WESTSIDE SUBWAY EXTENSION

Construction and Mitigation Technical Report

Metro

August 2010

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1.0 INTRODUCTION

This Final Construction and Mitigation Technical Report describes the construction scenarios and techniques expected to be used for the Westside Subway Extension Project and their potential impacts. This description of construction is based on information known to date about construction of the proposed Project. Construction specifics are rarely known before design. For purposes of the Draft Environmental Impact Statement/Environmental Impact Report (DEIS/EIR), potential impact is analyzed using a reasonable worst-case approach to describe the potential impacts. For example, several possible construction staging areas may be analyzed, even though not all of them would be used. Analyzing potential “maximum impact,” also allows the environmental process to identify potential constraints and mitigation.

In general, it is anticipated that tunneling of the subway will be performed with pressurized-face tunnel boring machines (TBMs) and the stations will be excavated using cut-and-cover techniques. Several construction sequences are under consideration, and many possibilities for tunneling strategies are described and evaluated. The most advantageous approaches will likely develop as the alignments, crossover locations, alternative station locations, and availability of long-term construction staging areas become defined better in future stages of this project.

Various types of contractor work and storage areas will be necessary for construction of the various elements of the project, such as tunnels, station box excavations, station entrances, crossover boxes, pocket tracks, mid-line concrete pour locations, traction power substation (TPSS) locations, and ventilation shaft locations. However, the most off-street space is needed for entry areas from which mining operations and the insertion/extraction of TBMs would be conducted. This includes the handling of precast-concrete tunnel segment (lining) supply, spoil removal, tunnel water supply and wastewater removal, power supply and other tunnel utilities. The characteristics of these work and storage areas that are important for consideration in the DEIS/EIR are summarized in this report as they are identified at this time.

This report summarizes the potential impacts associated with the construction of the Westside Subway Extension Project. The impacts addressed in this section would occur only during the construction period and would therefore be temporary and relatively short-term. The impacts discussed include construction scenarios based on typical and anticipated subway construction techniques, equipment and timing, and the anticipated construction staging areas that would be used by the construction contractors. The construction scenarios are used to evaluate construction impacts and to identify/propose mitigation measures.

Section 2.0 of this report provides a summary of the project description. Section 3.0 summarizes the federal, state, and local environmental regulations and guidelines pertinent to construction of the proposed project. Section 4.0 describes construction methods, techniques, and equipment anticipated to be used for the Westside Subway Extension, based on Metro’s extensive subway construction experience. Sections 5.0 through 8.0 describe the affected environment, environmental consequences of construction and potential mitigation that would lessen business disruption and impacts to traffic, parking and transit, air quality, noise and vibration, and utilities.

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 Los Angeles County Metropolitan Transportation Authority (Metro) Long Range Transportation Plan (LRTP) and the Southern California Association of Governments (SCAG) Regional Transportation Plan (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.

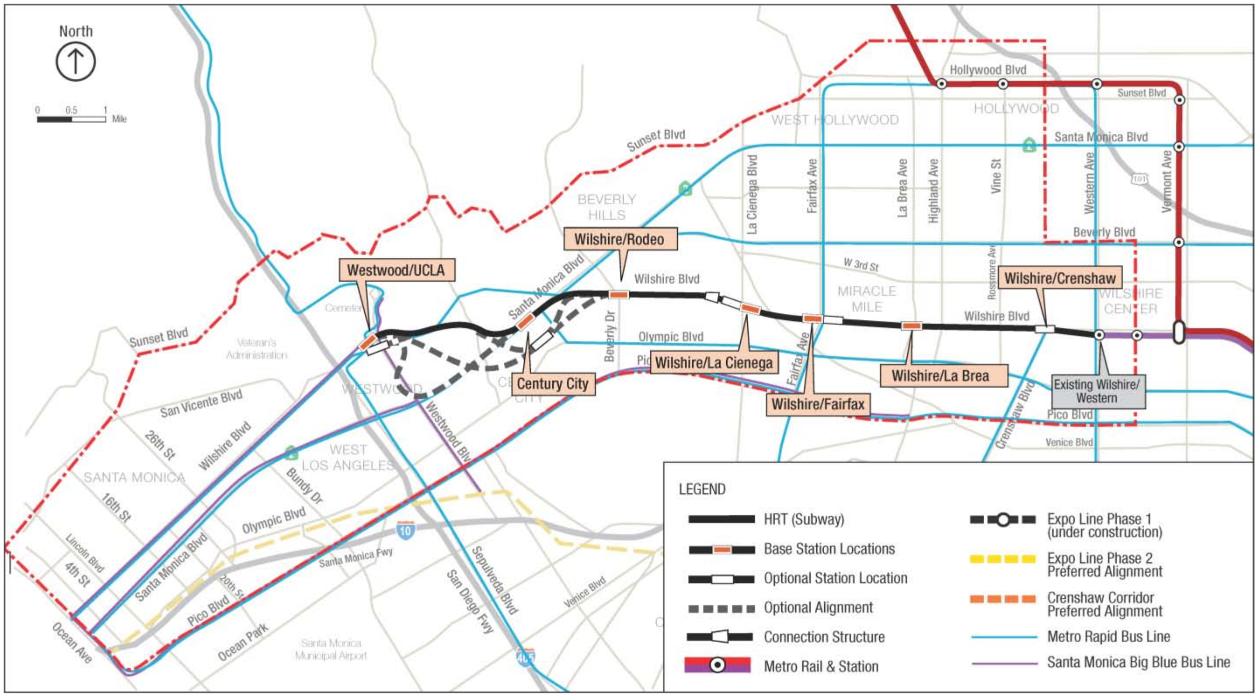

Figure 2-1. Alternative 1—Westwood/UCLA Extension

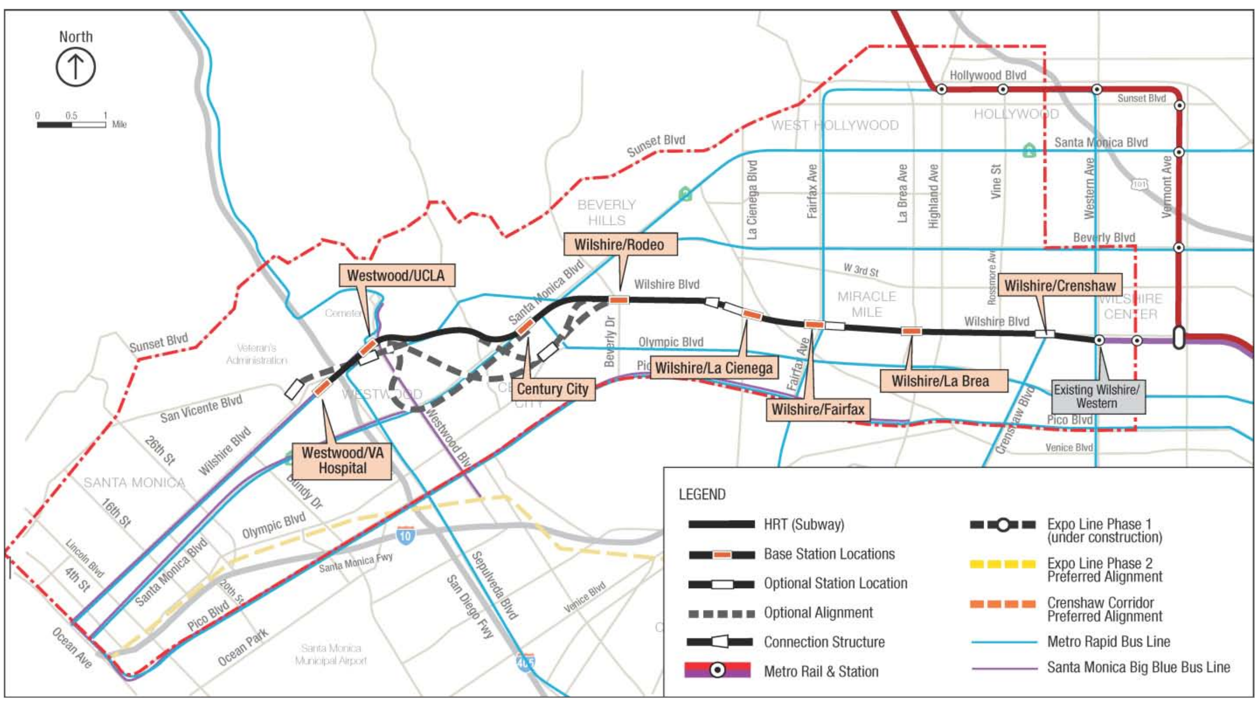

Figure 2-2: Alternative 2 – Westwood/Veterans Administration (VA) Hospital Extension

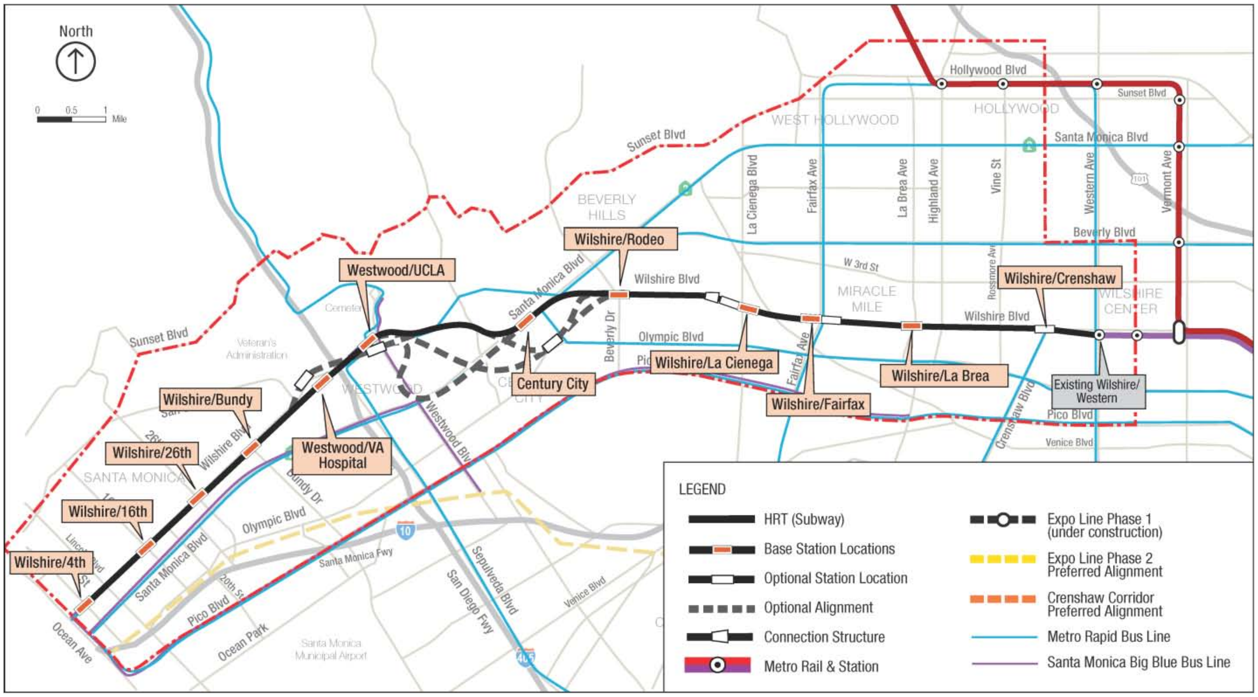

Figure 2-3: Alternative 3 – Santa Monica Extension

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.

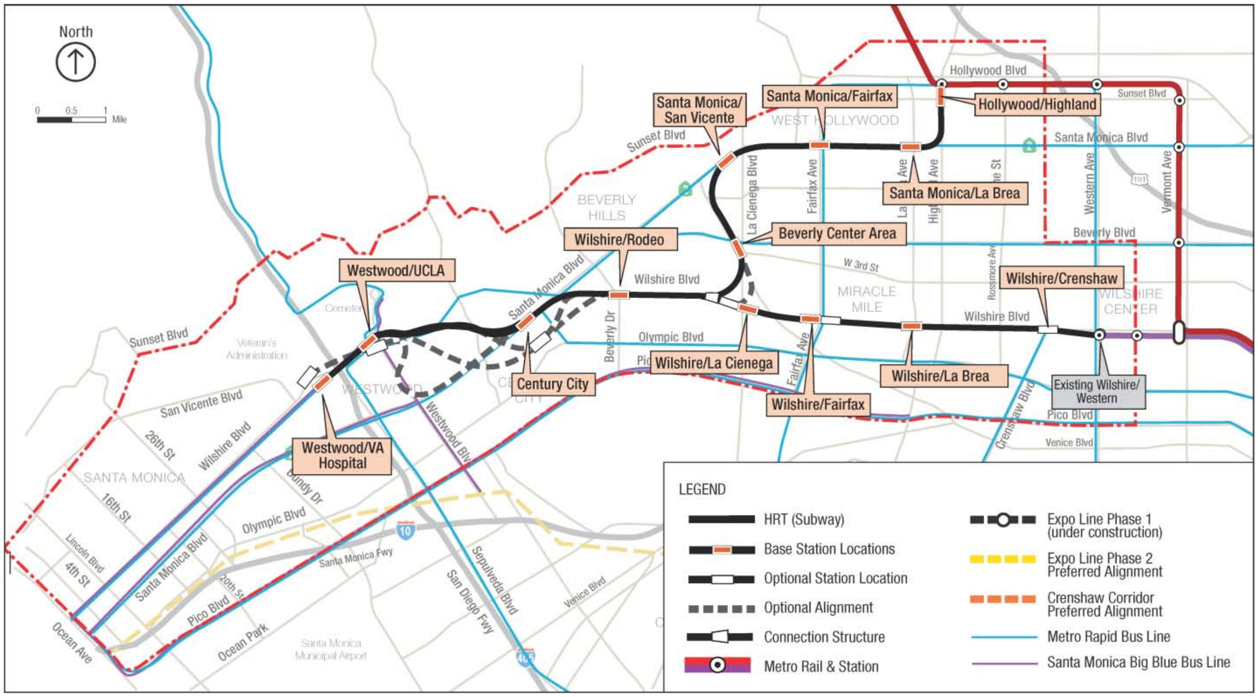

Figure 2-4: Alternative 4 – Westwood/VA Hospital Extension plus West Hollywood Extension

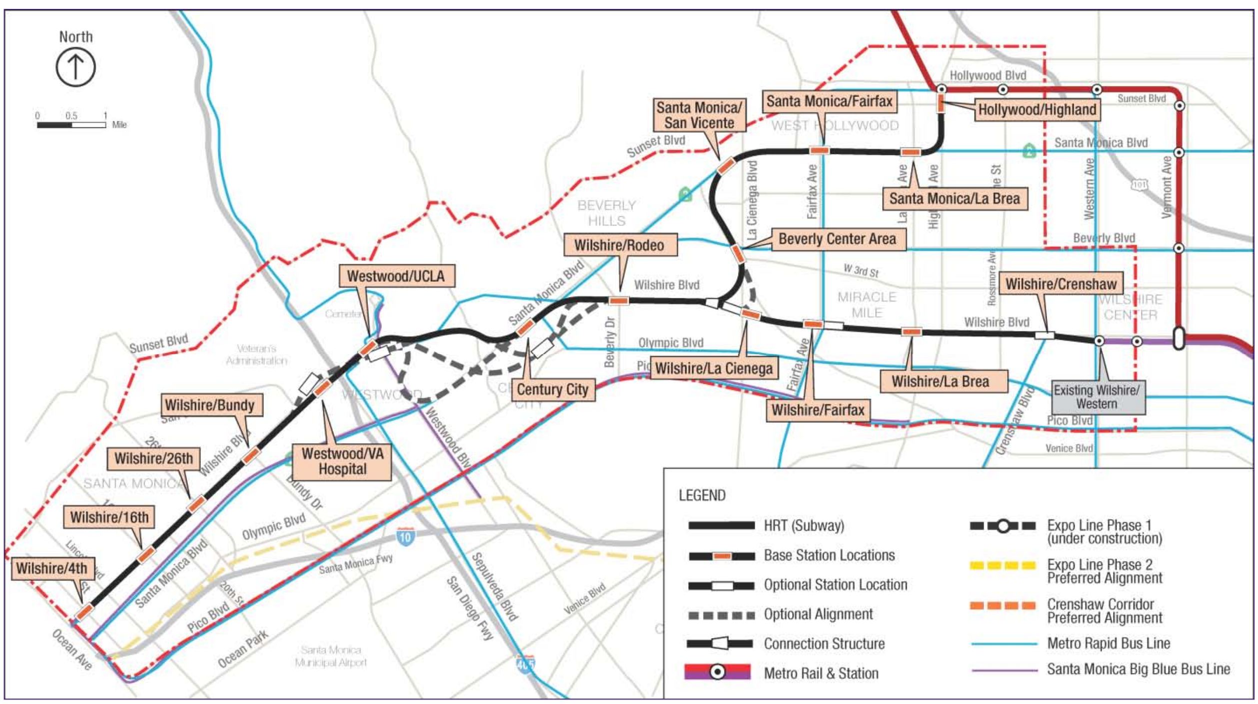

Figure 2-5: Alternative 5 – Santa Monica Extension plus West Hollywood Extension

2.4 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.

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: 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
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		●	●	●	●

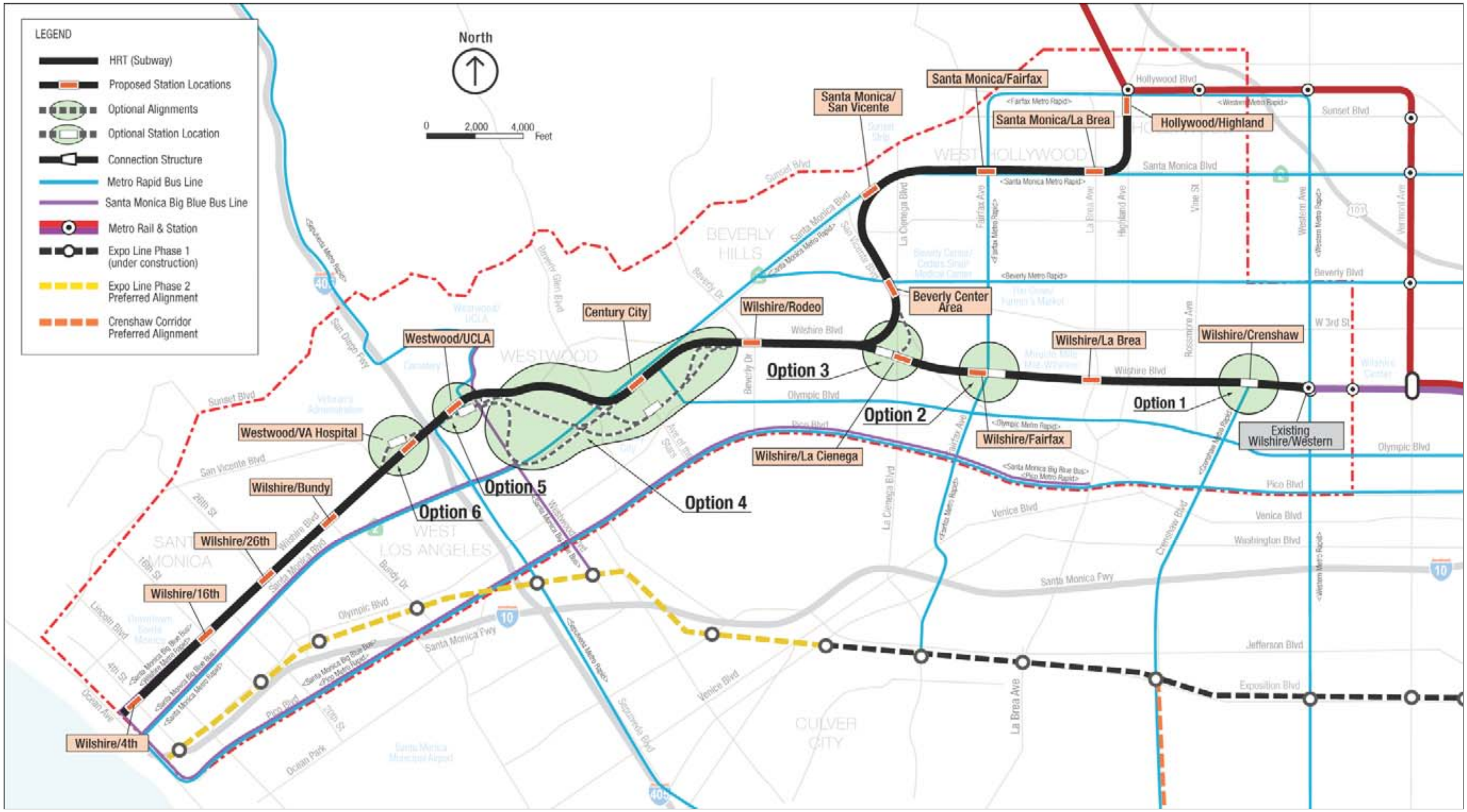

Figure 2-6: Station and Alignment Options

2.4.1 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).

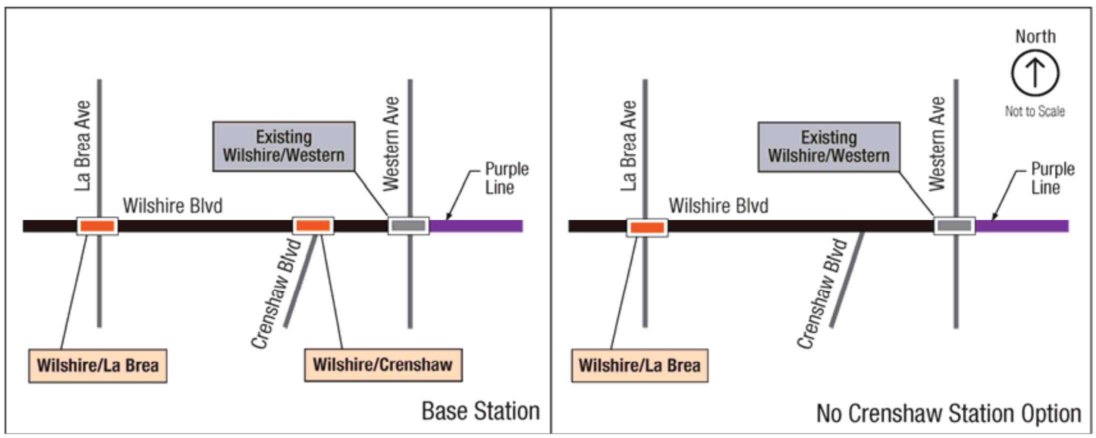

Figure 2-7: Option 1—No Wilshire/Crenshaw Station Option

2.4.2 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.

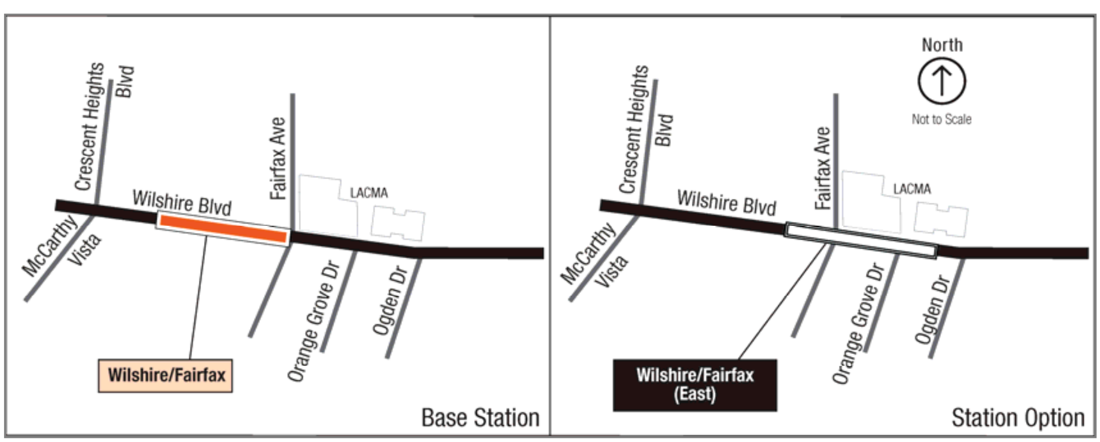

Figure 2-8: Option 2 – Fairfax Station Option

2.4.3 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.

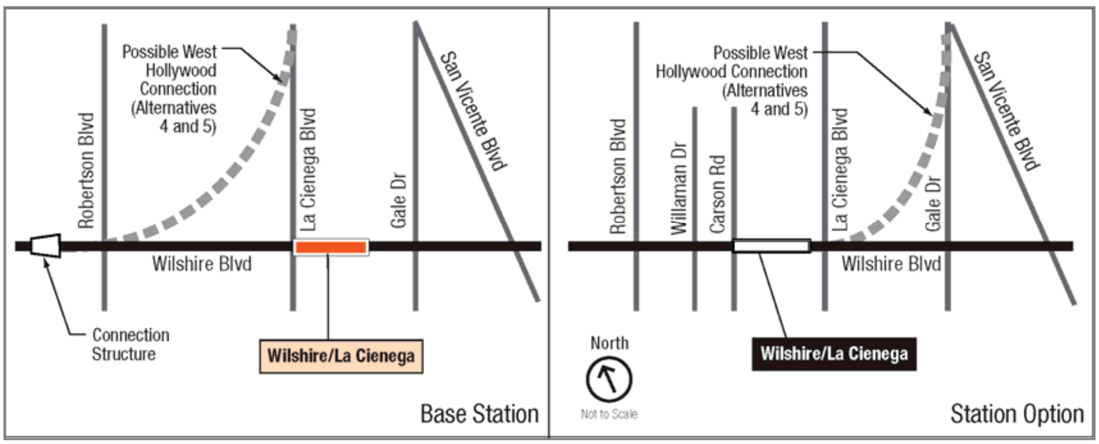

Figure 2-9: Option 3—La Cienega Station Option

2.4.4 Option 4 – Century City Station and Segment Options

2.4.4.1 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.

2.4.4.2 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.

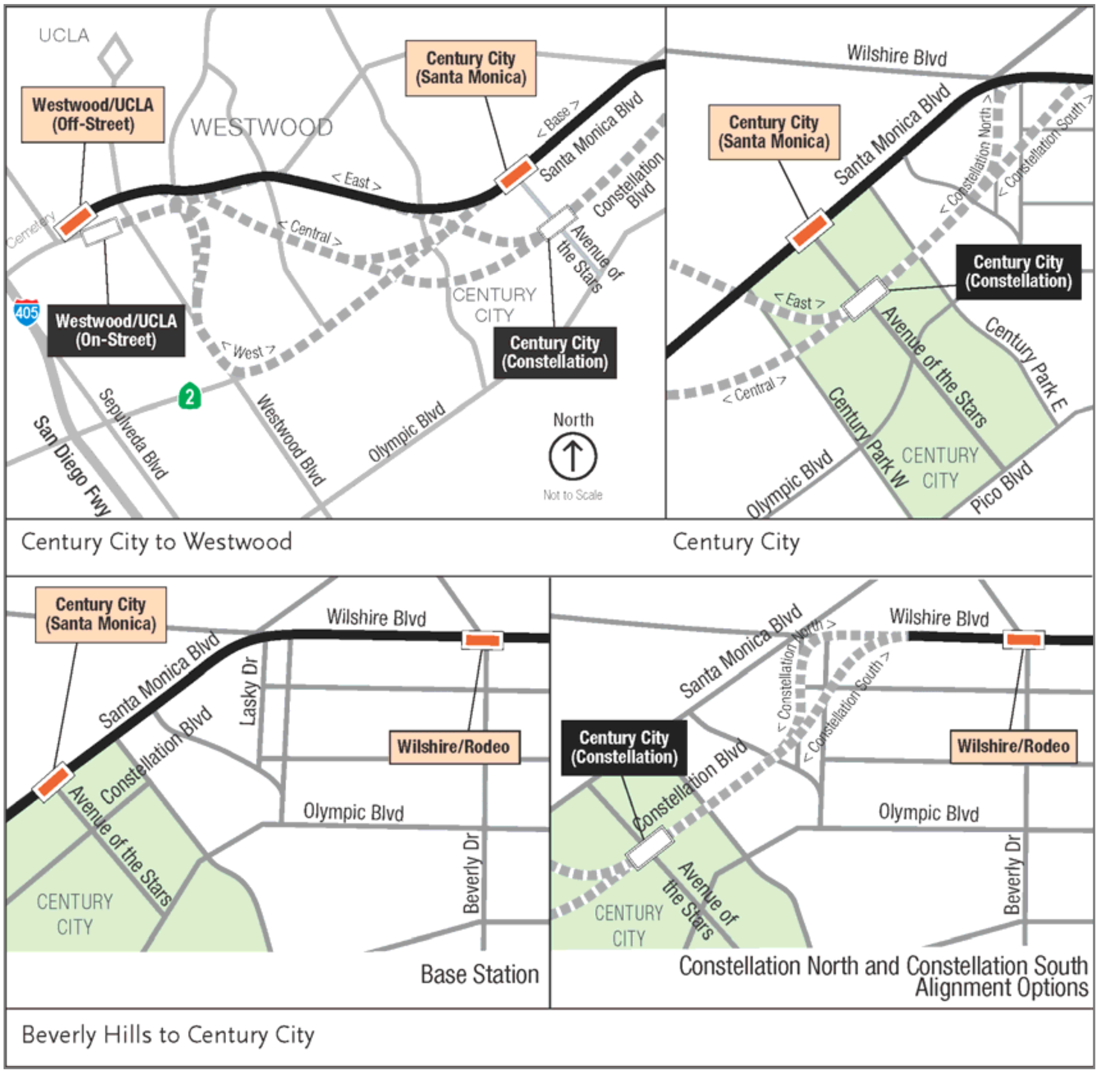

Figure 2-10: Century City Station Options

2.4.5 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).

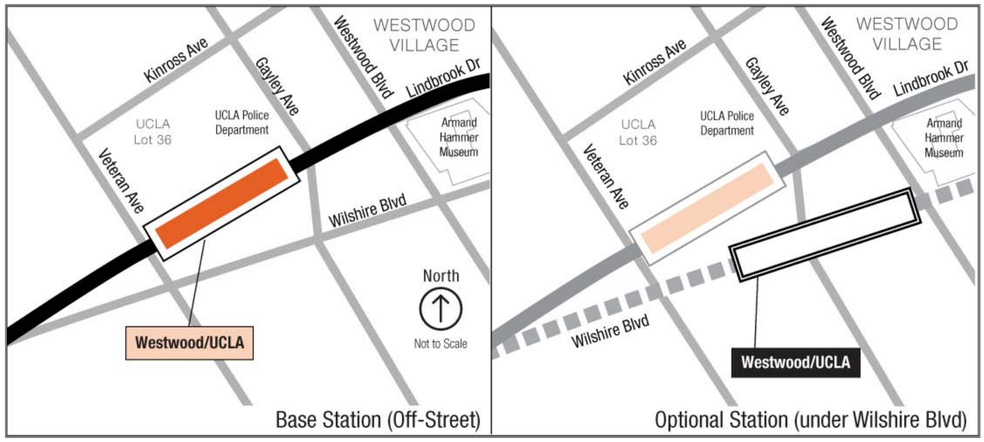

Figure 2-11: Option 5 – Westwood/UCLA Station Options

2.4.6 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. (Shown in Figure 2-12)

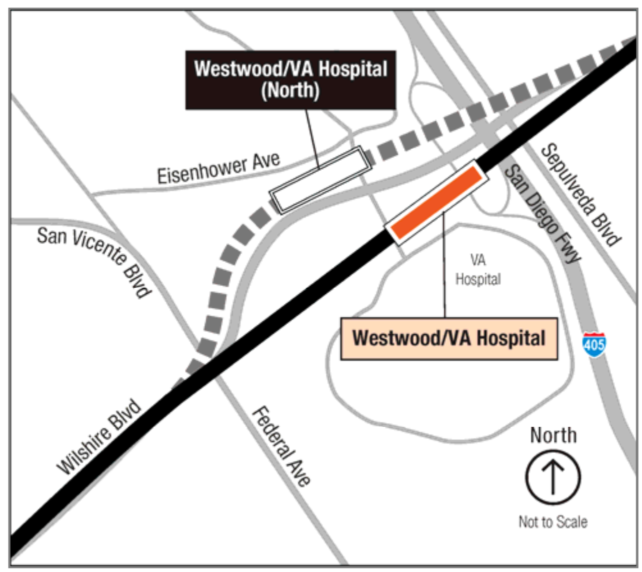

Figure 2-12: Option 6—Westwood/VA Hospital Station North

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.

2.5 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.

2.6 Other Components of the Build Alternatives

2.6.1 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.

2.6.2 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.

2.6.3 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

2.6.4 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	Alternative 1 Westwood/ UCLA Extension	Alternative 2 Westwood/ VA Hospital Extension	Alternative 3 Santa Monica Extension	Alternative 4 Westwood/VA Hospital Extension Plus West Hollywood Extension	Alternative 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	Pocket Track	Pocket Track	Pocket Track	Pocket Track	Pocket Track
Wilshire/26th	N/A	N/A	Double Crossover	N/A	Double Crossover

2.6.5 Rail Operations Center

The existing Rail Operations Center (ROC), shown on Figure 2-13, 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.

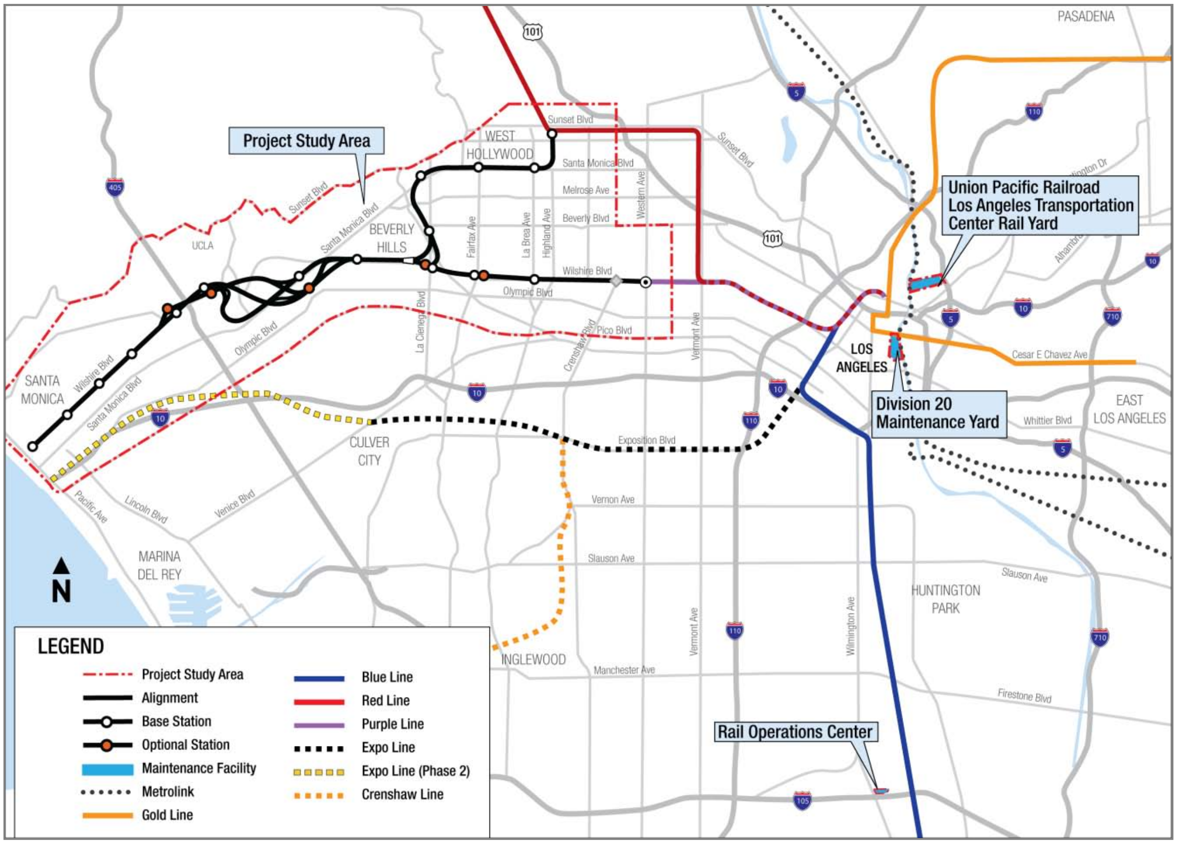

Figure 2-13: Location of the Rail Operations Center and Maintenance Yards

2.6.6 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.

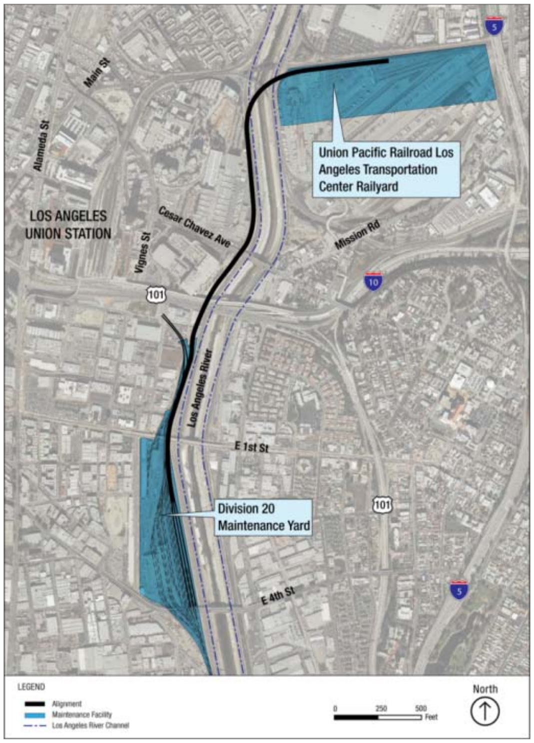

Figure 2-14: Maintenance Yard Options

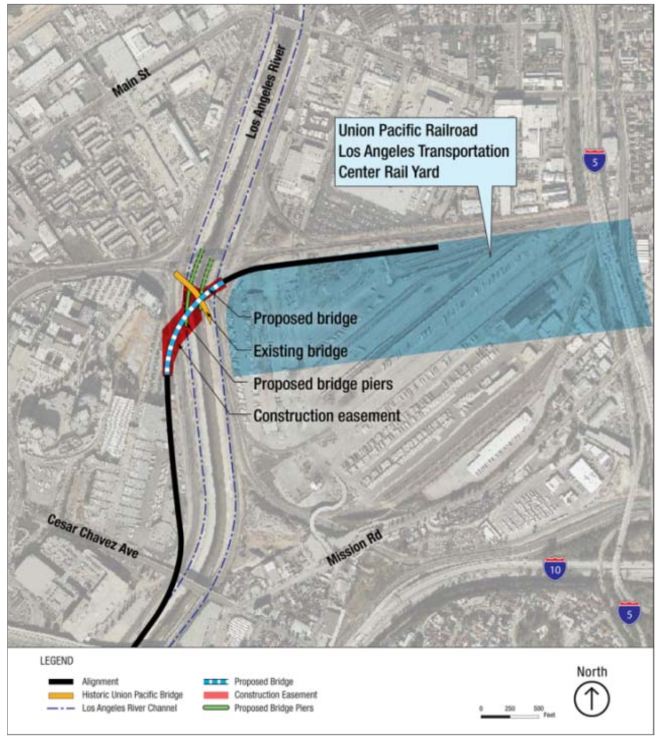

Figure 2-15: UP Railroad Rail Bridge

2.7 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.

2.7.1 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.

2.7.2 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 REGULATORY SETTING

This section summarizes federal, state, and local environmental regulations and guidelines pertinent to construction of the proposed project.

3.1 Federal Regulations

Construction of the project would require compliance with the following federal regulations:

3.1.1 Transit Noise and Vibration Impact Assessment.

The Office of Planning and Environment in the Federal Transit Administration (FTA) has established guidelines to assess noise and vibration impacts from construction of proposed mass transit projects.[1]

- Federal Clean Air Act (42 USC 7401 et seq.)—The Clean Air Act (CAA), amended in 1990, is the comprehensive federal law that regulates air emissions from stationary and mobile sources, including construction equipment. The CAA authorizes the Environmental Protection Agency (EPA) to establish National Ambient Air Quality Standards (NAAQS) to protect public health and public welfare and to regulate emissions of hazardous air pollutants.[2]
- Federal Clean Air Act Conformity Requirement (42 USC 7506 Section 176(c))—The Federal Clean Air Act Conformity Requirement (42 USC 7507 Section 176(c)) sets limits by the federal government on financial assistance for, license or permit, approve, any activity that does not conform to approved implementation plan performed the lead agency.[3] Long term construction projects such as the proposed project may be affected by this requirement.
- National Ambient Air Quality Standards (NAAQS)—The Clean Air Act requires EPA to set the NAAQS for wide-spread pollutants with numerous and diverse sources considered to be harmful to public health and the environment. The EPA has promulgated NAAQS for six air pollutants: sulfur dioxide (SO_2), particulate matter ($PM_{2.5}$ and PM_{10}), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), and lead. The Act requires EPA to review the scientific data upon which the standards are based, and revise the standards, if necessary, every five years.[4] Effects of construction emissions on ambient air quality are evaluated using these standards.
- Clean Water Act—The United States Army Corps of Engineers (COE) under Section 404 of the Clean Water Act is responsible for a permit program for the discharges of dredged or fill material into waters of the U.S. The current plans for the Westside Subway Extension Corridor does not call for discharge of any dredged or fill material into the Los Angeles River or any other waters of the U.S.

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[1] United States Department of Transportation Federal Transit Administration. 2006. Transit Noise and Vibration Impact Assessment (FTA-VA-90-1003-06) Chapter 12, Noise and Vibration During Construction: http://www.slocog.org/Library/PDF/Reports_Publications/4_Regional%20Trans%20Plan/5_References.pdf.
[2] United States Environmental Protection Agency Website: http://www.epa.gov/regulations/laws/caa.html.
[3] Cornell University Law School Website: http://www.law.cornell.edu/uscode/42/usc_sec_42_00007506----000-.html.
[4] United States Environmental Protection Agency Website: http://www.epa.gov/ttn/naaqs/.

- Federal Noise Control Act—The Noise Control Act of 1972 gives the U.S. Environmental Protection Agency (EPA) the authority to establish noise regulations to control major sources of noise, including transportation vehicles and construction equipment.[5]
- Resource Conservation and Recovery Act—The Resource Conservation and Recovery Act (RCRA) under Title 40, Protection of the Environment of the CFR, regulates hazardous wastes that may be encountered during construction activities. This statute provides for proper handling and disposal of any encountered hazardous materials.
- Toxics Substances Control Act—The Toxics Substances Control Act regulates handling of polychlorinated biphenyl wastes encountered during construction or demolition.
- Comprehensive Environmental Response, Compensation, and Liability Act—The Comprehensive Environmental Response, Compensation, and Liability Act regulates the handling and removal of underground storage tanks that may be encountered during construction.

3.2 State Regulations

Construction of the project would require compliance with the following state regulations, standards, and guidelines:

- California Clean Air Act—The California Clean Air Act, Chapter 1568, Statues of 1988; AB 2595 (1) established a legal mandate to achieve California's ambient air quality standards by the earliest practicable date; (2) prescribes a number of emission reduction strategies and requires annual progress in cleaning up the air; and (3) grants authority to the state's local air pollution control districts to adopt and enforce transportation control measures (TCMs).[6]
- California Ambient Air Quality Standards—California Ambient Air Quality Standards (CAAQS) define air quality standards and the maximum amount of pollutants that can be present in outdoor air without harm to public health. California law authorizes the California Air Resources Board (CARB) to set ambient (outdoor) air pollution standards (California Health & Safety Code Section 39606) in consideration of public health, safety, and welfare.[7]
- State Water Resources Control Board/Regional Water Quality Control Board—The State Water Resources Control Board, under Section 402 of the Clean Water Act, establishes a permitting system for the discharge of any pollutant (except for dredge or fill) into the waters of the United States. The permit is also called the National Pollution Discharge Elimination System (NPDES) permit. In California, the Regional Water Quality Control Board (RWQCB) oversees the permitting process. The jurisdiction of the RWQCB relative to the NPDES permits extends to "waters of the U.S." which is defined as: (1) navigable waters, (2) tributaries of navigable waters, and (3) wetlands. The project does not contain any potential impacts on the Los Angeles River or any other "waters of the U.S." resulting from construction activities (including discharge from dewatering activities related to structures or below ground rail construction).
- California Global Warming Solutions Act (AB 32)—The California Global Warming Solutions Act (AB 32), enacted in 2006, set the 2020 greenhouse gas emissions reduction

[5] United States Department of Transportation Federal Transit Administration: http://www.fhwa.dot.gov/environment/polguid.pdf.
[6] Chapter 1568, Statutes of 1988; AB 2595.
[7] California Environmental Protection Agency Air Resources Board Website: http://www.arb.ca.gov/research/aaqs/caaqs/caaqs.htm.

goal into law. It directed the California Air Resources Board (CARB) to begin developing discrete early actions to reduce greenhouse gases while also preparing a Scoping Plan to identify how best to reach the 2020 limit.[8]

- Senate Bill No. 375, Chapter 728 (SB 375)—California state law (Senate Bill No. 375 (SB 375) requires the CARB to set regional targets for the purpose of reducing greenhouse gas emissions from passenger vehicles, for 2020 and 2035. If regions developed integrated land use, housing and transportation plans that meet the SB 375 target, new projects in these regions can be relieved of certain review requirements of the California Environmental Quality Act (CEQA).[9]
- Governor's Executive Order S-13-08—Governor Executive Order S-13-08, enacted November 14, 2008, Executive Order S-13-08 enhances the state's management of climate impacts from sea level rise, increased temperatures, shifting precipitation and extreme weather events.[10]
- California Administrative Code, Title 24—California Administrative Code, Title 24, known as the California Building Standards Code or just "Title 24," contains the regulations that govern the construction of buildings in California.[11]
- Noise Element of the General Plan—The California Department of Health Services (CDHS) has studied the correlation of noise levels and their effects on various land uses and has established guidelines for evaluating the compatibility of various land uses as a function of community noise exposure. Section 65302(f) of the California Government Code requires each community to prepare and adopt a comprehensive long-range general plan for its physical development containing seven mandatory elements, including a noise element. The noise element must (1) identify and appraise noise problems in the community, (2) recognize Office of Noise Control guidelines, and (3) analyze and quantify current and projected noise levels, including noise from construction activities.
- California State CEQA Guidelines (CCR §§ 15000-15387)—The California State CEQA Guidelines (CCR §§ 15000-15387) are the regulations that explain and interpret the law for both public agencies required to administer CEQA and for the public agency. The guidelines further provide objectives, criteria and procedures for the overly evaluation of projects and preparation of environmental impact reports, negative declarations, and mitigated negative declarations by public agencies.[12]

3.3 Local Regulations

Construction of the project would require compliance with the following regional regulations and guidelines, well as city policies and ordinances:

- South Coast Air Quality Management District Guidelines and Criteria—SCAQMD reports to the CARB at the state level and is therefore responsible for reducing air pollution and attaining the State of CAAQS, and the NAAQS set forth by the EPA. SCAQMD provides guidelines (such as construction and operational criteria pollutant thresholds) used for determining the significance of air quality impacts from the

[8] California Environmental Protection Agency Air Resources Board Website: http://www.arb.ca.gov/cc/ab32/ab32.htm.
[9] California Environmental Protection Agency Air Resources Board Website: http://www.arb.ca.gov/cc/sb375/sb375.htm.
[10] California Climate Change Portal Website: http://www.climatechange.ca.gov/adaptation/.
[11] California Department of General Services Website: http://www.dsa.dgs.ca.gov/Code/title24.htm.
[12] California Environmental Resources Evaluation System Website: http://ceres.ca.gov/ceqa/.

implementation of a proposed project. Thresholds have been established by SCAQMD for six criteria pollutants: carbon monoxide (CO), reactive organic gases (ROG), nitrogen oxides (NO_X), sulfur dioxide (SO_2), coarse particulate matter (PM_{10}), and fine particulate matter ($PM_{2.5}$).[13]

Local jurisdiction General Plan Noise and Land Use policies and ordinances

- City of Los Angeles General Plan Framework.[14] This plan is used to determine compatibility of proposed construction activities.
  - **LU 3.15.1** Prepare detailed plans for land use and development of transit-oriented districts consistent with the provisions of the General Plan Framework Element and the Land Use/Transportation Policy.
  - **LU 3.15.2** Work with developers and Metropolitan Transportation Authority to incorporate public-and neighborhood-serving uses and services in structures located in proximity to transit stations, as appropriate.
  - **LU 3.15.3** Increase density generally within one quarter mile of transit stations, determining appropriate locations based on consideration of the surrounding land use characteristics to improve their viability as new transit routes and stations are funded in accordance with Policy.
  - **LU 3.15.6** Establish standards for the inclusion of bicycle and vehicular parking at and in the vicinity of transit stations; differentiating these to reflect the intended uses and character of the area in which they are located.

Applicable policies from the City of Los Angeles General Plan include policies from the Wilshire Community Plan and Westwood Community Plan.[15]

- Wilshire Community Plan:
  - **LU 12-1.1** Encourage non-related developments to provide employee incentives for using alternatives to the automobile (car pools, van pools, buses, shuttles, subways, bicycles, walking) and provide flexible work schedules.
  - **LU 15-1.3** Manage the supply of on-street parking to provide convenient parking for customers of commercial land uses and to encourage employees to park in off-street lots or garages or use alternate modes of transportation.
  - **N - Los Angeles Municipal Code Section 111 et seq.** Noise ordinance establishes sound measurement and criteria, minimum ambient noise levels for different land uses zoning classifications, sound emission levels for specific uses (radio, television sets, vehicle repairs and amplified equipment, etc.), hours of operation for certain uses (construction activity, rubbish collections, etc.), standards for determining noise deemed a disturbance of the peace, and legal remedies for violations. Its ambient noise standards are consistent with current state and federal noise standards.[16]
  - **N – 2.2** Enforce and/or implement applicable city, state, and federal regulations intended to mitigate proposed noise producing activities, reduce intrusive noise, and alleviate noise that is deemed a public nuisance.

[13] http://www.aqmd.gov/search/runsearch.asp.
[14] http://cityplanning.lacity.org/cwd/framwk/chapters/00/00.htm.
[15] http://cityplanning.lacity.org/complan/pdf/wilcptxt.pdf.
[16] http://cityplanning.lacity.org/cwd/gnlpln/noiseElt.pdf/

- ► **N – 3.1** Develop land use policies and programs that will reduce or eliminate potential existing noise impacts.

- Westwood Community Plan:
  - ► **LU 1-2.1** Locate higher-density residential within designated multiple family and near commercial centers and major bus routes where public services facilities and infrastructure will support this development.
  - ► **LU 9-2.1** Develop an intermodal mass transportation plan to implement linkages to future mass transit service.
  - ► **LU 10-1.1** Encourage non-residential developers and schools to provide employee incentives for utilizing alternatives to the automobile (i.e., carpools, vanpools, buses, flex time, bicycles, and walking).
- City of Los Angeles Noise Element—The City of Los Angeles has adopted local guidelines based on the community noise compatibility guidelines established by the CDHS for use in assessing the compatibility of various land use types with a range of noise levels. These guidelines are set forth in the City General Plan Noise Element and are expressed in terms of Community Noise Equivalent Levels (CNEL). CNEL guidelines for specific land uses are classified into four categories: (1) "normally acceptable," (2) "conditionally acceptable," (3) "normally unacceptable," and (4) "clearly unacceptable." A CNEL value of 70 dBA is considered the dividing line between a "conditionally acceptable" and "normally unacceptable" noise environment for noise sensitive land uses, including single-family and multi-family residences and schools. The primary objective and policy contained in this element that relates to construction noise is:
  - ► **Objective 2** Reduce or eliminate non-airport related intrusive noise, especially relative to noise sensitive uses.
  - ► **Policy 2.2** Enforce and/or implement applicable city, state and federal regulations intended to mitigate proposed noise producing activities, reduce intrusive noise and alleviate noise that is deemed a public nuisance.
- City of Beverly Hills[17]—Policies that can be used in evaluating impacts of construction activities include:
  - ► **LU 1.1** Conserve existing residential neighborhoods and accommodate growth and change in non-residential areas where development builds on and enhances the viability of existing business sectors that are Beverly Hills' strengths, promotes transit accessibility, is phased to coincide with infrastructure funding and construction, and designed to assure transitions and compatibility with adjoining residential neighborhoods.
  - ► **LU 1.2** Prioritize growth and accommodate the highest development densities in proximity to major transit corridors and rail transit stations as developed in the future.
  - ► **LU 3.1** City Form. Accommodate a balance of mix of land uses and require that development be located and designed to enable residents access by walking, bicycle,

[17] http://www.beverlyhills.org/services/planning/plan/draft_general_plan.asp

or public transit to jobs, commerce, entertainment, services, and recreation, thereby reducing automobile use, energy consumption, air pollution, and greenhouse gases.

- **LU 3.2** Allow the greatest development density on properties in proximity of public transit stops, stations, and corridors to facilitate its access and use in lieu of the automobile.
- **LU 6.2** Regional Coordination. Cooperate with adjoining and regional agencies to jointly plan land uses, transportation, and infrastructure that provide a cohesive and integrated strategy to accommodate growth that is environmentally, economically, and socially sustainable.
- **LU 8.4** Senior Housing. Encourage the development of senior housing neighborhoods that is accessible to commercial services, health and community facilities, and public transit.
- **LU 21.1** (Wilshire Boulevard Transit Oriented Development Center (Generally between La Cienega Boulevard and San Vicente Boulevard). Accommodate office, retail, residential, mixed use, live/work and live work development that facilitates access to and by public transit and reduce automobile trips, pollution, and energy consumption.
- **N 4.1** Enforce Hours of Construction Activity. Enforces restrictions on hours of construction activity to minimize the impacts of noise and vibration from the use of trucks, heavy drilling equipment, and other heavy machinery to adjacent uses, particularly in residential areas.

- City of West Hollywood[18]—Policies that can be used in evaluating impacts of construction activities include:
  - **LU – 1.9.1** Allow the continuation of existing and development of new public streets, parking facilities, storm drainage, and other infrastructure in locations which serve and are integrated with the city's land uses.
  - **LU – 1.19.30** Require that all uses and buildings enhance pedestrian activity along Santa Monica Boulevard with the land use urban design polices and standards specified for Issue 6.
  - **N - 17.1.1** Require development in areas where the ambient noise level exceeds 65 dB (A) to incorporate special treatment measures into project design to reduce interior noise levels. In addition to measures called out in the Uniform Building Code and State Noise Insulation Standards (California Administrative Code, Title 24), the following standards should be required of new development in these areas: (a.) use sufficient glazing for all sliding glass doors and all windows; (b.) use insulation between walls and other appropriate measures adequately reduce noise to acceptable levels (l17.1 and l17.5).
  - **N - 17.1.6** Require new equipment and vehicles purchased by the City of West Hollywood to comply with noise performance standards consistent with the best available noise reduction technology (l17.20).
  - **N - 17.1.8** Work with local agencies to provide public transit services which reduce traffic and noise (l17.20).

[18] City of West Hollywood. 2004. General Plan, Section 1.0 Land use and Urban Design; Section 17.0 Noise.

- **N - 17.1.9** Work with public transit agencies to ensure that the equipment they use does not generate excessive noise levels (l17.20).
- **N - 17.5.1** Require that construction activities which may impact adjacent residential units be limited to 8 a.m. to 7 p.m. during weekdays, except under special circumstances approved by the City; limited to interior construction between 8 a.m. and 7 p.m. on Saturdays; and prohibited on Sundays (l17.4).
- **N - 17.5.2** Require that construction activities incorporate feasible and practical techniques which minimize the noise impacts on adjacent uses (l17.4. and l17.17).
- **N - 17.6.1** Monitor and update data regarding the City's current and project noise levels (l17.26).
- **N - 17.6.2** Employ state-of-the-art advances in noise impact mitigation as they become available (l17.28).
- **N - 17.8.2** Encourage public agencies and institutions located in the City to incorporate appropriate measures to contain noise generated by their activities on-site (l17.25).

- City of Santa Monica[19]—Policies that can be used in evaluating impacts of construction activities include:
  - **LU – 1.3.4** Downtown Core area requires that a majority of ground floor street frontage on a block by block basis be active pedestrian-oriented use (shop-fronts, cultural activities, cafes, and other uses catering to walk-in traffic) in order to promote pedestrian activity at the ground floor. In the Downtown Frame area, require pedestrian-oriented design features for all ground street frontage.
  - **N – 1** Provide for measures to reduce noise impacts from transportation noise sources.
  - **N – 4** The City shall develop measures to control construction noise impacts.
- County of Los Angeles[20]—Policies that can be used in evaluating impacts of construction activities include:
  - **LU – 1.2** Promote and develop transit oriented districts along major transit corridors.
  - **LU – 1.4** Promote land use practices that encourage housing to be developed in proximity to employment opportunities.
  - **LU – 2.8** Promote compact, walkable, well-designed development.
  - **N - 1.1** Ensure the compatibility of land uses throughout the County to minimize the exposure to excessive noise levels.
  - **N – 1.2** Employ effective noise abatement measure to achieve acceptable levels of noise as defined by the Los Angeles County Exterior Noise Standards.
  - **N – 1.3** Ensure cumulative impacts related to noise do not exceed excessive levels.

[19] http://www.shapethefuture2025.net/links.html.
[20] http://planning.lacounty.gov/assets/upl/project/gp_web-ch03.pdf; City of Santa Monica.1992. Noise Element of the General Plan Goals, Policies, and Implementation.

Local jurisdiction noise ordinances and codes (and their requirements) that apply to construction activities include:

- City of Los Angeles[21]
  - Chapter 9 Noise Regulation
  - Article 1 General Provisions
  - Article 2 Special Noise Sources
  - - 113.03 Construction Noise
  - - 112.05 Maximum Noise Level of Powered Equipment or Powered Hand Tools
  - Article 6 General Noise
- City of Beverly Hills[22]
  - 5-1-102: Definitions
  - 5-1-104: General Standards Relative to Disturbance of Peace
  - 5-1-202: Machinery, Equipment, Fans, and Air Conditioning
- City of West Hollywood[23]
  - 19.28.70 Noise Mitigation
  - 9.09.040 Prohibited Noises – General Standard
  - Chapter 9.08 Noise
  - 9.09.050 Prohibited Noise – Specific Examples (c)(f)
- City of Santa Monica[24]
  - 4.12.010 Declaration of policy.
  - 4.12.020 Definitions.
  - 4.12.030 Exemptions.
  - 4.12.040 Exterior equivalent noise level measurement methodology.
  - 4.12.050 Designated noise zones.
  - 4.12.060 Exterior noise standards.
  - 4.12.070 Vibration.
  - 4.12.110 Restrictions on demolition, excavation, grading, spray painting, construction, maintenance, or repair of buildings.
  - 4.12.120 Posting of construction signs.
  - 4.12.130 Location, screening, and noise measurement of mechanical equipment.
  - 4.12.170 Noise reduction in project siting and design.

[21] http://www.amlegal.com/nxt/gateway.dll?f=templates&fn=default.htm&vid=amlegal:lamc_ca.
[22] http://www.sterlingcodifiers.com/codebook/index.php?book_id=466.
[23] http://qcode.us/codes/westhollywood/.
[24] http://www.qcode.us/codes/santamonica/.

- County of Los Angeles[25]
  - Chapter 12.08 Part 2 General Provisions
  - 12.08.030 Terminology—Conformity with ANSI standards
  - 12.08.090 Construction period.
  - 12.08.100 Cumulative Period.
  - 12.08.110 Decibel.
  - 12.08.130 Emergency machinery, vehicle of alarm
  - 12.08.140 Emergency work.
  - 12.08.160 Grading
  - 12.08.240 Noise histogram
  - 12.08.250 Noise Level (LN)
  - 12.08.260 Noise-sensitive zone
  - 12.08.350 Vibration
  - Part 3 Community Noise Criteria
  - 12.08.380 Noise zones designated
  - 12.08.390 Exterior noise standards
  - Part 4 Specific Noise Restrictions
  - 12.08.440 Construction noise
  - 12.08.470 Noise disturbance in noise-sensitive zones
  - 12.08.560 Vibration
  - Chapter 12.12 Building Construction Noise

[25] http://search.municode.com/html/16274/index.htm

4.0 SUMMARY OF CONSTRUCTION METHODS, TECHNIQUES, AND EQUIPMENT

4.1 Introduction

This section summarizes construction methods, techniques, and equipment anticipated to be used for the Westside Subway Extension, and based on Metro's extensive subway construction experience. In general, conventional construction techniques and equipment will be used, as typically performed in the Southern California region. This will include the use of specialized pressurized-face Tunnel Boring Machines (TBMs), which will be discussed further below. Although competitive bidding has the potential to bring about other, more innovative methods of construction, the following is a description of the major construction methods and techniques that are considered likely to be used for the Westside Subway Extension construction.

Major project elements include underground stations, tunnels, station-related facilities, maintenance and yard facilities, trackwork, ventilation equipment, and the installation of specialty systems work such as traction power, communication, and signaling equipment.

4.1.1 General Construction Scenario

Construction activities would begin simultaneously at several locations along the selected routes to accommodate areas of work requiring lengthy construction times, such as for the tunnels and underground stations, and to bring the different segments of the project to completion to meet the project completion schedule.

Many contractors specializing in various methods of construction would be working on the project during the construction period. Construction of the project would follow all applicable local, state, and federal laws for building and safety. Working hours would be varied to meet special circumstances and restrictions. Standard construction methods would be used for traffic, noise, vibrations and dust control, consistent with all applicable laws, and as described in the following sections.

The subsequent sections of this report discuss the alternatives proposed for the project, including the tunnel alignment and station locations. The expected construction schedules are summarized at the end of each of these sections. Generally, construction will be divided into a series of activities, which are often overlapping to minimize the duration of construction and the associated impacts. Table 4-1 depicts a typical sequence of construction activities for a tunnel segment of approximately 2 miles. In general, the duration of tunnel excavation (mining) would range from 10 to 18 months. This does not include the time for TBM procurement/mobilization, which is the time to prepare the work area for the equipment and to assemble the machine and its support components. Depending on the ground conditions encountered, site and work area constraints and the number of TBMs used for tunnel excavation, these durations can vary.

