed to be highly annoyed. Each decibel increase to 70 dBA adds about 3 percentage points to the number of people highly annoyed. Above 70 dBA, each decibel increase results in about a 4 percent increase in the percentage of the population highly annoyed.

TABLE 1 Definition of Acoustical Terms Used in this Report

Term	Definition
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 micro Pascals.
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.
L_{max}, L_{min}	The maximum and minimum A-weighted noise level during the measurement period.
L_{01}, 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.
Day/Night Noise Level, L_{dn} or DNL	The average A-weighted noise level during a 24-hour day, obtained after addition of 10 decibels to levels measured in the night between 10:00 pm and 7:00 am.
Community Noise Equivalent Level, CNEL	The average A-weighted noise level during a 24-hour day, obtained after addition of 5 decibels in the evening from 7:00 pm to 10:00 pm and after addition of 10 decibels to sound levels measured in the night between 10:00 pm and 7:00 am.
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 Activities	Noise Level (dBA)	Common Indoor Activities
	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), California Department of Transportation, September 2013.

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 method is the Peak Particle Velocity (PPV). The PPV is defined as the maximum instantaneous positive or negative peak of the vibration wave. In this report, 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 or frequent intermittent vibration levels produce. The guidelines in Table 3 represent syntheses of vibration criteria for human response and potential damage to buildings resulting from construction vibration.

Construction activities can cause vibration that varies in intensity depending on several factors. The use of pile driving and vibratory compaction equipment typically generates the highest construction related groundborne vibration levels. Because of the impulsive nature of such activities, the use of the PPV descriptor has been routinely used to measure and assess groundborne vibration and almost exclusively to assess the potential of vibration to cause 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. 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 as people in an urban environment, may tolerate a higher vibration level.

Structural damage can be classified as cosmetic only, such as paint flaking or minimal extension of cracks in building surfaces; minor, including limited surface cracking; or major, that may threaten the structural integrity of the building. Safe vibration limits that can be applied to assess the potential for damaging a structure vary by researcher. The damage criteria presented in Table 3 include several categories for ancient, fragile, and historic structures, the types of structures most at risk to damage. Most buildings are included within the categories ranging from “Historic and some old buildings” to “Modern industrial/commercial buildings”. 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.

The annoyance levels shown in Table 3 should be interpreted with care since vibration may be found to be annoying at 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.

TABLE 3 Reaction of People and Damage to Buildings from Continuous or Frequent Intermittent Vibration Levels

Velocity Level, PPV (in/sec)	Human Reaction	Effect on Buildings
0.01	Barely perceptible	No effect
0.04	Distinctly perceptible	Vibration unlikely to cause damage of any type to any structure
0.08	Distinctly perceptible to strongly perceptible	Recommended upper level of the vibration to which ruins and ancient monuments should be subjected
0.1	Strongly perceptible	Threshold at which there is a risk of damage to fragile buildings with no risk of damage to most buildings
0.25	Strongly perceptible to severe	Threshold at which there is a risk of damage to historic and some old buildings.
0.3	Strongly perceptible to severe	Threshold at which there is a risk of damage to older residential structures
0.5	Severe - Vibrations considered unpleasant	Threshold at which there is a risk of damage to new residential and modern commercial/industrial structures

Source: Transportation and Construction Vibration Guidance Manual, California Department of Transportation, September 2013.

Regulatory Background

The State CEQA Guidelines, Appendix G, are used to assess the potential significance of impacts pursuant to local General Plan policies. The project is located within unincorporated Contra Costa County, but is within the planning area of the City of Walnut Creek. Therefore, both the County and City regulatory criteria are considered in this analysis. A summary of applicable regulatory criteria is provided below.

State CEQA Guidelines. The CEQA contains guidelines to evaluate the significance of effects of environmental noise attributable to a proposed project. Under CEQA, noise impacts would be considered significant if the project would result in:

(a) Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies;

(b) Generation of excessive groundborne vibration or groundborne noise levels;

(c) For a project located within the vicinity of a private airstrip or 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 would expose people residing or working in the project area to excessive noise levels?

Checklist items (a) and (b) are applicable to the proposed project. The project is not located within the vicinity of a private airstrip or a public airport and would not expose people residing or working

in the project area to excessive aircraft noise levels; therefore, item (c) is not carried further in this analysis.

California Building Code, Title 24, Part 2. The current version of the California Building Code (CBC) requires interior noise levels attributable to exterior environmental noise sources to be limited to a level not exceeding 45 dBA L_{dn}/CNEL in any habitable room.

Contra Costa County General Plan. The Noise Element of Contra Costa County's 2020 General Plan sets forth policies to "ensure that new developments will be constructed so as to limit the effects of exterior noise on the residents" and to "maintain appropriate noise conditions in all areas of the County".

Policy 11-1 New projects shall be required to meet acceptable exterior noise level standards as established in the Noise and Land Use Compatibility Guidelines contained in Figure 11-6. These guidelines, along with the future noise levels shown in the future noise contours maps, should be used by the county as a guide for evaluating the compatibility of "noise sensitive" projects in potentially noisy areas.

Policy 11-2 The standard for outdoor noise levels in residential areas is a L_{dn} of 60 dB. However, a L_{dn} of 60 dB or less may not be achievable in all residential areas due to economic or aesthetic constraints. One example is small balconies associated with multi-family housing. In this case, second- and third-story balconies may be difficult to control to the goal. A common outdoor use area that meets the goal can be provided as an alternative.

Policy 11-4 Title 24, Part 2, of the California Code of Regulations requires that new multi-family housing projects, hotels, and motels exposed to a L_{dn} of 60 dB or greater have a detailed acoustical analysis describing how the project will provide an interior L_{dn} of 45 dB or less. The County also shall require new single-family housing projects to provide for an interior L_{dn} of 45 dB or less.

Policy 11-6 If an area is currently below the maximum "normally acceptable" noise level, an increase in noise up to the maximum should not be allowed necessarily.

Policy 11-8 Construction activities shall be concentrated during the hours of the day that are not noise-sensitive for adjacent land uses and should be commissioned to occur during normal work hours of the day to provide relative quiet during the more sensitive evening and early morning hours.

Policy 11-9 Sensitive land use shall be encouraged to be located away from noise areas, or the impacts of noise on these uses shall be mitigated. If residential areas are planned adjacent to industrial noise sources, then a noise study shall be performed to determine the extent of any noise impacts and recommend appropriate noise mitigation measures.

Contra Costa County Municipal Code. The Contra Costa County Municipal Code contains the following regulations that are applicable to the Project:

> *716-8.1004 – Grading Regulation Work hours.* If operations under the permit are within five hundred feet (152.4 meters) of residential or commercial occupancies, except as otherwise provided by conditions of approval for the project, grading operations shall be limited to weekdays and to the hours, between seven-thirty a.m. and five-thirty p.m., except that maintenance and service work on equipment may be performed at any time.

