CHAPTER 4—ENVIRONMENTAL ANALYSIS, CONSEQUENCES, AND MITIGATION

This chapter presents additional information about the environmental impacts of Section 2 of the Project in response to the Final Decision on Motions for Summary Judgment and Ruling in Regards to Remedies (Final Decision) of the United States District Court for the Central District of California in *Beverly Hills Unified School District v. Federal Transit Administration, et al.,* CV 12-9861-GW(SSx) on August 12, 2016. This chapter also assesses any changes to environmental impacts that would result from the changed location of construction staging activities at the Century City Constellation Station, changes to surrounding land uses near the Century City Constellation Station, and design refinements at the Wilshire/Rodeo Station.

4.1 Introduction

In response to the Final Decision, this chapter focuses on the following:

- An analysis of the potential public health impacts of nitrogen oxides (NOx) emissions during construction of the Century City Constellation Station and tunneling for Section 2 of the Project
- An analysis of the potential risks of soil gas migration from tunneling or other construction activities related to Section 2 of the Project
- A discussion of the completeness of the available seismic risk information related to Section 2 of the Project
- A discussion of post-Draft Environmental Impact Statement/Environmental Impact Report (Draft EIS/EIR) seismic and ridership studies available to the Federal Transit Administration (FTA) and related to Section 2 of the Project

In addition, this chapter provides analysis of the long-term operational and short-term construction environmental impacts related to the following changes in Section 2 of the Project:

- Relocation of the construction staging activities at the Century City Constellation Station as described in Chapter 2 of this Draft Supplemental Environmental Impact Statement and Section 4(f) Evaluation (Draft SEIS)
- Changes in land uses adjacent to the construction staging areas in Century City, including the opening of a medical rehabilitation facility along Century Park East and the planned and approved modernization of Beverly Hills High School (BHHS), which are described in further detail in Section 4.2 of this Draft SEIS
- Elimination of the double crossover on the east end of the Wilshire/Rodeo Station and the associated change in the station box, which is planned to extend from Beverly Drive to Canon Drive.

At the Wilshire/Rodeo Station, even though the double crossover was eliminated and the station box has slightly shifted, the long-term operations and construction staging and activities generally remain the same as discussed in the Final EIS/EIR. Therefore, the

environmental effects near the Wilshire/Rodeo Station remain the same as in the Final EIS/EIR. However, the alignment in the vicinity of the Perpetual Savings Bank was refined. The Final EIS/EIR also identified the Perpetual Savings Bank for subsurface easements; however, the refined design at the Wilshire/Rodeo station indicates that the tunnels would not pass below that property and, therefore, easements from that properties would not be required. Two additional subsurface easements would be required and are discussed in Chapter 4.

This chapter provides analysis of long-term operational impacts related to noise and vibration (Section 4.2), seismic and subsurface gas hazards (to address the Final Decision) (Section 4.3), and historic resources (Section 4.4).

The relocation and refinement of the construction activities do not affect how Section 2 of the Project will operate once the construction is complete because trains will operate in a below-grade tunnel in the same alignment as described in the Final EIS/EIR, except as noted in Chapter 2 in regards to the refinement at Wilshire/Rodeo Station and west of the Century City Station.

As described in Chapter 2 of this Draft SEIS, the tunnel alignment was refined slightly since to Final EIS/EIR to accommodate the removal of the double crossover at the Wilshire/Rodeo Station and to optimize the radii of the curves. The alignment refinement results in avoiding tunneling beneath the Perpetual Savings Bank Building (9720 Wilshire Boulevard), but does require subsurface easements beneath two properties that were not identified in the Final EIS/EIR:

- 216 S Lasky Drive (AIN: 4328-007-016): multi-family residential
- 2029 Century Park East (AIN: 4319-016-029): commercial

The subsurface easements will not result in displacement or relocation of any structures on the surface of the parcel. Therefore, no adverse impacts related to subsurface easements are anticipated. In addition, a permanent easement would be required at 1950 Avenue of the Stars to support the station entrance and an approximately 3,000 square feet of permanent easements would be needed for ventilation and exhaust shafts within the Westfield Mall property located along the north side of Constellation Boulevard. As required by both the Uniform Relocation Assistance and Real Property Acquisition Policies Act and the California Relocation Assistance Act, Metro would fairly compensate property owners for all permanent and subsurface property easements. The acquisition and displacement impacts would not be considered an adverse impact with the implementation of the measures specified in Section 4.2 of the Final EIS/EIR.

Based on these considerations, the following resource areas are not discussed further in this Draft SEIS with respect to long-term operation of Section 2 of the Project, and the long-term operational impacts and mitigations measures relating to these areas remain unchanged from the Final EIS/EIR:

- **Land Use, Socioeconomic Characteristics, Environmental Justice, Visual Quality, and Parklands and Community:** The surrounding land use types, socioeconomic conditions, and visual character remain the same as those analyzed in the Final EIS/EIR. Although the BHHS campus is undergoing a modernization program, the use of the BHHS property remains as a public school. Likewise, while the physician-

run hospital is being converted into a medical rehabilitation facility, it is continuing its use as a medical facility. Furthermore, neither of these facilities is immediately adjacent to the station area. No new parklands or community facilities have been developed around the station areas since publication of the Final EIS/EIR. The operations of Section 2 of the Project, which remain the same as those analyzed in the Final EIS/EIR, will not conflict with existing land uses, land use plans, or land use policies or result in a disproportionately high and adverse impact to minorities and low-income communities.

- **Air Quality, Climate Change, and Energy:** As stated in the Final EIS/EIR, operation of Section 2 of the Project is expected to decrease regional vehicle miles traveled, which will reduce energy consumption and lower emissions of some air pollutants, resulting in beneficial air quality and climate change effects. Since the refinements analyzed in this Draft SEIS do not affect operations, these energy, air quality, and climate change beneficial effects remain.
- **Hazardous Waste and Materials, Ecosystems/Biological Resources, Water Resources, and Archaeological and Paleontological Resources:** The changes at the BHHS campus and the conversion of the physician-run hospital into a medical rehabilitation facility do not introduce new hazardous waste or materials or archaeological or paleontological resources. These land use changes also do not affect the surrounding ecosystems/biological resources or water resources. Because the operations of Section 2 of the Project remain unchanged from those analyzed in the Final EIS/EIR, the assessment of these resource areas also remains unchanged. No significant impacts are anticipated related to hazardous materials or waste or water resources. The removal of trees during construction is addressed in Section 4.5.6 of this Draft SEIS. The Area of Potential Effects (APE) for the tunnel and stations remains unchanged from that analyzed in the Final EIS/EIR. The potential to encounter previously unknown archaeological or paleontological resources during construction is discussed below.
- **Safety and Security:** Since Section 2 of the Project will operate as identified in the Final EIS/EIR, Section 2 of the Project will not have a significant effect on safety and security with the incorporation of the measures described in the Final EIS/EIR. Safety related to subsurface gas risk as it relates to the BHHS campus is described in Section 4.3 of this Draft SEIS.
- **Growth-Inducing Impacts, Relationship between Short-term and Long-term Productivity, and Irreversible and Irretrievable Commitments of Resources:** Section 2 of the Project is located within a densely developed urban area, which remains a densely developed urban area with the surrounding land use changes, and will not extend into undeveloped areas that may induce changes. As identified in the Final EIS/EIR, potential indirect growth-inducing effects may result from opportunities Section 2 of the Project provides for micro-scale growth, including economic growth. Even with the refinements to the construction staging areas, the local short-term impacts and use of resources are consistent with the maintenance and enhancement of long-term productivity for the local area and region. The consumption of irreversible and irretrievable resources during construction and operation will not result in the unnecessary, inefficient, or wasteful use of such resources.

The Final Decision, the changes in construction staging activities at the Century City Constellation Station, the proposed modernization of the BHHS campus, and the conversion of the physician-run hospital into a medical rehabilitation facility were examined to identify potential impacts during construction. The proposed construction staging areas in this Draft SEIS are a refinement to Scenario B, which was analyzed in the Final EIS/EIR. The resource areas and the construction impact determinations and mitigation measures that are unchanged from the Final EIS/EIR are:

- **Land Use, Socioeconomics, Economic and Fiscal, and Environmental Justice Construction Impacts**: The surrounding land uses types and socioeconomic conditions remain the same as those analyzed in the Final EIS/EIR. Although the BHHS campus is undergoing a modernization program, the use of the property remains a public school. Likewise, while the physician-run hospital is being converted into a medical rehabilitation facility, its use as a medical facility remains. The construction of Section 2 of the Project will not directly conflict with the identified land use plans, policies, and regulations. The use of the proposed properties for construction activities will not substantially alter land uses in the station area vicinity. Construction impacts will affect neighborhoods surrounding construction staging areas, regardless of demographic or socioeconomic character. Construction activities may temporarily impact businesses, particularly those adjacent to construction sites, but at a minimum one access point to those businesses will be maintained at all times.
- **Climate Change and Energy Construction Impacts:** With the refinements to the location of the construction staging areas, the construction methods and approach continue to remain consistent with the construction methods analyzed in the Final EIS/EIR. Construction of Section 2 of the Project will not significantly increase daily carbon dioxide equivalent (CO_{2e}) emissions and will not lead to a wasteful, inefficient, or unnecessary use of energy.
- **Hazardous Waste and Materials and Water Resources Construction Impacts:** Although the staging area locations were refined slightly, the areas of excavation and construction approach remain consistent with those identified in the Final EIS/EIR. The tunnel is anticipated to be below the lowest point of contaminated soils. As contaminated groundwater may be encountered during construction, it will be treated in accordance with applicable permits' requirements prior to discharge or disposal. Preparation of construction staging areas will require the demolition of structures. If asbestos and/or lead is identified in these structures, the materials will be handled by licensed contractors in accordance with applicable regulations. The construction of Section 2 of the Project will not adversely affect the municipal water supply. Anticipated dewatering activities will require a permit from the Los Angeles Regional Water Quality Control Board, and if contaminated groundwater is encountered it will be managed in compliance with applicable permits and regulations. The drainage structures affected by construction will be resized or relocated to maintain drainage functions and prevent flooding or ponding. Construction and wastewater disposal will be conducted in accordance with applicable regulatory water quality requirements and permits.

- **Safety and Security Construction Impacts:** The construction approach and methods are consistent with those identified in the Final EIS/EIR, although the construction locations have been refined. As explained in Chapter 2 of this Draft SEIS, a 20-foot noise barrier will surround all construction staging areas, which provides site security. The safety of construction workers and the general public remains a key element of construction activities, which will be conducted in accordance with the U.S. Occupational Safety and Health Administration, the California Occupational Safety and Health Administration, the California Public Utilities Commission, and Metro policies and practices.
- **Archaeological and Paleontological Resources Construction Impacts**: With the exception of Area 5, all of the construction activities are within the area of potential effects established for Section 2 of the Project in the Final EIS/EIR. Area 5 is proposed to be used for materials storage at the surface with no excavation proposed at this location. Therefore, construction activities will not disturb archaeological or paleontological resources at Area 5. The Final EIS/EIR identified the potential for construction activities to encounter subsurface prehistoric and/or historic archaeological deposits, as well as fossils from non-asphaltic deposits, and mitigations in case such resources are encountered.

Section 4.5 of this Draft SEIS includes an analysis of the construction-related impacts to the following resource areas:

- Acquisition and Displacement of Existing Uses (Section 4.5.1)
- Visual Quality (Section 4.5.2)
- Air Quality (Section 4.5.3)
- Noise and Vibration (Section 4.5.4)
- Geological Hazards (subsurface gas) (Section 4.5.5)
- Ecosystems and Biological Resources (Section 4.5.6)
- Parklands and Community Services and Facilities (Section 4.5.7)
- Historic Resources Construction Impacts (Section 4.4)

Finally, this chapter includes an analysis of the cumulative operational and construction impacts that could result from construction and operation of Section 2 of the Project.

4.2 Noise and Vibration

This section provides analysis of long-term operational impacts related to noise and vibration for Section 2 of the Westside Purple Line Extension Project.

4.2.1 Affected Environment/Existing Conditions

Noise-sensitive land uses, such as residencies, parks, schools, hospitals, places of worship, and theater, were identified in the immediate vicinity of each station location and near any proposed project at-grade facilities, such as emergency generators in Section 4.6.2 of the *Westside Subway Extension Final Environmental Impact Statement/Environmental Impact Report* (Final EIS/EIR) (Metro 2012j). These locations were considered because of the potential for different sources of operations noise at street level near the stations. Land uses along the Project directly above the subway

tunnel and between stations would not be affected by noise. Groundborne noise and vibration effects from train operations through the subway tunnels are analyzed at these locations above the tunnel alignment. The land uses surrounding the Century City Constellation Station are shown in Figure 4-1.

Figure 4-1. Land Uses Surrounding the Century City Constellation Station

The existing noise and vibration environment have not changed from what was described in the Final EIS/EIR. Since the publication of the Final EIS/EIR, a medical rehabilitation facility on Century Park East has opened and the BHHS campus is undergoing its approved modernization program (Figure 4-2). However, as described below, both of these uses are typical urban facilities. During the preparation of the Final EIS/EIR, noise levels were measured for 24 hours at the Wilshire/Rodeo and Century City Stations.

At the Wilshire/Rodeo Station, noise levels were measured at 120 Canon Drive south of Wilshire Boulevard (near the Wilshire/Rodeo Station). This property is located behind the retail and office buildings that front the proposed station site. The first-row land uses along the proposed station location are retail and office buildings. Multi-family residential land uses are located behind the first-row land uses to the south of Wilshire Boulevard; one hotel and an apartment building are located north of Wilshire Boulevard behind the retail and office land uses. An Ldn of 64 dBA and a peak noise hour of Leq(h) of 66 dBA were measured at this location.

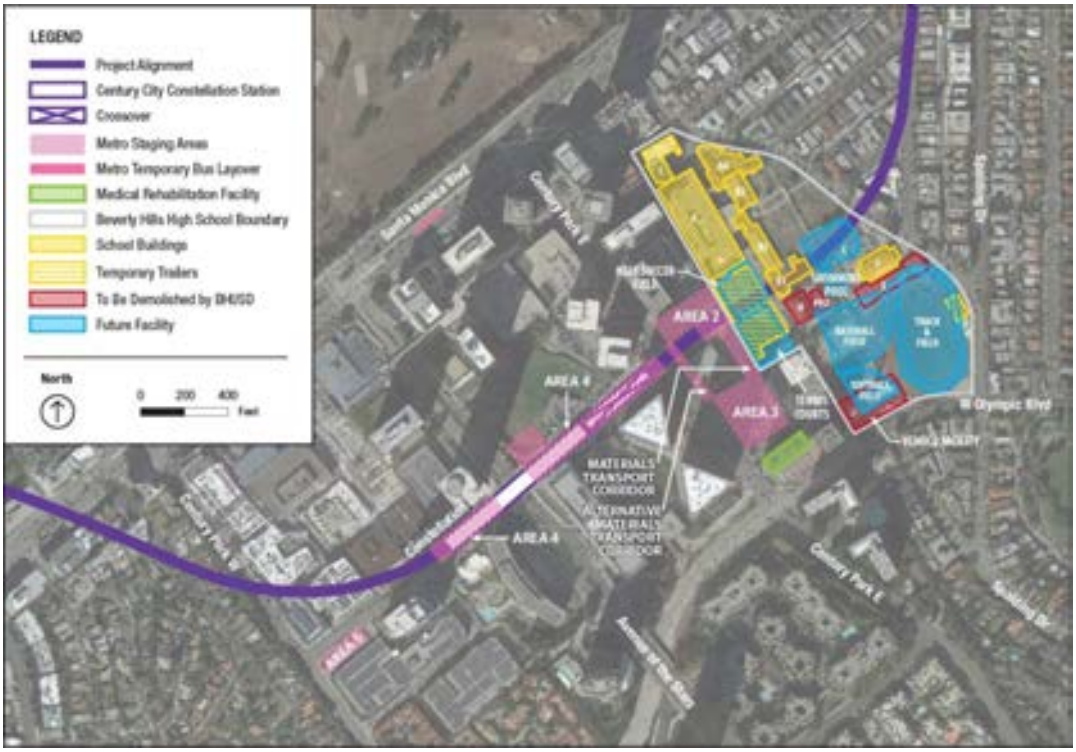


Figure 4-2. Beverly Hills High School Modernization Program

At the Century City Station, noise levels were measured at the northeast corner of Avenue of the Stars and Constellation Boulevard. A future condominium and offices are proposed on this corner and the Century Plaza Hotel is located on the southwest corner, which is also planned to be converted into a hotel and residential use. All other land uses in the immediate area are office buildings or shopping centers. An Ldn of 74 dBA and a peak noise hour Leq(h) of 78 dBA were measured at this location.

The existing ground vibration levels are typical of an urban environment, with the background VdB levels expected to range from 50 to 65 according to FTA's guidance manual *Transit Noise and Vibration Impact Assessment* (FTA 2006). As the area is typical of an urban environment, ambient vibration levels were not measured but vibration propagation tests were conducted to project the rate at which vibration attenuates. The results of this study for the BHHS are presented as part of the analysis in Section 4.2.2.

On the northeast corner of Century Park East and Olympic Boulevard is a former physician-run hospital at 2080 Century Park East. This facility was closed in 2008 due to funding issues and recently reopened under new ownership as a remodeled 9-story, 138-bed medical rehabilitation facility with inpatient services. The facility was not in operation at the time of the Final EIS/EIR studies but is a typical urban facility which is not a generator or substantial traffic or noise. The medical rehabilitation facility is located more than 1,000 feet away from the station entrance and is not above the tunnel alignment and therefore is not considered a sensitive receptor during operations or subject to noise or vibration impacts during operations.

Located immediately east of the Century City Constellation construction staging area is BHHS, which is undergoing a modernization of the campus. In 2008, the Beverly Hills Unified School District (BHUSD) issued its Draft Master Plan that was accepted by the California Board of Education and became final in 2010. The *Beverly Hills High School, Hawthorne K-8 School, and El Rodeo K-8 School Improvement Project Final EIR* (BHUSD 2015) was completed in 2015. Construction activities for the campus began in 2015 and are scheduled to continue through 2020; therefore, some BHHS construction activities will be concurrent with construction activities for Section 2 of the Project. As shown in Figure 4-2, the BHHS modernization program includes the following:

- Improvements/modifications to Buildings A (Main Class Rooms), B1 (Domestic Science), B2 (Old Class Rooms), B3 (Peters Auditorium), B4 (Salter Wing), F (Swim Gym), and L (Science Laboratories)
- Construction of a new athletics building (Building C) with underground parking
- Construction of an aquatics center
- Demolition of Buildings E (Gymnasium) and H (Maintenance & Operations; Moreno High School)
- Reconfiguration of athletic fields
- Construction of a new pedestrian plaza, enhancements to "graduation lawn," and conversion of Heath Avenue into a pedestrian walk
- Elimination of circulation on Heath Avenue, but the existing parking garage in Building A used by students and staff will remain

In total, the modernization will increase BHHS campus parking from 544 spaces to 712 spaces. During construction, portable classrooms will temporarily be located on the current lacrosse fields, which are immediately to the east of and adjacent to the Century City Constellation Station construction staging areas.

Due to its location immediately above the tunnel alignment, groundborne noise and vibration analysis was conducted for the BHHS modernization program. The BHHS campus is not in the immediate vicinity of the station box and therefore would not be subject to surface level noise during operations. Potential for noise impacts during construction is considered in Section 4.5.4 of this Draft SEIS.

4.2.2 Environmental Impacts/Environmental Consequences

Noise

The noise and vibration impacts of the Project are consistent with those analyzed in Section 4.6.3 of the Final EIS/EIR. The removal of the double crossover structure at the Wilshire/Rodeo Station and subsequent shortening of station box does not affect the noise producing activities at the station during operations because the train and station operations would remain the same as described in the Final EIS/EIR. The design of the Century City Constellation Station is consistent with how it was presented in the Final EIS/EIR.

At both the Wilshire/Rodeo and Century City Constellation Stations, components of the Project with the potential to generate noise that will be audible at the surface are the station ventilation systems, which are subject to periodic testing, and will adhere to

Metro design levels and not exceed FTA Noise Impact Criteria. At both the Wilshire/Rodeo and Century City Constellation Stations, the station ventilation fan noise would be designed so as not to exceed a maximum noise level of 45 dBA at a distance of 50 feet from the ventilation shaft outlet at the sidewalk grating or at the setback line of the nearest building, whichever is closest. The estimate fan noise levels over a 24-hour period (Ldn) and one-hour period (Leq) are presented in Table 4-1 along with the measured existing noise levels and the FTA noise impact criteria. Emergency ventilation fans would be periodically tested during the afternoon when the existing ambient traffic noise levels are at their highest.

Table 4-1. Predicted Station Ventilation Fan Noise

	Measured Existing Noise Level (dBA)	Estimated Maximum Fan Noise (dBA)	FTA Noise Impact Criteria (dBA)
Wilshire/Rodeo	Ldn = 64	Ldn = 61	Ldn = 61
Century City Constellation	Ldn = 74	Ldn = 61	Ldn = 66

Noise from rail operations, including the interaction of wheels on tracks, motive power, signaling and warning systems, and the TPSS will occur well below ground. Future traffic increases at the station locations would be minimal and would not add to the existing measured noise levels. Therefore, no adverse effects related to noise are anticipated during operations of Section 2 of the Project.

Groundborne Noise and Vibration

To accommodate the shorter Wilshire/Rodeo station box and optimize operations, the alignment was adjusted slightly between the Wilshire/Rodeo and Century City Stations as described in Chapter 2 of this Draft SEIS. This revised alignment requires subsurface easements beneath two properties that were not identified in the Final EIS/EIR: 216 Lasky Drive (multi-family residential) and 2029 Century Park East (commercial). To account for the alignment adjustment, groundborne vibration and noise predictions were prepared at these two properties.

Section 2 of the Project would pass 55 to 80 feet beneath the BHHS campus (to the tops of the tunnels), including existing Building B1 and the proposed Building C, a new athletic facility with proposed underground parking. The operational noise and vibration impacts to Building B1 were considered in the Final EIS/EIR, but the operational noise and vibration impacts to Building C were not. With the proposed subterranean parking structure, the top of tunnels would pass between approximately 8.5 and 18 feet beneath the foundation of Building C (24.5 to 34 feet to top of rails) with the shallowest point on the western end of the parking structure. The Gymnasium and the PE offices are located within Building C. The *Westside Purple Line Extension Beverly Hills High School Master Plan Groundborne Vibration Assessment – Revision 1* (Metro 2017f) (Appendix E) considers the potential for groundborne noise and vibration impacts to BHHS Building C and presents groundborne vibration and noise predictions, which are summarized in this section.

Groundborne noise is considered for the potential to create an annoyance as well as the potential to damage buildings:

- **Human Annoyance from Vibration:** Potential human annoyance from vibration is assessed using root mean squared (RMS) vibration velocity. As described in Section 4.6.3 of the Final EIS/EIR, groundborne vibration from transit vehicles is characterized using RMS vibration velocity amplitude expressed as VdB. The vibration perception threshold for most humans is around an RMS vibration level of 65 to 70 VdB. Levels from 70 to 75 VdB are typically noticeable but acceptable to most persons. Levels higher than 80 VdB are often considered unacceptable.
- **Building Damage from Vibration:** Vibration, as it is related to risk of building damage, is generally assessed in terms of peak particle velocity (PPV) in units of inches per second (in/sec). The damage risk threshold from construction vibration ranges from 0.12 in/sec for historic buildings and cultural resources to 0.5 in/sec and for architectural damage to 2.0 in/sec for structural damage.

Following FTA guidance established in the *Transit Noise and Vibration Impact Assessment* (FTA 2006), the significance of vibration impacts is based on the vibration level, the type of land use, and whether the vibration events occur frequently, occasionally, or infrequently. Frequent events are more than 70 vibration events of the same source per day. Most transit subway projects, including this one, fall into that category.

Excessive ground vibration from transit subway operations can sometimes result in a low-pitched rumbling sound occurring within a nearby building during the train pass-by called groundborne noise. The FTA groundborne vibration and groundborne noise impact criteria are shown in Table 4-2.

The groundborne noise and vibration analysis in the Final EIS/EIR uses vibration impact thresholds defined by the FTA in the *Transit Noise and Vibration Impact Assessment* (FTA 2006). Schools are considered FTA Category 3 receivers in this FTA guidance. The thresholds for Category 3 receivers are 75 VdB for groundborne vibration and 40 A-weighted decibels (dBA) for groundborne noise.

An important factor in projecting levels of groundborne vibration is the rate at which the vibration dissipates as it travels away from the source where it is generated. The relationship between a vibration source and the resulting vibration of the ground is known as the transfer mobility. The transfer mobility was determined by conducting vibration measurements in which the vibration pulses from a dropped weight were measured at various distances from the source. A load cell (force transducer) is used to measure the force input to the ground from the dropped weight, and calibrated vibration transducers are used to measure the vibration pulses at various distances from the source, as shown in Figure 4-3. The frequency-dependent propagation characteristics are derived from the transfer function relationships of the ground surface vibration and the force. The tests were conducted by dropping the weight down a borehole to the depth of the top of rail, which is the location of the vibration source that results from the train running along the rail.

Table 4-2. FTA Groundborne Vibration and Groundborne Noise Impact Criteria for General Assessment

Land Use Category	Groundborne Vibration Levels (VdB re 1 micro-inch/second)			Groundborne Noise Impact Levels (dB re 20 micro Pascals)		
	Frequent Events[1]	Occasional Events[2]	Infrequent Events[3]	Frequent Events[1]	Occasional Events[2]	Infrequent Events[3]
Category 1: Buildings where vibration would interfere with interior operations	65 VdB[4]	65 VdB[4]	65 VdB[4]	N/A[5]	N/A[5]	N/A[5]
Category 2: Residences and buildings where people normally sleep	72 VdB	75 VdB	80 VdB	35 dBA	38 dBA	43 dBA
Category 3: Institutional land uses with primarily daytime use	75 VdB	78 VdB	83 VdB	40 dBA	43 dBA	48 dBA

Source: *Transit Noise and Vibration Impact Assessment* (FTA 2006)
[1]Frequent Events are defined as more than 70 vibration events of the same source per day. Most rapid transit projects fall into this category.
[2]Occasional Events are defined as between 30 and 70 vibration events of the same source per day. Most commuter trunk lines have this many operations.
[3]Infrequent Events are defined as fewer than 30 vibration events of the same kind per day. This category includes most commuter rail branch lines.
[4]This criterion limit is based on levels that are acceptable for most moderately sensitive equipment, such as optical microscopes. Vibration-sensitive manufacturer or research will require detailed evaluation to define the acceptable vibration levels. Ensuring lower vibration levels in a building often requires special design of the HVAC systems and stiffened floors.
[5]Vibration-sensitive equipment is generally not sensitive to groundborne noise.

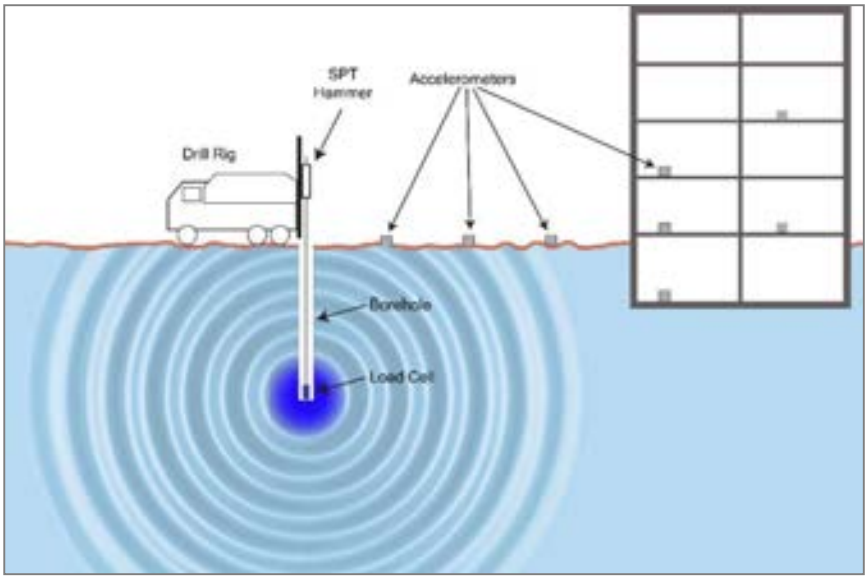


Figure 4-3. Borehole Test Configuration

Downhole vibration propagation measurements were made at several places on or near the BHHS campus in 2011 in support of the Final EIS/EIR. Borehole site G-165 was located on Heath Avenue, directly west of Building B1 (Figure 4-4). Vibration testing was conducted at three depths of 55 feet, 65 feet, and 75 feet. Several receiver positions were measured at the surface, including three measurements made inside the classrooms. The results of this testing are included in the *Westside Subway Extension Noise and Vibration Study* (Metro 2011a).

Figure 4-4. Location of Borehole Site G-165

The vibration propagation measurements were used to define the Line Source Transfer Mobility (LSTM) as a function of the diagonal distance from the top of rail. The LSTM is combined with the Force Density Level of a Metro Red Line Breda Vehicle, which is the predicted vibration excitation caused by the transit rail vehicle wheels as they travel along the tracks, to make groundborne vibration and groundborne noise predictions. Because a subterranean parking garage is proposed beneath Building C, the analysis assumed the recommended FTA coupling loss to building foundation for a large masonry building on spread footings.

Table 4-3 and Table 4-4 shows the FTA thresholds and the predicted groundborne vibration and noise levels for a single train passby and simultaneous passby of two trains, respectively, for the Gymnasium and PE office in Building C, the planned future facility on the BHHS campus that would be located directly over the Section 2 tunnel, based on the vibration propagation measurements.

Table 4-3. Predicted Groundborne Vibration and Noise Levels at BHHS Building C – Single Train Passby

	FTA Category 3 Thresholds	Building C Gymnasium (1st Floor) Predicted Levels	Building C PE Office (2nd Floor) Predicted Levels
With Building C Subterranean Parking Structure			
Groundborne Vibration (Lv)	75 VdB	72 VdB	70 VdB
Groundborne Noise (La)	40 dBA	53 dBA	51 dBA
Without Building C Subterranean Parking Structure			
Groundborne Vibration (Lv)	75 VdB	65 VdB	63 VdB
Groundborne Noise (La)	40 dBA	32 dBA	30 dBA

Source: *Transit Noise and Vibration Impact Assessment* (FTA 2006) and *Beverly Hills High School Master Plan Groundborne Vibration Assessment –Revision 1* (Metro 2017f) (Appendix E)

Table 4-4. Predicted Groundborne Vibration and Noise Levels at BHHS Building C – Two Train Passby

	FTA Category 3 Thresholds[1]	Building C Gymnasium (1st Floor) Predicted Levels	Building C PE Office (2nd Floor) Predicted Levels
With Building C Subterranean Parking Structure			
Groundborne Vibration (Lv)	83 VdB	75 VdB	73 VdB
Groundborne Noise (La)	48 dBA	56 dBA	54 dBA
Without Building C Subterranean Parking Structure			
Groundborne Vibration (Lv)	83 VdB	68 VdB	66 VdB
Groundborne Noise (La)	48 dBA	35 dBA	33 dBA

Source: *Transit Noise and Vibration Impact Assessment* (FTA 2006) and Beverly *Hills High School Master Plan Groundborne Vibration Assessment –Revision 1* (Metro 2017f) (Appendix E)
Notes: 1. FTA Category 3 thresholds for infrequent events of fewer than 30 per day.

As shown in Table 4-3, the predicted maximum level groundborne vibration and groundborne noise for a single train passby at the Building C Gymnasium and PE Office would exceed the FTA Category 3 groundborne noise threshold of 40 dBA if the BHHS subterranean parking structure is constructed as currently proposed. It is predicted not to exceed the groundborne vibration threshold of 75 VdB. If the subterranean parking structure is not constructed, the predicted train groundborne vibration and the groundborne noise levels are not predicted to exceed FTA Category 3 thresholds at the Building C Gymnasium and PE Office.

The predicted groundborne vibration and groundborne noise, presented in Table 4-4, is a maximum level for simultaneous passby of two trains. It is not expected that two trains will simultaneously pass under Building C for more than 21 times per day. The FTA threshold for infrequent events of fewer than 30 per day is used to assess the potential

effect of this occurrence. If the subterranean parking structure is constructed as currently proposed, the two train predicted groundborne noise at the Building C Gymnasium and PE Office would exceed the FTA Category 3 groundborne noise threshold of 48 dBA. It is predicted not to exceed the groundborne vibration threshold of 83 VdB. If the subterranean parking structure is not constructed, the predicted train groundborne vibration and the groundborne noise levels are not predicted to exceed FTA Category 3 thresholds at the Building C Gymnasium and PE Office.

The predicted groundborne vibration and noise levels presented in Table 4-3 and Table 4-4 account for the proposed location of the Building C subterranean parking structure, which extends the building foundation to within approximately 8.5 feet of top of tunnel (24.5 feet from the top of rail) at the shallowest point. Any changes to the proposed building location and/or building design would affect the groundborne vibration and groundborne noise levels. If the distance between the top of rail and the building foundation increases, the predicted groundborne vibration and noise levels would be lower.

At 40 feet or more between top of rail and building foundation, the predicted groundborne noise levels would not exceed the FTA threshold of 40 dBA at the Gymnasium or PE Office for a single train passby or 48 dBA for a two train passby. However, constructing the tunnel at that depth would increase costs and result in less efficient train operations. The gradient of the tunnels east of Constellation Station is already approaching the maximum of 4 percent permitted by Metro criteria. Therefore, lowering the tunnels below BHHS buildings would require a corresponding increase in the depth of the Century City Constellation Station. Increasing the depth of the Century City Constellation Station is not technically prudent as all the additional depth would be below the water table, meaning increased dewatering and hence settlement due to dewatering impacting buildings adjacent to the station. The increased depth of the station would also result in increased loads on shoring from building foundations now within the zone of influence of the deeper station or foundation loads now further above the bottom of excavation. In addition to not being technically prudent, the deeper excavation will result in higher volumes of excavation, a longer construction timeline and street closures, and subsequently higher construction costs. Furthermore, placing the station at that depth would create an inconvenience for passengers by increasing the amount of time required to access and egress the station.

Table 4-5 shows the FTA thresholds and the predicted groundborne vibration and noise levels at 216 Lasky Drive and 2029 Century Park East. As shown, the groundborne vibration and groundborne noise is predicted not to exceed FTA thresholds at these locations for their respective land uses. As stated in the Final EIS/EIR, the groundborne vibration and groundborne noise is predicted not to exceed FTA thresholds at any other vibration sensitive land uses along Section 2 of the Project.

Table 4-5. Predicted Groundborne Vibration and Noise Levels at 216 Lasky Drive and 2029 Century Park East

	FTA Groundborne Vibration Thresholds	Groundborne Vibration (Lv)	FTA Groundborne Noise Thresholds	Groundborne Noise (La)
216 Lasky Drive (Multi-family Residential)	72 VdB	60 VdB	35 dBA	26 dBA
2029 Century Park East (Commercial)	75 VdB	71 VdB	40 dBA	38 dBA

4.2.3 Mitigation Measures

The predicted groundborne vibration resulting from operation of Section 2 of the Project would not exceed FTA Category 3 thresholds for Gymnasium and PE office at BHHS's Building C if the BHHS subterranean parking structure is not built. If the distance between the top of rail and the Building C foundation with the subterranean parking structure is less than 40 feet, the predicted groundborne noise levels resulting from operation of Section 2 of the Project would exceed FTA Category 3 thresholds for the Gymnasium and PE office at BHHS's Building C. With the implementation of the following mitigation, the groundborne noise level is predicted not to exceed the FTA Category 3 thresholds and no groundborne noise impacts would remain.

- VIB-3—Use of Groundborne Noise Minimization Techniques: If the distance between the top of rail and the BHHS Building C foundation is less than 40 feet, resilient rail fasteners, floating slab track or other similar technology will be incorporated into the project design to reduce groundborne noise to levels that do not exceed FTA Category 3 groundborne noise threshold at BHHS Building C.

4.3 Geologic Hazards

The Final Decision identified the following three issues related to geologic hazards to be addressed in this SEIS:

- An analysis of the potential risks of soil gas migration from tunneling or other construction activities related to Section 2 of the Project to nearby structures and, depending on the results of that analysis, additional disclosures and/or assessments
- A discussion of the completeness of the available seismic risk information related to Section 2 of the Project
- A discussion of the post-Draft EIS seismic studies available to the FTA and related to Section 2 of the Project

The geologic hazards analysis of the Project in the *Westside Subway Extension Final Environmental Impact Statement/Environmental Impact Report* (Final EIS/EIR) (Metro 2012j) is incorporated into this SEIS by reference. This section provides updated information to Section 4.8 of the Final EIS/EIR to address the Final Decision and incorporates the results of all available geotechnical investigations, including

investigations carried out after the Draft EIS/EIR publication, as they relate to the following:

- Surface fault rupture
- Subsurface gas and oil fields

The findings of the geotechnical investigations carried out after the Draft EIS/EIR publication are consistent with the information provided in the Final EIS/EIR for the following areas of geologic hazards, which, as directed by the Final Decision, are not the subject of this SEIS:

- Seismic ground shaking
- Liquefaction and seismic settlement

As part of the Final Decision, the SEIS should provide the public with an opportunity to comment on the post-Draft EIS/EIR additional seismic studies. To do so, the Project is presented in this section as it was analyzed in the Final EIS/EIR, with both the Century City Constellation Station and the Century City Santa Monica Station locations. The Century City Constellation Station and alignment is described in Chapter 2 of this SEIS.

The Century City Santa Monica Station and alignment location analyzed in the additional studies is consistent with the description in Chapter 2 of the Final EIS/EIR as follows: the Century City Santa Monica Station would be located underneath Santa Monica Boulevard from just west of Century Park East to Moreno Drive. A separate crossover box would be located east of Moreno Drive. The entrance would be located on the southwest corner of Santa Monica Boulevard and Century Park East.

Following the publication of the Draft EIS/EIR, investigations were carried out in the Century City area to address the Metro Board of Directors' motion to study tunneling safety in the Board-approved Locally Preferred Alternative (LPA) tunnel alignment between Beverly Hills and Westwood. Two reports, the *Westside Subway Extension Century City Area Tunneling Safety Report* (Metro 2011d) and the *Westside Subway Extension Century City Area Fault Investigation Report* (Metro 2011c) were prepared to present the results of these studies in detail. The soil boring logs, gas monitoring well diagrams, and detailed geologic profiles from these studies along the LPA were presented in the *Westside Subway Extension Preliminary Geotechnical and Environmental Report* (Metro 2011g) and in the *Westside Subway Extension Century City Area Fault Investigation Report* (Metro 2011c). The findings of the reports were reviewed by Metro's Tunnel Advisory Panel and an Independent Review Panel (refer to the *Tunnel Advisory Panel Final Report* [Metro 2011j] and *Report of Independent Review Panel* [Metro 2011ao]).

The reports' findings were presented to the Metro Board of Directors and released to the general public on October 19, 2011. The presentation made to the Metro Board of Directors is appended to this SEIS (*Presentation to Planning & Programming Committee* [Metro 2011i]) and the video is available on the Metro project website at www.Metro.net/purplelineext.

The results of these investigations were incorporated into the Final EIS/EIR. All of the geotechnical reports prepared for the Final EIS/EIR are also appended to this SEIS.

Following completion of the Final EIS/EIR, the City of Beverly Hills and the Beverly Hills Unified School District (BHUSD) submitted a series of letters (described further below) to Metro regarding Metro's interpretation of the geotechnical data in the Final EIS/EIR. Metro reviewed all of the letters and prepared responses, both written and oral, in May 2012 when Section 2 of the Project was approved. The following documentation relates to the Board approval of the Final EIS/EIR and selection of the Century City Constellation Station, and is appended to this SEIS:

- *Transcript: Special Meeting of the MTA Board to Conduct Public Hearing* (Metro 2012a)
- *Final EIS/EIR Presentation to Metro Committee* (Metro 2012d)
- *Metro Board Report* (Metro 2012e)
- *Appendix D to Metro Board Report* (Metro 2012f)

Since the Final EIS/EIR was certified in 2012, additional geotechnical investigations have been performed by Metro during Advanced Preliminary Engineering. In addition to the reports listed above, the following reports have been prepared by Metro since 2012 and are appended to this SEIS:

- *Geotechnical Design Memorandum – Section 2, Tunnel Reaches 4 and 5* (Metro 2016e)
- *Geotechnical Design Memorandum – Century City Constellation Station* (Metro 2016f)
- *Geotechnical Design Memorandum – Wilshire/Rodeo Station* (Metro 2016g)
- *Geotechnical Data Report–Tunnel Reaches 4 and 5* (Metro 2016h)
- *Geotechnical Data Report – Century City Constellation Station* (Metro 2016i)
- *Environmental Data Report – Century City Constellation Station* (Metro 2015a)
- *Westside Purple Line Extension Section 2 Geotechnical Fault Investigations Summary Memorandum (*Metro 2016a*)*
- *Westside Purple Line Extension Project, Section 2 Addendum to the Final Environmental Impacts Report* (Metro 2015e)
- *Fault Investigation Report Transect 9—Tunnel Reach 5* (Metro 2017c)
- *Probabilistic Fault Displacement Hazard Evaluation* (Metro 2017d)
- *Assessment of Tunneling and Station Excavation Risks Associated with Subsurface Gas along Section 2 – Revision 1* (2017b)

In addition to reports prepared by Metro, other property owners in the Project's vicinity prepared a number of independent geotechnical fault investigation reports, which have been reviewed by Metro and used by Metro in further analysis of geologic conditions in the vicinity, as described herein. Those reports as listed below, are incorporated into this SEIS by reference and are summarized in Appendix B:

- *Fault Hazard Assessment of the West Beverly Hills Lineament, Beverly Hills High School* (Leighton Consulting, Inc. [LCI] 2012a)
- *Initial Response to California Geological Survey Review Comments, Fault Rupture Hazard Review, Beverly Hills High School* (LCI 2012b)
- *Second Response to California Geological Survey Review Comments, Fault Rupture Hazard Review, Beverly Hills High School (*LCI 2012c)
- *Addendum to Second Response to California Geological Survey Review Comments, Fault Rupture Hazard Review, Beverly Hills High School* (LCI 2013)
- *Fault Rupture Hazard Investigation, 1802 Avenue of the Stars, 10250 Santa Monica Boulevard, 1930 Century Park West* (Geocon West 2013)

- *Report of Phase II Site-Specific Fault Rupture Investigation* (Geocon West 2014)
- *Report of Fault Rupture Hazard Investigation* (Feffer Geological Consulting [FGC] and Geocon West 2012)
- *Summary of Fault Trench Study at 10131 Constellation Boulevard - Century City* (GeoKinetics Geotechnical & Environmental Engineers [GeoKinetics] 2013)
- *Geohazard Report, El Rodeo K-8 School* (LCI 2015);
- *Updated Fault Hazard Assessment and Response to CGS Review Letter, El Rodeo K8 School* (LCI 2016)

Based on the data in the above-listed geotechnical fault investigation reports, a number of opinion reports were prepared by various parties either criticizing the Metro investigations or attempting to present different interpretations as to the meaning of the reported data and the geoseismic conditions of the area. The following such reports, along with Metro responses, incorporated herein by reference, have been prepared since the publication of the Draft EIS/EIR and were considered by Metro and FTA in preparing this Draft SEIS:

- *Preliminary Literature and Geomorphic Evaluation of the Eastern Santa Monica Fault Zone, and Potential Impacts Associated with Fault Surface Rupture Relative to Proposed LA Metro Stations in Century City (*Kenney GeoScience [KGS] 2011)
- *Geomorphic, Structural and Stratigraphic Evaluation of the Eastern Santa Monica Fault Zone, and West Beverly Hills Lineament* (KGS 2012)
- *Hazard Assessment Study* (Exponent 2012a)
  - *Response to Hazard Assessment Study by Exponent* (Metro 2012h)
  - *Response to Metro Comments* (Exponent 2012b)
  - *Reply to Exponent Responses* (Metro 2012b)
- *Preliminary Review Comments of Century City Area Fault Investigation Report, Westside Subway Extension Project Century City and Beverly Hills Area* (Shannon & Wilson 2012)
  - *Response to Preliminary Review Comments of Century City Area Fault Investigation Report by Shannon and Wilson* (Metro 2012g)
- *Response to Leighton Consulting Report [Fault Hazard Assessment of the West Beverly Hills Lineament, Beverly Hills High School]* (Metro 2012c)
- *Preliminary Revised Fault Map Based on Geomorphic, Structural and Stratigraphic Evaluation in the Century City/Cheviot Hills Area (*KGS 2013)
- *Structural and Stratigraphic Evaluation of the Century City-Cheviot Hills Area* (KGS 2014)
- *Evaluation of Regional and Local Seismic Issues within the Beverly Hills Unified School District and their Public and Scientific Issues* (KGS and PrimeSource Project Management LLC [PSPM] 2016)

In addition, the California Geological Survey (CGS) has issued a revised geologic map of the Los Angeles Basin that includes the Century City area, which is discussed in Section 4.3.1. This map, although not produced for use in surface fault rupture hazard evaluation or seismic shaking hazard evaluation, illustrates the Newport-Inglewood and Santa Monica Faults.

