Exposition Metro Line Construction Authority

Exposition Corridor Transit Project Phase 2

Final Environmental Impact Report

Technical Background Report

FINAL

Geology, Soils, and Seismicity

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Prepared for:

Exposition Metro Line Construction Authority

By:

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ERRATA

The Exposition Metro Line Construction Authority (Expo Authority) has determined that the bike path and Second Street Santa Monica Terminus are no longer under consideration as part of the Expo Phase 2 Light-Rail Transit project. This Technical Background Report was drafted prior to the final definition of the LRT Alternatives that was presented in the Draft Environmental Impact Report (DEIR). Accordingly, discussion of the bike path and Second Street Santa Monica Terminus still remain in this report but no longer apply and should be disregarded.

Contents

1. INTRODUCTION 1
1.1 Overview 1
1.2 Project Summary 1
1.2.1 No-Build Alternative 1
1.2.2 Transportation Systems Management (TSM) Alternative 2
1.2.3 Light-Rail Transit (LRT) Alternatives 2

2. AFFECTED ENVIRONMENT 6
2.1 Regional Setting 6
2.2 Local Setting 8

3. REGULATORY SETTING 21
3.1 State 21
3.1.1 Alquist-Priolo Earthquake Fault Zoning Act 21
3.1.2 California Building Code 22
3.1.3 Seismic Hazards Mapping Act 22
3.1.4 Caltrans Seismic Design Criteria 23
3.1.5 Surface Mining and Reclamation Act 23
3.2 Local 23
3.2.1 Los Angeles County Metropolitan Transportation Authority (Metro) 24

4. ENVIRONMENTAL CONSEQUENCES 24
4.1 Analytic Methodology 24
4.2 Environmental Criteria 25
4.3 Analysis 25
4.4 Cumulative Impacts 29

5. REFERENCES 30

Figures

Figure 1-1 Project Location 4
Figure 2-1 Geologic Formations Map 7
Figure 2-2 Oil Fields and Methane Zones Map 12
Figure 2-3 Seismic Hazards Map 14

Tables

Table 1-1 Station Locations..... 5

Table 2-1 Exposition Corridor Phase 2 Segment Summary..... 8

Table 2-2 Fault Summary—5th Street and Colorado Avenue.....15

Table 2-3 Fault Summary—Exposition Boulevard and Sepulveda Boulevard.....16

Table 2-4 Fault Summary—Exposition Boulevard and Venice Boulevard.....18

1. INTRODUCTION

1.1 Overview

This report examines the potential adverse impacts associated with geology, soils, and seismicity of the study area as a result of implementation of the proposed Exposition Corridor Transit Project Phase 2 (Expo Phase 2). The potential adverse effects on geology, soils, and seismicity have been identified from a review of available published and unpublished geotechnical literature pertinent to the proposed project. These include but are not limited to the safety elements of the general plans for the city and county of Los Angeles, and the cities of Culver City and Santa Monica; aerial photographs; Official Alquist-Priolo Earthquake Fault Zone Maps; Official Seismic Hazard Zone Maps; geologic and topographic maps; other publications by the California Geological Survey, the U.S. Geological Survey, and the California Division of Oil and Gas; and available geotechnical reports pertinent to the project.

The analysis of potential geologic and seismic impacts along the project alignment was determined specifically from (1) the Los Angeles County Seismic Safety Element (1990); (2) the City of Los Angeles Safety Element (1996); (3) the Seismic Hazard Zone Maps published by the California Division of Mines and Geology (1999); (4) Alquist-Priolo Earthquake Fault Zone Maps; and (5) reports prepared for the Los Angeles Metropolitan Transportation Authority (Metro) for the Expo Phase 2 project and for other Leighton Group, Inc. projects in the vicinity.

The determination of significance was based on guidelines established by CEQA. Per Section 15358 of the CEQA Guidelines, a significant geotechnical impact on the environment is defined as a substantial or potentially substantial adverse change in the physical environment due to the Expo Phase 2 project. A significant impact on the project is defined as one having a substantially or potentially substantial adverse effect on the Expo Phase 2 project.

1.2 Project Summary

The proposed Exposition Corridor Transit Project Phase 2 (referred to as either the Expo Phase 2 project or proposed project) would involve the implementation of new or upgraded corridor transit solutions within a western portion of Los Angeles County in the cities of Los Angeles, Culver City, and Santa Monica. Six alternatives are analyzed. The alternatives include the No-Build Alternative, Transportation Systems Management (TSM) Alternative, and four Light-Rail Transit (LRT) Alternatives. A brief description of these alternatives is provided below.

1.2.1 No-Build Alternative

The No-Build Alternative includes only Metro service features that currently exist or have been explicitly committed for project buildout in the year 2030. As such, the No-Build Alternative includes existing fixed guideway Metro Rail and Metro Liner bus rapid transit (BRT) systems currently under operation, the full implementation of the Metro Rapid Bus program, represented as twenty-eight routes across Los Angeles County, and planned peak-only rapid bus lanes along Wilshire Boulevard between Western Avenue and Bundy Drive. The rest of the bus network is based on June 2007 service patterns for Metro, Los Angeles Department of

Transportation (LADOT), Culver City, and Santa Monica Big Blue Bus, as well as committed enhancements to those services anticipated by 2030. Based on direction from Metro, their bus fleet will be assumed to include a mix of articulated and higher-capacity 45-foot buses in 2030.

1.2.2 Transportation Systems Management (TSM) Alternative

The TSM Alternative seeks to address the corridor transit needs without major capital investments and includes the improvements outlined in the No-Build Alternative plus three additional components. These three components include (1) addition of a rapid bus route connecting downtown Culver City with downtown Santa Monica; (2) associated service improvements on selected north/south routes to feed stations along the new rapid bus route; and (3) service improvements on selected routes, connecting Westside communities to the Phase 1 Terminus.

1.2.3 Light-Rail Transit (LRT) Alternatives

LRT is defined as a metropolitan electric railway system characterized by its ability to operate single cars or short trains along exclusive rights-of-way at ground level, on aerial structures, in subways, or, occasionally, in streets, and to board and discharge passengers at track or car-floor level. Light-rail vehicles are driven electrically with power drawn from an overhead electric line. LRT provides a cleaner, more energy-efficient form of transportation than automobiles and is quieter than conventional rail systems.

The LRT alignment would extend rail from the current Phase 1 terminus station at Venice/Robertson to a terminus station in Santa Monica at 4th Street and Colorado Avenue. The LRT Alternatives are as follows:

- LRT 1 (Expo ROW–Olympic Alternative) would utilize approximately 5 miles of the existing Expo ROW from the Expo Phase 1 terminus until reaching the intersection with Olympic Boulevard in Santa Monica. From that point, the alignment would follow Olympic Boulevard to the proposed terminus station.
- LRT 2 (Expo ROW–Colorado Alternative) would also utilize the existing Expo ROW from the Expo Phase 1 terminus until reaching the intersection with Olympic Boulevard in Santa Monica. From that point, the alignment would continue within the Expo ROW to west of 19th Street, then diverge from the Expo ROW and enter onto Colorado Avenue east of 17th Street and follow the center of Colorado Avenue to the proposed terminus.
- LRT 3 (Venice/Sepulveda–Olympic Alternative) would divert from the Expo ROW at the Expo Phase 1 terminus and follow Venice Boulevard and Sepulveda Boulevard until reaching the intersection with the Expo ROW. The alignment would then continue westward along the Expo ROW and Olympic Boulevard identical to the LRT 1 Expo ROW–Olympic Alternative.
- LRT 4 (Venice/Sepulveda–Colorado Alternative) would divert from the Expo ROW at the Expo Phase 1 terminus and follow Venice Boulevard and Sepulveda Boulevard until reaching the intersection with the Expo ROW. The alignment would then continue westward along the Expo ROW and Colorado Avenue identical to the LRT 2 Expo ROW–Colorado Alternative.

Geographic Segments

The proposed project traverses several jurisdictions, including the cities of Los Angeles, Culver City, and Santa Monica, and spans distinct communities within each jurisdiction. In order to account for these differences, the proposed project is described and examined at two different scales, from broad to specific—Westside of Los Angeles County and geographic segments with special consideration of proposed station areas—to identify potential impacts.

For purposes of this discussion, the LRT Alternatives have been divided into geographic segments for ease of analysis (Figure 1-1 [Project Location]). For the area between the Phase 1 terminus and the Exposition/Sepulveda intersection, there are two alternative alignments: Segment 1 (Expo ROW) and Segment 1a (Venice/Sepulveda). Segment 2 (Sepulveda to Cloverfield) is common to all LRT Alternatives. For the area between the Cloverfield/Olympic intersection and a terminus in Santa Monica, there are also two alternative alignments: Segment 3 (Olympic) and Segment 3a (Colorado). Thus, the segments are as follows:

