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MEMORANDUM

To:	Andrew Metzger, Project Manager, Circlepoint
From:	Ace Malisos, Air Quality and Noise Manager, Kimley-Horn Noemi Wyss AICP, Environmental Planner, Kimley-Horn Kimley-Horn and Associates, Inc.
Date:	March 30, 2023
Subject:	Alameda County Rail Safety Enhancement Program – Acoustical Analysis Berkeley IS/MND (Addison Way, Bancroft Way, Cedar Street)

1.0 PURPOSE

The purpose of this memorandum is to identify the acoustical impacts associated with construction and operations of two at-grade rail crossings, located in the City of Berkeley, in Alameda County, California. Crossings are existing and located in the western portion of Berkeley. This analysis has been undertaken to analyze whether the proposed project would result in any significant environmental impacts related to noise and vibration.

2.0 PROPOSED PROJECT DESCRIPTION

The proposed project is located in the City of Berkeley in Alameda County, California. The project site consists of three existing at-grade rail crossings. The crossings are along Union Pacific Railroad (UPRR) tracks where UPRR tracks intersect with local streets. Each of the crossings are listed in **Table 1** below, noting the jurisdiction and local street intersections listed from north to south. The Map ID number corresponds to crossing locations shown on **Figure 1**.

Table 1: Crossing Locations

Jurisdiction	Intersection	Map ID
Berkeley	Cedar Street	1
Berkeley	Addison Street	2
Berkeley	Bancroft Way	3
Source: Circlepoint, 2023.		