Table 4-1: Typical Sequence and Average Time Required for Construction

Activity	Tasks	Average Time Required (months)1
Preconstruction	Locate utilities; establish ROW and project control points and centerlines; and establish/relocate survey monuments.	4 – 6
Site Preparation	Relocate utilities and clear and grub ROW (demolition); widen streets; establish detours and haul routes; erect safety devices and mobilize special construction equipment; prepare construction equipment yards and stockpile materials.	12 – 18
Heavy Construction	Construction of stations and entrances, tunnels and associated structures; major systems facilities; disposal of excess material; backfilling of stations and portal, and refinish roadways and sidewalks.	24 – 36
Medium Construction	Lay track; construct surface facilities (including above-ground structures), drainage, and backfill; and pave streets.	12 – 24
Light Construction	Install all system elements (electrical, mechanical, signals, and communication), traffic signals, street lighting where applicable, landscaping, signing and striping; close detours; clean-up and test system.	6 – 12
Pre-Revenue Service	Testing of power, communications, signaling, and ventilation systems; training of operators and maintenance personnel.	5 – 6
Project Ready for Revenue Service		

[1]Some of these activities will be conducted in parallel.

During the construction period, the number of workers on the various construction sites at any one time will vary depending on the activities being performed. During the peak construction periods, work will be underway at several station sites and tunnel excavation will be concurrently progressing. During subsequent sections of this report, the anticipated numbers of construction workers will be presented for the alternatives discussed.

In general, excavated materials will be loaded onto trucks and removed from the site, or stored within the work areas for subsequent re-use as backfill. Excavated materials that are contaminated would be handled in accordance with the appropriate regulatory requirements. Typically, such materials would be separated, loaded onto trucks, and removed to an appropriate and regulated disposal site; although, on-site storage and re-use as contained fill may be possible if the level of contamination permits.

Based on the full build-out of the Westside Subway Extension (Alternative 5), the total volume of material to be excavated for all tunnel and station construction is expected to be approximately 7 million loose cubic-yards (CY). Using a truck load volume of 20 CY per truck, total tunnel and station excavations would require approximately 350,000 truckloads of material to be removed from the construction sites during the entire construction period. This number will be reduced to the extent that excavated materials can be stored and re-used. Further details on excavation and truck volumes are included in subsequent sections.

In addition to the tunnels and underground stations other Elements Common to All Build Alternatives include:

- Use of building protection measures such as underpinning or ground improvement (including grouting), combined with a geotechnical monitoring program as required to monitor and protect structures identified for such measures.
- Relocation, modification, or protection in-place of existing utilities in the path of the planned excavations.
- Removal or relocation of structures at construction staging sites and area around station entrances, where necessary.
- Construction of entrances to the underground stations.
- Construction of urban design enhancements around station entrances.
- Construction of surface and subsurface drainage systems.
- Construction of traction power substations with electrical power feeds.
- Construction of trackwork, ventilation, traction power, communications and signaling systems for train operations.
- Construction of emergency (backup) power systems.
- Construction of station finishes including fare vending equipment, elevators, escalators, landscaping, signage, and other amenities necessary for a functional station.
- Conducting system integration testing, simulated revenue operation test runs, and final commissioning of the system.

4.1.1.1 Preconstruction

Pre-construction evaluations would be completed during design phases to determine the condition of existing buildings, (including utilities and other structures or features) which are in proximity to the stations, tunnels and other underground structures. Analysis of adjacent buildings and property with respect to the excavation for underground stations and tunnels is necessary to determine whether additional protection work such as special excavation support systems, underpinning, or grouting is considered necessary to mitigate settlement. Geologic information is also considered when determining the need and methods for building protection. Concern for the integrity of the adjacent structures would also influence the method of excavation and type of support systems.

Prior to physical construction, buildings and facilities that could be affected (impacted) by the construction work will be surveyed to document their preconstruction condition. These preconstruction surveys are recorded and archived in case of disputes or claims associated with construction impacts. Immediately prior to the commencement of actual construction the essential results of these surveys will be confirmed, or corrected.

Preconstruction activities will also include the preparation of worksite traffic control plans, which will require regulatory agency approvals.

Local Business Surveys

Community relations and construction staff from Metro would contact and interview individual businesses, allowing for knowledge and understanding of how these businesses carry out their work. This survey identifies business usage, delivery, and shipping patterns and critical times of the day or year for business activities. This information will be used by Metro to develop construction requirements and Worksite Traffic Control plans, identify alternative access routes, and make efforts during construction to maintain critical business activities.

Geotechnical and Environment Investigations

During preliminary and final design of the project, subsurface (geotechnical) investigations would be undertaken to further evaluate geology, groundwater, seismic, and environmental conditions along the alignment. The geologic conditions will influence design and construction methods specified for stations, tunnels and other underground structures, as well as foundations. These investigations would be spaced along the alignment at tunnels, stations, and ancillary facilities to evaluate soil, rock, groundwater, seismic, and geo-environmental conditions, particularly to note locations where hydrocarbon or other contaminant deposits may be encountered.

Cultural Resource Investigations

The Cultural Resources Technical Report (Metro, 2010) provides details on historic, archeological and paleontological investigations and potential impacts. Areas known to have tar deposits and/or tar sands with potential paleontological features may require preliminary preparation and excavation is likely to take place early on and possibly as separate contracts in order to orderly and carefully remove the resources (i.e., fossils, artifacts, etc.) and prepare the ground for the coming excavations. In-street work will typically necessitate on-going lane closures.

In specific cases where paleontological or other significant cultural resources are found, it may be possible to alter the cut-and-cover construction methods to allow for sufficient time to evaluate and recover the resources while not requiring the complete suspension of construction activities. One such method could be to employ raised decking, which would allow for traffic to be restored as originally planned without disturbing the encountered resources. The decking system would be elevated above the existing street level, which would also require ramps for traffic to transition on-to and off-of the decking. Although raised decking may temporarily increase the visual impacts to adjacent properties, as well as present some access restrictions, this method would significantly reduce traffic impacts during any period of cultural resource investigation and/or recovery.

Historic Properties

There are existing historic resources adjacent to the proposed alternative alignments. Such properties could include structures located above tunnels that deviate outside street limits, as well as structures directly adjacent to tunnels, stations, or cut-and-cover construction areas, or areas proposed for acquisition. Specific impacted historic properties will be identified in the later stages of design as station entrances and design options are selected.

Other Preconstruction Work

Other preconstruction work will include surveys of site conditions, structures and other notable features. Sites for additional construction yards and staging will be acquired and noted in contract documents for bidding contractors. Public and environmental concerns will be noted and also incorporated into the construction documents as required by the project's mitigation and monitoring plans. Preparatory planning and community/stakeholder meetings will take place to make the public aware of what is to take place.

Construction Staging Areas

Temporary easements, typically a portion of the sidewalk, traffic lanes, and/or parking areas would be required at various locations for construction staging. Construction within the streets is also envisioned where no off-street areas can be identified for work-sites and/or access to underground excavations.

Construction Site Setup and Mobilization

Prior to construction activities, contractors will prepare the site to accept workers, equipment, and materials. This setup will include site preparations (including clearing, grubbing and grading), following by mobilization of initial equipment and materials. Prior to construction, work sites may require clearing and building demolition (see below) in some areas.

Construction Field Offices

In the earliest stages of construction, contractors and construction managers will establish field offices for personnel use during construction activities. In some cases, the field offices will be established in existing office space in the vicinity of the work areas. Where space allows, temporary jobsite trailers will be established for field offices. These offices will typically include power, environmental controls, offices, conference rooms, bathrooms, data/communications, and associated infrastructure. In some cases, on-site parking spaces are included adjacent to the offices. Often these offices are operational on a 24-hour basis to match the construction operations.

Building Demolition

As part of providing the space needed for construction, or preparing the necessary work areas, building demolition is often required. Such building demolition is performed by the main construction contractors or by specialty contractors in advance of the major contracts. In either case, demolition operations necessitate strict controls to ensure that adjacent buildings and infrastructure are not damaged or otherwise impacted by the demolition operations. These controls include construction fencing and barricades, environmental monitoring, and limits on the types of equipment and demolition procedures. Demolition equipment typically includes bulldozers and front-end loaders, which are often specially developed or modified to allow for precise and controlled dismantling (demolition). Prior to demolition, contractors may salvage items such as fixtures, mechanical equipment, and lumber. Where economical, materials such as steel and concrete may be recycled.

Utilities

Underground utilities must be thoroughly researched and locations noted on contract drawings. Handling of utilities is a time consuming and potentially delaying operation and will require that, as much as possible, notification and locations be contained in construction contract documents. During preconstruction, existing utilities may be more closely inspected and evaluated, including depth, condition, and exact location. An operation called “potholing” is typically done to physically locate certain utilities, which can then be appropriately marked or protected prior to main construction. Where in-place protection is not sufficient, relocation of utilities is required (see below). Utility relocations can be done prior to or during main construction operations, depending on the sensitivity of the utility.

4.1.1.2 Underground Utilities

Prior to beginning construction it would be necessary to relocate, modify or protect in place all utilities and underground structures that would conflict with excavations. The contractor will verify locations through potholing methods and where feasible, the utility will be relocated so as to stay out of station or other surface structure excavation. Where the utility cannot be relocated outside the excavation footprint, it will be exposed and hung from the supporting structure (deck beams) for the roadway decking over the cut-and-cover structure.

Shallow utilities, such as maintenance holes or pull boxes, which would interfere with excavation work, will require relocation. The utilities alignments will be modified and moved away from the proposed facilities. Utility relocation takes place ahead of station and other underground structure excavation. During this time, it may be necessary to close additional traffic lanes at one time.

It is possible that in some instances, block-long sections of streets would be closed temporarily for utility relocation and related construction operations. Pedestrian access (sidewalks) would remain open and vehicular traffic would be re-routed. Temporary night sidewalk closures may be necessary in some locations for the delivery of oversized materials. Special facilities, such as handrails, fences, and walkways will be provided for the safety of pedestrians.

Minor cross streets and alleyways may also be temporarily closed but access to adjacent properties will be maintained. Major cross streets would require partial closure, half of the street at a time, while relocating utilities.

Subject to other constraints, the underground stations have been located to avoid to the extent possible conflicts with the space occupied by utilities. Impacted utilities are expected to include storm drains, sanitary sewers, water lines, power lines, gas pipelines, oil pipelines, electrical ductbanks and transmission lines, lighting, irrigation lines, and types of communications, including phone (fiber optic), data, cable TV, etc.

Utilities, such as high-pressure water mains and gas lines, which could represent a potential hazard during cut-and-cover and open-cut station construction and that are not to be permanently relocated away from the work site, would be removed from the cut-and-cover or open-cut area temporarily to prevent accidental damage to the utilities, to construction personnel and to the adjoining community. These utilities would be relocated temporarily by the contractor at the early stages of the operations and reset in essentially their original locations during the final backfilling above the constructed station.

Utilities that need not be relocated, either permanently or temporarily, are uncovered during the early stages of excavation. These buried utilities, with the possible exception of sewers, are generally found within several feet of the street surface. They can be reinforced, if necessary, and supported in-place by hanging from deck beams.

All utility relocations will be coordinated with the utility owner. Relocation and protection of underground utilities will require excavation to the depth of the existing utility line and installation of a replacement utility in a new location, followed by backfilling and reconstruction of the pavement or surface improvements. This will occur within the affected ROW and on nearby streets as required.

Utility relocations often entail some form of temporary service interruptions, which are typically limited to short periods during the cut-over from the existing to the relocated service. Such service interruptions are typically planned to occur at periods of minimum use (such as nights or weekends for businesses), so that outages have the least impact on users.

Relocation of utilities would generally be performed before construction of the stations, tunnels or related facilities. Construction equipment typically required for relocation and restoration includes shovels, spaders, backhoes, excavators, trenchers, trucks, small cranes, and generators/compressors. Concrete trucks, asphalt trucks, pavers, rollers and compactors are typically required for street restoration.

In addition to utility relocations, various new utilities will be installed as required. These new installations can be expected to include communications cables (including fiber optic lines), electrical duct-banks, drainage facilities (pipelines, catch basins, etc.), water supply lines, and lighting.

4.1.2 Station/Cut-and-Cover Construction

All stations would be designed to accommodate Metro Heavy Rail six-car trains (i.e., approximately 450-ft long platforms). Each station will be designed somewhat differently, but all stations have similar dimensions: approximately 680-ft long, 70-ft wide (to fit considering two tracks, a middle column and side room) and 60-ft to 70-ft below street level. Side entrances would typically be about 60-ft long, 20-ft wide, and 25-ft deep.

For stations, cut-and-cover construction methods are anticipated. In an urban area, this construction technique generally begins by opening the ground surface to an adequate depth to permit support of existing utility lines and to install soldier piles, or other means of retaining the excavation. After the surface opening is covered with a temporary decking so traffic and pedestrian movement can continue, excavation proceeds to the necessary depth from beneath the decking. A concrete station box structure is then built within the excavated space, backfilled up to street level, and the surface is restored. The temporary excavation will be retained by an approved excavation support system, also known as a shoring system. In addition, adjacent building foundations will also be supported as necessary.

In addition to stations, excavations will also be needed for various ancillary structures such as crossovers, pocket tracks, vent shafts, emergency exits, and systems facilities. Typically, cut-and-cover techniques would also be used for these ancillary structures. On this project, cut-and-cover construction is minimized to structures connecting to the surface, with the majority of the alignment constructed below ground in tunnels.

A typical station excavation would occur over an approximately 12-month period and would result in approximately 120,000 CY of excavated soil. A bulk factor adds about 30 percent to the soil volume. Assuming approximately eight months for each station excavation, it would take approximately 25 to 50 haul truck trips per day to remove the excavated soils. However, the frequency of truck haul trips will depend on the contractor's equipment methods and rate of excavation. Further information is providing in subsequent sections.

It is estimated that approximately 12 to 18 months will be needed to establish the surface work area, install the support of excavation, and to complete excavation so as to be able to turn the station over for tunnel operations or for station concrete work. The total sequences described for underground station construction could be up to 48 months. Based on the anticipated volume of excavation for the tunnel and cut-and-cover stations, it is estimated that an average of 25 to 80 dump trucks per day would be required to haul and dispose of the excavated soils during excavation cycles.

4.1.2.1 Excavations in Potentially Gassy Ground

Methane is a hazard in confined spaces. As such, it is essential that tunnel workers be sufficiently protected, and thus detection and monitoring equipment would be required (see section 3.1). Fans similar to those used to dilute hydrogen sulfide concentrations would also dilute methane concentrations in the tunnel. Once above-ground, methane dissipates rapidly in the atmosphere and would not be a health hazard.

Station design would also include gas monitoring and detection systems, as well as ventilation equipment to dissipate gas. For stations, the use of relatively impermeable diaphragm or slurry walls may be required to reduce gas inflows, as well as requirements for additional ventilation, monitoring, and worker training for exposure to hazardous gases. In extreme cases, some work may require worker use of personal protective equipment (PPE), such as fitted breathing apparatus. Stations constructed in gas zones would have similar interior dimensions as other stations. Details concerning the special requirements for the permanent structure design of stations are included in the geologic hazard section of the Geotechnical and Hazardous Materials Technical Report (Metro, 2010).

Excavation equipment used below the decking may be required to be sealed and/or be of explosion-proof design. In areas of potential H_2S exposure, there are a number of techniques that can be used to lower the risk of H_2S release or exposure. Because station excavations are less confined than tunnels, gas exposure issues are anticipated to be less significant. Although pre-treatment of the ground/water prior to excavation, such as with hydrogen peroxide, is an option, it is not expected to be required.

Previous projects in the Methane Risk Zone have been successfully and safely excavated. Multiple underground parking garages have been constructed in this area. For example, the Los Angeles County Museum of Art built a two-level subterranean parking structure in a Methane Risk Zone. During excavation, hydrogen sulfide (above safe working levels) was encountered on several occasions. Workers donned PPE to protect against exposure during these events. Further investigation of operating underground structures will be undertaken during future design phases to assess effectiveness of barrier systems and detection equipment used.

4.1.2.2 Excavation Support System

The support of excavation is an important factor in the construction of deep excavations and there are various suitable methods that a contractor might construct. These methods could include soldier piles with lagging, slurry walls, or other similar techniques. It should be noted that the initial or temporary support system for the station excavation is typically designed and constructed by the station contractor. However, the final support for the station excavation is provided by the concrete station box structure, which is a permanent work element, designed by Metro's designers and built by the station contractor.

If the pre-construction building assessments indicate the necessity to protect nearby existing structures, the first step in construction of an underground station is to support the foundations of buildings adjacent to the station excavation. This is typically done by underpinning, which involves the placement of additional foundation elements under the building to support the structure well below the area to be excavated. Alternatively, the ground below the existing foundations can be improved by other means such as grouting. In lieu of underpinning or grouting, or in combination with grouting, the support of adjacent structures is commonly accomplished by use of more rigid excavation support systems, which in conjunction with proper excavation and bracing procedures, serves as building protection. **Figure** 4-1**Error! Reference source not found.** illustrates a typical cut-and-cover construction sequence.

Figure 4-2**Error! Reference source not found.** illustrates the initial excavation of Metro's Gold Line Eastside Extension's (MGLEE) 1st/Soto Station. The excavation's initial support system(s) is typically comprised of braced soldier piles and lagging, although alternative systems could include reinforced concrete drilled-in-place piles, tangent pile walls, diaphragm walls (slurry walls), and tied-back excavations. Initial support allows support of the ground while soil is removed from the excavation. This support remains in place for the duration of tunneling and other temporary work. Final support includes the concrete slabs, walls, and walkways for the stations entrances.

Some lateral movement of the excavation walls may occur during removal of soil. The amount of movement will depend on the contractor's excavation methods, wall design, and the height of the wall. Project specifications will call for monitoring of walls and adjacent ground for lateral movements and surface settlement. Acceptable movements, such that adjacent buildings can be protected, will be determined during final design. Specifications will call for the contractor to take appropriate action if limiting movements are approached.

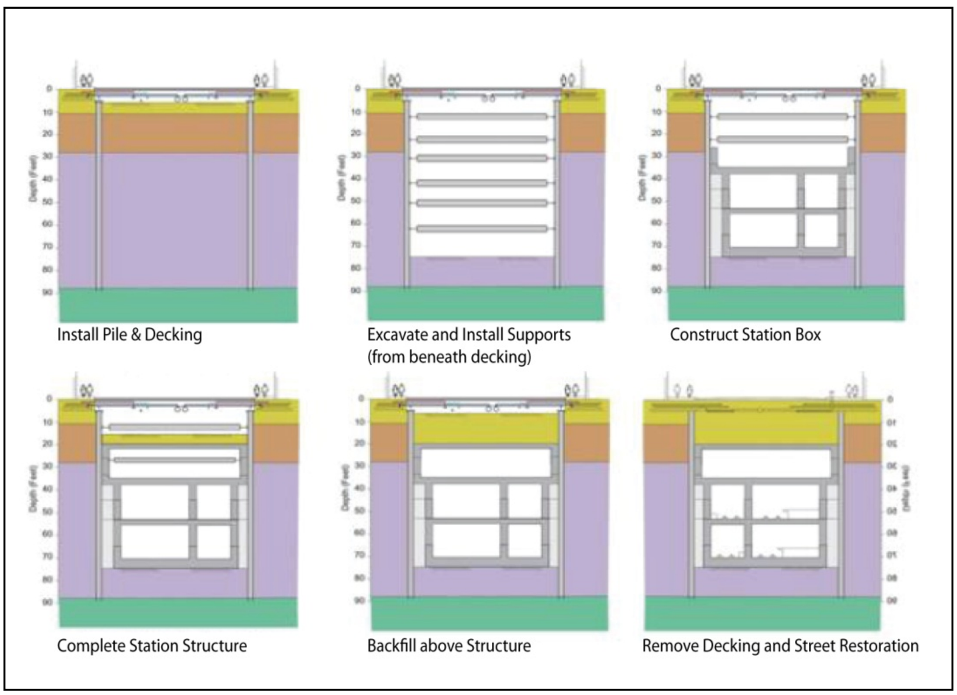

Figure 4-1: Typical Cut-and-Cover Construction Sequence

Figure 4-2: Typical Cut-and-Cover Construction Activities from the Metro Gold Line Eastside Extension

4.1.2.3 Soldier Pile and Lagging

Soldier pile and lagging walls are a type of shoring system typically constructed along the perimeter of excavation areas to hold back the soil around the excavation. This support system consists of installing soldier piles (vertical steel beams) at regular intervals and placing lagging in between the piles to form the retaining structure. Pre-auguring will be necessary for installation of the soldier piles. Pre-auguring involves drilling holes for each pile from the street surface (Figure 4-3**Error! Reference source not found.**) to eliminate the need for pile driving equipment and thereby reduce project noise and vibration levels that would otherwise occur while pile driving. The lagging, which spans and retains the soil between the piles, is typically timber or shotcrete (sprayed-on concrete).

Figure 4-3: Drilling for Soldier Pile Installation

A soldier pile and lagging excavation and support system is shown in Figure 4-4. To install the piles, the contractor would first occupy one side of the street to install one line of soldier piles. The soldier pile installation will require partial closures of traffic lanes on the side of the street where the equipment would be staged. The equipment required for installation of the soldier piles includes drill rigs, concrete trucks, cranes, and dump trucks.

Figure 4-4: Typical Soldier Pile and Lagging System (Metro Gold Line Eastside Extension)

After installation of soldier piles on both sides of the street at the station excavations, soldier piles would then be installed across the street at the station ends. This operation would also require lane closures, and is often done during night-time or weekend periods. The contractor would then proceed with installation of deck beams, installation of the deck panels and excavation and bracing. Deck panels (decking) allow continued traffic and pedestrian circulation since they will typically be installed flush with the existing street or sidewalk levels. However, deck installation would require night-time street closures on weekdays or full road closures on weekends with traffic detours. The decking would be installed in progressive stages.

A soldier pile and lagging system is generally used where groundwater is not a hazard or where grouting, or lowering of the groundwater level (dewatering) can be used to mitigate water leakage between piles. Dewatering is discussed in more detail below.

Alternatives to soldier pile and lagging walls include slurry walls and secant or tangent pile walls (see next section below). Use of slurry wall construction can provide a nearly water-tight excavation, eliminating the need to dewater.

4.1.2.4 Special Shoring Designs

In general, the shoring design along the alignment falls into one of three categories:

- Areas of no ground water;
- Areas of shallow ground water; and
- Areas with asphaltic sands, subsurface gases, and groundwater.

For station and other excavations where water is not anticipated, conventional soldier piles and lagging is expected, which is discussed above. This is also the most common shoring system used in the Los Angeles area.

The groundwater along the alignment varies in depth and expected inflow rate. Along most of the Segment 1 alignment, experience indicates that underground excavations on the order of 50- to 60-ft deep were successfully performed with minimum dewatering effort due to the presence of less permeable soils. Depending on the situation, this dewatering has been accomplished with a few strategically located wells supplemented by gravel-filled trenches and sumps as the excavation proceeded. In such cases, conventional soldier piles with lagging have been adequate.

However, there are some locations along Wilshire where the groundwater is near the ground surface, potentially under artesian pressure. In such cases, the use of dewatering through multiple wells is often necessary. Also, the use of soldier piles with lagging may be inadequate and a slurry (diaphragm) wall, secant pile, or similar system may be implemented. Slurry walls have been used along the Wilshire Boulevard corridor for a building basement/foundation at the intersection of Wilshire and Veteran Boulevard.

4.1.2.5 Tangent Pile or Secant Pile Walls

Tangent pile walls consist of contiguous drilled piles that touch each other. The contiguous wall generally provides a better groundwater seal than the soldier pile and lagging system, but some grouting or dewatering could still be needed to control leakage between piles. Similar to the soldier pile installation described above, the contractor would occupy one side of the street and drill the piles sequentially to form the retaining wall.

A secant pile wall system is similar to the tangent pile wall but the piles have some overlap, facilitating better water tightness and rigidity. The method consists of boring and concreting the primary piles at centers slightly less than twice the pile diameter. Secondary piles are then bored in between the primary piles, prior to the concrete achieving much of its strength. The completed secant pile wall for the Barnsdall Shaft in Hollywood for the Metro Red Line project is shown on Figure 4-5. Because of the close spacing of tangent piles, utilities crossing the wall often require relocation. The equipment required for installation of the tangent pile or secant pile walls includes drill rigs, concrete trucks, cranes, and dump trucks.

Figure 4-5: Secant Pile Wall Used at the Barnsdall Park Shaft

4.1.2.6 Diaphragm/Slurry Walls

Diaphragm walls (commonly known as slurry walls) are structural elements used for retention systems and permanent foundation walls. Slurry walls are constructed using deep trenches or panels which are kept open by filling them with a thick bentonite slurry mixture. After the slurry-filled trench is excavated to the required depth, structural elements (typically a steel reinforcement cage) are lowered into the trench and concrete is pumped from the bottom of the trench, displacing the slurry. Figure 4-6 and Figure 4-7 illustrate slurry wall excavation equipment.

Figure 4-6: Typical Slurry Wall Panel Excavation

Figure 4-7: Rebar Cage for Typical Slurry Wall Panel

Tremie concrete is placed in one continuous operation through one or more pipes that extend to the bottom of the trench. The concrete placement pipes are extracted as the concrete fills the trench. Once all the concrete is placed and has cured, the result is a structural concrete panel. Grout pipes can be placed within slurry wall panels to be used later in the event that leakage through wall sections, particularly at panel joints, is observed. The slurry that is displaced by the concrete is saved and reused for subsequent panel excavations.

Slurry wall construction advances in discontinuous sections such that no two adjacent panels are constructed simultaneously. Stop-end steel members are placed vertically at each end of the primary panel to form joints for adjacent secondary panels. In some cases, these members are withdrawn as the concrete sets. Secondary panels are constructed between the primary panels to create a continuous wall. Panels are usually 8- to 20-ft long, with widths varying from 2 to 5 feet.

Slurry wall construction would occur in stages, working on one side of the street at a time. These walls have been constructed in virtually all soil types to provide a watertight support system in addition to greater wall stiffness to control ground movement. Because slurry walls are thicker and more rigid than many other shoring methods, the walls may in some cases be used as the permanent structural wall, although this application is not anticipated for this project. Where slurry walls are used, the thickness of the permanent structural walls can sometimes be reduced, i.e., when compared to wall thicknesses used with a conventional soldier pile and lagging system.

Slurry walls are generally not adaptable to utility crossings and all utilities crossed by the wall would require temporary or permanent relocation. The equipment required for installation of the slurry walls includes clamshell or rotary head excavators, concrete trucks, slurry mixing equipment, cranes, slurry treatment plant, and dump trucks. The bentonite slurry would require disposal after a number of re-use cycles.

4.1.3 Station Construction in Potentially Gassy Ground

As discussed above, the use of slurry walls may be required for station excavation in potential gas areas. In addition, the final structure may include additional sealing from gas intrusion, such as with special gas-resistant membranes and/or joint sealants, which will increase resistance to leakage. Station design would also include gas monitoring and detection systems, as well as ventilation equipment to dissipate gas. Details concerning the special requirements for the permanent structure design of stations are included in the geologic hazard section of the Geotechnical and Hazardous Materials Technical Report (Metro, 2010).

4.1.3.1 Excavation and Decking

After installation of the temporary shoring (support) system and initial excavation, the contractor would proceed with installation of the deck beams, followed by multiple sequences of excavation and installation of cross bracing. In special situations, such as where cross-bracing impedes access from above, tie-back systems may be used. Tie-backs are strong cable strands that are installed and grouted into pre-drilled holes extending out and downward from the excavation support wall. After the grout sets and the cables are firmly anchored into competent ground, the tie-backs are tensioned to provide lateral support to the wall. The use of tie-backs may require temporary underground easements.

Deck panels (decking) are placed on the deck beams to allow traffic and pedestrian circulation to resume after the initial excavation. These deck panels are typically constructed of precast reinforced concrete. The decking is typically installed flush with the existing street or sidewalk level. Deck panel installation would require temporary street closures at the cut-and-cover areas and would be installed in progressive stages.

Entrances for TBM operations (i.e., tunnel portal locations) would follow similar construction methods as for the station excavations. Because the TBM entrances are typically in street locations, side entrances are often required in adjacent off-street locations. In such cases, the excavation in adjacent off-street locations may remain open to ground surface level and thus no decking would be used during construction.

4.1.3.2 Dewatering

Prior to installation of the ground support system, dewatering is likely to be required at the underground station sites to temporarily lower the groundwater level (if groundwater is present) below the station excavation depth or to an impermeable soil layer. This facilitates installation of the piles, improves soil stability, and allows excavation in dry conditions. Groundwater is pumped from wells installed around the perimeter of the excavation. If contaminated water is encountered, it is typically treated at the site prior to discharge. At the completion of the stations, pumping is discontinued and groundwater levels return to their natural level.

If dewatering methods are used, and depending on the site soil conditions and groundwater level at the time of construction, some surface settlement could be experienced due to groundwater lowering. Dewatering and groundwater pumping rates will be estimated during final geotechnical investigations and pump tests.

In general, water will be pumped out of sump pits as the excavation proceeds downward. Ditches and gravity flow will be used to drain the water into the low-lying sumps. Water will be passed through a settling basin to remove solids before being pumped into the local storm drain or sanitary sewer system. Based on prior experience along Wilshire corridor, deep basement excavation dewatering has been accomplished by pumping from limited number of deep wells strategically located within the site and augmented by gravel-filled trenches and sumps throughout the excavation area. It is anticipated that dewatering flows will be processed on site to remove oils and solids. Depending on the anticipated discharge flows at each excavation location, the excess flow capacity in the sewer systems will be checked to determine the optimal discharge point(s).

4.1.4 Station Drainage

It is anticipated that the majority of stations will not be provided with subdrain systems or permanent dewatering wells. On this basis, the station structures where shallow groundwater exists will have to be thoroughly waterproofed. Even in such cases, an internal sump pump system may be required at some stations. Within the gassy areas, a special waterproofing system will be required to also provide a barrier against gas intrusion.

4.1.4.1 Settlement Protection Measures

Underground excavation for stations using the cut-and-cover technique can result in some ground relaxation and deformation of the retained soils. The magnitude of ground movement depends on the strength of the surrounding ground and the rigidity of the shoring system. For cut-and-cover excavation, the zone potentially susceptible to ground movement generally extends a lateral distance approximately equal to the depth of the excavation. Buildings within this zone will be evaluated for susceptibility to settlement and the need for additional protection measures. Typical building protection measures are discussed below.

Presence of Existing Tie-backs

At proposed station locations planned adjacent to the existing deep basements, there may be existing abandoned tie-backs projecting into the space of the planned station. These tie-backs, although no longer in service, will interfere with the construction of shoring and station walls. In many cases, the locations of these tie-backs can be reasonably well established. Accordingly, if soldier piles and lagging are used, the soldier piles can be spaced to avoid the tie-backs during drilling and these tie-backs can later be de-tensioned and cut off as the excavation and lagging proceeds. The presence of abandoned tiebacks can be significantly more problematic if tangent or secant piles are installed or if slurry wall systems are used. Specialized methods and equipment to de-tension and cut the tiebacks have been used, but it is often preferred to adopt a soldier pile and lagging system where tie-backs are known to exist.

Existing Foundations

Many of the station excavations will be within close proximity of existing foundations. Careful planning and execution will be required to protect these existing foundations. Depending on specific situations, foundations may have to be underpinned. If feasible, a preferred approach is to design a more rigid excavation support system that can resist the additional loads imposed by the adjacent foundations. In such cases, a stiffer tangent pile, secant pile or slurry wall shoring system may be required. Pre-loading of excavation support bracing may also be implemented.

For buildings adjacent to cut-and-cover construction, it is anticipated that the shoring system, in conjunction with internal bracing, will provide a relatively rigid temporary support for the proposed excavation that would result in deformation within the tolerable limits of the structures. Evaluations during future phases, along with previous Metro experiences, will help determine the appropriate levels of monitoring, protection, and mitigation measures required during construction.

Asphaltic Sands

When excavating in asphaltic sands (tar sands) (see Geotechnical and Hazardous Materials Technical Report. Metro, 2010)), efforts will be undertaken to avoid excessive disturbance. Excavation methods will be closely controlled to minimize over-excavation or vibrations. In some cases, a layer of gravel may have to be placed over the asphaltic sands to permit construction traffic. Also, when grade is achieved within these soils, a mud slab will be required to minimize disturbance. Asphaltic sands are present along the alignment between about La Brea Avenue and Fairfax Avenue; with heavier concentrations near Wilshire Boulevard and Fairfax Avenue. Groundwater is also present in this reach.

The asphaltic sands have unique properties and the engineering characteristics are not as well documented as compared to other soils. However, contrary to common expectations, it is proven that these sands possess shear strength. Design parameters for excavation support systems in asphaltic sands will need to consider some additional pressure due to these soils. There are numerous cases of successful experience in construction of deep basements and underground parking structures in the Wilshire/Fairfax area soils, such as construction of underground structures at the Los Angeles County Museum of Art. Similar designs elements, construction techniques and operating methods and procedures can be applied to the planned excavations.

4.1.5 Backfilling

Excavation at the station will require backfilling over the top (roof) of the station structure to fill the area between the structure and street surface. This backfilling is typically done with imported soils, which are delivered by truck. Backfilling will be primarily carried out in the last three or four months as the station is completed. Depending on the station configuration, this operation will be done in stages. Each station will require approximately 20,000 CY of imported backfill deliveries, or roughly 1,000 truck-loads (depending on the type of trucks used). During peak backfill periods, approximately 50-100 trucks per day would be expected to bring backfill into the site.

The number of backfill deliveries can be reduced by stockpiling excavated materials on site for re-use. It will not be feasible to re-use tunnel excavated materials for backfill because of the conditioning agents and/or slurry added to the excavated soils. Soils excavated from station sites may be suitable for re-use. However, given the urban area, sites suitable for soil stockpiling will be very limited.

4.1.5.1 Disposal of Excavated Materials

With the decking installed and the utilities supported, the major excavation work for the station box can proceed. Spoils from station sites would be moved out from under the deck onto an off-street work site or closed parking/traffic lane and loaded from there into haul trucks. Occasionally spoils loading in the street during excavation and the initial drilling of soldier piles and deck installation could be required.

Assuming each station to be approximately 680-ft long by 70-ft wide by 60-ft deep, the average volume of material from the cut-and-cover station excavation for each station is approximately 135,000 CY, which is based on the soils expanding by approximately 30 percent through the excavation and loading process. For deeper or longer stations, this volume would increase. For instance, for a 70-ft deep station, the average volume of material is approximately 160,000 CY.

This excavated material would be brought to the surface and loaded into trucks for disposal. Assuming and the use of 20 CY haul trucks, the total number of excavation truck trips required would be approximately 5,000 to 7,000 trucks. For a typical station configuration, this would equate to a maximum of approximately 50-60 truck trips per day.

The distance to the various landfill sites will vary. A special study examining excavated materials disposal reviewed existing state approved landfills within 20 miles of the project sites and indicated an available capacity for all waste generated by the project alternatives. Also, demand for fill by other construction projects in the Los Angeles area may facilitate the re-use of excavated materials on other projects. For further details on the analysis, an identification of the landfills and their capacities, and haul routes that would minimize impacts, see Transportation Impacts Technical Report (Metro, 2010).

Contaminated spoils are separated as soon as they are identified during the excavation cycle. Personnel qualified in identification and handling of these materials is on-site during the excavation operations. These spoils would be temporarily stockpiled separately on-site and handled in accordance with applicable regulations for handling and transporting contaminated materials. All trucking of materials to landfills would be timed to correspond with hours of operation.

4.1.5.2 Traffic

Traffic flow can be affected during the entire period of construction of at any given location, which is typically anticipated to be approximately 4-5 years. Depending on the traffic flow and location, a variety of mechanisms are available to control and maintain traffic in constricted intersections, including decking to temporarily replace street pavement and sidewalks, and temporary bridges. Decking will typically contain hatches or removable panels to facilitate lowering equipment or materials (such as odd-shaped and outsize items) down into the station excavation with minimal traffic disruption.

Cross streets, if used, will typically be carried through intersections on similar decked structures. Pedestrian access (sidewalks) would remain open, although in some instances, portions of the sidewalks may be closed temporarily for decking construction. Where sidewalks must be temporarily removed, pedestrian access will be maintained by bridges, temporary walkways, and other means. Some streets may also have to be temporarily closed under certain special circumstances, such as deck beam installation.

Trucking for supplies brought into the site is estimated to be approximately 5-10 trucks per work-day for the duration of station construction. For example, during a one-year period, assuming 5-6 work-days per week, this equate to approximately 1,800 truck trips. This does not include delivery of tunnel segments, concrete trucks, or imported backfill deliveries, which are addressed later in this report.

This estimate also does not include worker/employee commutes. The number of workers will vary depending on the operation needs, but for a typical station location, the estimated number of workers is approximately 85 personnel daily. This assumes two shifts of approximately 35 workers each plus approximately 15 office employees (counting both the contractor and the construction manager).

4.1.6 Ventilation Shafts and Emergency Exits

A number of ventilation structures and, for some options, emergency exit structures will be required. The station structures will generally house emergency ventilation fan shafts as well as separate emergency exit shafts at both ends of the stations. Ventilation fans are used for extracting smoke from tunnels and stairs for evacuation in the event of an emergency, such as a fire in the underground areas. The exact location of these facilities would be determined during the final design. These shafts are typically constructed as extensions of the station excavation, using cut-and-cover construction methods.

Mid-line ventilation structures will also be required where long tunnel reaches exist between stations. The construction of mid-line ventilation structures will be similar to Stations (cut-and-cover), only much shorter in length, generally less than 200-ft. Mid-line ventilation structures will be positioned based on the ventilation design of the overall system.

In addition, to ventilation and emergency exit structures, stations will usually include some above-ground structures that will be completed near the end of the station construction cycle. These above-ground structures may be limited to entrance features, stairways, and elevator/escalator entry points. In some case, Metro operations and maintenance spaces, including power equipment, communications facilities and/or control rooms, may be housed in above-ground structures.

4.1.7 Pocket Tracks and Crossovers

The rail system will require crossovers and pocket tracks for proper operation. Crossovers allow trains to move from one track to the other. A pocket track is a third track set between the existing two running tracks for temporary storage of out-of-service trains and for use as an emergency crossover. Pocket tracks and crossovers will be constructed using cut-and-cover construction.

Each crossover will be approximately 450-ft long, 60-ft wide, and 60-ft below ground (depending upon the distances between track centers). Pocket tracks will be approximately 1100-ft long, 60-ft wide, and 60-ft below ground.

4.1.8 Tunnel Construction

Figure 4-8: Typical Transit Tunnel

Whereas stations, crossovers, and ventilation structures will generally be constructed by cut-and-cover methods, the running tunnels will be constructed by mechanized tunneling methods. The use of pressurized-face TBMs (**Figure** 4-10**Error! Reference source not found.**) is planned to optimize control of the ground and to minimize settlement overlying and surrounding the tunnels. TBMs are large-diameter horizontal "drills" that continuously excavate circular tunnel sections. There are two types of pressurized-face TBMs, Earth-Pressure Balance (EPB), or Slurry-Face TBM.

Figure 4-9: Typical Pressurized-Face TBM

It is expected that the TBM used for different reaches of the tunnels will be subject to varying, site-specific requirements, including geologic conditions. For instance, where hydrocarbons and/or gases are expected to be encountered it is likely that a specialized Slurry-Face TBMs will be required. Where there is no known deposit of hydrocarbons, it is expected that the contractor will have the option of using either a Slurry-Face or EPB TBM. Each TBM operation has its own advantages and disadvantages that will be weighed by the bidding contractors. The characteristics of these machines are discussed further below.

4.1.8.1 Earth Pressure Balance (EPB) TBMs

In North America, EPB TBMs are the most common. These TBMs rely on balancing the thrust pressure of the machine against the soil and water pressures from the ground being excavated. EPB TBMs are generally well suited for mining in soft ground, which is expected along the Westside Subway Extension alignment. Gassy tunneling conditions are also anticipated and are discussed further below. These TBMs can also mine through variable soils, groundwater, and methane conditions and may also be adapted for harder materials. On the Metro Gold Line Eastside Extension project, EPB TBMs were successfully used to mine about 1.4 miles of tunnel. The excavation method for an EPB TBM is based on the principle that tunnel face support is provided by the excavated soil itself.

The excavated soil in an EPB TBM is contained in a chamber behind the cutting wheel by a bulkhead as shown in **Figure** 4-10. The "earth pressure" in this chamber balances the external soil and groundwater load which in turn minimizes movement of the ground in front of the TBM. The screw conveyor and rate of TBM advance restrict the rate of soil removed from the chamber to maintain the earth pressure.

Typically, EPB TBMs require that the soil at the excavation face is "conditioned" to help provide a more fluid and cohesive material and improve material flow and handling characteristics. This conditioning, which includes the use of non-toxic, biodegradable polymers, surfactants, bentonite and similar agents, aids in ensuring consistency of the excavated soils, maintaining the appropriate face pressures, and in reducing wear on the TBM components.

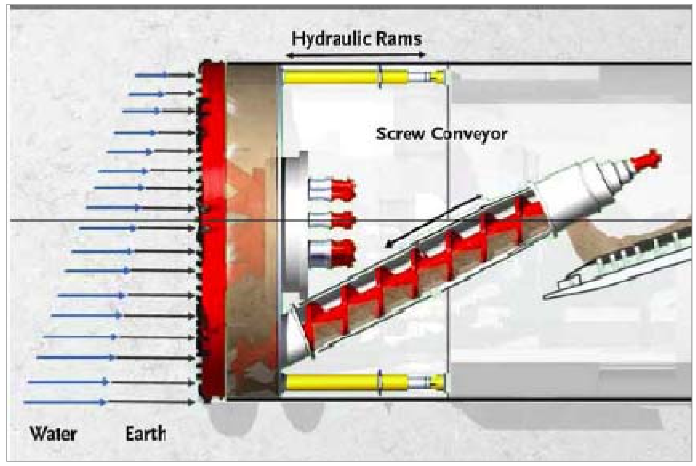

Figure 4-10: Schematic of Earth-Pressure Balance TBM

When the conditioned excavated spoils are transported through the tunnel to the ground surface, it is still wet. This often requires drying of the spoils prior to transport off-site and/or lining of spoil hauling trucks to prevent water from leaking onto roadways. An example of TBM spoils removed from a tunnel at a construction staging site is depicted in **Figure** 4-11.

Figure 4-11: Wet Soil at Surface EPB TBM

4.1.8.2 Slurry-Face TBMs

Slurry-Face TBMs will likely be required for tunneling in the elevated gas zones, where the addition of the slurry and the relatively closed spoil removal system provides additional protection against gas intrusion into the tunnel environment. Where lower gas concentrations are expected, EPB TBMs may also be suitable.

With Slurry-Face TBMs, a bentonite (clay) mixture or "slurry" is injected in a pressurized environment at the tunnel excavation face. This combination of pressure and slurry stabilizes supports the soils during excavation. Depending on the ground encountered, conditioners may be added to the slurry. Excavated soil is mixed with the slurry fluid and then pumped out of the tunnel through large (approximately 18" diameter) pipelines with in-line booster pumps, depending on the length of the tunnel.

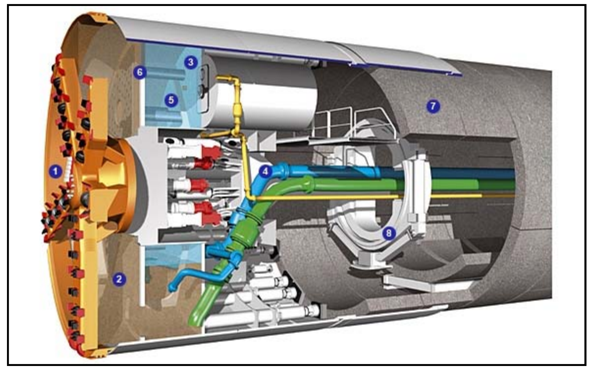

Figure 4-12: Typical Slurry-Face TBM with Precast Segment Lining

With a Slurry-Face TBM, excavated materials are transported from the tunnel face to an above-ground separation plant via pipelines. The excavated materials are treated at the plant, where they are separated from the slurry mixture. This process would also allow for the safe dispersion of any potentially gaseous components above ground without endangering tunnel personnel.

One of the effects of slurry excavation methods involves handling clean-up from spills, such as from leaky joints and worn pipe lines. Because the pipelines are often buried, slurry leakage is typically limited to the slurry mixing facility or slurry treatment plant. Slurry clean-up and removal will meet the strict standards of governing agencies and the needs of the surrounding community.

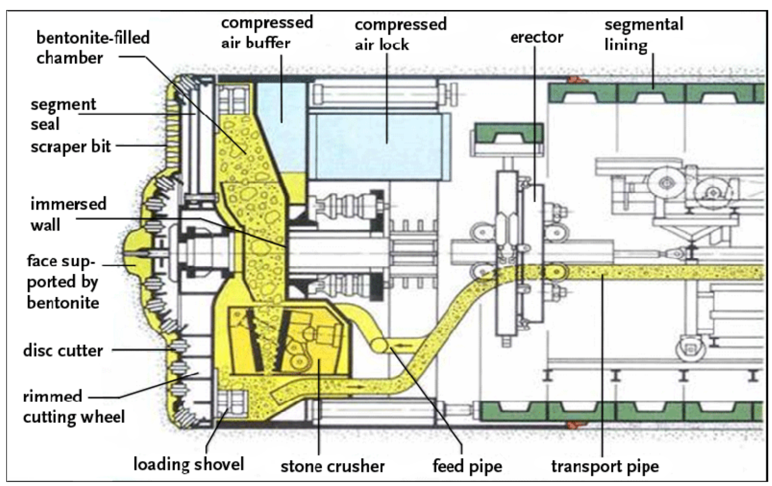

Figure 4-13: Slurry-Face TBM Tunnel with Slurry Pipeline in Foreground

Figure 4-14: Schematic of Slurry-Face TBM

As an alternative to on-site spoil/slurry separation, it may be possible to transport the slurry to an alternate location for treatment. This would likely entail additional lengths of slurry pipelines along streets or sidewalks, although such pipelines would probably need to be buried in shallow trenches to reduce potential community impacts. Depending on the distance to be pumped for treatment/separation and subsequent off-site disposal, this alternative may not be economical based on the time and cost to install, operate, and remove the additional pipelines and related infrastructure. There are also community and public safety concerns about the potential for slurry leakage and associated hazards. The processed water used in the slurry is also a potential source of concern and will require proper containment, treatment, and disposal. Slurry treatment is discussed in further detail in subsequent sections.

Figure 4-15: Typical Slurry Mixing Plant

4.1.9 Contractor Work and Storage Areas

Contractor work and storage areas would be necessary for construction of the tunnels, similar to that required for stations and ancillary facilities. Construction staging areas are required for assembly, setup, materials storage, and operation. Typically, these staging areas will be at station excavations to facilitate access to the tunnel. Off-street space will be needed for setup, insertion, operation, and extraction of TBMs. Work areas are also required to support tunnel excavation operations, including processing and removal of tunnel spoils, handling of precast concrete tunnel lining segments, and tunnel utilities (including ventilation, water supply, wastewater removal, power supply, etc.). Use of in-street work areas will only be utilized when no off-street alternative exists.

Typically, a tunnel staging site of roughly 1-2 acres in area (200-ft by 300-ft or equivalent) is required at the starting point of each tunnel drive. In addition to direct TBM support, such as storage for tunnel precast concrete segments, this space is needed for loading/unloading facilities, construction equipment, worker facilities, and offices.

4.1.10 Tunnel Excavation

Tunneling generally has less visible effect on surrounding areas than cut-and-cover methods since the street surface and utilities are not appreciably disturbed and there is less traffic disruption. The specific tunneling technique used will depend largely on the geologic conditions. The tunnels for this project are expected to be excavated in soft ground (i.e., clays, sands and silts), using TBMs. This soft-ground can also consist of gravels, cobbles, and sometimes boulders. Two circular tunnels, bored side-by-side separated by a pillar of ground between, are proposed. An alternative is an “over-under” configuration in which one tunnel is bored directly above the other. This stacked arrangement is recommended only where right-of-way area above is constrained or where special design circumstances come into play, such as at transfer/interchange structures between separate rail lines.

Figure 4-16: Typical TBM-excavated Tunnel with Precast Concrete Segmental Liner

The TBMs will require launching area to start each tunneling operation. Following tunnel excavation, the TBM would be dismantled and retrieved at the designated exit point (construction shaft). The TBM can then be transported back to the launching area, reassembled, and repeat its journey for the second twin tunnel. As in prior Metro subway construction, two TBMs could be launched at the same time.

Tunnel driving operations consist of a series of activities. The TBM is advanced a small distance (typically 4 to 5 feet) by means of hydraulic jacks, which push against the previously installed tunnel lining ring. Following a complete “push” to advance the TBM, the hydraulic jacks are retracted and the next lining ring is installed. This process is repeated as the tunnel advances from one station to the next.

When initially starting a tunnel drive from a shaft or station excavation, a heavy steel frame is typically erected to allow a rigid structure for the TBM to push from so that it can start to move forward and excavate through the ground outside the station or shaft (see **Figure** 4-17). Often, the soils that the TBM will initially mine through are treated to improve their strength and reduce susceptibility to settlement.

Temporary precast concrete segmental liners are erected behind the TBM, which allow for continued advanced. The initial tunnel lining segments erected within the shaft are later removed once the TBM is fully “buried” and is mining continuously.

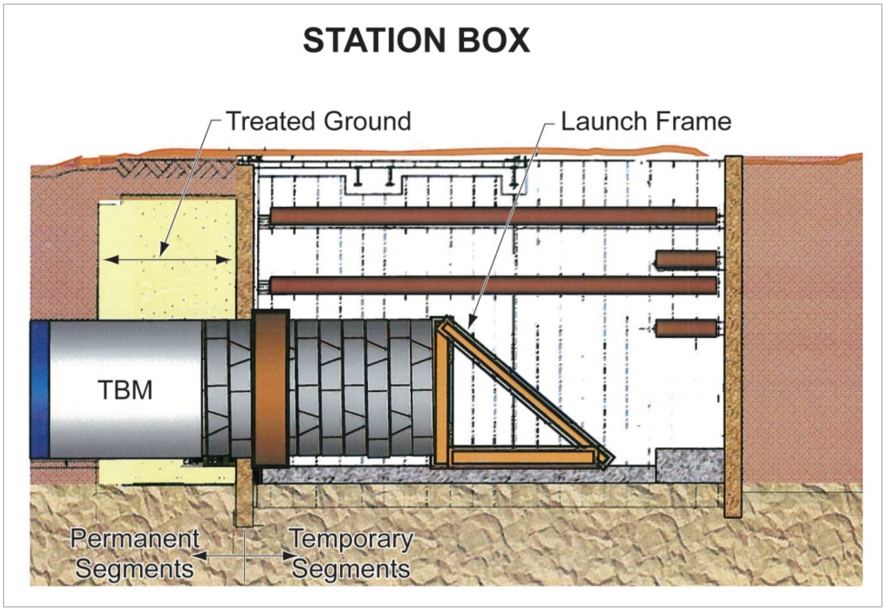

Figure 4-17: Launching a TBM from the Station Excavation

Excavated materials would be removed through isolated construction shafts or at cut-and-cover station excavations. With a conventional TBM, the excavated materials (spoils) are taken to the rear of the TBM by a screw conveyor and deposited on a conveyor belt. The conveyor belt drops the spoils into mine cars, which are then transported back to the launching area by a locomotive operating on temporary rail tracks fastened to the bottom of the tunnel. At the shaft, the mine cars are lifted out by a crane or hoist and the material is loaded into trucks for off-site disposal or temporarily stockpiled at the site for later disposal. Alternatively, belt conveyor systems could be used to transport spoils, through the tunnel and/or from the shaft to the surface.

Spoils would be disposed off-site at locations which are usually selected by the construction contractor with appropriate regulatory approvals, depending on the specific conditions of the spoils. With the expected use of pressurized-face TBMs, the spoils must generally undergo at least partial treatment on-site before being loaded on trucks for off-site disposal.

Figure 4-18: Typical TBM Tunnel Shown During Construction

4.1.10.1 Settlement Resulting from Tunnel Excavation

During the TBM tunnel excavation operations, the machine excavates slightly more soil than is taken up by the final lining. This is often referred to as "ground loss," which is the term for the small excavated volume that is greater than that defined by the permanent tunnel structure. These ground losses can produce surface settlement. The settlement can occur during mining or, depending on ground conditions, the time between the actual ground losses and the manifestation of the settlement could be days or weeks after the mining. Pressurized-face TBMs have become the leading soft ground tunnel excavation technology worldwide. A principal reason for this is the reduction in ground loss and settlement versus non-pressurized methods.

The amount of ground surface settlement will be a function of the tunnel depth, tunnel size, proximity of adjacent tunnels, ground conditions, TBM characteristics, and the contractor's excavation techniques. In addition to ensuring adequate face pressures through the use of pressurized-face TBMs, the requirement for precast segmental linings, grouted as the TBM advances, also minimizes settlement potential. The grouting operation is performed within the tunnel behind the TBM to promptly fill the annular space between the segmental lining and the surrounding ground.

In addition, at specific locations based on ground conditions or sensitive facilities above the tunnel, additional methods can be used to improve the ground prior to tunnel excavation and further minimize settlement potential. Such methods include permeation or chemical grouting, jet grouting, ground freezing and structural underpinning.

The width of the potential settlement zone is approximately two times the depth of the tunnel. Accordingly, structures located within these settlement/deformation zones would be further evaluated for potential impact and required mitigation measures.

As discussed above, pressure is maintained at the face of the TBM tunnel excavation to reduce the potential for ground loss, soil instability or surface settlement. In addition, a rigid, precast, bolted, gasketed lining system would be employed. In combination with the face pressure, grout would be injected immediately behind the TBM, in the annular space between the installed precast concrete liners (tunnel rings) and the excavated ground. The pressurized-face TBM can excavate below the groundwater table without requiring dewatering or lowering of the groundwater table. Metro recently completed the Gold Line Eastside Extension tunnels using EPB TBMs with no discernable settlements.

4.1.10.2 Settlement Protection Measures for Tunnels

For shallow tunnels below sensitive structures or utilities, additional methods can be employed to further reduce settlement. Such methods would depend on the ground conditions and structure details at specific areas. Some of the protective methods that could be employed along the alignment are discussed below.

Permeation Grouting

Permeation grouting is a method used to improve the ground prior to tunneling. Chemical (sodium silicate) or cement-based grouts are injected into the ground to fill voids between soil particles and provide greater strength and stand-up time for the soils. This grout can be placed through pipes from the surface before the tunnel reaches the grouted area, from pits or shafts adjacent to the grouted area, or in some instances from the tunnel face. In this latter case, the tunneling machine must be stopped for a period of time to drill ahead, install grout pipes, pump grout, and allow the grout to solidify. Permeation grouting is typically used in sandy soils, which are common along the Westside Subway Extension alignment. The permeation grouting method has been used successfully for the Metro Red Line in instances where the tunnel passed under potentially sensitive structures such as the US 101 freeway (downtown, Hollywood and at Universal City), and the Metro Gold Line Eastside Extension at its crossing of the I-5 freeway.

Compaction Grouting
Compaction grouting involves consolidating the ground prior to or following tunnel excavation. Compaction grouting entails the controlled injection of a stiff grout (typically sand with a small amount of cement) into the soils at and above the planned tunnel excavation. Grout pipes are installed in advance of tunneling and grout is injected to pre-consolidate the ground prior to the tunnel passing or to replace ground lost after the tunnel excavation. In either case, the grout improves the soil integrity and makes the ground more resistant to deformation. Compaction grouting methods were used successfully on the Metro Gold Line Eastside Extension.

Compensation Grouting
Compensation grouting is an alternate method in which grout is injected as the tunnel is excavated. Compensation grouting involves carefully controlled injection of grout between underground excavations and structures requiring protection from settlement. For tunnel applications, the grout pipes are installed above the intended tunnel position, in advance of tunneling. Grout is injected above the tunnel crown as the TBM excavation advances. The grout densifies the soil above the tunnel crown and replaces some of the ground that may be lost during the mining operations. This method prevents ground loss from propagating to the surface, thus mitigating settlement. A key component in controlling compensation grouting is careful monitoring of both structure and ground movements to allow the timing and quantities of grout injected to be optimized. Similar methods were used in several instances for the Metro Red Line project in the Downtown Los Angeles area and along portions of Hollywood Boulevard.

For grouting methods, surface preparation would likely be required (traffic controls, removal of landscaping, etc.) to allow space for drilling equipment, installation of grout pipes, and injection of grout. In cases where large structures are above the tunnel, access into the building or basements (where basements exist) could be required for grouting operations. In such cases, the use of the building could be limited during the grouting operations. After grouting is completed, the area would be restored to its existing condition.

The potential community impacts associated with these grouting methods, which are often performed from streets and sidewalks, can in some cases be mitigated by using directional drilling methods. Directional drilling can be done from off-street locations and can allow for horizontal orientation of grout holes along the tunnel alignment. This method, which was employed on the Metro Gold Line Eastside Extension, can provide an efficient grouting system with less community impact.

Underpinning
Underpinning involves supporting the foundations of an existing building by carrying its load bearing element to deeper levels than its previous configuration. This helps protect the

building from settlement that may be caused by construction work in the soils near that foundation. It permanently extends the foundations of a structure to an appropriate level beyond the range of influence of the construction activity. This can be accomplished by providing deeper piles adjacent to or directly under the existing foundation and transferring the building foundation loads onto the new system. Underpinning may not be appropriate if the building is directly above the tunnel.

Existing Foundations

Some limited sections of tunnels may be within close proximity of existing foundations. Careful planning and execution will be required to protect such existing foundations. Depending on specific situations, such footings may need to be underpinned. Similar to potential situations in the cut-and-cover excavation, specific conditions may exist where building foundations above the tunnel could impart additional loads on the tunnel lining. In such cases, the tunnel lining would have to be designed for the additional loads, such as those imposed by adjacent building foundations where the tunnel alignment crosses beneath or near high-rise structures.

Presence of Existing Tie-backs

It is possible that abandoned tie-backs could project into the planned tunnel excavation area. Such situations are problematic because the TBMs cannot excavate through such tie-backs. The tie-back cables must be cut and removed from the area to be mined by the TBM so that the TBM cutter-head is not damaged. Tiebacks are anticipated, at areas adjacent to deep basements and/or parking garages in buildings generally constructed after 1965. Specific locations will be studied in detail in subsequent stages of design.

Where the locations of the tie-backs can be reasonably well established, it is possible to mine up to the tie-back and stop. Then the forward chamber of the TBM can be pressurized with compressed air and workers can enter ahead of the machine to cut and remove the tie-back(s). In such situations, workers operating in a compressed air environment are subject to strict safety protocols including time limitations and the need to decompress follow any such compressed air work periods. Tiebacks are anticipated in locations, for example, that are adjacent to deep basements or underground parking garages in buildings constructed after 1965. However, it is usually not preferred to stop a pressurized-face TBM during mining and to avoid such situations a small-diameter shaft would need to be excavated from the ground surface so that the tie-back(s) can be cut prior to the TBM mining through the area.

Depending on the number of tie-backs intruding into the tunnel envelope and the depth of the tunnel, a short section of cut-and-cover excavation may be required in the tie-back zone. Such an excavation would likely be decked over similar to the methods used for station excavations. However, rather than constructing a concrete tunnel structure inside the excavation, the TBM would still be used to “walk-through” the open excavation and would still erect the precast tunnel segments. Once the TBM had progressed completely through the area, backfill would be placed and compacted around the precast segments and up to the ground surface, which would then be restored.

In any of the situations above, the ground in the tie-back areas may need to be improved or strengthened prior to cutting the tie-back to minimize ground losses and associated settlement. This ground improvement can be accomplished through various grouting methods or, when below the groundwater table, by using ground freezing.

Tunneling in Gassy Ground

Gassy conditions likely to be experienced during construction are described in the Geotechnical and Hazardous Materials Technical Report (Metro, 2010). Tunneling in gassy and/or tar-laden ground presents additional challenges for the safe execution of the construction work and for the integrity of the equipment and facilities. The primary line of defense against encountering gas involves adequate ventilation, which dilutes and transports encountered gases out of the tunnel. In addition, gas monitoring devices will be utilized to automatically shut-down electric power to the TBM, excluding backup safety lighting. In the event of a machine shut- down, personnel will be trained in what procedure they are to take, generally to retreat to the rear of the TBM equipment while gas monitoring personnel, with proper protective equipment, check the source and cause of the power shut off. TBMs and associated equipment used in the tunnel will be sealed and be of explosion-proof design for use in a gassy environment.

As referenced earlier, a fully enclosed system, such as a pressurized-face Slurry-Face TBM is expected to be used for tunneling in known gassy or potentially gassy areas. This technology is considered an improvement over the methods used during construction of Metro's initial operating segments. Tunneling using a Slurry-Face TBM minimizes exposure of workers to elevated gas concentrations underground, since the excavated soil is removed in a fully enclosed slurry pipeline to an above-ground, enclosed treatment plant. Where an EPB TBM can be converted to operate similar to a Slurry-Face TBM, with a closed spoil transport system, it would afford similar benefits and would likely be acceptable for use.

In areas of potential H_2S exposure, there are a number of techniques that can be used to lower the risk of H_2S exposure. First, it has been studied that the mixing and dilution of the Slurry-Face TBM excavation process itself reduces the potential for gas generation.