Furthermore, the City of Los Angeles established the Preliminary Fault Rupture Study Areas (PFRSA) in 2015, where fault investigations are required by the City of Los Angeles Department of Building and Safety in areas under that agency's jurisdiction. The PFRSA in the Century City area includes the Santa Monica Fault as shown in CGS, 2014, generally along Santa Monica Boulevard between the Cities of Santa Monica and Beverly Hills (LA 2015).

Information in this section has been developed based on a review of the data and opinions presented in all of the above-listed geotechnical documents. This Draft SEIS provides the public the opportunity to comment on the geotechnical work and Metro's geoseismic studies completed to date.

4.3.1 Existing Conditions/Affected Environment

The existing conditions and affected environment related to geologic hazards for Section 2 of the Project are presented in the following sections. Where appropriate, the geologic conditions are described for the entire Study Area with a focus on Section 2 of the Project. The changes to the land uses at a medical rehabilitation facility on Century Park East and to BHHS are described in Section 4.2.1 of this Draft SEIS. Unless otherwise noted, the existing conditions remain the same as they were identified in Section 4.8 of the Final EIS/EIR.

The fundamental geology of the Study Area has not changed since the publication of the Final EIS/EIR. However, extensive additional studies were conducted after the Final EIS/EIR.

The additional studies provided more data on faulting in the vicinity of the Century City Station options (Metro 2011c). In addition, fault studies were performed on several properties along and adjacent to the Project alignment by the property owners (see References), as well as along the alignment by Metro (2016). These studies provided additional scientific/technical analysis regarding the Santa Monica Fault zone that confirmed, and in some cases supplemented, the existing geotechnical and geological information in the environmental review record (refer to Section 4.8 of the Final EIS/EIR).

Study Area Geology

Geological Setting

The Project lies at the intersection of the northern end of the northwest-trending Peninsular Ranges physiographic province with the southern portion of the east-west-trending Transverse Ranges physiographic province (Figure 4-5). The Peninsular Ranges physiographic province includes the nearby San Jacinto and Santa Ana Mountains. The Transverse Ranges physiographic province includes the Santa Monica Mountains.

The Los Angeles Basin, which lies at the northwest end of the Peninsular Ranges physiographic province, is an elongated northwest-trending, sediment-filled trough that is up to 6 miles deep. At its surface, the Los Angeles Basin is an alluvial coastal plain composed mainly of stream- and alluvial fan-deposited sediments originating from nearby mountains. In the Project area, the sediments originated primarily from the south flank of the Santa Monica Mountains.

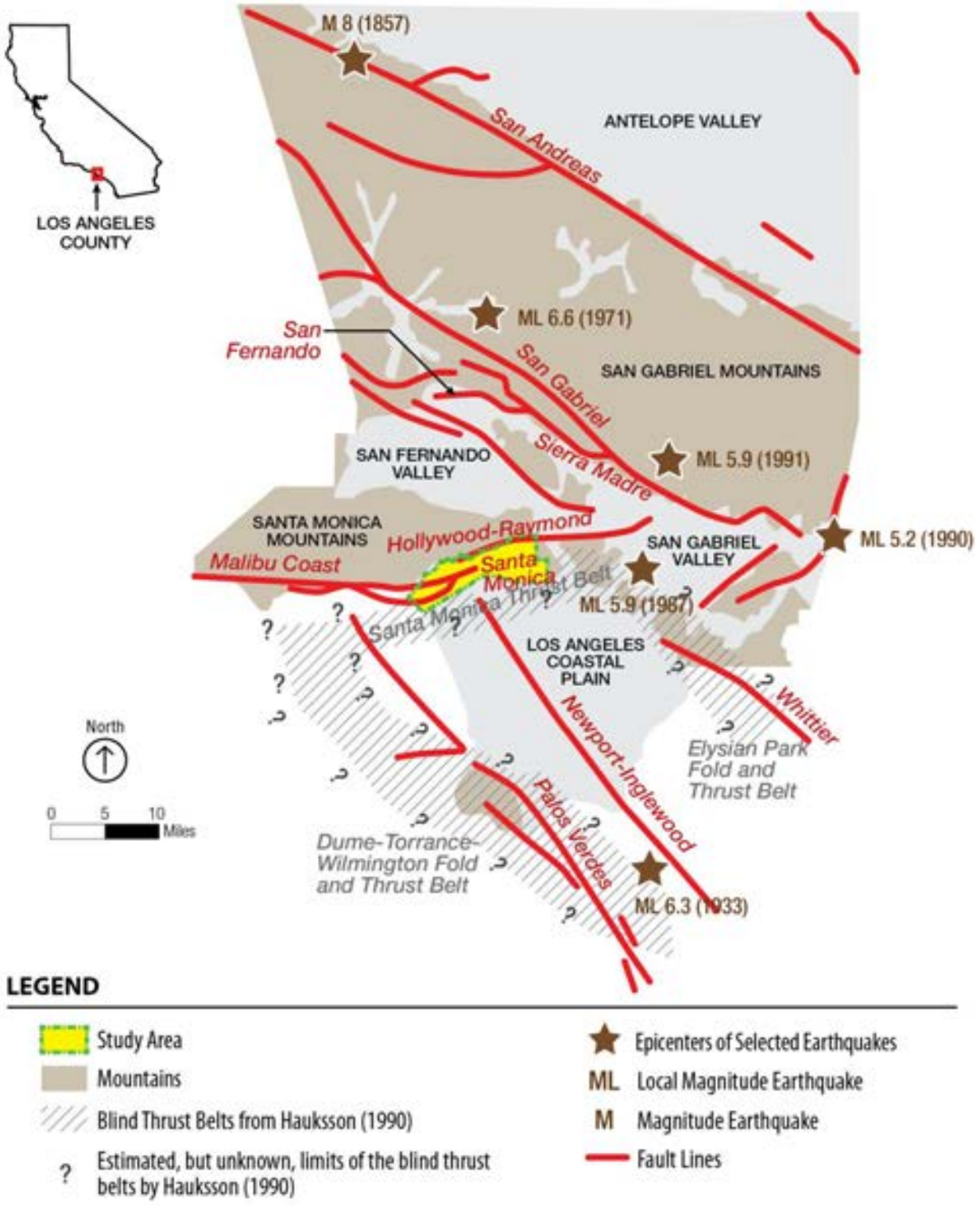


Figure 4-5. Physiographic Provinces and Identified Earthquake Faults in Los Angeles County, from Metro Supplemental Seismic Design Criteria, 2015

Geology

A geological unit (or "Formation") is a grouping of rock or soil of an identifiable origin and age that is defined by its distinctive and dominant features. There are four geologic units within the tunnel and station depth horizon of Section 2 of the Project, as shown in Table 4-6, with the youngest units being present at the shallowest depths and older units being below the younger units. Geology in Section 2 of the Project is shown in Figure 4-6 as it is currently understood based on published studies. Geology in relation to Section 2 of the Project tunnel is shown in Figure 4-7.

Table 4-6. Geologic Units within Depth Range of Tunnel and Station

Age	Geologic Formation (age)	Age (Thousands of years)	Symbol	Composition	Location in Study Area
Youngest 	Younger Alluvium (Holocene)	Recent to 11	Qal	Poorly consolidated, interlayered silts, clays, and silty sands with some sand layers and gravel	Beverly Hills east of the vicinity of Moreno Drive
	Older Alluvium/ Alluvial Fan (Late Pleistocene)	11-500	Qalo	Non-marine sediments	All areas
	Lakewood (Pleistocene)	350-500	Qlw	Sands, silty sands with some clayey sand layers	Century City and Beverly Hills west of Lasky Drive
Oldest	San Pedro (Pleistocene)	500+	Qsp	Fine-grained sand and silty sand with few interbeds of medium- to course-grained sand and some local silt layers. Some asphaltic sand	Century City and Beverly Hills west of Lasky Drive and east of vicinity of Roxbury Drive

Sources: *Westside Subway Extension Geotechnical and Hazardous Materials Technical Report* (Metro 2015i), Section 3.2.2, modified 2016
Note: Geologic Units = units appearing at any depths ranging from the ground surface to bottom of the tunnel

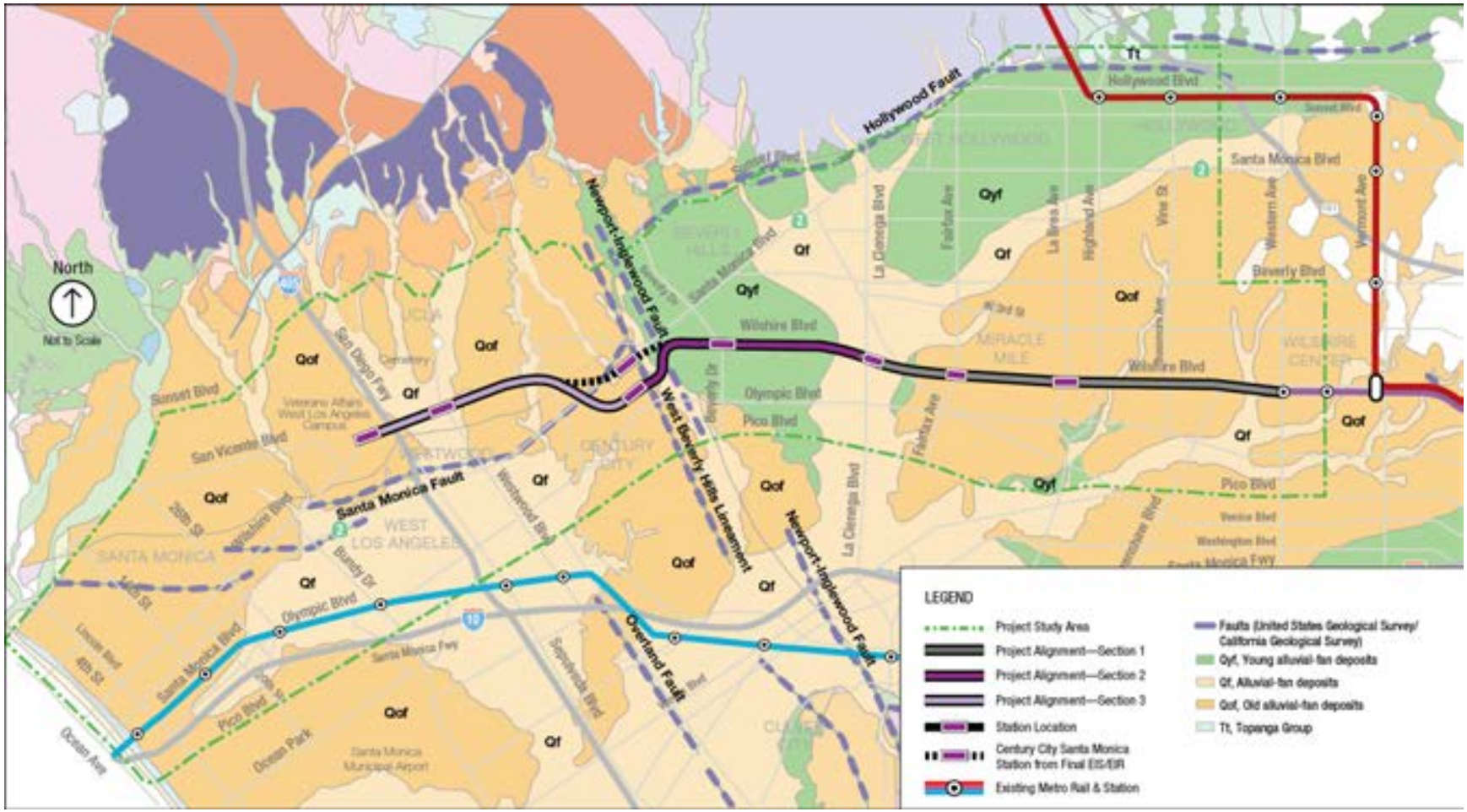
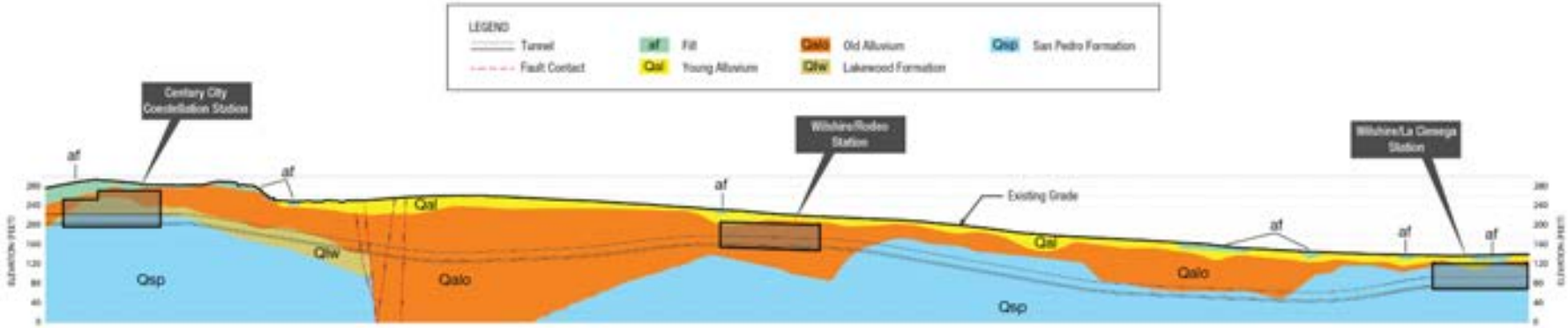


Figure 4-6. Surface Geology and Identified Earthquake Faults



Sources: *Westside Purple Line Extension Section 2 Fault Investigation Report* (Metro 2016a) and *Westside Purple Line Extension Geotechnical Data Report–Tunnel Reaches 4 and 5* (Metro 2015d)

Figure 4-7. Geologic Cross-Section for Section 2 of the Project

Seismic Hazards

The following section describes faulting in the Study Area, seismicity, and seismically induced hazards.

Fault Characterization

Numerous faults are present in the Los Angeles area, with many of these faults occurring near the edges (or "margins") of the Los Angeles Basin. This fact is not disputed, nor is the fact that many of the faults constitute hazards for the built environment. As stated in the Metro Supplemental Seismic Design Criteria: "except for the Newport-Inglewood Structural Zone, most surface geological faults such as the Santa Monica, Hollywood, and Whittier faults occur along the Basin margins."

The hazards presented by faults can be classified as primary, secondary, and tertiary: the primary hazard is ground surface rupture, which can cause fault displacement of the ground surface where the fault reaches up to the ground surface; the secondary hazard is shaking caused by the earthquake rupture. The hazard of surface-rupture displacement is confined to a narrow zone along the fault, whereas the shaking hazard can be present at large distances from a fault, depending on the magnitude of the earthquake. In addition, the shaking hazard itself can result in tertiary effects such as damage to structures, liquefaction of the ground, and instability of slopes within the zone of significant seismic shaking from the earthquake.

In order to evaluate the risk of the primary, secondary, and tertiary effects of earthquakes, the locations of faults must first be evaluated and then a determination is made whether those faults present a hazard for the particular project. Often the terms "active" and "inactive" are applied to help represent the risk of a particular fault having future earthquakes that would affect a project; in those terms, an active fault would represent a fault presenting an increased potential hazard for a project, whereas an inactive fault would represent a fault presenting a lower potential hazard for a project.

Characterization of faults includes a determination of a fault's location and activity. The following sections define the process for characterizing faults.

How are faults explored?

Faults are explored by conducting subsurface investigations. A fault is located by identifying geologic materials broken by a plane that is vertical or inclined. The fault often causes the same geologic material on each side of the fault to be "offset" by some distance due to movement on the fault, either horizontally or vertically, or some combination of the two. Therefore, if the explorations show a horizontal geologic layer that is identified at different depths within a short horizontal distance, that offset can sometimes be attributed to fault activity. The explorations consist of borings, cone penetration tests (CPTs), trenches, or geophysical scanning methods. A transect refers to a series of borings, CPTs, or geophysical explorations that extend in a line when shown on a map. The purpose of arranging the explorations as a "transect" is to allow for a geologic cross-section to be drawn based on the data obtained from the explorations.

How is an active fault defined?

The standard of practice for evaluation of a fault is to first establish whether a fault is active or inactive, based primarily on the timing of the last rupture event. The definition of "active" is not straight-forward and agency standards vary nationwide. The CGS defines an "active" fault as having ruptured in the last 11,700 years before present. However, the use of a single date as definite evaluation of the potential for future rupture is both arbitrary and overly simplistic, as stated by the CGS:

> *The evaluation of a given site with regard to the potential hazard of surface fault rupture is based extensively on the concepts of recency and recurrence of faulting along existing faults. In a general way, the more recent the faulting the greater the probability for future faulting (Allen, 1975). Stated another way, faults of known historic activity during the last 200 years, as a class, have a greater probability for future activity than faults classified as Holocene age (last 11,000 years), and a much greater probability of future activity than faults classified as Quaternary age (last 1.6 million years). However, it should be kept in mind that certain faults have recurrent activity measured in tens or hundreds of years whereas other faults may be inactive for thousands of years before being reactivated. (CGS Note 49, Guidelines for Evaluating the Hazard of Surface Fault Rupture, 2002)*

Other standards for defining a fault as "active" are used by other agencies, such as those used for dams and nuclear power plants. As described by the State of California Division of Safety of Dams (DSOD) publication regarding active faults, "numerous definitions for active faulting have been proposed, but no one definition has been universally accepted...." (DSOD 2001). The DSOD defines an "active" seismic source as a fault that has ruptured within the last 35,000 years. As stated by the DSOD:

> *The 35,000-year value was selected based on the belief that Holocene activity (the last 10,000 years) is not a sufficiently conservative criterion for elimination of a fault when estimating ground motion for dam design....This or any fault activity criterion is somewhat arbitrary by its very nature. There is no physical reason why a fault that has not moved during the last 35,000 years cannot move again. This point is illustrated by the October 16, 1999 Magnitude 7.1 Hector Mine Earthquake. Much of the fault zone that produced this earthquake had not ruptured previously during the Holocene, clearly illustrating the need to design dams for a criterion more conservative than Holocene activity. The 35,000-year criterion was selected because it provides this conservatism, while retaining the practicality of having several age-dating techniques available to investigating geologists.*

Similarly, the U.S. Nuclear Regulatory Commission provides guidelines for evaluation of faults; rather than using the term "active," the Commission uses the term "capable," which is defined as a fault that "has exhibited one or more of the following characteristics: (1) Movement at or near the ground surface at least once within the past 35,000 years or movement of a recurring nature within the past 500,000 years...." (USNRC 2015).

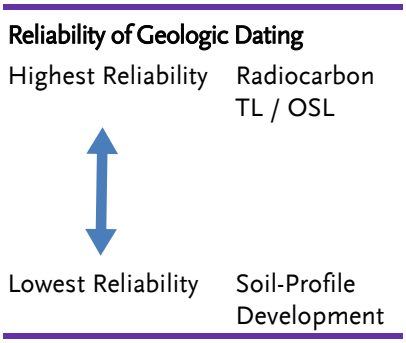
Because a subway is a critical facility, it is prudent to consider some faults as active even if the age of the most recent rupture on those faults is more than 11,700 years before the present. Recent significant earthquakes in Southern California demonstrate this:

- June 28, 1992: Magnitude 7.3 Landers Earthquake centered in the Mojave Desert, which ruptured the Johnson Valley, Kickapoo (also known as Landers), Homestead Valley, Homestead/Emerson, Emerson Valley, and Camp Rock Faults, several sections of which had pre-Landers ruptures older than would have been caused for those faults to be considered active according to the classification using Holocene activity 11,700 years before the present.
- October 16, 1999: Magnitude 7.1 Hector Mine Earthquake also centered in the Mojave Desert, which ruptured the Lavic Lake Fault and the Bullion Fault, portions of which would not have been considered Holocene-active based on their prior activity (see additional commentary on this earthquake in the DSOD quotation above).

How is the age of geologic features determined?

Various methods are used to estimate the dates of geologic materials. For example, the City of Los Angeles identifies three methods that may be used for determining the age of geologic units to assess the age of fault activity (LA 2015):

- Radiocarbon dating
- Thermoluminescence (TL) and Optical Stimulated Luminescence (OSL) dating
- Soil-Profile Development



Radiocarbon dating measures the radioactive decay of carbon-14. The radiocarbon dating method produces a numerical age up to approximately 50,000 years and has optimal resolution in the age range of interest for evaluating active faulting. The reliability of radiocarbon dating is considered to be relatively high compared to other dating methods.

TL and OSL dating techniques evaluate the last exposure of quartz and feldspar minerals to sunlight prior to burial and measure the age of sediments (soils) in the range of 10 to 500,000 years. TS and OSL dating are methods of dating late Quaternary sediments older than radiocarbon limits of about 50,000 years.

Soil-Profile Development compares soils developed within a similar climate, parent material, organisms, topography, and time. The Soil-Profile Development method requires a geologist to be familiar with Quaternary climatic cycles to which dating of geologic layers is commonly correlated.

There are uncertainties associated with dating using any of these methods and, therefore, dating of multiple samples and by multiple methods is prudent as a means to reduce the uncertainty associated with dating soil deposits.

How are shaking hazard and rupture hazard determined?

If a fault is considered to be active, then the possible risk of future earthquakes on that fault is evaluated. In order to evaluate the risk due to future earthquakes on a particular fault, first the potential magnitudes of future events on that fault are estimated. The magnitude is a quantification of the energy released by an earthquake, which can be obtained from past earthquakes based on measurements of the maximum motion recorded by seismographs, which record the trembling of the ground. Basically, the magnitude scale is exponential, where each whole magnitude number is 32 times the strength of the previous whole magnitude number below it (for example, a magnitude 6 earthquake is 32 times stronger than a magnitude 5 earthquake).

The shaking hazard from an earthquake on the fault is computed using numerical quantities to describe the earthquake activity on a fault, including the "slip rate" (typically given in units of millimeters/year) which indicates on average how much potential earthquake energy is stored up in the fault per year. The greater the slip rate, the greater the likelihood of earthquakes on the fault.

The risk of rupture hazard on the fault is evaluated based on the largest future earthquake magnitude estimated for the fault, as well as the slip rate. The fault is categorized with regard to rupture hazard based on these two values.

Uncertainty in Fault Location Investigations

Evaluation of fault locations and orientations ("strike") requires evidence of offset (or breaking) of sediment layers deposited at the location of the fault prior to the last large earthquake on that fault. In fault investigations that use a line of borings, an offset is inferred by the observation of a particular sediment layer being present at a lower depth in one boring as compared to the same sediment layer in the next boring in the line. This inference of offset has uncertainty because there are other reasons that sediment layers can be at varying elevations in adjacent borings, such as tilting of deposits over a broad area or landslide activity, as examples. In addition, once an offset has been observed and characterized as representing a fault, the evaluation of the potential of that fault to rupture in the future requires a means to date the deposits that have been offset at the location of the fault. This process of fault evaluation can result in uncertainty regarding the state of activity of a specific fault strand, particularly where multiple faults have been identified, such as in the zone of active faulting associated with the Santa Monica Fault.

In most of the Los Angeles urbanized area, development of buildings, streets, and other infrastructure occurred early before geologists had an opportunity to explore the land for faults and before the hazard that faults represented was well understood. Because of this development, much of the ground surface evidence of past faulting has been obliterated, requiring more extensive subsurface explorations where those can be performed. The obliteration of faulting evidence includes removal of the upper younger earth material as prior projects excavated sites for basements or installed subterranean features such as large utilities. It has only been in recent decades that some investigations could be undertaken in the heavily urbanized areas where known faults occur to better identify the exact location of those faults. This results in uncertainty in fault locations.

Fault investigations have been performed by Metro and by others in the vicinity of Section 2 of the Project, and these studies have utilized portions of the land surface that have not been developed; nevertheless, the built-over portions of the land surface in the vicinity of the Project have resulted in remaining uncertainty, especially at the Century City Santa Monica Station location and at the crossings of the tunnels by faults. The uncertainties have been eliminated at the Century City Constellation Station due to the ability to obtain direct evidence of no past faulting at that location.

Faults Crossing the Section 2 Study Area

The Section 2 Study Area lies within a seismically active region. The most significant seismic sources related to the Project are listed in Table 4-7. Known significant fault traces are delineated by the U.S. Geological Survey (USGS) and the CGS. These faults, as they are currently understood based on published studies, are listed in Table 4-7, and those in the Study Area are shown in Figure 4-6.

Two faults that have been identified as being potentially capable of generating surface rupture are located within the Section 2 Study Area and both are in close proximity to Section 2 of the Project: the Santa Monica Fault and the Newport-Inglewood Fault, which are both described in the following sections.

Santa Monica Fault

The State of California identifies the Santa Monica fault zone as an active fault along its entire length within the most recent geologic epoch (the Holocene, which extends from about 11,700 years before the present). The State bases this conclusion on the most thorough scientific research published to date on the fault zone (Dolan, et al. 2000a and Dolan, et al. 2000b). This information, along with recent fault investigations performed by Metro as part of the Project as well as fault investigations performed by owners of properties in the vicinity of Section 2 of the Project, are used as the primary sources for scientific information about the Santa Monica fault zone. This section describes the current understanding of the fault locations and characteristics. The fault's relationship to Section 2 of the Project is described in Section 4.3.2.

Table 4-7. Selected Major Faults and Fault Segments in Study Area

Fault or Fault Segment	Approximate Distance to Study Area (in miles)[1]	Approximate Maximum Credible Earthquake Magnitude (Mw)[2, 3]
Santa Monica	0	6.6
Newport-Inglewood	0[4]	7.1
Hollywood	0.25	6.4
Malibu Coast	2	6.7
Upper Elysian Park	2	6.4
Puente Hills	2.5	6.6—single segment rupture 7.1—multi-segment rupture
Raymond	4.5	6.5
Palos Verdes	5.5	7.3
Verdugo-Eagle Rock	10	6.9
Sierra Madre	11	7.2
Anacapa-Dume	11.75	7.5
Northridge	13.75	7.0
San Fernando	14.25	6.7
Whittier	14.75	6.8
Santa Susana	17	6.7
San Andreas (Mojave)	33	7.4

Source: *Geotechnical Data Report – Century City Constellation Station* (Metro 2015e) Table 5-2, Summary of Potential Seismic Sources. Distances shown originally in kilometers were converted to miles and approximated.

Notes:

[1] Distances represent the distance from the closest trace of the fault to the closest portion of the Project.

[2] The moment magnitude scale (denoted as Mw) is now used by seismologists rather than the former Richter scale. Magnitude is based on the moment of the earthquake, which is equal to the rigidity of the Earth multiplied by the average amount of slip on the fault and the size of the area that slipped. The scale retains the familiar numerical magnitude units defined by Richter.

[3] Magnitude from CGS 2003, 2013.

[4] The Newport-Inglewood fault zone is referenced in recent literature as crossing the tunnel alignment between the Wilshire/Rodeo and Century City Constellation Stations as discussed in the *Century City Area Fault Investigation Report* (Metro 2011c), USGS/CGS 2006, and CGS 2014/2016. However, based on recent investigations as described in the text, it is possible that the Newport-Inglewood Fault might not cross the tunnel alignment.

The geologic literature that existed prior to the Final EIS/EIR supported a model wherein the Santa Monica fault zone was defined as a left lateral reverse fault, active at the Veterans Affairs West Los Angeles Medical Center area (investigated in the area north of Ohio Avenue, west of Sawtelle Boulevard, and south of Dowlen Drive), and extending east to Century City. In the Century City area, the fault "stepped" toward the north to the Hollywood Fault, also an active left lateral reverse fault (CGS, 2006). The Santa Monica fault zone is defined as an oblique-left-lateral reverse fault that would displace in an east-west and vertical direction. The concept of displacement during an earthquake is shown in Figure 4-8. The Santa Monica fault zone is comprised of several faults, individually referred to as fault traces or fault strands. As described below, in the eastern portion of Century City, the Santa Monica fault zone splays toward the northeast into a northern fault zone north of Santa Monica Boulevard (the Santa Monica North Fault). In Century City, the Santa Monica fault zone also splays into a southern zone south of Santa Monica Boulevard (the Santa Monica South Fault). As shown in Table 4-7, the Santa Monica fault zone could have a maximum credible earthquake magnitude (Mw) of 6.6 based on estimates from the State of California (CGS 2003). The area along Santa Monica Boulevard, particularly between Spalding Drive/Wilshire Boulevard in Beverly Hills and Century Park West and continuing to the west, is geologically complex due to this faulting.

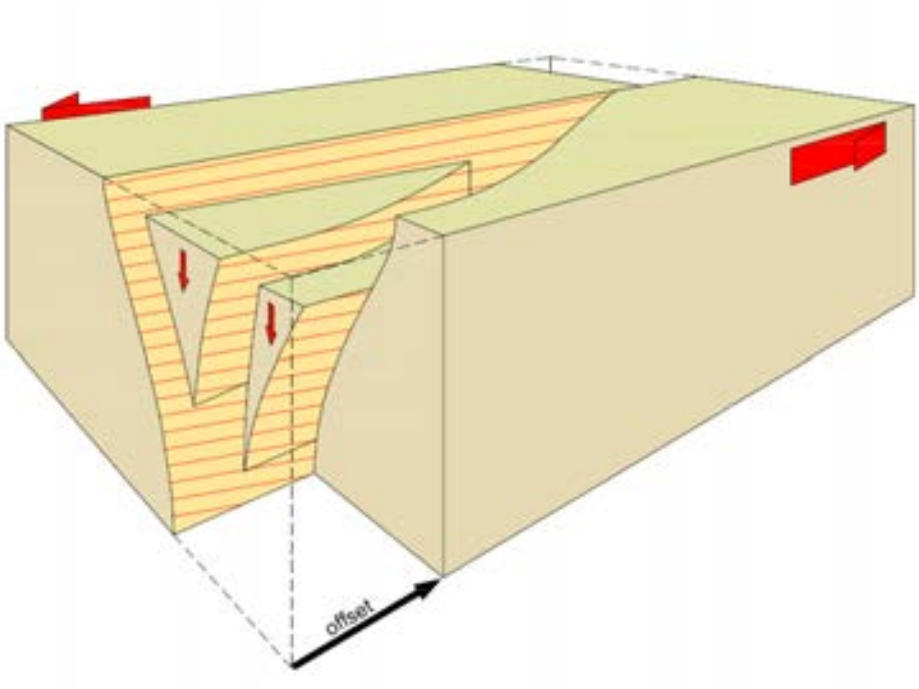


Figure 4-8. Santa Monica Fault Zone Schematic

Since publication of the Draft EIS/EIR in 2010, numerous geotechnical investigations have been conducted by both Metro and local property owners in the Century City vicinity, providing additional data to strengthen the understanding of the Santa Monica Fault. That being said, a full understanding may not be realized due to physical limitations to subsurface investigations as described in Uncertainty in Fault Location Investigations section on page 4-27 of this Draft SEIS. Those limitations include the fact that the majority of the land in the area is developed with structures, under which it is very difficult to excavate fault investigation trenches or borings. In addition, much of the remaining undeveloped land consists of streets with numerous utilities whose presence limits the availability and ability for explorations or obscure geologic evidence of faulting. Since 2011, the fault investigation reports identified in Section 4.3 and summarized in Appendix B have been performed. In addition, many other investigations have been performed for various purposes in Century City. The locations of the subsurface explorations are shown in Figure 4-9. The 2011 Metro investigation was the first investigation specifically performed to evaluate the Santa Monica Fault and Newport-Inglewood Fault models, prevailing at that time, for the Century City area.

Subsequent fault investigations to evaluate specific properties have also been conducted in the Century City vicinity. Investigative methods included trenching, continuous core borings, CPTs, and geophysical seismic reflection surveys. Trenching, which is the most reliable form of fault investigation, was frequently limited or not pursued due to the presence of existing structures, including underground utilities. Locations of explorations were generally targeted to a specific location of a previously interpreted fault. In those subsequent fault investigations, dating methods rarely included radiocarbon dating testing or other numerical dating methods (although such dating would have reduced the uncertainty in conclusions obtained), and where performed were not always considered credible by the authors of the reports presenting those dating results. For example, the dating was not considered credible by the authors of the report because of the methodology used to collect the sample and the potential for contamination of the sample by soils from other locations in the boring. The qualitative dating method of soil development profiling was performed for most of these investigations; this method is subjective and has high uncertainty because of the need to correlate soils in the study area with other soils elsewhere that have been dated, rather than the use of direct dating techniques that provide greater certainty.

Table 4-8 briefly summarizes the studies performed and some of the major conclusions reached. A more detailed summary of the various studies is presented in the *Westside Purple Line Extension Section 2 Geotechnical Fault Investigations Summary Memorandum* (Metro 2016c) included in Appendix B of this Draft SEIS.

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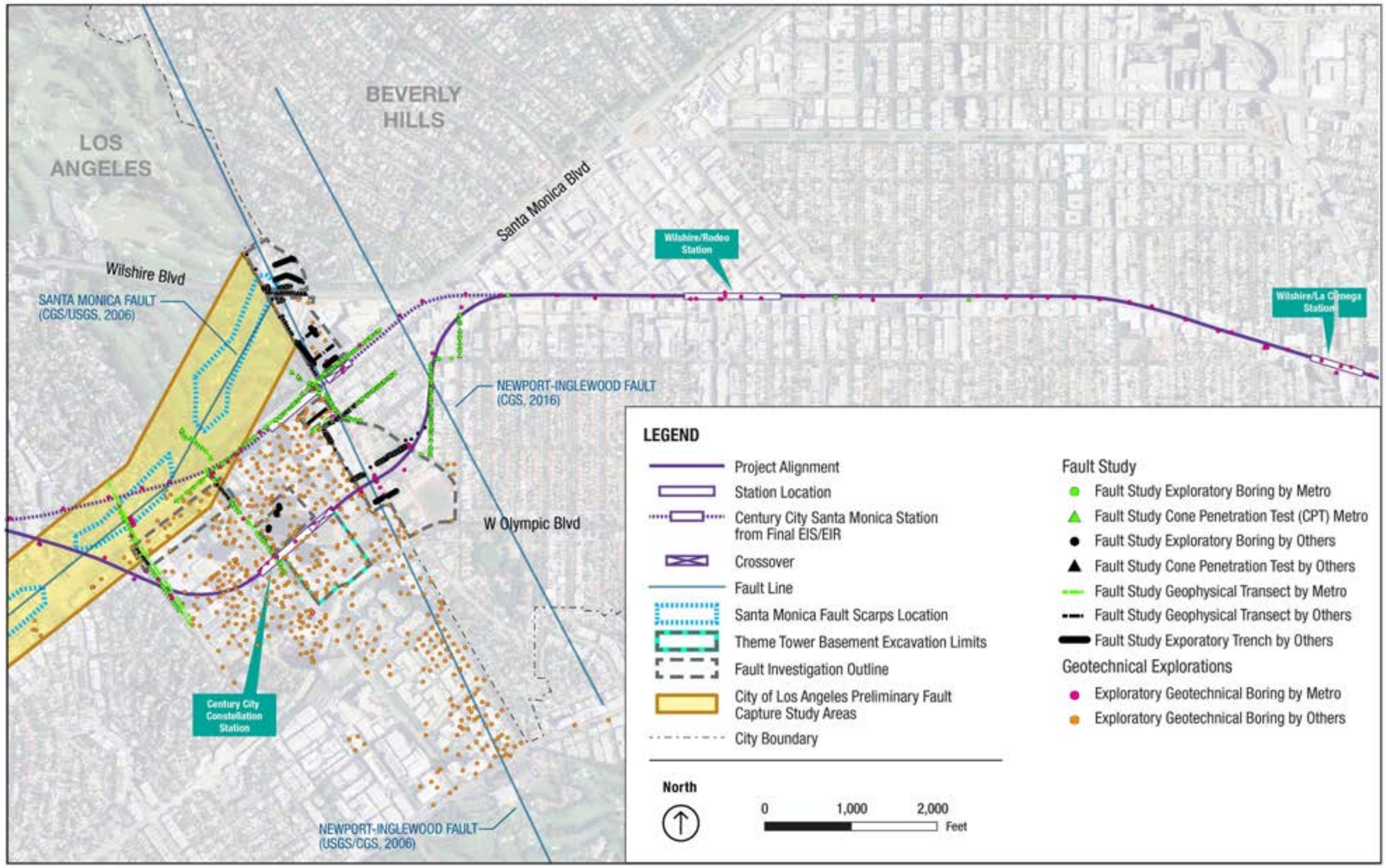


Figure 4-9. Geotechnical and Fault Investigations along Section 2 of the Project

Table 4-8. Summary of Century City Area Fault Investigation Studies

Study Name	Agency / Consulting Firm	Date	Location	Type of Investigation	Study Summary
Century City Area Fault Investigation, Westside Subway Extension	Metro/Parsons Brinckerhoff	2011	Century City Area	Borings, CPTs, Geophysical Profiling	• System of faults associated with both Santa Monica Fault and Newport-Inglewood Fault were interpreted. • Secondary fault strands and zones of distributed near-surface deformation are likely to occur in association with Santa Monica and Newport-Inglewood Faults. • Direct evidence demonstrates that there is no faulting at Century City Constellation Station. • Evidence of complex faulting and potential multiple strands of active faults at station locations along Santa Monica Boulevard, with associated uncertainty in locations of all potential fault strands.
Fault Rupture Hazard Review	BHUSD/Leighton Consulting, Inc. (LCI) and Earth Consultants International (ECI)	2012a, 2012b, 2012c, and 2013	Beverly Hills High School	Trenching, Borings, CPTs	• Major east-west trending fault observed in a trench in the northern portion of BHHS campus; fault appears to be associated with Santa Monica Fault and presence of fault at this location indicates that the overall Santa Monica Fault zone is wider than previously evaluated. The major fault strand was interpreted as not extending to the top of Pleistocene sediments and was therefore not considered Holocene-active for the purpose of school facility development. • Numerous fractures were observed in other trenches at the site; the additional fractures were considered to be due to slope creep, tilting due to seismic ground shaking, and expansion-contraction of expansive soils rather than due to faulting. • Additional fractures were encountered in some trenches, including some with small apparent vertical offsets, but were interpreted as not representing Holocene-active faulting because they were not observed to extend to the top of Pleistocene sediments. • Concluded that north-south trending faults previously interpreted by Metro based on offsets of soil layers were due to tilting of the beds and not faulting.

Study Name	Agency / Consulting Firm	Date	Location	Type of Investigation	Study Summary
Report of Fault Rupture Hazard Investigation	Crescent Heights/Geocon West Inc. and Feffer Geological Consulting	2012	10000 Santa Monica Boulevard	Trenching	• Trench excavated in southwest-northeast direction only in order to evaluate the potential for northwest-southeast-trending Newport-Inglewood fault at the site. • No trenching performed in an orientation to evaluate potential for northeast-southwest-trending Santa Monica fault strands. • No northwest-southeast oriented faults were observed within the trench. • Steeply dipping fractures, vertically and laterally discontinuous, were observed, interpreted as being due to ground shaking rather than faulting.
Fault Rupture Hazard Investigation	Westfield/Geocon West Inc.	2013	1801 Avenue of the Stars, 10250 Santa Monica Boulevard, 1930 Century Park West	Borings	• Performed to evaluate northwest-southeast trending faults south of Santa Monica Boulevard. • Five significant faults, identified as Faults A, B, C, D, and E, were interpreted as being in close proximity to Santa Monica Boulevard in the investigation. These faults appear to be associated with the Santa Monica fault zone. • Based on correlation of interpreted primary stratigraphy and buried soils, soil-stratigraphic age estimates, and geomorphic analysis (rather than other numerical dating methods such as radiocarbon dating) concluded that the faults investigated are not Holocene-active.
Fault Trench Study	JMB/GeoKinetics	2013	10131 Constellation Boulevard	Trenching	• Did not observe "deformation, shearing, vertical offsets, horizontal offsets, or other indications of fault activity" in three trenches excavated and concluded that there was no evidence for faulting.

Study Name	Agency / Consulting Firm	Date	Location	Type of Investigation	Study Summary
Phase II Site-Specific Fault Rupture Hazard Investigation	Allen Matkfins Leck Gamble Malory & Natsis LLP/Geocon West Inc.	2014	9900 Wilshire Boulevard	Borings, CPTs, Trenching	• Numerous faults were interpreted along investigation Transects A and B (northwest-southeast trenching and east-west trenching, respectively): faults were identified with names Fault A through Fault J. • Fault activity based on interpreted primary stratigraphy, buried soil stratigraphic age estimates (rather than numerical laboratory age dating such as radiocarbon). • Faults A through E and J were interpreted as not being Holocene-active. • Faults G, H, and I were interpreted as being Holocene-active. • Fault F was not able to be identified as Holocene-active or not being Holocene-active due to lack of specific boring data on west side of fault.
Fault Hazard Assessment	BHUSD/Leighton Consulting, Inc.	2014 and 2016	El Rodeo K8 School	Trenching, Borings, CPTs, Well Monitoring	• Interpreted that three of the east-west-trending faults at El Rodeo campus were not Holocene-active and that no Holocene-active faults are present on El Rodeo K8 School campus or its associated buildings. • Fault activity based on interpreted primary stratigraphy, buried soil stratigraphic age estimates (rather than numerical laboratory age dating such as radiocarbon). Other geologic features previously identified by Geocon West as faults were re-interpreted as a result of erosional channeling or tilted sediments.
Evaluation of Regional and Local Seismic Issues within the BHUSD	BHUSD/KGS and PrimeSource Project Management LLC	2011, 2012, 2013, 2014, and 2016	Beverly Hills Unified School District and broader Century City/Hollywood Area	Reviewed prior investigations and reinterpreted regional framework and activity	• Hypothesis made that Santa Monica Boulevard Fault and western Hollywood Basin cross faults became inactive approximately 200,000 years ago; therefore, Santa Monica Fault North, Santa Monica Fault South, and eastern San Vicente Fault should be considered Holocene-inactive. • Hypothesis made that the western Hollywood fault zone may be inactive. • Cross Fault No. 1 in western Hollywood Basin is inactive. • Rancho Fault and western San Vicente Fault may be active. • Studies do not indicate that there is faulting activity at Century City Constellation Station area.

Study Name	Agency / Consulting Firm	Date	Location	Type of Investigation	Study Summary
Hazard Assessment Study	City of Beverly Hills/Exponent/Metro response	2012	Century City Area	Review of Metro 2011 investigation and evaluation	• Opined that Constellation Boulevard station alternative had less risk exposure to faulting hazards than Santa Monica Boulevard Station alternative. • Suggested additional trenching investigations at Santa Monica Boulevard and adjacent properties. • Metro responded and developed alignment at Century City Constellation Station where there are no faults and where gassy ground risk can be mitigated.
Preliminary Review Comments of Century City Area Fault Investigation Report	City of Beverly Hills/Shannon and Wilson	2012	Century City and Beverly Hills Area	Review of Metro 2011 investigation and evaluation	• Opined that additional exploration should be conducted at Constellation Station location. • Determined that Santa Monica Station or a location to the east had seismic activity risks due to high probability of ground deformation resulting from earthquakes. • Suggested station location along Santa Monica Boulevard toward the west side of Century City if no active faults were present.
Fault Investigation for Section 2 of Project	Metro/Parsons Brinckerhoff	2016	North along Lasky Drive, east along Charleville Boulevard, then north along Spalding Drive in Beverly Hills, between Moreno Drive on the south and Wilshire Boulevard on the north	Borings, CPTs	• Faults identified along central to northern portion of transect and far southern portion. • Faults at central to northern portion of transect identified as Holocene-active faults. • Not able to determine current state of activity of fault at southern portion. • Faults at central to northern portion of transect: strike (orientation) of faults could not be definitively determined, but considered to likely represent strands of the Santa Monica South Fault Zone.