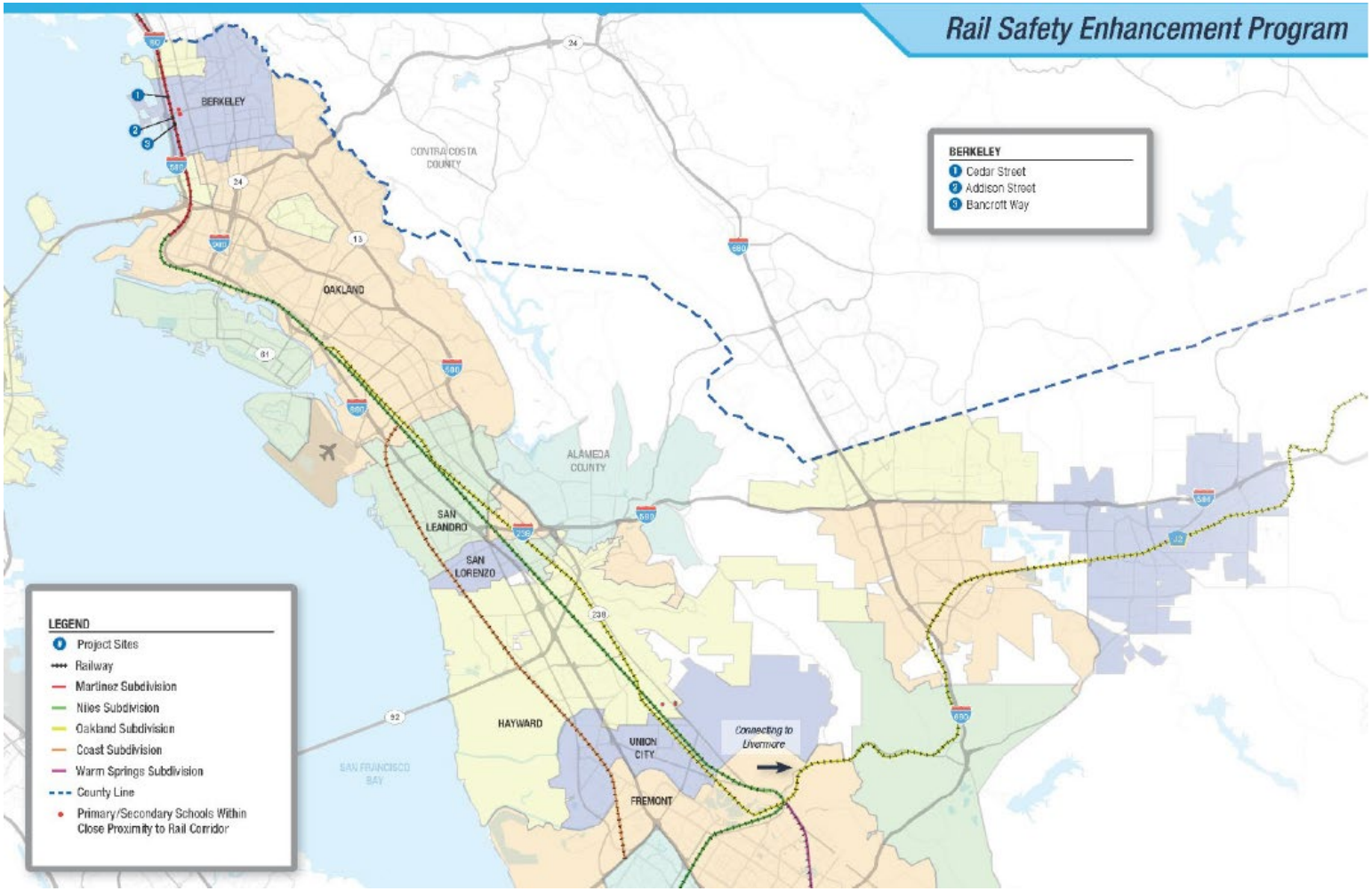

Figure 1: Project Site Map

Site conditions are similar between crossings. The three crossings consist of entirely developed area which is predominantly impervious except for the gravel shoulder next to the UPRR tracks. All three local streets are two-lane side streets with existing railroad gates (one in each direction) with lights and street painting at the crossing location. The existing conditions at each crossing location are described in detail in **Table 2**.

Table 2: Existing Conditions

Intersection	Description	Map ID
Cedar Street	Two-lane side street with paved median, sidewalks, and landscaping. Very little pervious surface except at landscaped areas and UPRR gravel shoulder. Single-arm gates in each direction of traffic.	1
Addison Street	Two-lane side street with paved median, sidewalks, and landscaping. Very little pervious surface except at landscaped areas and UPRR gravel shoulder. Single-arm gates in each direction of traffic.	2
Bancroft Way	Two-lane side street with paved median, sidewalks, and landscaping. Very little pervious surface except at landscaped areas and UPRR gravel shoulder. Single-arm gates in each direction of traffic.	3
Source: Circlepoint, 2023.		

The project consists of rail safety improvements to existing at-grade rail crossings. The improvements are designed to increase safety for all motorists and pedestrians. This includes restricting access to UPRR tracks, improving signage, accessibility improvements, and other safety features. The proposed safety improvements at each crossing are listed in **Table 3**. In addition, these crossings will require the construction of new driveway access to adjacent parcels.

Table 3: Proposed Safety Improvements

Intersection	Description	Excavation/Grading	Map ID
Cedar Street	• Remove portions of existing pavement/concrete • Install new roadway striping/pavement marking, roadside signs, curb and gutter, security access gates/fencing, pavement, ADA detectable pavers, vehicular gate and cantilever, and "No Trespassing" signs • Add new driveway	The project will require ground disturbing work, excavation, grading for creation of a new driveway.	1
Addison Street	• Remove portions of existing pavement/concrete	The project will require ground disturbing work,	2

Intersection	Description	Excavation/Grading	Map ID
	• Install new roadside signs, raised delineators, curb and gutter, security access gates/fencing, pavement, ADA detectable pavers, "No Trespassing" signs, and new sidewalk • Add new driveway (portions of which are outside of existing City/UPRR ROW. A temporary construction easement will be required).	excavation, grading for creation of a new driveway.	
Bancroft Way	• Remove portions of existing pavement/concrete • Install new roadway striping/pavement marking, roadside signs, raised medians, curb and gutter, security access gates/fencing, pavement, ADA detectable pavers, "No Trespassing" signs, and new sidewalk • Add new driveway	The project will require ground disturbing work, excavation, grading for creation of a new driveway.	3
Source: Circlepoint, 2023.			

Construction of the project is anticipated to take approximately 12 months, beginning in the fourth quarter of 2024, and concluding in the fourth quarter of 2025. Construction would occur in one phase with distinct activities/sub-phases (i.e., demolition, grading, paving). Construction noise levels activity have been quantified based upon the construction activity and equipment types. Construction at each crossing will generally include:

- Temporary closure of the crossing with an appropriate detour for vehicles and cyclists
- Removal of outdated or non-functioning crossing control equipment, fencing, signage, pavement, and other materials
- Installation of new fencing, crossing control equipment, signage, sidewalks and pavement, and other safety features

The following crossings have unique elements or requirements for their construction:

- Cedar Street: Construct new driveway and install new fencing at new driveway location on southwest side of intersection for aggregate distribution site.
- Addison Street: Construct new driveway further west on Addison Street, remove on-street parking and construct gate and curb and gutter in new location on southwest side of intersection for Pacific West Chemical.

