

**2800 TELEGRAPH AVENUE
BERKELEY, CA
CONSTRUCTION NOISE AND VIBRATION STUDY**



Prepared For: Bright Street, VIA Design Build

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Resonance Project No. 26030.01

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1.0 Project Description

This project consists of the replacement of an existing single-story residential building with a new 6-story multi-family building that includes a community space and one very low-income unit; the project is located at 2800 Telegraph Avenue in Berkeley, CA. This report provides a summary of construction-related noise and vibration criteria established by the City of Berkeley, the expected noise and vibration levels at nearby sensitive receivers from project-related construction activity, and the recommended mitigation measures to meet the criteria. Construction information provided by the project team has been used to estimate construction noise and vibration levels at the nearest sensitive receivers.

To address potentially excessive construction noise, Section 6.0 provides noise control recommendations and other Conditions of Approval requirements; to address potential vibration concerns, see Section 8.0 for recommended equipment buffer zones.

2.0 Construction Noise Standards

The construction activities for this project are expected to produce noise levels that are consistent with those found during typical development activities in urban areas. Conditions of Approval are provided by the City of Berkeley to mitigate any potential disturbance due to construction, presented in Section 2.1.

Relevant standards in the City's Noise Ordinance are also considered in this analysis. Applicable portions of the municipal code construction noise ordinance are presented in Section 2.2.

2.1 Berkeley Conditions of Approval – Construction Noise

- **Construction Noise Reduction Program (COA #14):** The applicant shall develop a site-specific noise reduction program prepared by a qualified acoustical consultant to reduce construction noise impacts to the maximum extent feasible, subject to review and approval of the Zoning Officer. The noise reduction program shall include the time limits for construction listed above, as measures needed to ensure that construction complies BMC Section 13.40.070, Prohibited Acts. The noise reduction program should include, but shall not be limited to, the following available controls to reduce construction noise levels as low as practical:
 - 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. (*Impact pile driving is not planned – this item is not applicable*).

- G. Construct solid plywood fences around construction sites adjacent to operational businesses, residences or other noise-sensitive land uses where the noise control plan analysis determines that a barrier will be effective at reducing noise.
- H. Erect temporary noise control blanket barriers, if necessary, along building facades facing construction sites. This mitigation will 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.
- **Construction Noise Management – Public Notice Required (COA #17):** At least two weeks prior to initiating any construction activities at the site, the applicant shall provide notice to businesses and residents within **500 feet** of the project site. This notice shall at a minimum provide the following: (1) project description, (2) description of construction activities during extended work hours and reason for extended hours, (3) daily construction schedule (i.e., time of day) and expected duration (number of months), (4) the name and phone number of the Project Liaison that is responsible for responding to any local complaints, and (5) that construction work is about to commence. The liaison would determine the cause of all construction-related complaints (e.g., starting too early, bad muffler, worker parking, etc.) and institute reasonable measures to correct the problem. A copy of such notice and methodology for distributing the notice shall be provided in advance to the City for review and approval.
- **Construction Phases (COA #18):** The applicant shall provide the Zoning Officer with a schedule of major construction phases with start dates and expected duration, a description of the activities and anticipated noise levels of each phase, and the name(s) and phone number(s) of the individual(s) directly supervising each phase. The Zoning Officer or his/her designee shall have the authority to require an on-site meeting with these individuals as necessary to ensure compliance with these conditions. The applicant shall notify the Zoning Officer of any changes to this schedule as soon as possible.
- **Construction Hours (COA #34):** Construction activity shall be limited to between the hours of 7:00 AM and 6:00 PM on Monday through Friday and between 9:00 AM and 4:00 PM on Saturday. No construction-related activity shall occur on Sunday or any Federal Holiday.
- **Construction Hours – Exceptions (COA #35):** 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 the Zoning Officer and request an exception for a finite period of time. If the Zoning Officer approves the 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.
- **Project Construction Website (COA #36):** The applicant shall establish a project construction website with the following information clearly accessible and updated monthly or more frequently as changes warrant:
 - Contact information (i.e., “hotline” phone number, and email address) for the project construction manager.
 - Calendar and schedule of daily/weekly/monthly construction activities.

- The final Conditions of Approval, Mitigation Monitoring and Reporting Program, Transportation Construction Plan, Construction Noise Reduction Program, and any other reports or programs related to construction noise, air quality, and traffic.

2.2 Berkeley Municipal Code – Construction Noise

Per Berkeley’s Conditions of Approval (COA #14), project-related construction noise shall be evaluated against the noise standards contained in the City of Berkeley Municipal Code. The following activities are prohibited:

- Section 13.40.070(B)(7): Construction/Demolition.
 - Operating or causing the operation of any tools or equipment used in construction, drilling, repair, alteration, or demolition work before 7 AM on a weekday (or before 9 AM on a weekend or holiday) or after 7 PM on a weekday (or after 8 PM 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.

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 (see Table 1).

The Berkeley Municipal Code includes different restrictions for construction noise depending on the duration of operation of equipment. Table 1 presents the maximum sound levels for nonscheduled, intermittent, short-term operation (less than 10 days) of mobile equipment as well as recurring and long-term operation (period of 10 days or more) of stationary equipment. The proposed construction plan delivered by the project team provides details of each construction phase.

Table 1: Berkeley Municipal Code - Construction Equipment Noise Limits at Property Line
 (Ref. Tables 13.40-3 and 13.40-4)

Time Period	Length of Construction Phase (Days)	Maximum Allowable Noise Levels (dBA)	
		R-1, R-2 Residential	Commercial / Industrial
Weekdays, 7 AM to 7 PM	< 10	75	85
	≥ 10	60	70
Weekends, 9 AM to 8 PM and legal holidays	< 10	60	70
	≥ 10	50	60

The Berkeley Municipal Code provides an equipment noise limit standard in cases where ambient noise levels are greater than the noise limits presented in Table 1.

