Construction Noise and Vibration Management Plan

2300 Ellsworth Multi-Family

City of Berkeley, California

December 18, 2024

Project #230302

Prepared for:

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INTRODUCTION

This report describes sound levels associated with construction of the proposed 2300 Ellsworth Multi-Family project site in the City of Berkeley, California. This noise reduction plan will outline the control of noise on the site based on a preliminary construction schedule, the list of noise producing equipment anticipated to be used on site, and the proximity of the site to neighboring properties.

Noise levels produced by noise generating equipment on site are predicted at the nearest receptors to determine expected noise levels during construction and practical recommendations are provided to mitigate noise transmission.

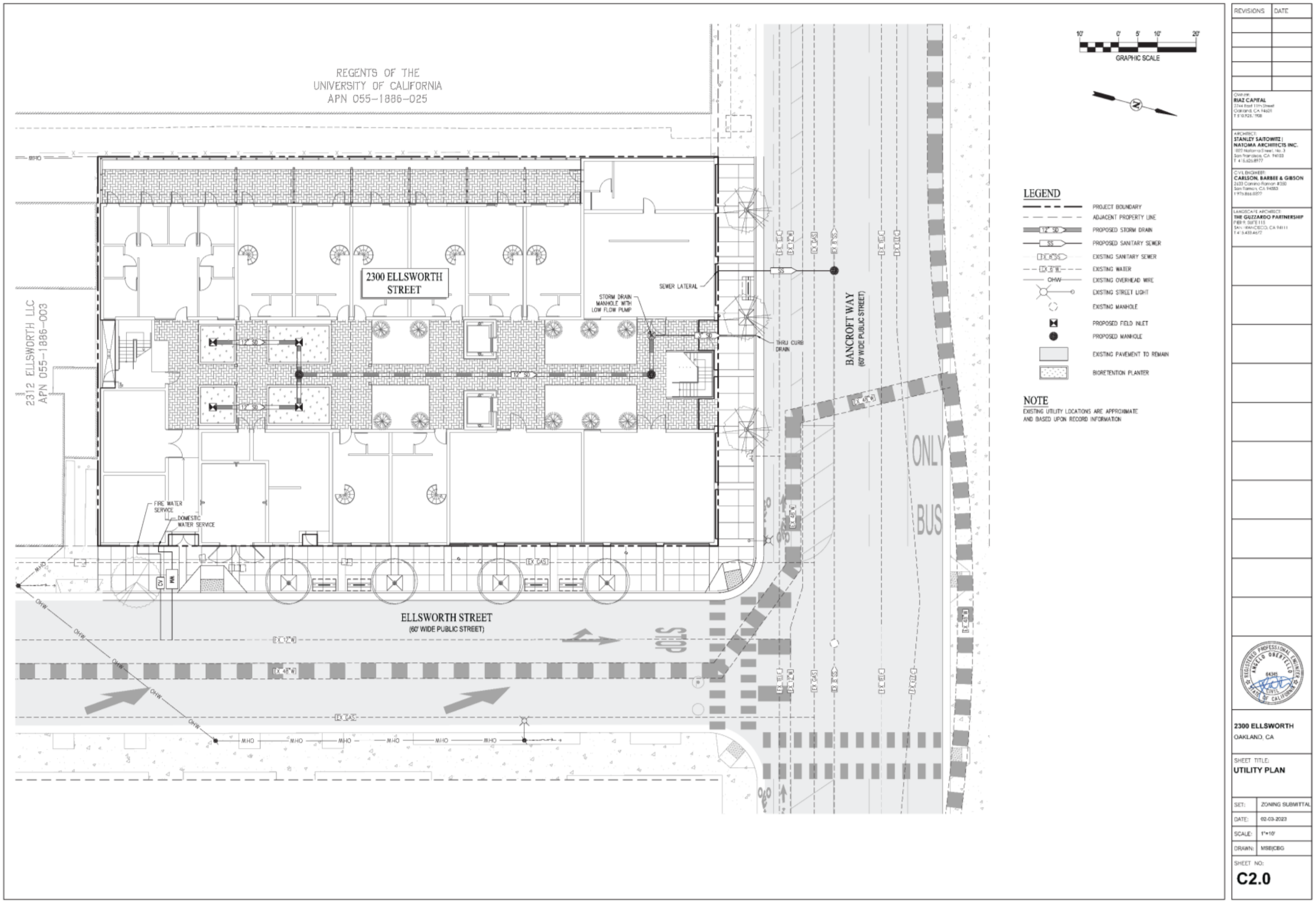
Figure 1 shows the proposed project site plan.

PROJECT SETTING

A vicinity map showing the proposed project site and surrounding properties is shown on **Figure 2**. The site is located in Berkeley, immediately southwest of the intersection of Bancroft Way and Ellsworth Street.

Noise sensitive uses in the area include the following:

- R1 – Career Counseling Library directly to the west
- R2 – Residence directly to the south of the project site
- R3 – Residence directly to the south of the project site
- R4 – Saint Mark's Episcopal Church directly to the east
- R5 – Residence to the southeast

