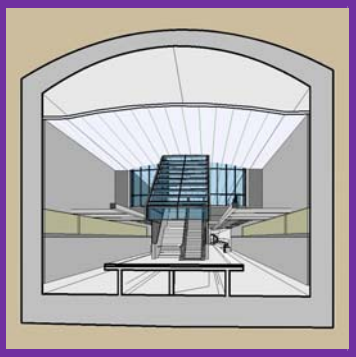
LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

WESTSIDE PURPLE LINE EXTENSION PROJECT, SECTION 2
ADVANCED PRELIMINARY ENGINEERING

Contract No. PS-4350-2000


Construction **Noise/ Vibration Mitigation and Monitoring Plan**

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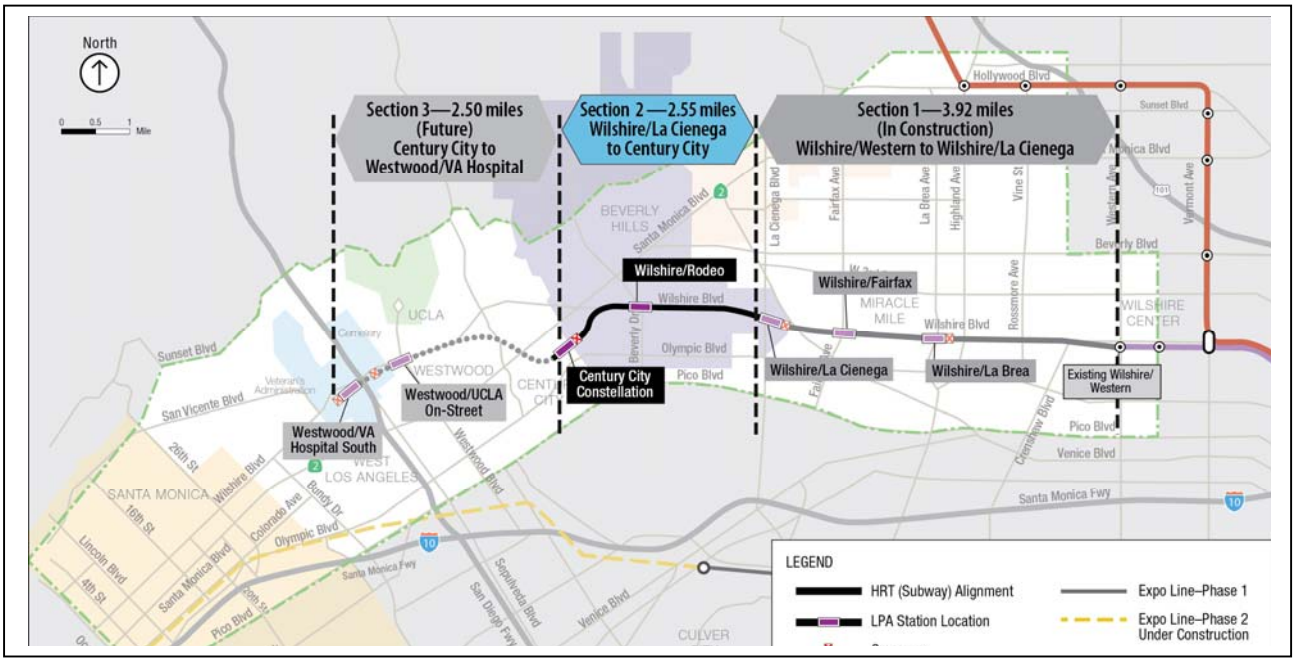
1.0 INTRODUCTION

The Westside Subway Extension Project is located in western Los Angeles County, and will extend the heavy rail Metro Purple Line subway line westward from the existing Wilshire/Western station to the Veterans Administration (VA) Hospital in Westwood. The subway lies within the Cities of Los Angeles and Beverly Hills, and a part of unincorporated Los Angeles County in the vicinity of the Federal Building and the Veterans Administration Hospital area.

The project consists of approximately nine miles of twin bore tunnels, seven underground stations, and modifications to the existing Division 20 rail vehicle storage and maintenance facility. The project will be constructed in three sections which are shown in Figure 1-1 and with further contracts for modifications to the Division 20 Maintenance Yard.

Figure 1-1: Project Sections



A design / build contract for Section 1 was awarded on November 5, 2014 and Notice to Proceed issued on January 12, 2015. Section 2 received Entry into Engineering from the FTA on December 31, 2014. Advanced Preliminary Engineering for Section 2 is now underway with the goal of issuing a Request for Proposals in late 2015.

The Westside Subway Extension Section 2 Project (the Project) involves construction activities which generate high noise and vibration levels. This Construction Noise and Vibration Plan (the Plan) discloses the predicted noise and vibration effects of construction activities related to the Project based on possible construction methods, though the actual means and methods employed during construction will be determined by the construction contractors and may differ from those described in this document.

This Plan outlines the potential noise and vibration effects of constructing Section 2, a 2.55 mile section with two stations at Wilshire/ Rodeo and Century City on Constellation Blvd. It describes possible construction methods, though the actual means and methods employed during construction will be determined by the construction contractors and may differ from those outlined in this document.

The Plan was prepared to meet the criteria, standards, and mitigation commitments in the Westside Subway Extension Final Environmental Impact Statement/ Environmental Impact Report (EIS/EIR), March 2012. The Plan identifies receivers where noise or vibration impact may occur as a result of construction activities, provides additional information on the noise and vibration limits for the planned means and methods of construction, and recommends mitigation measures and monitoring locations where necessary.

2.0 CONSTRUCTION ACTIVITIES

The Project's plans call for lay down and staging areas to support the station construction and tunneling activities. Site plans and more detailed descriptions of the activities to be conducted at each laydown site can be found in the Westside Purple Line Extension - Section 2 Construction Approach (June 2015). A brief description of each construction area and the noise and vibration generating construction activities modeled in this Plan follow below. The locations of the construction areas discussed below are shown in Figure 2-3 and Figure 2-4.

2.1 Wilshire/Rodeo

A station box will be constructed below Wilshire Boulevard between S. Crescent Drive and S. Beverly Drive as shown on Figure 2-3. The lay down and staging areas supporting the construction of the Wilshire/Rodeo Station are:

Wilshire/Rodeo Station Box: Construction of the Wilshire/Rodeo Station box includes installation of piling and lagging, excavation below street level and installation of main deck beams and street decking. The installation of the main deck beams and street decking occurs over the 56 hour weekend closure (16 weekend closures). The remaining excavation is done under the street decking system. Spoils are hoisted to the surface by crane and temporarily stockpiled in the adjacent laydown and staging areas. The spoils are then loaded onto trucks for transportation to a disposal site. Once excavation is complete, station concreting occurs which includes concreting of station appendages and entrance structure. Concreting is followed backfilling and compaction of the station, appendages and entrance structure. Concurrent with the backfilling and compaction operation is installation of station mechanical and electrical in the various ancillary spaces/rooms and the entrance structure. Station finishes follows including those in the station entrance. Concurrent with the installation of the station finishes, site restoration occurs including AC pavement, concrete sidewalks, curbs, gutters, street lighting, signal systems, landscaping, signing, pavement striping and installation of street furniture.

Wilshire South Staging Area (Site 9447 Wilshire Blvd): This site is utilized for materials staging to support construction of Rodeo Station. The site includes an open shaft which allows access to the main station box, storage containers, air scrubbers and a water treatment plant. This staging area is shown on Figure 2-1 labeled as Parcel 4. This staging site will be used during station excavation to stockpile, load and haul-out excavated materials.

Wilshire North Staging Area (Site 9384 thru 9440 Wilshire Blvd): This site is utilized for muck handling for excavation down to 12' below street level. Once the main deck beams and street decking are in place, this site will revert over to support construction of Rodeo Station. The site includes an open shaft which allows access to the main station box, temporary power and a water treatment plant. This staging site will be used during station excavation to stockpile, loading and haul-out of excavated materials. This staging area is shown on Figure 2-1 labeled as Parcels 1, 2, and 3.

Figure 2-1: Lay down and Staging Areas at Wilshire/Rodeo Station

2.2 Century City/Constellation

A station box will be constructed below Constellation Boulevard between Century Park East and Solar Way (Figure 2-4). The lay down and staging areas supporting the construction of the Century City Station are:

Median of Constellation Boulevard: Main construction staging to support all construction operations necessary to construct Century City/Constellation station with the exception of installing main deck beams and street decking which occurs continuously over the 56 hour weekend closures (21 weekend closures). As there are no spoils storage areas available, all spoils are immediately loaded onto trucks and taken to disposal sites. This site is to be utilized for both day and night work shifts. This area is shown on Figure 2-2 labeled as Site 4.

Construction Site 1940 Century Park East (CPE): Primary use is to support tunneling operations for day and night shifts. This site also is to receive materials such as pre-cast concrete segments which constitute the tunnel lining. This site will also support the mining of cross-passages and concreting of tunnels and cross-passages, mechanical, electrical and finishes for day shifts. This area is shown on Figure 2-2 labeled as Site 2. Tunnel ventilation and air scrubbing equipment will be located on this site, together with a temporary substation providing power for tunneling equipment

Construction Site 1950 CPE: Access shaft to support tunneling operations for day and night shifts during tunneling. The access shaft facilitates removal of tunnel muck as well as for deliveries of precast segments to rail mounted cars below which will be taken to the TBM's rear trailing gear for installation as the tunnel liner. Other miscellaneous material appurtenances will also be delivered in this manner. This site also supports concreting of tunnels (invert & walkway) and cross-passages, mechanical, electrical and finishes for day shifts. This area is shown on Figure 2-2 labeled as Site 2. During construction of the access shaft, the site will also be used by excavating and hoisting equipment

required for shaft construction. At the completion of tunnel construction, the shaft will be used to support rail welding. Stock rail will be delivered to the site by trucks. The rail will be lowered down to track level through the shaft and placed in stockpiles. A portable rail welding plant will be set up at the bottom of the shaft to weld stock rail into continuous welded rail (CWR) strings approximately 500 ft long. The CWR strings will also be stockpiled within the tunnels

Construction Site 2040 CPE: Main construction staging site to support tunneling operations for day and night shifts during tunneling. This site also supports the drying and storage of tunnel muck until such time as it is loaded onto trucks and taken to disposal sites. This site houses the compressor plant, ventilation plant, grout plant, foam plant, conveyor system, machine shop and electrical shop. Upon completion of tunneling, this site reverts to daytime use to support concreting of tunnels and cross-passages, mechanical, electrical and finishes. This area is shown on Figure 2-2 labeled as Site 3.

Construction Site at Constellation Boulevard and Century Park West (Parcel W3901): Primary use of this site for miscellaneous tool storage as well as limited materials storage to support Century City/Constellation Station construction operations. This site is to be for both day and night work shifts. This area is shown on Figure 2-2 labeled as Site 5.

Once tunnels have been completed, the tunneling operation will demobilize, thereby leaving construction sites 1940 CPE, 1950 CPE, and 2040 CPE to support construction of the Century City/Constellation Station and Systems installation (Trackwork, Traction Power, Automatic Train Control and Communications).

Figure 2-2: Lay down and Staging Areas at Century City/Constellation Station

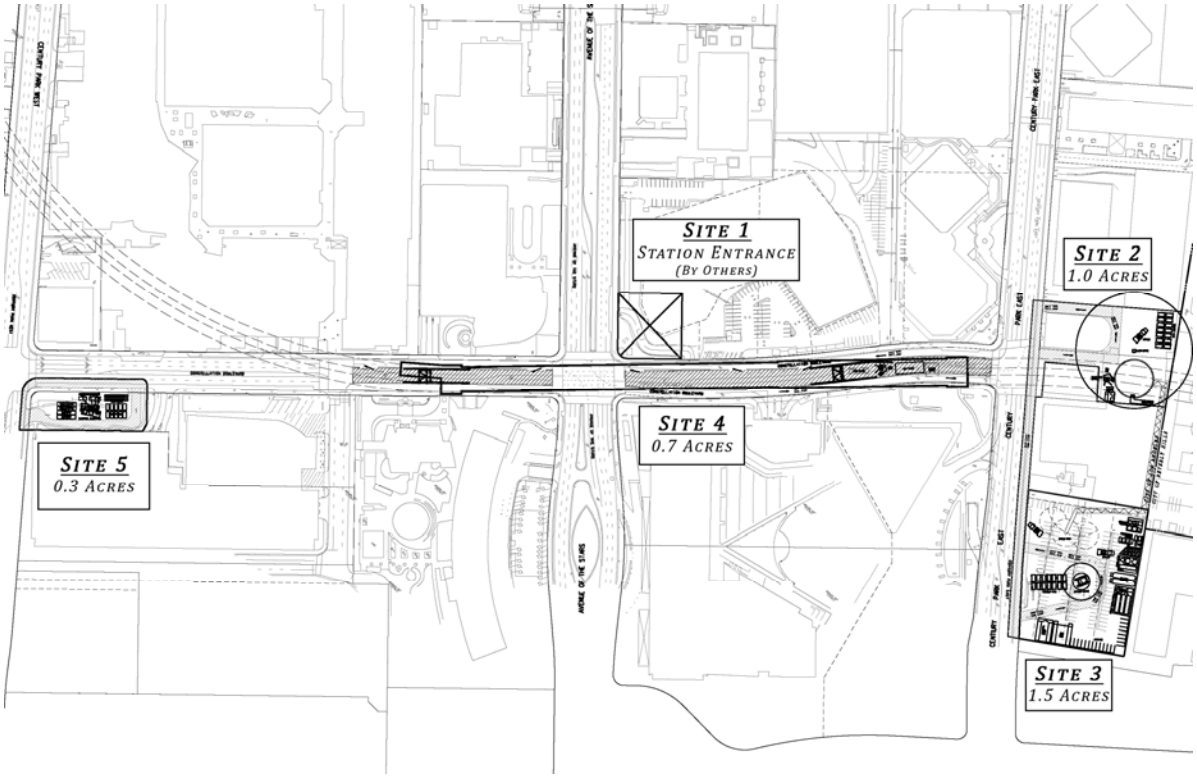


Figure 2-3: Wilshire/Rodeo Station Construction Sites and Noise Receivers

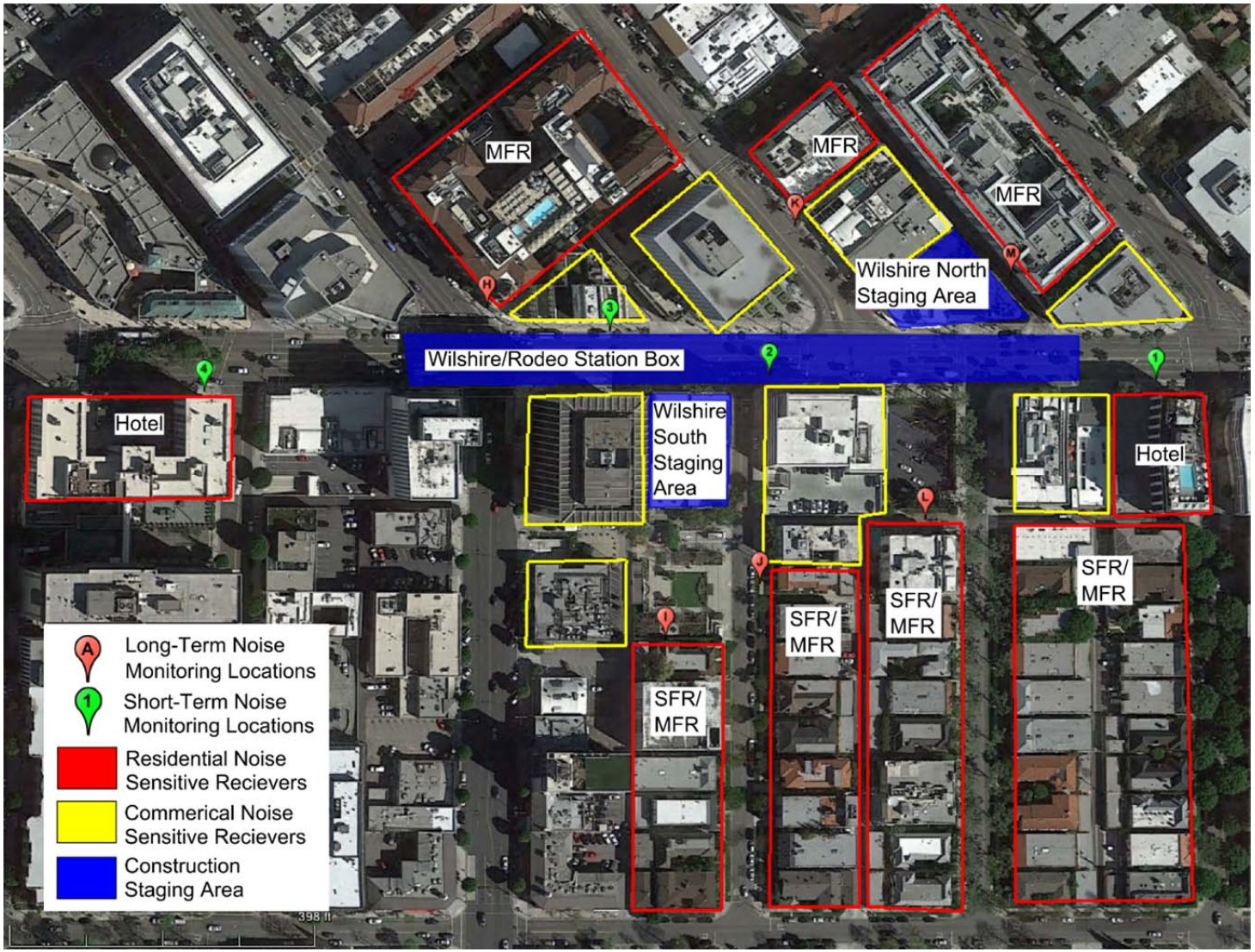
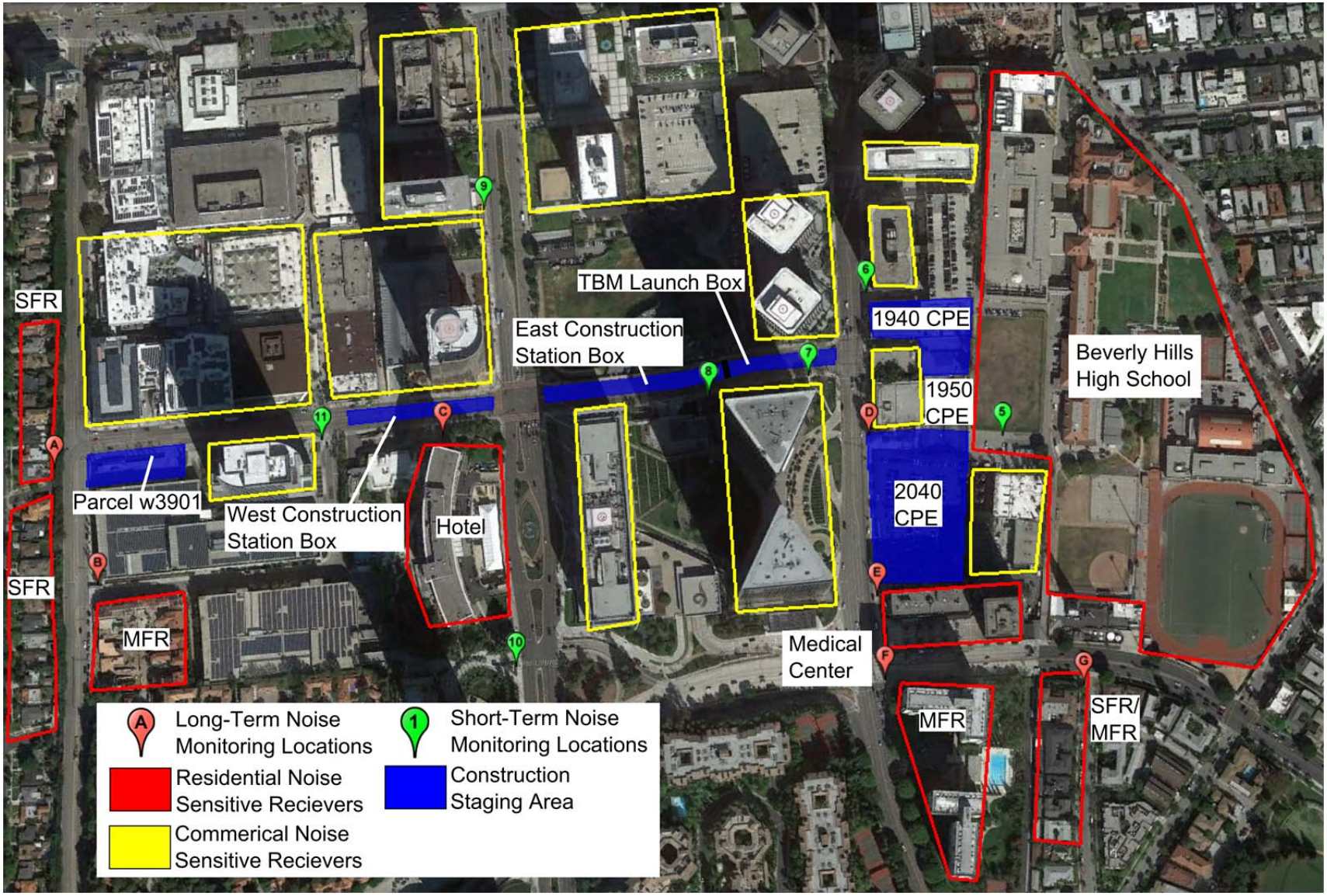


Figure 2-4: Century City/Constellation Station Construction Sites and Noise Receivers



3.0 PRE-CONSTRUCTION NOISE MEASUREMENTS

Existing noise conditions were documented at sensitive receivers closest to the construction areas to determine the baseline ambient noise levels before construction activities. The locations of the noise sensitive receivers are shown on Figure 2-3 and Figure 2-4. These existing noise measurements are used as the basis for:

- A noise variance from the City of Los Angeles for construction during the nighttime hours 9:00 P.M. to 7:00 A.M.
- A noise variance from the City of Beverly Hills for construction during the evening hours of 6:00 P.M. to 9:00 P.M. and nighttime hours of 9:00 P.M. to 8:00 A.M.
- Establish City of Beverly Hills daytime construction noise limits during the hours of 8:00 A.M. to 6:00 P.M.

Existing daytime noise, from 7:00 A.M. to 9:00 P.M., at receivers in the City of Los Angeles was not measured because the City has a construction noise limit of 75 dBA for these hours.

The results of the noise measurements are presented in Table 3-1 and Table 3-2. The table presents the average of the measured daytime, evening, and nighttime noise levels (Leq) for receivers in the jurisdiction of the City of Beverly Hills and the nighttime Leq, for receivers within the jurisdiction of the City of Los Angeles. Detailed measurement results are presented in Appendix B.

