Appendix C Geotechnical Reconnaissance

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GEOCON

GEOTECHNICAL RECONNAISSANCE

PROPOSED RESIDENTIAL DEVELOPMENT
5600 BEACH BOULEVARD
BUENA PARK, CALIFORNIA

DRAFT

JULY 2024
PROJECT NO. W1953-88-01

PREPARED FOR:
Shopoff Advisors, LP
Irvine, California

Project No. W1953-88-01
July 2024

Mr. Blair Ruffner
Shopoff Advisors, LP
18565 Jamboree Road, Suite 200
Irvine, California 92612

Subject: REPORT OF GEOTECHNICAL RECONNAISSANCE
PROPOSED RESIDENTIAL DEVELOPMENT
5600 BEACH BOULEVARD
BUENA PARK, CALIFORNIA
APN: 066-572-08

Dear Mr. Ruffner:

In accordance with your authorization of our proposal dated June 4, 2024, we have prepared this geotechnical reconnaissance report for the subject property located at 5600 Beach Boulevard in the City of Buena Park, California. The purpose of this report was to evaluate the subject property from a geologic and geotechnical standpoint for potential future development.

The scope of work presented herein does not include site-specific borings and this report is intended for due-diligence purposes only; it is not intended for submittal to the building official. A comprehensive design level geotechnical investigation will be required once the project moves beyond the due-diligence phase of the project.

If you have any questions regarding this report, or if we may be of further service, please contact the undersigned.

Very truly yours,

GEOCON WEST, INC.

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<u>Disclaimer</u>: This DRAFT is intended for the use of the project team to help with the on-going design of the project and provided as a courtesy for review only. This DRAFT should not be relied upon for final design nor produced and submitted to regulatory agencies until a FINAL document is completed with the signature and stamps of the design professionals.

John Stapleton	Jelisa Thomas Adams	Gerald A. Kasman
PE 96134	GE 3092	CEG 2251

(email) Addressee

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GEOTECHNICAL RECONNAISSANCE

1. PURPOSE AND SCOPE

This report presents the result of our geotechnical reconnaissance for the proposed residential development located at 5600 Beach Boulevard, in the City of Buena Park, California (see Vicinity Map, Figure1). The purpose of this desktop-level study was to evaluate subsurface soil and geologic conditions and identify potential geologic or seismic hazards that may impact planned development of the site. The project boundaries are shown on Figure 2A and 2B, Site Plan.

The scope our evaluation included review and evaluation of pertinent geologic and seismologic information pertaining to the site including published geologic maps, City of Buena Park (City) public documents, geologic and seismic hazard maps published by California Geological Survey (CGS), and other in-house reports and geologic maps pertaining to the site. These documents include but are not limited to the State of California official Alquist-Priolo Earthquake Fault Zone maps and Seismic Hazard Zone maps published by the CGS.

2. SITE AND PROJECT DESCRIPTION

The subject site is located at 5600 Beach Boulevard in the City of Buena Park, California. The site is currently occupied by a 2-story and a 3-story industrial structure. The site appears to be relatively level. The site is bounded by railroad tracks to the northeast, by the Brea Creek Channel to the south, and by Beach Boulevard to the west. Along the frontage with Beach Boulevard, a small slope descends from the site to the street elevation due to the grading of the street to go under the railroad crossing. Surface water drainage at the site appears to flow to the city streets. The existing site conditions are shown on Figure 2A.

Based on the information provided by the Client, it is our understanding that the likely development scenario consists of 110-units of 3-story townhomes; 114-units of single-story duets; with associated interior streets and surface parking. Additionally, approximately 0.75 acres of the 13.75-acre site is earmarked for a future affordable housing development. Plans depicting the proposed development are shown on Figure 2B.

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3. BACKGROUND RESEARCH

Geocon performed background research of the site by contacting the City of Buena Park and requesting geotechnical and geologic reports pertaining to the site, as well as through the website GeoTracker. The City could not provide copies of available reports without an affidavit from the consultants who prepared the reports. However, the City would allow us to view reports in person.

We reviewed two reports prepared by Converse Consultants (dated September 28, 2018, and January 8, 2019) for a proposed Building #10 located in the north portion of the subject site, as well as a report located north of the railroad tracks prepared by Soil Testing Engineering, Inc. (dated November 13, 1986).

The September 28, 2018, report was prepared by Converse Consultants and consisted of excavating two hollow-stem auger borings to depths of 21½ and 51½ feet below the ground surface. Existing artificial fill was encountered up to a depth of 5 feet below the ground surface. Groundwater was encountered in boring BH-2 at a depth of approximately 42 feet below the ground surface. Laboratory testing indicated the onsite soils had a "low" expansion potential. A liquefaction analysis was performed using the data collected from BH2 using the software LiquefyPro and 2016 California Building Code (CBC) seismic design parameters. Using the encountered groundwater depth of 42 feet and a historic high groundwater depth of 20 feet, the liquefaction analysis estimated seismically-induced settlements up to 0.8 inches and seismically-induced differential settlements up to 0.4 inches over a distance of 30 feet. The report recommended the use of grading and conventional foundations for support of the new structure.