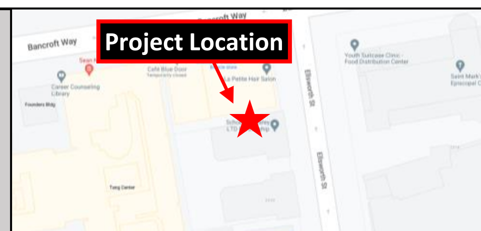


2300 Ellsworth Street Multi-Family

City of Berkeley, California

Figure 1

Project Site Plan



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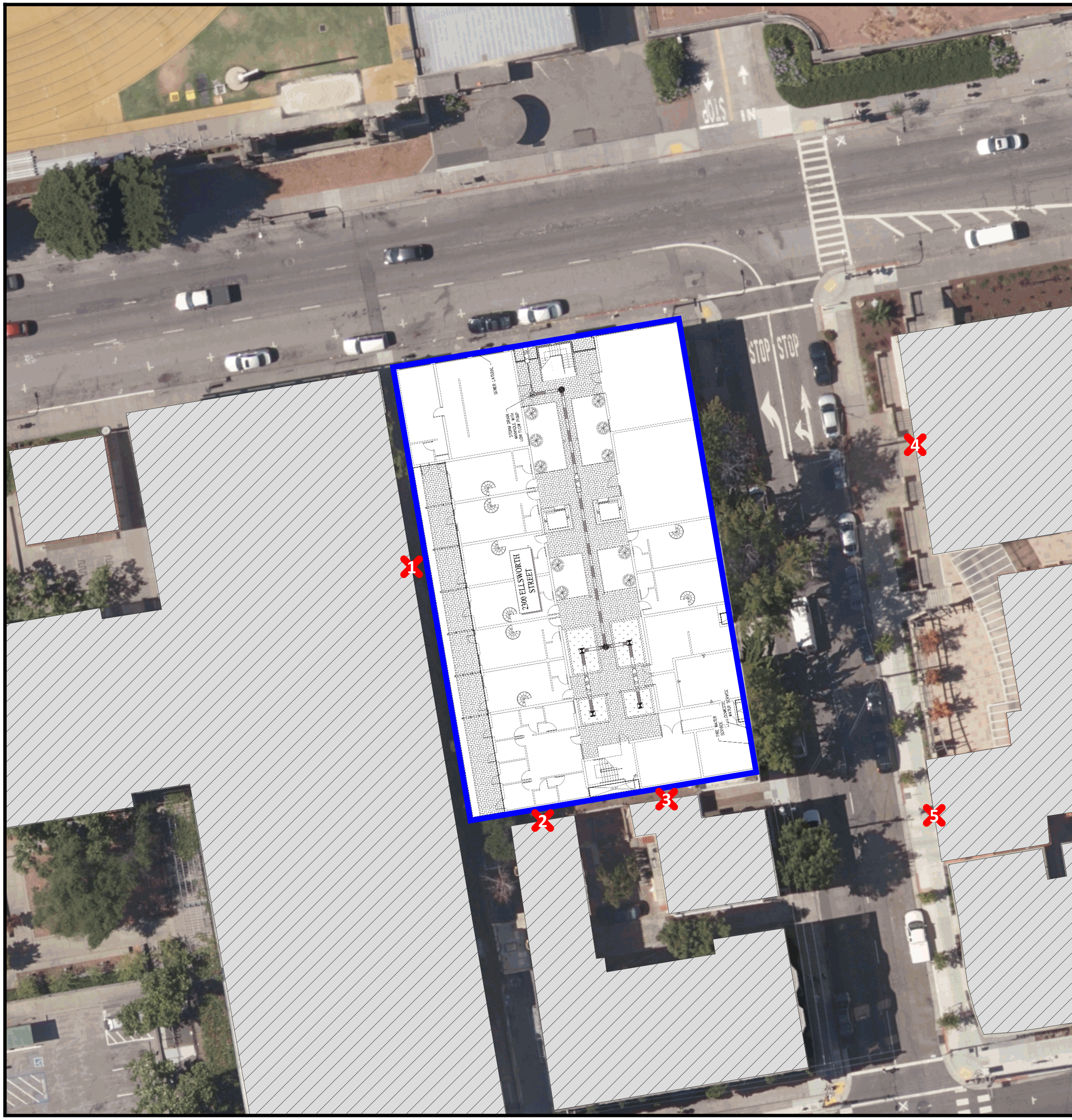

2300 Ellsworth Street MF

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Figure 2

Noise Receptors Location Map

Noise Level, dB(A)

65 <	(yellow)	<=	70
70 <	(orange)	<=	75
75 <	(purple)	<=	80
80 <	(dark blue)		

Legend

- Existing Building
- Project Site

Scale 1:50

0 10 20 40 60 80 feet

N

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BACKGROUND INFORMATION ON NOISE

Fundamentals of Acoustics

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

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

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

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

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

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

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

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

TABLE 1: TYPICAL NOISE LEVELS

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

Source: Caltrans, Technical Noise Supplement, Traffic Noise Analysis Protocol. September, 2013.

Effects of Noise on People

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

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

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

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

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

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

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

Regulatory Context

City of Berkeley General Plan

7. Construction/Demolition.

   (a) Operating or causing the operation of any tools or equipment used in construction, drilling, repair, alteration, or demolition work before 7:00 a.m. on a weekday (or before 9:00 a.m. on a weekend or holiday) or after 7:00 p.m. on a weekday (or after 8:00 p.m. on a weekend or holiday) such that the sound therefrom across a residential or commercial real property line violates Section 13.40.050 or 13.40.060, except for emergency work of public service utilities or by variance issued by the EHD. (This section shall not apply to the use of domestic power tools as specified in subsection B.11 of this section.)

   (b) Noise Restrictions at Affected Properties. Where technically and economically feasible, construction activities shall be conducted in such a manner that the maximum sound levels at affected properties will not exceed those listed in the following schedule:

AT RESIDENTIAL PROPERTIES:

Table 13.40-3: Mobile Equipment. Maximum sound levels for non-scheduled, intermittent, short-term operation (less than 10 days) of mobile equipment:

	R-1, R-2 Residential	R-3 and above Multi-Family Residential	Commercial/Industrial
Weekdays 7:00 a.m. to 7:00 p.m.	75 dBA	80 dBA	85 dBA
Weekends 9:00 a.m. to 8:00 p.m. and legal holidays	60 dBA	65 dBA	70 dBA

Table 13.40-4. Stationary Equipment. Maximum sound levels for repetitively scheduled and relatively long-term operation (period of 10 days or more) of stationary equipment:

	R-1, R-2 Residential	R-3 and above Multi-Family Residential	Commercial/Industrial
Weekdays 7:00 a.m. to 7:00 p.m.	60 dBA	65 dBA	70 dBA
Weekends 9:00 a.m. to 8:00 p.m. and legal holidays	50 dBA	55 dBA	60 dBA

Existing Noise Conditions

Short-term noise monitoring was conducted to establish existing ambient noise levels around the project site. **Figure 2** shows the locations of the ambient noise survey points. **Table 2** provides a summary of the collected ambient noise readings and **Appendix B** provides the complete results of the ambient noise survey.

