WESTSIDE SUBWAY EXTENSION

Noise and Vibration Technical Report

Metro

August 2010

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Acronyms and Abbreviations

ANSI	American National Standards Institute
APE	area of potential effects
CEQA	*California Environmental Quality Act*
db	decibel
dBA	A-weighted decibel
DIL	dynamic insertion loss
EIS/EIR	environmental impact statement/environmental impact report
FTA	Federal Transit Administration
HRT	heavy rail transit
L_{dn}	average day-night noise level
L_{eq}	equivalent sound level
$L_{eq(h)}$	hourly equivalent sound level
L_{max}	maximum noise level during an event
LRTP	*Long-Range Transportation Plan*
Metro	Los Angeles County Metropolitan Transportation Authority
MOS	minimum operable segments
mph	miles per hour
NEPA	*National Environmental Policy Act* (42 USC 4321-4347)
PPV	peak particle velocity
RMS	root mean squared
ROC	Rail Operations Center
RTP	*Regional Transportation Plan*
SCAG	Southern California Association of Governments
SPT	standard penetration test
TBM	tunnel boring machines
TPSS	traction power substation
TSM	transportation system management
UPRR	Union Pacific Railroad
VA	Veterans Affairs
VdB	vibration decibels

1.0 INTRODUCTION

This technical report presents the methodology and assumptions that were used to analyze potential impacts from noise and vibration generated by operation of the proposed Westside Subway Extension project alternatives. Noise and vibration resulting from construction of the Project are addressed separately in the *Westside Subway Extension Construction and Mitigation Technical Report* (Metro 2010b).

Noise and vibration would be generated during the operations phase of the Project. The purpose of this technical report is to evaluate the potential for environmental impact on noise- and vibration-sensitive uses. The project study corridor includes several residential areas and other sensitive land uses, including, but not limited to, parklands, schools, libraries, medical, and religious facilities that may be adversely affected by noise and vibration. A comprehensive listing of these types of uses is provided in the *Westside Subway Extension Parklands and Other Community Facilities Technical Report* (Metro 2010a).

Some land uses are more sensitive to noise or vibration than other uses. The potential for sensitive uses to experience noise impacts is related to their distance to the proposed project alternative alignments. Thus, representative land uses were selected for worst-case analyses based on their sensitivity to noise and vibration and their proximity to the Project's train tracks.

In addition to effects on sensitive uses, vibration effects pose a concern for the structures of historic properties located very close to heavy rail transit (HRT) activities. Although none of the most sensitive type of historic structure ("extremely fragile") was identified in proximity to the alternative track alignments, this most sensitive category of historic building was evaluated for potential HRT operations vibration impacts as a conservative approach.

The noise impact analysis for the Project was based on federal and state requirements. For National Environmental Policy Act (NEPA) compliance, the analysis used criteria as defined in the U.S. Federal Transit Administration (FTA) guidance manual *Transit Noise and Vibration Impact Assessment* (FTA 2006). These criteria are based primarily on community reaction to noise. The impact analysis also followed guidance contained in the *California Environmental Quality Act* (CEQA) Guidelines (PRC 2009), Appendix G, which provides criteria for determining if a project would result in significant adverse effects from noise. These criteria are focused on whether the project would cause a substantial permanent, temporary, or periodic increase in ambient noise levels in the project vicinity above levels existing without the project, or expose persons to or generate noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies. Thus, in addition to the FTA guidelines, the study will evaluate relevant regulatory standards of the Cities of Beverly Hills, Los Angeles, Santa Monica, West Hollywood, and the unincorporated portions of Los Angeles County through which the project alternatives pass. Relevant noise control ordinances are cited in Section 7.0, References.

Potential vibration effects of the Project were evaluated. The FTA has developed impact criteria for acceptable levels of vibration and ground-borne noise. Vibration levels from HRT operations that would be high enough to cause any sort of building damage, even minor cosmetic damage, are extremely unlikely.

2.0 PROJECT DESCRIPTION

This chapter describes the alternatives that have been considered to best satisfy the Purpose and Need and have been carried forward for further study in the Draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR). Details of the No Build, Transportation Systems Management (TSM), and the five Build Alternatives (including their station and alignment options and phasing options or minimum operable segments [MOS]) are presented in this chapter.

2.1 No Build Alternative

The No Build Alternative provides a comparison of what future conditions would be like if the Project were not built. The No Build Alternative includes all existing highway and transit services and facilities, and the committed highway and transit projects in the Metro LRTP and the SCAG RTP. Under the No Build Alternative, no new transportation infrastructure would be built within the Study Area, aside from projects currently under construction or projects funded for construction, environmentally cleared, planned to be in operation by 2035, and identified in the adopted Metro LRTP.

2.2 TSM Alternative

The TSM Alternative emphasizes more frequent bus service than the No Build Alternative to reduce delay and enhance mobility. The TSM Alternative contains all elements of the highway, transit, Metro Rail, and bus service described under the No Build Alternative. In addition, the TSM Alternative increases the frequency of service for Metro Bus Line 720 (Santa Monica–Commerce via Wilshire Boulevard and Whittier Boulevard) to between three and four minutes during the peak period.

In the TSM Alternative, Metro Purple Line rail service to the Wilshire/Western Station would operate in each direction at 10-minute headways during peak and off-peak periods. The Metro Red Line service to Hollywood/Highland Station would operate in each direction at five-minute headways during peak periods and at 10-minute headways during midday and off-peak periods.

2.3 Build Alternatives

The Build Alternatives are considered to be the "base" alternatives with "base" stations. Alignment (or segment) and station options were developed in response to public comment, design refinement, and to avoid and minimize impacts to the environment.

The Build Alternatives extend heavy rail transit (HRT) service in subway from the existing Metro Purple Line Wilshire/Western Station. HRT systems provide high speed (maximum of 70 mph), high capacity (high passenger-carrying capacity of up to 1,000 passengers per train and multiple unit trains with up to six cars per train), and reliable service since they operate in an exclusive grade-separated right-of-way. The subway will operate in a tunnel at least 30 to 70 feet below ground and will be electric powered.

Furthermore, the Build Alternatives include changes to the future bus services. Metro Bus Line 920 would be eliminated and a portion of Line 20 in the City of Santa Monica would be eliminated since it would be duplicated by the Santa Monica Blue Bus Line 2. Metro Rapid

Bus Line 720 would operate less frequently since its service route would be largely duplicated by the Westside Subway route. In the City of Los Angeles, headways (time between buses) for Line 720 are between 3 and 5 minutes under the existing network and will be between 5 and 11.5 minutes under the Build Alternatives, but no change in Line 720 would occur in the City of Santa Monica segment. Service frequencies on other Metro Rail lines and bus routes in the corridor would be the same as for the No Build Alternative.

2.3.1 Alternative 1—Westwood/UCLA Extension

This alternative extends the existing Metro Purple Line from the Wilshire/Western Station to a Westwood/UCLA Station (Figure 2-1). From the Wilshire/Western Station, Alternative 1 travels westerly beneath Wilshire Boulevard to the Wilshire/Rodeo Station and then southwesterly toward a Century City Station. Alternative 1 then extends from Century City and terminates at a Westwood/UCLA Station. The alignment is approximately 8.60 miles in length.

Alternative 1 would operate in each direction at 3.3-minute headways during morning and evening peak periods and at 10-minute headways during midday. The estimated one-way running time is 12 minutes 39 seconds from the Wilshire/Western Station.

2.3.2 Alternative 2—Westwood/Veterans Administration (VA) Hospital Extension

This alternative extends the existing Metro Purple Line from the Wilshire/Western Station to a Westwood/VA Hospital Station (Figure 2-2). Similar to Alternative 1, Alternative 2 extends the subway from the Wilshire/Western Station to a Westwood/UCLA Station. Alternative 2 then travels westerly under Veteran Avenue and continues west under the I-405 Freeway, terminating at a Westwood/VA Hospital Station. This alignment is 8.96 miles in length from the Wilshire/Western Station.

Alternative 2 would operate in each direction at 3.3-minute headways during the morning and evening peak periods and at 10-minute headways during the midday, off-peak period. The estimated one-way running time is 13 minutes 53 seconds from the Wilshire/Western Station.

2.3.3 Alternative 3—Santa Monica Extension

This alternative extends the existing Metro Purple Line from the Wilshire/Western Station to the Wilshire/4th Station in Santa Monica (Figure 2-3). Similar to Alternative 2, Alternative 3 extends the subway from the Wilshire/Western Station to a Westwood/VA Hospital Station. Alternative 3 then continues westerly under Wilshire Boulevard and terminates at the Wilshire/4th Street Station between 4th and 5th Streets in Santa Monica. The alignment is 12.38 miles.

Alternative 3 would operate in each direction at 3.3-minute headways during the morning and evening peak periods and operate with 10-minute headways during the midday, off-peak period. The estimated one-way running time is 19 minutes 27 seconds from the Wilshire/Western Station.

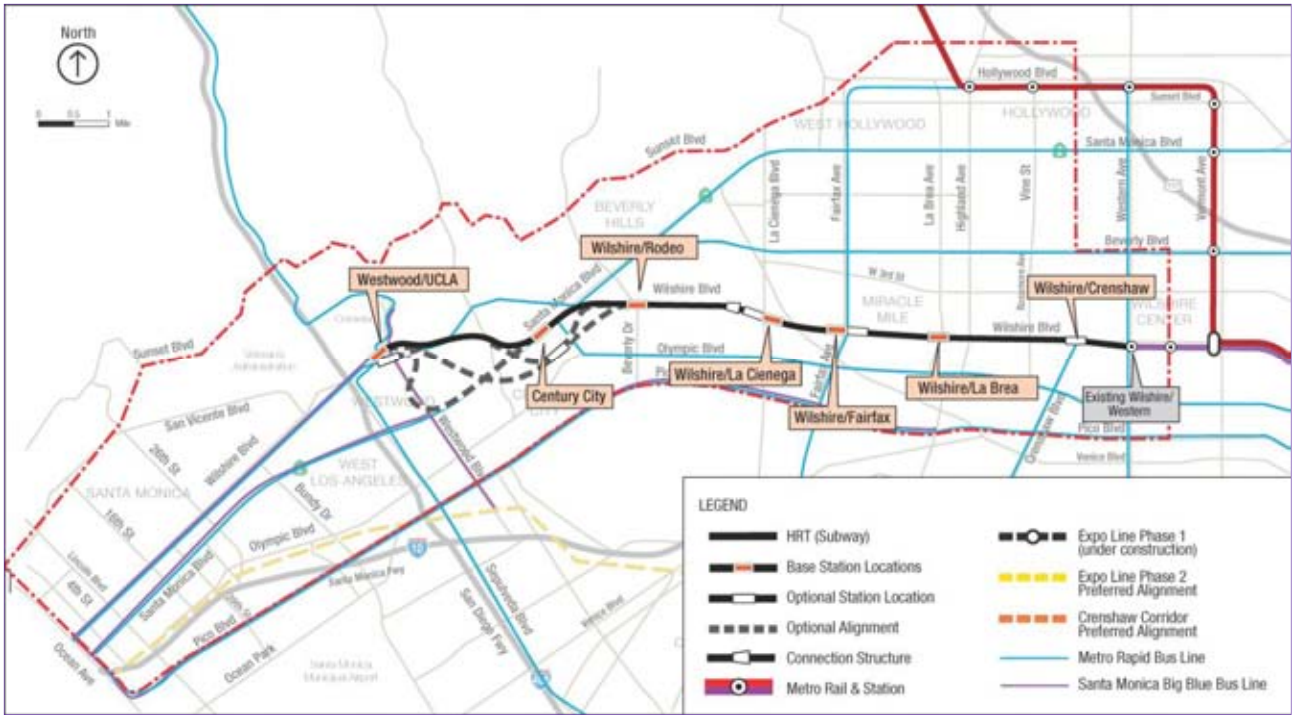


Figure 2-1. Alternative 1—Westwood/UCLA Extension

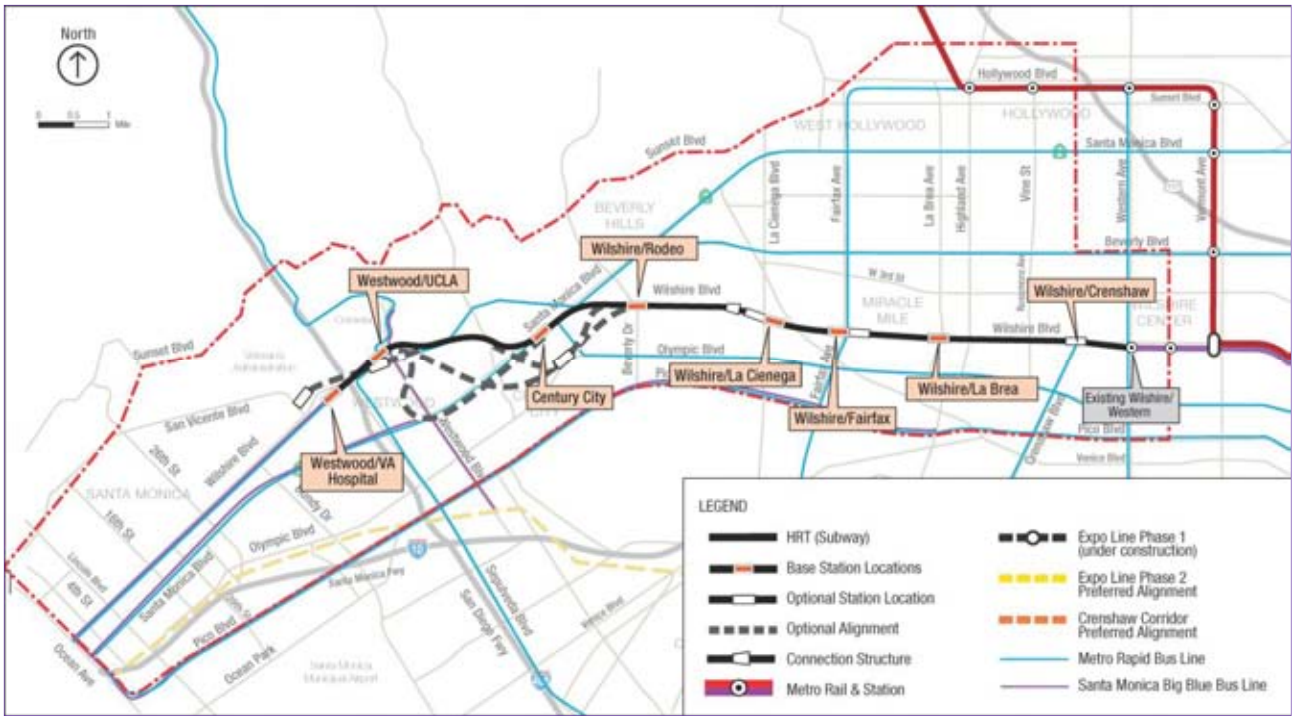


Figure 2-2. Alternative 2—Westwood/Veterans Administration (VA) Hospital Extension

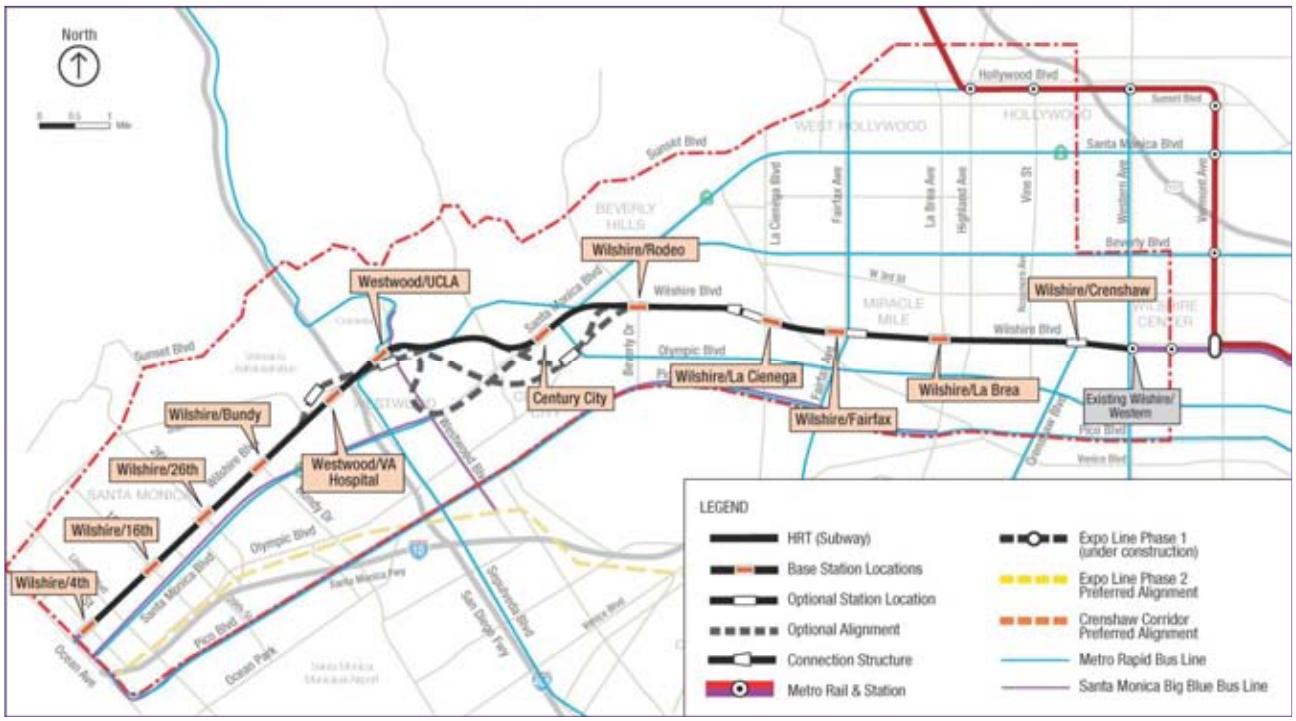


Figure 2-3. Alternative 3—Santa Monica Extension

2.3.4 Alternative 4—Westwood/VA Hospital Extension plus West Hollywood Extension

Similar to Alternative 2, Alternative 4 extends the existing Metro Purple Line from the Wilshire/Western Station to a Westwood/VA Hospital Station. Alternative 4 also includes a West Hollywood Extension that connects the existing Metro Red Line Hollywood/Highland Station to a track connection structure near Robertson and Wilshire Boulevards, west of the Wilshire/La Cienega Station (Figure 2-4). The alignment is 14.06 miles long.

Alternative 4 would operate from Wilshire/Western to a Westwood/VA Hospital Station in each direction at 3.3-minute headways during morning and evening peak periods and 10-minute headways during the midday off-peak period. The West Hollywood extension would operate at 5-minute headways during peak periods and 10-minute headways during the midday, off-peak period. The estimated one-way running time for the Metro Purple Line extension is 13 minutes 53 seconds, and the running time for the West Hollywood from Hollywood/Highland to Westwood/VA Hospital is 17 minutes and 2 seconds.

2.3.5 Alternative 5—Santa Monica Extension plus West Hollywood Extension

Similar to Alternative 3, Alternative 5 extends the existing Metro Purple Line from the Wilshire/Western Station to the Wilshire/4th Station and also adds a West Hollywood Extension similar to the extension described in Alternative 4 (Figure 2-5). The alignment is 17.49 miles in length. Alternative 5 would operate the Metro Purple Line extension in each direction at 3.3-minute headways during the morning and evening peak periods and 10-minute headways during the midday, off-peak period. The West Hollywood extension would operate in each direction at 5-minute headways during peak periods and 10-minute headways during the midday, off-peak period. The estimated one-way running time for the

Metro Purple Line extension is 19 minutes 27 seconds, and the running time from the Hollywood/Highland Station to the Wilshire/4th Station is 22 minutes 36 seconds.

2.3.6 Stations and Segment Options

HRT stations consist of a station "box," or area in which the basic components are located. The station box can be accessed from street-level entrances by stairs, escalators, and elevators that would bring patrons to a mezzanine level where the ticketing functions are located. The 450-foot platforms are one level below the mezzanine level and allow level boarding (i.e., the train car floor is at the same level as the platform). Stations consist of a center or side platform. Each station is equipped with under-platform exhaust shafts, over-track exhaust shafts, blast relief shafts, and fresh air intakes. In most stations, it is anticipated that only one portal would be constructed as part of the Project, but additional portals could be developed as a part of station area development (by others). Stations and station entrances would comply with the *Americans with Disabilities Act of 1990*, Title 24 of the California Code of Regulations, the California Building Code, and the Department of Transportation Subpart C of Section 49 CFR Part 37.

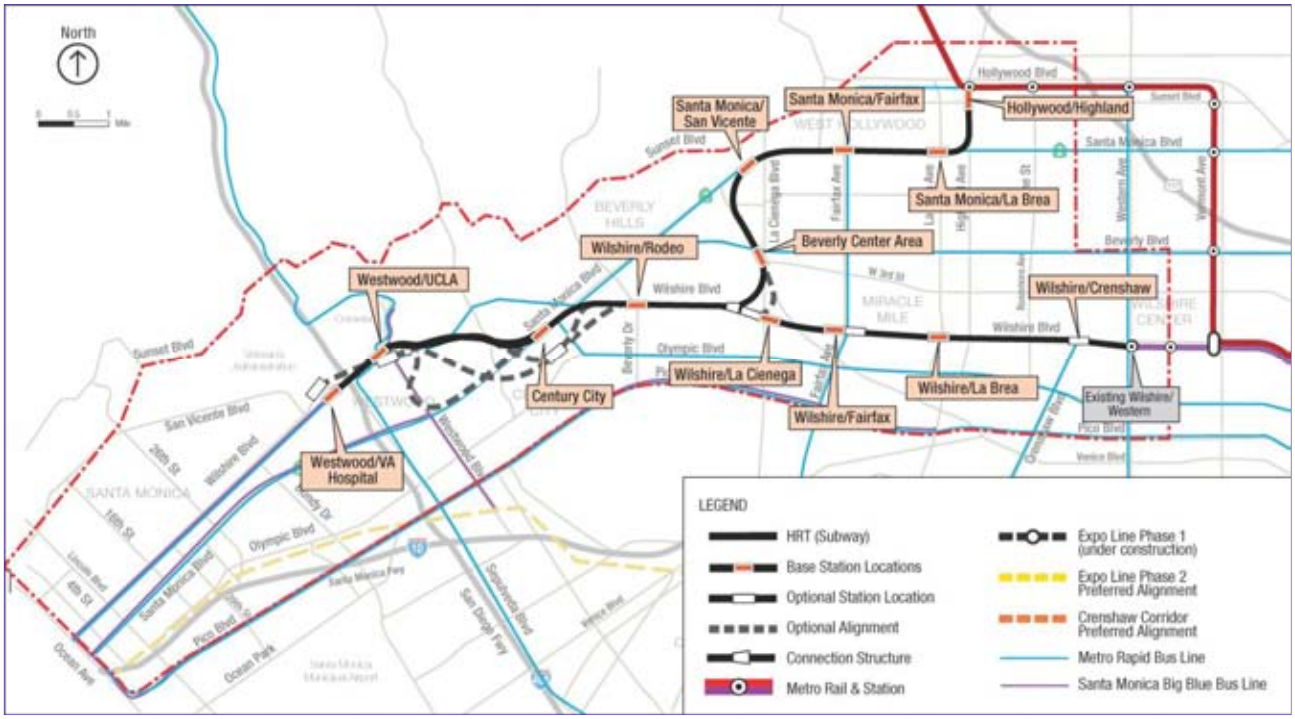


Figure 2-4. Alternative 4—Westwood/VA Hospital Extension plus West Hollywood Extension

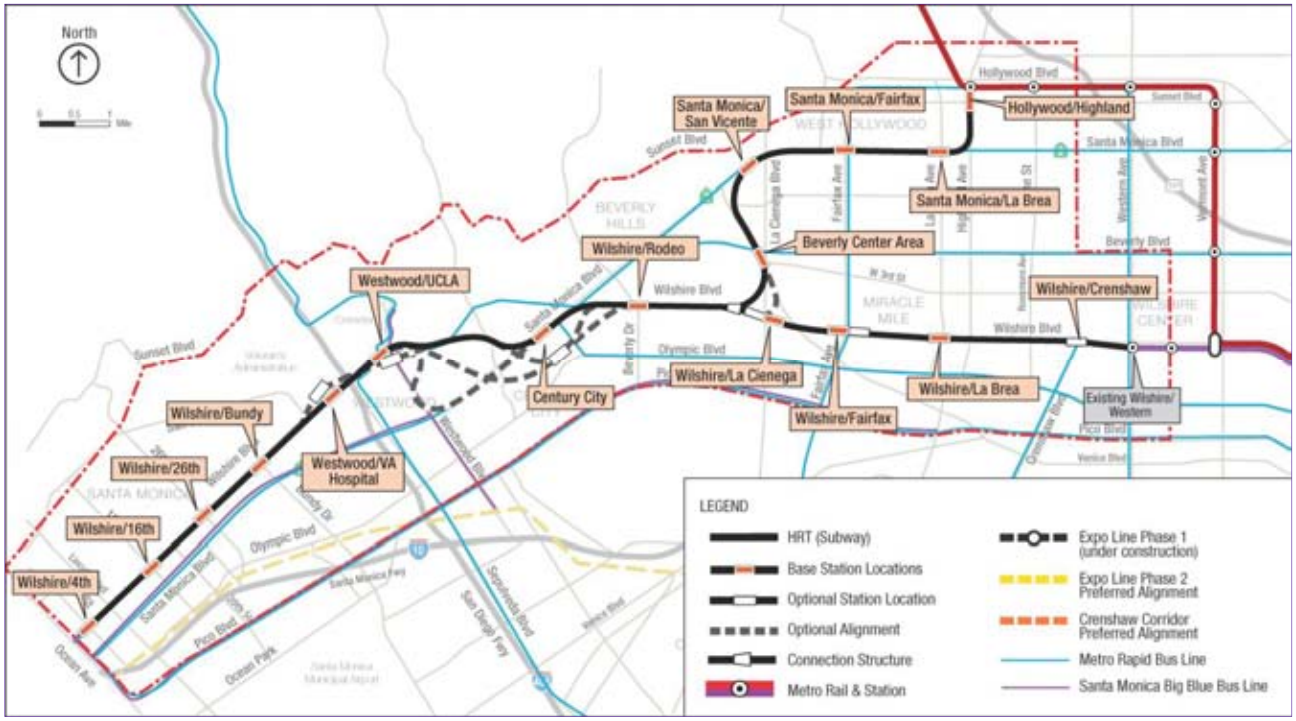


Figure 2-5. Alternative 5—Santa Monica Extension plus West Hollywood Extension

Platforms would be well-lighted and include seating, trash receptacles, artwork, signage, safety and security equipment (closed-circuit television, public announcement system, passenger assistance telephones), and a transit passenger information system. The fare collection area includes ticket vending machines, fare gates, and map cases.