City of Walnut Creek General Plan. The Safety and Noise Chapter of Walnut Creek's 2025 General Plan sets forth the policies and actions to assess and control environmental noise. The pertinent policies and associated actions are summarized as follows:

Policy 8.1 Apply the noise and land use compatibility table and standards to all residential, commercial, and mixed-use proposals, including condominium conversions.

The noise and land use compatibility table includes quantitative standards for exterior noise levels at various land uses. Single family residential and hospital care facilities would be considered "normally acceptable" in noise environments characterized by an L_{dn} of 60 dBA or below, "conditionally acceptable" in noise environments characterized by an L_{dn} of 60 to 75 dBA or "unacceptable" in noise environments characterized by an L_{dn} of greater than 75 dBA. Multifamily residences would be considered "normally acceptable" in noise environments characterized by an L_{dn} of 65 dBA or below, "conditionally acceptable" in noise environments characterized by an L_{dn} of 65 to 75 dBA or "unacceptable" in noise environments characterized by an L_{dn} of greater than 75 dBA.

Policy 8.2 Address the issue of residences affected by intermittent urban noise from sources such as heating, ventilating, and air-conditioning equipment, and by outdoor maintenance activities such as parking lot sweeping and early morning garbage collection.

Action 8.2.1 For new single-family residential projects, use a standard of 60 L_{dn} for exterior noise in private use areas.

Action 8.2.2 For new multi-family residential projects and for residential component of mixed-use development, use a standard of 65 L_{dn} in outdoor areas, excluding balconies.

Action 8.2.3 Strive for a maximum interior noise level of 45 L_{dn} in all new residential units.

Policy 9.1 Control all residential and commercial noise sources to protect the existing noise environment.

Action 9.1.1 Require the evaluation of noise mitigation measures for projects that would cause a substantial increase in noise.

City of Walnut Creek Municipal Code. The City's Municipal Code sets forth policies "to control and, in some instances, prohibit noise and vibration which may impact the health, safety or welfare of the citizens of Walnut Creek". The City limits construction to within the hours of 7:00 a.m. and 6:00 p.m. on weekdays, which are not holidays, or to those hours specified in individual building and grading permits, as authorized by the Chief of Code Enforcement or City Engineer.

Existing Noise Environment

The 30.8 acre site is currently accessed from an extension of Seven Hills Ranch Road, situated between the Walnut Creek Channel and the City of Walnut Creek boundary. The site adjoins existing single-family residences to the south and west (across Walnut Creek Channel) and adjoins a townhouse development along its easterly boundary. Seven Hills School, a private K-8 facility, is located to the north of the Site, and a portion of Heather Farms Park (City of Walnut Creek) is located to the northeast.

Due to the COVID-19 pandemic, traffic volumes have decreased, resulting in non-representative traffic noise levels in the area. As a result, the ambient noise environment at the site is characterized through compilation of existing data, noise modeling, and a site visit to verify on-site conditions.

The site visit took place on Thursday, June 25, 2020, and included three short-term (15-minute) attended noise measurements, as shown in Figure 1. Noise measurements were made along the future project driveway at Kinross Drive (ST-1), in front of the residence at 89 Kings Oak Place (ST-2), and adjacent to the equestrian center at Heather Farms Park (ST-3). Noise levels at these locations ranged from 48 to 50 dBA L_{eq}, primarily resulting from distant traffic noise, occasional aircraft overflights, and natural noise (e.g., birds). The results of the short-term measurements are shown in Table 4. Due to recent noise monitoring efforts in the area, comparing current noise levels to data made at the same locations prior to the pandemic, noise levels are anticipated to be 0 to 2 dBA below 'typical' levels.

TABLE 4 Summary of Short-Term Noise Measurement Data

Measurement Location	Measured Noise Levels (dBA)				Primary Noise Source
	L_{10}	L_{50}	L_{90}	L_{eq}	
ST-1: Future Project Driveway, Kinross Drive (6/25/2020, 10:05 to 10:20 am)	49	48	46	48	Distant traffic, occasional aircraft, birds
ST-2: Front of Residence at 89 Kings Oak Place (6/25/2020, 10:35 to 10:50 am)	49	47	46	48	Distant traffic, occasional aircraft
ST-3: Equestrian Center at Heather Farms Park (6/25/2020, 11:20 to 11:35 am)	51	45	43	50	Local traffic on North San Carlos Drive, distant noise at Heather Farm Corp Yard

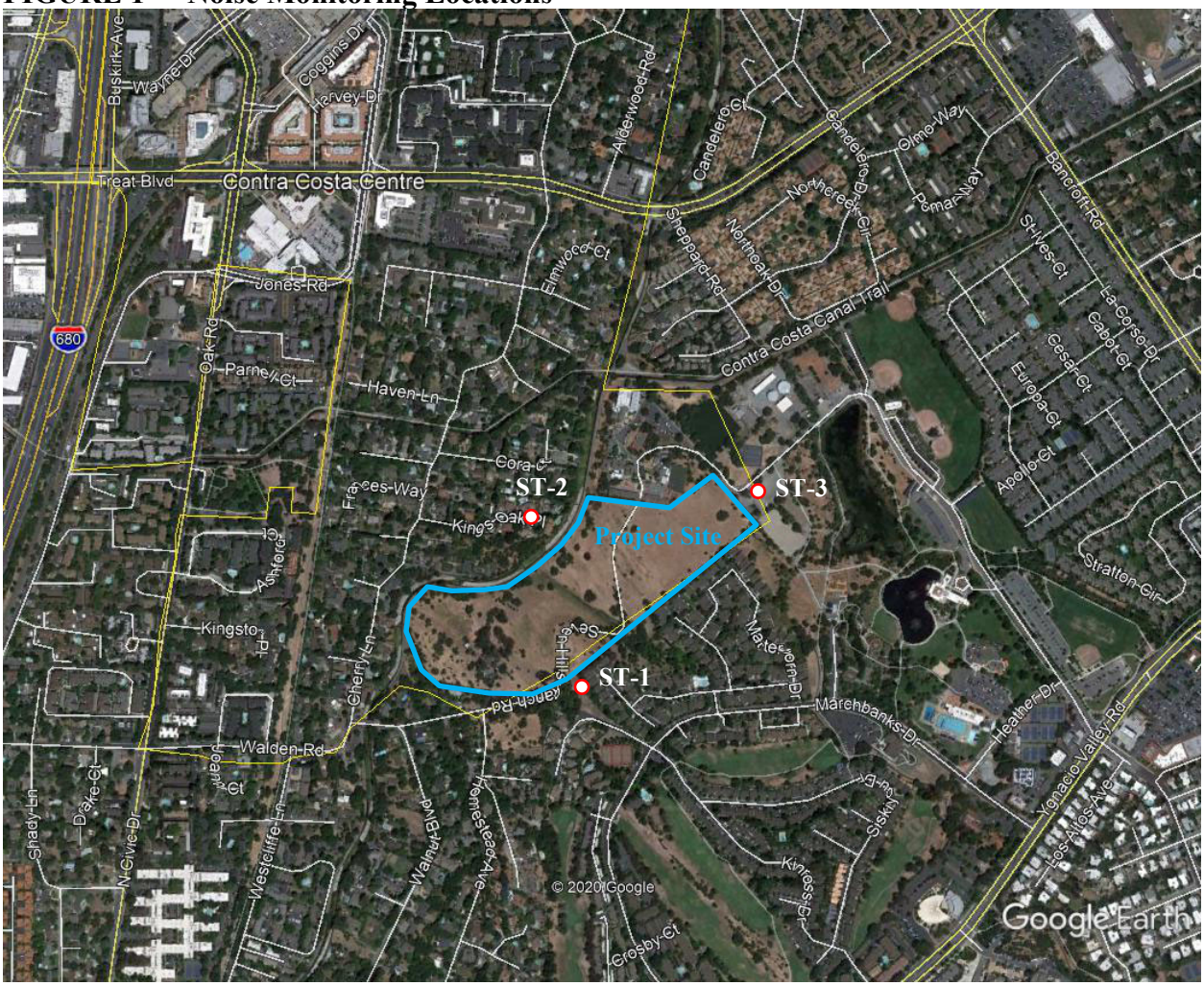
To confirm the results of noise monitoring, measured levels were compared to data from the Walnut Creek General Plan and traffic noise modeling. The closest highways and local roads of