- Section 13.40.050.A.3.a, Exterior Noise Standards:
 - If the measured ambient noise level is greater than the level permissible within any of the noise limit categories above, the sound level when measured on any other property shall not exceed the ambient noise level for a cumulative period of more than 30 minutes in any hour.

2.3 Construction Noise Standards – Summary

- Per the Berkeley Municipal Code Noise Ordinance, project-related construction noise from phases lasting at least 10 days (i.e. Demolition, Grading, Building Construction) shall be evaluated against the noise levels presented in Table 1:

- R-1 and R-2 residential uses near project site: Maximum 60 dBA (weekdays) and 50 dBA (weekends) during the daytime allowable hours of construction.
- Commercial uses near project site: Maximum 70 dBA (weekdays) and 60 dBA (weekends) during the daytime allowable hours of construction.
- Per the Berkeley Municipal Code Noise Ordinance, project-related construction noise from phases lasting less than 10 days (Site Preparation) shall be evaluated against the noise levels presented in Table 1:
 - R-1 and R-2 residential uses near project site: Maximum 75 dBA (weekdays) and 60 dBA (weekends) during the daytime allowable hours of construction.
 - Commercial uses near project site: Maximum 85 dBA (weekdays) and 70 dBA (weekends) during the daytime allowable hours of construction.

3.0 Construction Vibration Standards

3.1 Berkeley Conditions of Approval – Construction Vibration

- **Damage Due to Construction Vibration (COA #15):** The project applicant shall submit screening level analysis prior to, or concurrent, with demolition building permit. If a screening level analysis shows that the project has the potential to result in damage to structures, a structural engineer or other appropriate professional shall be retained to prepare a vibration impact assessment (assessment). The assessment shall take into account project specific information such as the composition of the structures, location of the various types of equipment used during each phase of the project, as well as the soil characteristics in the project area, in order to determine whether project construction may cause damage to any of the structures identified as potentially impacted in the screening level analysis. If the assessment finds that the project may cause damage to nearby structures, the structural engineer or other appropriate professional shall recommend design means and methods of construction to avoid the potential damage, if feasible. The assessment and its recommendations shall be reviewed and approved by the Building and Safety Division and the Zoning Officer. If there are no feasible design means or methods to eliminate the potential for damage, the structural engineer or other appropriate professional shall undertake an existing conditions study (study) of any structures (or, in case of large buildings, of the portions of the structures) that may experience damage. This study shall establish the baseline condition of these structures, including, but not limited to, the location and extent of any visible cracks or spalls; and include written descriptions and photographs.

The study shall be reviewed and approved by the Building and Safety Division and the Zoning Officer prior to issuance of a grading permit. Upon completion of the project, the structures (or, in case of large buildings, of the portions of the structures) previously inspected will be resurveyed, and any new cracks or other changes shall be compared to pre-construction conditions and a determination shall be made as to whether the proposed project caused the damage. The findings shall be submitted to the Building and Safety Division and the Zoning Officer for review. If it is determined that project construction has resulted in damage to the structure, the damage shall be repaired to the pre-existing condition by the project sponsor, provided that the property owner approves of the repair.

Note: Condition of Approval (COA #15) requires the project to evaluate construction vibration in terms of building damage. Since this Condition of Approval does not provide significant criteria for

building damage due to construction-related vibration, this analysis will consider the standards provided by the Federal Transit Authority – see Section 3.2.

3.2 Building Damage due to Vibration – Federal Transit Administration

The Federal Transit Administration (FTA) has adopted vibration standards that are used to evaluate potential building damage impacts related to construction activities. The vibration damage criteria adopted by the FTA are shown in Table 2. Since COA #15 does not provide significant criteria for construction-related vibration, this analysis will consider the maximum levels provided below.

Table 2: Construction Vibration – Damage Criteria

Building/Structural Category	Maximum Peak Particle Velocity (PPV), in/sec
I. Reinforced-concrete, steel or timber (no plaster)	0.5
II. Engineered concrete and masonry (no plaster)	0.3
III. Non-engineered timber and masonry buildings	0.2
IV. Buildings extremely susceptible to vibration damage	0.12

Federal Transit Administration, 2018. Transit Noise and Vibration Impact Assessment Manual (FTA Report No. 0123), Table 7-5

4.0 Environmental Setting

The project site is surrounded by commercial (C-C) and residential (R-2) zoned properties. As determined by our long-term environmental noise measurements, the primary source of noise at the project site is traffic along Telegraph Avenue, followed by traffic along Stuart Street.

4.1 Existing Noise Environment

Resonance Acoustics conducted environmental noise measurements to quantify the existing noise environment around the project site. A Type 1 Larson Davis Model 831 and a Type 1 Rion NL-53 sound level meter were used for the site noise measurements. Equipment was calibrated immediately prior to and following the measurements. Measurement descriptions are provided below:

- **Long-term Measurement 1 (LT-1):** This 48-hour measurement was conducted between August 23 and 25, 2023, and was attached to a tree along Telegraph Avenue. The sound level meter was positioned approximately 15 feet above grade. Noise levels at this location were primarily controlled by traffic on Telegraph Avenue. Secondary noise sources included pedestrians and aircraft.
- **Long-term Measurement 2 (LT-2):** This 48-hour measurement was conducted between March 10 and 12, 2026 and was attached to a utility pole along Stuart Street. The sound level meter was approximately 11 feet above grade. Noise levels at this location were primarily controlled by traffic along Stuart Street. Secondary noise sources were traffic along Telegraph Avenue, pedestrians, and aircraft.