The sound level meters were programmed to record the maximum, median, and average noise levels at each site during the survey. The maximum value, denoted L_{max}, represents the highest noise level measured. The average value, denoted L_{eq}, represents the energy average of all of the noise received by the sound level meter microphone during the monitoring period. The median value, denoted L_{50}, represents the sound level exceeded 50 percent of the time during the monitoring period.

Larson Davis Laboratories (LDL) Model 831 precision integrating sound level meters were used for the ambient noise level measurement survey. The meter was calibrated before and after use with a CAL 200 acoustical calibrator to ensure the accuracy of the measurements. The equipment used meets all pertinent specifications of the American National Standards Institute for Type 1 sound level meters (ANSI S1.4).

TABLE 2: SUMMARY OF EXISTING BACKGROUND NOISE MEASUREMENT DATA

Site	Date	Average Measured Noise Levels, dBA		
		Daytime (7:00 am - 10:00 pm)		
		L_{eq}	L_{50}	L_{max}
ST-1: 30 ft. to CL of Ellsworth St.	4/4/2023 10:50 AM	66	59	89
ST-2: 30 ft. to CL of Ellsworth St.	4/4/2023 11:03 AM	56	53	73
ST-3: 30 ft. to CL of Bancroft Way	4/6/2023 11:16 AM	73	61	98

Source: Saxelby Acoustics – 2023

Based upon the ambient noise measurements shown in **Table 2**, the existing noise level was found to be less than, or approximately equal to, the City's allowable construction noise level limit of 65 dBA.

CONSTRUCTION SCHEDULE AND ANTICIPATED EQUIPMENT

Construction of the project is anticipated to occur over approximately 16 months. While activity during later phases of construction is anticipated to occur inside, which will be significantly quieter, early phases of site work, demolition, excavation, and foundation work will incorporate the use of noise producing equipment outside. A brief description of each phase is listed below:

Demolition – Phase will utilize standard excavator equipment with occasional use of breaking hammers to demolish existing CMU, masonry, and timber frame construction buildings on site.

Grading/Excavation/Shoring – The excavation equipment will be standard excavating equipment. It is expected that there will be three excavators on site; one stockpiling, one loading trucks, and one assisting the shoring contractor. There may also be up to two rubber-tired dozers at any given time. It is anticipated that the earthwork will take 3 weeks.

Foundation – Phase will include construction using standard pump trucks for the larger concrete pours.

Wood Framing – Standard nailing equipment will be used to attach them. Phase will incorporate installation of mild structural steel and miscellaneous welding.

Exterior Shell – Exterior consists of stucco and cement board siding. Primary noise sources are handheld saws, nail guns and screw guns.

Roofing – Mechanically fastened TPO roof.

None of the sources identified above are expected to be “extreme” noise generators under typical operating conditions at nominal distances of 50 ft. or greater from the equipment. “Extreme” noise generators are defined as those generating maximum noise levels above 90 dBA.

CONSTRUCTION NOISE ANALYSIS

The Federal Highway Administration’s (FHWA) Roadway Construction Noise Model (RCNM) was used to predict noise levels for standard construction equipment used for roadway improvement projects. The assessment of potential significant noise effects due to construction is based on the standards and procedures described in the Federal Transit Authority (FTA) guidance manual and FHWA’s RCNM.

The RCNM is a Windows-based noise prediction model that enables the prediction of construction noise levels for a variety of construction equipment based on a compilation of empirical data and the application of acoustical propagation formulas. It enables the calculation of construction noise levels in more detail than the manual methods, which eliminates the need to collect extensive amounts of project-specific input data. RCNM allows for the modeling of multiple pieces of construction equipment working either independently or simultaneously, the character of noise emission, and the usage factors for each piece of equipment.

Construction noise varies depending on the construction process, type of equipment involved, location of the construction site with respect to sensitive receptors, the schedule proposed to carry out each task (e.g., hours and days of the week), and the duration of the construction work.

Noise sources in the RCNM database include actual noise levels and equipment usage percentages. This source data was used in this construction noise analysis. **Table 3** shows predicted construction noise levels for each of the project construction phases.

Table 3: Construction Equipment Noise Levels for Primary Construction Phases

Equipment	Quantity	Usage (%)	Maximum, L_{max} (dBA at 50 feet)	Hourly Average, L_{eq} (dBA at 50 feet)
Demolition				
Concrete/Industrial Saws	1	20	90	83
Excavators	3	40	81	82
Rubber Tired Dozers	2	40	82	81
			Total:	**87**
Grading/Excavation/Shoring				
Excavators	1	40	81	77
Graders	1	40	85	81
Rubber Tired Dozers	1	40	82	78
Tractors/Loaders/Backhoes	3	40	79	80
			Total:	**85**
Foundation				
Excavators	1	40	81	77
Concrete Mixer Truck	1	40	79	75
Concrete Pump Truck	1	20	81	74
			Total:	**80**
Steel Erection/Framing				
Crane	1	16	81	73
Forklifts	2	40	83	82
Generator Sets	1	50	81	78
Tractors/Loaders/Backhoes	1	40	79	75
Crane	1	16	81	73
Welders	1	40	74	70
			Total:	**85**
Exterior Shell				
Air Compressors	3	40	78	79
			Total:	**79**

Source: FHWA, Roadway Construction Noise Model (RCNM), January 2006.

Based upon the **Table 3** data, demolition is predicted to be the loudest phase of construction with an average noise exposure of 87 dBA at 50 feet. Saxelby Acoustics used the SoundPLAN noise model to calculate noise levels at the nearest sensitive receptors. The results of this analysis are shown graphically on **Figure 3**. A summary of the noise prediction results for each phase of construction are shown in **Table 4**.