In addition, areas that have been determined to be at risk of elevated H_2S levels can be treated by injecting hydrogen peroxide into the ground/water in advance of the tunnel excavation. This "in-situ oxidation" method reduces H_2S levels even before the ground is excavated. This pre-treatment method is unlikely to be necessary where a Slurry-Face TBM is used, but may be implemented in at tunnel-to-station connections or at cross-passage excavation areas, which are discussed further below. Injection wells may be required at close spacings so that hydrogen peroxide is injected throughout the targeted area. Also, because this treatment requires high hydrogen peroxide concentrations, there are worker health and safety issues. The oxidation process releases pure oxygen, which could be a flammability concern in the tunnel. This can be mitigated with increased monitoring and ventilation

In addition to pre-treatment of the ground/water prior to mining, additives can be injected into the bentonite slurry during the mining and/or prior to discharge into the slurry treatment plant. The use of sodium hydroxide as an additive to raise the pH of the slurry has been found to be effective to suppress H_2S gas releases or "off-gassing." However, because of health and safety issues associated with use of sodium hydroxide, Cal/OSHA has previously indicated that they would not support such an application in a tunnel environment. In the slurry treatment plant, which can be more tightly controlled and monitored, sodium hydroxide dosing may be possible.

A more promising technique is the addition of zinc oxide to the slurry, a method commonly used in oil-field operations. The zinc oxide precipitates out dissolved sulfides to similarly reduce any potential for H_2S release or exposure. The slurry pipelines can be equipped with H_2S sensors that can automatically start zinc oxide dosing when certain levels are reached. However, if zinc dosages are significant enough, the post-treatment solids could be considered contaminated, which could require disposal at special facilities.

These treatments can neutralize the presence of hydrogen sulfide, thus improving the safety of workers involved in the slurry and separation plant systems. Such treatments have the additional benefit of reducing the corrosive effects of H_2S when it is dissolved in the slurry or groundwater.

Further to the treatment methods discussed above, the above-ground slurry treatment plant can be designed and operated to minimizing off-gassing both within the plant and to the environment surrounding the plant. This can principally be done by segregating slurry treatment areas and providing separate ventilation systems for areas exposed to off-gassing. The ventilation systems can also be out-fitted with air monitoring and treatment systems, such as scrubbers, to ensure that air leaving the plant environment meets air quality standards, including odor controls.

Where warranted, continuous air quality monitoring can be employed in the areas around the slurry treatment plant. These systems can be remotely monitored and equipped with alarms for warning of elevated gas levels and, if necessary, shutting down the tunnel excavation until air quality improves. Data-logging systems may also be employed to check the safe limits of exposure over time. These systems are frequently employed in the wastewater treatment industry and can be adapted to this application.

Tunnel Safety Considerations

All underground construction will require reviews and consents from Cal/OSHA, the Metro Tunnel Advisory Panel, and the Metro Fire Life Safety Committee, which includes members from the Los Angeles City and County Fire Departments, as well as Metro safety specialists.

Prior to tunnel construction, designs will have been developed to minimize gas intrusion into the tunnel or station under construction and for the final structure. These designs may include some combination of continuous, sealed excavation support systems, pressurized-face TBMs with closed spoil transport systems, pre-treatment of potential gas areas, and special membranes and systems to seal tunnel linings and structural elements. These concepts will be further developed during preliminary design. Additional precautions involve a strict adherence to tunnel safety standards, including use of tunnel ventilation systems during construction, monitoring for gas, and use of specialized mechanical and electrical equipment.

In California, tunnel construction safety is governed by the California Occupational Safety and Health Administration (Cal/OSHA) Tunnel Safety Orders and worker safety training. California Electrical Safety Orders also will apply for use of electric equipment. California Tunnel Safety Orders are considered to be among the most comprehensive, structured, and most stringent in the world, and have been cited for use in other states.

Where methane and/or H_2S gases could be encountered, the regulations are specific and begin with the tunnel classification. The classifications range from "non-Gassy" where there is little likelihood of encountering gas during the construction of the tunnel, to "Gassy" which is applied when gas in the tunnel is likely to be encountered at a concentration greater than 5 percent of the Lower Explosive Limit (LEL) of the gas. More specific safety requirements of the Tunnel Safety Orders are described below:

Ventilation

The tunnel must have adequate ventilation to dilute gasses to safe levels. Methane is combustible when mixed with air in the range of between 5 percent and 15 percent by volume. Below 5 percent (the LEL), it is not explosive, however lower alarm levels are set at 10 percent of the LEL for a margin of safety. Similarly, hydrogen sulfide (H2S) levels must be maintained well below safe worker exposure limits, given by OSHA to be 10 parts per million (ppm). Project tunneling specifications will reference the Tunnel Safety Orders and require excess ventilation capacity. Gas levels are monitored continuously and recorded over time to ensure no exposure to maximum levels or sustained levels. The main ventilation systems must exhaust flammable gas or vapors from the tunnel, be provided with explosion-relief mechanisms, and be constructed of fire-resistant materials.

Because of the additional hazards associated with the potential presence of hydrogen sulfide gas, tunnel ventilation systems in gassy tunneling areas will need to be robust and capable of delivering large volumes of air to the tunnel environment. In addition, due to the corrosive nature of H_2S gas, the typically-used rolled steel vent ducting may have to be replaced with fiberglass ducts, which are less readily-available and more expensive.

Internal combustion engines and other equipment, such as lighting, must meet standards of the US Mine Safety and Health Administration (MSHA). These approvals require verification that equipment is safe with respect to not producing sparks or emitting gas into the tunnel.

Smoking is not allowed in the tunnel, nor is standard welding, cutting, or other spark-producing operations. Special permits and additional air monitoring are required if welding or cutting operations are essential for the work. In addition, welding is only allowed in stable atmospheres containing less than 10 percent of the LEL and under the direct supervision of qualified personnel.

A fixed system of continual automatic monitoring equipment is provided for the working areas of the tunnel. The monitors have sensors situated to detect gas and automatically signal the workers and shut down electric power in the tunnel (except for ventilation, lighting, and pumping equipment necessary to evacuate personnel) when 20 percent or more of LEL is encountered. In addition, a manual shut down control is required. Tests for flammable and hazardous gas and petroleum vapors are conducted in the return air and measured a short distance from the work areas.

A refuge chamber or alternate escape route must be maintained within 5,000 feet of the face of a tunnel classified as gassy or extra-hazardous. Workers must be provided with emergency rescue equipment and trained in its use. Refuge chambers are to be equipped with a compressed air supply, a telephone, and means of isolating the chamber from the tunnel atmosphere.

Health and safety training and procedures are required based on the hazards anticipated. A process that involves training, auditing, and monitoring is required to ensure that procedures are followed and that health and safety can be maintained during construction.

Environmental controls will also be required to dilute and control elevated methane and/or H_2S to protect workers underground, workers above-ground, and the areas surrounding tunnel excavation and ventilation sites. Issues associated with gaseous release during construction will be minimized based on the requirement for a pressurized-face TBM with a closed spoil transport system in the affected reaches. The use of these technologies in the potential gas areas will minimize exposure of workers to elevated gas concentrations, since the excavated soil is not exposed while in the tunnel environment. Vapor controls and monitoring, and possibly other safety design features to be determined during Preliminary Engineering, will be employed at the surface if gaseous contaminants are released as the slurry is treated at the separation plant and then circulated for reuse by the TBM.

In addition, special personal protective equipment, such as supplied-air respirators, will be readily available in key locations within the tunnel when operating in potential H_2S zones or when air monitoring warrants this step. In these cases, all tunnel personnel will receive special safety training associated on the use of this equipment as well as other safety-related precautions.

4.1.10.3 Surrounding Properties

By itself, there is no discernable difference with respect to surrounding properties or historic resources from tunneling in the potentially gassy areas versus tunneling in other zones. The ancillary ventilation and other facilities used in the elevated gas zones are not substantially different from those used for tunnels outside the gas zones, and are unlikely to result in a greater potential to affect these properties.

Slurry Treatment Plant

With the Slurry-Face TBM method of tunneling, a bentonite slurry is used to apply fluid (hydraulic) pressure to the tunnel face and to transport soil cuttings from the TBM to the surface. The slurry that is pumped from the TBM to the separation plant contains excavated soils, which are processed to separate the soil (solids) from the slurry (liquid). After processing, the soil is disposed of off-site and the “cleaned” bentonite slurry is pumped back to the TBM. The slurry is pumped in and out of the tunnel through a series of pipes. The result is that excavated material is kept enclosed and in a fluid state until it reaches the above-ground slurry treatment plant.

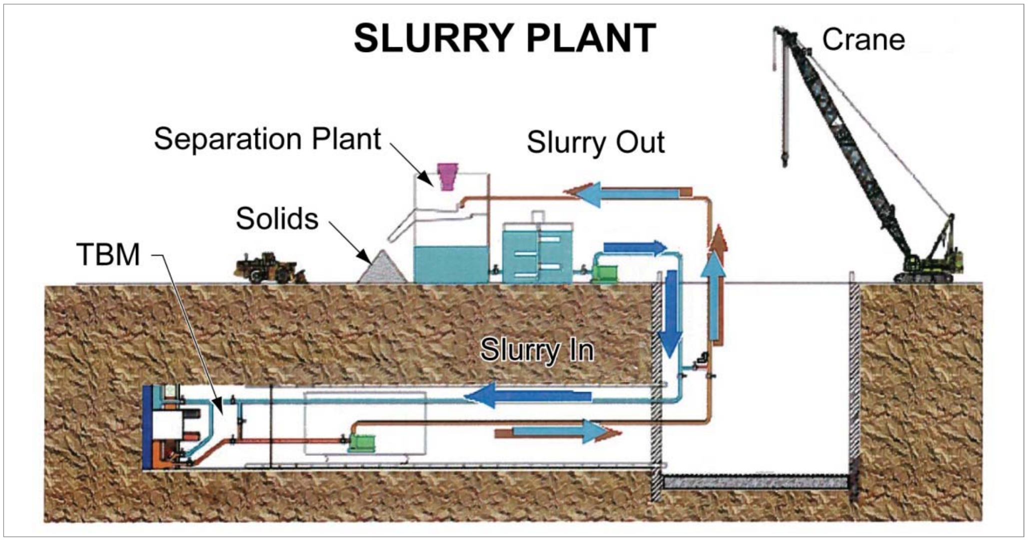

Figure 4-19: Schematic of Typical Slurry-Face TBM Operation

This method involves the setup of a temporary slurry treatment plant(s) at surface. The slurry treatment plant provides two basic functions: 1) to prepare the bentonite slurry by mixing the slurry for use in the tunneling process, and 2) to treat the used slurry, i.e., the slurry discharge coming from the TBM. The slurry discharge will be pumped out via pipeline to the ground surface where will undergo a separation process for soil (clay, sand, and gravel) removal. The removal process involves settling and the use of sieves for separation of large particles and centrifuges for small particles. Once the excavated material is separated from the slurry, the resulting soil can typically be stockpiled at the plant grounds or at off-site locations for approximately two to three days to dry before being hauled to a landfill or other disposal facility.

The slurry plant is anticipated to require an approximately one-half-acre site for the equipment and enclosure. The facility is anticipated to be approximately 50-ft tall (see figures below). Water removed from the discharge slurry would be recycled for further use in preparing the bentonite slurry.

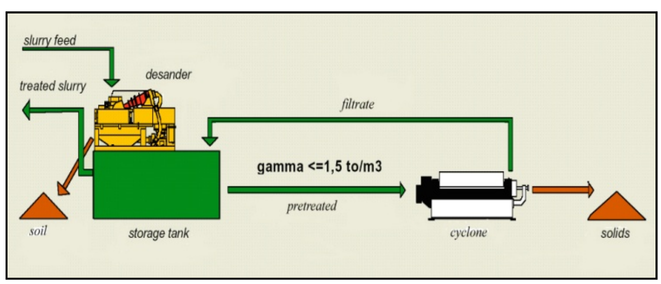

Figure 4-20: A Schematic Diagram of Slurry Treatment Process

Slurry treatment plants recently used are shown in Figure 4-21 and Figure 4-22. When space and noise restrictions are of concern, treatment plants may be containerized for size reduction and sound proofing.

Figure 4-21: Typical Slurry Treatment Facilities (Stacked Configuration)

Figure 4-22: Enclosed Slurry Plant with Materials Storage Silos

Excavated Materials (Spoil) Removal

Spoils would be disposed off-site at locations that are usually selected by the construction contractor, with the concurrence of applicable authorities. However, because all tunneling would be performed with pressurized-face TBMs, the spoils must undergo some treatment (drying of EPB-TBM spoil; or de-sanding and other processing of Slurry-TBM spoil) on-site before being loaded on to trucks for off-site disposal. For mostly sandy soils, drying can likely be accomplished on-site. For soils with higher water content (clays), and in the event that the volume of such soils is substantial, an additional temporary off-site storage/drying location may be needed. This can be avoided if a disposal facility that accepts wet soils can be identified. Additional separation processes may also be an option. Suitable disposal sites will be identified to ensure the excavated material can be removed and transported to the disposal area in a timely and efficient operation. Designated haul routes will be followed, as noted in the Task 10.12 Technical Report.

Environmental concerns are often encountered at the site areas where spoils are transported from the underground work locations to the ground surface and then loaded into trucks. These are typically work zones subject to noise and dust control restrictions. Noise and/or dust walls are typically required to mitigate these concerns. The impact of tunnel construction activities on storm water is a consideration as far as the potential for these excavated materials to come in contact with storm water or be discharged into storm water drainage facilities.

Disposal of Tunnel Spoils

For typical disposal of excavated materials, see the following sections on station construction and excavation. For a typical tunnel excavation operation, mining both tunnels at approximately 20-ft per 10-hour shift, the rate of spoil removal would be approximately 130 loose cubic-yards (CY) per hour to be hauled off-site. From any single construction staging site this material will be produced from two tunneling machines, which will often operate simultaneously. It would be expected that on better mining days the spoils to be removed could be doubled to be in the range of 250 loose CY per hour, or approximately 12 trucks per hour, which would equate to one truck every 4-5 minutes. With temporary stockpiling of spoils on the site, the hauling could be partially deferred to off-shifts (night-time periods) and to weekends. For a typical mining day, approximately 75 to 100 truck-loads of spoil would leave the site, although the truck traffic can be controlled by the contractor and can be distributed throughout the day-time and/or night-time periods, if allowed by local regulatory agencies.

Excavated soils and excess material would be transported off-site to approved disposal sites along designated routes. If materials are suspected to be contaminated, testing would be required prior to transportation. Soils containing contaminants will be characterized, excavated, loaded onto trucks, and transported off-site to a treatment or disposal facility. Waste disposal profiles will be generated from soil sampling and site characterization data. Based on the site characterization data, soils excavated at the site will be classified as non-hazardous or hazardous depending on the concentration of the impacted soil. Depending on the test results of the soils, disposal options could include the following sites:

For hazardous materials: [see also Geotechnical and Hazardous Materials Technical Report (Metro, 2010).

- Waste Management Inc., Kettleman City, CA
- Clean Harbors Environmental Services, Buttonwillow, CA
- Veolia Environmental Services, Azusa, CA
- US Ecology Nevada, Inc., Beatty, NV

For non-hazardous, petroleum hydrocarbon-containing wastes:

- Thermal Processing Systems Treatment, Adelanto, CA
- Waste Management, Palmdale Landfill, Palmdale, California;
- Waste Management, McKittrick Waste Disposal Facility, McKittrick, California;
- Thermal Remediation Solutions, Azusa, California

For contaminated, non-hazardous soils:

- Philadelphia Recycling, Mira Loma, CA
- Municipal landfills, or other locations identified by the contractor.

Disposal of Contaminated Soils during Construction

The issue of disposal of soils and other waste from construction in the potentially gassy areas, which may also contain tar and other potential contaminants, is preliminarily addressed through records-database searches and other available information. The focus is on identifying any special handling and/or safety issues associated with these materials and identifying existing disposal facilities with available capacity.

This segment would likely encounter soils impacted with petroleum hydrocarbons, volatile organic compounds (VOCs), and hydrogen sulfide (H_2S) from natural sources. In addition, sites impacted by underground storage tanks, dry cleaners, and other potential waste generators may also be encountered.

Tunnel Lining Construction
Precast concrete segments with gaskets will furnish the initial and final support of the tunnel and along, with ventilation and utility piping, is the major logistical component of the tunnel excavation operation.

Single-pass, double-gasketed, precast concrete segments are considered the lining system of choice to limit infiltration of water and gas through the final lining. These systems are well-proven worldwide and provide a high-quality tunnel lining very close behind the TBM excavation. Based on the groundwater regime anticipated, this type of lining system is optimal. However, in areas of gassy ground, additional steps may be required to provide greater protection against gas leakage into the tunnel environment, either during the tunnel excavation period or subsequently. Further details on segment design and testing is included in the Geotechnical and Hazardous Materials Technical Report (Metro, 2010).

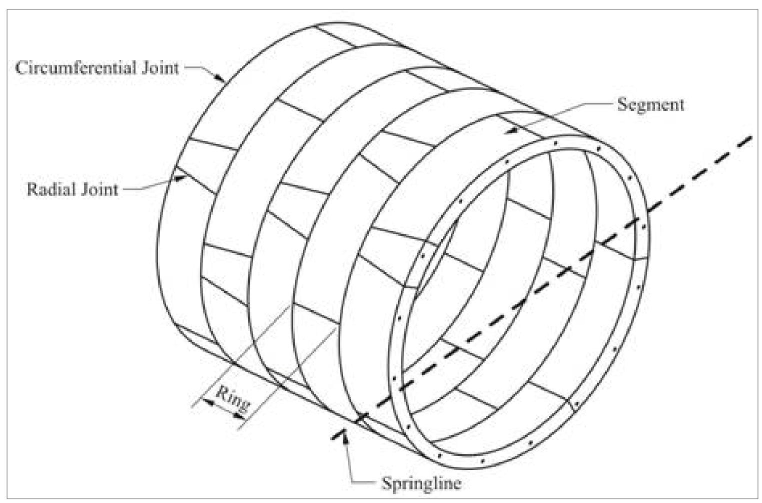

Figure 4-23: Typical Precast Concrete Segmental Tunnel Lining

These steps may include some combination of the following:

- Separate application of barrier seal to be installed on surface joints.
- Additional segment thickness to allow for wider gaskets, with more surface area and thus an improved seal for prevention of water/gas migration.
- Special high-performance concrete, which is less permeable, with or without additional reinforcement.
- Application of surface-applied grout or mortar seal to joints between segments.
- Addition of hydrophilic (swelling) seals to one of the gaskets.

- Supplemental injection of a self-sealing, water- and gas-proof product between gaskets.
- Coatings on segments to reduce concrete permeability.
- Addition of a secondary high-density polyethylene (HDPE) membrane and protective concrete on the inside surface of the finished tunnel.
- A membrane applied in the base of the tunnel only, prior to placement of the trackbed and walkway concrete, with tunnel diameter space provisions to permit subsequent installation of a full-perimeter membrane or similar product with protective concrete (i.e., should it be determined to be necessary in the future).

As mentioned earlier, the tunnel lining may need to be designed for additional loads imposed by existing building foundations above the tunnel.

The precast concrete segments are fabricated off-site and delivered by truck to the site. Several days or weeks of segments may be stored at the work site to ensure and uninterrupted supply to the tunnel excavation operations. A typical precast segment storage area is shown in. Care is required to ensure that the segment gaskets are not damaged during transport, shipment, or due to prolong exposure to sunlight. Depending on the gasket composition and the typical storage period, the segment gaskets may need to be installed onto the segments at the site, as opposed to at the off-site pre-fabrication facility. If this is necessary, a small enclosure is required to install the gaskets under controlled conditions.

Figure 4-24: Precast Concrete Segments Storage

Cross-passage Construction
Cross-passages between adjacent tunnels are to be constructed at intervals along the running tunnels. These openings will be almost entirely hand-excavated (mined with small excavators as opposed to TBMs) and concreted. Before exposing the ground, particularly where water or gas will be encountered, it is good practice to install a tight seal of improved soils (using grout or other soil improvement methods) around the perimeter of the area to be excavated. Because excavation and construction of these structures is particularly

sensitive to ground, water and gas conditions, cross-passage locations may be shifted to some extent to take advantage of favorable ground conditions.

Individually, ground conditions will dictate the method and detail of preparing the cross-passage site for excavation. It is contemplated that after ground treatment, a tight ring with grouted holes will be drilled from within the tunnel and then grouted with chemical or cement grout designed for the ground encountered. Steel spiling bars (pre-reinforcement) may also be employed, which will be drilled or driven from the tunnel above the cross-passage envelope.

Alternately, depending on the availability of access at the surface, drilling and grouting might take place from above the tunnels. Although surface drilling is often more disruptive to traffic and the surrounding community, it may provide for a greater control and quality of grouted ground and minimize impacts to tunnel excavation operations. In areas of weaker soils or higher groundwater, jet grouting from the surface may be utilized to provide a higher-strength and more consistent area of improved ground for cross-passage excavation. When below the water table, ground freezing is another method that could be considered.

Cross-passages will be excavated by non-mechanized, sequential excavation methods. Sequential excavation and support methods call for the ground to be excavated incrementally in small areas and stabilized or supported prior to advancing the next increment. The ground can be stabilized with an array of different methods including steel supports, spiling pre-reinforcement, and shotcrete (sprayed concrete). Excavated soils would be removed through the TBM tunnels. The sequence of excavation would be determined during design stage and controlled and modified as needed during construction based on actual conditions encountered. This construction technique is considered in special instances where the planned depth, shape, or length of the tunnel may not be cost effective using more traditional methods.

Ground movements, possibly resulting in surface settlement, could also occur during excavation for cross-passages between tunnels. The amount of settlement would be a function of the sequence of excavation and the amount of ground support (including thickness of shotcrete applied), each of which are adjusted during mining to minimize ground settlement.

Because it is difficult to construct cross-passages at the same time as excavating the running tunnels, cross-passage construction typically is done when the excavation of the main tunnel is not proceeding. Therefore, the construction of cross-passages is often on the critical path for tunnel construction.

In areas with potential exposure to gas, special monitoring will be as required for each cross-passage location. At the breakouts from the main tunnel, grouting and other aspects of the construction will not vary substantially from the normal (less gassy) procedure. However, as mentioned earlier, pre-treatment of the ground to reduce the potential for gas exposure is an option. Also, probe holes extending into the cross-passage area from the main tunnel will likely be drilled prior to starting the cross-passage excavation. Such probe holes would be beneficial for detecting water and/or gas and can allow for excavation plans to be adjusted based on this new information.

Because the environment for the cross-passage excavation is not as well sealed as that for the main TBM tunnels, additional requirements for gas monitoring, detection, ventilation, and worker protection systems will likely be required.

The permanent lining for cross-passages will likely be constructed of cast-in-place concrete. However, in potential gas areas, special gas-resistant membranes and/or joint sealants may be required. These measures would be similar to those used for stations constructed in potential gas areas. The completed cross-passages may also be equipped with gas monitoring and detection systems, as well as special ventilation equipment to dissipate gas. The requirements for these systems will be determined during Preliminary Engineering.

4.2 Alternative 1 – Westwood/UCLA Extension

This section describes the likely sequence of construction activities necessary to construct the tunnel, stations, and operations/maintenance facilities of Alternative 1. Generally, Alternative 1 (from Wilshire/Western to Westwood/UCLA) would likely be designed and constructed in the following three segments or reaches:

- Segment 1 – Construction of the alignment from the existing Wilshire/Wilshire/Western Station to the Wilshire/Wilshire/Fairfax Station. This segment is the same as MOS 1.
- Segment 2 – Construction of the alignment from Wilshire/Fairfax Station to the Century City Station. Tunnel construction would be largely dependent on the Century City Station option chosen, which is being evaluated at this time. The terminus of Segment 2 is the same as MOS 2.
- Segment 3 – Construction of the alignment between the Century City Station and Westwood/UCLA Station.

Depending on available funding, more than one segment could be constructed concurrently.

4.2.1 Construction Scenario - Segment 1 – Wilshire/Western to Wilshire/Fairfax

4.2.1.1 Preconstruction

In addition to the preconstruction activities outlined in Section 4.1.1.1, the areas surrounding the Fairfax and La Brea stations are known to have tar deposits and or tar sands with potential paleontological features. Preliminary preparation and excavation is likely to take place early on and possibly as separate contracts in order to orderly and carefully remove the resources (i.e., fossils, artifacts, etc.) and prepare the ground for the coming excavations. In-street work will typically necessitate on-going lane closures.

4.2.1.2 Stations

Within the Wilshire/Western to Wilshire/Fairfax reach, there are two or three new stations to construct (Wilshire/Crenshaw, Wilshire/La Brea, and Wilshire/Fairfax Stations) and an existing station (Wilshire/Western) to tie in to. Under Option 1, the Wilshire/Crenshaw would be deleted and a vent would be constructed between Crenshaw and Lorraine Boulevard. These new stations, in addition to modifications required to the existing Wilshire/Western Station are described in Table 4-2 below.

Table 4-2: Alternative 1, Segment 1 Station Descriptions

Station Notes	
Wilshire/Western	Wilshire/Western Station currently exists and is in operation. The west wall of the existing station will need to be removed to allow for the rail and systems to be extended into the new segment.
Wilshire/Crenshaw	Option 1 includes a design option to not construct this station and a vent shaft would be constructed at this location.
Wilshire/La Brea	Wilshire/La Brea Station is near the midpoint of Segment 1.
Wilshire/Fairfax	Asphalt (tar) impregnated soil is located in the lower reaches of the Wilshire/Fairfax Station (Paleontological issues to be discussed in subsequent chapters).

At the existing Wilshire/Western Station, a west-end TBM retrieval shaft is a consideration in comparing the "gutting or stripping" of two TBMs versus the need for relatively small retrieval shafts. In addition, the site is potentially reasonable for use in supporting tunnel excavation operations.

The Wilshire/La Brea Station is a viable site for tunnel mining. Potential construction work area appears to be a half-block width and a block long at the east end of the station, which could be used for receiving TBMs entering from the west and for the entry of TBMs to excavating to the east.

The Wilshire/Fairfax Station has a reasonable potential construction work area and is the likely preferred location to launch two TBMs for tunnel excavation, particularly considering the major access point for tunneling to the west of Fairfax. After the tunnels are excavated, the ensuing work would include concrete placing, cross-passage construction, vent shafts, intermediate access shaft construction (if required), and all finishing and utility installation operations. The site of this station has known hydrocarbon and subsurface gas deposits) that will potentially slow the construction and special controls will be required.

Given this consideration, tunnel excavation operations could alternatively be staged from an access shaft just west of the existing Wilshire/Western, with the tunnels proceeding westward to Wilshire/Fairfax. Although space is more constrained at this location, and construction could create more impacts on Metro customers using the station, it would be also be advantageous to launch the TBMs from a non-gassy zone.

In order to maintain traffic, all but two of the station excavations (Westwood/UCLA Station—Off Street Station and Westwood/VA Hospital Station) are to be decked over to support traffic. Depending upon site constraints a station deck and support of excavation may be installed in stages over the street using several street closures. Partial street closures would typically occur during night-time periods, while full road closures, if necessary, would occur over extended weekends. The local community will be consulted concerning the road closure periods. Removal of decking after construction of the station and tunnels will be similarly staged.

After the station or track structure has been completed, backfilling operations atop the structure will commence. Street and site restoration activities are discussed in a subsequent section.

In the section between Wilshire/Western and Wilshire/Fairfax, a crossover structure is planned west of the Wilshire/La Brea Station. An optional location for the crossover would be at the Wilshire/Fairfax Station, west of the station.

4.2.1.3 Station Excavation

It is anticipated that all station excavations along this segment would encounter variable amounts of subsurface gas and groundwater. Therefore, the use of more impermeable excavation support walls and/or dewatering systems will be the likely methods of station initial support.

Table 4-3 shows the estimated volume of material from the cut-and-cover station excavation and the associated daily truck trips and truck loads for each station in Segment 1 from Wilshire/Western to Wilshire/Fairfax.

Table 4-3: Estimated Amounts of Excavated Materials for Station Construction for Segment 1

Station	Estimated Total CY Excavated	Estimated Daily Haul Truck Trips	Estimated Total Haul Truck Loads
Wilshire/Western*	12,000	25	600
Wilshire/Crenshaw	160,000	25-50	8,000
Wilshire/La Brea	200,000	25-50	10,000
Wilshire/Fairfax	135,000	25-50	7,000

* TBM Access Shaft adjacent to existing station

Contractor Work and Storage Areas

Contractors work and storage areas will be necessary for construction of station excavations, tunneling, station entrances, crossover boxes, pocket tracks, mid-line structures, TPSS locations, and ventilation or emergency exit shaft locations. Several potential construction staging sites have been identified; however, not all of these potential construction staging sites would be selected for use.

Wilshire/Crenshaw

potential construction site is proposed for the Metro-owned property between Crenshaw and Lorraine Boulevards.

Wilshire/La Brea

A potential construction site is proposed for the Metro-owned property, on the north side of Wilshire Boulevard, between La Brea Avenue and Detroit Street. Another potential site is just west of La Brea Avenue, on the south side of Wilshire Boulevard. A double crossover is currently planned on the west side of the station.

Wilshire/Fairfax

A potential construction site is proposed for the entire parcel immediately north of Wilshire Boulevard, south of the apartments, between Fairfax and Crescent Heights and also on the south side of Wilsire, west of Fairfax. An alternative location for a double crossover is on the west side of the station. The Johnnies restaurant building is to remain. A potential construction site is proposed at South Ogden Drive.

In order to mine east along this segment, the Wilshire/Fairfax Station excavation would be the first item of construction, after demolition of existing buildings designated to be removed. Several options are available for staging this construction. A side entry to the station excavation of approximately 40-ft in length, would afford access of the TBM and construction machinery to the tunnel headings at the east end of the station excavation. A construction staging area of about 150-ft by 1000-ft to the north side of the station is envisioned, and all material delivery and removal of excavated materials could take place within these confines.

The lot south of the LACMA between Orange Grove Aveune and Ogden Drive has potential for use as an additional construction staging area. Another potential construction staging site has been identified on the south side of the station west of Fairfax. While these logically would not work well as a TBM launch site, it could be beneficially used for staging TBM equipment components and be used as an interim storage area for precast segments, ventilation line, utility lines, and for ease of transfer to the main mining location at the Fairfax site.

Two TBMs could be assembled at the Wilshire/Fairfax Station construction staging area, located between South Crescent Heights Boulevard and Fairfax Avenue to the north side of Wilshire Boulevard. Components would be lowered to tunnel grade at the side access and then moved into position for use at the tunnel faces or headings. Utilities, air, water, disposal, electricity, sanitation, and communication equipment could be positioned near the east end of the 150-ft by 1000-ft construction yard.

This construction yard, besides being used for the normal staging of precast concrete segments, fan or ventilation line, temporary spoil storage, shaft support (air, water, electricity, spoil hoisting), offices and shops, would also be used for the mixing and processing of slurry that could be used in the slurry wall excavation support or tunnel excavation operations. If used, the slurry TBM support facilities would likely be confined to an area of approximately 100-ft by 75-ft. In many cases, an additional area of approximately 100-ft by 200-ft would be required for the slurry treatment (separation) facility, which would include filters, centrifuges, and vibrator equipment. Often this equipment can be stacked to save space. Additional description of the slurry separation process is in the tunnel construction section below.

4.2.1.4 Station Construction

The cut-and-cover stations will be constructed with poured-in-place concrete, which will differ substantially depending on the length and the design configuration for the structure. Access for the concrete forming and placing is limited and the construction will be slow and difficult to precisely determine. The duration for completing the concrete and architectural work is expected to be approximately 24-32 months. The amount of concrete being placed will likely be upward of 30,000 CY, which will take approximately 3,000 transit mix truck loads for each station. Reinforcement steel will average a total of 3,500 tons per station.

The construction sequence for the station structures would include construction of the foundation base slab, followed by the installation of exterior walls and any interior column elements. Slabs are typically poured as the columns and intermediate floor and roof wall pours progress. Station entrance locations are generally used as access points to the underground station during the construction process. Exterior entrances would be constructed after the station structure has been completed.

During station construction, approximately 5 to 10 concrete trucks per day can be anticipated for normal operation. Occasional large pours would be needed at the stations, depending on the construction sequencing and schedule. These large pours could potentially require 30 to 40 trucks per day. The larger pours are expected to be performed at night to ensure supply and delivery of concrete and to minimize traffic impacts. Other support and delivery trucks, approximately up to 10 to 20 trucks per day, would also be anticipated during the peak station construction periods to bring materials such as rails, structural steel, and mechanical and electrical equipment.

Station concrete construction and architectural finish work will take place after tunnel operations are completed. Once the tunnel construction operation is past, the station work will have free access. This work may commence to some degree from one end of the station as long as interference with the tunneling operations is controlled. Once station structure work is complete, the station excavation will be backfilled and the permanent roadway will be constructed.

4.2.1.5 Tunnel Construction

The tunnels could be excavated eastward from the Wilshire/Fairfax Station to the existing Wilshire/Western Station. The route of advance of the tunnels would be from the below-grade Wilshire/Fairfax Station, through the Wilshire/La Brea Station and on to Wilshire/Western Station.

Whereas stations, crossovers, and ventilation structures will generally be constructed by cut-and-cover methods, the running tunnels will be constructed by mechanized tunneling methods. TBM components will be shipped to the tunnel construction sites by trucks. Several oversize deliveries will be required, some of which will be done during nights and weekends. However, these large component deliveries are limited to initial setup period for the, as well as during the removal period after excavation work is complete. If a TBM is to be re-used to excavate a subsequent adjacent tunnel, the entire machine may be transported by road from one site to the next. This is a rare event, which often requires full or partial road closures and is typically done during night-time periods.

The pre-cast concrete liners are pre-fabricated off-site and delivered by truck to the site. Segment loads are estimated to be 6 to 10 truck loads per day for the duration of tunneling based on an estimated overall excavation rate of 30- to 50-ft per day. Segments needed for at least several days' production are generally stored at the work-site to allow continuous tunneling as the rates of advance may vary between 0- and 100-ft per day. Tunneling operations are typically continuous, occurring six or seven days a week, usually with two 10-hour shifts per day.

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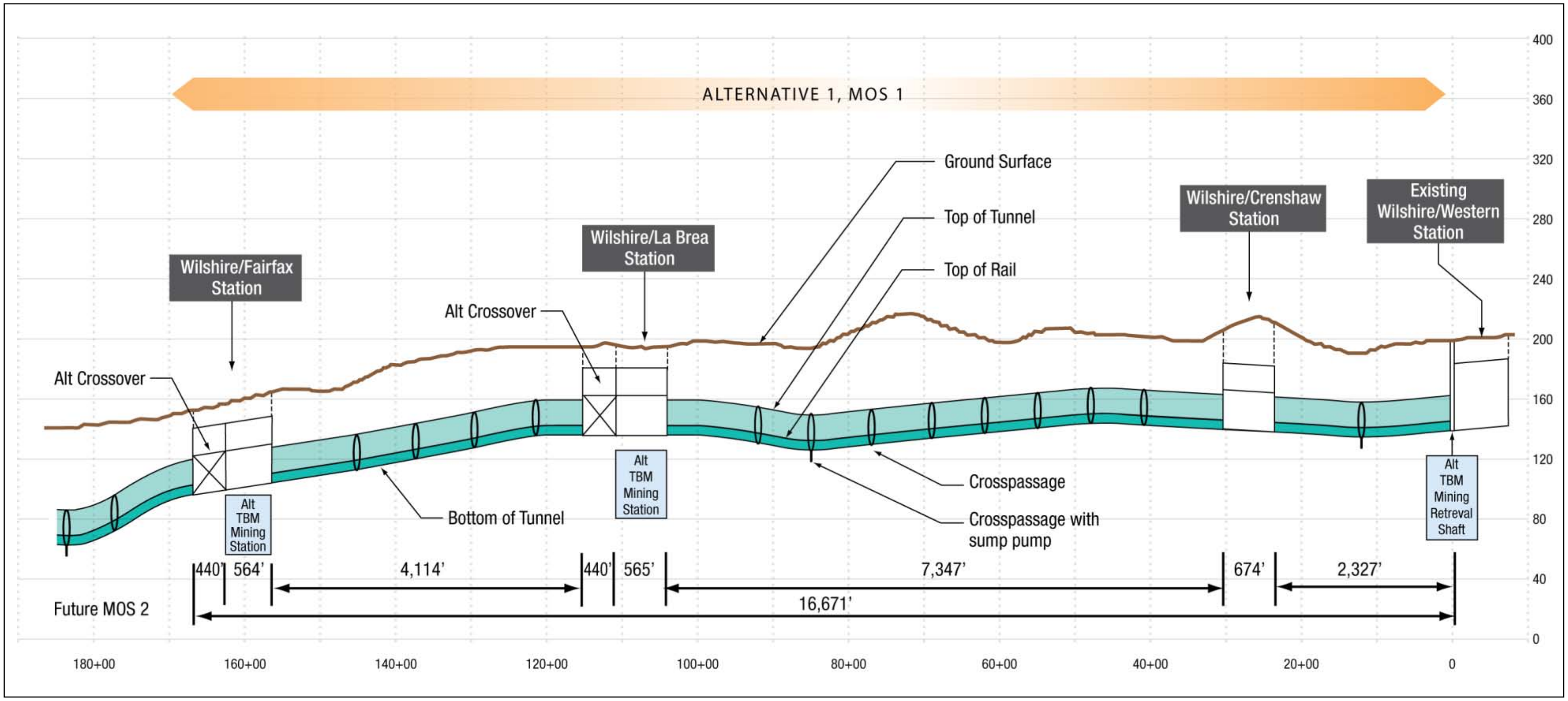
Table 4-4: Tunnel and Construction Lengths for Alternative 1, Segment 1

Station	Length (feet)	Description
0+00		From Wilshire/Western Station proceeding west under Wilshire Boulevard
23+90	2,390	Enter Wilshire/Crenshaw Station (Option)
30+40	650	Exit Wilshire/Crenshaw Station proceeding west under Wilshire Boulevard
103+60	7,320	Enter Wilshire/La Brea Station
112+00	840	Exit Wilshire/La Brea Station proceeding west under Wilshire Boulevard
156+40	4,440	Enter Wilshire/Fairfax Station
165+60	920	Exit Wilshire/Fairfax Station proceeding west under Wilshire Boulevard
	16,560 (3.13 miles)	Total Length
	2,410	Total Station Length
	14,150 (2.7 miles)	Total Twin Tunnel Length
Scenarios to Consider		
A	Mine with TBMs from Fairfax and remove them from the new retrieval shaft at Wilshire/Western Station. Alternate plan, to leave TBM shields in the ground at Wilshire/Western and remove remaining equipment from Wilshire/Crenshaw shaft.	
B	Mine with TBMs from Fairfax, retrieving them at La Brea and with two TBMs from La Brea removing them from the new retrieval shaft at Wilshire/Western Station, or stripping the TBMs, leaving the steel shield in place.	
C	Mine east from La Brea to Western and west from La Brea to Fairfax.	
D	Mine from east to west, from Wilshire/Western. Remove TBMs at Wilshire/Fairfax. This scenario would allow for tunnel excavation to continue to the west.	



Note: Alternative 1, Segment 1 is the same as MOS 1.

Figure 4-25: Alternative 1, Segment 1- Wilshire/Western Station to Wilshire/Fairfax Station

Anticipated Ground Conditions

Geologic conditions for the Westside Subway Extension are described in the Geotechnical and Hazardous Materials Technical Report (Metro, 2010). In tunnel terminology, the tunnels will be excavated through soft ground, as opposed to rock. Much of the tunnel will be excavated below the groundwater table. In addition, some of the alignment will be in gassy ground conditions, including methane and hydrogen sulfide. In limited areas, naturally-occurring tar sands will be encountered.

It should be noted that some weak rock is anticipated to be encountered in far easterly reaches near Wilshire/Western station. However, the presence of this rock will have no appreciable effect on the rate of advance or operation of the pressurized-face TBMs.

The tunnel will also be excavated through the Santa Monica Fault zone. In general, the tunnel advance rate is not expected to be significantly affected. However, in specific sections where displacements along fault traces are probable, the tunnel construction methodology may be altered to better account for the potential for displacement in a seismic event. Specific measures to be studied further could include the following:

- Cut-and-cover construction methods could be used at the fault zone in advance of the TBM mining through the area. In this case, the cut-and-cover excavation would be done first, the TBM would "walked-through" the excavation (and then continue mining normally), and an over-sized cast-in-place concrete tunnel structure would be built within the excavation. This tunnel structure would then be backfilled above and the surface restored, similar to methods used at stations.
- Alternatively, the TBM mining could proceed normally through the area, and then subsequently the tunnel lining could be enlarged. The process to enlarge the tunnel would be done following mining in this segment and would likely be done concurrent with nearby cross-passage excavations. Construction methods would be similar to cross-passages as ground improvement would be required before any tunnel lining segments could be removed. Where feasible, dewatering of this area may also be done. Once the segments are removed in the area to be enlarged, and new over-sized cast-in-place concrete tunnel lining would be constructed, including transition structures at the interface with the segmental tunnel lining.
- With either of the above option, it may be possible to shift a cross-passage or a mid-line vent structure location to be closely coincident with the fault zone. Because special construction methods will be necessary anyway for these structures, this would avoid the need to significantly alter the typical TBM tunnel excavation.
- If the fault zone occurs in a relatively short tunnel drive, another option would be to use a larger diameter TBM to excavate that particular reach of tunnel. However, the required over-size is anticipated to be significant enough that this large diameter TBM would not be used in other tunnel sections. For this reason, this alternative may be the least practical.

In addition to above, the tunnel alignment may be adjusted based on the fault orientation and/or surface conditions above the tunnel. This step would mitigate some of the impacts from the above alternatives.

Potentially Impacted Soils

Potentially impacted soils may be encountered during construction of the selected alignment near existing and historic underground storage tank sites (UST) including gasoline stations, dry cleaners, and industrial facilities. Soils may be impacted with petroleum hydrocarbons, VOCs, and H_2S. Many soils along the Wilshire Boulevard Corridor are impacted with tar and crude oil due to presence of oil producing formations, evidenced by existing and abandoned oil fields.

TBM Operations

It is anticipated that all tunneling and station excavations along this segment from the existing Wilshire/Western Station to the proposed Wilshire/Fairfax Station would encounter subsurface gas and groundwater. Therefore, it is recommended to use TBMs that can be equipped to mine with closed spoil transport systems, i.e. pipelines or similar systems where the excavated materials are not exposed to the tunnel environment.

Selection of an EPB or Slurry-Face TBM may be a contractor's preference based on the machines expected performance in the anticipated ground conditions. To some extent, EPB TBMs are better suited to less permeable soils (clays), while Slurry-Face TBMs are better suited to more permeable soils (sands and gravels). With modern and evolving TBM designs, it may be possible to use "dual-mode" machines to convert from a slurry excavation operation into an EPB operation and still have the potential to covert the operation back to slurry mode.

Following tunnel excavation, the TBMs may then be dismantled underground with the shield (outer shell) left in place, such as at the Wilshire/Western Station if the TBM mines from west to east. An alternative to dismantling the TBM would be to excavate a separate retrieval shaft. However, from a traffic management standpoint due to traffic impacts at the retrieval shaft, retrieving the TBM is less desirable than dismantling the TBM. An exception is if the TBMs could be re-used immediately or in a reasonable timeframe for constructing the next reach of tunnel (i.e., Segment 2); the disruption caused by retrieval from the street may be justified.

The Metro-owned parcel on the north side of Wilshire between S. La Brea and S. Detroit has potential for use as an additional interim construction staging area. The nearby site at S. Ogden is less workable as a TBM launch site, but could be used for staging TBM equipment components. The S. Odgen site may also be used as an interim storage area for precast segments, ventilation line, utility lines, etc. in support of the main mining operation.

Estimated Volume of Excavated Materials from Tunnel Construction

For this segment, the total volume of excavated materials for the tunnel excavation from Wilshire/Western to Wilshire/Fairfax is estimated to be approximately 450,000 CY. Based on this volume and the anticipated sequence of construction, the maximum truck counts for tunnel spoil removal is estimated to be from 40-80 daily truck trips.

The tunnel spoils will be loaded onto trucks for removal to the disposal sites. The loading and hauling of tunnel spoils will be restricted to minimize disturbance to residences and other noise-sensitive areas.

Considering the complete and full length of the tunnels, approximately 13-14 miles, the total volume of material excavated from all the tunnels will be approximately 2.0 million loose CY.

Construction Personnel and Parking

The estimated number of construction personnel for different activities are as summarized in Table 4-5.

Table 4-5: Construction Activity Summary for Alternative 1, Segment 1 Construction

Activity	Duration (months)	Construction Equipment							Soil (CY)	Concrete (CY)	Haul Truck Trips per Day	Workers per Day
		Haul Truck	Concrete Truck	Dozer	Excavator	Crane	Drill Rig	Flatbed				
Pre-Construction	4-6						X	X	N/A	N/A	5	10-20
Site Preparation	12-18	X	X	X	X				1,000	1,000	10-20	20-30
Access Point at Wilshire/Western Station	18-30	X	X	X	X	X	X	X	12,000	4,000	20-30	20-30
TBM Tunnel from Wilshire/Western to Wilshire/La Brea	12-24	X	X	X	X	X		X	300,000	Precast Segments	40-80	50-80
Wilshire/Crenshaw Station (Option)	24-48	X	X	X	X	X	X	X	160,000	17,250	25-50	20-30
Wilshire/La Brea Station (Cut-and-Cover)	24-48	X	X	X	X	X	X	X	200,000	17,250	25-50	20-30
TBM Tunnel from Wilshire/La Brea to Wilshire/Fairfax	6-10	X	X	X	X	X		X	150,000	Precast Segments	40-80	50-80
Wilshire/Fairfax Station (Cut-and-Cover)	24-48	X	X	X	X	X	X	X	135,000	20,000	25-50	20-30
Operating Systems Installation	5-6					X		X	N/A	N/A	2	20-30

In most situations, there will be several concurrent construction operations and many crews of workers at each site. When concurrent work sites are considered, it can be expected that there will be approximately 150 field workers during day shift, another 60 for swing shift and approximately 30 office personnel, for a total of approximately 240 daily personnel.

Workers will be encouraged to use public transportation for commutation to the work sites. In addition, the contractors will make arrangement for nearby off-site parking locations that can be used by the construction workers. However, all such parking areas will require Metro approval. If necessary, transportation to and from public transit stops and/or parking areas will also be provided at the beginning and end of work shifts.

Street/Site Restorations

This work restores the street or ground surface to its original condition, or better. The site restoration operations will closely follow the previous work of building the station structures. One half of a street will be restored at a time in order to maintain the surface traffic flow. Or alternately, depending on regulatory agency and community approvals, the restoration work may take place over weekend periods when the entire street might be temporarily closed to through traffic. Backfill material will be trucked in, placed, and compacted.

During the backfilling above station structures and other cut-and-cover structures, final utility installations would be performed to establish the utilities in their permanent locations. New sewer manholes and cable/duct vaults are built. Sidewalks that have been removed to allow for station excavations would then be restored to their original configurations. Following the completion of backfilling, the permanent street would be constructed, including required paving, striping, and signage. Street and sidewalks would be restored in accordance with City standards, including landscaping required.

4.2.1.6 Vent Shafts and Emergency Exits

Construction of ventilation shafts, include mid-line ventilation structures, and emergency exits and construction of cross-passages will generally take place following the completion of the tunnel excavation. To an extent though, shaft and exit work might be done in advance and only the connection to the tunnel liner be necessary upon completion of the tunnel mining. Shafts and exits will connect to surface streets or surrounding areas and be subject to all the requirements of public interface. Cross-passages though take place solely below the surface and will be subject to detailed coordination with on-going tunnel construction. Vent shafts, emergency exits, and cross-passage work will be exposed to conditions of encountering hydrocarbons and will be subject to strict ventilation and ground support requirements.

In general, ventilation fans and noise-producing equipment will be housed in below-grade spaces to minimize noise to the extent possible and to minimize the amount of above-ground space needed. Ventilation Shafts have not been designated at this early stage, but they would be expected to be located between stations approximately one mile from a given station. These shafts can be considered to be mini versions of station structures in that generally the identical structural support of excavation and concrete construction methods will be utilized. Whereas a station may extend some 600 feet or more in length, the vent structure will likely not exceed one hundred feet in length and traffic and public interfacing will be much simpler to perform. Construction duration for building these ventilation structures will be basically the same length as for the stations due to the need for tunneling operations, excavation, and concrete lining, to be able to continue through the vent shaft. Alternatively though, the lower track level chambers might be isolated which would allow the upper structure to be completed.

4.2.1.7 Summary

All work will conform to project specifications and industry standards. The equipment used in construction would include graders, dozers, cranes, concrete trucks, pumping equipment, flat bed trucks, dump trucks to haul dirt, tunnel boring machines, and rail mounted cars to transport materials within the tunnel. Spoils would be hauled away from the work sites by trucks to approved disposal sites. Table 4-6 summarizes the sequence of construction activities anticipated for Segment 1.

Table 4-6: Sequence of Construction Activities – Alternative 1, Segment 1

Activity	Duration	Description	Equipment Required
Pre-construction	Up to a year	Limited excavation. Preliminary preparation and excavation for paleontological deposits.	Largely hand tools and small equipment
Tunnel Construction	Approx. 3 years or more, counting TBM fabrication and mobilization	Excavation and tunnel lining	TBM, slurry pumping and separation equipment, concrete equipment
Underground Utilities	Half a year or so	Locate, move and support utilities	Hand tools and small excavation equipment
Station Excavation	Approx. 1-year	Support of excavation and cut-and-cover excavation	Various excavation equipment and a crane
Station Construction	Approx. 2-½years	Form and place concrete structure, finish work, architectural and mechanical	Concrete form and placing equipment
Street/Site Restorations	Approx. 4 months	Paving and sidewalks	Paving equipment
Vent Shafts and Emergency Exits	Concurrent - approx. 12 months	Shafts and cross-passages	Crane and tunnel equipment

4.2.2 Construction Scenario –Segment 2 – Century City Extension

Table 4-7 shows tunnel and construction lengths for each station included in Segment 2. There are several scenarios that may be used for the tunnel mining and related construction of Segment 2:

- **Wilshire/Fairfax Tunneling West to Century City (Santa Monica Boulevard Station):** If sufficient work site area and a mining shaft remain at Wilshire/Fairfax concurrent with or following completion of Segment 1, TBMs could proceed from the Wilshire/Fairfax Station west to the Century City Station. In this scenario, the TBMs would be removed at the Century City Station area located along Santa Monica Boulevard.
- **Century City (Santa Monica) Station Tunneling East to Wilshire/Fairfax:** This option is a "skewed" station from the middle of Santa Monica Boulevard at the west end to a tie-in at the east end, with a reasonably good construction work area. Using this station, an alternative would be to mine east from Century City Station to the Wilshire/Fairfax Station. If the Century City Station is located along Santa Monica Boulevard, there is sufficient area that could be made available within the Santa Monica Boulevard right of way. But this site is isolated in that it is located in the middle of active roads and the isolation and shape makes utilization in the street center largely prohibitive. To this end, the Wilshire/Fairfax crossover (which may be eliminated based on operations planning simulations) or other shaft excavation would be left with temporary decking for removal of the TBMs during Segment 1 construction, and then

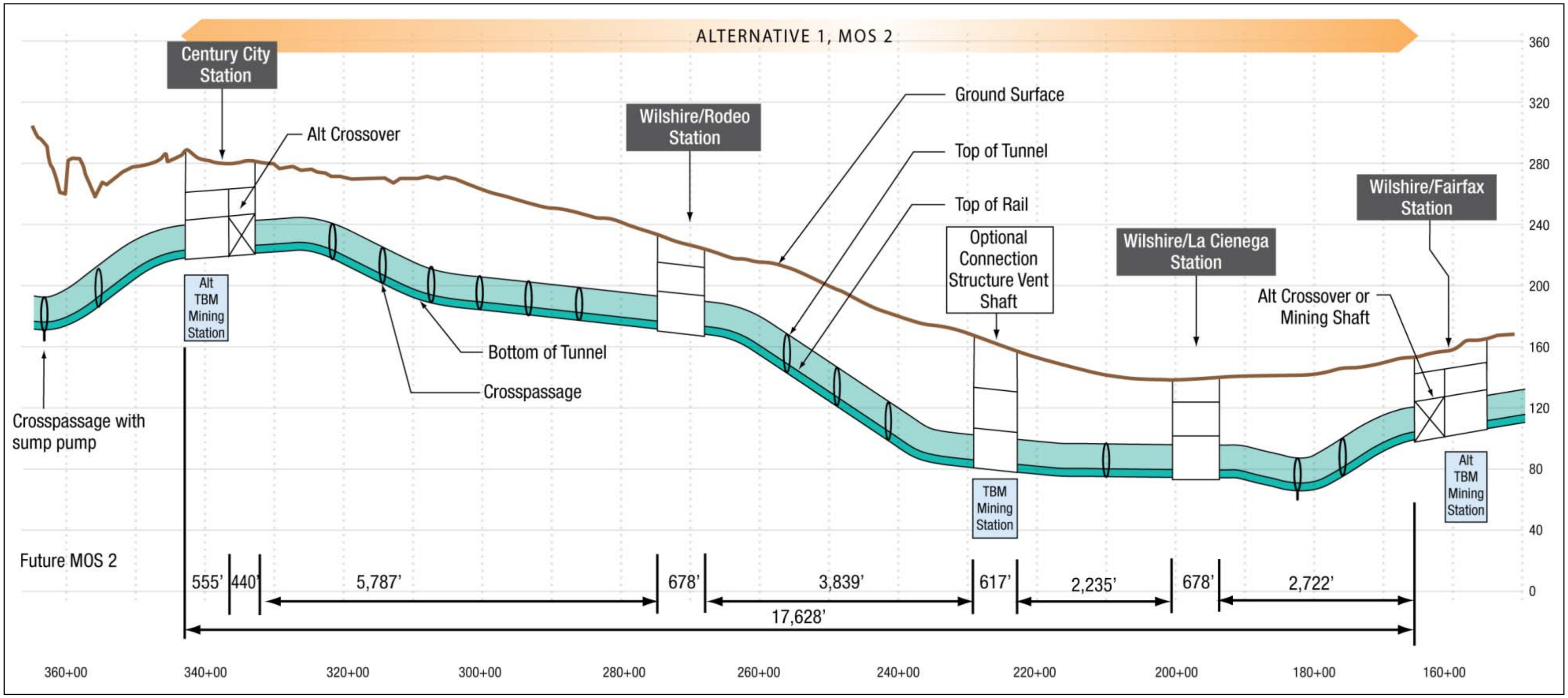
permanently covered as part of Segment 2. Dependent on the length of time that the Segment 1 segment has to operate prior to work on Segment 2, this may or may not be a feasible option.

- **Century City (Constellation) Station Tunneling East to Wilshire/Fairfax:** Again, this alternative would be to mine east from Century City (Constellation) Station to the Wilshire/Fairfax Station. To this end, the Wilshire/Fairfax crossover (which may be eliminated based on operations planning simulations) or other shaft excavation would be left with temporary decking for removal of the TBMs during Segment-1 construction, and then permanently covered as part of Segment 2. Dependent on the length of time that the Segment 1 portion is in operation prior to work starting on Segment 2, this may or may not be a feasible option.
- **Wilshire/Fairfax Tunneling West to Century City (Constellation) Station:** If the Century City Station is located on Constellation Boulevard at Avenue of the Stars, work space may be limited to station construction and TBM retrieval only. Hence, mining would need to proceed west from the Wilshire/Fairfax Station. However, if construction work area can be made available when needed for tunnel construction, TBM mining could proceed from Century City (Constellation Boulevard) Station to the Wilshire/Fairfax Station.
- **Wilshire/La Cienega Station Tunneling:** This station could be used for tunnel excavation (mining) to both east and west, retrieving the machines at Wilshire/Fairfax and at Century City. This site is also close to the West Hollywood tunnel connection to the main Wilshire line. However, the work areas currently available are limited, which severely constrains this scenario. Given the constraints at Century City and the potential interference at Wilshire/Fairfax, the Wilshire/La Cienega site may be considered in the future if additional construction work area can be made available.

Table 4-7: Tunnel and Construction Lengths for Alternative 1, Segment 2

Station	Length (feet)	Description
165+60	0	Exit Wilshire/Fairfax Station
202+60	3,700	Enter Wilshire/La Cienega Station
213+80	1,120	Exit Wilshire/La Cienega Station
269+30	5,550	Enter Wilshire/Rodeo Station
275+80	650	Exit Wilshire/Rodeo Station continuing westerly under Wilshire
333+00	5,720	Enter Century City Station (varies depending on Century City Station location)
342+80	980	Exit Century City station.
	17,720 (3.4 miles)	Total Length
	2,750	Station Length
	14,970 (2.8 miles)	Twin Tunnel Length
Scenarios to Consider		
A	Mine from Century City (Santa Monica Boulevard) Station toward the east with two TBMs retrieving them from Wilshire/Fairfax.	
B	Mine from Century City (Constellation Boulevard) Station toward the east with two TBMs retrieving them from Wilshire/Fairfax.	

C	Mine from Wilshire/Fairfax toward the west using the existing mining site and retrieve TBMs from Century City.



Note: The terminus for Alternative 1, Segment 2 is the same as MOS 2.

Figure 4-26: Alternative 1, Segment 2- Wilshire/Fairfax Station to Century City Station

Segment 2 may be constructed using the one of the Century City stations proceeding east. The alternatives are to excavate the tunnel east from either of the two viable Century City sites, both from which excavation would proceed east to Wilshire/Fairfax. Considering construction viability, either of the Century City Stations (at Santa Monica Boulevard or Constellation Boulevard), could be selected.

Alternatively, Segment 2 might potentially be constructed using the Wilshire/Fairfax Station work areas, proceeding west. However, the use of this station depends on the timing of the Segment 1 construction, which may have used the Wilshire/Fairfax Station to excavate east. In this scenario, if the Wilshire/Fairfax Station concrete work is delayed, or if a west extension of the station is provided to allow excavation of Segment 2, then the concept is viable.

4.2.2.1 Preconstruction

The La Brea tar pit area in the vicinity of the Wilshire/Fairfax Station is known to have tar and/or tar sands with paleontological features that must be protected and otherwise removed intact. However, since the excavation of this station will already be complete, this will not be a concern unless the station excavation (construction shaft) is extended west. If an extension is used, preliminary preparation and excavation is to take place early on in Segment 2, or even in Segment 1. In this case, separate “advanced work” contracts may be utilized in order to orderly and carefully excavate through and prepare the ground for the coming station excavation. This early work may necessitate on-going lane closures.

Other preconstruction work in Segment 2 will be as outlined in the general construction scenario.

4.2.2.2 Underground Utilities

The handling of underground utilities in this segment will be similar to that described in the general construction scenario.

4.2.2.3 Stations

The end of the line for Segment 2, at Century City, either at Santa Monica Boulevard or at Constellation Avenue would likely be the location of a tunnel portal entry/exit point, due to its confined conditions. If Fairfax is used as the station for tunnel excavation mining would have to proceed from the Wilshire/Fairfax Station west to the Century City Station. To this end, the Fairfax tail tracks, beyond the end of the station platform (if required for operations), would have to be left with temporary decking during Segment 1 construction, and then permanently covered as part of Segment 2. Dependent on the length of time that the Segment 1 portion has to operate prior to work on Segment 2, this may or may not be a feasible option.

If tunneling commences at the Wilshire/Fairfax Station, the mining entry locations are the same as Segment 1, except from the west end of the station. If the Century City (Santa Monica) Station location is used as an entrance, TBMs would be assembled at the Century City Station construction staging area and would be moved vertically to tunnel grade or horizontally from established side access points and then slid into position for use at the tunnel faces or headings. Utilities, air, water, disposal, electricity, sanitation, and communication would be positioned near the working entries to the tunnels for the mining operations. Wilshire/Rodeo Station, though potentially workable for staging tunnel excavation, is too near the western reach and is not considered a good mining station.

Table 4-8: Alternative 1, Segment 2 Station Descriptions

Station	Notes
Wilshire/La Cienega	Wilshire/La Cienega Station would likely be utilized only for station construction and transporting TBMs through the excavation. Using the site as a TBM launch/retrieval station would break the mining reaches into disproportionate lengths so as to be economically less viable.
Wilshire/Rodeo	No construction staging areas have been identified. The station would likely have to be built by closing down lanes in Wilshire Boulevard and/or side streets.
Century City (Santa Monica Blvd)	This station has alternatives on Santa Monica and Constellation, with the station running essentially east and west on Santa Monica Blvd., but skewed to the southern side on the east. This layout ties the station into a sizeable construction work area, rendering it a feasible station location.
Century City (Constellation Blvd) (Option 4)	Segment Option-Constellation North provides for tunnel realignment through the Constellation Boulevard Station. This site has what appears to be a large and workable construction work area at the northeast end. Either of these two station options on Santa Monica and Constellation Boulevards appears to be workable and the choice of selection perhaps will be from other than construction.

Station Excavation

This is largely described in the previous sections as far as it pertains to support of excavation, support of utilities and construction of roadway decking, including general sequencing of the work.

Segment 2 would contain 6 total stations: 3 stations from Segment 1 - Wilshire/Crenshaw, Wilshire/La Brea, and Wilshire/Fairfax, and 3 new stations - Wilshire/La Cienega, Wilshire/Rodeo, and Century City. Station options are at Wilshire/Crenshaw, Wilshire/La Cienega, and Century City. Depending upon selected tunnel alignment there might also be an open cut connection structure west of La Cienega.

Table 4-9: Estimated Amounts of Excavated Materials for Station Construction for Segment 2

Station	Estimated Total CY Excavated	Estimated Daily Haul Truck Trips	Estimated Total Haul Truck Loads
Wilshire/La Cienega	140,000	25-50	7,000
Wilshire/Rodeo	140,000	25-50	7,000
Century City (with crossover)	200,000	25-50	10,000

Wilshire/La Cienega - A potential construction site is proposed for the northeast corner of Wilshire and La Cienega Boulevards, extending northward on La Cienega Boulevard.

Wilshire/Rodeo Station - A potential construction site is proposed for the property on the southwest corner of Wilshire Boulevard and Canon.

