4.9 Geotechnical/Subsurface/Seismic/Hazardous Materials

This section summarizes the existing geologic conditions in the project area, including the general topography, geologic materials, faults, seismicity, and potential hazardous materials. The information in this section is based on Appendix U, Geotechnical/Subsurface/Seismic/ Hazardous Materials Technical Memorandum, and Appendix W, Energy Resources Technical Memorandum, of this EIS/EIR.

This section has been updated since publication of the Draft EIS/EIR to address comments received on the Supplemental Environmental Assessment/Recirculated Sections of the Draft EIR (Supplemental EA/Recirculated Draft EIR Sections), as indicated in the Responses to Comments, Volume F-4, of this Final EIS/EIR, and based on refinements to the Locally Preferred Alternative (LPA). A vertical line in the margin is used to show where revisions have occurred to this section since publication of the Draft EIS/EIR, excluding minor edits for consistency and correction of formatting and minor typographical errors.

Minor modifications have been made to this section since publication of the Draft EIS/EIR, which include the addition of information from Appendix U, Geotechnical/Subsurface/Seismic/ Hazardous Materials Technical Memorandum. Since designation of an LPA, mitigation measures have been refined and confirmed for the LPA, which are listed in Section 4.9.4.2 below, based on input received during the Draft EIS/EIR public review period. No changes to the NEPA impact findings or CEQA impact determinations were identified as a result of refinements to the LPA that have occurred since publication of the Draft EIS/EIR. Mitigation measures listed for the LPA in this section have been carried forward and included in the Mitigation Monitoring and Reporting Program (MMRP) for the LPA, Chapter 8, of this Final EIS/EIR.

The analysis of geotechnical, subsurface, seismic, and hazardous material impacts associated with the LPA is detailed below in Section 4.9.3.5.

4.9.1 Regulatory Framework

NEPA requires an evaluation of potential impacts related to hazardous materials, including:

- The potential to encounter existing hazardous materials during project activities, and
- The potential for the proposed project to generate new hazardous materials that could affect the surrounding human and natural environments.

CEQA requires study of potential impacts related to geology, soils, and seismicity. The L.A. CEQA Thresholds Guide specifies additional thresholds of significance pertaining to creation or acceleration of geologic hazards, acceleration of erosion and sedimentation processes, alteration of distinct and prominent geologic and topographic land features, creation of hazards to the public by release or transport of hazardous materials, and interference with an adopted emergency response or evacuation plan. These thresholds are evaluated by determining whether the project would expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:

- Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault,
- Strong seismic ground shaking,
- Seismic-related ground failure, including liquefaction,
- Landslides,
- Result in substantial soil erosion or the loss of topsoil,
- Be located on a geologic unit or soil that is unstable or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse,
- Location on expansive soil, creating substantial risks to life or property,
- Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state,
- Release or transport of hazardous materials, or
- Interference with an adopted emergency response or evacuation plan.

These thresholds have been incorporated into the analysis documented in this section.

Relevant regulations and programs also include:

- Federal:
  - Resource Conservation and Recovery Act
  - Superfund Amendments and Reauthorization Act
  - Comprehensive Environmental Response, Compensation, and Liability Act
  - Toxic Substances Control Act
  - Federal Occupational Safety and Health Act
- State:
  - Alquist-Priolo Act
  - Seismic Hazards Mapping Act of 1990
  - Surface Mining and Reclamation Act

- California Hazardous Waste Control Law
- Carpenter-Presley-Tanner Hazardous Substances Account Act
- State of California Occupational Safety and Health Act
- Unified Hazardous Waste and Hazardous Materials Management Regulatory Program
- Waters Bill of 1985
- La Follette Bill of 1986
- South Coast Air Quality Management District Rule 1403

- Local:
  - City of Los Angeles General Plan – Safety Element and Seismic Safety Element
  - The Mineral and Energy Resources Section of the County's General Plan
  - Uniform Fire Code
  - Los Angeles Municipal Code – Methane and Methane Buffer Zones

4.9.2 Affected Environment

4.9.2.1 Regional Geology

The proposed project alignments would traverse the southeastern end of the Elysian Park Hills and the ancient floodplain of the Los Angeles River. The geomorphology ranges from gently sloping alluvial floodplain surfaces to hillside slopes of moderate relief and grade. The steepest slopes along the alignment surface are between 3rd Street at Flower Street and Olive Street at 2nd Street. The Los Angeles River floodplain covers the broad, gently sloping, alluvial terrain east of the Bunker Hill area. Artificial fill of variable thickness underlies the proposed alignment near the surface. Fill materials consist of mixtures of sand, silt, clay, with variable amounts of construction debris. Deep areas of fill to depths of approximately 25 feet below ground surface are present at abandoned tunnels and storm drain excavations that have been backfilled. The regional geology and soils in the site vicinity are shown on Figure 4.9-1. The historical high groundwater in the vicinity of the alignment ranged between 30 to 70 feet below the existing grade. Additional groundwater information is found in the Water Resources Technical Memorandum (Appendix V).

4.9.2.2 Faulting and Seismicity

No known Holocene Active or Latest Pleistocene Active faults trend through the project area. The project area is not located within a currently established Alquist-Priolo earthquake fault zone for surface fault rupture. Holocene Active faults within ten miles of the planned alignment include the Hollywood fault (4.3 miles northwest of the proposed alignment), the Raymond fault (4.9 miles northeast of the proposed alignment), the Newport-Inglewood fault zone (7.0 miles

west-northwest of the proposed alignment), Verdugo fault (7.1 miles north-northeast of the proposed alignment), and the Santa Monica fault (9.2 miles west of the proposed alignment). Although the Hollywood fault is considered active by the State Geologist, an Alquist-Priolo Earthquake Fault Zone has not yet been established for the Hollywood fault due to its poorly defined location along its length. Other potentially active faults not definitively proven to exist may be located as close as one-half mile from the project area. A detailed inventory of regional fault zones is available in Appendix U, Geotechnical/Subsurface/Seismic/Hazardous Materials Technical Memorandum. Seismic hazards that could affect the project alignment include ground shaking from an earthquake along one of the active faults in the region. Liquefaction-induced ground failure has historically been another major cause of earthquake damage in Southern California. Potential liquefaction zones in the project area are depicted in Figure 4.9-2.

Seismically induced settlement includes compression of dry soils above groundwater and liquefaction-induced settlement of liquefiable soils below groundwater. Seismically induced settlement occurs primarily within loose to moderately dense sandy soils due to volume reduction during or shortly after an earthquake event. The composition of most of the artificial fill along the proposed project alignment is expected to be undocumented and could include these loose soils. In addition, a portion of the alluvial soils along the alignment are anticipated to be loose to medium dense. Accordingly, both the portions of the proposed alignment mapped within the liquefiable zone and those underlain by undocumented fill have the potential to experience seismically induced settlement.

The proposed project alignment is not located within an earthquake-induced landslide zone according to the State of California Seismic Hazard Zones for the Hollywood and Los Angeles Quadrangles. However, the northwest portion of the project area in the vicinity of the proposed 2nd/Hope Street station (the area east of the US 101/SR 110 interchange) is within the Hillside Ordinance area according to the City of Los Angeles Seismic Safety Element (1996). Figure 4.9-2 shows potential landslide hazards in the project area.

Earthquake-induced flooding can be caused by failure of dams or other water-retaining structures due to an earthquake. Due to the absence of such structures in the vicinity of the alignment, the potential for such hazards to affect the project is considered low. The proposed alignments are located in an urbanized area composed mainly of impervious surfaces that include well-developed drainage infrastructure, so the project would not substantially increase the risk of flooding.

4.9.2.3 Seiches and Tsunamis

Seiches are large waves generated in enclosed bodies of water in response to ground shaking. Tsunamis are tidal waves generated in large bodies of water by fault displacement or major ground movement such as submarine landslides.