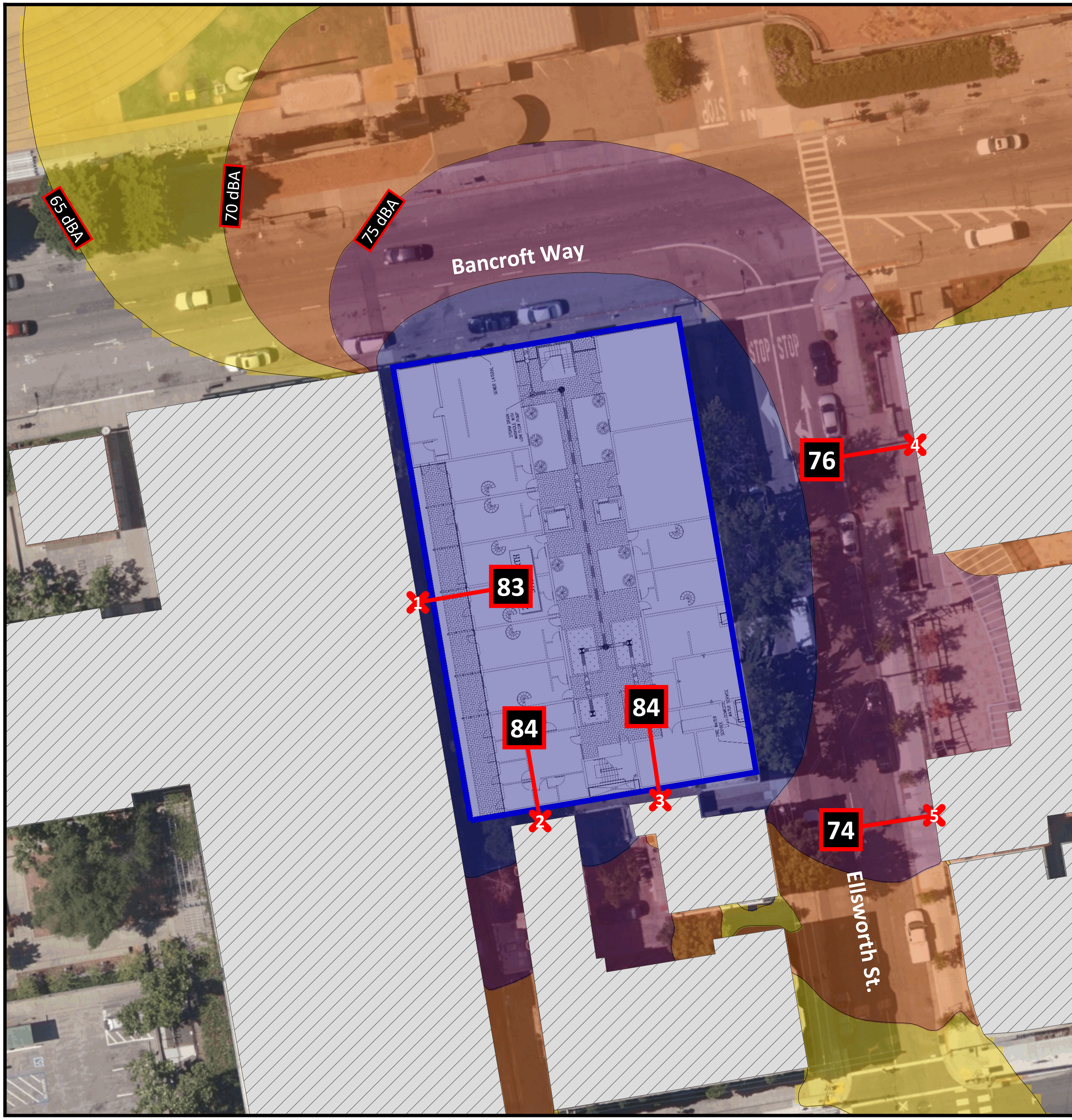

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Figure 3

Peak Construction Noise Levels Leq,d, dB(A)

Noise Level, dB(A)

65 < <= 70
70 < <= 75
75 < <= 80
80 <

Legend

Existing Building
Project Site

Scale 1:50

0 10 20 40 60 80 feet

N

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Table 4: Predicted Construction Noise Levels by Loudest Phases

Receiver	Predicted Unshielded Noise Level, L_{eq}	Predicted Noise Level with Shielding, L_{eq}
Demolition		
R1 – Career Counseling Library directly to the west	83 dBA	66 dBA
R2 – Residence directly to the southwest of the project site	84 dBA	67 dBA
R3 – Residence directly to the southeast of the project site	84 dBA	68 dBA
R4 – Saint Mark's Episcopal Church directly to the east	76 dBA	67 dBA
R5 – Residence to the southeast	74 dBA	63 dBA
Grading/Excavation/Shoring		
R1 – Career Counseling Library directly to the west	81 dBA	64 dBA
R2 – Residence directly to the southwest of the project site	82 dBA	65 dBA
R3 – Residence directly to the southeast of the project site	82 dBA	66 dBA
R4 – Saint Mark's Episcopal Church directly to the east	74 dBA	65 dBA
R5 – Residence to the southeast	72 dBA	61 dBA
Foundation		
R1 – Career Counseling Library directly to the west	76 dBA	59 dBA
R2 – Residence directly to the southwest of the project site	77 dBA	60 dBA
R3 – Residence directly to the southeast of the project site	77 dBA	61 dBA
R4 – Saint Mark's Episcopal Church directly to the east	69 dBA	60 dBA
R5 – Residence to the southeast	67 dBA	56 dBA
Steel Erection/Framing		
R1 – Career Counseling Library directly to the west	81 dBA	64 dBA
R2 – Residence directly to the southwest of the project site	82 dBA	65 dBA
R3 – Residence directly to the southeast of the project site	82 dBA	66 dBA
R4 – Saint Mark's Episcopal Church directly to the east	74 dBA	65 dBA
R5 – Residence to the southeast	72 dBA	61 dBA
Exterior Shell		
R1 – Career Counseling Library directly to the west	75 dBA	58 dBA
R2 – Residence directly to the southwest of the project site	76 dBA	59 dBA
R3 – Residence directly to the southeast of the project site	76 dBA	60 dBA
R4 – Saint Mark's Episcopal Church directly to the east	68 dBA	59 dBA
R5 – Residence to the southeast	66 dBA	55 dBA

As can be seen from the results outlined in the table above, noise levels from the loudest phases of construction could exceed the 80 dBA code limit at the nearby residential property lines without shielding. If the loudest pieces of equipment were able to be shielded by plywood site fencing or other temporary shrouds, a 6-10 dBA reduction would be expected. In this case, predicted noise levels would range between 58-76 dBA, meeting the City of Berkeley 80 dBA construction noise limit for residential uses and 85 dBA for commercial/industrial uses.