Table 2-1 lists the stations and station options evaluated and the alternatives to which they are applicable. Figure 2-6 shows the proposed station and alignment options. These include:

- Option 1—Wilshire/Crenshaw Station Option
- Option 2—Fairfax Station Option
- Option 3—La Cienega Station Option
- Option 4—Century City Station and Alignment Options
- Option 5—Westwood/UCLA Station Option
- Option 6—Westwood/VA Hospital Station Option

Table 2-1. Alternatives and Stations Considered

Stations	Alternatives				
	1	2	3	4	5
	Westwood/ UCLA Extension	Westwood/ VA Hospital Extension	Santa Monica Extension	Westwood/ VA Hospital Extension Plus West Hollywood Extension	Santa Monica Extension Plus West Hollywood Extension
Base Stations					
Wilshire/Crenshaw	●	●	●	●	●
Wilshire/La Brea	●	●	●	●	●
Wilshire/Fairfax	●	●	●	●	●
Wilshire/La Cienega	●	●	●	●	●
Wilshire/Rodeo	●	●	●	●	●
Century City (Santa Monica Blvd)	●	●	●	●	●
Westwood/UCLA (Off-street)	●	●	●	●	●
Westwood/VA Hospital		●	●	●	●
Wilshire/Bundy			●		●
Wilshire/26th			●		●
Wilshire/16th			●		●
Wilshire/4th			●		●
Hollywood/Highland				●	●
Santa Monica/La Brea				●	●
Santa Monica/Fairfax				●	●
Santa Monica/San Vicente				●	●
Beverly Center Area				●	●
Station Options					
1—No Wilshire/Crenshaw	●	●	●	●	●
2—Wilshire/Fairfax East	●	●	●	●	●
3—Wilshire/La Cienega (Transfer Station)	●	●	●	●	●
4—Century City (Constellation Blvd)	●	●	●	●	●
5—Westwood/UCLA (On-street)	●	●	●	●	●
6—Westwood/VA Hospital North		●	●	●	●

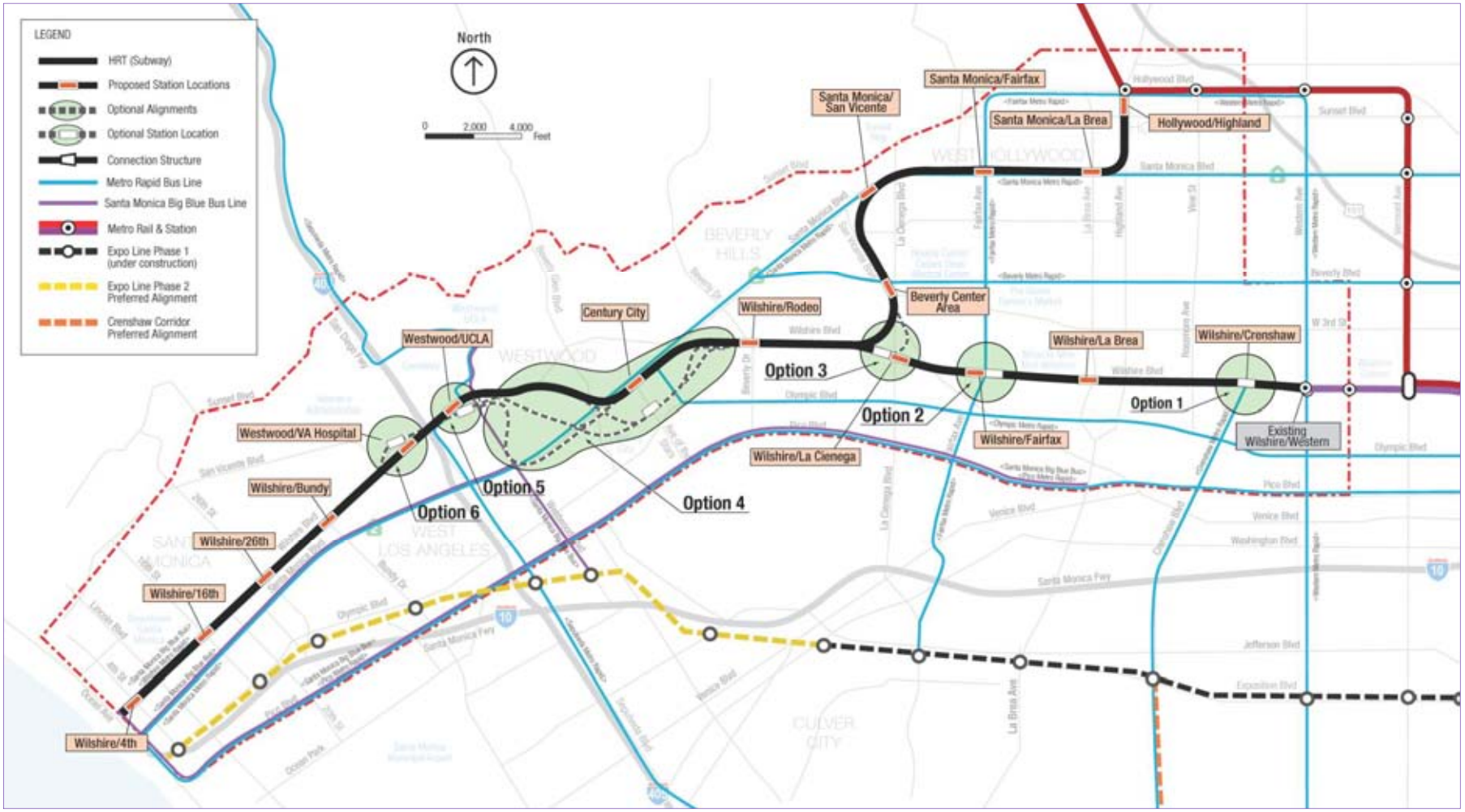


Figure 2-6. Station and Alignment Options

2.3.7 Option 1—Wilshire/Crenshaw Station Option

- **Base Station: Wilshire/Crenshaw Station**—The base station straddles Crenshaw Boulevard, between Bronson Avenue and Lorraine Boulevard.
- **Station Option: Remove Wilshire/Crenshaw Station**—This station option would delete the Wilshire/Crenshaw Station. Trains would run from the Wilshire/Western Station to the Wilshire/La Brea Station without stopping at Crenshaw. A vent shaft would be constructed at the intersection of Western Avenue and Wilshire Boulevard (Figure 2-7).

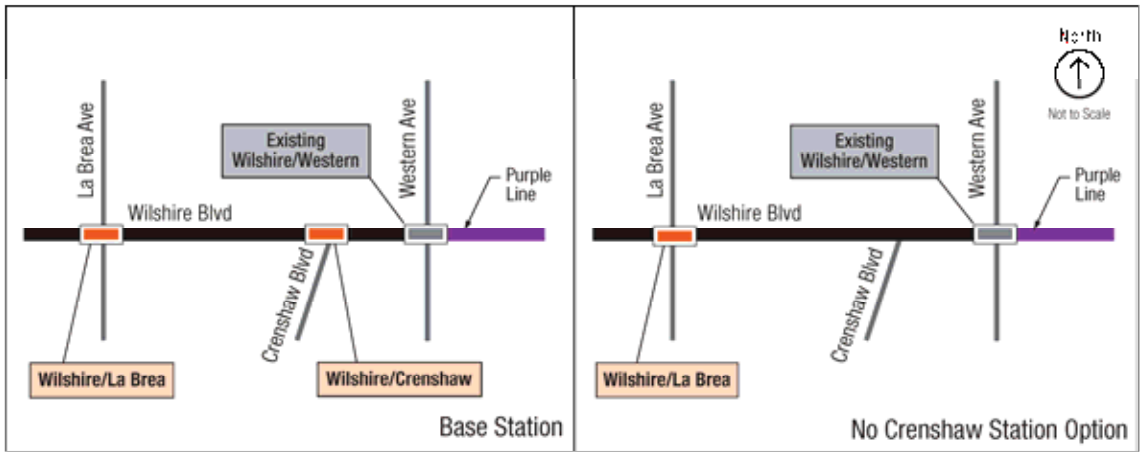


Figure 2-7. Option 1—No Wilshire/Crenshaw Station Option

2.3.8 Option 2—Wilshire/Fairfax Station East Option

- **Base Station: Wilshire/Fairfax Station**—The base station is under the center of Wilshire Boulevard, immediately west of Fairfax Avenue.
- **Station Option: Wilshire/Fairfax Station East Station Option**—This station option would locate the Wilshire/Fairfax Station farther east, with the station underneath the Wilshire/Fairfax intersection (Figure 2-8). The east end of the station box would be east of Orange Grove Avenue in front of LACMA, and the west end would be west of Fairfax Avenue.

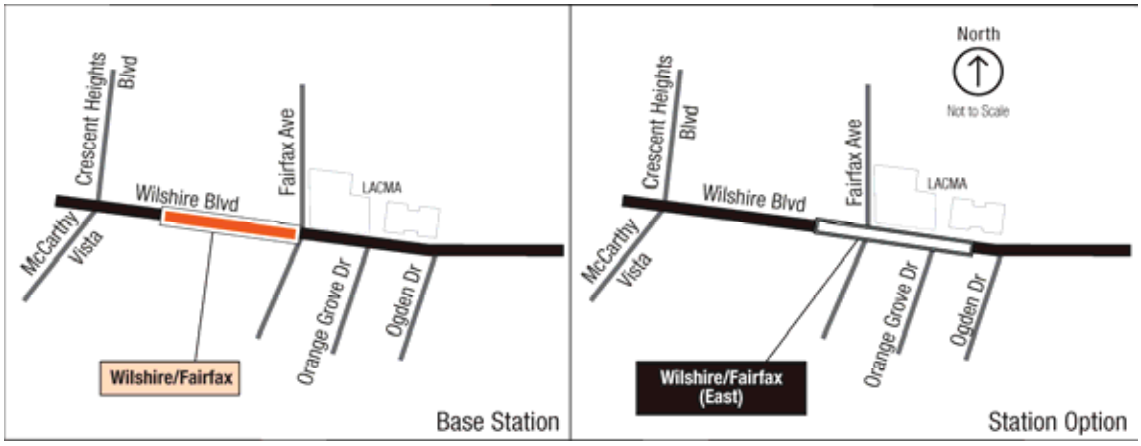


Figure 2-8. Option 2—Fairfax Station Option

2.3.9 Option 3—Wilshire/La Cienega Station Option

- **Base Station: Wilshire/La Cienega Station**—The base station would be under the center of Wilshire Boulevard, immediately east of La Cienega Boulevard. A direct transfer between the Metro Purple Line and the potential future West Hollywood Line is not provided with this station. Instead, a connection structure is proposed west of Robertson Boulevard as a means to provide a future HRT connection to the West Hollywood Line.
- **Station Option: Wilshire/La Cienega Station West with Connection Structure**—The station option would be located west of La Cienega Boulevard, with the station box extending from the Wilshire/Le Doux Road intersection to just west of the Wilshire/ Carson Road intersection (Figure 2-9). It also contains an alignment option that would provide an alternate HRT connection to the future West Hollywood Extension. This alignment portion of Option 3 is only applicable to Alternatives 4 and 5.

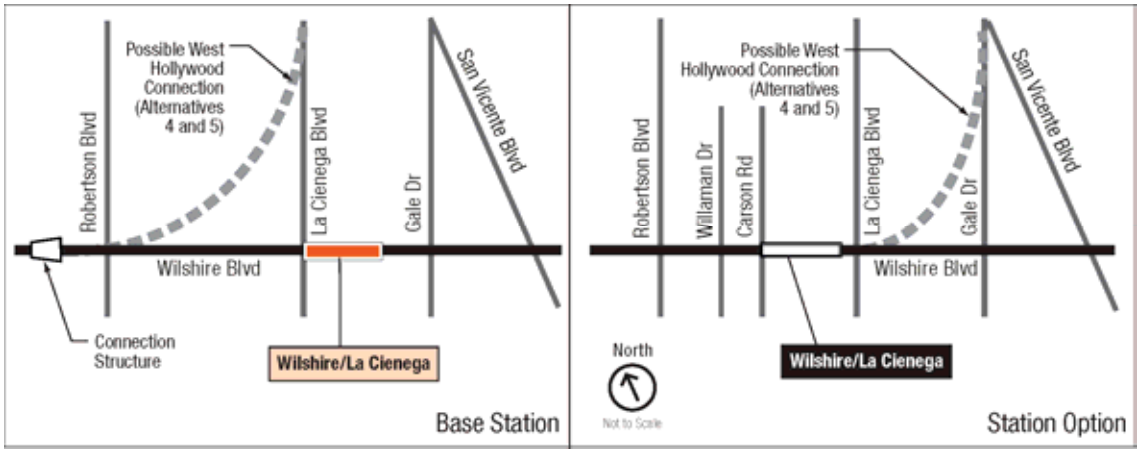


Figure 2-9. Option 3—La Cienega Station Option

2.3.10 Option 4—Century City Station and Segment Options

2.3.10.1 Century City Station and Beverly Hills to Century City Segment Options

- **Base Station: Century City (Santa Monica) Station**—The base station would be under Santa Monica Boulevard, centered on Avenue of the Stars.
- **Station Option: Century City (Constellation) Station**—With Option 4, the Century City Station has a location option on Constellation Boulevard (Figure 2-10), straddling Avenue of the Stars and extending westward to east of MGM Drive.
- **Segment Options**—Two route options are proposed to connect the Wilshire/Rodeo Station to Century City (Constellation) Station: Constellation North and Constellation South. As shown in Figure 2-10, the base segment to the base Century City (Santa Monica) Station is shown in the solid black line and the segment options to Century City (Constellation) Station are shown in the dashed grey lines.

2.3.10.2 Century City to Westwood Segment Options

Three route options considered for connecting the Century City and Westwood stations include: East, Central, and West. As shown in Figure 2-10, each of these three segments would be accessed from both Century City Stations and both Westwood/UCLA Stations. The base segment is shown in the solid black line and the options are shown in the dashed grey lines.

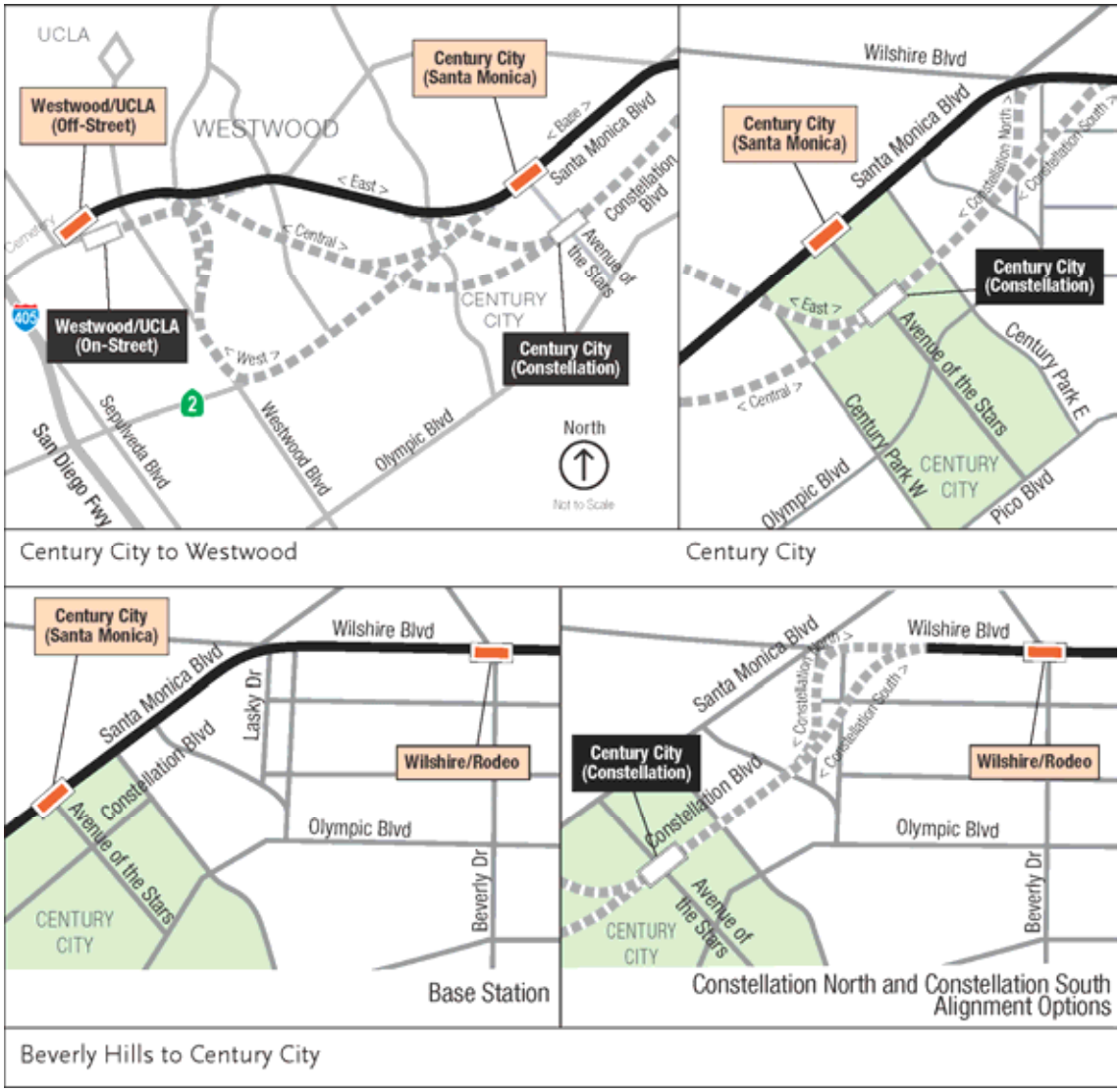


Figure 2-10. Century City Station Options

2.3.11 Option 5—Westwood/UCLA Station Options

- **Base Station: Westwood/UCLA Station Off-Street Station Option**—The base station is located under the UCLA Lot 36 on the north side of Wilshire Boulevard between Gayley and Veteran Avenues.
- **Station Option: Westwood/UCLA On-Street Station Option**—This station option would be located under the center of Wilshire Boulevard, immediately west of Westwood Boulevard (Figure 2-11).

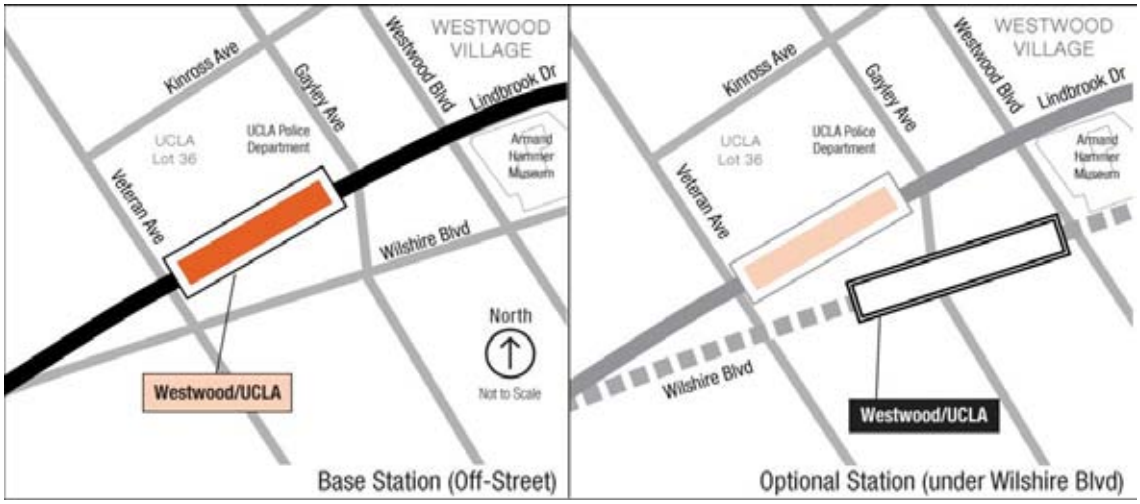


Figure 2-11. Option 5—Westwood/UCLA Station Options

2.3.12 Option 6—Westwood/VA Hospital Station Option

- **Base Station: Westwood/VA Hospital**—The base station would be below the VA Hospital parking lot on the south side of Wilshire Boulevard in between the I-405 exit ramp and Bonsall Avenue.
- **Station Option: Westwood/VA Hospital North Station**—This station option would locate the Westwood/VA Hospital Station on the north side of Wilshire Boulevard between Bonsall Avenue and Wadsworth Theater (Figure 2-12). To access the Westwood/VA Hospital Station North, the alignment would extend westerly from the Westwood/UCLA Station under Veteran Avenue, the Federal Building property, the I-405 Freeway, and under the Veterans Administration property just east of Bonsall Avenue.

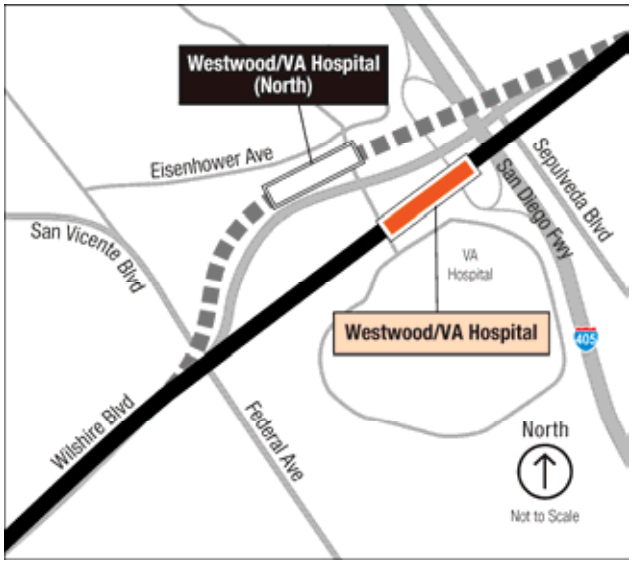


Figure 2-12. Option 6—Westwood/VA Hospital Station North

2.4 Base Stations

The remaining stations (those without options) are described below.

- **Wilshire/La Brea Station**—This station would be located between La Brea and Cloverdale Avenues.
- **Wilshire/Rodeo Station**—This station would be under the center of Wilshire Boulevard, beginning just west of South Canon Drive and extending to El Camino Drive.

- **Wilshire/Bundy Station**—This station would be under Wilshire Boulevard, east of Bundy Drive, extending just east of Saltair Avenue.
- **Wilshire/26th Station**—This station would be under Wilshire Boulevard, with the eastern end east of 26th Street and the western end west of 25th Street, midway between 25th Street and Chelsea Avenue.
- **Wilshire/16th Station**—This station would be under Wilshire Boulevard with the eastern end just west of 16th Street and the western end west of 15th Street.
- **Wilshire/4th Station**—This station would be under Wilshire Boulevard and 4th Street in Santa Monica.
- **Hollywood/Highland Station**—This station would be located under Highland Avenue and would provide a transfer option to the existing Metro Red Line Hollywood/Highland Station under Hollywood Boulevard.
- **Santa Monica/La Brea Station**—This station would be under Santa Monica Boulevard, just west of La Brea Avenue, and would extend westward to the center of the Santa Monica Boulevard/Formosa Avenue.
- **Santa Monica/Fairfax Station**—This station is under Santa Monica Boulevard and would extend from just east of Fairfax Avenue to just east of Ogden Drive.
- **Santa Monica/San Vicente Station**—This station would be under Santa Monica Boulevard and would extend from just west of Hancock Avenue on the west to just east of Westmount Drive on the east.
- **Beverly Center Area Station**—This station would be under San Vicente Boulevard, extending from just south of Gracie Allen Drive to south of 3rd Street.

2.5 Other Components of the Build Alternatives

2.5.1 Traction Power Substations

Traction power substations (TPSS) are required to provide traction power for the HRT system. Substations would be located in the station box or in a box located with the crossover tracks and would be located in a room that is about 50 feet by 100 feet in a below grade structure.

2.5.2 Emergency Generators

Stations at which the emergency generators would be located are Wilshire/La Brea, Wilshire/La Cienega, Westwood/UCLA, Westwood/VA Hospital, Wilshire/26th, Highland/Hollywood, Santa Monica/La Brea, and Santa Monica/San Vicente. The emergency generators would require approximately 50 feet by 100 feet of property in an off-street location. All would require property acquisition, except for the one at the Wilshire/La Brea Station which uses Metro's property.

2.5.3 Mid-Tunnel Vent Shaft

Each alternative would require mid-tunnel ventilation shafts. The vent shafts are emergency ventilation shafts with dampers, fans, and sound attenuators generally placed at both ends of a station box to exhaust smoke. In addition, emergency vent shafts could be used for station cooling and gas mitigation. The vent shafts are also required in tunnel segments with more than 6,000 feet between stations to meet fire/life safety requirements. There would be a connecting corridor between the two tunnels (one for each direction of train movement) to provide emergency egress and fire-fighting ingress. A vent shaft is approximately 150 square

feet; with the opening of the shaft located in a sidewalk and covered with a grate about 200 square feet.