According to the City of Los Angeles Seismic Safety Element (1996) and the County of Los Angeles Seismic Safety Element (1990), the project area is more than ten miles from the ocean and is not located within areas potentially impacted by either tsunamis or seiches.

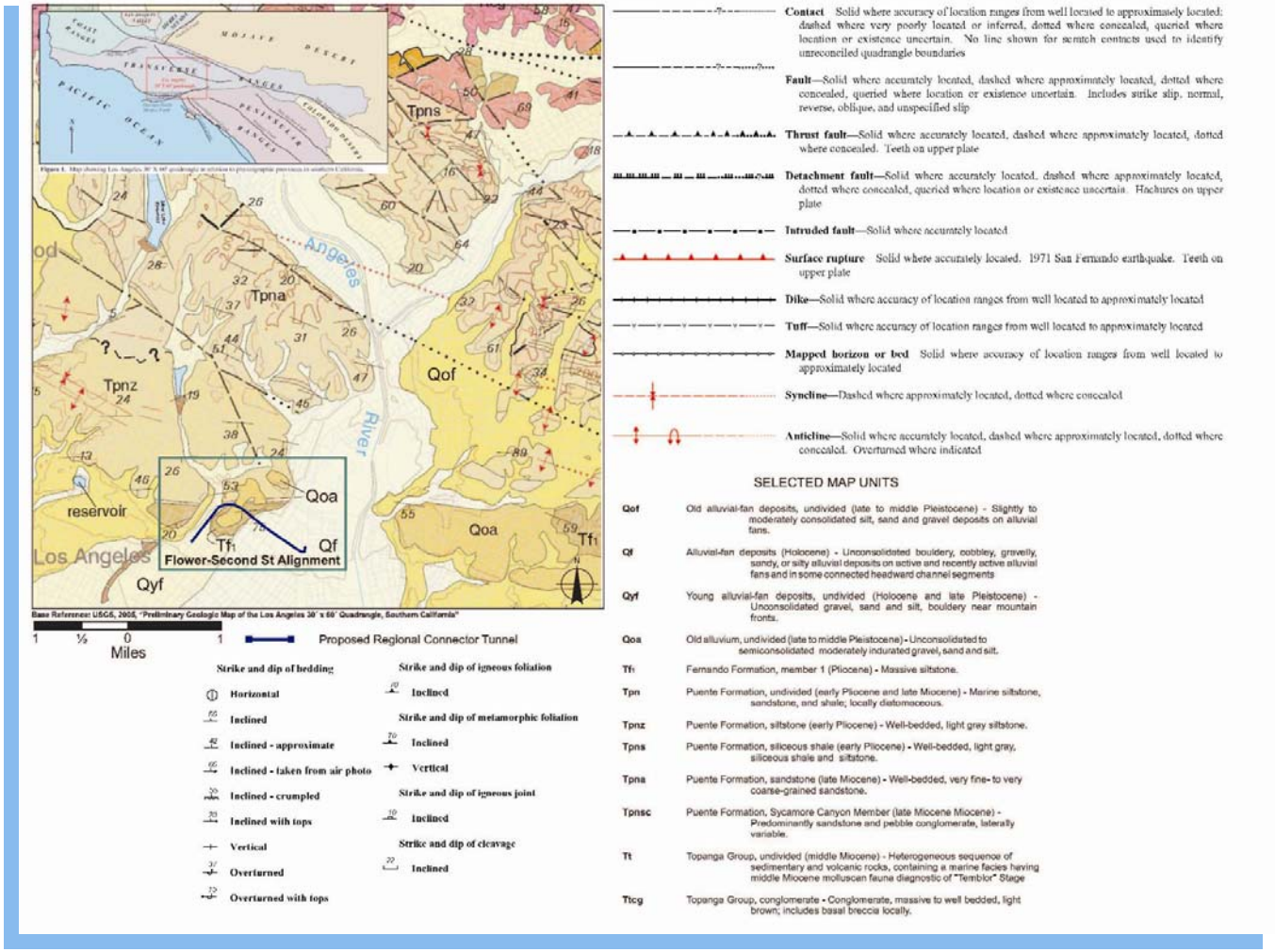

Figure 4.9-1. Regional Geologic Map

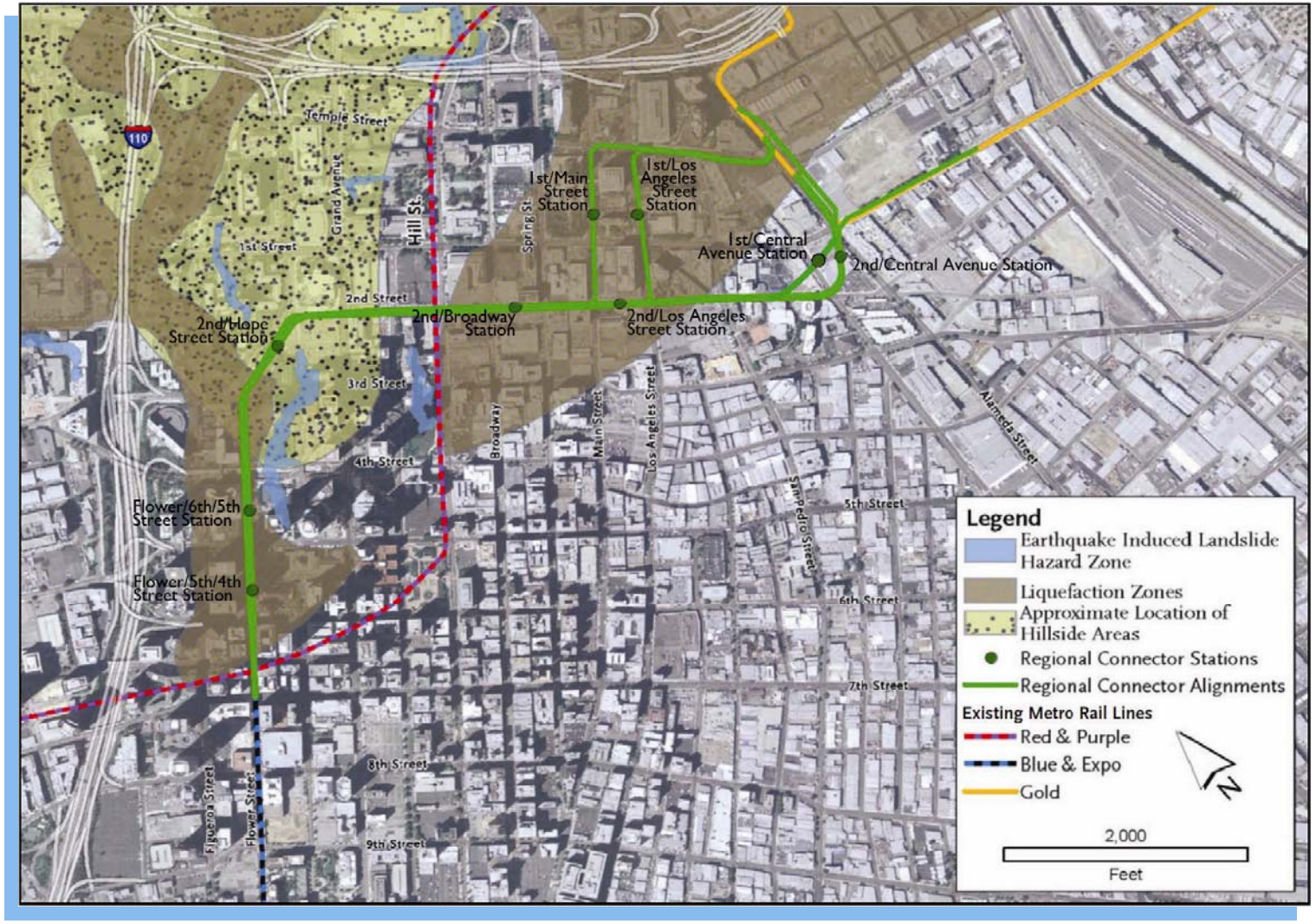

Figure 4.9-2. Liquefaction and Landslide Hazards

4.9.2.4 Mineral Resources

Regarding the loss of mineral resources, the project area traverses areas underlain by geologic materials such as sand and gravel that may be considered mineral resources and could be used as construction aggregates. However, these materials have not been previously mined along the project alignment. Furthermore, mining of these materials in an urbanized environment is not considered economical. However, there is a potential for re-use of excavated material as fill.