Study Name	Agency / Consulting Firm	Date	Location	Type of Investigation	Study Summary
Probabilistic Fault Displacement Hazard Evaluation	Metro/Parsons Brinckerhoff	2017	Santa Monica Fault Crossings of Section 2 in Beverly Hills	No additional explorations for this evaluation	• In order to assess the potential impact of fault rupture to the tunnel, the probabilistic fault displacement hazard analysis (PFDHA) was performed in accordance with the Metro Supplemental Seismic Design Criteria. • The locations and extent of faults in the PFDHA model were The Uniform California Earthquake Rupture Forecast (UCERF) 3 (Field et al., 2013). • The potential fault crossings of the South Trace of the Santa Monica Fault as defined in UCERF3 are located along Tunnel Reach 5; a mapped eastern extension of the South Trace passes across the subway tunnel alignment at Lasky Drive and at Wilshire Boulevard (Field et al., 2013; Metro 2017). • An inferred northern extension of the Newport-Inglewood fault also may cross the subway tunnel alignment at Lasky Drive (California Geological Survey 2017) and was considered in the PFDHA model. • The displacement hazard for the Santa Monica fault was evaluated from a series of 18 scenario ruptures that include multi-fault ruptures on the adjacent Anacapa Dume, Malibu Coast, Hollywood, and Raymond faults, and on two traces of the Santa Monica fault in the Beverly Hills area: the North Trace and the South Trace. • The PFDHA model assumed that displacement during ruptures along the Santa Monica fault is distributed along both the Santa Monica North and South Traces, with 75 percent of the displacement in each postulated rupture scenario occurring on the South Trace and 25 percent occurring on either the North Trace or in the area between the two traces of the Santa Monica faults. • The results of the evaluation for the Santa Monica South Trace (at Lasky Drive and also at Wilshire Boulevard) provided an expected displacement of <1 cm in the event of the 150-year return period earthquake (ODE) and 13.0 cm in the event of the 2,450-year return period earthquake (MDE). • The results of the evaluation for the Newport-Inglewood North Extension at Lasky Drive provided an expected displacement of <1 cm in the event of both the ODE and MDE events.

Based on Metro's review and interpretation of the available data, an improved knowledge of the numerous fault strands associated with the Santa Monica fault zone has been developed. This includes a number of faults in the vicinity of Santa Monica and Wilshire Boulevards in the Century City to western Beverly Hills area, as shown in Figure 4-10. Some of these faults are interpreted to extend upward close to the existing ground surface. The orientations of these faults (e.g., north-south, east-west, or other orientations) are not well established by the data obtained to date. The type of faulting associated with the Santa Monica and Newport-Inglewood Faults, which have strike slip faulting where the two sides of the fault slide past each other horizontally, can result in little to no apparent vertical offset of soils, which makes it difficult to observe the effects of the faulting in past earthquakes. There is evidence for large amounts of strike slip faulting on the Santa Monica south fault zone (the portion of the fault zone south of Santa Monica Boulevard).

As along most major fault systems, additional secondary fault strands and zones of possible distributed near-surface deformation are also likely to occur in association with these faults. The methods of investigation used in the fault investigation study may not detect such smaller features. Thus, a buffer zone extending approximately 100 feet beyond the detected main traces of the faults was established to include areas that may be subject to ground rupture, folding, secondary faulting, and off-fault distributed deformation expected during an earthquake. Such features are likely to be found within the structurally complex zone of the widening of the Santa Monica fault zone going from west to east.

The investigations indicate that the Santa Monica fault zone increases in width (from north to south) toward the eastern side of the Century City area into Beverly Hills. The zone, several hundred feet wide, would be subject to both vertical distortion and shearing horizontally along one or more strands of the fault during large earthquakes. In other words, there is a broad zone along Santa Monica Boulevard, extending both north and south of Santa Monica Boulevard in Century City and western Beverly Hills, in which there is a potential for vertical and horizontal ground rupture movement when utilizing the conservative criteria necessary for subway station construction. This zone of faulting is indicated by the presence of numerous faults encountered in the vicinity of Santa Monica Boulevard from Century Park West to Century Park East, as shown in Figure 4-10. It should be noted that this zone of faulting extends south to approximately half-way between Santa Monica Boulevard and Constellation Boulevard, but does not extend as far south as Constellation Boulevard. A similar zone of faulting was shown by CGS, as indicated in Figure 4-10 as a yellow zone, which does not extend as far south as the site-specific studies described above have indicated.

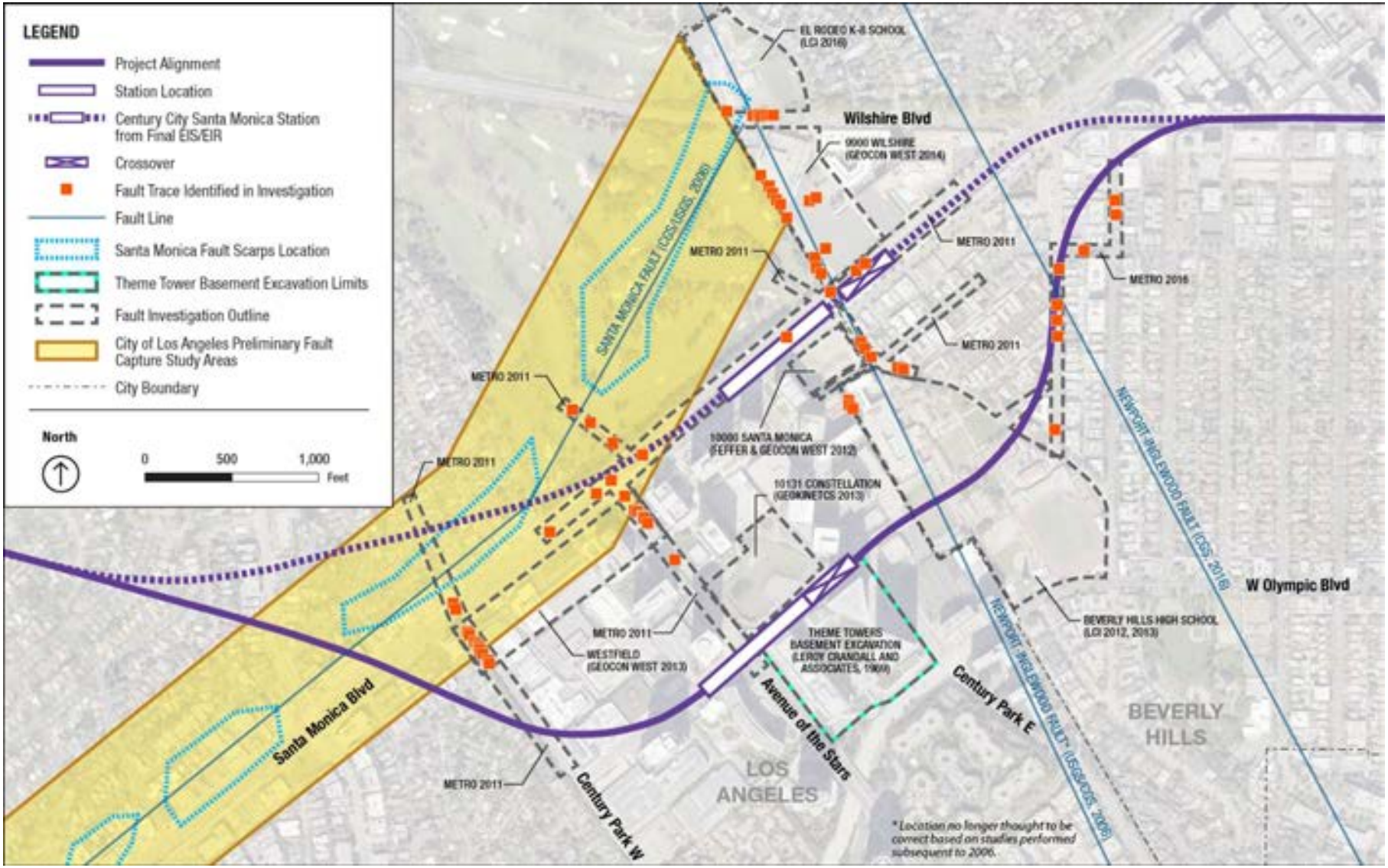


Figure 4-10. Faults Encountered in Investigations in the Century City Area

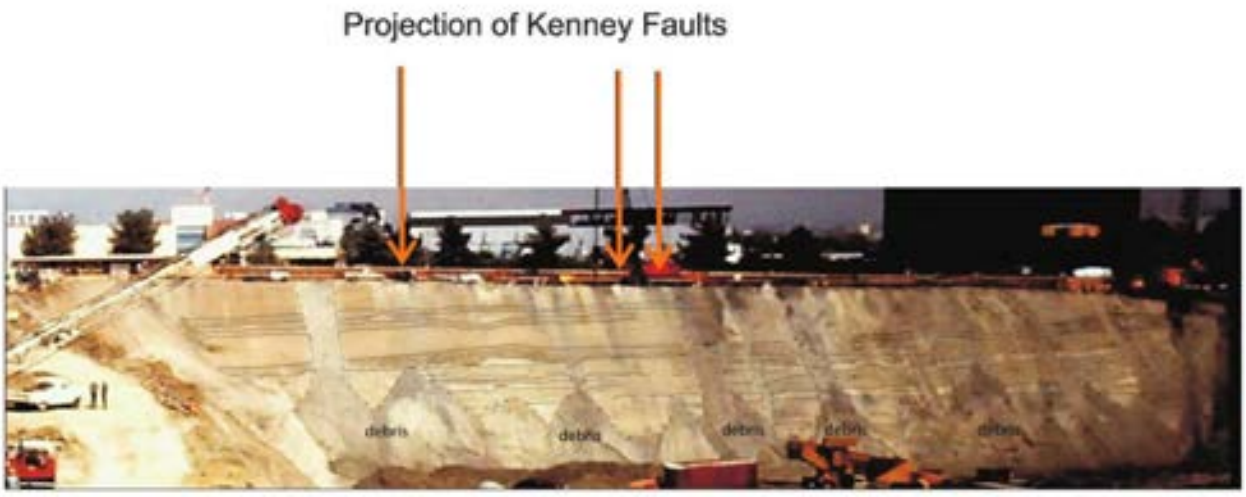
The 2011 Metro investigation included two transects that extended from north of Santa Monica Boulevard. The transect along Century Park West extends south to Constellation Boulevard, and the transect along Avenue of the Stars extends south of Constellation Boulevard. Based on these transects, which included continuous core borings, CPTs, and geophysical seismic reflection surveys, as well as information from prior geotechnical explorations and the 100-foot-deep basement excavation for the Theme Towers/former ABC Entertainment Center and Shubert Theater complex along the south side of Constellation Boulevard, there is evidence that there is no faulting in sediments interpreted to be at least 600,000 years old along Constellation Boulevard. This is illustrated in a photograph taken of the excavation for the Century City Theme Towers during construction (Figure 4-11). Unlike most deep excavations, the Century City Theme Tower excavation initially included the excavation using a slope for the full depth of the deep basement. As a by-product of the excavation technique, a geologic profile could be seen from Avenue of the Stars to Century Park East along the south side of Constellation Boulevard. The continuous and horizontal layering of the exposed side of the excavation provided direct evidence that no faulting was present along the north side of the excavation.

What are "Transects"?

A transect refers to a series of borings, CPTs, or geophysical explorations that extend in a line when shown on a map. The purpose of arranging the explorations as a "transect" is to allow for a geologic cross-section to be drawn based on the data obtained from the explorations.

Figure 4-11. Century City Theme Towers during Construction circa 1972 – North Side of Excavation Illustrating Lack of Faulting in Soil Layers

In addition, the exposed eastern side of the Century City Theme Towers excavation showed direct evidence of no faulting, including at three locations that were hypothetically considered to possibly have faulting per Kenney Geoscience (KGS 2012), as shown in Figure 4-12.



Photograph of East Wall of 1970's Basement Excavation Along Century Park East

Depth is Approximately 100 Feet

Note that the faults postulated by Kenney project through exceptionally well-exposed, unfaulted stratigraphy that is at least 600,000 years old. These observations preclude the possibility of late Quaternary faulting through the site.

Figure 4-12. Projection of Kenney Hypothetical Faults at Century City Theme Towers

Finally, locations that were hypothetically considered to possibly have faulting just north of Constellation Boulevard per Kenney Geoscience (KGS 2012), were investigated by fault trenches as part of geotechnical explorations for a potential development at the northeast corner of Constellation Boulevard and Avenue of the Stars, and were found to have no faulting (GeoKinetics 2013).

Additional photographs and description of the excavation can be seen in the *Response to Preliminary Review Comments of Century City Area Fault Investigation Report by Shannon and Wilson* (Metro 2012g).

Although some of the Santa Monica fault strands are not interpreted to be Holocene-active according to some of the studies (Geocon West 2013 and LCI 2012a, 2012b, 2012c, and 2013), a potential for fault rupture along these strands cannot be discounted for a critical facility such as a subway station, as described in the section above regarding definition of fault activity.

Although the activity of some of the strands of the Santa Monica Fault are disputed by various parties as described above, there is a common understanding that fault traces exist along Santa Monica Boulevard. Based on the entirety of geologic information available to

date in the Century City/West Beverly Hills Area, as described above, there is direct evidence that there is no faulting along Constellation Boulevard, while there is direct evidence of faulting immediately in the vicinity of Santa Monica Boulevard. Some of the faulting in the vicinity of Santa Monica Boulevard has evidence of Holocene activity, which would indicate that strands of the Santa Monica Fault are active in the vicinity of Santa Monica Boulevard. Where the evidence of faulting in near-surface soils has been destroyed by prior construction activities, there will always be a degree of uncertainty regarding the exact locations of fault strands and the activity of those strands.

Beverly Hills Lineament/Newport-Inglewood Fault

The geomorphic feature called the West Beverly Hills Lineament is a feature previously considered to possibly be a northwest-southeast trending fault acting as a tear fault connecting the Santa Monica and Hollywood Faults, and a northerly extension of the Newport-Inglewood Fault. Metro performed investigative work in the vicinity of BHHS, and considered north-south trending apparent offsets of soil layers as potentially an expression of the Newport-Inglewood Fault. This feature was further investigated at BHHS by Leighton Consultants, Inc. (LCI 2012a, 2012b, 2012c, and 2013), which found that the apparent offsets were due to tilting of the beds and not faulting. Based on these additional explorations, it was concluded that the previously identified north-south offsets are not faults within the main BHHS campus.

Subsequent to these investigations, the CGS in 2014 and 2016 produced maps indicating the Newport-Inglewood Fault extending northward into Beverly Hills, east of the BHHS campus. No additional subsurface investigations were conducted by CGS as part of the development of these maps; the maps were developed by review of Lidar maps and interpretation of publications, including some or all of the publications listed within this section.

Later, Metro performed additional fault explorations along Lasky Drive, Charleville Boulevard, and Spalding Drive in Beverly Hills (Metro 2016a). The explorations encountered several offsets that are considered to be due to faulting and that approximately align with the mapped location of the Newport-Inglewood Fault (CGS 2014, 2016). However, the faults observed at that location are likely associated with the east-west-trending Santa Monica Fault rather than the Newport-Inglewood Fault based on the alignment of the offsets.

There is currently no direct evidence of faulting associated with the Newport-Inglewood Fault crossing the Project, even though the Newport-Inglewood Fault is being shown by CGS 2014/2016 as crossing the Project. The West Beverly Hills Lineament crosses the Project, however based on the studies conducted to date, the lineament is currently not thought to be a fault or reflect the location of the Newport-Inglewood Fault. This location is different from those provided in the Final EIS/EIR because additional studies as described above were performed in the area; some faults previously thought to be associated with the Newport-Inglewood Fault are now concluded to represent strands associated with the Santa Monica South Fault, and some offsets previously identified as faults are now concluded to represent a gradually sloping surface of soil layers. Some of the faults previously identified as crossing the Project as being the Newport-Inglewood

Fault are now thought to be associated with the Santa Monica Fault Zone; however, whether those faults are associated with the Newport-Inglewood Fault or the Santa Monica Fault zone, they represent a fault rupture hazard for the tunnel, which is consistent with the conclusions presented in the Final EIS/EIR.

Surface Fault Rupture

During moderate-to-large earthquakes, fault slip usually creates breaks (or ruptures) of the ground surface. If the rupture extends to the surface, there is visible movement on a fault (surface rupture) that produces a scarp or step at the surface if there is vertical movement. As described above, the Santa Monica fault zone crosses the Project and represents a potential surface fault rupture hazard to the Project if it crosses the Project directly. Based on an analysis performed by Dolan et al. (Dolan 2000a), the Santa Monica fault zone is capable of generating earthquakes in the magnitude range M6.9 to M7.2, with average surface displacements of approximately 3 to 6 feet. The magnitude range is higher than the CGS (2003) estimate as it assumes a potentially longer rupture length.

Study Area Subsurface Gas Conditions and Oil Wells

Section 2 of the Project will pass through or near several active or abandoned oil fields and existing oil wells (active and abandoned) that are present within the Study Area. Some areas of rock and soil overlying the oil fields are known to contain naturally occurring methane and/or hydrogen sulfide gases; in other areas the soil and rock have been found to have no or low levels of methane and hydrogen sulfide. At locations with existing or former oil wells, methane or hydrogen sulfide levels are sometimes elevated. For example, the BHHS campus has oil production in the extreme southern area of campus, and there have been measured high levels of methane and/or hydrogen sulfide in that area, whereas other areas, away from the oil production area, have had consistently low levels of methane and hydrogen sulfide in the soil.

Methane and hydrogen sulfide are considered hazardous because of their explosive properties. Also, hydrogen sulfide is highly toxic when inhaled, and can be smelled at lower, non-toxic, levels. These gases can seep into existing buildings and into open excavations, such as tunnels, from the surrounding soil and through open fractures or faults in deep bedrock. Figure 4-13 and Figure 4-14 show the oil fields in and around the Project Study Area and the portion of Section 2 of the Project in the Century City area, respectively.

What is "ppm"?

"ppm" is a measure of the concentration of a gas or liquid in the overall gas or liquid. For instance, the concentration of methane in air can be expressed as "x" ppm where "x" represents the parts of methane per million parts of air. 1,000 ppm methane would represent that there are 1,000 parts methane per 1,000,000 parts air, corresponding to 0.1%

Figure 4-13. Oil Fields/Wells in Project Study Area

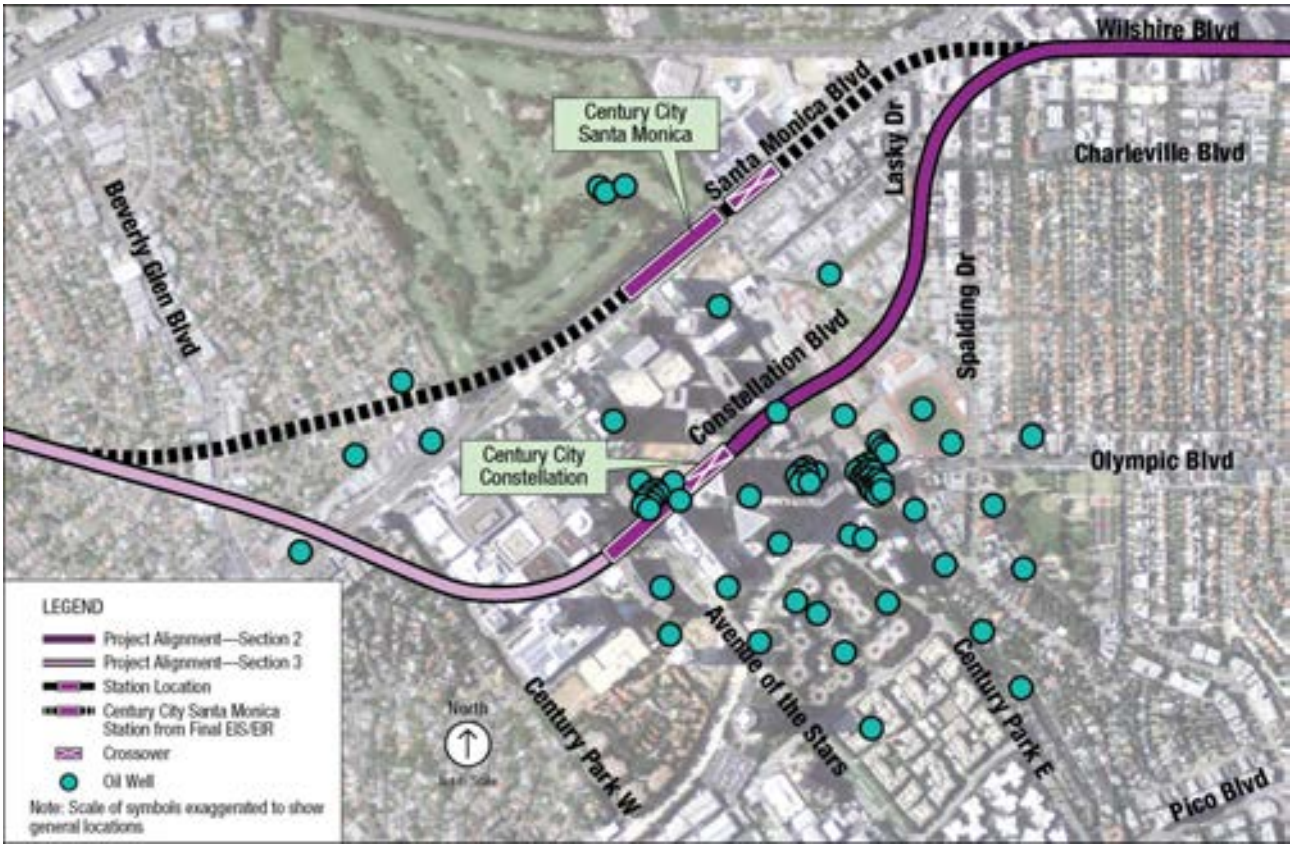


Figure 4-14. Mapped Oil Wells in Century City Area

Hydrogen Sulfide Gas Characteristics

Hydrogen sulfide is produced by the anaerobic decomposition of organic and inorganic matter that contains sulfur. As stated above, it is highly toxic, in certain concentrations, when inhaled. It is potentially explosive at concentrations between 4 and 46 percent and it is highly corrosive. Hydrogen sulfide (density ~1.54 g/l at atmospheric pressure) is heavier than air and, at high concentrations within the ground tends to accumulate just above the groundwater table and within depressions. It is highly soluble in water. According to the American Conference of Governmental Industrial Hygienists (ACGIH 2001), hydrogen sulfide gas has an exposure limit or threshold limit value-time weighted average (TLV) of 10 ppm for continuous exposure and 15 ppm for Threshold Limit Value—Short Term Exposure Limit. This threshold limit value is the concentration to which it is believed that workers can be exposed continuously for a short period of time without suffering from irritation, chronic or irreversible tissue damage, or narcosis of sufficient degree to increase the likelihood of accidental injury, impair self-rescue ability, or materially reduce work efficiency, and provided that the daily exposure limit is not exceeded. A Short Term Exposure Limit is defined as a 15-minute total weighted average exposure that should not be exceeded at any time during a workday. The California Occupational Safety and Health Administration (Cal/OSHA) also sets these as the exposure limits. Hydrogen sulfide gas has a characteristic “rotten-egg” type odor that is perceptible to most people at concentrations at, or below, approximately 1 ppm.

Radon is a gas that can cause lung cancer and other health problems. Los Angeles is located in an area with a general indoor radon potential of between 2.0 and 4.0 pico Curies per liter of air (pCi/l). The USEPA action level for radon is above 4.0 pCi/l; hence, radon is not a large concern for the Study Area.

What is "pico Curies per liter of air"?

"pico Curies" is a measure of the radioactivity of a substance, in this case radon gas. A curie represents the radioactivity of one gram of radium. Radium decays at a rate of about 2.2 trillion disintegrations ($2.2x10^{12}$) per minute. A picocurie is one trillionth of a curie. Thus, a picocurie (abbreviated as pCi) represents 2.2 disintegrations per minute. One pico Curie per liter of air represents the radioactivity equivalent to one trillionth of a gram of radium that is present in one liter of air.

Methane Gas Characteristics

Methane is common in oil and gas fields and is often found with hydrogen sulfide gas. Methane gas is explosive when its concentration is between 5 and 15 percent at atmospheric oxygen levels, but is not toxic. Five and 15 percent are known as the lower and upper explosive limits, respectively. At higher percentages in air, it can be an asphyxiant as it displaces oxygen. Under normal atmospheric conditions, the oxygen content in air is approximately 21 percent by volume; if the oxygen content is reduced below 19.5 percent by volume by the displacement of others gases, the air is considered to be oxygen-deficient, in accordance with Occupational Safety and Health Administration (OSHA) guidelines. Methane (density ~0.72 g/l at atmospheric pressure) is lighter than air and it tends to rise through the ground and dissipate. Methane is moderately soluble in water. A total weighted average exposure of 1,000 parts per million (ppm) (0.1 percent) has recently been added to the American Conference of Governmental Industrial Hygienists' recommended practices; peak values are allowed to be higher than 1,000 ppm, but an weighted average exposure of 1,000 ppm is used in order to prevent adverse health hazards for prolonged exposure.

Methane Risk Zones

After a methane explosion due to gas accumulation under a store in the Third Street and Ogden Avenue area in 1985, the City of Los Angeles created a task force to provide recommendations for construction in areas where subsurface methane gas could be a hazard. Following the recommendations of the task force, the City of Los Angeles Department of Public Works Bureau of Engineering has mapped potential Methane Zones and Methane Buffer Zones, and most recently updated its map in 2004, as shown with respect to the Study Area in Figure 4-15 (as modified to interpolate boundaries of the zones into the City of West Hollywood, City of Beverly Hills, and Veteran's Affairs properties). The City of Los Angeles Municipal Code, Chapter IX, Building Regulations, Article 1, Division 71, Methane Seepage Regulations, requires construction projects located within a Methane Zone or Methane Buffer Zone to comply with the City's Methane Mitigation Standards to control methane intrusion emanating from geologic formations. Mitigation requirements are determined according to the actual methane levels and pressures detected in the subsurface at a site. Mitigation measures can include both active and passive ventilation systems to ensure exchange of air, gas barriers (membranes around basements and foundations), and sensors in interior spaces to monitor the presence of gas and its pressure.

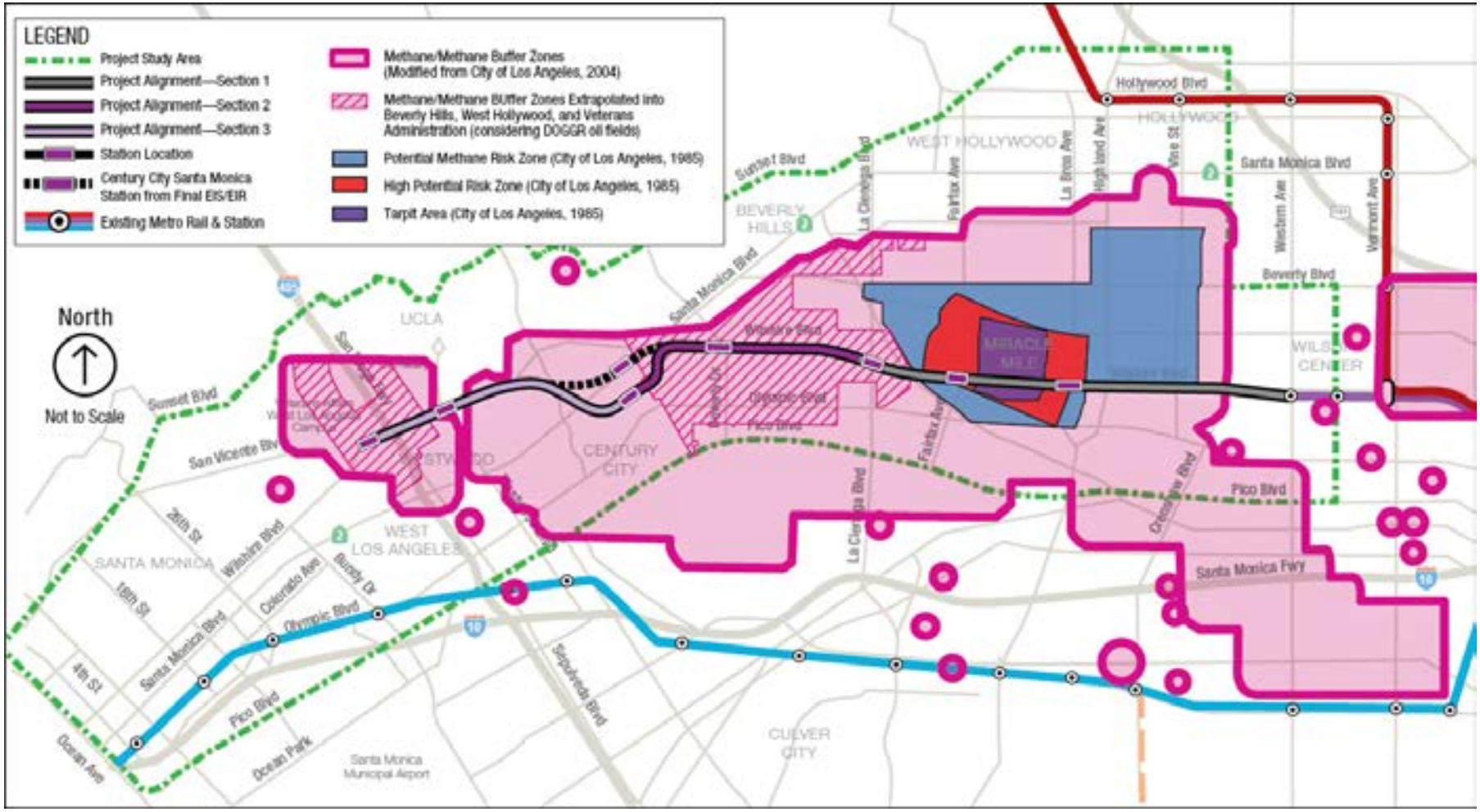


Figure 4-15. Methane Risk Zone

Methane and Hydrogen Sulfide Threshold Levels

Various agencies/organizations including the Environmental Protection Agency, City of Los Angeles, American Society for Testing and Materials, State of California Department of Toxic Substances Control have published guidelines or requirements for evaluation of Methane and Hydrogen Sulfide in the ground. Metro 2017b provides more details on the guidelines of these agencies/organizations in evaluation of methane and hydrogen sulfide.

Metro's approach for the Project to evaluate methane and hydrogen sulfide in the ground incorporates consideration of the guidelines of all of the agencies described above. As an example, the State of California Department of Toxic Substances Control guideline for school facilities indicates field investigations of soil gas should be performed where methane concentrations are anticipated to be greater than 5,000 ppm in the ground. As a result, Metro has performed gas investigations and mitigation with regard to soil gas along the WPLE alignment. Metro has defined "elevated" gas conditions as areas where gas monitoring readings have shown methane levels greater than 5 percent (corresponding to the LEL), or hydrogen sulfide levels above 5 ppm (corresponding to the OSHA PEL) (Metro 2017b). Section 4.5.5 of this Draft SEIS further describes monitoring of the working environment for elevated gas conditions during tunneling.

Gas Condition Investigations along Section 2

Metro examined existing data along the Study Area and installed new soil borings and gas monitoring wells along the Section 2 alignment to evaluate soil, groundwater conditions, and the presence of hazardous gases and their potential to affect construction and design of the Project (Metro 2011g). Gas monitoring wells were installed in locations known as being within methane areas. The locations of wells along Section 2 are shown on Figures 4-12 through 4-15.

In addition, soil gas investigations were performed at the BHHS site in 2003 by Camp Dresser & McKee, in 2004 by Ultra Systems, in 2012 by Environmental Audit Inc. (EAI), in 2015 by EAI (Refs. 25 and 26), and in 2016 by EAI, and as shown in the *Metro Geotechnical Data Report and Environmental Data Report Section 2* (Metro 2015e and 2015g).

Existing Levels of Methane and Hydrogen Sulfide along Section 2

At least 194 soil gas samples have been collected at various locations along Section 2 of the Project, of which 111 detected methane and 21 detected hydrogen sulfide. The Metro soil gas samples were obtained at depths similar to the planned tunnel depths. Some of the samples obtained by others were at depths shallower than the planned tunnel, but were also considered as an indicator of general soil gas conditions. Figure 4-16 and Figure 4-17 show maximum reported methane levels on the BHHS campus/Century City area and area of BHHS, respectively. Figure 4-18 and Figure 4-19 show maximum reported hydrogen sulfide levels on the BHHS campus/Century City area and area of BHHS, respectively. A summary of the methane and hydrogen sulfide readings along Section 2 of the Project is provided in *Assessment of Tunneling and Station Excavation Risks Associated with Subsurface Gas along Section 2–Revision 1* (Metro 2017b).

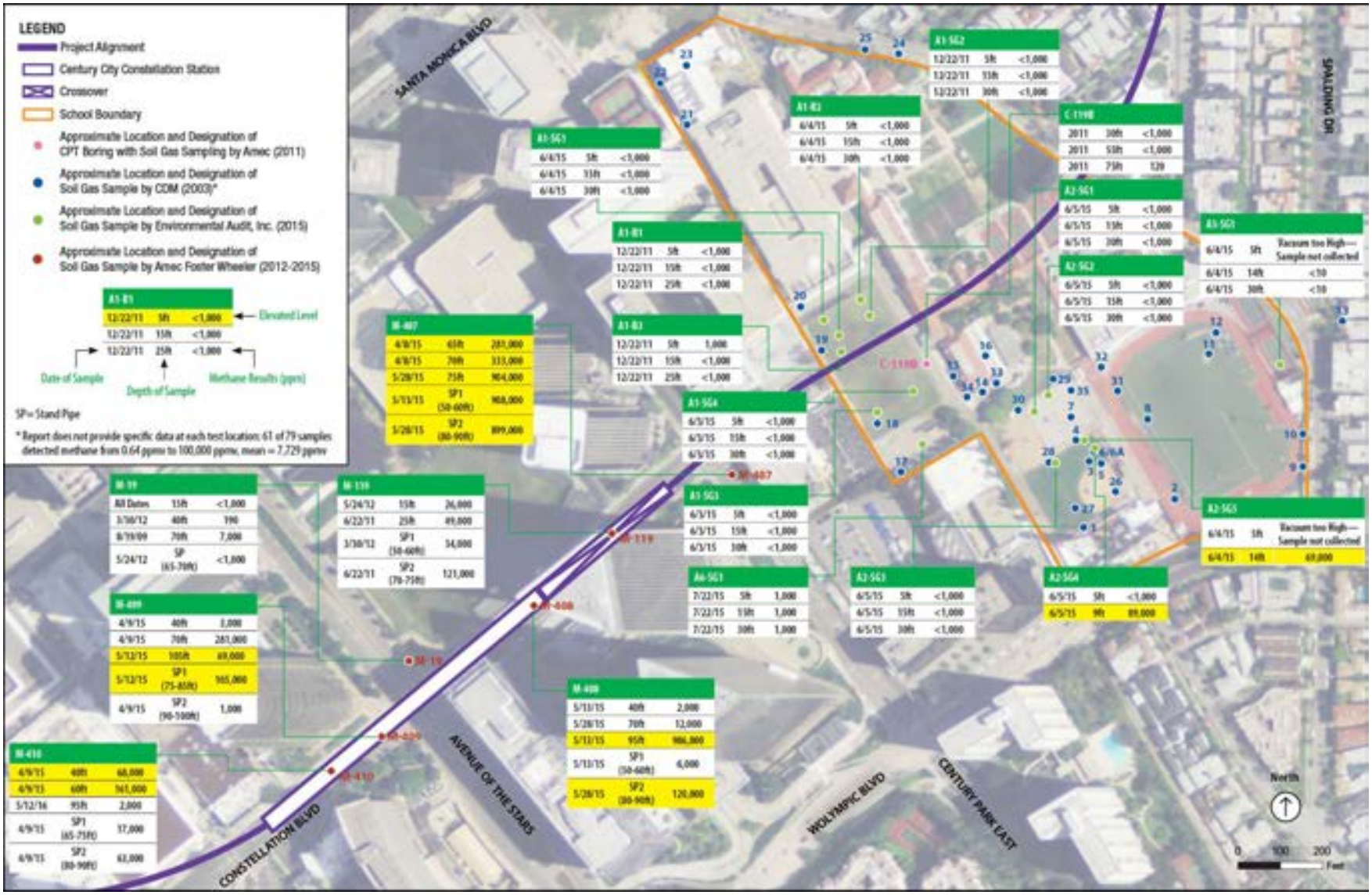


Figure 4-16. Methane Readings in Century City and on Beverly Hills High School Campus

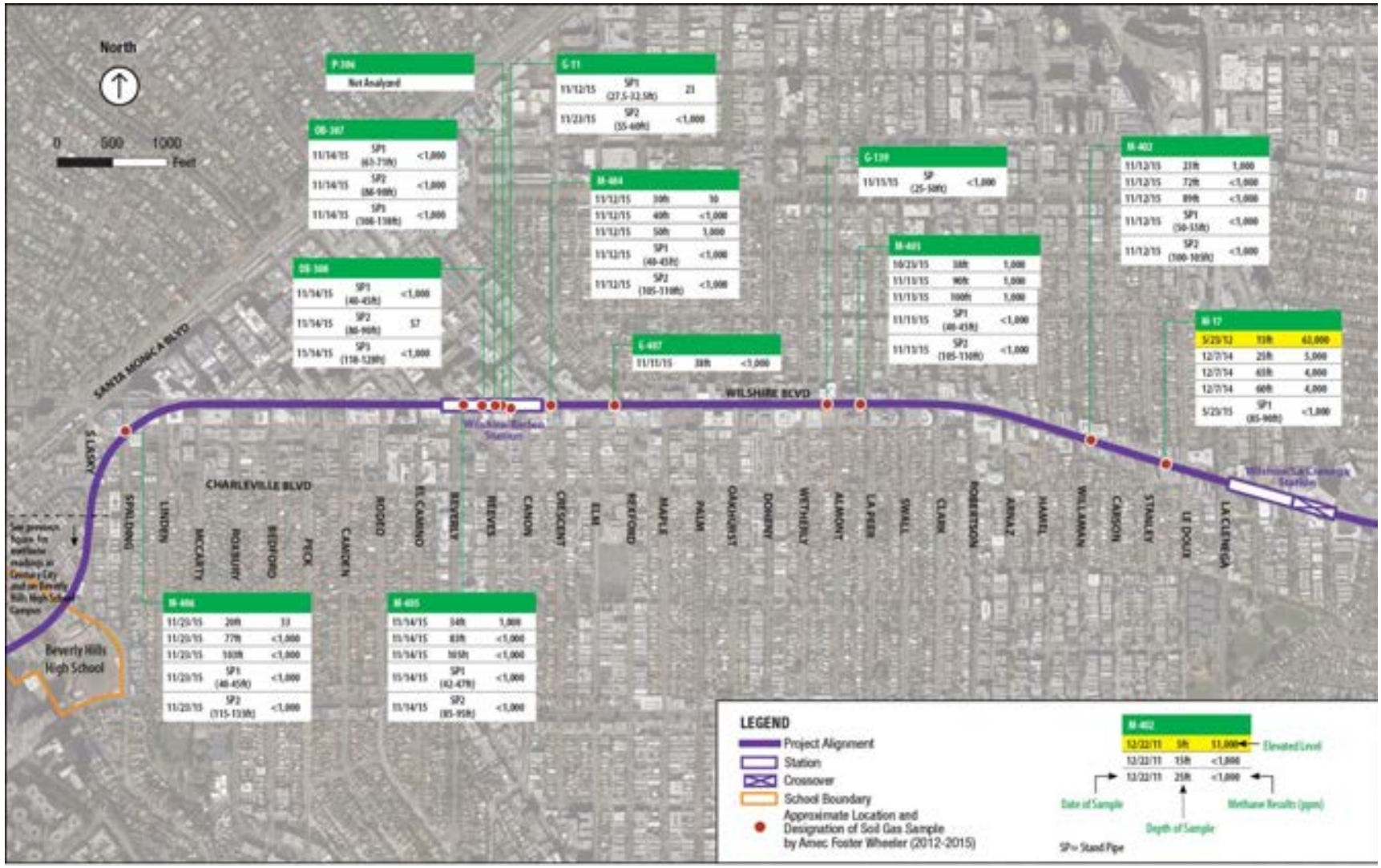


Figure 4-17. Methane Readings along Section 2 of the Project, East of Lasky Drive

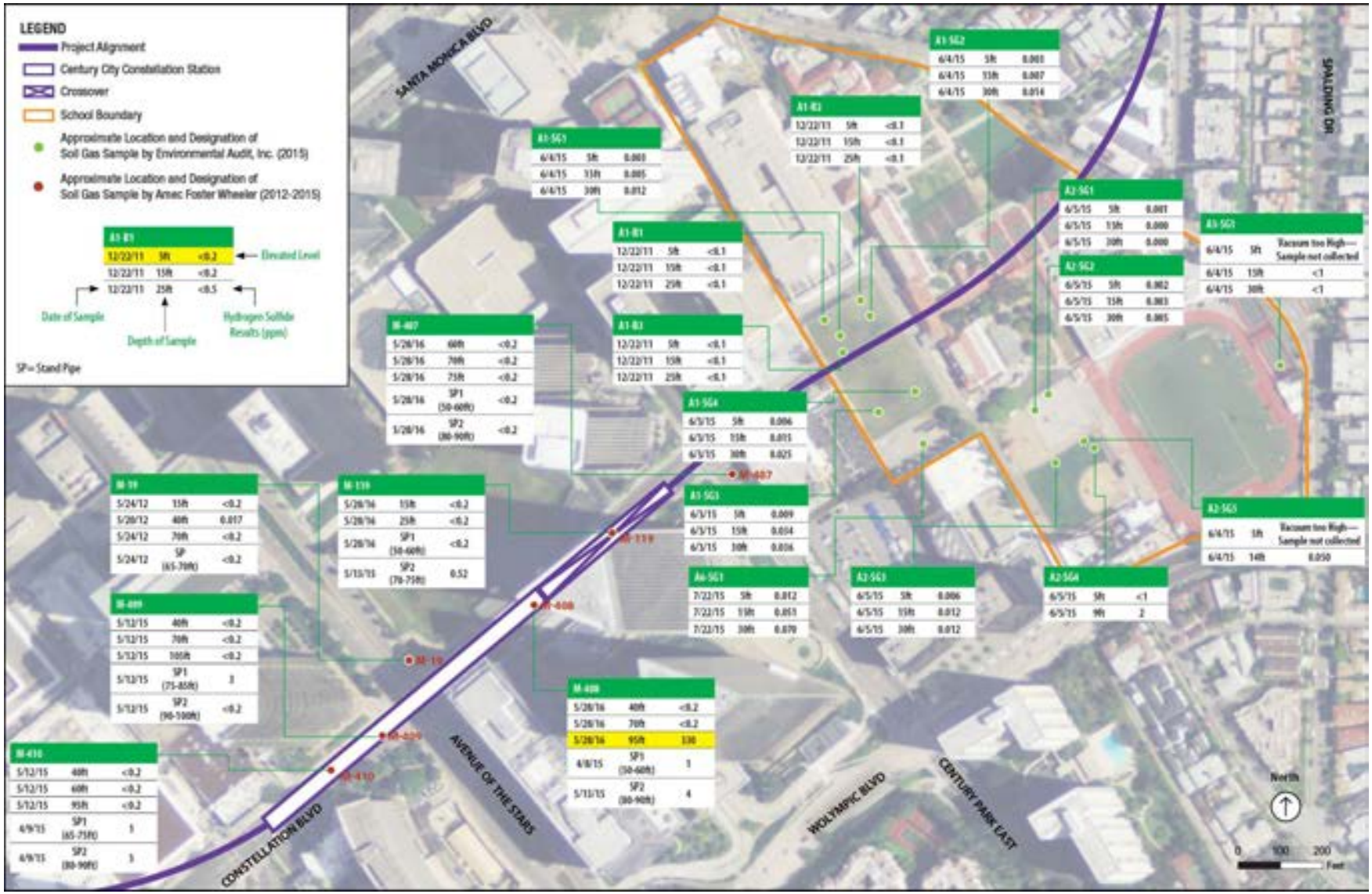


Figure 4-18. Hydrogen Sulfide Readings in Century City and on Beverly Hills High School Campus

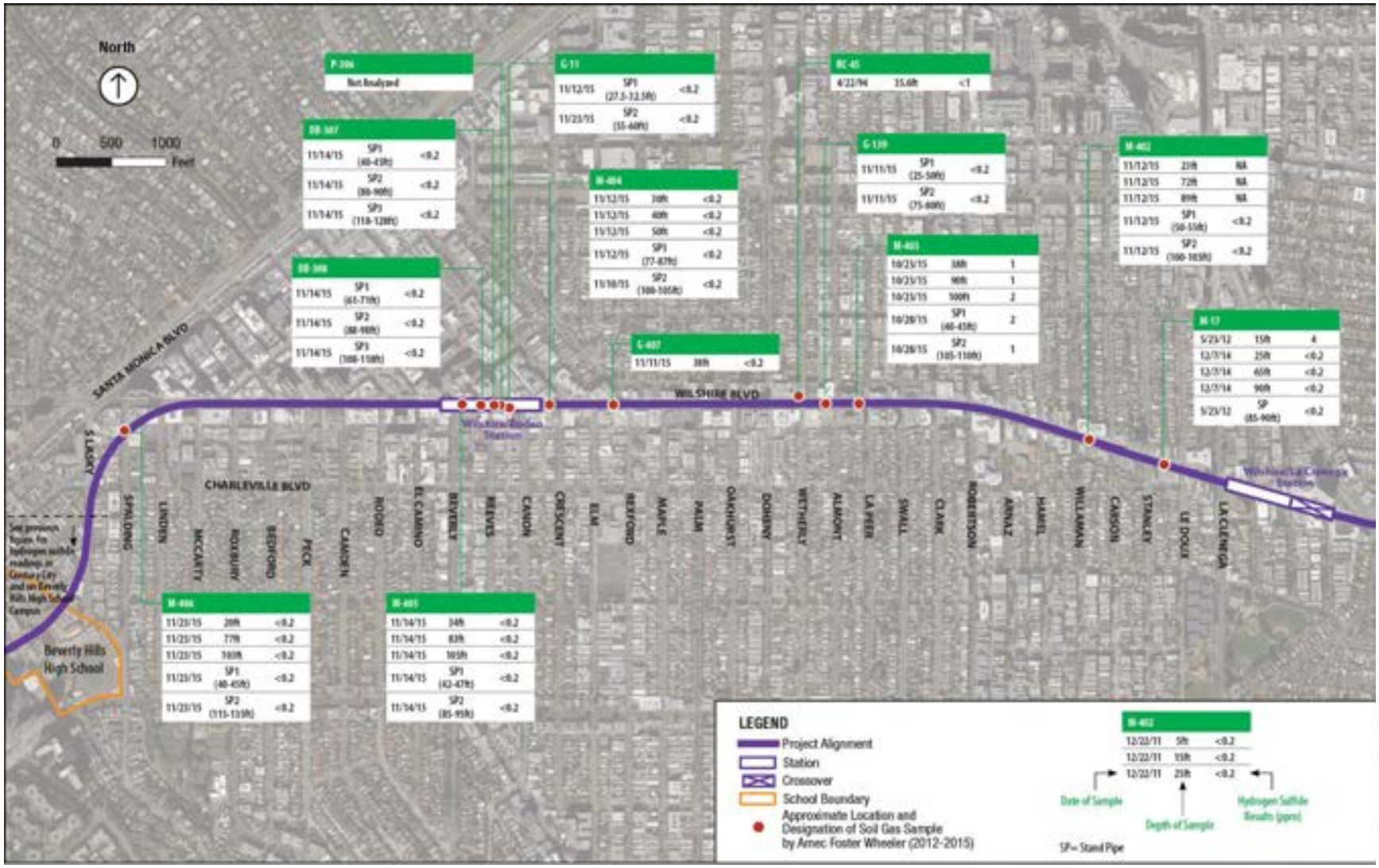


Figure 4-19. Hydrogen Sulfide Readings along Section 2 of the Project, East of Lasky Drive

The methane readings along Section 2 of the Project are as follows from east to west:

- The highest concentration of methane measured in the ground east of Stanley Drive is 6.3 percent (63,000 ppm).
- The highest concentration of methane between Stanley Drive (two blocks west of La Cienega Boulevard) and the City of Los Angeles/Beverly Hills boundary was 0.1 percent (1,000 ppm).
- At BHHS, elevated levels of methane gas (above explosive limits) have not been identified at any locations outside of the upper field basketball court area (over 400 feet south of the tunnel alignment) and the southeast corner of the northern parking lot (Figure 4-16).
- The highest concentration of methane measured in the ground west of the City of Los Angeles/Beverly Hills boundary was 98.6 percent (986,000 ppm). This reading is representative of the higher soil gas conditions measured at the Century City Constellation Station, and based on measurements taken east of the City of Los Angeles/Beverly Hills boundary (both at shallow depths and tunnel depth), elevated methane readings do not occur east of the boundary.