The noise measurement locations and the project site boundary are shown in Figure 1.



Figure 1: Noise Measurement Locations

4.1.1 Weather

We reviewed online weather data for both long-term measurements (the nearest available historical weather data is from the weather station ID KCABERKE278 in Berkeley, accessed through weatherunderground.com). For the August 23 through August 25, 2023 measurement, the temperature ranged from 58 to 89 degrees Fahrenheit, wind speed was up to 7 miles per hour (mph), and there was no precipitation. For the March 10 through March 12, 2026 measurement, the temperature ranged from 45 to 74 degrees Fahrenheit, wind speed was up to 3 miles per hour (mph), and there was no precipitation. After reviewing noise levels during this timeframe, we conclude the wind noise did not affect the measurements.

4.1.2 General Noise Conditions

The primary source of noise at the project site is traffic along Telegraph Avenue, followed by traffic along Stuart Street. Emergency vehicle sirens are infrequent events that do not reflect the typical noise environment.

Table 3 summarizes the existing ambient noise levels. Figure 2 and Figure 3 represent the continuous sound levels throughout the measurement periods at LT-1 and LT-2, respectively.

Table 3: Ambient Noise Levels during Construction Hours

Measurement Location	Maximum 1-hour Noise Level, $L_{EQ-1\text{ hr}}$ (dBA)	Minimum 1-hour Noise Level, $L_{EQ-1\text{ hr}}$ (dBA)
LT-1: Telegraph Avenue	73	68
LT-2: Stuart Street	63	55

