APPENDIX G

GEOTECHNICAL EVALUATION

Preliminary Geotechnical Evaluation

Orange County Transit District
Transit Security and Operations Center
Anaheim, California

STV Incorporated

1055 West Seventh Street, Suite 3150 | Los Angeles, California 90017

September 8, 2017 | Project No. 210248002

Geotechnical | Environmental | Construction Inspection & Testing | Forensic Engineering & Expert Witness

Geophysics | Engineering Geology | Laboratory Testing | Industrial Hygiene | Occupational Safety | Air Quality | GIS

Ninyo & Moore

Geotechnical & Environmental Sciences Consultants

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Preliminary Geotechnical Evaluation

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Transit Security and Operations Center
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Mr. Steven Fierce, Architect
Senior Project Manager
STV Incorporated
1055 West Seventh Street, Suite 3150 | Los Angeles, California 90017

DRAFT

September 8, 2017 | Project No. 210248002

Ronald Hallum, PG, CEG
Principal Geologist

Carol A. Price, PG, CEG
Principal Geologist

Kurt S. Yoshii, PE, GE
Principal Engineer

RDH/CAP/KSY/sc

Distribution: (1) Addressee (via e-mail)

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1 INTRODUCTION

In accordance with your request and authorization, Ninyo & Moore has performed a preliminary geotechnical evaluation of the proposed Orange County Transit District (OCTA) Transit Security and Operations Center (TSOC) project in the city of Anaheim, California (Figures 1 and 2). Based on information provided by OCTA, the project involves creation of a combined security and operations center.

The purpose of this preliminary geotechnical evaluation was to assess the geologic conditions at the site and develop preliminary conclusions regarding potential geologic and seismic impacts associated with the project. Where appropriate, recommendations to mitigate potential geologic hazards, as noted in this report, have been provided.

This evaluation addresses the site geologic conditions and the impacts associated with potential geologic and seismic hazards in the project area for inclusion in the environmental planning documents for the project. Our geotechnical evaluation was based on review of readily available geologic and seismic data and published geotechnical literature pertinent to the project site, and site reconnaissance. Our evaluation did not include subsurface exploration and associated laboratory testing. The results of our evaluation are intended for preliminary planning purposes. During detailed project design, subsurface exploration should be conducted by the project geotechnical consultant at the location of proposed site improvements to evaluate the site-specific geologic conditions and provide appropriate geotechnical recommendations for design and construction of the project in conjunction with the structural engineer.

2 SCOPE OF SERVICES

Ninyo & Moore's scope of services has included review of geotechnical background materials, geologic reconnaissance of the project area, and geotechnical analysis. Specifically, we have performed the following tasks:

- Review of readily available topographic and geologic maps, published geotechnical literature, geologic and seismic data, soil data, groundwater data, and aerial photographs.
- Review of in-house information related to our previous work in the project vicinity.
- Research and review of readily available geotechnical reports at the State of California GeoTracker (2017) website for commercial properties in the project area that included subsurface geotechnical data relative to the subject evaluation.
- Review of geotechnical aspects of project plans and documents pertaining to the TSOC site vicinity.

- Geotechnical site reconnaissance by a representative from Ninyo & Moore conducted on August 16, 2017, to observe and document the existing surface conditions at the project site and to core the existing pavement at three locations.

- Compilation and analysis of existing geotechnical data pertaining to the site.

- Assessment of the general geologic conditions and seismic hazards affecting the area and evaluation of their potential impacts on the project.

- Preparation of this report presenting the results of our study, as well as our conclusions regarding the project's geologic and seismic impacts, and recommendations to address the impacts to be included in the environmental planning documents.

3 PROJECT DESCRIPTION

Currently, OCTA's core operational and security functions are centralized at the OCTA Garden Grove bus base. Within this existing facility, the following OCTA functions are currently housed:

- Operations Training (Bus)
- Central Communications (Bus)
- Field Operations (Bus)
- Transit Police Services (Bus, Paratransit, and Rail)
- Emergency Operations Center (Agency wide)
- File Storage

We understand that most of these existing functions will be transferred to the new facility upon completion. Although final design is not complete at this time, we anticipate that a two to three-story office-type structure is proposed to be constructed at the site.

4 SITE DESCRIPTION

The roughly 3-acre triangular site is located in the city of Anaheim and is bounded on the north by West Lincoln Avenue, on the east by South Manchester Avenue, and along the southwest by existing railroad tracks and commercial/industrial developments. Interstate Highway 5 is located approximately 250 feet northeast of the property. The central and eastern portions of the site are currently occupied by automobile repair businesses and surface parking. The center of the site is partially paved with a combination of asphalt concrete (AC) and Portland cement concrete (PCC). The western roughly third of the project site is currently unimproved. The project study site is relatively level and is at an existing elevation of approximately 135 feet above Mean Sea Level (MSL).

5 GEOLOGY

5.1 Regional Geology

The State of California is divided into geomorphic provinces defined by geographic location, large-scale bedrock types, and tectonic structure. The project site is situated at the northwest end of the Peninsular Ranges geomorphic province of southern California. This geomorphic province encompasses an area that extends approximately 125 miles from the Transverse Ranges province and the Los Angeles Basin south to the Mexican border, and beyond another approximately 775 miles to the tip of Baja California. The Peninsular Ranges province varies in width from approximately 30 to 100 miles and is characterized by northwest-trending mountain range blocks separated by similarly northwest-trending faults (Norris and Webb, 1990).