4.9.2.5 Hazardous Materials

A search of regulatory databases, including federal, state, and local environmental records, as well as historical mapping, was conducted for the project. The database search results include facilities that handle hazardous materials but have not necessarily had a release to the environment as well as sites that are documented as closed cases where past satisfactory remediation has occurred. These listings do not represent a potential concern for the proposed project and were eliminated from further evaluation.

In some instances, more information was requested from regulatory agencies to determine the current status of a site. In addition, Sanborn fire insurance maps, maps of the Union Station Methane Buffer Zone and Methane Zone and the Los Angeles City Methane Buffer Zone, and oil well construction and abandonment records provided additional information used to determine which sites pose a potential concern with respect to hazardous materials.

The *Hazardous Materials Investigation and Analysis* (CDM 2009) for the Regional Connector Transit Corridor project classifies properties of concern as High, Moderate, or Low based on the following criteria:

- High – sites with known/probable soil, groundwater, or soil gas contamination that have not been remediated, or where remediation is incomplete or undocumented. Other considerations include the type and mobility of any contamination, distance to a project, groundwater impacts, and the location with respect to the inferred or known direction of groundwater flow.

- Moderate – sites with known/potential soil, groundwater, or soil gas contamination and where remediation is in progress, contaminants do not appear to pose a concern for a project, or where construction would occur within mapped Methane Buffer Zones. Sites may also be considered a Moderate level of concern based on the type and intensity of former land use (e.g., chemical manufacturers, machine shops, gas stations, etc.), even though they did not otherwise have an environmental database listing.

- Low – sites that are not likely or are less likely to impact soil and/or groundwater that would be encountered during construction of a project. These may include sites having permitted air toxic emissions or some sites with spills or leaks to the environment that were subsequently remediated and have received case closure.

Figure 4.9-3 shows the properties of High or Moderate concern.

The City of Los Angeles, Department of Public Works, Bureau of Engineering, has mapped Potential Methane Zones and "buffer zones". The City's Municipal Code, Chapter IX, Building Regulations, Article 1, Division 71, Methane Seepage Regulations, requires construction projects located within the Methane Zone or Methane Buffer Zone to be consistent with the City's Methane Mitigation Standards to control methane intrusion emanating from geologic formations.

In addition to hazardous materials that are known or suspected to exist at the properties listed in Appendix U, Geotechnical/Subsurface/Seismic/Hazardous Materials Technical Memorandum other hazardous materials may be present (CDM 2009). Transformers located above- and below-grade along the alignments may contain polychlorinated biphenyls (PCBs). Lead may also be present in surface soil from historic emissions of leaded fuel from vehicles on adjacent roadways. Since most soil along the proposed alignment is covered by asphalt or concrete, exposure to these hazardous materials is unlikely. However, buildings along the proposed alignments that were constructed prior to 1979 may contain asbestos and buildings constructed prior to 1978 may contain lead-based paint that could be released during demolition. These hazardous materials would present a concern for the proposed project, as exposure to these materials at certain levels may cause adverse health effects to workers and the general public.

4.9.3 Environmental Impacts/Environmental Consequences

The following sections summarize the evaluation of potential geotechnical, subsurface, seismic, and hazardous materials impacts for each alternative. Impact conclusions for all of the alternatives are based on the thresholds identified above in Section 4.9.1. Table 4.9-1 summarizes the results of the analysis.

4.9.3.1 No Build Alternative

As the No Build Alternative does not involve construction of any new transit infrastructure beyond projects already identified in Metro's 2009 Long Range Transportation Plan (LRTP), it would not result in any geotechnical, subsurface, seismic, or hazardous materials impacts.

4.9.3.1.1 NEPA Finding

The No Build Alternative would not have adverse geotechnical, subsurface, seismic, or hazardous materials effects.

4.9.3.1.2 CEQA Determination

The No Build Alternative would not have significant geotechnical, subsurface, seismic, or hazardous materials impacts.

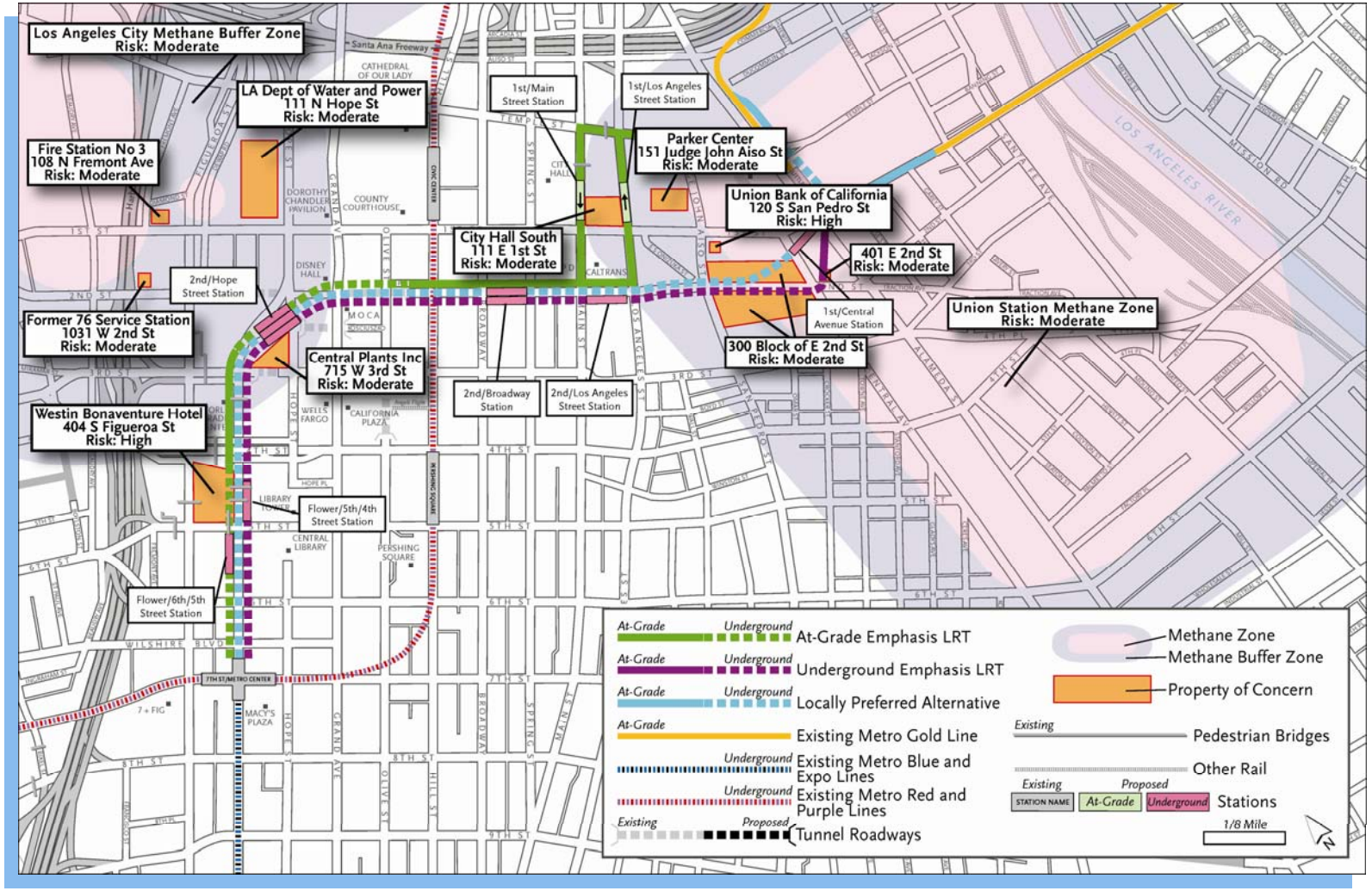

Figure 4.9-3. Known or Suspected Hazardous Materials in Soil and/or Groundwater within 0.25 Mile of Proposed Alignments