Table 3-1: Pre-Construction Noise Measurement Results Wilshire/Rode Station

Site No.	Measurement Location	Daytime Leq[b]	Evening Leq[b]	Nighttime Leq[b]
H	210 N. Beverly Drive (MFR)	72 dBA	70 dBA	69 dBA
I	133-153 S. Reeves Drive (SFR/MFR)	59 dBA	56 dBA	54 dBA
J	Sitaj Hotel, 120 S. Reeves Drive	58 dBA	56 dBA	52 dBA
K	192 N. Canon Drive (Offices)	68 dBA	65 dBA	65 dBA
L	121-157 S. Canon Drive (SFR/MFR)	61 dBA	61 dBA	57 dBA
M	AKA Beverly Hills Hotel, 155 N. Crescent Drive	62 dBA	60 dBA	62 dBA
1	Beverly Sixty Hotel, 9360 Wilshire Boulevard[a]	76 dBA	74 dBA	72 dBA
2	The Rolex Building, 9420 Wilshire Boulevard (Offices) [a]	74 dBA	72 dBA	70 dBA
3	Sterling Plaza/Bank of California, 9441 Wilshire Boulevard (Offices) [a]	74 dBA	72 dBA	71 dBA
4	Beverly Wilshire Hotel, 9500 Wilshire Boulevard[a]	73 dBA	72 dBA	70 dBA

Notes:
[a] 1-hour measurements were taken at Sites 1 through 4. The daytime Leq, evening Leq, and nighttime Leq were estimated by comparing the 1-hour measurement to the same hour of the nearest 24-hour measurement location.
[b] Daytime is from 8:00 A.M. to 6:00 P.M., evening is from 6:00 P.M. to 9:00 P.M. and nighttime is from 9:00 P.M. to 8:00 A.M.,
MFR – Multi-Family Residences
SFR – Single-Family Residences

Table 3-2: Pre-Construction Noise Measurement Results Century City/Constellation Station

Site No.	Measurement Location	Nighttime Leq[b]		
A	1918-1952 Fox Hills Drive (MFR)	58 dBA		
B	2050 Century Park West (MFR)	59 dBA		
C	Hyatt Regency Century Plaza Hotel, 2025 Avenue of the Stars	56 dBA		
D	2010 Century Park East (Offices)	63 dBA		
E	Century City Hospital & Medical Center, 2080 Century Park East	63 dBA		
F	2160 Century Park East (MFR)	65 dBA		
6	1888 Century Park East (Offices)[a]	63 dBA		
7	Century Plaza Towers, 2049 Century Park East (Offices)[a]	59 dBA		
8	Annenberg Space for Photography and the Skylight Studios, 10050 Constellation Boulevard[a]	56 dBA		
9	Bain & Company Building, 1901 Avenue of the Stars[a]	61 dBA		
10	The Century, 10 West Century Drive (Offices)[a]	57 dBA		
11	Constellation Place, 10250 Constellation Boulevard (Offices)[a]	64 dBA		
Sites G and 5 are in the City of Beverly Hills and subject to the Beverly Hills' Noise Code				
		Daytime	**Evening**	**Nighttime**
G	401 Shirley Place, Beverly Hills (SFR)	68 dBA	68 dBA	63 dBA
5	Beverly Hills High School[a]	56 dBA	53 dBA	51 dBA

Notes:
[a] 1-hour measurements were taken at Sites 5 through 11. At these locations the daytime Leq, evening Leq, and nighttime Leq were estimated by comparing the 1-hour measurement to the same hour of the nearest 24-hour measurement location.
[b] Nighttime is from 9:00 P.M. to 7:00 A.M as defined by the City of Los Angles Municipal Code.
MFR – Multi-Family Residences
SFR – Single-Family Residences

4.0 CONSTRUCTION NOISE LIMITS

The Project is subject to the local noise limits set forth in the City of Los Angeles Municipal Code (LAMC) and the City of Beverly Hills Municipal Code (BHMC). The Wilshire/Rodeo construction areas are located in the City of Beverly Hills and are subject to the BHMC. The Century City/Constellation construction areas are in the City of Los Angeles and are subject to the LAMC. The exceptions are those noise sensitive receivers within the City of Beverly Hills limits are affected by the activities at Century City/Constellation construction sites on Century Park East. These receivers, single-family residences on Shirley Place (Site G) and Beverly Hills High School (Site 5) are subject to the BHMC.

4.1 City of Los Angeles Noise Limits

Section 112.05 of the LAMC sets a maximum noise level for powered equipment of 75 dBA at a distance of 50 feet when operated within 500 feet of a residential zone. However, compliance with this standard is not required where “technically infeasible”. Technically infeasible means that the established noise limits cannot be met with at the project site despite the use of mufflers, shields, sound barriers, and/or other noise reduction devices or techniques employed during the operation of equipment.

Section 111.02 of the LAMC provides procedures and criteria for the measurement and impact assessment of noise sources. Specifically, the procedures provide for a penalty of 5 dBA for steady high-pitched noise or repeated impulsive noises. Conversely, the procedures provide a credit of 5 dBA for noise occurring less than 15 minutes in a period of 60 consecutive minutes during the day because short-term noise events are typically less annoying than continuous noise sources.

The LAMC also restricts the hours of construction activities. Section 41.40 prohibits construction between the hours of 9:00 P.M. and 7:00 A.M. Monday through Friday, 6:00 P.M and 8:00 A.M on Saturday, and at any time on Sunday. Construction during nighttime hours or on Sunday requires a noise variance. If a noise variance is obtained, construction can be conducted during nighttime hours with a noise limit of 5 decibels above the measured ambient.

Pre-construction noise measurements were conducted at the sensitive receivers adjacent to the construction areas to determine the pre-construction ambient noise levels and nighttime construction noise limits. The noise measurement results are presented in Section 0. More detailed information on the ambient measurement results are shown in Appendix B.

4.2 City of Beverly Hills Noise Limits

Section 5-1-202 of the BHMC limits the noise level of any machinery, equipment, pump, fan, air conditioning apparatus, or similar mechanical device in any manner so as to create any noise which would cause the noise level at the property line of any property to exceed the ambient noise level by more than five decibels.

Section 5-1-205 of the BHMC restricts the hours of construction activity during the hours of 6:00 P.M. and 8:00 A.M. of any day or at any time on a Sunday or public holiday. The Project may be granted an afterhours construction permit authorizing work during restricted hours if the city building official determines that the public interest will be served by such a permit.

The BHMC does not mention the nighttime noise limit that is applied if a nighttime noise permit is obtained. In this Plan, we assume that the nighttime noise limit will be five decibels above the ambient

noise level. This is consistent with the limit applied during the nighttime hours in the City of Los Angeles and with the limit applied during the daytime in the city of Beverly Hills.

4.3 Summary of Noise Limits

A summary of the noise limits is presented in Table 4-1. The table presents the different noise limits for City of Los Angeles and the City of Beverly Hills. Additionally, there are different limits for different times of day. For the noise impact analysis in this Plan, the limits are applied at the facade of the nearest sensitive receivers. Residential land uses (where people sleep) or institutional land uses such as theatres, churches, or schools are considered to be sensitive receivers. Commercial and industrial land uses are not considered sensitive and are not assessed for impact in this Plan.

Table 4-1: Summary of Construction Noise Limits

Construction Activity	Noise Limit[1], dBA
City of Los Angeles Daytime (7:00 A.M.-9:00 P.M.), general activities	75 dBA
City of Los Angeles Daytime (7:00 A.M.-9:00 P.M.), steady high-pitch noise or repeated impulsive noises	70 dBA
City of Los Angeles Daytime (7:00 A.M.-9:00 P.M.), less than 15 minute duration in a period of 60 consecutive minutes	80 dBA
City of Los Angeles Nighttime (9:00 P.M.-7:00 A.M.), all activities	Nighttime Ambient + 5dB
City of Beverly Hills Daytime (8:00 A.M.-6:00 P.M.), all activities	Daytime Ambient +5 dB
City of Beverly Hills Evening (6:00 P.M.-9:00 P.M.), all activities	Evening Ambient + 5dB
City of Beverly Hills Nighttime (9:00 P.M.-8:00 A.M.), all activities	Nighttime Ambient + 5 dB

Notes:
[1]Noise limit applies to the facade of the closest noise sensitive property.

5.0 CONSTRUCTION VIBRATION LIMITS

The primary concern regarding construction vibration relates to risk of damage. Vibration is generally assessed in terms of peak particle velocity (PPV) for risk of building damage. PPV is the appropriate metric for evaluating the potential of building damage and is often used when monitoring blasting and construction vibration because it relates to the stresses that are experienced by the buildings.

Vibration damage risk thresholds from the Westside Subway Extension Final EIS/EIR are presented in Table 5-1. The table presents PPV thresholds for different building categories. The 'Structural Building Damage' category is the level above which there is a risk that structural damage may occur. The 'Architectural Building Damage' category is the level above which there is a risk that superficial building damage, such as small cracks, may occur. The third category, 'Damage Risk to Historic Buildings and Cultural Resource Structures' is meant to apply to historic buildings that are particularly susceptible to damage. In this Plan, we use the 'Architectural Building Damage' threshold of 0.5 PPV for all non-historic structures. Where the PPV exceeds 0.5, monitoring or other appropriate mitigation measures such as using alternative construction approaches, are considered.

Table 5-1: Construction Vibration Damage Risk Thresholds

Building Category	Peak Particle Velocity (in/sec)
Structural Building Damage	2.0
Architectural Building Damage	0.5
Damage Risk to Historic Buildings and Cultural Resource Structures	0.12 to 0.2
Source: Westside Subway Extension Final EIS/EIR, LAMTA, March 2012.	

A survey of the cultural resources and historic properties within the project area were completed as part of the EIS/EIR.

Table 5-2 lists the properties identified in the survey which are eligible for the National Register of Historic Places (NRHP) and the California Register of Historic Places (CHRP) and are within 500 feet of any of the construction laydown areas or other major construction activities. Based the existing condition of the properties identified as historic these building will be assessed with the upper limit of the damage risk threshold of 0.2 PPV in/sec in this Plan. This is a conservative threshold to prevent any architectural damage to the buildings.

Table 5-2: Properties Listed and Eligible as NRHP

Property	Status
Sterling Plaza/Bank of California, 9441 Wilshire Boulevard	Potentially Eligible NRHP, CRHP
Ace Gallery, 9430 Wilshire Boulevard	Potentially Eligible NRHP, CRHP
Union Bank Building, 9460 Wilshire Boulevard	Potentially Eligible NRHP, CRHP
Beverly Hills High School	Potentially Eligible NRHP, CRHP
Century Plaza Hotel, 2025 Avenue of the Stars	Potentially Eligible NRHP, CRHP
Source: Historic Properties Supplemental Survey Technical Report, LAMTA, March 2012.	

5.1 Groundborne Noise

During tunnel excavation the operation of the tunnel train will result in groundborne noise levels that could affect receivers above the tunnel such as residences, hotels, theaters, churches, and schools. Metro has adopted a groundborne noise criteria for tunneling that is based on adding 5 dB to the FTA groundborne noise criteria. Table 5-3 lists the criteria which are also included in Metros' Contract Specification Section 01565, Construction Noise and Vibration Control, which will be included as part of the contract documents for this Project.

Table 5-3: Allowable Maximum Interior Groundborne Noise from Underground Construction Activities (Lmax)

Land Use Activity	Groundborne Noise Level Limits – L_{max} (dBA)
Single-Family Dwellings	40
Multi-Family Dwellings	45
Hotel/Motel	45
Offices	50
Commercial Buildings	55
Concert Halls, Recording and TV Studios	30
Auditoriums and Music Rooms	35
Churches and Theaters	40
Hospital Sleeping Rooms	45
Schools and Libraries	50
Note: Maximum ground borne noise is as measured in the inside of the affected noise sensitive structure.	

6.0 CONSTRUCTION NOISE PREDICTIONS

6.1 Noise Prediction Methodology

The projected daytime and nighttime construction noise levels were modeled using CadnaA version 4.0, a three dimensional graphics oriented noise modeling program that uses the International Standards Organization (ISO)9613, a general purpose standard for outdoor noise propagation. CadnaA incorporates the following elements:

- An emission model to determine the noise generated by the equipment at a reference distance.
- A propagation model that calculates how the noise level varies with distance.
- A prediction model that sums the noise of each source at sensitive locations.

The noise modeling includes the effects of ground cover, the shielding of building structures, and the reduction provided by a noise barrier wall (if one is specified in the construction plans). The construction noise levels were estimated at each of the receivers within close proximity to the construction sites. The source noise levels used in the model for different pieces of construction equipment are based on the actual measured noise level data presented in Table 6-1. This data is from the Federal Highway Administration (FHWA) Roadway Construction Noise Model.

6.2 Noise Prediction Results and Impact Assessment

Noise prediction models were developed for each construction site based on the project plan drawings and the current means and methods planned for the construction phases. Each of the construction sites where nighttime activities will occur are assumed to have a noise barrier wall of different heights erected around the perimeter of each site and construction at that site would use low noise emission equipment as specified by Metro's Specification Section 01 56 19, Construction Noise and Vibration Control (Appendix C). The following sections present predictions of noise levels at sensitive receivers in the vicinity of the laydown areas and other areas where construction activity is scheduled to take place. The hourly noise levels from the proposed construction activities (Leq) and the applicable noise limits at the nearest receivers are presented in Table 6-2 and Table 6-3.

6.2.1 Wilshire/Rodeo Station

Activities at the Wilshire/Rodeo site consist of construction of the station box and support of underground mining activities. There are three construction areas, all of which will support construction activities during nighttime hours from 6:00 P.M. to 8:00 A.M. During these nighttime hours the following equipment is expected to be used at each of these areas:

- Wilshire/Rodeo Station Box Area: boom crane, rough terrain crane, fork lift truck, and a pickup truck.
- Wilshire South Staging Area: rough terrain crane, excavator, dump trucks, fork lift truck, and pickup truck.
- Wilshire North Staging Area: hydraulic crane, excavator, dump trucks, fork lift truck, and pickup truck.

Moveable noise barriers, as shown in Figure 9-3, shall be used to mitigate noise at surface work sites within the perimeter of the Wilshire/Rodeo Station Box Area. A 20 foot high noise barrier walls shall be constructed at the perimeters of the Wilshire South Staging Area and the Wilshire North Staging Area. The noise barrier walls will be constructed in accordance with Metro's Specification Section 01 56 19, Construction Noise and Vibration Control (Appendix C). Equipment used during nighttime hours at these construction areas shall comply with the low noise equipment emission limits also specified in Section 01 56 19. Wilshire/Rodeo noise receivers are presented below. The predicted construction noise at the nearby noise sensitive receivers to these construction areas during the daytime, evening, and nighttime hours compared with the BHMC noise levels limits of the existing ambient noise plus 5 dB are presented in Table 6-2. The predicted construction noise levels at all the receiver sites analyzed do not exceed the daytime, evening, or nighttime BHMC noise limits.

Table 6-1: Construction Equipment Noise Emission Levels

Equipment Description	Lmax Noise Limit at 50 ft, dB Slow	Is Equipment an Impact Device?
Auger Drill Rig	85 dBA	No
Backhoe	80 dBA	No
Boring Jack Power Unit	80 dBA	No
Chain Saw	85 dBA	No
Clam Shovel	93 dBA	Yes
Compactor (ground)	80 dBA	No
Compressor (air)	80 dBA	No
Concrete Mixer Truck	85 dBA	No
Concrete Pump Truck	82 dBA	No
Concrete Saw	90 dBA	No
Crane (mobile or stationary)	85 dBA	No
Dozer	85 dBA	No
Dump Truck	84 dBA	No
Excavator	85 dBA	No
Flat Bed Truck	84 dBA	No
Front End Loader	80 dBA	No
Generator (25 KVA or less)	70 dBA	No
Generator (more than 25 KVA)	82 dBA	No
Gradall	85 dBA	No
Horizontal Boring Hydraulic Jack	80 dBA	No
Impact Pile Driver (diesel or drop)	95 dBA	Yes
Jackhammer	85 dBA	Yes
Mounted Impact Hammer (hoe ram)	90 dBA	Yes
Paver	85 dBA	No
Pickup Truck	55 dBA	No
Pneumatic Tools	85 dBA	No
Pumps	77 dBA	No
Rock Drill	85 dBA	No
Scraper	85 dBA	No
Slurry Plant	78 dBA	No
Slurry Trenching Machine	82 dBA	No
Soil Mix Drill Rig	80 dBA	No
Tractor	84 dBA	No
Vacuum Excavator (Vac-Truck)	85 dBA	No
Vacuum Street Sweeper	80 dBA	No
Vibratory Concrete Mixer	80 dBA	No
Vibratory Pile Driver	95 dBA	No
Welder	73 dBA	No
Source: Federal Highway Administration (FHWA) Roadway Construction Noise Model, 2006		

Table 6-2: Wilshire/Rodeo Nighttime Construction Noise – Leq (dBA)

Receiver[1]	Location	Daytime Construction Noise	Daytime Noise Limit[2]	Evening Construction Noise	Evening Noise Limit	Nighttime Construction Noise	Nighttime Noise Limit
H	210 N. Beverly Drive (MFR)	69	77	54	75	54	74
I	133-153 S. Reeves Drive (SFR/MFR)	59	64	55	61	55	59
J	Sirtaj Hotel 120 S. Reeves Drive	60	63	57	61	57	57
K	192 N. Canon Drive (Offices)	64	73	54	70	54	70
L	121-157 S. Canon Drive (SFR/MFR)	63	66	52	66	52	62
M	AKA Beverly Hills Hotel, 155 N. Crescent Drive	62	67	59	65	59	67
1	Beverly Sixty Hotel, 9360 Wilshire Boulevard	65	81	54	79	54	77
2	The Rolex Building, 9420 Wilshire Boulevard (Offices)	70	79	62	77	62	75
3	Sterling Plaza/Bank of California, 9441 Wilshire Boulevard (Offices)	72	79	62	77	62	76
4	Beverly Wilshire Hotel, 9500 Wilshire Boulevard	63	78	52	77	52	75

Notes:
[1]The location of the modeled receiver is shown on Figure 2-3.

6.2.2 Century City/Constellation Station

Activities at the Century City/Constellation site consist of launching of the TBM, construction of the station box, removal of the tunnel spoils, and support of station and tunnel underground mining activities. There are five construction areas, all of which, will support construction activities during nighttime hours from 9:00 P.M. to 7:00 A.M for most of the noise receivers that are within the jurisdiction of the City of Los Angeles and 6:00 P.M. to 8:00 A.M. for those two receivers, Site G, SFR on Shirley Place and Site 5, Beverly Hills High School that are within the jurisdiction of the City of Beverly Hills. During these nighttime hours the following equipment is expected to be used at each of these areas:

- 2040 CPE Construction Area: front end loader, boom crane, haul trucks, ventilation plant, compressor plant, foam plant, conveyor system, mechanical shop, and electrical shop.
- 1940-1950 CPE Construction Area: excavator, roller compactor, dozer, tower crane, rough terrain crane, hydraulic crane, haul trucks, fork lift truck, conveyor system, concrete pump, dewatering station, pickup truck, tunnel ventilation fans and scrubbers.
- TBM Launch Site: dozer, excavator, front end loader, boom crane, rough terrain crane, concrete pump, fork lift truck, and pickup truck.
- Century City/Constellation Station Box: grader, roller compacter, dozer, excavator, front end loader, boom crane, rough terrain crane, concrete pump, haul trucks, fork lift truck, pickup truck, and ventilation fans.

- Construction Site at Constellation Boulevard and CPW (Parcel W3901): forklift and pickup truck.

A noise barrier wall shall be constructed at the perimeter of the following construction areas:

- 2040 CPE Construction Area - 20 foot high
- 1940-1950 CPE Construction Area - 20 foot high
- Construction Site at Constellation Boulevard and CPW (Parcel W3901) – 20 foot high

At the Century City/Constellation Station Box and the TBM Launch Site areas a moveable noise barrier, as shown in Figure 9-3, shall be used at the perimeter of the construction sites.

The noise barrier wall and moveable noise barrier shall be constructed in accordance with Metro's Specification Section 01 56 19, Construction Noise and Vibration Control (Appendix C). Equipment used during nighttime hours at these construction areas shall comply with the low noise equipment emission limits also specified in Section 01 56 19.

Table 6-3 presents the predicted construction noise during the daytime, evening, and nighttime hours for Receivers G and 5 which are in the City of Beverly Hills, compared with the BHMC noise levels limits of the existing ambient noise plus 5 dB. The remaining receiver sites which are within the City of Los Angeles are presented showing the predicted daytime construction noise is compared to the LAMC noise limit of 75 dBA and the nighttime construction noise to the existing ambient noise plus 5 dB.

As shown in Table 6-3, the daytime construction noise level at Site 5, Beverly Hills High School, would exceed the noise limit by 2 dB. At all the other sites analyzed the daytime noise limits are not exceeded. At Site C, Hyatt Regency Century Plaza Hotel, the nighttime noise limit is exceeded by 2 dB and At Site 5 the nighttime noise limit would be exceeded by 1 dB. At all the other sites analyzed the evening and nighttime noise limits are not exceeded.

At both the Century City Station Box and the 1940-1950 CPE Construction Area moveable noise barriers and/or sound control curtains located closer to the construction activities could be used to further reduce the construction noise at Sites C and 5 to below the noise limit.

The Contractor will be responsible for providing additional noise control measures and/or limiting the equipment and construction activities to be used at the Century City/Constellation Station Box Area to meet the LAMC nighttime noise limit at Site C and at the 1940-1950 CPE Construction Area to meet the BHMC daytime and nighttime noise limits at Site 5.