significance to the site include Interstate 680 (I-680), located about 2,400 feet to the east, Treat Boulevard, located about 1,500 feet to the north, and Ygnacio Valley Road, located about 2,500 feet to the south. The project site is well shielded from all of these roadways by intervening terrain and/or structures. The Walnut Creek General Plan specifies a noise level of 75 dBA L_{dn} at a distance of 250 feet from I-680 and noise levels of 72 to 75 dBA L_{dn} at the roadside adjacent to local roads of significance (Treat Boulevard and Ygnacio Valley Road). At a distance of 2,400 feet, I-680 traffic is calculated to generate an unshielded noise level of 60 dBA L_{dn}. Treat Boulevard would generate unshielded traffic noise levels of 50 to 53 dBA L_{dn} at a distance of 1,500 feet and Ygnacio Valley Road would generate unshielded traffic noise levels of 47 to 50 dBA L_{dn} at a distance of 2,500 feet. Shielding is estimated to provide an additional 15 to 20 dBA of noise reduction for all these traffic noise sources, resulting in distant traffic noise levels below 45 dBA L_{dn} at the project site.

Traffic noise modeling was conducted to calculate the contribution of local traffic noise to the noise environment at the site using the Federal Highway Administration's Traffic Noise Model (TNM version 2.5), using traffic volume inputs from the project's traffic study. Based on noise modeling, traffic noise levels at 50 feet from the center of Kinross Drive west of Marchbanks Drive, along its alignment extending into the Project Site, are calculated to be 50 dBA L_{dn} under existing conditions. Noise levels would drop off at a rate of approximately 4.5 dBA per doubling of distance from the roadway.

In addition to traffic noise, the site would be exposed to noise generated by activities at Seven Hills School, located to the north. The Seven Hills School serves about 400 students in preschool through 8th grade. Meaningful noise data from school activities could not be obtained during the timeframe of this project, due to school closures resulting from the COVID-19 pandemic. The most significant noise events associated with schools are typically large spectator activities (>300 spectators), such as football games. Review of the school website indicates that the school offers volleyball, flag football, cross county, basketball, fitness, golf, and mixed recreation to middle school students. Given the small size of the school (400 students), that the school does not serve high school students, and that the school does not include any large capacity outdoor bleacher facilities, significant noise events are unlikely to occur. Noise levels from athletic field events are typically 57 to 60 dBA L_{eq} at a distance of 100 feet from the center of the field, including spectator and on-field noise. Average noise levels generated during hardscape activities typically range from 59 to 67 dBA L_{eq} at 50 feet.

FIGURE 1 Noise Monitoring Locations



Source: Google Earth

GENERAL PLAN CONSISTENCY ANALYSIS

The impacts of site constraints such as exposure to excessive levels of noise and vibration are not considered under CEQA. This section addresses the project's consistency with the policies set forth in the Contra Costa County and Walnut Creek General Plans.

Noise and Land Use Compatibility

The applicable General Plan policies were presented in detail in the Regulatory Background section and are summarized below:

- Both the Contra Costa County and Walnut Creek General Plans specify a 'normally acceptable' exterior noise level of 60 dBA L_{dn} for single-family residences. The County uses the same 60 dBA L_{dn} threshold for multifamily residences, hospitals, and nursing homes, with exceptions for small balconies. The City uses an exterior noise threshold of 60 dBA L_{dn} for hospitals and 65 dBA L_{dn} for multifamily residences. The more conservative 60 dBA L_{dn} threshold is used for all residential, nursing home, and hospital land uses in this analysis.

- The County and City General Plan standard for interior noise levels in residences and other habitable rooms is 45 dBA L_{dn}, consistent with the State Building Code.

Future Exterior Noise Environment

With no major transportation noise sources within 1,500 feet of the site, future exterior noise levels would continue to result primarily from local and distant traffic. As described in the Existing Noise Environment section of this document, the noise environment at the site is anticipated to range from 48 to 50 dBA L_{dn} under existing conditions, with noise levels calculated to reach 53 dBA L_{dn} under the cumulative plus project scenario at the roadside of Kinross Drive west of Marchbanks Drive along its alignment extending into the Project Site. Noise levels are not anticipated to exceed 60 dBA L_{dn} at any proposed exterior use areas and would be considered 'normally acceptable' throughout the site.

Future Interior Noise Environment

Exterior noise levels throughout the site are anticipated to be 53 dBA L_{dn} or less. Standard residential construction provides approximately 15 dBA of exterior-to-interior noise reduction, assuming the windows are partially open for ventilation. Therefore, interior noise levels would achieve the 45 dBA L_{dn} interior threshold with standard construction only. No additional noise insulation features are needed.

NOISE IMPACTS AND MITIGATION MEASURES

This section describes the significance criteria used to evaluate project impacts under CEQA, provides a description for each project impact, and presents mitigation measures, where necessary, to provide a compatible project in relation to adjacent noise sources and land uses.