Table 2-2. Mid-Tunnel Vent Shaft Locations

Alternative/Option	Location
Alternatives 1 through 5, MOS 2	Part of the connection structure on Wilshire Boulevard, west of Robertson Boulevard
Alternatives 2 through 5	West of the Westwood/VA Hospital Station on Army Reserve property at Federal Avenue and Wilshire Boulevard
Option 4 via East route	At Wilshire Boulevard/Manning Avenue intersection
Option 4 to Westwood/UCLA Off-Street Station via Central route	On Santa Monica Boulevard just west of Beverly Glen Boulevard
Option 4 to Westwood/UCLA On-Street Station via Central route	At Santa Monica Boulevard/Beverly Glen Boulevard intersection
Options 4 via West route	At Santa Monica Boulevard/Glendon Avenue intersection
Options 4 from Constellation Station via Central route	On Santa Monica Boulevard between Thayer and Pandora Avenues
Option from Constellation Station via West route	On Santa Monica Boulevard just east of Glendon Avenue

2.5.4 Trackwork Options

Each Build Alternative requires special trackwork for operational efficiency and safety (Table 2-3):

- **Tail tracks**—a track, or tracks, that extends beyond a terminal station (the last station on a line)
- **Pocket tracks**—an additional track, or tracks, adjacent to the mainline tracks generally at terminal stations
- **Crossovers**—a pair of turnouts that connect two parallel rail tracks, allowing a train on one track to cross over to the other
- **Double crossovers**—when two sets of crossovers are installed with a diamond allowing trains to cross over to another track

Table 2-3. Special Trackwork Locations

Station	1 Westwood/ UCLA Extension	2 Westwood/ VA Hospital Extension	3 Santa Monica Extension	4 Westwood/ VA Hospital Extension Plus West Hollywood Extension	5 Santa Monica Extension Plus West Hollywood Extension
Special Trackwork Locations—Base Trackwork Alternatives					
Wilshire/Crenshaw	None	None	None	None	None
Wilshire/La Brea	Double Crossover	Double Crossover	Double Crossover	Double Crossover	Double Crossover
Wilshire/Fairfax	None *MOS 1 Only: Terminus Station with Tail tracks*	None *MOS 1 Only: Terminus Station with Tail tracks*	None *MOS 1 Only: Terminus Station with Tail tracks*	None *MOS 1 Only: Terminus Station with Tail tracks*	None *MOS 1 Only: Terminus Station with Tail tracks*
Wilshire/La Cienega	None	None	None	None	None
Station Option 3 - Wilshire/La Cienega West	Turnouts	Turnouts	Turnouts		
Wilshire/Robertson Connection Structure	Equilateral Turnouts - for future West Hollywood connection	Equilateral Turnouts - for future West Hollywood connection	Equilateral Turnouts - for future West Hollywood connection	Equilateral Turnouts	Equilateral Turnouts
Wilshire/Rodeo	None	None	None	None	None
Century City	Double Crossover *MOS 2 Only: Terminus Station with Double Crossover and tail tracks*	Double Crossover *MOS 2 Only: Terminus Station with Double Crossover and tail tracks*	Double Crossover *MOS 2 Only: Terminus Station with Double Crossover and tail tracks*	Double Crossover *MOS 2 Only: Terminus Station with Double Crossover and tail tracks*	Double Crossover *MOS 2 Only: Terminus Station with Double Crossover and tail tracks*
Westwood/UCLA	End Terminal with Double Crossover and tail tracks	Double Crossover	Double Crossover	Double Crossover	Double Crossover
Westwood/VA Hospital	N/A	End Terminal with Turnouts and tail tracks	Turnouts	End Terminal with Turnouts and tail tracks	Turnouts
Wilshire/Bundy	N/A	N/A	None	N/A	None
Wilshire/26th	N/A	N/A	None	N/A	None
Wilshire/16th	N/A	N/A	None	N/A	None
Wilshire/4th	N/A	N/A	End Terminal with Double Crossover. Pocket Track with Double Crossover, Equilateral Turnouts and tail tracks	N/A	End Terminal with Double Crossover, Pocket Track with Double Crossover, Equilateral Turnouts and tail tracks
Hollywood/ Highland	N/A	N/A	N/A	Double Crossover and tail tracks	Double Crossover and tail tracks
Santa Monica/La Brea	N/A	N/A	N/A	None	None
Santa Monica/Fairfax	N/A	N/A	N/A	None	None
Santa Monica/ San Vicente	N/A	N/A	N/A	Double Crossover	Double Crossover
Beverly Center	N/A	N/A	N/A	None	None
Additional Special Trackwork Location (Optional Trackwork)					
Wilshire/Fairfax	Double Crossover	Double Crossover	Double Crossover	Double Crossover	Double Crossover
Wilshire/La Cienega	Double Crossover	Double Crossover	Double Crossover	Double Crossover	Double Crossover
Wilshire/ Rodeo	None	None	None	Pocket Track	Pocket Track
Wilshire/26th	N/A	N/A	Double Crossover	N/A	Double Crossover

2.5.5 Rail Operations Center

The existing Rail Operations Center (ROC), shown on the figure below, located in Los Angeles near the intersection of Imperial Highway and the Metro Blue Line does not have sufficient room to accommodate the new transit corridors and line extensions in Metro's expansion program. The Build Alternatives assume an expanded ROC at this location.

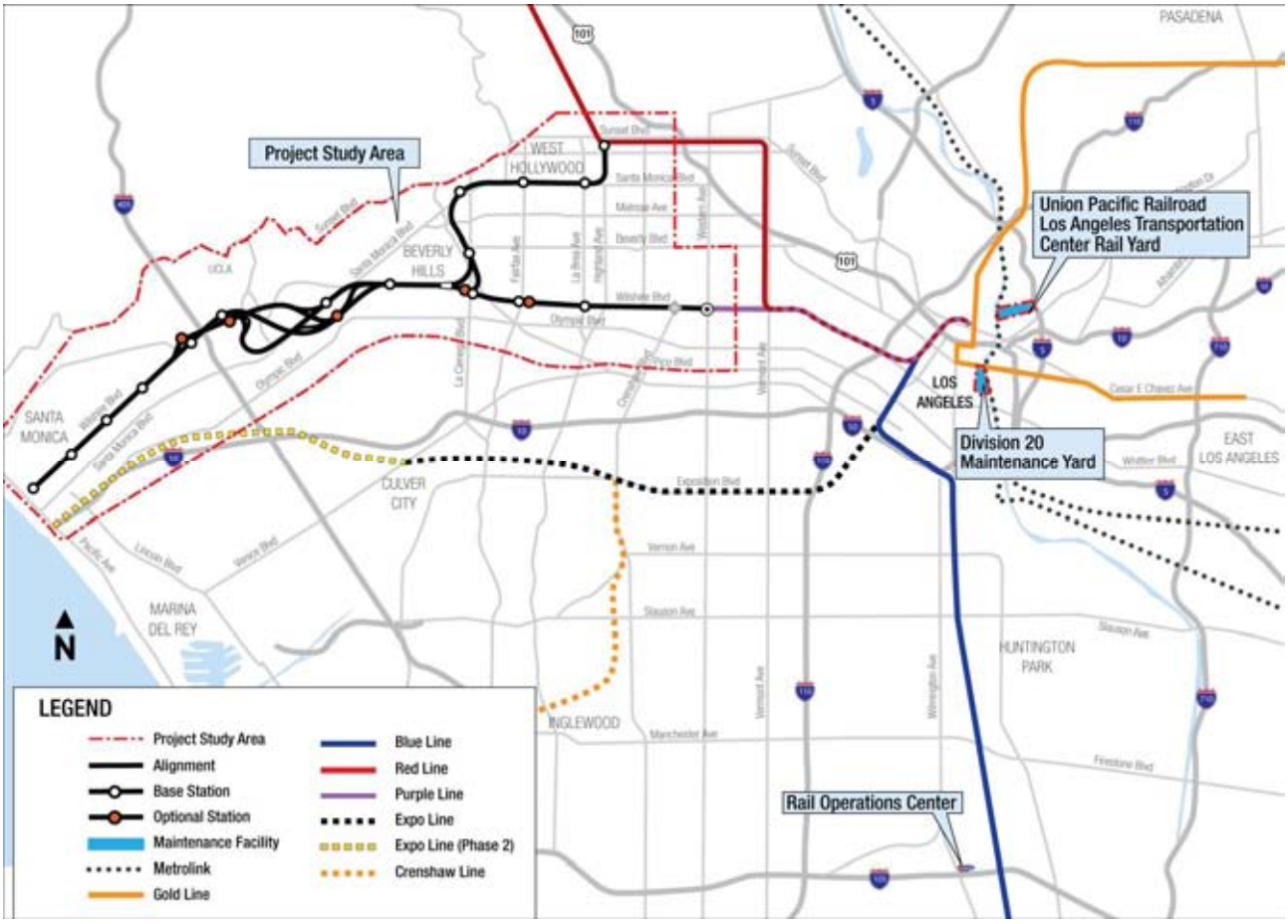


Figure 2-13. Location of the Rail Operations Center and Maintenance Yards

2.5.6 Maintenance Yards

If any of the Build Alternatives are chosen, additional storage capacity would be needed. Two options for providing this expanded capacity are as follows (Figure 2-14 and Figure 2-15):

- The first option requires purchasing 3.9 acres of vacant private property abutting the southern boundary of the Division 20 Maintenance and Storage Facility, which is located between the 4th and 6th Street Bridges. Additional maintenance and storage tracks would accommodate up to 102 vehicles, sufficient for Alternatives 1 and 2.
- The second option is a satellite facility at the Union Pacific (UP) Los Angeles Transportation Center Rail Yard. This site would be sufficient to accommodate the vehicle fleet for all five Build Alternatives. An additional 1.3 miles of yard lead tracks from the Division 20 Maintenance and Storage Facility and a new bridge over the Los Angeles River would be constructed to reach this yard.

Figure 2-14. Maintenance Yard Options

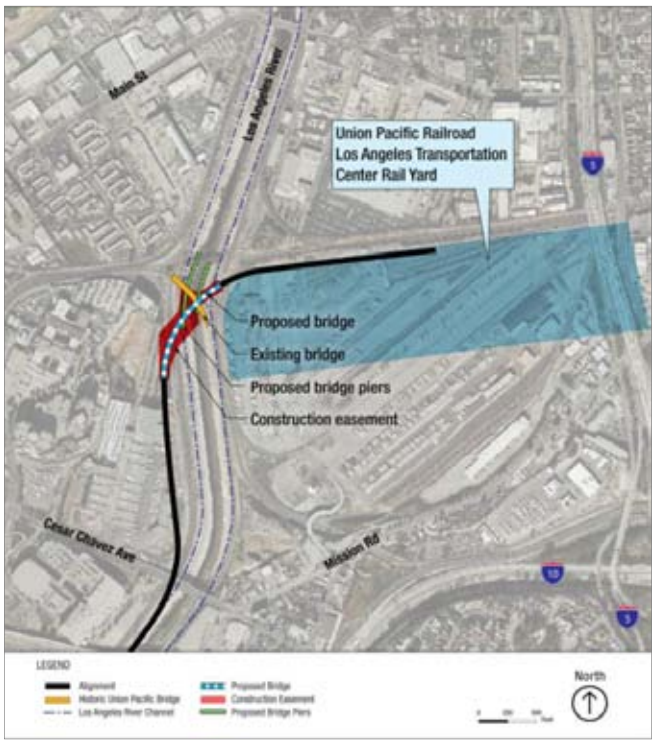


Figure 2-15. UP Railroad Rail Bridge

2.6 Minimum Operable Segments

Due to funding constraints, it may be necessary to construct the Westside Subway Extension in shorter segments. A Minimum Operable Segment (MOS) is a phasing option that could be applied to any of the Build Alternatives.

2.6.1 MOS 1—Fairfax Extension

MOS 1 follows the same alignment as Alternative 1, but terminates at the Wilshire/Fairfax Station rather than extending to a Westwood/UCLA Station. A double crossover for MOS 1 is located on the west end of the Wilshire/La Brea Station box, west of Cloverdale Avenue. The alignment is 3.10 miles in length.

2.6.2 MOS 2—Century City Extension

MOS 2 follows the same alignment as Alternative 1, but terminates at a Century City Station rather than extending to a Westwood/UCLA Station. The alignment is 6.61 miles from the Wilshire/Western Station.

3.0 STANDARDS AND REGULATIONS

3.1 Noise Standards

The noise impact analysis for this project is based on criteria as defined in *Transit Noise and Vibration Impact Assessment* (FTA 2006). The basic goals of the noise criteria are to minimize the adverse noise impacts on the community and to provide feasible and reasonable noise control where necessary and appropriate.

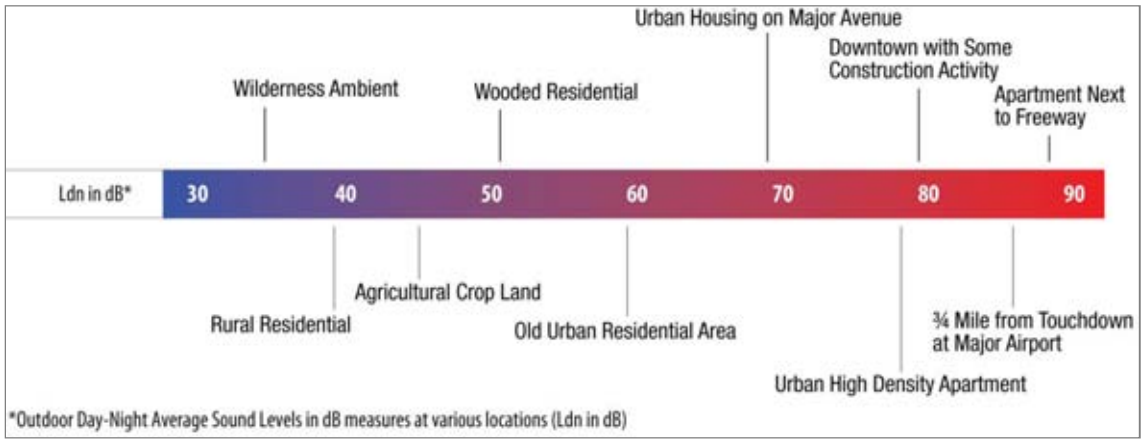
Sound and noise (unwanted sound) are measured in units of decibels. A-weighted decibels (dBA) account for the human perception of sound with less sensitivity to low pitch and very high pitch sounds. FTA guidelines assess noise impacts for various land use categories using different noise metrics or descriptors. The most common metrics used to describe transit noise are the average equivalent sound level (L_{eq}) or the average day-night sound level (L_{dn}). Some land use types and activities are more sensitive to noise than others (e.g., parks, libraries, schools, places of worship, and residences are typically more noise-sensitive than industrial and commercial areas). The FTA Noise Impact Criteria classifies sensitive land uses into three categories as indicated in Table 3-1.

Table 3-1. FTA Land Use Categories and Metrics for Transit Noise

Land Use Category	Noise Metric (dBA)	Description of Land Use Category
1	Outdoor $L_{eq(h)}$*	Tracts of land where quiet is an essential element in their intended purpose. This category includes lands set aside for serenity and quiet and such land uses as outdoor amphitheaters and concert pavilions, as well as National Historic Landmarks with significant outdoor use.
2	Outdoor L_{dn}	Residences and buildings where people normally sleep. This category includes homes, hospitals, and hotels where a nighttime sensitivity to noise is assumed to be of utmost importance.
3	Outdoor $L_{eq(h)}$*	Institutional land uses with primary daytime and evening use. This category includes schools, libraries, theaters, and churches where it is important to avoid interference with such activities as speech, meditation, and concentration on reading material.

Source: FTA Transit Noise and Vibration Impact Assessment, Final Report, May 2006.
*L_{eq} for the noisiest hour of transit-related activity during hours of noise sensitivity.

For residential land uses near the project alignment and facilities, the noise descriptor that will be used is L_{dn}, which represents the cumulative 24-hour day-night noise level and accounts for the greater sensitivity to noise during the nighttime hours when people are sleeping. For land uses involving daytime and evening uses only, the noise descriptor $L_{eq\,(h)}$ representing the noisiest hour of transit–related activity during which human activities occur at noise-sensitive locations will be used. The standards are based on community reaction to noise and require evaluation of project-related changes to existing noise conditions using a sliding scale. The higher the level of existing noise exposure, the less room there is for a project to contribute additional noise. Typical examples of environmental noise levels are presented in Figure 3-1.



Source: EPA.

Figure 3-1. Typical Day-Night (L_{dn}) Sound Levels

Subway projects generally produce very little above-ground exposure to noise. The exceptions are construction activities (addressed in the *Construction and Mitigation Technical Report*) and the noise from ground level station-related activities, such as parking and passenger drop-off locations, patron portal ingress/egress, plus tunnel vent discharge ducts, standby emergency generators, traction power substations, and maintenance shops/yards. This noise is considered part of subway operations.

Figure 3-2 and Table 3-2 show the FTA noise criteria which are used to determine "moderate" and "severe" levels of impact. In general, with respect to NEPA, the "severe" level of impact is considered a significant adverse effect. The first column of Table 3-2 shows the existing noise exposure, and the remaining columns show the additional noise exposure level for the transit project above which an impact would occur. The future total noise exposure would be the combination of the existing noise exposure and the additional noise exposure caused by the Westside Subway Extension Project. As the existing noise exposure level increases, the amount of the additional allowable noise caused directly by the project that can be added decreases.

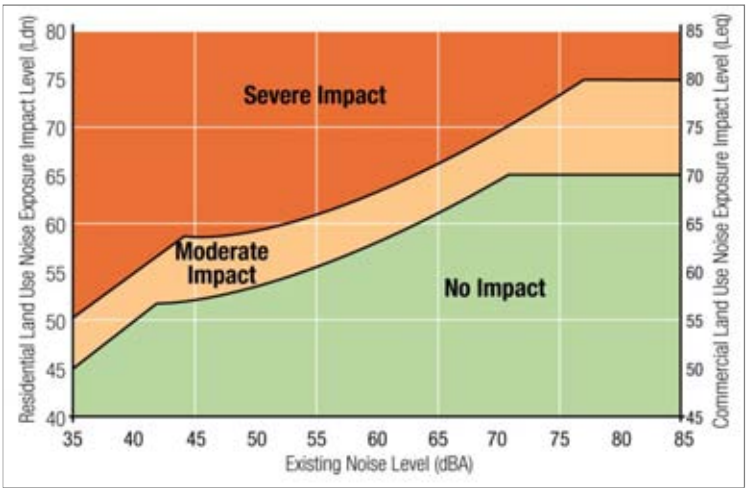


Figure 3-2. Noise Impact Criteria for Transit Projects

Table 3-2. Noise Impact Criteria

Existing Noise Exposure (L_{eq} or L_{dn}[1])	Project Noise Exposure Impact Thresholds: L_{dn} or L_{eq}[1] (all noise levels in dBA)			
	Category 1 or 2 Sites		Category 3 Sites	
	Moderate Impact	Severe Impact	Moderate Impact	Severe Impact
<43	Amb.+10	Amb.+15	Amb.+15	Amb.+20
43-44	52	58	57	63
45	52	58	57	63
46-47	53	59	58	64
48	53	59	58	64
49-50	54	59	59	64
51	54	60	59	65
52-53	55	60	60	65
54	55	61	60	66
55	56	61	61	66
56	56	62	61	67
57-58	57	62	62	67
59-60	58	63	63	68
61-62	59	64	64	69
63	60	65	65	70
64	61	65	66	70
65	61	66	66	71
66	62	67	67	72
67	63	67	68	72
68	63	68	68	73
69	64	69	69	74
70	65	69	70	74
71	66	70	71	75
72-73	66	71	71	76
74	66	72	71	77
75	66	73	71	78
76-77	66	74	71	79
>77	66	75	71	80

Source: Transit Noise and Vibration Impact Assessment (FTA 2006)
[1] L_{dn} is used for land uses where nighttime sensitivity is a factor; daytime L_{eq} is used for land uses involving only daytime activities.

The following two levels of impact are included in the FTA criteria. The level of impact also affects potential mitigation requirements for the Project.

- **Severe Impact—**Severe noise impact is considered an adverse effect as this term is used in NEPA and implementing regulations. Severe noise impacts represent the most compelling need for mitigation. However, before mitigation measures are considered, alternative locations/alignments are evaluated to determine whether it is feasible to avoid severe impacts altogether. If it is not practical to avoid severe impacts by changing the location or design of the project, mitigation measures must be considered. Severe impacts have the greatest adverse effect on the community; thus, there is a presumption by FTA that mitigation would be incorporated in the project unless there are truly extenuating circumstances which prevent its incorporation.
- **Moderate Impact**—Project noise levels in the moderate impact range also require consideration and adoption of mitigation measures when they are considered reasonable. While impacts in this range are not of the same magnitude as severe impacts, there can be circumstances which make a compelling argument for mitigation. These other factors can include the predicted increase over existing noise levels, the type and number of noise-sensitive land uses affected, existing outdoor/indoor sound

insulation, community views, special protection provided by law, and the cost-effectiveness of mitigating noise to more acceptable levels.

It is the policy of the Los Angeles County Metropolitan Transportation Authority (Metro) to mitigate project noise and vibration impacts where practicable, feasible, and reasonable in accordance with FTA guidelines and consistent with *Metro Design Criteria* (Metro 1995/2009). According to FTA guidance, noise levels below the moderate impact threshold would result in no perceptible impact to the affected noise-sensitive properties.

With respect to CEQA, project noise levels are evaluated in accordance with applicable portions of CEQA Guidelines Appendix G which states that a significant impact from noise may occur if the Project results in

- Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies
- Exposure of persons to or generation of excessive ground-borne vibration or ground-borne noise levels
- A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project
- A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project
- The exposure of people residing or working in the project area to excessive noise levels, for a project located within an airport land use plan or, where such a plan has not been adopted, within 2 miles of a public airport or public use airport
- The exposure of people residing or working in the project area to excessive noise levels, for a project within the vicinity of a private airstrip

This technical report evaluates the applicable regulatory and planning standards of the Cities of Los Angeles, West Hollywood, Beverly Hills, Santa Monica, and Los Angeles County through which the project alternatives would pass.

3.2 Vibration Standards

The FTA has developed impact criteria for acceptable levels of ground-borne noise and vibration (Table 3-3 and Table 3-4). Ground-borne vibration from transit vehicles is characterized in terms of the root mean squared (RMS) vibration velocity amplitude. A 1-second RMS time constant is assumed. This is in contrast to vibration from construction activities that could cause building damage typically characterized by the peak particle velocity (PPV). In addition to units of inches per second, the amplitude or strength of vibration may be expressed as a velocity level in units of velocity decibels (VdB). VdB is obtained in a manner similar to sound level decibels by logarithmically comparing measured or predicted vibration amplitude to a reference amplitude of 1 micro-inch/second. When assessing the potential for building damage, ground-borne vibration is usually expressed in terms of the PPV using units of inches per second but may also be expressed using VdB values. The threshold of vibration perception for most humans is around 65 to 70 VdB; levels in the 70- to 75-VdB range are often noticeable but acceptable; and levels greater than 80 VdB are generally considered unacceptable.

Table 3-3 summarizes the FTA impact criteria for ground-borne vibration and ground-borne noise caused by project operations. The criteria are applicable as measured or calculated at a point just exterior to the building's foundation using the shortest distance from the activity

(construction or operations). Some buildings, such as concert halls, television and recording studios, and theaters, can be very sensitive to vibration but do not fit into any of the three standard categories. Along the proposed alignments, special-use buildings that may be especially sensitive to vibration have been noted and evaluated individually. Because of the sensitivity of these buildings, they often warrant identification during the environmental review of a transit project and special attention during the project's engineering design phase. Table 3-4 provides criteria for acceptable levels of operations-based ground-borne vibration and ground-borne noise for various types of special buildings.

Table 3-3. FTA Ground-borne Vibration and Ground-borne Noise Impact Criteria

Land Use Category	Ground-borne Vibration Impact Levels (VdB re: 1 micro-inch/sec)			Ground-borne Noise Impact Levels (dB re 20 micro Pascals)		
	Frequent Events[1]	Occasional Events[2]	Infrequent Events[3]	Frequent Events[1]	Occasional Events[2]	Infrequent Events[3]
Category 1: Buildings where vibration would interfere with interior operations	65 VdB[4]	65 VdB[4]	65 VdB[4]	N/A[4]	N/A[4]	N/A[4]
Category 2: Residences and buildings where people normally sleep	72 VdB	75 VdB	80 VdB	35 dBA	38 dBA	43 dBA
Category 3: Institutional land uses with primarily daytime use	75 VdB	78 VdB	83 VdB	40 dBA	43 dBA	48 dBA

Source: Transit Noise and Vibration Impact Assessment (FTA 2006)

[1] "Frequent Events" are defined as more than 70 vibration events of the same source per day. Most rapid transit projects fall into this category.
[2] "Occasional Events" are defined as between 30 and 70 vibration events of the same source per day. Most commuter rail lines have this many events.
[3] "Infrequent Events" are defined as fewer than 30 vibration events of the same kind per day. This category includes most commuter rail branch lines.
[4] This criterion limit is based on levels that are acceptable for most moderately sensitive equipment, such as optical microscopes. Vibration-sensitive manufacturing or research will require detailed evaluation to define acceptable vibration levels. Ensuring lower vibration levels in a building often requires special design of the HVAC systems and stiffened floors.