- Bancroft Way: Construct new driveway and install new fencing at new driveway location further west on Bancroft Way on northwest side of intersection for aggregate distribution site.

3.0 EXISTING NOISE

The primary sources of existing noise in the project vicinity are those associated with the operations of railway and rail crossing and mobile traffic noise. The noise associated with these sources may represent a single-event noise occurrence, short-term noise, or long-term/continuous noise.

Sensitive Receptors

Noise exposure standards and guidelines for various types of land uses reflect the varying noise sensitivities associated with each of these uses. Residences, hospitals, schools, guest lodging, libraries, and churches are treated as the most sensitive to noise intrusion and therefore have more stringent noise exposure targets than do other uses, such as manufacturing or agricultural uses that are not subject to impacts such as sleep disturbance.

The project site is located in an urban area at the edge of Interstate 80 (I-80) in the City of Berkeley. The surrounding land uses are predominantly commercial and industrial uses, with some surrounding residential uses. **Table 4: Sensitive Receptors** lists the distances and locations of the nearby sensitive receptors.

Table 4: Sensitive Receptors

Crossing	Sensitive Receptor Description	Distance and Direction from the Crossing
Cedar Street	Single-family Residential	365 feet east
	Berkeley Unified Pre-School	0.30-mile northeast
Addison Street	Multi-family Residential	15 feet east
		20 feet west
Bancroft Way	Single-family Residential	675 feet southeast

4.0 THRESHOLDS AND SIGNIGICANCE CRITERIA

Construction

Construction noise estimates are based upon noise levels on typical noise levels generated by construction equipment published by the Federal Transit Administration (FTA) and FHWA. Construction noise is assessed in dBA L_{eq}. This unit is appropriate because L_{eq} can be used to describe noise level from operation of each piece of equipment separately, and levels can be combined to represent the noise level from all equipment operating during a given period. The Federal Transit Administration's (FTA) *Transit Noise and Vibration Impact Assessment Manual* (2018) (FTA Noise and Vibration Manual) identifies a maximum 1-hour noise level standard of 90 dBA L_{eq} at residential uses and 100 dBA L_{eq} at commercial and industrial uses for short-term construction activities.

Reference noise levels are used to estimate noise levels at nearby sensitive receptors based on a standard noise attenuation rate of 6 dB per doubling of distance (line-of-sight method of sound attenuation for point sources of noise). Construction noise level estimates do not account for the presence of intervening structures or topography, which may reduce noise levels at receptor locations. Therefore, the noise levels presented herein represent a conservative, reasonable worst-case estimate of actual temporary construction noise.

Vibration

Groundborne vibration levels associated with construction-related activities for the project were evaluated utilizing typical groundborne vibration levels associated with construction equipment, obtained from FTA published data for construction equipment. Potential groundborne vibration impacts related to structural damage and human annoyance were evaluated, considering the distance from construction activities to nearby land uses and typically applied criteria for structural damage and human annoyance.

5.0 REGULATORY SETTING

City of Berkeley Municipal Code

The City of Berkeley Municipal Code (BMC), Title 13: Public Peace, Morals and Welfare, Chapter 13.40 (Community Noise) addresses noise impacts. The ordinance establishes exterior and interior noise standards at receiving land uses and construction activity noise regulations as included below.

The ordinance restricts construction activities to weekdays between the hours of 7:00 a.m. and 7:00 p.m. and on weekdays and holidays, between 9:00 a.m. and 8:00 p.m., except for emergency work. Construction activities are divided into two categories: mobile equipment and stationary equipment. Mobile equipment, as defined by BMC Section 13.40.070, includes sound levels for nonscheduled, intermittent, short-term operation of less than 10 days of jackhammers, drills, saws, sander grinder, and similar tools. Stationary equipment, according to BMC Section 13.40.070, would be repetitively scheduled and relatively long-term operation for longer than 10 days. Equipment used during construction of the proposed project would be considered stationary because construction would last longer than 10 days. Where technically and economically feasible, construction activities shall be conducted in such a manner that maximum sound levels at affected properties will not exceed those listed in **Table 5** below.

Table 5: Maximum Stationary Equipment Construction Noise Levels (dBA), BMC Section 13.40.070

	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	65	70
Weekends and legal holidays 9:00 a.m. to 8:00 p.m.	50	55	60
Source: City of Berkeley Municipal Code Table 13.40-4 (2014).			