Table 4.9-1. Summary of Potential Impacts to Geotechnical/Subsurface/Seismic/Hazardous Materials

Alternative	Geotechnical Impacts[1]	Seismic Impacts[2]	Hazardous Materials[3]	Adverse NEPA Effects After Mitigation	Significant CEQA Impacts After Mitigation
No Build	None	None	None	None	None
TSM	None	None	None	None	None
At-Grade Emphasis LRT	None	Adverse effects/ significant impacts not significant/ adverse after mitigation	Adverse effects/ significant impacts not significant/ adverse after mitigation	None	None
Underground Emphasis LRT	Adverse effects/ significant impacts not significant/ adverse after mitigation	Adverse effects/ significant impacts not significant/ adverse after mitigation	Adverse effects/ significant impacts not significant/ adverse after mitigation	None	None
LPA	Adverse effects/ significant impacts not significant/ adverse after mitigation	Adverse effects/ significant impacts not significant/ adverse after mitigation	Adverse effects/ significant impacts not significant/ adverse after mitigation	None	None

Notes:
[1] Geotechnical impacts might include risk of landslides, soil erosion, or ground settlement due to unstable soils.
[2] Seismic impacts could include known faults, liquefaction risks, seismic-related flooding.
[3] Hazardous material risks include methane zone and methane zone buffer areas, contaminated soil and groundwater, and hazardous building materials.

4.9.3.2 TSM Alternative

The TSM Alternative includes all of the provisions of the No Build Alternative, plus two new shuttle bus routes through downtown Los Angeles. The implementation of these shuttle bus routes would not introduce any additional geotechnical, subsurface, seismic, or hazardous materials impacts compared to the No Build Alternative.

4.9.3.2.1 NEPA Finding

The TSM Alternative would not result in adverse geotechnical, subsurface, seismic, or hazardous materials effects.

4.9.3.2.2 CEQA Determination

The TSM Alternative would not result in significant geotechnical, subsurface, seismic, or hazardous materials impacts.

4.9.3.3 At-Grade Emphasis LRT Alternative

4.9.3.3.1 Geotechnical, Subsurface, and Seismic Hazards

The At-Grade Emphasis LRT Alternative does not cross any known fault. However, the At-Grade Emphasis LRT Alternative would be potentially susceptible to liquefaction in portions of the proposed alignment along Flower Street between Wilshire Boulevard and 2nd Street, and along 2nd Street between Hill and San Pedro Streets. The portions of the alignment within the mapped liquefiable zone or underlain by undocumented fill may be susceptible to seismically induced settlement.

Therefore, there is limited potential for adverse effects related to liquefaction and seismically induced settlement for portions of the At-Grade Emphasis LRT Alternative, but there would not be a potential for adverse impacts related to active or potentially active faults, landslides, flooding, seiches, or tsunamis.

The proposed construction would have the potential for adverse impacts related to ground settlement and differential settlement on adjacent structures including historical buildings. Further evaluation and survey would be performed during design to confirm building types and existing conditions, and to develop criteria to limit potential movement to acceptable threshold values.

Regarding the loss of mineral resources, the project area traverses areas underlain by geologic materials such as sand and gravel that may be considered mineral resources and could be used as construction aggregates. However, these materials have not been previously mined along the project alignment and, given the dense urban environment, are not accessible to be mined. Furthermore, mining of these materials in an urbanized environment is not considered economical. However, there is potential for the excavated material to be reused as fill. Therefore, the At-Grade Emphasis LRT Alternative would not result in a significant impact associated with the loss of availability of a known mineral resource that would be of value to the region and the residents of the state.

4.9.3.3.2 Hazardous Materials

During construction of the At-Grade Emphasis LRT Alternative, there is the potential to encounter hazardous materials along the proposed alignment (Figure 4.9-3). Construction of the at-grade portions of the alignment would entail clearing and grading of shallow soil, during which shallow groundwater could also be encountered. The underground portions of the At-Grade Emphasis LRT Alternative along Flower Street (approximately 45 percent) would require trenching or tunneling, and as a result would encounter deeper soils and groundwater. Known and/or suspected soil and/or groundwater contamination exists at properties directly within and near to the proposed alignment, as shown in Figure 4.9-3. Additional site-specific soil, groundwater, and/or soil gas investigation activities may be necessary at these properties to further delineate potential areas of contamination and guide construction activities.

Groundwater encountered during construction dewatering would require testing and either on-site treatment and discharge in accordance with applicable standards or transport to a treatment and/or disposal facility.

Lead may be present in surface soils along the proposed alignment from historical vehicle emissions, and PCBs may exist in surface or subsurface soils from leaking transformers located above- or below-grade. During construction, release of these hazardous materials in contaminated soil and/or groundwater could result in exposure to workers, the public, and sensitive receptors, such as schools within 0.25 mile. This could occur through the release of dust or vapors from exposed soil and/or groundwater. Until further study is conducted, the actual levels of hazardous materials that could be encountered in soil and/or groundwater during construction are unknown. Compliance with the federal, state, and local laws and regulations regarding hazardous materials listed in Section 4.9.1 would be required during construction of the At-Grade Emphasis LRT Alternative. In addition, mitigation would be required to reduce potential impacts to construction workers from encountering contamination during construction.

There is potential for hazardous materials, such as fuels and hydraulic oil used for construction equipment, paints, lubricating fluids, and solvents for maintenance to be accidentally released during construction. Direct impacts could result from an accidental release. The implementation of the best management practices (BMPs) in Section 4.9.4.1 of the Draft EIS/EIR would ensure that potential direct impacts from an accidental release would be less than significant. Compliance with existing laws and regulations would reduce the potential for significant impacts from an accidental release of hazardous materials during operation as well.

The proposed alignment would cross methane zones and methane buffer zones associated with oil deposits in the project area, as shown in Figure 4.9-3. The At-Grade Emphasis LRT Alternative alignment would cross into the Union Station Oil Field along Los Angeles and Temple Streets based on maps published by the California Division of Oil, Gas, and Geothermal Resources (CDOGG 2003). The Union Station Oil Field has been delineated as a Methane Zone by the City of Los Angeles Department of Public Works, Bureau of Engineering. The proposed alignment would also cross a City of Los Angeles Methane Buffer Zone north of 3rd Street and west of Grand Avenue. Petroliferous odors have been reported in several borings drilled north of 3rd Street between Flower Street and Grand Avenue.

Excavation within these zones may encounter naturally occurring hydrocarbon gases, including hydrogen sulfide and methane. Methane and hydrogen sulfide are considered hazardous because of their explosive properties. Additionally, hydrogen sulfide is highly toxic when inhaled. These gases can seep into tunnels and other excavations through soil and also through discontinuities (fractures, faults, etc.) in bedrock.

Mitigation requirements are determined according to the actual methane levels and pressures detected on a site. Mitigation measures could 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.

If construction of the At-Grade Emphasis LRT Alternative requires building demolition, release of hazardous materials including asbestos fibers and lead-based paint particles could occur, which could result in a potential impact. Mitigation, as described in Section 4.9.4 of the Draft EIS/EIR, would reduce this potential direct impact to a less than significant level.