The predominant rock type that underlies the Peninsular Ranges province is a Cretaceous-age igneous rock (granitic rock) referred to as the Southern California batholith. Older Jurassic-age metavolcanic and metasedimentary rocks and older Paleozoic limestone, altered schist, and gneiss are present within the province. Cretaceous period marine sedimentary rocks, and younger Tertiary period rocks comprised of volcanic, marine, and non-marine sediments overlie the older rocks (Norris and Webb, 1990). More recent Quaternary period sediments, primarily of alluvial origin, comprise the low-lying valley and drainage areas within the region, while Quaternary marine terrace deposits and beach deposits are present along the coastal areas.

5.2 Site Geology

The TSOC project site is located near the central portion of the Orange County coastal plain. Regional geologic maps indicate the site is underlain by Recent to Holocene-age younger alluvial deposits. These deposits typically consist of moderately to well-consolidated sand, silty sand, and sandy silt. Fill soils of varying thickness and material types related to roadways, utilities, and existing developments are also present over portions of the project area. A regional geologic map of the site vicinity showing the distribution of geologic units is presented on Figure 3.

5.3 Groundwater

The California Geological Survey (CGS) Seismic Hazard Zone report for the project area indicates that the historic high groundwater in the vicinity of the site is greater than 50 feet below the ground surface (CGS, 1997b). Various boring logs and monitoring wells in the vicinity of the project site indicate that the groundwater elevations in the project area range from approximately 65 to over 100 feet below existing grades. Fluctuations in the depth to groundwater may occur due to flood events, seasonal precipitation, variations in ground elevations, groundwater pumping, and other factors.

5.4 Existing Pavement

During our site reconnaissance on August 16, 2017, our personnel performed three pavement cores in the existing pavement. The approximate location of the cores is indicated on Figure 2.

Core No.	AC Thickness	Base Thickness
C-1	3½	
C-2	3½	
C-3	3	

6 FAULTING AND SEISMICITY

The project site is located in a seismically active area, as is the majority of southern California, and the potential for strong ground motion at the site is considered significant during the design life of proposed improvements. Table 1 lists selected principal known active faults within approximately 50 miles of the site and the maximum moment magnitude (M_{max}) as published by the United States Geological Survey (USGS, 2014a) in general accordance with the Uniform California Earthquake Rupture Forecast, version 3 (Field, et al., 2013). The approximate fault-to-site distances listed in Table 1 were calculated using the USGS web-based program (USGS, 2008).

Table 1 – Principal Regional Active Faults

Fault	Approximate Fault-to-Site Distance miles (kilometers) [1]	Maximum Moment Magnitude (M_{max}) [1]
Puente Hills (Blind Thrust)	2.8 (4.5)	7.1
Elsinore	7.9 (12.8)	6.8
San Joaquin Hills (Blind Thrust)	8.4 (13.5)	7.1
Newport Inglewood	10.5 (16.9)	7.1
San Jose	14.6 (23.6)	6.4
Chino-Central Avenue	15.9 (25.9)	6.7
Upper Elysian Park (Blind Thrust)	18.9 (30.4)	6.4
Raymond	22.2 (35.7)	6.5
Cucamonga	23.4 (37.9)	6.9
Clamshell – Sawpit Canyon	24.1 (39.0)	6.5
Verdugo	24.2 (39.2)	6.9
Hollywood	26.1 (40.0)	6.4
Santa Monica	31.9 (51.7)	6.9
Malibu Coast	36.6 (58.9)	6.4
Sierra Madre (San Fernando)	37.1 (59.7)	7.2
San Jacinto	38.0 (61.2)	6.7
Coronado Bank	38.0 (61.2)	7.1
San Gabriel	38.9 (62.7)	7.1
San Andreas	41.0 (66.4)	7.4

Notes:
[1] United States Geological Survey (USGS), 2008.

The faults in southern California are classified as active, potentially active, and inactive faults. As defined by the CGS, active faults are faults that have ruptured within Holocene time, or within approximately the last 11,000 years. Potentially active faults are those that show evidence of movement during Quaternary time (approximately the last 1.6 million years) but for which evidence of Holocene movement has not been established. Inactive faults have not ruptured in the last approximately 1.6 million years. Figure 4 shows the approximate site location relative to the principal faults in the region based on the Fault Activity Map of California (Jennings and Bryant, 2010).

Active faults in the vicinity of the proposed TSOC site include the Puente Hills Blind Thrust fault zone located approximately 2.8 miles north of the site and the Elsinore fault located approximately 7.9 miles northeast of the site. Blind thrust faults, including the Puente Hills fault, are low-angle faults at depths that do not break the ground surface and are, therefore, not shown on Figure 4. Although blind thrust faults do not have a surface trace, they can be capable of generating damaging earthquakes and are included in Table 1.