Table 3-4. FTA Ground-borne Vibration and Ground-borne Noise Impact Criteria for Special Buildings

Land Use Category	Ground-borne Vibration Impact Levels (VdB re 1 micro-inch/sec)		Ground-borne Noise Impact Levels (dB re 20 micro Pascals)	
	Frequent Events[1]	Occasional or Infrequent Events[2]	Frequent Events[1]	Occasional or Infrequent Events[2]
Concert halls	65 VdB	65 VdB	25 dBA	25 dBA
TV studios	65 VdB	65 VdB	25 dBA	25 dBA
Recording studios	65 VdB	65 VdB	25 dBA	25 dBA
Auditoriums	72 VdB	80 VdB	30 dBA	38 dBA
Theaters	72 VdB	80 VdB	35 dBA	43 dBA

Source: Transit Noise and Vibration Impact Assessment (FTA 2006)
[1] "Frequent Events" are defined as more than 70 vibration events of the same source per day. Most rapid transit projects fall into this category.
[2] "Occasional Events" are defined as between 30 and 70 vibration events of the same source per day. Most commuter rail lines have this many events.

Specification of mitigation measures requires a frequency distribution, or spectrum, of the vibration energy to determine whether the vibrations are likely to generate a significant response in a receiving building or structure. The FTA Detailed Vibration Analysis method

provides an estimate of building response in terms of a one-third octave band frequency spectrum.

International standards have been developed for the effects of vibration on people in buildings with ratings related to annoyance and interference with activities based on frequency distribution of acceptable vibrations. These criteria have been supplemented by industry standards for vibration-sensitive equipment. Both sets of criteria are expressed in terms of one-third octave band velocity spectra, with transient events like train pass-bys described in terms of the maximum RMS vibration velocity level with a 1-second averaging time. The measurement point is specified as the floor of the receiving building at the location of the prescribed activity.

The vibration impact criteria are shown in Figure 3-3 where the international standard curves and the industry standards are plotted on the same figure. Explanations of the various criteria curves are presented in Table 3-5. Band levels that exceed a particular criterion curve indicate the need for mitigation and the frequency range within which the treatment needs to be effective.

These criteria use a frequency spectrum because vibration-related problems generally are caused by resonances of the structural components of a building or vibration-sensitive equipment. Resonant response is frequency-dependent. A detailed analysis can provide an assessment that identifies potential problems resulting from resonances.

The detailed vibration criteria are based on generic cases when people are standing or equipment is mounted on the floor in a conventional manner. Consequently, the criteria are less stringent at very low frequencies below 8 Hz. Where special vibration isolation has been provided in the form of pneumatic isolators, the resonant frequency of the isolation system is very low. Consequently, in this special case, the curves may be extended flat at lower frequencies.

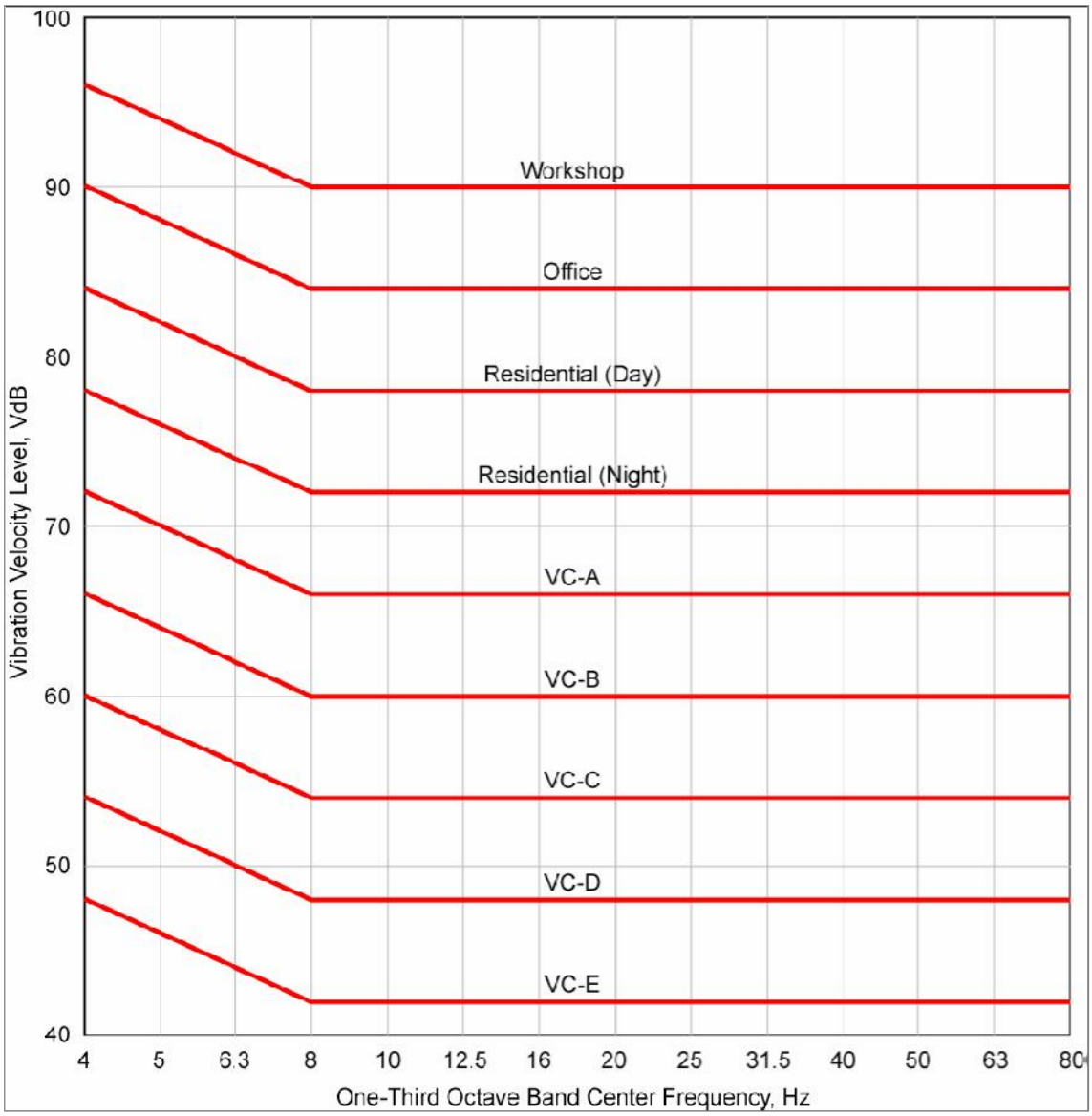


Figure 3-3. Criteria for Detailed Vibration Analysis

Table 3-5. Interpretation of Vibration Criteria for Detailed Analysis

Criterion Curve (see Figure 3-3)	Max Level—micro-inch/sec (VdB)	Description of Use
Workshop (ISO)	32000 (90)	Distinctly feelable vibration. Appropriate to workshops and nonsensitive areas.
Office (ISO)	16000 (84)	Feel able vibration. Appropriate to offices and nonsensitive areas.
Residential Day (ISO)	8000 (78)	Barely fellable vibration. Appropriate to sleep areas in most instances. Probably adequate for computer equipment, probe test equipment and low-power (to 20X) microscopes.
Op. Theatre (ISO)	4000 (72)	Vibration not feelable. Suitable for sensitive sleep areas. Suitable in most instances for microscopes to 100X and for other equipment of low sensitivity.
VC-A	2000 (66)	Adequate in most instances for optical microscopes to 400X, microbalances, optical balances, proximity and projection aligners, etc.
VC-B	1000 (60)	An appropriate standard for optical microscopes to 1000X, inspection and lithography equipment (including steppers) to 3 micron line widths.
VC-C	500 (54)	A good standard for most lithography and inspection equipment to 1 micron detail size.
VC-D	250 (48)	Suitable in most instances for the most demanding equipment including electron microscopes (TEMs and SEMs) and E-Beam systems, operating to the limits of their capability.
VC-E	125 (42)	A difficult criterion to achieve in most instances. Assumed to be adequate for the most demanding of sensitive systems including long path, laser-based, small target systems and other systems requiring extraordinary dynamic stability.

Source: Transit Noise and Vibration Impact Assessment (FTA 2006)

4.0 AFFECTED ENVIRONMENT/EXISTING CONDITIONS

4.1 Area of Potential Effect

The Project corridor's area of potential effects (APE) for noise and vibration is in the urban core of the Cities of Los Angeles, West Hollywood, Beverly Hills, and Santa Monica, plus unincorporated portions of Los Angeles County.

For project locations with ground-level equipment ancillary to stations, new or modified ground-level buildings, such as the Rail Operations Center (ROC), or potential maintenance facilities, including at-grade track, this technical report assesses the potential for noise impacts at noise sensitive uses using the FTA screening distances. FTA guidance (FTA 2006) for at-grade facilities is applicable as follows:

- For rail transit stations, the distances specified to determine a noise APE are 100 feet where there are buildings between the source and the receiver and 200 feet from stations in unobstructed areas—these distances are also applicable to the ROC.
- For rail yards and shops, the distances are 650 feet and 1,000 feet, respectively.

The noise screening procedure specified in the FTA guidelines addressing surface (at-grade) facilities is not applicable for the underground track portion of a deep subway project. For the below-grade portions of subway systems, there is no air-born noise and the screening distances are focused on vibration effects. For the subway portions of the build alternatives, this study initially assessed the potential for vibration and ground-borne noise impact at sensitive uses by applying the screening distances listed in Table 4-1. To provide more specific information regarding the likelihood of project vibration impacts from project operations in tunnels, the FTA general vibration analysis approach up to building foundations was used as a starting point.

Table 4-1. Screening Distances for Vibration Assessment

Type of Project	Critical Distance for Land Use Categories Distance from Right-of-Way or Property Line		
	Category 1	Category 2	Category 3
Conventional commuter railroad	600	200	120
Rail rapid transit	600	200	120
Light rail transit	450	150	100
Intermediate capacity transit	200	100	50
Bus projects (if not previously screened out)	100	50	—

Source: Transit Noise and Vibration Impact Assessment (FTA 2006)
*The land use categories are defined in Chapter 8 of *Transit Noise and Vibration Impact Assessment*. Some vibration-sensitive land uses are not included in these categories. Examples are concert halls and TV studios which, for the screening procedure, should be evaluated as Category 1 and theaters and auditoriums which should be evaluated as Category 2.

4.2 Existing Conditions

This technical report identifies and evaluates noise-sensitive land uses, such as residential, and particularly sensitive special facilities, such as surgery centers, live theatre performance spaces, schools, and auditoria. Potentially noise-sensitive land uses were identified or determined not to exist in the vicinity of each station location and near any proposed project at-grade facilities.

The existing conditions of the noise environment were based on measurements. These measurements were conducted at 18 sites primarily in areas near sensitive uses, including residences and other buildings where people normally sleep, such as hospitals and hotels/motels, if they were within the FTA screening distance to project-noise-producing activities or facilities. The measurements included 17 long-term (24-hour) and 1 short-term (15-minute) measurement. The 1 short-term (15-minute) noise measurement was conducted to obtain additional existing noise level information at the Veterans Affairs (VA) Hospital campus. All noise measurements were conducted in a manner consistent with applicable American National Standards Institute (ANSI) procedures for community noise measurements.

Typical examples of environmental noise levels are presented in Figure 3-1. The existing environmental noise levels along the project alignments within the noise APE are typical of an urban environment, with L_{dn} ranging from 60 to 74 dBA. Measured noise levels are presented in Table 4-2. The description of the existing noise environment is described in the following sections, organized by which alternative(s) would affect the location. Noise measurement locations are shown in Figure 4-1. through Figure 4-19.

4.2.1 No Build Alternative

The No Build Alternative is represented by the composite of all noise measurement locations.

4.2.2 Transportation System Management Alternative

The Transportation System Management (TSM) Alternative is represented by the composite of all noise measurement locations.

4.2.3 Alternative 1—Westwood/UCLA Extension

Existing noise levels were measured for this alternative at the following proposed stations:

4.2.3.1 Wilshire/Crenshaw Station

Noise levels were measured for 24 hours at 4100 S. Bronson Avenue on the Southeast corner of Wilshire Avenue and Bronson Avenue (Figure 4-2.). This apartment building is the closest category B land use to the proposed station location. The Los Altos Hotel is located on the Northeast corner of Wilshire Avenue and Bronson Avenue. The remaining land uses adjacent to the proposed station are office buildings and parking lots. Single-family residential land uses are located behind the office buildings on both sides of Wilshire Boulevard. An L_{dn} of 74 dBA and a peak noise-hour $L_{eq\,(h)}$ of 74 dBA were measured at this location.

Table 4-2. Existing Noise Levels

Measure-ment Site	Station	Address	L_{dn}	Peak Hour Noise $L_{eq}(h)$	Time of Peak Hour Noise	Alternative and Option	Figure
1	Wilshire/ Crenshaw	4100 Wilshire Blvd	74	74	4:00 p.m.	1, 2, 3, 4, 5, MOS 1 and MOS 2	4-2
2	Wilshire/La Brea	5353 Wilshire Blvd	67	67	6:00 p.m.	1, 2, 3, 4, 5, MOS 1 and MOS 2	4-3
3	Wilshire/Fairfax	6224 Orange Street	76	73	6:00 a.m.	1, 2, 3, 4, 5, Option 2 MOS 1 and MOS 2	4-4
4	Wilshire/La Cienega	8601 Wilshire Blvd	71	78	1:00 p.m.	1, 2, 3, 4, 5, MOS 2 and Options 1 and 3	4-5
5	Wilshire/Rodeo	120 Canon Dr	64	66	3:00 p.m.	1, 2, 3, 4, 5, MOS 2 and Option 4	4-6
6	Century City (Santa Monica Blvd)	1743 Club View Dr	63	65	4:00 p.m.	1, 2, 3, 4, 5 MOS 2, and Option 4	4-7
7	Westwood/UCLA (Off-Street and On-Street)	Veteran Ave and Wilshire Blvd	74	79	3:00 p.m.	1, 2, 3, 4, 5, and Options 4 and 5	4-8
8	Wilshire/VA Hospital (Alt 1 and 4 Tail Tracks)	VA Hospital	60	64	3:00 p.m.	1,2,3,4, 5 and Option 6	4-9
9	Wilshire/Bundy	1224 Saltair Ave	65	67	3:00 p.m.	3 and 5	4-10
10	Wilshire/26th	1138 26th Street	70	69	7:00 a.m.	3 and 5	4-11
11	Wilshire/16th	1142 16th Street	62	61	2:00 p.m.	3 and 5	4-12
12	Wilshire/4th	1122 4th Street	67	64	5:00 p.m.	3 and 5	4-13
13	Hollywood/ Highland	6767 Selma Place	69	67	6:00 a.m.	4, 5	4-14
14	Santa Monica/ La Brea	7119 Detroit Street	74	76	10:00 a.m.	4 and 5	4-15
15	Santa Monica/Fairfax	1050 Orange Grove Ave	67	68	5:00 p.m.	4 and 5	4-16
16	Santa Monica/San Vicente	909 Westbourne Drive	68	65	8:00 a.m.	4 and 5	4-17
17	Beverly Center Area	Westbury Terrance Residence	73	70	7:00 to 9:00 a.m.	4, 5	4-18
18	Century City (Constellation)	Future Residence at Avenue of the Star and Constellation Blvd	74	78	4:00 p.m.	1, 2, 3, 4, 5, MOS 2 and Option 4	4-19