The January 8, 2019, report was prepared by Converse Consultants to provide updated recommendations for the use of cast-in-drilled-hole (CIDH) piles for support of the new building. A discussion explaining the reason for the change in foundation recommendations was not provided in the report.

The November 13, 1986, report included the excavation and logging of 21 borings. Given that this report was prepared for a property on the other side of the railroad tracks, the soil conditions are anticipated to be somewhat different than at the subject site. The notable findings of this report include a lack of groundwater in the borings, drilled to maximum depths of 35½ feet and "medium" expansive soils.

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In addition to the reports viewed at the City, the following report was obtained via GeoTracker:

- *Soil and Ground Water Contamination Study,* dated April 14, 1987, prepared by Converse Environmental Consultants California, Project No. 86-42209-01

Converse Environmental Consultants California (CECC) performed a soil and groundwater contamination study at the site by excavating five 8-inch diameter borings using a hollow-stem auger drilling machine to depths of 55 feet below the ground surface near the location of an underground storage tank (UST). Groundwater was encountered in all excavations at a depth of approximately 44 feet below the existing ground surface. Since the objective of the study was to evaluate the soils and groundwater for contamination related to the UST, the report and borings do not include information relevant to geologic hazards at the site or laboratory testing to determine geotechnical soil properties.

4. GEOLOGIC SETTING

The subject site is situated in the northern portion of the Orange County Coastal Plain, a relatively flat-lying alluviated surface with an average slope of less than 20 feet per mile. The lowland surface is bounded by hills and mountains on the north and east and by the Pacific Ocean to the south and southwest. Locally, the site is located at the southern portion of a valley, toe of an alluvial fan, that derives from the surrounding Coyote Hills.

5. SOIL AND GEOLOGIC CONDITIONS

Based on published geologic maps of the area, the site is underlain by Holocene age young alluvial fan deposits that consist of sand and silt, with lesser amounts of clay (California Geological Survey, 2012). A geologic map of the surface soils for the site and surrounding areas is provided in Figure 3.

5.1 Artificial Fill

Artificial fill is likely present throughout the property as a result of the past site development. The depth and quality of the fill is unknown and will need to be evaluated as part of a comprehensive geotechnical investigation.

5.2 Younger Alluvium

Based on a limited review of the prior borings by Converse (1987), the Holocene age young alluvial fan deposits underlying the site generally consist of interbedded silty to sandy clay, sandy silt and silty sand with various amounts of fine to coarse gravel. The physical properties of the alluvial deposits will need to be evaluated during the comprehensive geotechnical investigation.

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6. GROUNDWATER

Review of the Seismic Hazard Zone Report for the La Habra Quadrangle (California Division of Mines and Geology [CDMG], 1997, revised 2001) indicates that the historically highest groundwater level in the area is poorly defined and could be interpreted as between 10 and 20 feet below the existing ground surface. Groundwater information presented in this document is generated from data collected in the early 1900's to the late 1990s.

Groundwater was encountered in the environmental borings performed by Converse (1987) at a depth of approximately 44 feet below existing ground surface. Groundwater was also encountered in the Converse 2018 borings at a depth of approximately 42 feet below the existing ground surface. As part of our research, we identified three groundwater monitoring wells through the California Department of Water Resources located within a 1.5-mile radius from the site with data recorded between 1971 to 2024. Information regarding the well construction and the target aquifer are unknow at this time; therefore, information from these wells is not included herein.

Based on the depth of groundwater in the previous borings, the interpreted historic high groundwater levels in the immediate area, and the proposed on-grade construction, it is anticipated that static groundwater is neither expected to be encountered during construction, nor have a detrimental effect on the project. However, site-specific borings will be required to evaluate groundwater conditions at the site and its potential impact on the proposed development.

7. GEOLOGIC HAZARDS

7.1 Surface Fault Rupture

The numerous faults in Southern California include Holocene-active, pre-Holocene, and inactive faults. The criteria for these major groups are based on criteria developed by the California Geological Survey (CGS, formerly known as CDMG) for the Alquist-Priolo Earthquake Fault Zone Program (CGS, 2018). By definition, a Holocene-active fault is one that has had surface displacement within Holocene time (about the last 11,700 years). A pre-Holocene fault has demonstrated surface displacement during Quaternary time (approximately the last 1.6 million years) but has had no known Holocene movement. Faults that have not moved in the last 1.6 million years are considered inactive.