Based on our background review, the site vicinity is not transected by known active or potentially active faults. The site is not located within a State of California Earthquake Fault Zone (EFZ) (Hart and Bryant, 2007). The site not is located within a State of California Seismic Hazard Zone as an area considered susceptible to liquefaction (CGS, 2001a, 2001b), as shown on Figure 5.

7 METHODOLOGY FOR GEOLOGIC IMPACT AND HAZARD ANALYSES

As outlined by the California Environmental Quality Act (CEQA), the TSOC project site has been evaluated with respect to potential geologic and seismic impacts associated with the project. Evaluation of impacts due to potential geologic and seismic hazards is based on our review of readily available published geotechnical literature and geologic and seismic data pertinent to the proposed project, and site reconnaissance. The references and data reviewed include, but are not limited to, the following:

- Geologic maps and fault maps from the CGS and USGS.
- Topographic maps from the USGS.
- State of California EFZ Maps.
- State of California Seismic Hazards Zones Reports and Maps.
- Seismic data from the CGS and USGS.

- Geotechnical publications by the CGS and USGS.
- Subsurface geotechnical data from previous subsurface explorations in the project vicinity.
- Aerial photographs.

8 THRESHOLDS OF SIGNIFICANCE

A summary of the potential geologic and seismic impacts that could affect the project site are presented in Table 2. According to Appendix G of the CEQA guidelines (California Environmental Resources Evaluation System [CERES], 2005a, 2005b), a project is considered to have a geologic impact if its implementation would result in or expose people/structures to potential substantial adverse effects, including the risk of loss, injury, or death involving hazards involving one or more of the geologic conditions presented in Table 2. Table 2 also presents the impact potential as defined by CEQA associated with each of the geologic conditions discussed in the following sections.

Table 2 – Summary of Potential Geologic Impacts/Hazards

Geologic Condition	Impact Potential[1]			
	Potentially Significant Impact	Less than Significant with Mitigation Incorporation	Less than Significant Impact	No Impact
Earthquake Fault Rupture			x	
Strong Seismic Ground Shaking		x		
Seismically Related Ground Failure, Including Liquefaction		x		
Landslides				x
Substantial Soil Erosion			x	
Subsidence			x	
Compressible/Collapsible Soils		x		
Expansive Soils		x		
Groundwater and Excavations			x	

Note:
[1]Reference: CERES, 2005, Appendix G – Environmental Checklist Form, Final Text, dated October 26.
Website: http://ceres.ca.gov/topic/envlaw/ceqa/guidelines/appendices.html

9 CONCLUSIONS AND RECOMMENDATIONS FOR POTENTIAL GEOLOGIC AND SEISMIC IMPACTS/HAZARDS

The purpose of our evaluation was to provide an overview of the geotechnical site conditions and the potential geologic/seismic hazards that may affect developing the TSOC project. Our evaluation was based on review of readily available geologic, seismic and groundwater data, previous subsurface exploration data by Ninyo & Moore and others, site reconnaissance, and engineering analyses. Based on the results of our geotechnical evaluation, the construction of the TSOC project is not anticipated to have a significant impact on the geologic environment. However, development within the project area may be subjected to potential impacts from geologic and seismic hazards.

The potential geologic/seismic hazards and geotechnical constraints described in the following sections will involve various types of mitigation in order to reduce the potential impacts and suitably prepare the site and proposed structures for development. Mitigation generally includes sound engineering practice in the design and construction of future development, including the implementation of appropriate geotechnical recommendations prior to the design and construction of the facilities, in the project area. General mitigation concepts regarding the potential geotechnical hazards and constraints at the TSOC site are presented in the following sections. Prior to design of future improvements, detailed subsurface geotechnical evaluation should be performed to address the site-specific conditions at the locations of the planned improvements and to provide detailed recommendations for design and construction.

9.1 Surface Fault Rupture

Surface fault rupture is the offset or rupturing of the ground surface by relative displacement across a fault during an earthquake. Based on our review of referenced geologic and fault hazard data and site reconnaissance, the project site is not transected by known active or potentially active faults. The active Puente Hill Blind Thrust fault is located approximately 2.8 miles north of the site. The site is not located within a State of California EFZ (Hart and Bryant, 2007). Therefore, the potential for surface rupture is considered low. However, lurching or cracking of the ground surface as a result of nearby seismic events is possible.

9.2 Seismic Ground Shaking

Earthquake events from one of the regional active or potentially active faults near the project area could result in strong ground shaking which could affect the project site and proposed improvements. The level of ground shaking at a given location depends on many factors, including the size and type of earthquake, distance from the earthquake, and subsurface geologic conditions. The type of construction also affects how particular structures and improvements perform during ground shaking.

The 2016 California Building Code (CBC) specifies that the Risk-Targeted, Maximum Considered Earthquake (MCE_R) ground motion response accelerations be used to evaluate seismic loads for design of buildings and other structures. The MCE_R ground motion response accelerations are based on the spectral response accelerations for 5 percent damping in the direction of maximum horizontal response and incorporate a target risk for structural collapse equivalent to 1 percent in 50 years with deterministic limits for near-source effects. The horizontal peak ground acceleration (PGA) that corresponds to the MCE_R for the site was calculated as 0.6g using the USGS (USGS, 2014b) seismic design tool (web-based).