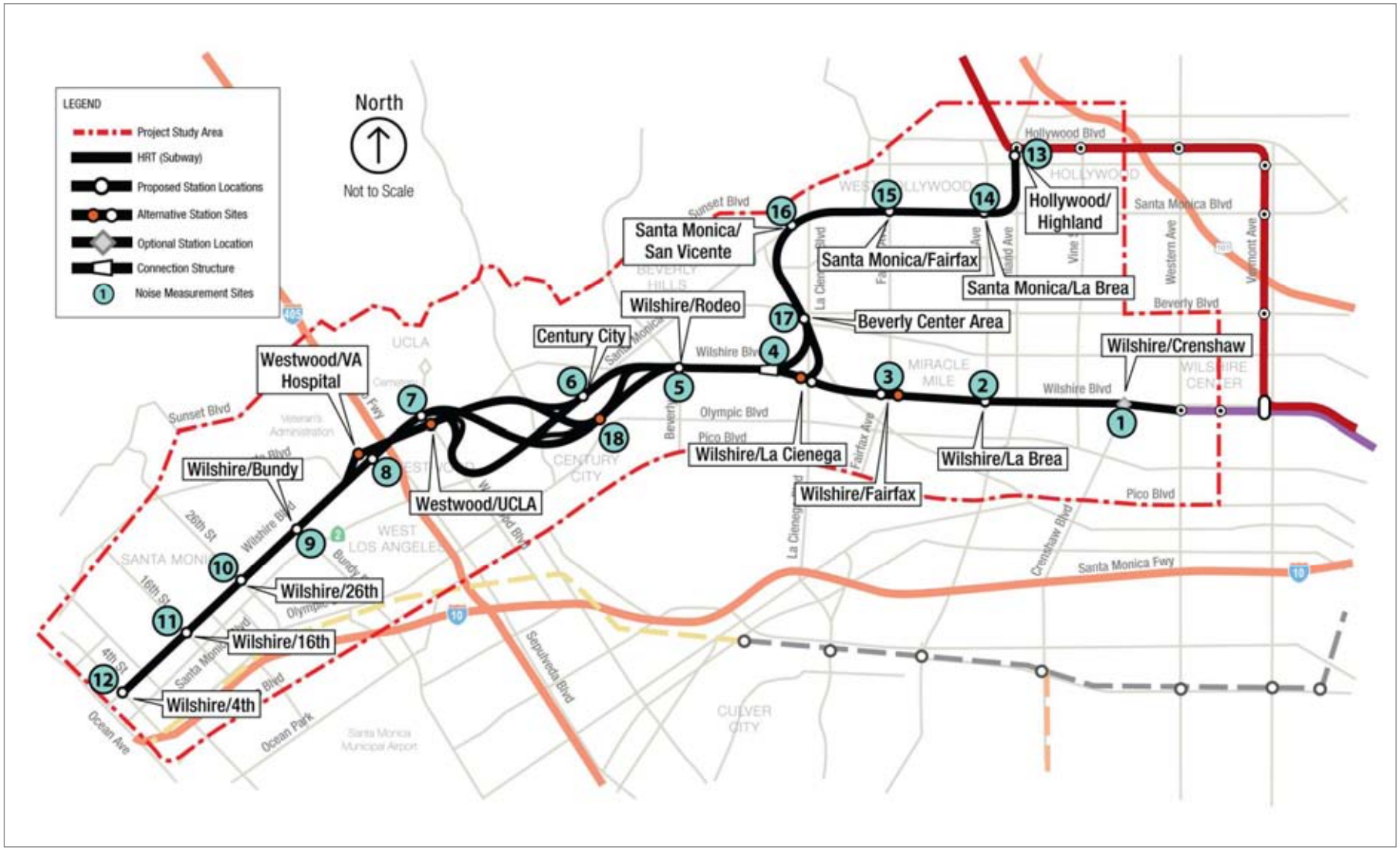


Figure 4-1. Key Map of Noise Measurement Sites

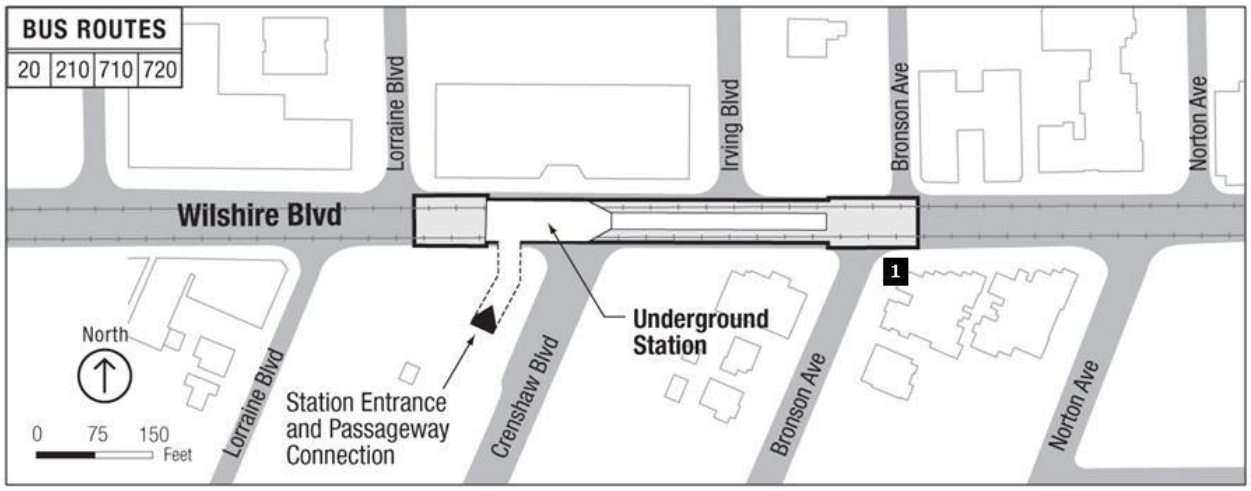


Figure 4-2. Measurement Site 1 near Wilshire/Crenshaw Station

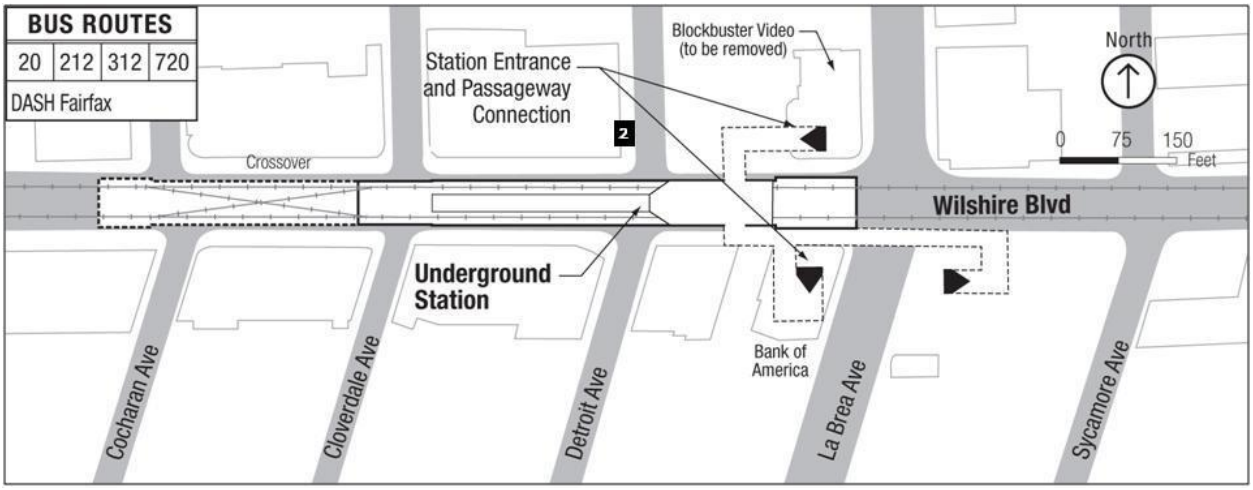


Figure 4-3. Measurement Site 2 near Wilshire/La Brea Station

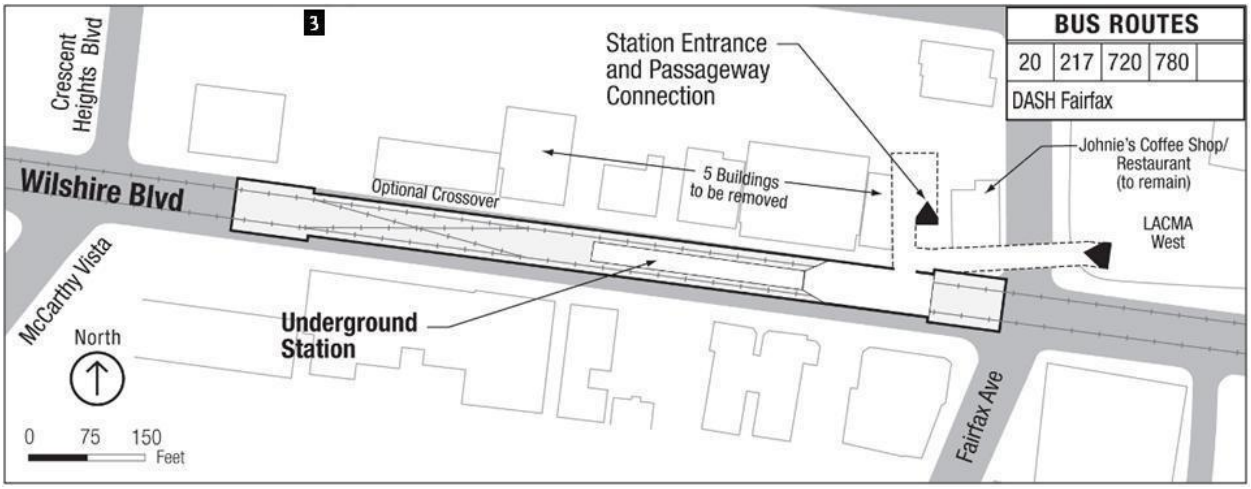


Figure 4-4. Measurement Site 3 near Wilshire/Fairfax Station

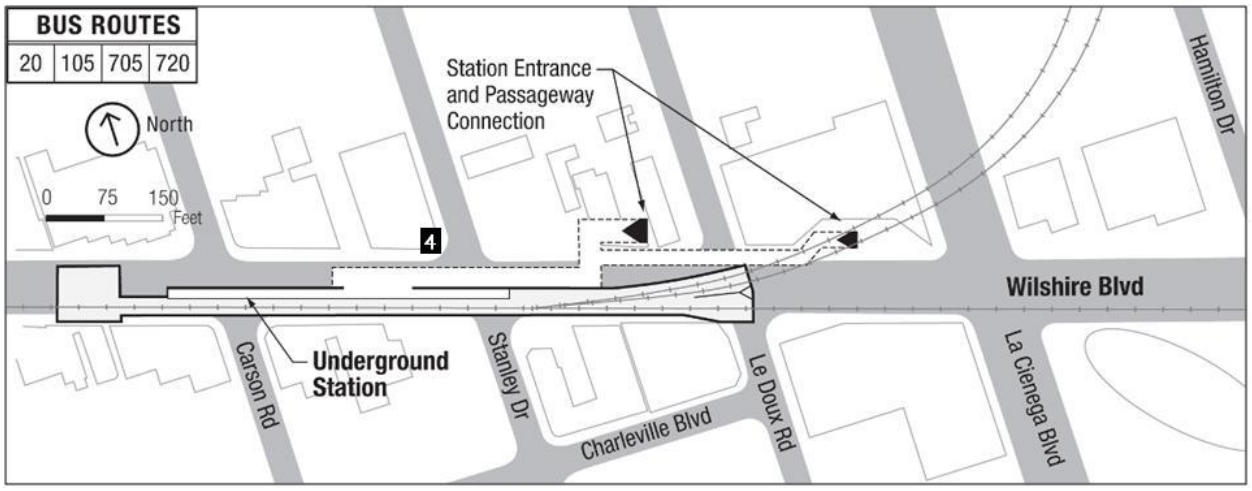


Figure 4-5. Measurement Site 4 near Wilshire/La Cienega Station

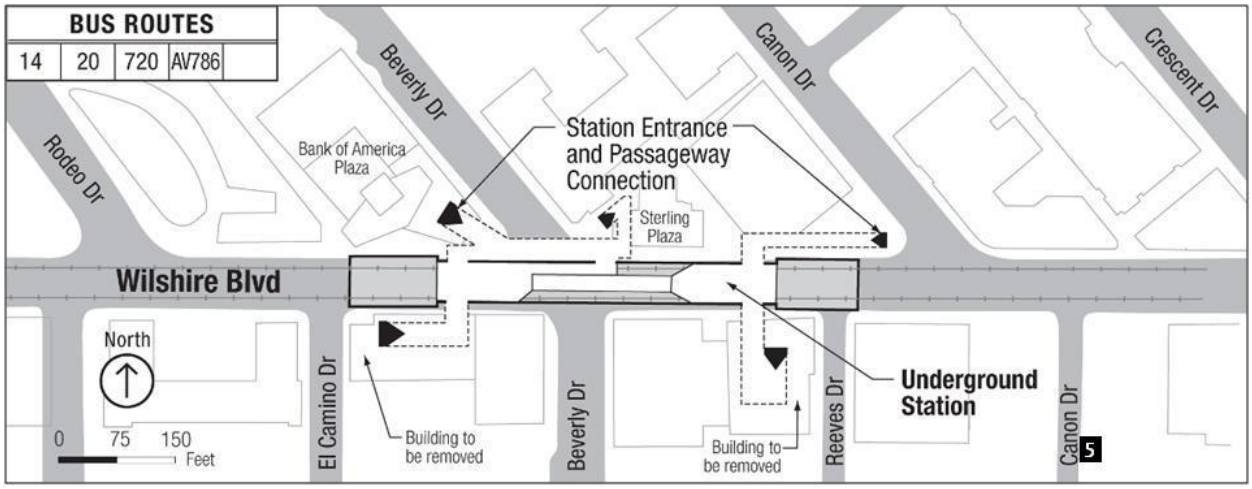


Figure 4-6. Measurement Site 5 near Wilshire/Rodeo Station

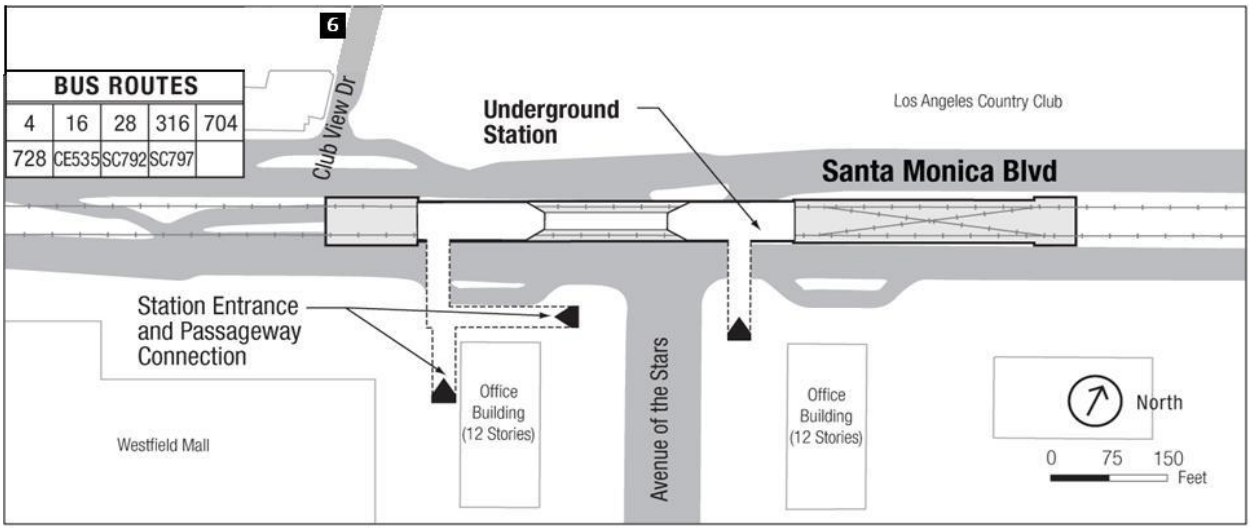


Figure 4-7. Measurement Site 6 near Century City (Santa Monica Boulevard) Station