Concentrations of hydrogen sulfide gas above the National Institute for Occupational Safety and Health Recommended Exposure Limit of 10 ppm have not been identified at any location along the Section 2 tunnel alignment east of the City of Los Angeles/Beverly Hills Beverly, including on the BHHS property. One reading of hydrogen sulfide was elevated, with a reading of 330 ppm, in M-408, between Century Park East and Avenue of the Stars.

As described above, a considerable amount of subsurface data is available for the Section 2 alignment, including the portion that extends across the BHHS property. That data indicates elevated levels of combustible gas are present along portions of the alignment. Elevated levels of methane gas have been identified along portions of tunnel reaches 4 and 5 (the far eastern end of tunnel reach 4 at well M-17, and the far western end of tunnel reach 5), and around the Century City Constellation Station. At BHHS, elevated levels of methane gas have not been identified at any locations outside of the upper field basketball court area and the southeast corner of the northern parking lot. Elevated concentrations of hydrogen sulfide have not been identified at any location along the alignment at the BHHS property, but do appear at the Century City Constellation Station. The gas readings along the Section 2 alignment were performed in a phased manner to provide greater number of measurements in areas considered or previously measured to potentially have elevated levels of methane or hydrogen sulfide. Both horizontal and vertical variability were considered in the evaluations, based on readings performed and based on the layering and permeability of the earth materials. Refer to the *Assessment of Tunneling and Station Excavation Risks Associated with Subsurface Gas along Section 2–Revision 1* (Metro 2017b) for a more detailed description of the existing subsurface gas conditions along Section 2 of the Project.

4.3.2 Environmental Impacts/Environmental Consequences

Surface Fault Rupture

As described above in Section 4.3.1, the Santa Monica fault zone, as it is currently understood, extends along and parallel to Santa Monica Boulevard in West Los Angeles. Traces of the fault zone have been encountered by numerous investigations, as shown in Figure 4-10. Based on Metro's current interpretation of the fault data, with the Century City Station located on Constellation Boulevard, the tunnel alignment would cross the Santa Monica Fault at a high angle northwest of Century City between the Century City Constellation Station and the Westwood/UCLA Station for Section 3. If the Century City Station were to be located on Santa Monica Boulevard, the fault traces would run parallel to the tunnel alignment and cross the station box itself. This section provides a discussion of hazards posed by the fault in relation to each of the Century City Station locations.

Subway stations, because they are habitable structures for human occupancy, may not be built in active fault zones per regulatory codes, including the Alquist-Priolo Act, and because of the practical difficulty of designing a safe and repairable structure as required by Metro's Design Criteria. For Maximum Design Earthquake events in the Santa Monica Fault zones, fault displacements could be on the order of approximately 3 to 6 feet. Metro's underground stations are complex two-story structures up to 1,000 feet long and include systems and ventilation equipment. As stated in the *Preliminary Review Comments of Century City Area Fault Investigation Report, Westside Subway Extension Project Century City and Beverly Hills Area* (Shannon & Wilson 2012), "we did not find references to stations knowingly placed across an active fault trace." As an example, for the Metro Crenshaw/LAX Line light rail project currently under construction, the La Brea Station was moved in order to not be constructed over the active Newport-Inglewood Fault.

An area susceptible to surface fault rupture can range from tens to several hundred feet wide, depending on the fault characteristics. Avoidance is the recommended means of mitigating surface fault rupture hazards for facilities such as passenger stations. Based on Metro's geologic studies and other studies for adjacent properties, the Century City Santa Monica Station option would be located within the broad zone of the Santa Monica Fault, with multiple faults (some identified as Holocene-active, and some on which most-recent rupture has not been definitively identified) potentially passing through station locations along Santa Monica Boulevard. As stated in the *Preliminary Review Comments of Century City Area Fault Investigation Report, Westside Subway Extension Project Century City and Beverly Hills Area* (Shannon & Wilson 2012), "relocating the station further south or east along Santa Monica Boulevard…has risks similar to the current proposed Santa Monica Station owing to high probability of ground deformation stemming from earthquakes originating from the SMFZ [Santa Monica Fault Zone] or by previously unmapped fault splays." Thus, surface fault rupture poses a risk of, and uncertainty related to, this station location that cannot be mitigated with available techniques and measures. In comparison, the location of the Century City Constellation Station has direct evidence of no faulting at or in the immediate vicinity of

the station. The Century City Constellation Station is not located in a fault zone or a fault buffer zone, and thus fault rupture is not a hazard for this station location.

For linear facilities such as tunnels, avoidance of faults may not be possible. Thus, the preferred designs for tunnels are to cross the faults as nearly perpendicular as possible to the faults to limit the area of potential damage due to fault ruptures. Depending on the predicted fault off-set and area over which the movement is distributed, some distortion can be accommodated by the tunnel structure.

The approach for design of tunnels traversing active faults is documented in Metro's Seismic Design Criteria and has a well-established precedent. As described in the *Westside Subway Extension Century City Area Tunnel Safety Report* (Metro 2011d), potential tunnel damage is also repairable. A similar approach is adopted for transportation infrastructure in general, including highways, bridges, and pipelines. These structures of necessity have to cross faults, and these established design approaches minimize damage and allow for repair.

In some cases, such as in the Metro Red Line tunnel crossing the Hollywood fault zone, the tunnels are built larger through a fault zone to accommodate potential future fault displacement. This is not always practical, particularly when tunnel boring machines with segmental linings are used. For potentially large anticipated tunnel deformations in fault zones, articulated joint designs have been developed as a means to satisfactorily and efficiently mitigate the seismic risk, providing that sufficient elasticity can be provided in the tunnel lining at the fault (Russo 2002). Other solutions include placing a stiff but crushable material behind the tunnel lining to allow movement. These types of solutions were used for other tunnels in Los Angeles that cross the Newport-Inglewood fault zone, such as the North Outfall Replacement Sewer, and the North Outfall Sewer – East Central Interceptor Sewer, two large-diameter tunnel projects that were both over-bored with compressible material placed between the over-bored tunnel and the final tunnel lining. Where fault rupture displacement may be distributed over a longer distance, more flexible tunnel lining, such as steel tunnel lining segments that can accommodate some strain, can be considered.

In the design for the Century City tunnels, the specific Maximum Design Earthquake and Operating Design Earthquake fault displacements will be used, together with further exploration to refine the fault zone locations specific to the selected tunnel alignment. With this design, hazard from surface fault rupture will be minimized.

In conclusion, based on all of the recent fault investigations presented in Section 4.3.1, there are numerous faults in the vicinity of Santa Monica Boulevard, which could pose a hazard for a *station* on Santa Monica Boulevard, as well as a greater length of hazard along the subway tunnel that would serve a Santa Monica Boulevard station. A fault rupture event would cause extensive damage to both a Santa Monica Boulevard station and the adjacent tunnel because there are no known engineering methods available to construct a subterranean subway station that could withstand the rupture without collapse. For these reasons, locating a *station* on Santa Monica Boulevard poses a high risk to public safety.

In comparison, there is direct evidence of the absence of faulting at the Century City Constellation station location, indicating no risk of damage due to fault rupture at this station location. With elimination of the double crossover at the Wilshire/Rodeo Station and slight shifting of the station box there was no evidence encountered to indicate the presence of active faulting at the Wilshire/Rodeo Station. Therefore, there is minimal risk of the Section 2 stations being subject to damage due to fault rupture, resulting in no adverse effect.

The tunnels connecting the Century City Constellation Station to the Wilshire/Rodeo Station to the east and the Westwood/UCLA Station to the west will be able to be designed to accommodate potential fault rupture in accordance with Metro Design Criteria and practice of other agencies in California for constructing tunnels at fault crossings (a design accommodation that is not possible for design of a station located on an active fault). Therefore, there is no adverse effect for the tunnel crossing.

Hazardous Subsurface Gas and Oil Fields

Metro has extensively studied the characteristics of methane and hydrogen sulfide with respect to their effects on the construction and operation of its facilities, as methane and hydrogen sulfide are present in the ground surrounding the existing Metro Red and Purple Lines and the underground portion of the Metro Gold Line Eastside Extension. Since 1984, Metro has been developing documentation and methods for reducing or eliminating hazardous conditions in its facilities under construction and in operation, some of which are as follows:

- In 1984, Metro developed the Alerting Report on Tunneling Liners, which included tunnel construction methods, lining methods, and ventilation requirements for the then proposed 1983 alignment of the Red Line tunnels (along Wilshire Boulevard and Fairfax Avenue).
- In 1985, Metro commissioned the development of the Congressionally Ordered Reengineering Study that established methane conditions along alternative alignments and led to the re-alignment of the then- proposed Metro Red Line into its current alignment.
- Metro designed a “two-pass” tunnel lining system (i.e., two tunnel linings that were constructed in sequence, with the second lining being constructed within the first lining) for the Metro Red Line that included a high-density polyethylene water and gas barrier in tunnel construction.
- Metro undertook a study for the Mid-City area to locate and monitor gas-bearing geologic formations to determine the extent of the gas reservoirs, examine methods of treatment for pre-tunneling and tunneling timeframes, and recommend tunnel and station configurations to avoid the most gaseous areas.
- Metro implemented a double-gasketed tunnel liner that can flex enough to protect the tunnel from gas intrusion before, during, and after an earthquake.

Metro continuously monitors for gaseous environments in its tunnels, and has emergency ventilation in all its tunnel facilities in addition to the standard ventilation provided in the tunnels.

Section 2 of the Project passes through an area characterized by oil fields; thus the possibility of encountering gaseous conditions cannot be completely eliminated. A discussion of the risks of tunneling through areas of methane and/or hydrogen sulfide gases along Section 2 of the Project is provided in Section 4.5.5 of this Draft SEIS and *Assessment of Tunneling and Station Excavation Risks Associated with Subsurface Gas along Section 2–Revision 1*(Metro 2017b). Therefore, Metro has specified design and construction measures to address gassy environments. Furthermore, the elevated soil gas concentrations and pressures present in some areas along Section 2 of the Project are not higher than those encountered previously during design and construction of underground stations and tunnels for the Metro Red Line.

Experience has been gained from the construction of existing buildings, with up to five levels of underground parking, in the Wilshire/Fairfax and adjacent area (most notably the existing Citi National Bank mid-rise building at 6100 Wilshire Boulevard at the southwest corner of Wilshire Boulevard and Fairfax Avenue, which has five basement levels). In more recently constructed buildings, construction of the subterranean walls has included water and gas-proof membranes in order to fulfill requirements of the City of Los Angeles methane regulations, as enforced by the Los Angeles Department of Building and Safety. Existing buildings in Century City along Constellation Boulevard have also been constructed in the gassy ground conditions, with up to five levels of underground parking for the Century City Theme Towers complex (up to 100 foot depth, similar to the basement excavation shown in Figure 4-12). Additional buildings have recently been completed or are currently being designed in Century City with provisions for the anticipated methane conditions in the area, as required by the Los Angeles Department of Building and Safety, such as the recently completed "The Century" high-rise tower at 1 West Century Drive and the "New Century" high-rise tower complex at 2025 Avenue of the Stars, planned to start construction in 2017.

Tunnels and stations for the Project will be designed to provide a redundant protection system against gas intrusion hazard, such as those described in the City of Los Angeles Municipal Code, Chapter IX, Building Regulations, Article 1, Division 71, Methane Seepage Regulations. In compliance with these regulations, specific requirements are determined according to the actual methane levels and pressures detected on a site, and the identified specific requirements will be incorporated into the design and construction. Therefore, the risk posed by hazardous subsurface gas to the operations of Section 2 of the Project will be minimized. Further methods to reduce the risk of gas exposure and intrusion into the Metro structures are described below.

Most gases, if present, are purged from the tunnels simply by the air movement caused by the action of trains running through the tunnels. Nevertheless, during non-revenue operations, air velocity must be maintained at a minimum of 100 feet per minute, per Metro's Design Criteria. This air velocity is the minimum that the ventilation system must achieve to direct gases toward the nearest point of extraction and prevent hazardous gases from accumulating during the hours when the trains are not operating. Additional ventilation is also employed during revenue operations. In addition, gas and waterproofing systems considered in preliminary and Final Design include the following:

- Specially designed precast concrete liners used for the primary tunnel lining for ground support and water/gas barrier are designed with the possibility of adding a secondary liner as needed if leakage occurs at some future time. This approach is being used on Section 1 of the Project.
- At some locations, the lining may include thicker segments than what was provided to date to protect against corrosion and so that wider gaskets could be used to increase the performance of the gasket seals.
- Reduced permeability tunnel segment concrete—the segments may include steel fibers or other types of fiber reinforcement for denser concrete as well as coatings.
- Double-gasket design to provide a second seal for a more redundant system. This also facilitates post-installation repair of leaks (if needed) by grouting the areas between the gaskets.
- Segment Insert Materials—use of non-corrosive plastics, for example plastic dowels, at segment circumferential joints.
- Rapid repair methods such as pre-installed grout tubes within water-proofing systems.
- In station structures, water/gas proofing membranes are to be "compartmentalized" so that leakage, if it occurs, can be isolated and readily repaired using pre-installed grout tubes.
- Other methods for gas and waterproofing will be added for evaluation as they are identified.

As shown in Figure 4-13 and Figure 4-14, abandoned oil wells have been identified near or within the Section 2 Project alignment. Based on the existing information, design of Section 2 of the Project has avoided oil wells where their locations have been identified. During Final Design, additional studies and testing will be performed to further ensure that all oil wells are identified and re-abandoned or removed according to approved California State Department of Oil, Gas, and Geothermal Resources procedures prior to tunneling or station excavation. Testing will include magnetic scanning to locate metallic well casings within the immediate area of the tunnel alignment and station limits. With these safeguards, the presence of existing oil wells is not considered a hazard for operation of Section 2 of the Project. Refer to Section 4.5.5 of this Draft SEIS for additional information on the risks of constructing tunnels in areas with oil wells.

Furthermore, the tunnel is a ventilated space with barriers preventing communication of gases between the interior and exterior of the tunnel as described above. The presence of the tunnel will not influence the soil gas already within the ground, in particular because there are no "open" preferential pathways (such as open fractures) for gas within the ground (refer to Section 4.5.5). The tunnel does not provide new pathways for gas transmission, as the tunneling methodology utilizes grout along its length such that the space around the tunnel is sealed by the grout. Therefore, the presence of the constructed tunnel will have no influence on the long-term migration of soil gas to the ground surface or into buildings or increase the risk of explosion, resulting in no adverse effect.

4.3.3 Completeness of Information

In response to the Final Decision's requirement for a more thorough discussion of the completeness of the seismic risk information, this section has been prepared in compliance with 40 CFR § 1502.22(b), which states:

> *(b) If the information relevant to reasonably foreseeable significant adverse impacts cannot be obtained because the overall costs of obtaining it are exorbitant or the means to obtain it are not known, the agency shall include within the environmental impact statement: (1) A statement that such information is incomplete or unavailable; (2) a statement of the relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment; (3) a summary of existing credible scientific evidence which is relevant to evaluating the reasonably foreseeable significant adverse impacts on the human environment, 4) the agency's evaluation of such impacts based upon theoretical approaches or research methods generally accepted in the scientific community. For the purposes of this section, "reasonably foreseeable" includes impacts which have catastrophic consequences, even if their probability of occurrence is low, provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason.*

As discussed in Section 4.3.1, the seismic risk analysis was prepared in compliance with 40 CFR § 1502.22(b) as follows. The completeness of information related to subsurface gas is presented in Section 4.5.5 of this Draft SEIS.

(1) A statement that such information is incomplete or unavailable

The information relevant to reasonably foreseeable significant adverse impacts is considered complete to the degree necessary for the purposes of the planning and preliminary design of Section 2 of the Project; however, as described in the Uncertainty in Fault Location Investigations section on page 4-27 of this Draft SEIS, there is uncertainty inherent to the fault location investigation process, including those uncertainties due to the physical constraints of investigation in the densely developed urban portion of Los Angeles in the vicinity of Section 2 of the Project.

Geotechnical investigations are designed to provide an understanding of the subsurface/geologic conditions at a site based on geologic maps, site reconnaissance, existing data, and an exploration program, usually including a reasonable number of borings drilled to the depths of interest. The completeness of the investigation is assessed by standards of practice; guidelines, including federal, state, local, and industry; and the judgment of Licensed Geologists and/or Engineers practicing Geology and Geotechnical Engineering.

A comprehensive record of the subsurface conditions is not possible to assemble based on a finite number of geotechnical explorations because of the intrinsic variability within earth materials; therefore, a full dataset of the subsurface conditions cannot be ascertained until excavation for the project (foundation, station structure, etc.) is complete, and even then, only to the depth and lateral limits of excavation. The Uncertainty in Fault Location Investigations section on page 4-27 of

this Draft SEIS further explains the challenges of investigating the geologic conditions in dense, urbanized areas and the resulting uncertainty in fault locations. In addition, there are differing scientific opinions regarding the activity of some of the fault strands identified in the studies in the vicinity of Section 2 of the Project, which in itself presents uncertainty.

Keeping these limitations in mind, Section 4.3.1 and Section 4.3.2 of this Draft SEIS include the following:

- Documentation that demonstrates no risk from surface fault rupture hazard for the Wilshire/Rodeo Station and the alignment east of that station.
- Documentation that demonstrates evidence of faulting and therefore risk associated with surface fault rupture hazard if a station was located along Santa Monica Boulevard.
- Documentation that demonstrates no risk from surface fault rupture hazard for the Century City Constellation Station, including direct scientific evidence of no faulting along the station.
- Documentation that demonstrates there is a potential risk from surface fault rupture along the tunnel alignment between the Wilshire/Rodeo Station and the Century City Constellation Station. The information regarding the risk at this particular location is partially complete at this time because faults have been found to cross the alignment in the vicinity of Lasky Drive, Charleville Boulevard, and Spalding Drive; further investigations have been required to be performed by the design-builder to better evaluate/constrain the location and width of fault zones in order that the tunnel is designed to accommodate displacement in the event of an earthquake on the faults.

(2) A statement of the relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment

As described above, although there remain uncertainties regarding the fault investigation, the evaluations performed demonstrate directly that there is no risk from faulting at the Century City Constellation Station, such that the station can be safely designed at this location, but the tunnel zone between those two stations has evidence of fault crossing (fault zone) with associated fault rupture hazard. The fault rupture displacement hazard can be accommodated in design of a tunnel, as described in Section 4.3.2. The tunnel will be designed such that collapse of the tunnel does not occur due to fault rupture displacement, and the tunnel and tracks can be repaired after such an event. With the additional information required to be obtained by the design-builder prior to approval of design, including additional geotechnical explorations to evaluate the length of the zone of faulting across the tunnel, the currently incomplete information along the portion of the alignment between the intersection of Lasky Drive and Moreno Drive and the Wilshire/Rodeo Station will be made complete with respect to tunnel design to accommodate fault displacement.

Although incomplete, the data available regarding faulting along Santa Monica Boulevard is sufficient to conclude that constructing the proposed Century City Santa Monica Boulevard Station would pose a risk to human life, creating a significant adverse impact. The data is also sufficient to demonstrate that the risk of surface fault rupture along Santa Monica Boulevard is greater than the risk at the Century City Constellation Station because there is evidence of faulting along Santa Monica Boulevard and evidence of no faulting at the Century City Constellation Station. This conclusion is reached despite the uncertainties described above due to the sufficiency of the available data.

(3) A summary of existing credible scientific evidence which is relevant to evaluating the reasonably foreseeable significant adverse impacts on the human environment
The conclusions provided in Section 4.3.1 of this Draft SEIS were made utilizing the review of published references, and all existing studies conducted by either Metro or private property owners. Table 4-8 provides a summary of existing studies of the Santa Monica Fault that were reviewed in the preparation of this Draft SEIS. These studies are described in further detail in Appendix B.

(4) The agency's evaluation of such impacts based upon theoretical approaches or research methods generally accepted in the scientific community.
Section 4.3.1 of this Draft SEIS concludes that the stations along Section 2 will not be impacted by fault rupture since there is direct evidence of no faulting at the Wilshire/Rodeo and Century City Constellation Stations. However, the Century City Santa Monica Station would be located along numerous faults, which could pose a hazard. A fault rupture event would cause extensive damage to a station on Santa Monica Boulevard because there are no known engineering methods available to construct a subterranean subway station that could withstand the rupture without collapse.

Similarly, there is evidence that there is no faulting along the alignment of the tunnel at or east of the Wilshire/Rodeo Station. However, because of potential for faulting in a portion of the tunnel between the Wilshire/Rodeo Station and the Century City Constellation Station, that portion of the tunnel will be designed to accommodate potential fault rupture displacement using methods similar to those previously employed in California (refer to Power 1998 for methods used in design) Examples include the design of the following subway tunnel projects:

- Metro Red Line through the Hollywood Fault in Hollywood (northwest of the Hollywood/Highland Station)
- BART tunnels through fault zones in the San Francisco Bay Area (see Power 1998)

The Metro Design Criteria describes design of tunnels in the zone of fault crossing (Metro 2015k).

4.3.4 Mitigation Measures

Construction and design will be performed in accordance with Metro's Design Criteria, the most current Federal and State seismic and environmental requirements, and State and local building codes. By compliance with these requirements, potential impacts from geologic hazards will be minimized along Section 2 of the Project with the Century City Constellation Station. The mitigation measures identified in the Final EIS/EIR and listed below are also included to further avoid and minimize impacts. With compliance with existing requirements and implementation of these identified mitigation measures, no additional mitigation is necessary for long-term geologic hazards and there is no adverse effect.

With gas and waterproofing systems considered in preliminary and Final Design of Section 2 of the Project and incorporation of these mitigation measures, the hazards associated with hazardous subsurface gasses during operation of Section 2 of the Project will be minimized and there is no adverse effect.

- **GEO-1—Seismic Shaking:** Metro design criteria require probabilistic seismic hazard analyses (PSHA) to estimate earthquake loads on structures. These analyses take into account the combined effects of all nearby faults to estimate ground shaking. During Final Design, site-specific PSHAs will be used as the basis for evaluating the ground motion levels along the Project. The structural elements of the Project will be designed and constructed to resist or accommodate appropriate site-specific estimates of ground loads and distortions imposed by the design earthquakes and conform to Metro's Design Standards for the Operating and Maximum Design Earthquakes. The concrete structures are designed according to the Building Code Requirements for Structural Concrete (ACI 318) by the American Concrete Institute.
- **GEO-2—Fault Crossing Tunnel, Fault Rupture, Tunnel Crossing:** Design will allow for the tunnels to cross the faults nearly perpendicular to limit the area of potential damage and will use Metro's two-level approach to assess fault offset and the associated structural design required to accommodate the offset. During Final Design, fault crossings will be designed for the ground conditions at the crossing location and incorporate the methods used to excavate and support the tunnel. Metro Design Criteria require use of a probabilistic approach to determine the Maximum Design Earthquake and Operating Design Earthquake. Design must include the following:
  - Prevent collapse of the tunnel to ensure tunnel safety
  - Maintain structural continuity of tunnel ring
  - Prevent flow of water and soil
  - Establish the tunnel size to maintain tunnel clearances and provide a guideway for derailed trains to decelerate without impact
  - Several preliminary design approaches or combinations have been considered and will be further developed in Final Design:
    - Steel tunnel rings with compressible material between the ring and soil to accommodate movement of the fault
    - Flexible steel linings
    - Articulated joints between tunnel segments for added flexibility

  - Oversized tunnel to allow additional movement and, to some extent, more rapid repair after a seismic event. This could also be accomplished using cut and cover methods.

- **GEO 3—Operational Procedures during Earthquake**: In addition to design measures implemented on the existing Red line, Metro will implement Standard Operating Procedures in seismic areas to detect earthquakes and will provide back-up power, lighting, and ventilation systems to increase safety during tunnel or station evacuations in the event of loss of power due to an earthquake. For example, seismographs are located in 11 of the existing Metro Red/Purple Line stations to detect ground motions and trigger Standard Operating Procedures (SOP #8 – Earthquake) by the train operators and controllers. Operating procedures are dependent on the level of earthquake and include stopping or holding trains, gas monitoring, informing passengers, communications with Metro's Central Control, and inspecting for damage.
- **GEO 4—Liquefaction and Seismic Settlement:** At liquefaction or seismic settlement prone areas, evaluations by geotechnical engineers will be performed to provide estimates of the magnitude of the anticipated liquefaction or settlement. Based on the magnitude of evaluated liquefaction, a suitable mitigation will be selected, either structural design, or ground improvement (such as deep soil mixing) or deep foundations to non-liquefiable soil (such as drilled piles). Site specific design will be selected based upon the State of California Guidelines design criteria set forth in the *Metro Seismic Design Criteria*.
- **GEO 5—Hazardous Subsurface Gas Operations:** As with the existing Red and Purple Lines and the Metro Gold Line Eastside Extension, Metro will install gas monitoring and detection systems with alarms, as well as ventilation equipment to dissipate gas to safe levels according to Metro's current design criteria and Cal/OSHA standards for a safe work environment. Measures will include, but are not limited to, the following for both tunnel and station operation:
  - High volume ventilation systems with back-up power sources
  - Gas detection systems with alarms
  - Emergency ventilation triggered by the gas detection systems
  - Automatic equipment shut-off
  - Maintenance and operations personnel training
  - Gas detection instrumentation is set to send alarms to activate ventilation systems and evacuate the structures as follows: methane gas—minor alarm at 10 percent of the lower explosive limit (activate ventilation) and major alarms at 20 percent of the lower explosive limit (evacuation of area)
  - Hydrogen sulfide—Minor alarm at 8 ppm and major alarm at 10 ppm
- **GEO 6—Hazardous Subsurface Gas Structural Design:** Tunnels and stations will be designed to provide a redundant protection system against gas intrusion hazard. The primary protection from hazardous gases during operations is provided by the physical barriers (tunnel and station liner membranes) that keep gas out of tunnels and stations. As with the existing Metro Red and Purple Lines and the Metro Gold Line Eastside Extension, tunnels and stations will be designed to exclude gas to

below alarm levels (GEO-5) and include gas monitoring and detection systems with alarms, as well as ventilation equipment to dissipate gas.
At stations in elevated gassy ground (e.g., Wilshire/Fairfax), construction will be accomplished using slurry walls—or similar methods such as continuous drilled piles—to provide a reduction of gas inflow both during and after construction than would occur with conventional soldier piles and lagging.

Other station design concepts to reduce gas and water leakage are the use of additional barriers; compartmentalized barriers to facilitate leak sealing; and flexible sealants, such as poly-rubber gels, along with high-density polyethylene-type materials used on Metro's underground stations.

Consideration of secondary station walls to provide additional barriers or an active system (low or high pressure barrier) will also be studied further to determine if they will be incorporated into the Project.

The evaluations for station and tunnel construction materials will include laboratory testing programs such as those conducted for the Metro Gold Line Eastside Extension during development of the double gasket system and material testing for long-term exposure to the ground conditions for materials such as rubber gaskets used for tunnel segment linings. Testing programs will examine:

- Segment leakage—gasket seal under pressure before, during, and after seismic movements. This will include various gasket materials and profiles (height and width).
- Gasket material properties—effective life and resistance to deterioration when subjected to man-made and natural contaminants, including methane, asphaltic materials, and hydrogen sulfide.
- Alternative products to high-density polyethylene products such as poly-rubber gels, now in use in ground containing methane in other cities could be considered. Alternative methods for field testing of high-density polyethylene joints will be examined to provide additional quality control during installation. These are now being used for landfill liners and water tunnels under internal water pressure.

- **GEO 7—Tunnel Advisory Panel Design Review:** The Metro Tunnel Advisory Panel will review designs with respect to geologic hazards in areas of identified higher risk. These include the Century City area (seismic risk) and the Fairfax area (gassy ground risk). The panel will be supplemented, as necessary, by qualified experts in seismic design, gas intrusion, and ground contaminant effects on underground structures.

4.4 Historic Properties

4.4.1 Affected Environment/Existing Conditions

The description of Historic Properties located in Section 2 of the Project Study Area has not changed from what was provided in Section 4.14 of the Final EIS/EIR. However, changes and refinements to the Project require a slight expansion of the Area of Potential Effects (APE) to accommodate a materials storage area in the block bounded of Solar Way, Constellation Boulevard and Century Park West. This area, as well as the area between the Wilshire/Rodeo and Century City Constellation Stations, which is under consideration as part of this Draft SEIS, includes four historic properties: the Century Plaza Hotel, the AAA Building, the Century Park Towers, and BHHS (Figure 4-20). These properties were within the Project's previously established APE and are listed in or were determined eligible for listing in the National Register of Historic Places (NRHP). Because of proposed changes to the construction staging area and the materials storage area in their vicinity, effects to these historic properties are being reassessed.

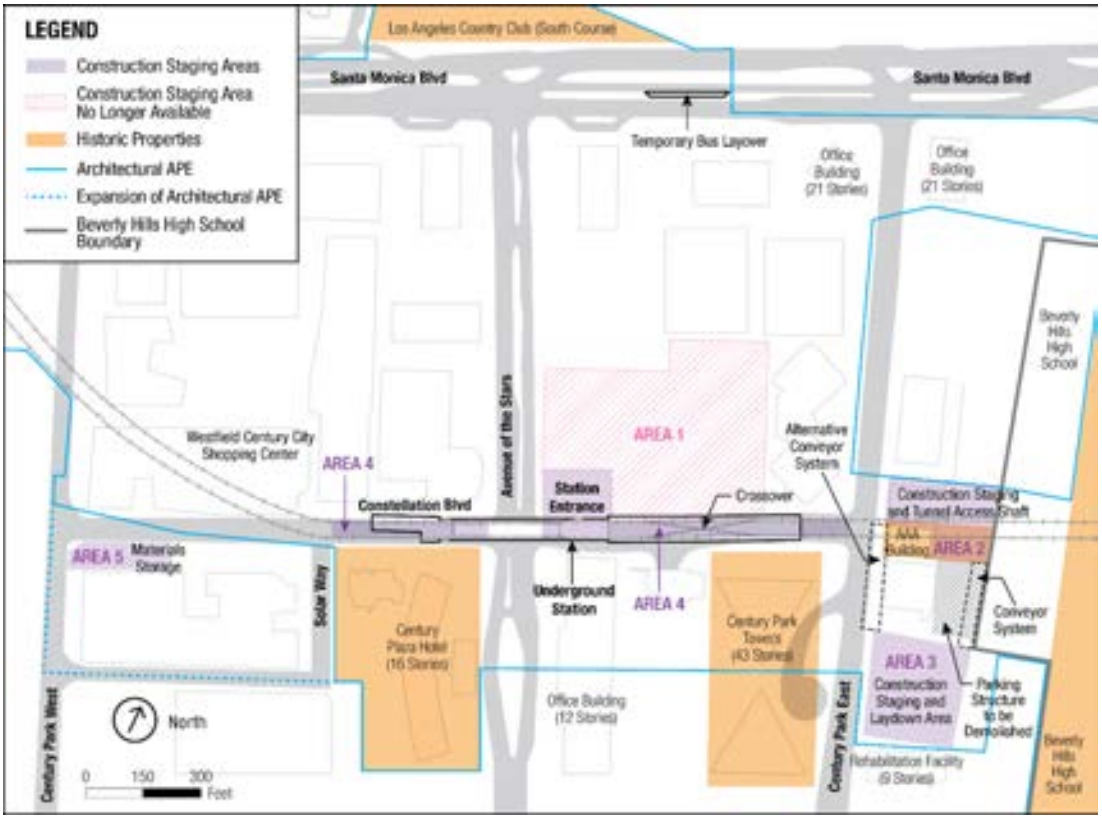


Figure 4-20. Historic Properties in the Vicinity of the Century City Constellation Station

In addition to the changes in the construction staging areas at the Century City Constellation Station, the double crossover at the Wilshire/Rodeo Station was eliminated. As a result, the station box shifted east from El Camino Drive to Canon Drive and now extends from Beverly Drive to Canon Drive, reducing the length of the

station box and corresponding underground station excavation from approximately 1,150 feet to approximately 950 feet. The shortening of the underground station would result in lower construction costs and slightly reduced impacts to traffic and disruption to the surrounding streets and businesses due to a smaller construction footprint along Wilshire Boulevard, reduced time needed for station excavation and fewer truck trips needed for hauling excavated material. Because the station footprint and construction effects are being minimized, there are no new adverse effects in the vicinity of the Wilshire/Rodeo Station. Due to the refinement of the alignment in the Century City area, the tunnels no longer require subsurface easements beneath the Perpetual Savings Bank or the Barn, reducing the number of historic properties the tunnel passes beneath.

No additional historic properties, including archeological sites or built historic properties, are present in the area that is part of the expanded APE. Furthermore, no additional historic properties are present in any area that is subject to re-evaluation as part of Project changes or refinements.

4.4.2 Environmental Impacts/Environmental Consequences

As part of Section 106 studies completed for the Final EIS/EIR, forty-one historic properties were identified within the APE. As part of the assessment of effects, FTA determined that the proposed Project would have no adverse effect to forty properties. One property, the Ace Gallery, would be adversely affected by the Project because of proposed demolition. For information on these properties, please refer to Section 4.14.5 of the Final EIS/EIR.

Since publication of the Final EIS/EIR, a proposed development on the northeast corner of Constellation Boulevard and Avenue of the Stars has resulted in changes to the Century City Constellation Station construction staging sites as described in Section 2.3.2 of this SEIS. The construction staging sites include two locations along Century Park East and require the full acquisition of 1940 Century Park East, 1950 Century Park East, and 2040 Century Park East properties. This change also requires installation of a tunnel access shaft and a materials transport corridor, including a conveyor belt, to connect staging sites on 1950 Century Park East with the staging site at 2040 Century Park East, the use of an existing bus layover area for storage, temporary bus layover on Santa Monica Boulevard, and placement of ventilation/exhaust structures on the Westfield Century City property (Figure 4-20).

The proposed construction activities for the Century City Constellation Station and tunneling of Section 2 are located in the vicinity of four historic properties as defined by Section 106: the AAA Building, the Century Park Towers, the Century Plaza Hotel, and BHHS. Figure 4-20 depicts the location of each historic property in relation to the construction staging areas, the tunnel, and the Century City Constellation Station. Construction staging areas would be located north, east and west (in the public right-of-way) of the AAA Building, north and east of Century Park Towers, north and west of the Century Plaza Hotel, and west of BHHS. As part of this reassessment it is important to note that the proposed project changes result in avoiding tunneling beneath the Perpetual Savings Bank due to the alignment refinement between the Wilshire/Rodeo

and Century City Constellation Stations. Consultation with the SHPO regarding the reassessment of effects is ongoing at the date of issue of this Draft SEIS.

As previously assessed in the Final EIS/EIR, Section 2 Project activities in the vicinity of the AAA Building would include construction of a bored heavy rail tunnel and the Century City Constellation Station, which, when complete, would be located outside the boundary of the historic properties. The Section 2 tunnels would be constructed approximately 60 feet beneath the AAA Building (to top of tunnel) on an east-west axis beneath Constellation Boulevard and BHHS. The tunnel underground features would not be visible at the surface on the AAA Building property and would be outside of the historic property boundary of the AAA Building, which only extends to the building foundation. The AAA Building has also been identified as a site that may be used as a potential project office during construction. This potential use would not result in any changes to the exterior and any potential interior alterations would be temporary or reversible.

Section 2 of the Project would also include construction of the proposed Century City Constellation Station below ground at the intersection of Constellation Boulevard and Avenue of the Stars. The Century City Constellation Station would consist of an underground station box with a central platform area. The station box would be built using cut-and-cover construction, connecting with bored sections of the tunnels for its underground alignment. Underground station construction would occur outside of the historic properties' boundaries, within the street footprint of Constellation Boulevard.

The station entrance would be located in the northeast quadrant of Constellation Boulevard and Avenue of the Stars outside the historic properties' boundaries. The proposed station entrance would span approximately one-third of the block and be approximately .25 acre and will be incorporated into the surrounding built environment. The station design will incorporate site design to integrate it into its surroundings. The aboveground features would also include stairs, escalators, and elevators; ancillary ventilation shafts would be located at the Westfield Century City Shopping Center, which is not a historic property.

A construction staging area will be located adjacent to the historic property boundary of the AAA Building; across Century Park East approximately 150 feet from Century Park Towers; and immediately adjacent to the BHHS property boundary, but 150 feet from the BHHS historic property boundary. These changes to the Project will not adversely affect BHHS. Section 2 of the Project would travel in a tunnel under the BHHS campus. The top of the tunnels would be between 60 and 70 feet below the ground surface as it crosses under the campus. There would be no changes to surface features on the high school campus, nor would the Project elements be visible from the school campus. Construction vibration levels would be less than the levels that could potentially structurally damage fragile buildings and would not substantially diminish the utility of the historic buildings. With mitigation, operational groundborne noise and vibration levels would be less than the FTA noise impact criteria for institutional use and would not affect the ability to continue classroom activities at the high school. Tunneling with a pressurized-face tunnel boring machine would not cause significant ground settlement

that would result in structural damage to the historic building. The BHHS integrity of location, design, setting, materials, workmanship, feeling, and association will not be minimized as a result of the proposed Project. Therefore, the Project will continue to have no adverse effect on BHHS, consistent with previous effects assessments.

To accommodate construction staging activities at this site, demolition of the garage on the AAA Building's parcel will occur. While the garage is within the boundary of the historic property, it does not contribute to the eligibility of the property for the NRHP and has been considered as a distinct entity from the AAA Building. In correspondence dated December 8, 2011, the California SHPO concurred that the AAA Building only was determined eligible for listing in the NRHP. The previously completed *Westside Subway Extension Project: Historic Properties Supplemental Survey Technical Report* (Metro 2012) contains an updated State of California Building, Structure, and Object Record form (updated November 2011). The report stated that the garage was distinct from the historic Brutalist AAA Building and was not intended to be a contributing element to the historic property from the original architect's design perspective.

Project-related activities that will occur within the construction staging area include vehicle parking; an equipment and supply storage within a laydown area; a tunnel access shaft; and a conveyor system that will be either ground-level or elevated on the eastern side of the parcel or elevated on the western side of the parcel to transport excavated soils and other ancillary construction activities supporting the staging area.

Construction activities are anticipated to continue for approximately seven years. Tunneling activities, which would result in the most noticeable construction activities at the tunnel shaft adjacent to the AAA Building, would last for approximately two of those seven years. Therefore, minimization measures to control the effects of construction are planned. These measures would include noise and dust minimization efforts and best practices; with respect to working hours only; and use of equipment such as a hospital-grade muffler and using low-noise emission construction equipment to minimize construction effects. A comprehensive list of general noise control measures can be found in the report entitled *Westside Purple Line Extension AAA Building Construction Noise and Vibration Assessment* (Metro 2016d).

Current studies indicate that dust and vibration levels will remain within acceptable levels and would not cause adverse indirect effects *(Westside Purple Line Extension AAA Building Construction Noise and Vibration Assessment*, (Metro 2016d)). Contractors will monitor construction to ensure that dust and vibration do not exceed the acceptable levels. Most of the equipment can be operated without risk of damage at distances of seven feet or greater from the AAA Building with the exception of a vibratory roller and large bulldozer which would be operated no closer than 35 to 40 feet. In addition to implementing recommendations based on the contents of *Westside Purple Line Extension AAA Building Construction Noise and Vibration Assessment* (Metro 2016d), the contractor is required to submit a Vibration Monitoring Plan. Vibration monitoring shall be performed at the AAA Building closest to the locations where equipment and/or construction activities generate a substantial amount of ground-borne vibration. Vibration monitoring at the AAA Building shall consist of continuous measurements of

vibration at the closest building façade to the construction activities. All vibration monitors used should be equipped with an "alarm" feature to provide notification that the 0.2 PPV vibration damage risk threshold has been approached or exceeded.