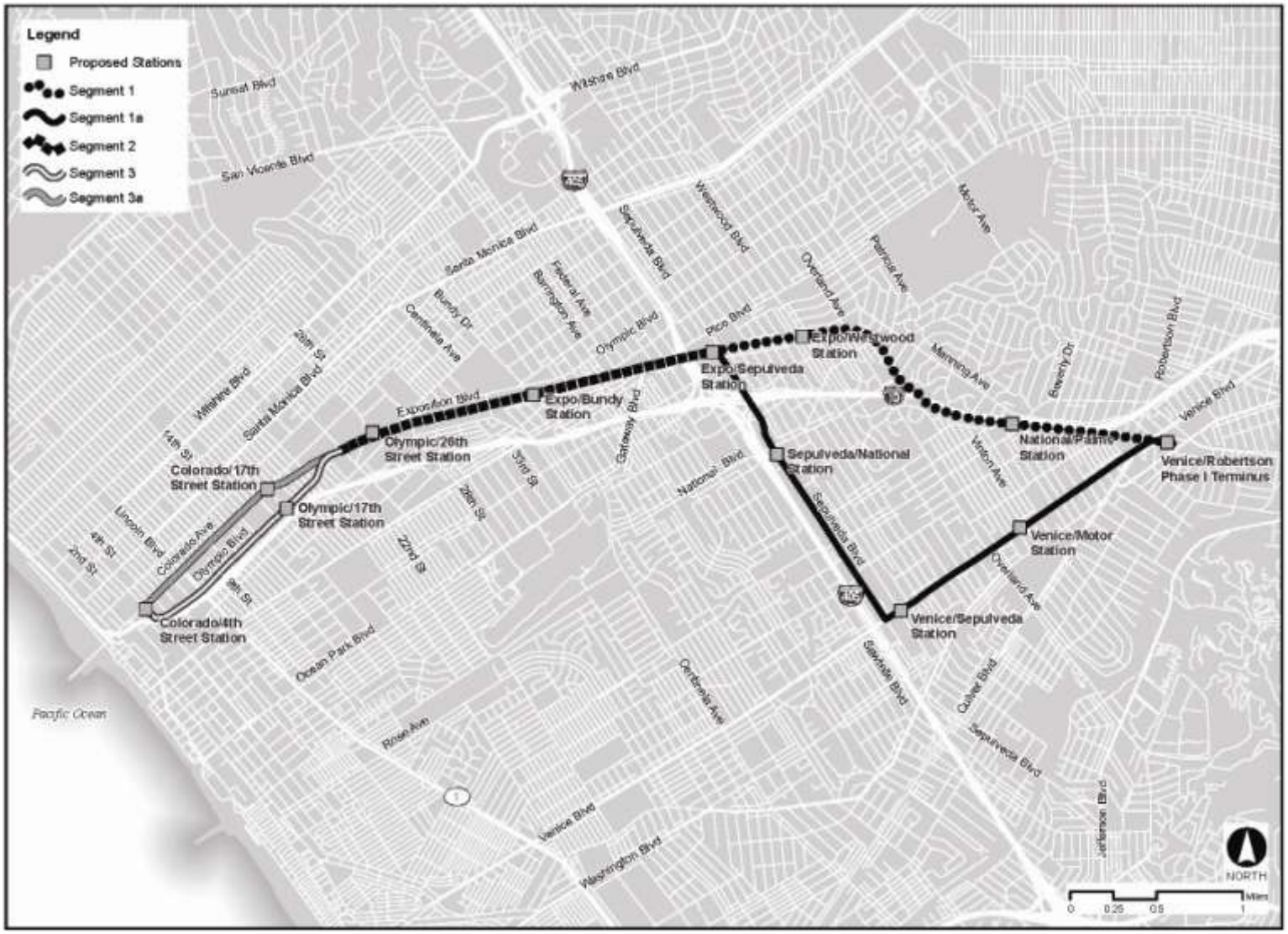
- Segment 1: Follows the Expo ROW from the Expo Phase 1 terminus station in Culver City to the Expo ROW/Sepulveda Boulevard intersection, approximately 2.8 miles in length
- Segment 1a: Follows westerly in the median of Venice Boulevard from the Expo Phase 1 terminus station in Culver City to the Venice Boulevard/Sepulveda Boulevard intersection, then follows northerly in the center of Sepulveda Boulevard to the Expo ROW/Sepulveda Boulevard intersection, approximately 3.7 miles in length
- Segment 2: Follows the Expo ROW from the Expo ROW/Sepulveda Boulevard intersection to the Expo ROW/Olympic Boulevard intersection, approximately 2.3 miles in length
- Segment 3: Follows the median of Olympic Boulevard from the Expo ROW/Olympic Boulevard intersection to the Phase 2 terminus option at 4th Street and Colorado Avenue in Santa Monica, approximately 1.5 miles in length
- Segment 3a: Follows the Expo ROW from the Expo ROW/Olympic Boulevard intersection to west of 19th Street in Santa Monica. The alignment then diverges onto Colorado Avenue east of 17th Street and continues along the center of Colorado Avenue terminating between 4th Street and 5th Street, approximately 1.5 miles in length.

In response to comments received on the DEIR and after further analysis and coordination with various stakeholders, five design options have been added in the FEIR for the LRT Alternatives:

- Sepulveda Grade Separation Design Option
- Expo/Westwood Station No Parking Design Option
- Maintenance Facility Buffer Design Option
- Colorado Parking Retention Design Option
- Colorado/4th Parallel Platform and South Side Parking Design Option

Stations

Table 1-1 (Station Locations) provides a description of each station within the various segments, including the approximate location, the type of proposed station (i.e., at grade or aerial), and the amount of parking to be provided.



Source: PBS&J, ESRI 2009

Figure 1-1 Project Location

Table 1-1 Station Locations

Name	Location	LRT: EXPO ROW Alignment	LRT: Venice/ Sepulveda Alignment	Parking
Segment 1: Expo ROW				
National/Palms	Expo ROW just west of the aerial structure over National Boulevard/Palms Boulevard	On Embankment	N/A	0
Expo/Westwood	Within Expo ROW, ~~E~~east of Westwood Boulevard ~~on Exposition Boulevard~~	At grade	N/A	170
Segment 1a: Venice/Sepulveda				
Venice/Motor	Venice Boulevard, east of Motor Avenue	N/A	At grade	0
Venice/Sepulveda	On Venice Boulevard, east of Sepulveda Boulevard	N/A	Aerial	0
Sepulveda/National	South of National Boulevard above the center of Sepulveda Boulevard	N/A	Aerial	250
Segment 2: Sepulveda to Cloverfield				
Expo/Sepulveda	West of Sepulveda Boulevard and Exposition Boulevard	At grade (aerial design option)	At grade (aerial design option)	~~270~~260
Expo/Bundy	Bundy Drive and Exposition Boulevard	Aerial	Aerial	250
Olympic/26th Street	East of 26th Street on Olympic	At grade	At grade	0
Segment 3: Olympic				
Olympic/17th Street	East and west side of 17th Street within the median of Olympic Boulevard	At grade	At grade	0
Colorado/4th	~~4th Street, east of Colorado Avenue~~On the existing commercial block bounded by 4th Street, 5th Street, and Colorado Avenue	Aerial	Aerial	~~250~~0
Segment 3a: Colorado				
Colorado/17th Street	Center of Colorado Avenue west of 17th Street	At grade	At grade	70
Colorado/4th	~~Center of Colorado Avenue between 2nd Street and 4th Street or o~~On the existing commercial block bounded by 4th Street, 5th Street, and Colorado Avenue	At grade	At grade	~~225~~0

SOURCE: DMJM Harris, 2008, updated 2009.

Maintenance Facilities

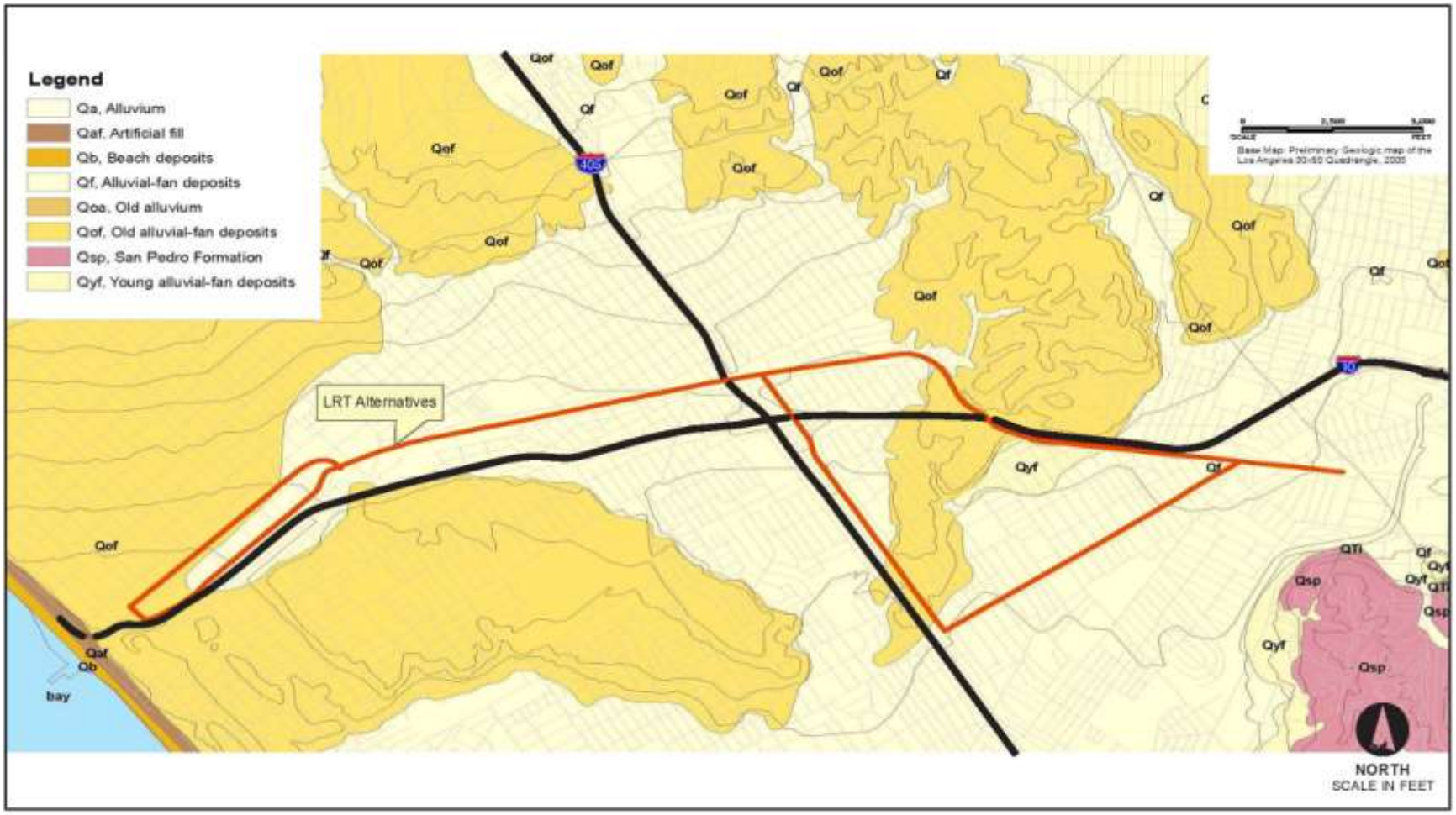
A Maintenance Facility is proposed to be constructed as a part of the Expo Phase 2 project. The Maintenance Facility site would be located on a parcel or parcels within the City of Santa Monica immediately south of the Expo ROW, north of Exposition Boulevard, and east of Stewart Street. The site is currently occupied by a surface parking lot and light-industrial facility. The maintenance facility is to be designed and built to meet the maintenance needs of the LRT vehicles required to operate Phase 2 through the year 2030. It could operate 24 hours a day in three shifts. The maintenance facility would consist of outdoor storage for ~~20 to 36~~approximately 43 to 45 LRT vehicles and associated storage track; trackway to connect to the main line and allow the movement of LRT vehicles from the main line track to and within the maintenance facility area; main yard shop building with office and vehicle repair areas; vehicle wash facility; traction power substation; and parking for 65~~ to 70~~ employees. The main yard shop structure would be approximately ~~300~~ 350 feet long and ~~166~~ 189 feet wide, two stories in height, and with a total area of approximately 125,000 square feet. The structure would be built of concrete block or corrugated metal or a combination thereof.