During long-term operation of the At-Grade Emphasis LRT Alternative, there is the potential for the below-grade portions of the alignment to act as a preferential pathway for existing groundwater contamination to move to areas distant from the project.

Indirect impacts could occur from the accidental release of hazardous materials during the transport of soil or other media contaminated with hazardous materials to a disposal facility located away from the project area during construction.

There is the potential for cumulative impacts associated with hazards and hazardous materials from the At-Grade Emphasis LRT Alternative. A number of related construction projects have been identified and some of those projects could involve ground-disturbing construction where there is potential to encounter hazardous materials in soil and/or groundwater. In addition, other construction activities in the project area may entail building demolition, with the potential for release of asbestos fibers from asbestos containing materials and lead particles from lead-based paint. The additive effect of ongoing and future activities could result in cumulative impacts to human health or the environment through release of hazardous materials.

4.9.3.3.3 NEPA Finding

There is the potential for adverse effects with respect to liquefaction, seismically induced settlement, and hazardous materials for portions of the At-Grade Emphasis LRT Alternative. Mitigation would be required to reduce the severity of these potential effects to not adverse.

4.9.3.3.4 CEQA Determination

Potential impacts associated with liquefaction, seismically induced settlement, landslides, flooding, and hazardous materials could occur during construction and operation of the At-Grade Emphasis LRT Alternative. Compliance with federal, state, and local laws and regulations regarding hazardous materials would reduce many of these impacts to a less than significant level. In addition, implementation of mitigation measures would be required to address specific issues (e.g., liquefaction, settlement, potential presence of subsurface gases, asbestos containing materials and lead-based paint), which would reduce impacts to a less than significant level.

4.9.3.4 Underground Emphasis LRT Alternative

4.9.3.4.1 Geotechnical, Subsurface, and Seismic Hazards

The geotechnical, subsurface, and seismic hazards associated with the Underground Emphasis LRT Alternative would be similar to those of the At-Grade Emphasis LRT Alternative except that a greater proportion of the alignment is underground and would be potentially susceptible to adverse impacts related to ground settlement and differential settlement on adjacent structures. Ground improvement would be required in advance of tunneling to provide adequate support and to minimize settlement. In addition, a pre-construction survey of adjacent structures and all

historical buildings in the vicinity would be conducted to establish a baseline against which to measure potential construction-induced damage. Construction monitoring would be required during construction to ascertain the criteria are met.

In addition, a limited portion of the eastern edge of the Underground Emphasis LRT Alternative alignment near the intersection of Alameda and 1st Streets would be within the mapped Inundation Hazard Area (Figure 4.10-1). The majority of the Underground Emphasis LRT Alternative is not located in an area mapped with the potential to be susceptible to flooding. The alignment is located in an urbanized area covered with impervious surfaces and includes a well-developed drainage infrastructure. The proposed project would not increase the risk of flooding.

Regarding the loss of mineral resources, the project area traverses areas underlain by geologic materials such as sand and gravel that may be considered mineral resources and could be used as construction aggregates. However, these materials have not been previously mined along the project alignment and, given the dense urban environment, are not accessible to be mined. Furthermore, mining of these materials in an urbanized environment is not considered economical. There is also potential for the excavated material to be reused as fill. Therefore, the Underground Emphasis LRT Alternative would not result in a significant impact associated with the loss of availability of a known mineral resource that would be of value to the region and the residents of the state.

With implementation of mitigation, potential effects related to geologic, subsurface, or seismic hazards would be reduced to a less than significant level. Figure 4.9-4 illustrates a typical alignment profile for the Underground Emphasis LRT Alternative, which shows the area of greatest ground cover over the tunnel (i.e., greatest depth from ground surface to tunnel grade) and the locations of borings associated with field explorations conducted for the project. Figure 4.9-5 provides the legend for Figure 4.9-4.

4.9.3.4.2 Hazardous Materials

The potential hazardous materials impacts associated with the Underground Emphasis LRT Alternative would be similar to those of the At-Grade Emphasis LRT Alternative. However, since a greater portion of the alignment would be underground, more of the project area would be susceptible to the potential spread of contaminated groundwater and release of subsurface oilfield gases. As with the At-Grade Emphasis LRT Alternative, the proposed alignment would cross methane zones and methane buffer zones associated with oil deposits in the vicinity, as shown in Figure 4.9-3. Excavation within these zones may encounter naturally occurring hydrocarbon gases, including hydrogen sulfide and methane. Therefore, construction of this alternative would require consistency with the City's Methane Mitigation Standards. Also, the Underground Emphasis LRT Alternative would require more property acquisition and demolition of existing structures, which could heighten the risk of potential release of asbestos fibers and lead-based paint particles.

4.9.3.4.3 NEPA Finding

The Underground Emphasis LRT Alternative would have the potential for adverse effects with respect to liquefaction, seismically induced settlement, ground loss due to tunneling, and hazardous materials. Ground loss refers to the ground movement that could occur immediately around the tunnel periphery. Mitigation would be required to reduce the severity of these effects to not adverse.

4.9.3.4.4 CEQA Determination

Potential significant impacts associated with liquefaction, seismically induced settlement, ground loss due to tunneling, and hazardous materials could occur during construction and operation of the Underground Emphasis LRT Alternative. Many of these impacts would be addressed with adherence to federal, state, and local laws and regulations regarding hazardous materials. However, mitigation would be required to address specific issues, including potential ground loss due to tunnel construction, liquefaction hazard, presence of subsurface gases, asbestos containing materials, and lead-based paint. With mitigation, potentially significant impacts would be reduced to less than significant.

4.9.3.5 Locally Preferred Alternative

4.9.3.5.1 Geotechnical, Subsurface, and Seismic Hazards

The geotechnical, subsurface, and seismic hazards for the LPA would be similar to those of the Underground Emphasis LRT Alternative. The LPA does not cross any known fault. However, there is the potential for liquefaction in portions of the proposed alignment along Flower Street between Wilshire Boulevard and 2nd Street, and along 2nd Street between Hill and San Pedro Streets. The portions of the alignment within the mapped liquefiable zone or underlain by undocumented fill may be susceptible to seismically induced settlement. In addition, the northwest portion of the project area (east of the US 101/SR 110 interchange) is within the Hillside Ordinance area, where there is a potential for landslides. The potential for landslide hazards to affect the site is considered low because the proposed 2nd/Hope Street station would be embedded below-grade and located predominately in bedrock. However, temporary slope stability during station construction would be evaluated and shoring would be designed to incorporate slope conditions as appropriate. The LPA would also not increase the risk for landslide hazards in this area because the alignment would be embedded below-grade, located predominately in bedrock, and shoring would be designed to incorporate slope conditions as appropriate.

A limited portion at the eastern edge of the alignment near the intersection of 1st and Alameda Streets is within the mapped Inundation Hazard Area. However, the majority of the LPA is not located in an area mapped with the potential to be susceptible to flooding. The alignment is located in an urbanized area covered with impervious surfaces and includes a well-developed drainage infrastructure. The proposed project would not increase the risk of flooding. There is also no potential for seiches and tsunamis, as the alignment is more than ten miles from the Pacific Ocean and there are no reservoirs nearby. The LPA alignment is overlain by alluvial soils and undocumented fill that are potentially susceptible to ground loss associated with tunnel construction.

