SECTION 1
Introduction

1.1 Project Description

The California Department of Transportation (Caltrans) retained CH2M HILL to provide engineering support for the extension of Interstate (I) 710 from its existing terminus at Valley Boulevard. CH2M HILL teamed with Earth Mechanics, Inc. (EMI), Jacobs Associates (JA), and ILF to provide engineering services for this project. The engineering services included geotechnical, geological, seismic, and hydrogeological investigations for the proposed extension. Caltrans Geotechnical Services and the CH2M HILL team jointly conducted the study, including planning of the exploration program, conducting field exploration, and evaluation of geotechnical data. Caltrans and Los Angeles County Metropolitan Transportation Authority (Metro) will use the results of this study during future evaluations of the technical, operational, and financial feasibility of the project, and during the potential environmental study phase of the project.

The extension of the I-710 project has been in the planning stages for over 40 years. A surface freeway has been proposed in the past, but has received mixed reactions from the stakeholders. In an effort to move the project forward, Caltrans and Metro proposed a tunnel for the extension. In 2006, Metro performed an initial feasibility assessment study to evaluate the option of connecting I-710 at Valley Boulevard to I-210. This CH2M HILL study is an extension of the Metro study, focusing on the geotechnical aspects of the project.

Based on requests from local cities, a “route-neutral” approach was used to conduct the geotechnical evaluation. A route-neutral approach means that no one route for the tunnel is being favored over another. All practicable routes for extending I-710 are being considered based on factual data. As part of the route-neutral concept, the project area has been defined as the area between I-10 to the south, SR-2 to the west, I-210 to north, and I-605 to the east, as shown in Figure 1-1. The CH2M HILL team has been requested to evaluate the subsurface conditions on all practical routes for extending I-710 within the project area. Caltrans Geotechnical Services and the CH2M HILL team identified the five study zones shown in Figure 1-2 as the basis for this geotechnical study.

1.2 Background

I-710 serves as a major north-south link in the Los Angeles County transportation network. This freeway is an extensively traveled facility in Los Angeles County. Metro, in conjunction with Caltrans, is in the process of widening I-710 from the Port of Los Angeles to SR-60 to lessen the congestion within this area. Currently, I-710 terminates at Valley Boulevard, and the traffic coming off I-710 continues on local streets within the cities of Alhambra, South Pasadena, and Los Angeles causing major traffic congestion.
FIGURE 1-1
Project Study Area
SR-710 Tunnel Technical Study
1.2.1 Previous Caltrans Evaluations
Caltrans has been studying concepts to extend the freeway to relieve traffic congestion and to improve the regional air quality within the general area. The Southern California Association of Governments (SCAG) has described the extension of I-710 as the key project necessary to enhance mobility in the area. The completion of this project is expected to improve the quality of life and provide regional improvement to air quality according to SCAG.

1.2.2 Metro Feasibility Assessment Study
Metro completed a study in 2006 to assess the feasibility of extending I-710 at Valley Boulevard to I-210 using a tunnel. Three tunnel alignments were considered extending from the north end of the existing I-710 Freeway in south Alhambra to the existing I-210 Freeway in Pasadena. The study concluded that the tunnel concept is feasible to complete the freeway, and no fatal flaws were identified. The scope of the previous Metro study included technical, operational, and financial feasibility in addition to geotechnical feasibility.

1.2.3 Zone Specific Route-Neutral Evaluation
Subsequent to the completion of the Metro feasibility study, Caltrans was requested by stakeholders to perform additional geotechnical exploration across a wider area to evaluate subsurface conditions. The current study documented in this report is in response to that request.

To follow a route-neutral concept on the evaluation of geotechnical conditions along the extension of I-710, five study zones were selected as shown in Figure 1-2. The study zones were selected by both Caltrans and CH2M HILL, after evaluating available data related to subsurface geology. The limits of the study zones are defined with consideration given to anticipated subsurface geology, based on the initial review of the subsurface conditions and on the project team’s experience with the geology in the study area. The limits of each zone are described as follows:

**Zone 1** – From the terminus of I-710 at Valley Boulevard, this zone extends westerly and ends near the southern terminus of SR-2. Zone 1 is approximately 5.0 to 5.5 miles long and about 1.5 mile wide at the western end. Zone 1 is located entirely within the City of Los Angeles.

**Zone 2** – From the terminus of I-710 at Valley Boulevard, this zone extends northwesterly and intersects the SR-2 near the midpoint between I-5 and SR-134. Zone 2 is approximately 5.0 to 5.5 miles long and about 1 mile wide at the northwestern terminus at SR-2. Zone 2 is located entirely within the City of Los Angeles.

**Zone 3** – From the terminus of I-710 at Valley Boulevard, this study zone extends north and terminates at SR-134 and I-210. Zone 3 is approximately 4.5 to 5.0 miles long and about 2.5 miles wide at the northern terminus. Zone 3 is located within the cities of Los Angeles, Alhambra, South Pasadena, and Pasadena.

**Zone 4** – From the terminus of I-710 at Valley Boulevard, this study zone extends in a northeasterly direction and terminates at I-210 between SR-134 and I-605, approximately 3 miles east from SR-134. Zone 4 is approximately 6.0 to 7.5 miles long and about 2.2 miles
wide at its terminus at I-210. Zone 4 is located within the cities of Los Angeles, Alhambra, South Pasadena, Pasadena, San Marino, and East Pasadena.