Since the release of the DEIR and in response to comments, the Expo Authority has worked with the City of Santa Monica, Metro, and the community to identify alternative layouts for the Maintenance Facility. As a result of these collaborative efforts, a Maintenance Facility Buffer Design Option has been developed for evaluation in the FEIR. This design option would occupy only a portion of the Verizon site, with an extension of the facility into the existing Santa Monica College parking lot to the west. Utilization of the adjacent parking lot on the west side of the Verizon site would create an approximate 100- to 110-foot buffer between the Maintenance Facility and the residential area on the south side of Exposition Boulevard. The Maintenance Facility Buffer Design Option would include much of the same facilities as the original Maintenance Facility concept.

2. AFFECTED ENVIRONMENT

2.1 Regional Setting

The Expo Phase 2 Corridor area geological and seismic hazard study area~~)~~ is located on the west side of Los Angeles County and ~~can be~~is defined ~~by~~ for this section as the Phase 1 Terminus Station to the east at Venice and Robertson Boulevards; the Pacific Ocean to the west; the Santa Monica Mountains to the north; and the Baldwin Hills to the south. Mountains and hills generally expose Late Cretaceous to Late Pleistocene-age sedimentary and igneous rocks and bound the great Los Angeles Basin along the north, northeast, east, and southeast (Yerkes 1965). The Los Angeles Basin is a northwest-trending structural trough, alluviated lowland plain, approximately 50 miles long and 20 miles wide. The Expo Phase 2 Corridor alignment traverses approximately 6.6 miles of Quaternary to Pleistocene age alluvial fan deposits within the southerly portion of the basin. For the past 15,000 years, the Ballona and Centinela Creeks have intermittently transported material eroded from the upland areas and deposited sand, silt, and clay as the creeks meandered across the floodplain of the Los Angeles Basin to Santa Monica Bay. The location of the study area in relation to the geologic formations within the area is shown in Figure 2-1 (Geologic Formations Map).



Source: Leighton Consulting Inc.

Figure 2-1 Geologic Formations Map

The geologic structure of the alluvial materials is anticipated to be generally massive. However, it can be interpreted, based on a geologic depositional environment typical of flood plain and alluvial deposits that cross-stratification (channel trough cross-stratification or traverse bar-tabular cross-stratification) sedimentary structure exists at depth. Possible relevance of these sedimentary features could include local impermeable zones with the potential for perched groundwater.

The Los Angeles Basin is part of the Peninsular Ranges geomorphic province of California that is characterized by sub-parallel blocks sliced longitudinally by young, steeply dipping northwest-trending fault zones. The Basin, located at the northerly terminus of the Peninsular Ranges, is the site of active sedimentation and the strata are interpreted to be as much as 31,000 feet thick in the center of the trough.

The eastern end of the alignment lies adjacent to a complex system of faults and folds that extend southeast through the Los Angeles Basin identified as the Newport-Inglewood structural zone. This structural zone is a controlling factor of the nearby Baldwin Hills geomorphology. The steep uplifted terrain of the Baldwin Hills is vulnerable to landsliding and erosion, triggered largely by sustained, heavy rains (CDMG 1982). Other landsliding in the region is largely due to the effects of ground shaking.

2.2 Local Setting

The Expo Phase 2 corridor generally extends between Culver City and Santa Monica. The alignment options have been sectioned off into five segments and are defined in Table 2-1 (Exposition Corridor Phase 2 Segment Summary). Segment stations and elevations have been taken from the Exposition Transit Project Phase 2 Plans and Profiles in Appendix E of the DEIR.

Table 2-1 Exposition Corridor Phase 2 Segment Summary

Segment No.	Segment Name	Approximate Station (feet)	Approximate Segment Length (feet)
1	Expo ROW	502+00 to 655+00	15,300
1a	Venice/Sepulveda	502+00 to 705+00	20,300
2	Sepulveda to Cloverfield	655+00 to 760+00	10,500
3	Olympic	760+00 to 850+00	9,000
3a	Colorado	760+00 to 850+00	9,000

Segment 1: Expo ROW to Sepulveda

Segment 1 is proposed to traverse the Expo ROW for an approximate distance of 2.9 miles between the intersection of S. Robertson Boulevard and Exposition Boulevard to the intersection of Sepulveda Boulevard and Exposition Boulevard. Existing elevation along this segment gradually increases from approximately 106 feet below mean sea level (msl) at the intersection of S. Robertson and Exposition Boulevard to approximately 169 feet (msl) at the intersection of Sepulveda Boulevard and Exposition Boulevard.

Anticipated underlying materials include artificial fill associated with the existing development of Exposition Boulevard and surrounding buildings and utilities. Fill materials are anticipated to be comprised of native alluvial soils. The young, Holocene in age (11,000 years old to recent) native alluvial soils are unconsolidated, detrital sediments consisting of variable amounts of gravel, sand, silt, and clay. Alluvial soils are anticipated to be in excess of 100 feet in depth within this portion of the alignment. In the area along the proposed Segment 1 from the intersection of Exposition Boulevard and Palms Boulevard to the intersection of Exposition Boulevard and Westwood Boulevard, older, Pleistocene age, alluvial sediments and shallow marine sediments are mapped (~~Dibblee 1991~~Leighton Consulting, Inc. 2007). These older sediments are weakly consolidated and are comprised of sand, gravel, and silt (~~Dibblee 1991~~Leighton Consulting, Inc. 2007).

Segment 1a: Venice/Sepulveda to Expo ROW

Segment 1a is proposed to traverse Venice Boulevard for approximately 1.9 miles from the intersection of S. Robertson Boulevard and Exposition Boulevard south to the intersection of Venice Boulevard and Sepulveda Boulevard, then turn north on to Sepulveda Boulevard and traverse approximately 1.9 miles to the intersection of Venice Boulevard and Exposition Boulevard. Existing elevations along this segment gradually decrease from approximately 106 feet (msl) at the intersection of S. Robertson Boulevard and Exposition Boulevard to approximately 60 feet (msl) at the intersection of Venice Boulevard and Sepulveda Boulevard, and then gradually increase to 169 feet (msl) at the intersection of Sepulveda Boulevard and Exposition Boulevard.

Anticipated underlying materials include artificial fill associated with the existing development of Venice and Sepulveda Boulevards and surrounding buildings and utilities. Fill materials are anticipated to be comprised of native alluvial soils. The native alluvial soils are Holocene in age (11,000 years old to recent), unconsolidated detrital sediments consisting of variable amounts of gravel, sand, silt, and clay. Alluvial soils are anticipated to be in excess of 100 feet in depth within this portion of the alignment. In the area along the proposed Segment 1a, from the intersection of Rose Avenue and Sepulveda Boulevard to the intersection of Venice Boulevard and Sepulveda Boulevard, older, Pleistocene age (1.6 million to 11,000 years old), alluvial detrital sediments and shallow marine sediments are mapped (~~Dibblee 1991~~Leighton Consulting, Inc. 2007). The older sediments are weakly consolidated and are comprised of sand, gravel, and silt (~~Dibblee 1991~~Leighton Consulting, Inc. 2007).

Segment 2: Expo ROW to Olympic

Segment 2 is proposed to traverse the Expo ROW for approximately 2.0 miles from the intersection of Sepulveda Boulevard and Exposition Boulevard to the intersection of Olympic Boulevard and 26th Street. Existing elevations along this segment gradually decrease from approximately 169 feet (msl) at the intersection of Sepulveda Boulevard and Exposition Boulevard to approximately 158 feet (msl) at the intersection of Olympic Boulevard and 26th Street.

Anticipated underlying materials include artificial fill associated with the existing development of Exposition Boulevard and surrounding buildings and utilities. Fill materials are anticipated to be comprised of native alluvial soils. The native alluvial soils are Holocene in age (10,000 years old to recent), unconsolidated detrital sediments consisting of variable amounts of gravel, sand, silt,

and clay (~~Dibblee 1991~~Leighton Consulting, Inc. 2007). Alluvial soils are anticipated to be in excess of 100 feet in depth along this portion of the alignment.

Segment 3: Olympic to Terminus

Segment 3 is proposed to traverse Olympic Boulevard for approximately 1.7 miles from the intersection of Olympic Boulevard and 26th Street to the intersection of Olympic Boulevard and 4th Street. Existing elevations along this segment gradually decrease from approximately 158 feet (msl) at the intersection of Olympic Boulevard and 26th Street to approximately 64 feet (msl) at the intersection of Olympic Boulevard and 4th Street.

Anticipated underlying materials include artificial fill associated with the existing development of Olympic Boulevard and surrounding buildings and utilities. Fill materials are anticipated to be comprised of native alluvial soils. The native alluvial soils are Holocene in age (10,000 years old to recent), unconsolidated detrital sediments consisting of variable amounts of gravel, sand, silt, and clay (~~Dibblee 1991~~Leighton Consulting, Inc. 2007). Alluvial soils are anticipated to be in excess of 100 feet in depth along this portion of the alignment. In the area along the proposed Segment 3 at the intersection of Olympic Boulevard and 4th Street, older alluvial sediments of Pleistocene age (1.6 million to 11,000 years old) are mapped (~~Dibblee 1991~~Leighton Consulting, Inc. 2007). The older sediments are unconsolidated to weakly consolidated and are comprised of varying amounts of gravel, sand, silt, and clay (~~Dibblee 1991~~Leighton Consulting, Inc. 2007).

Segment 3a: Expo ROW and Cloverfield to Terminus

Segment 3a is proposed to traverse Colorado Avenue approximately 1.7 miles from the intersection of Olympic Boulevard and 26th Street to the intersection of Colorado Avenue and 4th Street. An alternate station on the west end is planned at the intersection of Colorado Avenue and 2nd Street. Existing elevations along this segment gradually decrease from approximately 158 feet (msl) at the intersection of Olympic Boulevard and 26th Street to approximately 60 feet (msl) at the intersection of Colorado Avenue and 4th Street.