Caltrans Best Practices for Noise Control

Standard Caltrans measures that are used for all projects include that construction noise shall not exceed a maximum sound level of 86 dBA at 50 feet from job site activities between the hours of 9:00 p.m. to 6:00 a.m. The following standard measures will also be implemented to minimize or reduce the potential for noise impacts from project construction:

- Limit paving and demolition activities to 7:00 a.m. to 7:00 p.m., where feasible.
- Equip all internal combustion engine driven equipment with intake and exhaust mufflers that are in good condition and appropriate for the equipment.
- Prohibit unnecessary idling (i.e., greater than 5 minutes in duration) of internal combustion engines within 100 feet of residences.
- Avoid staging of construction equipment within 200 feet of residences and locate all stationary noise-generating construction equipment, such as air compressors, portable power generators, or self-powered lighting systems as far as practical from noise-sensitive receptors.
- Utilize "quiet" air compressors and other "quiet" equipment where such technology exists.

6.0 IMPACT ANALYSIS

6.1 Construction

Construction Noise

Construction noise typically occurs intermittently and varies depending on the nature or phase of construction (e.g. land clearing, grading, excavation, paving). Noise generated by construction equipment, including earth movers, material handlers, and portable generators, can reach high levels. During construction, exterior noise levels could affect the residential neighborhoods surrounding the construction site. Project construction would occur approximately 15 feet from existing single-family residences. However, construction activities would occur throughout the project site and would not be concentrated at a single point near sensitive receptors. Noise levels typically attenuate (or drop off) at a rate of 6 dB per doubling of distance from point sources, such as industrial machinery. During construction, exterior noise levels could affect the residential neighborhoods near the construction site.

Construction activities associated with development of the project would include demolition, grading, and paving. Such activities may require graders, dozers, and tractors during grading; cranes, forklifts, generators, tractors, and welders during construction; and pavers, rollers, mixers, tractors, and paving equipment during paving. Grading and excavation phases of project construction tend to be the shortest in duration and create the highest construction noise levels due to the operation of heavy equipment required to complete these activities. It should be noted that only a limited amount of equipment can operate near a given location at a particular time. Equipment typically used during this stage includes heavy-duty trucks, backhoes, bulldozers, excavators, front-end loaders, and scrapers. Operating cycles for these types of construction equipment may involve one or two minutes of full-power operation followed by three to four minutes at lower power settings. Other primary sources of

noise would be shorter-duration incidents, such as dropping large pieces of equipment or the hydraulic movement of machinery lifts, which would last less than one minute. According to the applicant, no pile-driving would be required during construction.

Noise generated by construction equipment, including earth movers, material handlers, and portable generators, can reach high levels. Typical noise levels associated with individual construction equipment are listed in **Table 6: Typical Construction Equipment Noise Levels.**

Table 6: Typical Construction Equipment Noise Levels

Equipment	Typical Noise Level (dBA) at 50 Feet from the Source (reference level)
Concrete Mixer	85
Concrete Pump	82
Concrete Vibrator	76
Cranes	88
Dozer	85
Generator	82
Grader	85
Loader	80
Paver	85
Pump	77
Roller	85
Saw	76
Scraper	85
Shovel	82
Truck	84
Source: Federal Transit Administration, Transit Noise and Vibration Impact Assessment Manual, September 2018. Notes: Calculated using the inverse square law formula for sound attenuation: $dBA_2 = dBA_1+20Log(d_1/d_2)$Where: dBA_2 = estimated noise level at receptor; dBA_1 = reference noise level; d_1 = reference distance; d_2 = receptor location distance	

Following the FTA's methodology for quantitative construction noise assessments, the FHWA Roadway Construction Noise Model (RCNM) was used to predict construction noise. Per the FTA Transit Noise and Vibration Manual, when calculating construction noise, all construction equipment is assumed to operate simultaneously at the center of the active construction zone. Because in reality, equipment would be operating throughout the site and not all of the equipment would be operating at the point closest to the sensitive receptors and considering the distance between the center of the project site and the sensitive receptors is a reasonable assumption. These assumptions represent the worst-case noise scenario because construction activities would typically be spread out throughout the project site, and thus some equipment would be further away from the affected receptors. In addition, construction noise levels are not constant, and in fact, construction activities and associated noise levels would fluctuate and generally be brief and sporadic, depending on the type, intensity, and location of construction activities. Construction noise would also be acoustically dispersed throughout the project site and will be masked by freeway noise and roadway noise. The noise levels

identified in **Table 7: Project Construction Noise Levels**, show the exterior construction noise at the nearest sensitive receptors, without accounting for attenuation from existing physical barriers.