**Zone 5** – From the terminus of I-710 at Valley Boulevard, this study zone extends easterly and ends at I-605. Zone 5 is approximately 9.5 to 11.0 miles long and about 2.5 miles wide at the eastern terminus. The eastern limit of Zone 5 at I-605 extends roughly from Arrow Highway on the north to midway between Lower Azusa Road and Ramona Boulevard on the south. Zone 5 is north of I-10 and is located within the cities of Los Angeles, Alhambra, San Gabriel, Rosemead, Arcadia, Temple City, El Monte, North El Monte, and Irwindale.

In accordance with the route-neutral approach, a specific alignment for the tunnel in each zone was not selected. The exploration program was developed to determine preliminary subsurface information for any tunnel alignment across the dimensions of each zone. The major focus has been to characterize the materials that would be encountered within these zones, such that the results can be used to evaluate any given tunnel alignment within the study area.

### 1.2.4 Advisory and Steering Committee Participation

Caltrans formed a Technical Advisory Committee (TAC) and Steering Committee (SC) for this project to provide guidance, as needed. The members of this committee were selected to represent the various stakeholders with interest in the completion of this project.

TAC and SC consist of representatives from Caltrans, Metro, cities, counties, and councils. Caltrans, Metro, and CH2M HILL conducted meetings with both TAC and SC to discuss the selected study zones and the overall scope of work. The scope of work for the geotechnical study along with the study zones were agreed upon by both TAC and SC. The findings and status of the project were presented at several meetings with TAC and SC. The final report is to be submitted to TAC and SC for their concurrence.

### 1.3 Purpose of Geotechnical Study

The purpose of the geotechnical study is to evaluate the geologic, groundwater, and seismic conditions along the selected study zones to determine if it is feasible to construct a tunnel through these conditions. In addition, the geologic data interpretation will enable comparison of the key geological factors for tunneling in the zones. The study evaluated the geologic conditions, groundwater conditions, seismicity, faulting, potential for contaminated soil or groundwater, and presence of naturally occurring gas with respect to each of the tunnel study zones.

For the purpose of this study, the invert (bottom) of the tunnel is assumed to be about 200 feet below ground surface (bgs); the diameter of the tunnel is assumed to be about 50 feet. Our understanding is that a detailed evaluation of the tunnel profile and tunnel configuration will be made during the environmental documentation phase in the future.

### 1.4 Scope of Work

Caltrans Geotechnical Services and CH2M HILL jointly developed the exploration program to evaluate the subsurface conditions. The field exploration provided information on soil, rock, and groundwater conditions anticipated within the selected zones. The exploration
program was developed based on available data, such as previously conducted borings, available geologic maps, and fault and seismic data, to provide information necessary for characterization purposes. The team also evaluated existing information from deep well logs and other previously conducted geotechnical investigations to plan the exploration program for this study phase. In situ testing and logging were also performed within the borings.

The approach to selection of the exploration locations was to obtain subsurface information to characterize various materials that were anticipated within the assumed tunnel zone. Borings and/or geophysical testing were performed to obtain the characteristics of the formations within the zones. The geotechnical program that was developed to evaluate the subsurface conditions within the study area includes the following tasks:

- Collect and review available information including previous geotechnical and geological data, geologic and seismic maps, and fault information.
- Summarize relevant information from similar tunneling projects completed in the Los Angeles area, in California, and in the world.
- Review published geologic mappings.
- Study lineaments to confirm published fault interpretations and check for unknown faults.
- Conduct field exploration and laboratory testing programs:
  - Drill 25 borings (one inclined) to depths ranging from 150 to 500 feet.
  - Perform in situ testing and logging consisting of pressuremeter tests, caliper tests, acoustic televiewer (ATV), downhole shear wave velocity measurements, and packer tests.
  - Convert selected borings into groundwater monitoring points by installing piezometers.
  - Perform 17 seismic reflection lines, 78 multi-channel analyses of surface waves (MASW), and refraction microtremor (ReMi) testing.
  - Conduct laboratory testing on selected soil and rock samples for the purpose of characterizing and determining the engineering and excavation properties of material likely to be encountered.
- Evaluate the collected data in conjunction with previously collected data to characterize the subsurface conditions in each zone.
- Prepare this geotechnical summary report, which contains the findings of the exploration program and a preliminary comparison of zones relative to tunneling conditions.
- Present the findings of the exploration program to TAC, SC, and surrounding communities.
1.5 Report Organization

This geotechnical summary report is organized into 5 volumes, including 16 sections in the main text, geotechnical maps/plates, and appendixes.

Volume I
- Executive Summary provides a brief summary of key aspects of this report.
- Sections 1 through 6 summarize the introduction; data collection and review; field investigation; regional geology, faulting, and seismicity; groundwater evaluation; and hazardous materials.
- Sections 7 through 11 describe site conditions encountered in Zones 1 through 5.
- Section 12 presents previous tunneling experience.
- Section 13 provides a comparison of ground conditions for tunneling in each zone.
- Section 14 presents the summary of findings and conclusions.
- Section 15 describes limitations of the geotechnical study.
- Section 16 provides references used in the preparation of this report.
- Plates (geotechnical maps and figures) are provided at the end of the main text in Volume I.

Volume II
- Appendix A presents boring logs.
- Appendix B provides groundwater monitoring data.

Volume III
- Appendix C contains geophysical investigation data.

Volume IV
- Appendix D provides in situ test results.
- Appendix E presents laboratory test results.

Volume V
- Appendix F contains the Environmental Screening Assessment (ESA).