Significance Criteria

The following criteria were used to evaluate the significance of environmental noise resulting from the project:

1. **Temporary or Permanent Noise Increases in Excess of Established Standards:** A significant impact would be identified in the following cases:

    a. Operational Noise in Excess of Standards. A significant noise impact would be identified if the project operations would generate noise levels that would exceed applicable noise standards presented in the General Plan or Municipal Code.

    b. Permanent Noise Increase. A significant permanent noise increase would occur if a) the noise level increase is 5 dBA L_{dn} or greater, with a future noise level of less than 60 dBA L_{dn}, or b) the noise level increase is 3 dBA L_{dn} or greater, with a future noise level of 60 dBA L_{dn} or greater.

    c. Temporary Noise Increase. A significant temporary noise impact would be identified if construction-related noise would substantially exceed existing conditions and extend over a period of more than one year, occur outside of the hours specified in the Municipal Code, or be conducted without the inclusion of best management practices.

2. **Generation of Excessive Groundborne Vibration:** A significant impact would be identified if the construction of the project would expose persons to excessive vibration levels. Groundborne vibration levels exceeding 0.3 in/sec PPV would have the potential to result in cosmetic damage to buildings.

Impact 1: **Temporary or Permanent Noise Increases in Excess of Established Standards.** Impact 1 has three components which are addressed below: (a) on-site operational noise **(potentially significant)**; (b) off-site operational traffic noise increases **(less than significant)**; and (c) temporary noise increases during construction **(potentially significant)**.

a) Operational Noise in Excess of Standards

On-site components of the project that would produce noise would include parking lots, mechanical equipment, and maintenance building operations. Neither Contra Costa County, nor the City of Walnut Creek define a quantitative noise level limit for operational noise sources. Noise levels in the surrounding neighborhoods are generally in the range of 50 to 55 dBA L_{dn}. Therefore, for consistency with the County and City General Plan guidelines (60 dBA L_{dn}), and to ensure

noise levels are not substantially increased in the surrounding areas, operational noise would be limited to 50 dBA L_{eq} during daytime hours and 40 dBA L_{eq} during nighttime hours.

Parking Lots

Parking would be provided throughout the site. At-grade parking spaces would be located to the west and to the north of the Independent Living Courtyard Apartment Building, and to the north, west, and south of the health care building. Subterranean parking will be provided under portions of the Independent Living Courtyard Apartment Building. Parking activities occurring in the subterranean parking garage would not be anticipated to be audible outside of the parking garage.

Noise levels generated by typical parking activities would include vehicular circulation, louder engines, car alarms, squealing tires, door slams, and human voices. The typical sound of a passing car at 15 mph would be about 50 to 60 dBA L_{max} at a distance of 50 feet. The noise of an engine start is similar. Door slams typically produce noise levels lower than engine starts. The hourly average noise level resulting from all these noise-generating activities in a busy small parking lot would reach 40 dBA L_{eq} at a distance of 50 feet from the parking area. However, noise produced by parking areas at similar facilities are often much lower during given the limited activity. Noise levels during less busy periods, such as at night, would be significantly lower. Operational noise associated with parking lots would be below 50 dBA L_{eq} during daytime hours and 40 dBA L_{eq} during nighttime hours, and below 45 dBA L_{dn}, resulting in a **less-than-significant** impact.

Mechanical Equipment

The project would include mechanical equipment such as heating, ventilation, and air conditioning systems (HVAC). Information regarding the number, type, and size of the mechanical equipment units to be used in the proposed project was not available at the time of this study. Typical multi-family or mixed-use building HVAC units are anticipated to generate noise levels of 50 to 60 dBA at 50 feet from the equipment, depending on the equipment selected. Single family residential units are typically quieter.

Assuming that HVAC and other mechanical equipment would be located on the rooftops of the proposed structures, the nearest noise sensitive land use is approximately 50 feet from the 'worst-case' location where a rooftop HVAC unit is likely to be placed. At an unshielded distance of 50 feet, HVAC units would be anticipated to generate a noise level of 50 to 60 dBA L_{eq}. Assuming 24-hour operations, this would result in a day-night average noise level of 56 to 66 dBA L_{dn}. Shielding from equipment enclosures and surrounding structures would provide 10 to 15 dBA of noise reduction. Under a worst-case scenario, unshielded mechanical equipment noise could exceed the City's compatibility threshold by as much as 6 dBA, the nighttime noise limit by as much as 15 dBA, and ambient noise levels by as much as 10 dBA. No equipment is anticipated for a project of this scale that would make meeting the applicable noise limits with standard noise control measures difficult. However, during final design of the mechanical systems, the noise levels from the various pieces of equipment should be calculated to ensure compliance with the daytime (50 dBA L_{eq}) and nighttime (40 dBA L_{eq}) noise limits at the nearest residences. This is a **potentially significant** impact.

Maintenance Building Operations

The maintenance building is to be located in the southern portion of the property and will house offices, a shop to repair golf carts, a generator, a laundry facility, and a trash compactor. Equipment and activities located inside the building, with doors and windows in the closed position, are unlikely to generate substantial noise levels outside of the structure.

The emergency diesel generator would be located at the southwest corner of the maintenance building, approximately 80 feet from the nearest residential property line to the east. The generator would be located in an outdoor mechanical yard and shielded by an approximate 10-foot masonry noise barrier. A 500 kW emergency diesel generator was assumed to be tested periodically and to provide power to the Care Center in the event of a power failure. Given the location of the generator and setting, it was also assumed that the generator would be fitted with a Level II acoustical enclosure to ensure that noise levels are reduced as much as feasible on site and in surrounding areas. Based on the assumptions outlined above, generator noise levels would range from 66 to 71 dBA at 23 feet and from 60 to 65 dBA at 80 feet when accounting for intervening acoustical shielding from structures. Such noise levels would not be considered significant given the infrequent testing schedule and the fact that extended operation would only occur during emergencies.

Trash compactors typically generate maximum noise levels of 50 to 60 dBA L_{max} at 50 feet, depending on the power rating and enclosure characteristics. The location of the trash compactor is not known at this time. Assuming it is located in the 'worst-case' location to the southeast of the maintenance building, it would be allocated about 30 feet horizontally from the closest townhome and depressed about 30 feet below the pad elevation of this townhome. It is anticipated that use of the trash compactors would be during daytime hours only. Therefore, only the daytime noise threshold is relevant. Again, when properly controlled, noise from mechanical equipment noise should meet the applicable noise limits. During final design of the mechanical systems, the noise levels from the various pieces of equipment should be calculated to ensure compliance with the daytime (50 dBA L_{eq}) noise limit at the nearest residences. This is a **potentially significant** impact.