As described above in the Regulatory Setting section, the BMC limits the hours of construction to the less sensitive hours of the day (7:00 a.m. – 7:00 p.m. weekdays, 9:00 a.m. – 8:00 p.m. weekends and holidays). Therefore, construction would not occur during normal sleeping hours for residents, which is the most sensitive time for exposure to noise. This section also states that during the construction period, where technically and economically feasible, construction activities shall be conducted in such a manner that the maximum sound levels from stationary equipment at affected properties will not exceed 60 dBA L_{eq} on weekdays and 50 dBA L_{eq} on weekends and holidays in the R-1 and R-2 zoning districts, and 70 dBA L_{eq} on weekdays and 60 dBA L_{eq} on weekends and holidays in commercial districts. As shown in **Table 7**, it is anticipated that noise from construction of the proposed project would exceed these limits without implementation of noise reduction measures.

Table 7: Project Construction Noise Levels

Construction Phase	Receptor Location		Worst Case Modeled Noise Level, dBA $L_{eq\ (8\text{-}hour)}$ [2]	BMC Noise Standard, dBA L_{eq} [3]	Exceeded?
	Land Use	Distance (feet)[1]			
Demolition	Cedar Street Residential Receptor	370	66.4	60	**Yes**
	Addison Street Residential Receptor	75	80.3		**Yes**
	Addison Street Residential Receptor	100	77.8	60	**Yes**
	Bancroft Way Residential Receptor	700	60.9		**Yes**
Grading	Cedar Street Residential Receptor	370	69.5	60	**Yes**
	Addison Street Residential Receptor	75	83.4		**Yes**
	Addison Street Residential Receptor	100	80.9	60	**Yes**
	Bancroft Way Residential Receptor	700	64.0		**Yes**
Paving	Cedar Street Residential Receptor	370	65.1	60	**Yes**
	Addison Street Residential Receptor	75	79.0		**Yes**
	Addison Street Residential Receptor	100	76.5	60	**Yes**
	Bancroft Way Residential Receptor	700	59.6		**No**
Building Construction	Cedar Street Residential Receptor	370	65.5	60	**Yes**
	Addison Street Residential Receptor	75	79.3		**Yes**
	Addison Street Residential Receptor	100	76.8	60	**Yes**
	Bancroft Way Residential Receptor	700	59.9		**No**

1. Distance measured from the center of the project site to the receptor's nearest property line.
2. Modeled noise levels conservatively assume the simultaneous operation of all pieces of equipment.
3. BMC Section 13.40.070 states that during the construction period, where technically and economically feasible, construction activities shall be conducted in such a manner that the maximum sound levels from stationary equipment at affected properties will not exceed 60 dBA L_{eq} on weekdays and 50 dBA L_{eq} on weekends and holidays in the R-1 and R-2 zoning districts, and 70 dBA L_{eq} on weekdays and 60 dBA L_{eq} on weekends and holidays in commercial districts.

Source: Federal Highway Administration, *Roadway Construction Noise Model,* 2006. Refer to Appendix A for noise modeling results.

As shown in **Table 7**, the highest exterior noise level at the nearest sensitive receptors would occur during the grading stage of construction and would be 83.4 dBA which would exceed the 60 dBA L_{eq} BMC noise limit. These assumptions represent the worst-case noise scenario because construction activities would typically be spread out throughout the project site, and thus some equipment would be further away from the affected receptors. In addition, construction noise levels are not constant, and in fact, construction activities and associated noise levels would fluctuate and generally be brief and sporadic, depending on the type, intensity, and location of construction activities. Construction noise would also be acoustically dispersed throughout the project site and will be masked by freeway noise and roadway noise.

The project would be required to implement several of the City's COAs including COA Construction Noise Reduction Program (#17), COA: Construction Noise Management – Public Notice Required (#21), COA: Construction Phases (#22), COA: Construction Hours (#49), COA: Construction Hours – Exceptions (#50), and COA: Project Construction Website (#51), would reduce construction noise levels at nearby receptors to the maximum extent that is technically and economically feasible. Because noise would be reduced to the maximum extent that is technically and economically feasible, the project construction would be consistent with the regulations outlined in the Berkeley noise ordinance, BMC Section 13.40.070. The proper implementation of these COAs would ensure that the construction of the proposed project would not conflict with the City of Berkeley's construction noise standards and therefore, construction noise impacts would be less than significant.

Standard Conditions of Approval:

COA: Construction Noise Reduction Program (#17). 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 with BMC Section 13.40.070. 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.

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.

COA: Construction Noise Management – Public Notice Required (#21). 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.

COA: Construction Phases (#22). 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.