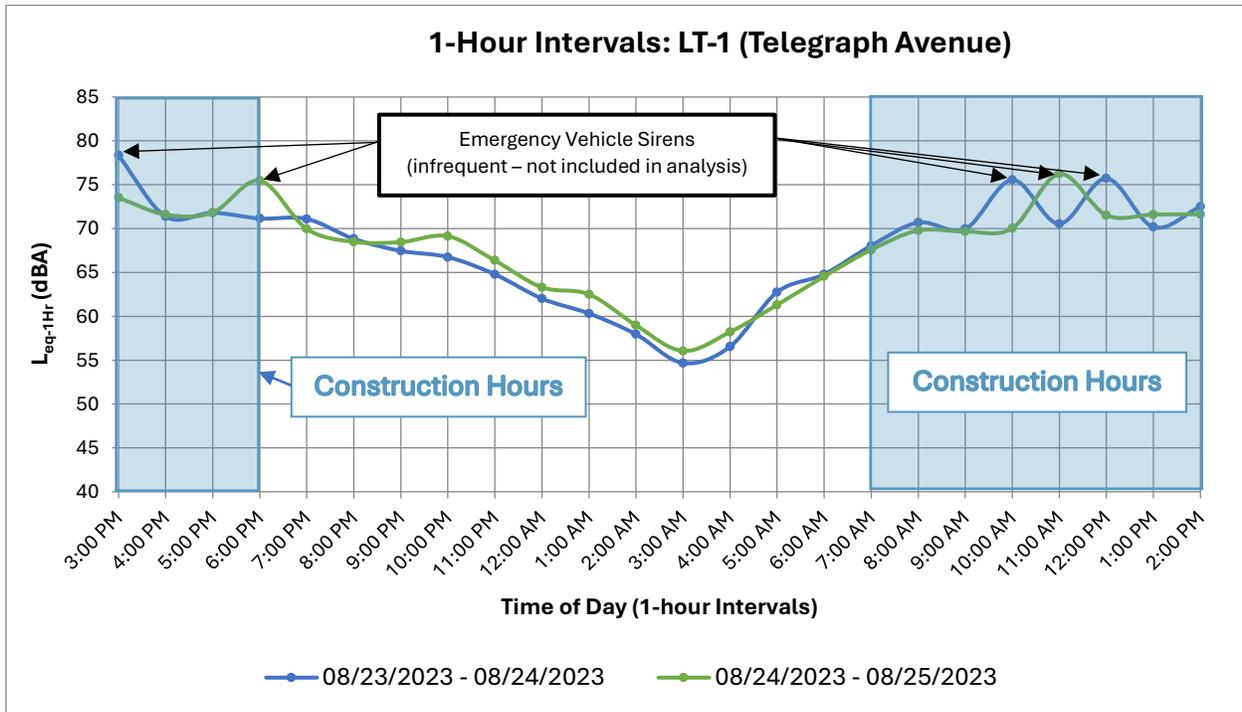


Figure 2: Continuous Noise Levels at LT-1

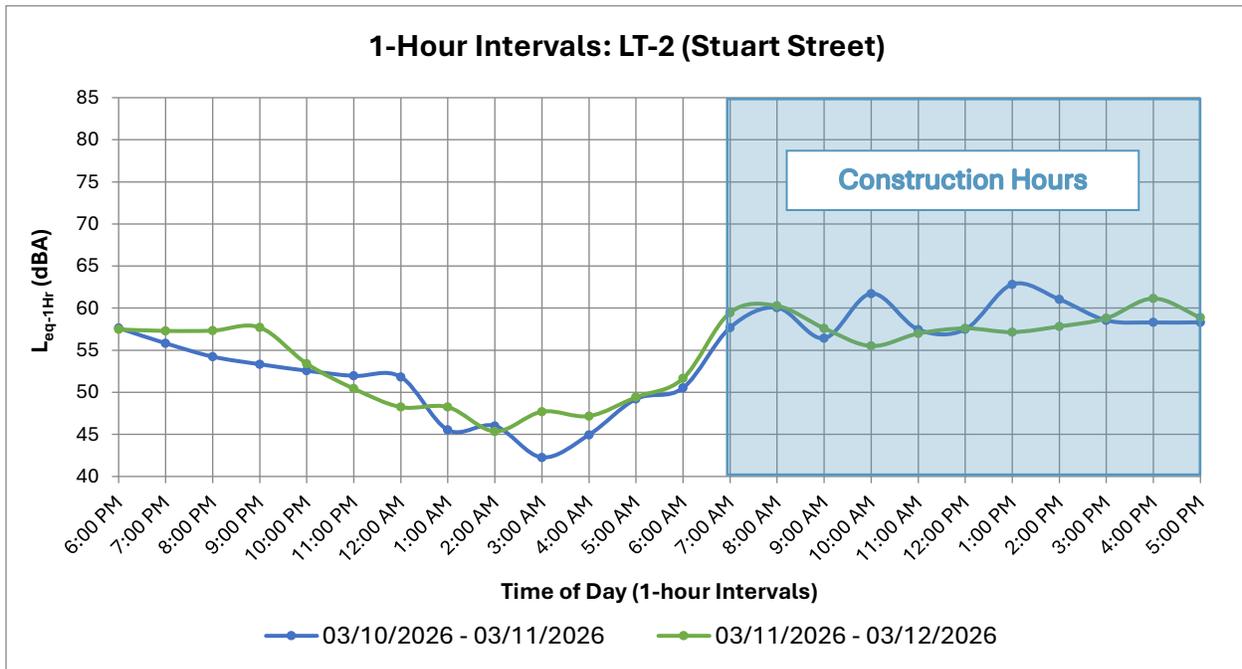


Figure 3: Continuous Noise Levels at LT-2

4.1.3 Construction Noise Limit Adjustment

Table 3 shows the minimum measured ambient levels are 68 dBA along Telegraph Avenue and 55 dBA along Stuart Street. These levels exceed Code limits for residential zones for short and long-term construction phases as well as commercial zones for long-term construction phases. Per Section 13.40.050.A.3.a, the construction noise analysis uses the minimum measured ambient level in lieu of Code limits where applicable. Those that are applicable are noted in Table 4 and Table 7 below.

4.2 Sensitive Receivers

Key information about the receivers used in this analysis is shown in Table 4. Although other receivers within the vicinity of the project site may be exposed to some level of project construction noise, the following receivers are expected to be impacted to the greatest extent and are therefore considered representative of more distant sensitive receivers. Figure 4 shows the locations of the noise sensitive receivers in the vicinity of the project site that are considered in this study.

Table 4: Representative Receivers Most Impacted by Project Construction

Receptor	Long-term Construction Noise Criteria (dBA)	Building Damage Due to Vibration Threshold ¹	Distance between Construction Site and Receiver (feet)	
			Average Dist. ²	Min. Dist. ³
1. 2812 Telegraph Ave (R-2 residential zone)	68 ⁴	Non-engineered timber or masonry (PPV 0.2 in/sec)	30	5
2. 2346 & 2348 Stuart St (C-C commercial zone)	60	Non-engineered timber or masonry (PPV 0.2 in/sec)	35	5
3. 2347 Stuart St (R-2 residential zone)	55 ⁴	Non-engineered timber or masonry (PPV 0.2 in/sec)	125	85
4. 2744 Telegraph Ave (R-2 residential zone)	55 ⁴	Non-engineered timber or masonry (PPV 0.2 in/sec)	80	55
5. 2425 Stuart St, Willard Middle School (R-2 residential zone)	55 ⁴	Engineered concrete and masonry with no plaster (PPV 0.3 in/sec)	180	145
6. 2801, 2803, & 2805 Telegraph Ave (C C-C commercial zone)	68 ⁴	Non-engineered timber or masonry (PPV 0.2 in/sec)	130	100
7. 2807 & 2809 Telegraph Ave (C-C commercial zone)	68 ⁴	Non-engineered timber or masonry (PPV 0.2 in/sec)	125	95
8. 2811, 2813, 2815A, & 2815B Telegraph Ave (C-C commercial zone)	68 ⁴	Non-engineered timber or masonry (PPV 0.2 in/sec)	150	140

¹ Federal Transit Administration vibration damage criteria
² Distance from center of project site to boundary of receiver site
³ Distance from boundary of project site to boundary of receiver site (For adjacent properties, the minimum distance was set to 5 feet)
⁴ Ambient used per Section 13.40.050.A.3.a since the minimum measured level per Table 3 exceeds the Berkeley Municipal Code limit.



Figure 4: Noise Sensitive Receivers in the Project’s Vicinity

5.0 Construction Noise Analysis

5.1 Construction Phases

Based on our construction outline provided by the project team (received on March 2, 2026), we understand construction will last for approximately 24 months. Table 5 presents a summary of the planned construction activities based on the construction schedule we received.

Table 5: Construction Phase Timeline

Construction Phase	Start Date	End Date
Demolition	4/29/2026	5/29/2026
Site Preparation	5/29/2026	5/31/2026
Grading	5/31/2026	6/10/2026
Building Construction	7/11/2026	4/11/2028
Completion Date	--	4/15/2028

5.2 Construction Noise Evaluation

The primary construction noise impacts will occur from noise generated by the operation of heavy equipment on the project site. Intermittent noise impacts will also result from trucks arriving and departing from the site. Construction activities associated with the project include demolition, grading/excavation, and building construction. On March 2, 2026, Resonance Acoustics received a list of equipment used for each construction phase and additional clarification was provided on

March 19 and 20, 2026. Table 6 presents this list of equipment, and the equivalent type and reference L_{EQ} noise levels at 50 feet from the Federal Transportation Administration (FTA) and the Federal Highway Administration (FHWA). Most of the heavy construction equipment will not be running at full capacity throughout each construction period and will not be restricted to one location. To account for this variation in usage, a usage factor (assigned to each piece of equipment in the by the FHWA “Roadway Construction Noise Model”) has been incorporated to the reference noise levels presented in Table 6.