Anticipated underlying materials include artificial fill associated with the existing development of Colorado Avenue and surrounding buildings and utilities. Fill materials are anticipated to be comprised of native alluvial soils. The native alluvial soils are Holocene in age (10,000 years old to recent) unconsolidated detrital sediments consisting of variable amounts of gravel, sand, silt, and clay (~~Dibblee 1991~~Leighton Consulting, Inc. 2007). Alluvial soils are anticipated to be in excess of 100 feet in depth along this portion of the alignment. In the area along the proposed Segment 3a from the intersection of Colorado Avenue and 9th Street to the western terminus at Colorado Avenue and 4th Street, older, Pleistocene age (1.6 million to 11,000 years old), alluvial sediments are mapped, (~~Dibblee 1991~~Leighton Consulting, Inc. 2007). The older sediments are unconsolidated to weakly consolidated and are comprised of gravel, sand, silt, and clay (Dibblee 1991).

Groundwater

The project alignment is located in the Charnock sub-basin, which is a sub-basin of the Santa Monica Basin. The groundwater levels along the alignment range from approximately 30 feet to greater than 50 feet bgs as measured during a concurrent geotechnical investigation conducted by Leighton Consulting. Potentially perched groundwater conditions were observed in recent and previous investigations in the vicinity of the alignment and may be present along portions of

the alignment. Based on a review of a number sites on Geotracker, a regulatory database for cleanup sites, depth to groundwater from I-405 west toward the Colorado/4th Street Station is approximately 45 feet bgs, although, it has been reported to vary from approximately 25 to 55 feet bgs. In general, the proposed alignment between Washington Boulevard and Exposition Boulevard in Culver City to 4th Street and Colorado Avenue in Santa Monica is under-lain by contamination-affected groundwater. The contaminants typically are volatile organic compounds (VOCs), methyl tertiary-butyl ether (MTBE), tetrachloroethylene (i.e., perchloroethylene) (PCE) and trichloroethylene (TCE) (Leighton Consulting, Inc 2009).[1] ~~Groundwater levels east of Washington Boulevard have been historically greater than 10 feet beneath the existing ground surface (bgs). Groundwater levels west of Washington Boulevard have been historically greater than 30 feet bgs.~~ Groundwater is not expected to be a constraint since the alignment is to be constructed almost entirely at-grade with cuts less than 6 feet in depth.

Subsurface Gas

Based on maps from the California Division of Oil, Gas, and Geothermal Resources (~~Dibblee 1991~~Leighton Consulting, Inc. 2007), the alignment is located south of the Cheviot Hills Oil Field. Common problems associated with oil field properties include methane and hydrogen sulfide soil gas, oil seepage, contaminated soils, leaking wells, and wells not plugged and abandoned to current standards. Site-specific geotechnical investigations have not been initiated.

The Cheviot Hills Oil Field covers an area of approximately 800 acres and was discovered in 1958 in the northerly Los Angeles Basin along a line of hills that trend roughly northwest from Sawtelle to Los Angeles City oil fields. This trend is characterized by complex folding and faulting that occurred in the late Miocene age and also in the Plio/Pleistocene age along the Newport Inglewood Structural Fault Zone. The Cheviot Hills oil field is on the western limb of an anticlinal fold with a nearly east/west strike. The productive horizons are from Tertiary age Modelo Formation at depths between 4,500 and 7,200 feet along the zone.

Portions of the proposed alignment along Segment 1a are within the City of Los Angeles' Methane and Methane Buffer Zones. The location of the study area in relation to oil fields and the City of Los Angeles' Methane and Methane Buffer Zones is presented in Figure 2-2 (Oil Fields and Methane Zones Map).

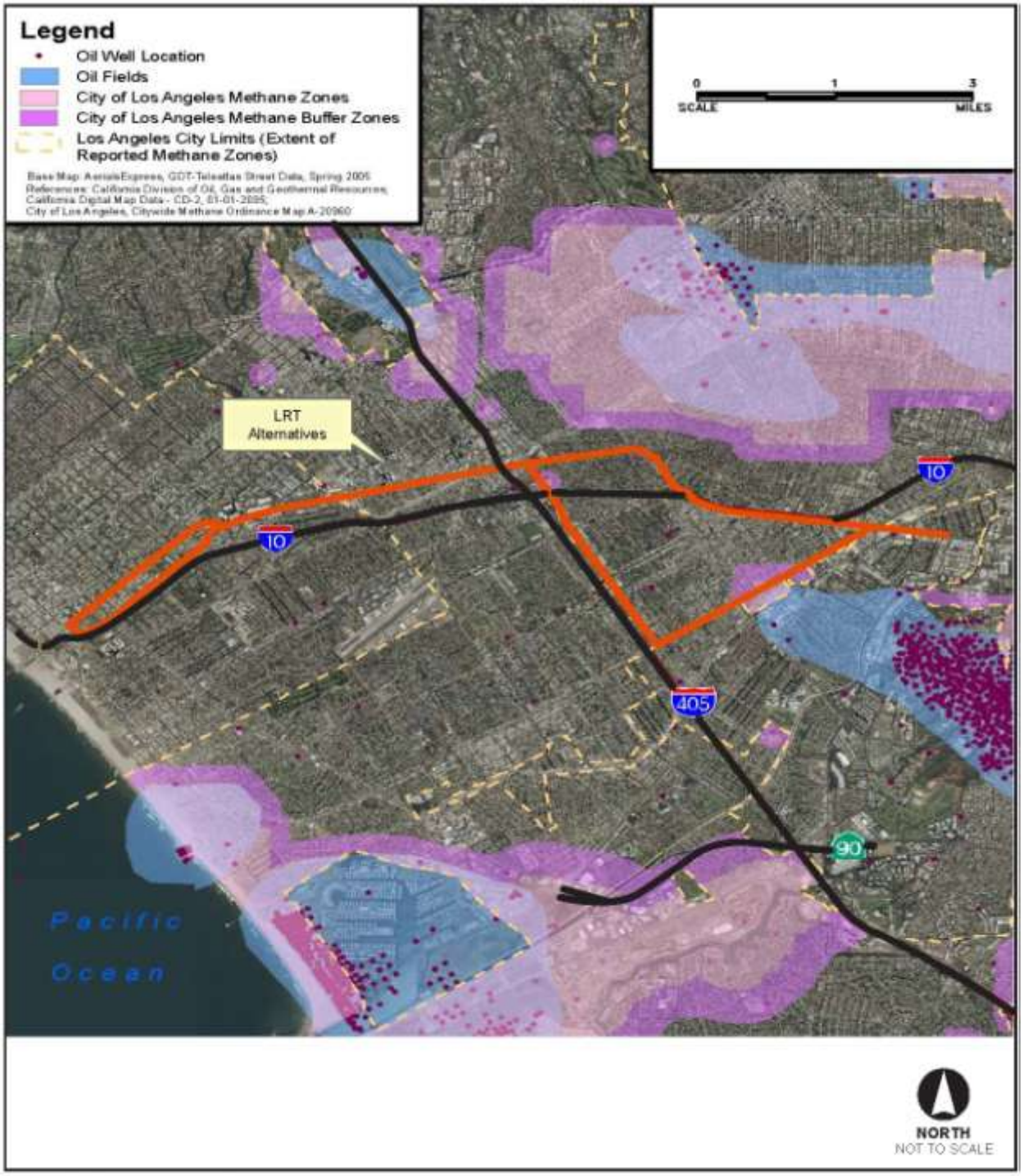
Corrosivity

Based on results of chemical testing performed as part of the previous investigation for the Exposition Corridor Transit Project Phase 1 (Expo Phase 1), which encountered similar non-marine alluvium, subsurface materials along Expo Phase 2 are expected to be classified as corrosive to severely corrosive to metals, and moderately deleterious to concrete.

Faults and Seismicity

The two principal seismic considerations for most properties in Southern California are surface rupturing of earth materials along fault traces and damage to structures due to seismically-induced ground shaking. The fault classification system adopted by the California Division of Mines and Geology (CDMG), relative to the state legislation delineating the Earthquake Fault

[1] Depth to groundwater measured for a project near 4th Street in Santa Monica indicated groundwater levels at about 47 to 50 feet bgs.



Source: Leighton Consulting Inc.

Figure 2-2 Oil Fields and Methane Zones Map

Zones along active or potentially active faults (Alquist-Priolo Act), is used for structures. An active fault is one that is known to have moved in Holocene time (the last 11,000 years). A fault that is known to have moved during the last 1.6 million years (Pleistocene time), but has not been proven by direct evidence to have either moved or not moved within the last 11,000 years, is considered to be potentially active. Any fault proven to not have moved within the last 11,000 years is considered inactive.

The Expo Phase 2 alignments, at the eastern end near the Baldwin Hills, are adjacent to the northerly projection of the Newport-Inglewood fault zone. The westernmost section of the Expo Phase 1 alignment, immediately east of the Expo Phase 2 alignments, is located within a designated Alquist-Priolo special fault study zone associated with the Newport-Inglewood Fault (refer to Figure 2-3 [Seismic Hazards Map]). West of the Newport-Inglewood fault zone and mapped as traversed by the alignment, are the Overland Avenue fault and Charnock fault. Summaries of the known faults along the alignments are included in Table 2-2 (Fault Summary—5th Street and Colorado Avenue), Table 2-3 (Fault Summary—Exposition Boulevard and Sepulveda Boulevard), and Table 2-4 (Fault Summary—Exposition Boulevard and Venice Boulevard).