Century City Station - A potential construction site is proposed for the alternate Constellation Boulevard site, where sufficient space is available for a tunnel excavation operation. This potential work area appears to have minimally 500-ft by 300-ft available, three and a half acres or more. This station has two potential options. The base station is on Santa Monica Boulevard and the station option is on Constellation Boulevard. Undated drawing A-006.2.1 depicts the station running essentially east and west on Santa Monica, but skewed to the southern side on the east. This depiction ties the station into a very sizeable construction lay down and work area rendering it a feasible station location. Segment Option-Constellation North provides for tunnel realignment through the Constellation Boulevard Station. This site too has what appears to be a large and workable construction lay down and work area at the northeast end as depicted on undated drawing A-006.3. Either of these two station options appears to be workable and the choice of selection perhaps will be from other than construction criterion

Station Construction

With regard to the new stations on this segment, Wilshire/La Cienega, Wilshire/Rodeo, and Century City, the general construction approach is largely as has been described previously as far as it pertains to support of excavation, support of utilities and construction of roadway decking, including the general sequencing of the work.

In general, station concrete construction and architectural finish work will take place after tunnel operations are completed and when the station work will have free access. Some work may commence concurrent with the tunneling, as long as it is limited to the station area farthest away from the tunnel. In this way, any interference with the tunneling operations is limited.

4.2.2.4 Tunnel Construction

The tunnel is to be excavated using approved pressurized-face TBMs, with or without slurry, since hydrocarbon deposits or potential gas areas are not expected to be significant in this reach.

It is expected that groundwater (and perhaps limited gassy conditions) may be encountered along some portions, such as the west end near the Wilshire/Fairfax station, and in the Century City area. Therefore, consideration may be given to use of Slurry-Face TBMs to mine this portion of the alignment as well as Segment 1. If slurry mining is used from the Fairfax station it is expected that separation will take place on-site and the processed materials disposed of through conventional methods.

Estimated Volume of Excavated Materials from Tunnel Construction

The total volume of excavated materials for the tunnel excavation from Wilshire/Fairfax to Century City is estimated to be approximately 525,000 CY. Based on this volume and the anticipated sequence of construction, the maximum truck counts for tunnel spoil removal is estimated to be from 40-80 daily truck trips.

4.2.2.5 Street/Site Restorations

This work is largely described above and is the reverse of the previous work of building any of the stations. The stations will have the top or roof concrete completed followed by earthen backfill, road deck removal, removal of the top 8’ or so of the structure utilized for support of excavation, roadway paving, pedestrian sidewalk construction including full restoration of access to the businesses. The final condition of the street and sidewalk upon restoration will be critical to attaining final acceptance of the construction contract.

4.2.2.6 Vent Shafts and Emergency Exits

Construction of ventilation shafts, emergency exits and construction of cross-passages will be as generally described in the preceding section.

This segment also includes the connection structure for the West Hollywood Extension.

4.2.2.7 Summary

Table 4-10: Sequence of Construction Activities – Segment 2

Activity	Duration	Description	Equipment Required
Pre-construction	None is expected	Controlled excavation	Largely hand tools and small equipment
Tunnel Construction	Approx. 3 or more years, counting TBM purchase	Excavation and tunnel lining	TBM, potentially slurry pumping and separation equipment, concrete equipment
Underground Utilities	Approx. 6 months	Locate, move and support utilities	Hand tools and small excavation equipment
Station Excavation	Approx. 1 year	Support of excavation and cut-and-cover excavation	Various excavation equipment and a crane
Station Construction	Approx. 2-½ years	Form and place concrete structure, finish work, architectural and mechanical	Concrete form and placing equipment
Street/Site Restorations	Approx. 4 months	Paving and sidewalks	Paving equipment
Vent Shafts and Emergency Exits	Concurrent, approx. 6 months	Shafts and cross-passages	Crane and tunnel equipment

4.2.3 Construction Scenario - Segment 3 – Century City to Westwood/UCLA

4.2.3.1 Stations

Westwood/UCLA Station - Potential construction sites are proposed on UCLA Lot 36 between Gayley Avenue and Veteran Avenue and north of Wilshire Boulevard. This off-street site would allow a separation of Segment 3 construction activities from adjacent Segment 2 activities (if concurrent), which would be advantageous. There would be no need for covering or decking the station since there would be no traffic. The open excavation would provide economic and schedule benefits.

Table 4-11: Estimated Amounts of Excavated Materials for Station Construction

Station	Estimated Total CY Excavated	Estimated Daily Haul Truck Trips	Estimated Total Haul Truck Loads
Westwood/UCLA	120,000	25-50	6,000

The main work area is around 350-ft by 300-ft and there are additional areas to both the east and west that are suitable for staging, parking, storage, and work areas.

Special Shoring Design

Similar to previous discussions, some areas of Westwood have shallow groundwater, potentially under artesian pressure. This has necessitated the use of dewatering operations through multiple wells. In such cases the use of soldier piles with lagging may be inadequate and a slurry wall, secant pile, or similar excavation support system may be necessary.

4.2.3.2 Tunnel Construction

For Segment 3 ending at the Westwood/UCLA Station, a crossover would be located west of the station, east of Sepulveda Boulevard to allow for trains to "switch" tracks to change direction. Tail tracks would be located on the west side of the I-405 Freeway with a vent shaft just on the VA Hospital property that will not preclude a future station location. Trains would enter the crossover from the east, extend along one of the tail/pocket tracks, and head back to the Westwood/UCLA Station to travel eastward.

The segment of the alignment connecting the Century City Station and the Westwood/UCLA Station is not as likely to be classified highly gassy and, hence may be mined with EPB TBMs. Other construction elements will be as described in the preceding sections.

Due to the over 2-mile length between the Century City and Westwood stations, it is likely that one to two mid-line vent shafts will be required. Similar mid-line ventilation structures were discussed in earlier sections. As was the process for the Metro Red Line North Hollywood Tunnels, vent shafts may be constructed ahead of tunneling, with TBMs transported through (walked-through) the vent shaft excavations.

This segment of Alternative 1 would likely be mined with two TBMs driven eastbound from the Westwood/UCLA Station towards the Century City Station.

Estimated Volume of Excavated Materials from Tunnel Construction

The total volume of excavated materials for the tunnel excavation from Century City to Westwood/UCLA is estimated to be approximately 300,000 CY. Based on this volume and the anticipated sequence of construction, the maximum truck counts for tunnel spoil removal is estimated to be from 40-80 daily truck trips.

The TBMs would be dismantled underground with the shell left in place. Alternatively, the TBMs could be removed at the Century City Station if the excavation from the Segment 2 construction is left with temporary decking.

4.2.4 Construction Schedule

Alternative 1 (from Wilshire/Western to Westwood/UCLA Extension) would be constructed in three segments.

Design and construction of Segment 1 (from Wilshire/Western to Wilshire/Fairfax) is expected to take about 7-½ years. Final design (including bid process) for Segment 1 is expected to take approximately two years. Following design, construction would start at the primary tunnel mining location (possibly at Wilshire/Western or at Wilshire/Fairfax). Construction (not considering pre-construction) is expected to take about 5-½ years.

Design and construction of Segment 2 (from Wilshire/Fairfax to Century City) would be largely dependent on the options chosen. However the schedule is anticipated to be approximately a year less than for Segment 1, due to the pre-construction activities connected with the tar deposits for Segment 1. On this basis, a total design and construction duration of about 6-½ years is a reasonable expectation. This is based on the concept that pre-construction would start a year earlier than construction on Segment 1. These early activities would focus in the tar pit areas at Fairfax and La Brea.

It has not been determined if Segment 2 will have sufficient funding to start up before Segment 1 is completed. Further, it is not determined what station will be used to excavate the tunnel. There are advantages in excavating tunnel from the Wilshire/Fairfax Station, but this has the drawback that to do so may delay the start up of Segment 2, as well as possibly delay the completion of the Wilshire/Fairfax station. In order to define start and finish dates for Segment 2 the various options need to be evaluated in more detail.

Design and construction of Segment 3 of Alternative 1 (located between Century City and Westwood/UCLA extension) is expected to take approximately 5-½ years. Currently there are no significant pre-construction activities envisioned for this segment. By staging the tunnel excavation operation from the Westwood/UCLA Station (or some other more westerly station) to excavate east to the Century City Station, this reach of tunnel and station would be able to proceed independently of any effect of work timing for Segment 1 and Segment 2.

Together Segments 1, 2 and 3 constitute Alternative 1, which would be constructed within a time-span of approximately 7-½ years if all work is concurrently scheduled. However, given the space limitations and other constraints, it would be difficult to advance all three segments at the same time. It is possible that one or more of the segment reaches will be advanced further ahead of the adjacent reaches, thus reducing the amount of concurrent work in the same proximity. Under this scenario, Alternative 1 construction would take from 9 to 15 years for completion.

4.2.5 Options

This section describes the variations to construction techniques and schedule that the station and alignment Options may cause for Alternative 1. Except for the initial establishment of station excavation to the point where tunnel excavation operations can commence, station construction will generally not affect tunnel excavation.

Tunnel concreting operations might be affected, depending on how the contracts where tunnel and station interface are set up. Some stations are of larger size (length) than others and some concrete work is more complex than others so durations of station construction will vary. In general, it will be the station used in staging tunnel excavation operations that will get finished last, and will be on the critical path.

4.2.5.1 Station Options

Option 1 - Remove Wilshire/Crenshaw Station

Option A is an option to not include the Wilshire/Crenshaw Station. A vent shaft would need to be constructed in this location if the station is deleted. The vent shaft would be located mid-way between Crenshaw Boulevard and Lorraine Boulevard. This option involves an elimination of what would otherwise be concurrent work and therefore would not materially affect the Segment 1 tunnel operations or overall schedule. The construction of a smaller ventilation shaft though will invoke similar concerns as a station, only the structure would be smaller and less involved.

Wilshire/Crenshaw Station is considered too close to Wilshire/Western Station and the eastern terminus of Segment1 to be an effective mining station, even though it may have the potential for having a large construction work area.

Option 2 - Wilshire/Fairfax Station– East

For this option, a potential construction staging area is on the south side of Wilshire Boulevard between Orange Grove Avenue and Ogden Drive. A double crossover is planned as an option on the west side of the station. This is potentially additional work space for the tunnel and station construction. However, this added area is merely a supplement to the main construction yard to the north and west of the Wilshire/Fairfax intersection.

Option 3 - Wilshire/La Cienega Station with Transfer Station

This station is multi-level (or stacked vertically), with one track below the other and vertical circulation connecting the two. The station needs to be stacked to stay within the Wilshire Boulevard right-of-way and not extend below adjacent structures. With the stacked tunnel configuration, vertical cross-passages will be needed. The vertical cross-passages consist of stairwells connecting the upper and lower tracks. The cross-passage would be constructed by cut-and-cover methods as a small extension out from the main cut-and-cover excavation and structure. However, there is limited space for this work and innovative construction techniques may be required to allow construction with minimal right-of-way and construction impacts. A potential construction site is proposed for the property on the north side of Wilshire Boulevard, between Le Doux Road and Stanley Drive.

Option 4 – Century City (Constellation) Station

While the station location does not shift, the cut-and-cover construction will extend to Century Park East, due to tie-backs from an existing building foundation on the southwest corner of Constellation Boulevard and Century Park East. A potential construction site is proposed for the property on the east corner of Constellation Boulevard and Century Park East. There is a potential construction staging area at the southeast corner of Constellation Boulevard and Century Park West at the existing bus layover area.

This option furnishes an acceptable and perhaps more desirable station location for tunnel construction, although this depends on available construction staging area at time of construction.

Option 5 - Westwood/UCLA Station - On Street

The potential construction site is proposed for the UCLA Lot 36 property on the northwest corner of Wilshire Boulevard and Gayley Avenue. This option, if selected, would reverse the positive effects of having the station off the street, and therefore is not a preference for use as a tunneling site.

Option 6 – Westwood/ VA Hospital – North of Wilshire

Option 6 appears viable but does not indicate any particular benefit over the base Westwood/VA Hospital Station.

4.2.5.2 Alignment Options

Option 4: Beverly Hills to Century City Segment Options

These variations are essentially tunnel alignment alternates and do not affect public access. Tunneling under private property should not pose a greater physical problem, however liability exposure must be considered. Option 4 has three options for traveling between the

Wilshire/Rodeo Station and the Century City Station. These include the base alignment, which travels from the Wilshire/Rodeo Station, along Santa Monica Boulevard to the Century City (Santa Monica) Station; and North Constellation alignment and Constellation alignment that are described below; that traverse one of two routes to the optional Century City (Constellation) Station. The variation in construction schedules for these options are described below.

There is no significant change to the overall construction and schedule scenario for the Constellation alignment option assuming tunnels are aligned clear of subsurface building supports or lowered below them. This option will require further study and geotechnical exploration.

The North Constellation option has a potentially undesirable affect in that it involves an “S” curve for tunnel mining operations which can become problematic in holding tunnel alignment. Additionally, the curves appear to be tight, or of rather small radius. In general, any curve is more difficult to hold than a straight line and any curve means that the tunnel precast segments have to be “different” and installed in the right place at the right point in the mining operation. This option may not be as viable as the base alignment or the Constellation alignment option.

Option 4 – Century City to Westwood UCLA Segment Options

The East, Central and West Segment Options connect either Century City Station (Santa Monica Boulevard Station or Constellation Station) to either Westwood/UCLA Station (On-Street or Off-Street Station). The West Segment Option would add approximately 4,000 LF of additional tunnel compared to the base alignment.

Once the tunnel alignment has been determined, it is expected that any of these options are suitable for implementation and will have little effect on the construction scenario or schedule.

4.2.5.3 Trackwork Options

Locations for the additional track work for each alternative were identified, and then evaluated through a rail operations simulation. The evaluation, done in conjunction with Metro, considered location and size of crossovers, pocket tracks and tail tracks. The work involving these options is essentially only an extension of the work of excavating and concreting a station except that it is not as complicated. Cut-and-cover construction methods would be used, similar to that described in the previous sections.

The excavated structure can generally be “narrowed” from that needed for construction of the passenger portion of the station and the concrete work will be simplified, i.e., less deep, less wide, and less complicated. The schedule would be only nominally affected and potentially not affected at all, assuming additional manpower is added to the construction work crews so that the work is concurrent with other activities.

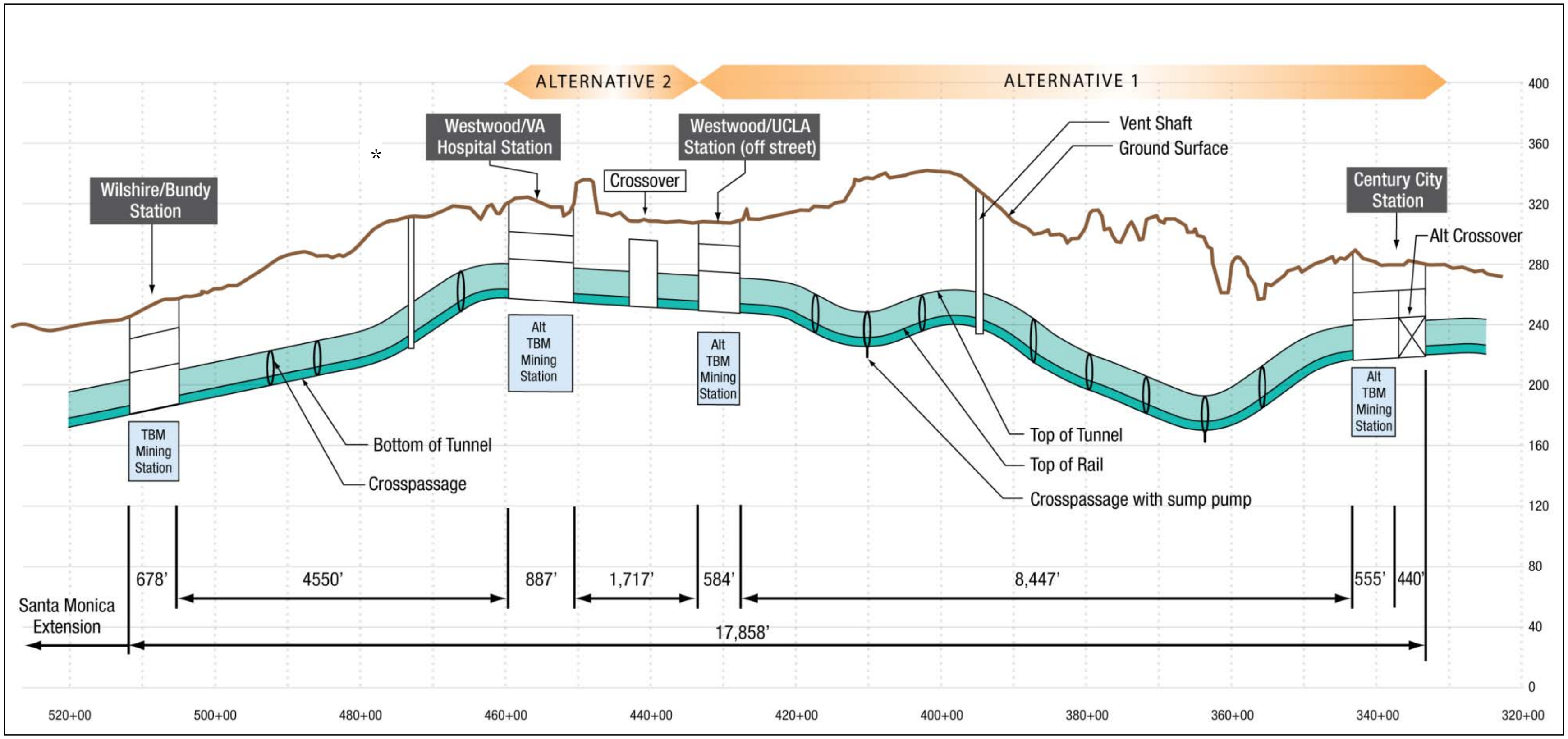


Figure 4-27: Century City Station to Wilshire/Bundy

4.2.5.4 Maintenance Yards

Division 20 Maintenance Yard

This work appears to be essentially surface work in soils that have been exposed over the years to potentially contaminating influences of on-going equipment maintenance and storage. For this reason it is foreseen that excavated materials will be processed for re-use or disposed of at suitable dump sites. Since this yard is actively being utilized coordination of the work and delineation of permissible work areas will be a requirement.

It is assumed that this will involve a structure far less complicated than that for an in-line station and would be a completely separate item of work. As such, it would have virtually no impact on the critical path as long as construction contracts are handled in a timely manner.

Union Pacific Railroad – Los Angeles Transportation Center Rail Yard

This work is essentially at the surface and involves a new, perhaps a singular, alignment from the Division 20 Maintenance yard northward into the north side of the Union Pacific Railroad Los Angeles Transportation Center Rail Yard. The alignment crosses over the Los Angeles River and an existing bridge which means that there will be an approach grade built into the abutment and the bridge crossing structure. This new alignment parallels existing and active track systems and therefore will require strict coordination of the work with train traffic. Preliminary plans depict a couple of bridge piers located in the bottom of the concrete-lined Los Angeles River channel which will require coordination with and permits from the U.S. Army Corps of Engineers and all other resource agencies. More advanced structural design will allow better planning for components such as subsurface construction for the piers and for a more structured consideration of what the abutment construction will consist.

It is assumed that this will involve a structure far less complicated than that for an in-line station and would be a completely separate item of work. As such, it would have virtually no impact on the critical path as long as construction contracts are handled in a timely manner.

4.3 Alternative 2 - Westwood/VA Hospital Extension

Alternative 2 would add the Westwood to VA Hospital Extension to the segments that have been described under Alternative 1. Alternative 2 would also add the Westwood/VA Hospital Station to the stations included under Alternative 1.

The Westwood/VA Hospital station would be located below the Veterans Administration (VA) parking lot in between the I-405 exit ramp and Bonsall Avenue. Several sites in this area have the potential for use in the construction of the station and the tunnels from this site's un-decked station box.

Table 4-12: Estimated Amounts of Excavated Materials for Westwood/VA Hospital Station Construction

Station	Estimated Total CY Excavated	Estimated Daily Haul Truck Trips	Estimated Total Haul Truck Loads
Westwood/VA Hospital	300,000	25-50	15,000

4.3.1 Construction Scenario

The Westwood VA Hospital Station has sufficient surface working area to be able to effectively conduct tunnel mining operations, especially if the location south of Wilshire Boulevard is used.

Station construction would be accomplished without decking and tunneling could proceed east. The Westwood/VA Hospital Station site within Wilshire Boulevard would have more restricted work areas and consideration again would be given to driving tunnels to the west from Century City.

Alternative 2 has a number of terminus options for pocket track/tail track and crossover configurations which will be constructed by cut-and-cover methods.

The segment between the Century City Station and the Westwood/VA Hospital Station is not considered gassy and, hence could be mined with EPB TBMs, a slurry machine not being necessary. Spoil removal will be by conventional methods using spoil cars or conveyors, perhaps in combination, and crane hoisting or vertical conveyance at the station utilized for mining.

Due to the over 2-mile length between the Century City and Westwood/VA Stations, it is expected that 1-2 mid-line vent structures will be required. These vent shafts may be constructed ahead of tunneling, with TBMs transported through the excavation.

Table 4-13: Tunnel and Construction Lengths for Alternatives 1 and 2

Station	Length (feet)	Description
342+80	4940	Exit Century City Station continuing westerly under Santa Monica Boulevard
392+20	0	Water Table drops below tunnel [Take out?]
429+80	3760	Alignment re-enters the Wilshire corridor
431+50	170	Enter Westwood/UCLA Station (Alternative 1)
438+00	650	Exit Westwood/UCLA Station proceeding westerly under Wilshire
457+60	1960	Enter Westwood/VA Station (Alternative 2)
464+00	640	Exit Westwood/VA Station
	15,610 (3.0 miles)	Total Length
	2,270	Station Length
	13,340 (2.5 miles)	Twin Tunnel Length
Scenarios to Consider		
A	Mine with 1 TBM from Westwood/VA Station, remove the TBM from Century City, and return it to Westwood/VA Station.	
B	Mine with 2 TBMs from Westwood/VA and remove them from Century City.	
Station Notes		
Westwood/VA Hospital Station	Westwood/VA Hospital Station would furnish a very workable area for conducting a mining operation and it has the added aspect of remaining an “open” excavation. Therefore, Westwood/VA is the recommended mining station.	
Westwood/UCLA Station	Re-positioned Westwood/UCLA Station has virtually all construction working area needed and is a viable mining station. It is, though, a short distance from the Century City Station, making it a second choice to using Westwood/VA Station for mining operations.	

Alternative 2 would likely be mined with two TBMs driven east from the Westwood/VA Hospital Station towards the Century City Station. Due to the surface work area constraints at the Century City Station, the TBMs may be dismantled underground with the shell left in place. Alternatively, the TBMs could be removed at the Century City Station if the excavation from the Segment 2 construction is left with temporary (removable) decking.

Since the Westwood/VA Hospital station is located on VA property, station excavation could remain open, without the need for temporary decking. No street closures would be necessary; however traffic controls would be needed for entering and exiting of construction traffic onto adjacent roadways.

Utilities, air, water, disposal, electricity, sanitation, and communication would be positioned near the working entries to the tunnels for the mining operations. At least one of the two preferred terminus options for the Westwood/VA Hospital Station has an access site at the Army Reserve area near Federal Way. Mining operations could be set up at this site to further remove tunneling activities from the hospital entrance.

4.3.1.1 Estimated Volume of Excavated Materials from Tunnel Construction

The total volume of excavated materials for the tunnel excavation from Westwood/UCLA to Westwood/VA Hospital is estimated to be approximately 35,000 CY. Based on this volume and the anticipated sequence of construction, the maximum truck counts for tunnel spoil removal is estimated to be from 40-60 daily truck trips.

Removal of spoil materials could later be moved to the crossover area on the Federal Building (GSA) site such that the VA Station could be completed. Spoil haul routes are more efficient from the VA site than the GSA site, especially if, as stated above, the preferred loaded truck haul route is to the south. In general, Wilshire/Veteran to Wilshire/Sepulveda is very congested.

4.3.2 Construction Schedule

Construction of this segment is expected to take approximately 5-½ years. This is based on minimal pre-construction activities. This is based on the tunnel excavation operations from the Westwood/VA Hospital station to excavate east into the Westwood/UCLA Station. Using this scenario, this reach of tunnel and station will be able to proceed independently of any effect of work timing for any of the easterly positioned tunneling contracts.

4.3.3 Options

4.3.3.1 Option 6: VA Hospital – North of Wilshire

Option 6 would locate the Westwood/VA Hospital Station on the north side of Wilshire Boulevard, as opposed to the south side. A potential construction staging site is proposed in the parking lot on the north side of the station box, between the historic chapel and the Wadsworth Theater.

4.4 Alternative 3 – Santa Monica Extension

This alternative includes the seven stations previously described in Alternative 1, plus four additional stations extending west to the City of Santa Monica, for a total of 11 stations assuming Option 1, the Wilshire/Crenshaw Station, is deleted. All optional stations (discussed above) could also be applied to this alternative. The construction sites for additional stations are described below.

Wilshire/Bundy - Potential construction sites are proposed for the southeast corner of Wilshire Boulevard and Bundy Drive, and the northwest corner of Wilshire Boulevard between Bundy Drive.

Wilshire/26th - Potential construction sites are proposed for the northeast and northwest corners of Wilshire Boulevard and 26th Street.

Wilshire/16th - Potential construction sites are proposed for the northeast and northwest corners of the Wilshire Boulevard and 15th Street intersection.

Wilshire/4th - Potential construction sites are proposed for the southeast corner of Wilshire Boulevard and 4th Street.

Table 4-14: Estimated Amounts of Excavated Materials for Station Construction

Station	Estimated Total CY Excavated	Estimated Daily Haul Truck Trips	Estimated Total Haul Truck Loads
Wilshire/Bundy	160,000	25-50	8,000
Wilshire/26th	140,000	25-50	7,000
Wilshire/16th	140,000	25-50	7,000
Wilshire/4th	480,000	25-50	24,000

4.4.1 Construction Scenario

It is considered impractical to stage tunnel excavation operations from the Wilshire/26th Street site. This is a low-density residential neighborhood and is not close to any freeway. However, if the construction impacts could be mitigated, the tunnel could be excavated from the Wilshire/26th Street Station west towards 4th Street and then east towards the Westwood/VA Hospital Station.

The Westwood/VA Hospital site is considered optimal. The tunnel excavation could proceed from the Westwood/VA Hospital Station area (or alternatively the proposed tunnel site on the U.S. Army Reserve area near Federal Way) to the west, all the way to 4th Street in downtown Santa Monica.

From the Westwood/VA Hospital Station to the Wilshire/4th Street Station, this segment measures approximately 3.7 miles in length. There is little or no potential for gas along this segment, so that mining could be accomplished with EPB TBMs, although a slurry machine may be used due to availability from other segments. If an EPB TBM is used, the spoil removal will be by conventional methods using spoil cars or conveyors, perhaps in combination, and crane hoisting or vertical conveyance at the site utilized for mining.

There is a block-size work area available on the north side of the Wilshire/26th Street Station. Additional work areas are available north and south of the eastern end of the station. Excavation for the Wilshire/26th Street Station would require “lane channelization” in order to install soldier piling and cap beams for support of temporary roadway decking during short term lane closures that would require the entire roadway to be partially closed. With the approximately 680-ft length of station involved, three partial road closures may be needed in order to assure Wilshire Boulevard would be opened back up to full traffic within allotted time-frames.

The tunnel may be excavated through traces of the Santa Monica fault zone along sections of Wilshire Boulevard. Although the construction methods and tunnel advance rate are not expected to be significantly affected, specific measures may be necessary as discussed in Alternative 1 above.

4.4.1.1 Estimated Volume of Excavated Materials from Tunnel Construction

The total volume of excavated materials for the tunnel excavation from Westwood/VA Hospital to Wilshire/4th is estimated to be approximately 530,000 CY. Based on this volume and the anticipated sequence of construction, the maximum truck counts for tunnel spoil removal is estimated to be from 40-80 daily truck trips.

4.4.2 Construction Schedule

Construction of the Santa Monica Extension is expected to take approximately 5-½ years. This based on minimal pre-construction activities. The tunnel excavation operation will likely use the Westwood/VA Hospital Station to excavate west into Santa Monica. Except for staging two tunnel excavation operations out of this site, this final reach of tunnel and stations will be able to proceed independently of the easterly reaches of the tunnel. This reach includes four (4) new stations, but they may be contracted out separately or as a part of the tunnel portion of the contract. In order to meet the 5½-year construction duration, all stations would be constructed at least partially concurrent.

Table 4-15: Tunnel and Construction Lengths for Alternative 3

Station	Length	Description	
464+00	0	Exit Westwood/VA Station proceeding westerly	This uses Westwood/VA Station for mining westward.
513+30	1,440	Enter Wilshire/Bundy Station	
519+80	650	Exit Wilshire/Bundy Station proceeding westerly under Wilshire	
558+10	3,830	Enter Wilshire/26th St Station	
564+60	650	Exit Wilshire/26th St Station proceeding westerly under Wilshire	
597+70	3,310	Enter Wilshire/16th St Station	
604+10	640	Exit Wilshire/16th St Station proceeding westerly under Wilshire	
641+00	3,690	Enter Wilshire/4th St Station	
658+60	1,760	Exit Wilshire/4th St Station terminating and end of tail track	
	19,460 (3.7 miles)	Total Length	
	4,680	Station Length	
	14,780 (2.8 miles)	Twin Tunnel Length	

Scenarios to Consider:	
A	Mine with 1 TBM from Westwood/VA Station (or alternatively the proposed tunnel site on the U.S. Army Reserve area near Federal Way) through to the Wilshire/4th Street Station and open tail tracks. Or as a less preferable alternative, mine in the opposite direction, from Wilshire/4th Street Station into Westwood/VA Station. Either way, retrieve the TBM and re-use it for the 2nd run of mining.
B	Mine with 2 TBMs from Westwood/VA Station (or alternatively the proposed tunnel site on the U.S. Army Reserve area near Federal Way) through to the Wilshire/4th Street Station and open tail tracks. Or mine in the opposite direction, from Wilshire/4th Street Station into Westwood/VA Station.

Station Notes	
Westwood/VA	Westwood/VA Station appears to have sufficient space for mining east and west, as well as good freeway access.
Wilshire/Bundy	Wilshire/Bundy Station has a reasonable construction work area, but is not situated in a favorable location for mining.
Wilshire/26th Street	Wilshire/26th Street Station is near the midpoint of the last reach of the system, but the area is severely constrained, with only a small available construction work area that is far from freeway access. This site is not currently considered viable for major tunnel mining.
Wilshire/16th Street	Wilshire/16th Street Station is too near the terminus Wilshire/4th Street Station and the west terminus to become an effective mining station and doesn't seem to have viable construction work area.
Wilshire/4th Street	Wilshire/4th Street Station is the west terminus and is viable as a retrieval shaft. It does not have sufficient work area to become a viable tunnel mining station and is located a long distance from freeway access.

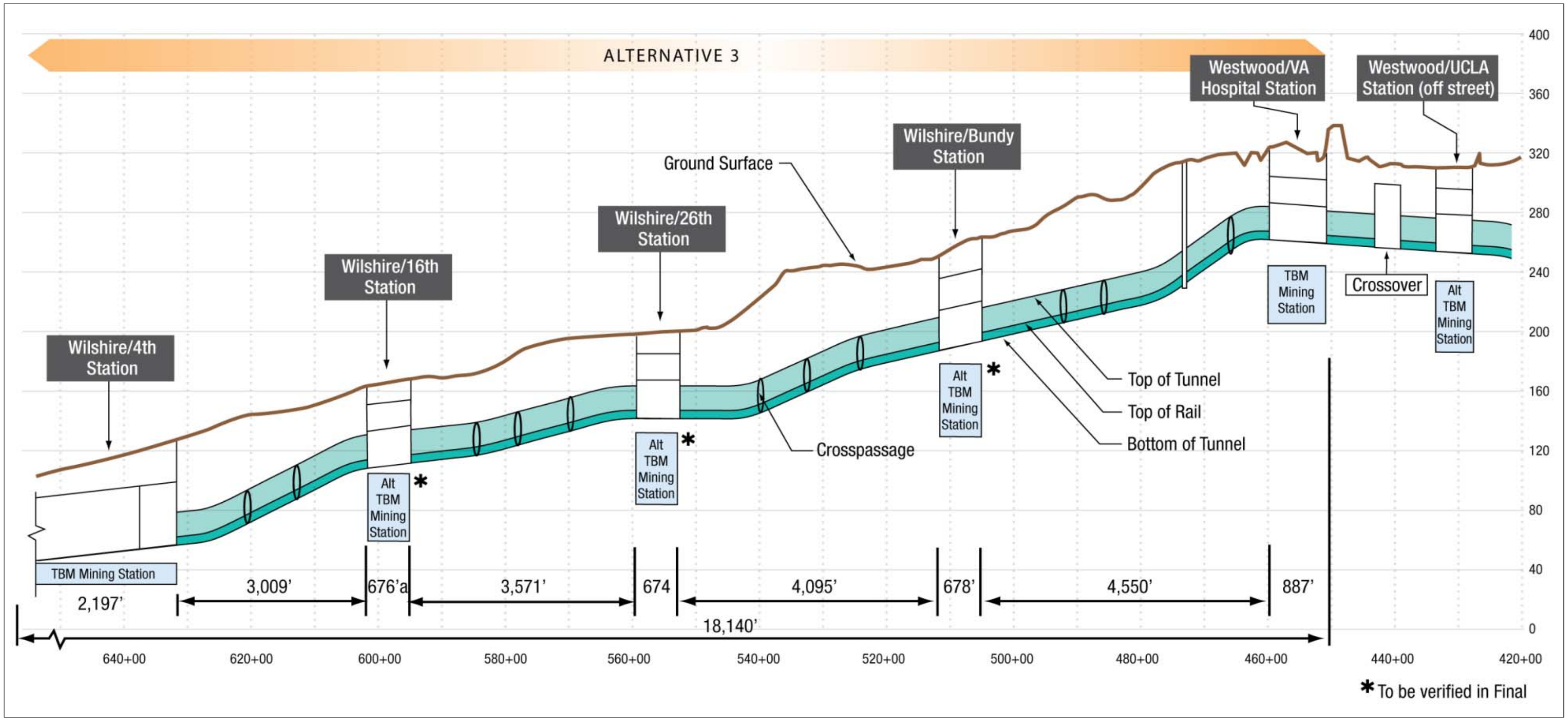


Figure 4-28: Westwood/VA Hospital Station to Wilshire/4th Street

4.5 Alternative 4 – Westwood/VA Hospital Extension plus West Hollywood Extension

Alternative 4 would add the West Hollywood Extension to the segments described under Alternative 2. Stations along the alternative include:

- Hollywood/Highland, an existing station – Potential construction staging sites are proposed on the property on the east side of Highland Avenue in the block between Selma Place and Hawthorn Avenue, and on the west side of Highland Avenue in the block north of Hawthorn Avenue. This station site has a construction work area of approximately 200 ft by 200 ft, almost one full acre, on the west side near, but not on, Hollywood. Though certainly not large, it is a workable construction site. A McDonald's business facility may be removed for a station entrance. It is thought that the physical aspects of such a removal would not be complicated but that perhaps local perception might present some concern. If so, perhaps McDonalds could be temporarily relocated into another structure through agreement and then be reconstructed on the property left after construction of the subway and station is completed.
- Santa Monica/La Brea - Potential construction staging site is proposed for the northwest corner of Santa Monica Boulevard and La Brea Avenue. The 6 story condominium at the La Brea Station work site might be considered a typical example of multistory structures that will require some special consideration. Any such building will have a substructure support system that will have to be researched and considered in the design for support of excavation for the station, in this case the La Brea Station. There is almost any number of various ways that could have been used originally in the support of the 6 story condominium. The structure could have a basement and have a concrete piling substructure will a concrete spread cap or footing relatively near the surface. The structure might be founded a few stories below and constructed of heavy concrete walls and footings, possibly further supported laterally through a tie-back system. Whatever the construction of the existing structure, it must be researched and provisions made under the contract to alter, possibly increasing side loading restraint for the contractor's approved support of excavation for the La Brea Station.
- Santa Monica/Fairfax - Potential construction staging sites are proposed for the property on the north side and south side of Santa Monica Boulevard between Orange Grove and Fairfax Avenues. This station is favorably located near the midpoint of the reach of tunneling and very likely would become the contractor's choice for excavating tunnels each direction from the excavated station. The general outcome of this station as the origin of tunnel mining is that the tunnels would theoretically be completed in shorter order but the station itself would have a delayed completion.
- Santa Monica/San Vicente - Potential construction areas are limited at this station site. A potential construction staging site is proposed on the south side of Santa Monica Boulevard at the west end of the station on Metro Division 7 property. Unlike the stations along Wilshire Boulevard, the Santa Monica/San Vicente Station and the Beverly Center Area Station and work area are situated in near residential zones rather than being in the midst of active businesses. As such any construction activity will result is some disturbance to individuals and noise limitation along with monitoring will need to be closely controlled. Conceivably sound walls will need to be designed and constructed to substantial heights, maybe thirty feet, or even higher. Wind loading

against such structures can be quite large so the structural support system must be adequate. In addition, the quality of the surface components of the wall itself must be such as to muffle or absorb sound and must also be visually acceptable to the public. Conceivably the wall covering might be easily modified or altered to produce a change in "look" when desirable, and certainly graffiti will need to be periodically removed or otherwise covered. The sound emanating from construction equipment will need to be controlled as much as possible. Back up alarms are designed to alert workers in the vicinity of moving machinery and are generally a requirement of safety regulators but suitable compromises must be worked out to "still" the noise at time when surrounding neighbors are sleeping. Public relations efforts with the immediate neighbors will be an on-going challenge.

- Beverly Center Area - A potential construction site is proposed on the south side of 3rd Street, between San Vicente and La Cienega Boulevards. A station at this site would have a very limited area for construction staging. This will curtail materials stock piling and storage of equipment and supplies. This severe lack of construction work area will mean that the contractor will need to acquire his own storage and handling work site and plan the production work accordingly. The cost for building this station will reflect the constraints imposed by lack of construction work area.

  The Beverly Center Area Station has active storm drain pipes that run parallel to the length of the station. One pipe is a 27" diameter vitrified clay pipe and the other is a 33" diameter reinforced concrete pipe. Possibly these pipes could be supported under the roadway decking but it is suggested that they be replaced with a new continuous/ extruded pipe hung under the roadway decking. The existing pipes would be plumbed into and out of manholes at each end of the station. Alternatively, the existing pipe lines could be re-routed around instead of through the station area, if substantial room is located. It is noted that other site locations encounter storm drain piping to varying degrees but that in itself should not be considered any more detrimental than the necessary re-routing of utility services.

Table 4-16: Estimated Amounts of Excavated Materials for Station Construction for the West Hollywood Extension

Station	Estimated Total CY Excavated	Estimated Daily Haul Truck Trips	Estimated Total Haul Truck Loads
Connection Structure	130,000	25-50	8,200
Beverly Center Area	145,000	25-50	7,200
Santa Monica/San Vicente	200,000	25-50	10,000
Santa Monica/Fairfax	140,000	25-50	7,000
Santa Monica/La Brea	140,000	25-50	7,000
Hollywood/Highland *	330,000	40-80	16,600

* Access shaft adjacent to existing Hollywood/Highland station.

4.5.1 Construction Scenario

This alternative would have the same general construction techniques as described under Alternative 2 for the alignment between Wilshire/Western and Westwood/VA Hospital Extension.

With regard to the West Hollywood Extension, there are some locations along the alignment where shallow groundwater is encountered. Previous excavation sites have necessitated the use of dewatering to lower the groundwater level. As discussed previously, the use of soldier piles with lagging may be inadequate in these areas and a slurry (diaphragm) wall, secant pile or similar system may be necessary. In addition, some potentially gassy ground may be encountered in the southern portion of the alignment. However, it is anticipated that either an EPB or Slurry-Face TBM could be used. Spoil removal and other construction methods would be similar to that described in the preceding sections.

Mining operations could proceed with one or two TBMs from the Santa Monica/La Brea Station, the Santa Monica/San Vicente Station, the Beverly Center Area Station, or the Santa Monica/Fairfax Station eastward toward the existing station at Hollywood/Highland, where the TBM(s) would be retrieved and re-used for mining. The reaches from the selected mining station would be mined a longer distance from Santa Monica/Fairfax south to Wilshire/La Cienega and, depending upon the time constraints, could be mined with either one or two TBMs. The Santa Monica/Fairfax Station site is the most central location from which to mine.

Although there are substantial concerns regarding community impacts, the Santa Monica/ Fairfax Station could potentially be used as a tunnel mining site. Mining operations would proceed from this station east towards the existing station at Hollywood/Highland and south towards the Wilshire/La Cienega Station. The construction work site for the mining operations would likely be adjacent to North Fairfax Avenue. Construction traffic would need to be separated by traffic control measures. It is expected that a side entry of approximately 40-ft in length would afford access for the TBM and construction machinery to the tunnel headings at both ends of the station.

Excavation of the Santa Monica/Fairfax Station would require “lane channelization” in order to install soldier piling and cap beams for support of temporary roadway decking during short-term lane closures that would require the entire roadway to be closed. With the approximately 680-ft length of station involved, three road closures may be needed in order to ensure that Santa Monica Boulevard would be opened back up to full traffic within allotted time-frames.

Similar to Segment 2, the easterly drive is shorter than the westerly drive and could potentially be accomplished with one TBM to be extracted at the Hollywood/Highland Station and re-launched at Santa Monica/Fairfax. The longer westerly portion would be constructed with two TBMs. These TBMs could be either dismantled or removed intact at the Wilshire/La Cienega station, depending on whether a retrieval shaft would have been provided there as part of Segment 2 construction. Utilities, air, water, disposal, electricity, sanitation, and communication would be positioned near the working entries to the tunnels for the mining operations.

4.5.1.1 Preconstruction

This work will be essentially as described above and there are no recognized differences.

4.5.1.2 Tunnel Construction

This work will be essentially as described above and there are no recognized differences.

Estimated Volume of Excavated Materials from Tunnel Construction

The total volume of excavated materials for the tunnel excavation from Wilshire/La Cienega to Hollywood/Highland is estimated to be approximately 760,000 CY. Based on this volume and the anticipated sequence of construction, the maximum truck counts for tunnel spoil removal is estimated to be from 40-80 daily truck trips.

4.5.1.3 Underground Utilities

This work will be essentially as described above and there are no recognized differences.

4.5.1.4 Stations

There are four new underground stations to construct and two existing stations to tie in to, or enter with the TBM. This station construction work will be essentially as described above and there are few recognized differences.

4.5.1.5 Street/Site Restorations

This work will be essentially as described above and there are no recognized differences.

4.5.1.6 Vent Shafts and Emergency Exits

This work will be essentially as described above and there are no recognized differences.

Table 4-17: Tunnel and Construction Lengths for the West Hollywood Extension

Station	Length (feet)	Description
0+00	0	Take off from Highland/Hollywood Station at the Red Line and proceed southerly.
9+70	970	Exit Highland/Hollywood Station
50+70	4,100	Enter Santa Monica/La Brea Station
56+40	570	Exit Santa Monica/La Brea Station
69+00	1,260	Enter Santa Monica/Fairfax Station
74+50	550	Exit Santa Monica/Fairfax Station
156+70	8,220	Enter Santa Monica/La Cienega Station
166+00	930	Exit Santa Monica/La Cienega Station
215+50	4,950	Enter Beverly Center Area Station
221+20	570	Exit Beverly Center Area Station
263+13.23	4,193	Enter Wilshire/La Cienega Station
	26,313 (5.0 miles)	Total Length
	3,590	Station Length
	22,723 (4.3 miles)	Twin Tunnel Length
Scenarios to Consider		
A	Mine east and then north from Santa Monica/La Brea and remove from Hollywood/Highland. Mine from Santa Monica/La Brea west and then south to Wilshire/La Cienega and remove them from a retrieval shaft at Wilshire/La Cienega.	
B	Mine east and then north from Santa Monica/San Vicente and remove from Hollywood/Highland. Mine from Santa Monica/San Vicente west and then south to Wilshire/La Cienega and remove them from a retrieval shaft at Wilshire/La Cienega.	
C	Although severely constrained and not considered optimal, the tunnels could be mined east and then north from Santa Monica/Fairfax and removed from Hollywood/Highland. Also mine from Santa Monica/Fairfax west and then south to Wilshire/La Cienega and remove them from a retrieval shaft at Wilshire/La Cienega.	
Station Notes		
Wilshire/ La Cienega	Wilshire/La Cienega has a fairly good work site, but by the time Alternative 4 or 5 is under construction, this would be a working station. Plus the connection into the Segment 2 tunnel is tangential. Therefore, this likely not a good site for mining operations. Note that a retrieval shaft near the tangential tie-in may be economical and would help to facilitate the complicated work of constructing the tie-in.	
Beverly Center Area	Beverly Center Area Station site has only a relatively small potential construction work site and is close to Wilshire/La Cienega Station.	
Santa Monica/San Vicente	Santa Monica/San Vicente Station site, located on Santa Monica Boulevard between San Vicente and La Cienega Boulevards (at Westbourne Drive), has limited construction work areas, which would constrain tunnel mining operations.	
Santa Monica/ Fairfax	Santa Monica/Fairfax Station is severely constrained and is not considered optimal for mining operations.	
Santa Monica/La Brea	Santa Monica/La Brea Station has some parking lots that could become fairly good work areas for tunnel mining operations. Although it is located close to the northerly (Highland Station) terminus, which is less efficient than other sites, it may be the most viable tunnel mining location.	
Hollywood/ Highland	Hollywood/Highland Station exists, but it may need to be "opened up" to make it a transfer station. There seems some room for construction work area on Highland south of Hollywood. A TBM retrieval shaft might be economical.	

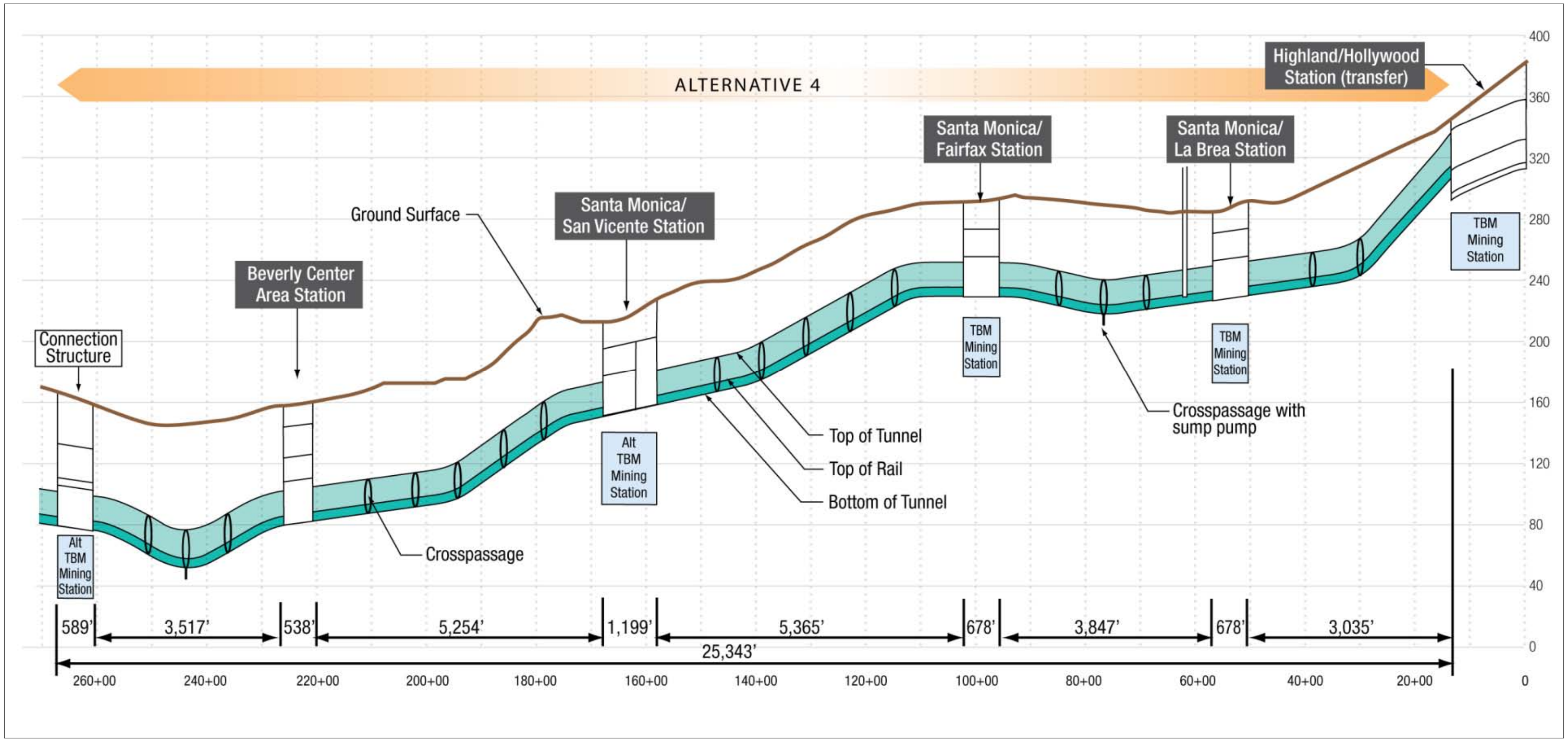


Figure 4-29. West Hollywood Extension, Hollywood/Highland to Connecting Structure

4.5.1.7 Summary

Table 4-18: Sequence of Construction Activities – West Hollywood Extension

Activity	Duration	Description	Equipment Required
Pre-construction	None is expected	Controlled excavation	Largely hand tools and small equipment
Tunnel Construction	Approximately 3 or more years, counting TBM purchase	Excavation and CIP tunnel lining	Pressurized-Face TBM, potentially slurry pumping and separation equipment, concrete equipment
Underground Utilities	Approximately 6 months	Locate, move and support utilities	Hand tools and small excavation equipment
Station Excavation	Approximately 1 year	Support of excavation and cut-and-cover excavation	Various excavation equipment and a crane
Station Construction	Approximately 2-½ years	Form and place concrete structure, finish work, architectural and mechanical	Concrete form and placing equipment
Street/Site Restorations	Approximately 4 months	Paving and sidewalks	Paving equipment
Vent Shafts and Emergency Exits	Concurrent, Approximately 6 months	Shafts and cross-passages	Crane and tunnel equipment

4.5.2 Construction Schedule

Construction of the West Hollywood Extension is expected to take approximately 6-½ years (assuming no need for pre-construction). It is most likely that the tunnel excavation operation will use the Santa Monica/La Brea Station, in which to excavate the tunnels. Using this scenario, the excavation of the tunnels would take place in opposite directions out of the same station. This work would be able to proceed independently of all other tunneling work except for where the tunnel would tie into the Wilshire/La Cienega Station. If additional construction work area can be provided, the Santa Monica/San Vicente Station site would be a viable alternative for tunnel mining.

This reach includes four (4) new stations, but they might be contracted out separately or as a part of the tunnel portion of the contract. In order to meet the 6-½ year construction duration, all stations would be constructed at least partially concurrently.

The tunnel tie-in into the station at La Cienega will consist of constrained or “slow” work, based on the construction abutting completed work. For this reason, an extra year has been added to the schedule. If the station utilized for tunnel excavation is near the mid-point in the reach, the potential savings in time for excavation could be great enough to reduce this need for an additional year.

4.6 Alternative 5 – Santa Monica Extension plus West Hollywood Extension

Alternative 5 would add the West Hollywood Extension to the work described under Alternative 3. Stations and tunnels along the alternative include have already been addressed above and include all previously noted segments.

4.6.1 Construction Scenario

Alternative 5 adds the West Hollywood Extension to the work described under Alternative 3. This scenario involves the entire sum total of all work mentioned above. It is the complete system.

The construction methods and expected scenarios are not significantly different in Alternative 5 then as described in the preceding sections.

4.6.2 Construction Schedule

Alternative 5 would entail construction of all segments (Wilshire/Western to Westwood/UCLA Extension, Westwood/VA Hospital Extension, Santa Monica Extension, and the West Hollywood Extension). The duration of construction for all segments is could theoretically be expected to take approximately 7-½ years if all work is concurrently scheduled and executed.

However, it would be difficult for all of these segments to be advanced concurrently given the scale of construction activities. The existing roadways and infrastructure would present constraints to advancing the many different construction operations at the same time. In addition, there would be accumulated impacts on the community. It is more probable to expect that one or more of the Segment 1, 2, and 3 reaches would be substantially completed before a next reach can begin. If only a minimum of overlap between the segments is assumed, with appropriate geographical separation, it can be expected that the total construction period could be extended to as much as 20 years.

Nevertheless, the overlap between segments can be increased through effective program management and the provision of sufficient resources, funding and community support. In overall scenarios in which the work is realistically optimized through an aggressive design and construction program, the total construction period could be reduced to approximately 10 to 16 years.

Accounting for multiple-shift work operations, it is expected that the total number of construction workers will be between 500 and 750 at such peak construction periods.

4.7 Maintenance and Operation Facility Sites

Development of maintenance facilities will include the construction of storage tracks, shop buildings, and associated wayside structures, such as vehicle cleaning facilities, electrical substations and employee facilities. Generally, the structures would be low-rise, from two to three stories in height (maximum), with parking provided at areas physically separated from the trackways.

Construction of these facilities would entail some demolition, site clearing and grading. Shallow excavations and/or pile installations would be required for structure foundations. Trenching and excavation would also be required for utilities and rail systems installations.

4.8 MOS 1 – Fairfax Extension

4.8.1 Construction Scenario

Construction of MOS 1 is the same as Segment 1 of Alternative 1 and is assumed to be the first item of work to be done. Should this be the only work performed, the station at Wilshire/Fairfax would become the terminus and would likely include a crossover and/or tail tracks.

4.8.2 Construction Schedule

Design and construction of MOS 1 (from Wilshire/Western to Wilshire/Fairfax) is expected to take approximately 7-½ years (see previous Segment 1 discussion).

It is expected that several tunneling contracts will be let at the same time so that some construction can occur simultaneously on different reaches of tunnel. The time to permit the construction, assembly or retrofitting of TBMs, and the completion of necessary excavation at the stations, is approximately 9 to 12 months. Total time to construct the tunnels and stations is approximately 7-½ years, counting pre-construction activities for handling “tar pits” and historical fossilization.

4.9 MOS 2 – Century City Extension

4.9.1 Construction Scenario

This work has been described above and there are no notable differences.

Construction of MOS 2 would not be constructed in isolation as several key elements depend on the completion of MOS 1.

4.9.2 Construction Schedule

Generally, the schedule for MOS 2 is dependent on completion of MOS 1. Similar to Segment 2 of Alternative 1, design and construction of MOS 2 (from Wilshire/Fairfax to Century City) would be largely dependent on the options chosen. Similar to MOS 1, the total time to construct the MOS 2 tunnels and stations is approximately 6-½ years.

Depending on the work breakdown, each tunneling contract will take approximately 24 to 36 months to complete both excavation and concreting, using two TBMs per contract. Construction of the concrete structure of each cut-and-cover station will take about 27 to 42 months to complete. The construction process would be similar to that used for MOS 1 construction, except that it is not expected to encounter concentrations of hydrocarbons and gasses.

4.10 Parking Facilities at Stations

No parking facilities are currently envisioned for the project. If considered, parking facilities would be severely limited, mainly due to space constraints at the station locations. Depending on future studies, minimal parking facilities could be developed for Metro operations and maintenance personnel.

At some station sites, replacement parking facilities may be developed in conjunction with the station construction, however such parking areas would only replace parking removed by the construction operations.

For surface facilities, construction would involve site grading, subgrade preparation, paving, striping, and signage. Equipment used would include compressors, pumping equipment, paving machines, dump trucks, front-end loaders, compacting equipment and water trucks.

If parking garages were selected for replacement parking in later stages of design, equipment typically used in building construction would be involved. Excavation and/or piling for foundations would be followed by site grading and concrete placement operations. Equipment required would include cranes, delivery trucks, spoil haulers, concrete trucks and concrete pumping equipment, generators/compressors, dump trucks, front-end loaders, compacting equipment and water trucks.

4.11 Systems Installations and Facilities

4.11.1 Trackwork

Trackwork will be constructed below grade in the completed tunnels and station structures. Trackwork construction involved the installation of trackbed components on the completed concrete structures, followed by the laying of rails. In general, third rail (traction power) and conduits for systems installations will be constructed at the same time as, or closely following, the trackwork. Rails, conduits, and associated components will be brought into the tunnels at selected station locations with appropriate off-street access, and in some cases via the existing system.

4.11.2 Electrical Substations and Facilities

In general, electrical substation and facilities will be located within available spaces in the stations, crossovers, ventilation shafts, emergency exits, and related facilities. Some electric power equipment may be located within street-level spaces. Substations will include Traction Power Substations (TPSS) and smaller facility power substations. The locations of these facilities will be spaced along the alignment and may be located at or near to each station. These electrical facilities will be appropriately separated from the public (revenue) areas of the system and will include appropriate security.

4.11.3 Communications and Signaling

Communications and signaling systems need less space than electrical facilities and can be accommodated within rooms and niches in the stations, tunnels, crossovers, ventilation shafts, emergency exits, cross-passages, and related facilities. The locations of these facilities will be spaced along the alignment and will be positioned at or near to each station. These facilities will be appropriately separated from the public (revenue) areas of the system and will include appropriate security.

Operations and control facilities will be housed within existing Metro facilities or may be incorporated into above-ground ancillary facilities at stations and/or maintenance yards for this project.

5.0 AFFECTED ENVIRONMENT

This section summarizes the affected environment for particular environmental disciplines affected by construction. The conditions described in this section would only occur during construction and would be temporary and short-term, as opposed to ongoing during the operational phase of the proposed alternatives. This section is drawn from the technical reports in these various disciplines.

5.1 Traffic, Parking, and Transit

Construction activities are likely to impede the normal flow of traffic causing some lanes and roadway segments in the study area to be closed. In order to minimize any disruption to traffic, mitigation of potential traffic impacts, traffic management and control measures will be implemented with the coordination and involvement of appropriate public agencies.

Street closures required for construction would generally be limited to nighttime, weekend, and/or off peak closures. No closures are expected during morning and evening peak travel periods, except for specific areas discussed in the following sections. Potential street closure locations would be identified in close coordination with the local agencies. As these street closure requirements are identified, traffic would be rerouted to adjacent intersections with detours clearly signed and marked.

The estimated construction-related impacts on traffic are based on construction staging for the five build alternatives as well as two Minimum Operating Segments (MOSs). More detailed information on construction staging is presented in the Traffic Handling and Construction Staging Technical Report (Metro, 2010).

Although sixteen alignment and six station-location options are still under consideration along the proposed alignment (particularly in the Century City-Westwood area), the construction staging assumes that the two MOSs and five alternatives would follow the "Baseline" alignments as shown on the key map drawings C1-100, C2-100, C3-100, C4-100 and C5-100 in Traffic Handling and Construction Staging Technical Report (Metro, 2010). Currently, the alignment is subdivided into the following segments:

- Alternative 1: Westwood/UCLA Extension
- Alternative 2: Westwood/VA Hospital Extension
- Alternative 3: Santa Monica Extension
- Alternative 4: Westwood/VA Hospital plus West Hollywood Extension
- Alternative 5: Santa Monica Extension plus West Hollywood Extension
- MOS-1: Wilshire/Western (existing station) to Wilshire/Fairfax Station
- MOS-2: Wilshire/Fairfax Station to Century City Station

5.1.1 Regional Roadway Network

The study area is generally well served by a roadway network of arterial streets and freeways, which provide options for travel both north/south and east/west. However, the study area contains some of the most congested arterial streets in the County. Existing development throughout the study area prevents the addition of new roadways and severely limits the expansion of existing facilities.

5.1.1.1 Freeways

Two freeways traverse the study area. The San Diego Freeway (I-405) runs north/south through the study area just west of Westwood and UCLA and provides the primary access to/from the north and south. The Santa Monica Freeway (I-10) runs just outside the study area until Santa Monica city limits but parallels key east-west arterials and provides regional access from the east. Both freeways are widely recognized as some of the most congested in both the Los Angeles region and the nation, and experience high traffic volumes throughout the day, well beyond the traditional peak travel hours. The study area freeway network is described below.

- I-10 Freeway (Santa Monica Freeway) – The Santa Monica Freeway is a major east/west freeway that traverses the southern portion of the study area. It extends from the Pacific Ocean and the City of Santa Monica on the west to downtown Los Angeles and beyond on the east. Near the proposed project alignment, the Santa Monica Freeway provides five lanes of travel in each direction, including auxiliary lanes. The ramps that lie in the study area include the Cloverfield Boulevard, 20th Street, and Lincoln Boulevard on- and off-ramps. Peak hour conditions along the Santa Monica Freeway are generally congested in both directions, with a slightly higher volume of traffic traveling west in the a.m. peak and east in the p.m. peak. For this reason, observations of eastbound and westbound on-ramps indicate greater congestion in the peak direction.
- I-405 Freeway (San Diego Freeway) – The San Diego Freeway is a major north/south freeway that connects the San Fernando Valley to West Los Angeles, the South Bay area, and Orange County. In the study area, the San Diego Freeway provides five to six lanes of travel in each direction, including northbound and southbound carpool lanes and auxiliary lanes. The ramps that lie in the study area include the Sunset Boulevard, Wilshire Boulevard, Santa Monica Boulevard, and Olympic Boulevard on- and off-ramps.

5.1.1.2 Daily Traffic Volumes

This section describes freeway volumes at key interchanges and segments in the study area.

- I-10 Freeway (Santa Monica Freeway) – In the study area, the average daily (weekday) traffic[26] on the Santa Monica Freeway varies between 148,000 vehicles at the Lincoln Boulevard interchange, 192,000 vehicles at the Cloverfield Boulevard interchange, and 244,000 vehicles at the Bundy Drive interchange. At key interchanges south of the study area, average daily traffic varies between 260,000 vehicles at the Overland Avenue Interchange, 267,000 vehicles at the Robertson Boulevard Interchange, and 277,000 vehicles at the La Brea Avenue Interchange
- I-405 Freeway (San Diego Freeway) – In the study area, the average daily (weekday) traffic on the San Diego Freeway varies between 319,000 vehicles at the Olympic Boulevard interchange, 302,000 vehicles at the Santa Monica Boulevard interchange, 289,000 vehicles at the Wilshire Boulevard interchange, and 281,000 vehicles at the Waterford Street/Montana Avenue interchange.