Mitigation Measure 1a: Prior to the issuance of building permits, mechanical equipment shall be selected and designed to reduce impacts on surrounding uses to meet 50 dBA L_{eq} during daytime hours and 40 dBA L_{eq} during nighttime hours. A qualified acoustical consultant shall be retained by the project applicant to review mechanical noise as the equipment systems are selected in order to determine specific noise reduction measures necessary to reduce noise to comply with the noise limits at all adjacent noise sensitive land uses. Noise reduction measures could include, but are not limited to, locating equipment away from noise sensitive locations, selection of equipment that emits low noise levels and/or installation of noise barriers such as enclosures and parapet walls to block the line of sight between the noise source and the nearest receptors. If properly designed and controlled, the combined worst-case noise level due to the operation of on-site noise sources including the project parking lots, mechanical equipment, and maintenance building operations would not be substantially increased with the project and would remain below the 60 dBA L_{dn} noise and land use compatibility thresholds established for residential land uses by Contra Costa County and the City of Walnut Creek. *Implementation of Mitigation Measure 1a would reduce this impact to* ***less-than-significant****.*

b) Permanent Noise Increases from Project Traffic

A significant permanent noise increase would occur if traffic or activities generated by the project would substantially increase noise levels at sensitive receptors in the project vicinity. Neither Contra Costa County, nor the City of Walnut Creek define what noise level increase would be considered substantial. In line with other Bay Area cities and counties, a substantial increase would occur if: a) the noise level increase is 5 dBA L_{dn} or greater, with a future noise level of less than 60 dBA L_{dn}, or b) the noise level increase is 3 dBA L_{dn} or greater, with a future noise level of 60 dBA L_{dn} or greater.

Traffic data developed for the project was reviewed to calculate potential traffic noise level increases attributable to the project expected along roadways serving the site. Roadways evaluated in the analysis included Marchbanks Drive, Kinross Drive, Ygnacio Valley Road, and North San Carlos Drive.

Based on a comparison of traffic volumes under the Existing and Existing Plus Project scenarios, the largest traffic noise increase attributable to the project would be along Kinross Drive north of Marchbanks Drive, which would serve as the main project entrance. Based on traffic noise modeling in TNM, traffic noise levels at a distance of 50 feet from the center of this roadway would increase from 50 dBA L_{dn} under existing conditions to 53 dBA L_{dn} under existing plus project and cumulative plus project conditions. Since the resulting traffic noise level along this roadway segment would be below 60 dBA L_{dn}, the 5 dBA noise increase threshold would apply. The traffic noise increase attributable to the project on the other surrounding roadways would be less than 3 dBA L_{eq} on all analyzed roadway segments. Traffic noise increases would be below the 3 dBA and 5 dBA L_{dn} thresholds of significance. This is a **less-than-significant** impact.

Mitigation Measure 1b: None required.

c) Temporary Noise Increases from Project Construction

Contra Costa County Municipal Code 716-8.1004 establishes that grading construction operations within 500 feet of residential or commercial occupancies shall be limited to weekdays and to the hours between 7:30 a.m. and 5:30 p.m. The City of Walnut Creek limits construction to within the hours of 7:00 a.m. and 6:00 p.m. on non-holiday weekdays. Neither Contra Costa County, nor the City of Walnut Creek provide quantitative noise limits for construction.

The significance of temporary noise increases resulting from construction depend upon the noise levels generated by various pieces of construction equipment, the timing and duration of noise-generating activities, the distance between construction noise sources and noise-sensitive areas, and the presence of intervening shielding features such as buildings or terrain. Construction noise impacts primarily result when construction activities occur during noise-sensitive times of the day (e.g., early morning, evening, or nighttime hours), the construction occurs in areas immediately adjoining noise-sensitive land uses, or when construction lasts over extended periods of time.

Construction activities would be carried out in stages. During each stage of construction, there would be a different mix of equipment operating, and noise levels would vary by stage and vary

within stages, based on the amount of equipment in operation and the location at which the equipment is operating. Typical construction noise levels at a distance of 50 feet are shown in Tables 5 and 6. Table 5 shows the average noise level range by construction phase and Table 6 shows the maximum noise level range for different construction equipment. Table 6 levels are consistent with construction noise levels calculated for the project in the Federal Highway Administration (FHWA) Roadway Construction Noise Model (RCNM), including the anticipated equipment that would be used for each phase of the project.

TABLE 5 Typical Ranges of Construction Noise Levels at 50 Feet, L_{eq} (dBA)

	Domestic Housing		Office Building, Hotel, Hospital, School, Public Works		Industrial Parking Garage, Religious Amusement & Recreations, Store, Service Station		Public Works Roads & Highways, Sewers, and Trenches	
	I	II	I	II	I	II	I	II
Ground Clearing	83	83	84	84	84	83	84	84
Excavation	88	75	89	79	89	71	88	78
Foundations	81	81	78	78	77	77	88	88
Erection	81	65	87	75	84	72	79	78
Finishing	88	72	89	75	89	74	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.

TABLE 6 Construction Equipment, 50-foot Noise Emission Limits

Equipment Category	L_{max} Level (dBA)[1,2]	Impact/Continuous
Arc Welder	73	Continuous
Auger Drill Rig	85	Continuous
Backhoe	80	Continuous
Bar Bender	80	Continuous
Boring Jack Power Unit	80	Continuous
Chain Saw	85	Continuous
Compressor[3]	70	Continuous
Compressor (other)	80	Continuous
Concrete Mixer	85	Continuous
Concrete Pump	82	Continuous
Concrete Saw	90	Continuous
Concrete Vibrator	80	Continuous
Crane	85	Continuous
Dozer	85	Continuous
Excavator	85	Continuous
Front End Loader	80	Continuous
Generator	82	Continuous
Generator (25 KVA or less)	70	Continuous
Gradall	85	Continuous
Grader	85	Continuous
Grinder Saw	85	Continuous
Horizontal Boring Hydro Jack	80	Continuous
Hydra Break Ram	90	Impact
Impact Pile Driver	105	Impact
Insitu Soil Sampling Rig	84	Continuous
Jackhammer	85	Impact
Mounted Impact Hammer (hoe ram)	90	Impact
Paver	85	Continuous
Pneumatic Tools	85	Continuous
Pumps	77	Continuous
Rock Drill	85	Continuous
Scraper	85	Continuous
Slurry Trenching Machine	82	Continuous
Soil Mix Drill Rig	80	Continuous
Street Sweeper	80	Continuous
Tractor	84	Continuous
Truck (dump, delivery)	84	Continuous
Vacuum Excavator Truck (vac-truck)	85	Continuous
Vibratory Compactor	80	Continuous
Vibratory Pile Driver	95	Continuous
All other equipment with engines larger than 5 HP	85	Continuous

Notes: [1] Measured at 50 feet from the construction equipment, with a "slow" (1 sec.) time constant.

[2] Noise limits apply to total noise emitted from equipment and associated components operating at full power while engaged in its intended operation.

[3]Portable Air Compressor rated at 75 cfm or greater and that operates at greater than 50 psi.