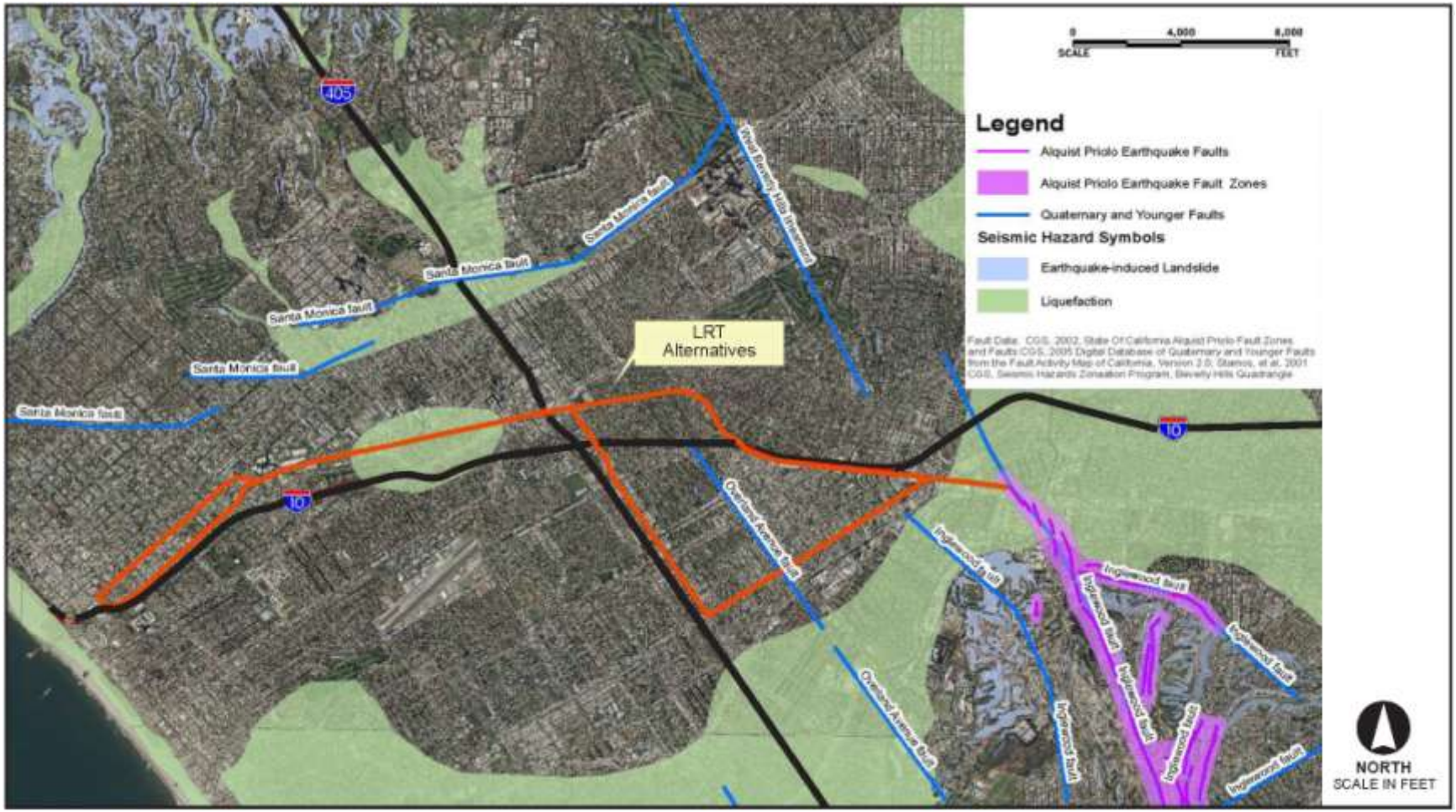
The Overland Avenue fault is inferred to cut late Pleistocene terrace deposits and to be concealed under alluvium (Poland et al. 1959). The dip of the Overland Avenue fault is unknown and the western side has dropped approximately 30 feet, apparently forming a groundwater barrier (Poland et at., 1959). The fault fails to displace the “50-foot gravel” of the Ballona Gap, which is apparently earliest Holocene or Pre-Holocene (Poland et al. 1959). The fault has not been observed at the surface.

The Charnock fault is an inferred fault paralleling the trend of the Overland Avenue fault. It is east side down, thus the area between the Charnock and Overland Avenue faults is apparently a graben. The angle of the Charnock fault is not known. The Charnock fault fails to displace the “50-foot gravel” of the Ballona Gap (Poland et al., 1959), but is depicted as cutting the upper Pleistocene deposits. The fault has not been observed at the surface. The Overland Avenue and Charnock faults are probably Pre-Holocene and thus do not meet the state’s current definition of an active fault.

Based on the current understanding of the geologic framework of the area, the seismic hazard which is expected to have the highest probability of impacting the alignment is ground shaking resulting from an earthquake occurring along any of several major active and potentially active faults in Southern California. Known regional active faults that could produce significant ground shaking at the site include the Puente Hills Blind Thrust, Upper Elysian Park Blind Thrust, Newport-Inglewood, Hollywood, and Raymond faults, among others. The closest of these is the Newport-Inglewood fault, with a surface projection of potential rupture area located in the eastern section of the alignment. The location of the alignment in relation to known faults is shown on Figure 2-3 (Seismic Hazards Map).

Liquefaction

Liquefaction is the loss of soil strength or stiffness due to a build up of pore-water pressure during severe ground shaking. Liquefaction is associated primarily with loose (low density), saturated, fine- to medium-grained, cohesion-less soils. Effects of severe liquefaction can include sand boils, excessive settlement, bearing capacity failures, and lateral spreading.



Source: Leighton Consulting Inc.

Figure 2-3 Seismic Hazards Map

Table 2-2 Fault Summary—5th Street and Colorado Avenue

Abbreviated Fault Name	Approximate Distance mi	Approximate Distance (km)	Estimated Maximum Earthquake Event: Maximum Earthquake Magnitude (Mw)	Estimated Maximum Earthquake Event: Peak Site Acceleration (g)	Estimated Maximum Earthquake Event: Estimated Site Intensity (Modified Mercalli)
Santa Monica	1.3	(2.1)	6.6	0.626	X
Malibu Coast	2.7	(4.3)	6.7	0.537	X
Newport-Inglewood (LA Basin)	6.2	(9.9)	7.1	0.331	IX
Palos Verdes	6.6	(10.7)	7.3	0.338	IX
Hollywood	6.8	(11.0)	6.4	0.307	IX
Anacapa-Dume	11.8	(19.0)	7.5	0.337	IX
Puente Hills Blind Thrust	11.9	(19.1)	7.1	0.286	IX
Upper Elysian Park Blind Thrust	13.2	(21.2)	6.4	0.181	VIII
Northridge (E. Oak Ridge)	15.2	(24.4)	7.0	0.224	IX
Verdugo	16.1	(25.9)	6.9	0.201	VIII
Raymond	17.0	(27.4)	6.5	0.151	VIII
Sierra Madre (San Fernando)	19.4	(31.3)	6.7	0.149	VIII
Santa Susana	20.1	(32.3)	6.7	0.144	VIII
Sierra Madre	21.3	(34.3)	7.2	0.183	VIII
Simi-Santa Rosa	23.2	(37.3)	7.0	0.149	VIII
San Gabriel	24.2	(38.9)	7.2	0.126	VIII
Holser	26.0	(41.9)	6.5	0.094	VII
Whittier	27.2	(43.7)	6.8	0.086	VII
Oak Ridge (Onshore)	27.9	(44.9)	7.0	0.122	VII
Clamshell-Sawpit	30.0	(48.3)	6.5	0.079	VII
San Cayetano	33.0	(53.1)	7.0	0.101	VII
San Jose	34.8	(56.0)	6.4	0.060	VI
San Joaquin Hills	38.8	(62.5)	6.6	0.061	VI
Chino-Central Ave. (Elsinore)	40.3	(64.8)	6.7	0.063	VI
San Andreas-Whole M-1a	42.7	(68.7)	8.0	0.113	VII
San Andreas-Mojave M-1b-1	42.7	(68.7)	7.4	0.079	VII
San Andreas-1857Rupture M-2a	42.7	(68.7)	7.8	0.100	VII
San Andreas-Cho-Moj M-1b-1	42.7	(68.7)	7.8	0.100	VII
Oak Ridge (Blind Thrust Offshore)	42.9	(69.1)	7.1	0.079	VII
Ventura-Pitas Point	43.7	(70.3)	6.9	0.066	VI
Cucamonga	43.7	(70.4)	6.9	0.066	VI

Table 2-2 Fault Summary—5th Street and Colorado Avenue

Abbreviated Fault Name	Approximate Distance mi	Approximate Distance (km)	Estimated Maximum Earthquake Event: Maximum Earthquake Magnitude (Mw)	Estimated Maximum Earthquake Event: Peak Site Acceleration (g)	Estimated Maximum Earthquake Event: Estimated Site Intensity (Modified Mercalli)
Newport-Inglewood (Offshore)	44.1	(71.0)	7.1	0.059	VI
Channel Island Thrust (Eastern)	44.6	(71.7)	7.5	0.100	VII
Santa Ynez (East)	45.5	(73.2)	7.1	0.057	VI
San Andreas-Carrizo M-1c-2	47.3	(76.1)	7.4	0.068	VI
Oak Ridge Mid-Channel Structure	47.9	(77.1)	6.6	0.049	VI
Mission Ridge-Arroyo Parida Santa Ana	49.8	(80.2)	7.2	0.070	VI
Elsinore (Glen Ivy)	50.1	(80.7)	6.8	0.040	V
Red Mountain	52.5	(84.5)	7.0	0.056	VI
San Jacinto-San Bernardino	58.5	(94.2)	6.7	0.030	V
Santa Cruz Island	58.7	(94.5)	7.0	0.048	VI
San Andreas-SB M-1	60.0	(96.5)	7.5	0.054	VI
San Andreas-SB-Coach. M-2b	60.0	(96.5)	7.7	0.063	VI
San Andreas-SB-Coach. M-1b-2	60.0	(96.5)	7.7	0.063	VI
Garlock (West)	60.3	(97.0)	7.3	0.046	VI
Coronado Bank	60.8	(97.9)	7.6	0.057	VI
Pleito Thrust	61.2	(98.5)	7.0	0.046	VI

SOURCE: EQFAULT (Blake, 2000)

Peak Site Acceleration based on Sadigh et al. (1997)

Table 2-3 Fault Summary—Exposition Boulevard and Sepulveda Boulevard

Abbreviated Fault Name	Approximate Distance mi	Approximate Distance (km)	Estimated Maximum Earthquake Event: Maximum Earthquake Magnitude (Mw)	Estimated Maximum Earthquake Event: Peak Site Acceleration (g)	Estimated Maximum Earthquake Event: Estimated Site Intensity (Modified Mercalli)
Santa Monica	1.1	(1.8)	6.6	0.642	X
Newport-Inglewood (LA Basin)	2.6	(4.2)	7.1	0.449	X
Hollywood	3.7	(6.0)	6.4	0.429	X
Malibu Coast	5.7	(9.2)	6.7	0.392	X