Construction effects will be temporary and will not substantially alter the historic setting of the areas around the historic properties, which have already been altered by modern high-rise buildings. Construction activities will not materially alter in an adverse manner the physical characteristics that convey the historic significance of the AAA Building. The use of the building as a potential project office will have no adverse effect on the historic character-defining features of the building. The exterior will not be affected and effects to the interior will be temporary and reversible. The use of the building as a project office is consistent with its historic use as an office building. Indirect effects such as dust and vibration will not affect character-defining features of the historic properties and will be temporary.

After construction is completed, only the Century City Constellation Station elements, which were previously determined to have no adverse effect, will remain. The construction staging area will be restored and improved with appropriate landscaping and hardscape finishes, although the non-historic garage adjacent to the AAA Building will no longer be present. The removal of the garage will result in a change in the setting in the vicinity of the AAA Building, but there are no significant historic views to or from the AAA Building and the garage was not a contributing element to the historic property or a significant architectural feature on its own. Therefore, the removal of the garage will not alter character-defining historic features of the area.

The materials storage area is located to the west of the Century Plaza Hotel, across Solar Way. The site is currently a 0.3-acre Metro bus layover location. The site would be used for approximately seven years for trailer offices, construction materials storage, and parking of construction equipment associated with station construction. There would be no ground-disturbing activity at the site other than for installation and removal of sound walls, and for removal and restoration of curbs and landscaping. After station construction is complete, the site would be returned to its current use as a layover facility for Metro buses. The four historic properties retain integrity of location, design, materials, workmanship, feeling, or association. No direct physical effects would occur to contributing elements or character-defining features within the historic properties' boundaries. Although the proposed Century City Constellation Station's above-ground station entrance and escalators would be visible from portions of the historic properties, these Project features, when completed, represent a minor alteration to the area's visual setting and do not impact character-defining features of the setting. Similarly, the materials storage area, which will be temporary, will be across the street but visible from the Century Plaza Hotel; however, this area is currently used as a bus layover facility. No historic viewsheds or historic setting will be affected by the change from a bus layover facility to a materials storage area. After construction is complete, the area will return to use as a bus layover facility.

Atmospheric changes, such as noise and dust, and visual changes, which are potential indirect effects that could affect integrity of setting, are expected for the duration of station construction, which can be expected to last seven years. However, minimization measures and best practices will reduce construction effects, and these effects will be temporary in nature. Additionally, integrity of setting is low or not retained at all in this vicinity due to modern construction and an absence of character-defining historic viewsheds that contribute to the significance of historic properties (refer to Figure 4-21). After Section 2 of the Project is built, the areas directly around the construction staging area and the materials storage area will be returned to their prior condition and only the station itself, which was previously determined to have no adverse effect, will remain.

Source: Google Earth, 2017

Figure 4-21. AAA Building Setting

Permanent Project effects, which include those that are the result of Project operations, will be minimal. With mitigation, no noise or vibration effects are anticipated as a result of Project operation. Because the Project will be underground in the vicinity of the four historic properties, no visual effects are anticipated. The station entrance will not be visible from BHHS and the AAA Building. The station entrance is located across Avenue of the Stars from the Century Plaza Hotel, approximately 300 feet away, and the entrance is more than 500 feet from the Century Park Towers. The permanent presence of the station entrance will not affect any character-defining historic features or historic viewsheds or settings of the nearby historic properties. Most notably, the scale of the adjacent properties are much larger than the station entrance, which will be comparatively small.

As described above, the removal of the garage adjacent to the AAA Building will result in a change in the setting in the vicinity of the AAA Building, but there are no significant historic views to or from the AAA Building and the garage was not a contributing element to the historic property or a significant architectural feature on its own. Therefore, the permanent effect from its removal is not an adverse effect according to Section 106 regulations.

Based on the assessment of temporary construction-related and permanent project effects, Section 2 of the Project will have no adverse effect to the AAA Building, Century Park Towers, BHHS, and the Century Plaza Hotel. No additional adverse effects will result from Section 2 of the Project. All prior effects assessments for the other thirty-eight historic properties remain valid, including a Determination of Adverse Effect for the Ace Gallery located in Section 2. Therefore, the overall project finding remains unchanged.

Consultation with the SHPO on the proposed project refinements and the reassessment of effects is pending. Beverly Hills Unified School District and the City of Beverly Hills have requested to be Section 106 consulting parties. FTA has granted this request and both groups will be included in forthcoming Section 106 consultation, affording them the opportunity to comment on historic preservation-related aspects of the Project.

4.4.3 Mitigation Measures

Because the project work described above will result in no adverse effect to historic properties, no additional mitigation will be required. The prior adverse effect finding of effect resulting from the proposed removal of the Ace Gallery remains in place. However, no additional adverse effects are anticipated as a result of the proposed project refinements. As described above, the proposed project work will not adversely affect character-defining features or integrity. Consultation with the SHPO on the proposed project refinements and the reassessment of effects is pending.

While no other Section 106 mitigation is required because there are no additional adverse effects, the measures and best practices described in Section 4.4.2 that will avoid or minimize construction effects will be implemented. These measures will avoid or minimize indirect effects such as noise, vibration, or atmospheric effects and are important considerations in avoiding unanticipated adverse effects.

The mitigation contained in "Memorandum of Agreement between the Federal Transit Administration and the California State Historic Preservation Officer Regarding the Los Angeles Westside Subway Extension Project, Los Angeles County, California" remains valid and in place. However, the minimization measures described in detail in Section 4.4.2 include noise, vibration, and dust minimization efforts and best practices. Contractors will monitor construction to ensure that dust and vibration do not exceed the acceptable levels. These minimization practices are being implemented in order to maintain the reassessment finding of no adverse effect for the four historic properties that are proximate to the proposed staging areas.

4.5 Construction Impacts and Mitigation

The following construction impacts analysis focuses on changes to Section 2 of the Project, including the relocation of construction staging activities at the Century City Constellation Station described in Chapter 2 and the proposed land use changes adjacent to the construction sites at Century City Constellation Station. This section will also analyze those issues identified in the Final Decision. The Transportation Construction Impacts analysis is presented in Chapter 3, along with a more detailed discussion of the construction approach.

Section 4.5 summarizes Section 2 construction activities and methods and is followed by a description of construction impacts by resource area. With the exception of the changes to the construction staging locations at the Century City Constellation Station, the construction activities and methods remain largely unchanged from what was described in Appendix E, Construction Methods, of the *Westside Subway Extension Final Environmental Impact Statement/Environmental Impact Report* (Final EIS/EIR) (Metro 2012j). This information is summarized here for reference.

Overview of Construction Activities

Construction activities for Section 2 of the Project have not changed from what was described in Section 4.15.1 of the Final EIS/EIR with the exception of the relocation of construction staging activities for the Century City Constellation Station. Table 4-9 provides an overview of the general sequence and approximate duration of construction activities, and Table 4-10 provides a summary of construction activities, including types of construction equipment to be used, volumes of soil and concrete, haul truck trips per day, and approximate range of workers required per day. Major construction activities for Section 2 of the Project could begin as early as January 2018 with expected completion in 2026.

Tunnel Construction

Tunnels would be constructed using tunnel boring machines (TBMs)—large-diameter horizontal "drills" that continuously excavate circular tunnel sections (Figure 4-22). The TBM would excavate two parallel tunnels (21 feet in diameter) similar to the twin tunnels excavated for the Metro Gold Line Eastside Extension subway (Figure 4-23).

Both the ground in front of the machine and the horizontal "hole" it creates are continuously supported by the TBM pressurized face, shield, and pre-cast concrete tunnel liners that are installed as the machine progresses. This method creates a tunnel with little or no disruption at the surface and reduces risk of settlement. The TBM technology allows the tunnel lining to be installed concurrently with the excavation and without lowering groundwater levels. Excavated materials are removed through the tunnel to the shaft area and brought to the surface for disposal off-site, typically in a landfill or re-used for fill material.

Table 4-9. Generalized Sequence and Approximate Duration of Construction Activities

Activity[1]	Duration[2]	Description	Equipment Required
Survey and pre-construction	4 to 6 months	Surveys and limited excavation	Largely hand tools and small equipment
Underground utilities	Approximately 18 to 24 months	Locate, move, and support utilities	Hand tools and small excavation equipment
Tunnel construction[3]	Approximately 8 to 12 months for a typical 1-mile length between stations [3]	Excavation and tunnel lining	TBM, slurry pumping and separation equipment, concrete equipment. Hauling equipment to remove spoil and bring in segments and tunnel supplies. Instrumentation and monitoring equipment
Station box piling and decking	Approximately 12 to 15 months	Installation of excavation support, installation of dewatering and instrumentation wells, removal of street pavement and subgrade, installation of deck beams and precast concrete deck panels	Pile drilling equipment, well drilling equipment for instrumentation and dewatering wells, cranes, excavators, potholing equipment, hauling equipment to remove spoil and bring in piles, beams, deck panels, concrete trucks, tanks and mixing equipment for drilling fluids, cutting and welding equipment
Station excavation	Approximately 1 year	Support of excavation and cut-and-cover excavation	Various excavation equipment, drilling equipment, slurry wall equipment, and cranes, loaders, and trucks Instrumentation and monitoring equipment
Station construction	Approximately 2.5 years	Form and place concrete structure, finish work, architectural and mechanical	Hauling equipment to bring in ready mix concrete and building materials. Concrete form and placing equipment, cranes, trucks, soil compaction equipment, trucks, and cranes
Street/site restorations	Approximately 4 months	Paving and sidewalks	Paving equipment
Vent shafts and emergency exits	Approximately 12 months	Shafts and cross-passages	Crane and tunnel equipment
Systems installation and facilities	Approximately 2.5 years	Installation of trackbed, rails, third rail (traction power); conduits for systems installations; electrical substations; and communications and signaling	Crane, flatbed trucks, hand tools and small equipment, and rail welding equipment

Activity[1]	Duration[2]	Description	Equipment Required
Systems testing and pre-revenue operations	5 to 6 months	Testing of power, communications, signaling, and ventilation systems; training of operators and maintenance personnel	Small equipment and rail vehicles

Notes:
[1]Durations and activities shown are for one location (e.g., one station).
[2]Portions of activities would be conducted at the same time as other activities. For example underground utilities, station excavation, and station construction would be concurrent at any individual station location.
[3]Tunnel excavation generally would range from 8 to 12 months for the typical 1-mile length between stations, but would vary depending on the ground conditions encountered, site and work area constraints, length of tunnel, and the number of TBMs used.

Table 4-10. Construction Activity Summary

Activity	Construction Equipment							Soil (Cubic Yards)	Concrete (Cubic Yards)	Haul Truck Trips per Day	Workers per Day
	Haul Truck	Concrete Truck	Dozer	Excavator	Crane	Drill Rig	Flatbed				
Pre-construction						✓	✓	N/A	N/A	5	10-20
Site preparation	✓	✓	✓	✓	✓		✓	1,000	1,000	10-20	20-30
Operating systems installation	✓				✓		✓	N/A	N/A	2	20-30
TBM tunnel from Wilshire/ La Cienega to Century City	✓	✓	✓	✓	✓		✓	330,000	Precast Segments	90-130	50-80
Wilshire/Rodeo Station (cut-and-cover without double ")	✓	✓	✓	✓	✓	✓	✓	192,000	53,000	60-100	70-150
Century City Station (cut-and-cover with double crossover)	✓	✓	✓	✓	✓	✓	✓	256,000	70,000	80-120	50-225

As described in Section 4.3, Section 2 of the project is located in the City of Los Angeles' methane buffer zone. This would require use of pressure face TBMs to provide control of the ground as well as exposure of workers to gassy ground. The design-build contractor would select the specific type of TBM, either a slurry-face TBM (Figure 4-24) or an earth pressure balanced (EPB) TBM.

Figure 4-22. Pressurized-Face Tunnel Boring Machine

Figure 4-23. Twin Tunnels on Eastside Extension

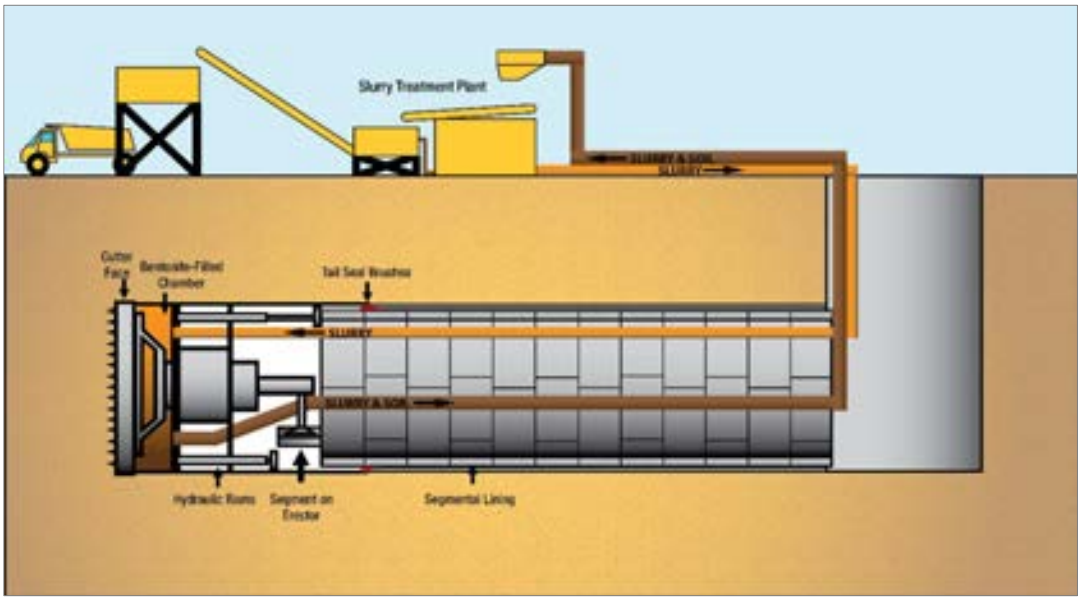


Figure 4-24. Tunneling in Gassy Areas with Pressure Face TBM

In North America, EPB TBMs are the most common and have been used successfully in Los Angeles. These TBMs rely on balancing the thrust pressure of the machine against the soil and water pressures from the ground being excavated. The EPB TBMs are generally well suited for boring in soft ground, the type of soil expected in the project area. An EPB TBM will be used for Section 1 of the project.

Slurry-face TBMs use a fully enclosed system to transport excavated soil to the surface. Bentonite (a clay mineral) slurry is pumped through pipelines to the TBM's pressurized face, and soil cuttings are suspended in the slurry and removed through the return slurry lines. A treatment plant is set up at the surface to separate slurry from soil cuttings so that the slurry can be recycled and the soil cuttings transported to a disposal site. The American

Public Transportation Association Peer Review of tunneling from 2005 concluded: "It is possible to tunnel and operate a subway along the Wilshire Corridor safely" using these new technologies. In all cases, contractors will monitor the surface and subsurface environment for compliance with the California Division of Occupational Safety and Health (Cal/OSHA) standards for worker safety and Air Quality Management District standards (refer to Section 4.3 for additional discussion of gassy ground conditions). Additional information on construction methods is provided in Appendix E of the Final EIS/EIR.

Tunnel excavation generally would range from 8 to 12 months for the typical 1-mile length between stations, but would vary, depending on the ground conditions encountered, site and work area constraints, length of tunnel, and the number of TBMs used.

The excavated material (for tunnel and station construction) is brought to the surface, stockpiled, and then hauled away by trucks to suitable disposal sites. The routes and times of hauling would be approved by local jurisdictions beforehand, and the public would be notified as part of the public involvement plan.

Cross-passages between adjacent tunnels would be constructed to connect tunnels at intervals of about every 800 feet. These openings would be excavated using small excavating equipment, such as backhoes, and subsequently concreted. Before exposing the ground, particularly where water or gas would be encountered, a tight seal of improved soils (using grout freezing or other soil improvements) would typically be installed around the area to be excavated.

Specific ground conditions would dictate the method and detail of preparing the cross-passage sites for excavation. Ground treatment for cross passages often includes drilling and grouting from above the tunnels at the street surface. Although surface drilling is often more disruptive to surface activities, it may provide for greater control of ground treatment application.

Station Construction

Station construction methods have not changed from those detailed in Section 4.15.2 of the Final EIS/EIR; however, in areas where gas is present, Cal/OSHA requires additional measures for equipment safety and monitoring the environment.

Since certification of the Final EIS/EIR, the double crossover structure at the Wilshire/Rodeo Station has been eliminated from the Section 2 Project design (refer to Section 2.3.3). As a result, the Wilshire/Rodeo station box beneath Wilshire Boulevard has been shortened to 950 feet. The shortening of the underground station would result in lower construction costs and slightly reduced impacts to traffic and disruption to the surrounding streets and businesses due to a smaller construction footprint along Wilshire Boulevard, reduced time needed for station excavation, and fewer truck trips needed for hauling excavated material.

Staging Areas

Construction staging areas (also referred to as "laydown areas") would be necessary for tunnel construction, stations, and ancillary facilities. Off-street space would be needed for setup, insertion, operation, and extraction of equipment and materials to the tunnel and

station excavations. Figure 4-25 shows an example of an off-street construction area for the Metro Gold Line Eastside Extension. The construction staging site for the Wilshire/Rodeo Station has not changed from that described in the Final EIS/EIR. As described in detail in Section 2.3.2 of this Draft SEIS, the construction staging areas for the Century City Constellation Station have changed from what was analyzed in the Final EIS/EIR.

Figure 4-25. Off-Street Construction Area on Metro's Gold Line Eastside Extension

Because of a proposed commercial development at the northeast corner of Constellation Boulevard and Avenue of the Stars, the construction staging area under Scenario A can no longer be used for Section 2 of the Project. Instead, the staging areas identified in the Final EIS/EIR as part of Scenario B would be used. The Scenario B construction staging sites (Area 2 and Area 3 in Figure 4-26) include two staging locations along Century Park East and require full acquisition of 1940 Century Park East, 1950 Century Park East, and 2040 Century Park East. An area approximately 0.25-acre in size would be required for construction of the station entrance at the northeast corner of Constellation Boulevard and Avenue of the Stars. The station entrance would be incorporated into future development to be constructed at this location.

In response to concerns expressed by the City of Beverly Hills and the BHUSD on potential air quality impacts of the construction staging to BHHS, alternative construction approaches to constructing a tunnel access shaft at 1950 Century Park East were considered. Chapter 2 and Chapter 5 of this Draft SEIS provides further discussion of these alternate tunnel access shaft locations. Due to the physical constraints and environmental impacts associated with placing the access shaft either within Constellation Boulevard or at the Wilshire/La Cienega Station, they are not considered further in this Draft SEIS. Locating the tunnel access shaft within Area 2 minimizes impacts to the community (particularly traffic impacts at Constellation Boulevard and Century Park East) and optimizes construction efficiency by locating the tunnel access shaft contiguous to the materials storage and stockpiles in Area 2 and with a connecting corridor to Area 3. The Area 2 location would not require street closures along Constellation Boulevard for tunneling activities after the initial closures for the assembly and launch of the TBMs, reducing disruption to Century City residents and visitors.

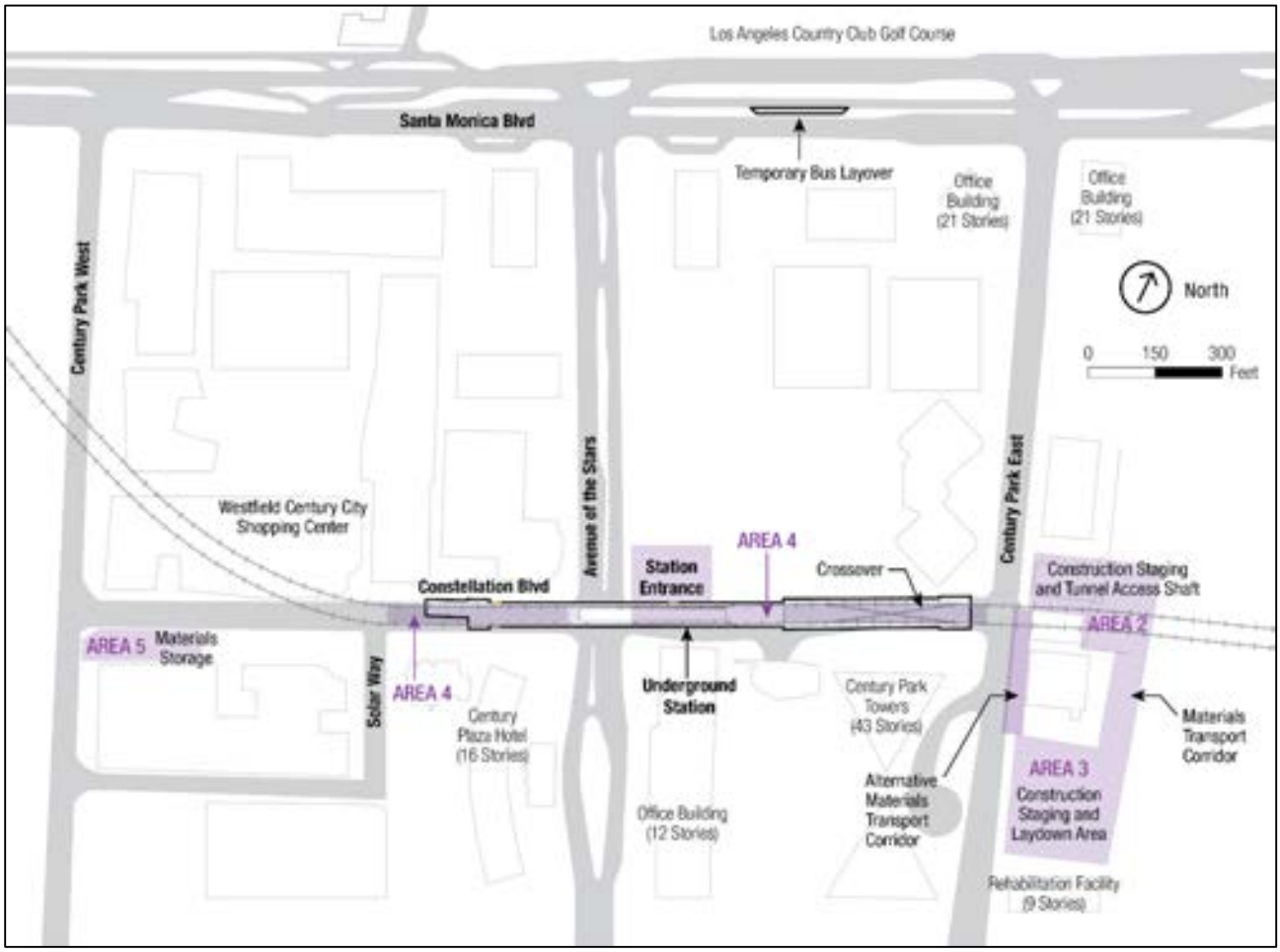


Figure 4-26. Century City Constellation Construction Staging Areas

4.5.1 Acquisition and Displacement of Existing Uses

Section 4.2.2 of the Final EIS/EIR describes the land ownership and leasing/easement agreements that would change as a result of the Project. As identified in the Final EIS/EIR, 1940, 1950 and 2040 Century Park East would be acquired by Metro. A permanent easement would be required at 1950 Avenue of the Stars to support the station entrance. In addition to the full acquisitions, partial acquisitions, permanent easements, and temporary construction easements identified in the Final EIS/EIR, the change in construction staging areas for the Century City Constellation Station would require additional temporary and permanent easements as indicated below.

The change in construction staging areas for the Century City Constellation Station would require a new temporary construction easement for materials storage and construction offices at the 0.3-acre bus layover site located at the southeast corner of Century Park West and Constellation Boulevard, owned by JMB Realty Corporation. To offset the loss of the five bus layover spaces, a new temporary bus layover area would be created in the median of Santa Monica Boulevard. Following construction of the Century City Constellation Station, the bus layover site used for construction material storage

would return to use as a bus layover site and the temporary layover site would be removed and the median of Santa Monica Boulevard would be returned to its previous condition. In addition, access to the fuel cell installation located on the northwest corner of the site would be maintained during the entire seven years the site is used by Metro for construction-related purposes. The fuel cell installation is in a partially enclosed area approximately 15 feet by 60 feet that is accessible from within the bus layover site. The fuel cells provide power to the Constellation Place office building at 10250 Constellation Boulevard.

An approximate 11,000-square-foot temporary construction easement may be used along the eastern portion of the property at 2010 Century Park East (AT&T building) for placement of the conveyor system and for a temporary access road between Staging Areas 2 and 3. The conveyor system would either run across the top of the existing parking structure on the east side of the AT&T building or, should agreement be reached with the property owners for removal of the parking structure, the conveyor would connect the shaft in Area 2 to Area 3 at ground level. The 11,000-square-foot temporary construction easement also includes space to support general construction staging activities for the duration of Section 2 of the Project.

If use of the eastern portion of the AT&T property is not feasible, the conveyor system would be placed in a temporary construction easement along the west side of the AT&T building, in a materials handling corridor along an approximately 400-foot-long section of Century Park East. The corridor would have a width encompassing one northbound traffic lane and sidewalk in the public right-of-way along the eastern side of Century Park East and an approximate 1,900-square-foot temporary construction easement between the AT&T building and the eastern edge of the sidewalk.

In addition to the temporary easements described above, approximately 3,000 square feet of permanent easements would be needed for ventilation and exhaust shafts within the Westfield Mall property located along the north side of Constellation Boulevard (Figure 4-27).

As described in Chapter 2 of this Draft SEIS, the tunnel alignment was refined slightly since to Final EIS/EIR to accommodate the removal of the double crossover at the Wilshire/Rodeo Station and to optimize the radii of the curves. The alignment refinement results in avoiding tunneling beneath the Perpetual Savings Bank Building (9720 Wilshire Boulevard), but does require subsurface easements beneath two properties that were not identified in the Final EIS/EIR:

- 216 S Lasky Drive (AIN: 4328-007-016): multi-family residential
- 2029 Century Park East (AIN: 4319-016-029): commercial

The subsurface easements will not result in displacement or relocation of any structures on the surface of the parcel. Therefore, no adverse impacts related to subsurface easements are anticipated.

Figure 4-27. Westfield Mall Easements

Construction-related Environmental Impacts/Environmental Consequences

There would be no additional construction-related impacts to communities and neighborhoods beyond those described in Section 4.15.3 of the Final EIS/EIR.

Metro would compensate property owners for the full acquisitions and permanent and temporary property easements as well as the removal of the parking structure. The structure at 1940 Century Park East would be demolished, which would be permanent. If agreed upon with the property owners, the demolition of the AT&T parking structure would be permanent. Currently, only a section of the ground floor of the AT&T parking structure is used to support their operations. If the parking structure is demolished, the construction laydown area would occupy half the footprint of the AT&T parking structure with the remainder available to AT&T for parking or other uses throughout construction.

The permanent easements needed for the station appendages in the Westfield Mall property would not affect the function or operation of the mall, and the appendages would be incorporated into the on-going renovation efforts at the site.

Mitigation Measures

As described in mitigation measure CN-3 below, compensation will be provided to AT&T for the temporary property easements on their property and for the removal of the parking structure if removal of the parking structure is agreed upon. In addition, compensation will be negotiated with the Westfield Mall and other property owners for permanent property easements required for the ventilation and exhaust shafts. With the changes to the Century City Constellation Station construction areas, the acquisition and displacement impacts would not be considered an adverse impact with the

implementation of the following mitigation measures specified in Section 4.2 of the Final EIS/EIR:

- **CN-1 Relocation Assistance and Compensation:** Metro will provide relocation assistance and compensation for all displaced businesses and residences, as required by both the Uniform Relocation Assistance and Real Property Acquisition Act and the California Relocation Assistance Act. All real property acquired by Metro will be appraised to determine its fair market value. Just compensation, which will not be less than the approved appraisal, will be made to each displaced property owner. Each business and residence displaced as a result of the LPA will be given advance written notice and will be informed of their eligibility for relocation assistance and payments under the Uniform Relocation Assistance and Property Acquisition Act. It is anticipated that most businesses will relocate and, as such, most jobs will be relocated and will not be permanently displaced. However, there are permanent job losses anticipated. Metro shall coordinate with the appropriate jurisdictions regarding business relocations.
- **CN-3 Compensation for Easements:** For easements, Metro will appraise each property to determine the fair market value of the portion that will be used for an easement either temporarily during construction or permanently above and below ground. As required by both the Uniform Relocation Assistance and Real Property Acquisition Policies Act and the California Relocation Assistance Act, just compensation, which will not be less than the approved appraisal, will be made to each property owner.

4.5.2 Visual Quality

Affected Environment/Existing Conditions

There is no change to the Study Area's existing visual environment, its general character, key features, and overall visual quality from what was described in Section 4.3 of the Final EIS/EIR, with the exception of the new medical rehabilitation facility and BHHS modernization, which are described in the affected environment/existing conditions in Section 4.2.

As described in Section 4.3 of the Final EIS/EIR, the general visual character of the Century City area consists of a dense auto-oriented urban center with tall buildings and wide boulevards and multi-level plazas with pedestrian overpasses. The Century City high-rise buildings are a visual landmark, and prominent buildings contribute to the area's visual character. Views are limited, but include distant mountains and the Hollywood sign. Mature trees, corporate plazas, and banners are prominent visual elements. The area has a generally pleasant appearance but lacks strong consistent architectural style and urban design features, and does not include sensitive visual resources.

Construction-related Environmental Impacts/Environmental Consequences

The visual effects associated with the construction staging changes at the Century City Constellation Station are similar to the effect identified in Section 4.15.3 of the Final EIS/EIR. As identified in the Final EIS/EIR, the construction activities include the use of heavy construction equipment, stockpiled construction-related materials, erosion devices, excavated materials, new lighting sources, fences, noise barriers, and temporary

removal of trees, which would conflict with the existing visual character and would result in a change in visual quality for the areas adjacent the construction sites. The Final EIS/EIR indicates that during the construction period, these visual elements would temporarily degrade the physical character of the station and staging areas, resulting in adverse effects without mitigation. Implementation of the mitigation measures identified would reduce the anticipated visual impacts.

Several changes associated with construction staging at the Century City Constellation Station would result in visual changes to the area that were not discussed in the Final EIS/EIR. These visual changes are described below. The removal of the double crossover at the Wilshire/Rodeo Station would not alter the visual effects of construction at this station as the proposed construction activities and locations would be consistent with those identified in Section 4.15.3 of the Final EIS/EIR. Due to the elimination of the double crossover, the duration of construction activities may be shortened slightly, reducing the duration of visual effects at this station.

The demolition of the existing parking structure and construction of an approximate 80-foot-diameter shaft to access the tunnel and installation of a materials transport corridor to move material out of the tunnel were not included in the Final EIS/EIR as part of the activities in construction Area 2. Construction of the access shaft is a new temporary condition and is adjacent to the AAA Building. With Area 2 surrounded by 20-foot-high temporary barriers (see Figure 4-28), the shaft opening would likely be visible from only the upper floors of the office building immediately north of Area 2 (1888 Century Park East) and the AAA Building. The shaft opening would not be visible to pedestrians or motorists on Century Park East or to students, faculty, and staff at BHHS. During the potential overlap between the BHHS campus modernization and Section 2 construction activities, the shaft opening would not be visible to students, faculty, and staff located temporarily in portable classrooms on the current BHHS lacrosse fields. A crane at the shaft would extend beyond the 20-foot high temporary barrier. The crane would be in the vicinity of the AAA Building and visible to BHHS and the public on Century Park East (see Figure 4-29), but would be located in a dense commercial urban visual environment surrounded by high rise structures, would not block scenic viewsheds or vistas and therefore, would not result in a substantial change to visual quality.

If the AT&T building parking structure were removed, a materials transport corridor, consisting of a conveyor system, temporary access road, and temporary pipe racks carrying utility lines, water, grout, foam, compressed air, etc. between Areas 2 and 3, would be placed at ground level. Under this scenario, the conveyor system would not be visible to the surrounding properties except for the upper floors of the office building immediately north of Area 2 (1888 Century Park East), the AAA Building, and the medical rehabilitation facility south of Area 3 (2080 Century Park East). Removal of the parking structure would not substantially alter the visual character of the surrounding area as construction activities and demolition of structures are already planned to occur in the immediate vicinity of the AT&T building, including the demolition of 1940 Century Park East and the parking garage of the AAA Building (1950 Century Park East) immediately north of the AT&T parking structure.

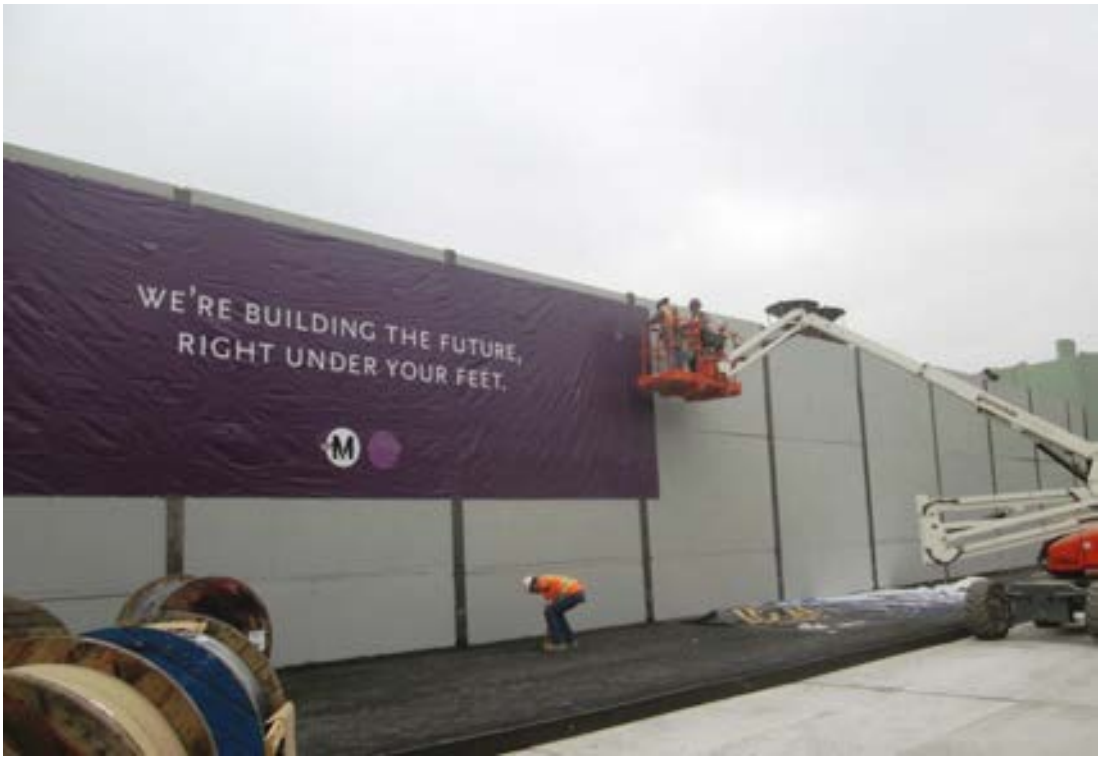


Figure 4-28. Typical 20-foot Noise Barrier at Construction Staging Areas

Figure 4-29. Crane at the Wilshire/La Brea Muck Shaft

If the parking structure were not demolished and the conveyor system and temporary pipe racks must span the top level of the three-story parking structure, a taller vertical conveyor from the shaft would be required in order to span the parking structure. Since the shaft conveyor system would be higher than the standard 20-foot barrier surrounding the site, it would be visible to both the upper floors of the office building immediately north of Area 2, the AAA Building, and could be visible to BHHS located immediately east of the staging areas and the conveyor system (see Figure 4-30).

Figure 4-30. Typical Enclosed Conveyor

If it is not feasible to install a materials transport corridor on the east side of the AT&T building, the conveyor system would be elevated approximately 15 feet high across the west side of the AT&T building and the AAA Building as part of a materials handling corridor. Access to the AT&T building and the AAA Building would be maintained beneath the conveyor. As the installation of the elevated conveyor and use of an approximate 400-foot portion of Century Park East for movement of materials and equipment would be located in a dense commercial urban visual environment surrounded by high rise structures, it would not block scenic viewsheds or vistas and therefore, would not result in a substantial change to visual quality. Up to eight trees along Century Park East may be removed to accommodate the conveyor system and materials handling corridor creating an additional visual effect along this portion of Century Park East. Following construction, the conveyor belt would be removed and the area would be restored with replacement trees per mitigation measure VIS-2 and the sidewalk and traffic lane would return to use.

During construction, the access shaft conveyor would be screened and the horizontal conveyor system between Areas 2 and 3 would be enclosed to minimize its visual effect regardless of which option for its placement is used.

Construction staging activities in Area 3 would be visible to the new long-term rehabilitation facility at 2080 Century Park East. The nine-story structure is located immediately south of Area 3, and views from the north side of the building would be affected by construction staging activities in Area 3, including hauling operations to remove excavated material and storage of equipment and materials. In addition, construction-related lighting sources would be introduced in Area 3, which could affect the north side of the rehabilitation facility. Several large trees along the northern edge of the rehabilitation facility property would provide some screening of Area 3.

During potential concurrent construction of the BHHS campus modernization and Section 2 of the Project, the 20-foot-high barrier surrounding Area 3 would shield construction staging activities from students, faculty, and staff in temporary portable classrooms on the current BHHS lacrosse fields.

The use of the bus layover at the corner of Century Park West and Constellation Boulevard (Area 5) would create a new temporary visual change for the office building (10250 Constellation Boulevard) located east of the site, primarily the offices facing west. With the bus layover site surrounded by a 20-foot-high barrier, only the upper floors of the office building, which would overlook the materials and equipment storage in Area 5, would be affected.

Installation of the temporary bus layover site in the Santa Monica Boulevard median could require removal of up to four small trees and landscaping within the median. Removal of trees and vegetation and construction of a bus layover area would result in a visual change for motorists traveling east on Santa Monica Boulevard. Once the temporary layover site is no longer needed, the median would be restored.

Mitigation Measures

With the change of construction staging activities and introduction of several new visual elements during the construction of Section 2 of the Project, including the access shaft and conveyor system, to the Century City Constellation Station area, the construction period visual impacts would be minimized with the implementation of the following mitigation measures identified in Section 4.15 of the Final EIS/EIR. With implementation of mitigation, the Project would not result in additional adverse temporary visual-related impacts beyond those discussed in the Final EIS/EIR.

- **CON-2 Timely Removal of Erosion Devices:** Visually obtrusive erosion-control devices, such as silt fences, plastic ground cover, and straw bales, will be removed as soon as the area is stabilized.
- **CON-3 Location of Construction Materials:** Stockpile areas will be located in less visibly sensitive areas and, whenever possible, not be visible from the road or to residents and businesses. Limits on heights of excavated materials will be developed during design based on the specific area available for storage of material and visual impact.

- **CON-4 Construction Lighting:** Lighting will be directed toward the interior of the construction staging area and be shielded so that it will not spill over into adjacent residential areas or outdoor areas that are used at night such as cafes, plazas, and other gathering areas where users may stay for an extended period of time and is integral to the enjoyment of the land use. In addition, temporary sound walls of Metro approved design will be installed at station and work areas. These will block direct light and views of the construction areas from residences
- **CON-5 Screening of Construction Staging Areas:** Construction staging areas will be screened to reduce visual effects on adjacent viewers.
- **VIS-2 Replacement for Tree Removal:** Where mature trees are removed, replacement with landscape amenities of equal value will be incorporated into final designs, where feasible, to enhance visual integrity of the station area.

4.5.3 Air Quality

This air quality analysis focuses on the construction phase impacts of the Century City Constellation Station in Section 2 of the Project. The removal of the double crossover at the Wilshire/Rodeo Station would not substantially alter the construction approach at this station and if anything would result in reduced emissions and reduced impacts to air quality due to smaller station footprint, decreased construction activities, and decreased excavation volumes. Therefore, it is not discussed further in this section.

As documented in the *Westside Purple Line Extension Century City Constellation Station Air Quality Technical Memorandum - Revision 1* (Metro 2017g) (Appendix F), analyses have been conducted to determine the following:

- Whether construction-related emissions would exceed the South Coast Air Quality Management District's (SCAQMD) Local Significance Thresholds
- Whether construction-related emissions would cause exceedances of air quality standards or cause any health risk issues at nearby sensitive land uses

The analysis is summarized in the sections below.

Affected Environment/Existing Conditions

"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; they are also responsible for 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.

Pollutants that degrade air quality in the United States are governed by the Federal Clean Air Act (CAA); the CAA is administered by the U.S. Environmental Protection Agency (USEPA). In addition to being subject to the requirements of the CAA, pollutants that degrade air quality in California are also governed under the California Clean Air Act (CCAA). The CCAA, as amended in 1992, requires all air quality management 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.

State and National Ambient Air Quality Standards

As required by the Clean Air Act, National Ambient Air Quality Standards (NAAQS) have been established for six major air pollutants. These pollutants are: carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM_{10} and $PM_{2.5}$), 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.

Both State and Federal standards are summarized in Table 4-11. 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.

Table 4-11. State and Federal 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)[8]	1 Hour	0.09 ppm (180 µg/m^3)	Ultraviolet Photometry	—	Same as Primary Standard	Ultraviolet Photometry
	8 Hour	0.070 ppm (137 µg/m^3)		0.070 ppm (137 µg/m^3)		
Respirable Particulate Matter (PM_{10})[9]	24 Hour	50 µg/m^3	Gravimetric or Beta Attenuation	150 µg/m^3	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	20 µg/m^3		—		
Fine Particulate Matter ($PM_{2.5}$)[9]	24 Hour	—		35 µg/m^3	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	12 µg/m^3	Gravimetric or Beta Attenuation	12.0 µg/m^3	15 µg/m^3	
Carbon Monoxide (CO)	1 Hour	20 ppm (23 mg/m^3)	Non-Dispersive Infrared Photometry (NDIR)	35 ppm (40 mg/m^3)	—	Non Dispersive Infrared Photometry (NDIR)
	8 Hour	9.0 ppm (10 mg/m^3)		9 ppm (10 mg/m^3)		
	8 Hour (Lake Tahoe)	6 ppm (7 mg/m^3)		—		
Nitrogen Dioxide (NO_2)[10]	1 Hour	0.18 ppm (339 µg/m^3)	Gas Phase Chemiluminescence	100 ppb (188 µg/m^3)	—	Gas Phase Chemiluminescence
	Annual Arithmetic Mean	0.030 ppm (57 µg/m^3)		53 ppb (100 µg/m^3)	Same as Primary Standard	
Sulfur Dioxide (SO_2)[11]	1 Hour	0.25 ppm (655 µg/m^3)	Ultraviolet Fluorescence	75 ppb (196 µg/m^3)	—	Ultraviolet Flourescence; Spectrophotometry (Pararosaniline Method)
	3 Hour	—		—	0.5 ppm (1300 µg/m^3)	
	24 Hour	0.04 ppm (105 µg/m^3)		0.14 ppm (for certain areas)[11]	—	
	Annual Arithmetic Mean	—		0.030 ppm (for certain areas)[11]	—	
Lead [12,13]	30 Day Average	1.5 µg/m^3	Atomic Absorption	—	—	High Volume Sampler and Atomic Absorption
	Calendar Quarter	—		1.5 µg/m^3	Same as Primary Standard	
	Rolling 3-Month Average	—		0.15 µg/m^3		
Visibility Reducing Particles[14]	8 Hour	See footnote 14	Beta Attenuation and Transmittance through Filter Tape	No Federal Standards		
Sulfates	24 Hour	25 µg/m^3	Ion Chromatography			
Hydrogen Sulfide	1 Hour	0.03 ppm (42 µg/m^3)	Ultraviolet Fluorescence			
Vinyl Chloride[12]	24 Hour	0.01 ppm (26 µg/m^3)	Gas Chromatography			

Source: *Ambient Air Quality Standards* (CARB 2016a)

See next page for footnotes.

Table 4-11 (continued)

Footnotes

[1] California standards for ozone, carbon monoxide (except 8-hour Lake Tahoe), sulfur dioxide (1 and 24 hour), nitrogen dioxide, and 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 arithmetic mean) are not to be exceeded more than once a year. The ozone standard is attained when the fourth highest 8-hour concentration measured at each site 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 calendar year with a 24-hour average concentration above 150 µg/m3 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 the U.S. EPA for further clarification and current national 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 measurement method 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 USEPA. An “equivalent method” of measurement may be used but must have a “consistent relationship to the reference method” and must be approved by the U.S. EPA.

[8] On October 1, 2015, the national 8-hour ozone primary and secondary standards were lowered from 0.075 to 0.070 ppm.