[26] *2008 Traffic Volumes on California State Highways*, State of California Department of Transportation, Traffic Operations Division.

Arterials

The study area contains some of the most congested streets in Los Angeles County. The high population and employment densities in the study area have resulted in eastbound and westbound directional travel being congested during both the a.m. and p.m. peak periods. The arterials in the study area serve the employment centers as well as local and regional travel. In addition, they are used as alternates to the I-10 and I-405 freeways during non-recurrent delays such as accidents, breakdowns, lane closures and other random events. Key east/west arterials include Hollywood, Sunset, Santa Monica, Beverly, Wilshire, Olympic, and Pico Boulevards and Melrose Avenue. Key north/south arterials include vital streets such as Crenshaw, La Cienega, San Vicente, Robertson, Beverly Glen, Westwood, Sepulveda, and Lincoln Boulevards; Western, La Brea, and Fairfax Avenues; and Bundy Drive. These key arterials can be classified as one of two street types: a Major Class II Highway or a Secondary Highway. A Major Class II Highway is defined as a roadway with a 104’ right-of-way (ROW), 12’ sidewalks, 13’ curb lanes (off-peak parking, peak through), four full-time through lanes, and one dedicated left turn lane/median. A Secondary Highway is defined as roadway with a 90’ ROW, 10’ sidewalks, 19’ curb lanes (all day parking), four full-time through lanes, and one dedicated left turn lane/median. The key study area arterials are described below.

Major East/West Arterials (Listed from North to South)

- Hollywood Boulevard – Hollywood Boulevard is a major east/west arterial that is classified as a Major Class II Highway. It extends from Laurel Canyon Boulevard on the west to Sunset Boulevard on the east. In the study area, it generally has two travel lanes in each direction. Dedicated left-turn lanes are provided at most intersections.
- Sunset Boulevard – Sunset Boulevard is a major east/west arterial that is classified as a Major Class II Highway. It extends from the Pacific Coast Highway on the west to Grand Avenue in Downtown Los Angeles to the east. In the study area, it generally has two full-time travel lanes in each direction, with the parking lane used as a travel lane during peak periods in some locations. Dedicated left-turn lanes are provided at most intersections.
- Santa Monica Boulevard – Santa Monica Boulevard is a major east/west arterial that is classified as a Major Class II Highway. It extends from Ocean Avenue in Santa Monica on the west to Sunset Boulevard in the Silver Lake neighborhood of Los Angeles on the east. In the study area, it generally has two travel lanes in each direction. Dedicated left-turn lanes are provided at most intersections.
- Melrose Avenue – Melrose Avenue is a major east/west arterial that is classified as a Secondary Highway.
- Beverly Boulevard – Beverly Boulevard is a major east/west arterial that is classified as a Major Class II Highway. It extends from Santa Monica Boulevard in Beverly Hills on the west to Glendale Boulevard near Downtown Los Angeles on the east. In the study area, it generally has two travel lanes in each direction. Dedicated left-turn lanes are provided at most intersections.
- Wilshire Boulevard – Wilshire Boulevard is a major east/west arterial that is classified as a Major Class II Highway. It extends from Ocean Avenue in Santa Monica on the west to Grand Avenue in Downtown Los Angeles on the east. In the study area, it generally has two full-time travel lanes in each direction, with the parking lane used as a travel lane

during peak periods in many locations. Dedicated left-turn lanes are provided at most intersections.

- Olympic Boulevard – Olympic Boulevard is a major east/west arterial that is classified as a Major Class II Highway. It extends from 5th Street in Santa Monica on the west to Downtown Los Angeles and further on the east. In the study area, it generally has two to three full-time travel lanes in each direction, with the parking lane used as a travel lane during peak periods in some locations. Dedicated left-turn lanes are provided at most intersections.
- Pico Boulevard – Pico Boulevard is a major east/west arterial that is classified as a Major Class II Highway. It extends from Ocean Avenue in Santa Monica on the west to Central Avenue in Downtown Los Angeles on the east. In the study area, it generally has two full-time travel lanes in each direction, with the parking lane used as a travel lane during peak periods in many locations. Dedicated left-turn lanes are provided at most intersections.

Major North/South Arterials (Listed from East to West)

- Western Avenue – Western Avenue is a major north/south arterial that is classified as a Major Class II Highway. It extends from Los Feliz Boulevard on the north to San Pedro on the south. In the study area, it generally has two travel lanes in each direction. Dedicated left-turn lanes are provided at major intersections.
- Crenshaw Boulevard – Crenshaw Boulevard is a major north/south arterial that is classified as a Major Class II Highway. It extends from Wilshire Boulevard on the north to the City of Rancho Palos Verdes on the south. In the study area, it generally has two travel lanes in each direction. Dedicated left-turn lanes are provided at most major intersections.
- La Brea Avenue – La Brea Avenue is a major north/south arterial that is classified as a Major Class II Highway. It extends from Hollywood Boulevard on the north to Century Boulevard on the south. In the study area, it generally has two full-time travel lanes in each direction, with the parking lane used as a travel lane during peak periods in many locations. Dedicated left-turn lanes are provided at most intersections.
- Fairfax Avenue – Fairfax Avenue is a major north/south arterial that is classified as a Major Class II Highway north of Melrose Avenue, and Secondary Highway south of Melrose Avenue. It extends from Hollywood Boulevard on the north to La Cienega Boulevard on the south. In the study area, it has one to two travel lanes in each direction. Dedicated left-turn lanes are provided at most intersections.
- La Cienega Boulevard – La Cienega Boulevard is a major north/south arterial that is classified as a Major Class II Highway. It extends from Sunset Boulevard on the north to El Segundo Boulevard on the south. In the study area, it generally has two travel lanes in each direction. Dedicated left-turn lanes are provided at most intersections.
- San Vicente Boulevard – San Vicente Boulevard is a major north/south arterial that is classified as a Major Class II Highway. It extends from Santa Monica Boulevard on the north to Venice Boulevard on the south. In the study area, it generally provides two to three travel lanes in each direction. Dedicated left-turn lanes are provided at most intersections.

- Robertson Boulevard – Robertson Boulevard is a major north/south arterial that is classified as a Secondary Highway. It extends from Santa Monica Boulevard on the north to Washington Boulevard on the south. In the study area, it generally provides one to two travel lanes in each direction. Dedicated left-turn lanes are provided at most intersections.
- Beverly Glen Boulevard – Beverly Glen Boulevard is a major north/south arterial classified as a Secondary Highway north of Wilshire Boulevard and Major Class II Highway south of Wilshire Boulevard. It extends from Ventura Boulevard on the north to Pico Boulevard on the south. In the study area, it generally provides one to two travel lanes in each direction. Dedicated left-turn lanes are provided at most intersections.
- Westwood Boulevard – Westwood Boulevard is a major north/south arterial that is classified as a Major Class II Highway north of Santa Monica Boulevard, and Secondary Highway south of Santa Monica Boulevard. It extends from Le Conte Avenue and the UCLA campus on the north to just south of National Boulevard. In the study area, it generally has two travel lanes in each direction. Dedicated left-turn lanes are provided at most intersections.
- Sepulveda Boulevard – Sepulveda Boulevard is a major north/south arterial that is classified as a Major Class II Highway. It extends from the San Fernando Valley on the north to the City of Manhattan Beach on the south. In the study area, it generally has two travel lanes in each direction. Dedicated left-turn lanes are provided at most intersections.
- Bundy Drive – Bundy Drive is a north/south arterial. In the City of Los Angeles, it is classified as a Collector north of Wilshire Boulevard and Secondary Highway south of Wilshire Boulevard. It extends from the hills above Sunset Boulevard on the north to Centinela Avenue on the south. In the study area, it generally has one to two travel lanes in each direction. Dedicated left-turn lanes are provided at most major intersections.
- Lincoln Boulevard – Lincoln Boulevard is a major north/south arterial that is classified as a Major Class II Highway. It extends from San Vicente Boulevard in Santa Monica on the north to Sepulveda Boulevard on the south. In the study area, it generally has two travel lanes in each direction. Dedicated left-turn lanes are provided at most intersections.

5.1.1.3 Pedestrian Volumes

High pedestrian activity (established as peak hour volumes of 500 or more pedestrians crossing a study intersection) was observed around these potential station locations:

- Wilshire/Fairfax
- Wilshire/Beverly
- Century City
- Wilshire/4th
- Santa Monica/La Brea
- Santa Monica/Fairfax
- Santa Monica/San Vicente
- Beverly Center

Overall, the highest levels pedestrian activity was recorded in the Westwood station area, followed by Beverly Hills and downtown Santa Monica. Pedestrian activity was also significant along the Santa Monica corridor in West Hollywood.

5.1.2 Level of Service

The commonly accepted operational analysis methodology from 2000 Highway Capacity Manual (HCM) (Transportation Research Board, 2000)was used to estimate delay and corresponding LOS at each study intersection. The operations analysis methodology rates intersection conditions based on the average delay, measured in seconds, experienced by drivers.

LOS is a qualitative measure used to describe the condition of traffic flow, ranging from LOS A (free flow conditions) to LOS F (congested conditions), with LOS E representing theoretical capacity. Table 5-1 provides LOS definitions for signalized intersections using the HCM methodology. Weekday a.m. and p.m. peak hours were selected for analysis because they represent the most critical periods of traffic congestion in the study area, compared to other time periods such as weekday or weekend midday. The LOS definitions and ranges of delay shown in the following table represent average conditions for all vehicles at an intersection across an entire hour. Delays longer than the average condition are experienced by motorists on certain movements and/or during peak times within the peak hour.

Generally, the minimum acceptable LOS for any intersection in an urbanized area is LOS D. Because the study area is in an urbanized area, LOS D will serve as the minimum acceptable standard for the Westside Sunway Extension.

5.1.3 Alternative 1 –Westwood/UCLA Extension

Construction impacts on transportation would involve traffic, transit, and pedestrian movements primarily along Wilshire Boulevard, from Western Avenue (current terminus of the Metro Purple Line) to the general vicinity of Westwood Boulevard. In addition to being one of the major travel corridors in the study area, Wilshire Boulevard is a major transit link that includes Metro Rapid bus service and a future dedicated bus lane.

High levels of boarding activities take place along the affected portions of Wilshire Boulevard, including station locations such as Fairfax Avenue, Century City, and Westwood Boulevard. In Westwood, affected transit operations include buses operated by Metro, Santa Monica Transit Big Blue Bus, Culver City Bus, and the UCLA Campus Shuttle. Pedestrian and bicycle movements could be affected at bus stops, street crossings, and along portions of streets affected by construction.

5.1.4 Alternative 2 – Westwood/VA Hospital Extension

Construction impacts on transportation would include those identified in Section 5.1.1 plus those occurring west of the Westwood/UCLA station area. Added items include general traffic, transit, and pedestrian movements between the general vicinity of Westwood Boulevard and the VA Hospital just west of I-405. In addition to Wilshire Boulevard traffic, construction impacts could involve I-405 ramps. Added transit impacts would involve Metro bus operations on Wilshire Boulevard near the Veterans Hospital. Pedestrian and bicycle movements could be affected at bus stops, street crossings, and along portions of streets affected by construction.

Table 5-1: Level of Service Definitions for Signalized Intersections

Level of Service	Control Delay (seconds/vehicle)	Interpretation*
A	<10.0	This level of service occurs when progression is extremely favorable and most vehicles arrive during the green phase. Most vehicles do not stop at all. Short cycle lengths may also contribute to low density.
B	>10.0 and <20.0	This level generally occurs with good progression, short cycle lengths, or both. More vehicles stop than with LOS A, causing higher levels of average delay.
C	>20.0 and <35.0	These higher delays may result from fair progression, longer cycle lengths, or both. Individual cycle failures may begin to appear at this level. The number of vehicles stopping is significant at this level, though many still pass through the intersection without stopping.
D	>35.0 and <55.0	At level D, the influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression, long cycle lengths, or high volume-to-capacity ratios. Many vehicle stop, and the proportion of vehicles not stopping declines. Individual cycle failures are noticeable.
E	>55.0 and <80.0	This level is considered by many agencies to be the limit of acceptable delay. These high delay values generally indicate poor progression, long cycle lengths, and high volume-to-capacity ratios. Individual cycle failures are frequent occurrences.
F	>80.0	This level, considered unacceptable by most drivers, often occurs with oversaturation; that is, when arrivals flow rates exceed the capacity of the intersection. It may also occur at high volume-to-capacity ratios below 1.0 with many individual cycle failures. Poor progression and long cycle lengths may also be major contributing causes to such delay levels.

Source: Highway Capacity Manual, Transportation Research Board, 2000.
*Level of service interpretation was derived from Highway Capacity Manual 1994, Transportation Research Board, 1994.

5.1.5 Alternative 3 – Santa Monica Extension

Construction impacts on transportation would include those identified in Section 5.1.2 plus those occurring west of the VA Hospital station area. Added items include general traffic, transit, and pedestrian movements between the vicinity of the VA Hospital and Santa Monica (Wilshire Boulevard and Fourth Street). Added transit impacts would involve Metro and Santa Monica Transit Big Blue Bus service on Wilshire Boulevard. Pedestrian and bicycle movements could be affected at bus stops, street crossings, and along portions of streets affected by construction.

5.1.6 Alternative 4 – Westwood/VA Hospital Extension plus West Hollywood Extension

Construction impacts on transportation would include those identified in Section 5.1.2 plus impacts on transportation between the existing Hollywood/Highland Station and the general vicinity of Wilshire Boulevard and La Cienega Boulevard. Both Wilshire Boulevard and Santa Monica Boulevard would be affected by construction-related impacts. In West

Hollywood, construction impacts would also affect Metro and West Hollywood City Line/Dayline bus operations. Pedestrian and bicycle movements could be affected at bus stops, street crossings, and along portions of streets affected by construction.

5.1.7 Alternative 5 – Santa Monica Extension plus West Hollywood Extension

Alternative 5 incorporates extensions to Santa Monica as well as West Hollywood. Traffic-related impacts would include involve Wilshire Boulevard and Santa Monica Boulevard. Large segments of Wilshire Boulevard would be affected by construction in several station areas between Western Avenue and Fourth Street in Santa Monica. Traffic on Santa Monica Boulevard would be affected between La Brea Avenue and La Cienega Boulevard and potentially in Century City, depending on the final decision for a station location.

Bus routes operated by Metro, the Santa Monica Big Blue Bus, Culver City Bus, and West Hollywood City Line/Dayline would be affected by construction. Pedestrian and bicycle movements could be affected at bus stops, street crossings, and along portions of streets affected by construction.

5.1.8 MOS 1 – Fairfax Station Terminus

Traffic impacts under MOS 1 will involve station locations along Wilshire Boulevard between Western Avenue and Fairfax Avenue, including Crenshaw (optional) and La Brea. Metro bus service pedestrian and bicycle access along Wilshire Boulevard at these station areas would also be affected.

5.1.9 MOS 2 – Century City Station Terminus

Traffic impacts under MOS 2 will involve station locations identified in Section 5.1.6 plus station areas in the vicinity of La Cienega Boulevard, Rodeo Drive, and Century City. Traffic impacts primarily invoke Wilshire Boulevard, but, depending on the selected station in Century City, impacts could also include Santa Monica Boulevard. Construction impacts would affect Metro bus service on Wilshire Boulevard and potentially Santa Monica Boulevard. Pedestrian and bicycle movements could be affected at bus stops, street crossings, and along portions of streets affected by construction.

5.2 Air Quality

This section presents methodology and preliminary calculations for determining potential emissions, gas, and odor impacts related to tunneling in Known gassy or potentially gassy areas. The analysis is based on existing available data and information from other projects constructed in the project area. The analysis focuses on potential air emissions and odors associated with gas releases along the alignment between the Wilshire/Western and Wilshire/La Cienega Stations. Air pollutant emissions from construction activity include those associated with the slurry treatment plant, tunneling, removal, and transport of soils for disposal, station construction, and workers' travel.

"Air Pollution" is a general term that refers to one or more chemical substances that degrade the quality of the atmosphere. Individual air pollutants degrade the atmosphere by reducing visibility, damaging property, reducing the productivity or vigor of crops or natural vegetation, and/or reducing human or animal health. Air quality is a term used to describe the amount of air pollution the public is exposed to.

Air quality in the United States is governed by the Federal Clean Air Act (CAA) and is administered by the U.S. Environmental Protection Agency (USEPA). In addition to being subject to the requirements of the CAA, air quality in California is also governed under the California Clean Air Act (CCAA).

The CCAA, as amended in 1992, requires all air districts in the State to endeavor to achieve and maintain State Ambient Air Quality Standards. The California Air Resources Board (CARB) administers the CCAA statewide. A brief description of these and other involved agencies are described below, as is the CAA.

5.2.1 U.S. Environmental Protection Agency

The USEPA is responsible for establishing the National Ambient Air Quality Standards and enforcing the Clean Air Act, and regulates emission sources, such as aircraft, ships, and certain types of locomotives, under the exclusive authority of the federal government. The USEPA also has jurisdiction over emission sources outside state waters (e.g., beyond the outer continental shelf) and establishes various emission standards, including those for vehicles sold in states other than California. Automobiles sold in California must meet the stricter emission standards established by CARB. For additional information about the USEPA, the reader can contact its general internet address found at www.epa.gov. Additional information on the activities of USEPA Region IX, which includes California, can be found at www.epa.gov/region9. Finally, additional information on the activities of USEPA's Office of Mobile Sources can be found at www.epa.gov/omswww/mshome.htm.

5.2.2 California Air Resources Board

CARB, which became part of the California Environmental Protection Agency (CalEPA) in 1991, is responsible for ensuring implementation of the CCAA, meeting state requirements of the CAA, and establishing State Ambient Air Quality Standards. It is also responsible for setting emission standards for vehicles sold in California and for other emission sources such as consumer products and certain off-road equipment. CARB also established passenger vehicle fuel specifications. The internet address for CalEPA is www.calepa.cahwet.gov; the address for CARB is www.arb.ca.gov.

CARB also oversees the functions of local air pollution control districts and air quality management districts, which in turn administer air quality activities at the regional and county level. The CCAA is administered by CARB at the state level and by the Air Quality Management Districts at the regional level.

5.2.3 South Coast Air Quality Management District

The South Coast Air Quality Management District (SCAQMD) was created to protect the public from the harmful effects of air pollution, achieve and maintain air quality standards, foster community involvement, and develop and implement cost-effective programs meeting state and federal mandates, considering environmental and economic impacts.

Specifically, the SCAQMD is responsible for monitoring air quality and planning, implementing, and enforcing programs designed to attain and maintain state and federal ambient air quality standards in the district. Programs developed include air quality rules and regulations that regulate stationary source emissions, including area sources and point sources and certain mobile source emissions. The SCAQMD is also responsible for establishing permitting requirements for stationary sources and ensuring that new, modified, or relocated stationary sources do not create net emissions increases and, therefore, are consistent with the region's air quality goals. The SCAQMD enforces air quality rules and regulations through a variety of means, including inspections, educational or training programs, or fines, when necessary.

5.2.4 Clean Air Act Amendments of 1990

The Clean Air Act Amendments of 1990 (CAAA) direct the USEPA to implement environmental policies and regulations that will ensure acceptable levels of air quality. Under the CAAA, a project cannot:

Cause or contribute to any new violation of any National Ambient Air Quality Standards (NAAQS) in any area

- Increase the frequency or severity of any existing violation of any NAAQS in any area
- Delay timely attainment of any NAAQS or any required interim emission reductions or other milestones in any area

5.2.5 National and State Ambient Air Quality Standards

As required by the Clean Air Act, NAAQS have been established for six major air pollutants. These pollutants are: carbon monoxide, nitrogen dioxide, ozone, particulate matter (PM10 and PM2.5), sulfur dioxide, and lead. The State of California has also established ambient air quality standards, known as the California Ambient Air Quality Standards (CAAQS). These standards are generally more stringent than the corresponding federal standards and incorporate additional standards for sulfates, hydrogen sulfide, vinyl chloride, and visibility reducing particles.

State and federal standards are summarized in Table 5-2. The "primary" standards have been established to protect the public health. The "secondary" standards are intended to protect the nation's welfare and account for air pollutant effects on soil, water, visibility, materials, vegetation, and other aspects of the general welfare.

5.2.6 Existing Conditions

5.2.6.1 Local Meteorology

The surrounding atmosphere is an important element in assessing an area's ambient air quality. The study area is located in the South Coast Air Basin (SCAB), which includes all of Los Angeles and Orange counties, as well as portions of Riverside and San Bernardino counties.

The SCAB is bordered by the Pacific Ocean to the west and the San Bernardino mountains to the east. Prevailing winds in the SCAB are mainly out of the west. These prevailing winds are due to the proximity of the SCAB to the coast and the blocking nature of the San Bernardino Mountains to the east; air masses pushed onshore into the basin are often trapped by the San Bernardino Mountains.

During the summer the SCAB is generally influenced by a Pacific Subtropical High cell that sits off the coast, inhibiting cloud formation and encouraging daytime solar heating. The SCAB is rarely influenced by cold air masses moving south from Canada and Alaska, as these frontal systems are weak and diffuse by the time they reach the basin. The SCAB is classified as a dry-hot desert climate.

5.2.6.2 Local Monitored Air Quality

The South Coast air pollutant levels are measured at monitoring stations that CARB maintains. The monitoring stations nearest the project study area are located in Los Angeles at Veterans Hospital and North Main Street. The last three years of available monitored data for these locations are summarized in Table 5-3 to illustrate the study area's general air quality trends. Detailed monitored data is located in Appendix A.

Table 5-2: State and Federal Air Quality Standards

Ambient Air Quality Standards

Pollutant	Averaging Time	California Standards [1]		Federal Standards [2]		
		Concentration [3]	Method [4]	Primary [3,5]	Secondary [3,6]	Method [7]
Ozone (O_3)	1 Hour	0.09 ppm (180 $\mu g/m^3$)	Ultraviolet Photometry	—	Same as Primary Standard	Ultraviolet Photometry
	8 Hour	0.070 ppm (137 $\mu g/m^3$)		0.075 ppm (147 $\mu g/m^3$)		
Respirable Particulate Matter (PM10)	24 Hour	50 $\mu g/m^3$	Gravimetric or Beta Attenuation	150 $\mu g/m^3$	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	20 $\mu g/m^3$		—		
Fine Particulate Matter (PM2.5)	24 Hour	No Separate State Standard		35 $\mu g/m^3$	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	12 $\mu g/m^3$	Gravimetric or Beta Attenuation	15.0 $\mu g/m^3$		
Carbon Monoxide (CO)	8 Hour	9.0 ppm (10mg/m^3)	Non-Dispersive Infrared Photometry (NDIR)	9 ppm (10 mg/m^3)	None	Non-Dispersive Infrared Photometry (NDIR)
	1 Hour	20 ppm (23 mg/m^3)		35 ppm (40 mg/m^3)		
	8 Hour (Lake Tahoe)	6 ppm (7 mg/m^3)		—	—	—
Nitrogen Dioxide (NO_2)	Annual Arithmetic Mean	0.030 ppm (57 µg/m3)	Gas Phase Chemiluminescence	0.053 ppm (100 $\mu g/m^3$)	Same as Primary Standard	Gas Phase Chemiluminescence
	1 Hour	0.18 ppm (339 $\mu g/m^3$)		0.100 ppm (see footnote 8)	None	
Sulfur Dioxide (SO_2)	Annual Arithmetic Mean	—	Ultraviolet Fluorescence	0.030 ppm (80 $\mu g/m^3$)	—	Spectrophotometry (Pararosaniline Method)
	24 Hour	0.04 ppm (105 $\mu g/m^3$)		0.14 ppm (365 $\mu g/m^3$)	—	
	3 Hour	—		—	0.5 ppm (1300 $\mu g/m^3$)	
	1 Hour	0.25 ppm (655 $\mu g/m^3$)		—	—	—
Lead[9]	30 Day Average	1.5 $\mu g/m^3$	Atomic Absorption	—	—	—
	Calendar Quarter	—		1.5 $\mu g/m^3$	Same as Primary Standard	High Volume Sampler and Atomic Absorption
	Rolling 3-Month Average[10]	—		0.15 $\mu g/m^3$		
Visibility Reducing Particles	8 Hour	Extinction coefficient of 0.23 per kilometer — visibility of ten miles or more (0.07 — 30 miles or more for Lake Tahoe) due to particles when relative humidity is less than 70 percent. Method: Beta Attenuation and Transmittance through Filter Tape.		No Federal Standards		
Sulfates	24 Hour	25 $\mu g/m^3$	Ion Chromatography			
Hydrogen Sulfide	1 Hour	0.03 ppm (42 $\mu g/m^3$)	Ultraviolet Fluorescence			
Vinyl Chloride[9]	24 Hour	0.01 ppm (26 $\mu g/m^3$)	Gas Chromatography			

See footnotes on next page ...

For more information please call ARB-PIO at (916) 322-2990 California Air Resources Board (02/16/10)

1. California standards for ozone, carbon monoxide (except Lake Tahoe), sulfur dioxide (1 and 24 hour), nitrogen dioxide, suspended particulate matter—PM10, PM2.5, and visibility reducing particles, are values that are not to be exceeded. All others are not to be equaled or exceeded. California ambient air quality standards are listed in the Table of Standards in Section 70200 of Title 17 of the California Code of Regulations.

2. National standards (other than ozone, particulate matter, and those based on annual averages or annual arithmetic mean) are not to be exceeded more than once a year. The ozone standard is attained when the fourth highest eight hour concentration in a year, averaged over three years, is equal to or less than the standard. For PM10, the 24 hour standard is attained when the expected number of days per calender year with a 24-hour average concentration above 150 $\mu g/m^3$ is equal to or less than one. For PM2.5, the 24 hour standard is attained when 98 percent of the daily concentrations, averaged over three years, are equal to or less than the standard. Contact U.S. EPA for further clarification and current federal policies.

3. Concentration expressed first in units in which it was promulgated. Equivalent units given in parentheses are based upon a reference temperature of 25°C and a reference pressure of 760 torr. Most measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 torr; ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.

4. Any equivalent procedure which can be shown to the satisfaction of the ARB to give equivalent results at or near the level of the air quality standard may be used.

5. National Primary Standards: The levels of air quality necessary, with an adequate margin of safety to protect the public health.

6. National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

7. Reference method as described by the EPA. An “equivalent method” of measurement may be used but must have a “consistent relationship to the reference method” and must be approved by the EPA.

8. To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 0.100 ppm (effective January 22, 2010).

9. The ARB has identified lead and vinyl chloride as 'toxic air contaminants' with no threshold level of exposure for adverse health effects determined. These actions allow for the implementation of control measures at levels below the ambient concentrations specified for these pollutants.

10. National lead standard, rolling 3-month average: final rule signed October 15, 2008.

For more information please call ARB-PIO at (916) 322-2990 **California Air Resources Board (02/16/10)**

Table 5-3: Air Pollutant Levels at CARB Monitoring Stations Near the Study Area

Air Pollutant	Standard/ Exceedance**	Veterans Hospital West Los Angeles			North Main Street Los Angeles		
		2006	2007	2008	2006	2007	2008
Carbon Monoxide (CO)	Year Coverage*	99%	94%	96%	95%	95%	97%
	Max. 1-hour Concentration (ppm)	2.9	2.7	2.7	3.5	3.2	2.9
	Max. 8-hour Concentration (ppm)	2.0	1.96	1.76	2.68	2.15	1.96
	# Days>Federal 1-hour Std. of >35 ppm	0	0	0	0	0	0
	# Days>Federal 8-hour Std. of >9 ppm	0	0	0	0	0	0
	# Days>California 8-hour Std. of >9.0 ppm	0	0	0	0	0	0
Ozone (O3)	Year Coverage*	98%	98%	96%	98%	97%	96%
	Max. 1-hour Concentration (ppm)	0.099	0.117	0.111	0.108	0.115	0.109
	Max. 8-hour Concentration (ppm)	0.074	0.088	0.097	0.079	0.103	0.090
	# Days>Federal 8-hour Std. Of >0.075 ppm	0	2	2	3	3	3
	# Days>California 1-hour Std. Of >0.09 ppm	3	2	3	8	3	3
	# Days>California 8-hour Std. Of >0.07 ppm	2	2	8	7	6	6
Nitrogen Dioxide (NO2)	Year Coverage*	94%	93%	96%	97%	96%	95%
	Max. 1-hour Concentration (ppm)	0.078	0.082	0.090	0.111	0.104	0.122
	Annual Average (ppm)	0.017	0.019	0.018	0.029	0.030	0.027
	# Days>California 1-hour Std. of >0.18 ppm	0	0	0	0	0	0
Sulfur Dioxide (SO2)	Year Coverage*	NM	NM	NM	99%	90%	96%
	Max. 24-hour Concentration (ppm)	NM	NM	NM	0.006	0.005	0.003
	Annual Average (ppm)	NM	NM	NM	0.001	0.000	0.000
	# Days>Federal 24-hour Std. of >0.14 ppm	NM	NM	NM	0	0	0
Suspended Particulates (PM10)	Year Coverage*	NM	NM	NM	95%	93%	79%
	Max. 24-hour Concentration (µg/m3)	NM	NM	NM	59.0	78.0	66.0
	#Days>Fed. 24-hour Std. of>150 µg/m3	NM	NM	NM	0	0	0
	#Days>California 24-hour Std. of>50 µg/m3	NM	NM	NM	3	5	2
	State Annual Average (µg/m3)	NM	NM	NM	30.1	33.0	NA
Suspended Particulates (PM2.5)	Year Coverage*	NM	NM	NM	90%	86%	88%
	Max. 24-hour Concentration (µg/m3)	NM	NM	NM	56.2	64.1	78.3
	State Annual Average (µg/m3)	NM	NM	NM	16.0	NA	16.2
	#Days>Fed. 24-hour Std. of>35 µg/m3	NM	NM	NM	11	20	10
	National Annual Average (µg/m3)	NM	NM	NM	15.5	16.7	15.9
Lead	Maximum Monthly Concentration (µg/m3)	NM	NM	NM	NM	NM	NM
	# Months Exceeding Federal Std.	NM	NM	NM	NM	NM	NM
	# Months Exceeding State Std.	NM	NM	NM	NM	NM	NM
Sulfates	Max. 24-hour Concentration (µg/m3)	NM	NM	NM	NM	NM	NM
	#Samples>California 24-hour Std.>=25 µg/m3	NM	NM	NM	NM	NM	NM

Sources: California Air Resources Board, 2010: http://www.arb.ca.gov/adam/welcome.html. EPA AIRSData (for 1-Hour CO only): http://www.epa.gov/air/data/geosel.html

NM = not measured; NA = not applicable

*Year Coverage indicates how extensive monitoring was during the time of year when high pollutant concentrations were expected.

**The number of days above the standard is not necessarily the number of violations of the standard for the year.

5.2.7 Alternative 1 – Westwood/UCLA Extension

The segment between the Wilshire/Western and Wilshire/La Cienega Stations is located in an area known to have pockets of subterranean methane and hydrogen sulfide gas. The geotechnical evaluation discussed above, included detailed information on gas concentrations in the project area and potential mitigation measures.

Because of the presence of methane, the City of Los Angeles has implemented special building code provisions for Methane Zones (having more restrictive mitigation requirements) and Methane Buffer Zones (having less restrictive mitigation requirements). Boundaries of the Methane Zone and Methane Buffer Zone within the City of Los Angeles portion of the project area are shown in the Geotechnical and Hazardous Materials Technical Report (Metro, 2010).

As discussed in the Geotechnical and Hazardous Materials Technical Report (Metro, 2010), in some areas of the project corridor near the La Brea tar pits, methane concentrations can be 90 – 100 percent by volume. Methane is a flammable, colorless, odorless gas that is an explosion hazard when mixed with air at concentrations exceeding 5 percent and less than 35 percent. Methane is non-toxic. However, methane can reduce the amount of oxygen in the air necessary to support life. Exposure to oxygen-deficient atmospheres (less than 19.5 percent) may produce dizziness, nausea, vomiting, loss of consciousness, and death. At very low oxygen concentrations (less than 12 percent), unconsciousness and death may occur without warning. It should be noted that before suffocation could occur, the lower flammable limit for methane in the air will have to be exceeded causing both an oxygen-deficient and an explosive atmosphere. Project-related methane impacts will be thoroughly discussed in the hazard analyses during the future conceptual and preliminary engineering phases because methane is mainly an explosive risk.

Methane is also a greenhouse gas that remains in the atmosphere for approximately 9 to 15 years. Methane is over 20 times more effective in trapping heat in the atmosphere than carbon dioxide over a 100-year period. It is emitted from a variety of natural and human-influenced sources, including landfills, natural gas and petroleum systems, agricultural activities, coal mining, stationary and mobile combustion, wastewater treatment, and certain industrial process.

The Geotechnical and Hazardous Materials Technical Report (*Metro, 2010)*, indicates that hydrogen sulfide concentrations can be as high as 1000 parts per million (ppm). One such measurement at this level was taken east of Curson Avenue and Wilshire Boulevard. All other measurements were less than 160 ppm, ranging from not detected (0) to 160 ppm between Wilshire and Western Boulevards and Crescent Heights, at the measurement locations. Hydrogen sulfide is a toxic, flammable, and colorless gas that poses an immediate fire and explosion hazard when mixed with air at concentrations exceeding 4 percent. Hydrogen sulfide has a distinct “rotten-egg” smell. Continuous inhalation of hydrogen sulfide can cause deadening of the sense of smell, dizziness, headache, nausea, and respiratory tract irritation. Because hydrogen sulfide can deaden the sense of smell, odor may not be an effective warning of the presence of hydrogen sulfide. Exposure to hydrogen sulfide concentrations greater than 500 ppm can result in respiratory arrest, coma, unconsciousness, and death. Therefore, avoiding fatal hydrogen sulfide gas concentrations will be the primary project-related safety issue.

Preliminary safety procedures related to hydrogen sulfide gas follow the Cal/OSHA procedures described in Section 4.0.

5.2.8 Alternative 2 – Westwood/VA Hospital Extension

Existing conditions for Alternative 2 are the same as Alternative 1. (Refer to Section 5.2.2 Alternative 1 – Westwood/UCLA Extension).

5.2.9 Alternative 3 – Santa Monica Extension

Existing conditions for Alternative 3 are the same as Alternative 1. (Refer to Section 5.2.2 Alternative 1 – Westwood/UCLA Extension).

5.2.10 Alternative 4 – Westwood/VA Hospital Extension plus West Hollywood Extension

Existing conditions for Alternative 4 are the same as Alternative 1. (Refer to Section 5.2.2 Alternative 1 – Westwood/UCLA Extension).

5.2.11 Alternative 5 – Santa Monica Extension plus West Hollywood Extension

Existing conditions for Alternative 5 are the same as Alternative 1. (Refer to Section 5.2.2 Alternative 1 – Westwood/UCLA Extension).

5.2.12 MOS 1 – Fairfax Station Terminus

Existing conditions for MOS 1 are the same as Alternative 1. (Refer to Section 5.2.2 Alternative 1 – Westwood/UCLA Extension).

5.2.13 MOS 2 – Century City Station Terminus

Existing conditions for MOS 2 are the same as Alternative 1. (Refer to Section 5.2.2 Alternative 1 – Westwood/UCLA Extension).

5.2.14 Maintenance and Operation Facility Sites

Existing conditions for Maintenance and Operation Facility Sites are the same as Alternative 1. (Refer to Section 5.2.2 Alternative 1 – Westwood/UCLA Extension).

5.3 Noise and Vibration

5.3.1 Existing Conditions – Noise Environment

The project alignment is located within the urbanized sections of four cities: Beverly Hills, Los Angeles, West Hollywood, and Santa Monica. The acoustical environment of these urban areas is dominated by typical urban noise sources, such as roadway traffic, aircraft, and activities on commercial and industrial land uses. Existing noise levels along the route are described in the Noise and Vibration Technical Report (Metro, 2010). The noise elements of three of the four communities through which this project is proposed to travel contain additional information regarding the existing levels of noise in the area. This information is summarized below.

The noise contours for the City of Beverly Hills are presented in Figure 5-1. This exhibit presents the 60 dBA, 65 dBA, and 70 dBA CNEL noise levels from the primary arterials within the City for the year 2005. The noise contours for the City of Santa Monica are presented in Figure 5-2. This exhibit presents the 60 dBA and 65 dBA CNEL noise levels from the primary arterials within the City for the year 2000.

The City of Los Angeles' noise ordinance contains a table that lists the ambient noise levels presumed for several land use zones for both the daytime and nighttime hours of the day. These noise levels are presented in Table 5-4. Additional noise levels presented in Figure 5-3 show a noise thermometer of typical environmental noise levels for both the exterior and interior noise sources.

Table 5-4: City of Los Angeles Presumed Ambient Noise Levels

Land Use Zone	Presumed Noise Levels (dBA, Leq)	
	Daytime (7:00 a.m. to 10:00 p.m.)	Nighttime (10:00 p.m. to 7:00 a.m.)
Residential	50	40
Commercial	60	55
Light Industrial	65	65
Heavy Industrial	70	70

Source: Los Angeles Municipal Code, Chapter 11, Section 111.02

Based on the above table and other measurements of existing conditions along the route,[27] the urban environment in the project area experiences noise levels ranging from 60 to 70 dBA CNEL. It is expected that the majority of the properties along project alignment currently experience ambient noise levels within this range. The less urban areas that are further away from the primary roadways along the alignment will experience lower levels than those shown, with a typical reduction of 3 dB per doubling of distance due to geometric spreading of acoustical energy. The areas closest to the busiest intersections will experience noise levels greater than those shown.

[27] See for example Santa Monica, 2004.

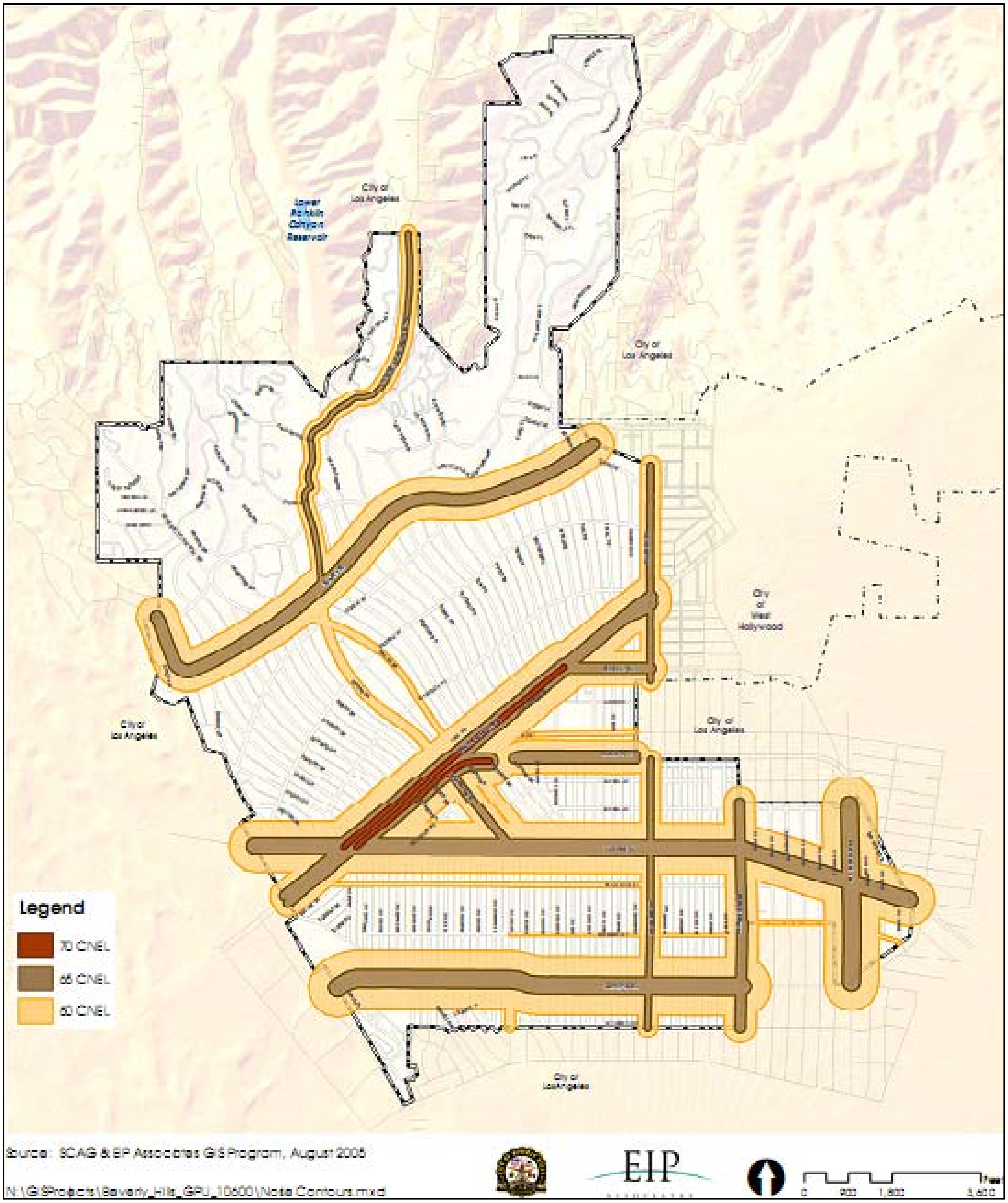


Figure 5-1. City of Beverly Hills – Existing (2005) Roadway Noise Contours

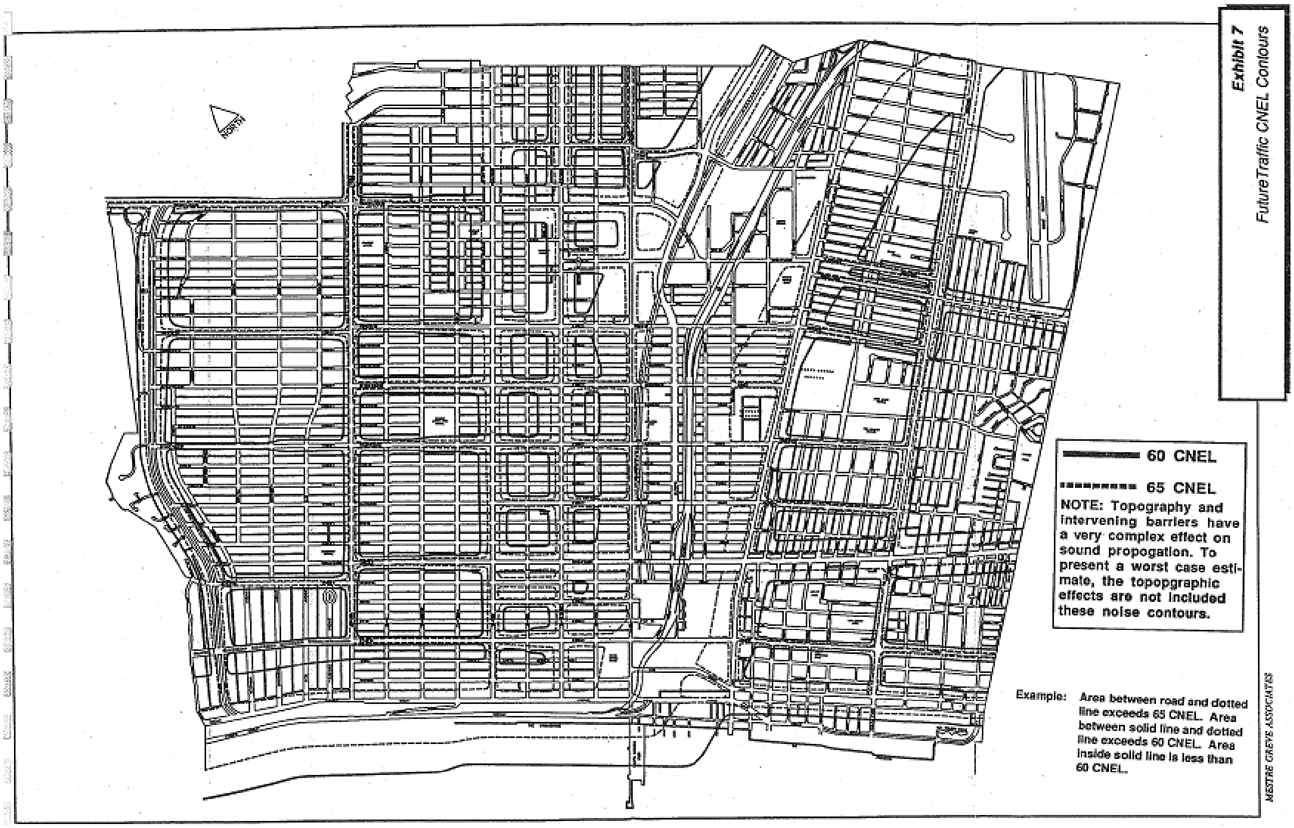
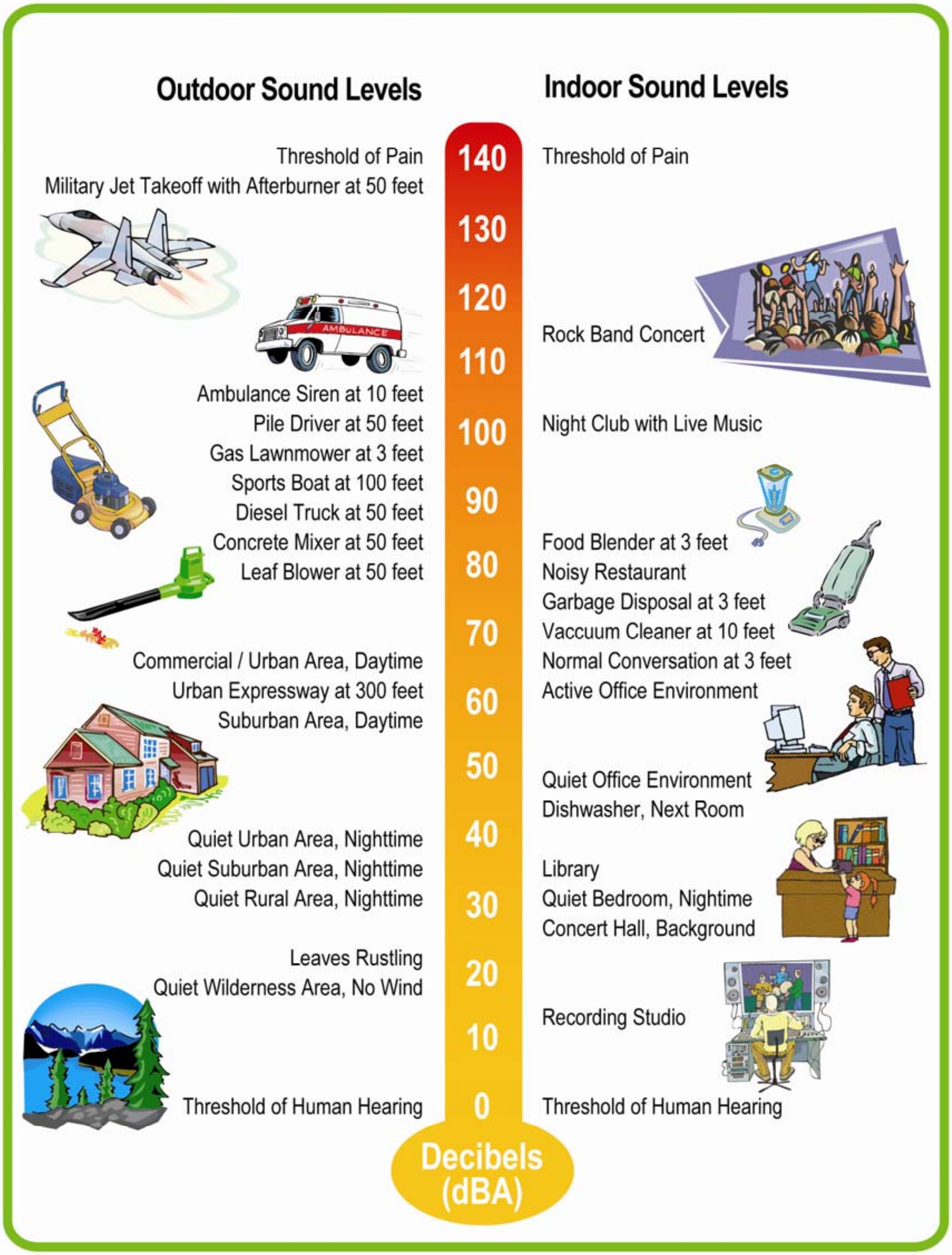


Figure 5-2: City of Santa Monica Future (2000) Roadway Noise



Source: URS Corporation, 2008

Figure 5-3: Typical Outdoor and Indoor Noise Levels (dBA)

5.3.2 Alternative 1 – Westwood/UCLA Extension

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

- 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. 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 use along the proposed station is office buildings and parking lots. Single-family residential land uses are located behind the office buildings on both side of Wilshire Boulevard. An Ldn of 74 dBA and a peak noise-hour Leq (h) of 74 dBA as measured at this location.
- 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. This apartment building is the closest category B land use to the proposed station location. The remaining land use along the proposed station is retail, service stores and parking lots. Single-family residential land uses are located behind the retail and service stores on both side of Wilshire Boulevard. An Ldn of 67 dBA and a peak noise hour Leq (h) of 67 dBA as measured at this location.
- 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. Residential land uses on Orange Street are the closest category B land use to the proposed station location. The first row land use along the proposed station is retail, service stores and parking lots. Single-family residential land uses are located behind the retail and service stores on both side of Wilshire Boulevard. An Ldn of 76 dBA and a peak noise hour Leq (h) of 73 dBA as measured at this location.
- 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 proposed station location. The first row land use along the proposed station is retail, two restaurants, one movie theatre, one gas station, and office buildings. Single-family residential land uses are located in behind the first row land uses on both side of Wilshire Boulevard. An Ldn of 71 dBA and a peak noise hour Leq (h) of 78 dBA as measured at this location.
- Wilshire/ Rodeo Station—Noise levels were measured for 24 hours at 120 Canon Drive south of Wilshire Boulevard. This is located in the behind the retail and office buildings that front the proposed station location. The first row land use along the proposed station is 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. A Ldn of 64 dBA and a peak noise hour Leq (h) of 66 dBA as measured at this location.
- Century City (Santa Monica Blvd)—Noise levels were measured for 24 hours at 1743 Club View Drive north of Santa Monica Boulevard. This is located in the behind the retail and office buildings that front the proposed station location. The first row land use along the proposed station is 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 in 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 Ldn of 63 dBA and a peak noise hour Leq (h) of 65 dBA as measured at this location.

- Westwood/UCLA Off-Street Station—Noise levels were measured for 24 hours north east corner at the intersection of Wilshire Boulevard and Veteran Avenue. The Veteran National Cemetery in located on the northwest corner of Wilshire Boulevard and Veteran Avenue. All other land use in the area in offices and retail stores. An Ldn of 74 dBA and a peak noise hour Leq (h) of 79 dBA as measured at this location.
- Westwood/UCLA Crossover and Tail Track—Noise levels were measured for 15 minutes in front of the Veteran Administration Hospital and compared to the 24-hour levels measured at for the Westwood/UCLA Off-Street Station. The area contains green space, a surface parking lot, and the VA Hospital. An Ldn of 60 dBA and a peak noise hour Leq (h) of 64 dBA as calculated at this location.

5.3.3 Alternative 2 – Westwood/VA Hospital Extension

In addition to the noise measurements at the stations for Alternative 1, additional existing noise levels were measured for this alternative at the following proposed station: Westwood/VA Hospital Station—Noise levels were measured for 15 minutes in front of the Veteran Administration Hospital and compared to the 24-hour levels measured at for the Westwood/UCLA Off-Street Station. The area contains green space, a surface parking lot, and the VA Hospital. An Ldn of 60 dBA and a peak noise hour Leq (h) of 64 dBA as calculated at this location.

5.3.4 Alternative 3 – Santa Monica Extension

In addition to the noise measurements at the stations for Alternative 1 and Alternative 2, additional existing noise levels were measured for this alternative at the following proposed stations:

Wilshire/Bundy Station—Noise levels were measured for 24 hours at 1224 Saltair Avenue south of Wilshire Boulevard. This is located in the behind the retail and office buildings that front the proposed station location. The first row land use along the proposed station is retail and office buildings. Single-family residential land uses are located in behind the first row land uses on both sides of Wilshire Boulevard, one hotel are located north of Wilshire Boulevard. An Ldn of 65 dBA and a peak noise hour Leq (h) of 67 dBA as measured at this location.

Wilshire/26th Station—Noise levels were measured for 24 hours at 1138 26th Street north of Wilshire Boulevard. This is located in the behind the gas station that front the proposed station location. The first row land use along the proposed station is retail buildings. Single-family residential land uses are located in 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 Ldn of 70 dBA and a peak noise hour Leq (h) of 69 dBA as measured at this location.

Wilshire/16th Station—Noise levels were measured for 24 hours at 1142 16th Street north of Wilshire Boulevard. This is located in the behind the retail and office buildings that front the proposed station location. The first row land use along the proposed station is retail buildings. Single-family residential land uses are located in behind the first row land uses on both sides of Wilshire Boulevard. An Ldn of 62 dBA and a peak noise hour Leq (h) of 61 dBA as measured at this location.

Wilshire/4th Station—Noise levels were measured for 24 hours at 1122 4th Street north of Wilshire Boulevard. This is located in the behind the retail and office buildings that front the proposed station location. The first row land use along the proposed station is retail buildings. Single-family residential land uses are located in behind the first row land uses on north sides of Wilshire Boulevard. An Ldn of 69 dBA and a peak noise hour Leq (h) of 67 dBA as measured at this location.

5.3.5 Alternative 4 – Westwood/VA Hospital Extension plus West Hollywood Extension

In addition to the noise measurements at the stations for Alternative 1 and 2, additional existing noise levels were measured for this alternative at the following proposed stations:

Hollywood/Highland—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 front Highland Avenue. Hollywood High School is located to the west of Highland Avenue. All other land use in the area in offices and retail stores. An Ldn of 69 dBA and a peak noise hour Leq (h) of 67 dBA as measured at this location.

Santa Monica/La Brea Station—Noise levels were measured for 24 hours at 7119 Detroit Street, north of Santa Monica Boulevard. The land uses along the proposed station location is retail, office space and industrial, with apartment south of Santa Monica Boulevard and West of Formosa Avenue. An Ldn of 74 dBA and a peak noise hour Leq (h) of 76 dBA as measured at this location.

Santa Monica/Fairfax Station—Noise levels were measured for 24 hours at 1050 Orange Grove Avenue, the first residential land used behind the commercial land use south of Santa Monica Boulevard. The land uses along the proposed station location is retail, office space and industrial, in front of residential land use on both sides Santa Monica Boulevard. An Ldn of 67 dBA and a peak noise hour Leq (h) of 68 dBA as measured at this location.

Santa Monica/San Vicente Station—Noise levels were measured for 24 hours at 909 Westbourne Drive, apartments located behind the commercial land use north of Santa Monica Boulevard. The land uses along the proposed station location is retail, office space and industrial, in front of residential land use on both sides Santa Monica Boulevard. An Ldn of 68 dBA and a peak noise hour Leq (h) of 65 dBA as measured at this location.

Beverly Center Station—Noise levels were measured for 24 hours at the Westbury Terrace. This is the only residential land use along the proposed station location other land use in the area are parking and retail shops. An Ldn of 73 dBA and a peak noise hour Leq (h) of 70 dBA as measured at this location.

5.3.6 Alternative 5 – Santa Monica Extension plus West Hollywood Extension

Existing noise conditions for this alternative are the same as those described in Sections 5.3.1 through 5.3.4 above.

5.3.7 MOS 1 – Fairfax Station Terminus

For MOS 1, existing noise levels were measured at the following proposed stations: Wilshire/Crenshaw Station, Wilshire/La Brea Station, and Wilshire/Fairfax Station. The noise levels for these stations are described under Alternative 1.

5.3.8 MOS 2 – Century City Station Terminus

For MOS 2, existing noise levels were measured at the following proposed stations: Wilshire/Crenshaw Station, Wilshire/La Brea Station, Wilshire/Fairfax Station, Wilshire/La Cienega Station, Wilshire/ Rodeo Station and Century City (Santa Monica Blvd). The noise levels for these stations are described under Alternative 1.

5.3.9 Station Options

Station Option 5-Westwood/UCLA On-Street Station—Noise levels were measured for 24 hours at the north-east corner of the intersection of Wilshire Boulevard and Veteran Avenue. The Veteran National Cemetery is located on the northwest corner of this intersection. 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.

Station Option 4-Century City (Constellation) Station—Noise levels were measured for 24 hours at the North-West corner at the intersection of Avenue of the Stars and Constellation Boulevard. A future condominium office is located east of this location and the Hyatt Hotel is located on the south west corner. All other land uses in the area are office buildings. An Ldn of 74 dBA and a peak noise hour Leq (h) of 78 dBA were measured at this location.

5.3.10 Maintenance and Operation Facility Sites

Existing noise conditions for the maintenance and operations facilities are similar to those described in Sections 5.3.1 through 5.3.4 above.

5.3.11 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 expected to range from 50 to 65 according to the FTA guidance manual (FTA 2006, Figure 7-3).

Additionally, in order to evaluate the vibration levels at the ground surface above the tunnels used by existing, in-service Metro Red Line subway trains, measurements of surface vibration levels were conducted and compiled in a report entitled Westside Extension Transit Corridor Study: Metro Red Line Vibration Study (Metro, 2009). This report is provided in the appendix of this DEIS/EIR. The measurements conducted during that study of areas with similar land use and community activity levels indicate that existing vibration levels at the ground surface typically ranged between 50 and 65 VdB. Some measurement locations immediately adjacent to busy streets yielded slightly higher but not perceptible vibration levels from transit bus and heavy truck pass-bys.

5.4 Utilities

Utility lines are located underneath or immediately adjacent, parallel to and across the roadways in the study area. Utility providers include municipal agencies, special utility districts, and private companies providing electricity, water, wastewater and stormwater collection, natural gas, steam, telecommunications, and cable television services.

5.4.1 Alternative 1 – Westwood/UCLA Extension

5.4.1.1 Electricity, Natural Gas, Steam, Telecommunications, and Cable Television Services

Alternative 1 includes dry utilities that will be impacted by the below structures indentified in Section 5.4 and may require temporary relocation, permanent relocation or protection in place.

5.4.1.2 Wastewater and Stormwater Collection[28]

Under Alternative 1, there are 13 existing storm drains that run underneath the proposed project alignment. A list of major utility providers is shown in Table 5-5.

[28] Westside Subway Extension - Advance Conceptual Engineering Report - Section 4.

Table 5-5: Major Utility Providers

Municipality	Providers
City of Los Angeles	Los Angeles Department of Water and Power Pacific Bell MCI Level 3 Communications Southern California Edison Southern California Gas Company Los Angeles County City Public Works Department , Sanitation Bureau Los Angeles City Public Works Department, Bureau of Street Lighting Los Angeles County Flood District
Los Angeles County	Pacific Bell Southern California Edison California Water Service Los Angeles County Sanitation District Los Angeles County Flood Control District
City of Beverly Hills	Southern California Gas Company Southern California Edison City of Beverly Hills Water Dept. City of Beverly Hills Storm Drain Dept. City of Beverly Hills Waste Water Dept. ATT
City of West Hollywood	MCI Western Union MFS Communications Level 3 Communications Water Storm Drain Waste Water
City of Santa Monica	Southern California Gas Company Southern California Edison Water Dept Storm Drain Dept Waste Water Verizon

5.4.2 Alternative 2 – Westwood/VA Hospital Extension

5.4.2.1 Electricity, Natural Gas, Steam, Telecommunications, and Cable Television Services

Alternative 2 includes dry utilities that will be impacted by the below structures indentified in Section 5.4 and may require temporary relocation, permanent relocation or protection in place.

5.4.2.2 Wastewater and Stormwater Collection

Under Alternative 2, there are 13 existing storm drains that run underneath the proposed project alignment. A list of major utility providers is shown in Table 5-5.

5.4.3 Alternative 3 – Santa Monica Extension

5.4.3.1 Electricity, Natural Gas, Steam, Telecommunications, and Cable Television Services

Alternative 3 includes dry utilities that will be impacted by the below structures indentified in Section 5.4 and may require temporary relocation, permanent relocation or protection in place.

5.4.3.2 Wastewater and Stormwater Collection

Under Alternative 3, 29 existing storm drains run underneath the proposed project alignment. A list of major utility providers is shown in Table 5-5.

5.4.4 Alternative 4 – Westwood/VA Hospital Extension plus West Hollywood Extension

5.4.4.1 Electricity, Natural Gas, Steam, Telecommunications, and Cable Television Services

Alternative 4 includes dry utilities that will be impacted by the below structures indentified in Section 5.4 and may require temporary relocation, permanent relocation or protection in place.

5.4.4.2 Wastewater and Stormwater Collection

Under Alternative 4, 20 existing storm drains run underneath the proposed project alignment. A list of major utility providers is shown in Table 5-5.

5.4.5 Alternative 5 – Santa Monica Extension plus West Hollywood Extension

5.4.5.1 Electricity, Natural Gas, Steam, Telecommunications, and Cable Television Services

Alternative 5 includes dry utilities that will be impacted by the below structures indentified in Section 5.4 and may require temporary relocation, permanent relocation or protection in place.

5.4.5.2 Wastewater and Stormwater Collection

There are 36 existing storm drains that run underneath the proposed project alignment. A list of major utility providers is shown in Table 5-5.

5.4.6 MOS 1 – Fairfax Station Terminus

5.4.6.1 Electricity, Natural Gas, Steam, Telecommunications, and Cable Television Services

MOS 1 includes dry utilities that will be impacted by the below structures indentified in Section 5.4 and may require temporary relocation, permanent relocation or protection in place.

5.4.6.2 Wastewater and Stormwater Collection

Under the MOS-1 Fairfax Station Terminus, there are 5 existing storm drains that run underneath the proposed project alignment. A list of major utility providers is shown in Table 5-5.