The 2016 CBC specifies that the potential for liquefaction and soil strength loss be evaluated, where applicable, for the mapped PGA (PGA_M) which is defined as the Maximum Considered Earthquake Geometric Mean (MCE_G) PGA with adjustment for site class effects in accordance with the American Society of Civil Engineers (ASCE) 7-10 Standard. The MCE_G PGA is based on the geometric mean PGA with a 2 percent probability of exceedance in 50 years. The MCE_G PGA was calculated using the USGS (USGS, 2014b) seismic design tool that yielded a mapped MCE_G PGA of 0.53g for the site and a site coefficient (F_{PGA}) of 1.00 for Site Class D.

This potential level of ground shaking could have high impacts on project improvements without appropriate design mitigation, and should be considered during the detailed design phase of the project. Mitigation of the potential impacts of seismic ground shaking can be achieved through project structural design. Structural elements of planned improvements can be designed to resist or accommodate appropriate site-specific ground motions and to conform to the current seismic design standards, including CBC building regulations. Appropriate structural design and mitigation techniques would reduce the impacts related to seismic ground shaking.

9.3 Liquefaction

Liquefaction is the phenomenon in which loosely deposited granular soils located below the water table undergo rapid loss of shear strength due to excess pore pressure generation when subjected to strong earthquake-induced ground shaking. Ground shaking of sufficient duration results in the loss of grain-to-grain contact due to rapid rise in pore water pressure causing the soil to behave as a fluid for a short period of time. Liquefaction is known generally to occur in saturated or near-saturated cohesionless soils at depths shallower than 50 feet. Factors known to influence liquefaction potential include composition and thickness of soil layers, grain size, relative density, groundwater level, degree of saturation, and both intensity and duration of ground shaking. The potential damaging effects of liquefaction include differential settlement, loss of ground support for foundations, ground cracking, heaving and cracking of slabs due to sand boiling, buckling of deep foundations due to liquefaction-induced ground settlement.

According to the Seismic Hazard Zones Map published by the State of California (CGS, 1998), the site is not located within an area considered susceptible to liquefaction (Figure 5). Recent data indicate that groundwater depths in the site vicinity are on the order of 60 to 100 feet below the ground surface; and the historic high groundwater depths in the site vicinity are greater than 50 feet.

Although not mapped as being in a known area subject to liquefaction, a detailed assessment of the potential for liquefaction and seismically induced dynamic settlement and its effect on the

TSOC improvements should be performed prior to design and construction of project improvements, and incorporated into the design, as appropriate. Site-specific geotechnical evaluations to assess the liquefaction and dynamic settlement characteristics of the on-site soils would include drilling of exploratory borings, cone penetration tests, evaluation of groundwater depths, and laboratory testing of soils

Structural design and mitigation techniques would be developed to reduce the impacts related to liquefaction. Mitigation alternatives for potential dynamic settlement related to liquefaction include supporting structures on deep pile foundations that extend through the liquefiable zones into competent material or stabilization of the liquefiable soils using in-situ ground improvement techniques such as vibro-replacement stone columns, rammed aggregate piers, compaction grouting, soil-cement mixing, or jet grouting. Soil stabilization would mitigate the liquefaction hazard and the new structures could then be supported on shallow foundation systems.

9.4 Landslides

Landslides, slope failures, and mudflows of earth materials generally occur where slopes are steep and/or the earth materials are too weak to support themselves. Earthquake-induced landslides may also occur due to seismic ground shaking. The site vicinity is relatively level and therefore not considered subject to seismically induced landsliding. Accordingly, the potential for landslides or mudflows to affect the project site is considered low.

9.5 Tsunamis

Tsunamis are long seismic sea waves (long compared to ocean depth) generated by sudden movements of the sea floor caused by submarine earthquakes, landslides, or volcanic activity. Based on the site elevation and inland location of the site, the potential for a tsunami to impact the site is considered low.

9.6 Soil Erosion

Erosion is a process by which soil or earth material is loosened or dissolved and removed from its original location. Future construction at the site will result in ground surface disruption during demolition, excavation, grading, and trenching that would create the potential for erosion to occur. Erosion can occur by varying processes and may occur at the site where bare soil is exposed to wind or moving water (both rainfall and surface runoff). The processes of erosion are generally a function of material type, terrain steepness, rainfall or irrigation levels, surface drainage conditions, and general land uses.

Based on our review of geologic references and site reconnaissance, the materials exposed at the surface of the project site include sands, silty sands, and sandy silt soils. Granular soils typically have low cohesion, and have a relatively higher potential for erosion from surface runoff when exposed in cut slopes or utilized near the face of fill embankments. Surface soils with higher amounts of clay tend to be less erodible as the clay acts as a binder to hold the soil particles together.

Future construction at the site may create the potential for soil erosion during excavation, grading, and trenching activities. However, a Storm Water Pollution Prevention Program incorporating Best Management Practices (BMPs) for erosion control is typically prepared prior to the start of construction to mitigate erosion during site construction. Typical BMPs include erosion prevention mats or geofabrics, silt fencing, sandbags, plastic sheeting, temporary drainage devices, and positive surface drainage to allow surface runoff to flow away from site improvements or areas susceptible to erosion. Surface drainage design provisions and site maintenance practices would reduce potential soil erosion following site development.