Table 6-3: Century City/Constellation Nighttime Construction Noise – Leq (dBA)

Receiver[1]	Location	Daytime Construction Noise	Daytime Noise Limit[2]	Evening Construction Noise	Evening Noise Limit[3]	Nighttime Construction Noise	Nighttime Noise Limit[4]
The following receivers are within the jurisdiction of the City of Beverly Hills							
G	401 Shirley Place (SFR)	45	73	40	73	40	68
5	Beverly Hills High School	63	61	57	58	57	56
The following receivers are within the jurisdiction of the City of Los Angles							
A	1918-1952 Fox Hills Drive (MFR)	54	75			50	63
B	2050 Century Park West (MFR)	42	75			38	64

Receiver[1]	Location	Daytime Construction Noise	Daytime Noise Limit[2]	Evening Construction Noise	Evening Noise Limit[3]	Nighttime Construction Noise	Nighttime Noise Limit[4]
C	Hyatt Regency Century Plaza Hotel, 2025 Avenue of the Stars	67	75			63	61
D	2010 Century Park East (Offices)	62	75			58	68
E[5]	Century City Hospital & Medical Center, 2080 Century Park East	67	75			54	68
F	2160 Century Park East (MFR)	52	75			41	70
6	1888 Century Park East (Offices)	63	75			50	68
7	Century Plaza Towers, 2049 Century Park East (Offices)	69	75			54	64
8	Annenberg Space for Photography and the Skylight Studios, 10050 Constellation Boulevard	66	75			54	61
9	Bain & Company Building, 1901 Avenue of the Stars	52	75			54	66
10	The Century, 10 West Century Drive (Offices)	57	75			54	62
11	Constellation Place, 10250 Constellation Boulevard (Offices)	58	75			54	69

Notes:
[1]The location of the modeled receiver is shown on Figure 2-4.
[2] Daytime is defined as 8:00 A.M. to 6:00 P.M. by the City of Beverly Hills and 7:00 A.M. to 9:00 P.M. by the City of Los Angeles.
[3] Evening is defined as 6:00 P.M. to 9:00 P.M. by the City of Beverly Hills. The City of Los Angeles municipal code does not include evening hour.
[4] Nighttime is defined as 9:00 P.M. to 8:00 A.M. by the City of Beverly Hills and 9:00 P.M to 7:00 A.M. by the City of Los Angeles.
[5] Construction noise at Site E was modeled at street level. A more detailed assessment of the construction noise at the upper floors of the Century City Hospital is presented in Section 6.2.3.

6.2.3 Century City Hospital and Medical Center

The Century City Hospital is adjoining 2040 CPE Construction Area. The 20 foot high noise barrier wall at the perimeter of this site will shield the construction noise activities at the street level of the hospital building resulting in an average nighttime noise level of 66 dBA which is 2 dB less than the noise limit of 68 dBA (see Table 6-3). Since the patient rooms of the hospital overlooking the construction site are on the upper floors of the building a more detailed noise assessment was prepared for this receiver.

The primary use of 2040 CPE construction site is for the main construction staging to support tunneling operations for day and night shifts during tunneling. This site also supports the drying and storage of tunnel muck until such time as it is loaded onto trucks and taken to disposal sites. It is expected that removal of muck from this site by truck will occur during nighttime hours. This site houses the compressor plant, ventilation plant, grout plant, foam plant, conveyor system, machine shop and electrical shop. A long boom crane and a front end loader will also operate during both day and night shifts. Upon completion of tunneling, this site reverts to daytime use to support concreting of tunnels and cross-passages, mechanical, electrical and finishes.

The assessment is based on the expected construction activities at the 2040 Century Park East (CPE) construction site between the hours of 9 P.M. and 7 A.M. (Figure 6-1). Patient rooms at the hospital facing the construction site are on the 3rd through the 8th floors of the building. The assessment includes the predicted construction noise at these floors and also adjusts the ambient noise levels measured at ground level at these different building heights.

Existing Ambient Noise Levels

Ambient noise measurements were conducted at the Century City Hospital at 2080 Century Park East, 180 feet from Olympic Boulevard (Site E) setback 4 feet from the street curb (Figure 6-1). The measured noise levels were then adjusted to account for the additional setback distance of the hospital building. The adjusted 24 one-hour Leq ambient noise levels at the face of the hospital building is graphically shown in Figure 6-2.

The measurements were conducted from 7 P.M. to 10 A.M. This time period was chosen to characterize the nighttime noise levels at the hospital. Section 41.40 of the Los Angeles Municipal Code requires a variance for nighttime construction from 9 P.M. to 7 A.M. The variance is based on not exceeding a noise limit of the ambient level plus 5 dB. Ambient noise measurements were not conducted during daytime hours because the City of Los Angeles has a maximum construction noise level limit of 75 dBA for daytime construction regardless of the ambient level.

Figure 6-1: Noise Measurement Sites

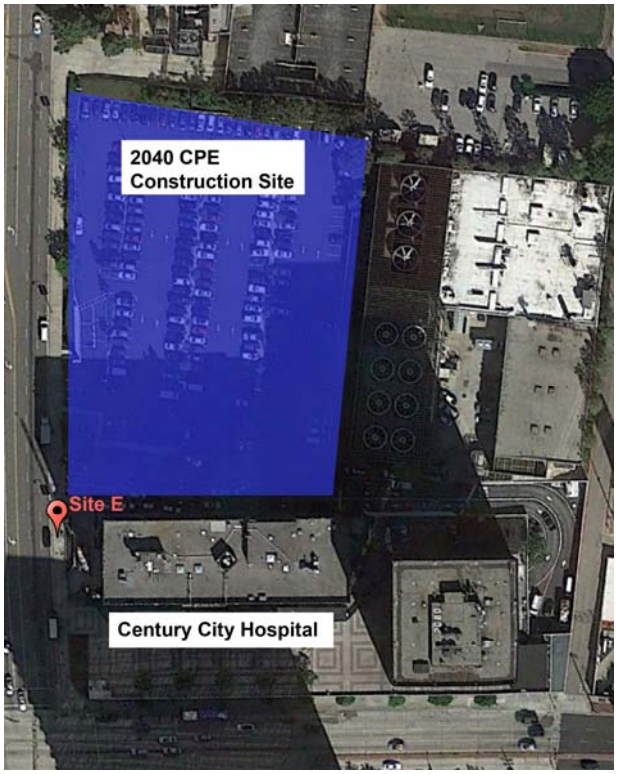
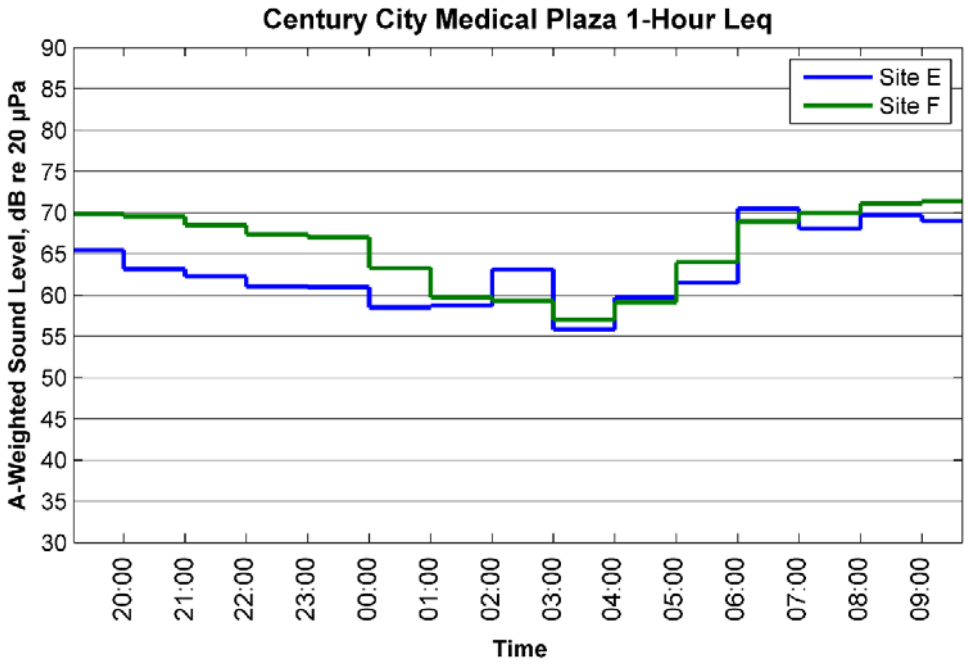


Figure 6-2: Century City Hospital Measured Noise Levels



As a worst case scenario the ambient noise of Leq=56 dBA measured from 3 A.M. and 4 A.M. was used as the nighttime noise impact threshold for the hospital building. The ambient was measured at ground level and adjusted for additional height of the 3rd through the 8th floor patient levels. The adjusted ambient along with the nighttime noise impact threshold are presented in Table 6-4 along with the predicted noise levels from nighttime construction activities. The predicted nighttime construction noise is based on a 20 foot noise barrier wall around the perimeter of the site and the use of low noise emission equipment.

Table 6-4. Nighttime Construction Noise Impact Thresholds at the Century City Hospital

Hospital Building Floor	Ambient Noise Level, Leq (dBA)	Los Angles Nighttime Construction Noise Limit, Leq (dBA)	Nighttime Construction Noise, Leq (dBA)	Exceeds the Nighttime Noise Limit (Y/N)
Ground Level	56	61	66	Y
Patient Floor 3	52	57	69	Y
Patient Floor 4	51	56	69	Y
Patient Floor 5	51	56	69	Y
Patient Floor 6	51	56	69	Y
Patient Floor 7	51	56	69	Y
Patient Floor 8	51	56	68	Y

The predicted construction noise at the patient floors exceeds the nighttime noise limits of existing ambient plus 5 dB. Additional noise control measures recommended for the 2040 CPE Construction Area to meet the nighttime noise limits are presented in Section 9.0 of this report.

7.0 CONSTRUCTION VIBRATION PREDICTIONS

7.1 Prediction Methodology

For this study, the FTA analytical/empirical construction vibration prediction model was used to estimate vibration levels propagate from construction equipment to vibration sensitive locations. The vibration model is based on a combination of previous works including measured equipment vibration emission data from the FTA and the Central Artery/Tunnel project in Boston, and ground transmissibility relationships found in Charles Dowding's reference textbook Construction Vibrations1. The fundamental equation used in the model is based on propagation relationships of vibration through average soil conditions and distance, as follows:

$$PPV_{receiver} = PPV_{ref} * \left({}^{100}/_{Dist_{receiver}} \right)^{n},$$

where:

PPVreceiver = predicted PPV at the receiver,

PPVref = reference PPV of equipment at 100 feet,

Distreceiver = distance from the receiver to the equipment in feet, and

n = 1.5 (the vibration attenuation rate through the soil).

The suggested value for n in the FTA Manual is 1.5. The value for n can lie between 1.0 and 2.0 and a value of 1.5 is commonly used in general models. The value of 1.1 is considered appropriate for this model because the project area has stiff soils which generally have a higher value of n.

Equipment vibration emission levels used for the predictions are shown in Table 7-1. The levels were gathered from measurements performed and published from several projects including the FTA Manual, Central Artery/Tunnel Project in Boston, and Dowding's textbook. The equipment with a reference PPV of N/A implies the equipment does not generate vibration levels significantly above normal ambient levels. Therefore, equipment such as generators and compressors that may require noise modeling and assessment are not assessed for vibration impact. The vibration generating equipment that is likely to be used during the Project is shown as highlighted in Table 7-1.

[1] Dowding, Charles, Construction Vibrations, Prentice Hall, Upper Saddle River, NJ, 1996.

Table 7-1: Equipment Vibration Emission Levels

Equipment Description	Vibration Type (Steady or Transient)	Ref PPV at 100 ft
Auger Drill Rig	Steady	0.011125
Backhoe	Steady	0.011
Compactor	Steady	0.03
Concrete Mixer	Steady	0.01
Concrete Pump	Steady	0.01
Crane	Steady	0.001
Large Dozer	Steady	0.07
Small Dozer	Steady	0.04
Dump Truck	Steady	0.01
Excavator	Steady	0.011
Flat Bed Truck	Steady	0.01
Front End Loader	Steady	0.011
Gradall	Steady	0.011
Grader	Steady	0.011
Horizontal Boring Hydraulic Jack	Steady	0.003
Hydra Break Ram	Transient	0.05
Impact Pile Driver	Transient	0.2
Insitu Soil Sampling Rig	Steady	0.011125
Jackhammer	Steady	0.030
Paver	Steady	0.01
Pickup Truck	Steady	0.01
Scraper	Steady	0.000375
Slurry Trenching Machine	Steady	0.002125
Soil Mix Drill Rig	Steady	0.011125
Tractor	Steady	0.01
Tunnel Boring Machine (rock)	Steady	0.0058
Tunnel Boring Machine (soil)	Steady	0.003
Vibratory Pile Driver	Steady	0.15
Vibratory Roller (large)	Steady	0.059
Vibratory Roller (small)	Steady	0.022
Blasting	Transient	0.75
Clam Shovel	Transient	0.02525
Rock Drill	Steady	0.011125
3-ton truck at 35 mph	Steady	0.0002

7.2 Prediction Results and Impact Assessment

Table 7-2 presents the distance beyond which the damage risk criteria would not be exceeded for the major vibration-generating pieces of equipment likely to be used for the Project. Most of the equipment can be operated without risk of damage at distances of 35 feet or greater from historic building or at distances of 20 feet or greater from non-historic buildings.

Table 7-2: Distance to Construction Vibration Impact Thresholds

Equipment	PPV Ref Level at 100 ft (in/sec)	Distance to Impact Threshold of 0.5 in/sec PPV[(a)]	Distance to Impact Threshold of 0.2 in/sec PPV[(a)]
Compactor	0.030 in/sec	10 ft	20 ft
Cranes	0.001 in/sec	2 ft	3 ft
Dozer	0.040 in/sec	15 ft	25 ft
Dump Truck	0.01 in/sec	3 ft	8 ft
Front End Loader	0.011 in/sec	4ft	8 ft
Jackhammer	0.035 in/sec	12 ft	22 ft

Notes:
[(a)]The impact threshold for non-historic buildings is 0.5in/sec PPV and the impact threshold for historic buildings is 0.2 in/sec PPV.

7.2.1 Wilshire/Rodeo Station

The Sterling Plaza/Bank of California building and Union Bank Building (see Table 5-2) are within 25 feet of the Wilshire/Rodeo Station Box Construction Area. At this distance there is the potential risk of exceeding the damage risk criteria of 0.20 inches/second during jackhammering, compacting, and operation of a dozer.

7.2.2 Century City/Constellation Station

The closest building of the Century Plaza Hotel to the station box construction is more than 40 feet from the edge of the construction. The Beverly Hills High School is over 200 feet from 2040 CPE and 1940-1950 CPE Construction Areas. At these distances it is not expected that the equipment assumed to be used for construction will exceed the damage risk criteria of 0.20 inches/second.

7.3 Tunnel Trains

Previous measurements conducted of tunnel trains operating during the construction of the Metro Red Line Segment 2 tunnel shows a predominance of high frequency energy, up to 125 Hz. This contrasts with the groundborne vibration from rail trains in subways where vibration levels usually peak below 60 Hz. The high frequency energy of the tunnel trains means the community intrusion is more likely to be caused by groundborne noise rather than perceptible vibration.

Tunnel trains are expected to operate for the duration of the tunnel construction typically 24 to 36 months until the final trackwork is installed. The vibration from the tunnel train operations is transmitted directly into the tunnel invert through the rails. Providing a resilient support under the track in the form of rubber rail pad will reduce the high frequency vibration and in most cases either eliminate or minimize the perception of the groundborne noise in the buildings above the tunnel.

7.4 Sensitive Receivers

There are several vibration sensitive receivers that may be affected during the tunnel excavation including:

- Montage Hotel and Condominiums

- Beverly Wilshire Hotel
- Apartment Buildings
- Hotels
- Medical Offices
- Beverly Hills High School Offices and Classrooms

As discussed above the effects of the TBM would be limited to a few days when its operations would be perceptible at these receivers. In terms of a tunnel train operating in the tunnel, mitigation measures to control train vibrations would need to be included for the entire length of the running tunnel from the Wilshire/Rodeo Station to the Century City/Constellation Station due to the close proximity of these receivers above the tunnel.

8.0 GROUNDBORNE VIBRATION DURING TUNNELING

The primary sources of vibration during tunneling are generated by the tunnel boring machine (TBM) and the tunnel train used to carry muck, pre-cast concrete tunnel segments and materials. The TBM will be used to excavate the running tunnel between the Wilshire/Rodeo and Century City/Constellation station boxes. The TBMs will be pressurized closed face tunnel boring machines. The tunnel trains run 24 hours a day in the underground tunnels if used to take out the muck disposed of by the tunnel boring machines. These trains have open gondolier cars which are pulled by a diesel locomotive and run at speed of about 5 to 10 mph. Tunnel trains follow the TBMs as they move ahead boring the tunnel. A conveyor connected to the center of the cutter head of the TBM delivers the muck to these trains. The trains carry the muck outside from the TBM area, where the cars are lifted to the surface through a shaft by gantry cranes and the muck is deposited in muck piles before loading on to dump trucks and then carried away from the construction site. These same tunnel trains are used to transport material and the precast tunnel lining segments. The tunnel trains run on temporary rails that are usually directly fixed to the invert of the tunnel. These trains are also used to carry tunnel segments and materials.

8.1 Tunnel Boring Machines

The main source of vibration during tunneling is when the TBM pushes the shield forward against the earth using a hydraulic ram. The vibration generated by this action would be perceptible above the tunnel at distances of 100 feet from the tunnel centerline and would approach human annoyance levels at closer distances. Most of the energy from the TBM operation is at low frequencies (30 Hz and lower). This would mean that if the TBM vibration is perceived in buildings above the tunnel, it will be perceived as feelable vibration rather than ground-borne noise.

Vibration levels from TBMs are always below damage risk levels, either structural damage or minor cosmetic damage such as hairline fractions in plaster or drywall. This is an important point since whenever ground-borne vibration is perceptible, most people's first response is "This must be damaging my house."

There is the potential for community intrusion during the passing of the TBM. The advance rate of the TBM is expected to be approximately 40 feet per day. The presence of the TBM beneath any one residential structure where it would be perceptible as either feelable vibration or ground-borne noise would be approximately three to four days. The intrusion would not be continuous but would occur only at times when the shield is pushed against the earth using the hydraulic ram approximately four to six times a day. There are no measures that can be used to mitigate the effects of the TBM other than keeping residents informed when the tunneling will occur in their area and that some vibration may be perceptible, but not damaging.

9.0 MITIGATION

A perimeter noise barrier wall has been incorporated into the design of the construction sites at Wilshire/Rodeo and Century City/Constellation Stations where nighttime construction will occur. The noise barrier wall shall be constructed in accordance with Metro's Specification Section 01 56 19, Construction Noise and Vibration Control (Appendix C). The noise and vibration predictions presented in this report identified impacts at the construction sites that require additional mitigation measures.

This section identifies mitigation measures to be used in addition to the noise barrier wall and low noise emission equipment to meet the nighttime noise limits. Also included are measures that should be considered if compliance with the noise limits are not met and general control measures that shall be implemented by the Contractor at all sites.

9.1 Wilshire/Rodeo Station

The potential for noise impact at sensitive receivers during both daytime and nighttime construction was determined not to exceed the BHMC and LAMC noise level limits using noise barrier walls and low noise emission equipment. It is not expected that any other noise mitigation measures are needed. The exception is the Century City Hospital (Site E) where additional mitigation measures are needed to reduce nighttime construction noise to the upper floor patient rooms on the 3rd through 8th floors.

9.2 Century City/Constellation Station

To meet the noise level limits required by the City of Los Angeles for nighttime construction at the Century City Hospital patient floors, levels 3 through 8, the following noise control measures will be required in addition to the 20-foot high noise barrier wall constructed around the perimeter of the 2040 CPE construction site (Figure 9-1) and the use of low noise emission equipment.

- The compressor plant, ventilation plant, grout plant, foam plant, machine shop and electrical shop are to be fully enclosed.
- The conveyor system is to be enclosed.
- The boom crane and front end loader used during the night shift are to be retrofitted with a hospital grade muffler and additional damping and insulation added to the engine compartments.
- A supplemental 16-foot noise barrier wall shall be built, as shown in Figure 9-1, to further shield the noise from the front end loader and crane operations.

With the implementation of these noise control measures,s Angeles nighttime construction noise limits as shown in Table 6-4. The nighttime construction noise contours at the face of the hospital building are shown graphically in Figure 9-2.

Figure 9-1: 2040 CPE and 1940-1950 CPE Construction Site Noise Barrier Walls

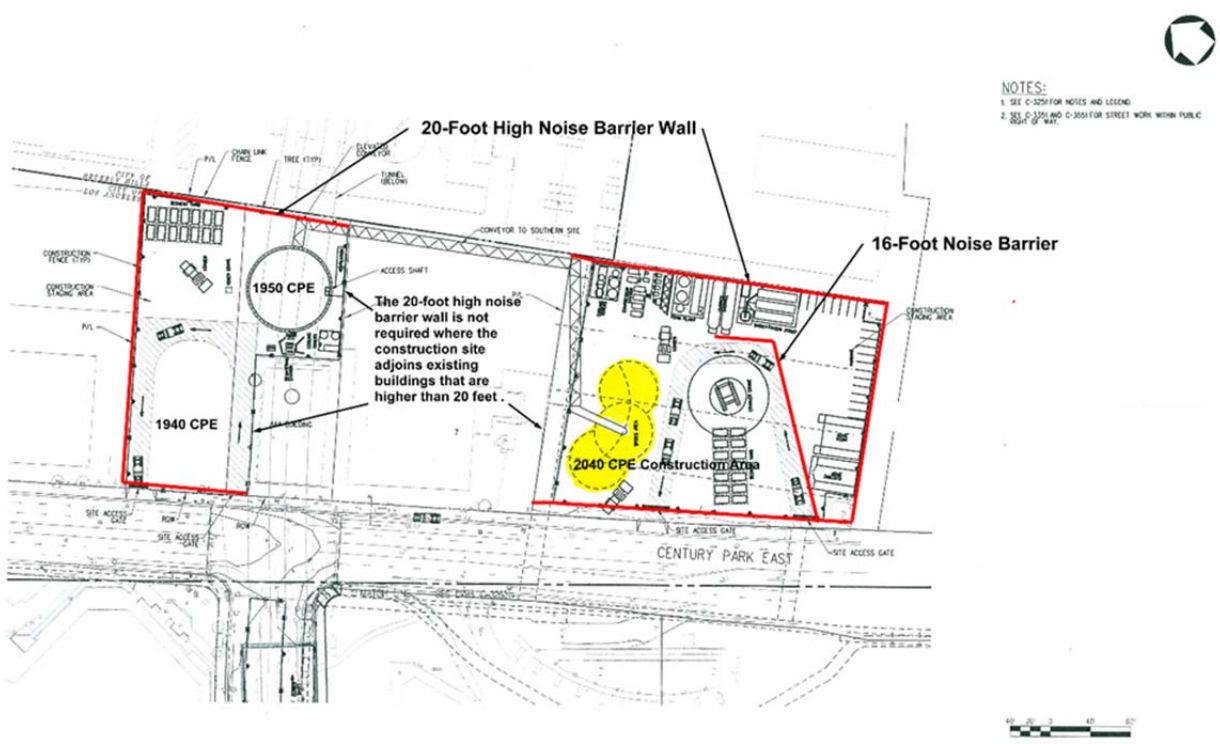
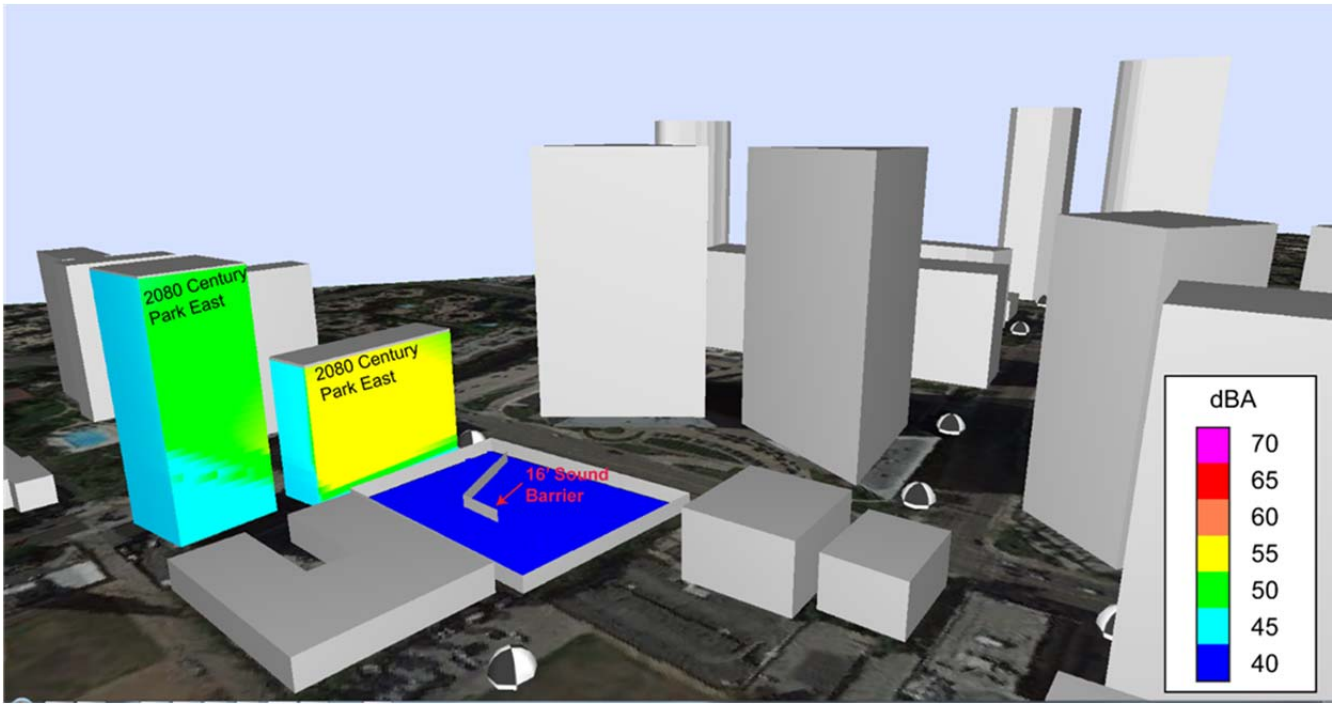


Figure 9-2: Nighttime Noise Level Contours at Century City Hospital



9.3 Backup Alarms

All equipment operating during nighttime hours at all construction sites shall use low impact backup alarms. The low impact back-up alarms shall comply with CCR Title 8, Section 1592, Warning Methods. For equipment that must comply with CCR Title 8, Section 1592(a), equip these vehicles with compliant white sound, broadband and multi-frequency type back-up alarm devices. For equipment subject to the requirements of CCR Title 8, Section 1592(b) the Contractor may choose to equip with automatic back-up audible alarms. Such alarms shall only be of a compliant white sound, broadband or multi-frequency back-up alarm type device.