Noise would also be generated during the construction phase by increased truck traffic on area roadways. A project-generated noise source would be truck traffic associated with transport of heavy materials and equipment to and from the construction site. This noise increase would be of short duration and would occur during daytime hours.

Per the City's Standard Conditions of Approval, Condition 18 the project would be required to develop a site-specific noise reduction program prepared by a qualified acoustical consultant to reduce construction noise impact. Specific requirements include, but are not limited to the following:

A. Construction equipment should be well maintained and used judiciously to be as quiet as practical.

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

C. Utilize "quiet" models of air compressors and other stationary noise sources where technology exists. Select hydraulically or electrically powered equipment and avoid pneumatically powered equipment where feasible.

D. Locate stationary noise-generating equipment as far as possible from sensitive receptors when adjoining construction sites. Construct temporary noise barriers or partial enclosures to acoustically shield such equipment where feasible.

E. Prohibit unnecessary idling of internal combustion engines.

F. If impact pile driving is required, pre-drill foundation pile holes to minimize the number of impacts required to seat the pile.

G. Construct solid plywood fences around construction sites adjacent to operational business, residences or other noise-sensitive land uses where the noise control plan analysis determines that a barrier would be effective at reducing noise.

H. Erect temporary noise control blanket barriers, if necessary, along building facades facing construction sites. This mitigation would only be necessary if conflicts occurred which were irresolvable by proper scheduling. Noise control blanket barriers can be rented and quickly erected.

I. Route construction related traffic along major roadways and away from sensitive receptors where feasible.

As noted above and shown in **Figure 4** use of shielding, as required per condition of approval 18-A would be sufficient to achieve the noise limits set by the City of Berkeley.

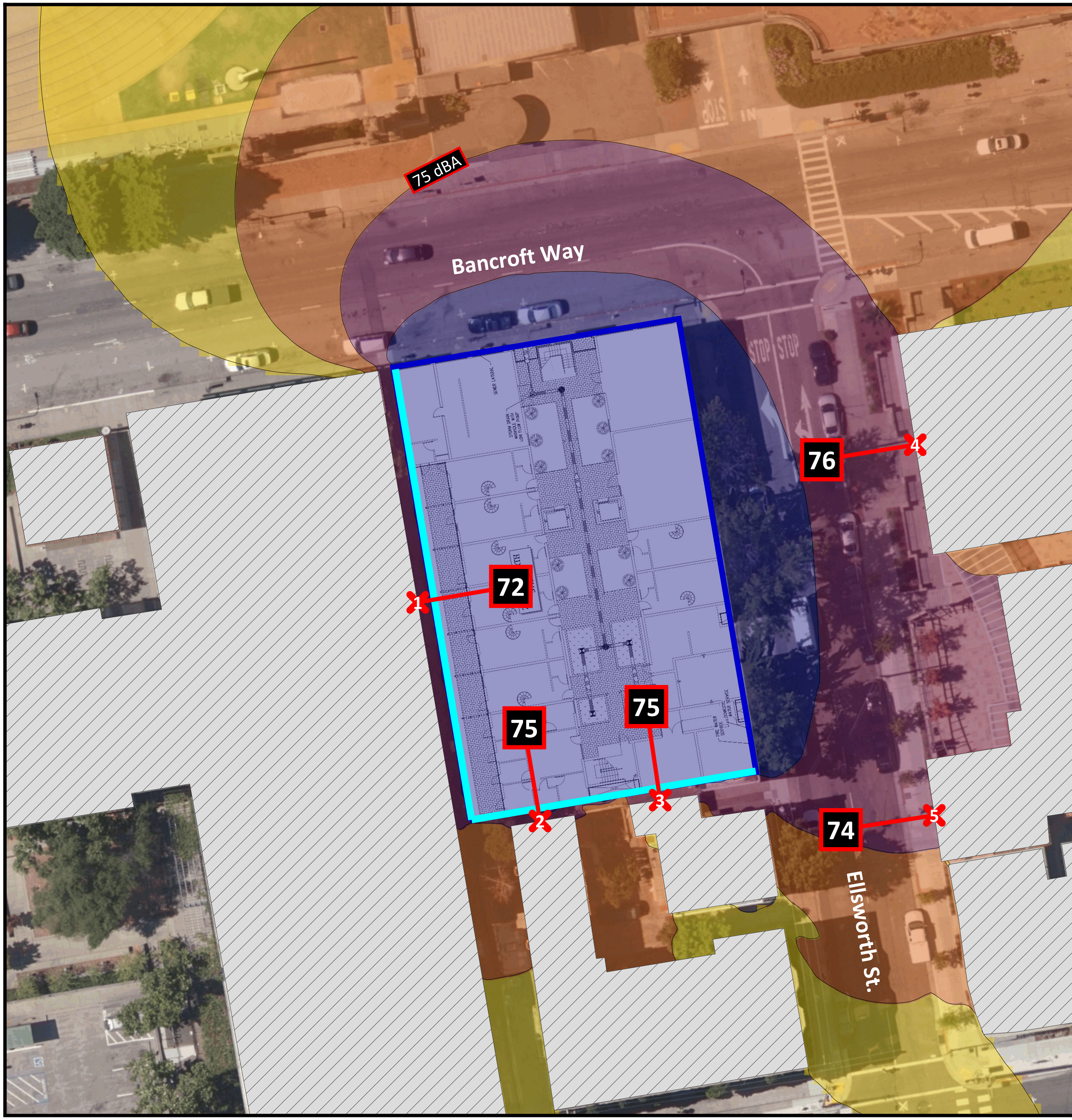

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Figure 4

Construction Noise Levels with Barrier
Leq,d, dB(A)