COA: Construction Hours (#49). 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.

COA: Construction Hours – Exceptions (#50). 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 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.

COA: Project Construction Website (#51). 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.

Further, the proposed project would be required to adhere to the Caltrans Standard Conditions that ensure that all construction equipment is equipped with properly operating and maintained mufflers and other state required noise attenuation devices, helping to reduce noise at the source. The Caltrans Standard Conditions would ensure that construction noise levels do not exceed the City's standards and that time-of-day restrictions are adhered to. Therefore, with implementation of these conditions, construction noise impacts to nearby receptors would be further reduced.

Construction Vibration

Increases in groundborne vibration levels attributable to the project would be primarily associated with construction-related activities. Construction on the project site would have the potential to result in varying degrees of temporary groundborne vibration, depending on the specific construction equipment used and the operations involved. Ground vibration generated by construction equipment spreads through the ground and diminishes in magnitude with increases in distance. The effect on buildings located in the vicinity of the construction site often varies depending on soil type, ground strata, and construction characteristics of the receiver building(s). The results from vibration can range from no perceptible effects at the lowest vibration levels, to low rumbling sounds and perceptible vibration at moderate levels, to slight damage at the highest levels. Groundborne vibrations from construction activities rarely reach levels that damage structures.

The FTA has published standard vibration velocities for construction equipment operations. In general, depending on the building category of the nearest buildings adjacent to the potential pile driving area, the potential construction vibration damage criteria vary. For example, for a building constructed with reinforced concrete with no plaster, the FTA guidelines show that a vibration level of up to 0.50 inch per second (in/sec) peak particle velocity (PPV) is considered safe and would not result in any construction vibration damage. In general, the FTA architectural damage criterion for continuous vibrations (i.e. 0.2 in/sec) appears to be conservative. The types of construction vibration impacts include human annoyance and building damage. Human annoyance occurs when construction vibration rises significantly above the threshold of human perception for extended periods of time. Building damage can be cosmetic or structural. Ordinary buildings that are not particularly fragile would not experience cosmetic damage (e.g. plaster cracks) at distances beyond

30 feet. This distance can vary substantially depending on soil composition and underground geological layer between vibration source and receiver.

Table 7: Typical Construction Equipment Vibration Levels, lists vibration levels at 15 and 25 feet (reference level) for typical construction equipment. Groundborne vibration generated by construction equipment spreads through the ground and diminishes in magnitude with increases in distance. As indicated in **Table 7**, based on FTA data, vibration velocities from typical heavy construction equipment operations that would be used during project construction range from 0.003 to 0.192 in/sec PPV from 10-25 feet from the source of activity. The nearest sensitive receptors are the single-family and multi-family residences approximately 15 feet from the active construction zone for the proposed project.

Table 7: Typical Construction Equipment Vibration Levels

Equipment	Typical Level (dBA) 15 Feet from the Source[1]	Typical Level (dBA) 25 Feet from the Source[1] (reference level)
Large Bulldozer	0.192	0.089
Loaded Trucks	0.164	0.076
Rock Breaker	0.127	0.059
Jackhammer	0.075	0.035
Small Bulldozer/Tractors	0.007	0.003

Source: Federal Transit Administration, Transit Noise and Vibration Impact Assessment Manual, September 2018
Notes: Calculated using the inverse square law formula for sound attenuation: $dBA_2 = dBA_1+20Log(d_1/d_2)$Where: dBA_2 = estimated noise level at receptor; dBA_1 = reference noise level; d_1 = reference distance; d_2 = receptor location distance

As shown in **Table 7: Typical Construction Equipment Vibration Levels**, the highest vibration levels are achieved with the large bulldozer operations. This construction activity is expected to take place during grading. As indicated in **Table 7**, construction equipment vibration velocities would not exceed the FTA's 0.20 PPV threshold. In general, other construction activities would occur throughout the project site and would not be concentrated at the point closest to the nearest residential structure. Therefore, vibration impacts associated with the project would be less than significant.

6.2 Operations

Operational Noise and Vibration

During operation, the improved crossings would function similar to the existing conditions. Vehicular traffic and pedestrians would be able to use the crossings as they do under existing conditions, but with improved safety. Operation of the project would not change the frequency or speed of existing trains along UPRR tracks or effect the volume of vehicles using the crossing. Since no change in vehicle or train trips and no new vehicle trips are generated by the project there would be no impact to operational noise as a result of project operation.

The project would generate groundborne vibration that could be felt at surrounding uses. However, the project operations would not result in any changes in railroad use or train trips. As a result, impacts from vibration associated with project operation would be less than significant.