Table 2-3 Fault Summary—Exposition Boulevard and Sepulveda Boulevard

Abbreviated Fault Name	Approximate Distance mi	(km)	Estimated Maximum Earthquake Event: Maximum Earthquake Magnitude (Mw)	Peak Site Acceleration (g)	Estimated Site Intensity (Modified Mercalli)
Puente Hills Blind Thrust	8.6	(13.8)	7.1	0.355	IX
Upper Elysian Park Blind Thrust	9.7	(15.6)	6.4	0.237	IX
Palos Verdes	9.8	(15.8)	7.3	0.274	IX
Raymond	13.5	(21.7)	6.5	0.191	VIII
Verdugo	13.5	(21.7)	6.9	0.235	IX
Northridge (E. Oak Ridge)	14.3	(23.0)	7.0	0.235	IX
Anacapa-Dume	15.3	(24.6)	7.5	0.282	IX
Sierra Madre (San Fernando)	17.6	(28.4)	6.7	0.165	VIII
Sierra Madre	18.2	(29.3)	7.2	0.211	VIII
Santa Susana	19.4	(31.2)	6.7	0.150	VIII
San Gabriel	21.4	(34.5)	7.2	0.141	VIII
Simi-Santa Rosa	23.7	(38.2)	7.0	0.146	VIII
Whittier	24.0	(38.7)	6.8	0.098	VII
Holser	25.5	(41.1)	6.5	0.096	VII
Clamshell-Sawpit	26.5	(42.6)	6.5	0.092	VII
Oak Ridge (Onshore)	28.5	(45.9)	7.0	0.119	VII
San Jose	31.5	(50.7)	6.4	0.68	VI
San Cayetano	33.5	(53.9)	7.0	0.099	VII
San Joaquin Hills	37.1	(59.7)	6.6	0.065	VI
Chino-Central Ave. (Elsinore)	37.2	(59.8)	6.7	0.070	VI
San Andreas-Whole M-1a	40.1	(64.5)	8.0	0.121	VII
San Andreas-Mojave M-1c-3	40.1	(64.5)	7.4	0.082	VII
San Andreas-1857Rupture M-2a	40.1	(64.5)	7.8	0.107	VII
San Andreas-Cho-Moj M-1b-1	40.1	(64.5)	7.8	0.107	VII
Cucamonga	40.3	(64.8)	6.9	0.073	VII
Newport-Inglewood (Offshore)	42.8	(68.8)	7.1	0.062	VI
Ventura-Pitas Point	45.8	(73.7)	6.9	0.062	VI
Santa Ynez (East)	46.0	(74.1)	7.1	0.056	VI
San Andreas-Carrizo M-1c-2	46.0	(74.1)	7.4	0.070	VI
Oak Ridge (Blind Thrust Offshore)	46.1	(74.2)	7.1	0.072	VI
Elsinore (Glen Ivy)	47.3	(76.2)	6.8	0.043	VI

Table 2-3 Fault Summary—Exposition Boulevard and Sepulveda Boulevard

Abbreviated Fault Name	Approximate Distance mi	(km)	Estimated Maximum Earthquake Event: Maximum Earthquake Magnitude (Mw)	Peak Site Acceleration (g)	Estimated Site Intensity (Modified Mercalli)
Channel Is. Thrust (Eastern)	47.8	(76.9)	7.5	0.092	VII
Oak Ridge Mid-Channel Structure	50.6	(81.4)	6.6	0.043	VI
Mission Ridge-Arroyo Parida Santa Ana	51.6	(83.0)	7.2	0.067	VI
Red Mountain	54.7	(88.0)	7.0	0.053	VI
San Jacinto-San Bernardino	55.0	(88.5)	6.7	0.032	V
San Andreas-SB M-1	56.4	(90.7)	7.5	0.058	VI
San Andreas-SB-Coach. M-1b-2	56.4	(90.7)	7.7	0.068	VI
San Andreas-SB-Coach. M-2b	56.4	(90.7)	7.7	0.068	VI
Cleghorn	58.7	(94.5)	6.5	0.025	V
Garlock (West)	60.3	(97.0)	7.3	0.046	VI
Coronado Bank	60.4	(97.2)	7.6	0.058	VI
Pleito Thrust	61.1	(98.4)	7.0	0.046	VI
Santa Cruz Island	62.0	(99.8)	7.0	0.045	VI

SOURCE: EQFAULT (Blake, 2000)
Peak Site Acceleration based on Sadigh et al. (1997)

Table 2-4 Fault Summary—Exposition Boulevard and Venice Boulevard

Abbreviated Fault Name	Approximate Distance mi	(km)	Estimated Maximum Earthquake Event: Maximum Earthquake Magnitude (Mw)	Peak Site Acceleration (g)	Estimated Site Intensity (Modified Mercalli)
Newport-Inglewood (LA Basin)	0.5	(0.8)	7.1	0.555	X
Santa Monica	2.8	(4.5)	6.6	0.519	X
Hollywood	4.0	(6.4)	6.4	0.416	X
Puente Hills Blind Thrust	6.5	(10.4)	7.1	0.415	X
Upper Elysian Park Blind Thrust	8.1	(13.1)	6.4	0.271	IX
Malibu Coast	9.2	(13.2)	6.7	0.314	IX
Palos Verdes	10.9	(17.6)	7.3	0.256	IX

Table 2-4 Fault Summary—Exposition Boulevard and Venice Boulevard

Abbreviated Fault Name	Approximate Distance mi	(km)	Estimated Maximum Earthquake Event: Maximum Earthquake Magnitude (Mw)	Peak Site Acceleration (g)	Estimated Site Intensity (Modified Mercalli)
Raymond	11.6	(18.6)	6.5	0.219	IX
Verdugo	12.6	(20.3)	6.9	0.235	IX
Northridge (E. Oak Ridge)	15.1	(24.3)	7.0	0.235	IX
Sierra Madre	17.0	(27.4)	7.2	0.282	IX
Sierra Madre (San Fernando)	17.5	(28.1)	6.7	0.165	VIII
Anacapa-Dume	17.7	(28.5)	7.5	0.211	IX
Santa Susana	20.7	(33.3)	6.7	0.150	VIII
San Gabriel	21.0	(33.8)	7.2	0.141	VIII
Whittier	21.5	(34.6)	6.8	0.146	VII
Clamshell-Sawpit	24.5	(39.4)	6.5	0.098	VII
Simi-Santa Rosa	25.7	(41.3)	7.0	0.096	VIII
Holser	26.8	(43.2)	6.5	0.092	VII
San Jose	29.0	(46.7)	6.4	0.119	VII
Oak Ridge (Onshore)	30.4	(48.9)	7.0	0.68	VII
Chino-Central Ave. (Elsinore)	34.7	(55.9)	6.7	0.099	VII
San Joaquin Hills	34.9	(56.1)	6.6	0.065	VI
San Cayetano	35.3	(56.8)	7.0	0.070	VII
Cucamonga	38.0	(61.1)	6.9	0.121	VII
San Andreas-Whole M-1a	39.5	(63.5)	8.0	0.082	VII
San Andreas-Mojave M-1c-3	39.5	(63.5)	7.4	0.107	VII
San Andreas-1857Rupture M-2a	39.5	(63.5)	7.8	0.107	VII
San Andreas-Cho-Moj M-1b-1	39.5	(63.5)	7.8	0.073	VII
Newport-Inglewood (Offshore)	40.7	(65.5)	7.1	0.062	VI
Elsinore (Glen Ivy)	44.7	(72.0)	6.8	0.062	VI
San Andreas-Carrizo M-1c-2	46.8	(75.3)	7.4	0.056	VI
Santa Ynez (East)	48.0	(77.2)	7.1	0.070	VI
Ventura – Pintas Point	48.3	(77.7)	6.9	0.072	VI
Oak Ridge (Blind Thrust Offshore)	48.6	(78.2)	7.1	0.043	VI
Channel Is. Thrust (Eastern)	50.3	(81.0)	7.5	0.092	VII
San Jacinto-San Bernardino	52.7	(84.8)	6.7	0.034	V
Oak Ridge Mid-Channel Structure	53.1	(85.5)	6.6	0.040	V

Table 2-4 Fault Summary—Exposition Boulevard and Venice Boulevard

Abbreviated Fault Name	Approximate Distance mi	(km)	Estimated Maximum Earthquake Event: Maximum Earthquake Magnitude (Mw)	Peak Site Acceleration (g)	Estimated Site Intensity (Modified Mercalli)
Mission Ridge-Arroyo Parida Santa Ana	53.9	(86.7)	7.2	0.063	VI
San Andreas-SB M-1	54.2	(87.2)	7.5	0.061	VI
San Andreas-SB-Coach. M-1b-2	54.2	(87.2)	7.7	0.058	VI
San Andreas-SB-Coach. M-2b	54.2	(87.2)	7.7	0.068	VI
Cleghorn	56.5	(90.9)	6.5	0.068	V
Red Mountain	57.1	(91.9)	7.0	0.025	VI
Coronado Bank	58.8	(94.6)	7.6	0.046	VI
Garlock (West)	61.8	(99.4)	7.3	0.045	VI

SOURCE: EQFAULT (Blake, 2000)
Peak Site Acceleration based on Sadigh et al. (1997)

A review of the Seismic Hazard Zones Map for Beverly Hills Seismic Hazard Zones Map (CDMG 1999) indicates that portions of the proposed project alignment are in an area mapped as being susceptible to liquefaction (Figure 2-3 [Seismic Hazards Map]). However, due to the depth to groundwater of the project site, potential impacts from liquefaction are considered low. Since the risk due to liquefaction is considered low, so also is the risk for lateral spreading considered low.

Segment 1: Expo ROW to Sepulveda

Liquefiable alluvial soils have been mapped along the eastern end of Segment 1, east of Station 500+00.

Segment 1a Venice/Sepulveda to Expo ROW

Liquefiable alluvial soils have been mapped in the general area and may be encountered along this segment of the alignment.

Segment 2: Expo ROW to Olympic

Liquefiable alluvial soils have been mapped in the area along Olympic Boulevard between the intersection of Olympic Boulevard and Stewart Street and the intersection of Olympic Boulevard and Pico Boulevard. The planned Segment 2 runs along this portion of Olympic Boulevard from approximately Station 680+00 to 735+00, underlying over 5,500 feet of the proposed development.

Segment 3: Olympic to Terminus

Liquefiable alluvial soils have been mapped in the general areas around Segment 3 and may be encountered along this segment of the alignment.

Segment 3a: Expo ROW and Colorado to Terminus

Liquefiable alluvial soils have been reported in the general areas around Segment 3a and may be encountered along this segment of the alignment.

Landslides

The topography of the alignment is relatively flat. The project area is not mapped as being at risk for landslides. Therefore, the potential for landslides is considered low.

3. REGULATORY SETTING

Information on geology, soils, and seismicity has been identified as a result of a review of available published and unpublished literature from applicable state and local agencies. Presented below are brief discussions of the regulatory framework applicable to the jurisdictions located within the study area.