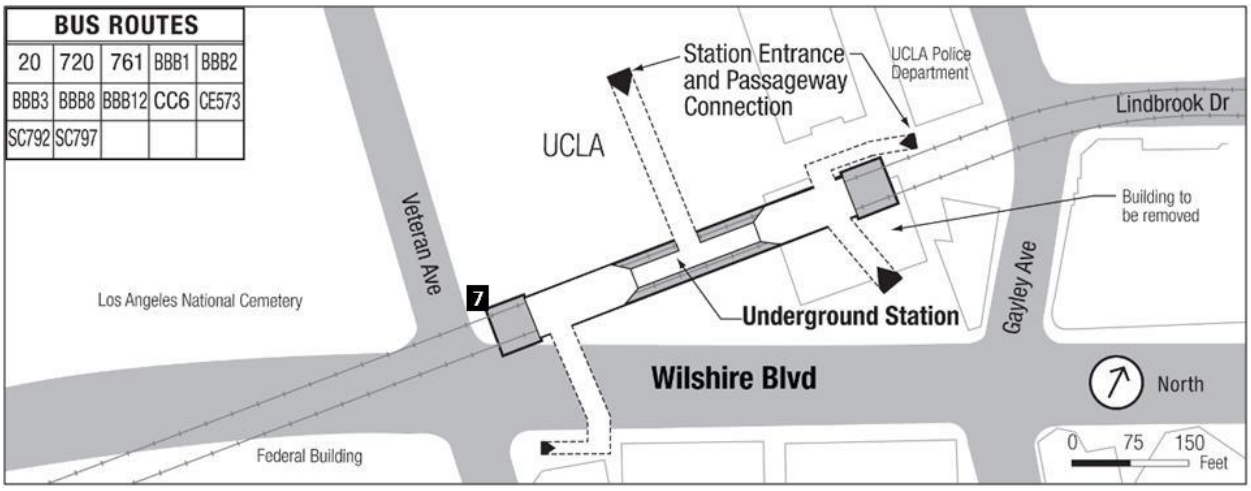


Figure 4-8. Measurement Site 7 near Westwood/UCLA Station

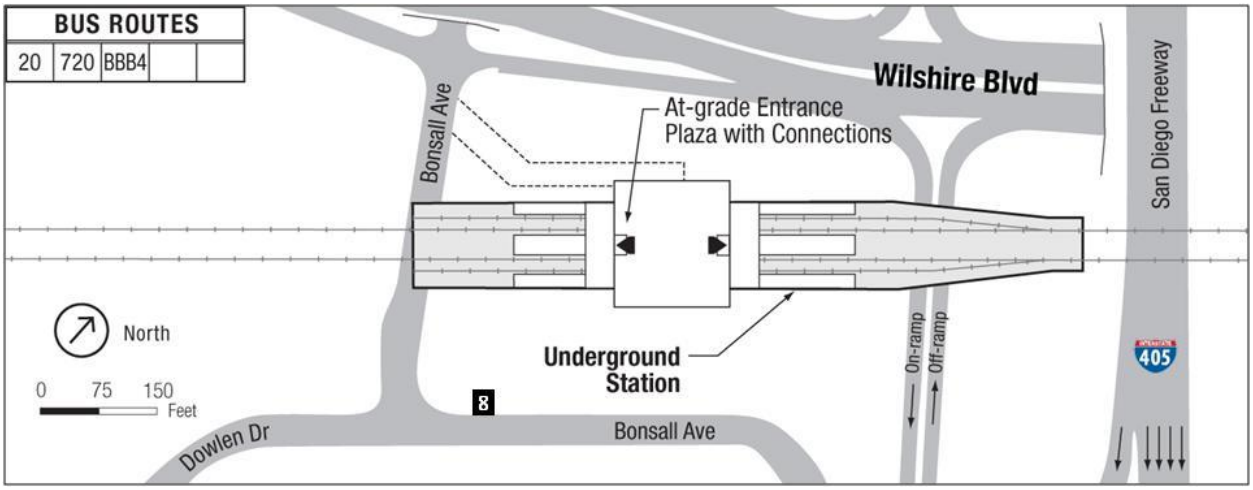


Figure 4-9. Measurement Site 8 near Westwood/VA Hospital Station

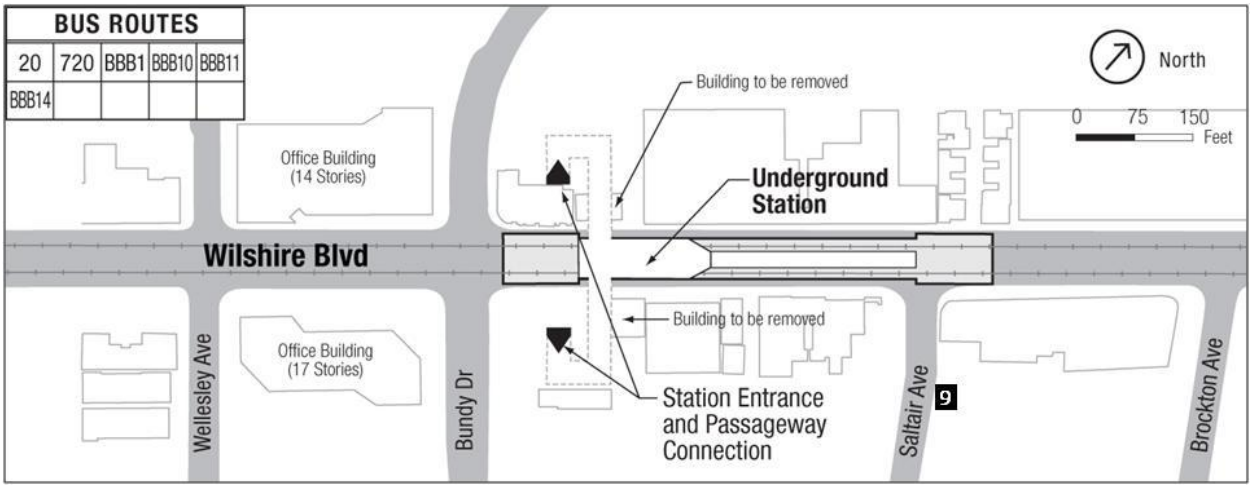


Figure 4-10. Measurement Site 9 near Wilshire/Bundy Station

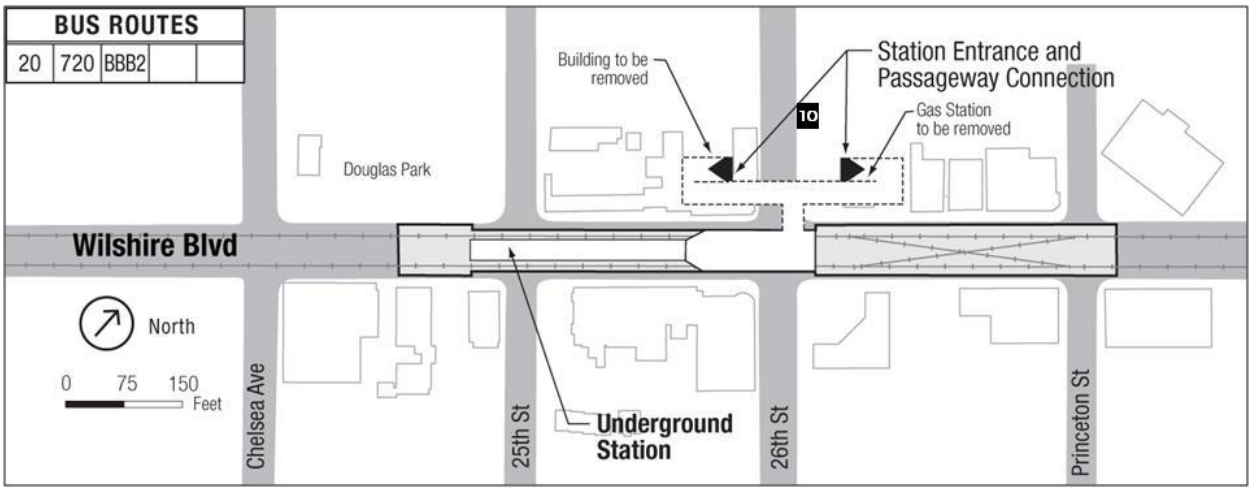


Figure 4-11. Measurement Site 10 near Wilshire/ 26th Street Station

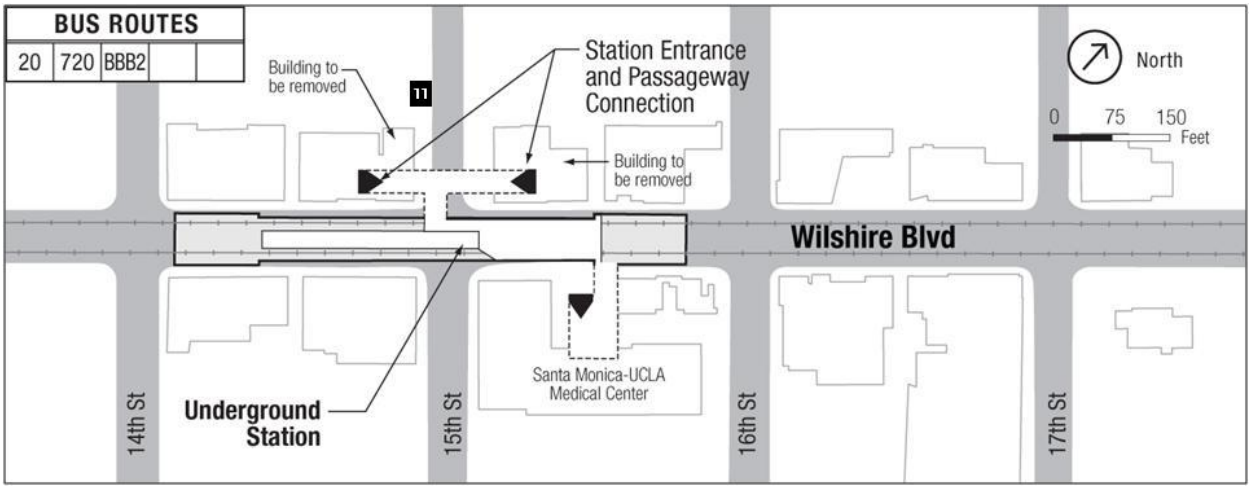


Figure 4-12. Measurement Site 11 near Wilshire/ 16th Street Station

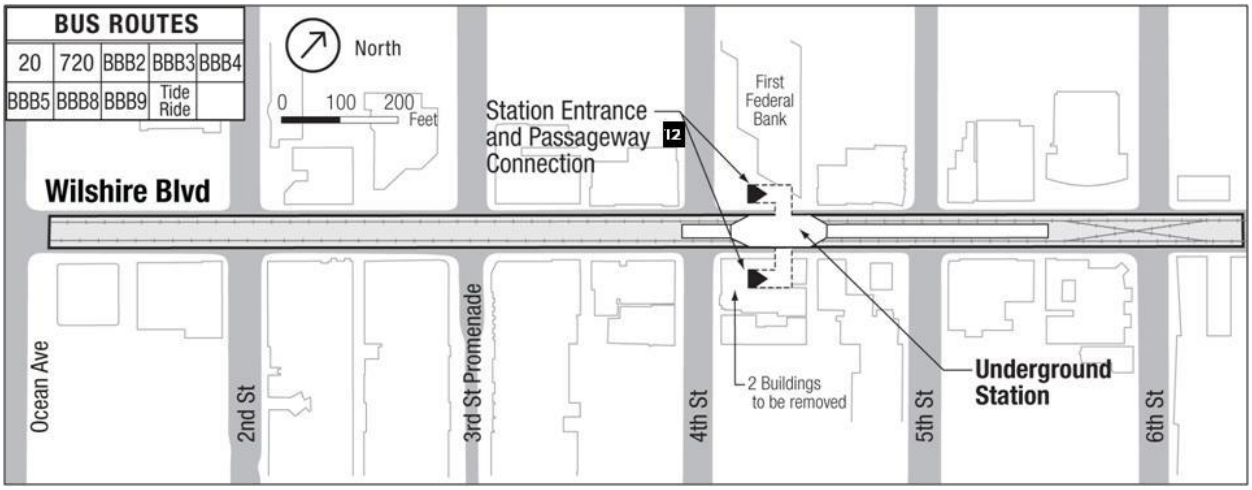


Figure 4-13. Measurement Site 12 near Wilshire/ 4th Street Station

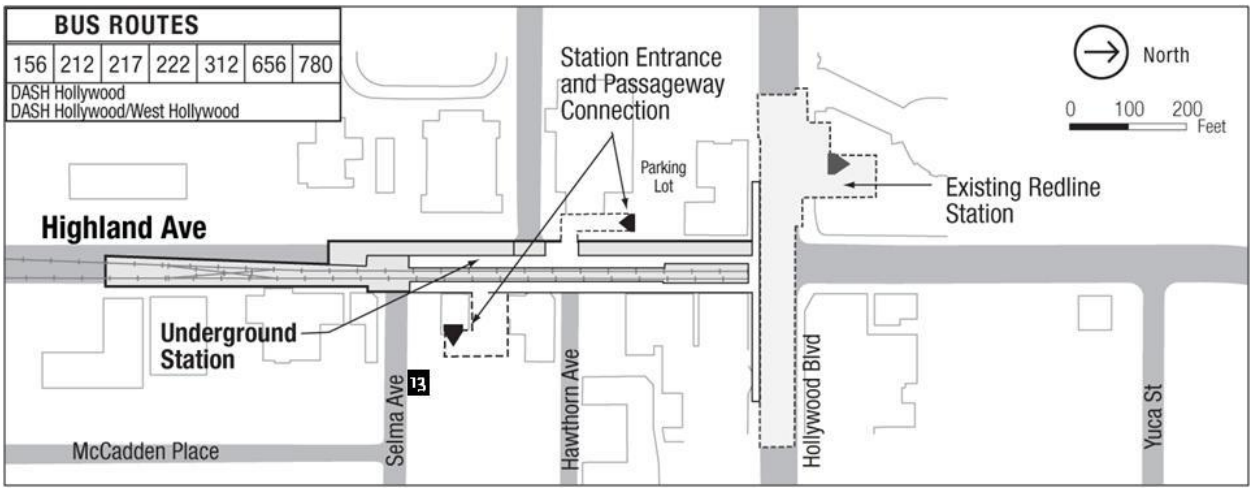


Figure 4-14. Measurement Site 13 near Hollywood/Highland Station

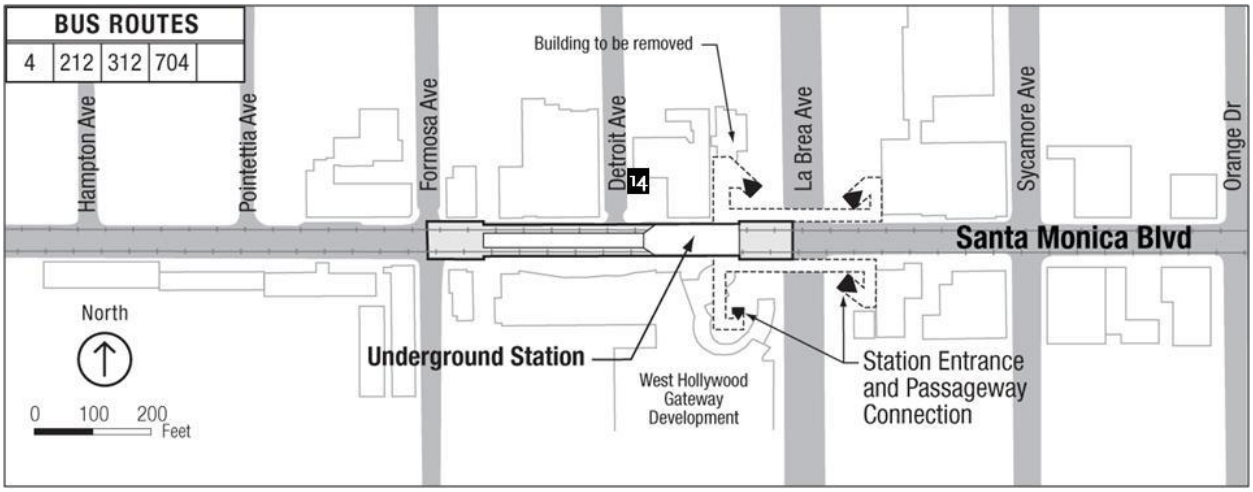


Figure 4-15. Measurement Site 14 near Santa Monica/ La Brea Station

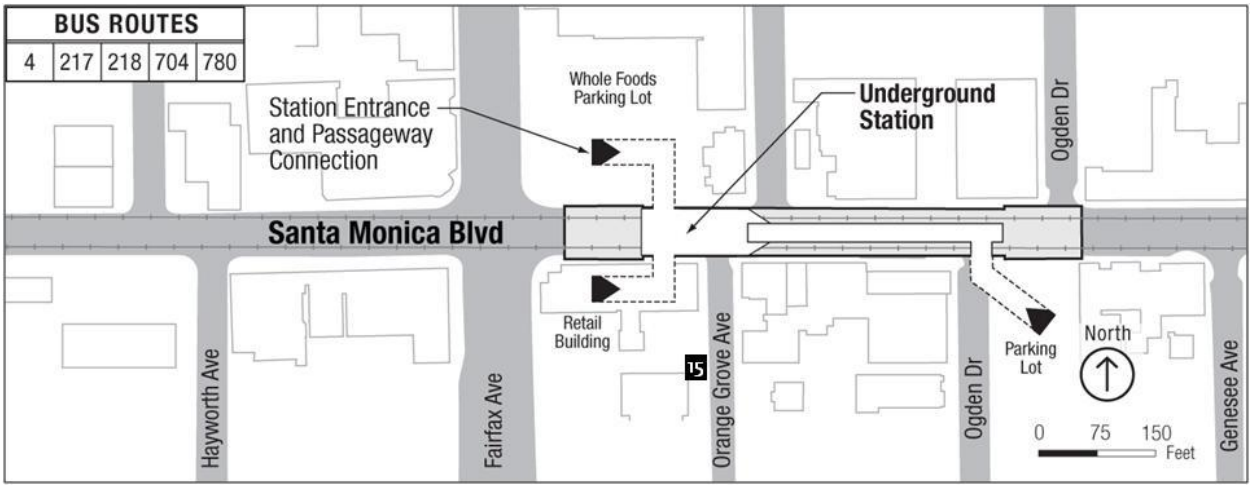


Figure 4-16. Measurement Site 15 near Santa Monica/Fairfax Station

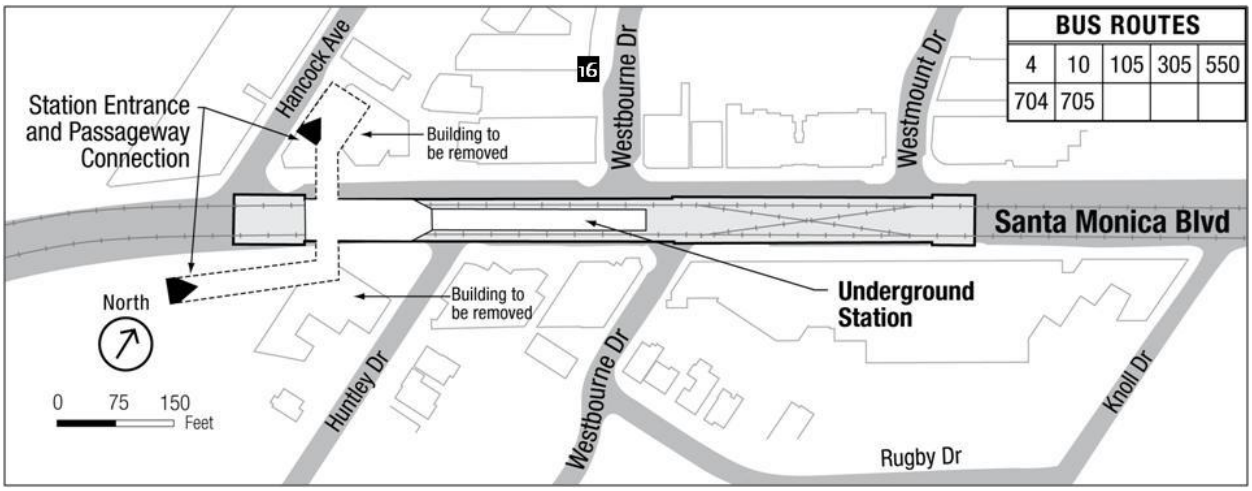


Figure 4-17. Measurement Site 16 near Santa Monica/San Vicente Station

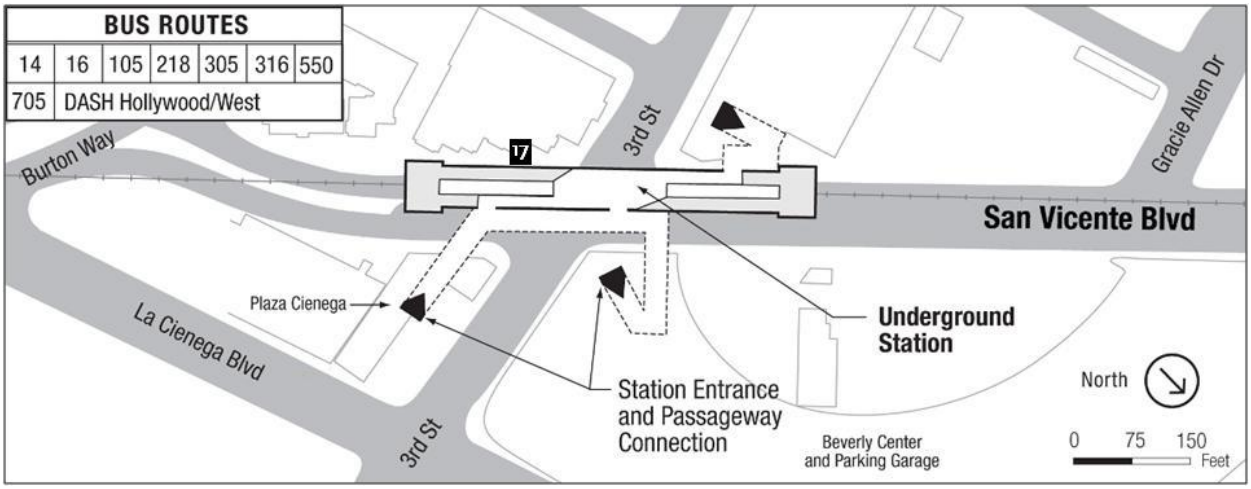


Figure 4-18. Measurement Site 17 near Beverly Center Area Station

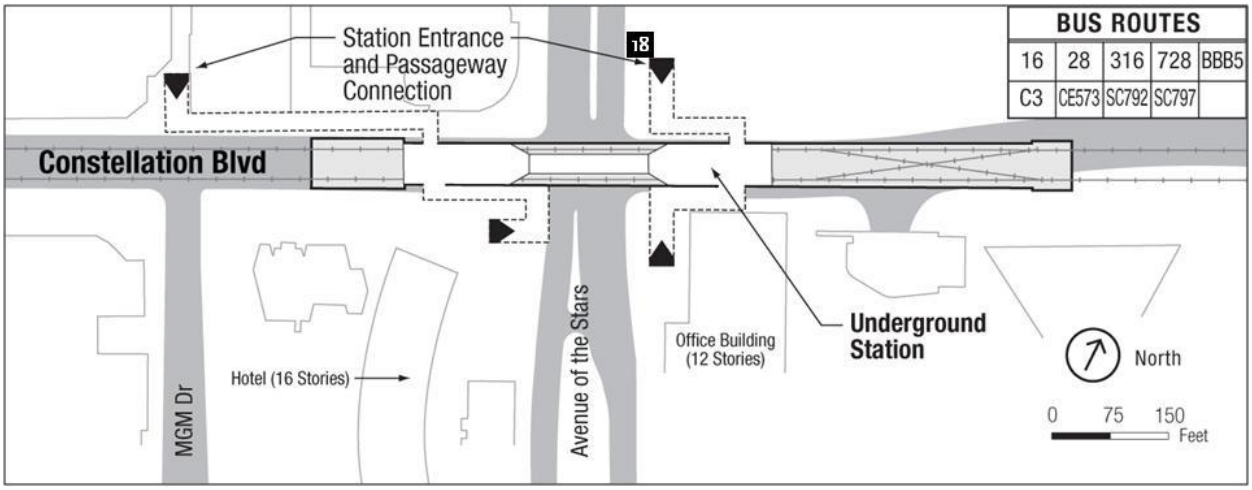


Figure 4-19. Measurement Site 18 near Century City (Constellation) Station

4.2.3.2 Wilshire/La Brea Station

Noise levels were measured for 24 hours at 5353 Wilshire Boulevard on the Northwest corner of Wilshire Avenue and Detroit Street (Figure 4-3). This apartment building is the closest category B land use to the proposed station location. The remaining land uses adjacent to the proposed station are retail, service stores, and parking lots. Single-family residential land uses are located behind the retail and service stores on both sides of Wilshire Boulevard. An L_{dn} of 67 dBA and a peak noise hour $L_{eq\ (h)}$ of 67 dBA were measured at this location.

4.2.3.3 Wilshire/Fairfax Station

Noise levels were measured for 24 hours at 6224 Orange Street in the backyard of the apartment building with a direct line of sight to Wilshire Avenue and the proposed station (Figure 4-4). Residential land uses on Orange Street are the closest category B land use to the proposed station location. The first row land uses adjacent to the proposed station are retail, service stores, and parking lots. Single-family residential land uses are located behind the retail and service stores on both sides of Wilshire Boulevard. An L_{dn} of 76 dBA and a peak noise hour $L_{eq\ (h)}$ of 73 dBA were measured at this location.

4.2.3.4 Wilshire/La Cienega Station

Noise levels were measured for 24 hours at 8601 Wilshire Avenue on the 11th floor sundeck of the apartment building. This is the only category B land use along the proposed station location (Figure 4-5). The first row land uses adjacent to the proposed station are retail, two restaurants, one movie theatre, one gas station, and office buildings. Single-family residential land uses are located behind the first row land uses on both sides of Wilshire Boulevard. An L_{dn} of 71 dBA and a peak noise hour $L_{eq\ (h)}$ of 78 dBA were measured at this location.

4.2.3.5 Wilshire/Rodeo Station

Noise levels were measured for 24 hours at 120 Canon Drive south of Wilshire Boulevard (Figure 4-6). This is located behind the retail and office buildings that front the proposed station location. The first row land uses adjacent to the proposed station are retail and office buildings. Single-family residential land uses are located behind the first row land uses to the south of Wilshire Boulevard; one hotel and an apartment are located north of Wilshire Boulevard behind the retail and office land uses. An L_{dn} of 64 dBA and a peak noise hour $L_{eq\ (h)}$ of 66 dBA were measured at this location.

4.2.3.6 Century City (Santa Monica Blvd)

Noise levels were measured for 24 hours at 1743 Club View Drive north of Santa Monica Boulevard (Figure 4-7). This is located behind the retail and office buildings that front the proposed station location. The first row land uses adjacent to the proposed station are retail and office buildings south of Santa Monica Boulevard. Los Angeles County Golf Club and retail stores are located north of the proposed station location. Single-family residential land uses are located behind the first row land uses to the north of Santa Monica Boulevard. South of the proposed station location, the land uses in retail and office space. An L_{dn} of 63 dBA and a peak noise hour $L_{eq\ (h)}$ of 65 dBA were measured at this location.

4.2.3.7 Westwood/UCLA Off-Street Station

Noise levels were measured for 24 hours at the Northeast corner of the intersection of Wilshire Boulevard and Veteran Avenue (Figure 4-8). The Los Angeles National Cemetery is

located on the Northwest corner of Wilshire Boulevard and Veteran Avenue. All other land uses in the area are offices and retail stores. An L_{dn} of 74 dBA and a peak noise hour $L_{eq\ (h)}$ of 79 dBA were measured at this location.

4.2.3.8 Westwood/UCLA Crossover and Tail Track

Noise levels were measured for 15 minutes in front of the VA Hospital and compared to the 24-hour levels measured at the Westwood/UCLA Off-Street Station (Figure 4-9). The area contains green space, a surface parking lot, and the VA Hospital. An L_{dn} of 60 dBA and a peak noise hour $L_{eq\ (h)}$ of 64 dBA were measured at this location.

4.2.4 Alternative 2—Westwood/VA Hospital Extension

In addition to the noise measurements at the stations for Alternative 1, additional existing noise levels were measured to describe areas that would be affected by this alternative at the following proposed station:

4.2.4.1 Westwood/VA Hospital Station

Noise levels were measured for 15 minutes in front of the VA Hospital and compared to the 24-hour levels measured at the Westwood/UCLA Off-Street Station (Figure 4-9). The area contains green space, a surface parking lot, and the VA Hospital. An L_{dn} of 60 dBA and a peak noise hour $L_{eq\ (h)}$ of 64 dBA were measured at this location.

4.2.5 Alternative 3—Santa Monica Extension

In addition to the noise measurements at the stations for Alternatives 1 and 2, additional existing noise levels were measured to describe areas that would be affected by this alternative at the following proposed stations:

4.2.5.1 Wilshire/Bundy Station

Noise levels were measured for 24 hours at 1224 Saltair Avenue south of Wilshire Boulevard (Figure 4-10.). This is located behind the retail and office buildings that front the proposed station location. The first row land uses adjacent to the proposed station are retail and office buildings. Single-family residential land uses are located behind the first row land uses on both sides of Wilshire Boulevard; one hotel is located north of Wilshire Boulevard. An L_{dn} of 65 dBA and a peak noise hour $L_{eq\ (h)}$ of 67 dBA were measured at this location.

4.2.5.2 Wilshire/26th Station

Noise levels were measured for 24 hours at 1138 26th Street north of Wilshire Boulevard (Figure 4-11). This is located behind the gas station that fronts the proposed station location. The first row land use adjacent to the proposed station is retail buildings. Single-family residential land uses are located behind the first row land uses on both sides of Wilshire Boulevard; a park is located to the north of Wilshire Boulevard west of 25th Street. An L_{dn} of 70 dBA and a peak noise hour $L_{eq\ (h)}$ of 69 dBA were measured at this location.

4.2.5.3 Wilshire/16th Station

Noise levels were measured for 24 hours at 1142 16th Street north of Wilshire Boulevard (Figure 4-12). This is located behind the retail and office buildings that front the proposed station location. The first row land use adjacent to the proposed station is retail buildings. Single-family residential land uses are located behind the first row land uses on both sides of Wilshire Boulevard. An L_{dn} of 62 dBA and a peak noise hour $L_{eq\ (h)}$ of 61 dBA were measured at this location.

4.2.5.4 Wilshire/4th Station

Noise levels were measured for 24 hours at 1122 4th Street north of Wilshire Boulevard (Figure 4-13). This is located behind the retail and office buildings that are adjacent to the proposed station location. The first row land use along the proposed station is retail buildings. Single-family residential land uses are located behind the first row land uses on the north side of Wilshire Boulevard. An L_{dn} of 69 dBA and a peak noise hour $L_{eq\ (h)}$ of 67 dBA were measured at this location.

4.2.6 Alternative 4—Westwood/VA Hospital Extension plus West Hollywood Extension

In addition to the noise measurements at the stations for Alternatives 1 and 2, additional existing noise levels were measured to describe areas that would be affected by this alternative at the following proposed stations:

4.2.6.1 Hollywood/Highland Station

Noise levels were measured for 24 hours at 6767 Selma Place east of Highland Avenue in the second row of apartments behind the retail store that fronts Highland Avenue (Figure 4-14). Hollywood High School is located to the west of Highland Avenue. All other land uses in the area are offices and retail stores. An L_{dn} of 69 dBA and a peak noise hour $L_{eq\ (h)}$ of 67 dBA were measured at this location.

4.2.6.2 Santa Monica/La Brea Station

Noise levels were measured for 24 hours at 7119 Detroit Street north of Santa Monica Boulevard (Figure 4-15). The land uses along the proposed station location are retail, office space, and industrial, with apartments south of Santa Monica Boulevard and west of Formosa Avenue. An L_{dn} of 74 dBA and a peak noise hour $L_{eq\ (h)}$ of 76 dBA were measured at this location.

4.2.6.3 Santa Monica/Fairfax Station

Noise levels were measured for 24 hours at 1050 Orange Grove Avenue, the first residential land use behind the commercial land use that is south of Santa Monica Boulevard (Figure 4-16). The land uses adjacent to the proposed station location are retail, office space, and industrial in front of residential land use on both sides of Santa Monica Boulevard. An L_{dn} of 67 dBA and a peak noise hour $L_{eq\ (h)}$ of 68 dBA were measured at this location.

4.2.6.4 Santa Monica/San Vicente Station

Noise levels were measured for 24 hours at the 909 Westbourne Drive apartments located behind the commercial land use north of Santa Monica Boulevard (Figure 4-17). The land uses adjacent to the proposed station location are retail, office space, and industrial in front of residential land use on both sides of Santa Monica Boulevard. An L_{dn} of 68 dBA and a peak noise hour $L_{eq\ (h)}$ of 65 dBA were measured at this location.

4.2.6.5 Beverly Center Area Station

Noise levels were measured for 24 hours at the Westbury Terrace (Figure 4-18). This is the only residential land use adjacent to the proposed station location; other land uses in the area are parking and retail shops. An L_{dn} of 73 dBA and a peak noise hour $L_{eq\ (h)}$ of 70 dBA were measured at this location.

4.2.7 Alternative 5—Santa Monica Extension plus West Hollywood Extension

The existing noise measurements that describe areas that would be affected by this alternative include the measurements for the all the stations under Alternatives 3 and 4.

4.2.8 MOS 1—Fairfax Extension

For minimum operable segment (MOS) 1, existing noise levels that were measured at the following proposed stations described under Alternative 1: Wilshire/Crenshaw, Wilshire/La Brea, and Wilshire/Fairfax describe areas that would be affected by MOS 1.

4.2.9 MOS 2—Century City Extension

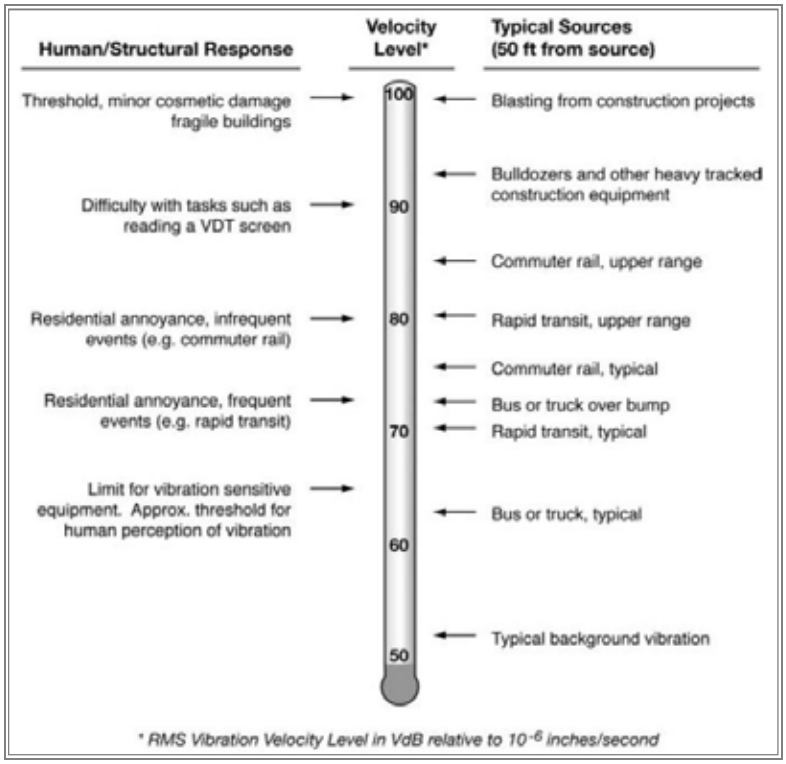
For MOS 2, existing noise levels that were measured at the following proposed stations described under Alternative 1: Wilshire/Crenshaw, Wilshire/La Brea, Wilshire/Fairfax, Wilshire/La Cienega, Wilshire/ Rodeo, and Century City (Santa Monica Boulevard) describe areas that would be affected by MOS 2.

4.2.10 Alignment Options

- **Option 1**—Includes all the stations in Alternatives 1, 2, 3, 4, and 5.
- **Option 2**—Includes all the stations in Alternatives 1, 2, 3, 4, and 5.
- **Option 3**—Includes all the stations in Alternatives 4 and 5.
- **Option 4**—Include all the stations in Alternatives 1, 2, 3, 4, and 5, plus the following:
  - **Century City (Constellation) Station**—Noise levels were measured for 24 hours at the Northwest corner of Avenue of the Stars and Constellation Boulevard (Figure 4-19). An office associated with a future condominium is located east of this location and the Hyatt Hotel is located on the Southwest corner. All other land use in the area is office buildings. An L_{dn} of 74 dBA and a peak noise hour $L_{eq\ (h)}$ of 78 dBA were measured at this location.
- **Options 5** —Include all the stations in Alternatives 1, 2, 3, 4, and 5, plus the following:
  - **Westwood/UCLA On-Street Station**—The noise levels measured for 24 hours at the Northeast corner of Wilshire Boulevard and Veteran Avenue for the Westwood/UCLA Off-Street Station also applies to this station option, since this measurement represents the local ambient noise environment. The Los Angeles National Cemetery is located on the Northwest corner of Wilshire Boulevard and Veteran Avenue. All other land uses in the area are offices and retail stores. An L_{dn} of 74 dBA and a peak noise hour $L_{eq\ (h)}$ of 79 dBA were measured at Wilshire Boulevard and Veteran Avenue.

4.3 Existing Conditions—Vibration Environment

The Project is located in the urban core of the cities of Los Angeles, West Hollywood, Beverly Hills, and Santa Monica, plus unincorporated portions of Los Angeles County. The existing ground vibration levels are typical of an urban environment, with the background VdB levels expected to range from 50 to 65 according to the FTA guidance manual. Figure 4-20 presents the typical range of ground-borne vibration levels.



Source: Transit Noise and Vibration Impact Assessment (FTA 2006)

Figure 4-20. Typical Ground-Noise Vibration Levels

An important factor in projecting levels of ground-borne vibration is the rate at which the vibration attenuates as it propagates away from the source. The relationship between a vibration source and the resulting vibration of the ground is known as the transfer mobility. The transfer mobility was determined by conducting vibration measurements in which the vibration pulses from a dropped weight were measured at various distances from the source. A load cell (force transducer) is used to measure the force input to the ground from the dropped weight, and calibrated vibration transducers are used to measure the vibration pulses at various distances from the source as shown in Figure 4-21. The frequency-dependent propagation characteristics are derived from the transfer function relationships of the ground surface vibration and the force. The tests were conducted by dropping the weight down a borehole to the depth of the subway tunnel invert.

A vibration propagation test was conducted at Fox Hills Drive and Missouri Avenue in Century City on June 9, 2010 (Figure 4-22). The borehole was constructed as part of the geotechnical studies that were being performed at that location. The designator for the borehole is SB2. The transfer mobility tests conducted for the 1st Street Tunnel as part of the *Los Angeles Eastside Corridor Final Supplemental Environmental Impact Statement/Final Subsequent Environmental Impact Report* (Metro 2005) were also used. The geology of the Eastside LRT 1st Street Tunnel is representative of the soil attenuation along the Westside Subway Extension. The geology and soil conditions for both of these areas consist of alluvial soils, with the tunnel profiles within the older, denser alluvium (clays, silts, and sands) characterized by standard penetration test (SPT) blow counts typically over 30, indicating dense to very dense granular soils and stiff to hard clays.

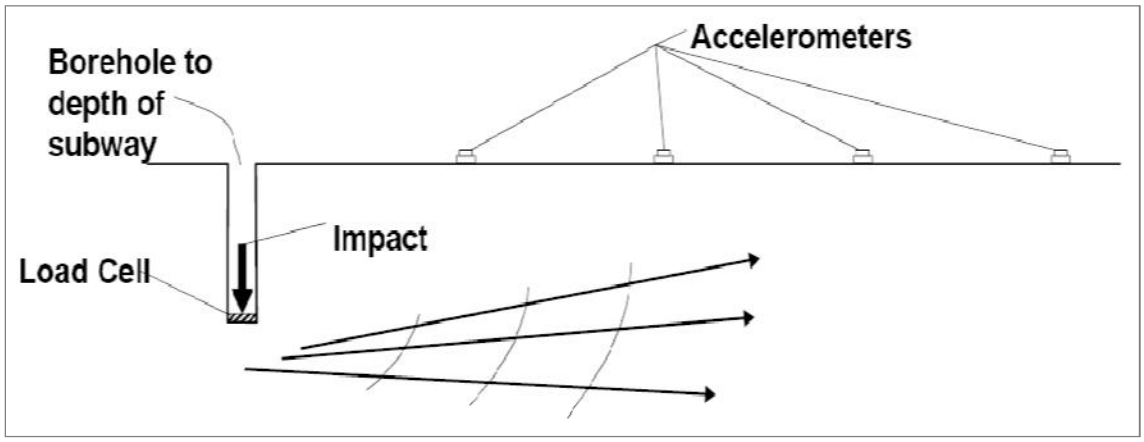


Figure 4-21. Test Configuration for Measuring Transfer Mobility

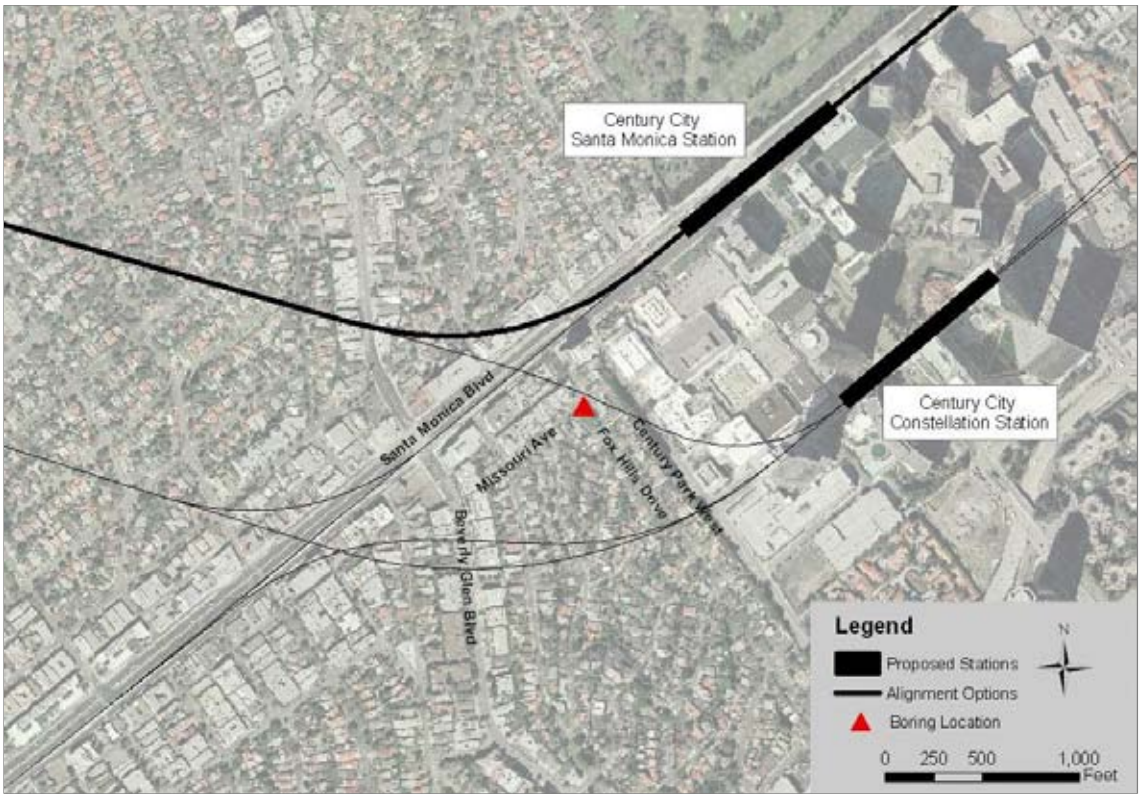


Figure 4-22. Location of Transfer Mobility Test

5.0 ENVIRONMENTAL CONSEQUENCES AND IMPACTS

5.1 Analysis Methodology

5.1.1 Transit Noise Assessment Methodology

The project-related operational noise levels used in the analysis of the Build Alternatives were based on FTA reference sound levels as provided in their guidelines, supplemented as appropriate by sound emission data from the existing Metro Red Line and Purple Line HRT subway vehicles. The operational assumptions (speed, headways, and schedule) used in estimating ridership, fare revenue, and other impacts of the proposed project were used for the operational noise and vibration analysis.

The methodology used to assess noise impact from the Project's below-grade subway operations follows the FTA methodology (FTA 2006). The analysis of project noise impact uses the existing noise levels as the baseline for comparison to existing-plus-project noise. The existing baseline conditions of the noise environment were based on the short-term measurement and long-term (24-hour) measurements that were previously discussed in Section 4.0. The FTA, in Table 2-1 of its guidance manual (FTA 2006), summarizes the common sources of transit noise. For subways, FTA lists the dominant noise components as fans and trains in tunnels producing noise through vent shafts.

Noise generated by this project's noise sources is not substantially different from noise generated by at-grade and elevated HRT projects with one very important difference: the Westside Subway Extension project is a deep subway. The subway train tracks are located between 50 and 130 feet below the ground surface. The noise generated below ground from the Westside Subway Extension rail transit operations would be from the interaction of train wheels on track, motive power, signaling and warning systems, plus the operation of traction power substations (TPSS). This noise would not be audible above ground. The guidance manual includes an *in general* comment that for subways, "Noise is not a problem."

Additional noise that would be generated above ground level by transit operations would include at-grade portions of stations, including patron portals to the underground stations, fan and vent shaft discharge locations, and emergency electrical power generators. Noise emissions from these above-ground components of the Project were evaluated, along with noise emissions from the proposed expanded Rail Operations Center, emergency egress locations, and maintenance facilities, such as yard and shop uses and the tracks servicing these facilities.