5.4.7 MOS 2 – Century City Station Terminus

5.4.7.1 Electricity, Natural Gas, Steam, Telecommunications, and Cable Television Services

MOS 2 includes dry utilities that will be impacted by the below structures indentified in Section 5.4 and may require temporary relocation, permanent relocation or protection in place.

5.4.7.2 Wastewater and Stormwater Collection

A list of major utility providers is shown in Table 5-5.

5.4.8 Maintenance and Operation Facility Sites

There are two Maintenance and Operations Facility Sites under consideration for the Westside Subway Extension. One site is located south of the existing Metro Purple Line/Red Line facilities between the 4th and 6th Streets Bridges along Santa Fe Avenue.

The second site includes the construction of new heavy rail yard leads from the existing Metro Purple Line/Red Line facilities along an existing rail corridor on the west bank of Los Angeles River to the Union Pacific Los Angeles Transportation Central Rail Yard located north of Metro's Central Maintenance Facility on the east side of Los Angeles River.

Utility impacts for the two Maintenance and Operations Facilities have not been identified but are not expected to be significant and will be addressed in a subsequent phase of the project.

5.5 Business Disruption

For the purpose of this evaluation of potential business disruption impacts, the affected environment is limited to the areas within one-block on either side of the alignment and in particular, the station construction areas. Information regarding business property Full Takes, Partial Takes, Permanent Easements, Temporary Construction Easements, and Permanent Underground Easements required for the project was obtained from the Real Estate-Acquisitions Technical Report (Metro, 2010). Information regarding land uses surrounding stations was obtained from the Task 14.1.02.1 Draft Land Use and Development Opportunities Report. Information regarding economic and fiscal analysis for the metropolitan area of Los Angeles was obtained from the Economic and Fiscal Impact Analysis and Mitigation Report (Metro, 2010). Table 5-6 summarizes the existing land uses (including commercial and business areas) around the proposed station areas of Alternatives 1 though 5 and MOS 1 and 2. Surrounding land uses listed are the uses that are within ¼-mile of the potential station locations, while adjacent uses are those uses located in the immediate vicinity of the station area.

Table 5-6: Existing Land Uses at Potential Station Locations

Alternative	Potential Station Location	Adjacent Land Uses	Surrounding Land Uses
1, 2, 3, 4, 5 MOS 1, 2	Wilshire Boulevard/Crenshaw Boulevard	Office, Vacant, Parking Lots, Commercial, Single- and Multi-Family Residential	Commercial, Institutional, Hotel, Vacant, Single- and Multi-Family Residential
1, 2, 3, 4, 5 MOS 1, 2	Wilshire Boulevard/La Brea Avenue	Office, Bank, Storefront Retail, Government, Church, Multi-family Residential, Parking Lots	Commercial, Institutional, Single- and Multi-Family Residential
1, 2, 3, 4, 5 MOS 1, 2	Wilshire Boulevard/Fairfax Avenue	Office, Museums, Restaurant, Storefront Retail, Multi-Family Residential	Commercial, Institutional, Open Space, Single- and Multi-Family Residential
1, 2, 3, 4, 5 MOS 2	Wilshire Boulevard/La Cienega Avenue	Office, Restaurant, Medical, Theater, Commercial, Multi-Family Residential	Commercial, Office, Single- and Multi-Family Residential, Open Space
1, 2, 3, 4, 5 MOS 2	Wilshire Boulevard/Rodeo Dr	Office, Commercial, Bank, Gallery Multi-Family Residential	Commercial, Parking Lot, Hotel, Office, Multi-Family Residential
1, 2, 3, 4, 5 MOS 2	Century City	Office, Commercial, Open Space	Commercial, Open Space, Single- and Multi-Family Residential, Institutional
1, 2, 3, 4, 5	Westwood	Office, Storefront Retail, Institutional, Vacant, Parking	Institutional, Commercial, Multi-Family Residential, Open Space
1, 2, 3, 5	Wilshire Boulevard/VA Hospital	Office, Storefront Retail, Strip retail, Service Station	Commercial, Single- and Multi-Family Residential, Institutional
3, 5	Wilshire Boulevard/Bundy Dr	Office, Restaurant, Supermarket, Storefront Retail, Storage	Commercial, Single- and Multi-Family Residential, Fitness, Vacant, Parking, Institutional
3, 5	Wilshire Boulevard/26th Street	Office, Restaurant, Drugstore, Storefront Retail	Commercial, Single- and Multi-Family Residential, Restaurant, Open Space, Institutional
3, 5	Wilshire Boulevard/16th Street	Storefront Retail, Office, Auto Dealership, Medical, Institutional, Multi-Family Residential	Commercial, Institutional, Multi-Family Residential
3, 5	Wilshire Boulevard/4th Street	Office, Storefront Retail, Multi-Family Residential	Commercial, Restaurant, Single- and Multi-Family Residential, and Institutional

Alternative	Potential Station Location	Adjacent Land Uses	Surrounding Land Uses
4, 5	Hollywood Boulevard/Highland Avenue	Regional Shopping Center, Museums, Transportation, Storefront Commercial, Multi-Family Residential, Lodging, Entertainment Venues, Restaurants	Commercial, Institutional, Multi-Family Residential
4, 5	Santa Monica Boulevard/ La Brea Avenue	Shopping Center, Strip Retail, Fast Food Restaurant, Storage, Auto Rental/Repair	Commercial, Industrial/Manufacturing, Multi-Family Residential, Parking, Office
4, 5	Santa Monica Boulevard/Fairfax Avenue	Storefront Retail, Grocery, Institutional, Auto Sales	Commercial, Office, Multi-Family Residential, Institutional, Parking,
4, 5	Santa Monica Boulevard/ San Vicente Boulevard	Office, Storefront Retail Public Facility/Transportation, Open Space	Commercial, Single- and Multi-Family Residential, Open Space, Institutional, Bank, Fitness, Hotel
4, 5	Beverly Center	Regional Shopping Center, Parking, Multi-Family Residential, Medical Center	Commercial, Single- and Multi-Family Residential, Institutional

Source: TAHA, 2010

5.5.1 Alternative 1 – Westwood/UCLA Extension

This alternative extends via subway from the existing Metro Purple Line Wilshire/Western Station to Westwood/UCLA. The current land uses adjacent to the proposed project stations are presented in Table 5-6. Commercial land use within 0.25 mile of stations proposed under Alternative comprises the following percentages, approximately:

- 7 percent of existing land use within 0.25 mile of the proposed Wilshire/Crenshaw Station.
- 20.5 percent of existing land use within 0.25 mile of the proposed Wilshire/La Brea Station.
- 4.7 percent of existing land use within 0.25 mile of the proposed Wilshire/Fairfax Station.
- 11.8 percent of existing land use within 0.25 mile of the proposed Wilshire/La Cienega Station.
- 22 percent of existing land use within 0.25 mile of the proposed Wilshire/Rodeo Station.
- 32 percent of existing land use within 0.25 mile of the proposed Century City.
- 8.8 percent of existing land use within 0.25 mile of the proposed Wilshire/Westwood Station.

5.5.2 Alternative 2 – Westwood/VA Hospital Extension

This alternative would follow the same alignment as Alternative 1 – Westwood/UCLA Extension but would include one additional station at the VA Hospital. The current land uses adjacent to the Alternative 2 proposed project stations are presented in Table 5-6.

In addition to commercial land use described under Alternative 1, commercial land use comprises the following percentages under Alternative 2, approximately:

- 0.5 percent of existing land use within 0.25 mile of the proposed Wilshire/VA Hospital Station.

5.5.3 Alternative 3 – Santa Monica Extension

This alternative would follow the same alignment and have the same stations as Alternative 2 – Westwood/VA Hospital Extension, but would also extend the alignment into the City of Santa Monica and add four additional stations. From the Wilshire/VA Hospital Station, the alignment would be under Wilshire Boulevard until the end of the line at Ocean Avenue. The current land uses adjacent to the Alternative 3 proposed project stations are presented in Table 5-6.

In addition to commercial land use described under Alternatives 1 and 2, commercial land use comprises the following percentages under Alternative 3, approximately:

- 3.6 percent of existing land use within 0.25 mile of the proposed Wilshire/Bundy Station.
- 5.6 percent of existing land use within 0.25 mile of the proposed Wilshire/26th Station.
- 10 percent of existing land use within 0.25 mile of the proposed Wilshire/16th Station.
- 15 percent of existing land use within 0.25 mile of the proposed Wilshire/4th Station.

5.5.4 Alternative 4 – Westwood/VA Hospital Extension plus West Hollywood Extension

Alternative 4 would follow the same alignment and have the same stations as Alternative 1 – Westwood/UCLA Extension. In addition, this alternative includes the West Hollywood Extension, which extends from the existing Metro Red Line Hollywood/Highland Station. From a new station in this location, this alignment extends southerly, centered under Highland Avenue, and continues south under Highland Avenue to just north of Lexington Avenue where it curves to Santa Monica Boulevard. The alignment continues westerly under the center of Santa Monica Boulevard until just east of the Santa Monica/San Vicente Boulevard intersection where the alignment curves south and is centered under San Vicente Boulevard. From San Vicente Boulevard, the alignment curves south and then southwesterly to cross under La Cienega Boulevard to the Wilshire/La Cienega Station. The current land uses adjacent to the Alternative 4 proposed project stations are presented in Table 5-6. In addition to commercial land use described under Alternative 1, commercial land use comprises the following percentages under Alternative 4, approximately:

- 53 percent of existing land use within 0.25 mile of the proposed Hollywood Highland Station.
- 18 percent of existing land use within 0.25 mile of the proposed Santa Monica/La Brea Station.

- 10 percent of existing land use within 0.25 mile of the proposed Santa Monica/Fairfax Station.
- 3.9 percent of existing land use within 0.25 mile of the proposed Santa Monica/San Vicente Station.
- 16 percent of existing land use within 0.25 mile of the proposed Beverly Center Station.

5.5.5 Alternative 5 – Santa Monica Extension plus West Hollywood Extension

Alternative 5 would follow the same alignment and have the same stations as Alternatives 3 and 4. The current land uses adjacent to the Alternative 5 proposed project stations are presented in Table 5-6.

5.5.6 MOS 1 – Fairfax Station Terminus

The Minimum Operable Segment (MOS 1) – Fairfax Extension Alternative would follow the same alignment as Alternative 1 and terminate at the Wilshire/Fairfax station. The current land uses adjacent to the MOS 1 proposed project stations are presented in Table 5-6.

5.5.7 MOS 2 – Century City Extension

The MOS 2 – Century City Extension would follow the same alignment as MOS 1 and would terminate at the Century City station. The current land uses adjacent to the MOS 2 proposed project stations are presented in Table 5-6.

5.5.8 Maintenance and Operation Facility Sites

The Westside Subway Extension project would require either the expansion of Metro Division 20 Rail Yard or the construction of a new rail yard to house and maintain the rail cars. The current land uses adjacent to the proposed project alignments are presented in detail in the Land Use Technical Report.

6.0 ENVIRONMENTAL CONSEQUENCES

Potential impact are analyzed using a reasonable worst-case approach to describe the potential impacts. For example, several possible construction staging areas may be analyzed, even though not all of them would be used. Analyzing potential “maximum impact,” also allows the environmental process to identify potential constraints and mitigation. Only one portal is currently envisioned for most stations and therefore, station area displacements and construction impacts related to station entrances would be less than shown, depending upon the portal site selection. Construction staging areas would generally be located on the site selected for the future portal.

6.1 Traffic, Parking, and Transit Impacts

In this section, estimated potential adverse impacts are described under each build alternative as well as the two MOSs. The proposed construction staging scenarios for the Westside Subway Extension Project will determine transportation-related construction impacts. These staging scenarios are further described in Traffic Handling and Construction Staging Report (Metro, 2010). The construction sequences described below reflect an initial identification of potential tunnel drive directions and sequences. There are several possibilities for tunneling and other more advantageous approaches will likely develop as the alignments, crossover locations, alternate station locations, and availability of long-term tunneling sites become better defined.

For each MOS and alignment alternative, estimated traffic-related impacts associated with contractor work and storage area, mining entry/exit locations and TBM operations, and truck haul routes are presented below. Information is also presented on traffic impacts associated with other construction elements, including vertical shafts, drop holes, grouting, and station portals. Designated haul routes will be identified during the final design phase of the project. These routes would be located in a manner that will minimize noise, vibration, and other possible impacts to adjacent businesses and neighborhoods. Following completion of the project, if slight physical damage to haul routes is found, any affected roads would be treated accordingly.

6.1.1 Traffic Lane Requirements

Traffic lane maintenance during construction will follow local agency requirements and standards with respect to lane widths, number of lanes and duration of temporary lane closures. During non-working hours, existing traffic lanes including turn lanes and two-way left turn lanes should be restored to the pre-construction/original condition unless otherwise authorized by the local jurisdiction. Worksite traffic control and construction will be planned to be staged to satisfy the following traffic lane requirements within the traffic control zone, as shown in **Table** 6-1.

6.1.2 Temporary Street Closures and Detour Routes

Traffic handling includes coordination with the impacted local governmental agencies to address the intersections for each station location that would be impacted during construction. These local governmental agencies include Caltrans, the County of Los Angeles, Los Angeles Department of Transportation (LADOT), and the cities of Beverly Hills, West Hollywood, and Santa Monica. Local agency traffic handling requirements and guidelines are listed in Section 2.1.1 of this document. Coordination and interaction with these agencies will determine which streets can be closed and the detour routes to be used should streets need to be closed for a limited period of time.

Table 6-1: Traffic Lane Requirements During Construction

Station Location	Agency	Street	Traffic Lane(s) Maintained
Wilshire/Crenshaw Station	Los Angeles	Wilshire Blvd.	2 Eastbound
			2 Westbound
Wilshire/La Brea Station	Los Angeles	Wilshire Blvd	2 Eastbound
			2 Westbound
Wilshire/Fairfax Station	Los Angeles	Wilshire Blvd.	2 Eastbound
			2 Westbound
Wilshire/La Cienega Station	Beverly Hills	Wilshire Blvd.	2 Eastbound
			2 Westbound
Connection Structure	Beverly Hills	Wilshire Blvd.	2 Eastbound
			2 Westbound
Wilshire/Rodeo Station	Beverly Hills	Wilshire Blvd.	2 Eastbound
			2 Westbound
Century City Station (Santa Monica Blvd.)	Los Angeles	Santa Monica Blvd.	3 Eastbound
			3 Westbound
Westwood/UCLA Station (Off-Street)	Los Angeles	Wilshire Blvd.	4 Eastbound
			3 Westbound
Wilshire/VA Hospital Station	Los Angeles	Wilshire Blvd.	4 Eastbound
			4 Westbound
Wilshire/Bundy Station	Los Angeles	Wilshire Blvd.	2 Eastbound
			2 Westbound
Wilshire/26th Station	Santa Monica	Wilshire Blvd.	2 Eastbound
			2 Westbound
Wilshire/16th Station	Santa Monica	Wilshire Blvd.	2 Eastbound
			2 Westbound
Wilshire/4th Station	Santa Monica	Wilshire Blvd.	2 Eastbound
			2 Westbound
Highland/Hollywood Station	Los Angeles	Highland Ave.	2 Northbound
			2 Southbound
Santa Monica/La Brea Station	West Hollywood	Santa Monica Blvd.	1 Eastbound
			1 Westbound
Santa Monica/Fairfax Station	West Hollywood	Santa Monica Blvd.	1 Eastbound
			1 Westbound
Santa Monica/San Vicente Station	West Hollywood	Santa Monica Blvd.	2 Eastbound
			2 Westbound
Beverly Center Area Station	Los Angeles	San Vicente Blvd.	2 Northbound
			2 Southbound
Wilshire/La Cienega Station (Option C)	Beverly Hills	Wilshire Blvd.	2 Eastbound
			2 Westbound
Century City Station (Constellation Blvd.)	Los Angeles	Constellation Blvd.	2 Eastbound
			2 Westbound
Westwood/UCLA Station (On-Street)	Los Angeles	Wilshire Blvd.	3 Eastbound
			3 Westbound

The expected year at which construction would take place will be determined so that construction related traffic impacts can be assessed based on the forecasted traffic volumes for that year. As part of the DEIS/EIR, an extensive traffic count program was performed within the study area. This was performed during May 2009 at 184 intersections. This information will be utilized to analyze construction related traffic impacts. These counts and future year traffic projections were used to establish baseline traffic conditions during construction.

6.1.2.1 Closed Streets

Street closures would generally be limited to nighttime, weekend and/or off peak closures. Street closures would be minimized during peak travel periods. Potential street closure locations will be identified in close coordination with the local agencies having jurisdiction. Station decks can be installed and removed with minimal (weekend only) street closures by decking a half street width at a time. But it takes longer and involves a greater duration of traffic disruption than if the street were completely closed for a few days at a time. In recent Metro projects, merchants, community groups, and government agencies have agreed to total street closures to install and remove decks to shorten the overall duration of disruption. A decision of this type will have to be made in cooperation with all affected groups, either during the EIS review process or later.

The current estimate is that construction of a typical station would take 34 to 42 months using cut-and-cover construction methods although the primary impact to traffic is usually associated with the time it takes to install piles and decking for the station box support system. For stations built under existing streets, the top 2 feet of the roadway would be removed and decking would be installed over an approximate 3 to 4 month period. Construction of the station would continue while traffic travels on the decking. This procedure would require partial street closures to install the decking. As partial street closure requirements are identified, traffic would be rerouted to adjacent intersections and the impact of the additional traffic will be determined.

6.1.3 Traffic Circulation Routes

Traffic projections underway for this project will provide information on expected traffic volumes at the intersections to be evaluated. Based on these traffic projections and the proposed construction staging areas, appropriate traffic circulation routes to bypass the area will be developed in conjunction with the local agencies.

6.1.3.1 Traffic Impacts Due to Street Closures and Traffic Diversions

If a street is expected to require closure, the projected traffic would be detoured to other streets in the vicinity of the station and the impacts of the additional traffic will be evaluated to see if mitigations are necessary. Preliminary traffic evaluations were performed at up to four key intersections at each station area, totaling 80 intersections, where diversion of traffic is anticipated due to full street closures during off-peak and night periods. The intersections that are candidates to be evaluated are shown in the following Table 6-2.

Table 6-2: List of Intersections Identified for Evaluation During Construction

Intersections Identified for Evaluation		
1	Western Avenue	Wilshire Boulevard
2	Western Avenue	Olympic Boulevard
A	Western Avenue	6th Street
B	Wilshire Boulevard	Wilton Drive
3	Crenshaw Boulevard	Wilshire Boulevard
4	Crenshaw Boulevard	Olympic Boulevard
5	Lucerne Avenue	Wilshire Boulevard
6	La Brea Avenue	3rd Street
7	La Brea Avenue	Wilshire Boulevard
8	La Brea Avenue	Olympic Boulevard
C	Wilshire Boulevard	Hauser Boulevard
D	Wilshire Boulevard	Highland Avenue
9	San Vicente Boulevard	Olympic Boulevard
10	Fairfax Avenue	Olympic Boulevard
E	Fairfax Avenue	3rd Street
F	Wilshire Boulevard	Fairfax Avenue
11	San Vicente Boulevard	Wilshire Boulevard
12	La Cienega Boulevard	3rd Street
G	Wilshire Boulevard	Robertson Boulevard
H	Wilshire Boulevard	La Cienega Boulevard
13	San Vicente Boulevard/Le Doux Road	Burton Way
14	La Cienega Boulevard	Olympic Boulevard
15	Robertson Boulevard	Burton Way
16	Robertson Boulevard	Olympic Boulevard
17	Beverly Drive	Santa Monica Boulevard
I	Rodeo Drive	Wilshire Boulevard
J	Wilshire Boulevard	Beverly Drive
K	Wilshire Boulevard	Crescent Heights Boulevard
L	Olympic Boulevard	Beverly Drive
18	Bovril Drive	Olympic Boulevard
19	Santa Monica Boulevard	Wilshire Boulevard
20	Beverly Glen Boulevard	Santa Monica Boulevard
21	Beverly Glen Boulevard	Olympic Boulevard
M	Avenue of the Stars	Olympic Boulevard
N	Avenue of the Stars	Santa Monica Boulevard
22	Westwood Boulevard	Wilshire Boulevard
23	Westwood Boulevard	Santa Monica Boulevard
O	Wilshire Boulevard	Gayley Avenue
P	Gayley Avenue	Le Conte Avenue
24	Glendon Avenue	Wilshire Boulevard
Q	Wilshire Boulevard	Federal Avenue
25	Sepulveda Boulevard	Wilshire Boulevard
26	Sepulveda Boulevard	Santa Monica Boulevard
28	Barrington Avenue	Wilshire Boulevard
31	Bundy Drive	Wilshire Boulevard
R	Bundy Drive	Montana Avenue
S	Wilshire Boulevard	Centinela Avenue
32	Bundy Drive	Santa Monica Boulevard
33	26th Street	Wilshire Boulevard

Intersections Identified for Evaluation		
34 T	26th Street 26th Street	Santa Monica Boulevard Montana Avenue
35	20th Street	Wilshire Boulevard
36	20th Street	Santa Monica Boulevard
37	14th Street	Wilshire Boulevard
38	14th Street	Santa Monica Boulevard
39	Lincoln Boulevard	Wilshire Boulevard
40	Lincoln Boulevard	Santa Monica Boulevard
41	7th Street	Wilshire Boulevard
42	7th Street	Santa Monica Boulevard
43	4th Street	California Avenue
44	4th Street	Wilshire Boulevard
45	4th Street	Santa Monica Boulevard
46	Ocean Avenue	California Avenue/California Incline
47	Ocean Avenue	Wilshire Boulevard
48	Ocean Avenue	Santa Monica Boulevard
49	Highland Avenue	Hollywood Boulevard
50 U V	Highland Avenue Highland Avenue Hollywood Boulevard	Sunset Boulevard Franklin Avenue Cahuenga Boulevard
51	Highland Avenue	Santa Monica Boulevard
52	La Brea Avenue	Hollywood Boulevard
53	La Brea Avenue	Sunset Boulevard
54 W	La Brea Avenue Santa Monica Boulevard	Santa Monica Boulevard Martel Avenue
55	La Brea Avenue	Melrose Avenue
56	Fairfax Avenue	Sunset Boulevard
57	Fairfax Avenue	Santa Monica Boulevard
58	Fairfax Avenue	Melrose Avenue
59	Crescent Heights Boulevard	Santa Monica Boulevard
60	La Cienega Boulevard	Sunset Boulevard
61	La Cienega Boulevard	Santa Monica Boulevard
62	La Cienega Boulevard	Melrose Avenue
63 X Y Z AA AB	La Cienega Boulevard San Vicente Boulevard La Cienega Boulevard Robertson Boulevard Burton Way Burton Way/San Vicente Boulevard	Beverly Drive 3rd Street 3rd Street 3rd Street Robertson Boulevard La Cienega Boulevard
64	San Vicente Boulevard	Beverly Drive
65	San Vicente Boulevard	Santa Monica Boulevard
66	San Vicente Boulevard	Melrose Avenue
67	San Vicente Boulevard	Sunset Boulevard
68	San Vicente Boulevard	Cynthia Street
69	Robertson Boulevard	Santa Monica Boulevard
70	Robertson Boulevard	Beverly Boulevard

6.1.4 Temporary Traffic Signal Plans

Temporary traffic signal plans are required when:

- Traffic signal equipment is temporarily relocated due to construction
- Traffic signal operation is modified to facilitate construction
- Existing intersection lane configuration is changed
- Visibility of traffic signal equipment is obscured by construction
- As directed by the local agencies having jurisdiction

Temporary traffic signal plans will be prepared by the construction contractor as part of the worksite traffic control plans. The temporary traffic signal locations are shown in Table 6-3. Temporary traffic signal plans must conform to the CA MUTCD and applicable local agency standards and guidelines. Within the City of Los Angeles, reference will be made to the City of Los Angeles Special Provisions and Standard Drawings for Installation and Modification of Traffic Signals. Plans shall be reviewed and approved by the each responsible agency prior to implementation.

Table 6-3: Temporary Traffic Signal Locations

Station Location	Agency	Intersections
Wilshire/La Brea Station	Los Angeles	Wilshire Blvd./Sycamore Ave.
	Los Angeles	Wilshire Blvd./La Brea Ave.
	Los Angeles	Wilshire Blvd./Detroit St.
	Los Angeles	Wilshire Blvd./Cloverdale Ave.
	Los Angeles	Wilshire Blvd./Cochran Ave.
	Los Angeles	Wilshire Blvd./Dunsmuir Ave.
Wilshire/Fairfax Station	Los Angeles	Wilshire Blvd./Fairfax Ave.
	Los Angeles	Wilshire Blvd./Crescent Heights
Wilshire/La Cienega Station	Beverly Hills	Wilshire Blvd./Gale Dr.
	Beverly Hills	Wilshire Blvd./La Cienega Blvd.
	Beverly Hills	Wilshire Blvd./San Vicente Blvd.
Connection Structure	Beverly Hills	Wilshire Blvd./Willaman Dr.
	Beverly Hills	Wilshire Blvd./Robertson Blvd.
	Beverly Hills	Wilshire Blvd./La Peer Dr.
Wilshire/Rodeo Station	Beverly Hills	Wilshire Blvd./Canon Dr.
	Beverly Hills	Wilshire Blvd./Beverly Dr.
	Beverly Hills	Wilshire Blvd./El Camino Dr.
	Beverly Hills	Wilshire Blvd./Rodeo Dr.
Century City (Santa Monica) Station	Los Angeles	Santa Monica Blvd./Avenue of the Stars
	Los Angeles	Santa Monica Blvd./Century City Mall
	Los Angeles	Wilshire Blvd./Century Park East
Westwood/UCLA Station (Off-Street)	Los Angeles	Wilshire Blvd./Veteran Ave.
Wilshire/VA Hospital Station	Los Angeles	Wilshire Blvd./Brockton Ave.
	Los Angeles	Wilshire Blvd./Bundy Dr.
Wilshire/Bundy Station	Los Angeles	Wilshire Blvd./Brockton Ave.
	Los Angeles	Wilshire Blvd./Bundy Dr.

Station Location	Agency	Intersections
Wilshire/26th Station	Santa Monica	Wilshire Blvd./Princeton St
	Santa Monica	Wilshire Blvd./26th St.
	Santa Monica	Wilshire Blvd./25th St.
	Santa Monica	Wilshire Blvd./Chelsea Ave.
Wilshire/16th Station	Santa Monica	Wilshire Blvd./18th St.
	Santa Monica	Wilshire Blvd./17th St.
	Santa Monica	Wilshire Blvd./16th St.
	Santa Monica	Wilshire Blvd./15th St.
	Santa Monica	Wilshire Blvd./14th St.
Wilshire/4th Station	Santa Monica	Wilshire Blvd./Lincoln Blvd.
	Santa Monica	Wilshire Blvd./7th St.
	Santa Monica	Wilshire Blvd./6th St.
	Santa Monica	Wilshire Blvd./5th St.
	Santa Monica	Wilshire Blvd./4th St.
	Santa Monica	Wilshire Blvd./3rd St.
	Santa Monica	Wilshire Blvd./2nd St.
	Santa Monica	Wilshire Blvd./Ocean Ave.
Highland/Hollywood Station	Los Angeles	Highland Ave./Yucca St.
	Los Angeles	Highland Ave./Selma Pl.
	Los Angeles	Highland Ave./Sunset Blvd.
	Los Angeles	Highland Ave./Leland Way
	Los Angeles	Highland Ave./De Longpre Ave.
Santa Monica/La Brea Station	West Hollywood	Santa Monica Blvd./La Brea Ave.
	West Hollywood	Santa Monica Blvd./Formosa Ave.
Santa Monica/Fairfax Station	West Hollywood	Santa Monica Blvd./Genessee Ave.
	West Hollywood	Santa Monica Blvd./Fairfax Ave.
Santa Monica/San Vicente Station	West Hollywood	Santa Monica Blvd./La Cienega Blvd.
	West Hollywood	Santa Monica Blvd./Westbourne Dr.
	West Hollywood	Santa Monica Blvd./San Vicente Blvd.
Beverly Center Area Station	Los Angeles	San Vicente Blvd./Beverly Blvd.
	Los Angeles	San Vicente Blvd./Gracie Allen Dr.
	Los Angeles	San Vicente Blvd./3rd St.
	Los Angeles	San Vicente Blvd./Burton Way
	Los Angeles	**La Cienega Blvd./3rd St.**
Wilshire/La Cienega Station (Option 3)	Beverly Hills	Wilshire Blvd./Gale Dr.
	Beverly Hills	Wilshire Blvd./La Cienega Blvd.
	Beverly Hills	Wilshire Blvd./Willaman Dr.
Century City (Constellation) Station (Option 4)	Los Angeles	Constellation Blvd./Avenue of the Stars
	Los Angeles	Constellation Blvd./Garden Ln.
	Los Angeles	Constellation Blvd./Century Park East
Westwood/UCLA Station (On-Street) (Option 5)	Los Angeles	Wilshire Blvd./Glendon Ave.
	Los Angeles	Wilshire Blvd./Westwood Blvd.
	Los Angeles	Wilshire Blvd./Midvale Ave.
	Los Angeles	Wilshire Blvd./ Veteran Ave.

6.1.5 Temporary Striping and Signing

Each affected agency will determine the need for temporary striping installation or modifications. Temporary striping would be considered for the following conditions:

- When traffic is to be diverted to the left of an existing centerline for two or more consecutive nights.
- When the work area is adjacent to an intersection and results in a transition within the intersection.
- When there is an unusual situation where traffic and physical conditions, such as speed or restricted visibility, occur
- Temporary signs would be implemented per the approved traffic control plans. Temporary sign devices include:
- Traffic signs (regulatory, warning and guide)
- Changeable message signs
- Arrow panels
- High-level warning devices
- When signs in a traffic control zone conflict with the implemented traffic control, the signs must be covered by the local agency's approved method to avoid confusion to the motorist.
- Temporary striping and signing plans shall be prepared by the construction contractor and approved by the agency having jurisdiction.

6.1.6 Parking Restriction and Parking Meters

When the construction activity impacts the existing on-street parking spaces, parking circulation plans shall be prepared by the construction contractor and approved by the agency having jurisdiction. The parking circulation plan must be coordinated with each impacted property representative.

6.1.7 Parking Conditions

As part of the DEIS/EIR, a parking impact and policy plan was prepared for the project. This will be utilized during the subsequent construction and traffic handling phase of the project. Existing parking meters affected by construction within the traffic control zone shall be removed or covered as directed by the agency having jurisdiction.

6.1.8 Temporary Parking Locations

As part of the DEIS/EIR, a parking impact and policy plan is being prepared for the project. This will be utilized during the stage construction and traffic handling phase of the project. Based on the proposed parking replacement strategy, temporary parking spaces can be considered for the impacted business or residents during construction.

6.1.9 Loading Zones

When the construction activity impacts the curb side passenger loading or commercial loading zones, loading zone circulation plans shall be prepared by the construction contractor and approved by the agency having jurisdiction. The loading zone plan must be coordinated with each impacted property representative.

When the construction activity impacts the existing newspaper stands, mail boxes, or bus shelters, an arrangement should be made with each impacted owner for relocation or removal.

6.1.10 Bus Stop Locations

Prior to implementation of any temporary street closures or any changes affecting the bus stop locations, the following transit providers will be contacted at least 100 days in advance. Emergency bus stop relocations will require a contractor employee to visit the office of the impacted bus agency to negotiate the needed change and in no event shall less than 14 days notice be provided:

- Metro
- LADOT DASH
- LADOT Commuter Express
- Santa Clarita Transit
- Culver City bus
- West Hollywood CityLine/Dayline
- Santa Monica Big Blue Bus
- Antelope Valley Transportation Authority

See the Transportation Impact Technical Report (Metro, April 2010), for the existing transit operation information and proposed transit mitigations

6.1.11 Pedestrian, Bicycle and Vehicular Access

When the construction activity encroaches into a sidewalk, walkway, or crosswalk area, special consideration must be given to pedestrian safety, and the following items should be considered for pedestrians in a temporary traffic control zone:

- Pedestrians should not be led into conflicts with work site vehicles, equipment, or operations.
- Pedestrians should not be led into conflicts with vehicles moving through or around the work site.
- Pedestrians should be provided with a safe, convenient, and accessible path.

6.1.12 Pedestrian Detours

Access by sidewalks will be maintained on both sides of the street at all Metro Construction sites at all times throughout construction. Access to all businesses for pedestrians will also be maintained at all times without any requirement for the business owners to make such a request.

All temporary sidewalk designs will be submitted to Metro for approval prior to installation. Temporary sidewalks need not be expensive, but they must be well built of approved material (wood or other), ADA compliant and having a well built cover. No rough edges or damaged wood will be allowed.

When pedestrians are diverted into the street or adjacent to an open trench, K-rail type concrete barriers or other approved barrier types would be used for barricading between pedestrian and vehicular traffic. Sidewalk closures, if necessary, will be approved by the affected agency having jurisdiction and only one side of the street should be closed at a time.

Pedestrian access to each business property would be provided during the essential hours as requested by the property representative. If acceptable alternate access points are provided, the impacted access may be closed.

6.1.13 Bicycle Access

As part of the DEIS/EIR, a preliminary bike lane design analysis was prepared for the project. This information will be utilized during the stage construction and traffic handling phase of the project. The bike lane design analysis will show the existing bike lanes and proposed bike lanes within the vicinity of the project.

During the construction phase, Metro approved bike routes will be maintained past all construction sites, whether via widened sidewalks or signed or striped bike detour routes.

6.1.14 Access and Impacts to Commercial and Business Driveways

When the construction activity impacts the existing business driveways, maintenance of traffic plans would be prepared by the construction contractor showing how vehicular access would be maintained to businesses and approved by the agency having jurisdiction. The construction activity must be coordinated with each impacted property representative.

During construction, driveway entrance and exits would be maintained during essential hours. If acceptable alternate access points (approved by the applicable agency) are provided, the impacted driveway may be closed.

The local agency may restrict the left-turn and/or right-turn vehicular movements entering and/or exiting driveways during construction.

6.1.15 Loss of Public Parking - Station Construction

Station construction under an active thoroughfare necessitates that the station be “decked” over with a supporting steel structure and deck panels. It is not particularly suitable to allow the deck structure to be used for duration parking of public vehicles and thus there will be a loss of normal parking space. In general public parking will spill over onto side streets on a first come basis. This problem will be aggravated by the parking of commuting vehicles for construction personnel. Any way this is looked at, this will present the public with a loss of parking throughout the duration of station construction.

Some mitigation might be attained through designation of a separate parking area for construction personnel possibly with busing provided to and from the work site and perhaps providing a separate additional area for the public to park. This becomes a matter of available space which in urban areas is not an easy matter to resolve.

6.1.16 Construction Staging

The evaluation of construction staging is based on the current consideration of the five build alternatives for the Westside Subway Extension as well as two Minimum Operating Segments (MOSs), which could be applicable to any of the five alternatives. Specifically, this concept calls for placing an initial Minimum Operating Segment (MOS-1) into construction and operation as funding becomes available, and then constructing follow-on MOS segments or more extensive construction segments as additional funding is attained.

Though sixteen alignment and six station-location options are still under consideration along the proposed alignment (particularly in the Century City-Westwood area) this write-up assumes that the two MOSs and five alternatives would follow the "Baseline" alignments as shown on the key map drawings C1-100, C2-100, C3-100, C4-100 and C5-100 in Appendix A. Currently, the alignment is subdivided into the following segments:

- Alternative 1: Westwood/UCLA Extension
- Alternative 2: Westwood/VA Hospital Extension
- Alternative 3: Santa Monica Extension
- Alternative 4: Westwood/VA Hospital plus West Hollywood Extension
- Alternative 5: Santa Monica Extension plus West Hollywood Extension
- MOS-1: Wilshire/Western (existing station) to Wilshire/Fairfax Station
- MOS-2: Wilshire/Fairfax Station to Century City Station

The construction sequences described below are an initial look at tunnel drive directions and sequences. There are many possibilities for tunneling and other more advantageous approaches will likely develop as the alignments, crossover locations, alternate station locations, and availability of long-term tunneling sites become better defined.

For each MOS and alignment alternative, contractor work and storage area, mining entry/exit locations and TBM operations, and truck haul routes are discussed below.

Contractor work and storage areas would be necessary for construction of station box excavations, station entrances, crossover boxes, pocket tracks, and ventilation shaft locations. However, the most off-street space is needed for off street stations and entry areas from which mining operations and the insertion/extraction of tunneling boring machines would be conducted. This includes the handling of precast-concrete tunnel segment supply, spoil (excavated materials) disposal, tunnel wastewater removal, power supply and other utilities. It is noted when no alternative exists, intermediate stations (between TBM launch and recovery sites) can be built without construction laydown sites located off the street. However the laydown areas will then have to be placed within the street itself involving the closure of half or more of the street for the duration of construction. This is very disruptive to the community and to be done only when absolutely no alternative exists.

Spoils would be disposed off-site at locations which are usually selected by the construction contractor with the concurrence of applicable authorities based on types of soils involved. However, because all tunneling would be performed with pressure-face tunnel boring machines (TBMs), the spoils must undergo partial treatment (possible drying of EPB-TBM spoil; or de-sanding and other processing of Slurry-TBM spoil), on-site before being loaded on trucks for off-site disposal. Suitable disposal sites will be identified to ensure the excavated material can be removed and transported to the disposal area in a timely and efficient operation.

6.1.17 Level of Service Thresholds

Please refer to Section 5.1, Affected Environment, Traffic, Parking, and Transit for an explanation of LOS Thresholds.

6.1.18 No Build Alternative

No construction will occur with the No Build Alternative, so no traffic related construction impacts would occur.

6.1.19 Transportation System Management (TSM) Alternative

No construction will occur with the Transportation System Management Alternative, so no traffic related construction impacts would occur.

6.1.20 Alternative 1 – Westwood/UCLA Extension

Station construction on the Westwood/UCLA site off-street in Lot 36 could be accomplished without decking and, if adequate area is available for tunneling operations, tunneling could proceed eastbound. The Westwood/UCLA Station site within Wilshire Boulevard would have more restricted work areas and consideration would be given to driving tunnels to the west from Century City.

The road closure would also impact Metro bus operations on Wilshire Boulevard and other streets as well as transit service operated by UCLA, the Santa Monica Big Blue Bus, DASH, and Culver City Bus. Any road closures should minimize as much as possible impacts on bus service reliability, travel time, and passenger convenience.

Pedestrian and bicycle access in the construction areas could also be affected. This includes street crossings, movements along sidewalks/bike lanes, access to local businesses, and access/waiting involving existing bus zones.

It is expected that truck hauling traffic to and from the Westwood/UCLA Station construction yard would be via Wilshire Boulevard to the I-405 (San Diego) Freeway, heading south, or north. The route might pick up I-10 east via other connecting freeways.

6.1.21 Alternative 2 – Westwood/VA Hospital Extension

If the VA Hospital site is the terminus, the site could be used as a TBM entry station, with mining proceeding eastbound to the Century City Station. Since the VA Hospital station is located on VA property, station excavation could remain open, without the need for temporary decking. While no street closures would be necessary, locating the terminus at the VA site may require (partial) closure of Bonsall Avenue, the Eastbound Bonsall/Wilshire on-ramp, and/or the I-405 on- and off-ramps adjacent to the site. Further traffic control would only be needed for entering and exiting of construction traffic onto adjacent roadways.

The road closure would also impact Metro bus operations on Wilshire Boulevard near the Veterans Hospital as well as in Westwood. The impacts under Alternative 2 would affect Metro bus service on Wilshire Boulevard and other streets as well as transit service operated by UCLA, the Santa Monica Big Blue Bus, DASH, and Culver City Bus. Any road closures should minimize as much as possible impacts on service reliability, travel time and passenger convenience.

Pedestrian and bicycle access in the construction areas could also be affected. This includes street crossings, movements along sidewalks/bike lanes, access to local businesses, and access/waiting involving existing bus zones.

It is assumed truck haul traffic to and from the construction yard at the Westwood/VA Hospital Station would be via Bonsall Avenue, Wilshire Boulevard and the I-405, San Diego Freeway, heading south, or north. The route might pick up I-10 east via other connecting freeways.

6.1.22 Alternative 3 – Santa Monica Extension

This segment could be mined from the Wilshire/26th Street station proceeding west towards 4th Street and east towards the Westwood/VA Hospital Station or an alternative tunnel site on the U.S. Army Reserve area near Federal Way. Excavation for the Wilshire 26th Street station would require lane channelization in order to install soldier piling and cap beams for support of temporary roadway decking during short term lane closures that would require the roadway to be partially closed. With the approximately 680-foot length of station involved, three partial road closures may be needed in order to assure that Wilshire Boulevard would be restored to normal operations within allotted timeframes.

Mining also could proceed from the Westwood/VA Hospital Station or alternative tunnel site on the U.S. Army Reserve area near Federal Way West about 3.7 miles to 4th Street in Santa Monica. Since the Westwood/VA Hospital Station would be located on VA property, tunneling access shaft could remain open, without the need for temporary decking. In this scenario, no street closures would be necessary at the TBM mining site, and traffic control would only be needed for entering and exiting of construction traffic onto adjacent roadways.

The road closure would impact Metro and Big Blue Bus service bus operations on Wilshire Boulevard. The impacts would also affect Metro bus service on Wilshire Boulevard and other streets as well as transit service operated by UCLA, DASH, the Santa Monica Big Blue Bus, and Culver City Bus. Any road closures should minimize as much as possible impacts on service reliability, travel time and passenger convenience.

Pedestrian and bicycle access in the construction areas could also be affected. This includes street crossings, movements along sidewalks/bike lanes, access to local businesses, and access/waiting involving existing bus zones.

Truck haul access would be via Wilshire from the VA Hospital site to the nearest freeway, I-10, or I-405 south or north. The route could also access I-10 east via other connecting freeways.

6.1.23 Alternative 4 – Westwood/VA Hospital Extension plus West Hollywood Extension

The Santa Monica/Fairfax Station could be used as the mining station under Alternative 4. Mining operations would proceed from this station east towards the existing station at Hollywood/Highland and south towards the Wilshire/Connection Structure. The construction worksite for the mining operations is adjacent to North Fairfax Avenue and construction traffic would need to be separated by traffic control measures.

Excavation of the Santa Monica/Fairfax Station would require lane channelization in order to install soldier piling and cap beams for support of temporary roadway decking during short term lane closures that would require the entire roadway to be closed. With the approximately 600-foot length of station involved, three road closures may be needed in order to allow Santa Monica Boulevard to be restored to normal operations within allotted timeframes.

Any road closures would affect Metro bus service on Wilshire Boulevard and other streets as well as transit service operated by UCLA, the Santa Monica Big Blue Bus, DASH, and Culver City Bus. In West Hollywood, the road closure would also impact Metro and West Hollywood City Line/Dayline bus operations on Santa Monica Boulevard. Any road closures should minimize as much as possible impacts on service reliability, travel time and passenger convenience.

Pedestrian and bicycle access in the construction areas could also be affected. This includes street crossings, movements along sidewalks/bike lanes, access to local businesses, and access/waiting involving existing bus zones.

It is assumed that truck haul traffic to and from the West Hollywood Station would use Santa Monica Boulevard to access the nearest freeway, I-101, a distance of approximately 3 miles. Alternatively, the I-10 Freeway might be accessed via Fairfax Avenue, a distance of approximately 4 miles; but, in comparison, this route would have a greater impact to the surrounding community.

6.1.24 Alternative 5 – Santa Monica Extension plus West Hollywood Extension

Alternative 5 incorporates the West Hollywood extension under Alternative 3. Since the segment from the Hollywood/Highland Station to the Wilshire/Connection Structure is identical to that described in Alternative 4, see Section 5.1.4 above for a description of construction-related traffic impacts for this segment.

6.1.25 MOS 1 – Fairfax Station Terminus

Excavation of Wilshire/Fairfax Station would require lane channelization, in order to install soldier piling and cap beams for support of temporary roadway decking during short term road closures. Partial closures allow a part of the roadway to remain open but increases the overall time for full installation of roadway deck.

Given the length of Wilshire/Fairfax Station, approximately 1,050 feet (depending on the final MOS end condition, which may include short tail tracks for safe deceleration behind the station), or an optional double cross over, will need a number of partial road closures. Lane closures for channeling the flow of traffic would use curb side lanes on one or both sides of Wilshire Boulevard. These lanes would be reopened upon completion of decking of the roadway for the entire station. As for temporary closures, Traffic Control Pans approved by LADOT will be prepared prior to start of work.

Any road closures would affect Metro bus service on Wilshire Boulevard and other streets Road closures should minimize as much as possible impacts on service reliability, travel time and passenger convenience.

Pedestrian and bicycle access in the construction areas could also be affected. This includes street crossings, movements along sidewalks/bike lanes, access to local businesses, and access/waiting involving existing bus zones.

It is expected that access to the 150 feet x 1,000 feet construction yard located near the Wilshire/Fairfax Station could follow Wilshire, then La Brea to I-10 or US-101. Alternatively, truck haul route might follow Wilshire to La Cienega to I-10. Traffic control for this work would consist mainly of channelization of construction-related and general-purpose traffic flow. If the Wilshire/Western site is used for the TBM starting location, haul routes would include Wilshire Boulevard to Western Avenue to US-101 (North) or I-5 (South).

6.1.26 MOS 2 – Century City Station Terminus

Station excavation would require lane channelization in order to install soldier piling and cap beams for support of temporary roadway decking during short-term lane closures that may not require the entire roadway to be closed. As many as three lane closures may be needed to assure Santa Monica Boulevard would be restored to normal operations within allotted timeframes. Lane closures for channeling the flow of traffic would be curb-side lanes on either side of Santa Monica Boulevard. These lanes would be re-opened upon completion of the decking of the roadway for the entire station.

Any road closures would affect Metro bus service on Santa Monica Boulevard and other streets. Road closures should minimize as much as possible impacts on service reliability, travel time and passenger convenience.

Pedestrian and bicycle access in construction areas could also be affected. This includes street crossings, movements along sidewalks/bike lanes, access to local businesses, and access/waiting involving existing bus zones.

Access to the Century City Station staging area would be via Santa Monica Boulevard or Olympic Boulevard directly to I-405. A potential Beverly Glen/Wilshire haul route could be impractical due to higher congestion as compared to Santa Monica or Olympic Boulevards. Alternatively, use of Avenue of the Stars or Century Park West to Westbound Pico, then Southbound Overland Avenue to I-10 may be more feasible; however Overland Avenue is narrow and often congested.

6.1.27 Vertical Shafts and Related Surface Openings

Traffic and/or pedestrian controls will be required for construction of ventilation shafts, emergency exit stairs, and other related openings to the ground surface that will be located outside the station box footprint. In general, the procedure for staging this work will be similar to the methods used for the main station box. Typically, these openings will be directly adjacent or very close to the main station excavation and will be constructed concurrently with the station work. Because these excavations are smaller in size and depth to the main station excavation, the duration of this work is relatively short, typically from 3-6 months and up to approximately 12 months. However, because such openings extend further beyond the station area, there will be additional impacts.

Some drop pipes used for tunnel construction generally would be located above the tunnel structure and are used for delivering concrete for tunnel lining. In general, access to the drop pipe would take place during a single work shift. The holes would basically be located away from intersections and likely near the middle of a block face. While use of drop pipes would likely be short-term, perhaps no greater than two weeks, a traffic control plan will be implemented.

Grouting operations may take place away from streets to improve the ground at cross passages and potentially for other immediate concerns where ground improvement becomes necessary. Traffic control for this type of operation is very similar to that used for drop pipes, the main difference being that it will usually be required for more than a shift and may extend into 24 hour-days. Traffic control, though disruptive to the public, is fairly simple to implement.

For work in the street, the operation will typically be sequenced so that existing traffic controls for the station work can be extended. When this extended area affects an intersection, the work in the intersection area will need to be staged so that traffic controls within the intersection are limited to off-peak periods. Often these additional surface openings affect sidewalks, which require temporary diversion of pedestrians. Typically, this work can be done such that a minimum sidewalk width is still provided during daylight hours. Full sidewalk closures, where necessary, would be limited to night and weekend periods.

It should be noted that similar surface openings may be constructed adjacent to midline vent structures, which are remote from station sites. However, in such cases, the methods above would still be applied.

6.1.28 Significance of Impacts

The traffic impacts during construction would be adverse (NEPA) and significant (CEQA).

6.1.29 Cumulative Impacts

The Regional Transportation Plan indicates that the region is expected to grow in both population and vehicle miles traveled (VMT). Development and redevelopment would result in increased traffic congestion, particularly along Wilshire Boulevard, and the major arterials in the project study. The No Build Alternative and TSM Alternative would not affect or contribute to a cumulative effect on traffic circulation or parking during project construction. Construction of the build alternatives would result in the temporary disruption and rerouting of traffic which would contribute to the cumulative increases in congestion in the study area. The study area is heavily developed and built out. Within the proposed corridor there are limited opportunities for off-street parking. For construction near station areas of limited on-street and off-street parking the build alternatives would result in a temporary cumulative adverse impacts where the available parking supply determined for the construction of each station does not meet the demands of the construction workers and displaced business and residential parking.

6.2 Air Quality Impacts

6.2.1 Methodology

An assessment of the air quality construction impacts was conducted as part of the March 2010 Westside Subway Extension Air Quality Technical Report (251A). The assessment utilized CARB's Urban Emissions Model (URBEMIS), the Road Construction Emissions Model, Version 6.3.2 (RCEM) developed by the Sacramento Metropolitan Air Quality Management District (SMAQMD), and the SCAQMD OFFROAD 2007 emission factors. The RCEM model estimates emissions of fugitive dust PM_{10} based on a screening emission factor of 20 pounds per day per acre of unpaved activity, and applies an estimated 50% fugitive dust reduction if the user indicates that water trucks will be used for dust control. SCAQMD OFFROAD2007 was used to develop emission factors from off-road construction equipment. Worker and delivery trip emissions factors were estimated using the EMFAC2007 emission factor model. Using these various data sources, daily construction emission levels were developed. These values were compared to the air quality construction significance thresholds shown in Table 6-4 to determine if the project would meet or exceed these values. As the construction schedule is very preliminary at this time, construction emissions were estimated for each major activity.

Once a detailed construction schedule is developed, a more refined construction analysis will be conducted to determine the air quality impacts of construction.

- **Odors**—Hydrogen sulfide gas has a distinctive "rotten egg" odor. The typical odor recognition threshold for hydrogen sulfide is 0.0005 parts per million (ppm) by volume. The odor analysis is based on existing information in the Geotechnical and Hazardous Materials Technical Report (Metro, August 2010*)*, and the United States Environmental Protection Agency (USEPA) SCREEN3 Model.
- **Construction Emissions**—The South Coast Air Quality Management District (SCAQMD) is responsible for regulating air quality in the South Coast Air Basin, which includes the project area. SCAQMD methodology and guidelines were utilized to calculate construction emissions for volatile organic compounds (VOC), nitrogen oxides (NO_x), carbon monoxide (CO), sulfur oxides (SO_x), particulate matter 2.5 microns or less in diameter ($PM_{2.5}$), and particulate matter 10 microns or less in diameter (PM_{10}).
- **Odor Impacts**—The Geotechnical and Hazardous Materials Technical Report (Metro, August 2010) discusses odor and gas issues associated with tunneling and excavating in known gassy or potentially gassy areas, and Section 4.2.1.5 of the Project Description discusses tunnel safety in gassy environments. This section addresses odors associated with hydrogen sulfide gas, as methane in its pure form is odorless. As indicated by the available measurement data, the hydrogen sulfide gas in the area occurs in localized "pockets" rather than in a continuous pattern and thus, the concentrations of the gas vary throughout the area. The odor evaluation presents examples where successful tunneling occurred in gassy areas and provides potential mitigation measures.

Hydrogen sulfide concentrations in the tunnel may be controlled utilizing a combination of techniques, also described in Section 4.0. Given the high potential for "pockets" of hydrogen sulfide in the segment between the Wilshire/Western and Wilshire/La Cienega Stations, it is likely that occasional odors from hydrogen sulfide would be detectable (above the typical odor recognition threshold of 0.0005 ppm) during construction.

Table 6-4: SCAQMD Air Quality Significance Thresholds

Mass Daily Thresholds1		
Pollutant	**Construction2**	**Operation3**
Nitrogen Oxides (NOx)	100 lbs/day	55 lbs/day
Volatile Organic Compounds (VOC)	75 lbs/day	55 lbs/day
Respirable Particulate Matter (PM10)	150 lbs/day	150 lbs/day
Fine Particulate Matter (PM2.5)	55 lbs/day	55 lbs/day
Sulfur Oxides (SOx)	150 lbs/day	150 lbs/day
Carbon Monoxide (CO)	550 lbs/day	550 lbs/day
Lead (Pb)	3 lbs/day	3 lbs/day
Carbon Dioxide equivalents (CO25)	Being developed at this time	Being developed at this time
Toxic Air Contaminants (TACs) and Odor Thresholds		
TACs (including carcinogens and non-carcinogens)	Maximum Incremental Cancer Risk ≥ 10 in 1 million Cancer Burden > 0.5 excess cancer cases (in areas ≥ 1 in 1 million) Hazard Index ≥ 1.0 (project increment)	
Odor	Project creates an odor nuisance pursuant to SCAQMD Rule 402	
Ambient Air Quality for Criteria Pollutants4		
NO2 1-hour average annual average	SCAQMD is in attainment; project is significant if it causes or contributes to an exceedance of the following attainment standards: 0.18 ppm (state) 0.03 ppm (state)	
PM10 24-hour average annual average	10.4 µg/m3 (construction)5 & 2.5 µg/m3 (operation) 1.0 µg/m3	
PM2.5 24-hour average	10.4 µg/m3 (construction)5 & 2.5 µg/m3 (operation)	
Sulfate 24-hour average	1 µg/m3	
CO 1-hour average 8-hour average	SCAQMD is in attainment; project is significant if it causes or contributes to an exceedance of the following attainment standards: 20 ppm (state) 9.0 ppm (state/federal)	

[1]*Source: SCAQMD CEQA Handbook (SCAQMD, Rev. March 2009).*
[2]Construction thresholds apply to both the South Coast Air Basin and Coachella Valley (Salton Sea and Mojave Desert Air Basins).
[3]For Coachella Valley, the mass daily thresholds for operation are the same as the construction thresholds.
[4]Ambient air quality thresholds for criteria pollutants based on SCAQMD Rule 1303, Table A-2 unless otherwise stated.
[5]Ambient air quality threshold based on SCAQMD Rule 403.
KEY: lbs/day = pounds per day
ppm = parts per million
µg/m3 = microgram per cubic meter
≥ = greater than or equal to

6.2.1.1 Gas Impacts

Methane is a hazard in confined spaces. As such, it is essential that tunnel workers be sufficiently protected, and thus detection and monitoring equipment would be required. Fans similar to those used to dilute hydrogen sulfide concentrations would also dilute methane concentrations in the tunnel. Once above-ground, methane dissipates rapidly in the atmosphere and would not be a health hazard.

Previous projects in the Methane Risk Zone have been successfully and safely excavated. Multiple underground parking garages have been constructed in this area. For example, the Los Angeles County Museum of Art built a two-level subterranean parking structure in a Methane Risk Zone. During excavation, hydrogen sulfide (above safe working levels) was encountered on several occasions. Workers donned PPE to protect against exposure during these events. Further investigation of operating underground structures will be undertaken during future design phases to assess effectiveness of barrier systems and detection equipment used.

6.2.1.2 Air Quality Impacts

Slurry Treatment Plant

The tunneling would require approximately 150 pounds of bentonite per one linear foot of the tunnel. Based on two tunneling machines, approximately 100 feet per day would be tunneled, using approximately 15,000 pounds of bentonite. Particulate matter emissions for the slurry treatment plant were calculated based on USEPA AP-42 calculation formulas for materials handling. The slurry treatment plant would include a bag house to collect dust during the mixing process. Bag houses typically filter at least 99% of fine particulate matter. As a result, the slurry treatment plant generates minimal dust emissions.

Tunneling

The tunneling would utilize a Slurry Face Tunnel Boring Machine (SF TBM) in the methane zones. The portion of the tunnel not located in the methane zone could be excavated using an EPB TBM. The SF TBMs use electric power, would be connected to the electric grid, and thus would not generate air emissions. Diesel locomotives would be used in the tunnel to transport workers, pre-cast concrete tunnel liner segments, and other materials to the SF TBM. It was assumed that tunneling activity would utilize two 185-horsepower diesel locomotives typically operating six hours per day. Locomotive emission rates were obtained from the USEPA *Emission Factors for Locomotives* (December 1997) document. Construction activity was assumed to occur in 2012.

Removal and Transport of Soils for Disposal

The tunneling could simultaneously utilize two tunneling machines, each with the capability of tunneling a 21-foot outside diameter for an assumed distance of 50 feet per day. Each tunneling machine would generate approximately 650 CYs of excavated soil per day on average resulting in a total of 1,300 CY per day. Excavated soil would be separated from the slurry and stockpiled on the surface for two to three days. The soil would be hauled to a landfill or other disposal area using trucks that would average approximately 20 CY per load. Thus, approximately 40 to 80 haul truck trips would be generated to remove the excavated material each day for tunnel excavation and 25 to 50 haul truck trips per day for station excavation. The estimated maximum truck trips (including, but not limited to, haul, concrete, and supply trucks) is 135 trucks. Truck emission rates were obtained from the California Air Resources Board's EMFAC2007 Motor Vehicle Emissions Inventory Model. Note that if more than two SF TBMs are used, the amounts of emissions would increase accordingly.

Heavy-duty construction equipment would be used to load the haul trucks. It was assumed that one front-end loader would load one truck in 15 minutes. Three front-end loaders would require approximately 11.25 hours to load haul trucks. Front-end loader emissions were obtained from CARB OFFROAD2007 Emissions Model.

Station Construction

Station construction activities would include demolition (as required at station entrances or other locations), excavation, and station construction. It was assumed that demolition would require two front-end loaders and 25 debris haul truck trips per day. Based on the CARB URBEMIS2007 Transportation and Land Use Program Model, demolition debris haul trucks were assumed to travel 30 miles per round trip.

Stations would be approximately 70 feet wide by 680 feet long and 60 feet deep with approximately 450-ft long platforms. Excavation would occur over an approximately 12-month period and would result in approximately 135,000 cubic yards of excavated soil. It would take 25 to 50 haul truck trips per day to remove the excavated soil over eight months. It was assumed that excavation equipment would include two excavators and two front-end loaders. Based on URBEMIS2007, excavation-related haul trucks were assumed to travel 20 miles per round trip.

Sources of air emissions during station construction would include heavy-duty equipment and heavy-duty truck trips associated with materials delivery. It was assumed that station construction equipment would include simultaneous operation of two front-end loaders, two forklifts, one crane, two pumps, and two miscellaneous pieces of equipment. It was further assumed that daily materials delivery activity would include ten trucks traveling 20 miles per round trip.

Heavy-duty equipment emission rates were obtained from OFFROAD2007 and truck emission rates were obtained from EMFAC2007. It was assumed that heavy-duty equipment would operate for 12 hours per day.

Worker Travel

The construction workers would commute to the site and the associated travel emissions would be a function of vehicle emission rates and commute distances. Vehicle emission rates were obtained from EMFAC2007. It was assumed that worker vehicles would be split equally between light-duty automobiles and light-duty trucks. The worker commute distance of 13.3 miles per one-way trip was obtained from URBEMIS2007.

6.2.2 No Build Alternative

No construction will occur with the No Build Alternative, so no air quality related construction impacts would occur.

6.2.3 Transportation System Management (TSM) Alternative

No construction will occur with the Transportation System Management Alternative, so no air quality related construction impacts would occur.

6.2.4 Alternative 1 – Westwood/UCLA Extension

As shown in Table 6-4, SCAQMD thresholds would be exceeded for NO_x for all station construction (with mining and without mining) and PM_{10} would be exceeded for a typical station with mining. Mitigation measures such as watering, the use of soil stabilizers, etc. could be applied to reduce the predicted PM_{10} levels to below the SCAQMD daily construction threshold levels. NO_x levels would be elevated due partially to the proposed use of diesel locomotives to extract soil during the tunnel boring process. Mitigation measures could help to reduce these impacts, but it is unlikely, given the current construction plan, that these levels would be below the SCAQMD threshold.

Table 6-5: Estimated Construction Impacts for Stations (lbs/day)

Activity	VOC	CO	NO_x	PM_{10}	$PM_{2.5}$
Typical Station with Mining					
Construction Equipment	69	300	1053	38	37
Dust Generated from Dirt Handling (Excavation, Backfilling, etc.)				231	
Mobile Sources (Deliveries, worker trips, hauling of material, etc.)	3	24	42	2	2
Total	72	324	1095	272	39
SCAQMD Thresholds	75	550	100	150	55
Typical Station with No Mining					
Construction Equipment	16	64	108	5	5
Dust Generated from Dirt Handling (Excavation, Backfilling, etc.)				120	
Mobile Sources (Deliveries, worker trips, hauling of material, etc.)	3	19	33	1	1
Total	19	83	141	126	6
SCAQMD Thresholds	75	550	100	150	55

Under Alternative 1, seven stations including Wilshire/Crenshaw would be constructed using cut-and-cover construction. The proposed Westwood/UCLA (Off-street) stations would be constructed without decking.

Preliminary estimates of construction emissions are presented in Table 6-5. As shown, the majority of emissions would occur as a result of removal and transport of soils for disposal from tunneling activity.

Hazardous hydrogen sulfide and methane concentrations and hydrogen sulfide odors may be mitigated utilizing various control techniques. Many of these techniques, described above, have previously been successfully utilized to excavate in the Methane Risk Zone and the Methane Buffer Zone. Given the potential for "pockets" of high concentration hydrogen sulfide in the segment between the Wilshire/Western and Wilshire/La Cienega stations, it is likely that odor from hydrogen sulfide would occasionally be detectable by workers and above the typical odor recognition threshold of 0.0005 ppm even after implementation of control techniques. However, because of the tar pits in this area, odors are already often detectable at the ground surface and it is unlikely that the additional hydrogen sulfide emissions would be noticeable.