3.1 State

3.1.1 Alquist-Priolo Earthquake Fault Zoning Act

The State of California legislation protecting the population of California from the effects of fault-line ground-surface rupture is the Alquist-Priolo Earthquake Fault Zoning Act. This State law was passed in response to the 1971 San Fernando Earthquake, which was associated with extensive surface fault ruptures that damaged numerous homes, commercial buildings, and other structures. At the directive of the Act, in 1972 the State Geologist began delineating Earthquake Fault Zones (called Special Studies Zones prior to 1994) around active and potentially active faults to reduce fault-rupture risks to structures for human occupancy.[2] This Act has resulted in the preparation of maps delineating Earthquake Fault Zones to include, among others, recently active segments of the Newport-Inglewood and San Andreas faults. The Act provides for special seismic design considerations if developments are planned in areas adjacent to active or potentially active faults.[3] The project site is not in a State of California

[2] Alquist-Priolo Earthquake Fault Zoning Act, California Public Resources Code, Division 2, "Geology, Mines, and Mining," Chapter 7.5 "Earthquake Fault Zones," Sections 2621 through 2630; signed into law December 22, 1972, most recently amended October 07, 1997.

[3] Hart, E.W., and W.A. Bryant. Interim Revision 2007. "Fault-Rupture Hazard Zones in California, Alquist-Priolo Earthquake Fault Zoning Act with Index to Earthquake Fault Zones Maps." California Division of Mines and Geology, Special Publication 42, 42 p. ~~California Geological Survey. 2003. CGS Special Publication 42, *Fault-Rupture Hazard Zones in California, Alquist-Priolo Earthquake Fault Zoning Act with Index to Earthquake Fault Zones Maps*. Revised 1997, Supplements 1 and 2, 1999, Supplement 3, 2003. Authors, E.W. Hart and W.A. Bryant.~~

Earthquake Fault Zone. The active Newport-Inglewood Fault Zone is approximately ¾-mile southwest of the site.

3.1.2 California Building Code

The State of California regulations to protect~~ing~~ the public from geo-seismic hazards, other than surface faulting, are contained in the 2007 California Code of Regulations, Title 24, Part 2 (the California Building Code [CBC]) and California Public Resources Code, Division 2, Chapter 7.8 (the Seismic Hazards Mapping Act). Both of these regulations apply to public buildings (and a large percentage of private buildings) intended for human occupancy.

Until January 1, 2008, the California Building Code (CBC) was based on the then-current Uniform Building Code and contained Additions, Amendments and Repeals specific to building conditions and structural requirements in the State of California. The 2007 CBC, effective January 1, 2008, is based on the current (2006) International Building Code and contains prominent enhancement of the sections dealing with fire safety, equal access for disabled persons, and environmentally friendly construction.[4] Each jurisdiction in the state may adopt its own building code based on the 2007 CBC. Local codes are permitted to be more stringent than Title 24, but, at a minimum, are required to meet all state standards and enforce the regulations of the 2007 CBC beginning January 1, 2008.

Chapters 16 and 16A of the 2007 CBC deal with Structural Design requirements governing seismically resistant construction, including (but not limited to) factors and coefficients used to establish seismic site class and seismic occupancy category for the soil/rock at the building location and the proposed building design. Chapters 18 and 18A of the 2007 CBC include (but are not limited to) the requirements for foundation and soil investigations (Sections 1802 & 1802A); excavation, grading, and fill (Sections 1803 & 1803A); allowable load-bearing values of soils (Sections 1804 & 1804A); and the design of footings, foundations, and slope clearances (Sections 1805 & 1805A), retaining walls (Sections 1806 & 1806A), and pier, pile, driven, and cast-in-place foundation support systems (Sections 1808, 1808A, 1809, 1809A, 1810 & 1810A). Chapter 33 of the 2007 CBC includes (but is not limited to) requirements for safeguards at work sites to ensure stable excavations and cut or fill slopes (Section 3304). Appendix J of the 2007 CBC includes (but is not limited to) grading requirements for the design of excavations and fills (Sections J106 & J107) and for erosion control (Section J110). The 2007 CBC would apply to the transit stations and the maintenance facility.

3.1.3 Seismic Hazards Mapping Act

The State of California Seismic Hazards Mapping Act became effective in 1991 to identify and map seismic hazard zones for the purpose of assisting cities and counties in preparing the safety elements of their general plans and to encourage land use management policies and regulations that reduce seismic hazards. The recognized hazards include strong groundshaking, liquefaction, landslides, and other ground failure. These effects account for approximately 95 percent of economic losses caused by earthquakes. The Act has resulted in the preparation of maps delineating Liquefaction and Earthquake-Induced Landslide Zones of Required Investigation. Mapping has been completed for the Newport Beach quadrangle, which contains

[4] California Building Standards Commission, *2007 California Building Code*, California Code of Regulations, Title 24, Part 2, Volumes 1 and 2, effective January 1, 2008.

the project site, and the official map was issued in April, 1997. The project site is in a zone of potential liquefaction. This information is reflected in the City's General Plan Environmental Hazards Element goals and policies (see below). The City's enforcement of its Building Code (see below) ensures the project would be consistent with those goals and policies and would comply with the requirements that derive from the Seismic Hazards Mapping Act.

3.1.4 Caltrans Seismic Design Criteria

The State of California has established construction standards and design criteria for roadways to safeguard life and property. Construction standards and seismic design criteria are contained in such regulatory codes as Caltrans' *Seismic Design Criteria Version 1.2* (Caltrans 2001, December); *Highway Design Manual*, Section 110.6 (Earthquake Consideration) and Section 113 (Geotechnical Design Report) (Caltrans 2001, November); and similar codes adopted by a city for roadway corridor protection. The *Seismic Design Criteria* would apply to any roadway widening required for the project.

State guidelines protecting bridges and overpasses from geo-seismic hazards are contained in Caltrans' Bridge Design Specifications, Bridge Memos to Designers, Bridge Design Practices Manual, and Bridge Design Aids Manual. Bridge design must be based on the "Load Factor Design methodology with HS20 44 live loading" (a procedure to incorporate the estimated weight of the vehicles and/or pedestrians on the bridge with the weight of the bridge for loading calculations). Seismic resistant design is required to conform to the Bridge Design Specifications, and Section 20 of Bridge Memos to Designers, as well as the Caltrans Seismic Design Criteria. The Bridge Design Specifications would apply to the project-proposed aerial structures.

3.1.5 Surface Mining and Reclamation Act

The State legislation regulating mineral resource zones is the Surface Mining and Reclamation Act of 1975.[5] This classifies mineral resources in the State and assures resource conservation in areas of competing land uses. The law has resulted in the preparation of Mineral Land Classification Maps delineating Mineral Resource Zones (MRZ) 1 through 4 for aggregate resources (sand, gravel, and stone).

3.2 Local

The Cities of Culver City, Los Angeles, and Santa Monica all have departments (i.e., public works), and documents (e.g., requirements for geotechnical technical reports prior to building construction) that regulate and oversee issues related to geology, soils, seismicity, and hazardous materials within the study area.

Section 15.02.100 of the Culver City Municipal Code has adopted the California Building Code as the Building Code for Culver City. The City of Los Angeles has adopted the 2007 CBC as the basis for its Building Code (Municipal Code Title 17, Chapter 17.04) through Ordinance No. 3789, adopted December 3, 2007. The *City of Santa Monica Municipal Code* Chapter 8.12

[5] Surface Mining and Reclamation Act of 1975, California Public Resources Code Division 2, Chapter 9, Section 2710 et seq., 1975.

(Building Code) has adopted the 2007 *California Building Code* for the Building Code for the City of Santa Monica.

3.2.1 Los Angeles County Metropolitan Transportation Authority (Metro)

Metro Design Criteria

In addition to the above-mentioned jurisdictions' policy documents, regulations pertaining to the visual quality and aesthetics of the proposed project would be required to comply with Metro's *Metro Design Criteria*. The *Metro Design Criteria* establishes the design criteria for preliminary engineering and final design of the Metro's Mid-City/Exposition Light-Rail Transit (LRT) Project. These criteria provide a uniform basis for the design of the LRT Project, and with suitable modification, for other future technology rail projects.

The *Metro Design Criteria* addresses seismic hazards in Section 5 (Structural). Section 5.1.2 (C) requires that all bridges and aerial structures be developed in accordance with Caltrans *Bridge Design Specifications*, Section 5.2.4 (Earthquake Forces) requires that stations and other structures not subject to rail transit loading be designed in accordance with county or City building codes depending on the jurisdiction where the structure is located. Section 5.8 (Soils and Geologic Data) requires that a geotechnical engineer shall investigate the subsurface conditions, perform laboratory testing, describe the geologic features of the area, and shall make recommendations relative to geotechnical behavior to be considered for design and construction. These findings shall be given in a Geotechnical Investigation Report prepared by the geotechnical engineer.

Additionally, Appendix A (Supplemental Criteria for Seismic Design of Aerial Structures and Bridges) to Section 5 of the *Metro Design Criteria* supersedes the standards set forth in Section 5 for all matters pertaining to the design of Metro bridges, aerial guideways and other operationally critical facilities on, or structurally supported, either above the ground surface or independently inside a below ground structure. All new structures shall be designed to resist the earthquake forces (EQ) and the ground displacement stipulated in these criteria.

4. ENVIRONMENTAL CONSEQUENCES

4.1 Analytic Methodology

The method for assessing impacts involves examining the Exposition Corridor Transit Project Phase 2 for known geologic hazards. If stations or structures are located within or directly adjacent to geologic hazard areas, there would be a potential for an impact that would require additional geotechnical studies and may require enhanced design to eliminate or mitigate the potential impact. Such additional studies and design were conducted following preliminary selection of the Recommended Preferred Alternative and will be ongoing during the final design process.

4.2 Environmental Criteria

Expo has identified the following CEQA criteria, taken, or adapted, from Appendix G of the 2008 CEQA Guidelines, as appropriate for this project. The project would have significant impacts associated with geology, soils, or seismicity if the project does any of the following:

- 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. Refer to Division of Mines and Geology Special Publication 42.
  - Strong seismic groundshaking
  - 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
- Be located on expansive soil, as defined in Table 18 1 A of the CBC (2001), creating substantial risks to life or property

4.3 Analysis

Criterion	**Would the project 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 (refer to Division of Mines and Geology Special Publication 42); strong seismic groundshaking; seismic-related ground failure, including liquefaction; or landslides?**

Impact GEO-1 Implementation of the proposed project would not 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. The proposed project would create *no adverse effect*.

No-Build Alternative

There would be roadway and transit service improvements associated with the No-Build Alternative. However, the only improvement that would change the physical environment in the Expo Phase 2 ROW would be the I-405 Widening project. The No-Build Alternative at the Expo

Phase 2 ROW would not be located within an Alquist-Priolo Fault zone or geoseismic risk areas. The No-Build Alternative would result in ***no effect*** associated with faults, groundshaking, ground failure, or landslides.