Noise Level, dB(A)

65 <	<=	70
70 <	<=	75
75 <	<=	80
80 <		

Legend

Existing Building

Project Site

Sound Wall

Scale 1:50

0 10 20 40 60 80 feet

N

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CONSTRUCTION VIBRATION ANALYSIS

Construction vibration impacts include human annoyance and building structural damage. Human annoyance occurs when construction vibration rises significantly above the threshold of perception. Building damage can take the form of cosmetic or structural. Saxelby Acoustics concur that the adjacent buildings 2312 Ellsworth Street and 2241 Durant Avenue should not be exposed to vibrations exceeding 0.2 inches per second (in/sec) peak particle velocity (PPV). This is based on the Federal Transit Administration (FTA)[1] guidance to limit construction damage risk to non-engineered timber and masonry buildings. A limit of 0.5 in/sec PPV for reinforced-concrete, steel or timber is also appropriate for 2222 Bancroft Way. **Table 5** shows the types of equipment proposed to be used for the project and the expected setback distances of that equipment.

TABLE 5: BUFFER DISTANCES OF PROPOSED CONSTRUCTION EQUIPMENT

Type of Equipment	Minimum Distance, feet[1]			PPV, in/sec		
	2312 Ellsworth	2241 Durant Avenue	2222 Bancroft Way	2312 Ellsworth[2]	2241 Durant Avenue[2]	2222 Bancroft Way[3]
Jackhammer	8	8	4	0.20	0.20	0.50
Large Bulldozer	15	15	8	0.20	0.20	0.50
Loaded Trucks	13	13	7	0.20	0.20	0.50
Small Bulldozer	2	2	1	0.20	0.20	0.50
Vibratory Hammer	12	12	7	0.20	0.20	0.50
Vibratory Roller	26	26	14	0.20	0.20	0.50

Notes:
[1]As measured from adjacent buildings facades.
[2]Construction Vibration Criteria of 0.2 ppv, in/sec
[3]Construction Vibration Criteria of 0.5 ppv, in/sec

It should be noted that these peak levels of construction vibration are typically very short in duration. Site grading is predicted to take approximately 7-9 days with foundation construction expected to take approximately 1 month. During this time construction activity occurs across the entire project site and is not concentrated at the closest property line. When construction activity occurs near the property line, the duration of the highest vibration levels shown in **Table 5** would typically be very short, in the order of several minutes at any one location on a given day. The total duration of the highest levels of vibration is likely in the order of several hours or less at any given receptor location.

Noise and Vibration Reduction Measures

To reduce construction noise and vibration levels, the following measures are recommended:

<u>Construction Days/Hours</u>

- Construction activity shall be limited to between the hours of 7:00 a.m. and 6:00 p.m. on Monday and Friday. Construction activities are allowed between 9:00 a.m. to 4:00 p.m. on Saturday only within the interior of the buildings with the doors and windows closed. No extreme noise generating activities greater than 90 dBA are allowed on Saturday. No construction-related activity shall occur on Sunday or any Federal Holiday.
- Equipment and trucks used for project construction shall utilize the best available noise control techniques (e.g., improved mufflers, equipment redesign, use of intake silencers, ducts, engine enclosures and acoustically-attenuating shields or shrouds) wherever feasible.
- Except as provided herein, impact tools (e.g., jack hammers, pavement breakers, and rock drills) used for project construction shall be hydraulically or electrically powered to avoid noise associated with compressed air exhaust from pneumatically powered tools. However, where use of pneumatic tools is unavoidable, an exhaust muffler on the compressed air exhaust shall be used; this muffler can lower noise levels from the exhaust by up to about 10 dBA. External jackets on the tools themselves shall be used, if such jackets are commercially available, and this could achieve a reduction of 5 dBA. Quieter procedures shall be used, such as drills rather than impact equipment, whenever such procedures are available and consistent with construction procedures.
- Applicant shall use temporary power poles instead of generators where feasible.
- Stationary noise sources shall be located as far from adjacent properties as possible, and they shall be muffled and enclosed within temporary sheds, incorporate insulation barriers, or use other measures as determined by the City to provide equivalent noise reduction.
- Dump truck loading during demolition will take place at the south edge of the site, as far as practical from adjacent sensitive receptors.
- The noise and safety enforcement manager for the project shall ensure responsive and corrective action to complaints within the same working day if the complaint is received during the noise-related incident and from sensitive receptors residing within the adjacent residential building.
- Operation of vibration generating equipment such vibratory rollers, excavators, rubber-tired dozers, graders, tractors/loaders/backhoes, concrete mixer trucks, concrete pump trucks, auger/drill rigs, jackhammer, and vibratory hammers shall be used at distances stated in **Table 5**, or greater.
- If vibration setbacks cannot be maintained, additional analysis of construction vibration, including documentation of pre-construction documentation of the existing condition of adjacent structures should be implemented.
- In the event of noise complaints, Saxelby Acoustics recommends site fencing consisting of ½" plywood[1] (1.45 lb/sf2) should be placed when feasible to shield nearby sensitive receptors. The

[1] The minimum ½" plywood (1.45 lb./sf^2) is predicted to provide a sound transmission loss of approximately 22 dBA at 500 hertz. 500 hertz is the typical center frequency of construction equipment. The predicted sound wall is

plywood barrier should be free from gaps, openings, or penetrations to ensure maximum performance. It is expected that this would include 8' tall plywood fencing around the perimeter of the project site.