6.2.5 Alternative 2 – Westwood/VA Hospital Extension

Impacts would be similar to Alternative 1. Under Alternative 2, eight stations would be constructed using cut-and-cover construction (no mining). Two of the proposed stations would be constructed with decking, Westwood/UCLA (Off-street) and Westwood/VA Hospital..

6.2.6 Alternative 3 – Santa Monica Extension

Impacts would be similar to Alternative 1. Under Alternative 3, twelve stations would be constructed using cut-and-cover construction. Two of the proposed stations would be constructed with decking, Westwood/UCLA (Off-street) and Westwood/VA Hospital. Mining would not be used to construct any stations under Alternative 3.

6.2.7 Alternative 4 – Westwood/VA Hospital Extension plus West Hollywood Extension

Impacts would be similar to Alternative 1. Under Alternative 4, thirteen stations would be constructed using cut-and-cover construction. Two of the proposed stations would be constructed with decking, Westwood/UCLA (Off-street) and Westwood/VA Hospital. Mining would not be used to construct any stations under Alternative 4.

6.2.8 Alternative 5 – Santa Monica Extension plus West Hollywood Extension

Impacts would be similar to Alternative 1. Under Alternative 5, seventeen stations would be constructed using cut-and-cover construction. Two of the proposed stations would be constructed with decking, Westwood/UCLA (Off-street) and Westwood/VA Hospital..

6.2.9 MOS 1 – Fairfax Station Terminus

Impacts would be similar to Alternative 1. Under MOS 1, three stations would be constructed using cut-and-cover construction. None of the proposed stations would be constructed with decking..

Since the Fairfax, and the La Brea, stations are located in known ground that contains hydrocarbon deposits, disturbance of the ground will generate varying degrees of toxic or dangerous gases. Submitted and approved construction techniques will take this into account and the public and construction personnel will be completely protected from harm. In order to perform the work there will be continual monitoring of the air environment and the operations will be altered as required to maintain a safe working atmosphere. There are numerous ways in which this can be accomplished but perseverance is the thing that must prevail.

Once excavation has been completed, though greatly diminished, the potential for developing gas leaks will exist and continuous monitoring will still be necessary. Opening new ground for construction of cross-passageways, shafts, and other structure will bring on new, and perhaps, an even more concentrated exposure. Perseverance in monitoring will alert personnel to alter ventilation, establish collection systems, or perhaps to temporarily evacuate. Emissions of dust and gases from the job site are to be controlled and maintained below acceptable limits. Dust from handling a “wet” slurry is not expected to become a problem, but gases emanating from the slurry treatment plant, if not properly handled, may become an issue requiring modification of equipment and or procedure.

6.2.10 MOS 2 – Century City Station Terminus

Impacts would be similar to Alternative 1 and MOS 1. Under MOS 2, six stations would be constructed using cut-and-cover construction (no mining). None of the proposed stations would be constructed with decking. Mining would not be used to construct any stations under MOS 2.

6.2.11 Maintenance and Operation Facility Sites

As shown in Table 6-6: Estimated Construction Impacts for Project Maintenance and Operation Facility Sites (lbs/day), SCAQMD thresholds would be exceeded for NO_x for construction of maintenance facility. NO_x levels would be elevated due partially to the proposed use of diesel locomotives to extract soil during the tunnel boring process. Mitigation measures could help to reduce these impacts, but it is unlikely, given the current construction plan, that these levels would be below the SCAQMD threshold.

Table 6-6: Estimated Construction Impacts for Project Maintenance and Operation Facility Sites (lbs/day)

Activity	VOC	CO	NOx	PM10	PM2.5
Maintenance Facility					
Construction Equipment	27	102	228	8	8
Dust Generated from Dirt Handling (Excavation, Backfilling, etc.)				TBD	
Mobile Sources (Deliveries, worker trips, hauling of material, etc.)	3	19	33	1	1
Total	30	121	261	9+	9
SCAQMD Thresholds	75	550	100	150	55

6.2.12 Significance of Impacts

The noise and vibration impacts during construction would be adverse (NEPA) and significant (CEQA).

6.2.13 Cumulative Impacts

Cumulative impacts are impacts on the environment that result from the incremental impact of a project when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. (40 CFR § 1508.7)

CEQA defines cumulative impact as follows:

- Two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts, and
- The change in the environment which results from the incremental impact of the project when added to other closely related past, present, or reasonably foreseeable future projects, and can result from individually minor, but collectively significant, projects taking place over a period of time (CEQA Air Quality Handbook*)*.

CEQA has put forth several possible assumptions to determine whether a project is significant enough to warrant a cumulative impact analysis. These include whether the project reduces the rate of growth in VMT, reduces emissions by a certain amount each year, or increases average vehicle ridership (CEQA Air Quality Handbook). This approach is not mandatory under CEQA, but is a possible way to determine whether a project is significant.

This project is predicted to reduce regional VMT and regional emission burden levels. It is included in the Draft Amendment #08-34 to the 2008 RTIP as Project ID #UT101, #1TR1002 and #1TR1003 (refer to page 5 of Draft Amendment). The Westside Subway Extension is also included in Metro's 2009 LRTP under Candidates for Private Sector Financial Participation – Transit Projects. The plan includes a transportation conformity determination for the entire region, as it accounts for future emissions from all mobile sources and ensures that attainment will not be delayed by future projects.

6.3 Noise and Vibration

This section evaluates the potential construction related noise impacts on sensitive receptors within the study area. Noise around and active construction site will be addressed by the contractor to meet noise control requirements and minimize impacts to the public. Provisions to control noise include providing substantial, sufficiently tall, and attractive sound walls.

Vibration is likely to be of little concern or impact for either station or tunnel excavation. Soldier piles, if used, are to be drilled; a method which does not result in noticeable vibration. Effects of vibration during project operation are discussed in the Noise and Vibration Technical Report (Metro, 2010).

Noise and vibration impacts from construction will vary greatly depending on location. The greatest potential for impacts is in the vicinity of underground stations, tunnel access portals, and construction laydown areas.

Although noise and vibration impacts may occur during all construction phases, the greatest potential for noise and vibration impact occurs during the heavy construction phase. Typical construction equipment noise emission levels are shown in Table 6-1. The values shown in Table 6-1 are representative of noise emissions from typical construction equipment and methods from empirical data obtained during similar construction projects. Precise noise emission levels for the actual equipment to be used on the project are not available at this time.

Noise levels from point source stationary noise sources, such as construction equipment decrease at a rate of 6 dB per doubling of distance. The noise emission levels shown in Table 6-7 are representative of construction noise levels at a distance of 50 feet. A distance of 250 feet from the construction area will be 14 dB less than the values shown in Table 6-7, and noise levels at 500 feet from the source will be 20 dB less that the values shown in Table 6-7.

The sensitive noise receptors for each Alternative are discussed in the following sections. The locations of potential noise and vibration sensitive receptors are shown in the following Westside Subway Extension Sensitive Noise Receptors Figures.

Table 6-7: Noise Level of Typical Construction Equipment at 50 feet (dBA Lmax)*

Construction Equipment	Noise Level at 50 Feet
Auger Drill Rig**	85
Backhoe	80
Ballast Equalizer	82
Ballast Tamper	83
Compactor	82
Concrete Mixer	85
Concrete Pump	82
Concrete Vibrator	76
Crane Derrick	88
Crane Mobile	83
Dozer	81
Grader	85
Impact Wrench	85
Jack Hammer	88
Loader	85
Paver	89
Pile Driver (Impact)	101
Pile Driver (Sonic)	96
Pneumatic Tool	85
Pump	76
Rail Saw	90
Rock Drill	98
Roller	74
Saw	76
Scarifer	83
Scraper	89
Shovel	82
Spike Driver	77
Tie Cutter	84
Tie Handler	80
Tie Inserter	85
Truck	88

Sources:
* *FTA Manual, Table 12-1, 2006.*
** *FHWA RCNM*

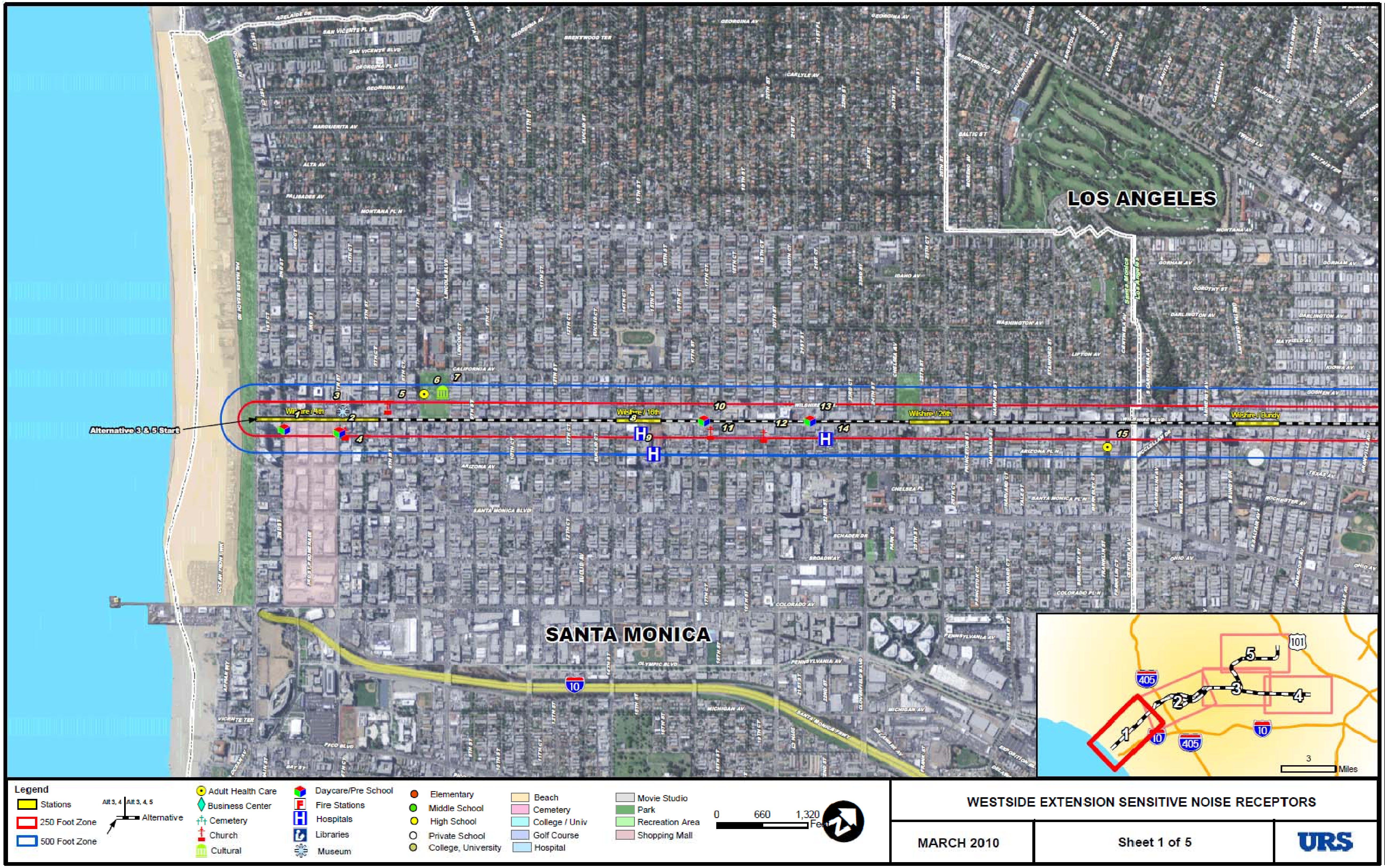
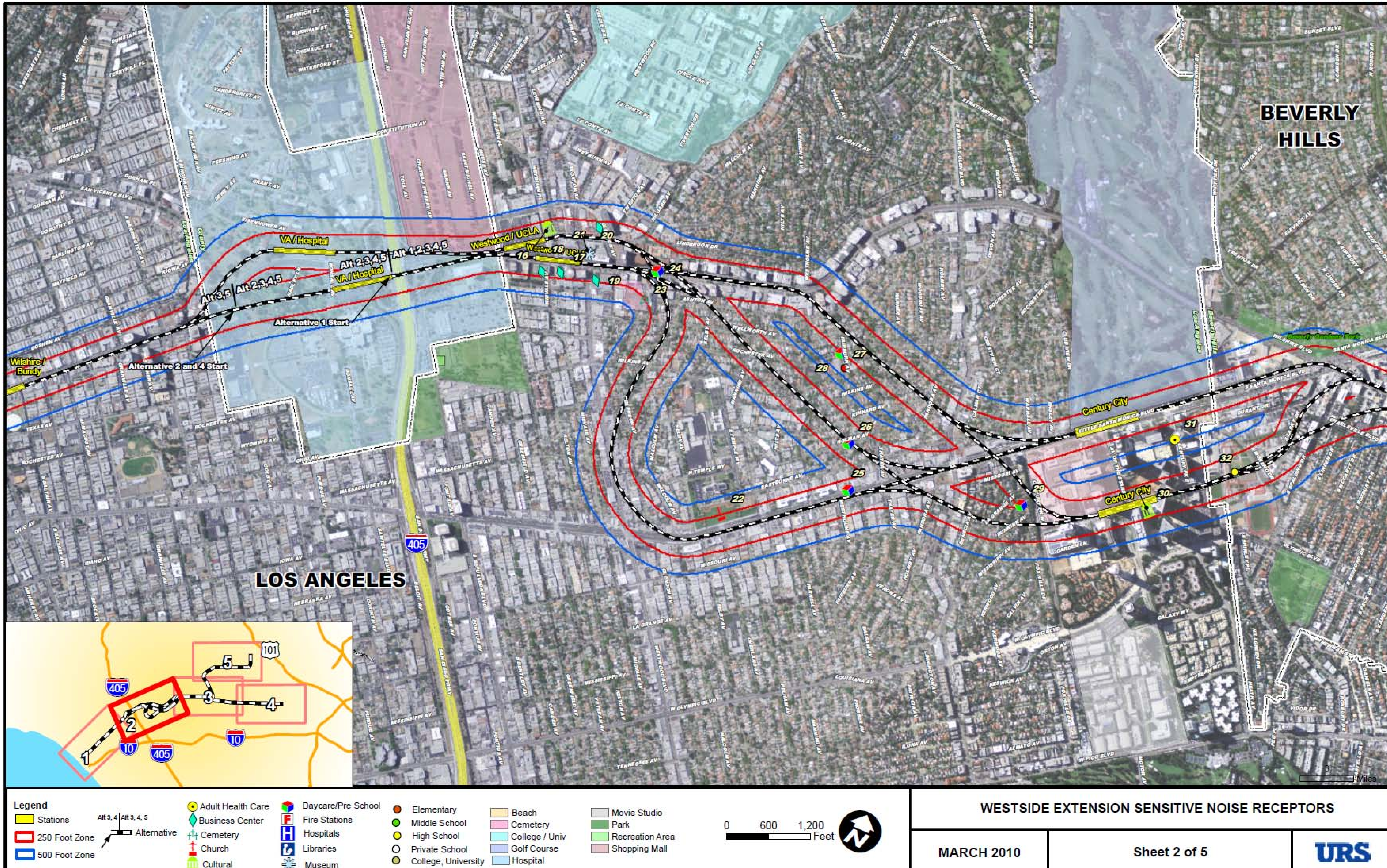
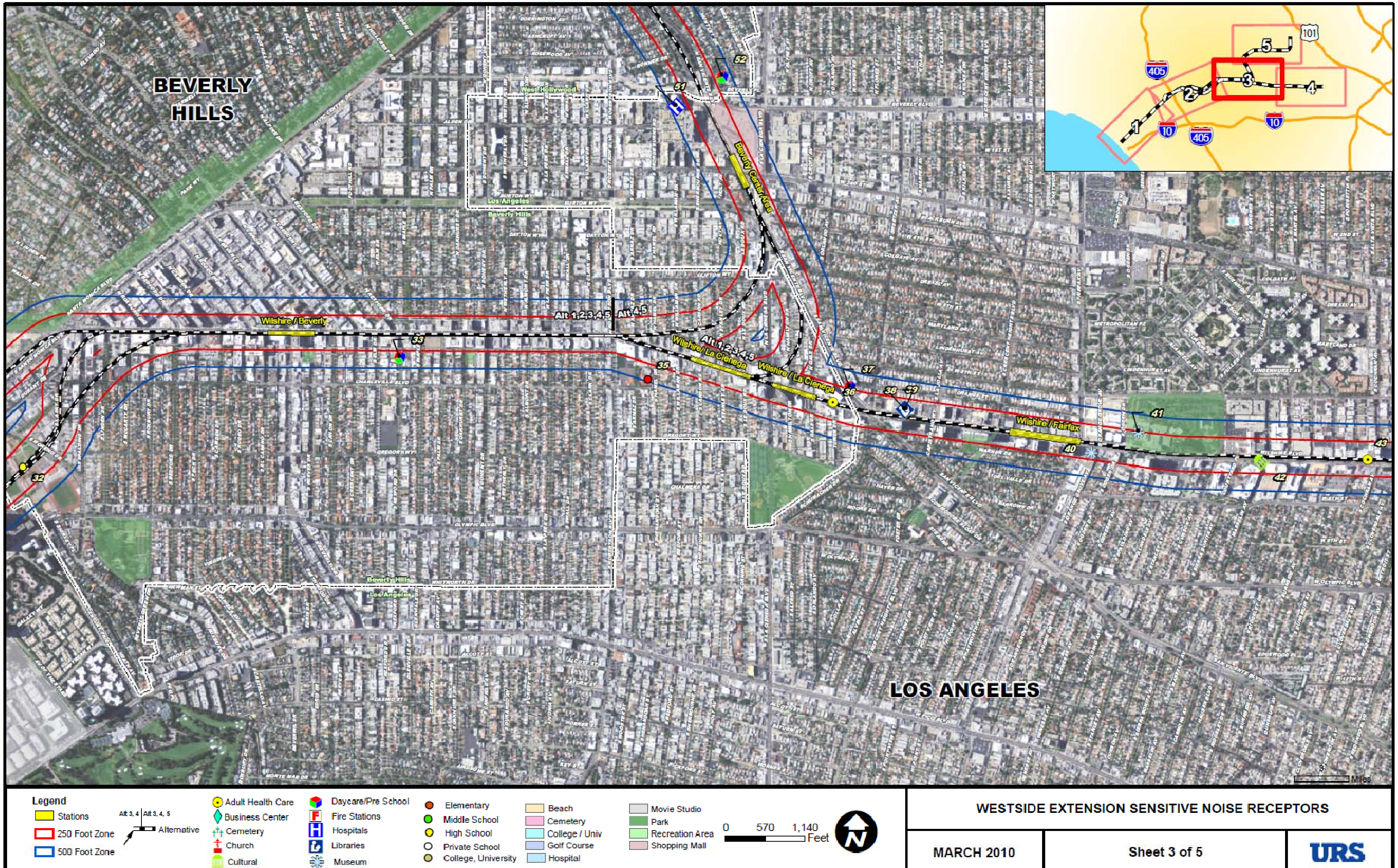
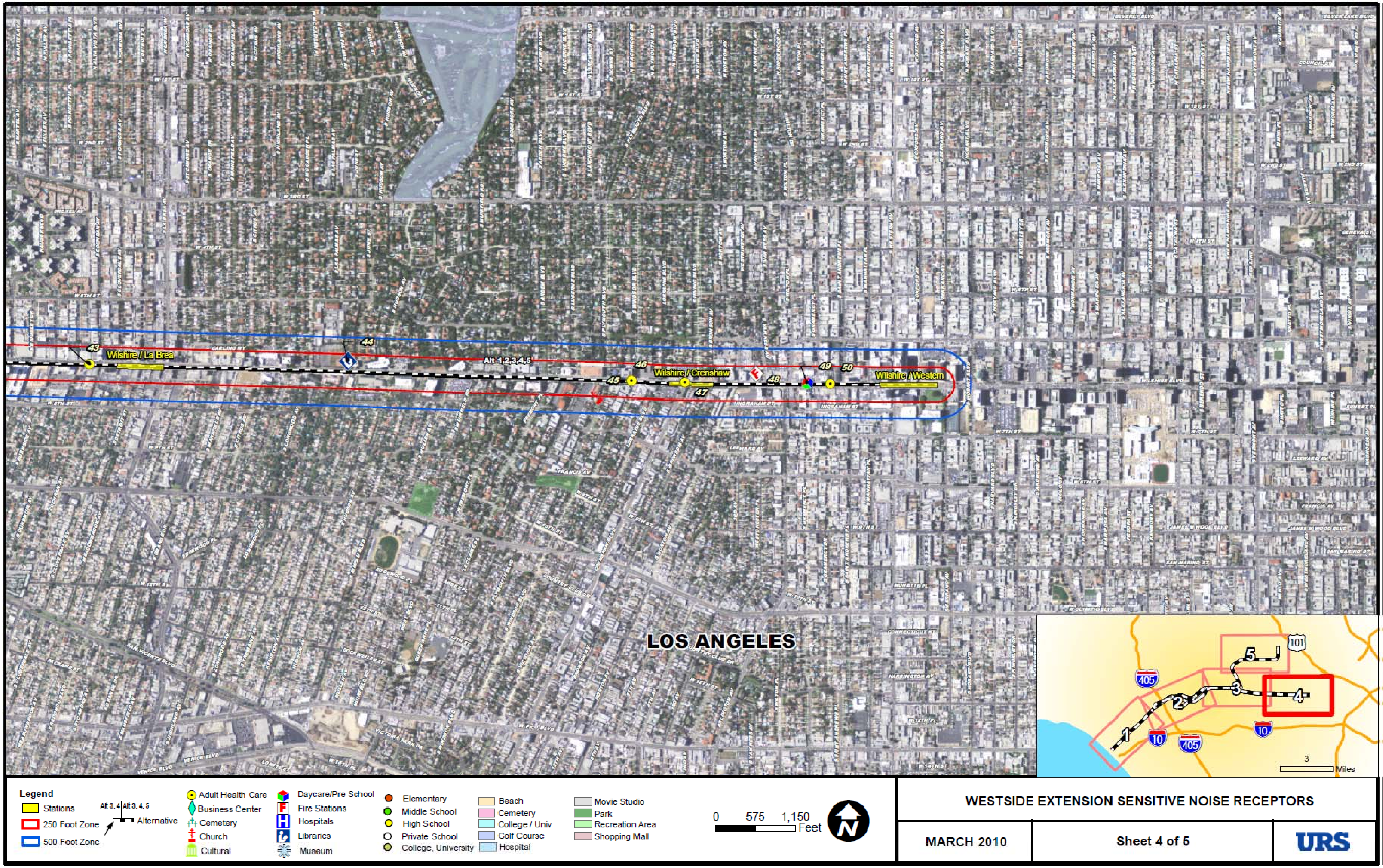
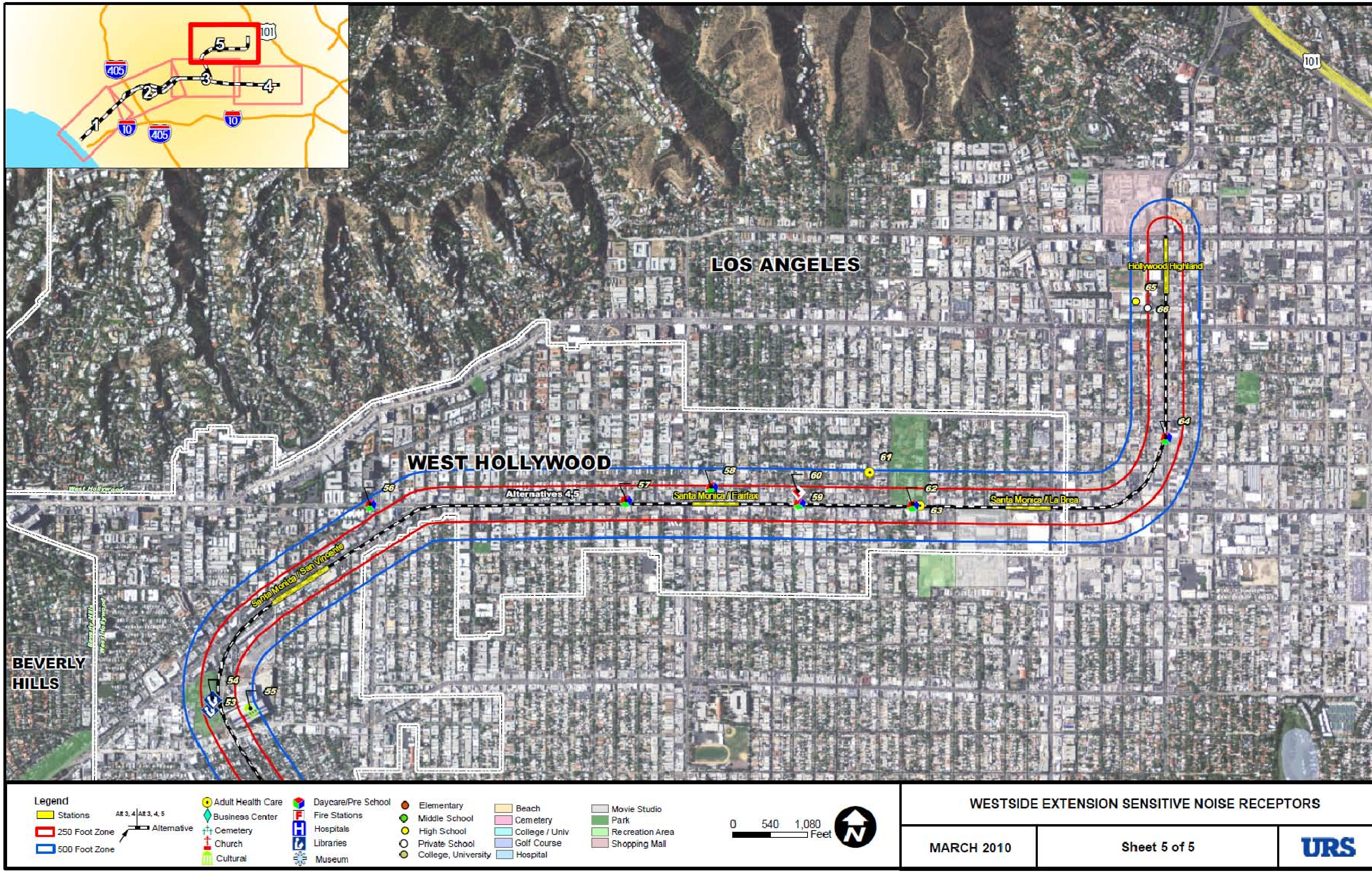


Figure 6-1: Noise Sensitive Receptors


BEVERLY HILLS
LOS ANGELES
VA / Hospital
Westwood / UCLA
Wilshire / Bundy
Century City
Alt 3,5
Alt 2,3,4,5
Alt 1,2,3,4,5
Alternative 1 Start
Alternative 2 and 4 Start
405
10
101
Legend
Stations
250 Foot Zone
500 Foot Zone
Alternative
Adult Health Care
Business Center
Cemetery
Church
Cultural
Daycare/Pre School
Fire Stations
Hospitals
Libraries
Museum
Elementary
Middle School
High School
Private School
College, University
Beach
Cemetery
College / Univ
Golf Course
Hospital
Movie Studio
Park
Recreation Area
Shopping Mall
0 600 1,200 Feet
WESTSIDE EXTENSION SENSITIVE NOISE RECEPTORS
MARCH 2010
Sheet 2 of 5
URS


BEVERLY HILLS
LOS ANGELES
West Hollywood
Los Angeles
Beverly Hills
Wilshire / Beverly
Alt 1,2,3,4,5
Alt 4,5
Wilshire / La Cienega
Beverly Center Area
Wilshire / Fairfax
32
33
35
36
37
38
39
40
41
42
43
51
52
1
2
3
4
5
405
10
101
Legend
Stations
250 Foot Zone
500 Foot Zone
Alt 3, 4
Alt 3, 4, 5
Alternative
Adult Health Care
Business Center
Cemetery
Church
Cultural
Daycare/Pre School
Fire Stations
Hospitals
Libraries
Museum
Elementary
Middle School
High School
Private School
College, University
Beach
Cemetery
College / Univ
Golf Course
Hospital
Movie Studio
Park
Recreation Area
Shopping Mall
0
570
1,140
Feet
WESTSIDE EXTENSION SENSITIVE NOISE RECEPTORS
MARCH 2010
Sheet 3 of 5
URS


Wilshire / La Brea
Wilshire / Crenshaw
Wilshire / Western
Alt 1,2,3,4,5
43
44
45
46
47
48
49
50
LOS ANGELES
Legend
Stations
250 Foot Zone
500 Foot Zone
Alt 3, 4
Alt 3, 4, 5
Alternative
Adult Health Care
Business Center
Cemetery
Church
Cultural
Daycare/Pre School
Fire Stations
Hospitals
Libraries
Museum
Elementary
Middle School
High School
Private School
College, University
Beach
Cemetery
College / Univ
Golf Course
Hospital
Movie Studio
Park
Recreation Area
Shopping Mall
0
575
1,150
Feet
WESTSIDE EXTENSION SENSITIVE NOISE RECEPTORS
MARCH 2010
Sheet 4 of 5
URS
1
2
3
4
5
405
101
10
3
Miles


LOS ANGELES
WEST HOLLYWOOD
BEVERLY HILLS
Alternatives 4,5
Santa Monica / San Vicente
Santa Monica / Fairfax
Santa Monica / La Brea
Hollywood Highland
53
54
55
56
57
58
59
60
61
62
63
64
65
66
101
405
10
1
2
3
4
5
Legend
Stations
250 Foot Zone
500 Foot Zone
Alt 3, 4
Alt 3, 4, 5
Alternative
Adult Health Care
Business Center
Cemetery
Church
Cultural
Daycare/Pre School
Fire Stations
Hospitals
Libraries
Museum
Elementary
Middle School
High School
Private School
College, University
Beach
Cemetery
College / Univ
Golf Course
Hospital
Movie Studio
Park
Recreation Area
Shopping Mall
0
540
1,080
Feet
N
WESTSIDE EXTENSION SENSITIVE NOISE RECEPTORS
MARCH 2010
Sheet 5 of 5
URS

6.3.1 No Build Alternative

Under the No Build Alternative there will be no construction activities and therefore no construction-related noise or vibration impacts would occur.

6.3.2 Transportation System Management (TSM) Alternative

The TSM Alternative requires no construction activities and therefore no construction-related noise or vibration impacts would occur.

6.3.3 Alternative 1 – Westwood/UCLA Extension

Potential noise and vibration sensitive receivers within 250 feet and 500 feet of the alignment have been identified based on GIS land use analysis for the proposed project alignment and station locations. There are a total of 17 identified potential noise and vibration sensitive receptors within 250 feet of the proposed alignment and an additional nine potential noise and vibration sensitive receptors within 500 feet of the proposed alignment (see the tables below).

For the proposed Alternative 1 stations, there are three potential noise and vibration sensitive receptors with 250 feet and an additional five potential noise and vibration sensitive receptors with 500 feet (see the tables below).

The types and levels of noise and vibration associated with tunneling and construction activities in the known gassy or potentially gassy areas would be generally the same as those associated with tunneling in the non-gas zones. In both zones, construction activities that generate noise include demolition, station construction, worker travel, hauling of soils and debris for disposal, deliveries of materials, and other related tasks.

Because a Slurry-Face TBM will likely be used for tunneling in the known gassy or potentially gassy areas, the slurry plant would be an additional component of the construction activities and associated noise. Noise from the treatment plant may be mitigated partially by enclosing the plant behind soundwalls or within a building. The noise associated with this single component would not result in higher noise levels as compared to the overall construction activities.

Table 6-8: Westwood/UCLA Extension - Noise and Vibration Sensitive Receivers Within 250 Feet of Project Alignment

ID	Name	Category
18	Gayley Center	Cultural
20	Armand Hammer Museum	Museum
21	Westwood Center	Business Center
24	Westwood Presbyterian School	Daycare
36	Carmelite Elder Care Management	Adult Health Care
38	Martyrs Memorial And Museum of the Holocaust	Museum
39	Peter M Khan Memorial Library	Library
40	Petersen Automotive Museum	Museum
41	Los Angeles County Art Museum	Museum
42	German Cultural Center	Cultural
43	Comfort Keepers	Adult Health Care
44	Memorial Branch Los Angeles Public Library	Library
46	Impact Clinical Trials (Adult Daycare)	Adult Health Care
47	Family Home Healthcare	Adult Health Care
48	FS	Fire Station
49	Evergreen Child Care	Daycare
50	Wilshire Adult Day Healthcare	Adult Health Care
Total 17		

Table 6-9: Westwood/UCLA Extension - Noise and Vibration Sensitive Receivers Within 250 to 500 Feet of Project Alignment

ID	Name	Category
16	Tishman Building	Business Center
27	Fairburn Avenue Elementary School	Elementary School
28	Fairburn PTA Star Program	Daycare
31	Elder Friends Inc.	Adult Health Care
33	Hebrew Academy Nessah	Daycare
34	Nessah Nursery School	Daycare
35	Horace Mann Elementary School	Elementary School
37	Montessori Children's World	Daycare
45	Wilshire United Methodist Church	Church
Total 9		

Table 6-10: Westwood/UCLA Extension - Noise and Vibration Sensitive Receivers Within 250 Feet of Proposed Stations

ID	Name	Category
18	Gayley Center	Cultural
40	Petersen Automotive Museum	Museum
47	Family Home Healthcare	Adult Health Care
Total 3		

Table 6-11: Westwood/UCLA Extension - Noise and Vibration Sensitive Receivers Within 250 to 500 Feet of Proposed Stations

ID	Name	Category
16	Tishman Building	Business Center
17	Unisys Building	Business Center
36	Carmelite Elder Care Management	Adult Health Care
37	Montessori Children's World	Daycare
43	Comfort Keepers	Adult Health Care
Total 5		

6.3.4 Alternative 2 – Westwood/VA Hospital Extension

Potential noise and vibration sensitive receivers within 250 feet and 500 feet of Alternative 2 have been identified based on GIS land use analysis for the proposed project alignment and station locations (see the tables below). There are a total of 17 identified potential noise and vibration sensitive receptors within 250 feet of the proposed alignment and an additional nine potential noise and vibration sensitive receptors within 500 feet of the proposed alignment.

For the proposed stations along Alternative 2, there are three potential noise and vibration sensitive receptors with 250 feet and an additional five potential noise and vibration sensitive receptors with 500 feet (see the tables below).

Table 6-12: Alternative 2 - Westwood/VA Hospital Extension - Noise and Vibration Sensitive Receivers Within 250 Feet of Project Alignment

ID	Name	Category
18	Gayley Center	Cultural
20	Armand Hammer Museum	Museum
21	Westwood Center	Business Center
24	Westwood Presbyterian School	Daycare
36	Carmelite Elder Care Management	Adult Health Care
38	Martyrs Memorial And Museum of the Holocaust	Museum
39	Peter M Khan Memorial Library	Library
40	Petersen Automotive Museum	Museum
41	Los Angeles County Art Museum	Museum
42	German Cultural Center	Cultural
43	Comfort Keepers	Adult Health Care
44	Memorial Branch Los Angeles Public Library	Library
46	Impact Clinical Trials (Adult Daycare)	Adult Health Care
47	Family Home Healthcare	Adult Health Care
48	FS	Fire Station
49	Evergreen Child Care	Daycare
50	Wilshire Adult Day Healthcare	Adult Health Care
Total 17		

Table 6-13: Alternative 2 - Westwood/VA Hospital Extension - Noise and Vibration Sensitive Receivers Within 250 to 500 Feet of Project Alignment

ID	Name	Category
16	Tishman Building	Business Center
27	Fairburn Avenue Elementary School	Elementary School
28	Fairburn PTA Star Program	Daycare
31	Elder Friends Inc.	Adult Health Care
33	Hebrew Academy Nessah	Daycare
34	Nessah Nursery School	Daycare
35	Horace Mann Elementary School	Elementary School
37	Montessori Children's World	Daycare
45	Wilshire United Methodist Church	Church
Total 9		

Table 6-14: Alternative 2 - Westwood/VA Hospital Extension - Noise and Vibration Sensitive Receivers Within 250 Feet of Proposed Stations

ID	Name	Category
18	Gayley Center	Cultural
40	Petersen Automotive Museum	Museum
47	Family Home Healthcare	Adult Health Care
Total 3		

Table 6-15: Alternative 2 - Westwood/VA Hospital Extension - Noise and Vibration Sensitive Receivers Within 250 to 500 Feet of Proposed Stations

ID	Name	Category
16	Tishman Building	Business Center
17	Unisys Building	Business Center
36	Carmelite Elder Care Management	Adult Health Care
37	Montessori Children's World	Daycare
43	Comfort Keepers	Adult Health Care
Total 5		

6.3.5 Alternative 3 – Santa Monica Extension

Potential noise and vibration sensitive receivers within 250 feet and 500 feet of Alternative 3 have been identified based on GIS land use analysis for the proposed project alignment and station locations (see the tables below). A total of 27 potential noise and vibration sensitive receptors were identified within 250 feet of the proposed alignment and an additional 14 potential noise and vibration sensitive receptors were within 500 feet of the proposed alignment.

For the proposed stations along Alternative 3, there are nine potential noise and vibration sensitive receptors with 250 feet and an additional six potential noise and vibration sensitive receptors with 500 feet (see the tables below).

Table 6-16: Alternative 3 - Santa Monica Extension - Noise and Vibration Sensitive Receivers Within 250 Feet of Project Alignment

ID	Name	Category
1	First Presbyterian Nursery	Daycare
2	Delphi Academy of Santa Monica	Daycare
3	Getty Center for the History of Art and the Humanities	Museum
4	Church of Saint Augustine By-The-Sea	Church
5	Nichiren Shoshu of America Temple	Church
8	Santa Monica Hospital Medical	Hospital
10	Pilgrim Lutheran Pre-School	Daycare
11	Pilgrim Lutheran Church	Church
12	The Lighthouse Church	Church
13	Cassidy Pre-School	Daycare
18	Gayley Center	Cultural
20	Armand Hammer Museum	Museum
21	Westwood Center	Business Center
24	Westwood Presbyterian School	Daycare
36	Carmelite Elder Care Management	Adult Health Care
38	Martyrs Memorial And Museum of the Holocaust	Museum
39	Peter M Khan Memorial Library	Library
40	Petersen Automotive Museum	Museum
41	Los Angeles County Art Museum	Museum
42	German Cultural Center	Cultural
43	Comfort Keepers	Adult Health Care
44	Memorial Branch Los Angeles Public Library	Library
46	Impact Clinical Trials (Adult Daycare)	Adult Health Care
47	Family Home Healthcare	Adult Health Care
48	FS	Fire Station
49	Evergreen Child Care	Daycare
50	Wilshire Adult Day Healthcare	Adult Health Care
Total 27		

Table 6-17. Alternative 3 – Santa Monica Extension – Noise and Vibration Sensitive Receivers within 250 to 500 feet of Project Alignment

ID	Name	Category
6	Joslyn Hall	Adult Health Care
7	Miles Memorial Playhouse	Cultural
9	UCLA Medical Center Orthopedic Hospital	Hospital
14	St Johns Hospital Health Center	Hospital
15	Mariner Post-Acute	Adult Health Care
16	Tishman Building	Business Center
27	Fairburn Avenue Elementary School	Elementary School
28	Fairburn PTA Star Program	Daycare
31	Elder Friends Inc.	Adult Health Care
33	Hebrew Academy Nessah	Daycare
34	Nessah Nursery School	Daycare
35	Horace Mann Elementary School	Elementary School
37	Montessori Children's World	Daycare
45	Wilshire United Methodist Church	Church
Total 14		

Table 6-18: Alternative 3 - Santa Monica Extension - Noise and Vibration Sensitive Receivers Within 250 Feet of Proposed Stations

ID	Name	Category
1	First Presbyterian Nursery	Daycare
2	Delphi Academy of Santa Monica	Daycare
3	Getty Center for the History of Art and the Humanities	Museum
4	Church of Saint Augustine By-The-Sea	Church
5	Nichiren Shoshu of America Temple	Church
8	Santa Monica Hospital Medical	Hospital
18	Gayley Center	Cultural
40	Petersen Automotive Museum	Museum
47	Family Home Healthcare	Adult Health Care
Total 9		

Table 6-19: Alternative 3 - Santa Monica Extension - Noise and Vibration Sensitive Receivers Within 250 to 500 Feet of Proposed Stations

ID	Name	Category
9	UCLA Medical Center Orthopedic Hospital	Hospital
16	Tishman Building	Business Center
17	Unisys Building	Business Center
36	Carmelite Elder Care Management	Adult Health Care
37	Montessori Children's World	Daycare
43	Comfort Keepers	Adult Health Care
Total 6		

6.3.6 Alternative 4 – Westwood/VA Hospital Extension plus West Hollywood Extension

Potential noise and vibration sensitive receivers within 250 feet and 500 feet of Alternative 4 have been identified based on GIS land use analysis for the proposed project alignment and station locations (see the tables below). A total of 26 potential noise and vibration sensitive receptors were identified within 250 feet of the proposed alignment, and an additional 16 potential noise and vibration sensitive receptors were identified within 500 feet of the proposed alignment.

For the proposed stations along Alternative 4, there are four potential noise and vibration sensitive receptors with 250 feet and an additional seven potential noise and vibration sensitive receptors with 500 feet (see the tables below).

Table 6-20: Alternative 4 - Westwood/VA Hospital Extension + West Hollywood Extension - Noise and Vibration Sensitive Receivers Within 250 Feet of Project Alignment

ID	Name	Category
18	Gayley Center	Cultural
20	Armand Hammer Museum	Museum
21	Westwood Center	Business Center
24	Westwood Presbyterian School	Daycare
36	Carmelite Elder Care Management	Adult Health Care
38	Martyrs Memorial And Museum of the Holocaust	Museum
39	Peter M Khan Memorial Library	Library
40	Petersen Automotive Museum	Museum
41	Los Angeles County Art Museum	Museum
42	German Cultural Center	Cultural
43	Comfort Keepers	Adult Health Care
44	Memorial Branch Los Angeles Public Library	Library
46	Impact Clinical Trials (Adult Daycare)	Adult Health Care
47	Family Home Healthcare	Adult Health Care
48	FS	Fire Station
49	Evergreen Child Care	Daycare
50	Wilshire Adult Day Healthcare	Adult Health Care
53	West Hollywood Branch County of Los Angeles Public	Library
54	West Hollywood Library	Library
57	Beverly Hills Montessori School	Daycare
58	Fountain Day School	Daycare
59	L' Chaim Daycare	Daycare
60	FS	Fire Station
62	West Hollywood Pre-School	Daycare
63	Partners Adult Day Healthcare	Adult Health Care
64	Hollywood Little Red School House	Daycare
Total 26		

Table 6-21: Alternative 4 - Westwood/VA Hospital Extension + West Hollywood Extension - Noise and Vibration Sensitive Receivers Within 250 to 500 Feet of Project Alignment

ID	Name	Category
16	Tishman Building	Business Center
27	Fairburn Avenue Elementary School	Elementary School
28	Fairburn PTA Star Program	Daycare
31	Elder Friends Inc.	Adult Health Care
33	Hebrew Academy Nessah	Daycare
34	Nessah Nursery School	Daycare
35	Horace Mann Elementary School	Elementary School
37	Montessori Children's World	Daycare
45	Wilshire United Methodist Church	Church
51	Cedars-Sinai Medical Center	Hospital
52	Mainmonides Academy	Daycare
55	Pacific Design Center	cultural
56	The Holloway School	Daycare
61	Raya's Paradise	Adult Health Care
65	Hollywood Senior High School	High School
66	Blessed Sacrament School	Private School
Total 16		

Table 6-22: Alternative 4 - Westwood/VA Hospital Extension + West Hollywood Extension - Noise and Vibration Sensitive Receivers Within 250 Feet of Proposed Stations

ID	Name	Category
18	Gayley Center	Cultural
40	Petersen Automotive Museum	Museum
47	Family Home Healthcare	Adult Health Care
58	Fountain Day School	Daycare
Total 4		

Table 6-23: Alternative 4 - Westwood/VA Hospital Extension + West Hollywood Extension - Noise and Vibration Sensitive Receivers Within 250 to 500 Feet of Proposed Stations

ID	Name	Category
16	Tishman Building	Business Center
17	Unisys Building	Business Center
36	Carmelite Elder Care Management	Adult Health Care
37	Montessori Children's World	Daycare
43	Comfort Keepers	Adult Health Care
65	Hollywood Senior High School	High School
66	Blessed Sacrament School	Private School
Total 7		

6.3.7 Alternative 5 – Santa Monica Extension plus West Hollywood Extension

Potential noise and vibration sensitive receivers within 250 feet and 500 feet of Alternative 5 have been identified based on GIS land use analysis for the proposed project alignment and station locations (see the tables below). There are a total of 36 identified potential noise and vibration sensitive receptors within 250 feet of the proposed alignment and an additional 21 potential noise and vibration sensitive receptors within 500 feet of the proposed alignment.

For the proposed stations along Alternative 5, there are ten potential noise and vibration sensitive receptors with 250 feet and an additional eight potential noise and vibration sensitive receptors with 500 feet (see the tables below).

Table 6-24: Alternative 5 - Santa Monica Extension + West Hollywood Extension - Noise and Vibration Sensitive Receivers Within 250 Feet of Project Alignment

ID	Name	Category
1	First Presbyterian Nursery	Daycare
2	Delphi Academy of Santa Monica	Daycare
3	Getty Center for the History of Art and the Humanities	Museum
4	Church of Saint Augustine By-The-Sea	Church
5	Nichiren Shoshu of America Temple	Church
8	Santa Monica Hospital Medical	Hospital
10	Pilgrim Lutheran Pre-School	Daycare
11	Pilgrim Lutheran Church	Church
12	The Lighthouse Church	Church
13	Cassidy Pre-School	Daycare
18	Gayley Center	Cultural
20	Armand Hammer Museum	Museum
21	Westwood Center	Business Center
24	Westwood Presbyterian School	Daycare
36	Carmelite Elder Care Management	Adult Health Care
38	Martyrs Memorial And Museum of the Holocaust	Museum
39	Peter M Khan Memorial Library	Library
40	Petersen Automotive Museum	Museum
41	Los Angeles County Art Museum	Museum
42	German Cultural Center	Cultural
43	Comfort Keepers	Adult Health Care
44	Memorial Branch Los Angeles Public Library	Library
46	Impact Clinical Trials (Adult Daycare)	Adult Health Care
47	Family Home Healthcare	Adult Health Care
48	FS	Fire Station
49	Evergreen Child Care	Daycare
50	Wilshire Adult Day Healthcare	Adult Health Care
53	West Hollywood Branch County of Los Angeles Public	Library
54	West Hollywood Library	Library
57	Beverly Hills Montessori School	Daycare
58	Fountain Day School	Daycare
59	L' Chaim Daycare	Daycare
60	FS	Fire Station
62	West Hollywood Pre-School	Daycare
63	Partners Adult Day Healthcare	Adult Health Care
64	Hollywood Little Red School House	Daycare
Total 36		

Table 6-25: Alternative 5 - Santa Monica Extension + West Hollywood Extension - Noise and Vibration Sensitive Receivers Within 250 to 500 Feet of Project Alignment

ID	Name	Category
6	Joslyn Hall	Adult Health Care
7	Miles Memorial Playhouse	Cultural
9	UCLA Medical Center Orthopedic Hospital	Hospital
14	St Johns Hospital Health Center	Hospital
15	Mariner Post-Acute	Adult Health Care
16	Tishman Building	Business Center
27	Fairburn Avenue Elementary School	Elementary School
28	Fairburn PTA Star Program	Daycare
31	Elder Friends Inc.	Adult Health Care
33	Hebrew Academy Nessah	Daycare
34	Nessah Nursery School	Daycare
35	Horace Mann Elementary School	Elementary School
37	Montessori Children's World	Daycare
45	Wilshire United Methodist Church	Church
51	Cedars-Sinai Medical Center	Hospital
52	Mainmonides Academy	Daycare
55	Pacific Design Center	Adult Health Care
56	The Holloway School	Daycare
61	Raya's Paradise	Adult Health Care
65	Hollywood Senior High School	High School
66	Blessed Sacrament School	Private School
Total 21		

Table 6-26: Alternative 5 - Santa Monica Extension + West Hollywood Extension - Noise and Vibration Sensitive Receivers Within 250 Feet of Proposed Stations

ID	Name	Category
1	First Presbyterian Nursery	Daycare
2	Delphi Academy of Santa Monica	Daycare
3	Getty Center for the History of Art and the Humanities	Museum
4	Church of Saint Augustine By-The-Sea	Church
5	Nichiren Shoshu of America Temple	Church
8	Santa Monica Hospital Medical	Hospital
18	Gayley Center	Cultural
40	Petersen Automotive Museum	Museum
47	Family Home Healthcare	Adult Health Care
58	Fountain Day School	Daycare
Total 10		

Table 6-27: Alternative 5 - Santa Monica Extension + West Hollywood Extension - Noise and Vibration Sensitive Receivers Within 250 to 500 Feet of Proposed Stations

ID	Name	Category
9	UCLA Medical Center Orthopedic Hospital	Hospital
16	Tishman Building	Business Center
17	Unisys Building	Business Center
36	Carmelite Elder Care Management	Adult Health Care
37	Montessori Children's World	Daycare
43	Comfort Keepers	Adult Health Care
65	Hollywood Senior High School	High School
66	Blessed Sacrament School	Private School
Total 8		

6.3.8 MOS 1 – Fairfax Station Terminus

Potential noise and vibration sensitive receivers within 250 feet and 500 feet of Alternative MOS 1 have been identified based on GIS land use analysis for the proposed project alignment and station locations. There are a total of 10 identified potential noise and vibration sensitive receptors within 250 feet of the proposed alignment and an additional one potential noise and vibration sensitive receptors within 500 feet of the proposed alignment.

For the proposed stations along Alternative MOS 1, there are x potential noise and vibration sensitive receptors with 250 feet and an additional x potential noise and vibration sensitive receptors with 500 feet.

6.3.9 MOS 2 – Century City Station Terminus

Potential noise and vibration sensitive receivers within 250 feet and 500 feet of Alternative MOS 2 have been identified based on GIS land use analysis for the proposed project alignment and station locations. There are a total of 13 identified potential noise and vibration sensitive receptors within 250 feet of the proposed alignment and an additional six potential noise and vibration sensitive receptors within 500 feet of the proposed alignment.

For the proposed stations along Alternative MOS 2, there are x potential noise and vibration sensitive receptors with 250 feet and an additional x potential noise and vibration sensitive receptors with 500 feet.

6.3.10 Maintenance and Operation Facility Sites

Based on GIS land use analysis there are no potential noise and vibration sensitive receivers within 500 feet of the Maintenance and Operation Facility Sites.

6.3.10.1 Vibration Impacts

Common vibration producing equipment used during station construction activities include, pile drivers, jackhammers, pavement breakers, hoe rams, augur drills, bulldozers and backhoes. Pile driving operations will probably be the activities that produce the highest level of vibration. Perceptible vibration levels could be experienced within 200 feet of pile driving operations.

Equipment used for underground construction, such as a tunnel boring machine and mine trains would generate vibration levels that could result in audible ground-borne noise levels in residential buildings at the surface. The operation of the mine trains would be the major source of underground construction vibration since it will operate continuously during the excavation, mining, and finishing of the tunnel.

Since underground construction is expected to occur continuously over a 24-hour day, there is the potential for these operations, particularly the mine trains, to be audible during the nighttime sleep hours when background noise levels inside the residential buildings are very low.

The most recent transit tunneling project in Los Angeles, the Metro Red Line Project, used a driven-shield TBM for the mining work. A ground vibration study of the mining operations was conducted to estimate construction vibration both from actual excavation of the tunnel and from the trains used to haul mine spoils out of the tunnel. The primary conclusions of the study are:

- Vibration from the tunnel excavation will rarely be a significant problem in adjacent areas, although the vibration can be sufficient to cause several hours of intrusive low level ground-borne vibration at areas above the tunnel.
- Although well below any damage thresholds, vibration from mine trains has the potential of causing intrusive ground-borne noise inside buildings above the tunnel.

6.3.11 Significance of Impacts

The noise and vibration impacts during construction would be adverse (NEPA) and significant (CEQA).

6.3.12 Cumulative Impacts

Cumulative noise and vibration impacts include noise and vibration associated with rerouting traffic, employee vehicle trips, and truck traffic along haul routes in addition to concurrent construction of other projects. At this time, information regarding street closures, rerouting traffic, employee vehicle trips, and haul routes is undetermined. Potential noise and vibration impacts from these activities will be determined as information becomes available.

6.4 Utilities

This section identifies the potential for the project to result in the disruption and/or relocation of utilities that would result in prolonged service disruption. A list of potential utility impacts at station locations is identified in Table 6-28.

It is expected that every major type of utility would be encountered in performing this work. During preconstruction, existing utilities may be more closely inspected and evaluated, including depth, condition, and exact location. An operation called “potholing” is typically done to physically locate certain utilities, which can then be appropriately marked or protected prior to main construction. Where in-place protection is not sufficient, relocation of utilities is required. Utility relocations can be done prior to or during main construction operations, depending on the sensitivity of the utility.

Prior to beginning construction it would be necessary to relocate, modify or protect in place all utilities and below-grade structures which would conflict with excavations for cut-and-cover stations, portals and vent shafts. Subject to other constraints, the below-grade stations would be located to avoid, to the extent possible, major conflicts with the space occupied by below-grade utilities. In certain instances, the positioning of a station or the location of station entrances and vent shafts would require that conflicting utilities be relocated to clear the way for the station structures. Utilities, such as water mains and gas lines, may represent potential hazards during cut-and-cover and open cut station construction. Utilities that are not to be permanently relocated away from the work site would be temporarily rerouted or protected in place to prevent accidental damage to the utilities, to construction personnel, and to the adjoining community. Buried utilities are often protected in place and supported by hanging from deck beams at cut-and-cover sections. Temporary interruptions in services (several hours) may be experienced during relocation or rerouting of utilities.

6.4.1 No Build Alternative

The No-Build Alternative would maintain the current utility service in the Corridor, and therefore would not impact utilities.

6.4.2 Transportation System Management (TSM) Alternative

The TSM Alternative would maintain the current utility service in the Corridor, and therefore would not impact utilities.

6.4.3 Alternative 1 – Westwood/UCLA Extension

6.4.3.1 Electricity, Natural Gas, Steam, Telecommunications, and Cable Television Services

Dry utilities will be impacted and may require temporary relocation, permanent relocation or protection in place. Impacts will be further validated in subsequent phases of the projects with consideration for early utility relocation evaluated to minimize impacts during the construction phase.

6.4.3.2 Wastewater and Stormwater Collection

There are potential conflicts identified at four station locations: La Brea, Rodeo Drive, Century City and UCLA that will require resolution by permanent relocation of the impacted storm drains and will be reviewed in more detail in subsequent phases of the project. Consideration for early utility relocation would be evaluated to minimize impacts during the construction of the station box.

6.4.4 Alternative 2 – Westwood/VA Hospital Extension

6.4.4.1 Electricity, Natural Gas, Steam, Telecommunications, and Cable Television Services

Dry utilities will be impacted and may require temporary relocation, permanent relocation or protection in place. Impacts will be further validated in subsequent phases of the projects with consideration for early utility relocation evaluated to minimize impacts during the construction phase.

6.4.4.2 Wastewater and Stormwater Collection

There are potential conflicts identified at four station locations: La Brea, Rodeo Drive, Century City and UCLA that may require resolution by permanent relocation of the impacted storm drains and will be reviewed in more detail in subsequent phases of the project. Consideration for early utility relocation would be evaluated to minimize impacts during the construction of the station box.

6.4.5 Alternative 3 – Santa Monica Extension

6.4.5.1 Electricity, Natural Gas, Steam, Telecommunications, and Cable Television Services

Dry utilities will be impacted and may require temporary relocation, permanent relocation or protection in place. Impacts will be further validated in subsequent phases of the projects with consideration for early utility relocation evaluated to minimize impacts during the construction phase.

6.4.5.2 Wastewater and Stormwater Collection

There are potential conflicts identified at seven station locations: La Brea, Rodeo Drive, Century City, UCLA, 26th Street, 16th Street and 4th Street that will require resolution by permanent relocation of the impacted storm drains and will be reviewed in more detail in subsequent phases of the project. Consideration for early utility relocation would be evaluated to minimize impacts during the construction of the station box.

6.4.6 Alternative 4 – Westwood/VA Hospital Extension plus West Hollywood Extension

6.4.6.1 Electricity, Natural Gas, Steam, Telecommunications, and Cable Television Services

Dry utilities will be impacted and may require temporary relocation, permanent relocation or protection in place. Impacts will be further validated in subsequent phases of the projects with consideration for early utility relocation evaluated to minimize impacts during the construction phase.

6.4.6.2 Wastewater and Stormwater Collection

There are potential conflicts identified at six station locations: La Brea, Rodeo Drive, Century City, UCLA, Hollywood/Highland and San Monica/San Vicente that will require resolution by permanent relocation of the impacted storm drains and will be reviewed in more detail in subsequent phases of the project. Consideration for early utility relocation would be evaluated to minimize impacts during the construction of the station box.

6.4.7 Alternative 5 – Santa Monica Extension plus West Hollywood Extension

6.4.7.1 Construction Impacts: Electricity, Natural Gas, Steam, Telecommunications, and Cable Television Services

Dry utilities will be impacted and may require temporary relocation, permanent relocation or protection in place. Impacts will be further validated in subsequent phases of the projects with consideration for early utility relocation evaluated to minimize impacts during the construction phase.

6.4.7.2 Construction Impacts: Wastewater and Stormwater Collection

There are potential conflicts identified at nine station locations: La Brea, Rodeo Drive, Century City, UCLA, 26th Street, 16th Street and 4th Street, Hollywood/Highland and San Monica/San Vicente that will require resolution by permanent relocation of the impacted storm drains and will be reviewed in more detail in subsequent phases of the project. Consideration for early utility relocation would be evaluated to minimize impacts during the construction of the station box.

6.4.8 MOS 1 – Fairfax Station Terminus

6.4.8.1 Electricity, Natural Gas, Steam, Telecommunications, and Cable Television Services

Dry utilities will be impacted and may require temporary relocation, permanent relocation or protection in place. Impacts will be further validated in subsequent phases of the projects with consideration for early utility relocation evaluated to minimize impacts during the construction phase.

6.4.8.2 Wastewater and Stormwater Collection

There are potential conflicts identified at one station location: La Brea that will require resolution by permanent relocation of the impacted storm drains and will be reviewed in more detail in subsequent phases of the project. Consideration for early utility relocation would be evaluated to minimize impacts during the construction of the station box.

6.4.9 MOS 2 – Century City Station Terminus

6.4.9.1 Electricity, Natural Gas, Steam, Telecommunications, and Cable Television Services

Dry utilities will be impacted and may require temporary relocation, permanent relocation or protection in place. Impacts will be further validated in subsequent phases of the projects with consideration for early utility relocation evaluated to minimize impacts during the construction phase.

6.4.9.2 Wastewater and Stormwater Collection

There are potential conflicts identified at three station locations: La Brea, Rodeo Drive and Century City, that will require resolution by permanent relocation of the impacted storm drains and will be reviewed in more detail in subsequent phases of the project. Consideration for early utility relocation would be evaluated to minimize impacts during the construction of the station box.

Table 6-28: Potential Utility Impacts

Station Location	Sewer	Storm	Water	Gas	Electric	Telephone/ Communi-cations
Wilshire/Crenshaw	X					X
Wilshire/La Brea	X	X	X	X	X	X
Wilshire/Fairfax	X		X		X	X
Wilshire/Fairfax - East	X		X			X
Wilshire/La Cienega	X	X				
Connection Structure	X					
Wilshire/La Cienega - West w/ Transfer (Option 3)	X	X				
Wilshire/Rodeo	X	X				
Century City (Santa Monica)	X	X			X	X
Century City (Constellation) (Option 4)	X	X	X		X	X
Westwood/UCLA (Off-Street)		X				
No. 14 Double Crossover						
Westwood/UCLA (On-Street) (Option 5)	X	X		X		X
Westwood/VA Hospital	X	X				
Westwood/VA Hospital – North (Option 6)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Wilshire/Bundy	X					
Wilshire/26th		X	X	X		
Wilshire/16th	X	X	X			
Wilshire/4th	X	X	X			
Hollywood/Highland	X	X				X
Santa Monica/La Brea	X	X				X
Santa Monica/Fairfax	X					X
Santa Monica/San Vicente	X	X				
Beverly Center Area	X	X				

6.4.10 Maintenance and Operation Facility Sites

The location of the maintenance sites would be Division 20 Maintenance Yard and Union Pacific Railroad Transportation Center Railroad. Utilities are currently provided for these locations. Therefore no utility relocation or protection would occur. Additional utility service would be needed for the expanded maintenance and operation facilities. No impacts to utilities are expected.

6.4.11 Significance of Impacts

The utility impacts during construction would be adverse (NEPA) and significant (CEQA) for all of the Build Alternatives.

6.4.12 Cumulative Impacts

A number of other development projects are currently under construction, in the planning stages, or proposed within the vicinity or adjacent to the proposed project. To minimize potential cumulative impacts associated with these projects, coordination of all projects with the utility service providers is critical to avoid any temporary or prolonged utility service outage. The utility companies and utility customers should consider planning any service upgrades now at the beginning of these urban renewal projects rather than trying to maintain a patch work utility infrastructure until all the proposed projects are completed. If acceptable to the utility providers, Metro will create a third party arbitrator to facilitate resolution of any disagreements between Metro, major utility companies, and city agencies regarding any utility issues. The third party arbitrator would rule on utility issues that would affect the proposed project or other development project within the vicinity or adjacent to the proposed project. With proper planning and scheduling, potential cumulative impacts would be reduced.