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The site is not within a state-designated Alquist-Priolo Earthquake Fault Zone (CGS, 2024a; 2024b; 1991) for surface fault rupture hazards. No Holocene-active or pre-Holocene faults with the potential for surface fault rupture are known to pass directly beneath the site. Therefore, the potential for surface rupture due to faulting occurring beneath the site during the design life of the proposed development is considered low. However, the site is located in the seismically active Southern California region, and could be subjected to moderate to strong ground shaking in the event of an earthquake on one of the many active Southern California faults. The faults in the vicinity of the site are shown in Figure 4, Regional Fault Map.

The closest surface trace of an active fault to the site is the Whittier Fault located approximately 6.1 miles to the north-northeast (CGS, 1991). Other nearby active faults are the Newport-Inglewood Fault Zone, the East Montebello Fault, and the Chino Fault located approximately 10 miles southwest, 12 miles northwest, and 18 miles southwest of the site, respectively (USGS, 2006; Ziony and Jones, 1989). The active San Andreas Fault Zone is located approximately 39 miles northeast of the site (USGS, 2006; Ziony and Jones, 1989).

Several buried thrust faults, commonly referred to as blind thrusts, underlie the Southern California area at depth. These faults are not exposed at the ground surface and are typically identified at depths greater than 3.0 kilometers. The October 1, 1987, M_w 5.9 Whittier Narrows earthquake and the January 17, 1994 M_w 6.7 Northridge earthquake were a result of movement on the Puente Hills Blind Thrust and the Northridge Thrust, respectively. The Puente Hills Blind Thrust underlies the site at depth. These thrust faults and others in the Los Angeles area are not exposed at the surface and do not present a potential surface fault rupture hazard at the site; however, these deep thrust faults are considered active features capable of generating future earthquakes that could result in moderate to significant ground shaking at the site.

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7.2 Seismicity

As with all of Southern California, the site has experienced historic earthquakes from various regional faults. The seismicity of the region surrounding the site was formulated based on research of an electronic database of earthquake data. The epicenters of recorded earthquakes with magnitudes equal to or greater than 5.0 in the site vicinity are depicted on Figure 5, Regional Seismicity Map. A partial list of moderate to major magnitude earthquakes that have occurred in the Southern California area within the last 100 years is included in the following table.

LIST OF HISTORIC EARTHQUAKES

Earthquake (Oldest to Youngest)	Date of Earthquake	Magnitude	Distance to Epicenter (Miles)	Direction to Epicenter
Long Beach	March 10, 1933	6.4	18	S
Tehachapi	July 21, 1952	7.5	97	NW
San Fernando	February 9, 1971	6.6	43	NW
Whittier Narrows	October 1, 1987	5.9	13	NNW
Sierra Madre	June 28, 1991	5.8	26	N
Landers	June 28, 1992	7.3	92	ENE
Big Bear	June 28, 1992	6.4	71	ENE
Northridge	January 17, 1994	6.7	39	NW
Hector Mine	October 16, 1999	7.1	110	ENE
Ridgecrest	July 5, 2019	7.1	132	NNE

The site could be subjected to strong ground shaking in the event of an earthquake. However, this hazard is common in Southern California and the effects of ground shaking can be minimized if the proposed structures are designed and constructed in conformance with current building codes and engineering practices.

7.3 Seismic Design Criteria

The following table summarizes the site-specific design criteria obtained from the 2022 California Building Code (CBC; Based on the 2021 International Building Code [IBC] and ASCE 7-16), Chapter 16 Structural Design, Section 1613 Earthquake Loads. The data was calculated using the online application U.S. Seismic Design Maps, provided by the Structural Engineers Association of California (SEAOC). The short spectral response uses a period of 0.2 second. We evaluated the Site Class based on the discussion in Section 1613.2.2 of the 2022 CBC and Table 20.3-1 of ASCE 7-16. The values presented on the following page are for the risk-targeted maximum considered earthquake (MCER).

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2022 CBC SEISMIC DESIGN PARAMETERS

Parameter	Value	2022 CBC Reference
Site Class	D	Section 1613.2.2
MCE_R Ground Motion Spectral Response Acceleration – Class B (short), S_S	1.558g	Figure 1613.2.1(1)
MCE_R Ground Motion Spectral Response Acceleration – Class B (1 sec), S_1	0.552g	Figure 1613.2.1(2)
Site Coefficient, F_A	1.0	Table 1613.2.3(1)
Site Coefficient, F_V	1.748	Table 1613.2.3(2)
Site Class Modified MCE_R Spectral Response Acceleration (short), S_{MS}	1.558g	Section 1613.2.3 (Eqn 16-20)
Site Class Modified MCE_R Spectral Response Acceleration – (1 sec), S_{M1}	0.964g*	Section 1613.2.3 (Eqn 16-21)
5% Damped Design Spectral Response Acceleration (short), S_{DS}	1.039g	Section 1613.2.4 (Eqn 16-22)
5% Damped Design Spectral Response Acceleration (1 sec), S_{D1}	0.643*	Section 1613.2.4 (Eqn 16-23)