Table 6: Noise Levels from Construction Equipment During Each Phase

Equipment Per Construction Emission Minimization Plan (Assumed Equipment shown in italics)	Equipment (Equivalent FTA/FHWA Reference)	Reference Noise Level at 50 feet (L_{EQ} dBA)
Demolition Phase		
Compact Tractor	Dozer	85
Compact Wheel Loader	Loader	80
Excavator, Hydraulic	Excavator	85
Forklift	Gradall	85
Paver	Paver	85
Roller	Roller	85
Site Preparation Phase		
Excavator, Mini Hydraulic	Excavator	85
Forklift	Gradall	85
Skid Steer Loader	Front End Loader	80
Grading Phase		
Forklift	Gradall	85
Skid Steer Loader	Front End Loader	80
Paver	Paver	85
Roller	Roller	85
Building Construction Phase		
Concrete Mixer Truck	Concrete Mixer Truck	85
Concrete Pump Truck	Concrete Pump Truck	82
Forklift	Gradall	85
<i>Man Lift</i>	Man Lift	85
<i>Saw x5</i>	Saw	76
<i>Pneumatic Tools x5</i>	Pneumatic Tools	85

Beyond the list of received equipment, we have also assumed that one man-lift, five saws, and five pneumatic tools will be in use during the building construction phase. If these assumptions over- or under-predict the equipment that will be used during construction/demolition, please let us know and we can adjust our calculations accordingly.

5.3 Construction Noise Calculation Results

Using the reference noise levels and associated usage factors for each planned equipment item, the estimated project-related construction noise levels were calculated for each receiver location. Note this analysis does not account for noise reduction provided by existing structures; barrier reduction would result in lower noise levels than what is presented below.

Construction noise levels are calculated in terms of average noise levels (L_{EQ}) and maximum noise levels (L_{MAX}).

- Average noise levels (L_{EQ}) consider all equipment items included in each phase, the typical usage factor (assigned to each piece of equipment in the FHWA “Roadway Construction Noise

Model”) and is presented in terms of the average distance between the project site and the boundary of the receiver property.

- Maximum noise levels (L_{MAX}) consider the loudest equipment item per phase operating at the minimum distance between source and receiver (i.e., an equipment item operating at the boundary of the project site closest to each individual receiver). Maximum noise levels do not consider usage factor.

Table 7 presents project-generated construction noise per phase, in terms of average noise levels (L_{EQ}) and maximum noise levels (L_{MAX}). Note that results are presented with respect to Code limits for Saturdays since the project construction is allowed to occur on Saturdays and weekday Code limits are less stringent. Meeting weekend limits satisfies weekday limits.

Table 7: Estimated Construction Equipment Noise Per Phase (Average Daily Noise Levels)

Receptor	Long-term Construction Criteria (dBA)	Construction Phase							
		Demolition		Site Prep		Grading		Building Construction	
		Average Noise Levels at Receivers (L _{EQ} , dBA)	Maximum Noise Levels at Receivers (L _{MAX} , dBA)	Average Noise Levels at Receivers (L _{EQ} , dBA)	Maximum Noise Levels at Receivers (L _{MAX} , dBA)	Average Noise Levels at Receivers (L _{EQ} , dBA)	Maximum Noise Levels at Receivers (L _{MAX} , dBA)	Average Noise Levels at Receivers (L _{EQ} , dBA)	Maximum Noise Levels at Receivers (L _{MAX} , dBA)
1. 2812 Telegraph Ave	68*	93	105	See Short-term Below		90	105	95	112
2. 2346, 2348 Stuart St	60	91	105			89	105	94	112
3. 2347 Stuart St	55*	80	80			78	80	83	87
4. 2744 Telegraph Ave	55*	84	84			82	84	87	91
5. 2425 Stuart St Willard Middle School	55*	77	76			75	76	80	83
6. 2801, 2803, 2805 Telegraph Ave	68*	80	79			78	79	82	86
7. 2807, 2809 Telegraph Ave	68*	80	79			78	79	82	86
8. 2811, 2813, 2815A, 2815B Telegraph Ave	68*	79	76			76	76	81	83
	Short-term Construction Criteria (dBA)								
1. 2812 Telegraph Ave	68	See Long-term Above		89	105	See Long-term Above		See Long-term Above	
2. 2346, 2348 Stuart St	70			88	105				
3. 2347 Stuart St	60			77	80				
4. 2744 Telegraph Ave	60			81	84				
5. 2425 Stuart St Willard Middle School	60			74	76				
6. 2801, 2803, 2805 Telegraph Ave	70			76	79				
7. 2807, 2809 Telegraph Ave	70			76	79				
8. 2811, 2813, 2815A, 2815B Telegraph Ave	70			75	76				
Bold levels indicate an exceedance of the criteria * Ambient used per Section 13.40.050.A.3.a since the minimum measured level per Table 3 exceeds the Berkeley Municipal Code limit.									

5.4 Construction Noise Summary

Construction activity is expected to generate construction noise levels that exceed the prescribed thresholds presented in Table 1 at sensitive receptors (in terms of average and maximum noise levels). As such, the noise reduction program should include noise reduction measures that may reduce construction noise levels as low as practical – see Section 6.0.