9.7 Subsidence

Subsidence is characterized as a sinking of the ground surface relative to surrounding areas, and can generally occur where deep soil deposits are present. Subsidence in areas of deep soil deposits is typically associated with regional groundwater withdrawal or other fluid withdrawal from the ground such as oil and natural gas. Subsidence can result in the development of ground cracks and damage to subsurface vaults, pipelines and other improvements.

Historic evidence of subsidence is not known to have occurred at the project site and the potential for subsidence in the project area is considered to be relatively low. To evaluate the potential for subsidence to affect future project components, surface reconnaissance and subsurface evaluation should be performed. During the detailed design phase of the project, site-specific geotechnical evaluations would be performed to assess the settlement potential of the on-site natural and fill soils. This may include detailed surface reconnaissance to evaluate site conditions, and drilling of exploratory borings or test pits and laboratory testing of soils, where appropriate, to evaluate site conditions.

9.8 Compressible/Collapsible Soils

Compressible soils are generally comprised of soils that undergo consolidation when exposed to new loading, such as fill or foundation loads. Soil collapse is a phenomenon where the soils undergo a significant decrease in volume upon increase in moisture content, with or without an increase in external loads. Buildings, structures and other improvements may be subject to excessive settlement-related distress when compressible soils or collapsible soils are present.

Based on our background review, the project area is underlain by younger to older alluvial deposits that are considered poorly to relatively well consolidated. Due to the presence of potentially compressible/collapsible soils at the site, there is a potential for differential settlement to affect future improvements without appropriate mitigation during detailed project design and construction.

To evaluate the potential for settlement to affect future project components, surface reconnaissance and subsurface evaluation should be performed. During the detailed design phase of the project, site-specific geotechnical evaluations would be performed to assess the settlement potential of the on-site natural soils and undocumented fill. This may include detailed surface reconnaissance to evaluate site conditions, and drilling of exploratory borings or test pits and laboratory testing of soils, where appropriate, to evaluate site conditions.

Alternatives to mitigate potential settlement due to compressible soils at the site include over-excavation and re-compaction, supporting structures on pile foundations, or in-situ ground improvement to limit settlement to acceptable levels so that structures are not adversely impacted. To mitigate potential settlement for other relatively light minor structures, new pavements and hardscape, loose/soft soils encountered at the subgrade and foundation levels of these improvements during construction can be removed and replaced with suitable compacted fill, based on detailed design stage recommendations.

9.9 Expansive Soils

Expansive soils include clay minerals that are characterized by their ability to undergo significant volume change (shrink or swell) due to variations in moisture content. Sandy soils are generally not expansive. Changes in soil moisture content can result from rainfall, irrigation, pipeline leakage, surface drainage, perched groundwater, drought, or other factors. Volumetric change of expansive soil may cause excessive cracking and heaving of structures with shallow foundations, concrete slabs-on-grade, or pavements supported on these materials.

Although the site vicinity is generally mapped as being underlain by granular soils, variable surface soils are anticipated at the site. Detailed assessment of the potential for expansive soils should be evaluated during the design phase of the project and mitigation techniques would be developed, as appropriate, to reduce the impacts related to expansive soils.

The potential for expansive soils to impact site improvements can be mitigated by removal of near-surface expansive soils and replacement with low expansive material during construction and providing positive surface drainage for site improvements to reduce infiltration of water into the subsurface. Additionally, expansive soil mitigation can involve design of site improvements to resist the effects of expansive soils, including deepening foundation members and strengthening foundations and slabs with additional reinforcement, or utilizing post-tensioned slabs.

9.10 Groundwater and Excavations

The depth of historic high groundwater at the project site has been mapped as greater than 50 feet below the ground surface (CGS, 1997b). Monitoring wells in the vicinity of the project site indicate that the groundwater elevations in the project area range from approximately 65 to over 100 feet below existing grades.

Proposed future improvements at the project site are anticipated to include excavations and site grading for new structures. Based on the groundwater levels reported in the site vicinity and the anticipated depth of construction activities, groundwater is not anticipated to have a significant impact on excavations for the planned project improvements.

Groundwater levels may be influenced by seasonal variations, precipitation, irrigation, soil/rock types, groundwater pumping, and other factors and are subject to fluctuations. On-site infiltration of stormwater related to low impact development guidelines may have an impact on existing and planned site improvements and should be evaluated during the detailed design phase of the project.

Further study, including subsurface exploration, should be performed during the detailed design phase of planned improvements to evaluate the presence of groundwater, and to evaluate the potential for stormwater infiltration at the site, and the potential impacts on design and construction of project improvements. Mitigation techniques should be developed, as appropriate, to reduce the impacts related to groundwater. The potential impacts due to groundwater would be reduced with incorporation of techniques such as casing, shoring and/or construction dewatering.

10 SOIL EXCAVATABILITY AND REUSE

Based on the mapped soil units at the site (silty sand and sandy silt), excavation should be generally accomplished with heavy-duty earth moving equipment in good condition. Additional subsurface investigation should be performed to further evaluate the excavatability of site earth materials.