Project construction would involve site preparation, grading and excavation, trenching and foundation work, new building framing and finishing, and paving. Foundations would be constructed using post tension slabs and drilled piers. Pile driving is not proposed as a method of construction. Site work is anticipated to start in July 2021 (12 months), followed by construction of the Independent Living Units and Clubhouse facilities (22 months), and then construction of the Health Center (18 months), for a total of 3 to 4 years of construction. Project specific construction equipment information was not provided.

Construction activities generate considerable amounts of noise, especially during earth-moving activities at the beginning of the construction schedule when heavy equipment is used. As shown in Table 5, mixed-use and hospital construction noise would be in the range of 78 to 89 dBA L_{eq} at a distance of 50 feet from the source. Noise levels would be lower as construction moves away from shared property lines or into shielded areas. Construction-generated noise levels drop off at a rate of about 6 dBA per doubling of the distance between the source and receptor. Shielding by buildings or terrain can provide an additional 5 to 10 dBA noise reduction at distant receptors.

The Federal Highway Administration's (FHWA's) Roadway Construction Noise Model (RCNM) was used to calculate the hourly average noise levels anticipated for the worst-case scenario for each construction phase, based on the equipment list provided by the applicant at the time of this study. RCNM includes representative sound levels for the most common types of construction equipment and the approximate usage factors of such equipment that were developed based on an extensive database of information gathered during the construction of the Central Artery/Tunnel Project in Boston, Massachusetts (CA/T Project or "Big Dig"). The usage factors represent the percentage of time that the equipment would be operating at full power. To estimate the worst-case scenario for each phase of the proposed project, it was assumed that all equipment provided for each phase would operate simultaneously. RCNM calculated construction noise levels ranging from 74 to 88 dBA L_{eq} at a distance of 50 feet from the source, which corresponded well with the EPA's typical range of construction noise levels.

Tables 7 and 8 summarize the equipment expected to be used for the construction of the project, the duration of each phase, and the estimated worst-case scenario noise levels expected at the property lines of the nearest surrounding noise-sensitive land uses assuming construction is occurring at the Independent Living Units construction area or at the Care Center construction area. During construction at both the Independent Living Units and the Care Center, construction equipment would likely be spread throughout the sites, but for purposes of modeling the worst-case scenario, all equipment was assumed to be operating in relatively the same area, with the geometrical center of construction equipment being the center of the construction sites. Therefore, the propagation distances were estimated from the center of the active construction site to the property lines of the surrounding receptors. No shielding effects were assumed for the estimated noise levels shown in Tables 7 and 8.

TABLE 7 Estimated Construction Noise Levels (Independent Living Units) at Nearby Land Uses

Phase	Time Duration	Construction Equipment (Quantity)	Calculated Hourly Average L_{eq}, dBA				
			Source Noise Level (50 feet)	Seven Hills School (830 feet)	Adirondack Way Residences (430 feet)	Homestead Avenue Residences (590 feet)	Kings Oak Place Residences (300 feet)
Demolition	7/1/2021-9/8/2021	Concrete/Industrial Saw (1) Excavators (3) Rubber Tired Dozers (2)	86	62	68	65	71
Site Preparation	9/9/2021-10/20/2021	Rubber Tired Dozers (3) Tractors/Loaders/Backhoes (4)	86	61	67	64	70
Grading/ Excavation	10/21/2021-2/2/2022	Scrapers (2) Excavators (2) Grader (1) Rubber Tired Dozer (1) Tractors/Loaders/Backhoes (2)	88	63	69	66	72
Trenching/ Foundation	10/21/2021-2/2/2022	Tractors/Loaders/Backhoes (2) Excavators (2) Scrapers (2) Grader (1) Rubber Tired Dozer (1)	88	63	69	66	72
Building – Exterior (Independent Living Units)	2/3/2022-10/11/2023	Crane (1) Forklifts (3) Generator Set (1) Tractors/Loaders/Backhoes (3) Welders (1)	84	60	65	63	69
Architectural Coating (Independent Living Units)	10/12/2023-11/29/2023	Air Compressor (1)	74	49	55	52	58
Paving	2/3/2022-4/20/2022	Pavers (2) Paving Equipment (2) Rollers (2)	85	60	66	63	69

TABLE 8 Estimated Construction Noise Levels (Care Center) at Nearby Land Uses

Phase	Time Duration	Construction Equipment (Quantity)	Calculated Hourly Average L_{eq}, dBA				
			Source Noise Level (50 feet)	Seven Hills School (190 feet)	Pyrenees Place Residences (240 feet)	Adirondack Way Residences (880 feet)	Kings Oak Place Residences (720 feet)
Demolition	7/1/2021-9/8/2021	Concrete/Industrial Saw (1) Excavators (3) Rubber Tired Dozers (2)	86	75	73	61	63
Site Preparation	9/9/2021-10/20/2021	Rubber Tired Dozers (3) Tractors/Loaders/Backhoes (4)	86	74	72	61	62
Grading/ Excavation	10/21/2021-2/2/2022	Scrapers (2) Excavators (2) Grader (1) Rubber Tired Dozer (1) Tractors/Loaders/Backhoes (2)	88	76	74	63	65
Trenching/ Foundation	10/21/2021-2/2/2022	Tractors/Loaders/Backhoes (2) Excavators (2) Scrapers (2) Grader (1) Rubber Tired Dozer (1)	88	76	74	63	65
Building – Exterior (Care Center)	10/12/2023-8/28/2024	Crane (1) Forklifts (3) Generator Set (1) Tractors/Loaders/Backhoes (3) Welders (1)	84	73	70	59	61
Architectural Coating (Care Center)	8/29/2024-9/25/2024	Air Compressor (1)	74	62	60	49	51
Paving	2/3/2022-4/20/2022	Pavers (2) Paving Equipment (2) Rollers (2)	85	73	71	60	62

Noise sensitive uses surround the site, including single-family residences to the south and further to the west (across Walnut Creek Channel), a townhouse development to the east, Seven Hills School to the north, and a portion of Heather Farms Park (City of Walnut Creek) to the northeast. Ambient daytime noise levels in these areas are in the range of 45 to 55 dBA L_{eq}. Some of these land uses are as close as 10 feet from the site property line and 30 feet from the closest proposed building. Construction noise levels are anticipated to be as much as 30 to 40 dBA above ambient noise levels when heavy construction is located adjacent to sensitive land uses. During the construction of the Independent Living Units, worst-case noise levels at the Seven Hills School would generally range from 60 to 63 dBA L_{eq}. The Care Center would be constructed closer to the school, yielding construction noise levels generally in the range of 73 to 76 dBA L_{eq}. Construction noise levels exceeding 60 dBA L_{eq} would have the potential to result in speech and activity interference outdoors and within buildings assuming that windows/doors are open for ventilation. Such noise levels would be possible when heavy equipment is operating within approximately 1,300 feet of receptors during the grading/excavation and trenching/foundation phases.