- It is recognized that certain construction activities, such as the placement of concrete, must be performed in a continuous manner and may require an extension of these work hours. Prior to initiating any activity that might require a longer period, the developer must notify that Zoning Officer and request, then two weeks prior to the expanded schedule, the developer shall notify businesses and residents within 500 feet of the project site describing the expanded construction hours. A copy of such notice and methodology for distributing the notice shall be provided in advance to the City for review and approval. The project shall not be allowed more than 15 extended working days.

CONCLUSIONS

Based on noise levels for the anticipated construction activity on site, and operational assumptions of the equipment, construction noise and vibration levels have been predicted at the surrounding sensitive receptors. To minimize the impact of construction noise and vibration on sensitive uses, practical measures have been recommended.

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predicted to achieve a minimum 4-11 dBA overall noise reduction. Therefore, the sound transmitted through the ½" plywood would be approximately 10-18 dB quieter than the sound coming over the top of the barrier and would not result in degradation of the 5-12 dBA noise reduction provided by the barrier.

Appendix A: Acoustical Terminology

Acoustics	The science of sound.
Ambient Noise	The distinctive acoustical characteristics of a given space consisting of all noise sources audible at that location. In many cases, the term ambient is used to describe an existing or pre-project condition such as the setting in an environmental noise study.
ASTC	Apparent Sound Transmission Class. Similar to STC but includes sound from flanking paths and correct for room reverberation. A larger number means more attenuation. The scale, like the decibel scale for sound, is logarithmic.
Attenuation	The reduction of an acoustic signal.
A-Weighting	A frequency-response adjustment of a sound level meter that conditions the output signal to approximate human response.
Decibel or dB	Fundamental unit of sound, A Bell is defined as the logarithm of the ratio of the sound pressure squared over the reference pressure squared. A Decibel is one-tenth of a Bell.
CNEL	Community Noise Equivalent Level. Defined as the 24-hour average noise level with noise occurring during evening hours (7 - 10 p.m.) weighted by +5 dBA and nighttime hours weighted by +10 dBA.
DNL	See definition of Ldn.
IIC	Impact Insulation Class. An integer-number rating of how well a building floor attenuates impact sounds, such as footsteps. A larger number means more attenuation. The scale, like the decibel scale for sound, is logarithmic.
Frequency	The measure of the rapidity of alterations of a periodic signal, expressed in cycles per second or hertz (Hz).
Ldn	Day/Night Average Sound Level. Similar to CNEL but with no evening weighting.
Leq	Equivalent or energy-averaged sound level.
Lmax	The highest root-mean-square (RMS) sound level measured over a given period of time.
L(n)	The sound level exceeded a described percentile over a measurement period. For instance, an hourly L50 is the sound level exceeded 50% of the time during the one-hour period.
Loudness	A subjective term for the sensation of the magnitude of sound.
NIC	Noise Isolation Class. A rating of the noise reduction between two spaces. Similar to STC but includes sound from flanking paths and no correction for room reverberation.
NNIC	Normalized Noise Isolation Class. Similar to NIC but includes a correction for room reverberation.
Noise	Unwanted sound.
NRC	Noise Reduction Coefficient. NRC is a single-number rating of the sound-absorption of a material equal to the arithmetic mean of the sound-absorption coefficients in the 250, 500, 1000, and 2,000 Hz octave frequency bands rounded to the nearest multiple of 0.05. It is a representation of the amount of sound energy absorbed upon striking a particular surface. An NRC of 0 indicates perfect reflection; an NRC of 1 indicates perfect absorption.
RT60	The time it takes reverberant sound to decay by 60 dB once the source has been removed.
Sabin	The unit of sound absorption. One square foot of material absorbing 100% of incident sound has an absorption of 1 Sabin.
SEL	Sound Exposure Level. SEL is a rating, in decibels, of a discrete event, such as an aircraft flyover or train pass by, that compresses the total sound energy into a one-second event.
SPC	Speech Privacy Class. SPC is a method of rating speech privacy in buildings. It is designed to measure the degree of speech privacy provided by a closed room, indicating the degree to which conversations occurring within are kept private from listeners outside the room.
STC	Sound Transmission Class. STC is an integer rating of how well a building partition attenuates airborne sound. It is widely used to rate interior partitions, ceilings/floors, doors, windows and exterior wall configurations. The STC rating is typically used to rate the sound transmission of a specific building element when tested in laboratory conditions where flanking paths around the assembly don't exist. A larger number means more attenuation. The scale, like the decibel scale for sound, is logarithmic.
Threshold of Hearing	The lowest sound that can be perceived by the human auditory system, generally considered to be 0 dB for persons with perfect hearing.
Threshold of Pain	Approximately 120 dB above the threshold of hearing.
Impulsive	Sound of short duration, usually less than one second, with an abrupt onset and rapid decay.
Simple Tone	Any sound which can be judged as audible as a single pitch or set of single pitches.

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Appendix B: Short-Term Ambient Noise Measurement Results

Appendix B1 : Short Term Noise Monitoring Results

Site:	**ST-1**
Project:	**2300 Ellsworth Street Multi Family Residential**
Location:	**South of Project Site**
Coordinates:	**(39.1200676, -121.6150012)**
Meter:	**LDL 831-2**
Calibrator:	**CAL200**