[9] On December 14, 2012, the national annual PM2.5 primary standard was lowered from 15 µg/m3 to 12.0 µg/m3. The existing national 24- hour PM2.5 standards (primary and secondary) were retained at 35 µg/m3, as was the annual secondary standard of 15 µg/m3. The existing 24-hour PM10 standards (primary and secondary) of 150 µg/m3 also were retained. The form of the annual primary and secondary standards is the annual mean, averaged over 3 years.

[10] To attain the 1-hour national standard, the 3-year average of the annual 98th percentile of the 1-hour daily maximum concentrations at each site must not exceed 100 ppb. Note that the national 1-hour standard is in units of parts per billion (ppb). California standards are in units of parts per million (ppm). To directly compare the national 1-hour standard to the California standards the units can be converted from ppb to ppm. In this case, the national standard of 100 ppb is identical to 0.100 ppm.

[11] On June 2, 2010, a new 1-hour SO2 standard was established and the existing 24-hour and annual primary standards were revoked. To attain the 1-hour national standard, the 3-year average of the annual 99th percentile of the 1-hour daily maximum concentrations at each site must not exceed 75 ppb. The 1971 SO2 national standards (24-hour and annual) remain in effect until one year after an area is designated for the 2010 standard, except that in areas designated nonattainment for the 1971 standards, the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standards are approved. Note that the 1-hour national standard is in units of parts per billion (ppb). California standards are in units of parts per million (ppm). To directly compare the 1-hour national standard to the California standard the units can be converted to ppm. In this case, the national standard of 75 ppb is identical to 0.075 ppm.

[12] 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.

[13] The national standard for lead was revised on October 15, 2008 to a rolling 3-month average. The 1978 lead standard (1.5 µg/m3 as a quarterly average) remains in effect until one year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978 standard, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.

[14] In 1989, the ARB converted both the general statewide 10-mile visibility standard and the Lake Tahoe 30-mile visibility standard to instrumental equivalents, which are "extinction of 0.23 per kilometer" and "extinction of 0.07 per kilometer" for the statewide and Lake Tahoe Air Basin standards, respectively.

Local Monitored Air Quality

Air quality data is measured at monitoring stations throughout the state by monitors that CARB/SCAQMD generally maintains. The monitoring stations nearest the Project Study Area are located at the Veterans Affairs Hospital in West Los Angeles and 1630 North Main Street in downtown Los Angeles. The last three years of available monitored data for these locations are summarized in Table 4-12 to illustrate the Study Area's general air quality trends.

Table 4-12. Air Quality Summary for Project Study Area Monitoring Stations (2013-2015)

Air Pollutant	Standard/Exceedance**	Veterans Hospital West Los Angeles			North Main Street Los Angeles		
		2013	2014	2015	2013	2014	2015
Carbon Monoxide (CO)	Year Coverage*	N/A	N/A	N/A	N/A	N/A	N/A
	Max. 1-hour Concentration (ppm)	1.9	22	1.6	2.5	2.5	3.2
	Max. 8-hour Concentration (ppm)	1.3	1.3	1.4	2.0	2.0	1.8
	# 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	N/A	N/A	N/A	N/A	N/A	N/A
Ozone (O_3)	Year Coverage*	88%	95%	98%	82%	94%	98%
	Max. 1-hour Concentration (ppm)	0.088	0.116	0.102	0.081	0.113	0.104
	Max. 8-hour Concentration (ppm)	0.075	0.094	0.072	0.069	0.094	0.074
	# Days>Federal 8-hour Std. of >0.070 ppm	0	5	2	0	6	6
	# Days>California 1-hour Std. of >0.09 ppm	0	1	2	0	3	2
	# Days>California 8-hour Std. of >0.070 ppm	1	6	3	0	7	6
Nitrogen Dioxide (NO_2)	Year Coverage*	72%	93%	93%	75%	95%	98%
	Max. 1-hour Concentration (ppm)	0.051	0.064	0.068	0.090	0.082	0.079
	Annual Average (ppm)	N/A	0.013	0.011	N/A	0.022	0.022
	# Days>California 1-hour Std. of >0.18 ppm	0	0	0	0	0	0
Sulfur Dioxide (SO_2)	Year Coverage*	N/M	N/M	N/M	N/M	N/M	N/M
	Max. 24-hour Concentration (ppm)	N/M	N/M	N/M	N/M	N/M	N/M
	Annual Average (ppm)	N/M	N/M	N/M	N/M	N/M	N/M
	# Days> Federal 1-hour Std. of >0.075 ppm	N/M	N/M	N/M	N/M	N/M	N/M
Suspended Particulates (PM_{10})	Year Coverage*	N/M	N/M	N/M	97%	92%	97%
	Max. 24-hour Concentration ($\mu g/m^3$)	N/M	N/M	N/M	57.0	66.0	73.0
	#Days>Fed. 24-hour Std. of>150 $\mu g/m^3$	N/M	N/M	N/M	0	0	0
	#Days>California 24-hour Std. of>50 $\mu g/m^3$	N/M	N/M	N/M	20	38	30
	National Annual Average ($\mu g/m^3$)	N/M	N/M	N/M	29.5	30.6	27.1
Suspended Particulates ($PM_{2.5}$)	Year Coverage*	N/M	N/M	N/M	95%	83%	94%
	Max. 24-hour Concentration ($\mu g/m^3$)	N/M	N/M	N/M	43.1	59.9	56.4
	State Annual Average ($\mu g/m^3$)	N/M	N/M	N/M	18.9	NA	12.5
	#Days>Fed. 24-hour Std. of>35 $\mu g/m^3$	N/M	N/M	N/M	1	6	7
	National Annual Average ($\mu g/m^3$)	N/M	N/M	N/M	12.0	N/A	12.3

Sources: South Coast Air Quality Management District, 2017: http://www.aqmd.gov/home/library/air-quality-data-studies/historical-data-by-year
EPA AirData, 2017 (for CO only): https://www.epa.gov/outdoor-air-quality-data/monitor-values-report
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.*

Attainment Status

Section 107 of the 1977 Clean Air Act Amendment requires that the United States Environmental Protection Agency (USEPA) publish a list of all geographic areas in compliance with the NAAQS, as well as those not attaining the NAAQS. Areas not in NAAQS compliance are deemed non-attainment areas. Areas that have insufficient data to make a determination are deemed unclassified and are treated as being attainment areas until proven otherwise. An area's designation is based on the data collected by the state monitoring network on a pollutant-by-pollutant basis.

Table 4-13. Study Area Attainment Status

Criteria Pollutant	Federal Attainment Status
Ozone (O_3)	Nonattainment
Nitrogen Dioxide (NO_2)	Attainment
Carbon Monoxide (CO)	Attainment/Maintenance
Particulate Matter (PM_{10})	Maintenance
Particulate Matter ($PM_{2.5}$)	Nonattainment
Lead	Nonattainment
All others	Attainment/Unclassified

Source: USEPA 2016

The Project Study Area is located in Los Angeles County. As shown Table 4-13, the USEPA has classified Los Angeles County as a nonattainment area for O_3, $PM_{2.5}$, and lead. Los Angeles County is listed as a maintenance area for CO and PM_{10}, as it was previously a nonattainment area for these pollutants.

Sensitive Receptors

Air-quality-sensitive land uses, such as residences, parks, schools, day care centers, hospitals, or parks and playgrounds, have not changed from what was described in Section 4.4.2 of the Final EIS/EIR, with the exception of the opening of the rehabilitation facility on Century Park East and the approved BHHS modernization program, as described in Section 4.2 of this Draft SEIS. The land uses immediately surrounding the Century City Constellation Station are primarily commercial with high-rise residential planned for the northeast and southwest corners of Constellation Boulevard and Avenue of the Stars. A hotel currently occupies the southwest corner of this intersection and residential uses are planned for the future. Adjacent to the proposed construction staging Century Park East are the BHHS campus and the medical rehabilitation facility. Residential land uses also border Century Park West. The receptor locations analyzed in this study are shown in Figure 4-31.

Construction-related Environmental Impacts/Environmental Consequences

Emission Burden Analysis

An assessment of the air quality construction impacts of the Century City Constellation Station, using the staging information and schedule described in Section 4.5, was conducted. This assessment used emission factors from the Air Resources Board (ARB) model for off-road vehicle and equipment emissions (OFFROAD), as well as the ARB model for on-road vehicle emissions (EMission FACtor program, or EMFAC). For the off-road vehicles and equipment, SCAQMD-specific OFFROAD 2011 emission factors, along with project-specific information on pieces of equipment for each construction phase, were used. For each piece of equipment, the ARB equipment type, number of pieces of equipment, horsepower, and utilization were provided by project engineers. Worker and delivery trip emissions factors were estimated using the EMFAC2014

Figure 4-31. AERMOD Layout with Grid and Sensitive Receptors

emission factor model. In addition, as listed in the *Air Quality Technical Memorandum – Revision 1* (Metro 2017g), specific pieces of equipment, are required to meet Tier 4 final emission standards. EPA adopted multiple tiers of emissions standards for offroad equipment ranging from Tier 1 to Tier 4, with Tier 4 being the most stringent.

Using these various data sources, daily construction emission levels were developed. These values were all shown to be below the air quality construction significance thresholds shown in Table 4-14.

Table 4-14. Estimated Maximum Daily Construction Emissions for Century City Constellation Station (lbs/day)

Activity	VOC	CO	NOx	PM_{10}	$PM_{2.5}$
Construction Equipment and Dirt Moving	1	37	16	9	2
Mobile Sources (deliveries, worker trips, hauling of material, etc.)	3	39	38	4	2
Highest Daily Total	4	76	54	13	4
SCAQMD Thresholds	75	550	100	150	55

Source: *Westside Purple Line Extension Century City Constellation Station Air Quality Technical Memorandum – Revision 1* (Metro 2017g) (Appendix F)
Notes: Total construction emissions may not occur during the same peak period as each emission source; therefore, the total construction emissions shown may not add up to the sum of the elements presented in this table. Peak construction emissions for all pollutants are predicted in the year 2020.

The regional emissions presented in Table 4-14 are those associated with construction of the Century City Constellation Station. These emission estimates are based upon updated models and information since issuance of the Final EIS/EIR and subsequent air quality analyses in 2012 and 2015. These updates include refinement of the construction emissions model, reflecting project specific equipment, including electrification of specific pieces of equipment, Tier 4 final emission standard requirements for specific pieces of equipment, and detailed equipment placement and usage. Due to these changes, the emissions presented in this report are significantly lower than those presented in the Final EIS/EIR and the *Westside Subway Extension Project Air Quality Memorandum* (Metro 2011m) for a typical station with a TBM entry/exit site.

Emissions of VOC, NOx and $PM_{2.5}$ presented in this report are also lower than those presented in the *Westside Subway Extension Project Air Quality Construction Impacts Memorandum* (Metro 2012k) for a typical station with a TBM entry/exit site under the Phased Construction Scenario after Mitigation (Table 3-5 in the *Westside Subway Extension Project Air Quality Construction Impacts Memorandum*), while emissions of CO and PM_{10} presented in this report are slightly higher (by 5 pounds per day) than those presented in the *Westside Subway Extension Project Air Quality Construction Impacts Memorandum*.

Estimated emissions of VOC, NOx, PM_{10}, and $PM_{2.5}$ are also lower than those presented in the *Addendum to the Final Environmental Report* (Metro 2015j) for the Century City Constellation Station (Table 3 on the *Addendum to the Final Environmental Report*), while emissions of CO are slightly higher (by 9 pounds per day) in this report.

As such, emissions associated with larger portions of the project (i.e. Section 2) would be significantly lower than those presented in the Final EIR/EIS and, with the exception of CO and PM_{10}, lower than those presented in the *Westside Subway Extension Project Air Quality Construction Impacts Memorandum* and the *Addendum to the Final Environmental Report*.

Microscale Analysis

A microscale (localized) air quality analysis was conducted to assess the potential impacts of construction activities. This analysis, which follows guidelines in SCAQMD's 2008 Final Localized Significance Threshold Methodology (SCAQMD 2008), shows the project's local impacts on the criteria pollutants of $PM_{2.5}$, PM_{10}, NO_2, and CO. For this analysis, refined modeling was conducted using USEPA's Atmospheric Dispersion Model (AERMOD), along with the emissions burdens estimated from the above construction emission burden analysis. The analysis followed SCAQMD's Modeling Guidance for AERMOD along with EPA's Guideline on Air Quality Models, updated on January 17, 2017. This guidance details modeling requirements including the requirement to model with and without terrain, and the application of a receptor grid in order to identify the maximum predicted concentrations.

Dispersion models use mathematical formulations to characterize the atmospheric processes that disperse pollutants emitted by emission sources, which in this case are the emissions generated by the construction equipment and vehicles operating within the project area. As directed by the guidance, the **A**merican Meteorological Society/ **E**nvironmental Protection Agency **R**egulatory **Mod**el (AERMOD) Version 16216r was used to determine microscale pollutant concentrations. AERMOD is a steady-state plume model. AERMOD incorporates current concepts about flow and dispersion in complex terrain. AERMOD is currently USEPA's state-of-the-art model for predicting pollution concentrations from emission sources. Based on estimated emission rates and meteorological inputs, AERMOD was used to predict pollutant concentrations at the selected receptor locations. Five years of meteorological data (2008 to 2012) from SCAQMD's West LA meteorological station were input into the AERMOD program.

Figure 4-31 presents the AERMOD model layout. The construction activities are shown in as the Metro staging areas. There are currently 13 areas where construction activity/hauling of material is planned to occur. The red crosses represent receptor locations where pollutant concentrations from construction activities are estimated. A total of 5,015 receptors were analyzed. In addition to the receptor grid laid over the study area, receptors were placed at sensitive land uses, including residences, schools, hotels, and medical facilities, adjacent to construction staging areas or haul routes.

AERMOD microscale modeling is used to predict concentrations resulting from emissions from construction equipment and vehicles operating within the project area. A background level must be added to this value to account for pollution entering the area from other sources. The background level is the component of the total concentration not accounted for through the microscale modeling analysis. Unique background levels, based on the specific details of the applicable standards and as recommended by USEPA and SCAQMD, have been added to modeled results. The resulting pollutant concentrations (modeled result + background) were then compared to the applicable NAAQS. This methodology is further detailed in the *Air Quality Technical Memorandum – Revision 1* (Metro, 2017g).

Table 4-15 presents the maximum levels modeled in the microscale analysis. As shown, there are predicted to be no exceedances of the NAAQS or CAAQS for CO or of the significant change threshold for $PM_{2.5}$. There are also no predicted exceedances of NAAQS for PM_{10}.

Table 4-15. Estimated Maximum Localized Pollutant Levels

Pollutant	Averaging Period	Background	On-Site Increment (Modeled Result)	Proposed Action (Modeled Result + Background) **	NAAQS	CAAQS
Nitrogen Dioxide (NO_2) ($\mu g/m^3$)	1-hour	95.9 NAAQS 127.1 CAAQS	106.4	202.3 NAAQS 233.5 CAAQS	188	339
	Annual	22.6	6.4	28.9	100	57
Carbon Monoxide (CO) (ppm)	1-hour	2.2	0.3	2.5	35	20
	8-hour	1.4	0.1	1.5	9	9.0
Particulate Matter (PM_{10}) ($\mu g/m^3$)	24-hour	65	65.6	130.3	150	50
Particulate Matter ($PM_{2.5}$)* ($\mu g/m^3$)	24-hour	N/A	7.8	N/A	10.4 (incremental)	10.4 (incremental)

Source: *Westside Purple Line Extension Century City Constellation Station Air Quality Technical Memorandum – Revision 1* (Metro 2017g) (Appendix F)
*Note: As per SCAQMD email on October 10, 2016, since the SCAQMD is nonattainment for $PM_{2.5}$ and background values already exceed NAAQS, the $PM_{2.5}$ increment should be compared to the SCAQMD significant change threshold for $PM_{2.5}$ for construction.
**Numbers may not add up exactly due to rounding.
ppm = parts per million; $\mu g/m^3$ = micrograms per cubic meter; N/A = not applicable; NAAQS = National Ambient Air Quality Standards

One exceedance is predicted for nitrogen dioxide (NO_2) 1-hour NAAQS and eight exceedances are predicted for the NO_2 1-hour CAAQS out of the 5,015 receptors modeled over a five-year period. The receptors demonstrating violations of the 1-hour NO_2 standard are located near construction staging Area 2 as shown in Figure 4-32 . One of those receptors is located on the BHHS campus at the site of the current temporary classrooms and future half-court soccer field. The violation is anticipated to occur between August and October 2020 when construction activities peak. Based on the BHHS modernization program, the temporary classrooms will no longer be in place at that time and the site will be used as a half-court soccer field.

Figure 4-32. Receptor Locations Predicted to Exceed NO_2 CAAQS and NAAQS

Violations of the CAAQS for PM_{10} are also predicted but no violations of the NAAQS for PM_{10} are predicted to occur. The violations of the CAAQS for PM_{10} are anticipated at most receptors modeled, including on the BHHS campus, because the background conditions already exceed the CAAQS.

The estimated maximum localized pollutant levels are based on expected production rates and equipment utilization. This information is often limited since it does not take into account the actual equipment on site and construction techniques that the contractor will actually employ. As such, predicted concentrations will be verified once the Contractor provides the final equipment and schedule. As discussed in more detail in the Mitigation Measures section below, based on the results of the verified analysis, the Contractor will be mandated to alter operating procedures/schedule/equipment if a violation of the applicable standards is predicted. The Contractor will be required to keep a log of construction equipment used during construction along with hours of operation of each specific piece of equipment to ensure that construction activities are not in violation of applicable air quality standards.

Health Risk Assessment

A population-wide health risk assessment was conducted to determine the potential health risks caused by construction of the Century City Constellation Station. The Hotspots Analysis and Reporting Program Version 2 (HARP2) Risk Assessment Standalone Tool (RAST) was used to analyze cancer, chronic, 8-hour chronic, and acute health risks associated with inhalation of pollutants of concern. Other exposure pathways were not evaluated, as this analysis only considers air pollutants. The

pollutants of concern analyzed in this health risk assessment were: diesel particulate matter, carbon monoxide, and nitrogen dioxide (NO_2). Each pollutant generated a risk value. PM_{10} was evaluated separately, and no risk was detected.

To account for sensitive receptors, the most conservative analysis (70 year resident, population-wide) was performed along with a 30 year exposure analysis. The cancer risk value indicates the number of individuals that develop cancer per million individuals as a result of exposure to a pollutant over an assumed lifetime of 70 years. HARP2 RAST uses the annual average air concentration of a pollutant, the known cancer inhalation slope factor for the pollutant, and the Office of Environmental Health Hazard Assessment derived intake rate percentile (resident) to calculate cancer risk. A ratio was applied to the cancer risk probability to account for project duration.

Non-carcinogenic chronic risk is determined by calculating hazard quotients and indices. A hazard quotient is calculated for each organ system affected by inhalation of a pollutant. A hazard index is the sum of each hazard quotient for a pollutant. HARP2 RAST contains a database with information on which pollutant affects which organ system(s). Using the average annual air concentration of a pollutant and the known non-carcinogenic chronic inhalation reference exposure level for the pollutant, HARP2 RAST calculates hazard quotients according to each affected organ system for a certain pollutant.

Similarly, non-carcinogenic acute risk is calculated by HARP2 RAST using the maximum hourly concentration of a pollutant, affected organ systems, and the known non-carcinogenic acute inhalation reference exposure level for the pollutant.

Cancer risk assessments were conducted for diesel particulate matter and NO_2. Results from the AERMOD modeling for sensitive receptors as detailed above were used in the HARP2 analysis. Using these parameters with a 3-year conservative exposure of 12 hours per day, 225 school days a year, and a constant maximum exposure level, the excess cancer risk did not exceed the SCAQMD excess cancer risk threshold of 10 in a million. The results of this analysis are summarized in Table 4-16. These results do not take into account the expected use of best available control technologies (BACT) on equipment that is required to be Tier 2 due to its subsurface use. As discussed previously, the construction parameters will be verified and the applicable BACT for each piece of equipment that can be safely installed, as per Mitigation Measure, CON-12, will be utilized.

Table 4-16. Excess Cancer Risk Assessment

Pollutant	Excess Cancer Risk 70 year/30 year (in a million)	Excess Cancer Risk Threshold (in a million)
Diesel Particulate Matter	7 / 6	10

Source: *Westside Purple Line Extension Century City Constellation Station Air Quality Technical Memorandum* (Metro 2016e) (Appendix F)

Non-carcinogenic chronic risk assessments were conducted for diesel particulate matter and NO_2. Non-carcinogenic acute risk assessments were conducted for CO and NO_2. Each pollutant generated hazard indices. The hazard indices did not exceed the SCAQMD threshold of 1.0. These results are summarized in Table 4-17.

Table 4-17. Acute and Chronic Non-Carcinogenic Risk Assessment

Pollutant	Risk Assessment Type	Hazard Index	Hazard Index Threshold
Diesel Particulate Matter	Chronic (non-carcinogenic)	.04	1.0
Nitrogen Dioxide (NO_2)	Acute (non-carcinogenic)	.05	1.0
Carbon Monoxide	Acute (Non-carcinogenic)	.02	1.0

Source: *Westside Purple Line Extension Century City Constellation Station Air Quality Technical Memorandum* (Metro 2016e) (Appendix F)

Given that the construction of Section 2 of the Project did not result in an exceedance of the SCAQMD excess cancer risk threshold or the non-carcinogenic chronic risk hazard indices, the construction of Section 2 of the Project would not result in an adverse impact to human health.

Mitigation Measures

The analysis of the construction of the Century City Constellation Station found estimated exceedances of $N0_2$ localized pollutant levels only during tunneling activities with the active use of the TBMs, which will last two to three years. As such, an additional mitigation measure is proposed to verify emissions once the equipment and schedule are verified to avoid adverse effects. With the implementation of mitigation, the construction of Section 2 of the Project would not result in additional adverse air quality impacts beyond those discussed in the Final EIS/EIR:

- **CON-6—Meet Mine Safety (MSHA) Standards:** Tunnel locomotives (hauling spoils and other equipment to the tunnel heading) will be approved by Metro to meet MSHA standards.
- **CON-7—Meet SCAQMD Standards:** Metro and its contractors will set and maintain work equipment and standards to meet SCAQMD standards, including NOx.
- **CON-8—Monitoring and Recording of Air Quality at Worksites:** Monitoring and recording of air quality at the worksites will be conducted. In areas of gassy soil conditions (Wilshire/La Brea and Wilshire/Fairfax work sites), air quality will be continuously monitored and recorded. Construction will be altered as required to maintain a safe working atmosphere. The working environment will be kept in compliance with federal, state, and local regulations, including SCAQMD and Cal/OSHA standards.
- **CON-9—No Idling of Heavy Equipment:** Metro specifications will require that contractors not unnecessarily idle heavy equipment.

- **CON-10—Maintenance of Construction Equipment:** Metro will require its contractors to maintain and tune engines per manufacturer's specifications to perform at EPA certification levels, where applicable, and to perform at verified standards applicable to retrofit technologies. Metro will also require periodic, unscheduled inspections to limit unnecessary idling and to ensure that construction equipment is properly maintained, tuned, and modified consistent with established specifications.
- **CON-11—Prohibit Tampering of Equipment:** Metro will prohibit its contractors from tampering with engines and require continuing adherence to manufacturer's recommendations.
- **CON-12—Use of Best Available Emissions Control Technologies:** Metro will encourage its contractors to lease new, clean equipment meeting the most stringent of applicable federal or state standards (e.g., Tier 3 or greater engine standards) or best available emissions control technologies on all equipment.
- **CON-13—Placement of Construction Equipment:** Construction equipment and staging zones will be located away from sensitive receptors and fresh air intakes to buildings and air conditioners.
- **CON-14—Measures to Reduce the Predicted PM10 Levels:** Mitigation measures such as watering, the use of soil stabilizers, etc. will be applied to reduce the predicted PM_{10} levels to below the SCAQMD daily construction threshold levels. A watering schedule will be established to prevent soil stockpiles from drying out.
- **CON-15—Reduce Street Debris:** At truck exit areas, wheel washing equipment will be installed to prevent soil from being tracked onto city streets, and followed by street sweeping as required to clean streets.
- **CON-16—Dust Control during Transport:** Trucks will be covered to control dust during transport of spoils.
- **CON-17—Fugitive Dust Control:** To control fugitive dust, wind fencing and phase grading operations, where appropriate, will be implemented along with the use of water trucks for stabilization of surfaces under windy conditions.
- **CON-18—Street Watering:** Surrounding streets at construction sites will be watered by trucks as needed to eliminate air-borne dust. In keeping with Metro's prior policy on the Eastside Gold Line, the contractor will water streets in the station area impacted by dust not less than once a day and more often if needed.
- **CON-19—Spillage Prevention for Non-Earthmoving Equipment:** Provisions will be made to prevent spillage when hauling materials and operating non-earthmoving equipment. Additionally, speed will be limited to 15 mph for these activities at construction sites.
- **CON-20—Spillage Prevention for Earthmoving Equipment:** Provisions will be made to prevent spillage when hauling materials and operating earth-moving equipment. Additionally, speed will be limited to 10 mph for these activities at construction sites.
- **CON-21—Additional Controls to Reduce Emissions:** EPA-registered particulate traps and other appropriate controls will be used where suitable to reduce emissions of particulate matter and other pollutants at the construction site.

- **CON-92 –AERMOD Verification:** The estimated maximum localized pollutant levels are based on a series of assumptions made about Contractor's equipment and schedule. These levels will be verified using the actual equipment and schedule proposed by the contractor. Based on the results of the verification, the contractor will be mandated to alter operating procedures/schedule/equipment if a violation of the applicable standards is predicted. Contractor will be required to keep a log of construction equipment used during construction along with hours of operation of each specific piece of equipment to ensure that construction activities are not in violation of applicable air quality standards.

4.5.4 Noise and Vibration

Affected Environment/Existing Conditions

The existing noise and vibration environment of Century City Station area and the identified noise-sensitive land uses, such as residences, parks, schools, hospitals, places of worship, and theaters, have not changed from that described in Section 4.6.2 of the Final EIS/EIR, with the exception of the new medical rehabilitation facility and BHHS modernization, which is described in the affected environment/existing conditions in Section 4.2 of this Draft SEIS. The Wilshire/Rodeo Station area was not considered in this analysis as the construction methods and locations are the same as those considered in the Final EIS/EIR. Therefore, there was no change to the impacts that were discussed in the Final EIS/EIR.

To further assess the construction noise impacts associated with changes in the Century City Constellation Station staging areas, a construction noise impact assessment was performed and documented in the *Westside Purple Line Extension Project, Section 2 Construction Noise and Vibration Assessment* (Metro 2017e) (Appendix E). As part of the detailed assessment, noise measurements were recorded at various receivers adjacent to construction areas in the City of Los Angeles and City of Beverly Hills to identify the preconstruction noise environment. Table 4-18 lists the results of those measurements, and Figure 4-33 shows the pre-construction noise measurement locations. The daytime construction noise limits in the City of Los Angeles Municipal Code (LAMC) are not dependent on the existing ambient levels, which is why they are not included in Table 4-18. Prior to construction, Metro shall review and update the noise sensitive locations listed in Table 4-18 and Figure 4-33, adding and deleting locations to reflect any changes.

Table 4-18. Pre-Construction Noise Measurement Results in the Century City Constellation Station Area

Receiver No.	Measurement Location	Daytime[c]	Evening[c]	Nighttime[b] Leq
A	1918-1952 Fox Hills Drive (MFR)			58 dBA
B	2050 Century Park West (MFR)			59 dBA
C	Hyatt Regency Century Plaza Hotel, 2025 Avenue of the Stars			56 dBA
D	2010 Century Park East (Offices)			63 dBA
E	Century City Rehabilitation Facility & Medical Center, 2080 Century Park East			63 dBA
F	2160 Century Park East (MFR)			65 dBA
6	1888 Century Park East (Offices)[a]			63 dBA
7	Century Park Towers, 2049 Century Park East (Offices)[a]			59 dBA
8	Annenberg Space for Photography and the Skylight Studios, 10050 Constellation Boulevard[a]			56 dBA
9	Bain & Company Building, 1901 Avenue of the Stars[a]			61 dBA
10	The Century, 10 West Century Drive (Offices)[a]			57 dBA
11	Constellation Place, 10250 Constellation Boulevard (Offices)[a]			64 dBA
Sites G, 5, N, and O are in the City of Beverly Hills and subject to the Beverly Hills' Noise Code				
G	401 Shirley Place, Beverly Hills (SFR)	68 dBA	68 dBA	63 dBA
5	Beverly Hills High School Lacrosse Field (a,d)	56 dBA	53 dBA	51 dBA
N	Beverly Hills High School Façade(e)	53 dBA	50 dBA	48 dBA
O	Beverly Hills High School Temporary Classroom Buildings Closest to the 1940 CPE Construction Site(f)	59 dBA	56 dBA	54 dBA

Source: *Westside Purple Line Extension Project, Section 2 Construction Noise and Vibration Assessment* (Metro 2017e) (Appendix E)

Notes:

(a) 1-hour measurements were taken at Receivers 5 through 11. At these locations, the daytime Leq, evening Leq, and nighttime Leq were estimated by comparing the 1-hour measurement to the same hour of the nearest 24-hour measurement location.

(b) Nighttime is from 9:00 p.m. to 7:00 a.m. as defined by the City of Los Angles Municipal Code.

(c) Daytime is from 8:00 A.M. to 6:00 P.M., evening is from 6:00 P.M. to 9:00 P.M. and nighttime is from 9:00 P.M. to 8:00 A.M as defined by the City of Beverly Hills.

(d) The measurements at Receiver 5 were taken before the temporary classrooms were located in the Lacrosse Field

(e) A distance adjustment was made between Receiver 5 and the closest building façade at Beverly Hills High School.

(f) A distance adjustment was made between Receiver O and Receiver 5.

MFR = multi-family residences; SFR = single-family residences

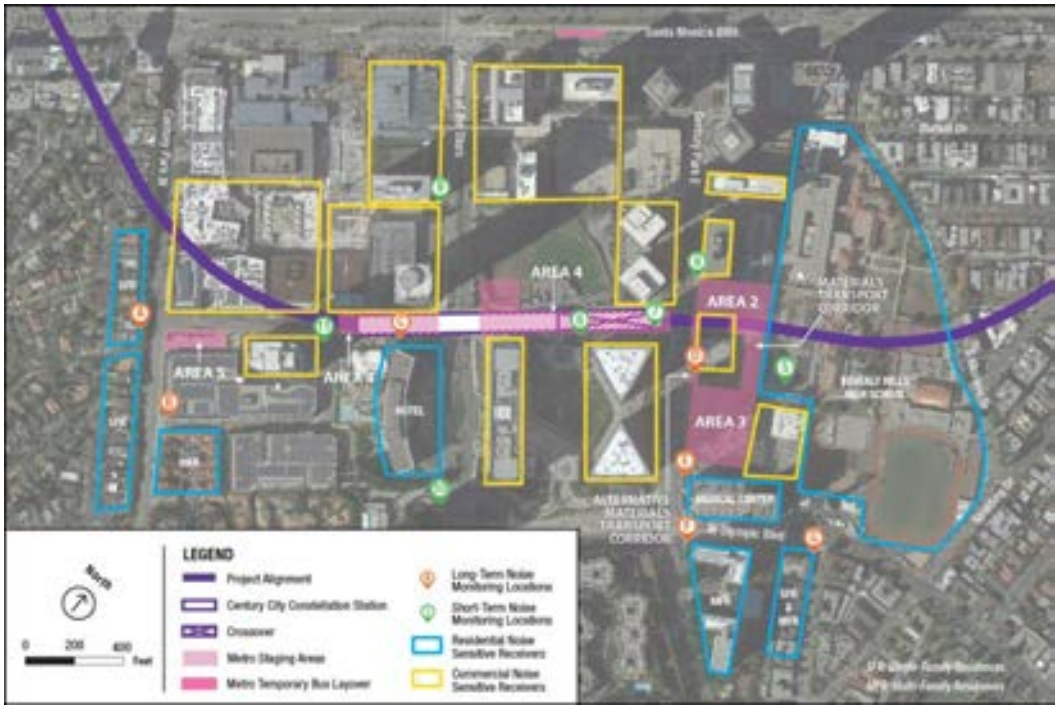


Figure 4-33. Pre-Construction Noise Measurement Locations in the Century City Constellation Station Area

Construction-related Environmental Impacts/Environmental Consequences

Construction Noise

Section 4.15.3 of the Final EIS/EIR presents the project construction-related noise and vibration impacts. Noise from at-grade construction of the stations would be generated by heavy equipment such as bulldozers, backhoes, hauling trucks, scrapers, loaders, cranes, and paving machines. Table 4-19 sets forth the noise emission levels for typical construction equipment. Noise levels from point source stationary noise sources, such as construction equipment, decrease at a rate of 6 decibels (dB) per doubling of distance. For example, at a distance of 250 feet from a construction area, noise would be 14 dB lower than at a distance of 50 feet.

Based on the typical noise levels presented in Table 4-19 and as identified in the Final EIS/EIR, all of the construction equipment would exceed the existing presumed nighttime ambient noise levels at the receivers in the City of Los Angeles and would introduce new sources of noise to the immediate vicinity of the construction sites. As stated in the Final EIS/EIR, noise impacts would be reduced through implementation of the identified mitigation measures, but adverse construction noise impacts could remain after mitigation in areas of concentrated construction activity, including near stations, tunnel access portals, and construction laydown areas.

Table 4-19. Noise Level of Typical Construction Equipment at 50 Feet (dBA Lmax)

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

Source: *Transit Noise and Vibration Impacts Assessment,* Table 12-1 (FTA 2006)

The following construction activities at site Areas 2 and 3 have the potential to generate noise impacts:

- Area 2 (1940 and 1950 Century Park East) would be primarily used to support tunneling operations, receive materials, support the mining of cross-passages, and concreting. Area 2 would also be used for the temporary electrical substation providing power to TBMs, tunnel lighting, ventilation, and for fume ventilation exhaust scrubbers. An access shaft would be located in Area 2 to support tunneling operations for day and night shifts during tunneling. The access shaft facilitates removal of tunnel muck, as well as for deliveries of precast segments to rail-mounted cars below, which would be taken to the TBM's rear trailing gear for installation as the tunnel liner. Other miscellaneous materials would also be delivered in this manner. This site also supports concreting of tunnels (invert and walkway) and cross-passages and installation of mechanical electrical equipment in tunnels and cross-passage. During construction of the access shaft, the site would be used by excavating and hoisting equipment required for shaft construction. At the completion of tunnel construction, the shaft would be used to support rail welding. Stock rail would be delivered to the site by trucks. The rail would be lowered down to track level through the shaft and placed in stockpiles. A portable rail welding plant would be set up at the bottom of the shaft to weld stock rail into continuous welded rail strings approximately 500-feet long. These rail strings would also be stockpiled within the tunnels.

- Area 3 (2040 Century Park East) would be primarily used for day and night stockpiling and off-hauling of tunnel muck for approximately two to three years during tunneling activities. The site would also be used during the duration of construction for equipment operation, material storage, and contractor offices. Equipment that may be in operation on site includes a compressor plant, ventilation plant, grout plant, foam plant, conveyor system, mobile cranes, and front end loader. The site would also include a machine shop and electrical shop. Upon completion of the tunneling operations, the site would be used to support concreting of tunnels, rail installation, and mechanical and electrical finishing.

The analysis assumed that the following equipment would be used on-site at each of the staging areas during nighttime hours[1]:

- Area 2: Tower crane, boom crane, pile rig drill, front end loader, Bob Cat, drilling polymer plant, concrete pumps, generator, ready mix trucks, pick-up trucks, haul trucks, ventilations fans, street sweepers, telehandler, water treatment plant, conveyor system, segment carrier, and roller compactor.
- Area 3: Front end loader, boom crane, haul trucks, excavator, concrete pumps, shotcrete machine, lift hoist, water treatment plant, ventilation plant, compressor plant, foam plant, grout plant, conveyor system, mechanical shop, and electrical shop.
- TBM Launch Site: Boom crane, rough terrain crane, pile drill rig, front end loader, Bob Cat, drilling polymer plant, concrete pumps, generator, ready mix trucks, pick-up trucks, street sweeper, light plants, welding plants, fork lifts, excavator, haul trucks, dozer, ventilation fans, and telehandler.
- Century City Constellation Station Box: Boom crane, rough terrain crane, pile drill rig, front end loader, Bob Cat, drilling polymer plant, concrete pumps, generator, ready mix trucks, pick-up trucks, street sweeper, light plants, welding plants, fork lifts, excavator, haul trucks, dozer, ventilation fans, and telehandler.
- Area 5: Telehandler, hydraulic crane, and pick-up truck.

The predicted construction noise levels and noise limits for the various receivers adjacent to the construction areas are presented in Table 4-20. This information shows the predicted construction noise during the daytime, evening, and nighttime hours for Receivers G, 5, N, and O in the City of Beverly Hills, compared to the Beverly Hills Municipal Code noise limit (i.e., existing daytime, evening, and nighttime ambient noise plus 5 dB). The remaining receiver sites are within the City of Los Angeles and are presented showing the predicted daytime construction noise compared to the LAMC noise limit of 75 A-weighted decibels (dBA), and the nighttime construction noise to the existing ambient noise plus 5 dB City of Los Angeles noise limit.

[1] Nighttime hours are 9:00 p.m. to 7:00 a.m. for the City of Los Angeles and 9:00 p.m. to 8:00 a.m. for the City of Beverly Hills.

Table 4-20. Century City Constellation Station Construction Noise - Leq (dBA)

Receiver[1]	Location	Daytime Construction Noise	Daytime Noise Limit[2]	Evening Construction Noise	Evening Noise Limit[3]	Nighttime Construction Noise	Nighttime Noise Limit[4]
The following receivers are within the jurisdiction of the City of Beverly Hills							
G	401 Shirley Place (SFR)	48	73	42	73	42	68
5	Beverly Hills High School	58	61	54	58	54	56
N	Beverly Hills High School Facade	56	58	50	55	50	53
O	Beverly Hills High School Temporary Classroom Buildings Closest to the 1940 CPE Construction Site	65	64	61	61	61	59
The following receivers are within the jurisdiction of the City of Los Angles							
A	1918-1952 Fox Hills Drive (MFR)	56	75	N/A	N/A	47	63
B	2050 Century Park West (MFR)	44	75	N/A	N/A	31	64
C	Hyatt Regency Century Plaza Hotel, 2025 Avenue of the Stars	68	75	N/A	N/A	59	61
D	2010 Century Park East (Offices)	67	75	N/A	N/A	61	68
E[5]	Century City Rehabilitation Facility & Medical Center, 2080 Century Park East	57	75	N/A	N/A	51	61
F	2160 Century Park East (MFR)	55	75	N/A	N/A	48	70
6	1888 Century Park East (Offices)	67	75	N/A	N/A	61	68
7	Century Park Towers, 2049 Century Park East (Offices)	71	75	N/A	N/A	65	64
8	Annenberg Space for Photography and the Skylight Studios, 10050 Constellation Boulevard	68	75	N/A	N/A	62	61
9	Bain & Company Building, 1901 Avenue of the Stars	61	75	N/A	N/A	55	66
10	The Century, 10 West Century Drive (Offices)	55	75	N/A	N/A	51	62
11	Constellation Place, 10250 Constellation Boulevard (Offices)	60	75	N/A	N/A	53	69

Source: *Westside Purple Line Extension Section 2 Construction Noise and Vibration Assessment* (Metro 2017e) (Appendix E)
Notes:
[1] The locations of the modeled receivers are shown on Figure 2-4 of the *Section 2 Construction Noise and Vibration Assessment* (Metro 2017e) (Appendix E).
[2] Daytime is defined as 8:00 a.m. to 6:00 p.m. by the City of Beverly Hills and 7:00 a.m. to 9:00 p.m. by the City of Los Angeles.
[3] Evening is defined as 6:00 p.m. to 9:00 p.m. by the City of Beverly Hills. The LAMC does not include evening hours.
[4] Nighttime is defined as 9:00 p.m. to 8:00 a.m. by the City of Beverly Hills and 9:00 p.m. to 7:00 a.m. by the City of Los Angeles.
[5] Construction noise at Site E was modeled at street level. The analysis of the upper floor construction noise is presented in Table 4-21.
Noise levels in red indicate an exceedance of the noise level limits.

The analysis assumed a 20-foot-high noise barrier around all sites, except for the Constellation Boulevard station box and TBM launch site areas, where a moveable noise barrier with an approximate height of 14 feet would be used to shield the construction activities. The equipment used during nighttime hours will comply with the low noise equipment emissions limits specified in Metro's Specification Section 01 56 19, Construction Noise and Vibration Control.

As shown in Table 4-20, the construction noise level at Site O, BHHS temporary classroom buildings closest to the Area 2 construction site, is predicted to exceed the noise limit by 1 dB for daytime and 2 dB for nighttime hours. The daytime, evening, and nighttime noise limits are not predicted to be exceeded at all the other sites within Beverly Hills analyzed. At Site 7, Century Park Towers, the nighttime noise limit is predicted to be exceeded by 1 dB. At Site 8, Annenberg Space for Photography and Skylight Studios, the nighttime noise limit is predicted to be exceeded by 1 dB, a different that is not perceptible to the human ear. The nighttime noise limits is not predicted to be exceeded at all the other sites analyzed within Los Angeles. The Contractor will be responsible for providing additional noise control measures and/or limiting the equipment and construction activities to be used at the LAMC nighttime noise limit and BHMC daytime and nighttime noise limits. Therefore, there would be no adverse effect at these sites.

The medical rehabilitation facility located immediately south of Area 3 is a new sensitive receptor that was not analyzed as part of the Final EIS/EIR. The 20-foot-high noise barrier wall at the perimeter of Area 3 and the 16-foot high noise barrier around the mucking operations would shield the construction noise activities at the street level of the building resulting in an average nighttime noise level of 51 dBA, which is 10 dB below the noise limit of 61 dBA (Table 4-20). Since the patient rooms of the rehabilitation facility overlooking the construction site are on the upper floors of the building, a more detailed noise assessment was prepared for this receiver and is presented in the *Westside Purple Line Extension, Section 2 Construction Noise and Vibration Assessment* (Metro 2017e) (Appendix E).

As a "worst-case scenario," the ambient noise of Leq = 56 dBA measured from 3 a.m. and 4 a.m. at Receiver E was used to determine the noise control measures for nighttime construction activities affecting the medical rehabilitation facility building. The ambient noise level was measured at ground level and adjusted for additional height of the third through the eighth patient floors. The adjusted ambient noise level and the nighttime noise impact threshold are presented in Table 4-21, along with the predicted noise levels from nighttime construction activities. The predicted nighttime construction noise level accounts for a 20-foot noise barrier wall around the perimeter of the site and the 16-foot high noise barrier around the mucking operations and the use of low noise emission equipment.

As presented in Table 4-21, the predicted construction noise at the patient floors exceeds the nighttime noise limits of existing ambient plus 5 dB, which is considered an adverse effect. Measures to minimize the nighttime construction noise are identified in the "Mitigation Measures" section below.

Table 4-21. Nighttime (3:00 A.M to 4:00 A.M) Construction Noise Impact Thresholds at the Medical Rehabilitation Facility

Medical Rehabilitation Facility Building Floor	Ambient Noise Level, Leq (dBA)	Los Angeles Nighttime Construction Noise Limit, Leq (dBA)	Nighttime Construction Noise, Leq (dBA)	Exceeds the Nighttime Noise Limits (Y/N)
Ground Level	56	61	51	N
Patient Floor 3	52	57	65	Y
Patient Floor 4	51	56	66	Y
Patient Floor 5	51	56	66	Y
Patient Floor 6	51	56	66	Y
Patient Floor 7	51	56	66	Y
Patient Floor 8	51	56	66	Y

Source: *Westside Purple Line Extension Section 2 Construction Noise and Vibration Assessment* (Metro 2017e) (Appendix E)
Note: Ambient noise levels were measured from 3:00 A.M. to 4:00 A.M.

The construction noise levels were also predicted at the facades of the AAA Building (1950 Century Park East), which is a historic property as defined by Section 106. Table 4-22 presents the predicted construction noise levels for the tunneling construction during the daytime hours of 7:00 a.m. to 6:00 p.m. for the AAA Building. As shown in Table 4-22, the daytime construction noise levels at the AAA Building would not exceed the 75 dBA LAMC noise limit and therefore there is no adverse effect at the AAA Building during construction.