6.0 Noise Reduction Measures

Since it is estimated that the construction noise limits will be exceeded, construction activities shall implement the measures outlined in Sections 6.1 through 6.6 below. By implementing the noise reduction measures outlined below, we expect to achieve a minimum noise reduction of at least 3 dB for construction equipment that move around the site (e.g., excavator, tractor, etc.).

6.1 Condition of Approval #14 (Construction Noise Reduction Program)

1. Construction equipment should be well maintained and used judiciously to be as quiet as practical.
2. Equip all internal combustion engine-driven equipment with mufflers, which are in good condition and appropriate for the equipment.
3. Use "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.
4. 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. For this project, we recommend a noise barrier between the site and the commercial receiver at 2346/2348 Stuart Street, located immediately to the west of the project site. The other adjacent receptors to the south and across Telegraph Avenue (east) and Stuart Street (north) would not significantly benefit from a barrier. The building immediately to the south is three-story and has no windows facing the project site. Remaining residential and commercial receptors across the avenue and street are all multi-story buildings. Note that, in general, upper floors do not benefit from perimeter barriers as it is not feasible to break the line-of-sight between upper floor windows and construction activity.

The selected barrier material should have a minimum surface density of 2.5 psf and there should be no gaps or breaks. 3/4" thick plywood is sufficient. Height of barrier is recommended to be 8 feet. See Figure 5 for a map showing the recommended barrier location.

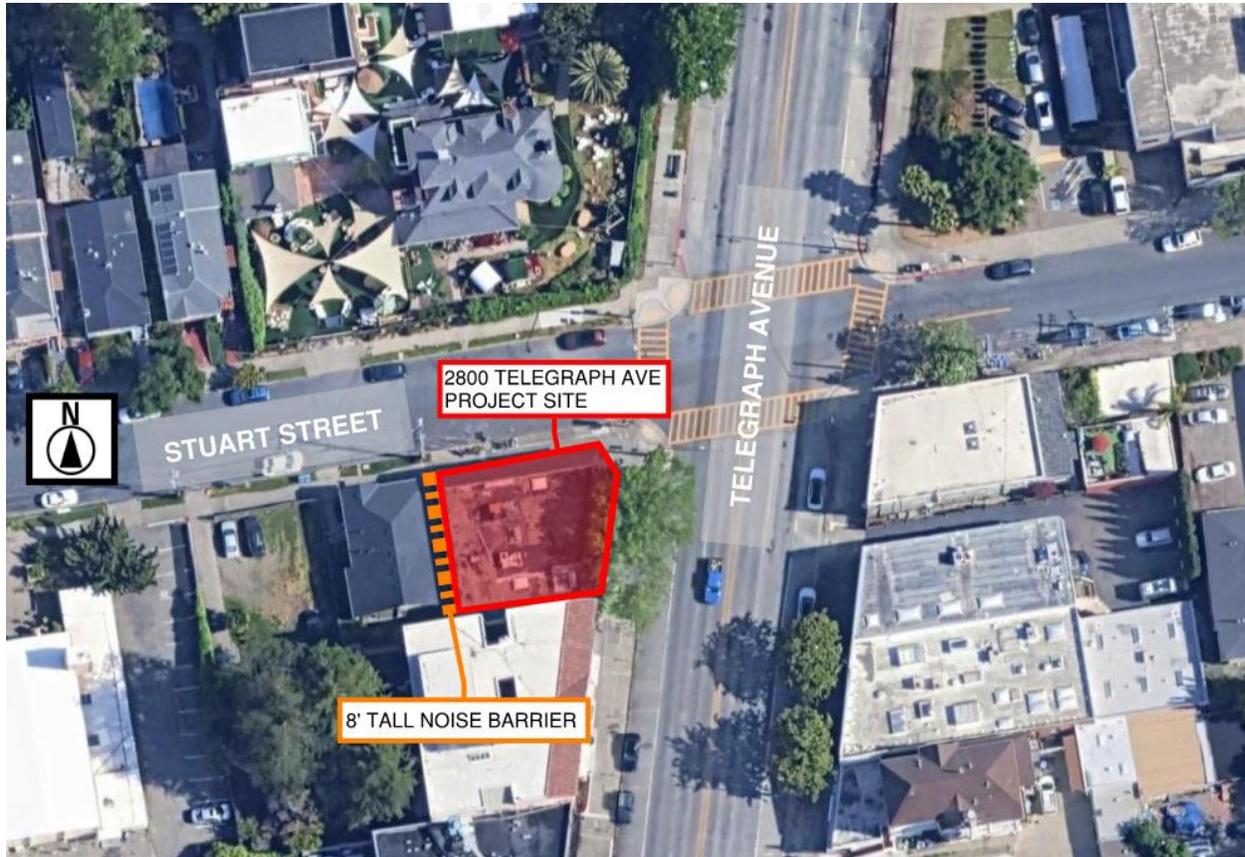


Figure 5: Recommended Noise Barrier Location

5. Prohibit unnecessary idling of internal combustion engines.
6. All equipment shall be turned off if not in use for more than 5 minutes.
7. Erect temporary noise control blanket barriers, if necessary, along building facades facing construction sites. This mitigation will only be necessary if conflicts occurred which were irresolvable by proper scheduling. Noise control blanket barriers can be rented and quickly erected.
8. Route construction related traffic along major roadways and away from sensitive receptors where feasible.
9. A barrier along the north and east sides of the project site may not fully block the line-of-sight between construction activities and nearby residences. However, the construction of a barrier fence could be effective at reducing construction noise levels to residences across Stuart Street.
10. Combine noisy operations so that they occur in the same time period. The total noise level produced will not be significantly greater than the level produced if the operation were performed separately (and the noise will be of shorter duration).
11. We understand that no impact pile driving is planned. However, if impact pile driving is required, pre-drill foundation pile holes to minimize the number of impacts required to seat the pile.