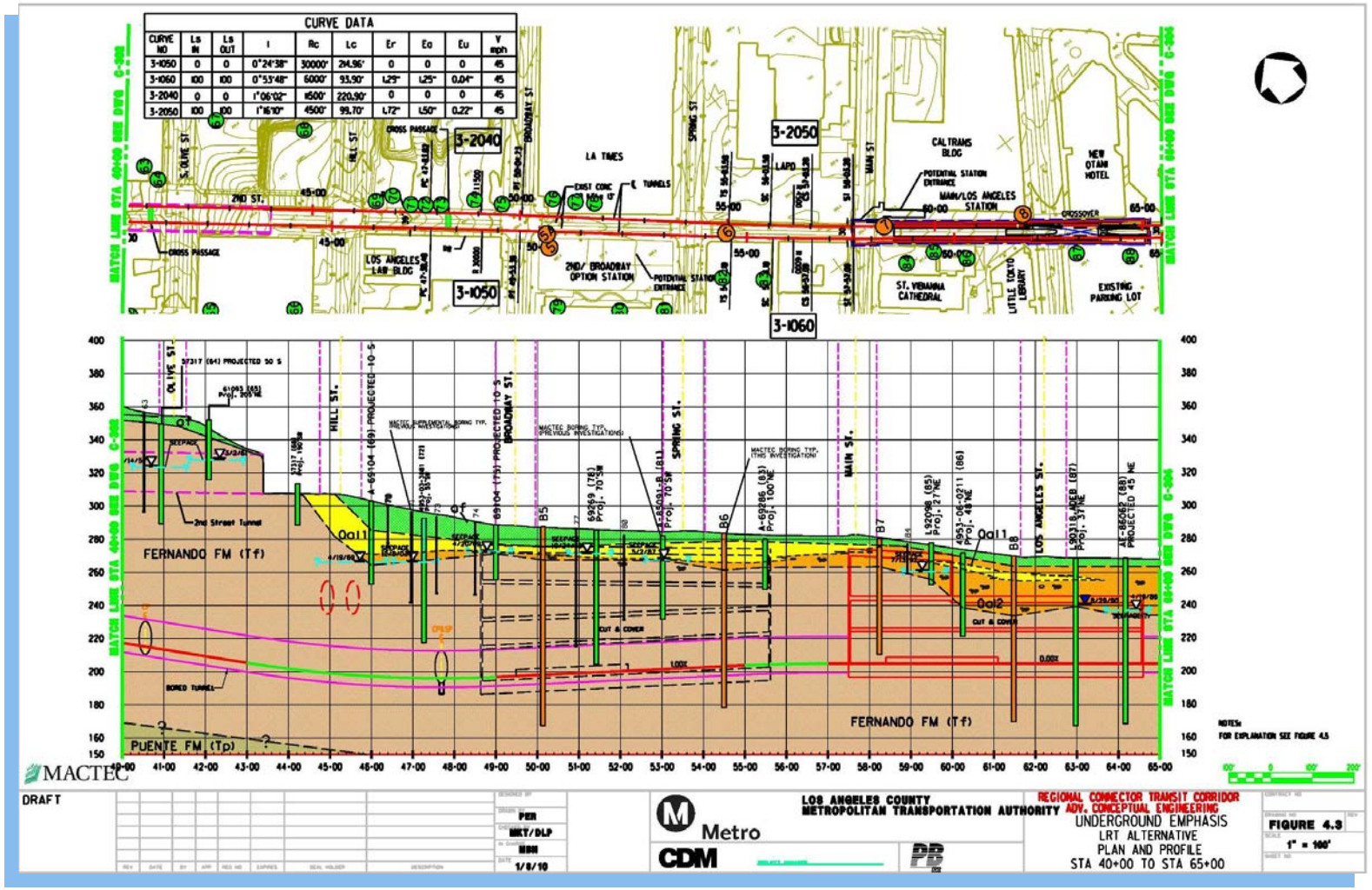

Figure 4.9-4. Underground Emphasis LRT Alternative Typical Underground Conditions

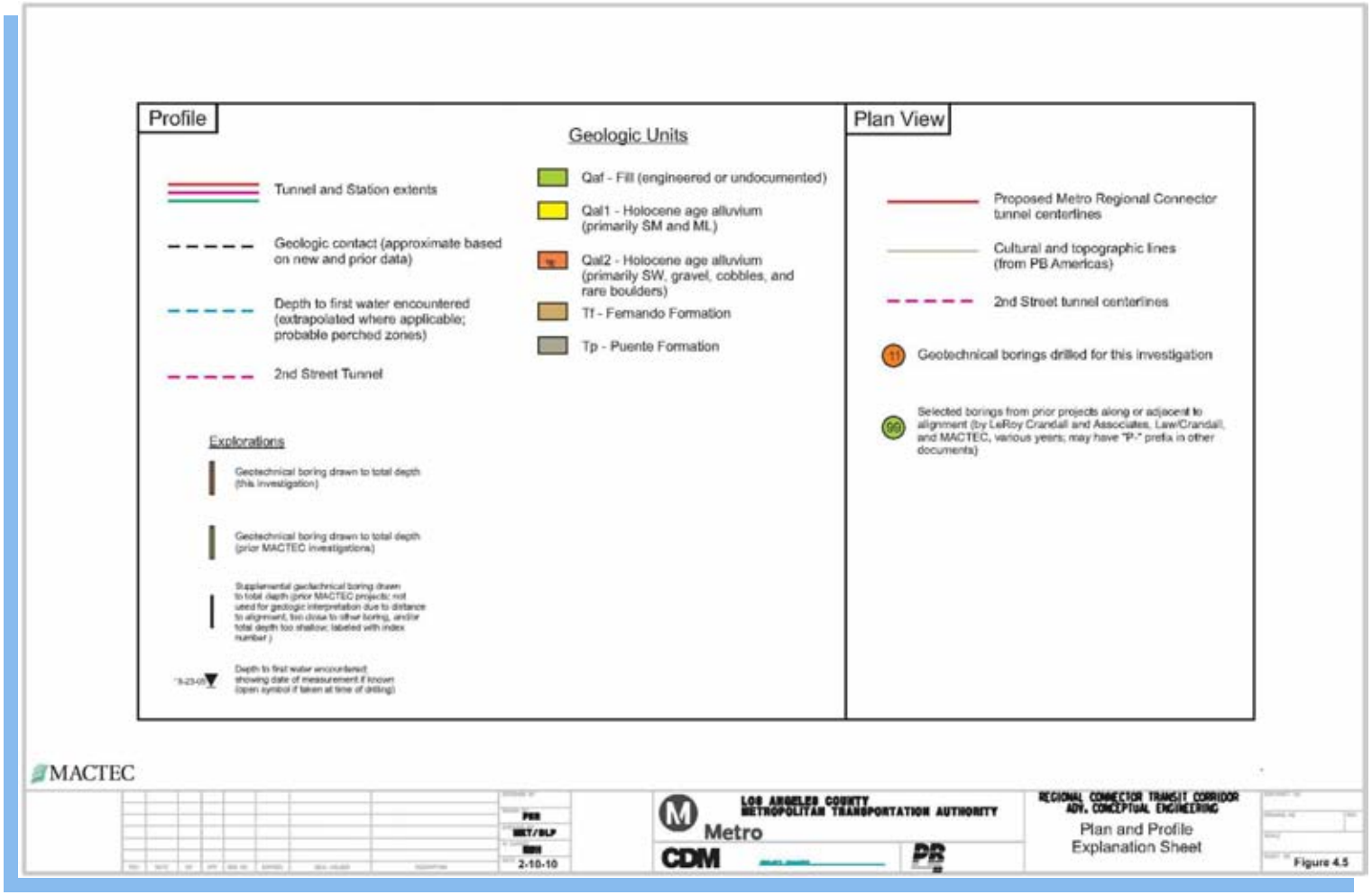

Figure 4.9-5. Geologic and Subsurface Formations Legend for Figure 4.9-4

There is the potential for adverse effects related to liquefaction, seismically-induced settlement, ground loss due to tunnel construction, and landslides for portions of the LPA alignment, but no potential for adverse impacts related to active or potentially active faults, flooding, seiches, or tsunamis.

The proposed tunneling would have the potential for adverse impacts related to ground settlement and differential settlement immediately above the alignment as well as adjacent to structures including the historical buildings. Ground improvement would be required in advance of tunneling to provide adequate support and to minimize settlement. In addition, a pre-construction survey of adjacent structures and all historical buildings in the vicinity would be conducted to establish a baseline against which to measure potential construction-induced damage. Construction monitoring would be required during construction to ascertain the criteria are met.