On-site soils (other than plastic clays, if encountered) with an organic content of less than approximately 3 percent by volume (or 1 percent by weight) are suitable for reuse as general fill material. Fill material should not contain rocks or lumps over approximately 3 inches in diameter, and not more than approximately 30 percent larger than ¾ inch. Oversize materials, if encountered, should be separated from material to be used for compacted fill and removed from the site. Moisture conditioning (including drying) of existing on-site materials may be anticipated if reused as fill.

11 PRELIMINARY FOUNDATION RECOMMENDATIONS

Based on our preliminary findings, it is anticipated that the proposed buildings and improvements may be supported on shallow, spread or continuous footings bearing on native soils or compacted fill. Additional evaluation including subsurface investigation, laboratory testing, and engineering analyses should be performed prior to final design of foundations or other improvements.

12 LIMITATIONS

The purpose of this study was to evaluate geotechnical conditions and potential geologic and seismic hazards at the site by reviewing readily available geotechnical data, and performing a site reconnaissance to provide a preliminary geotechnical report which can be utilized in the preparation of environmental documents for the project.

The geotechnical analyses presented in this report have been conducted in accordance with current engineering practice and the standard of care exercised by reputable geotechnical consultants performing similar tasks in this area. No other warranty, implied or expressed, is made regarding the conclusions, recommendations, and professional opinions expressed in this report. Our preliminary conclusions and recommendations are based on a review of readily available geotechnical literature, geologic and seismic data, and an analysis of the observed conditions. Variations may exist and conditions not observed or described in this report may be encountered.

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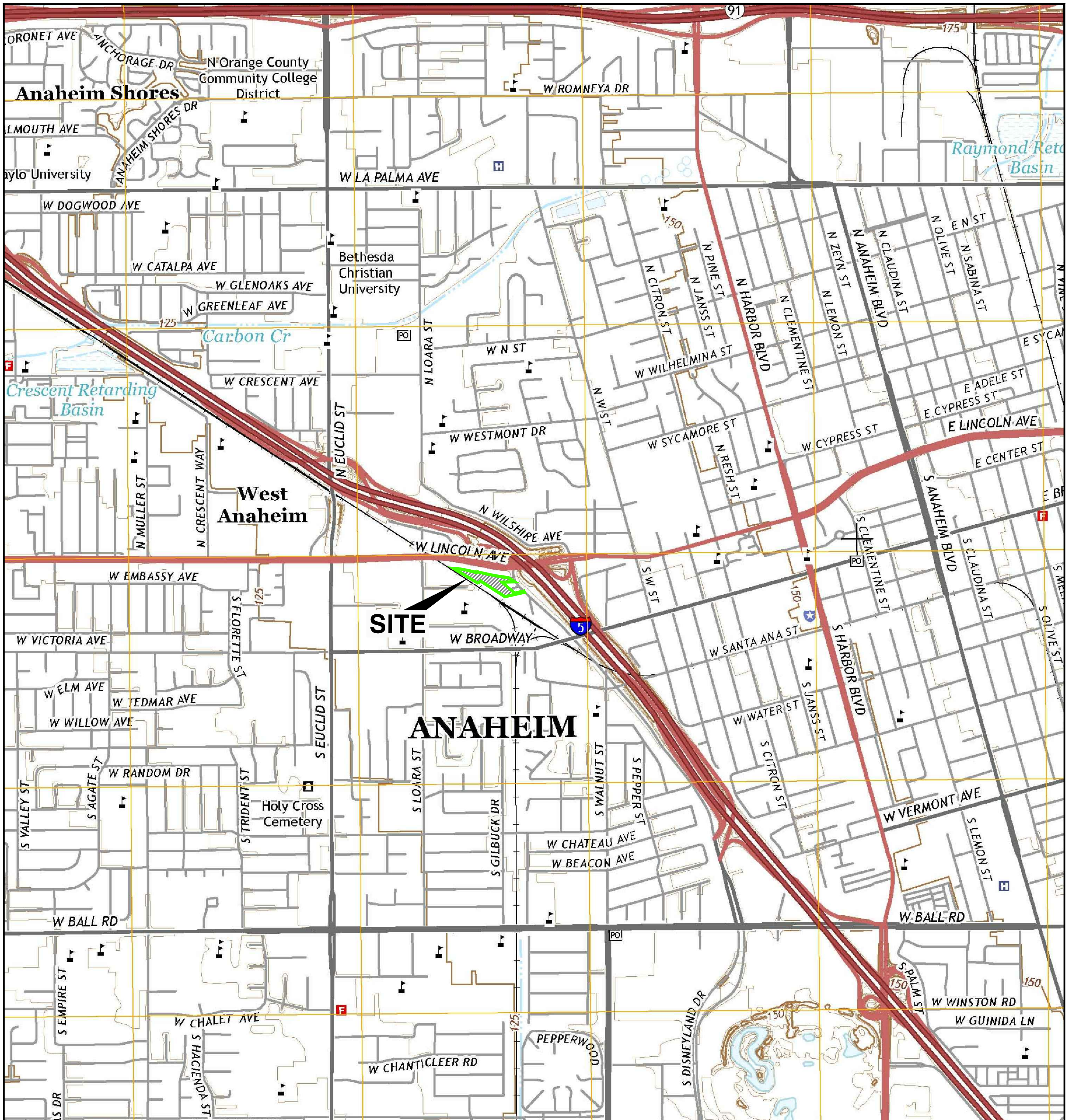
AERIAL PHOTOGRAPHS

Source	Date	Flight	Numbers	Scale
USDA	June 2, 1953	AXK-6K	81 and 82	1:24,000

FIGURES



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NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE. I REFERENCE: USGS, 2015.