The highest noise levels will occur during the grading/excavation and trenching/foundation phases, which is to be carried out using the heaviest concentration of equipment for the entire project site over a period of under one year. Framing, paving and other building and site improvements involving medium-heavy equipment will generate lower but still substantial noise levels, and are anticipated to continue for an additional 22 months. Thereafter, landscaping and interior improvements within the Clubhouse and Health Care Center will result in still noticeable but substantially reduced noise levels extending over an additional 18 months. The anticipated increase in temporary construction noise at off-site noise sensitive locations is considered a **potentially significant** impact due to the duration of construction and the proximity of construction to noise sensitive receptors. The topography of the site is such that the closest nearby noise sensitive locations to the south and east would not be easily shielded from major construction activities by temporary noise barriers constructed at the project perimeter. Again, construction noise levels would be highest when heavy construction takes place adjacent to receptors and would drop off at a rate of about 6 dBA per doubling of distance.

Mitigation Measure 1c: A Construction Noise Management Plan will be prepared by the construction contractor and implemented prior to the start of and throughout construction to reduce noise impacts on the nearby existing land uses. The plan will establish the procedures the contractor will take to reasonably minimize construction noise at the nearby existing land uses. The plan would include, but not be limited to, the following measures to reduce construction noise levels as low as practical:

- Construction activities shall be limited to weekdays between the hours of 7:30 a.m. and 5:30 p.m., incompliance with the Contra Costa County and City of Walnut Creek and Municipal Codes. Construction is prohibited on weekends and holidays;

- Construction equipment shall be well-maintained and used judiciously to be as quiet as practical;

- Equip all internal combustion engine-driven equipment with mufflers, which are in good condition and appropriate for the equipment;

- Utilize “quiet” models of air compressors and other stationary noise sources where technology exists;

- Locate all stationary noise-generating equipment, such as air compressors and portable power generators, a minimum of 200 feet from adjacent residential and classroom structures;

- Locate staging areas and construction material areas a minimum of 200 feet from adjacent residential and classroom structures;

- Prohibit all unnecessary idling of internal combustion engines;

- Consider temporary noise barriers during construction phases involving earth moving equipment (e.g., grading operations) where they would be effective in reducing the construction noise impact, when directly adjoining sensitive receptors, such as at the Seven Hills School. An eight-foot plywood noise barrier could reduce noise levels by at least 5 dBA.

- Designate a "disturbance coordinator" who would be responsible for responding to any local complaints about construction noise. The disturbance coordinator will determine the cause of the noise complaint (e.g., starting too early, bad muffler, etc.) and will require that reasonable measures warranted to correct the problem be implemented. Conspicuously post a telephone number for the disturbance coordinator at the construction site and include it in the notice sent to neighbors regarding the construction schedule.

Implementation of the above mitigation measures would limit construction hours and reduce construction noise levels at noise sensitive locations. The highest noise levels would occur during site grading, which is anticipated to be completed within a period of less than one year and during periods where construction is located directly adjacent to noise sensitive locations. With the implementation of Mitigation Measure1c, construction would meet all Contra Costa County and Walnut Creek noise policies and guidelines. However, neither the County nor the City provide quantitative noise limits for construction. Due to the long duration of construction and the increase in noise levels over ambient, this may be a significant and unavoidable impact.

Impact 2: **Generation of Excessive Groundborne Vibration due to Construction.** Construction-related vibration levels would exceed 0.3 in/sec PPV at structures located within 20 feet of heavy construction. **This is a potentially significant impact.**

Neither Contra Costa County nor the City of Walnut Creek specify a construction vibration limit. The California Department of Transportation (see Table 3) establishes a construction limit of 0.25 in/sec PPV for historic and old buildings, 0.3 in/sec PPV for older residential structures, and 0.5 in/sec PPV for new residential and modern commercial/industrial structures. The 0.3 in/sec PPV threshold would apply to structures in the vicinity of the project site.

Construction activities associated with the project would include site preparation, grading and excavation, trenching and foundation work, new building framing and finishing, and paving. Foundations would be constructed using post tension slabs with drilled piers. Pile driving is not proposed as a method of construction.
The closest structures to the site are a school building, located about 10 feet northeast of the property line and about 30 feet from the closest proposed building, a single-family residence, located about 10 feet west of the property line and 70 feet from the nearest proposed building, and a townhome, located about 20 feet south of the property line and 50 feet from the maintenance building. Residential structures to the north are as close as about 100 feet from the site.

Vibration levels would vary depending on soil conditions, construction methods, and equipment used. Table 8 presents typical vibration levels from construction equipment at a reference distance of 25 feet and at a variety of distances representative of the nearest surrounding structures. Vibration levels are highest close to the source, and then attenuate with increasing distance at the rate $(D_{ref}/D)^{1.1}$, where D is the distance from the source in feet and D_{ref} is the reference distance of 25 feet.

TABLE 8 Vibration Levels for Construction Equipment at Various Distances

Equipment		PPV at 10 ft. (in/sec)	PPV at 20 ft. (in/sec)	PPV at 25 ft. (in/sec)	PPV at 30 ft. (in/sec)	PPV at 100 ft. (in/sec)
Clam shovel drop		0.553	0.258	0.202	0.165	0.044
Hydromill (slurry wall)	in soil	0.022	0.010	0.008	0.007	0.002
	in rock	0.047	0.022	0.017	0.014	0.004
Vibratory Roller		0.575	0.268	0.210	0.172	0.046
Hoe Ram		0.244	0.114	0.089	0.073	0.019
Large bulldozer		0.244	0.114	0.089	0.073	0.019
Caisson drilling		0.244	0.114	0.089	0.073	0.019
Loaded trucks		0.208	0.097	0.076	0.062	0.017
Jackhammer		0.096	0.045	0.035	0.029	0.008
Small bulldozer		0.008	0.004	0.003	0.002	0.001

Source: Transit Noise and Vibration Impact Assessment, United States Department of Transportation, Office of Planning and Environment, Federal Transit Administration, September 2019 as modified by Illingworth & Rodkin, Inc., June 2020.

As indicated in Table 8, project construction would be anticipated to produce vibration levels greater than the 'older residential' structure threshold of 0.3 in/sec PPV within 20 feet of construction. The single-family home to the west, townhomes to the south, and school buildings to the east are all located within 20 feet of the property line of the site. Only minor landscaping and parking lot construction activities would be located near shared property lines. Distances from major construction elements, such as building construction, would be 30 feet or greater from existing structures and would not be anticipated to exceed 0.3 in/sec PPV at these locations.