6.2 Condition of Approval #17 (Construction Noise Management – Public Notice Required)

12. At least two weeks prior to initiating any construction activities at the site, the applicant shall provide notice to businesses and residents within 500 feet of the project site. This notice shall at a minimum provide the following: (1) project description, (2) description of construction activities during extended work hours and reason for extended hours, (3) daily construction schedule (i.e., time of day) and expected duration (number of months), (4) the name and phone number of the Project Liaison for the project that is responsible for responding to any local complaints, and (5) that construction work is about to commence. The liaison would determine the cause of all construction-related complaints (e.g., starting too early, bad muffler, worker parking, etc.) and institute reasonable measures to correct the problem. A copy of such notice and methodology for distributing the notice shall be provided in advance to the City for review and approval.
13. Designate a “disturbance coordinator” who would be responsible for responding to any local complaints about construction noise. The name and telephone number of the disturbance coordinator should be provided to the City. 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. The disturbance coordinator shall record all noise complaints received and actions taken in response and submit this record to the project planner upon request.
14. Conspicuously post the name, telephone number, and responsibility for noise management of the disturbance coordinator at the construction site.

6.3 Condition of Approval #18 (Construction Phases)

15. Provide the Zoning Officer with a schedule of major construction phases with start dates and expected duration, a description of the activities and anticipated noise levels of each phase, and the name(s) and phone number(s) of the individual(s) directly supervising each phase.

6.4 Condition of Approval #34 (Construction Hours)

16. Construction activity shall be limited to between the hours of 7:00 AM and 6:00 PM on Monday through Friday, and between 9:00 AM and 4:00 PM on Saturday. No construction-related activity shall occur on Sunday or any Federal Holiday.

6.5 Condition of Approval #35 (Construction Hours – Exceptions)

17. 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 the Zoning Officer and request an exception for a finite period of time. If the Zoning Officer approves the 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 a 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 for more than 15 extended working days.

6.6 Condition of Approval #36 (Project Construction Website)

18. Establish a project construction website with the final Construction Noise Reduction Program.
19. Other information on the website should include:
 - Contact information (i.e. “hotline” phone number, and email address) for the project construction manager
 - Calendar and schedule of daily/weekly/monthly construction activities
 - The final Conditions of Approval, Mitigation Monitoring and Reporting Program, Transportation Construction Plan, and any other reports or programs related to construction noise, air quality, and traffic.

7.0 Construction Vibration Analysis

7.1 Construction Vibration Methodology

The primary construction vibration generation will occur from the operation of heavy equipment on the project site. Construction activities associated with the project will include phases for demolition/grading, substructure construction, and superstructure construction. Scheduled equipment for these activities is detailed in Table 8. No pile driving is planned. The following construction vibration analysis for building damage is consistent with the methods presented in the Federal Transit Administration Transit Noise and Vibration Impact Assessment Manual (2018). The manual provides the following equation to apply when calculating vibration propagation to a receiver:

$$PPV_{equip} = PPV_{ref} \times \left(\frac{25}{D}\right)^{1.5}$$

Where: PPV_{equip} = the peak particle velocity of the equipment adjusted for distance, inches/sec

PPV_{ref} = the source reference vibration level at 25 feet, inches/sec

D = distance from the equipment to the receiver, feet

Equation 1: Peak Particle Velocity

Additionally, the equipment reference levels and the calculation procedures established by the FTA used for this analysis provide a reasonable estimate for a wide range of soil conditions. Table 8 presents the expected equipment mix for each phase and the equivalent equipment type and reference vibration levels at 25 feet (from the Federal Transit Administration).

Table 8: Typical Vibration Levels from Construction Equipment

Equipment (Per Construction Schedule)	Equipment (Equivalent FTA/FHWA Reference)	Reference Vibration Level at 25 feet (PPV, in/sec)
Compact Wheel Loader	Large Bulldozer	0.089
Excavator, Hydraulic	Large Bulldozer	0.089
Excavator, Mini Hydraulic	Small Bulldozer	0.003
Forklift	Large Bulldozer	0.089
Paver	Large Bulldozer	0.089
Roller	Large Bulldozer	0.089
Skid Steer Loader	Small Bulldozer	0.003

As shown in Table 8, due to limited available vibration reference levels from the FHWA, all equipment items that have the potential to generate high levels of vibration are matched with their most nearly equivalent vibration source. These conditions have been analyzed for all sensitive receivers presented in Table 9, with respect to potential for building damage.

7.2 Construction Vibration Calculation Results – Building Damage

All equipment items that have the potential to generate high levels of construction vibration are split into the following categories (see Table 8 for additional detail):

- Equipment considered similar to Large Bulldozers (i.e. hydraulic excavator, compact wheel loader, forklift, roller, paver)
- Equipment considered similar to Small Bulldozers (i.e. mini hydraulic excavator, skid steer loader)

Using the reference vibration levels for each category bulleted above, the estimated construction vibration levels with respect to building damage have been calculated for each receiver location, as shown in Table 9.