6.5 Business Disruption Impacts

This analysis discusses the disruption to businesses that would occur during the construction of the Metro Westside Subway Extension Project. It addresses construction effects on business which would continue to operate within leases of Metro-owned property along the corridor and businesses on adjacent privately owned parcels. Only one portal is currently envisioned for most stations and therefore, station area displacements would be less than shown, depending upon the portal site selection. Construction staging areas would generally be located on the site selected for the future portal.

This analysis is based on construction scenarios and techniques expected to be used for the Westside Subway Extension Project at this time. Further refinements in these business disruption descriptions will occur as the engineering team develops more detail regarding the construction scenarios and techniques that will be used. The business disruption effects addressed in this section would occur only during the construction period, and would therefore be temporary and relatively short-term. The construction scenarios described in Section 4.0 are used to evaluate construction impacts and to identify/propose mitigation measures. Information concerning business locations potentially affected by the project has been obtained from the Real Estate-Acquisitions Technical Report (Metro, 2010) and the Economic and Fiscal Impact Analysis and Mitigation Technical Report (Metro, 2010).

A majority of the Alternatives 1, 2, 3, 4, 5 and MOS 1 and 2 alignments would be constructed underneath existing transportation right-of-ways and are centered along the Wilshire Corridor, a designated transit corridor adopted by the City of Los Angeles General Plan Framework Transportation Element. The primary effects (both direct and indirect) on businesses are likely to be felt immediately adjacent to stations (less than 1/4-mile), diminishing with increasing distance from the station. Potential station area impacts, including, but not limited to, noise and traffic, are addressed individually in the relevant sections that analyze traffic and noise, but they are also summarized below.

- Traffic and Parking Effects—Businesses most likely to be affected by project construction would include those that depend on on-street parking or street access, which would be limited during construction. Access, however, will be provided by Metro at all times in some form or proximate location to all businesses. Employees and contractors requiring parking during construction would use only Metro-owned parcels for parking, thus not interfering with on-street parking for customers of businesses. Bicycle routes and pedestrian access will also be altered periodically throughout the construction period depending on the phase of construction. These changes in circulation patterns are expected to adversely affect businesses in the construction zones for several years during construction particularly as surface construction sequencing activity occurs adjacent to business areas.

- Noise/Vibration/Dust—Businesses that are sensitive to noise/vibration/dust may be affected by construction activities. Construction activities that generate noise/vibration/dust include demolition, cut-and-cover excavation and construction, dewatering, slurry treatment, worker travel, hauling of soils and debris for disposal, deliveries of materials, and other related tasks.

6.5.1 No Build Alternative

Under the No Build Alternative there will be no construction activities and therefore no construction-related business disruption impacts.

6.5.2 Transportation System Management (TSM) Alternative

The TSM Alternative requires no construction activities and therefore no construction-related business disruption impacts are anticipated under this alternative.

6.5.3 Alternative 1 – Westwood/UCLA Extension

Under Alternative 1, construction of the rail system would be fully underground and would not introduce any physical barriers that could affect a majority of businesses along the alignments. Construction of stations could require full and partial takes and temporary easements which would require relocations for those businesses. Construction of station portals could temporarily introduce barriers which could alter or hinder business, as discussed below.

Although Alternative 1 would attempt to maximize the public right-of-way for its alignment, stations, and ancillary structures, the following acquisitions and easements are anticipated:

- 40 Full Takes, including commercial business/retail spaces/offices and parking lots
- 5 Partial Takes, 3 commercial business/retail spaces/offices and 2 institutional
- 12 Permanent Easements, including 8 commercial business/retail spaces/offices
- 2 Temporary Construction Easements, 0 in commercial areas
- 218 Permanent Underground Easements, including numerous businesses that would not be affected by construction activities due to the depth of tunneling.

The acquisition of parcels for construction of the project would result in the displacement businesses. Each business displaced as a result of the proposed project would be given advance written notice and would be informed of their eligibility for relocation assistance and payments. Partial takes would not displace businesses. In addition, approximately 365 parking spaces would be removed from the UCLA property during construction which could indirectly hinder access to businesses in that area.

Regarding the loss of parking, typically, privately-operated parking lots are considered transitional land uses that could be developed by the owners for higher and better uses. Additionally, there are several other privately-operated parking lots and structures in the vicinity which could be used by the public for access to nearby businesses. Although loss of the current parking lot may cause a temporary inconvenience for customers, it would not represent a long-term adverse impact. This potential impact to parking would be partially offset by the increased public transit access provided by the proposed project in the long-term. No adverse impacts are anticipated due to the partial displacement of this parcel.

Table 6-29: Westwood/UCLA Extension Full Takes

APN	Address	Jurisdiction	Current Use	Intended Use
5093005006	3818 Wilshire Blvd	Los Angeles	Bridal Salon Retail Space	Construction Staging
5093005005	3820 Wilshire Blvd	Los Angeles	Elite Tailors Retail Space	Construction Staging
5093005004	3828 Wilshire Blvd	Los Angeles	Restaurant (Young Dong)	Construction Staging
5093005003	3832 Wilshire Blvd	Los Angeles	ECC Academy Retail Space	Construction Staging
5093005002	3846 Wilshire Blvd	Los Angeles	Wilshire State Bank Bldg Retail Spaces	Construction Staging
5093005009	3835 Ingraham St	Los Angeles	Residential Parking For Mercury Apartments	Construction Staging
5093005010	3841 Ingraham St	Los Angeles	Parking Lot Behind Wilshire Bank Bldg	Construction Staging
5093005011	3847 Ingraham St	Los Angeles	Parking Lot Behind Wilshire Bank Bldg	Construction Staging
5090032900	N/A	Los Angeles	Metro-Owned Vacant Lot/Parking	Potential Entrance/ Construction Staging
5090032005	675 Crenshaw Blvd	Los Angeles	Single-Family Residence	Entrance/Construction Staging
5507024010	5200 Wilshire Blvd	Los Angeles	Empty Lot Corner Of La Brea/Wilshire	Entrance
5507024009	5220 Wilshire Blvd	Los Angeles	Empty Lot Corner Of La Brea/Wilshire	Entrance
5089001027	711 S La Brea Ave	Los Angeles	Bank of America	Entrance/Construction Staging
5089001026	5318 Wilshire Blvd	Los Angeles	Retail Space	Entrance/Construction Staging
5089001025	729 S La Brea Ave	Los Angeles	Bank Parking	Construction Staging
5089001009	718 S Detroit St	Los Angeles	Parking Lot	Construction Staging
5089001008	722 S Detroit St	Los Angeles	Parking Lot	Construction Staging
5089001007	726 S Detroit St	Los Angeles	Parking Lot	Construction Staging
5086010004	6000 Wilshire Blvd	Los Angeles	Parking Lot For Retail Space	Construction Staging
5086010003	6010 Wilshire Blvd	Los Angeles	Retail Space	Construction Staging
5086010002	6018 Wilshire Blvd	Los Angeles	Retail Space Art Gallery	Construction Staging
5086010001	6030 Wilshire Blvd	Los Angeles	Retail Space Art Gallery	Construction Staging
5510027003	6111 Wilshire Blvd	Los Angeles	Marinello's Beauty School	Entrance

APN	Address	Jurisdiction	Current Use	Intended Use
5510027040	6121 Wilshire Blvd	Los Angeles	99 Cent Store	Staging
5510027005	6133 Wilshire Blvd	Los Angeles	Offices	Staging
5510027006	6139 Wilshire Blvd	Los Angeles	Parking For Offices	Staging
5510027038	6155 Wilshire Blvd	Los Angeles	Commercial	Generator & Staging
5088002034	6120 Wilshire Blvd	Los Angeles	Commercial	Entrance & Staging
5088002035	6122 Wilshire Blvd	Los Angeles	Residential/Commercial	Entrance & Staging
5088002036	N/A	Los Angeles	Commercial	Entrance & Staging
5088002037	6130 Wilshire Blvd	Los Angeles	Commercial	Entrance & Staging
5088002038	6146 Wilshire Blvd	Los Angeles	Commercial	Entrance & Staging
4333029015	8400 Wilshire Blvd	Beverly Hills	Restaurant	Construction Staging/Generator
4333029016	8412 Wilshire Blvd	Beverly Hills	Parking Lot For Medical Group Company	Construction Staging/Generator
4333029017	8420 Wilshire Blvd	Beverly Hills	Medical Bldg	Construction Staging
4333029014	N/A	Beverly Hills	Parking Lot For Businesses	Construction Staging/Generator
4334021059	8471 Wilshire Blvd	Beverly Hills	Citibank	Entrance/Construction Staging
4334008021	8755 Wilshire Blvd	Beverly Hills	Under Construction	Connection Structure
4334008020	8767 Wilshire Blvd	Beverly Hills	Under Construction	Connection Structure
4331001045	9430 Wilshire Blvd	Beverly Hills	Ace BH Art Gallery	Entrance/Construction Staging

To construct Alternative 1 – Westwood/UCLA Extension, two parcels would be acquired partially (Table 6-30). In addition, approximately 365 parking spaces would be removed from the UCLA property.

Table 6-30: Westwood/UCLA Extension Partial Takes

APN	Address	Jurisdiction	Current Use	Intended Use
5508007900	5301 Wilshire Blvd	Los Angeles	Property owned by LACMTA	Potential Entrance/ Construction Staging
4328033001	9460 Wilshire Blvd	Beverly Hills	Union Bank Building	Potential Entrance/ Construction Staging
4363026905	1100 Veteran Ave	Los Angeles	UCLA Property	Potential Entrance/ Construction Staging/ Generator
4324002027	10990 Wilshire Blvd	Los Angeles	Offices	Potential Entrance
4365008904	N/A	Los Angeles	VA Hospital	Station Envelope/Potential Entrance/Vent Shaft/Generator

Source: TAHA, 2010

To construct Alternative 1 – Westwood/UCLA Extension, permanent easements would be required from ten parcels (Table 6-30). Under Alternative 1, permanent easements would be required for station entrances, staging, and placement of generators on these parcels. The exact locations of the station entrances have not been determined, but they would not disrupt operations of the businesses or uses at these parcels.

Table 6-31: Westwood/UCLA Extension: Permanent Easements

APN	Address	Jurisdiction	Current Use	Intended Use
5508017007	6067 Wilshire Blvd	Los Angeles	LACMA	Potential Entrance
5510027035	6101 Wilshire Blvd	Los Angeles	Johnie's Coffee Shop	Potential Entrance
4334021060	8447 Wilshire Blvd	Beverly Hills	Offices	Potential Entrance
4333028015	8484 Wilshire Blvd	Beverly Hills	Flynt Publications	Potential Entrance
4343013028	9401 Wilshire Blvd	Beverly Hills	Citibank	Potential Entrance
4343013011	9429 Wilshire Blvd	Beverly Hills	Citibank/Sterling Bldg.	Potential Entrance
4343014022	9461 Wilshire Blvd	Beverly Hills	Bank of America Plaza	Potential Entrance
4343014023	9461 Wilshire Blvd	Beverly Hills	Offices	Potential Entrance
4343014024	9461 Wilshire Blvd	Beverly Hills	Offices	Potential Entrance
4343014025	9461 Wilshire Blvd	Beverly Hills	Offices	Potential Entrance
4319002046	1800 Avenue Of The Stars	Los Angeles	Plaza	Potential Entrance
4319003061	1801 Avenue Of The Stars	Los Angeles	Plaza	Potential Entrance

Source: TAHA, 2010

To construct Alternative 1 – Westwood/UCLA Extension, temporary construction easements would be required for two parcels (Table 6-31).

Table 6-32: Westwood/UCLA Extension: Temporary Construction Easements

APN	Address	Jurisdiction	Current Use	Intended Use
4324017903	11000 Wilshire Boulevard	Los Angeles	Federal Building	Cut & Cover
4365008904	11300 Wilshire Boulevard	Los Angeles	VA Hospital	Cut & Cover

Source: TAHA, 2010

Two (2) temporary construction easements would be involved and 217 parcels would possibly be subject to noise/vibration during underground tunneling construction activities, although due to the depth of tunneling impacts are not expected to be major.

- APN 4324017903 (11000 Wilshire Boulevard, Los Angeles; Figure 5-10 # 124) – This Federal Building parcel is not commercially occupied, but it is discussed here because it is currently occupied with federal offices. Part of the parcel is anticipated to be utilized for the cut and cover construction of the crossover tracks. Although no part of the building is anticipated to be impacted, part of the landscaped plaza would be disturbed and have restricted access during construction. However, access to the building would be maintained, as would security around the building. This easement would be temporary, and the site would be returned to pre-construction conditions once construction is completed. No adverse impacts are anticipated due to this temporary construction easement.

- APN 4365008904 (11300 Wilshire Boulevard, Los Angeles County; Figure 5-10 # 125) – This parcel is currently occupied by the Los Angeles County Veterans Administration (VA) Hospital and grounds, while not a commercial property is discussed here because of its dependence on customers (patients). Part of the parcel is anticipated to be utilized for the cut and cover construction of the pocket tracks and potentially an access point for the Tunnel Boring Machines (TBMs). Although no part of the building is anticipated to be impacted, part of the landscaped area and parking lot would be disturbed and have restricted access during construction. However, access to the building would be maintained. This easement would be temporary, and the site would be returned to pre-construction conditions once construction is completed. No adverse impacts are anticipated due to this temporary construction easement.

Prior to construction activities, community relations and construction staff from Metro would contact and interview individual businesses, allowing for knowledge and understanding of how these businesses carry out their work. This survey identifies business usage, delivery, and shipping patterns and critical times of the day or year for business activities. This information will be used by Metro to develop construction requirements and Worksite Traffic Control plans, identify alternative access routes, and make efforts during construction to maintain critical business activities.

The following construction activities could temporarily disrupt business activity near stations:

- **Construction Staging Areas:** Temporary easements, typically a portion of the sidewalk, traffic lanes, and/or parking areas would be required at various locations for construction staging. Construction within the streets is also envisioned where no off-street areas can be identified for work-sites and/or access to underground excavations, which could temporarily impact access to businesses.
- **Building Demolition:** As part of providing the land needed for construction, or preparing the necessary work areas, building demolition is often required. Demolition operations necessitate strict controls to ensure that adjacent buildings and infrastructure are not damaged or otherwise impacted by the demolition operations. These controls include construction fencing and barricades, environmental monitoring, and limits on the types of equipment and demolition procedures, which could temporarily impact access to businesses. Noise, vibration, and dust related to building demolition could also impact local businesses.
- **Utility Relocation and Street Closures:** Prior to construction it would be necessary to relocate, modify or protect in place all utilities and underground structures that would conflict with excavations. During this time, it may be necessary to occupy additional traffic lanes at one time. It is possible that in some instances, block-long sections of streets would be closed temporarily for utility relocation and related construction operations, which could temporarily impact access to businesses. Pedestrian access (sidewalks) would remain open. Temporary night sidewalk closures may be necessary in some locations for the delivery of oversized materials. Special facilities, such as handrails, fences, and walkways will be provided for the safety of pedestrians.

Minor cross streets and alleyways may also be temporarily closed but access to adjacent properties will be maintained. Major cross streets would require partial closure, half of the street at a time, while relocating utilities. Subject to other constraints, the underground stations have been located to avoid to the extent possible conflicts with the space occupied by utilities. Utilities, such as high-pressure water mains and gas lines, which could represent a potential hazard during cut-and-cover and open-cut station construction and that are not to be permanently relocated away from the work site, would be removed from the cut-and-cover or open-cut area temporarily to prevent accidental damage to the utilities, to construction personnel and to the adjoining community including businesses. These utilities would be relocated temporarily by the contractor at the early stages of the operations and reset in essentially their original locations during the final backfilling above the constructed station.

Utilities that need not be relocated, either permanently or temporarily, but that may be uncovered during the early stages of excavation, may require special provisions to provide access to businesses. These buried utilities, with the possible exception of sewers, are generally found within several feet of the street surface. They can be reinforced, if necessary, and supported by hanging from deck beams.

Utility relocations often entail some form of temporary service interruptions, which are typically limited to short periods during the cut-over from the existing to the relocated service. Such service interruptions are typically planned to occur at periods of minimum use (such as nights or weekends for businesses), so that outages have the least impact on users. In the event that utility relocation causes a service interruption, businesses could be impacted as they would be without these essential services.

In addition to utility relocations, various new utilities will be installed as required. These new installations can be expected to include communications cables (including fiber-optic lines), electrical duct-banks, drainage facilities (pipelines, catch basins, etc.), water supply lines, and lighting. These installations will generally be timed to coincide with major utility relocations where possible to minimize disruption to utility users, including businesses.

- **Stations:** Within the Wilshire/Western to Wilshire/Fairfax reach, there are two or three new stations to construct: Wilshire/Crenshaw, Wilshire/La Brea, and Wilshire/Fairfax. Wilshire/Crenshaw remains as an optional station at this time). Depending upon site constraints a station deck and support of excavation may be installed several lanes at a time or possibly through full road closures over extended weekends. Removal of decking after construction of the station and tunnels will be similarly staged. Takes and easements for local property (including businesses) would be required to construct stations. Temporary business closures to adjacent areas would be minimized to maintain access to businesses that are not directly affected.
- **Contractor Work and Storage Areas:** The on-street Wilshire/Fairfax Station excavation would be the first item of construction after demolition of existing buildings designated to be removed. Two TBMs could be assembled at the Wilshire/Fairfax Station construction staging area, located between South Crescent Heights Boulevard and Fairfax Avenue to the north side of Wilshire Boulevard. Utilities, air, water, disposal, electricity, sanitation, and communication equipment could be positioned near the east

end of the construction yard. Use of these working areas and yards would minimize adverse effects on businesses in the Wilshire/Fairfax station area.

- **Station Excavation and Construction:** Station Excavation and Construction could potentially impact access to businesses through increased traffic, dust, and noise and vibration. A typical station excavation would occur over an approximately 18-month period. The total sequences described for underground station construction could be up to 48 months. It is estimated that an average of 25 to 50 dump trucks per day would be required to haul and dispose of the excavated soils during excavation cycles for stations, which could cause increased traffic in the areas of station excavation.
- **Excavation Support:** If the pre-construction building assessments indicate the necessity to protect nearby existing structures, the first step in construction of an underground station is to support the foundations of buildings adjacent to the station excavation. This is typically done by underpinning, which involves the placement of additional foundation elements under the building to support the structure well below the area to be excavated. Alternatively, the ground below the existing foundations can be improved by other means such as grouting. In lieu of underpinning or grouting, or in combination with grouting, the support of adjacent structures is commonly accomplished by use of more rigid excavation support systems, which could temporarily impact use of access to underground structures by some businesses.
- **Dewatering:** Dewatering is likely to be required at the underground station sites to temporarily lower the groundwater level (if present) below the station excavation depth or to an impermeable soil layer. Installation of dewatering wells using drilling rigs could disrupt businesses.
- **Settlement**: Underground excavation for stations using the cut-and-cover technique can result in some ground relaxation and deformation of the retained soils. Buildings within the zone potentially susceptible to ground movement will be evaluated for susceptibility to settlement and the need for additional protection measures. Typical building protection measures are discussed Geotechnical and Hazardous Materials Technical Report (Metro, August 2010).
- **Traffic:** Businesses depend on access to customers. Traffic flow can be affected during the entire period of construction of at any given location, which is typically anticipated to be approximately 4-5 years. Depending on the traffic flow and location, a variety of mechanisms are available to control and maintain traffic in constricted intersections, including decking to temporarily replace street pavement and sidewalks, and temporary bridges. Decking will typically contain hatches or removable panels to facilitate lowering equipment or materials (such as odd-shaped and outsize items) down into the station excavation with minimal traffic disruption.

  Cross streets, if used, will typically be carried through intersections on similar decked structures. Pedestrian access (sidewalks) would remain open, although in some instances, portions of the sidewalks may be closed temporarily for decking construction. Where sidewalks must be temporarily removed, pedestrian access will be maintained by bridges, temporary walkways, and other means. Some streets may also have to be temporarily closed under certain special circumstances, such as deck beam installation, which could impact access to businesses.

- **Tunnel Settlement Protection Measures:** Structures (including businesses) located within settlement/deformation zones would be evaluated for potential impact and required mitigation measures. For shallow tunnels below sensitive structures or utilities, additional methods can be employed to reduce settlement. Such methods would depend on the ground conditions and structure details at specific areas.
- **Excavated Materials (Spoil) Removal:** During a subsequent phase of the project, suitable soil disposal sites will be identified to ensure the excavated material can be removed and transported to the disposal area in a timely and efficient operation. [Reference to haul routes to be inserted] Environmental concerns are often encountered at the site areas where spoils are transported from the underground work locations to the ground surface and then loaded into trucks. These are typically work zones subject to noise and dust control restrictions. Noise and/or dust walls are sometime required to mitigate these concerns.

Alternative 1 would displace businesses that involve 302 jobs. The acquisition of parcels would result in loss of $1,896,885property tax revenue dollars.

6.5.4 Alternative 2 – Westwood/VA Hospital Extension

This alternative would follow the same alignment as Alternative 1 – Westwood/UCLA Extension but would include one additional parcel at the VA Hospital.

To construct Alternative 2, impacts resulting from full takes, permanent easements, construction easements, and sub-surface permanent easements on parcels would be the same as under Alternative 1. Construction staging would occur near the VA Hospital. Under Option 6, the potential construction staging site is located in the parking lot on the north side of the station box near Wadsworth Theater.

Impacts from the construction phase for Alternative 2 would be the same as the described above for Alternative 1. In addition, if the Westwood/VA Hospital site is the terminus of choice, the site could be used as a TBM entry station, with mining proceeding east to the Century City Station. Since the Westwood/VA Hospital Station is located on VA property, station excavation could remain open, without the need for temporary decking. No street closures would be necessary. The VA site may require (partial) closure of Bonsall Avenue, the eastbound Bonsall/Wilshire on-ramp, and/or the 405 on and off ramps adjacent to the site. Further traffic control would only be needed for entering and exiting of construction traffic onto adjacent roadways, which could temporarily impact access to businesses.

Business disruption from Alternative 2 would cause the loss of 302jobs. The acquisition of parcels would result in loss of $1,896,885 property tax revenue dollars.

6.5.5 Alternative 3 – Santa Monica Extension

Although Alternative 3 would attempt to maximize the public right-of-way for its alignment, stations, and accessory structures, the following types and amounts of displacements are anticipated:

- 59 Full Takes, including approximately more than 17 businesses and 2 parking lots in addition to those described under Alternatives 1 and 2
- 5 Partial Takes, same as Alternatives 1 and 2

- 13 Permanent Easements, same as Alternatives 1 and 2 plus one additional easement for Alternative 3
- 2 Temporary Construction Easement, same as Alternatives 1 and 2
- 219 Permanent Underground Easements, same as Alternatives 1 and 2

These parcels would be utilized for construction staging, below grade tunneling, station locations, generator locations, and vent locations. Some station plans have multiple entrance options, though not all of them would be constructed. In these cases, all potential takings and easements for station entrances are evaluated.

Table 6-33: Alternative 3 – Santa Monica Extension: Additional Full Takes (Not in Alternatives 1 or 2)

APN	Address	Jurisdiction	Current Use	Intended Use
4265016050	N/A	Los Angeles	Ralph's Grocery Store	Potential Entrance/Construction Staging
4265016030	12071 Wilshire Blvd	Los Angeles	Small Businesses Nail/Barber/Tailor/Shoe Repair	Potential Entrance/Construction Staging
4265016029	12081 Wilshire Blvd	Los Angeles	Restaurant	Potential Entrance/ Construction Staging
4263003003	12036 Wilshire Blvd	Los Angeles	Wireless Electronics Store	Potential Entrance/ Construction Staging
4263003002	12040 Wilshire Blvd	Los Angeles	Storage Tanks	Potential Entrance/ Construction Staging
4263003001	12048 Wilshire Blvd	Los Angeles	Storage Tanks	Potential Entrance/ Construction Staging
4263003271	12054 Wilshire Blvd	Los Angeles	Storage Tanks	Potential Entrance/ Construction Staging
4266016054	2601 Wilshire Blvd	Santa Monica	Gas Station	Potential Entrance
4276001027	2525 Wilshire Blvd	Santa Monica	Several Small Businesses (Relax The Back, Starbucks, Postal, Tanning)	Potential Entrance/ Construction Staging/ Generator
4276001025	2515 Wilshire Blvd	Santa Monica	Non-Profit (Environment Now)	Potential Entrance/ Construction Staging/ Generator
4276001026	2501 Wilshire Blvd	Santa Monica	Several Shops (Shoe Repair, Nail Salon, Clothing Store, Jewelry, Tennis Shop, Scuba Shop) and Tennis Courts on Roof	Potential Entrance/ Construction Staging
4281005026	1501 Wilshire Blvd	Santa Monica	Electronics Store	Construction Staging
4281005025	1511 Wilshire Blvd	Santa Monica	Mattress Store	Construction Staging
4281011010	Wilshire Blvd and 15th Street	Santa Monica	Parking Lot	Construction Staging
4281011011	1433 Wilshire Blvd	Santa Monica	Izzy's Deli	Potential Entrance/ Construction Staging

APN	Address	Jurisdiction	Current Use	Intended Use
4281011012	1423 Wilshire Blvd	Santa Monica	Mattress Store	Potential Entrance/ Construction Staging
4281011025	1419 Wilshire Blvd	Santa Monica	Cleaners/Tehran Market	Potential Entrance/ Construction Staging
4291004015	412 Wilshire Blvd	Santa Monica	Jewelry/Bank	Potential Entrance/ Construction Staging
4291004014	1207 4th St	Santa Monica	Offices	Potential Entrance/ Construction Staging

Source: TAHA, 2010

Alterative 3 requires additional full acquisitions under Alternative 1 and 2 (

Table 6-33). Each business displaced would be given advance written notice and would be informed of their eligibility for relocation assistance and payments. Where relocation of a particular business would be required, it is anticipated that most of the jobs associated with the business would be relocated as well. Therefore, there would be no net loss of jobs. No adverse impacts associated with this displacement are anticipated.

To construct Alternative 3, the partial acquisitions and temporary construction easement under Alternatives 1 and 2 would be the same for Alternative 3; therefore impacts would be the same as under Alternatives 1 and 2. As described previously, no structures on these parcels would be displaced or relocated as a result of these permanent underground easements.

One additional permanent easement on commercial property is anticipated under Alternative 3 in addition to those under Alternative 1 and 2. These permanent easements would be required to accommodate station entrances. The exact locations of the station entrances have not been determined, but they would not disrupt operations of the businesses or uses in these parcels. The owners and tenants of the parcels would be given advance written notice and would be informed of their eligibility for payments for use of their space for the station entrances. No adverse impacts are anticipated due to these permanent easements.

Table 6-34: Alternative 3 – Santa Monica Extension: Additional Permanent Easement (Not in Alternatives 1 or 2)

APN	Address	Jurisdiction	Current Use	Intended Use
4292013029	401 Wilshire Boulevard	Santa Monica	Offices	Potential Entrance

Source: TAHA, 2010

- **Construction Scenario:** Indirect impacts from the construction phase for Alternative 2 parallels the description described above for Alternative 1.
- **Construction Schedule:** Construction of the Santa Monica Extension is expected to take approximately 5-½ years. Businesses in the area of station locations could expect to experience direct or indirect impacts during this time.

Alternative 3 would displace businesses that involve the loss of 413 jobs. The acquisition of parcels would result in loss of $2,399,775 property tax revenue dollars.

6.5.6 Alternative 4 – Westwood/VA Hospital Extension plus West Hollywood Extension

Alternative 4 would follow the same alignment and have the same stations as Alternative 1 – Westwood/UCLA Extension. In addition, this alternative includes the West Hollywood Extension, which extends from the existing Metro Red Line Hollywood/Highland Station. From a new station in this location, this alignment extends southerly, centered under Highland Avenue, and continues south under Highland Avenue to just north of Lexington Avenue where it curves to Santa Monica Boulevard. The alignment continues westerly under the center of Santa Monica Boulevard until just east of the Santa Monica/San Vicente Boulevard intersection where the alignment curves south and is centered under San Vicente Boulevard. From San Vicente Boulevard, the alignment curves south and then southwesterly to cross under La Cienega Boulevard to the Wilshire/La Cienega Station.

Although Alternative 4 would attempt to maximize the public right-of-way for its alignment, stations, and accessory structures, the following acquisitions and easements are anticipated:

- 64 Full Takes, including approximately 16 businesses/business areas and 8 parking lots in addition to those described in Alternative 1.
- 6 Partial Takes, the same as Alternative 1.
- 16 Permanent Easements, including approximately 3 businesses and 1 parking lot in addition to those described in Alternative 1.
- 3 Temporary Construction Easements, the same as Alternative 1 plus one additional easement.
- 328 Permanent Underground Easements.

These parcels would be utilized for construction staging, below grade tunneling, station locations, generator locations, and vent locations. Some station plans have multiple entrance options, though not all of them would be constructed. In these cases, all potential takings and easements for station entrances are evaluated.

Each business displaced as a result of the proposed project would be given advance written notice and would be informed of their eligibility for relocation assistance and payments. It is anticipated that where relocation would be required, it would result in the relocation of most of the jobs that would be potentially displaced. Therefore, there would be no net loss of jobs overall. No adverse impacts associated with this displacement are anticipated.

One additional parcel that would be partially acquired (APN 4337017903) has not been identified under Alternatives 1 through 3.

- APN 4337017903 (8800 Santa Monica Boulevard, West Hollywood; Figure 5-19 #37) – This parcel is currently occupied by the Metro Division 7 Maintenance Yard and Offices. Construction of the Alternative 4 – Westwood/VA Hospital Extension plus West Hollywood Extension is anticipated to take part of the parcel for the station entrance and for construction staging. Although no part of the building is anticipated to be impacted, part of the parking lot would be utilized. Access to the building and the maintenance yard would be maintained. This parcel is currently owned by Metro. No adverse impacts are anticipated due to the partial displacement of this parcel.

Permanent easements would be required to accommodate station entrances on 16 parcels. The exact locations of the station entrances have not been determined, but they would not disrupt operations of the businesses or uses in these parcels. The owners and tenants of the parcels would be given advance written notice and would be informed of their eligibility for payments for use of their space for the station entrances. No adverse impacts are anticipated due to these permanent easements.

To construct Alternative 4, temporary construction easements would be required for two parcels. One of these parcels was identified as a temporary construction easement under Alternative 1. For the section, construction of Alternative 4 is anticipated to utilize portions of the Metro Division 7 Maintenance Yard parcel for construction staging. Although no part of the building is anticipated to be impacted, part of the parking lot would be utilized for equipment and material storage. Access to the building and the maintenance yard would be maintained. This parcel is currently owned by Metro. No adverse impacts to other businesses are anticipated due to this temporary construction easement.

Alternative 4 would displace businesses that involve the loss of 363 jobs. The full acquisition of parcels would result in loss of $2,438,395 property tax revenue dollars.

Table 6-35: Alternative 4 – Westwood/VA Hospital Extension plus West Hollywood Extension: Additional Permanent Easements (Not in Alternatives 1 or 2)

APN	Address	Jurisdiction	Current Use	Intended Use
5531017020	7118 Santa Monica Boulevard	West Hollywood	Vacant	Potential Entrance
5530014001	7780 Santa Monica Boulevard	West Hollywood	Car Leasing Parking Lot	Potential Entrance
4334006019	8575 W 3rd Street	Los Angeles	Parking Lot	Potential Entrance
4334007008	121 N La Cienega Boulevard	Los Angeles	Commercial	Potential Entrance

- **Construction Scenario:** This alternative would have the same general construction techniques as described under Alternative 2 for the alignment between Wilshire/Western and Westwood/VA Hospital Extension. Impacts to businesses resulting from post constriction, tunnel constriction, underground utilities, stations, street/site restorations, vent shafts and emergency exits will be essentially the same as described in Alternative 1; there are no recognized differences.
- **Estimated Volume of Excavated Materials from Tunnel Construction**: The total volume of excavated materials for the tunnel excavation from Wilshire/La Cienega to Hollywood/Highland is estimated to be approximately 330,000 CY. Based on this volume and the anticipated sequence of construction, the truck counts for tunnel spoil removal is estimated to be from 40-80 daily truck trips, which could temporarily impact an increased amount of businesses due to additional traffic.

6.5.7 Alternative 5 – Santa Monica Extension plus West Hollywood Extension

Although Alternative 5 would attempt to maximize the public right-of-way for its alignment, stations, and accessory structures, the following acquisitions and easements are anticipated:

- 83 Full Takes, including 18 commercial business/retail spaces/offices and 11 parking lots under ; approximately more than 20 businesses and 2 parking lots under

Alternative 2; and approximately 15 businesses/business areas and 8 parking lots under Alternative 4.

- 6 Partial Takes, including 0 commercial business/retail spaces/offices and 1 parking lot under ;
- 17 Permanent Easements, including 8 commercial business/retail spaces/offices under ; two additional easements for Alternative 3; and easements for 2 businesses and 1 parking lot under Alternative 4.
- 3 Temporary Construction Easements, including 0 in commercial areas under ;
- 328 Permanent Underground Easements, including numerous businesses that would not be affected by construction activities due to the depth of tunneling under Alternatives 1 and 4.

Alternative 5 would displace businesses that involve the loss of 474 jobs. The full acquisition of parcels would result in loss of $2,941,285 property tax revenue dollars.

- **Construction Scenario:** Alternative 5 adds the West Hollywood Extension to the work described under Alternative 3. This scenario involves the entire sum total of all work mentioned above. It is the complete system. The construction methods and expected scenarios are not greatly different in Alternative 5 than as described in Alternatives 1 through 5.
- **Construction Schedule:** The duration of construction for all segments could take approximately 7-½ years if all work is concurrently scheduled and executed; however it is unlikely that the existing roadways and infrastructure can accommodate so many different construction operations at the same time. In addition, the accumulated impacts on the community including local businesses would be adverse. It is more probable to expect that one or more of the Segment 1, 2, and 3 reaches would be substantially completed before a next reach can begin. If only a minimum of overlap between the segments is assumed, with appropriate geographical separation, it can be expected that the total construction period could be extended to as much as 20 years. If overall scenarios in which the work is realistically optimized through an aggressive design and construction program, the total construction period that local businesses would endure could be reduced to approximately 10 to 16 years.

6.5.8 MOS 1 – Fairfax Station Terminus

The Minimum Operable Segment (MOS 1) – Fairfax Extension Alternative would follow the same alignment as Alternative 1 and terminate at the Wilshire/Fairfax station.

The MOS would follow the same alignment as Alternative 1 and terminate at the Wilshire/Fairfax station. The following acquisitions and easements are anticipated for MOS 1:

- 32 Full Takes
- 1 Partial Take
- 2 Permanent Easements

No temporary construction easements or permanent underground easements are anticipated under the MOS 1 – Wilshire Extension.

No temporary construction easements or permanent underground easements are anticipated under MOS 1. MOS 1 would displace businesses that involve the loss of 216 jobs. The acquisition of parcels would result in loss of $648,021 property tax revenue dollars.

To construct the MOS 1, 27 parcels would be fully acquired. These parcels were identified as full takes under Alternative 1. One parcel would be partially acquired (APN 5508007900). This parcel was already identified as a partial take under Alternative 1. Permanent easements would be required for two parcels for the construction of the Wilshire/Fairfax station (APNs 5508017007 and 5510027035). These parcels were identified as permanent easements under MOS 2 – Century City Station Terminus.

Construction of MOS 1 is the same as Segment 1 of Alternative 1 and is assumed to be the first item of work to be done. Should this be the only work performed, the station at Wilshire/Fairfax would become the terminus and would likely include a crossover and/or rail tracks.

The construction scenario and Schedule and would have the same impacts as Alternative 1.

6.5.9 MOS 2 – Century City Station Terminus

The MOS 2 – Century City Extension would follow the same alignment as and have all but one of the stations of Alternative 1. The MOS 2 – Century City Extension would follow the same alignment as and have all but one of the stations of Alternative 1.

The following acquisitions and easements are anticipated to construct MOS 2:

- 40 Full Takes
- 2 Partial Take
- 12 Permanent Easements
- 4 Permanent Underground Easements

MOS 2 would displace businesses that involve the loss of 280 jobs. The acquisition of parcels would result in loss of $1,073,932 property tax revenue dollars.

To construct the MOS 2 – Century City Extension, 40 parcels would be fully acquired. These parcels were identified as full takes under Alternative 1. Two parcels would be partially acquired. Ten parcels would require permanent easements for the construction of the Wilshire/Fairfax station. Permanent underground easements would be required for four parcels (APNs 4319003902, 4328001001, 4328001023, 4328001024). All of these parcels were identified as permanent underground easements under Alternative 1.

The construction scenario and Schedule and would have the same impacts as Alternative 1.

6.5.10 Maintenance and Operation Facility Sites

The Westside Subway Extension Project would require either the expansion of Metro Division 20 Rail Yard or the construction of a new rail yard to house and maintain the rail cars. The expansion of Metro Division 20 Rail Yard would involve four full takes of vacant land and eight partial acquisitions in the rail yard area, which would be a property tax revenue loss of $1,892,645. For the Union Pacific rail yard, two full takes, three partial takes, 13 permanent easements, and three temporary construction easements would be required for this rail yard option. This would result in a property tax revenue loss of $2,890,941. No residences would be impacted for the construction of either of the maintenance and operation facility sites.

Development of maintenance facilities will include the construction of storage tracks, shop buildings, and associated wayside structures, such as vehicle cleaning facilities, electrical substations and employee facilities. Generally, the structures would be low-rise, from two to three stories in height (maximum), with parking provided at areas physically separated from the trackways.

Construction of these facilities would entail some demolition, site clearing and grading. Shallow excavations and/or pile installations would be required for structure foundations. Trenching and excavation would also be required for utilities and rail systems installations.

6.5.11 Significance of Impacts

The business disruption impacts during construction would be adverse (NEPA) and significant (CEQA).

6.5.12 Cumulative Impacts

Business disruptions and displacements are site-specific in nature and would not contribute cumulatively to other displacement in the project area. Therefore, no cumulative adverse impacts associated with displacement and relocation are anticipated.

6.6 Relationship Between Local Short-Term Use of Resources and Maintenance and Enhancement of Long-Term Productivity

This section describes the relationship between local short term use of resource and maintenance and enhancement of long-term productivity as related to construction impacts.

6.6.1 No Build and Transportation System Management (TSM) Alternatives

The No Build and TSM Alternatives would not require short-term use of resources, since no construction would occur.

6.6.2 Alternatives 1, 2, 3, 4, and 5; MOS 1 and 2; and Maintenance Yards

For these alternatives, the Westside Subway Extension Project would result in temporary construction-related increases in noise, traffic congestion and delays, and air pollutants. Construction of stations could require the loss of historic structures.

These and other short-term environmental impacts (i.e., "uses" of the environment) would be balanced by achieving an improved transit system for the Los Angeles metropolitan area. Maintaining an expanded transit system would permit a more efficient movement of people and would enhance long-term productivity.

Irreversible and Irretrievable Commitment of Resources

This section describes the irreversible and irretrievable resources that would be used by construction of the build alternatives. The No-Build and Transportation System Management alternatives would not involve the use of construction resources.

The build alternatives would involve the commitment of a range of natural, physical, human, and fiscal resources. The build alternatives would require space to construct the Westside Subway Extension stations. The build alternatives would also require right-of-way on several areas along the alignment stations and portals. The land used for the proposed project is considered an irreversible commitment during the time period that the land is used for a transportation facility.

Considerable amounts of fossil fuels, labor, and construction materials (such as cement, aggregate, and steel) would be expended. Workers are expected to be drawn from the regional labor pool, with specialty trades generating demand from outside the Los Angeles Area.

Additionally, large amounts of labor and natural resources would be used in the fabrication and preparation of construction materials. These materials are generally not retrievable. However, they are not in short supply, and their use would not have an adverse effect upon continued availability of these resources.

The build alternatives would require a substantial expenditure of funds, which would not be retrievable.

The commitment of these resources is based on the concept that the Los Angeles metropolitan area would benefit from an expanded regional transit system. The benefits of an expanded transit system will be considered when evaluating the proposed commitment of these resources.

7.0 MITIGATION MEASURES

This section summarizes the mitigation measures proposed for the particular environmental disciplines affected by construction. Details are described in the sections of this document pertinent to each affected area.

Measures to minimize adverse environmental effects will include:

- Cut-and-cover construction will be minimized and used only at stations and other special structure locations.
- Construction will be phased so that all station areas are not impacted at the same time.
- Cut-and-cover construction will substitute integrated panel decking (typically asphaltic coated steel) in place of wooden plank decking wherever feasible. (Integrated panel decking presents a neater appearance and a smoother roadway surface; it is typically much thinner in cross-section, thereby minimizing the difference in levels between decking and existing grade. It is often, however, more expensive.)
- Contractors will be required to control traffic during construction by following the "Work Area Traffic Control" Manual (most recent edition) prepared by the City of Los Angeles; Standard Plan S-610-12, "Notice to Contractors-Comprehensive" (most recent edition), prepared by Bureau of Engineering, City of Los Angeles; and "Standard Specifications for Public Works Construction" (most recent edition). Comparable standards would be enforced for work conducted in the other jurisdictions along the alignment.
- Before the start of construction, possibly during Final Design, traffic control plans, including detour plans, will be formulated in cooperation with the City of Los Angeles and other affected jurisdictions (County, State). The plans will be based upon lane requirements and other special requirements obtained from the Los Angeles City Department of Transportation for construction within the city and from other appropriate agencies for construction in those jurisdictions. The excavation and decking of arterial streets crossing the rail alignment will be phased so that the capacity of these streets is not reduced unnecessarily.
- Unless unforeseen circumstances dictate, no designated major or secondary highway will be closed to vehicular or pedestrian traffic. No collector or local street or alley will be completely closed preventing local vehicular or pedestrian access to residences, businesses, or other establishments.
- To the extent possible, major surface excavations will be adjacent to undeveloped areas (such as parking lots).
- Additional soil borings will be made in critical areas to precisely define the vertical and horizontal extent of tar sands. These borings will also include in situ measurements of gas content and soil expansion potential. Laboratory testing of tar and sand samples from the borings will be conducted to provide information on their strength and deformation characteristics at different temperatures, confining pressures, strain rates, and stress levels. Based on data derived from the above tests, specific excavation, shoring, and foundation design criteria will be formulated to ensure short and long term stability of project facilities in tar sand areas.

- A multiple-station, constant gas monitoring system will be used in tunnel excavations. The monitoring system will be calibrated to detect minute quantities of gas that would be released as TBMs move into areas of greater gas concentration. As concentrations of gas increase toward limits set to avoid explosive levels in the tunnel, other actions will be taken.
- Where beneficial, small-diameter holes will be drilled at least 20 feet into the tunnel working face ahead of the TBM to relieve pressurized gas pockets before they are encountered by heavy excavation equipment. At the shallow depths of the tunnels gas pressures will be relatively low and easy to handle. Wells can also be sunk ahead of the TBMs so gas can be dissipated (and pumped out if necessary).
- An adequately sized collection and ventilation system will be installed to prevent the buildup of explosive gas concentrations anywhere in the tunnel.
- Final design and construction will be coordinated with Cal OSHA and with the California Bureau of Mines, who have responsibility for compliance with state orders on safety of subsurface tunneling through hazardous materials.
- Related water quality impacts will be avoided by removing the suspended solids in siltation basins and, where necessary, removing hydrocarbons in oil/water separators.
- Construction contractors would be required to immediately clean up any accidentally spilled materials, including not only sediment but also vehicle fuels and lubrication fluids.
- The periodic cleaning of streets and sidewalks in the construction area would also be required to regularly remove the more nominal, day-to-day operational spills.

7.1 Alternatives 1, 2, 3, 4, and 5; MOS 1 and 2; and Maintenance and Operation Facility Sites

7.1.1 Traffic, Parking, and Transit

Mitigation for construction-related traffic impacts will involve development of traffic control plans that will need to be approved by the appropriate public agency. The traffic control plans will provide for the reasonably safe and efficient movement of road users, including pedestrian and bicyclists, through or around the permanent or temporary construction work areas. Information on the traffic control plans are presented in this section. Further details on these plans are in the Traffic Handling and Construction Staging Report (Metro, 2010).

The traffic control plans will need to recognize local agency requirements and guidelines, including:

- City of Los Angeles: CA MUTCD, WATCH Manual, The Standard Specifications for Public Works Construction, "Brown Book" Special Provisions and Standard Drawings (City of Los Angeles), and Standard Worksite Traffic Control Plans (City of Los Angeles)
- City of Beverly Hills :CA MUTCD and WATCH Manual
- City of Santa Monica: CA MUTCD, WATCH Manual, and Traffic Control Plan Preparation Guidelines (City of Santa Monica)
- City of West Hollywood: CA MUTCD and WATCH Manual

- County of Los Angeles: CA MUTCD and WATCH Manual
- Caltrans: CA MUTCD

A traffic control zone is an area of a roadway where road user (vehicle, pedestrian, and bicyclist) conditions are changed due to a construction activity or by a direction of uniformed law enforcement officers. Most traffic control zones are divided into four areas: the advance warning area, the transition area, the construction activity area and the termination area. The traffic control zone also includes the streets identified as the detour routes on the approved traffic control plans. The following sections describe the traffic control zones that would be required at station areas for the Westside Subway Extension.

In order to better facilitate traffic flow and avoid major disruptions and bottlenecks due to construction, Traffic Control Zones (in particular Advance Warning Areas) should extend beyond one arterial street to either side of station construction sites. This will better disperse heavy traffic flows on the major arterials and help the roadway network better absorb the traffic impacts from construction.

Traffic lane maintenance during construction will follow local agency requirements and standards with respect to lane widths, number of lanes and duration of temporary lane closures. During non-working hours, existing traffic lanes including turn lanes and two-way left turn lanes should be restored to the pre-construction/original condition unless otherwise authorized by the local jurisdiction.

Coordination and interaction with appropriate agencies will determine which streets can be closed and the detour routes to be used should streets need to be closed for a limited period of time. The expected year at which construction would take place will be determined so that construction-related traffic impacts.

Temporary traffic signal plans will be required when the following occur:

- Traffic signal equipment is temporarily relocated due to construction
- Traffic signal operation is modified to facilitate construction
- Existing intersection lane configuration is changed
- Visibility of traffic signal equipment is obscured by construction
- As directed by the local agencies having jurisdiction

Each affected agency will determine the need for temporary striping installation or modifications. Temporary striping would be considered for the following conditions:

- When traffic is to be diverted to the left of an existing centerline for two or more consecutive nights.
- When the work area is adjacent to an intersection and results in a transition within the intersection.
- When there is an unusual situation where traffic and physical conditions, such as speed or restricted visibility, occur

- Temporary signs would be implemented per the approved traffic control plans. Temporary sign devices include:
  - Traffic signs (regulatory, warning and guide)
  - Changeable message signs
  - Arrow panels
  - High-level warning devices
- When signs in a traffic control zone conflict with the implemented traffic control, the signs must be covered by the local agency's approved method to avoid confusion to the motorist.
- Temporary striping and signing plans shall be prepared by the construction contractor and approved by the agency having jurisdiction.

When the construction activity impacts existing newspaper stands, mail boxes, or bus shelters, an arrangement should be made with each impacted owner for relocation or removal.

Emergency bus stop relocations will require a contractor employee to visit the office of the impacted bus agency to negotiate the needed change. In no event shall the notice be less than 14 days. Prior to implementation of any temporary street closures or any changes affecting bus zone locations, the following transit providers will be contacted at least 100 days in advance of the proposed closure date:

- Metro
- LADOT DASH
- LADOT Commuter Express
- Santa Clarita Transit
- Culver City bus
- West Hollywood CityLine/Dayline
- Santa Monica Big Blue Bus
- Antelope Valley Transportation Authority

When the construction activity impacts the existing on-street parking spaces, parking circulation plans shall be prepared by the construction contractor and approved by the agency having jurisdiction. The parking circulation plan must be coordinated with each impacted property representative.

As part of the DEIS/EIR, a parking impact and policy plan is being prepared for the project. This will be utilized during the subsequent construction and traffic handling phase of the project. Existing parking meters affected by construction within the traffic control zone shall be removed or covered as directed by the agency having jurisdiction. Based on the proposed parking replacement strategy, temporary parking spaces can be considered for the impacted business or residents during construction.

When the construction activity impacts curb side passenger loading or commercial loading zones, loading zone circulation plans shall be prepared by the construction contractor and approved by the agency having jurisdiction. The loading zone plan must be coordinated with each impacted property representative.

When the construction activity encroaches into a sidewalk, walkway, or crosswalk area, special consideration must be given to pedestrian safety, and the following items should be considered for pedestrians in a temporary traffic control zone:

- Pedestrians should not be led into conflicts with work site vehicles, equipment, or operations.
- Pedestrians should not be led into conflicts with vehicles moving through or around the work site.
- Pedestrians should be provided with a safe, convenient, and accessible path.

Access to sidewalks will be maintained on both sides of the street at all Metro construction sites at all times. Access to all businesses by pedestrians also will be maintained at all times without requirement by business owners to make such a request.

All temporary sidewalk designs shall be submitted to Metro for approval prior to installation. Temporary sidewalks need not be expensive, but they must be well built of approved material (wood or other), ADA compliant and having a well built cover. No rough edges or damaged wood will be allowed.

When pedestrians are diverted into the street or adjacent to an open trench, K-rail type concrete barriers or other approved barrier types would be used for barricading between pedestrian and vehicular traffic. Sidewalk closures, if necessary, will be approved by the affected agency having jurisdiction and only one side of the street should be closed at a time.

Pedestrian access to each business property would be provided during the essential hours as requested by the property representative. If acceptable alternate access points are provided, the impacted access may be closed.

As part of the DEIS/EIR, a preliminary bike lane design analysis is being prepared for the project. This information will be utilized during the stage construction and traffic handling phase of the project. The bike lane design analysis will show the existing bike lanes and proposed bike lanes within the vicinity of the project. During the construction phase, Metro-approved bike routes will be maintained past all construction sites, by widened sidewalks or by signed or striped bike detour routes.

When the construction activity impacts the existing business driveways, maintenance of traffic plans would be prepared by the construction contractor showing how vehicular access would be maintained to businesses and approved by the agency having jurisdiction. The construction activity must be coordinated with each impacted property representative.

During construction, driveway entrance and exits would be maintained during essential hours. If acceptable alternate access points (approved by the applicable agency) are provided, the impacted driveway may be closed. The local agency may restrict left-turn and/or right-turn vehicular movements entering and/or exiting driveways during construction.

7.1.2 Air Quality

To reduce air quality impacts related to construction activities, the following mitigation measures are recommended to be implemented:

- Mitigation measures such as watering, the use of soil stabilizers, etc. would be applied to reduce the predicted PM_{10} levels to below the SCAQMD daily construction threshold levels. The following types of measures would be specified during construction to reduce emissions:
- At truck exit areas, wheel washing equipment would be installed to prevent soil from being tracked onto city streets, and followed by street sweeping as required to clean streets.
- Trucks would be covered to control dust during transport of spoils.
- Spoil removal trucks would operate at a Metro approved emission level, including standards adopted by the Port of Long Beach's Clean Trucks Program, and all.
- Tunnel locomotives (hauling spoils and other equipment to the tunnel heading) would be approved by Metro.
- Metro and its contractors would set and maintain work equipment and standards to meet SCAQMD standards including NOx.
- Continuous monitoring and recording of the air environment would be conducted, particularly in areas of gassy soils. Construction will be altered as required to maintain a safe working atmosphere. The working environment would be kept in compliance with Federal, State, and local regulations.

7.1.3 Noise and Vibration

This section identifies feasible mitigation measures and strategies to be incorporated into project designs and construction to minimize noise and vibration impacts.

To reduce the potential for noise and vibration impacts associated with project construction, noise and vibration control measures will be incorporated within Metro's plans, specifications, and estimates ("bid") documents for each segment to reduce potential impacts, including:

- Comply with the City of Los Angeles, City of Beverly Hills, City of Santa Monica, City of West Hollywood, and County of Los Angeles noise ordinance during construction hours. Comply with City of Los Angeles, City of Beverly Hills, City of Santa Monica, City of West Hollywood, and County of Los Angeles standards for short-term operation of mobile equipment and long-term construction operations of stationary equipment, including noise levels and hours of operation;

- Hours of construction activity would be varied to meet special circumstances and restrictions. Municipal and building codes of each city in the Study Area include restrictions on construction hours. The Cities of Los Angeles and Santa Monica limit construction activity to 8 a.m. to 6 p.m. on Monday through Friday and 9 a.m. to 5 p.m. on Saturdays, with no construction on Sundays and federal holidays. The City of Beverly Hills identifies general construction hours of 8:00 a.m. to 6:00 p.m. from Monday through Saturday. The City of West Hollywood restricts construction activity to 8:00 a.m.

to 7:00 p.m. for Monday through Friday. On Saturday, only interior work in West Hollywood may be conducted from 8:00 a.m. to 7:00 p.m. For all the cities in the Study Area, construction is prohibited on Sundays and city holidays. Construction outside of these working periods would require a permit from the applicable city.

- Prepare readily visible signs indicating “Noise Control Zone”;
- Use noise-control devices that meet original specifications and performance;
- Use fixed noise-producing equipment to comply with regulations in the course of project activity;
- Use mobile or fixed noise-producing equipment that are equipped to mitigate noise as much as it is practical;
- Use electrically-powered equipment;
- Use noise control techniques, procedures, and acoustically treated equipment to minimize impact noise;
- Erection of temporary noise barriers and sound-control curtains where project activity is unavoidably close to noise-sensitive receptors;
- Use designated haul routes based on the least overall noise impact Route heavily-loaded trucks away from residential streets, if possible. Select streets with the fewest noise sensitive receptors if no alternatives are available;
- Use non-noise sensitive, designated parking areas for project-related vehicles;
- Locate stockpiles, staging areas, and other noise-producing operations as far as practicable from noise-sensitive receptors;
- Limit use of horns, whistles, alarms, and bells;
- Require contractors to avoid shouting, yelling, screaming or profanity at locations outside the project site boundaries;
- Require all noise-producing project equipment and vehicles to use internal combustion engines equipped with mufflers and air-inlet silencers, where appropriate, in good operating condition that meet or exceed original factory specifications. Mobile or fixed “package” equipment (e.g., arc- welders, air compressors) shall be equipped with shrouds and noise control features that are readily available for that type of equipment.
- Locating fixed noise-generating equipment as far from noise sensitive land uses as is practical.
- Prohibit any project-related public address or music system from being audible at any adjacent receptor.
- Operate earth-moving equipment on the construction lot as far away from vibration-sensitive sites as possible.
- Phase demolition, earth moving, and ground impacting operations so as not to occur in the same time period.
- Avoid nighttime activities.

- Avoid impact pile driving where possible in vibration sensitive areas. Drilled piles or the use of sonic or vibratory pile drivers should be used where the geological conditions permit their use.
- Select demolition methods not involving impact where possible.
- Avoid vibratory rollers and packers near vibration sensitive areas.

7.1.4 Utilities

This section identifies feasible mitigation measures and strategies to be incorporated into project designs and construction to minimize impacts to public utility services.

The following measures will minimize any potential utility service interruptions and conserve resources:

- Follow Metro Design Criteria and Standards (Volumes I through IV), and applicable utility standards and criteria or best industry practices.
- Comply with applicable utility policies and strategies as specified in the adopted operational comprehensive plans of the City of Los Angeles and the County of Los Angeles, including those provisions related to levels of service, conservation strategies, and coordination of service provisions.
- Incorporate City of Los Angeles, County of Los Angeles, and California State energy code, building code, fire code, Metro's Design Criteria and Standards (Volumes I through IV), and other applicable requirements into all design aspects of the system, stations, maintenance facility, and parking areas.
- Use standard practices such as installing devices to reduce the impact of stray current between the traction power system and the utilities facilities, or replace particularly metallic utility infrastructure with nonmetallic materials.
- Coordinate with affected water utilities and local fire departments to ensure that water use, especially at the maintenance facility and subway section, does not compromise flow required for fire protection.
- Maintain and protect existing utilities in place during construction.
- Provide temporary connection for services that must be disconnected for extended periods of time.
- Maintain existing service as long as reasonably possible; if necessary, manholes, pipes, vaults, and other access points may have to be relocated.
- Notify users well in advance of any anticipated service disruption and coordinate with the utility owner's convenient times for necessary service outages.
- Monitor the project's contractors as part of construction management/oversight and include terms in construction contracts that encourage contractors to actively seek to avoid accidental disruption of service.
- Coordinate the schedules of multiple utility rearrangements in order to minimize negative impacts on users.

- Develop a contingency plan in cooperation with the utility providers for emergency repairs of any utilities unexpectedly found or that disintegrated because of age during excavations.
- Adjust portions of the alignment of station locations, where feasible, to prevent a major utility relocation.
- Comply with the City of Los Angeles and the County of Los Angeles on procedures for utility construction, inspection, and operation.
- Use pipe and conduit support systems, trench sheeting and shoring, and other precautionary measures during construction to minimize the potential for damage to exposed utilities.

7.1.5 Business Disruption

This section identifies feasible mitigation measures and strategies to be incorporated into project designs and construction to minimize impacts to businesses during construction. These mitigation measures are presented in Sections 7.1.1 Traffic, 7.1.2 Air Quality, 7.1.3 Noise and Vibration, and 7.1.4 Utilities. Generally, Metro would provide relocation assistance and compensation for all displaced businesses as required by both the Uniform Act and the California Act. Where acquisitions and relocations are unavoidable, FTA and Metro would follow the provisions of both acts and their amendments. For easements, Metro would appraise each property to determine the fair market value of the portion that would be utilized either temporarily during. Just compensation, which shall not be less than the approved appraisal would be made to each property owner.

Feasible mitigation measures and strategies to be incorporated into project designs and construction to minimize impacts to businesses during construction include:

- Conduct outreach efforts to communicate construction plans and schedules and to discuss key business operating requirements.
- Coordinate with local Chambers of Commerce to develop detailed implementation plans for mitigation measures
- Adjust project construction procedures where feasible to accommodate key business requirements such as delivery and shipping times to maintain critical business activity.
- Hold regular meetings or briefings with business owners
- Use technology for communication with business, including maintained construction status web sites, automated text messaging services, twitter feeds, and similar measures
- Provide additional advertising and business promotion during particular periods of business disruption
- Develop worksite traffic control plans (see traffic sections)
- Require clear access to be maintained to adjacent businesses during normal business hours (see traffic section).
- Require additional signage for affected businesses to facilitate access by customers
- Provide flyers on buses explaining route and stop changes within business corridors (see traffic section)

- Monitoring alternative bicycle and sidewalk and pedestrian access routes to ensure safety and cleanliness. (see traffic section)

7.2 CEQA Determination

This section summarizes the level of impact per CEQA.

7.2.1 Traffic, Parking, and Transit

After the implementation of the listed mitigation measures, potentially significant traffic impacts would continue in the active construction areas through the length of the construction period.

7.2.2 Air Quality

As discussed in Section 6.2, the Air Quality impacts during construction would be significant under CEQA. The SCAQMD thresholds would be exceeded for NO_x for all Build Alternatives and PM_{10} would be exceeded for a typical station with mining. NOx levels would be elevated due partially to the proposed use of diesel locomotives to extract soil during the tunnel boring process. Mitigation measures could help to reduce these impacts, but it is unlikely, given the current construction plan, that these levels would be below the SCAQMD threshold.

7.2.3 Noise and Vibration

As discussed in Section 6.3, the noise and vibration impacts during construction would be significant.

7.2.4 Utilities

Because all affected utilities would be relocated, no significant impacts on natural gas, telephone and telecommunications, cable television, water supply, wastewater, or solid waste collection and disposal services are expected during proposed project construction. Minor service disruptions to utility customers during certain periods may occur, but major interruptions are not expected as a result of the sufficient capacity and strategies to provide additional service as the proposed project is constructed. Therefore, no significant impacts would occur.

7.2.5 Business Disruption

Prior to the implementation of the above mitigation measures, significant construction related business disruption impacts would occur in the areas of air quality, noise, transit, traffic, parking, and pedestrian and bicycle movements. Substantial negative effects on business land uses in the construction zones during critical construction periods are also anticipated.

7.3 Impacts Remaining After Mitigation

This section describes the construction impacts that would remain after mitigation measures are implemented.

7.3.1 No Project

No significant impacts would occur with this alternative, since no construction would occur.

7.3.2 Transportation System Management (TSM)

No significant impacts would occur with this alternative, since no construction would occur.

7.3.3 Westwood/UCLA Extension

With the implementation of the above mitigation measures, significant construction related impacts would still remain in the areas of traffic, air quality, noise, and business disruption. No significant impacts to utilities would occur.

7.3.4 Alternative 2 – Westwood/VA Hospital Extension

With the implementation of the above mitigation measures, significant construction related impacts would still remain in the areas of traffic, air quality, noise, and business disruption. No significant impacts to utilities would occur.

7.3.5 Alternative 3 – Santa Monica Extension

With the implementation of the above mitigation measures, significant construction related impacts would still remain in the areas of traffic, air quality, noise, and business disruption. No significant impacts to utilities would occur.

7.3.6 Alternative 4 – Westwood/VA Hospital Extension plus West Hollywood Extension

With the implementation of the above mitigation measures, significant construction related impacts would still remain in the areas of traffic, air quality, noise, and business disruption. No significant impacts to utilities would occur.

7.3.7 Alternative 5 – Santa Monica Extension plus West Hollywood Extension

With the implementation of the above mitigation measures, significant construction related impacts would still remain in the areas of traffic, air quality, noise, and business disruption. No significant impacts to utilities would occur.

7.3.8 MOS 1 – Fairfax Station Terminus

With the implementation of the above mitigation measures, significant construction related impacts would still remain in the areas of traffic, air quality, noise, and business disruption. No significant impacts to utilities would occur.

7.3.9 MOS 2 – Century City Station Terminus

With the implementation of the above mitigation measures, significant construction related impacts would still remain in the areas of traffic, air quality, noise, and business disruption. No significant impacts to utilities would occur.

7.3.10 Maintenance and Operation Facility Sites

Since no sensitive receptors would be affected by traffic, air quality, or noise from construction of these sites, and since no disruption of businesses or utilities would occur, no significant construction related impacts would occur from the construction of Maintenance and Operation Facility Sites.

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