Table 4-22. Predicted Daytime Construction Noise at AAA Building

Location at AAA Building Facade	Noise Level, Leq(h) (dBA)
A	70
B	70
C	69
D	67

Source: *Westside Purple Line Extension AAA Building Construction Noise and Vibration Assessment–Revision 1*(Metro 2017h) (Appendix E)

As described in Chapter 3 of this Draft SEIS, the proposed haul route along Century Park West would run adjacent to a residential neighborhood. As a result, traffic noise at the residential areas to the west side of Century Park West would increase during nighttime operations of the haul trucks. Haul trucks operating between the hours of 12:00 midnight and 5:00 AM must have lower emission limits (80 dBA at 50 feet) than normally required by the California Vehicle Code. All trucks used for these nighttime hours must be certified in accordance with these specifications. Necessary steps shall be taken by the Contractor to comply with this limit, which may include fitting the equipment with high grade engine exhaust silencers and engine casing sound insulation.

Construction Vibration

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

Vibration damage risk thresholds from the Final EIS/EIR are presented in Table 4-23. The table presents PPV thresholds for different building categories. The 'Structural Building Damage' category is the level above which there is a risk that structural damage may occur. The 'Architectural Building Damage' category is the level above which there is a risk that superficial building damage, such as small cracks, may occur. The third category, 'Damage Risk to Historic Buildings and Cultural Resource Structures' is meant to apply to historic buildings that are particularly susceptible to damage. The upper range of the threshold for historic buildings of 0.2 PPV is used to assess damage risk to the AAA Building. The lower range of the threshold of 0.12 PPV would be used for fragile historic buildings and fragile cultural resources. Where the PPV is expected to exceed 0.2, monitoring is required. When the construction vibration exceeds 0.2 PPV mitigation measures such as using alternative construction approaches, are considered.

Table 4-23. Construction Vibration Damage Risk Thresholds

Building Category	Peak Particle Velocity (in/sec)
Structural Building Damage	2.0
Architectural Building Damage	0.5
Damage Risk to Historic Buildings and Cultural Resource Structures	0.12 to 0.2

Source: *Westside Subway Extension Final EIS/EIR* (Metro 2012j)

Table 4-24 presents the distance beyond which the damage risk criteria of 0.20 in/sec would not be exceeded for the major vibration-generating pieces of equipment likely to be used for the Project. Most of the equipment can be operated without risk of damage at distances of eight feet or greater from the AAA Building except for a vibratory roller and large dozer, which should be operated no closer than 25 to 40 feet.

The closest building of the Century Plaza Hotel to the Century City Station box construction is more than 40 feet from the edge of the construction. BHHS is over 200 feet from Area 2 and Area 3. At these distances, it is not expected that the equipment assumed to be used for construction will exceed the damage risk criteria of 0.20 inches/second for these structures.

Table 4-24. Distance to Construction Vibration Impact Thresholds

Equipment	PPV Ref Level at 100 ft (in/sec)[a]	Distance to Impact Threshold of 0.2 in/sec PPV
Cranes	0.001	3 ft
Dozer	0.04 to 0.07	25 to 40 ft
Front End Loader	0.011	8 ft
Vibratory Roller	0.059	35 ft
Excavator	0.011	8 ft
Auger Drill Rig	0.011	8 ft

Source: *Westside Purple Line Extension AAA Building Construction Noise and Vibration Assessment–Revision 1* (Metro 2017h) (Appendix E)

At the Wilshire/Rodeo Station, the Sterling Plaza/Bank of California building and Union Bank Building are within 25 feet of the Wilshire/Rodeo Station box construction area. At this distance, there is the potential risk of exceeding the damage risk criteria of 0.20 inches/second during jackhammering, compacting, and operation of a dozer.

Groundborne Noise and Vibration During Tunneling

The primary sources of vibration during tunneling are generated by the TBM and the tunnel train used to carry muck, pre-cast concrete tunnel segments, and materials. Previous measurements conducted of tunnel trains operating during the construction of the Metro Red Line Segment 2 tunnel shows a predominance of high frequency energy, up to 125 Hz. This contrasts with the groundborne vibration from rail trains in subways where vibration levels usually peak below 60 Hz. The high frequency energy of the tunnel trains means effects are more likely to be caused by groundborne noise rather than perceptible vibration.

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

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

Based on previous measurements conducted of the Metro Red Line Section 2 construction in 1993 made near the Wilshire/Western Station, the vibration levels from TBMs were below damage risk levels, either for structural damage or minor cosmetic damage such as hairline fractions in plaster or drywall.

The advance rate of the TBM is expected to be approximately 40 feet per day. The presence of the TBM beneath any one residential structure where it would be perceptible as either feelable vibration or groundborne noise would be approximately three to four days. The vibration would not be continuous but would occur only at times when the shield is pushed against the earth using the hydraulic ram, approximately four to six times a day. Measures can be used to keep residents informed when the tunneling will occur in their area and that some vibration may be perceptible, but not damage buildings.

Mitigation Measures

During tunneling activities, which is expected to last two to three years, the construction of Section 2 of the Project is predicted to exceed City of Beverly Hills noise limits at the temporary BHHS classroom building, and to exceed the City of Los Angeles noise limits the Century Park Towers, the Annenberg Space for Photography, and the medical rehabilitation facility. Mitigation measures CON-91 through CON-96 are new mitigations designed to minimize the construction noise and vibration impacts at the Wilshire/Rodeo and Century City Constellation Stations in addition to mitigation measures CON-22 through CON-41 that were already identified in Section 4.15 of the Final EIS/EIR. The Contractor shall be responsible for providing additional noise control measures and/or limiting the equipment and construction activities to reduce the construction noise at these sites to comply with the noise level limits. With the implementation of the following mitigation measures, the construction of Section 2 of the Project would not result in additional adverse noise or vibration impacts beyond those discussed in the Final EIS/EIR.

- **CON-22 Hire or Retain the Services of an Acoustical Engineer:** Hire or retain the services of an acoustical engineer to be responsible for preparing and overseeing the implementation of the Noise Control and Monitoring Plans. The Noise Control and Monitoring Plan will ensure that noise levels are at or below criteria levels in Metro Baseline Specifications Section 01565, Construction Noise and Vibration Control.
- **CON-23 Prepare Noise Control Plan:** Prepare a Noise Control Plan that includes an inventory of construction equipment used during daytime and nighttime hours, an estimate of projected construction noise levels, and locations and types of noise abatement measures that may be required to meet the noise limits specified in the Noise Control and Monitoring Plan.
- **CON-24 Comply with the Provisions of the Nighttime Noise Variance:** In the case of nighttime construction, the contractor will comply with the provisions of nighttime noise variances issued by local jurisdictions. The variance processes for the Cities of Los Angeles and Beverly Hills require the applicant to provide a noise mitigation plan and to hold additional public meetings before granting the variance to allow work that would be performed outside the permitted working hours.
- **CON-25 Noise Monitoring:** Conduct periodic noise measurements in accordance with an approved Noise Monitoring Plan, specifying monitoring locations, equipment, procedures, and schedule of measurements and reporting methods to be used.

- **CON-26 Use of Specific Construction Equipment:** At night, use only construction equipment operating at the surface of the construction site under full load, are certified to meet specified lower noise level limits set in the Noise Control Plan, and specified in the noise variance application.
- **CON-27 Noise Barrier Walls for Nighttime Construction:** Where nighttime construction activities are expected to occur, erect Metro designed noise barrier walls at each construction site prior to the start of construction activities. Barriers should be designed to reduce construction site noise levels by at least 5 dBA.
- **CON-28 Comply with Local Noise Ordinances:** Construction will comply as applicable with the City of Los Angeles, City of Beverly Hills, and County of Los Angeles noise ordinances during construction hours. Compliance with City of Los Angeles, City of Beverly Hills, 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, also will occur. Hours of construction activity will 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 City of Los Angeles limits 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. For all the cities in the Study Area, construction is prohibited on Sundays and city holidays. Construction outside of these working periods will require a variance from the applicable city. The variance processes for the Cities of Los Angeles and Beverly Hills and the County of Los Angeles require the applicant to provide a noise mitigation plan and hold additional public meetings.
- **CON-29 Signage:** Readily visible signs indicating "Noise Control Zone" will be prepared and posted on or near construction equipment operating close to sensitive noise sites.
- **CON-30 Use of Noise Control Devices:** Noise control devices that meet original specifications and performance will be used.
- **CON-31 Use of Fixed Noise-Producing Equipment for Compliance:** Fixed noise-producing equipment will be used to comply with regulations in the course of Project-related construction activity.
- **CON-32 Use of Mobile or Fixed Noise-Producing Equipment:** Mobile or fixed noise producing construction equipment that are equipped to operate within noise levels will be used to the extent practical.
- **CON-33 Use of Electrically Powered Equipment:** Electrically powered equipment will be used to the extent practical.
- **CON-34 Use of Temporary Noise Barriers and Sound-Control Curtains:** Temporary moveable noise barriers and sound-control curtains will be erected where construction activity is predicted to exceed the noise limits and is unavoidably close to noise-sensitive receivers.
- **CON-35 Distance from Noise-Sensitive Receivers:** Within each construction area, earth-moving equipment, fixed noise generating equipment, stockpiles, staging areas, and other noise producing operations will be located as far as practicable from noise-sensitive receivers.

- **CON-36 Limited Use of Horns, Whistles, Alarms, and Bells:** Use of horns, whistles, alarms, and bells will be limited for use as warning devices, as required for safety.
- **CON-37 Requirements for Project Equipment:** All noise-producing project equipment, including vehicles that use internal combustion engines, will be required to be equipped with mufflers and air-inlet silencers, where appropriate, and kept in good operating condition that meets or exceeds original factory specifications. Mobile or fixed "package" equipment will be equipped with shrouds and noise-control features that are readily available for that type of equipment.
- **CON-38 Limited Audibility of Project Related Public Addresses or Music:** Any Project-related public address or music system will not be audible at any sensitive receiver.
- **CON-39 Use of Haul Routes with the Least Overall Noise Impact:** To the extent practical, based on traffic flow, designated haul routes for construction-related traffic will be used based on the least overall noise impact. For example, heavily loaded trucks will be routed away from residential streets if possible. Where no alternatives are available, haul routes will take into consideration streets with the fewest noise-sensitive receivers.
- **CON-40 Designated Parking Areas for Construction-Related Traffic:** Non-noise sensitive designated parking areas for Project-related traffic will be used.
- **CON-41 Enclosures for Fixed Equipment:** Enclosures for fixed equipment, such as TBM slurry processing plants, will be required to reduce noise.
- **CON-91 – Construction Noise Minimization at Medical Rehabilitation Facility:** If needed to comply with City of Los Angeles noise ordinances nighttime noise limits at the medical rehabilitation facility, the following noise-control measures or similar approaches will be used in Area 3:
  - Fully enclose the compressor plant, ventilation plant, grout plant, foam plant, machine shop, and electrical shop. Enclose the conveyor system.
  - All equipment used from 9 p.m. to 7 a.m. Monday through Friday, 6 p.m. to 8 a.m. Saturdays, and anytime on Sunday including boom crane and front-end loader shall be low emission equipment as required by Metro Specification Section 01 56 19, Construction Noise and Vibration Control, Parts 3.01 and 3.04, and Table 4.
  - Retrofit the boom crane and front end loader to be used during nighttime (9 p.m. to 7 a.m. Monday through Friday, 6 p.m. to 8 a.m. Saturdays, and anytime on Sunday) operations with a hospital-grade muffler and additional damping and insulation added to the engine compartments.
  - Install an additional 16-foot noise barrier wall within the interior of Area 3 to further shield noise from the front-end loader and crane operations.
- **CON 92 Additional Noise Mitigations at Century City Constellation:** If needed to comply with City of Los Angeles of City of Beverly Hills noise ordinances at the Century City Constellation Station construction sites, the Contractor shall be responsible for providing additional noise control measures and/or limiting the equipment and construction activities to reduce the construction noise at these sites to comply with the noise level limits by implementing the following or similar measures:

- Moveable noise barriers that can be located within the construction site in close proximity to the equipment and activities that are exceeded the impact thresholds. The moveable noise barriers shall be constructed in accordance with Metro's Specification Section 01 56 19, Construction Noise and Vibration Control, Article 2.03, Moveable Noise Barriers. The height of the moveable noise barrier shall be a minimum of 14 feet.
- Noise control curtains that can be tented over the area where the noisy equipment is operating. The noise curtain shall be constructed in accordance with Metro's Specification Section 01 56 19, Construction Noise and Vibration Control, Article 2.04, Noise Control Curtains
- Replacing the standard engine exhaust muffler with a hospital grade engine silencer for stationary cranes, front end loaders, dozers, and any other diesel powered equipment operating during nighttime hours.

- **CON-93 – Backup Alarms:** All equipment operating during nighttime hours at all construction sites shall use low impact backup alarms. The low impact back-up alarms shall comply with CCR Title 8, Section 1592, Warning Methods. For equipment that must comply with CCR Title 8, Section 1592(a), equip these vehicles with compliant white sound, broadband and multi-frequency type back-up alarm devices. For equipment subject to the requirements of CCR Title 8, Section 1592(b) the Contractor may choose to equip with automatic back-up audible alarms. Such alarms shall only be of a compliant white sound, broadband or multi-frequency back-up alarm type device.

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

- **CON-94 – Haul Truck Noise Emission Limits:** Limit trucks operating off-site between the hours of 12:00 midnight and 5:00 AM to the extent feasible. Trucks that must operate during these hours should be fitted with equipment such as high grade engine exhaust silences and engine casing sound insulation or other equivalent devices.
- **CON-95 – Vibration Control for Tunnel Train:** If ground-borne noise limits or ground-borne vibration limits are exceeded, the contractor will be required to take action to reduce noise and/or vibrations to acceptable levels. Such action could include: 1. A durable resilient system to support the tunnel train tracks. Such as system would include: a. Resilient mat under the tracks b. A resilient grommet or bushing under the heads of any track fasteners. 2. The hardness of the resilient mat should be in the 40 to 50 durometer range and be about 1 to 2" thick, depending on how heavily loaded the cars would be. 3. The Contractor shall select the mat thickness so that the rail doesn't bottom out during a train pass by. 4. Reduce the speed of the tunnel trains. 5. Maintain the tunnel train track and train wheels in good order to reduce potential vibration impacts, including keeping gaps between track sections to a minimum and frequent maintenance to avoid wheel flats.

- **CON-96 – Vibration Monitoring Plan:** The Contractor is required to submit a Vibration Monitoring Plan prepared, stamped, and administered by the Contractor's Acoustical Engineer. As part of the implementation of this plan, vibration monitoring will be performed at the historic Sterling Plaza/Bank of California, Union Bank Building, and AAA Building closest to the locations where equipment and/or construction activities generate a substantial amount of ground-borne vibration. Vibration monitoring will consist of continuous measurements at the building façade closest to the construction activities. All vibration monitors used will be equipped with an "alarm" feature to provide notification if the 0.2 PPV vibration damage risk threshold has been approached or exceeded.

4.5.5 Geological Hazards

Affected Environment/Existing Conditions

Section 4.3 provides a detailed description of the affected environment/existing conditions related to geologic hazards. As the discussion in this section focuses mainly on subsurface gas, the subsurface gas existing conditions are summarized here for reference. Refer to Section 4.3 and the *Assessment of Tunneling and Station Excavation Risks Associated with Subsurface Gas along Section 2–Revision 1* (Metro 2017b) in Appendix B of this Draft SEIS for additional information on methane and hydrogen sulfide gases.

Methane and hydrogen sulfide are the primary gases of concern that could be encountered during the tunneling activities for Section 2 of the Project. The general characteristics of both of these gases are summarized in Section 4.3 of this Draft SEIS.

Portions of Section 2 of the Project will involve tunneling through ground that contains elevated concentrations of methane and hydrogen sulfide gas. For the Project, Metro defines elevated concentrations of gases as encountered in the ground as:

- Methane greater than 5 percent (50,000 ppm), corresponding to the lower explosive limit
- Hydrogen sulfide greater than 0.0005 percent (5 ppm), corresponding to OSHA PEL

The areas with most widespread elevated concentrations of methane and hydrogen sulfide gas are along Section 1 of the Project. Oil-bearing deposits essentially extend up to the ground surface along Wilshire Boulevard in the area of the La Brea Tar Pits, which is part of Section 1. The tunnel in the La Brea Tar Pits area will be excavated through ground containing close to 100 percent (1,000,000 ppm) methane gas and up to approximately 0.65 percent (6,500 ppm) hydrogen sulfide gas.

In contrast to Section 1, the oil-bearing deposits in Section 2 of the Project, including the area of the BHHS campus, are located 2,000 feet or more below the ground surface, much deeper than the planned tunnels and station. Based on the soil boring data collected for Section 2 of the Project by Metro and others (see Section 4.3 and Appendix B of this Draft SEIS for more details regarding the subsurface gas investigations performed), elevated concentrations and volumes of methane or hydrogen sulfide gas are not present along Section 2 of the Project between Stanley Drive (west of the Wilshire/La Cienega Station) and the City of Los Angeles/City of Beverly Hills boundary (east of the Century City Constellation Station), which is the majority of the Section 2

alignment. The highest concentration of methane measured along this stretch of Section 2 was 0.1 percent (1,000 ppm). The highest concentration of hydrogen sulfide measured in the ground along this stretch of Section 2 was 0.0002 percent (2 ppm). At BHHS, elevated levels of methane gas (above explosive limits) have not been identified at any locations outside of the upper field basketball court area and the southeast corner of the northern parking lot.

On the far eastern end of the Section 2 alignment (east of Stanley Drive), the highest concentration of methane measured in the ground is 6.3 percent (63,000 ppm), which is considered slightly elevated, and the highest concentration of hydrogen sulfide was 0.0004 percent (4 ppm), which is not considered elevated.

On the far western end of the Section 2 alignment (west of the City of Los Angeles/City of Beverly Hills boundary), the highest concentration of methane measured in the ground was 98.6 percent (986,000 ppm) and the highest concentration of hydrogen sulfide measured in the ground west of the City of Los Angeles/City of Beverly Hills boundary was 0.0330 percent (330 ppm), both considered elevated.

Refer to Figure 4-16 through Figure 4-19 in Section 4.3 of this Draft SEIS for maps showing the measured methane and hydrogen sulfide levels at points along the Section 2 alignment.

Subsurface Gas and Oil Wells

Construction-related Environmental Impacts/Environmental Consequences

The risks associated with the operation of Section 2 of the Project are evaluated in Section 4.3 of this Draft SEIS. The risks presented by tunneling through subsurface gas and near oil wells are evaluated for four categories:

- Risk of gas migration through soil and accumulation at the surface and in buildings
- Risk of an explosion due to the accumulation of gas at the surface and in buildings
- Risk of accumulation of gas in tunnels and risk to construction workers
- Risk of encountering abandoned oil wells

The removal of the double crossover at the Wilshire/Rodeo Station would not substantially alter the construction approach at this station or the risk related subsurface gas; therefore, it is not discussed specifically in this section.

Risk of Gas Migration through Soil and Accumulation at the Surface and in Buildings

The potential for subsurface gases to migrate is related to the pressure and concentration of those gases (documented under existing conditions) as well as to the soil and groundwater conditions. Along Section 2, tunneling will take place through either saturated or unsaturated soils (above and below the groundwater level). The risks of gas migration associated with each of these soil types is described in the following paragraphs. Refer to the Overview of Construction Activities provided in Section 4.4 of this Draft SEIS for a description of tunneling methods.

In saturated soils (below the groundwater table), the pores between soil grains are filled with groundwater (Figure 4-34). When a TBM cutting head moves through a soil, the groundwater pressures in saturated soils can temporarily increase in the vicinity of the

TBM. This increase in pressure is controlled and limited through operation and continuous monitoring of the TBM. The increase is greatest at the location of the TBM cutting head and dissipates rapidly as the distance from the TBM increases. The TBM operation is designed to balance the existing soil and groundwater pressure so that it does not add or remove soil or groundwater outside of the machine as part of tunneling. Monitoring of the pressure within the TBM cutting head chamber and pressures above and around the shield provides confirmation that the balanced condition is maintained. After the TBM has passed, the pressures in the ground return to pre-tunneling levels.

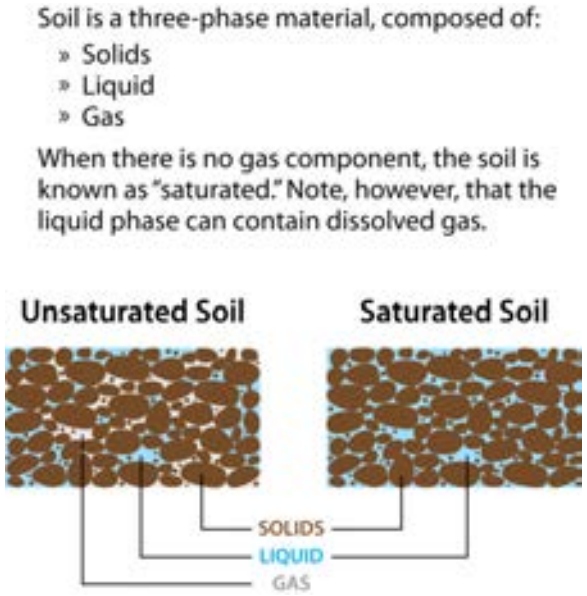


Figure 4-34. Saturated and Unsaturated Soils

The temporary pressure increase that occurs in saturated soils (when tunneling through saturated soils) will not affect soil gas below the groundwater table since soil gas is not present because the soils are saturated with water. A rise in the surface of the groundwater table above the TBM could provide a potential for pressurization or displacement of soil gas above the groundwater table to exist. However, the proposed tunneling procedures, by design, will not alter the level of the groundwater table. It should also be noted that fluctuations in groundwater levels and related movement of soil gases above the groundwater table occur naturally due to seasonal or cyclical rises and drops in groundwater. As with the pressures around the TBM, instrumentation will be installed to monitor groundwater pressures prior to, and during, tunneling operations. Therefore, the act of tunneling will not have an impact on the groundwater table and resulting potential changes in gas pressures/concentrations above the groundwater table.

Unsaturated soils have a combination of water and gas in the pores (Figure 4-34). The gases in the pores contain constituents found in the air, and in some cases, could also include methane and/or hydrogen sulfide as discussed above. The gas contained within the pore space of unsaturated soils is compressible. As a result, for unsaturated soils through which some of the tunneling will occur, the incremental pressure produced by the TBM will not propagate outward in the same way it can with saturated soils.

A simple analogy involves the propagation of a wave. A wave can be created by a disturbance or pressure pulse in a body of water. Because of the incompressibility of water, the wave can propagate outward radially a significant distance from the point

where it was created. The same mechanism does not occur with compressible fluids such as soil gases. The compressibility of gas limits its outward propagation.

The "fluid" that is maintained at the TBM cutting head would have to flow into and through the soil pore space in order to displace and potentially pressurize any soil gas that is present. That fluid consists of the soil that is excavated from the tunnel bore and mixed with additives (surfactants) to make it less abrasive and a more uniform consistency. Due to the nature and consistency of that fluid, it will not flow through the types of soil deposits that are present along the alignment (silty sand, silts, and clays). As such, there is not a mechanism by which measurable displacement of soil gases could occur away from the TBM with the proposed tunneling method.

During excavation of the tunnel, water and gas are prevented from traveling along the sides of the tunnel by pressure grouting around the tunnel. Grout is pressure injected around the tunnel through the tail of the tunneling shield as it advances. This is done not only to minimize surface settlement but also to provide continuous support of the segmental tunnel lining and to reduce the flow of water and gas along the contact between the tunnel and the ground. Grout pressures and the volumes injected are monitored during each advance of the tunnel shield, and a continuous digital record is obtained for immediate viewing by the contractor's engineers and operators and for review and evaluation. In addition, if necessary, a program of check grouting is carried out to test for grout placement around the lining after the grout is in place.

Questions have been raised about the potential movement of gases through "preferential pathways" such as faults or fissures in the ground. The geologic materials above the planned depth of excavation along Section 2 of the Project have been evaluated through investigations utilizing trenches, borings, and geophysical testing procedures. There are two types of ground in a general sense: rock or soil. Faults/fractures in rock can provide a preferential pathway for fluids (liquids or gases) to flow through the rock, because those faults/fractures can be "open" to some extent. In soils, faults do not generally represent an "open" preferential pathway for fluid flow because most fractures in soil in a relatively stable earth environment, such as along Section 2 of the Project, are flush or have been infilled with soil eroding from above (instability resulting in open fractures in soil could be present in locations with landsliding, which is not present along Section 2 of the Project). Indeed, the investigations performed in the vicinity of the tunnel found some faults within soils, but no open fissures/fractures were present in the soil that would present a preferential flow path for gases; all existing faults and other contacts between dissimilar earth materials have been found to be flush and tight or filled with soil rather than open. For example, in fault trench FT-2 by Leighton Consulting, Inc. (LCI, 2012a), "Several clay filled fractures or cracks were documented…" Similarly, in fault trench FT-3, two zones of minor faulting were encountered, but the faults and fractures were found to be infilled with soil (and not open) (LCI, 2012a). Also, in fault trench FT-4, "several clay filled fractures were observed" rather than being open fractures. This is consistent with what would be anticipated for the types of alluvial materials that are present along the Section 2 Project alignment. An example of a fault encountered in a trench excavation at BHHS is shown below in Figure 4-35(a), and a photograph of the Newport-Inglewood Fault encountered at

Los Angeles Southwest College is shown in Figure 4-35(b). These are examples of the closed, tight nature of faults encountered in similar geologic materials as to those along the entire Project Alignment at tunnel depths. In conclusion, these closed faults do not provide a preferential path for movement of soil gases in the subsurface because these closed faults do not represent an open vertical path along which gases could preferentially move.

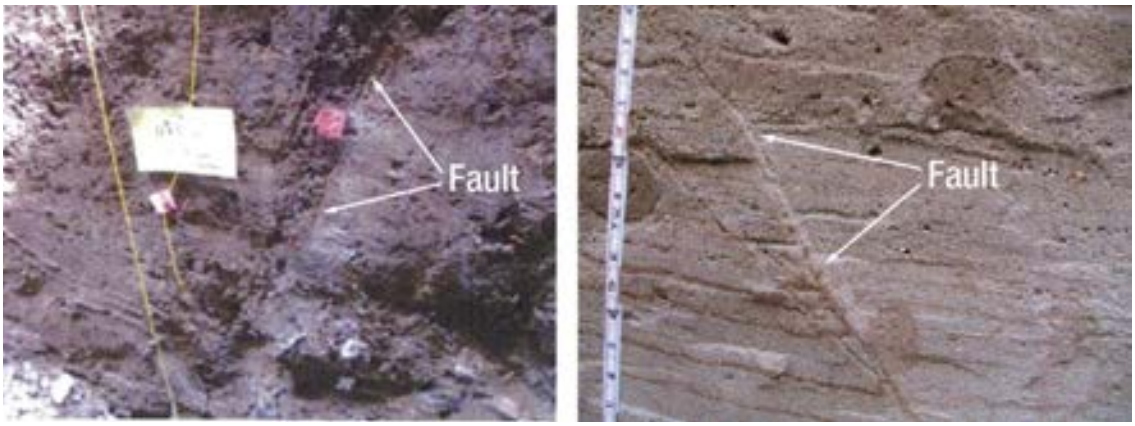


Figure 4-35. Photographs of faults encountered in trench explorations (a) at BHHS (LCI, 2012a), and (b) Newport-Inglewood Fault at Los Angeles Southwest College (Mactec, 2007)

In addition, the stratigraphy along the BHHS campus consists of horizontal layers of fine-grained (such as clay) alluvial deposits and layers of coarse-grained (such as sand) alluvial deposits, as shown in Figure 4-36 The layers of fine-grained material prevent rapid movement of gases vertically through the ground. Therefore, with the tunneling methods, proposed, no additional vertical pathways of gas travel are introduced.

Considering all of the above, even with no nearby tunneling activities, when sufficient concentrations of gases are present in the subsurface, the potential exists for those gases to accumulate at the surface and below, and possibly enter, buildings. The risk increases if the gas pressures are higher than atmospheric pressure.

Testing has been done to document the concentrations and pressures of subsurface gas along the Section 2 alignment. The data is presented in the *Geotechnical Baseline Report (*Metro 2015d) the *Section 2 Addendum to the Final Environmental Report* (Metro 2015e), and the *Geotechnical Data Report - Tunnel Reaches 4 and 5* (Metro 2016h). As summarized in the existing conditions above, the data indicates that elevated concentrations and volumes of methane and hydrogen sulfide gas are not present along Section 2 of the Project between Stanley Drive (west of the Wilshire/La Cienega Station) and the City of Los Angeles/City of Beverly Hills boundary (east of the Century City Constellation Station). Elevated levels of methane gas are present at the far eastern portion of the Section 2 alignment (east of Stanley Drive) and elevated levels of methane and hydrogen sulfide gas are present within the immediate area of the Century City Constellation Station (west of the City of Los Angeles/City of Beverly Hills boundary).

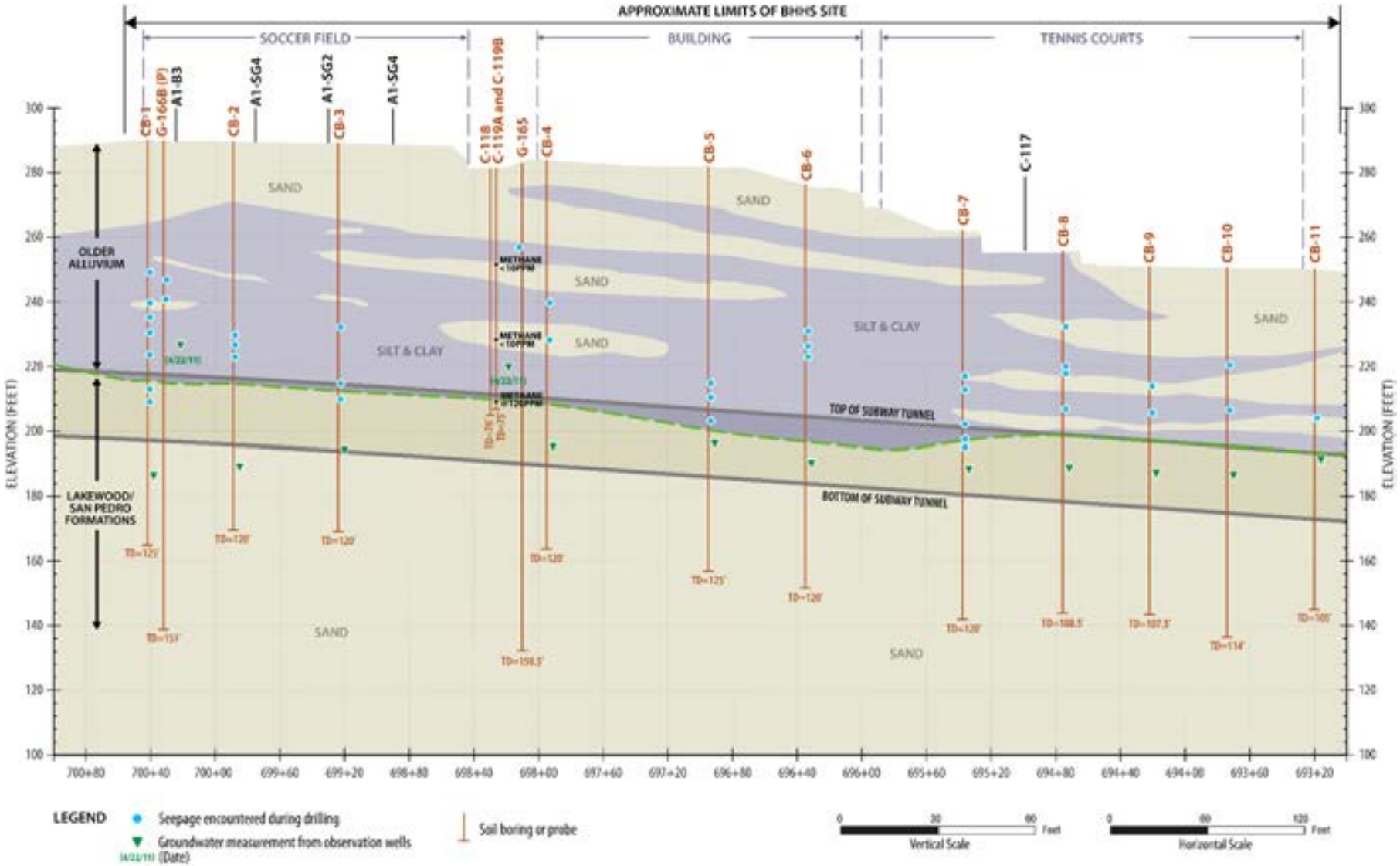


Figure 4-36. Stratigraphic Cross Section along Proposed Tunnel Alignment beneath BHHS and Vicinity

Given the non-elevated subsurface gas concentrations and pressures along most of the Section 2 alignment, the current level risk for additional subsurface gases to migrate to buildings or to emit from the ground surface is low along most of the Section 2 alignment. Gas that enters the atmosphere dilutes rapidly. There is a higher risk of gas migrating to buildings or off-gassing (emitting) from the ground surface west of the City of Los Angeles/City of Beverly Hill boundary or east of Stanley Drive.

However, the *incremental* risk that the proposed tunneling activities could cause subsurface gas to migrate to buildings, or to off-gas from the ground surface, is negligible. This is due to the absence of elevated levels of methane and hydrogen sulfide gas along the majority of the alignment (measured both at tunnel depth and in shallower materials), coupled with the absence of a viable mechanism by which the proposed tunneling activities could cause pressurization and/or migration of subsurface gas the distance to the ground surface. In addition, there are no evident "preferential paths" for migration of gases to the surface in the soils at tunnel depth and above along the alignment. Because of the absence of a viable mechanism for tunneling activities to cause migration of subsurface gas to the surface, and because of the lack of preferential vertical paths of gas to the ground surface, even in areas with elevated soil gas levels at depth, the incremental risk of increased gases at the surface due to tunneling activities is negligible. Since the incremental risk is negligible, there is no adverse effect related to migration of subsurface gas during tunneling activities.

Risk of Explosion due to Accumulation of Gas at the Surface and in Buildings

The risk of gas accumulation in and below structures exists in all areas of the Los Angeles basin where gas occurs in the ground. Where gas accumulates at a concentration above the lower explosive limit, there is a risk of explosion in confined spaces (not in soil), if sufficient oxygen is present and if there is a source of ignition. Although the existing risk of an explosion due to build-up of methane and hydrogen sulfide gas along most of the Section 2 alignment is low, the result of such an explosion, if it were to occur, would be severe. Since the incremental risk of the tunnel construction to cause subsurface gas to migrate to buildings or off-gas from the ground surface is negligible, so too is the incremental risk of an explosion. Since the incremental risk of an explosion is negligible, there is no adverse effect related to explosion risk during tunneling activities.

Since this pre-existing risk to buildings is present in areas of the Los Angeles basin where methane levels are elevated, the City of Los Angeles has acknowledged the risk by implementing measures for permitting of design and construction of structures in City of Los Angeles Methane Zone or Methane Buffer Zones, and Metro has implemented measures during design, construction, and operation of their facilities throughout Los Angeles County where existing subsurface gases are encountered. Similarly, the City of Beverly Hills has implemented the provisions of the California Building Code (as part of the Beverly Hills Building Code) that require the geotechnical report for a project "specify whether methane exists on site" and includes "results of the testing procedure and the proposed mitigation measures."

Gas wells were installed along the alignment during the geotechnical investigations. Additional multi-stage (varying depths) soil gas wells (or probes) will be installed along the alignment in areas where elevated gas has been detected. The probes will be monitored for methane, hydrogen sulfide, oxygen, and carbon dioxide before, during, and after tunneling. In addition, in areas where elevated gas levels have been detected and in the vicinity of known oil wells, ambient air monitoring will be performed at the ground surface to screen for indications of soil gas emissions. This may be done daily during the tunneling operation and less frequently before and after tunneling.

If gas probes or ambient air monitoring indicate significant deviations from the pre-construction levels, combustible gas monitoring will be conducted in the interior of the closest building(s). In the highly unlikely event that elevated gas levels are found—and persist—the affected building(s) will be ventilated to reduce the gas levels.

Risk of Accumulation of Gas in Tunnels and Risk to Construction Workers

Since the western end of Section 2 of the Project (west of the City of Los Angeles/City of Beverly Hills boundary) and the eastern end of Section 2 of the Project (east of Stanley Drive) are located in ground that is known to contain elevated methane and/or hydrogen sulfide, the potentially explosive or otherwise harmful gases could be encountered during the excavation of the tunnels and station boxes. This condition represents a potential exposure risk to workers in the tunnels and stations.

The combination of the proposed tunneling method, the proposed monitoring and ventilation, and the treatment of gases in the tunnel and station excavation, reduces the risk of exposure of workers to soil gases. These procedures are described below:

- **Tunneling Equipment and Protocol:** A pressure face tunnel mining system will be used, as described in Section 4.4 of this Draft SEIS. This technology is a considerable improvement over the methods used during construction of Metro's initial Red Line operating segments, and was used successfully for the Metro Gold Line Eastside Extension Project. It is currently being used for the Metro Crenshaw/LAX Line and the Metro Regional Connector Line tunnels, both under construction. New technologies developed over the course of the design phases also will be considered. Appendix E of the Final EIS/EIR presents additional information on tunneling technology, and the *Westside Subway Extension Century City Area Tunneling Safety Report* (Metro 2011d) contains additional information on tunneling in gassy conditions and areas with suspected oil well casings.
- **Detection and monitoring:** Detection and monitoring equipment will be required to warn of the presence of methane and/or hydrogen sulfide in the excavations. Once excavation has been completed, Metro will continue to monitor for gases within the completed tunnel and stations. Exposing new ground for construction of cross-passageways, shafts, and other structures could also expose workers to potentially hazardous gases, and monitoring will continue as these other types of structures are excavated. Monitoring will alert personnel working in the tunnel and station excavations to enhance ventilation, don personal protective equipment, suspend excavation activities, and if warranted, temporarily evacuate the excavation.

- **Ventilation:** Fans will provide air movement to dilute methane and hydrogen sulfide concentrations in the tunnels and stations. Toxic gases such as hydrogen sulfide emanating from a slurry treatment plant (if used), will be captured and treated (absorbed and/or neutralized). Once above ground, methane rises and dissipates rapidly in the atmosphere and will not be a public health hazard.
- **Treatment of Exhaust Air:** Air scrubbers will be specified to treat hydrogen sulfide to meet Air Quality Management District standards before release from the tunnel/station ventilation system.

Furthermore, for underground construction classified as "Gassy" by the State of California Division of Occupational Safety and Health (Cal/OSHA) (California Code of Regulations, Title 8, Tunnel Safety Orders), specific requirements will include compliance with the following Tunnel Safety Orders:

- All equipment used in the tunnel must be approved. For example, internal combustion engines and other equipment such as lighting must meet approval standards of the U.S. Mine Safety and Health Administration. These approvals require verification that equipment is safe with respect to not producing sparks or emitting gas into the tunnel.
- Smoking will not be allowed in the tunnel, nor is standard welding, cutting, or other spark-producing operations, in accordance with Cal/OSHA requirements. Special permits and additional air monitoring will be required if welding or cutting operations are essential for the work. In addition, welding will only be allowed in stable atmospheres containing less than 10 percent of the lower explosive limit and under the direct supervision of qualified personnel.
- A fixed system of continuous automatic monitoring equipment will be provided for the heading (working area of the tunnel), spoils handling transfer points, and return air sources. The monitors will be equipped with sensors situated so as to detect any anticipated gas to be encountered. Monitors will automatically signal the heading, give visual and audible warnings, and shut down electric power in the tunnel—except for acceptable ventilation, lighting, and pumping equipment necessary to evacuate personnel, when 20 percent or more of the lower explosive limit is encountered. In addition, a manual shut down control will be provided near the heading.
- Tests for flammable and hazardous gas and petroleum vapors will be conducted in the return air and measured a short distance from the working surfaces.
- Whenever gas levels in excess of 10 percent of the lower explosive limit are encountered, Cal/OSHA will be notified immediately. After the approval to proceed by Cal/OSHA, any work will then be conducted with required precautionary measures such as increased ventilation.
- The main ventilation systems must exhaust flammable gas or vapors from the tunnel, will be provided with explosion-relief mechanisms, and will be constructed of fire-resistant materials. This exhaust requirement means that only rigid fan lines (as opposed to flexible) and two-way fan systems that operate in both directions by blowing exhaust out from the tunnel and blowing air in to the tunnel could be used

in gassy tunnels. The tunnel (and stations) must have adequate ventilation to dilute gases to safe levels.

- 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 (typically pre-fabricated) will be equipped with a compressed air supply, a telephone, and means of isolating the chamber from the tunnel atmosphere. The emergency equipment, air supply, and rescue chamber installation will be acceptable to Cal/OSHA.

Special health and safety training and procedures will be implemented due to the health and safety issues associated with tunneling through a zone known to have elevated methane, hydrogen sulfide, and oil seeps. These procedures may require basic Hazardous Waste and Emergency Response training (29 CFR 1926 Subpart M), as well as training for excavations in a hazardous atmosphere (29 CFR 1926 Subpart P).

Previous projects in the Methane Risk Zone, for example, Metro's Red Line tunnels, have been successfully and safely excavated using procedures similar to those proposed for the Project alignment.

Multiple underground parking garages, such as the Century City Theme Towers parking facility adjacent to the Century City Constellation Station, the Century Plaza Hotel parking basement, and the Westfield Shopping Center basement, have been constructed in the vicinity of Section 2 of the Project alignment.

Numerous basements and underground parking structures have also been constructed along Wilshire Boulevard in areas with elevated subsurface gas levels without incident. Most of those underground structures were constructed before 1986 with no mitigation measures specific to methane, or have basic measures consisting of ventilation. In contract, the Project will have extensive gas barriers and gas monitoring and ventilation measures. Some of the buildings along Wilshire Boulevard adjacent to the Project alignment, such as buildings at the Los Angeles County Museum of Art, are in close proximity to the La Brea Tar Pits.

In addition, in 2013-2014, Metro constructed a 75-foot-deep exploratory shaft in an area where high concentrations of subsurface gas were present, to evaluate construction procedures and potential rates of gas emission from the excavation. This exploratory shaft was advanced through tar-saturated gassy ground in the Wilshire/Fairfax area. The test excavation and the ongoing work along Section 1 of the Project have confirmed the suitability of the excavation, monitoring, and mitigation measures that were proposed for the Project in the Final EIS/EIR.

A number of other tunnels have been safely constructed in the Los Angeles Basin as described in the *Century City Area Tunneling Safety Report* (Metro 2011d). With implementation of similar monitoring, ventilation, and treatment construction measures along Section 2 of the Project as are currently being used in Section 1 of the Project (including the Wilshire/Fairfax Station) (discussed under mitigation), the impact on worker safety will be mitigated.

With the implementation of the proposed tunneling techniques, the risk to construction workers is low and presents no adverse effect.

Risks of Encountering Abandoned Oil Wells

The locations of abandoned oil wells, including the six identified abandoned oil wells on the BHHS property, have been evaluated based upon State Department of Oil, Gas and Geothermal Resources (DOGGR) records, historic aerial photographs Figure 4-37, and geophysical (magnetometer) surveys to identify more precisely the location of metal casings. Based upon this information, the closest known abandoned oil well at the BHHS site is believed to be approximately 35 feet from the proposed alignment. In addition, an abandoned well may be located near the tunnel alignment near Century Park East. Finally, several former wells have been identified near the Century City Constellation Station. Apart from these wells, the likelihood of encountering a well along Section 2 is low. Nevertheless, as described below, additional precautionary measures are proposed to screen for wells along the alignment before and during the proposed tunneling activities.

Figure 4-37. Historic Photo of Oil Wells in Century City Area

Such measures include performing a supplemental geophysical survey along the proposed tunnel alignment prior to construction in the areas of known oil production and mapped wells. This survey will incorporate ground-penetrating radar and/or electromagnetic testing procedures to screen for oil wells and other subsurface improvements along the tunnel. If any anomalies are detected, shallow excavations will be made to expose and observe such anomalies. Other planned techniques include horizontal directional drilling with magnetometers used to detect metal casings. Procedures for handling abandoned oil wells are further described below and in the *Century City Area Tunneling Safety Report* (Metro 2011d).