The compliant white sound, broadband and multi-frequency type back-up alarm device shall be a self-adjusting, "smart" reversing, alarm that continually adjusts to 5 dB above ambient. Acceptable manufacturers are Brigade, ECCO or approved equal. The compliant white sound, broadband and multi-frequency type back-up alarm device shall be rated as medium duty or heavy duty, as the field conditions and/or usage would dictate.

9.4 Running Tunnel from Wilshire/Rodeo and Century City/Constellation Stations

To reduce the vibration generated by a tunnel train the Contractor shall be required to use a durable resilient system to support and the tunnel train tracks. Such as system would include a resilient mat under the tracks and a resilient grommet or bushing under the heads of any track fasteners. The hardness of the resilient mat should be in the 40 to 50 durometer range and be about 1 to 2" thick, depending on how heavily loaded the cars would be. The Contractor would need to select the mat thickness so that the rail doesn't bottom out during a train passby.

If the Metro ground-borne noise limits presented in Table 5-3 are exceeded, the contractor shall be required to take action to reduce vibrations to acceptable levels. Such action could include reducing the train speed, additional rail and tie isolation, and maintain the tunnel train track and train wheels in good order to reduce potential vibration impacts, including keeping gaps between track sections to a minimum and more frequent maintenance to avoid wheel flats.

9.5 Additional Mitigation Measures

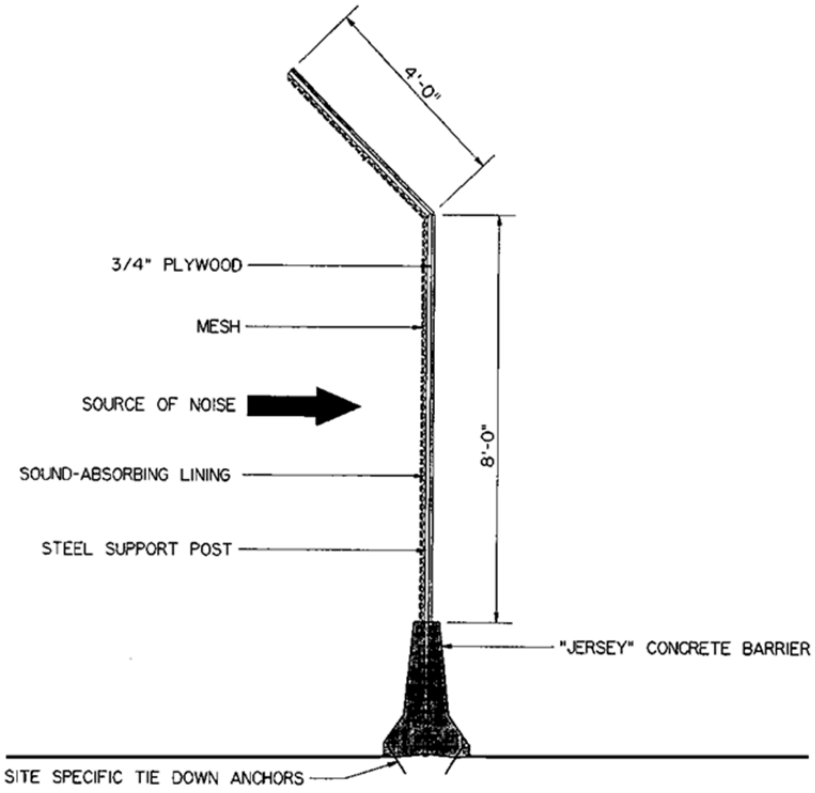
The following are additional noise control measures that can be used to at the construction site to shield noise generating equipment.

- Moveable noise barriers that can be located within the construction site in close proximity to the equipment and activities that are exceeded the impact thresholds. The moveable noise barriers shall be constructed in accordance with Metro's Specification Section 01 56 19, Construction Noise and Vibration Control, Article 2.03, Moveable Noise Barriers (Appendix C). The height of the moveable noise barrier shall be a minimum of 14 feet. A representative design of a moveable noise barrier used for other construction projects is shown in Figure 9-3.

- Noise control curtains that can be tented over the area where the noisy equipment is operating. The noise curtain shall be constructed in accordance with Metro's Specification Section 01 56 19, Construction Noise and Vibration Control, Article 2.04, Noise Control Curtains (Appendix C).

- Replace the standard engine exhaust muffler with a hospital grade engine silencer for stationary cranes, front end loaders, dozers, and any other diesel powered equipment operating during nighttime hours.

Figure 9-3: Representative Moveable Noise Barrier Design



9.6 General Noise and Vibration Control Measures

The following general noise and vibration control measures shall be implemented by the Contractor at all construction sites:

- Readily visible signs indicating “Noise Control Zone” would be prepared.
- Noise-control devices that meet original specifications and performance would be used.
- Fixed noise-producing equipment would be used to comply with regulations in the course of project activity.
- Mobile or fixed noise-producing equipment that are equipped to mitigate noise to the extent practical would be used.
- Electrically-powered equipment would be used to the extent practical.
- Temporary noise barriers and sound-control curtains would be erected where project activity is unavoidably close to noise-sensitive receivers.

- Designated haul routes would be used based on the least overall noise impact Route heavily-loaded trucks away from residential streets, if possible. Identification of haul routes would consider streets with the fewest noise sensitive receivers if no alternatives are available.
- Non-noise sensitive, designated parking areas for project-related vehicles would be used.
- Earth-moving equipment, fixed noise-generating equipment, stockpiles, staging areas, and other noise-producing operations would be located as far as practicable from noise-sensitive receivers.
- The use of air horn type devices, including but not limited to vehicle mounted or hand held, shall not be used to communicate signals from one area of the project site to another. Compliance with the requirements of the Tunnel Safety Orders for signaling systems shall be obtained through the use of other auditory or visual systems other than the use of air horn type devices.
- Use of horns, whistles, alarms, and bells would be limited.
- All noise-producing project equipment and vehicles would be required to use internal combustion engines equipped with mufflers and air-inlet silencers, where appropriate, and kept in good operating condition that meet or exceed original factory specifications. Mobile or fixed “package” equipment (e.g., arc- welders, air compressors) would be equipped with shrouds and noise control features that are readily available for that type of equipment.
- Any project-related public address or music system would not be audible at any adjacent receiver.
- Demolition, earth moving, and ground impacting operations would be phased so as not to occur in the same time period.
- Impact pile driving would be avoided. Drilled piles drivers would be used where the geological conditions permit their use.
- Demolition methods would be selected to minimize noise and vibration impact where possible.
- Use of vibratory rollers and packers would be avoided near vibration sensitive areas.
- An elastomer isolator would be installed between the floor of the tunnel and the rails and ties on which the tunnel train carrying excavated materials operates. If the Metro ground-borne noise limits or ground-borne vibration limits are exceeded, the Contractor shall be required to take action to reduce vibrations to acceptable levels. Such action could include reducing the tunnel train speed, additional rail and tie isolation, and more frequent rail and wheel maintenance.
- Enclosures for fixed equipment such as TBM slurry processing plants would be required in order to reduce noise.

Metro Baseline Specifications Section 01565, Construction Noise and Vibration Control requires that the contractor shall, among other provisions

- Hire or retain the services of an Acoustical Engineer to be responsible for preparing and overseeing the implementation of the Noise Control and Monitoring Plans.
- Prepare a Noise Control Plan that includes an inventory of construction equipment used during daytime and nighttime hours, estimate of projected construction noise levels, and locations and types of noise abatement measures that may be required to meet the specified noise limits.

- In the case of nighttime construction, the contractor shall comply with the provisions of the nighttime noise variance issued by the local jurisdictions.
- Conduct periodic noise measurement in accordance with an approved Noise Monitoring Plan, specifying monitoring locations, equipment, procedures, and schedule of measurements and reporting methods to be used.
- During nighttime hours, use equipment at the surface of the construction site that, operating under full load, is certified to meet specified lower noise level limits than standard equipment.
- For nighttime construction activities, erect Metro designed noise barrier walls at each construction site prior to the start of any construction activities.

10.0 MONITORING

The Contractor is required to submit a Noise and Vibration Monitoring Plan prepared, stamped, and administered by the Contractor's Acoustical Engineer. Noise and vibration monitoring shall be performed at locations in the vicinity of all of the construction sites.

10.1 Noise Monitoring

There are two types of noise monitoring that shall be performed, depending on the location and the expected level of impact. The first type is continuous noise monitoring, which is to be performed in areas where nighttime work is anticipated from 6:00 P.M. to 8:00 A.M. in the City of Beverly Hills and from 9:00 P.M. to 7:00 AM. In the City of Los Angeles. The second type is short-term noise monitoring, which consists of weekly short-duration (1 hour or more) measurements to verify that noise levels during construction do not exceed the predicted noise levels or relevant impact criteria.

Continuous noise monitoring will require the installation of permanent monitoring stations that include microphones, sound level meters, power sources, and associated ancillary equipment. Each continuous noise monitoring station should also include data transmission capabilities to make remote access possible. Monitors should be installed in locations that provide a direct line of sight to construction activities and are representative of residential (or otherwise noise-sensitive) receivers.

In all measurement sites the continuous noise monitor shall be located at side of the building closest to the construction activities no closer than 3 feet from the building façade. If this is not possible and another site is selected the measured data shall be adjusted to the building setback distance from the construction activities.

Weekly short-term noise measurements may be performed using a sound level meter and associated ancillary equipment. Short-term measurements should be conducted at a height of approximately 5 feet above ground level.

Contractor must initiate short-term noise monitoring when performing a new activity or as requested by Metro.

10.1.1 Wilshire/Rodeo

Continuous noise levels shall be monitored at the following locations:

- 210 N. Beverly Drive (Site H)
- Sirtaj Hotel, 120 S. Reeves Drive (Site J)
- AKA Beverly Hills Hotel, 155 N. Crescent Drive (Site M)
- Beverly Sixty Hotel (Site 1)

Short-term noise measurements shall be conducted on a weekly basis during daytime and nighttime hours at the following locations:

- 133-153 S. Reeves Drive (Site I)
- 192 N. Canon Drive (Site K)

- 121-157 S. Canon Drive (Site L)
- The Rolex Building, 9420 Wilshire Boulevard (Site 2)
- Sterling Plaza/Bank of California, 9441 Wilshire Boulevard (Site 3)

If the measured levels exceed the noise limits specified in Table 4-1, reduce the noise levels by appropriate abatement measures, or terminate the construction activity responsible for the noise limit exceedance.

10.1.2 Century City/Constellation

Continuous noise levels shall be monitored at the following locations:

- Hyatt Regency Century Plaza Hotel (Site C)
- Century City Hospital (Site E)

Short-term noise measurements will be conducted on a weekly basis during daytime and nighttime hours at the following locations:

- Beverly Hills High School (Site 5)
- 401 Shirley Place (Site G)
- 1918-1952 Fox Hills Drive (Site A)
- 2050 Century Park West (Site B)
- 2010 Century Park East (Site D)
- 2160 Century Park East (Site F)
- 1888 Century Park East (Site 6)
- Century Plaza Towers, 2049 Century Park East (Site 7)
- Annenberg Space for Photography and the Skylight Studios, 10050 Constellation Boulevard (Site 8)
- Bain & Company Building, 1901 Avenue of the Stars (Site 9)
- The Century, 10 West Century Drive (Site 10)
- Constellation Place, 10250 Constellation Boulevard (Site 11)

If the measured levels exceed the noise limits specified in Table 4-1, reduce the noise levels by appropriate abatement measures, or terminate the construction activity responsible for the noise limit exceedance.

10.2 Vibration Monitoring

Vibration monitoring for this project shall consist of continuous measurements of vibration at the closest building façade to the construction activities of the following historic buildings using a permanent vibration monitor:

- Sterling Plaza/Bank of California, 9441 Wilshire Boulevard
- Union Bank Building, 9460 Wilshire Boulevard

Short term vibration measurements shall also be conducted at buildings closest to the construction activities during periods of construction when equipment that generate a substantial amount of ground-borne vibration (such as jack hammer or compactor) are in use. All vibration monitors used for either permanent monitoring or short term measurements should be equipped with an “alarm” feature to provide notification that vibration impact criteria have been approached or exceeded.

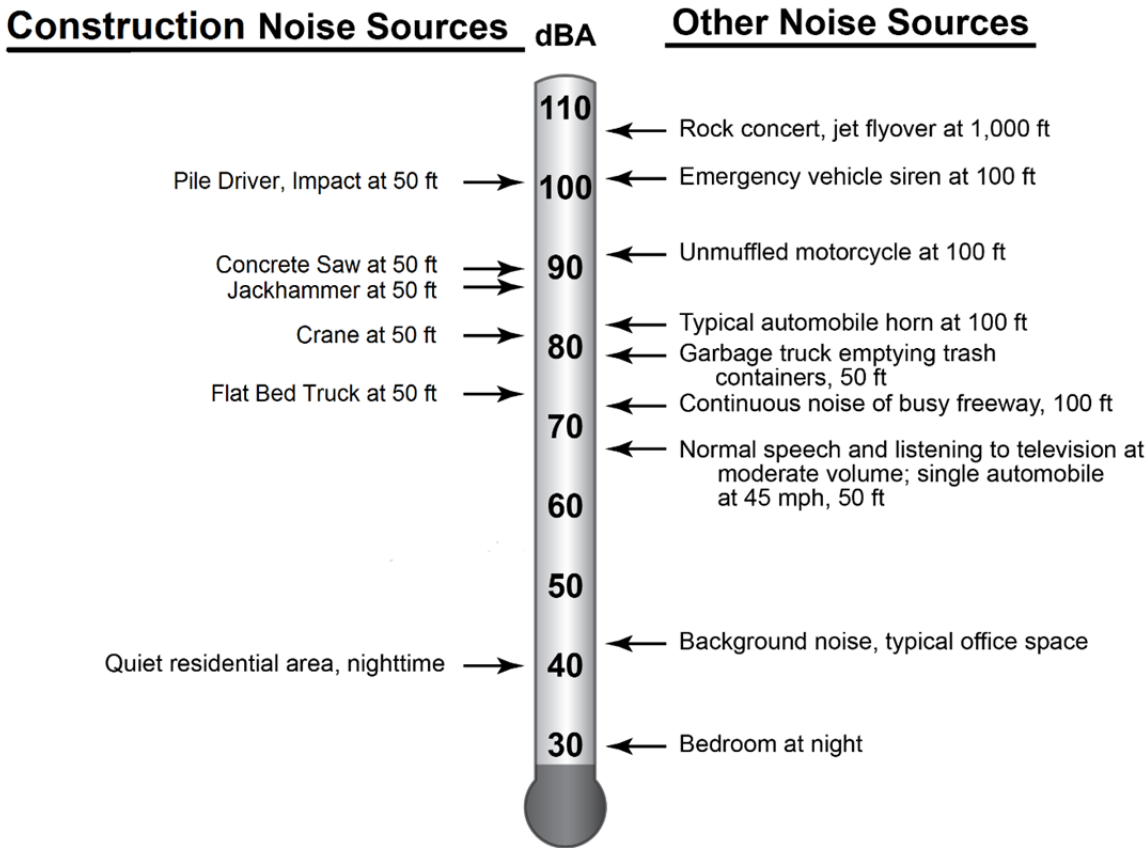
APPENDIX A FUNDAMENTALS OF NOISE AND VIBRATION

APPENDIX A FUNDAMENTALS OF NOISE AND VIBRATION

Sound is mechanical energy transmitted by pressure waves in a compressible medium such as air. Noise is generally defined as unwanted or excessive sound. Sound can vary in intensity by over one million times within the range of human hearing. Therefore, a logarithmic scale, known as the decibel scale (dB), is used to quantify sound intensity and compress the scale to a more manageable range.

Sound is characterized by both its amplitude and frequency (or pitch). The human ear does not hear all frequencies equally. In particular, the ear deemphasizes low and very high frequencies. To better approximate the sensitivity of human hearing, the A-weighted decibel scale has been developed. A-weighted decibels are abbreviated as "dBA." On this scale, the human range of hearing extends from approximately 3 dBA to around 140 dBA. As a point of reference, Figure A-1 includes examples of A-weighted sound levels from common indoor and outdoor sounds.

Figure A-1: Typical Outdoor and Indoor Noise Levels



Using the decibel scale, sound levels from two or more sources cannot be directly added together to determine the overall sound level. Rather, the combination of two sounds at the same level yields an increase of 3 dBA. The smallest recognizable change in sound level is approximately 1 dBA. A 3-dBA increase is generally considered perceptible, whereas a 5-dBA increase is readily perceptible. A 10-dBA increase is judged by most people as an approximate doubling of the perceived loudness.

Two of the primary factors that reduce levels of environmental sounds are increasing the distance between the sound source and the receiver and having intervening obstacles, such as walls, buildings, or terrain features that block the direct path between the sound source and the receiver. Factors that act to increase the loudness of environmental sounds include the proximity of the sound source to the receiver, sound enhancements caused by reflections, and focusing caused by various meteorological conditions.

Brief definitions of the measures of environmental noise used in this report are:

- **Equivalent Sound Level (Leq)**: Environmental sound fluctuates constantly. The equivalent sound level (Leq), sometimes referred to as the energy-average sound level, is the most common means of characterizing community noise. Leq represents a constant sound that, over the specified period, has the same sound energy as the time-varying sound.
- **Day-Night Sound Level (Ldn)**: Ldn is basically a 24-hour Leq with an adjustment to reflect the greater sensitivity of most people to nighttime noise. The adjustment is a 10-dB penalty for all sound that occurs between the hours of 10 P.M. and 7 A.M. The effect of the penalty is that, when calculating Ldn, any event that occurs during the nighttime is equivalent to 10 of the same event during the daytime. Ldn is the most common measure of total community noise over a 24-hour period.
- **Maximum Sound Level (Lmax)**: The maximum sound level over a period of time or for a specific event can also be a useful parameter for characterizing specific noise sources. Standard sound level meters have two settings, fast and slow, which represent different time constants. Lmax using the fast setting will typically be 1 to 3 dB greater than Lmax using the slow setting.
- **Percent Exceedance Level (Lxx)**: This is the sound level that is exceeded for xx percent of the measurement period. For example, L99 is the sound level exceeded 99 percent of the measurement period. For a one hour period, the sound level is less than L99 for 36 seconds of the hour and the sound level is greater than L1 for 36 seconds of the hour. L1 represents typical maximum sound levels, L33 is approximately equal to Leq when free-flowing traffic is the dominant noise source, L50 is the median sound level, and L99 is close to the minimum sound level.
- **Sound Exposure Level (SEL)**: SEL is a measure of the total sound energy of an event. In essence, all sound from the event is compressed into a one-second period. This means that SEL increases as the event duration increases and as the event sound level increases. SEL is useful for estimating the Ldn that would be caused by individual events such as train passbys.