6.3 Cumulative Noise

Noise by definition is a localized phenomenon, and drastically reduces as distance from the source increases. Cumulative noise impacts involve development of the project in combination with ambient growth and other related development projects. As noise levels decrease as distance from the source increases, only projects in the nearby area could combine with the project to potentially result in cumulative noise impacts.

Cumulative Construction Impacts. The project's construction activities, when properly mitigated, would still not result in a substantial temporary increase in ambient noise levels. The project construction would comply with BMC Section 8.52.350, stating construction hours are limited to the hours of 7:00 a.m. and 7:00 p.m. and on weekdays and holidays, between 9:00 a.m. and 8:00 p.m. Additionally, the Caltrans Best Practices for Noise Control would also be implemented to minimize or reduce the potential for noise impacts from project construction. There would be periodic, temporary noise impacts that would cease upon completion of construction activities. The project would contribute to other proximate construction noise impacts if construction activities were conducted concurrently. However, based on the noise analysis above, the project's construction-related noise impacts would be less than significant following compliance with local regulations and mitigation measures outlined in this study.

Construction activities at other planned and approved projects would be required to take place during daytime hours, and the City and project applicants would be required to evaluate construction noise impacts and implement mitigation, if necessary, to minimize noise impacts. The project would be required to comply with the applicable City of Berkeley Municipal Code limitations on allowable hours of construction. Therefore, project construction would not contribute to cumulative impacts and impacts in this regard are not cumulatively considerable.

Cumulative Operational Impacts. Cumulative noise impacts describe how much noise levels are projected to increase over existing conditions with the development of the project and other foreseeable projects. Cumulative noise impacts would occur primarily as a result of increased traffic on local roadways due to buildout of the project and other projects in the vicinity. However, noise from generators and other stationary sources could also generate cumulative noise levels.

During operation, the improved crossings would function similar to the existing conditions. Operation of the project would not change the frequency or speed of existing trains along UPRR tracks or effect the volume of vehicles using the crossing. Since no change in vehicle or train trips and no new vehicle trips are generated by the project there would be no impact to operational noise as a result of project operation. The project would generate groundborne vibration that could be felt at surrounding uses. However, the project operations would not result in any changes in railroad use or train trips Therefore, the project, in combination with cumulative background traffic noise levels, would result

in a less than significant cumulative impact. The project's contribution to noise levels would not be cumulatively considerable.

7.0 REFERENCES

1. California Department of Transportation, *California Vehicle Noise Emission Levels*, 1987.
2. California Department of Transportation, *Standard Specifications,* 2018.
3. California Department of Transportation, *Traffic Noise Analysis Protocol*, 2011.
4. California Department of Transportation, *Technical Noise Supplement to the Traffic Noise Analysis Protocol*, 2013.
5. California Department of Transportation, *Transportation and Construction Vibration Guidance Manual*, 2013.
6. City of Berkeley, *Municipal Code*, 2021.
7. Cyril M. Harris, *Handbook of Noise Control*, Second Edition, 1979.
8. Cyril M. Harris, *Noise Control in Buildings – A Practical Guide for Architects and Engineers*, 1994.
9. Elliott H. Berger, Rick Neitzel, and Cynthia A. Kladden. *Noise Navigator Sound Level Database with Over 1700 Measurement Values*, July 6, 2010.
10. Federal Highway Administration, *Roadway Construction Noise Model*, 2006.
11. Federal Highway Administration, Roadway *Construction Noise Model User's Guide Final Report*, 2006.
12. Federal Interagency Committee on Noise, *Federal Agency Review of Selected Airport Noise Analysis Issues*, 1992.
13. Federal Transit Administration, *Transit Noise and Vibration Impact Assessment Manual*, September 2018.
14. Kariel, H. G., *Noise in Rural Recreational Environments*, Canadian Acoustics 19(5), 3-10, 1991.
15. United States Environmental Protection Agency, *Protective Noise Levels (EPA 550/9-79-100)*, 1979.