Questions have been asked about the potential for vibration due to the TBM to cause damage to existing oil wells. The peak acceleration estimated to be experienced in the ground at a distance of 25 feet from the tunnel during tunneling operations is 0.015g (where 1g is the acceleration due to gravity, equal to 32.2 feet per second squared). For comparison, the recorded peak ground acceleration (PGA) from the California Strong

Motion Instrumentation Program (CSMIP) at the Century City North (CCN) station during the 1994 Northridge Earthquake was 0.26g. This was the closest ground recording to Beverly Hills High School from the Northridge Earthquake. Acceleration of 0.26g due to the earthquake is more than an order of magnitude (over a factor of 10) greater than anticipated ground shaking due to tunneling. Therefore, the tunneling vibration does not present additional risk of damage to existing oil wells. Never-the-less, monitoring will be conducted during tunnel operations to identify changes in gas levels.

Procedures for Handling Abandoned Oil Wells

Oil wells typically have a larger diameter steel "surface" casing that extends from just below the ground surface to a depth of 100 feet or more, with one or more smaller-diameter steel casings located inside that surface casing. When the wells are abandoned, DOGGR requires that the casings be filled with a series of cement plugs along their lengths. The upper cement plug that is provided at the ground surface must be at least 25 feet in length but typically extends to depths of 100 to 200 feet. If the TBM were to encounter an oil well at the proposed tunnel depths, it would likely do so within the surface casing interval. The steel casings and associated cement plugs could damage the TBM cutting head, resulting in the need for repairs and associated project delays. The cutting head could also significantly damage the well casing(s). However, because of the depth of the tunnel (on the order of tens of feet) would be relatively shallow compared to the depth of the wells and the production zone (on the order of thousands of feet), the presence of multiple largely redundant plugs within the well casings, and the depth of soil cover over the top of the tunnels (on the order of tens of feet), it is highly unlikely the damage would result in the release of combustible gas from the damaged casing reaching the surface. This is because the path of least resistance for gas under pressure would be for the gas to enter the TBM chamber rather than move through the tens of feet of soil cover. If gas enters the TBM pressure chamber and mucking system, it would be detected by the existing TBM instrumentation. If sufficient quantity were detected, tunneling operations would cease so that gas entering the tunnel could be controlled.

If an abandoned well is found and access to the top of the well is available at the ground surface, then the well can be re-abandoned after removing the portion of steel casing at the tunnel depth. The work to remove the casings and re-abandonment would be performed by specialty contractors from the surface via a borehole or small-diameter shaft drilled down to below the invert of the proposed tunnel. The re-abandonment of abandoned oil wells in tunnels is described in the *Century City Area Tunneling Safety Report* (Metro 2011d).

If an abandoned well is found that would obstruct tunnel excavation and access to the top of the well is not available at the ground surface (i.e., the well is located under a structure), several options exist. Depending on the well's location with respect to the tunnel, it first would be determined whether it is possible to adjust the tunnel alignment to avoid the abandoned well. This is feasible if the well is very near the side of the tunnel. Second, it would have to be determined if altering the alignment is feasible with respect to constructability issues and operation of the system. If this is not possible, then the steel casings would have to be removed.

To remove steel casings at depth without access from the surface, access would be required from underground at tunnel depth. Options for such access include from within the tunnel that encountered the abandoned well or from the parallel tunnel. The procedures for removal of the steel casings and abandonment of the well at depth are detailed in the *Century City Area Tunneling Safety Report* (Metro 2011b). Access procedures are described below:

- **Access from within the tunnel that is in the way of the casing:** To remove the casing from within the tunnel being excavated, access would be required in front of the TBM's face or cutterhead. Depending on ground and groundwater conditions, ground treatment, such as grouting, would be required in the area around the well to provide safe, stable ground conditions in front of the TBM free of excessive groundwater. The ground treatment could be performed from within the TBM, such that surface access is not required, or in some cases using angled grout holes from the surface to reach the area to be stabilized with grout. Metro specifications for TBMs require that grouting of the ground can be done from the TBM.
- **Access from the parallel TBM:** To access the casing from the other tunnel drive, an adit (small tunnel) could be mined from the parallel tunnel to the location of the abandoned oil well before the tunnel that would encounter the oil well was driven. The construction of the adit would be similar to that of the construction of a standard cross passage between tunnels and would likely be constructed using the Sequential Excavation Methods with ground treatment performed from within the excavation to control ground and groundwater. Depending on ground conditions (i.e., sufficient ground water), ground freezing methods also could be considered to stabilize the ground.

Although a release of combustible gas through this mechanism is unlikely, it is possible. If a casing were damaged by the TBM and that well contained gas under pressure, some amount of methane and/or hydrogen sulfide gas could be released into the tunnel working area as well as to the ground surface through the well casing as stated above. The risk of such an event occurring is low and therefore no adverse effect.

As presented in the Final EIS/EIR, mitigation measures are proposed to further reduce the risk. The measures taken include a detailed review of DOGGR records and historical aerial photographs to identify potential oil well locations, geophysical testing to screen for potential oil wells along the proposed alignment.

40 CFR Analysis

In response to the Final Decision's requirement for a more thorough discussion of the completeness of the evaluation of subsurface gas risk during tunneling, this section has been prepared in compliance with 40 CFR § 1502.22(b), which states:

> *(b) If the information relevant to reasonably foreseeable significant adverse impacts cannot be obtained because the overall costs of obtaining it are exorbitant or the means to obtain it are not known, the agency shall include within the environmental impact statement: (1) A statement that such information is incomplete or unavailable; (2) a statement of the relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment;*

(3) a summary of existing credible scientific evidence which is relevant to evaluating the reasonably foreseeable significant adverse impacts on the human environment, 4) the agency's evaluation of such impacts based upon theoretical approaches or research methods generally accepted in the scientific community. For the purposes of this section, "reasonably foreseeable" includes impacts which have catastrophic consequences, even if their probability of occurrence is low, provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason.

Based on the evaluation described in Section 4.5.5, this analysis was prepared in reference 40 CFR § 1502.22(b) as follows:

(1) A statement that such information is incomplete or unavailable:
The available data is considered to be sufficient to both characterize and mitigate risks associated with the proposed tunneling construction. Investigations of soil gas conditions are designed to provide an understanding of the likelihood for encountering methane and hydrogen sulfide during construction of the Project, and are based on:

- Geologic and regulatory maps regarding soil gas.
- Existing data related to conditions that are commonly associated with the presence of methane and hydrogen sulfide, such as oil production, naturally occurring near-surface petroleum, and landfills or other organic matter.
- An exploration program in areas thought to potentially include methane that usually include a reasonable number of borings drilled to the depths of interest, with both in-situ testing (testing within the ground as opposed to testing on a sample removed from the ground) of methane/hydrogen sulfide and installation of monitoring wells for sampling of gas and continued observation of soil gas over time. The completeness of the investigation is assessed by standard of practice, guidelines that include the exploration techniques specified by City of Los Angeles' methane evaluation requirements, and the professional judgment of Licensed Geologists and/or Engineers practicing Geotechnical Engineering.

A complete knowledge of the existing subsurface gas conditions is not possible to assess based on a finite number of explorations because of the intrinsic variability of soil gas within earth materials. Nevertheless, if explorations in an area show similar soil gas measurements, then the likelihood of anomalously high soil gas between explorations is related to the distance between explorations and the understanding of the subsurface conditions that could produce methane/hydrogen sulfide in that area. Extensive exploration and testing has been performed along the proposed tunnel alignment such that the subsurface conditions have been characterized sufficiently to identify and mitigate potential hazards. This data includes at least 82 exploratory borings along with 18 soil gas and/or groundwater monitoring wells (in addition to many other wells performed on the BHHS campus by others) and thousands of soil gas measurements over a multi-year period. The subsurface data that has been compiled along the Section 2 alignment is presented in Section 4.3 of this Draft SEIS.

Regarding the potential presence of oil wells along the tunnel alignment, it is not possible to completely eliminate the potential for the presence of an existing oil well. However, extensive research into oil well records and historical documentation and photography has been performed, geophysical testing has been performed near each suspected oil well location (including consideration of uncertainty in the mapped locations, which could be as much as 200 feet off of the actual locations), and additional testing of the subsurface at tunnel depth has been required to be performed by the construction contractor. Evidence for the existence of unknown oil wells directly along the tunnel alignment has not been uncovered. See section entitled "Risk of Encountering Abandoned Oil Wells" on page 4-125 for a further description of the evaluations performed along the alignment. Therefore, the combined research and testing performed to date and required to be performed is sufficient to identify and characterize the risk of encountering existing abandoned oil wells.

(2) A statement of the relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment:
As described above, although it is not possible to obtain complete knowledge of the existing subsurface gas conditions, the available data is believed to be sufficient to both characterize and mitigate risks associated with the proposed tunneling construction. Nevertheless, the relevance of further explorations would be to provide further information about variation in soil gas in the ground. As a precautionary measure, additional data will be collected, and mitigation measures will be undertaken, as set forth in this document.

(3) A summary of existing credible scientific evidence which is relevant to evaluating the reasonably foreseeable significant adverse impacts on the human environment:
The existing credible scientific evidence includes the extensive subsurface stratgraphic, soil gas, groundwater, and a geophysical data that has been compiled for the Section 2 alignment along with the DOGGR and historic aerial photographic records pertaining to oil well locations. These data are summarized in Section 4.3.1 of this Draft SEIS and are based, in part, on subsurface gas investigations performed by Metro for Section 2 of the Project and by subsurface gas investigations performed by others on the BHHS campus. Refer to Section 4.3.1, including Figure 4-18, for a summary of soil gas readings obtained in the western portion of Section 2 of the Project.

(4) The agency's evaluation of such impacts based upon theoretical approaches or research methods generally accepted in the scientific community:
Analysis of the available data indicates the risk for tunneling construction to cause explosive or toxic gases to enter buildings or to be emitted from the ground surface is low – except for a scenario where an unknown and improperly abandoned oil well is encountered during tunneling. This scenario is considered to be highly unlikely based on the data evaluated to date. A further discussion is provided in the

Assessment of Tunneling and Station Excavation Risks Associated with Subsurface Gas along Section 2–Revision 1 (Metro, 2017b).

Mitigation Measures

Existing soil gas conditions in Section 2 of the Project (with the exception of west of the City of Los Angeles/City of Beverly Hills boundary and east of Stanley Drive) are not considered "elevated," and therefore the risk of encountering methane or hydrogen sulfide associated with the proposed Section 2 tunneling is low and there is no adverse effect related to tunneling activities. In the areas with existing elevated levels of methane and/or hydrogen sulfide, there is negligible incremental risk for migration of these gases to the ground surface or into buildings due to tunneling activities. Nevertheless, monitoring and mitigation measures were proposed in the Final EIS/EIR to further evaluate and reduce the risk of methane or hydrogen sulfide entering buildings and the risk due to the presence of unknown oil wells.

Based on the further analysis on the risk associated with the potential presence of subsurface gas during tunneling presented in this Draft SEIS, the construction period subsurface gas impacts would remain no adverse effect with implementation of the following mitigation measures, as specified in Section 4.15 of the Final EIS/EIR. CON-8, CON-51, and CON-54 will mitigate risk to workers in the tunnel, and CON-53 will mitigate risk to both structures at the surface and workers in the tunnel.

- **CON-8—Monitoring and Recording of Air Quality at Worksites:** Monitoring and recording of air quality at the worksites will be conducted. In areas of gassy soil conditions (Wilshire/La Brea and Wilshire/Fairfax work sites), air quality will be continuously monitored and recorded. Construction will be altered as required to maintain a safe working atmosphere. The working environment will be kept in compliance with Federal, State, and local regulations, including SCAQMD and Cal/OSHA standards.
- **CON 51—Techniques to Lower the Risk of Exposure to Hydrogen Sulfide:** The primary method for reducing exposure to subsurface gases is dilution through the ventilation system. In areas where hydrogen sulfide is encountered, several additional techniques could be used to lower the risk of exposure. The primary measures to prevent exposure to hydrogen sulfide gas are separation of materials from the tunnel environment through use of enclosed tunneling systems such as pressurized-face TBMs and increased ventilation capacity to dilute gases to safe levels as defined by Cal/OSHA. Secondary measures could include pre-treatment of groundwater containing hydrogen sulfide by displacing and oxidation of the hydrogen sulfide by injecting water (possibly containing dilute hydrogen peroxide) into the ground and groundwater in advance of the tunnel excavation. This "in-situ oxidation" method reduces hydrogen sulfide 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 at tunnel-to-station connections or at cross-passage excavation areas and where open excavation and limited dewatering may be conducted, such as for emergency exit shafts and low-point sump excavations.

When needed to reduce hydrogen sulfide to safe levels for slurry treatment; additives could be mixed with the bentonite (clay) slurry during the tunneling and/or prior to discharge into the slurry separation plant. For example, zinc oxide could be added to the slurry as a "scavenger" to precipitate dissolved hydrogen sulfide when slurry hydrogen sulfide levels get too high. Gas levels will be maintained in accordance with Cal/OSHA requirements for a safe working environment.

- **CON-53—Oil Well Locations and Abandonment:** Pre-construction geophysical surveys will be conducted to detect oil wells should unknown wells be present along the tunnel alignment. Detection of oil wells will include use of magnetic devices to sense oil well casings within the tunnel alignment. It is anticipated that the geophysical survey will be performed along the proposed tunnel alignment prior to construction in the areas of known oil production and mapped wells. This survey will incorporate techniques such as ground-penetrating radar and electromagnetic testing procedures to screen for oil well casings and other subsurface obstructions along the tunnel. These methods could be initiated from the ground surface, in horizontal holes drilled using horizontal directional drilling techniques, or a combination of methods. Shallow excavations may be made to expose and observe anomalies that are detected.

  Where the tunnel alignment cannot be adjusted to avoid well casings, the California Department of Conservation (Department of Oil, Gas and Geothermal Resources) will be contacted to determine the appropriate method to re-abandon the well. Oil well abandonment must proceed in accordance with California Laws for Conservation of Petroleum and Gas (1997), Division 3. Oil and gas, Chapter 1. Oil and Gas Conservation, Article 4, Sections 3228, 3229, 3230, and 3232. The requirements include written notification to DOGGR, protection of adjacent property, and before commencing any work to abandon any well, obtaining approval by the DOGGR. Abandonment work, including sealing off oil/gas bearing units, pressure grouting, etc., must be performed by a state-licensed contractor under the regulatory oversight and approval of DOGGR. Similarly, during construction if an unknown well is encountered, the contractor will notify Metro, Cal/OSHA, and Oil, Gas and Geothermal Resources for well abandonment, and proceed in accordance with state requirements.

- **CON-54—Worker Safety for Gassy Tunnels:** Although not specifically required for gassy tunnels, workers will be supplied with oxygen-supply-type self-rescuers (a breathing apparatus required for safety during evacuation of fires).
- **CON-89 – Gas Monitoring – Assessment:** Gas wells were installed along the alignment during the preliminary geotechnical investigations. Additional multi-stage (varying depths) soil gas wells (or probes) will be installed along the alignment in areas where elevated gas has been detected. The probes will be monitored for methane, hydrogen sulfide, oxygen, and carbon dioxide before, during, and after tunneling. Ambient air monitoring will also be performed at the ground surface to screen for indications of soil gas emissions. While elevated gas levels have not been detected at Beverly Hills High School, monitoring will be conducted in response to

concerns from the school district. Monitoring will be conducted daily during the tunneling operation beneath Beverly Hills High School and less frequently before and after tunneling. Any instance where methane is detected at or above a concentration of 5,500 ppm (10 percent LEL) or hydrogen sulfide is detected at or above a concentration of 20 ppm (OSHA PEL) in a soil probe (5 feet below the ground surface) will be investigated. Where these levels are exceeded, combustible gas monitoring will be performed in the interior of the closest building. In the unlikely event that elevated gas levels are found—and persist—the affected building(s) will be ventilated to reduce the gas levels.

Fault Rupture and Seismic Ground Shaking

Construction-related Environmental Impacts/Environmental Consequences

Construction within Section 2 of the Project will be susceptible to surface fault rupture and seismic ground shaking. The Century City station was located at Constellation Boulevard because it significantly reduces the risk of surface fault rupture compared to locating the Century City station on Santa Monica Boulevard (refer to Section 4.3 of this Draft SEIS).

Metro standards for design of temporary shoring systems include earthquake loading. Earth pressures for temporary earthquake loads are determined by the geotechnical consultant on a site-specific basis considering the site location and ground conditions, and typically assuming the probability of exceedance of the design loading is less than 10% in the typical 5 year duration wherein the temporary shoring is utilized for support of excavation. Construction will be performed in accordance with Metro Design Criteria that includes national standards and codes to protect the workers and work under construction considering seismic conditions.

Mitigation Measures

As stated in Section 4.15 of the Final EIS/EIR, no mitigation measures will further reduce the risk of fault rupture and seismic ground shaking during construction. Even with compliance with Metro Design Criteria, the risk during construction will remain low, resulting in no adverse effect.

4.5.6 Ecosystems and Biological Resources

Affected Environment/Existing Conditions

The ecosystems/biological resources in the Study Area have not changed from those identified in Section 4.10 of the Final EIS/EIR. The Section 2 of the Project construction area lies within a densely developed and urbanized area with limited ecosystems/biological resources. Land cover in this area is predominantly urban development with irrigated and maintained landscaping and some mature trees. Some migratory bird species may use these trees during migration. Native trees, including southern coast live oak riparian forest, California walnut woodland, and southern sycamore alder riparian and walnut forest, have the potential to occur in the area. No sensitive vegetation communities were previously observed.

Construction-related Environmental Impacts/Environmental Consequences

As described in the Final EIS/EIR, Section 2 of the Project is located in a densely developed urban land area, including the Century City Constellation Station area. No impacts to sensitive ecological or biological resources are anticipated. However, the changes in the construction staging would require additional tree removal beyond that identified in the Final EIS/EIR. The removal of the double crossover structure at the Wilshire/Rodeo Station and subsequent shortening of the station box would not result in the removal of any additional trees that were not already identified in the Final EIS/EIR. Construction of a new temporary Metro bus layover site in the median of Santa Monica Boulevard would require the removal of up to four small trees. In addition, if placement of the materials transport corridor on the east side of the AT&T building at 2010 Century Park East is not feasible, the materials transport corridor would be located along the west side of the building, which would require the removal of up to eight trees along Century Park East. An adverse impact could occur if an active migratory bird nest were disturbed in any of these trees. To offset the removal of mature trees, replacement trees would be provided.

Mitigation Measures

Changes in the construction staging at the Century City Constellation Station would require additional tree removal beyond that identified in the Final EIS/EIR and could result in an adverse impact if an active migratory bird nest were disturbed in any of these trees. Mitigation measures will be implemented to meet the requirements for compliance with the Migratory Bird Treaty Act and state migratory bird protection. With the implementation of mitigation, the construction period biological impacts of Section 2 of the Project would not result in additional adverse impacts beyond those discussed in the Final EIS/EIR:

- **CON-66 Biological Survey:** Two biological surveys will be conducted, one 15 days prior and a second 72 hours prior to construction that will remove or disturb suitable nesting habitat. The surveys will be performed by a biologist with experience conducting breeding bird surveys. The biologist will prepare survey reports documenting the presence or absence of any protected native bird in the habitat to be removed and any other such habitat within 300 feet of the construction work area (within 500 feet for raptors). If a protected native bird is found, surveys will be continued in order to locate any nests. If an active nest is located, construction within 300 feet of the nest (500 feet for raptor nests) will be postponed until the nest is vacated and juveniles have fledged and when there is no evidence of a second attempt at nesting.
- **CON-69 Avoidance of Migratory Bird Nesting Season:** Construction activities that involve removal or trimming will be timed to occur outside the migratory bird nesting season, which occurs generally from March 1 through August 31 and as early as February 1 for raptors.
- **CON-67 Compliance with City Regulations:** If construction or operation of the Project requires removal or pruning of a protected tree, a removal permit will be required in accordance with applicable municipal codes and ordinances of the city in which the affected tree is located. Within the City of Los Angeles, compliance with

the Native Tree Protection Ordinance will require a tree removal permit from the Los Angeles Board of Public Works. Similarly, within the City of Beverly Hills, applicable tree protection requirements, such as tree removal permits, will be followed. Tree removal permits may require replanting of protected trees within the Study Area or at another location to mitigate for the removal of these trees

- **VIS-2 Replacement for Tree Removal:** Where mature trees are removed, replacement with landscape amenities of equal value will be incorporated into final designs, where feasible, to enhance the visual integrity of station areas.

4.5.7 Parklands and Community Services and Facilities

Affected Environment/Existing Conditions

The description of parklands and community services and facilities located in Section 2 of the Project Study Area has not changed from what was provided in Section 4.13 of the Final EIS/EIR, with the exception of a new medical rehabilitation facility and improvements to the BHHS campus described in Section 4.2 of this Draft SEIS.

Three parks, recreation centers, and/or museum facilities are located within one-quarter mile of the Century City Constellation Station area:

- Beverly Hills Garden Park (Santa Monica Boulevard, Beverly Hills)
- Los Angles Country Club (10101 Wilshire Boulevard, Los Angeles)
- Beverly Hills High School (241 Moreno Drive, Beverly Hills)

One police station and one fire station would serve the Century City Constellation Station area:

- Los Angeles Police Department West Los Angeles Community Police Station (1663 Butler Avenue, Los Angeles)
- Los Angeles Fire Department Fire Station 92 (10556 Pico Boulevard, Los Angeles)

Three public schools are located within one-quarter mile of the Century City Constellation Station area:

- El Rodeo School (605 N. Whittier Drive, Beverly Hills)
- Beverly Hills Adult School (255 S. Lasky Drive, Beverly Hills)
- Beverly Hills High School (241 Moreno Drive, Beverly Hills)

The California Rehabilitation Institute (2080 Century Park East, Los Angeles) is the only medical facility located within one-quarter mile of the Century City Constellation Station area.

Construction-related Environmental Impacts/Environmental Consequences

Access to police and fire stations would not be affected by the changes to the construction staging areas in Century City because no stations are adjacent to where these sites and related construction activities would occur. However, police and fire emergency response routes to businesses and residences could be disrupted within the vicinity of construction areas. To minimize potential disruptions, the Los Angeles County Sheriff's Department, the Beverly Hills Police/Fire Departments, and the Los Angeles Police/Fire Departments would be informed of all lane closures and detours prior to construction so that emergency routes can be adjusted accordingly. Access to

necessary collector streets, local streets, and alleys would be maintained to ensure emergency routes are accessible.

Hospitals and medical care facilities near the construction sites that could be affected by emissions and/or noise and vibration include the new medical rehabilitation facility located at 2080 Century Park East. Refer to Section 4.5.3, Construction Air Quality, and Section 4.5.4, Construction Noise and Vibration, regarding temporary construction-related impacts and their associated mitigation measures. Access to the medical rehabilitation facility would be maintained during lane closures and detours associated with construction and cut-and-cover activities.

Of the parks, recreational centers, and schools located within one-quarter mile of the Century City Constellation Station area, the Beverly Hills Garden Park, the Los Angeles Country Club, El Rodeo School, and Beverly Hills Adult school would not be affected by the changes to the construction staging areas in Century City because they are not located adjacent to where these sites and related construction activities would occur. Construction activities would occur at staging Areas 2 and 3 adjacent to BHHS, which is considered both a school and a recreational facility. The City of Beverly Hills Community Services Department uses the high school fields for registered participation of youth and adult soccer, tennis, and football. The high school gymnasiums, Swim-Gym, and wrestling room are also used for city programs. The high school track is open for weekend recreational use, and the sports fields are open for other group use by permit. As described in Section 4.5.4, Construction Noise and Vibration, construction-related activities could result in noise impacts to BHHS, especially during tunneling activities, when Section 2 Project construction would overlap with the BHHS modernization and students and faculty are located temporarily in portable classrooms on the current BHHS lacrosse fields. The construction of Section 2 of the Project is predicted to exceed City of Beverly Hills noise limits at the temporary BHHS classroom buildings. With the implementation of mitigation measures, the construction of Section 2 of the Project would not result in additional adverse noise or vibration impacts to BHHS beyond those discussed in the Final EIS/EIR. .

Lane closures and detours due to construction activities could temporarily affect existing vehicular and pedestrian travel routes to BHHS. The BHUSD would be informed of changes to Metro bus routes, street closures, and pedestrian crossings prior to construction. Metro would ensure safety by developing and implementing measures that safeguard safety of pedestrians near schools.

Impacts to parklands and community services and facilities are not anticipated to result from the removal of the double crossover structure at the Wilshire/Rodeo Station and subsequent shortening of the station box beyond those identified in this section and consistent with the Final EIS/EIR. This would instead result in lower construction costs and slightly reduced impacts to traffic and disruption to the surrounding streets and businesses due to a smaller construction footprint along Wilshire Boulevard, reduced time needed for station excavation, and fewer truck trips needed for hauling excavated material.

Mitigation Measures

The changes to the Century City Constellation Station construction areas could result in construction period impacts to parklands and community services and facilities such as the new medical rehabilitation facility and BHHS. With the implementation of mitigation, the construction of Section 2 of the Project would not result in additional adverse impacts beyond those discussed in the Final EIS/EIR:

- **CON-82 Communication with Schools:** School districts and private school institutions along the alignment will be informed of changes to Metro bus routes, school bus routes, and pedestrian crossings prior to construction.
- **CON-83 Work with Transportation, Police, Public Works, and Community Service Departments:** Metro will work with transportation, police, public works, and community services departments of jurisdictions along the alignment to implement mutually agreed upon measures, such as posting of clearly marked signs, pavement markings, lighting as well as implementing safety instructional programs, to enhance the safety of pedestrians, particularly in the vicinity of schools and access routes to hospitals. The measures will be developed to conform to Metro Rail Transit Design Criteria and Standards, Fire/Life Safety Criteria, Volume IX.
- **CON-84 Instructional Rail Safety Programs for Schools:** Metro will provide at no charge to school districts an instructional rail safety program with materials to all affected elementary middle and high schools.
- **CON-85 Informational Program to Enhance Safety:** Metro will provide an on-going informational program to nearby medical facilities, senior centers, and parks if requested by these facilities, to enhance safety. The program will be similar to that described for the schools except the information and materials provided will be geared toward senior citizens.
- **CON-86 Traffic Control:** Contractors will be required to control traffic during construction by following the City of Los Angeles Work Area Traffic Control Manual; City of Los Angeles Bureau of Engineering Standard Plan S-610-12 (Notice to Contractors-Comprehensive); and the Bureau of Engineering Standard Specifications for Public Works Construction. Comparable standards will be enforced for work conducted in the other jurisdictions along the alignment.
- **CON-87 Designation of Safe Emergency Vehicle Routes:** Safe emergency vehicle routes will be designated around construction sites. The identification of the routes will be coordinated with other agencies.

4.6 Cumulative Impacts

This section examines the cumulative impacts that could result from implementation of Section 2 of the Project when considered in combination with identified past, present, and foreseeable future projects, including those that have changed since the certification of the Final EIS/EIR.

4.6.1 Methodology

The cumulative impacts analysis in this Draft SEIS utilizes the same methodology as the Final EIS/EIR, which followed the guidelines provided in "Considering Cumulative Effects under the National Environmental Policy Act" (Council on Environmental Quality, January 1997). In addition to long-term cumulative effects, cumulative effects associated short-term construction effects of the Project, when combined with construction effects of other projects, are addressed for the resource areas analyzed in this Draft SEIS.

4.6.2 Affected Environment/Existing Conditions

The Study Area for this cumulative impacts analysis has not changed from what was presented in Section 4.17.3 of the Final EIS/EIR. The analysis of cumulative impacts in this Draft SEIS is focused on the Century City Constellation Station area in Section 2 of the Project since the elimination of the train crossover at the Wilshire/Rodeo Station would slightly reduce construction impacts because of the reduced construction footprint and would not cause cumulative impact that is different from that considered in the Final EIS/EIR.

The analysis examined changed conditions in Section 2 of the Project. These changed conditions involve updated information about the past, present, and reasonably foreseeable future actions in the Century City area. While no new transportation projects are anticipated in the Century City area beyond those described in the Final EIS/EIR, several new public and commercial development projects are planned or are under construction. These projects are described in Table 4-25 and their locations are shown in Figure 4-38. In addition to the projects listed, the former physician-run hospital at 2080 Century Park East recently reopened as a remodeled 9-story, 138-bed medical rehabilitation facility with inpatient services. The medical rehabilitation facility is located more than 1,000 feet away from the Century City Constellation Station entrance and is a typical urban facility, which is not a generator or substantial traffic or noise. Since construction of the facility is complete, it was not analyzed in the cumulative construction analysis.

Table 4-25. Past, Present, and Reasonably Foreseeable Future Actions in the Century City Area

ID #	Project Title	Project Description	Status
1	Beverly Hills High School Modernization Project	As described in the Affected Environment/Existing Conditions of Section 4.2, the Beverly Hills High School campus has begun modernization of the school's campus.	Construction activities began in 2015 and are scheduled through 2020.
2	10000 Santa Monica Boulevard Project	Development of a 40-story residential project with 283 units. The project also includes 75,000 square feet of indoor and outdoor recreation/site amenities for project residents.	Substantially complete, building has opened.
3	Remodeling of the Westfield Century City Mall Property	An $800-million upgrade and expansion of the mall to provide upgraded facilities and new retail and hospitality services.	Currently under construction with expected completion date of spring 2017.
4	Century City Center - 1950 Avenue of the Stars	The property is fully entitled to build two 47-story residential towers and an additional 12-story residential building with a combined total of 483 residential units. The project also includes approximately 1.7 acres of open park space and 1,208 below ground parking spaces. Alternatively, the property is also entitled for one 37-story 700,000-square-foot office building, 25,830 square feet of low-rise one- and two-story office space, an approximately 1,300-square-foot Mobility Hub, a Transit Plaza, approximately 4,120 square feet of ancillary retail, and a partially subterranean parking structure with 1,579 stalls.	A Notice of Determination for project revisions was submitted in February 2015. Residential entitlements extend through September 2018, and office entitlements extend through 2021; if exercised, construction would be expected to follow and extend for one to two years.
5	Century Plaza Hotel Development Project - 2025 Avenue of the Stars	Project to restore the existing hotel and construct two 46-story buildings containing a mix of residential, restaurant, retail, and hotel uses behind the hotel. The project also includes a 2-acre publicly accessible garden/plaza with ground-level retail and restaurant uses.	Preliminary construction is underway with an expected completion date of early 2018.

Figure 4-38. Location of Cumulative Projects

4.6.3 Environmental Impacts/Environmental Consequences

This cumulative impacts discussion assesses the overall cumulative effects of Section 2 of the Project that have changed since certification of the Final EIS/EIR. The following analysis examines the cumulative operational impacts and then the cumulative construction impacts.

Cumulative Long-term Impacts

Additional detailed information about individual public and commercial development projects available since the approval of the Final EIS/EIR is provided in Section 4.5.2; however, as the Final EIS/EIR considered development in the Study Area consistent with the 2009 Metro Long Range Transportation Plan and the 2008 Southern California Association of Government's (SCAG) Regional Transportation Plan, these projects fall within the framework of what was considered and analyzed for long-term cumulative operational impacts in the Final EIS/EIR. The long-term impacts of the Project have not changed from those discussed in the Final EIS/EIR and the following topic areas all have no adverse impact during operations of the Project with implementation of mitigation. Therefore, the cumulative impacts for noise and vibration, land use and development, community and neighborhoods, parklands and other community facilities, visual effects, archeological resources, paleontological resources, energy, water quality, geologic

hazards, and hazardous materials would be the same as discussed in the Final EIS/EIR and the Project would continue to have effects that are less than cumulatively considerable. With regards to cultural and historic resources, the long-term impacts of the changes to the construction staging areas at Century City Constellation were assessed in Section 4.4 of this Draft SEIS and concluded that the construction and operation of the Project would result in no adverse effect to the cultural and historic resources near the Century City Constellation Station. Therefore, the cumulative effect of the Project to cultural and historic resources would not be cumulatively considerable.

Furthermore, the Project would provide additional transit service options to the Century City Station area, reducing, the traffic and parking demand in Century City area. Similarly, the Project would result in long term benefits to air quality and greenhouse gas emissions. Therefore, the Project will not result in additional or greater contribution to long-term cumulative impacts on transit, traffic, parking, air quality and greenhouse gas emissions other than those discussed in the Final EIS/EIR.

Cumulative Short-term Impacts

The cumulative short-term impacts analysis considers the potential impact of overlapping construction schedules of several projects in close proximity to the Project. Impacts are described as temporary since the duration of the impacts would be limited to the duration of construction. While the Century Plaza Hotel development project is scheduled to open in early 2018, the majority of its construction is expected to be completed prior to the start of Century City Constellation Station major construction activities, which would begin in January 2018 (refer to Section 2.5 of this Draft SEIS) and would not likely contribute to cumulative construction impacts. Of the projects identified in Table 4-25, the Beverly Hills High School (BHHS) modernization has a construction schedule that overlaps with Section 2 Project construction; however, the peak construction period for BHHS was estimated to occur in the spring of 2016 and would end before construction activities for Section 2 of the Project would begin. While the construction schedule of the Century City Center project is currently unknown and the Subsequent EIR identified expected completion of construction to be in 2015 (LSA 2013), as discussed in Section 2.3.2 of this Draft SEIS, development of the Century City Center project within the same timeframe as Section 2 of the Project would preclude the use of that property for the construction staging site for the Century City Constellation Station, resulting in the need for an alternative staging area. The overlapping construction of the Project, the BHHS modernization, and the construction of Century City Center could result in temporary cumulative impacts in the vicinity of the Century City Constellation Station area associated with street closures and traffic, air quality, noise and vibration, geologic hazards, access to businesses and public facilities, hazardous materials, water quality, aesthetics, and biological resources. Cumulative impacts of construction for each of these resource areas are discussed in the sections below.

Transportation

As discussed in Chapter 3 of this Draft SEIS, construction of Section 2 of the Project, including stations, alignment, and station entrances, will result in the temporary disruption and rerouting of traffic, including buses, which will contribute to the cumulative increase in congestion within the Section 2 Study Area.

The construction period for the BHHS campus improvements was scheduled between late 2015 and mid-2020, with the peak construction period scheduled between February 2016 and April 2016 (BHUSD 2015). As of the issue date of this Draft SEIS, the campus improvement project was underway and ongoing. Based on this schedule, the peak construction period for the BHHS campus improvements would not coincide with major construction activities for Section 2 of the Project, which would begin in January 2018, but between January 2018 and mid-2020, construction activities from Section 2 of the Project and less intensive construction activities at BHHS will overlap. The increase in construction traffic from both projects will result in incremental construction traffic impacts within the Study Area. Even though construction traffic from worker trips and haul trucks will occur during the off-peak hours for both projects to minimize traffic disruptions, the additional trips would increase overall traffic within the Section 2 Study Area. As a result, the Project will contribute incrementally to the cumulative traffic impact during construction.

If construction of the Century City Center were to move forward while Section 2 Project construction was ongoing, the cumulative construction impacts on traffic circulation, parking, transit, and other modes (pedestrian and bicycles) as a result of construction access, delivery of materials, and lane closures and detours would be expected to increase. If each project were constructed at separate times, then those impacts would not be additive. Compared to the construction of projects at separate times, the concurrent construction would have a higher intensity of impact for a shorter duration.

The contribution of the Project to cumulative temporary impact on the transportation system would be reduced with the implementation of traffic control plans (TCON-1), designated haul routes (TCON-2), and a transportation management plan (TCON-4) that also consider the timing of other development in Century City to coordinate closures and truck routing.

However, even with implementation of these measures, cumulative construction period impacts on public transit, traffic, parking, and pedestrian and bicycle access, while reduced, would remain as temporary adverse impacts.

Air Quality

There is a potential for cumulative construction impacts if peak construction activities and emissions from the Century City Constellation Station, the BHHS modernization, and the Century City Center development occur during the same time period, where the combined effect could have the potential to exceed South Coast Air Quality Management District (SCAQMD) thresholds. Table 4-26, Table 4-27, and Table 4-28 present the maximum daily construction emissions burdens for the Project, the BHHS modernization, and the Century City Center development as compared to SCAQMD daily thresholds. As shown, individually there are no projected exceedances of the SCAQMD thresholds by any of these projects. Peak daily air quality emissions for the Century City Center were anticipated to exceed the SCAQMD thresholds for volatile organic compounds (VOC) and nitrogen oxide (NOx) without mitigation; however, the mitigated peak daily levels would be below the thresholds (Table 4-28).

Table 4-26. Estimated Maximum Daily Construction Emissions for Century City Constellation Station (lbs/day)

Activity	VOC	CO	NOx	PM_{10}	$PM_{2.5}$
Highest Daily Total	4	76	54	13	4
SCAQMD Thresholds	**75**	**550**	**100**	**150**	**55**

Source: *Westside Purple Line Extension Century City Constellation Station Air Quality Technical–Revision 1* (Metro 2017g)

Table 4-27. Beverly Hills Unified School District Peak Combined Construction Emissions (lbs/day)

Activity	VOC	CO	NOx	PM_{10}	$PM_{2.5}$
Highest Daily Total	59.7	148.8	207.8	33.1	21.5
SCAQMD Thresholds	**75**	**550**	**100**	**150**	**55**

Source: *Beverly Hills High School, Hawthorne K-8 School, and El Rodeo K-8 School Improvement Project Final Environmental Impact Report* (BHUSD 2015)
Note: Peak CO, NOx, PM_{10}, and $PM_{2.5}$ predicted to occur during Month 11. Peak emissions for VOC predicted to occur in Month 49.

Table 4-28. Century City Center Mitigated Peak Combined Construction Emissions (lbs/day)

Activity	VOC	CO	NOx	PM_{10}	$PM_{2.5}$
Highest Daily Total	54.0	123.9	53.4	12.1	2.2
SCAQMD Thresholds	**75**	**550**	**100**	**150**	**55**

Source: *Century City Center Draft Subsequent EIR*, Table 4.4.AI (LSA 2013)

As shown in Table 4-27, peak BHHS construction emissions for the majority of pollutants (carbon monoxide, NOx, Particulate Matter (PM) PM_{10} and $PM_{2.5}$) are predicted to occur in Month 11 (roughly late 2016), except for VOCs, which are predicted to peak in Month 49 (roughly early 2020). Given this schedule, it is more likely that peak BHHS construction emissions for VOCs could overlap with peak emissions from

Century City Constellation Station construction, which would be underway in 2020. If peak BHHS VOC emissions (59.7 lbs/day) are added to peak Century City Constellation Station VOC emissions (4 lbs/day), the total (63.7 lbs/day) emissions would still be below the SCAQMD threshold.

However, if the Century City Center project proceeds forward, the combined emissions of overlapping peak construction periods of the three projects have the potential to exceed SCAQMD thresholds, resulting in a temporary adverse cumulative impact. However, given the current project timelines for all three projects, this peak construction overlap may not occur since the schedule and activities associated with construction of the Century City Center are currently unknown, while the Subsequent EIR identified expected completion of construction to be in 2015 (LSA 2013).

Noise and Vibration

Construction noise and vibration impacts are generally site-specific and localized to the vicinity of each related project. Construction activities for the Project will comply with local noise ordinances, including the City of Los Angeles Noise Ordinance, the City of Beverly Hills Noise Ordinance, and the County of Los Angeles Noise Ordinance, as well as the Metro Baseline Specifications Section 01565, Construction Noise and Vibration Control.

However, given the close proximity of Section 2 construction staging areas at Century City, the BHHS modernization program construction activities, and the potential Century City Center development, concurrent construction activities could have a cumulative noise impact on sensitive noise receivers in the area such as the BHHS, Century City Rehabilitation Facility & Medical Center, Hyatt Regency Century Plaza Hotel, office, multi-family and single-family residences (See Table 4-18 in Section 4.5.4 of this SEIS for a full list). With implementation of mitigation measures specified in the Final EIS/EIR and/or additional practices identified in Section 4.5.4 of this Draft SEIS, the Project contribution to the cumulative noise impact would be minimized.

Geologic Hazards

Excavation and construction of the Century City Center project and BHHS modernization could encounter subsurface gasses during construction that is unrelated to construction of the Project. As discussed in Section 4.5.5 of this Draft SEIS, the incremental risk that the Project's tunneling activities could cause subsurface gas to migrate is negligible; therefore, tunneling activities would not affect gas levels encountered by any of the other projects in the vicinity and would not increase risk. With the mitigation measures identified in Section 4.5.5, the Project would not contribute to a cumulative increase in risk from subsurface gas.

Likewise, the Century City Center project and BHHS modernization could be subject to fault rupture, seismic ground shaking, liquefaction, subsidence and settlement that is unrelated to construction of the Project. The risk of a fault rupture event impacting the any of the areas under construction during the period of construction is extremely small given the construction durations. During construction of Section 2 of the Project, designs to minimize risk of liquefaction-related damage include increasing the depth of

soldier piles to reach non-liquefiable zones or ground improvement to densify the soil prior to installation of the excavation support system and therefore liquefaction does not result in an adverse effect during construction. Soils in the construction area have previously experienced settlement associated with lowering of groundwater and as a result soil are not expected to have significant additional settlement. As the construction of the Project would not increase likelihood of damage associated with fault rupture, seismic ground shaking, liquefaction, subsidence and settlement, it would not contribute to a cumulative increase in risk.

Community and Neighborhood Effects

Construction of Section 2 of the Project will be disruptive to communities and neighborhoods in the immediate vicinity of construction activities. Construction of Section 2 of the Project will overlap with the construction of the BHHS modernization program from 2018 through 2020 and with the Century City Center development construction for one to two years once that project breaks ground. During these periods, the cumulative effects associated with noise and vibration, street closures and traffic, parking, aesthetics, access to businesses, parks and public facilities, and other construction-related effects during construction would be greater than if each project were constructed at separate times. The Project's contribution to community and neighborhood effects is cumulatively considerable in regards to street closures and access to business, parks and public facilities. However, these temporary adverse cumulative impacts would extend for a shorter total duration than if each project was constructed in succession.

Hazardous Materials

As described in Section 4.17.3 of the Final EIS/EIR, excavating and transporting soils affected by hazardous materials (spoils) for disposal will occur as part of Section 2 construction activities. Spoils will be disposed of off-site at licensed disposal facilities. Most of the projects identified in Table 4-25 are for commercial (office, hotel, retail) and high-density residential uses, including the Century City Center project, which are not large generators of hazardous materials. The BHHS campus, however, has environmental conditions that are expected to require remediation activities resulting in disposal of hazardous materials, including for soils that will be removed for construction of the underground parking structure on campus.

With 21 hazardous materials treatment storage and disposal facilities within the SCAG region, it is anticipated that there will be sufficient disposal capacity to accommodate contaminated materials disposal from construction of Section 2 of the Project and the other identified projects; however, as identified in the Final EIS/EIR, the transporting of hazardous materials for disposal from the Project and all other regional projects would be cumulatively considerable.

Water Quality

As described in Section 4.17.3 of the Final EIS/EIR, to protect water quality in the area, construction the Section 2 of the Project will proceed in strict compliance with all existing regulations and requirements. This includes meeting the Clean Water Act's National Pollutant Discharge Elimination System (NPDES) permit requirements,

incorporating Best Management Practices (BMPs,) and implementing a Standard Urban Stormwater Management Plan. Construction of Section 2 will not result in a conversion of pervious surfaces to impervious surfaces or in a substantial altercation of the existing amount or pattern of runoff. Therefore, no substantial increases in erosion, siltation, flooding, or exceedance of the stormwater drainage system's capacity will occur. All other projects under construction in the Century City area will also comply with all existing regulations and requirements and will not result in the conversion of pervious surfaces to impervious surfaces as this is a heavily developed urban area. Therefore, construction of the Project would not be cumulatively considerable.

Visual Effects

As identified in the Final EIS/EIR, temporary impacts during construction of Section 2 of the Project, including increased dust, stockpiling of construction-related materials, the presence of heavy equipment (e.g., cooling towers for the tunnel boring machines, cranes, bulldozers, graders, scrapers, and trucks), temporary barriers, and enclosures, will result in a localized temporary adverse impact. However, with the implementation of the mitigation measures specified in Section 4.15 of the Final EIS/EIR, the Project would minimize its contribution to cumulative visual effects within Century City.

Ecosystems and Biological Resources

As described in the Final EIS/EIR, the Section 2 Study Area is a densely developed urban area with limited biological resources. As identified in Section 4.5.6 of the Draft SEIS, construction of Section 2 would result in the removal of some street trees. However, implementation of identified mitigation measures will reduce this impact so no adverse impacts remain. Since Section 2 of the Project and all other projects under construction in the Century City area are within a densely built-out urban environment, they will not affect undisturbed natural areas. Therefore, the potential of the construction of the Project to contribute to significant cumulative effects on biological resources is not considerable.