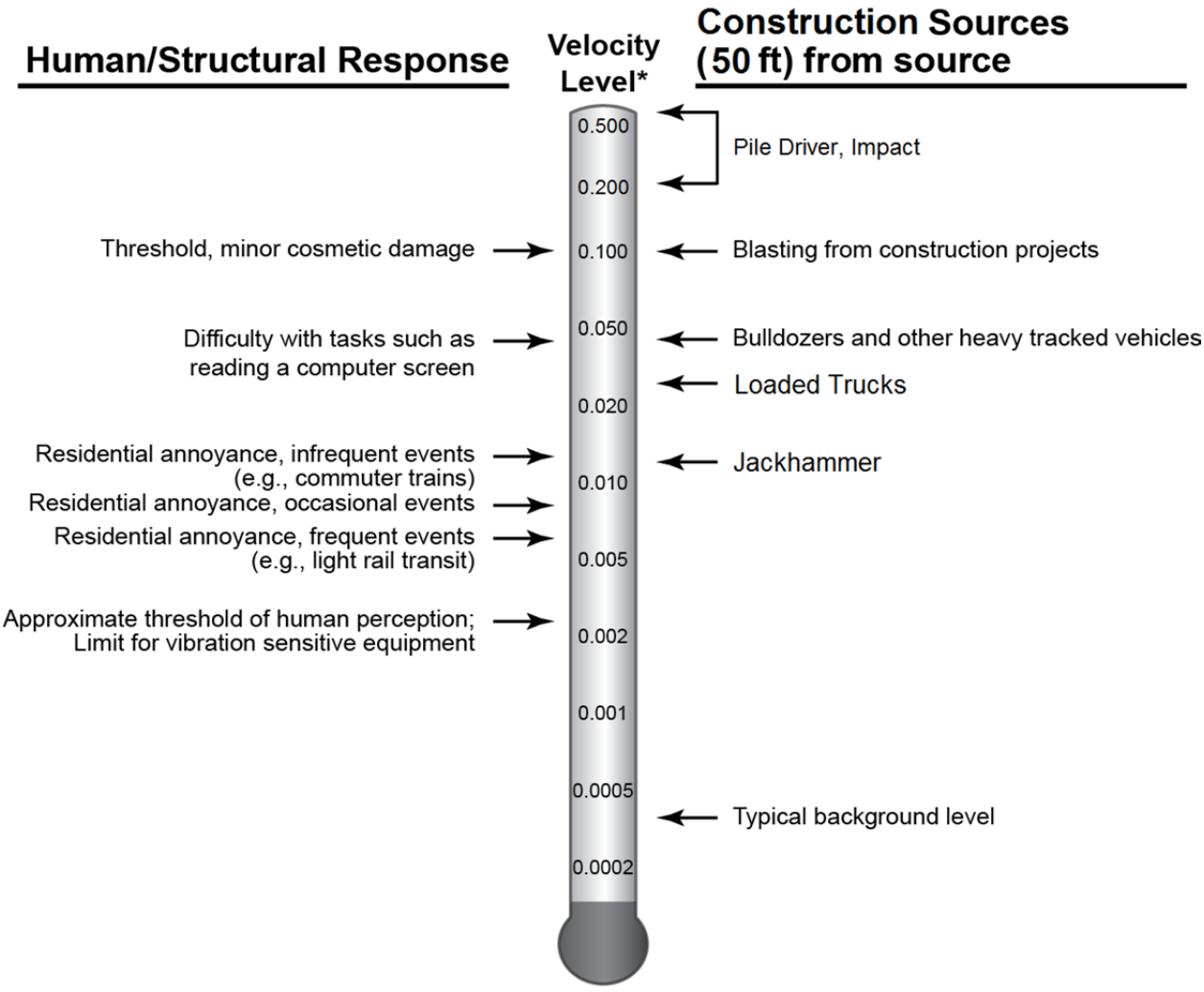
Vibration is an oscillatory motion that can be described in terms of the displacement, velocity, or acceleration of the motion. One potential effect from the proposed project is an increase in vibration that is transmitted from the tracks through the ground into adjacent houses. When evaluating human response, groundborne vibration is usually expressed in terms of decibels using the RMS vibration velocity. RMS is defined as the average of the squared amplitude of the vibration signal. To avoid confusion with sound decibels, the abbreviation VdB is used for vibration decibels. All vibration decibels in this report use a decibel reference of 1 µin/sec. Vibration can also be expressed as the peak particle velocity (PPV), which is generally used to evaluate whether vibration has potential to cause damage to fragile building structures. Peak particle velocity is normally expressed in inches per second.

The potential adverse effects of rail transit groundborne vibration are as follows:

- **Perceptible Building Vibration**: This is when building occupants feel the vibration of the floor or other building surfaces. Experience has shown that the threshold of human perception is around 65 VdB and that vibration that exceeds 75 to 80 VdB may be intrusive and annoying to building occupants.
- **Rattle**: The building vibration can cause rattling of items on shelves and hanging on walls, and various different rattle and buzzing noises from windows and doors.
- **Reradiated Noise**: The vibration of room surfaces radiates sound waves that may be audible to humans. This is referred to as groundborne noise. When audible groundborne noise occurs, it sounds like a low-frequency rumble. For surface rail systems the groundborne noise is usually masked by the normal airborne noise radiated from the transit vehicle and the rails.
- **Damage to Building Structures**: Vibration from rail systems is usually one to two orders of magnitude below the most restrictive thresholds for preventing building damage. However, fragile and extremely fragile structures may be susceptible to damage if the tracks are in sufficient proximity to the structure.

Figure A-2 shows typical RMS vibration velocity levels from rail and nonrail sources as well as the human and structure response to such levels.

Figure A-2: Typical RMS Vibration Velocity Levels



Often it is necessary to determine the contribution at different frequencies when evaluating vibration or noise signals. The 1/3-octave band spectrum is the most common procedure used to evaluate frequency components of acoustic signals. The term “octave” has been borrowed from music where it refers to a span of eight notes. The ratio of the highest frequency to the lowest frequency in an octave is 2:1. For a 1/3-octave band spectrum, each octave is divided into three bands where the ratio of the lowest frequency to the highest frequency in each 1/3-octave band is 21/3:1 (1.26:1). An octave consists of three 1/3 octaves.

The 1/3-octave band spectrum of a signal is obtained by passing the signal through a bank of filters. Each filter excludes all components except those that are between the upper and lower range of one 1/3-octave band. The FTA Guidance Manual is a good reference for additional information on transit noise and vibration and the technical terms used in this section.

Construction equipment can produce high levels of vibration, and many pieces of equipment will incite vibration levels greater than expected from train operations. Vibration from construction equipment is generally expressed as a peak particle velocity (PPV) in units of inches per second. The PPV is an instantaneous linear peak value and is more appropriate for assessing vibration when damage is a concern.

APPENDIX B NOISE MEASUREMENT RESULTS

APPENDIX B NOISE MEASUREMENT RESULTS

Noise measurements were conducted at sensitive receivers near the construction laydown areas to document the pre-construction ambient noise levels. This section includes brief descriptions of the measurement sites and tables of the hourly sound levels.

B.1 WILSHIRE/RODEO STATION

Six long-term (24-hour) measurements and four short-term (1-hour) measurement were conducted near the Wilshire/Rodeo laydown, staging, and construction areas to document the pre-construction ambient noise levels. The hourly results of the measurements are presented in Table B-1 and Table B-2. Brief descriptions of the measurement sites follow below:

- Site H - 210 North Beverly Drive: A long-term noise measurement was conducted from 10:19 A.M. on August 10th 2015 to 10:19 A.M. on August 11th 2015. The building is an apartment complex with ground floor retail. The microphone was located on the sidewalk in front of Beverly Drive, about 10 feet from the building façade, 20 feet from Wilshire Boulevard, the main source of traffic noise at this site. The microphone was 5 feet above street level.
- Site I - 133-153 South Reeves Drive: A long-term noise measurement was conducted from 9:04 A.M. on August 11th 2015 to 9:42 A.M. on August 12th 2015. The building is an apartment complex at the south end of Reeves Park. The microphone was located within this park, about 10 feet from the southern end of the park, 20 feet from the western end, and 100 feet from Reeves Drive. The main noise source at this site was traffic on Reeves Drive. The microphone was 5 feet above street level.
- Site J - 120 South Reeves Drive: A long-term noise measurement was conducted from 9:32 A.M. on August 11th 2015 to 10:32 A.M. on August 12th 2015. The microphone was located on the sidewalk in front of the Sirtaj Hotel. It was 13 feet from the building façade. It was 4 feet from Reeves Drive, the main source of traffic noise at this site. The microphone was 5 feet above street level.
- Site K - 192 North Canon Drive: A long-term noise measurement was conducted from 10:37 A.M. on August 10th 2015 to 11:02 A.M. on August 11th 2015. The building is an apartment/office complex with ground floor retail. The microphone was located on the sidewalk in front of Canon Drive, 6 feet from the building façade 220 feet from Wilshire Boulevard, and 4 feet from Canon Drive. The main source of traffic noise at this site was from Canon Drive. The microphone was 5 feet above street level.
- Site L - 121-157 South Canon Drive: A long-term noise measurement was conducted from 9:04 A.M. on August 11th 2015 to 9:42 A.M. on August 12th 2015. The building is an apartment complex on Canon Drive directly south of a small parking lot. The microphone was located in an alley between the apartment complex and the parking lot at the southern end of the alley, 190 feet from Wilshire Boulevard and 90 feet from Canon Drive. The main source of traffic noise at this site was from Canon Drive. The microphone was 5 feet above street level and 5 feet from the building wall.
- Site M – 155 North Crescent Drive: A long-term noise measurement was conducted from 8:35 A.M. on August 10th 2015 to 9:14 A.M. on August 11th 2015. The building is the AKA Beverly Hills Hotel located on Crescent Drive with one end of the building on Crescent Drive and the other on an alley between and Crescent Drive and Canon Drive. The microphone was located in this alley 3 feet from

the building façade, 265 feet from Wilshire Boulevard. The main noise source at this site was trucks coming through the alley. The microphone was 5 feet above street level.

- Site 1 – Beverly Sixty Hotel, 9360 Wilshire Boulevard: A long-term noise measurement was conducted from 8:57 A.M. on August 11th 2015 to 9:57 A.M. on August 11th 2015. The microphone was located on the sidewalk in front of the hotel on Wilshire Boulevard, the main traffic noise source at this site. The microphone was 3 feet from the building façade, 12 feet from Wilshire Boulevard, and 5 feet above street level.
- Site 2 – The Rolex Building, 9420 Wilshire Boulevard: A long-term noise measurement was conducted from 7:34 A.M. on August 11th 2015 to 8:37 A.M. on August 11th 2015. The microphone was located on the sidewalk in front of the building on Wilshire Boulevard, the main traffic noise source at this site. The microphone was 12 feet from the building façade, 3 feet from Wilshire Boulevard, and 5 feet above street level.
- Site 3 – Sterling Plaza/Bank of California, 9441 Wilshire Boulevard: A long-term noise measurement was conducted from 7:35 on August 11th 2015 to 8:39 on August 11th 2015. The microphone was located on the sidewalk in front of the building on Wilshire Boulevard, the main traffic noise source at this site. The microphone was 8 feet from the building façade, 5 feet from Wilshire Boulevard, and 5 feet above street level.
- Site 4 – Beverly Wilshire Hotel, 9500 Wilshire Boulevard: A long-term noise measurement was conducted from 7:25 A.M. on August 11th 2015 to 8:25 A.M. on August 11th 2015. The microphone was located on the sidewalk in front of the hotel building on South El Camino Drive 7 feet from the building façade, 18 feet from Wilshire Boulevard and 5 feet above street level. Traffic on Wilshire Boulevard was the main source of noise at this site.

Table B-1: Long-Term Noise Measurement Results at Wilshire/Rodeo

Hour Start	Site H	Site I	Site J	Site K	Site L	Site M
11:00	70.4	57.9	58.3	68.5	61.4	61.8
12:00	73.7	58.6	55.5	66.0	60.8	65.9
13:00	71.3	57.9	57.2	68.2	60.0	72.3
14:00	71.4	59.2	58.1	71.2	59.8	59.5
15:00	70.8	58.2	58.5	67.6	60.8	62.4
16:00	70.1	59.0	57.1	66.2	59.1	59.7
17:00	74.4	59.3	58.5	67.0	64.4	59.4
18:00	71.1	57.4	56.9	67.1	59.3	59.8
19:00	70.2	55.7	55.5	64.8	62.5	60.9
20:00	70.0	54.4	55.0	63.7	59.8	59.0
21:00	68.8	53.6	54.2	68.9	60.4	60.9
22:00	69.2	53.7	53.2	65.3	55.6	64.3
23:00	67.8	54.9	52.6	65.3	56.5	57.5
00:00	67.6	51.5	53.6	65.4	56.6	59.1
01:00	67.1	51.5	49.1	59.0	53.7	56.0
02:00	65.7	50.4	48.6	64.3	51.8	54.4
03:00	64.0	50.9	47.4	58.7	52.7	54.5
04:00	63.2	52.4	49.8	55.1	54.8	60.2
05:00	67.1	53.5	50.6	62.6	54.6	64.7
06:00	70.9	57.8	53.1	65.5	56.9	66.2
07:00	73.3	57.5	56.0	66.5	60.6	64.5
08:00	71.8	61.6	56.3	69.2	61.0	63.2
09:00	71.2	59.6	57.4	71.6	58.8	63.2
10:00	70.9	58.0	57.8	66.3	62.4	63.9
Daytime (8 am-6.pm)	72	59	60	64	63	62
Evening (6pm-9pm)	70	56	56	65	61	60
Nighttime (9pm-8am)	69	54	52	65	57	62

Table B-2: Short-Term Noise Measurement Results at Wilshire/Rodeo

Hour Start	Site 1	Site 2	Site 3	Site 4
11:00	74.1	72.2	72.3	71.5
12:00	77.5	75.5	75.6	74.8
13:00	75.1	73.1	73.2	72.4
14:00	75.1	73.2	73.2	72.4
15:00	74.5	72.6	72.7	71.8
16:00	73.9	71.9	72.0	71.2
17:00	78.2	76.2	76.3	75.5
18:00	74.8	72.9	73.0	72.2
19:00	73.9	71.9	72.0	71.2
20:00	73.7	71.8	71.9	71.1
21:00	72.5	70.6	70.7	69.9
22:00	72.9	71.0	71.1	70.2
23:00	71.5	69.6	69.7	68.9
00:00	71.3	69.3	69.4	68.6
01:00	70.8	68.9	69.0	68.2
02:00	69.4	67.5	67.6	66.8
03:00	67.7	65.8	65.9	65.0
04:00	66.9	64.9	65.0	64.2
05:00	70.8	68.8	68.9	68.1
06:00	74.6	72.6	72.7	71.9
07:00	77.1	75.1	75.2	74.4
08:00	75.5	73.6	73.7	72.9
09:00	74.9	73.0	73.0	72.2
10:00	74.6	72.6	72.7	71.9
Daytime (8 am-6.pm)	76	74	74	73
Evening (6pm-9pm)	74	72	72	72
Nighttime (9pm-8am)	72	70	71	70

B.2 CENTURY CITY/CONSTELLATION STATION

Six long-term nighttime measurements, from 9:00 P.M. to 7:00 A.M. (minimum 10 hour), one long-term 24-hour noise measurement, and seven short-term (1-hour) measurement were conducted near the Century City/Constellation laydown, staging, and construction areas to document the pre-construction ambient noise levels. The hourly results of the measurements are presented in Table B-3 and Table B-4. Brief descriptions of the measurement sites follow below:

- Site A – 1918 0 1952 Fox Hills Drive: A nighttime noise measurement was conducted from 7:55 P.M. on August 17th 2015 to 8:00 A.M. on August 18th 2015. The buildings are a row of single family house across from the trees on the western side of Century Park West. The microphone was located within

this tree area, 10 feet from the curb of Century Park West, the main traffic noise source at this site. The microphone was 5 feet above street level.

- Site B – 2050 Century Park West: A nighttime noise measurement was conducted from 7:21 P.M. on August 13th 2015 to 8:02 A.M. on August 14th 2015. The site is an under-construction apartment complex on the SE corner of Solar Way and Century Park West. The microphone was located 3 feet from the north side of Solar Way, 30 feet from the east curb of Century Park West, and 5 feet above street level. Traffic on Century Park West was the main source of noise at this site.
- Site C – Hyatt Regency Century Plaza Hotel, 2025 Avenue of the Stars: A nighttime noise measurement was conducted from 7:35 P.M. on August 13th 2015 to 8:11 A.M. on August 14th 2015. The microphone was located in the slightly hilly landscaped area between the hotel and Constellation Boulevard, 25 feet from Constellation Boulevard, and 70 feet from the hotel. The microphone was 8 feet above street level. Traffic on Constellation Boulevard was the main source of noise at this site.
- Site D – 2019 Century Park East: A nighttime noise measurement was conducted from 7:45 P.M. on August 12th 2015 to 8:11 A.M. on August 13th 2015. The microphone was located on the sidewalk in front office building at this location, 12 feet from Century Park East, 32 feet from the south side of the building, and 5 feet above street level. Daytime data was also taken from 9:30 A.M. on August 13th 2015 to 8:03 P.M. on August 13th 2015. The second location was 2 feet from Century Park East, 22 feet from the west side of the building, and 5 feet above street level. Traffic on Century Park East was the main source of noise at this site.
- Site E – Century Park Hospital and Medical Center, 2080 Century Park East: A nighttime noise measurement was conducted from 7:11 P.M. on August 13th 2015 to 9:39 A.M. on August 14th 2015. The microphone was located on the sidewalk of Century Park East, 4 feet from the curb and 40 feet from the building façade. The microphone was 5 feet above street level. Traffic on Century Park East was the main source of noise at this site.
- Site F – 2160 Century Park East: A nighttime noise measurement was conducted from 7:11 P.M. on August 13th 2015 to 9:39 A.M. on August 14th 2015. The site is a high rise apartment complex. The microphone was located on the sidewalk of Olympic Boulevard in front of the building, 4 feet from the curb and 20 feet from the façade. The microphone was 5 feet above street level. Traffic on Olympic Boulevard was the main noise source at this site.
- Site G – 401 Shirley Place, Beverly Hills: A long-term noise measurement was conducted from 10:28 A.M. on August 11th 2015 to 8:54 A.M. on August 12th 2015. The site is a row of single family houses on Shirley Place. The microphone was located on the sidewalk of Shirley place, 3 feet from the curb, 15 feet from the façade, and 40 feet from Olympic Boulevard, the main source of traffic noise at this site. The microphone was 5 feet above street level.
- Site 5 – Beverly Hills High School: A short-term noise measurement was conducted on August 12th 2015 from 8:36 P.M. to 8:57 P.M. at one location, and 8:59 P.M. to 9:30 P.M. at another location. At the first location the microphone was located in the back of the high school parking lot, closest to Century Park East. The main noise source at this location was the HVAC of the building located on Heath Ave behind the high school parking lot. The other measurement location at the corner of the high school soccer field and Heath Avenue. Both microphones were 5 feet above street level.
- Site 6 – 1888 Century Park East: A short-term noise measurement was conducted from 9:01 P.M. on August 12th 2015 to 10:01 P.M. on August 12th 2015. The microphone was located on the sidewalk of

Century Park East in front of the office building. The microphone 5 feet from the curb, 14 feet from the building façade, and 5 feet above street level. The traffic on Century Park East was the main source of noise at this site.

- Site 7 – Century Park Towers, 2049 Century Park East: A short-term noise measurement was conducted from 10:03 P.M. on August 12th 2015 to 11:03 P.M. on August 12th 2015. The microphone was located on the sidewalk of Constellation Boulevard, 5 feet from the curb, 100 feet from the building façade, and 5 feet above street level. Traffic on Constellation Boulevard was the main source of noise at this site.
- Site 8 - Annenberg Space for Photography and the Skylight Studios, 10050 Constellation Boulevard: A short-term noise measurement was conducted from 9:29 P.M. on August 12th 2015 to 10:45 P.M. on August 12th 2015. The microphone was located on the sidewalk of Constellation Boulevard in front of the art studio, 22 feet from the curb, 23 feet from the building façade, and 5 feet above street level. Traffic on Constellation Boulevard was the main source of noise at this site.
- Site 9 - Bain & Company Building, 1901 Avenue of the Stars: A short-term noise measurement was conducted from 9:29 P.M. on August 13th 2015 to 10:45 P.M. on August 13th 2015. The microphone was located on the sidewalk of Avenue of the Stars in front of the office building. It was 8 feet from the curb, 32 feet from the building façade, and 7.5 feet above street level. Traffic on Avenue of the Stars was the main source of noise at this site.
- Site 10 - The Century, 10 West Century Drive: A short-term noise measurement was conducted from 9:43 P.M. on August 13th 2015 to 10:44 P.M. on August 13th 2015. The microphone was located on the sidewalk of Avenue of the Stars in front of the apartment complex, 13 feet from the curb, 200 feet from the building façade, and 5 feet above street level. Traffic on Avenue of the Stars was the main source of noise at this site.
- Site 11 - Constellation Place, 10250 Constellation Boulevard: A short-term noise measurement was conducted from 9:43 P.M. on August 13th 2015 to 10:44 P.M. on August 13th 2015. The microphone was located in front of the office building on the sidewalk of Constellation Boulevard, 10 feet from the curb, 40 feet from the building façade, and 5 feet above street level. Traffic on Constellation Boulevard was the main source of noise at this site.

Table B-3: Long-Term Noise Measurement Results at Century City/Constellation

Hour Start	Site A	Site B	Site C	Site D	Site E	Site F	Site G
11:00							67.6
12:00							67.3
13:00							67.5
14:00							67.9
15:00							67.6
16:00							68.4
17:00							68.9
18:00							67.0
19:00							66.8
20:00							68.7
21:00	61.9	63.2	57.6	62.2	62.3	68.5	67.7
22:00	60.9	59.2	57.6	61.8	61.0	67.4	66.9
23:00	58.2	58.5	56.0	60.8	60.9	67.0	65.1
00:00	54.1	54.6	57.1	61.0	58.5	63.3	64.1
01:00	51.3	58.5	51.9	58.5	58.7	59.7	61.4
02:00	49.5	53.8	54.1	58.9	63.1	59.3	58.2
03:00	55.5	53.7	49.4	58.3	55.8	57.0	58.2
04:00	51.9	56.6	54.9	59.6	59.7	59.1	56.6
05:00	58.2	61.5	55.8	61.1	61.5	64.0	59.2
06:00	60.6	60.6	59.8	69.0	70.5	68.9	62.4
07:00							66.1
08:00							68.3
09:00							68.3
10:00							65.6
Daytime (8 am-6.pm)							69
Evening (6pm-9pm)							68
Nighttime (9pm-8am for Site G and 9pm-7am for Sites A through F)	58	59	56	63	63	65	63

Table B-4: Short-Term Noise Measurement Results at Century City/Constellation

Hour Start	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11
11:00	54.8						
12:00	56.1						
13:00	55.6						
14:00	54.9						
15:00	55.1						
16:00	54.6						
17:00	54.8						
18:00	53.7						
19:00	53.4						
20:00	51.5						
21:00	50.2	62.2	59.7	57.2	62.4	58.5	65.2
22:00	49.7	61.8	58.3	57.2	62.4	58.5	65.2
23:00	48.7	60.8	57.9	55.6	60.8	56.9	63.6
00:00	48.9	61.0	56.9	56.7	61.9	58.0	64.7
01:00	46.4	58.5	57.1	51.5	56.7	52.8	59.5
02:00	46.8	58.9	54.6	53.7	58.9	55.0	61.6
03:00	46.3	58.3	55.0	49.1	54.3	50.4	57.0
04:00	47.6	59.6	54.4	54.5	59.7	55.8	62.5
05:00	49.1	61.1	55.7	55.4	60.6	56.8	63.4
06:00	56.9	69.0	57.3	59.4	64.6	60.7	67.3
07:00	54.4						
08:00	56.3						
09:00	57.4						
10:00	55.7						
Daytime (8 am-6.pm)	56						
Evening (6pm-9pm)	53						
Nighttime (9pm-8am for Site 5 and 9pm-7am for Sites 6 through 11)	51	63	59	56	61	57	64

APPENDIX C SPECIFICATION SECTION 01 56 19 CONSTRUCTION NOISE AND VIBRATION CONTROL

Los Angeles County Metropolitan Transportation Authority
Westside Purple Line Extension Project, Section 2

SECTION 01 56 19

CONSTRUCTION NOISE AND VIBRATION CONTROL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Eliminating or minimizing noise and vibration generated by construction activities, and complying with applicable noise regulations, specification requirements, and noise and vibration limits specified within this Section.