5.1.2 Transit Vibration Assessment Methodology

Vibration impacts from transit operations are generated by motions/actions at the wheel/rail interface. The smoothness of these motions/actions is influenced by wheel and rail roughness, transit vehicle suspension, train speed, track construction (including types of fixation), the location of switches and crossovers, and the geologic strata (layers of rock and soil) underlying the track. Vibration from a passing train has a relatively small potential to move through the geologic strata and result in building vibration from energy transferred through the building's foundation. Vibration levels that would be high enough to cause any building damage, even minor cosmetic damage, are extremely unlikely.

Ground-borne noise is a low-frequency rumble noise related to operational vibration that may occur when excessive levels of vibration of a building's floors and walls result from transit system operations. The ground-borne noise is not generally an a concern for at-grade or aboveground transit operations because the level of airborne noise from a passing at-grade or elevated train that is transmitted through the windows or walls of a building would exceed the ground-borne noise level occurring inside the building. However, a deep subway produces no appreciable airborne noise above the ground surface. So, the analysis considers the ground-borne noise related to the operational vibration, since the ground-borne noise may be slightly audible within a building that otherwise has low internal background noise. Because ground-borne noise is directly related to ground-borne vibration, the level of ground-borne noise is a function of the distance from the tracks to the building.

The process used to evaluate potential impacts from ground-borne vibration and ground-borne noise follows those outlined in *Transit Noise and Vibration Impact Assessment* (FTA 2006). The projections are based on characterizing the magnitude of the vibration forces generated by a transit train in terms of a force density and characterizing the propagation through the soil with a transfer mobility function. The force density is assumed to represent the combined effects of the vehicle suspension, the wheel and rail condition, and the track support system and is assumed to be independent of the local geologic conditions. Force density level measurements of the Breda vehicle, which would likely be the heavy rail vehicle used for the Westside Subway Extension, was conducted by Wilson Ihrig & Associates as part of the *Ground Vibration Measurements of Train Operations on Segment 2A of the Los Angeles Metro Red Line* (Metro 1996). The force density levels were measured at 40 mph and, for the purpose of this study, were adjusted to 60-mph following the FTA Detailed Vibration Analysis methodogy (Figure 5-1.).

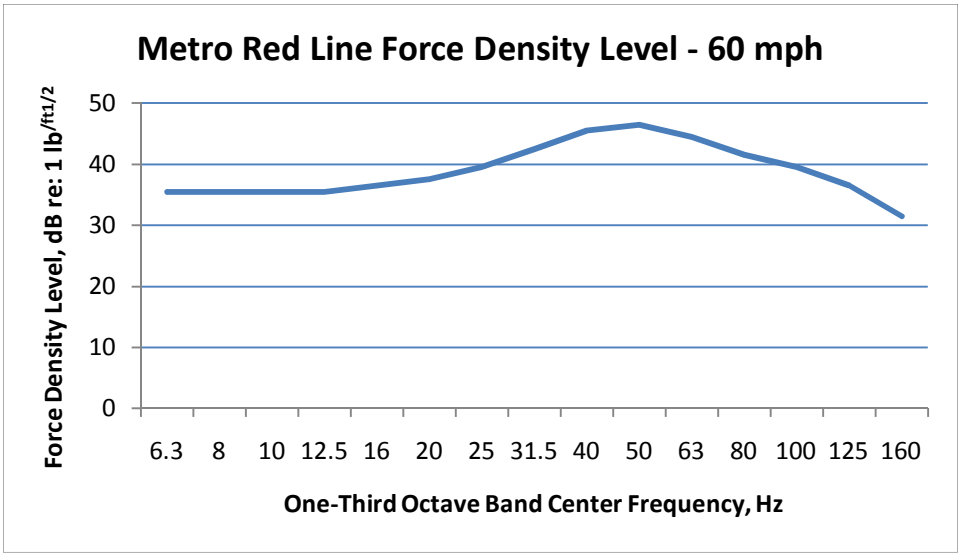


Figure 5-1. Measured Metro Red Line Force Density Level

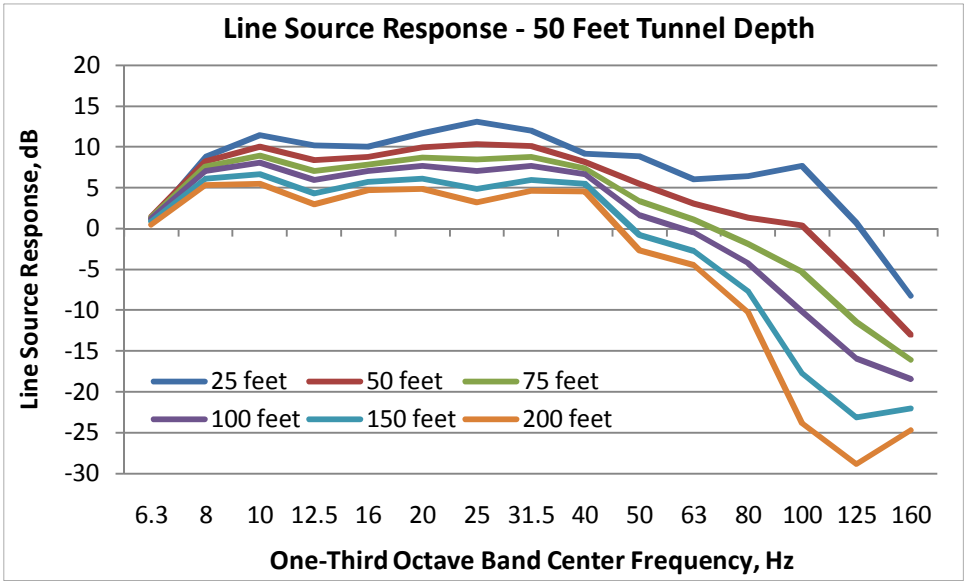


Figure 5-2. Measured Line Source Response for Tunnel Depth of 50 Feet

The transfer mobility function data used for this analysis is shown in Figure 5-2 as a line source response for a 50 foot tunnel depth measured at horizontal distances from the borehole of 25 to 200 feet. Line source responses for tunnel depths of 30 to 100 feet were also used. The combination of the force density (Figure 5-1.) and transfer mobility functions (Figure 5-2) provides an estimate at the ground surface as a function of distance from the tracks, the horizontal distance and the depth of the subway tunnels. All estimates of ground-borne vibration are calculated in one-third octave bands. The overall vibration level in VdB is calculated from the individual one-third octave bands and compared to the FTA criteria presented in Section 3 of this report. The predicted vibration levels are at the foundation of each building and do not include any estimates of building coupling loss. These projections are representative of first floor vibration levels for buildings constructed as a concrete slab on grade. In addition, a 5-decibel safety factor has been incorporated into all of the ground-borne vibration and ground-borne noise projections. The purpose of the safety factor is to account for the normal fluctuations in ground-borne vibration due to normal wheel and track wear, and unexpected differences in the local soil and geology that were not represented by the transfer mobility tests.

The ground-borne vibration and ground-borne noise were calculated at 183 receivers along the alignments of the project alternatives. Table 5-1 presents the predicted levels and FTA impacts criteria and Figure 5-3 through 5.5 show the locations of the receivers.

Table 5-1. Predicted Ground-borne Vibration and Ground-borne Noise at Vibration-Sensitive Receivers

ID #	Receiver	Tunnel Depth (feet)	Horizontal Distance (feet)	Predicted Ground-borne Vibration Level (VdB)	FTA Ground-borne Vibration Criteria (VdB)	Predicted Ground-borne Noise Level (dBA)	FTA Ground-borne Noise Criteria (dBA)	Alternatives, Alignment and Station Options
1	Ramada Inn	54	35	65	72	**38**	35	1,2,3
2	St Andrews Church	54	30	65	75	38	40	1,2,3
3	Apartments	58	40	65	72	**38**	35	1,2,3
4	Los Altos Hotel	62	30	64	72	**38**	35	1,2,3
5	Dunnes Inn	50	35	65	72	**38**	35	1,2,3
6	Wilshire United Methodist Church	50	40	65	75	38	40	1,2,3
7	Scottish Rite Masonic Temple	50	40	65	75	38	40	1,2,3
8	Wilshire Bell Theatre	50	40	65	72	**38**	35	1,2,3
9	Apartments	52	40	65	72	**38**	35	1,2,3
10	Apartments	54	35	65	72	**38**	35	1,2,3
11	Apartments	54	30	65	72	**38**	35	1,2,3
12	Apartments	52	60	63	72	33	35	1,2,3
13	SFR	62	120	62	72	31	35	1,2,3
14	Apartments	68	40	64	72	**38**	35	1,2,3
15	Apartments	59	50	63	72	33	35	1,2,3
16	Wilshire Private School	59	60	63	75	33	40	1,2,3
17	Apartments	54	30	65	72	**38**	35	1,2,3
18	Apartments	50	40	65	72	**38**	35	1,2,3
19	Korea Center	50	40	65	75	**38**	35	1,2,3
20	Apartments	53	35	65	72	**38**	35	1,2,3
21	Mid Wilshire Surgery Center	58	60	63	75	33	40	1,2,3
22	Craft and Farm Art Museum	58	35	65	75	38	40	1,2,3
23	LA County Museum of Art	50	50	63	75	33	40	1,2,3
24	Apartments	49	40	68	72	**42**	35	1,2,3
25	SFR	49	270	42	72	26	35	1,2,3
26	SFR	68	200	38	72	29	35	1,2,3
27	Los Angeles Museum of the Holocaust	68	40	64	75	38	40	1,2,3
28	SFR	68	170	61	72	30	35	1,2,3
29	Saban Theatre	68	30	64	72	**38**	35	1,2,3
30	Fine Arts Theatre	58	30	65	72	**38**	35	1,2,3
31	Apartments	60	30	64	72	**38**	35	1,2,3
32	Specialty Surgical Center	65	35	64	75	**38**	35	1,2,3
33	SFR	70	150	59	72	27	35	1,2,3
34	SFR	79	190	59	72	27	35	1,2,3,4,5
35	SFR	76	200	37	72	25	35	1,2,3,4,5
36	Apartments	52	60	63	72	33	35	1,2,3,4,5
37	SFR	54	170	59	72	27	35	1,2,3,4,5
38	Beverly Wilshire Hotel	57	35	65	72	**38**	35	1,2,3,4,5
39	SFR	70	330	37	72	25	35	1,2,3,4,5
40	The Peninsula Hotel	74	160	59	72	27	35	1,2,3,4,5
41	The Beverly Hilton	71	45	64	72	**37**	35	1,2,3,4,5
42	Skin Clinic	50	15	65	75	38	40	1,2,3,4,5
43	SFR	70	50	63	72	**39**	35	1,2,3,4,5
44	SFR	98	0	60	72	31	35	1,2,3,4,5
45	Apartments	96	0	60	72	31	35	1,2,3,4,5
46	SFR	120	0	56	72	25	35	1,2,3,4,5
47	SFR	98	0	60	72	31	35	1,2,3,4,5

Table 5-1. Predicted Ground-borne Vibration and Ground-borne Noise at Vibration-Sensitive Receivers (continued)

ID #	Receiver	Tunnel Depth (feet)	Horizontal Distance (feet)	Predicted Ground-borne Vibration Level (VdB)	FTA Ground-borne Vibration Criteria (VdB)	Predicted Ground-borne Noise Level (dBA)	FTA Ground-borne Noise Criteria (dBA)	Alternatives, Alignment and Station Options
48	SFR	96	0	60	72	31	35	1,2,3,4,5
49	Apartments	78	0	64	72	**37**	35	1,2,3,4,5
50	Apartments Hi-Rise	73	0	64	72	**37**	35	1,2,3,4,5
51	Apartments Hi-Rise	75	70	63	72	34	35	1,2,3,4,5
52	Apartments Hi-Rise	80	70	60	72	29	35	1,2,3,4,5
53	Apartments Hi-Rise	84	60	60	72	29	35	1,2,3,4,5
54	Apartments Hi-Rise	95	80	59	72	27	35	1,2,3,4,5
55	Apartments Hi-Rise	96	50	59	72	29	35	1,2,3,4,5
56	Apartments Hi-Rise	99	85	59	72	27	35	1,2,3,4,5
57	Apartments Hi-Rise	96	30	60	72	31	35	1,2,3,4,5
58	Apartments	104	0	56	72	25	35	1,2,3,4,5
59	Apartments	82	0	61	72	32	35	1,2,3,4,5
60	Armand Hammer Museum (Southside)	64	40	64	75	38	40	1,2,3,4,5
61	Gayley Center	56	30	65	75	38	40	1,2,3,4,5
62	Federal Building	50	60	63	75	33	40	1,2,3,4,5
63	VA Hospital	56	300	38	72	25	35	2,3,5
64	SFR	52	140	61	72	29	35	3,5
65	SFR	54	100	47	72	18	35	3,5
66	Barrington Plaza (apartments)	68	30	64	72	**38**	35	3,5
67	Apartments	74	195	59	72	27	35	3,5
68	Wilshire Motel	61	30	64	72	**38**	35	3,5
69	Condos Hi-Rise	60	30	64	72	**38**	35	3,5
70	Apartments-Mixed	58	30	65	72	**38**	35	3,5
71	Apartments	58	185	59	72	27	35	3,5
72	SFR	70	160	59	72	27	35	3,5
73	Apartments	78	125	60	72	27	35	3,5
74	Apartments	56	185	59	72	27	35	3,5
75	SFR	55	200	38	72	25	35	3,5
77	SFR	52	190	59	72	27	35	3,5
78	SFR	55	150	59	72	27	35	3,5
79	Surgery Center of Santa Monica	56	30	65	75	38	40	3,5
80	Pilgrim Lutheran Church	49	35	68	75	**42**	40	3,5
81	Santa Monica UCLA Medical Center	50	35	65	72	**38**	35	3,5
82	Apartments	48	130	60	72	33	35	3,5
83	Apartments	48	120	60	72	33	35	3,5
84	Apartments	67	130	62	72	31	35	3,5
85	Apartments	68	40	64	72	**38**	35	3,5
87	Apartments	62	30	64	72	**38**	35	3,5
88	Apartments	60	30	64	72	**38**	35	3,5
89	Apartments	55	170	59	72	27	35	3,5
90	Hollywood High	39	90	63	75	37	40	4,5
91	Apartments	31	160	56	72	28	35	4,5
92	SFR	34	160	56	72	28	35	4,5
93	SFR	60	30	64	72	**38**	35	4,5
94	SFR	52	200	38	72	25	35	4,5
95	Apartments	50	30	65	72	**38**	35	4,5
96	Apartments	52	20	65	72	**38**	35	4,5

Table 5-1. Predicted Ground-borne Vibration and Ground-borne Noise at Vibration-Sensitive Receivers (continued)

ID #	Receiver	Tunnel Depth (feet)	Horizontal Distance (feet)	Predicted Ground-borne Vibration Level (VdB)	FTA Ground-borne Vibration Criteria (VdB)	Predicted Ground-borne Noise Level (dBA)	FTA Ground-borne Noise Criteria (dBA)	Alternatives, Alignment and Station Options
97	SFR	52	130	61	72	29	35	4,5
98	Community Center	59	80	62	75	31	40	4,5
99	Apartments	62	150	61	72	30	35	4,5
100	Apartments	60	20	64	72	**38**	35	4,5
101	Fire Station 8	57	20	65	72	**38**	35	4,5
102	SFR	56	150	59	72	27	35	4,5
103	Apartments	56	150	59	72	27	35	4,5
104	SFR	51	130	61	72	29	35	4,5
105	SFR	100	58	54	72	23	35	4,5
106	Apartments	60	150	61	72	30	35	4,5
107	West Hollywood City Hall	62	25	64	75	38	40	4,5
108	SFR	62	100	62	72	31	35	4,5
109	Holloway Motel	62	70	64	72	34	35	4,5
110	Apartments	64	85	63	72	32	35	4,5
111	Ramada	65	120	62	72	31	35	4,5
112	SFR	55	180	59	72	27	35	4,5
113	SFR	56	140	61	72	29	35	4,5
114	Lofts	52	50	63	72	33	35	4,5
115	West Hollywood Library	70	50	63	75	34	40	4,5
116	SFR	66	10	64	72	**38**	35	4,5
117	SFR	66	90	63	72	32	35	4,5
118	SFR	52	80	62	72	31	35	4,5
119	SFR	69	60	64	72	34	35	4,5
120	SFR	70	0	64	72	**37**	35	4,5
121	SFR	70	210	37	72	25	35	4,5
122	SFR	70	110	60	72	30	35	4,5
123	SFR	73	110	60	72	30	35	4,5
124	SFR	74	220	37	72	25	35	4,5
125	Cedars Sinai Medical Center	70	30	64	72	**37**	35	4,5
126	Westbury Terrace (condominiums)	69	30	64	72	**38**	35	4,5
127	Apartments	76	230	37	72	25	35	4,5
128	SLS at Beverly Hills (hotel)	79	0	64	72	**37**	35	4,5
129	SFR	82	0	61	72	32	35	4,5
130	SFR	82	0	61	72	32	35	4,5
131	SFR	77	0	64	72	**37**	35	4,5
132	SFR	72	0	64	72	**37**	35	4,5
133	SFR	72	0	64	72	**37**	35	4,5
134	Apartments	98	0	60	72	31	35	Option 4, Constellation South
135	SFR	97	0	60	72	31	35	Option 4, Constellation South
136	SFR	80	0	61	72	32	35	Option 4, Constellation South

Table 5-1. Predicted Ground-borne Vibration and Ground-borne Noise at Vibration-Sensitive Receivers (continued)

ID #	Receiver	Tunnel Depth (feet)	Horizontal Distance (feet)	Predicted Ground-borne Vibration Level (VdB)	FTA Ground-borne Vibration Criteria (VdB)	Predicted Ground-borne Noise Level (dBA)	FTA Ground-borne Noise Criteria (dBA)	Alternatives, Alignment and Station Options
137	SFR	73	0	64	72	**37**	35	Option 4, Constellation South
138	SFR	61	30	64	72	**38**	35	Option 4, Constellation South
139	Beverly Hills High School (Constellation South)	72	0	64	75	37	40	Option 4, Constellation South
140	Future Residential Hi-Rise	60	40	64	72	**38**	35	Option 4, Constellation North and South
141	Hyatt	200	64	54	72	23	35	Option 4, Constellation North and South
142	Apartments	88	10	61	72	32	35	Option 4, Constellation North
143	Apartments	89	0	61	72	32	35	Option 4, Constellation North
144	Apartments	94	0	60	72	32	35	Option 4, Constellation North
145	SFR	70	0	64	72	**37**	35	Option 4, Constellation North
146	Beverly Hills Unified School District Instructional Center	60	0	64	75	38	40	Option 4, Constellation North
147	Beverly Hills High School (Constellation North)	74	0	64	75	37	40	Option 4, Constellation North
148	SFR	62	55	64	72	34	35	Option 5, Central
149	SFR	102	0	56	72	25	35	Option 5, Central
150	SFR	114	0	56	72	25	35	Option 5, Central
151	SFR	117	0	56	72	25	35	Option 5, Central
152	SFR	82	0	61	72	32	35	Option 5, Central
153	SFR	116	0	56	72	25	35	Option 5, Central
154	SFR	101	0	56	72	25	35	Option 5, Central
155	SFR	116	0	56	72	25	35	Option 5(On-Street), Central
156	SFR	142	0	56	72	25	35	Option 5 (On-Street) Central
157	High Rise Apartment	131	0	56	72	25	35	Option 5(On-Street), Central
158	Armand Hammer Museum (North Side)	79	50	63	75	34	40	Option 5(On-Street), East and Central
159	SFR	82	40	61	72	32	35	Option 5 West
160	Apartments	72	40	64	72	**37**	35	Option 5 West
161	Apartments	77	100	60	72	30	35	Option 5 West
162	Apartments	77	40	64	72	**37**	35	Option 5 West
163	Mormon Temple	72	300	36	75	25	40	Option 5 West

Table 5-1. Predicted Ground-borne Vibration and Ground-borne Noise at Vibration-Sensitive Receivers (continued)

ID #	Receiver	Tunnel Depth (feet)	Horizontal Distance (feet)	Predicted Ground-borne Vibration Level (VdB)	FTA Ground-borne Vibration Criteria (VdB)	Predicted Ground-borne Noise Level (dBA)	FTA Ground-borne Noise Criteria (dBA)	Alternatives, Alignment and Station Options
164	Travel Lodge	74	40	64	72	**37**	35	Option 5 West
165	Royal Santa Monica Motel	69	80	63	72	32	35	Option 5 West
166	SFR	72	40	64	72	**37**	35	Option 5 West
167	Apartments	84	25	61	72	32	35	Option 5 West
168	SFR	100	155	42	72	13	35	Option 5 West
169	SFR	99	0	60	72	31	35	Option 5 West
170	SFR	96	0	60	72	31	35	Option 5 West
171	SFR	89	30	61	72	32	35	Option 5 West
172	SFR	89	25	61	72	32	35	Option 5 West
173	SFR	106	0	56	72	25	35	Option 5 West
174	SFR	80	0	61	72	32	35	Options 4 and 5 East
175	SFR	79	0	64	72	**37**	35	Option 4 and 5 East
176	SFR	62	0	64	72	**38**	35	Option 4 and 5 Central
177	SFR	62	0	64	72	**38**	35	Option 4 and 5 Central
178	Apartments	56	0	65	72	**38**	35	Option 4 and 5 Central
179	Apartments	101	0	56	72	25	35	Option 4 and 5 Central
180	SFR	64	0	64	72	**38**	35	Options 4 and 5 West
181	Apartments	45	0	68	72	**42**	35	Options 4 and 5 West
182	Apartments	97	0	60	72	31	35	Options 4 and 5 West
183	SFR	60	200	38	72	29	35	4,5 Option 3
184	SFR	60	144	62	72	31	35	4,5 Option 3
185	Apartments	55	0	65	72	**38**	35	4,5 Option 3

Notes: 1. Bolded values indicate exceedance of FTA criteria
2. SFR = single-family residence
3. The ID numbers are shown on Figure 5-3 through 5-5

Figure 5-3. Vibration Sensitive Locations—Western Ave/Hollywood Blvd to Robertson Blvd

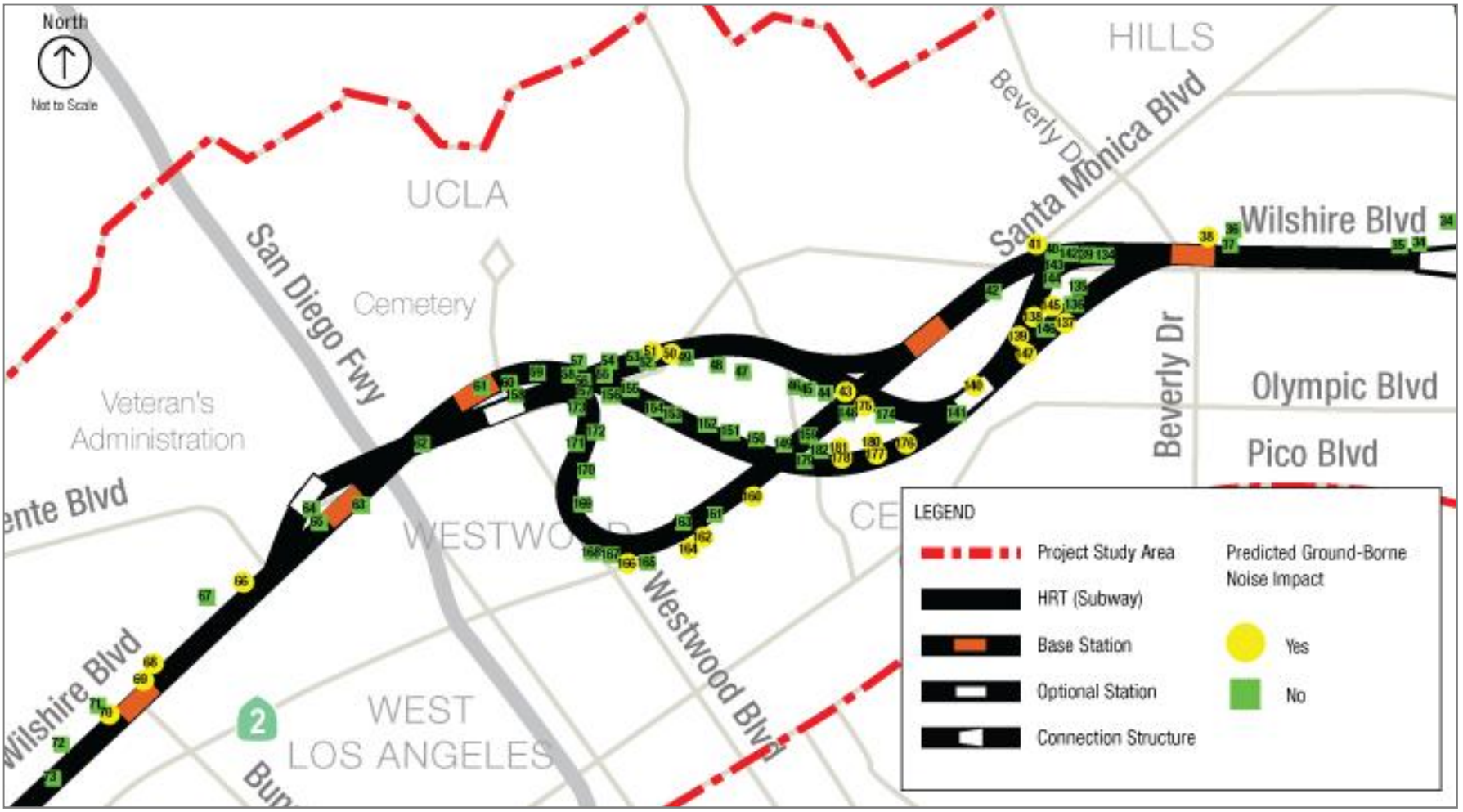


Figure 5-4. Vibration Sensitive Locations—Robertson Blvd to Barrington Ave

Figure 5-5. Vibration Sensitive Locations—Barrington Ave to 2nd Street

Vibration can damage historic structures located very close to operation of rail systems.[1] Furthermore, vibration may interfere with vibration-sensitive equipment. Thus, the potential for transit operations to affect historic structures and vibration-sensitive uses was evaluated. To be conservative, the FTA criterion level of 90 VdB for the most sensitive class of historic structure (extremely fragile) was used in the impact analysis of historic buildings generally. The predicted ground-borne vibration levels, as presented in Figure 5-1., would not exceed the FTA criterion of 90 VdB.