Table 9: Estimated Building Damage Potential due to Construction Vibration

	Applicable Limit (PPV, in/sec)	Min. Dist. (ft) From Project Prop. Line To Structures *	Estimated Maximum Construction Vibration (PPV, in/sec)	
			Equipment considered similar to Large Bulldozer	Equipment considered similar to Small Bulldozer
Reference Vibration at 25 ft	-	-	0.089	0.003
1. 2812 Telegraph Ave	0.2	5	1.00	0.03
2. 2346 & 2348 Stuart St	0.2	5	1.00	0.03
3. 2347 Stuart St	0.2	85	0.01	0.00
4. 2744 Telegraph Ave	0.2	55	0.03	0.00
5. 2425 Stuart St Willard Middle School	0.3	145	0.01	0.00
6. 2801, 2803, 2805 Telegraph Ave	0.2	100	0.01	0.00
7. 2807 & 2809 Telegraph Ave	0.2	100	0.01	0.00
8. 2811, 2813, 2815A, 2815B Telegraph Ave	0.2	140	0.01	0.00
Bold levels indicate an exceedance of the building vibration criteria. *For adjacent properties, the minimum distance was set to 5 feet.				

As shown in Table 9, construction activities have the potential to induce building damage when large equipment (i.e., equipment items with vibration levels equivalent to Large Bulldozers [see Table 8 for applicable equipment items]) operates in close proximity to the directly adjacent buildings (i.e., residential and commercial receivers bordering the project site property line). Potential vibration damage at these receivers is due to the proximity to the directly adjacent construction site. Potentially affected structures are highlighted in Figure 6. Project construction must implement the requirements outlined in Condition of Approval #15 – see Section 8.0.



Figure 6: Buildings Potentially Impacted by Construction Vibration

8.0 Vibration Impact Measures

As presented in Table 9, equipment that is operated near the directly adjacent buildings has the potential to cause building damage. The following conditions shall apply:

1. Based on the planned equipment, reference vibration levels for the equipment, and the neighboring buildings' construction types, we have calculated the minimum distances that must be maintained between the directly adjacent buildings and the construction equipment so as to not exceed the vibration limits for the adjacent buildings:
 - Equipment considered similar to Large Bulldozers (i.e., excavators, loaders, or JBL forklift) should maintain a **minimum buffer distance of 15 feet from the closest facade of a neighboring building.**
2. When calculating vibration propagation, the distance between the equipment source and neighboring building was iteratively adjusted to determine the minimum feasible distance that the planned equipment can be used without exceeding the building damage due to vibration thresholds presented in Table 2. These calculations were conducted using the procedures established by the FTA, detailed in Section 7.1. The project applicant/team should verify the 15-foot buffer can be maintained when using vibration-intensive equipment including excavators and loaded trucks. If it cannot be maintained, see the next item.
3. We understand the 15' buffer can be maintained and less vibration-intensive methods will be utilized at distances less than 15' (e.g., hand digging). If, for some reason, it is not feasible to

maintain the minimum buffer outlined in Item 1 at the project, construction activity could create a risk for potential damage at 2812 Telegraph Ave and 2346/2348 Stuart St. Therefore, project construction has the potential to cause damage and the following measures from the Conditions of Approval (COA #15) would apply:

- The structural engineer or other appropriate professional shall recommend design means and methods of construction to avoid potential damage. The assessment and its recommendations shall be reviewed and approved by the Building and Safety Division and the Zoning Officer. If there are no feasible design means or methods to eliminate the potential for damage, the structural engineer or other appropriate professional shall undertake an existing conditions study of any structures that may experience damage (as mentioned above, only the directly adjacent buildings are expected to be impacted by vibration levels with respect to building damage). This study shall:
 - Establish the baseline condition of these structures, including, but not limited to, the location and extent of any visible cracks or spalls; and
 - Include written descriptions and photographs.

The study shall be reviewed and approved by the Building and Safety Division and the Zoning Officer prior to issuance of a grading permit. Upon completion of the project, the structures previously inspected will be re-surveyed, and any new cracks or other changes shall be compared to pre-construction conditions and a determination shall be made as to whether the proposed project caused the damage. The findings shall be submitted to the Building and Safety Division and the Zoning Officer for review. If it is determined that project construction has resulted in damage to the structure, the damage shall be repaired to the pre-existing condition by the project sponsor, provided that the property owner approves of the repair.

Note, the above is informational only and would only apply if the 15' buffer could not be maintained.

This concludes our construction noise and vibration control plan for the 2800 Telegraph Avenue project in Berkeley, CA. Please do not hesitate to contact us with questions.

Appendix A: Definitions of Acoustical Terms

A-Weighted Sound Level: A decibel scale for sound level measurements using the “A” weighted network of a sound level meter and is denoted as “dBA.” The A-weighted network is shaped to correspond to the response of the human ear so that the results correlate approximately with human perception. It is the accepted standard for environmental noise measurements.

Day/Night Average Sound Level (L_{DN} or DNL): A descriptor established by the U.S. Environmental Protection Agency to describe the average day-night level with a 10 dB penalty applied to noise occurring during the nighttime hours (10 pm to 7 am) to account for the increased sensitivity of people during sleeping hours. A 10 dB increase in sound level is perceived by people to be twice as loud.

Decibel (dB): A scale that measures sound level pressure defined as 20 times the logarithm of the ratio of the sound level pressure to a standard reference pressure level of 20 μ Pa.

L_{eq} : The A-weighted equivalent continuous sound exposure level for a defined period of time.

L_{MAX} : The highest sound level in a stated period of time.

Appendix B: References

California Building Code, Title 24, Part 2 (Volumes 1 & 2), 2022.

Caltrans, 2022 AADT, <https://dot.ca.gov/programs/traffic-operations/census>, 2022.

Caltrans, Technical Noise Supplement to the Caltrans Traffic Noise Analysis Protocol, September 2013.