B. Metro has prepared a Final Environmental Impact Statement/Final Environmental Impact Report for the Westside Subway Extension, with supporting technical reports on noise and vibration, which describe impacts the Project will have on the environment and indicates measures Metro has agreed to implement. See 01 35 44 Environmental Mitigation and Monitoring.

C. Metro is pursuing an initial variance from The City of Los Angeles Board of Police Commissioners for nighttime and weekend construction for this Contract. Once the variance is obtained, the variance will be good for a 6 month period. Variance shall be renewable by contractor every six months on the condition that the Contractor is in good standing and no community complaints are registered. This variance would allow the Contractor to schedule Work at night and weekends subject to the provisions of the variance to Section 41.40 of the Los Angeles Municipal Code, and the provisions herein. The variance could be withdrawn if the construction noise levels exceed the ambient noise level on the premise of any occupied property by more than five decibels from 9:00 PM to 7:00 AM Monday through Friday, from 9:00 PM Friday to 8:00 AM Saturday, from 6:00PM Saturday to 8:00 AM Sunday and all day Sunday as well as from 6:00 PM Sunday to 7:00 AM Monday.

D. Metro is pursuing an initial variance from the City of Beverly Hills for night-time and weekend construction. Contractor will be responsible for renewing variance if initial variance is issued.

E. Use equipment with effective noise-suppression devices and employ other noise control measures such as enclosures and barriers necessary to protect the public. Schedule and conduct operations in a manner that will minimize, to the greatest extent feasible, the disturbance to the public in areas adjacent to the construction activities and to occupants of buildings in the vicinity of the construction activities.

F. Submit a Noise Control Plan and a Noise Monitoring Plan, as specified in this Section. Both plans shall be prepared by an Acoustical Engineer meeting the qualifications specified in this Section. Do not operate noise generating construction equipment at the construction site prior to acceptance of the Noise Control and Monitoring Plans. Update Noise Control Plan every three months.

G. Compliance with the requirements of this Section may require the use of equipment with special exhaust silencers or noise attenuating enclosures, and construction of temporary enclosures or noise barriers around activities.

H. Use haul routes and staging areas, as approved by Metro and the City of Los Angeles or City of Beverly Hills to minimize noise at residential and other sensitive receptor sites. Do not operate trucks used for removal of excavated material and delivery of construction materials on local residential streets or on streets that pass by schools during school hours, unless specifically accepted by Metro.

I. Metro will monitor Contractor's performance of tasks specified, and will inspect necessary records, reports and procedures.

J. Staff members shall be trained by and work with the Acoustical Engineer specified in this Section to conduct measurements and manage noise and vibration control.

K. Contractor will coordinate with Metro on communicating with the noise sensitive locations listed in Table 5 and others that may arise during the life of the project regarding noise and vibration monitoring, schedule of construction activities where activities may affect these locations, and implementing mitigation measures to reduce noise and vibration

1.02 RELATED SECTIONS

A.	Section 01 31 30	Interface with Other Jurisdictions
B.	Section 01 33 00	Submittal Procedures
C.	Section 01 35 23	Worksite Safety Requirements
D.	Section 01 35 53	Worksite Security Requirements
E.	Section 01 43 10	Project Quality Program Requirements - Design/Build
F.	Section 01 51 23	Temporary Construction Ventilation
G.	Section 01 56 26	Construction Fencing (Wood)
H.	Section 01 56 28	Construction Fencing (Chain Link)

1.03 REFERENCES

A. California Code of Regulations (CCR), Title 24

B. California Health and Safety Code (CHSC)

C. City of Los Angeles Building Code, Chapter XI, Los Angeles Noise Ordinance

D. City of Beverly Hills Municipal Code.

E. American National Standards Institute (ANSI):

1. ANSI S1.4 - Specification for Sound Level Meters

2. ANSI S1.10 – Methods for the calibration of microphones

3. ANSI S2.4 - Method for Specifying the Characteristics of Auxiliary Analog Equipment for Shock and Vibration Measurements

F. ASTM International (ASTM):

1. ASTM C423 - Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

2. ASTM E90 - Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

3. ASTM E413 - Classification for Rating Sound Insulation

G. International Electrotechnical Commission (IEC):

1. IEC 61672 - Electroacoustics Sound Level Meters

2. IEC 179 - Precision Sound Level Meters

H. Occupational Safety and Health Act (OSHA) regulations (CCR Title 8)

I. Society of Automotive Engineers (SAE):

1. SAE J88 - Sound Measurement Off-Road Work Machines - Exterior

2. SAE J366 - Exterior Sound Level for Heavy Trucks and Buses

3. SAE J994 - Alarm- Backup- Electric Laboratory Performance Testing

J. International Organization for Standardization (ISO):

1. ISO 9533 - Earth-moving machinery. Machine-mounted audible travel alarms and forward horns – Test methods and performance criteria.

K. U.S. Department of Transportation, Federal Highway Administration (FHWA):

1. Special Report Highway Construction Notes: Measurement, Prediction, and Mitigation. (March, 1977)

L. U.S. Department of Transportation, Federal Transit Administration (FTA), Transit Noise and Vibration Impact Assessment, FTA-VA-90-1003-06, May 2006

M. U.S. Environmental Protection Agency (EPA):

1. EPA Report NTID 300.1 – Notice from Construction Equipment and Operations, Building Equipment, and Home Appliances. (1972)

1.04 QUALITY ASSURANCE

A. Comply with requirements of Section 01 43 10, Project Quality Program Requirements – Design/Build.

B. Qualifications for the Acoustical Engineer:

1. The minimum requirements for the Acoustical Engineer: Bachelor of Science Degree or higher degree, from a qualified program in engineering, physics, or architecture offered by an accredited university or college, and ten years' experience in noise and vibration control engineering and noise and vibration analysis, or current enrollment as a full Member or Board-certified Member in the Institute of Noise Control Engineering.

2. Acoustical Engineer must demonstrate substantial and responsible experience in preparing and implementing construction noise control and monitoring plans on construction projects conducted in an urban setting calculating construction noise abatement measures.

3. Acoustical Engineer must demonstrate substantial and responsible experience in preparing and implementing construction noise control and monitoring plans on construction projects conduced in an urban setting, calculating construction noise abatement measures.

1.05 SUBMITTALS

A. Refer to Section 01 33 00, Submittal Procedures.

B. Qualifications and work experience of the Acoustical Engineer as specified in paragraph 1.04.B of this Section. This submittal is required prior to the submittal of the Noise Control and Noise Monitoring Plans.

C. Proposed locations for pre-construction ambient noise measurements at all work sites.

D. Pre-construction ambient noise level measurement report.

E. Contractor's Noise Control Plan as specified in this Section.

F. Contractor's Noise Monitoring Plan and the weekly Noise Measurement Reports as specified in this Section.

G. Noise measurement equipment makes and models, and calibration conformance certificates as specified in this Section.

H. Equipment noise certification reports as specified in this Section.

I. Shop and Working Drawings, computations, material data and other criteria, for noise abatement measures, identified in the Noise Control Plan and for moveable noise barriers, noise barrier walls and noise control curtains as specified in this Section. Have drawings and computations stamped by a License Professional Engineer registered in the State of California.

J. Contractors Weekly Vibration Measurement Reports as specified in this Section.

K. Contractor's Vibration Control Plans and Vibration Monitoring Plan as specified in this Section.

L. Material Safety Data Sheets (MSDS): Manufacturer's Material Safety Data Sheets for each type of material used in Work.

Los Angeles County Metropolitan Transportation Authority
Westside Purple Line Extension Project, Section 2

1.06 DEFINITIONS

A. Construction Site: For purpose of noise and vibration control requirements, the Contract limits of construction. This includes Right-of-Way lines, property lines, construction Easement Boundary or property lines and Contractor staging areas outside the defined boundary lines, used expressly for construction.

B. Noise Level Measurements: Unless otherwise indicated, the use of A-weighted and "slow" response settings of instrument complying with Type 2 requirements of latest revision of ANSI S1.4 and IEC 61672.

C. Pre-construction ambient noise levels: Existing noise levels measured 3 feet from the building face of the noise sensitive receivers so named herein.

D. A-Weighted Noise Levels: Decibels (referenced to 20 micro-Pascal) as measured with A-weighting network of standard sound level meter, abbreviated dBA.

E. C-Weighted Noise Level: Decibels (referenced to 20 micro-Pascal) as measured using the C-weighting network on a sound level meter complying with the criteria for a Type 1 (Precision) or Type 2 (General Purpose Sound Level Meter), as defined in the current revision of ANSI S1.4. Use the FAST setting on the sound level meter to measure the C-weighted sound level.

F. Vibration Measurements: The use of a vibration transducer, amplifier, peak detector, and frequency band filters complying with ANSI S2.4.

G. Vibration: Velocity in microinches per second. Vibration levels are expressed as velocity levels in Decibels referenced to one microinch per second, abbreviated VdB.

H. Daytime: As defined by the City of Los Angeles - 7:00 AM to 9:00 PM Monday through Friday local time, and Saturdays, 8:00 AM to 6:00 PM. As defined by the City of Beverly Hills - 8:00 AM to 6:00 PM Monday through Friday.

I. Nighttime: Periods other than daytime.

J. Noise Sensitive Locations: Residential areas, institutions, hospitals, parks, and other locations so named herein.

K. L_{max}: The maximum measured sound level.

L. One-hour Leq A weighted Equivalent Sound Level (Leq): The continuous sound level that represents the same sound energy as the varying sound levels over one hour.

M. Sound Transmission Class (STC): A single number rating calculated in accordance with ASTM E413, using values of sound transmission loss. It provides an estimate of the performance of a partition in certain common sound insulation problems.

N. Stationary/Continuous Noise: Daytime noise from stationary sources, and parked mobile sources that produce repetitive or long-term noise lasting more than two hours.

O. Mobile/Intermittent Noise: Daytime noise from non-stationary mobile equipment operated by a driver, or from source of intermittent, non-recurring on long-term basis, non-scheduled, non-repetitive, short-term noises (not lasting more than two hours).

1.07 RESPONSIBILITIES OF CONTRACTOR

A. Perform Work within the permissible noise levels, work schedule limitations, and procedures provided for in this Section and applicable Federal, state, county and municipal codes, regulations, and standards.

B. Other than those provided herein, be responsible for obtaining, at Contractor's own expense, permits, variances, equipment certifications, and other documents required by this Section and by applicable Federal, state, county and municipal codes, regulations and standards.

C. With regard to noise monitoring, include the following:

1. Furnish instrumentation for noise monitoring that complies with the standards specified in this Section and that is capable of measuring the sound levels defined in this Section.

2. Collect and report noise monitoring data, report whether the noise monitoring data indicates compliance under specialized in this Section, and submit a Noise Measurement Report to Metro on a weekly basis. Noise monitoring that is not conducted at the façade of the noise sensitive receiver should be adjusted accordingly.

3. Provide access to Metro to review measured data and coordinate the Contractor's schedule for noise monitoring.

4. Implement noise abatement measures as required by this Section, based on the Contractor's noise monitoring data and nuisance conditions reported by Metro.

D. With regard to vibration monitoring, include the following:

1. Furnish instrumentation for vibration monitoring that complies with the standards specified in Paragraph 1.02.A of this Section and that is capable of measuring the vibration levels defined in Paragraph 3.05.A of this Section

2. Collect and report vibration monitoring data, report whether the vibration monitoring data indicates compliance as specified in this Section, and submit a Vibration Measurement Report to Metro on a weekly basis.

3. Provide access to Metro to review measured data and coordinate with the Contractor's schedule for vibration monitoring schedules.

4. Implement vibration abatement measures as required by this Section, based on the Contractor's vibration monitoring data and nuisance conditions reported by Metro.

E. The adjacent noise and vibration sensitive locations include, but are not limited to, the following:

1. Properties listed in Table 5 of this Section

PART 2 - PRODUCTS

2.01 NOISE CONTROL MATERIALS

A. Noise control materials may be new or used. Used materials shall be sound and free of damage and defects and shall be of a quality and condition to perform their designed function.

2.02 NOISE BARRIER WALLS

A. Install noise barrier walls around all construction staging areas.

B. Use material that will last for the duration of construction of this Contract. Construct using AC Plywood or acceptable equal.

C. Line the construction site side of noise barrier walls with glass fiber or mineral wool type noise-absorbing material at least two inches thick. Protect this material using wire mesh or perforated sheets that are corrosion resistant and that have at least 30 percent open area and provision for water drainage, or provide a wall assembly with a STC-25 or greater, based on certified sound transmission loss data taken according to ASTM E90 and a Noise Reduction Coefficient (NRC) rating of NRC-0.70 or greater, based on certified sound absorption coefficient data taken according to ASTM C423.

D. Construct gates and doors in the wall either hinged or rolling of the same or equally effective material as the noise barrier wall. Construct gates and doors in the wall to ensure that the edges overlap the wall to eliminate gaps. During nighttime hours maintain gates and doors in a closed position except for brief periods of time to allow access to the Construction Site.

E. Attach lagging to support posts designed so that the wall will withstand 80 mph wind loads plus a 30 percent gust factor.

F. Provide flush mating surfaces of wall sides when walls are joined together or at corners. Close gaps between wall sections and between bottom edge of walls and grade with material that will completely close the gaps and be dense enough to attenuate noise.

G. Be responsible for the design, detailing and adequacy of the framework and supports, posts, attachment methods and other appurtenances required for the proper erection of the noise control barriers.

H. Prepare the design details for the noise control wall footing, steel posts, supports and framework, signed and sealed by a Professional Engineer licensed in the State of California. Submit the design and detailed engineering to Metro.

I. Design and install foundations or piers for walls that do not require excessive noise to remove.

J. Height of Noise Barriers: As required to meet noise control plan requirements, but not less than 20 ft. at Construction Laydown Yards.

K. Temporary Art and Displays: Refer to Sections 01 58 13 A, Temporary Signs and Banners, 01 56 26, Construction Fencing (Wood) and Section 01 56 28, Construction Fencing (Chain Link), for temporary artwork and displays.

L. Post readily visible signs indicating "Noise Control Zone" on or near construction equipment operating close to noise sensitive sites

2.03 MOVEABLE NOISE BARRIERS

A. Construct moveable barriers of AC Plywood sheeting, or other acceptable material. Line barriers on construction site side with glass fiber or mineral wool type sound absorbing material at least two inches thick to produce a noise barrier assembly with an STC25 rating or greater. Protect sound absorbing material by wire mesh or perforated sheets that are corrosion resistant and that have at least 30 percent open area, with provision for water drainage.

B. Provide materials and details of construction sufficiently weather resistant to last through the duration of construction of this Contract.

C. Construction Details:

1. Attach barrier panels to support frames constructed in sections to provide a moveable barrier utilizing the standard temporary precast concrete median barrier or other supports.

2. When barrier units are joined together, overlap the mating surfaces of the barrier sides or make flush with each other. Close gaps between barrier units, and between the bottom edge of the barrier panels and the ground, with material that will completely close the gaps and be dense enough to attenuate noise.

3. Height of barriers: As required to meet noise control plan requirements.

2.04 NOISE CONTROL CURTAINS

A. Noise Control Curtains: Durable, flexible composite material featuring a noise barrier layer bonded to a sound-absorptive material on one side.

1. STC rating of STC-25 or greater based on certified sound transmission loss data taken according to ASTM E90.

2. NRC rating of NRC 0.70 or greater based on certified sound absorption coefficient data taken according to ASTM C423.

B. Noise Barrier Layer: A rugged, impervious material with a surface weight of at least one pound per square foot.

C. Sound Absorptive Material: Include a protective facing, and securely attached to one side of the noise barrier layer over its entire surface.

1. Mildew resistant, vermin proof and non-hygroscopic.

D. The noise control curtain materials: Abuse resistant, exhibiting superior hanging and tear strength during construction. The curtain barrier material shall have a minimum

breaking strength of 120 lb/in. and a minimum tear strength of 30 lb/in. Based on the same test procedures, the curtain absorptive material facing shall have a minimum breaking strength of 100 lb/in. and a minimum tear strength of seven lb/in.

1. Corrosion resistant to most acids, mild alkalis, road salts, oils and grease.

2. Fire retardant, and approved by the City of Los Angeles Fire Department prior to procurement.

E. Construct gates and doors of a material with a STC 25 or greater rating.

F. Construction Details:

1. Install the noise control curtains in vertical segments extending the full curtain height, and have seams and joints with a minimum overlap of two inches and be sealed using hook fasteners or double grommets. Use construction details according to the manufacturer's recommendations.

2. Secure the curtain at ground level and/or at intermediate points by framework and supports.

3. Be responsible for the design, detailing and adequacy of framework, supports, ties, attachment methods and other appurtenances required for the proper installation of the curtain.

4. Height of Curtains: As required to meet noise control plan requirements.

5. Prepare and seal the design and details necessary for the noise control curtain framework and supports using a Professional Engineer licensed in the State of California. Submit the design and detailed engineering to Metro for review prior to procurement.

2.05 VIBRATION CONTROL FOR TUNNEL TRAIN

A. If ground-borne noise limits or ground-borne vibration limits are exceeded, the contractor will be required to take action to reduce noise and/or vibrations to acceptable levels. Such action could include:

1. A durable resilient system to support and the tunnel train tracks. Such as system would include:

a. Resilient mat under the tracks

b. A resilient grommet or bushing under the heads of any track fasteners.

2. The hardness of the resilient mat should be in the 40 to 50 durometer range and be about 1 to 2” thick, depending on how heavily loaded the cars would be.

3. The Contractor would need to select the mat thickness so that the rail doesn’t bottom out during a train passby.

4. Reduce the speed of the tunnel trains.

5. Maintain the tunnel train track and train wheels in good order to reduce potential vibration impacts, including keeping gaps between track sections to a minimum and more frequent maintenance to avoid wheel flats.

PART 3 - EXECUTION

3.01 ACOUSTICAL ENGINEER

A. Engage an Acoustical Engineer meeting requirements of Para 1.04B of this Section to be responsible for preparing and overseeing the implementation of the Noise Control Plan and mitigation measures.

3.02 NOISE LEVEL LIMITS

A. A summary of Allowable Construction Site Noise Levels in the cities of Los Angeles and Beverly Hills is provided on Table 2. Contractor to review and update to current City Codes and Ordinances.

B. Metro has taken measurements of the ambient noise levels at noise sensitive receivers near the construction areas. The measured ambient noise levels are presented in Table 1. These measured ambient levels are for information only and not to be used as the basis for developing allowable noise levels. Contractor shall review and update the noise sensitive locations listed in Table 5, adding and deleting locations to reflect changes since the date of the RFP.

C. Neither the LAPD nor the City of Beverly Hills have taken measurements of the ambient noise levels at construction locations. Contractor will take pre-construction 24-hour noise level measurements at each of the noise sensitive locations listed in Table 5. Where nighttime work is planned for any project sites, take pre-construction measurements at Table 5 locations during nighttime hours and provide to Metro. The selection of the measurement sites shall be subject to Metro approval. Measure levels, continuously over a 14 day period, 30 days prior to the beginning of construction, under the supervision of the Acoustical Engineer. Report data to Metro as 1-hour Leq (A-weighted) levels or other selected measurement period as directed by Metro. The Contractor's Acoustical Engineer will establish the day and night noise level limits based on the measured data for Metro's review and approval.

D. After completion of Contractor's pre-construction ambient noise measurements, Table 1 will be updated to indicate for each receiver site, the daytime, evening, and nighttime noise limits for construction. If either the LAPD or the City of Beverly Hills has granted the nighttime noise variance, it will include nighttime limits for selected sites, thus complementing these Ldn criteria, as shown in the Appendix. If LAPD or City of Beverly Hills noise limits differ from the Metro project noise criteria, apply the strictest.

E. The ground borne noise levels within building structures due to underground construction activities - Limited to the Lmax noise levels listed in Table 3.

F. At the surface of the construction site during nighttime hours use only equipment that, operating under full load, meets the noise limits specified in Table 4 when measured according to the test procedures used for equipment noise certification as specified in this Section.

G. Contractor is prohibited from operating equipment at night that does not meet nighttime noise emission limits in Table 4 below. If the Contractor's existing equipment on-site does not meet nighttime noise emission limits for surface construction activities specified in Table 4 or falls out of compliance, remove the non-compliant equipment promptly from nighttime service by immediately parking and turning off equipment when it is safe to do so.

H. Trucks operating off-site between the hours of 12:00 midnight and 5:00 AM must have lower emission limits (80 dBA at 50 feet) than normally required by the California Vehicle Code. All trucks used for these nighttime hours must be certified in accordance with these specifications. Take necessary steps to comply with this limit, which may include fitting this equipment with high grade engine exhaust silencers and engine casing sound insulation.

3.03 NOISE CONTROL MEASURES

A. Noise Barrier Walls

1. At the Wilshire/Rodeo Station laydown and staging work areas a 20-foot high noise barrier wall shall be erected around the perimeter of each of the work areas as shown in the Contract drawings in accordance with Article 2.02 of this Section.

2. At the Century City/Constellation Station laydown and staging work areas a 20-foot high noise barrier wall shall be erected around the perimeter of each of the work areas as shown in the Contract drawings in accordance with Article 2.02 of this Section.

B. Moveable Noise Barriers

1. For construction occurring at the Wilshire/Rodeo Station Box, Century City/Constellation Station Box and Century City/Constellation TBM Launch Area, moveable noise barriers with a nominal height of 14 feet shall be used at the perimeter of these sites in accordance with Article 2.03 of this Section.

C. These supplemental noise mitigation measures shall be provided at the 2040 CPE Work Area.

1. Compressor plant, ventilation plant, grout plant, foam plant, machine shop and electrical shop shall be fully enclosed.

2. Conveyor system shall be enclosed.

3. All diesel powered equipment, such as a boom crane or front end loader used during the night shift shall be retrofitted with a hospital grade muffler and additional damping and insulation added to the engine compartments.