5.2 Transit Noise Impacts

This technical report focuses on operational noise. Construction noise assessment methodology and impacts analysis may be found in the *Construction and Mitigation Technical Report*.

5.2.1 No Build Alternative

The No Build Alternative includes all existing highway and transit services and facilities, and the committed highway and transit projects in the Metro *2009 Long Range Transportation Plan* (LRTP) and the Southern California Association of Governments (SCAG) *2008 Regional Transportation Plan* (RTP).[2] Under the No Build Alternative, no new infrastructure would be built within the study corridor, aside from projects currently under construction or projects funded for construction, environmentally cleared, planned to be in operation by 2035, and identified in the RTP and LRTP.

The environmental noise that would result with this alternative would be a continuation of the current baseline levels of environmental noise in the project study corridor. Noise from motor vehicles travelling on the existing surface road network dominates the noise environment in the project area. A review of the traffic impact analysis prepared for this project (Fehr 2010) suggests that the existing traffic patterns and volumes would remain essentially unchanged. Because traffic-carrying capacity is already at or near saturation, there is almost no opportunity for any appreciable increase in traffic volumes on the existing network. Any slight local increases in traffic volume would be accompanied by a reduction in vehicle speeds, thus the net effect on community noise level (L_{dn}) is neutral, with a slight bias toward a non-perceptible (<1 dBA) traffic noise increase if there were to be any change at all. The No Build Alternative would cause no noise impacts.

5.2.2 Transportation System Management Alternative

The TSM Alternative enhances the No Build Alternative by expanding bus services. Although the frequency of buses and, therefore, the number of buses per day would increase, the relative change in the overall number of buses compared to the very large existing and future volumes of automobiles and trucks using the area's local and regional highways are small. Thus, the effect on the noise environment is also very small and not likely to be perceptible (<1 dBA) on an L_{dn} basis. The TSM Alternative would cause no noise impacts.

[1] An inventory of historic buildings was conducted, and the results may be found in the *Historic Survey Report* (URS 2010b).
[2] Metro is working with SCAG to update the RTP, which would add the projects identified in Metro's LRTP into the RTP. It is anticipated that the update will have been completed by May 2010.

5.2.3 All Build Alternatives

The noise-generating project components are common to all of the proposed build alternatives. The potential noise impacts of these common features are evaluated in this section and would occur with any of the build alternatives discussed below.

Because the Westside Subway Extension Project is an HRT deep subway, noise from rail transit operations, including the interaction of wheels on tracks, motive power, signaling and warning systems, and the TPSS would be well below ground and noise from these components of the proposed project would be inaudible at ground level and above. Thus, there would be no noise impact from these components of the project as described below.

The TPSSs for the entire system are planned to be co-located within the underground stations and would generate no noise outside of the station. No noise impacts are anticipated from TPSSs.

The non-train-noise associated with subway transit operations typically occurs at station locations where increased street-grade activity, such as parking lot use, may locally generate noise. The Westside Subway Extension Project does not propose to incorporate any station-related parking facilities; therefore, this source of transit-related noise would not be present and would not cause a noise impact.

The existing road and sidewalk network would be utilized for passenger access to the underground stations. The impact analysis found that, while noise could be generated in the aboveground portion of stations from pedestrians, bicyclists, and passenger drop off activities, these activities are not significant noise generators. Any brief noise would be minimal and would not result in noise impact.

The analysis predicted no noise impact for any of the build alternative, MOS 1, MOS 2 and all of the station and alignment options.

5.2.4 Other Components of the Build Alternatives

Other components of the Build Alternatives include emergency electrical power generators, subway tunnel vent discharge/emergency egress locations, an expanded ROC, and at-grade rail vehicle nightly storage and vehicle maintenance facilities.

Emergency electrical power generators are proposed to be located at the surface adjacent to the following stations: Wilshire/La Brea, Century City (Santa Monica), Century City (Constellation), Westwood/VA Hospital, Wilshire/26th, Hollywood/Highland, Santa Monica/La Brea, and Santa Monica/San Vicente. Noise from periodic testing of emergency power generators is project-related noise. Emergency electrical power generating equipment will be required to meet Metro the following provision in Section 2.8.7-D of Metro's *Design Criteria* for Emergency Power Generation Equipment*:*

> "Emergency power generator equipment noise shall be tested during the time of day when existing ambient noise is at its maximum level. Equipment testing shall be limited to a maximum period of ten (10) minutes once a week or less. During times of periodic testing, the emergency power generator equipment shall be limited to no more than 10 dBA sound level above the ambient noise levels or 10 dBA more than the levels listed for continuous noise in [Metro Design Criteria] Table 2-9 at a

distance of 50 feet from the generator or at the nearest building or occupied area, whichever is closer. Reduction of noise from these sources shall be achieved by barriers, enclosures, sound absorption materials and mufflers as applicable to the individual facility or unit design."

Metro's noise criteria table is reproduced below on Table 5-2.

Table 5-2. Metro Design Criteria for Noise from Transit System Ancillary Facilities

Community Area	Maximum Noise Level (dBA)	
	Transient	Continuous
Low-density residential	50	40
Average residential	55	45
High-density residential	60	50
Commercial	65	55
Industrial/highway	75	65

Source: Metro Design Criteria, Table 2-9 (Metro 2009)[3]

The criteria in the Metro Design Criteria table is applied at a distance of 50 feet from the shaft outlet or other ancillary facility or is applied at the setback line of the nearest building or occupied area, whichever is closer. The transient noise design goals apply to short-time duration events, such as passing train noise transmitted from vent shaft openings. The continuous noise design goals apply to noises such as fans, cooling towers, electrical power generators, or other long-duration noises. Because the project will be designed to meet these criteria, the at-grade emergency power generators would not create a noise impact.

There are potentially up to eight locations that may require a tunnel ventilation shaft. These locations are listed in Table 5-3.

Table 5-3. Potential Vent Shaft Locations

Alternative/Option	Location
Alternatives 1 through 5, MOS 2	Part of the connection structure on Wilshire Boulevard, west of Robertson Boulevard
Alternatives 2 through 5	West of the Westwood/VA Hospital Station on Army Reserve property at Federal Avenue and Wilshire Boulevard
Option 4 via East route	At Wilshire Boulevard/Manning Avenue intersection
Option 4 to Westwood/UCLA Off-Street Station via Central route	On Santa Monica Boulevard just west of Beverly Glen Boulevard
Option 4 to Westwood/UCLA On-Street Station via Central route	At Santa Monica Boulevard/Beverly Glen Boulevard intersection
Options 4 via West route	At Santa Monica Boulevard/Glendon Avenue intersection
Options 4 from Constellation Station via Central route	On Santa Monica Boulevard between Thayer and Pandora Avenues
Option from Constellation Station via West route	On Santa Monica Boulevard just east of Glendon Avenue

[3]Noise mitigation measures to be incorporated into project design and procurement documents as referenced in this technical report were based in part on the latest revision (Systemwide Baseline Change Notice (SBCN) 18 Rev. 001 05.03.95) to the *Metro Design Criteria*. At the time of this report, Metro is in the process of revising its Design Criteria. At this point the relevant sections in the *2009 Draft Metro Design Criteria* as referenced herein appear to be essentially unchanged from the 1995 version.

The "tunnel vents" that discharge air at the top of the shaft can be a source of noise at the ground surface during train operations. Excessive noise from tunnel air discharge vents can be readily attenuated by incorporating discharge silencers, sound attenuating louvers, or acoustic treatment to the vent shaft interior surface. Once the final vent shaft locations are established and the actual non-attenuated sound level expected from each tunnel vent shaft is known, the amount of vent shaft discharge noise attenuation that is required to have no impact can be calculated. The required noise levels can be achieved by inclusion of the following Metro criteria from Section 2.8.7-B of its Design Criteria into the project's design and construction contract documents:

> "For fan and vent shafts with surface gratings or openings, the noise shall be limited in accordance with the criteria for exterior noise from ancillary facilities *[Table 5-3 above]*. Vent shaft noise reductions shall be achieved by absorption treatment in the shafts applied to the walls and ceilings. Fan shaft noise reduction shall be achieved by use of standard duct attenuators in shafts where the fans are near the surface gratings. For shafts with fans located remotely from the grating, the noise reduction shall be achieved by the use of standard attenuators. Sound absorption treatment shall be applied to the fan room and shaft walls and ceilings, with the combination to achieve the total attenuation required. Where absorption treatment is necessary, the treatment shall have a minimum sound absorption coefficient of 0.6 at 250 Hz and 0.8 at 500 Hz."

With the incorporation of these specifications into the design of the project, there would be no impact from the project's fan and vent discharge locations.

Noise associated with the proposed expanded ROC would not materially contribute to the existing noise level, thus there would be no impact from this component of the Project.

The expanded vehicle storage and maintenance facilities associated with this Project would be located in the existing Division 20 Vehicle Storage and Maintenance Facility or would utilize nearby existing railroad facilities (Union Pacific Los Angeles Transportation Center Rail Yard) that are already in use for the same or similar purposes. The proposed storage and maintenance facilities are remote from residences and other noise-sensitive uses. Thus, there are no potential noise impacts from the vehicle storage and maintenance facilities proposed as part of this Project.

5.3 Transit Vibration Impacts

This report focuses on operational vibration impacts. Construction vibration assessment methodology and impacts analysis may be found in the *Construction and Mitigation Technical Report.*

5.3.1 No Build Alternative

No new sources of vibration would be introduced to the project area as a result of selecting this alternative. The No Build Alternative would result in no vibration impact.

5.3.2 Transportation System Management Alternative

The additional bus could be considered new sources of vibration that would be introduced to the project area as a result of selecting the TSM Alternative. Vibration generated by rubber-

tired vehicles, such as transit buses, is very small and highly unlikely to cause impact to any adjacent uses. The TSM Alternative would result in no vibration impact.

5.3.3 Build Alternatives

There are no vibration sensitive receivers that are predicted to exceed the FTA ground-borne vibration criteria. Exceedance of the FTA ground-borne noise criteria could occur at 42 residential building locations, 3 medical centers, 3 theaters, and 8 hotels/motels. These exceedances are in the range of 1 to 7 db above the 35-dBA ground-borne noise criterion. The majority of the locations are predicted to exceed the FTA criteria by no more than 3 dB with only two locations at 6 to 7 dB above the criterion. As part of the Preliminary Engineering design, transfer mobility tests would be conducted to confirm the predicted impact and the need for mitigation.

5.3.4 Alternative 1—Westwood/UCLA Extension

The FTA ground-borne noise criteria are predicted to be exceeded at 22 locations for Alternative 1. Figures 5-3 to 5-4 shows the 22 locations and Table 5-4 provides the cross streets for each of the 22 locations.

5.3.5 Alternative 2—Westwood/VA Hospital Extension

The FTA ground-borne noise criteria are predicted to be exceeded at the same 22 locations for Alternative 2 that were exceeded in Alternative 1. Figures 5-3 to 5-4 shows the 22 locations and Table 5-4 provides the cross streets for each of the 22 locations.

5.3.6 Alternative 3—Santa Monica Extension

Ground-borne noise, for Alternative 3, is predicted to exceed the FTA ground-borne noise criteria at the same locations as Alternates 1 and 2, shown in Figures 5-3 to 5-4 and listed in Table 5-4. The 8 additional locations are shown Figure 5-5 and Table 5-5 provides the cross streets for these additional locations.

5.3.7 Alternative 4—Westwood/VA Hospital Extension plus West Hollywood Extension

The FTA ground-borne noise criteria are predicted to be exceeded at 18 locations for Alternative 4 with baseline stations. The 18 locations are shown in Figures 5-3 and 5-4 and Table 5-6 provides the cross streets for each of the 18 locations.

5.3.8 Alternative 5—Santa Monica Extension plus West Hollywood Extension

Alternative 5 would included the predicted ground-borne noise impacts at the same locations listed in Table 5-5 and shown in Figure 5-5 for Alternatives 3 and the same 18 locations listed in Table 5-6 and shown in Figures 5-3 and 5-4 for Alternative 4.

Table 5-4. Ground-Borne Noise Impact Locations between Wilshire/Western Station to Westwood/VA Hospital Station —Alternatives 1, 2, 3, and MOS 2

ID#	Receiver	Cross Street	Cross Street	Alternative
1	Ramada Inn	St Andrews Place	Gramercy Place	1,2,3
3	Apartments	Norton Avenue	Bronson Avenue	1,2,3
4	Los Altos Hotel	Norton Avenue	Bronson Avenue	1,2,3
5	Dunnes Inn	Bronson Avenue	Crenshaw Boulevard	1,2,3
8	Wilshire Ebell Theatre	Lucerne Boulevard	Arden Boulevard	1,2,3
9	Apartments	Lucerne Boulevard	Arden Boulevard	1,2,3
10	Apartments	Arden Boulevard	Rossmore Avenue	1,2,3
11	Apartments	Rossmore Avenue	Murfield Road	1,2,3
14	Apartments	Tremaine Avenue	McCadden Place	1,2,3
17	Apartments	Mansfield Avenue	Orange Drive	1,2,3
18	Apartments	Detroit Street	Cloverdale Avenue	1,2,3
20	Apartments	Ridgely Drive	Hauser Boulevard	1,2,3
24	Apartments	Fairfax Avenue	Crescent Heights Bl.	1,2,3
29	Saban Theatre	Gale Drive	La Cienega Boulevard	1,2,3
30	Fine Arts Theatre	Le Doux Road	Stanley Drive	1,2,3
31	Apartments	Stanley Drive	Carson Drive	1,2,3
32	Specialty Surgical Center	Wilshire Boulevard	Robertson Boulevard	1,2,3
38	Beverly Wilshire Hotel	El Camino Drive	Rodeo Drive	1,2,3
41	The Beverly Hilton	Wilshire Boulevard	Moreno Drive	1,2,3
43	SFR	Wilshire Boulevard	Santa Monica Boulevard	1,2,3
50	Apartments Hi-Rise	Holme Ave	Selby Ave	1,2,3
51	Apartments Hi-Rise	Holme Ave	Selby Ave	1,2,3

Table 5-5. Ground-Borne Noise Impact Locations between Westwood/VA Hospital Station to Wilshire/4th Street Station —Alternatives 3 and 5

ID#	Receiver	Cross Street	Cross Street	Alternative
66	Barrington Plaza	Barry Avenue	Barrington Avenue	3,5
68	Wilshire Motel	Brockton Avenue	Saltair Avenue	3,5
69	Condos Hi-Rise	Saltair Avenue	Bundy Drive	3,5
70	Apartments-Mixed	Amherst Avenue	Wellesley Avenue	3,5
80	Pilgrim Lutheran Church	18th Street	17th Street	3,5
85	Apartments	9th Street	Lincoln Boulevard	3,5
87	Apartments	6th Street	5th Street	3,5
88	Apartments	6th Street	5th Street	3,5

Table 5-6. Ground-Borne Noise Impact Locations between Hollywood/Highland Station to Wilshire/La Cienega Station —Alternatives 4 and 5

ID#	Receiver	Cross Street	Cross Street	Alternative
90	Hollywood High School	Hollywood Boulevard	Sunset Boulevard	4,5
93	SFR	Highland Avenue	Lexington Avenue	4,5
95	Apartments	Poinsettia Place	Fuller Avenue	4,5
96	Apartments	Poinsettia Place	Fuller Avenue	4,5
100	Apartments	Curson Avenue	Stanley Avenue	4,5
101	Fire Station 8	Stanley Avenue	Spaulding Avenue	4,5
116	SFR	Melrose Avenue	Rangely Avenue	4,5
120	SFR	Rangely Avenue	Rosewood Avenue	4,5
125	Cedars Sinai Medical Center	Beverly Boulevard	San Vincente Boulevard	4,5
126	Westbury Terrace	Third Street	Burton Way	4,5
128	SLS at Beverly Hills (hotel)	La Cienega Boulevard	San Vincente Boulevard	4,5
131	SFR	Carson Road	Willaman Drive	4,5
132	SFR	Willaman Drive	Hamel Drive	4,5
133	SFR	Hamel Drive	Robertson Boulevard	4,5
38	Beverly Wilshire Hotel	El Camino Drive	Rodeo Drive	1,2,3,4,5
41	The Beverly Hilton	Wilshire	Moreno Drive	1,2,3,4,5
50	Apartments Hi-Rise	Holme Ave	Selby Ave	1,2,3,4,5
51	Apartments Hi-Rise	Holme Ave	Selby Ave	1,2,3,4,5

5.3.9 MOS 1—Fairfax Extension

The FTA ground-borne noise criteria are predicted to be exceeded at 12 locations for Alternative MOS 1. Table 5-7 provides the cross street for each of the 12 locations.

Table 5-7. Ground-Borne Noise Impact Locations—MOS 1

ID#	Receiver	Cross Street	Cross Street	Alternative
1	Ramada Inn	St Andrews Place	Gramercy Place	1,2,3
3	Apartments	Norton Avenue	Bronson Avenue	1,2,3
4	Los Altos Hotel	Norton Avenue	Bronson Avenue	1,2,3
5	Dunnes Inn	Bronson Avenue	Crenshaw Blvd	1,2,3
8	Wilshire Ebell Theatre	Lucerne Boulevard	Arden Boulevard	1,2,3
9	Apartments	Lucerne Boulevard	Arden Boulevard	1,2,3
10	Apartments	Arden Boulevard	Rossmore Avenue	1,2,3
11	Apartments	Rossmore Avenue	Murfield Road	1,2,3
14	Apartments	Tremaine Avenue	McCadden Place	1,2,3
17	Apartments	Mansfield Avenue	Orange Drive	1,2,3
18	Apartments	Detroit Street	Cloverdale Avenue	1,2,3
20	Apartments	Ridgely Drive	Hauser Boulevard	1,2,3

5.3.10 MOS 2—Century City Extension

The FTA ground-borne noise criteria are predicted to be exceeded at the same 20 locations for Alternative MOS 2 as are exceeded for Alternative 1. Figures 5-3 to 5-6 show the locations and Table 5-4 provides the cross streets for each of the 20 locations.

5.3.11 Stations

The FTA ground-borne noise criteria are predicted to be exceeded at four additional locations with Station Option 4 (Constellation Blvd) with Constellation South alignment, four additional locations with Option 4 (Constellation Blvd) with the Constellation North alignment, four additional locations with Option 5 (Westwood/ on and off-street station locations) with the West alignment , one additional location with Option 4 (Constellation Blvd) to Option 5 (Westwood/ on and off-street station locations) using the East alignment , three additional locations with Option 4 (Constellation Blvd) to Option 5 (Westwood/ on and off-street station locations) using the Central alignment, two additional locations with Option 4 (Constellation Blvd) to Option 5 (Westwood/ on and off-street station locations) using the West alignment, and one additional location with Option 3 (Wilshire/La Cienega Transfer Station) for Alternative 4 and 5. Figures 5-3 to 5-5 show these locations and Table 5-8 provides the cross streets for each of these locations.

Table 5-8. Ground-Borne Noise Impact Locations—Station Options & Alignments

ID#	Receiver	Cross Street	Cross Street	Station Options & Alignments
137	SFR	Lasky Drive	Moreno Drive	Option 4, Constellation South
138	SFR	Lasky Drive	Moreno Drive	Option 4, Constellation South
139	Beverly Hill High School	Moreno Drive	Century Park East	Option 4, Constellation South
140	Future Residential	Century Park East	Avenue of the Stars	Option 4, Constellation North and South
143	Apartments	Santa Monica Boulevard	Wilshire Boulevard	Option 4, Constellation North
145	SFR	Lasky Drive	Moreno Drive	Option 4, Constellation North
147	Beverly Hill High School	Moreno Drive	Century Park East	Option 4, Constellation North
160	Apartments	Holme Avenue	Prosser Avenue	Option 5 West
162	Apartments	Pelham Avenue	Overland Avenue	Option 5 West
164	Travel Lodge	Overland Avenue	Selby Avenue	Option 5 West
166	SFR	Glendon Avenue	Westwood Boulevard	Option 5 West
175	SFR	Missouri Avenue	Santa Monica Boulevard	Option 4 and 5 East
176	SFR	Century Park West	Fox Hill Drive	Option 4 and 5 Central
177	SFR	La Grange Avenue	Beverly Glen Boulevard	Option 4 and 5 Central
178	Apartments	Beverly Glen Boulevard	Pandora Avenue	Option 4 and 5 Central
180	SFR	La Grange Avenue	Beverly Glen Boulevard	Options 4 and 5 West
181	Apartments	Beverly Glen Boulevard	Pandora Avenue	Options 4 and 5 West
185	Apartments	San Vicente Boulevard	Hamilton Drive	4,5 Option 3

5.3.12 Other Components of the Build Alternatives

These components of the build alternatives, including the expanded vehicle storage and maintenance facility, the expanded ROC, plus fans, tunnel vents, and emergency electrical generators designed in accordance with Metro Design Criteria, as discussed in Section 5.2.4, would result in no vibration impact.

6.0 MITIGATION MEASURES

6.1 Mitigation Measures for Project Operations Noise

The FTA provides a selection of practical noise mitigation measures in its manual (FTA 2006) designed to address surface running or elevated transit systems that project sponsors should consider if noise impacts are expected. However, the Westside Subway Extension Project is conceived as an underground subway in a relatively deep and robust tunnel; thus, operational noise originating in the project's tunnels and stations would be inaudible at the ground surface. Other components of the build alternatives, including the expanded vehicle storage and maintenance facility, the expanded ROC, plus fans, tunnel vents, and emergency electrical generators designed in accordance with *Metro Design Criteria*, as discussed in Section 5.2.4, would result in no noise impact; thus, no mitigation measures are required.

6.2 Mitigation Measures for Project Operations Vibration and Ground-borne Noise

To mitigate the potential for ground-borne noise impacts to residential, theater, and hotel uses above the Westside Subway tunnel high, resiliency direct fixation rail fasteners would be incorporated into the design of the trackwork. A high resiliency rail fastener would reduce the ground-borne noise by 7 to 9 dBA. The type of rail fastener and extent of their use would be determined during Preliminary Engineering design.

6.3 Relationship between Local Short-term Use of Resources and Maintenance and Enhancement of Long-term Productivity

Incorporating necessary noise and vibration control and mitigation measures into any of the alternatives would require a minimal use of short-term resources, such as an upgraded exhaust silencer, a generator enclosure, or acoustical louvers on a vent discharge. The benefit is that noise- or vibration-sensitive activities would be unaffected and there would be no adverse effects on productivity.

6.4 Irreversible and Irretrievable Commitment of Resources

A substantial irreversible and irretrievable commitment of resources is not required to achieve no noise or vibration project impacts.

6.5 Cumulative Impacts

Operational noise and vibration emissions from the TSM and all build alternatives of this Project would occur only at very specific locations (e.g., TPSSs, emergency electrical power generators, subway tunnel vent discharge/emergency egress locations) and do not result in area-wide impacts. These emissions are independent and separated from each other in time and location and would not contribute to a cumulative impact.

6.6 CEQA Determination

Applying CEQA guidelines, any vibration or noise impacts must be mitigated or identified as a significant impact for which no abatement measures are available, due to economic,

social, environmental, legal, or technological conditions. CEQA does not provide specific thresholds for significant noise or vibration impact. For the Westside Subway Extension, the noise and vibration impact criterion, as defined by FTA, was applied as the CEQA threshold for significance.

CEQA guidelines indicate significant impacts would occur if the Project would result in:

- Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance or applicable standards of other agencies
- Exposure of persons to or generation of excessive ground-borne vibration or ground-borne noise levels
- A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project
- A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project
- For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, exposure of people residing or working in the project area to excessive noise levels
- For a project within the vicinity of a private airstrip, exposure of people residing or working in the project area to excessive noise levels

In conformance with CEQA, the project's operational noise and operational vibration were evaluated to determine if the project would cause significant noise or vibration impacts to the environment. The project's impact analyses concluded that the project as described, including the inclusion of noise control features as identified and discussed above for tunnel vent discharge locations and emergency power generators:

- Would not expose persons to or generate noise levels in excess of standards established in the local general plan or noise ordinance or applicable standards of other agencies
- Would not expose persons to or generate excessive ground-borne vibration but will exceed thresholds of significance for ground-borne noise levels
- Would not result in a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project
- Would not result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project
- Although portions of the project are located within 1.9 miles of the Santa Monica Municipal Airport boundary, the project would not expose people residing or working in the project area to excessive noise levels
- The project is not located within the vicinity of a private airstrip.

No operational noise and vibration impacts for any of the alternatives are anticipated and no mitigation beyond what is described above for ground-born noise would be required in accordance with CEQA.

If future project design changes might result in airborne noise impact, vibration impact, or ground-borne noise impact, a reanalysis should be conducted using the FTA General analysis methodology or Detailed methodology (FTA 2006), as appropriate, to determine if the redesigned project would result in impacts and if mitigation would be required.

6.7 Impacts Remaining after Mitigation

The ground-borne noise impacts would be mitigated to a level below the threshold of significance. No operational noise impacts for any of the alternatives are anticipated, thus no impacts remain.

7.0 REFERENCES

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