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FIGURE 1

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

SITE LOCATION

OCTA TRANSIT SECURITY AND OPERATIONS CENTER

ANAHEIM, CALIFORNIA

210248002 I 9/17

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LEGEND

SITE BOUNDARY

C-3 PAVEMENT CORE

NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE. I REFERENCE: GOOGLE EARTH, 2017.

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0 200 400

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FIGURE 2

Ninyo & Moore

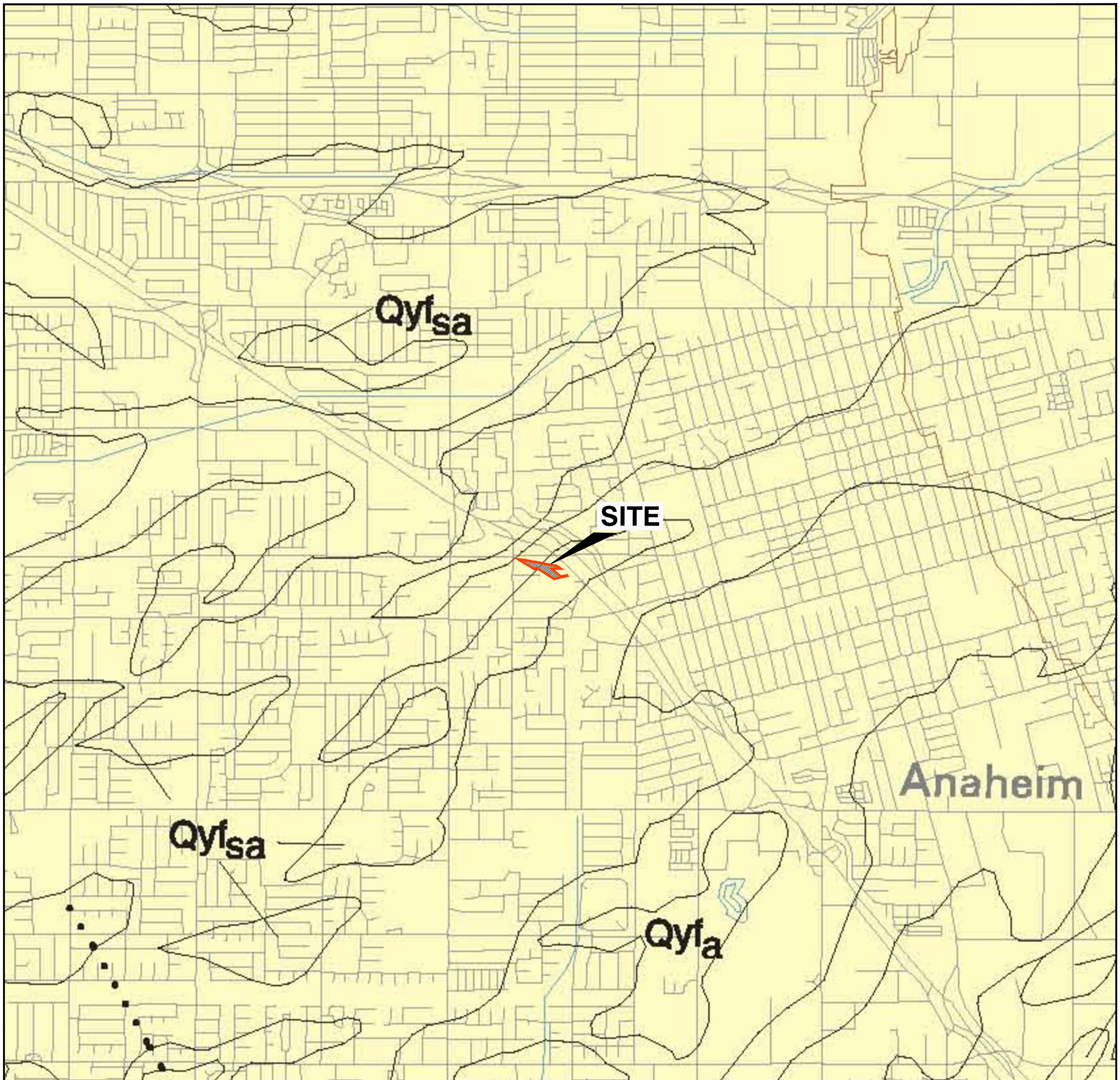
Geotechnical & Environmental Sciences Consultants

SITE PLAN

OCTA TRANSIT SECURITY AND OPERATIONS CENTER

ANAHEIM, CALIFORNIA

210248002 I 9/17



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LEGEND

Qyf	YOUNG ALLUVIAL FAN DEPOSITS
	GEOLOGIC CONTACT
....	FAULT

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NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE.