4. A supplemental 16-foot high noise barrier wall will be built on site, as shown in the Contract drawings in accordance with Article 2.02 of this Section to further shield the noise from spoils handling operations.

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3.04 NOISE CONTROL PLAN

A. Requirements:

1. The Acoustical Engineer is responsible for preparing and overseeing the implementation of the Noise Control Plan.

2. Submit the Noise Control Plan to Metro or its designee a minimum of 90 days prior to the start of work.

3. Noise Control Plan: Include the following for daytime and nighttime construction activities that may occur at the surface of the construction site:

   a. Site Drawing: Prepare a scaled drawing of the construction site indicating the following:

      1) Contract name and number

      2) Contractor's name

      3) Date

      4) Scale

      5) Direction of North

      6) Noise sensitive locations near the construction site

      7) Construction equipment locations used during daytime and nighttime hours, designated by the code letter used in Column (a) in Part A of the Noise Control Plan Form, Figure 4.

      8) Locations of the noise levels calculated for residential, commercial, and industrial areas as specified in this Section.

      9) Locations and types of noise abatement measures that may be required to meet codes and regulations as indicated by the calculations as specified in this Section.

   b. Equipment Inventory: Prepare an inventory of equipment used during daytime and nighttime hours by providing the following information in the indicated columns of Noise Control Plan Form, Figure 4.

      1) Column (a): Code letter in sketch to indicate position of equipment on site and to identify Certificates of Noise Compliance

      2) Column (b): Appropriate equipment category from Table 4

      3) Column (c): Equipment manufacturer and model, if known at the time of the Plan's preparation

      4) Column (d): Unique identifier (ID), such as registration number, if known at the time of the Plans preparation.

5) Column (e): Equipment horsepower

6) Column (f): Noise emission limit from Table 4.

7) Column (g): Estimated noise level at 50 feet; if greater than the value in Column (f), source noise control device (e.g. mufflers) must be used to comply with limit.

8) Column (h): Estimated date of first use on site

9) Column (i): Estimated date of last use on site.

c. Noise Calculations: Prepare calculations of daytime and nighttime L_{max} and one-hour L_{eq} noise levels expected at the nearest residential, commercial and industrial property line based on the equipment noise levels given in Part A of the Noise Control Plan Form. Determine the nearest property lines from the currently identified noise sensitive locations indicated in Table 5. Calculate preliminary one-hour L_{eq} construction noise projections for those sensitive locations and insert with locations into Table 6. Make the calculations for locations where noise emitted by applicable equipment will cause the greatest noise level for each type of land use, for daytime and nighttime periods if necessary. Provide the results on Part B of the Noise Control Plan Form with calculations included below the results, and with the locations for the calculations indicated on the site sketch. The noise calculation procedure shall be as follows:

1) Calculate L_{max} according to the method outlined below:

$L_{max}(\text{equipment}) = EL - 20 \log_{10} (D/50)$

where:

EL = Estimated equipment noise level at 50 feet, in dBA.

D = Distance from the equipment to property-line location, in feet.

Then, combine the individual contributions of each piece of equipment to obtain the overall maximum construction noise level at each location as follows:

$L_{max}(\text{overall}) = 10 \log_{10} (\text{SUM } 10^{[L_{max}(\text{equipment})/10]})$

2) Calculate one-hour L_{eq} according to the methodology recommended by the US Department of Transportation, Federal Highway Administration Special Report Highway Construction Noise: Measurement, Prediction and Mitigation, as follows:

First, calculate the construction one-hour L_{eq} at each property-line location for each item of equipment using the following equation:

One-hour $L_{eq}(\text{equipment}) = EL - 20 \log_{10}(D/50) + 10 \log_{10}(UF/100)$

where:

EL = Estimated equipment noise level at 50 feet, in dBA.

D = Distance from the equipment to the property-line location, in feet.

UF = "Usage factor," expressed as the percent of time that the equipment is operated at full power while on site. This factor shall be estimated by the Contractor or the qualified acoustical engineer. Guidelines for the selection of usage factors are provided by the US Environmental Protection Agency (EPA) Report NTID 300.1, Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances.

Then, combine the individual contributions of each piece of equipment to obtain the overall construction one-hour L_{eq} at each location as follows:

One-hour L_{eq}(overall) =10 $\log_{10}$ (SUM 10[one-hour Leq (equipment)/10])

3) Compare the calculated L_{max} and one-hour L_{eq} values with the Contract limits specified in this Section.

d. Description of Required Noise Abatement Measures as specified in Paragraph 3.2.B of this Section.

4. Noise Control Plan for Construction Activities Near Schools – If any primary or secondary schools are identified within the noise impact area of construction, the Contractor shall prepare noise control plans to maintain acceptable interior noise levels within the school classrooms and occupied spaced. Metro will develop these criteria in coordination with the Los Angeles Unified School District (LAUSD), the Beverly Hills Unified School District (BHUSD), and individual school administrators. The Contractor shall monitor the construction noise levels to ensure compliance.

5. Update the Noise Control Plan at three month intervals (based on Metro's initial acceptance date) and re-submit the Plan within 10 days of the start of each quarterly period. Update and re-submit the Noise Control Plan upon any major change in work schedule, construction methods, or equipment operations not included in the most recent Plan.

B. Noise Abatement Measures: If the results of the noise calculations prepared in accordance with this Section indicate that noise level limits listed in this Section will be exceeded, identify proposed noise abatement measures, their anticipated effects (dBA reductions), and a schedule for their implementation. Re-calculate the noise levels at the nearest sensitive receptor location property lines which include the anticipated noise reduction effects and submit the results on Part B of the Noise Control Plan Form. Include, as backup documentation to Part B of the Noise Control Plan, drawings, sketches, and suitable calculations which demonstrate anticipated

noise reduction benefits and that proposed structures or facilities comply with applicable building code requirements.

C. Noise Reduction Methods: To the extent required to meet the noise limits specified by this Section, include noise reduction measures listed below, or others of the Contractor's devising to minimize construction noise emission levels. Noise reduction measures include, but are not limited to the following:

1. Scheduling truck loading, unloading, and hauling operations so as to minimize noise impact near noise sensitive locations and surrounding communities.

2. Locating stationary equipment so as to minimize noise impact on the community.

3. Do not leave equipment pieces idling when not in use.

4. Limiting the use of enunciators or public address systems, except for emergency notifications. Any public address or music system must not be audible at any adjacent sensitive receiver

5. Maintaining equipment such that parts of vehicles and loads are secure against rattling and banging.

6. Limit the time that steel decking or plates for street decking or covering excavated areas are in use.

7. Grading of surfaced irregularities on construction sites to prevent the generation of impact noise and ground vibrations by passing vehicles.

8. Schedule Work to avoid simultaneous activities that both generate high noise levels.

3.05 NOISE MONITORING PLAN

A. Requirements:

1. Noise Monitoring Plan shall be prepared and administered by the Contractor's Acoustical Engineer.

2. 60 days prior to commencing work, submit the Noise Monitoring Plan to Metro, specifying the nighttime and daytime construction activities, monitoring locations, equipment, procedures, schedule of measurements and reporting methods to be used.

3. Furnish noise monitoring data to Metro or its designee on a weekly basis. Include measurements taken during the previous week.

4. In the event that the measured noise levels exceed allowable limits, halt operation of the activity causing the exceedance and immediately notify Metro within one hour of the exceedance. Work on that activity shall be suspended until such time as an alternative construction method can be used and additional Noise Abatement Measures can be implemented as specified in the Noise Control Plan before this same activity can be resumed.

5. If the measured nighttime levels exceed the noise limits specified in this Section, reduce the noise levels by appropriate abatement measures in order to comply with the nighttime Noise Variance requirements or terminate the nighttime construction activity responsible for the noise limits exceedance until the daytime hours when higher noise levels are permitted.

B. Measurement Locations:

1. Measure noise levels at the noise-sensitive locations identified in Table 5 of this Section. These locations may change during the Contract and shall be updated as required by Metro.

2. Prepare and submit a scaled plan indicating monitoring locations, including measurements to be taken at construction site boundaries and at nearby residential, commercial and industrial property lines.

C. Noise Monitoring - (Continuous Noise Monitoring Stations (CMS)

1. Maintain continuous noise monitoring stations (CMS) with internet access at minimum of four selected locations within the community affected by the nighttime construction activities, and with an additional continuous noise monitoring station at the station construction sites at Wilshire/Rodeo and Century City Constellation.

2. CMS stations shall be programmed with an initial trigger that provides an alert when the construction noise levels are within 3 dB of the noise limit and a second trigger when the noise levels are at or above the noise limit.

3. CMS stations shall continuously measure the equivalent sound level (one-hour Leq) and the maximum sound level (Lmax) on the A-Scale (dBA) and report the measured levels on a real time basis and/or one-hour time period or other selected measurement period as directed by Metro. CMS shall make audio recordings of all exceedances.

4. Provide noise monitor telemetry links and software and computer capable of continuously measuring noise and transmitting the measured data from each of the CMS by a web based application to a computer located at the contractor's office.

5. Contractor shall review and analyze CMS data each day. The Acoustical Engineer or his designee shall each day listen to the audio of the exceedence events and identify the cause is from contractors work and not other sources such as emergency vehicle siren, helicopter etc. Submit noise data to Metro or its designee on a weekly basis using the Noise Measurements Report Form provided in Figure 2.

6. Monitoring locations for CMS will be selected by LAPD, City of Beverly Hills and Metro to ensure that the Nighttime Noise Variance requirements are met. As work progresses at each of the construction areas it may be necessary to periodically relocate the continuous noise monitors to the area most sensitive to on-going construction noise activities.

D. Noise Monitoring – Hand Held Monitors

1. Provide Metro with one Type 1 (precision sound level meter that meets the requirements outlined in this Section.

2. Measurement Equipment:

a. Perform noise measurements with an instrument that is in compliance with the criteria for a Type 1 (Precision) or Type 2 (General Purpose) Sound Level Meter as defined in the current revision of ANSI S1.4.

b. Provide sound level meters capable of measuring the L_{max} and one-hour L_{eq} on both the A-Weighted and C-Weighted scales required by regulatory criteria and Noise Level Limits.

c. Calibrate sound level meters, microphones, and calibrators for certified laboratory conformance at least once a year. Submit a current certificate of conformance to Metro prior to using the sound level meter and submit updated certificates following subsequent calibrations on a yearly basis for the duration of this Contract or upon the completion of repairs to the instrument.

E. Measurement Procedure – Hand Held Monitors

1. Field calibrate the sound level meter using an acoustic calibrator, according to the manufacturer's specifications, prior to each measurement.

2. Except as otherwise indicated, perform measurements using the A weighting network and the SLOW response of the sound level meter.

3. Measure impulsive or impact noises using the C-Weighting network and the FAST response of the sound level meter.

4. Fit the measurement microphone with an appropriate windscreen at the location of the sensitive receptor at least four to six feet away from the nearest reflective surface.

5. Take noise measurements at 3 feet from the building face of noise sensitive locations within 150 feet of the construction site at least once each week and after a change in construction activity or construction location. Measurement Periods: Minimum of 15 minutes.

6. Construction noise measurements shall coincide with daytime and nighttime periods of maximum noise generating construction activity, and be taken during the construction phase or activity that has the greatest potential to create annoyance or to exceed applicable noise regulations and restrictions.

7. If, in the estimation of the person performing the measurements, outside noise sources contribute significantly to the measured noise level, repeat the measurements (with the same outside source contributions when construction is inactive to determine the background noise level

8. Submit noise data to Metro or its designee on a weekly basis using the Noise Measurements Report Form provided in Figure 2. Note the type of measurement (e.g. baseline, on-going construction) on the form.

9. Clearly identify monitoring locations and sketch on the back of the Noise Measurements Report Form, Figure 2, along with the locations of and distances from any noise sensitive location.

10. Identify construction equipment operating during the monitoring period and the locations sketched on the back of the Noise Measurements Report Form, along with the locations and distances to any noise sensitive location.

3.06 EQUIPMENT NOISE CERTIFICATION

A. Requirements for Construction Equipment:

1. Ensure that Contractor and Subcontractor equipment, of the categories listed in Table 4 to be used (during nighttime hours at the surface of the construction site) for a total duration greater than five days, shall be tested for compliance with the stated noise emission limits by the Acoustical Engineer during the first day of use on the construction site or at an alternative site acceptable to Metro.

2. Retest equipment as described above at six month intervals while in use on-site, and certify new equipment before being placed into service at the site.

3. For each piece of equipment tested, submit a noise report to Metro or its designee by completing the Application for Certificate of Equipment Noise Compliance provided in Figure 3. Ensure that the equipment identification number used for the Certificates is consistent with the identification number used in the Noise Control Plan.

4. Do not use equipment of the categories listed in Table 4, as described above on-site without valid certificates of noise compliance submitted as required.

B. Test Procedures for Construction Equipment:

1. Operate engine powered equipment by the Contractor or Contractor's representative at maximum governed rpm under full load conditions during the tests under the supervision of the Acoustical Engineer.

2. Test portable and mounted impact hammers, such as hoe rams and jackhammers to be used for concrete breaking, by the Acoustical Engineer during the first day of actual operation at the construction site under maximum load conditions as rated by the equipment manufacturer.

3. Noise certification measurements: As specified in Paragraph 3.03 F. of this Section. Use an acoustic calibrator of the type recommended by the sound level meter manufacturer prior to measurements.

4. If possible, make measurements at two locations:

a. Two feet outside the right side of the equipment casing, at a distance of 50 feet and height of five feet above ground level, and;

b. Two feet outside the left side of the equipment casing, at a distance of 50 feet and a height of five feet above ground level, with the equipment operating as indicated in items 3.04.B.1, or 2 above for a minimum period of one minute. Reduce measurements made at less than 50 feet, because of space limitations at the test site, by the values given in Table 7 to estimate the 50-foot sound level.

C. Compliance:

1. Submit a noise report to Metro for each item of equipment used on the surface of the construction site during nighttime hours of the categories listed in Table 4. Submit the report on the form shown in Figure 3 with certification by the Acoustical Engineer that equipment noise emissions do not exceed those prescribed in Table 4.

2. If the noise levels obtained during the tests exceed those specified in Table 4, remove such equipment from nighttime use until such equipment is modified and retested, or substitute other equipment to meet the noise level requirements.

3. Upon compliance Metro will mark the noise report indicating Metro's concurrence, including the certification date and equipment identification number, for verification by Metro. Keep the noise reports readily available on file in the construction field office for inspection by Metro upon request.

4. The Certificate of Noise Compliance will remain valid for a period of six months only. Delays caused by the certification refusal or by time lost in improving the rejected equipment or finding alternate acceptable equipment will not be a basis for monetary or time delay claims, or for avoidance of liquidated damages or withholding of payment.

5. Equipment shall be subject to spot noise level testing by Metro's discretion to determine that the equipment in use meets the requirements specified in Table 4. If such tests are requested by Metro, locate and operate the equipment as directed by Metro at the designated site so as to facilitate the measurements.

a. Provide Metro with a copy of the results of the measurements. If such tests demonstrate that any equipment does not comply with this part, Metro will revoke the certificate of Noise Compliance and the Contractor will take the equipment out of use according to requirements of this Section until compliance is achieved. A new Certificate of Noise Compliance will be issued upon proof of compliance.

3.07 VIBRATION LEVEL LIMITS

A. Measures applied to limit noise levels may in some cases limit vibration levels also. Measures specified above for noise levels are applicable.

B. All Areas: Conduct Construction activities so that vibration levels at a distance of 50 feet from construction limits or at nearest affected building (whichever is closer) do not exceed root-mean-square (rms) unweighted vibration velocity levels in vertical direction over a frequency range of 1 to 100 Hz as listed in Table 8. Limit ground-

borne noise inside buildings due to construction vibration to below the limits in Table 3.

C. Historic and Cultural Resources Structures – The Contractor will be responsible for the protection of vibration sensitive historic buildings or cultural resource structures that are within 200 feet of any construction activity. These structures have been identified in the Final EIS/EIR. Vibration from construction activities shall not exceed the Category IV levels as indicated in Table 9 for any length of time. The Contractor shall perform periodic vibration monitoring at the closest structure to any construction activities using approved seismographs. If at any time the construction activity results in vibration levels that exceed those specified herein, that activity shall be halted immediately and work on that activity shall be suspended until such time as an alternative construction method can be used that will result in lower vibration levels.

D. The groundborne vibration levels at building structures due to any construction activities shall be no greater than the peak particle vibration levels shown in Table 9. The Contractor shall perform periodic vibration monitoring at the closest occupied building structure to any construction activities using approved seismographs. If at any time the construction activity results in vibration levels that exceed those specified herein, that activity shall be halted immediately and work on that activity shall be suspended until such time as an alternative construction method can be used that will result in lower vibration levels.

E. Vibration levels at buildings affected by construction operations refer to vertical direction vibration on ground surface or building floor.

F. Conduct daily measurements of vibration during peak vibration generating construction activities.

3.08 VIBRATION CONTROL AND MONITORING PLAN

A. Requirements

1. Same as noted above for the Noise Control Plan (3.02.A) and Noise Monitoring Plan (3.03.A), applied to vibration, where applicable.

2. Vibration Calculations – In the absence of relevant vibration measurement data that can be applied to this Project, prepare calculations of maximum groundborne noise and vibration at representative buildings along the Project. Preliminary source vibration levels are indicated in Table 10. These source levels are preliminary in nature and it is up to the Contractor to verify and update information during construction (and, where possible, before construction). Provide the results on a form similar to Part B of the Noise Control Plan Form, with the calculations included below the results, and with the locations for the calculations indicated on the site sketch. The vibration calculation procedure shall be as follows:

a. Damage Assessment – Calculate the vibration according to the method outlined below:

$$PPV_{equipment} = PPV_{ref} \times (25/D)^{1.5}$$

where:

$PPV_{equipment}$ is the peak particle velocity in units of inches/second of the equipment adjusted for distance

PPV_{ref} is the reference vibration level in units of inches /second at 25 feet (see Table 10)

D is the distance from the equipment to the receiver, in feet.

b. Annoyance Assessment – Calculate the vibration according to the method outlined below:

$Lv(D) = Lv(25\ ft) - 30\ \log_{10}(D/25) + correction$

where:

Lv(D) is the rms vibration velocity in logarithmic units of VdB re 10^{-6} in/sec of the equipment, adjusted for distance.

Lv(25 ft) is the reference vibration level in logarithmic units of VdB re 10-6 in/sec at 25 ft (see Table 10).

D is the distance from the equipment to the receiver, in feet.

Correction is as noted in Table 11.

B. Vibration Abatement Measures – if the results of the vibration calculations or representative field data indicate that the vibration level limits listed in this Section will be exceeded, identify proposed vibration abatement measures, their anticipated vibration effects, and schedule for their implementation. Provide calculations demonstrating the effectiveness of the proposed abatement measures, and, if applicable, provide applicable drawings and sketches to indicate where such abatement measures will be placed.

C. Vibration Reduction Methods – See paragraph 3.02.C for methods which can reduce noise and vibration.

D. Vibration Measurement Locations

1. Measure vibration and groundborne noise at sensitive locations in the vicinity of the construction sites. These locations may change during the Contract and shall be updated as required by Metro.

2. Prepare and submit a scaled plan indicating monitoring locations.

E. Vibration Monitor

1. Maintain a vibration monitoring station with internet connection at the closest building to the vibration generating construction activities. See Section 3.05 for other requirements. Measure vibration and groundborne noise at a minimum of these locations where there are buildings that are eligible for listing on the National Register of Historic Properties:

a. Pending

F. Measurement Equipment

1. Use an Instantel Blastmate III, Minimate Plus, Minimate Series IV pro or approved equal to monitor vibration. See 3.03.E for groundborne noise equipment requirements.

2. Calibrate vibration equipment at a certified laboratory at least once a year. Provide calibration documentation to Metro prior to placing equipment in service.

G. Measurement Procedure – See 3.03.F for general guidelines applicable to spot check for vibration and groundborne noise.

3.09 CONSTRUCTION SITE NOISE CONTROL

A. Perimeter Noise Barrier Wall:

1. Furnish and install perimeter noise barrier walls along streets as indicated. The noise barrier walls shall provide sufficient noise reduction to meet the daytime or nighttime noise limits specified in this Section. It is the Contractor's responsibility to meet these limits by other methods such as installing additional fixed barrier walls or movable barriers, raising the height of the noise barrier walls, and providing additional noise control measures specified in this Section. Perimeter fencing shall be a minimum height of 20 ft.

2. Construct gates and/or doors in the wall either hinged or rolling of the same or equally effective material as the noise barrier wall. Construct gates and doors in the wall to ensure that the edges overlap the wall to eliminate gaps. During nighttime hours maintain gates and doors in a closed position except for brief periods of time to allow access to the Construction Site.

3. Install noise barrier walls, gates, and doors in the wall before commencing any work.

B. Noise Barrier Walls for Pile Installation and Grouting Stage Areas:

1. Provide Noise Control walls on perimeter of pile installation closure and grouting staging areas.

2. Provide noise absorptive material behind gawk screens on K-Rail which are adjacent to live traffic, and on construction chain link fencing, which is adjacent to the sidewalk.

3.10 CONSTRUCTION SITE VIBRATION CONTROL

A. Provide an elastomer isolator installed between the floor of the tunnel and the rails and ties on which the excavated materials train operates. The elastomer isolator shall be provided for the full extent of the running tunnel between the end of the Wilshire/La Cienega Station and the Constellation Century City Station.

B. Submit the excavated materials train rail vibration elastomer isolator design for Metro acceptance before installation of the track.

C. If the Metro ground-borne noise or ground-borne vibration limits (Table 3) are exceeded the Contractor will be required to take additional action to reduce vibration to acceptable levels.

3.11 CONSTRUCTION METHODS – EQUIPMENT

A. Minimize the use of impact devices, such as jackhammers, pavement breakers, and hoe rams. Where possible, use concrete crushers or pavement saws rather than hoe rams for tasks such as concrete deck removal and retaining wall demolition.

B. Pneumatic impact tools and equipment used at the construction site shall have intake and exhaust mufflers recommended by the manufacturers thereof, to meet relevant noise ordinance limitations and Metro project criteria shown in this Section.

C. Equip noise producing equipment i.e. jackhammers and pavement breakers with acoustically attenuating shields or shrouds recommended by the manufacturers thereof, to meet relevant noise ordinance limitations.

D. Line or cover hoppers, conveyor transfer points, storage bins, and chutes with sound-deadening material.

E. All noise producing equipment, including vehicles that use internal combustion engines will be required to be equipped with mufflers and air-inlet silencers, where appropriate, and kept in good operating condition that meets or exceeds original factory specifications. Mobile or fixed "package" equipment (e.g., arc welders, air compressors, ventilation fans) will be equipped with shrouds and similar noise control features, to meet noise ordinance limitations.