Appendix A

Noise Data

Project:

Construction Noise Impact on Sensitive Receptors

Parameters

Construction Hours:	Daytime hours (7 am to 7 pm)	8
	Evening hours (7 pm to 10 pm)	0
	Nighttime hours (10 pm to 7 am)	0
Leq to L10 factor		3

	Receptor (Land Use)	Distance (feet)	Shielding	Direction
1	Cedar Street (Residential)	370	0	E
2	Addison Street (Residential)	75	0	E
3	Addison Street (Residential)	100	0	W
4	Bancroft Way (Residential)	700	0	SE

					RECEPTOR 1		RECEPTOR 2		RECEPTOR 3		RECEPTOR 4		RECEPTOR 5		RECEPTOR 6		RECEPTOR 7	
Construction Phase	**Equipment Type**	**No. of Equip.**	**Acoustical Usage Factor**	**Reference Noise Level at 50ft per Unit, Lmax**	**Noise Level at Receptor 1, Lmax**	**Noise Level at Receptor 1, Leq**	**Noise Level at Receptor 2, Lmax**	**Noise Level at Receptor 2, Leq**	**Noise Level at Receptor 3, Lmax**	**Noise Level at Receptor 3, Leq**	**Noise Level at Receptor 4, Lmax**	**Noise Level at Receptor 4, Leq**	**Noise Level at Receptor 5, Lmax**	**Noise Level at Receptor 5, Leq**	**Noise Level at Receptor 6, Lmax**	**Noise Level at Receptor 6, Leq**	**Noise Level at Receptor 7, Lmax**	**Noise Level at Receptor 7, Leq**
Demolition																		
	Concrete Saw	1	20%	90	72.2	65.2	86.1	79.1	83.6	76.6	66.7	59.7	109.6	102.6	108.0	101.0	106.7	99.7
	Dozer	1	40%	82	64.3	60.3	78.2	74.2	75.7	71.7	58.8	54.8	101.7	97.7	100.1	96.1	98.8	94.8
Combined LEQ						**66.4**		**80.3**		**77.8**		**60.9**		**103.8**		**102.2**		**100.9**
Grading																		
	Concrete Saw	1	20%	90	72.2	65.2	86.1	79.1	83.6	76.6	66.7	59.7	109.6	102.6	108.0	101.0	106.7	99.7
	Crane	1	16%	81	63.2	55.3	77.1	69.1	74.6	66.6	57.7	49.7	100.6	92.6	99.0	91.1	97.7	89.7
	Dozer	1	40%	82	64.3	60.3	78.2	74.2	75.7	71.7	58.8	54.8	101.7	97.7	100.1	96.1	98.8	94.8
	Tractor	1	40%	84	66.6	62.6	80.5	76.5	78.0	74.0	61.1	57.1	104.0	100.0	102.4	98.4	101.1	97.1
	Grader	1	40%	85	67.6	63.6	81.5	77.5	79.0	75.0	62.1	58.1	105.0	101.0	103.4	99.4	102.1	98.1
Combined LEQ						**69.5**		**83.4**		**80.9**		**64.0**		**106.9**		**105.3**		**104.0**
Building Construction																		
	Concrete Saw	1	20%	90	72.2	65.2	86.1	79.1	83.6	76.6	66.7	59.7	109.6	102.6	108.0	101.0	106.7	99.7
	Flat Bed Truck	1	40%	74	56.9	52.9	70.8	66.8	68.3	64.3	51.4	47.4	94.3	90.3	92.7	88.7	91.4	87.4
Combined LEQ						**65.5**		**79.3**		**76.8**		**59.9**		**102.9**		**101.3**		**99.9**
Paving																		
	Concrete Mixer Truck	1	40%	79	61.4	57.4	75.3	71.3	72.8	68.8	55.9	51.9	98.8	94.8	97.2	93.2	95.9	91.9
	Paver	1	50%	77	59.8	56.8	73.7	70.7	71.2	68.2	54.3	51.3	97.2	94.2	95.6	92.6	94.3	91.3
	Roller	1	20%	80	62.6	55.6	76.5	69.5	74.0	67.0	57.1	50.1	100.0	93.0	98.4	91.4	97.1	90.1
	Tractor	1	40%	84	66.6	62.6	80.5	76.5	78.0	74.0	61.1	57.1	104.0	100.0	102.4	98.4	101.1	97.1
Combined LEQ						**65.1**		**79.0**		**76.5**		**59.6**		**102.5**		**100.9**		**99.6**
Overlapping Phases																		
Overlapping Phases						70.9		84.8		82.3		65.4		108.3		106.7		105.4
Overlapping Phases						65.1		79.0		76.5		59.6		102.5		100.9		99.6
Overlapping Phases						65.1		79.0		76.5		59.6		102.5		100.9		99.6
Overlapping Phases						65.1		79.0		76.5		59.6		102.5		100.9		99.6
Maximum Noise Level						**70.9**		**84.8**		**82.3**		**65.4**		**108.3**		**106.7**		**105.4**

Source for Ref. Noise Levels: RCNM, 2005