The US Bureau of Mines has analyzed the effects of blast-induced vibration on buildings in USBM RI 8507[1], and these findings have been applied to vibrations emanating from construction equipment on buildings[2]. Figure 2 presents the damage probability as reported in USBM RI 8507 and reproduced by Dowding assuming a maximum vibration level of 0.6 in/sec PPV. As shown on Figure 2, these studies indicate a less than 8% probability of "threshold damage" (referred to as cosmetic damage elsewhere in this report) at vibration levels of 0.6 in/sec PPV or less and no observations of "minor damage" or "major damage" at vibration levels of 0.6 in/sec PPV or less. Based on these data, cosmetic or threshold damage would be manifested in the form of hairline cracking in plaster, the opening of old cracks, the loosening of paint or the dislodging of loose objects. However, minor damage (e.g., hairline cracking in masonry or the loosening of plaster) or major structural damage (e.g., wide cracking or shifting of foundation or bearing walls) to the residential and commercial structures adjacent to the site would not be anticipated to occur assuming a maximum vibration level of 0.6 in/sec PPV.

Groundborne vibration levels from project construction would be anticipated to exceed 0.3 in/sec PPV when heavy construction, such as the use of vibratory rollers, is located within 20 feet of existing structures. Vibration levels may still be perceptible in areas further from the site during periods of heavy construction but would not be expected to cause structural damage. Although it is unlikely that heavy construction will be located so close to shared property lines, mitigation is provided to ensure that vibration impacts do not occur. This is a **potentially significant impact**.

Mitigation Measure 2: The following measures are recommended to minimize vibration impacts from construction activities:

- Avoid the use of vibratory rollers and other heavy construction equipment within 20 feet of existing structures.

- Place operating equipment on the construction site as far as possible from vibration-sensitive receptors.

- Use smaller equipment within 20 feet of the perimeter property lines adjoining off site structures to minimize vibration levels below the limits.

- Select demolition methods not involving impact tools within 100 feet of the perimeter property lines adjoining off site structures.

- Avoid dropping heavy objects or materials near vibration sensitive locations.

- A list of all heavy construction equipment to be used for this project known to produce high vibration levels (tracked vehicles, vibratory compaction, jackhammers, hoe rams, etc.) shall be submitted to the County by the contractor. This list shall be used to identify

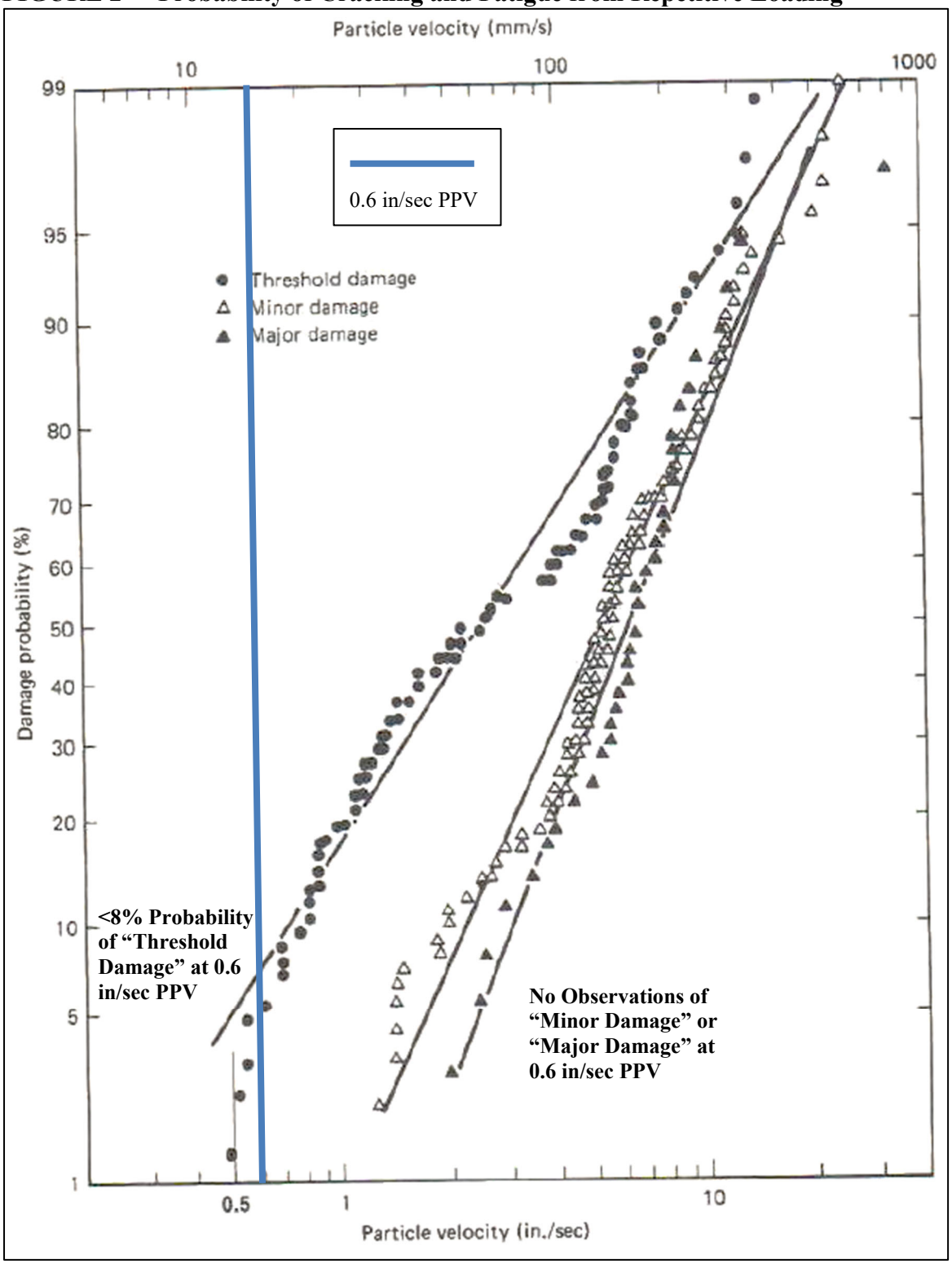
1 Siskind, D.E., M.S. Stagg, J.W. Kopp, and C.H. Dowding, Structure Response and Damage Produced by Ground Vibration form Surface Mine Blasting, RI 8507, Bureau of Mines Report of Investigations, U.S. Department of the Interior Bureau of Mines, Washington, D.C., 1980.

2 Dowding, C.H., Construction Vibrations, Prentice Hall, Upper Saddle River, 1996.

equipment and activities that would potentially generate substantial vibration and to define the level of effort required for continuous vibration monitoring.

Implementation of Mitigation Measure 2 would reduce groundborne vibration due to construction on off-site structures to a ***less-than-significant*** *level.*

FIGURE 2 Probability of Cracking and Fatigue from Repetitive Loading



Source: Dowding, C.H., Construction Vibrations, Prentice Hall, Upper Saddle River, 1996 as modified by Illingworth & Rodkin, Inc., June 2020.