F. Blasting and Impact Pile Driving is specifically prohibited from use. Use of vibrating and impact hammers shall also be limited due to close proximity of adjacent buildings

G. As required to meet the noise limits specified in this Section, use alternative procedures of construction, and select proper combination of techniques that generate least overall noise and vibration. Such alternative procedures include the following:

1. Use electric welders powered from utility main lines instead of riveting or electric generators/welders.

2. Mix concrete off-site instead of on-site.

3. Employ prefabricated structures instead of assembling on-site.

4. Solar powered arrow boards

5. VMS message signs

H. Use only construction equipment, both fixed and mobile, that is equipped to operate within noise limits. At night, use only equipment when, when operating at the surface of the construction site under full load, is certified to meet the specified lower noise

level limits set in the noise control plan and specified in the noise variance application.

I. Use construction equipment manufactured or modified to dampen noise and vibration emissions, such as:

1. Use electric electrically powered equipment to the extent possible instead of diesel powered equipment.

2. Use hydraulic tools instead of pneumatic impact tools.

3. Use electric instead of air or gasoline driven saws.

4. Whisper Jet diesel powered generators.

J. Readily visible signs indicating "Noise Control Zone" shall be used.

K. Noise control devices that meet original specifications and performance shall be used.

L. Mobile or fixed noise-producing equipment shall be equipped to mitigate noise to the extent practical would be used.

M. Earth-moving equipment, fixed noise-generating equipment, stockpiles, staging areas, and other noise-producing operations would be located as far as practicable from noise-sensitive receivers.

N. The use of air horn type devices, including but not limited to vehicle mounted or hand held, shall not be used to communicate signals from one area of the project site to another. Compliance with the requirements of the Tunnel Safety Orders for signaling systems shall be obtained through the use of other auditory or visual systems other than the use of air horn type devices.

O. Use of horns, whistles, alarms, and bells would be limited.

P. Any project-related public address or music system would not be audible at any adjacent receiver.

Q. Enclosures for fixed equipment such as TBM slurry processing plants would be required in order to reduce noise.

R. Used approved design of silencers for all ventilation fans.

3.12 CONSTRUCTION METHODS – OPERATIONS

A. Operate equipment so as to minimize banging, clattering, buzzing, and other annoying types of noises, especially near residential areas during the nighttime hours.

B. To the extent feasible, configure the construction site in a manner that keeps noisier equipment and activities as far as possible from noise sensitive locations and nearby buildings.

C. In no case shall the above restrictions limit the Contractor's responsibility for compliance with applicable Federal, state and local safety ordinances and regulations and other Sections of these construction specifications.

D. Maximize physical separation, as far as practicable, between noise generators and noise receptors. Separation includes following measures:

1. Provide enclosures for stationary items of equipment and barriers around particularly noisy areas on site.

2. Locate stationary equipment to minimize noise and vibration impact on community, subject to acceptance of Metro.

E. Demolition methods to be selected to minimize noise and vibration impact where possible.

F. Use of vibratory rollers and packers tobe avoided near vibration sensitive areas.

G. Temporary noise barriers and sound-control curtains to be erected where project activity is unavoidably close to noise-sensitive receivers.

H. Minimize noise-intrusive impacts during most noise sensitive hours. Limit activities such as concrete saw cutting to daytime and early evenings.

1. Plan noisier operations during times of highest ambient noise levels.

2. Keep noise levels relatively uniform; avoid excessive and impulse noises.

3. Turn off idling equipment.

4. Phase in start-up and shut-down of site equipment.

I. Select truck routes for muck disposal so that noise from heavy-duty trucks will have minimal impact on sensitive land uses (e.g., residential).

1. Conduct truck loading, unloading and hauling operations so noise and vibration are kept to a minimum.

2. Where possible, route heavily loaded trucks away from residential streets. Where no alternatives are available, haul route selection will take into consideration streets with the fewest noise-sensitive receivers..

3. Submit haul routes and staging areas to the City of Los Angeles, Bureau of Engineering and LADOT, or the City of Beverly Hills 30 days before required date.

J. Minimize vibrations from operations and equipment where necessary.

1. Maintain smooth surfaces for construction equipment and vehicles to travel on (e.g., truck routes, tunnel train rail) to minimize vibration.

2. Conduct TBM operations and maintain equipment to minimize unnecessary vibration.

K. Use non-noise sensitive, designated parking areas for project related traffic.

3.13 CONSTRUCTION METHODS – MOVEABLE NOISE BARRIERS

A. At a minimum, provide movable noise barriers for work in public right-of-way during night time hours in accordance with requirements of this Section for Moveable Noise Barriers.

B. Provide readily removable noise barriers so that they may be repositioned, as necessary, to provide noise abatement for non-stationary and stationary processes.

C. Installation, Maintenance, and Removal:

1. Install the barriers such that the sound-absorptive surfaces face the noise source.

2. Maintain the moveable noise barriers and repair damage that occurs, including, but not limited to, keeping barriers clean and free from graffiti, and maintaining structural integrity. Promptly repair or replace gaps, holes, and weaknesses in the barriers, and openings between, or under the units with new material.

D. The use of moveable noise barriers is a minimum noise control requirement that may not provide sufficient noise reduction to meet the daytime or nighttime noise limits specified in this Section. It is the Contractor's responsibility to meet these limits by other methods such as installing additional moveable noise barriers, installing noise barrier walls, and providing additional noise control measures specified in this Section as indicated.

3.14 CONSTRUCTION METHODS – NOISE CONTROL CURTAIN

A. Install noise control curtains in accordance with requirements of this Section for Noise Control Curtains, as required to meet the noise limits specified in this Section, to shield public from construction noise during the course of the Contract.

B. The noise control curtains shall be readily moveable so that they may be repositioned, as necessary, to provide noise abatement for non-stationary and stationary processes.

C. Installation, Maintenance and Removal:

1. The noise control curtains shall be installed without any gaps such that the sound-absorptive side faces the construction activity to be shielded.

2. Maintain the noise control curtains and promptly repair any damage that may occur. Gaps, holes or weaknesses in the curtain, or openings between the curtain and the ground shall be promptly repaired by the Contractor.

3.15 NOISE AWARENESS TRAINING

All Contractor personnel on site shall participate in 15 minute Noise Awareness Training provided by Metro.

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3.16 CONSTRUCTION SCHEDULE

When traffic restrictions allow, schedule saw cutting, jack hammering and other noisy activities during the day or early evening hours.

3.17 LOW IMPACT BACK-UP ALARMS

A. Use low impact back-up alarms on all equipment during nighttime hours. The equipment shall include, but not limited to, cranes, low boys, backhoes, loaders, concrete pumps, excavators, haulers, dump trucks, work trucks, and concrete mix trucks.

B. The low impact back-up alarms used by the Contractor shall comply with CCR Title 8, Section 1592, Warning Methods.

1. For equipment that must comply with CCR Title 8, Section 1592(a), equip these vehicles with compliant white sound, broadband and multi-frequency type back-up alarm devices.

2. For equipment subject to the requirements of CCR Title 8, Section 1592(b) and that the Contractor chooses to equip with automatic back-up audible alarms as the means for complying with this section; such alarms shall only be of a compliant white sound, broadband or multi-frequency back-up alarm type device.

3. The compliant white sound, broadband and multi-frequency type back-up alarm device shall be a self-adjusting, "smart" reversing, alarm that continually adjusts to 5 db above ambient. Acceptable manufacturers are Brigade, ECCO or approved equal.

4. The compliant white sound, broadband and multi-frequency type back-up alarm device shall be rated as medium duty or heavy duty, as the field conditions and/or usage would dictate.

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TABLE 1 – ALLOWABLE SOUND LEVELS OF TOTAL CONSTRUCTION SITE NOISE BASED ON METRO's AMBIENT NOISE MEASUREMENTS

Wilshire/Rode Station

Site No.	Measurement Location	Daytime Leq[a]	Evening Leq[a]	Nighttime Leq[a]
H	210 N. Beverly Drive (MFR)	77 dBA	75 dBA	74 dBA
I	133-153 S. Reeves Drive (SFR/MFR)	64 dBA	61 dBA	59 dBA
J	Sirtaj Hotel, 120 S. Reeves Drive	63 dBA	61 dBA	57 dBA
K	192 N. Canon Drive (Offices)	73 dBA	70 dBA	70 dBA
L	121-157 S. Canon Drive (SFR/MFR)	66 dBA	66 dBA	62 dBA
M	AKA Beverly Hills Hotel, 155 N. Crescent Drive	67 dBA	65 dBA	67 dBA
1	Beverly Sixty Hotel, 9360 Wilshire Boulevard	81 dBA	79 dBA	77 dBA
2	The Rolex Building, 9420 Wilshire Boulevard (Offices)	79 dBA	77 dBA	75 dBA
3	Sterling Plaza/Bank of California, 9441 Wilshire Boulevard (Offices)	79 dBA	77 dBA	76 dBA
4	Beverly Wilshire Hotel, 9500 Wilshire Boulevard	78 dBA	77 dBA	75 dBA

Notes:
[a] Daytime is from 8:00 A.M. to 6:00 P.M., evening is from 6:00 P.M. to 9:00 P.M. and nighttime is from 9:00 P.M. to 8:00 A.M.
MFR – Multi-Family Residences
SFR – Single-Family Residences

Century City/Constellation Station

Site No.	Measurement Location	Nighttime Leq[a]		
A	1918-1952 Fox Hills Drive (MFR)	63 dBA		
B	2050 Century Park West (MFR)	64 dBA		
C	Hyatt Regency Century Plaza Hotel, 2025 Avenue of the Stars	61 dBA		
D	2010 Century Park East (Offices)	68 dBA		
E	Century City Hospital & Medical Center, 2080 Century Park East – 1st floor	68 dBA		
E	Century City Hospital & Medical Center, 2080 Century Park East – 3rd floor	64 dBA		
E	Century City Hospital & Medical Center, 2080 Century Park East – 8th floor	63 dBA		
F	2160 Century Park East (MFR)	70 dBA		
6	1888 Century Park East (Offices)	68 dBA		
7	Century Plaza Towers, 2049 Century Park East (Offices)	64 dBA		
8	Annenberg Space for Photography and the Skylight Studios, 10050 Constellation Boulevard	61 dBA		
9	Bain & Company Building, 1901 Avenue of the Stars	66 dBA		
10	The Century, 10 West Century Drive (Offices)	62 dBA		
11	Constellation Place, 10250 Constellation Boulevard (Offices)	71 dBA		
Sites G and 5 are in the City of Beverly Hills and subject to the Beverly Hills' Noise Code				
		Daytime[b]	Evening[b]	Nighttime[b]
G	401 Shirley Place, Beverly Hills (SFR)	68 dBA	68 dBA	63 dBA
5	Beverly Hills High School	56 dBA	53 dBA	51 dBA

Notes:
[a] Nighttime is from 9:00 P.M. to 7:00 A.M as defined by the City of Los Angles Municipal Code.
[b] Daytime is from 8:00 A.M. to 6:00 P.M., evening is from 6:00 P.M. to 9:00 P.M. and nighttime is from 9:00 P.M. to 8:00 A.M.MFR – Multi-Family Residences
SFR – Single-Family Residences

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TABLE 2 – SUMMARY OF ALLOWABLE CONSTRUCTION SITE NOISE LEVELS (CITY OF LOS ANGELES AND CITY OF BEVERLY HILLS)

Construction Activity	Noise Limit[1], dBA
City of Los Angeles Daytime (7:00 A.M.-9:00 P.M.), general activities	75 dBA
City of Los Angeles Daytime (7:00 A.M.-9:00 P.M.), steady high-pitch noise or repeated impulsive noises	70 dBA
City of Los Angeles Daytime (7:00 A.M.-9:00 P.M.), less than 15 minute duration in a period of 60 consecutive minutes	80 dBA
City of Los Angeles Nighttime (9:00 P.M.-7:00 A.M.), all activities	Nighttime Ambient + 5dB
City of Beverly Hills Daytime (8:00 A.M.-6:00 P.M.), all activities	Daytime Ambient +5 dB
City of Beverly Hills Evening (6:00 P.M.-9:00 P.M.), all activities	Evening Ambient + 5dB
City of Beverly Hills Nighttime (9:00 P.M.-8:00 A.M.), all activities	Nighttime Ambient + 5 dB
Notes: [1]Noise limit applies to the facade of the closest noise sensitive property.	

TABLE 3 – ALLOWABLE MAXIMUM INTERIOR GROUND-BORNE NOISE FROM UNDERGROUND CONSTRUCTION ACTIVITIES

Land Use Activity	Groundborne Noise Level Limits – L_{max} (dBA)
Single-Family Dwellings	40
Multi-Family Dwellings	45
Hotel/Motel	45
Offices	50
Commercial Buildings	55
Concert Halls, Recording and TV Studios	30
Auditoriums and Music Rooms	35
Churches and Theaters	40
Hospital Sleeping Rooms	45
Schools and Libraries	50

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TABLE 4 – NOISE EMISSION LIMITS FOR CONSTRUCTION EQUIPMENT USED DURING NIGHTTIME HOURS; MEASURED AT 50 FEET FROM CONSTRUCTION EQUIPMENT(1)

Equipment Category	Lmax Level (dBA)
All other equipment > 5HP	81
Auger Drill Rig	81
Backhoe	75
Bar Bender	75
Boring Jack Power Unit	80
Chain Saw	81
Compactor	75
Compressor (2)	65
Compressor (other)	75
Concrete Mixer	71
Concrete Pump	77
Concrete Saw	81
Crane	81
Dozer	81
Dump Truck	81
Excavator	81
Flat Bed Truck	81
Front End Loader	75
Generator	77
Gradall	81
Grader	81
Horizontal Boring Hydraulic Jack	80
Jackhammer	81
Paver	81
Pickup Truck	55
Pneumatic Tools	81
Pumps	77
Rock Drill	81
Scraper	81
Soil Mix Drill Rig	80
Tractor	79
Vacuum Excavator (Vac Truck)	81
Vacuum Street Sweeper	80
Welder	73
Notes: (1) Noise emission limits apply to equipment used at surface on the construction site during nighttime hours of 9 pm to 7 am. (2) Portable Air Compressor that is rated at 75 cfm or greater and that operates at greater than 50 psi	

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TABLE 5 – NOISE SENSITIVE LOCATIONS

WILSHIRE/RODEO STATION

210 N. Beverly Drive
133-153 S. Reeves Drive
Sirtaj Hotel,120 S. Reeves Drive
192 N. Canon Drive
121-157 S. Canon Drive
AKA Beverly Hills Hotel, 155 N. Crescent Drive
Beverly Sixty Hotel, 9360 Wilshire Boulevard
The Rolex Building, 9420 Wilshire Boulevard
Sterling Plaza/Bank of California, 9441 Wilshire Boulevard
Beverly Wilshire Hotel, 9500 Wilshire Boulevard

CENTURY CITY/CONSTELLATION STATION

1918-1952 Fox Hills Drive
2050 Century Park West
Hyatt Regency Century Plaza Hotel, 2025 Avenue of the Stars
2010 Century Park East
Century City Hospital & Medical Center, 2080 Century Park East
2160 Century Park East
1888 Century Park East
Century Plaza Towers, 2049 Century Park East
Annenberg Space for Photography and the Skylight Studios, 10050 Constellation Boulevard
Bain & Company Building, 1901 Avenue of the Stars
The Century, 10 West Century Drive
Constellation Place, 10250 Constellation Boulevard
401 Shirley Place
Beverly Hills High School

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TABLE 6 – PRELIMINARY NOISE PROJECTIONS
(REFER TO DRAWING PREPARED ACCORDING TO REQUIREMENTS OF THIS SECTION.)

Activity	Typical Expected Leq Levels at 50 ft from Construction Equipment, with No Noise Control Measures (dBA)

TABLE 7 – ADJUSTMENTS FOR CLOSE-IN EQUIPMENT NOISE MEASUREMENTS

Measurement Values to be Subtracted from Measured Sound	
Distance (Feet)	**Level to Estimate Sound Level at 50 Feet (dBA)**
19-21	8
22-23	7
24-26	6
27-29	5
30-33	4
34-37	3
38-42	2
43-47	1
48-50	0

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TABLE 8 – CONSTRUCTION VIBRATION LIMITS FOR ANNOYANCE

Vibration Type	Permissible Aggregate Duration	Vibration Limit (peak particle velocity (PPV))	Vibration Limit (VdB re 10^{-6} in/sec)
Sustained	>1 hour/day	0.01 in/sec	80
Transient	<1 hour/day	0.03	90
Transient	<10 minutes/day	0.10	100

TABLE 9 – CONSTRUCTION VIBRATION LIMITS FOR DAMAGE RISK TO BUILDINGS

Building Category	Allowable Peak Vibration (peak particle velocity (PPV) in/sec)	Allowable Peak Vibration (VdB re 10^{-6} in/sec)
I. Reinforced-concrete, steel or timber (no plaster)	0.50	114
II. Engineered concrete and masonry (no plaster)	0.30	110
III. Non-engineered timber and masonry buildings	0.20	106
IV. Buildings extremely susceptible to vibration damage	0.12	101

TABLE 10 – VIBRATION SOURCE LEVELS FOR CONSTRUCTION EQUIPMENT(1)

Equipment	Peak Vibration at 25 ft (peak particle velocity (PPV) in/sec)	Approximate RMS Vibration at 25 ft (VdB re 10-6 in/sec)
Pile Driver (impact)	0.644 – 1.518	104 - 112
Pile Driver (sonic/vibratory)	0.170 – 0.734	93 - 105
Clam Shovel Drop (slurry wall)	0.202	94
Hydromill (slurry wall)	Soil 0.008 Rock 0.017	66 75
Vibratory Roller Compactor	0.210	94
Hoe Ram	0.089 – 0.19	87 - 94
Large Bulldozer	0.089	87
Caisson Drilling	0.089	87
Loaded trucks	0.076	86
Jackhammer	0.035	79
Small Bulldozer	0.003	58
Tunnel Boring Machine (2)	0.055 AT 33 ft	83 AT 33 ft
Tunnel Train (2)	0.050 AT 50 ft	82 AT 50 ft
Notes: (1) This source data is preliminary in nature and it is up to the Contractor to verify and update information during construction (and, where possible, before construction). (2) For underground sources, use the slant distance determined by calculating the hypotenuse of the triangle formed by the depth between the building and top-of-rail and the horizontal (plan) distance between the building and top-of-rail.		

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TABLE 11 – CORRECTION FACTORS FOR VIBRATION CALCULATIONS

Vibration	Correction Factors (dB)
Vibration (VdB) to groundborne noise (dBA)	-20dBA
Building coupling and path to sensitive space	4-stories or greater: -7 dB

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FIGURE 1
QUARTERLY NOISE CONTROL PLAN FORM - PART B

QUARTERLY NOISE CONTROL PLAN (DUPLICATE AS NEEDED)

Contract No.: _____ Contract Name: _____

Contractor: _____ Site: _____

Date: _____ Land Use: _____

Resubmit every 3 months.

PART B: RESIDENTIAL, COMMERCIAL AND INDUSTRIAL PROPERTY NOISE LEVELS

	Calculated Noise Levels (dBA)*	
	Calculated one hour Leq (dBA)	Calculated Lmax (dBA)
Nighttime		

NOISE ABATEMENT MEASURES **ANTICIPATED EFFECTS**

CALCULATIONS: Attach additional sheet(s) as needed.

Contract No(s): _____

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FIGURE 2. NOISE MEASUREMENTS REPORT FORM

Date: _____

Time:_____

NOISE MEASUREMENTS REPORT FORM

Measured By: _____ Of: _____
(Company)

Monitoring Address: _____
(Provide Sketch on Back)

Location No: _____ Wind Speed: _____ Km/Hr Direction:_____
(MPH x 1.6)

Location of Sound Level Meter: (No closer than 15 meters from equipment and 3 meters from building)

Monitoring was Conducted: _____ Meters from Equipment (_____)
(Type(s): Leave Blank for Baseline)

Land Use: ☐ Residential/Institutional ☐ Business/Recreational ☐ Industrial

Sound Level Meter: Make and Model: _____ ☐ A - Weighted Sound Level (Slow)
☐ C - Weighted Sound Level (Fast)

Duration of Measurement:_____
(15 minutes to 1 hour)

Calibration		Field Notes (example: 2200-2205 H, Airplane 90 dB)
one-hour L_{eq}		
L_{50}		
L_{10}		
$L_{1.0}$		
MAX_L		
Allowable Noise Limit		

Check one of the following:

☐ Ongoing Construction ☐ Post-Construction: _____ ☐ Baseline Conditions
(Contract)

(Complete all that apply below)

Active Contract(s): _____
(List all contracts that contribute to measured noise)

Complaint Response: _____
(Describe: Include Log-In Number)

Abatement Follow-up: _____
(Describe)

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FIGURE 3

EQUIPMENT SOUND LEVEL DATA REPORTING FORM

EQUIPMENT SOUND LEVEL DATA REPORTING FORM

APPLICATION FOR CERTIFICATE OF EQUIPMENT NOISE COMPLIANCE

Contractor Name: _____
Contract Name & Number: _____

Equipment Type: _____
Manufacturer & Model Number: _____
Identification Number: _____
Rated Power & Capacity: _____
Operating Condition During Test: _____

Measured Sound Levels at 20 to 50 feet:

Measured Values and Distance:
Right Side: _____ dBA (SLOW), at _____ feet
Left Side: _____ dBA (SLOW), at _____ feet

Estimated Values at 50-Foot Distance:
Right Side: _____ dBA (SLOW).
Left Side: _____ dBA (SLOW).

Maximum Values Allowed for this Equipment: _____ dBA (SLOW) at 50 feet.

If equipment sound level exceeds maximum value allowed, indicate action taken to achieve compliance:
_____
_____
_____

Name, Address & Phone No. _____
of Acoustical Engineer _____

Authorized Signature: _____ Date: _____
CONTRACTOR'S APPROVAL:
Authorized Signature: _____ Date: _____
ENGINEER'S CONCURRENCE:
Authorized Signature: _____ Date: _____

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FIGURE 4
QUARTERLY NOISE CONTROL PLAN FORM - PART A

QUARTERLY NOISE CONTROL PLAN - NIGHTTIME CONSTRUCTION ACTIVITIES AT THE SURFACE OF THE CONSTRUCTION SITE (DUPLICATE AS NEEDED)

Contract No.: _____ Contract Name: _____ Contractor: _____

Site: _____ Date: _____ Resubmit every three months

(ATTACH SITE SKETCH)

PART A: EQUIPMENT INVENTORY

Code letter (a)	Equipment				Noise Limit (f)	Estimated Noise at 50'* (g)	Date Begin (h)	Date End (i)
	Category (b)	Model (c)	ID# (d)	HP (e)				

END OF SECTION 01 56 19