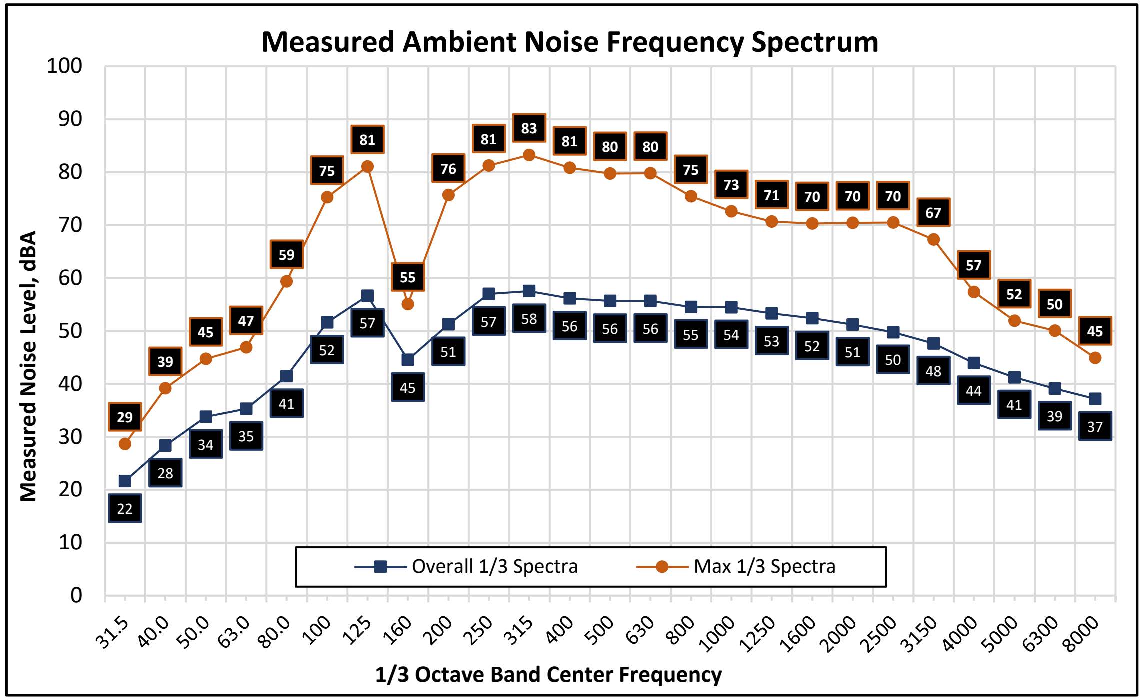
Start:	2023-04-04 10:50:51
Stop:	2023-04-04 11:00:51
SLM:	Model 831
Serial:	3141

Measurement Results, dBA

Duration:	0:10
L_{eq}:	66
L_{max}:	89
L_{min}:	48
L_{50}:	59
L_{90}:	52

Notes

Primary noise source is derived from traffic on Durant Avenue, secondary noise source is derived from traffic on Ellsworth Street. Lmax is driven by heavy truck passby.



Appendix B2 : Short Term Noise Monitoring Results

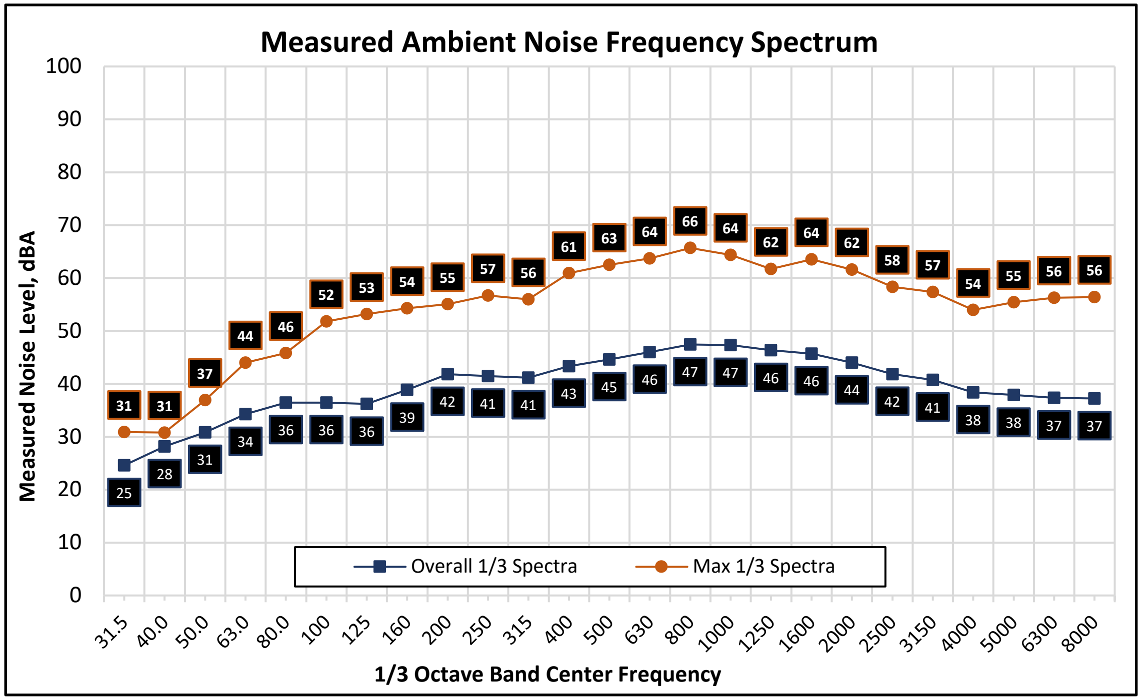
Site: ST-2
Project: 2300 Ellsworth Street Multi Family Residential
Meter: LDL 831-2
Location: East of the Project Site
Calibrator: CAL200
Coordinates: (39.1200676, -121.6150012)

Start: 2023-04-04 11:03:03
Stop: 2023-04-04 11:15:59
SLM: Model 831
Serial: 3141

Measurement Results, dBA	
Duration:	0:10
L_{eq}:	56
L_{max}:	73
L_{min}:	46
L_{50}:	53
L_{90}:	49

Notes

Primary noise source is drived from traffic on Bancroft Way, Lmax is driven by pedestrian traffic and emergency vehicles siren.



Appendix B3 : Short Term Noise Monitoring Results

Site: ST-3
Project: 2300 Ellsworth Street Multi Family Residential
Meter: LDL 831-2
Location: North of the Project Site
Calibrator: CAL200
Coordinates: (39.1200676, -121.6150012)

Start: 2023-04-04 11:16:14
Stop: 2023-04-04 11:36:14
SLM: Model 831
Serial: 3141

Measurement Results, dBA

Duration:	0:20
L_{eq}:	73
L_{max}:	98
L_{min}:	49
L_{50}:	61
L_{90}:	54

Notes

Primary noise source is traffic from Bancroft Avenue, Lmax is driven by Emergency vehicle sirens passing by.