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FIGURE 3

Ninyo & Moore

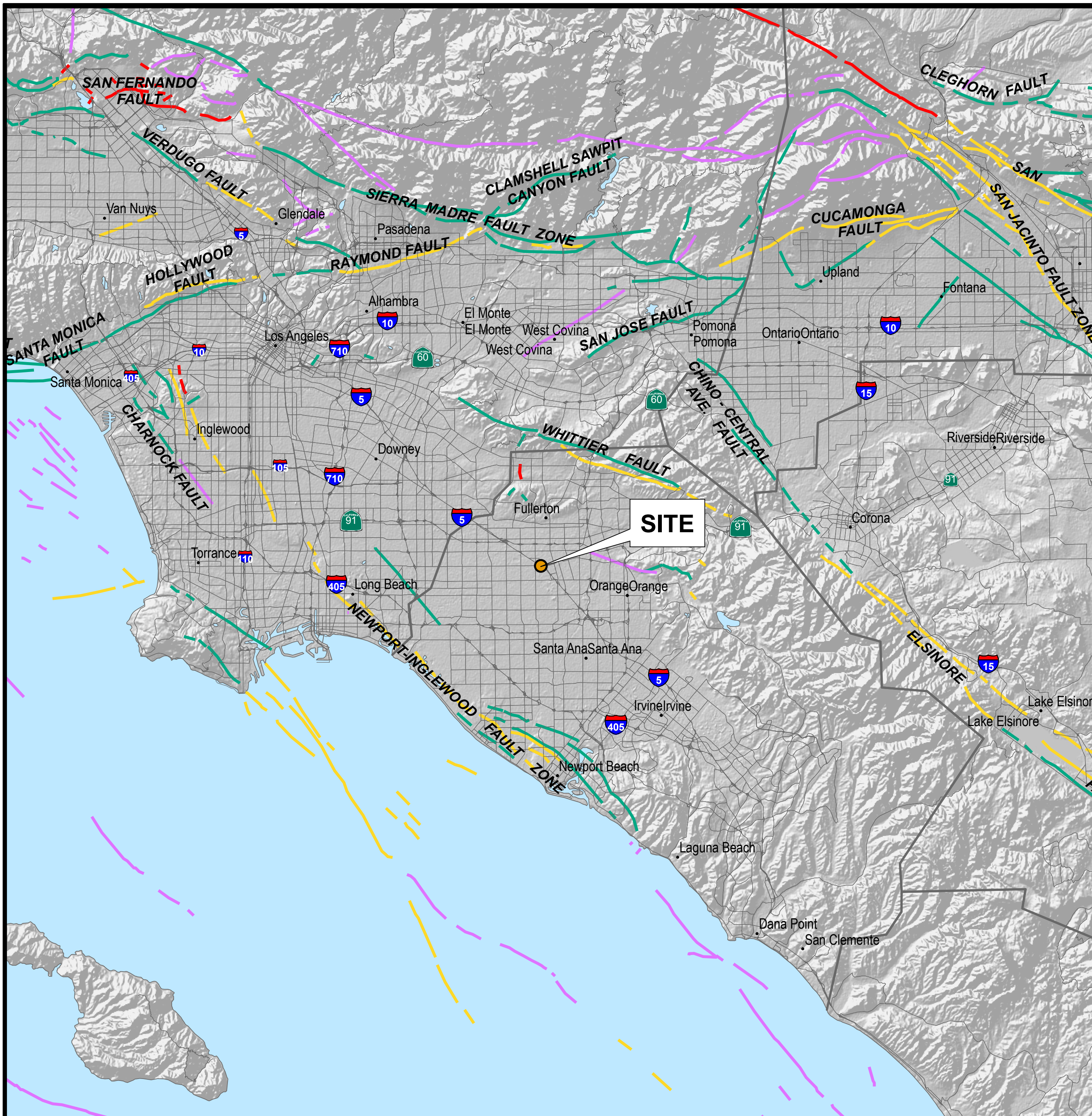
Geotechnical & Environmental Sciences Consultants

REGIONAL GEOLOGY

OCTA TRANSIT SECURITY AND OPERATIONS CENTER

ANAHEIM, CALIFORNIA

210248002 I 9/17



GIS DATA SOURCE: CALIFORNIA GEOLOGICAL SURVEY (CGS); ENVIRONMENTAL SYSTEMS RESEARCH INSTITUTE (ESRI)

LEGEND

FAULT ACTIVITY:

- HISTORICALLY ACTIVE
- HOLOCENE ACTIVE
- LATE QUATERNARY
- QUATERNARY
- COUNTY BOUNDARIES

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MILES

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FIGURE 4

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

FAULT LOCATIONS

OCTA TRANSIT SECURITY AND OPERATIONS CENTER
ANAHEIM, CALIFORNIA

210248002 | 9/17

LEGEND

LIQUEFACTION:
Areas where historic occurrence of liquefaction, or local geological, geotechnical and groundwater conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

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NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE. I REFERENCE: CDMG, 1999.

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FIGURE 5

SEISMIC HAZARD ZONES

OCTA TRANSIT SECURITY AND OPERATIONS CENTER

ANAHEIM, CALIFORNIA

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475 Goddard, Suite 200 | Irvine, California 92618 | p. 949.753.7070

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