Regarding the loss of mineral resources, the project area traverses areas underlain by geologic materials such as sand and gravel that may be considered mineral resources and could be used as construction aggregates. However, these materials have not been previously mined along the project alignment and, given the dense urban environment, are not accessible to be mined. Furthermore, mining of these materials in an urbanized environment is not considered economical. There is also potential for the excavated material to be reused as fill. Therefore, the LPA would not result in a significant impact associated with the loss of availability of a known mineral resource that would be of value to the region and the residents of the state.

With mitigation, potential effects related to geologic, subsurface, or seismic hazards would be reduced to a less than significant level.

4.9.3.5.2 Hazardous Materials

During construction of the LPA, there is the potential to encounter hazardous materials along the proposed alignment (Figure 4.9-3). The underground portions of the LPA would require trenching or tunneling, and as a result would encounter deeper soils and groundwater. Construction of the at-grade portions of the alignment would entail clearing and grading of shallow soil, during which shallow groundwater could also be encountered. Known and/or suspected soil and/or groundwater contamination exists at properties directly within and near to the proposed alignment, as shown in Figure 4.9-3. Additional site-specific soil, groundwater, and/or soil gas investigation activities may be necessary at these properties to confirm areas of contamination and guide construction activities. Groundwater encountered during construction dewatering would require testing and either on-site treatment and discharge in accordance with applicable standards or transport to a treatment and/or disposal facility.

Lead may be present in surface soils along the proposed alignment from historical emissions of leaded fuel from vehicles, and PCBs may exist in surface or subsurface soils from leaking transformers located above- or below-grade along the alignment. Since most soil along the proposed alignment is covered by asphalt or concrete, exposure to these hazardous materials is unlikely.

During construction, release of these hazardous materials in contaminated soil and/or groundwater could result in exposure to workers, the public, and sensitive receptors, such as schools within 0.25 mile. This could occur through the release of dust or vapors from exposed soil and/or groundwater. Additional site-specific soil, groundwater, and/or soil gas investigation activities will be conducted during final design to confirm areas of contamination and guide construction activities. Standard practices and contingency preparations would be employed during construction to prevent accidental release of hazardous materials. Compliance with the federal, state, and local laws and regulations regarding hazardous materials listed in Section 4.9.1 would be required during construction of the LPA. In addition, mitigation would be required to reduce potential impacts to construction workers from encountering contamination during construction.

There is potential for hazardous materials, such as fuels and hydraulic oil used for construction equipment, paints, lubricating fluids, and solvents for maintenance to be accidentally released during construction. Direct impacts could result from an accidental release. The implementation of the BMPs in Section 4.9.4.2.1 below would ensure that potential direct impacts from an accidental release would be less than significant. Compliance with existing laws and regulations would reduce the potential for significant impacts from an accidental release of hazardous materials during operation as well.

The proposed alignment would cross methane zones and methane buffer zones associated with oil deposits in the project area, as shown in Figure 4.9-3. The LPA alignment would cross into the Union Station Oil Field along 2nd, 1st, and Alameda Streets based on maps published by the California Division of Oil, Gas, and Geothermal Resources (CDOGG 2003). The Union Station Oil Field has been delineated as a Methane Zone by the City of Los Angeles Department of Public Works, Bureau of Engineering. The proposed alignment would also cross a City of Los Angeles Methane Buffer Zone north of 3rd Street and west of Grand Avenue. Petroliferous odors have been reported in several borings drilled north of 3rd Street between Flower Street and Grand Avenue.

Excavation within these zones may encounter naturally occurring hydrocarbon gases, including hydrogen sulfide and methane. Methane and hydrogen sulfide are considered hazardous because of their explosive properties. Additionally, hydrogen sulfide is highly toxic when inhaled. These gases can seep into tunnels and other excavations through soil and also through discontinuities (fractures, faults, etc.) in bedrock. Therefore, construction of this alternative would require consistency with the City's Methane Mitigation Standards.

Mitigation requirements are determined according to the actual methane levels and pressures detected on a site. Mitigation measures could 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.

Construction of the LPA would require demolition of buildings located on the northern portion of the block bounded by 1st, 2nd, Alameda Streets, and Central Avenue. There is potential for release of hazardous materials including asbestos fibers and lead-based paint particles associated with demolition of these buildings, which could result in a potential impact.

Mitigation, as described in Section 4.9.4.2 below, would reduce this potential direct impact to a less than significant level.

During long-term operation of the LPA, there is the potential for the below-grade portions of the alignment to act as a preferential pathway for existing groundwater contamination to move to areas distant from the project.

Indirect impacts could occur from the accidental release of hazardous materials during the transport of soil or other media contaminated with hazardous materials to a disposal facility located away from the project area during construction.

The hazardous materials impacts associated with the LPA would be similar to those of the Underground Emphasis LRT Alternative. However, since a greater portion of the alignment would be underground, more of the project area would be susceptible to the potential spread of contaminated groundwater and release of subsurface oilfield gases.

Low level electro magnetic fields (EMFs) would be generated by overhead catenary lines and traction power substations (TPSS) associated with operation of the LPA. Compared to overhead power lines which use 400 kV, the LRT would use 0.6 kV and produce very weak EMF, which would be well below exposure guidelines established by the American Conference of Governmental Industrial Hygienists and the International Commission on Non-Ionizing Radiation Protection (Sound Transit 2008). In addition, the majority of the LPA alignment and TPSS sites would be located underground away from sensitive receptors. Therefore, there would be no impacts from exposure to EMF.

There is the potential for cumulative impacts associated with hazards and hazardous materials from the LPA. A number of related construction projects have been identified and some of those projects could involve ground-disturbing construction where there is potential to encounter hazardous materials in soil and/or groundwater. In addition, other construction activities in the project area may entail building demolition, with the potential for release of asbestos fibers from asbestos containing materials and lead particles from lead-based paint. The additive effect of ongoing and future activities could result in cumulative impacts to human health or the environment through release of hazardous materials. Implementation of mitigation measures identified in Section 4.9.4.2, along with compliance with applicable hazardous waste laws and regulations would ensure the LPA would not result in a considerable contribution to cumulative impacts.

4.9.3.5.3 NEPA Finding

The LPA would have the potential for adverse effects with respect to liquefaction, seismically induced settlement, ground loss due to tunneling, and hazardous materials. Mitigation will be required to reduce the severity of these effects to not adverse.

4.9.3.5.4 CEQA Determination

The LPA would have potentially significant impacts associated with liquefaction, seismically induced settlement, ground loss due to tunneling, and hazardous materials during construction and operation. With mitigation, potential impacts would be reduced to less than significant.

4.9.4 Mitigation Measures

4.9.4.1 Updates to the Candidate Mitigation Measures from the Draft EIS/EIR

The Draft EIS/EIR included candidate mitigation measures for review and comment by the public, agencies, and other stakeholders. Since publication of the Draft EIS/EIR, Metro has adjusted and added specificity to the candidate mitigation measures for geotechnical, subsurface, seismic hazards, and hazardous materials impacts presented in the Draft EIS/EIR. The final LPA mitigation measures, shown in Section 4.9.4.2 below, are included in the MMRP for the LPA, Chapter 8, of this Final EIS/EIR, and supersede candidate mitigation measures identified in the Draft EIS/EIR. Updates to the mitigation measures made since publication of the Draft EIS/EIR include:

- The mitigation measure for EMFs is no longer needed for the LPA based on the updated hazardous materials analysis for the LPA. Refer to Section 4.9.3.5.2 above.
- Additional detail provided to mitigation measures for consistency with other sections.
- Additional detail provided for mitigation measures that assess the potential for hazardous materials and hazardous building materials to be encountered during construction.