Transportation Systems Management (TSM) Alternative

The TSM Alternative would include all of the improvements under the No-Build Alternative and new on-street bus services to directly serve the Expo Phase 2 community transit needs. Those additional improvements would include minor physical modifications such as upgraded bus stops and additional buses and would not be located within an Alquist-Priolo Fault zone or geoseismic risk areas. As with the No-Build Alternative, the TSM Alternative would result in ***no effect*** associated with faults, groundshaking, ground failure, or landslides.

LRT Alternatives

The project site is not in a State of California Earthquake Fault Zone. The active Newport-Inglewood Fault Zone is approximately ¾ mile southwest of the site. Potential impacts as related to groundshaking would occur if the guideway system (including but not limited to rail tracks, aerial structures, and overhead catenary system [OCS]) were affected by ground deformation and/or liquefaction. Inasmuch as the proposed project would be implemented under design standards that have been specifically developed to respond to seismic conditions, implementation of any of the LRT Alternatives would result in ***no adverse effect***.

FEIR Design Options

As the proposed Sepulveda Grade Separation, Colorado Parking Retention, Colorado/4th Parallel Platform and South Side Parking, Maintenance Facility Buffer, or Expo/Westwood Station No Parking design options would not require the expansion of the project into an Alquist-Priolo Fault zone or geoseismic risk area, impacts with respect to proposed uses in those areas would not occur. Further, development of the contemplated design options would be implemented under the same applicable design standards as for the LRT Alternatives. As such, ***no adverse effect*** would occur.

Criterion	**Would the project result in substantial soil erosion or the loss of topsoil?**

Impact GEO-2 Implementation of the Expo Phase 2 Project would not result in substantial soil erosion or the loss of topsoil; therefore, the proposed project would create *no adverse effect*.

No-Build Alternative

There would be roadway and transit service improvements associated with the No-Build Alternative. However, the only improvement that would change the physical environment in the Expo Phase 2 ROW would be the I-405 Widening project. The improvements to the 405 project in the Expo Phase 2 ROW would be subject to the CBC, relevant plans, codes, and regulations, including the National Pollution Discharge Elimination System (NPDES) permit requirements. As a result, the No-Build Alternative would result in ***no effect***.

Transportation Systems Management (TSM) Alternative

The TSM Alternative would include all of the improvements under the No-Build Alternative and new on-street bus services to directly serve the Expo Phase 2 community transit needs. Those additional improvements would include minor physical modifications such as upgraded bus stops and additional buses. As with the No-Build Alternative, the TSM Alternative would be subject to the CBC and relevant plans, codes, and regulations, including the NPDES permit requirements and would result in ***no effect***.

LRT Alternatives

The project would include ground-disrupting activities, such as excavation and trenching for foundations and utilities (associated with the transit stations, aerial structures, and maintenance facility) and soil compaction and site grading associated with the implementation of a new track system, all of which would disturb soils. The State Water Resources Control Board (SWRCB)—through its ~~National Pollution Discharge Elimination System (~~NPDES~~)~~ Program—requires erosion and sediment controls for projects with more than 1 acre of land disturbance. Requirements associated with the NPDES Program include preparation and implementation of a Stormwater Pollution Prevention Plan and a Water Quality Management Plan, with permanent erosion and sediment controls; and preparation and implementation of an erosion and sediment control plan, describing permanent erosion and sediment controls. The project would be required to comply with these existing regulations. Adherence to these requirements would prevent substantial on-site erosion and would ensure that the LRT Alternatives would not result in substantial soil erosion or the loss of topsoil; therefore, the proposed project would have ***no adverse effect***.

FEIR Design Options

Development of the Sepulveda Grade Separation, Colorado Parking Retention, Colorado/4th Parallel Platform and South Side Parking, Maintenance Facility Buffer, or Expo/Westwood Station No Parking design options would be conducted in conformance with the same applicable regulatory programs as the LRT Alternatives, such as NPDES requirements with respect to erosion and sediment control. Therefore, ***no adverse effect*** would occur.

Criterion	**Would the project 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?**

Impact GEO-3 Implementation of the proposed project would not create or result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse; therefore, the proposed project would create *no adverse effect*.

No-Build Alternative

There would be roadway and transit service improvements associated with the No-Build Alternative. Within the Expo Phase 2 study area, the No-Build Alternative would not involve geologic units, unstable soils, or areas susceptible to lateral spreading, subsidence, liquefaction, or collapse. Therefore, ~~T~~the No-Build Alternative would result in ***no effect***.

Transportation Systems Management (TSM) Alternative

The TSM Alternative would include all of the improvements under the No-Build Alternative and new on-street bus services to directly serve the Expo Phase 2 community transit needs. Those additional improvements would include minor physical modifications such as upgraded bus stops and additional buses, none of which involve geologic units, unstable soils, or areas susceptible to lateral spreading, subsidence, liquefaction, or collapse. As with the No-Build Alternative, the TSM Alternative would result in ***no effect***.

LRT Alternatives

Portions of the proposed LRT Alternatives are in an area mapped as being susceptible to liquefaction. Liquefiable alluvial soils have been mapped along the eastern end of the alignments, east of Venice Boulevard (Station 500+00). This area is common to all of the LRT Alternatives. Liquefiable alluvial soils have also been identified between approximately the Expo ROW east of Stewart Street and the Expo ROW at Pico Boulevard (Stations 735+00 to 680+00)~~. This area is common to all LRT Alternatives~~, which includes the grade separation for Centinela Avenue, Bundy Avenue, and Pico Boulevard, along with the retained fill between and after the structures. However, implementation of the LRT Alternatives would not exacerbate these geologic pre-existing conditions. Additionally, the LRT Alternatives would be constructed in compliance with the CBC and *Metro Design Criteria* to ensure that the project would not be adversely affected by liquefiable soils. Therefore, implementation of the LRT Alternatives would not have an effect related to on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse; therefore, ***no adverse effect*** would occur.

FEIR Design Options

Development of the Sepulveda Grade Separation, Colorado Parking Retention, Colorado/4th Parallel Platform and South Side Parking, Maintenance Facility Buffer, or Expo/Westwood Station No Parking design options would be conducted in accordance with CBC and *Metro Design Criteria* to insure that potential seismic hazards are minimized as with the proposed project. Therefore, ***no adverse effect*** would occur.

Criterion	Would the project be located on expansive soil, as defined in Table 18 1 A of the CBC (2001), creating substantial risks to life or property?

Impact GEO-4 **Implementation of the proposed project would not create substantial risks to life or property. Portions of the proposed project may be located on expansive soil as defined in Table 18 1 A of the CBC (2001). Compliance with the Metro Design Criteria would address any risk associated with expansive soils; therefore, the proposed project would create *no adverse effect*.**

No-Build Alternative

There would be roadway and transit-service improvements associated with the No-Build Alternative. Compliance with the CBC and relevant plans, codes, and regulations would ensure that there would be ***no effect***.

Transportation Systems Management (TSM) Alternative

The TSM Alternative would include all of the improvements under the No-Build Alternative and new on-street bus services to directly serve the Expo Phase 2 community transit needs. Those additional improvements would include minor physical modifications such as upgraded bus stops and additional buses. As with the No-Build Alternative, compliance with the CBC, and relevant plans, codes, and regulations, in addition to bus operations safety procedures, would ensure that there would be ***no effect***.

LRT Alternatives

Portions of the proposed project may be located on expansive soil as defined in Table 18 1 A of the CBC (2001). ~~Upon~~ After preliminary selection of the ~~LPA~~Recommended Preferred Alternative, further field investigation ~~would be~~was performed to identify areas where expansive soils may exist. ~~If~~ The locations of such soils are ~~found, their existence will be reported in the Final EIR. Regardless of the selected LPA,~~ reported in the *Geotechnical Exploration Report* prepared in the fall 2009. Therefore, compliance with *Metro Design Criteria*, the CBC, and relevant plans, codes, and regulations would ensure that the impacts would have ***no adverse effect***.

FEIR Design Options

Implementation of the Sepulveda Grade Separation, Colorado Parking Retention, Colorado/4th Parallel Platform and South Side Parking, Maintenance Facility Buffer, or Expo/Westwood Station No Parking design options would not exacerbate pre-existing geologic conditions and would be conducted in accordance with the CBC, *Metro Design Criteria*, and other relevant regulations to insure that potential for expansive soils to affect human health risks and property would be minimized. Therefore, ***no adverse effect*** would occur.

4.4 Cumulative Impacts

A cumulative analysis addresses the effects of the proposed project in combination with other planned and approved projects. This analysis would look at the proposed project on a local scale and include portions of Culver City, Los Angeles, and Santa Monica. The cumulative development scenario is the Expo Phase 2 project in combination with any other local development projects that might affect the project area.

Since no effects have been identified for the No-Build and TSM Alternatives, no cumulative effect could occur, and no further discussion is provided of these alternatives. In addition, no discussion of the impact criteria related to erosion, or construction on unstable soils is included as no impact would occur and these two criteria would also not have any cumulative impact.

Criteria	**Would the project 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. Refer to Division of Mines and Geology Special Publication 42; strong seismic groundshaking; seismic-related ground failure, including liquefaction; or landslides?**

Impacts associated with potential geologic hazards related to soil or other conditions occur at individual building sites. These effects are site-specific, and impacts would not be compounded by additional development. Buildings and facilities in the Cities of Los Angeles, Culver City, and Santa Monica would be sited and designed in accordance with the geotechnical and seismic guidelines and recommendations of each of the cities' municipal codes. Adherence to all relevant plans, codes, and regulations with respect to project design and construction would provide adequate levels of safety, and would ensure that the proposed project would not result in a cumulatively considerable contribution to cumulative impacts regarding groundshaking; therefore, the cumulative impact of the project would have ***no adverse effect***.

Criterion	**Would the project be located on expansive soil, as defined in Table 18 1 A of the CBC (2001), creating substantial risks to life or property?**

While implementation of the proposed project could affect the structural integrity of rails, roadways, or structures as a result of expansive soils, these effects are site-specific, and impacts would not be compounded by additional development. Adherence to all relevant plans, codes, and regulations with respect to project design and construction, such as the provisions of the various cities building codes, grading ordinances, and General Plan policies, as well as Caltrans design criteria and the National Pollution Discharge Elimination System, would ensure that the proposed project would not result in a cumulatively considerable contribution to cumulative impacts regarding expansive soils; therefore, the cumulative impact of the project would have ***no adverse effect***.

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