4.9.4.2 Final Mitigation Measures for the Locally Preferred Alternative

Mitigation measures listed for the LPA in this section have been carried forward and included in the MMRP for the LPA, Chapter 8, of this Final EIS/EIR. They are the final committed mitigation measures for the LPA. MMRP index numbers are shown in parenthesis after each mitigation measure.

4.9.4.2.1 Final Construction Mitigation Measures for the Locally Preferred Alternative

- Before any construction, a survey of structures within the anticipated zone of construction influence shall be conducted in order to establish baseline conditions. A geotechnical instrumentation and settlement monitoring plan and mitigation measures shall be developed and adhered to during construction to ensure appropriate measures are taken to address any construction-induced movement. If assessments indicate the necessity to proactively protect nearby structures, additional support for the structures by underpinning or other ground improvement techniques shall be required prior to the underground construction. Metro shall require the construction contractor to limit movement to less than acceptable threshold values for vertical, horizontal, and angular deformation as a performance standard. These acceptable threshold values shall be established such that the risk of damage to buildings and utilities will be negligible to very slight. For buildings, these threshold values will be based on the relationship of building damage to angular distortion and horizontal strain consistent with Boscardin and Cording (1989) and qualitative factors including but not limited to the type of structure and its existing condition. For utility mains, these threshold values shall be those established by the utility owners. Additional data and survey information shall be gathered during final design for each building and utility main to enable assessment of the tolerance of potentially affected structures and utilities. Additional engineering and design level geotechnical studies shall be performed to define the nature of the soils and to refine the means of achieving each performance specification. (GT-1)

- Ground improvement such as grouting or other methods shall be required to fill voids where appropriate and offset potential settlement when excess material has been removed during excavation. The criteria for implementing grouting or ground improvement measures shall be based on the analysis described in the above mitigation measure. (GT-2)

- The tunnel alignment shall be grouted in advance to provide adequate soil support and minimize settlement as geotechnical conditions require. (GT-3)

- Settlement along the project alignment shall be monitored using a series of measuring devices above the route of the alignment. Leveling surveys shall be conducted prior to tunneling to monitor for possible ground movements. (GT-4)

- Tunnel construction monitoring requirements shall be described and defined in design contract documents. Additional geotechnical provisions shall be included to the extent feasible, including use of an Earth Pressure Balance or Slurry Tunnel Boring Machine for tunnel construction to minimize ground loss. During tunnel construction, the soils encountered shall be monitored relative to anticipated soil conditions as described in a Geotechnical Baseline Report. (GT-5)

- A survey of historic properties and/or historical resources within 21 feet of vibration producing construction activity shall be conducted to confirm the building category, and to provide a baseline for monitoring of ground-borne vibration (GBV) and the potential for GBV to cause damage. The survey shall also be used to establish baseline, pre-construction conditions for historic properties and historical resources. During preliminary engineering and final design of the project, additional subsurface (geotechnical) investigations shall be undertaken to further evaluate soil, groundwater, seismic, and environmental conditions along the alignment. The analysis shall assist in the selection and development of appropriate support mechanisms for cut and cover construction areas and any sequential excavation method (mining) construction areas in accordance with industry standards and the Building Code. The subsurface investigation shall also identify areas that could experience differential settlement as a result of using a tunnel boring machine (TBM) in close proximity to historic properties and/or historical resources. An architectural historian or historical architect who meets the Secretary of Interior's Professional Qualification Standards shall provide input and review of design contract documents prior to implementation of the mitigation measures. (CR/B-2)

- A Contaminated Soil/Groundwater Management Plan shall be implemented during construction to establish procedures to follow if contamination is encountered in order to minimize associated risks. The plan shall be prepared during the final design phase of the project, and the construction contractor shall be held to the level of performance specified in the plan. The plan shall include procedures for the implementation of the following mitigation measures. (GT-6)

- Appropriate regulatory agencies shall be contacted if contaminated soil or groundwater is encountered. (GT-7)

- Sampling and analysis of soil and/or groundwater known or suspected to be impacted by hazardous materials shall be conducted. (GT-8)

- Procedures for the legal and proper handling, storage, treatment, transport, and disposal of contaminated soil and/or groundwater shall be delineated and conducted in consultation with regulatory agencies and in accordance with established statutory and regulatory requirements (refer to Section 4.9.1). (GT-9)

- Dust control measures such as soil wetting, wind screens, etc. shall be implemented for contaminated soil. (GT-10)

- Groundwater collection, treatment, and discharge shall be performed according to applicable standards and procedures (refer to Section 4.10.1). (GT-11)

- Worker Health and Safety Plan shall be implemented prior to the start of construction activities. All workers shall be required to review the plan, receive training if necessary, and sign the plan prior to starting work. The plan shall identify properties of concern, the nature and extent of contaminants that could be encountered during excavation activities, appropriate health and environmental protection procedures and equipment, emergency response procedures including the most direct route to a hospital, contact information for the Site Safety Officer. (GT-12)

- Impermeable grout and other appropriate measures shall be used where necessary to fill gaps between the tunnels and the surrounding earth to address the potential for creation of a preferential pathway and resulting spread of existing contaminated groundwater. (GT-13)

- Testing for subsurface gases shall be conducted along all portions of the underground alignment. (GT-14)

- Construction of the project shall be consistent with the City of Los Angeles Methane Mitigation Standards, established in accordance with City of Los Angeles Ordinance No. 175790 and No. 180619, which provide detailed installation procedures, design parameters, and test protocols for the methane gas mitigation system as well as methods to control methane intrusion emanating from geologic formations. (GT-15)

- Specialized excavation methods and equipment shall be implemented to protect workers and the public from exposure to toxic gases and prevent explosions. For instance, pressurized closed-face TBMs and other equipment outfitted with ventilation systems would be used, as needed, to excavate the tunnels associated with the LPA, including Slurry Face Machines (SFMs) and Earth Pressure Balance Machines (EPBMs). During tunneling, the volume of gas (or water containing dissolved gas) released from the soil is confined to the excavated material chamber of the TBM because of the closed-face and gas-tight lining that is installed immediately behind the TBM. The project shall also comply with the City's Methane Mitigation Standards, which include provisions to protect workers and the public. (GT-16)

- Prior to building demolition, surveys of asbestos containing materials and lead-based paint shall be conducted. If necessary, destructive sampling shall be used. All asbestos containing materials and lead-based paint shall be removed or otherwise abated prior to demolition in accordance with all applicable laws and regulations. (GT-17)

- The construction contractor shall be required to implement BMPs for handling hazardous materials in compliance with existing regulations. These shall include requirements for proper use, storage, and disposal of chemical products and hazardous materials used in construction; spill control and countermeasures, including employee spill prevention/response training; vehicle fueling procedures to avoid overtopping construction equipment fuel tanks; procedures for routine maintenance of construction equipment, including the proper containment and removal of grease and oils; procedures for the proper disposal of discarded containers of fuels and other chemicals. (GT-18)

- Metro shall develop and implement an Environmental Site Assessment program in accordance with appropriate laws and regulations (refer to Section 4.9.1) to assess the potential for hazardous materials that may be encountered during construction. (GT-20)

- Metro shall develop and implement plans for pre-demolition and demolition abatement of hazardous building materials (i.e., asbestos, lead-based paint, PCB-light ballasts) in accordance with appropriate laws and regulations such as the Toxic Substances Control Act (refer to Section 4.9.1). (GT-21)

4.9.4.2.2 Final Operational Mitigation Measures for the Locally Preferred Alternative

- Structures within methane zones and buffer zones shall be consistent with municipal code requirements for gas concentration/pressure testing on a specified frequency and, based on the results, appropriate mitigation measures or controls to be included in the design. These measures may include the use of gas-impermeable liners and venting to reduce or eliminate gas intrusion into stations and along the length of the underground segments. (GT-19)