*Per Supplement 3 of ASCE 7-16, a ground motion hazard analysis (GMHA) shall be performed for projects on Site Class "D" sites with 1-second spectral acceleration (S1) greater than or equal to 0.2g, which is true for this site. However, Supplement 3 of ASCE 7-16 provides an exception stating that that the GMHA may be waived provided that the parameter SM1 is increased by 50% for all applications of SM1. The values for parameters SM1 and SD1 presented above have not been increased in accordance with Supplement 3 of ASCE 7-16.

The table below presents the mapped maximum considered geometric mean (MCE_G) seismic design parameters for projects located in Seismic Design Categories of D through F in accordance with ASCE 7-16.

ASCE 7-16 PEAK GROUND ACCELERATION

Parameter	Value	ASCE 7-16 Reference
Mapped MCEG Peak Ground Acceleration, PGA	0.665g	Figure 22-9
Site Coefficient, F_{PGA}	1.1	Table 11.8-1
Site Class Modified MCEG Peak Ground Acceleration, PGA_M	0.732g	Section 11.8.3 (Eqn 11.8-1)

Conformance to the criteria in the above tables for seismic design does not constitute any kind of guarantee or assurance that significant structural damage or ground failure will not occur if a large earthquake occurs. The primary goal of seismic design is to protect life, not to avoid all damage, since such design may be economically prohibitive.

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7.4 Liquefaction Potential

Liquefaction is a phenomenon in which loose, saturated, relatively cohesionless soil deposits lose shear strength during strong ground motions. Primary factors controlling liquefaction include intensity and duration of ground motion, gradation characteristics of the subsurface soils, in-situ stress conditions, and the depth to groundwater. Liquefaction is typified by a loss of shear strength in the liquefied layers due to rapid increases in pore water pressure generated by earthquake accelerations.

The current standard of practice, as outlined in the "Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction in California" and "Special Publication 117A, Guidelines for Evaluating and Mitigating Seismic Hazards in California" requires liquefaction analysis to a depth of 50 feet below the lowest portion of the proposed structure. Liquefaction typically occurs in areas where the soils below the water table are composed of poorly consolidated, fine- to medium-grained, primarily sandy soil. In addition to the requisite soil conditions, the ground acceleration and duration of the earthquake must also be of a sufficient level to induce liquefaction.

The State of California Seismic Hazard Zone Map for the La Habra Quadrangle (CDMG, 2001) and the Buena Park General Plan (2010) indicate that the site is located in an area designated as having a potential for liquefaction, see Figure 6.

Converse Consultants (2018) performed a liquefaction potential evaluation using one borehole for the proposed Building #10 located in the northern portion of the site. The liquefaction analysis indicated that seismically-induced settlements were estimated to be up to 0.8 inches, and differential settlements of up to 0.4 inches over a distance of 30 feet. Due to the lack of borings in other areas of the site, the seismically-induced settlements in the Converse 2018 report may not be representative of the conditions across the site as underlying geology can vary. A site-specific evaluation of the potential for liquefaction for other areas of the site will be required prior to site development. Based on the available information, there is a potential for seismically-induced settlements to impact site development.

7.5 Slope Stability

The topography at the site is relatively level and the topography in the immediate site vicinity slopes very gently to the south-southwest. The site is not located within an area identified as having a potential for slope instability (City of Buena Park, 2010). Additionally, the site is not within an area identified as having a potential for seismic slope instability (CDMG, 1998). There are no known landslides near the site, nor is the site in the path of any known or potential landslides. Therefore, the potential for slope stability hazards to adversely affect the proposed development is considered low.

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7.6 Earthquake-Induced Flooding

Earthquake-induced flooding is inundation caused by failure of dams or other water-retaining structures due to earthquakes. Based on a review of the Buena Park General Plan (2010) and the Orange County General Plan (2004) the site is not located within a potential inundation area for an earthquake-induced dam failure. Therefore, the probability of earthquake-induced flooding is considered very low.

7.7 Tsunamis, Seiches, and Flooding

The site is not located within a coastal area. Therefore, tsunamis are not considered a significant hazard at the site.

Seiches are large waves generated in enclosed bodies of water in response to ground shaking. No major water-retaining structures are located immediately up gradient from the project site. Therefore, flooding resulting from a seismically induced seiche is considered unlikely.

According to the Buena Park General Plan (2010), the site is within a 0.2% Annual Chance Flood Hazard (500-year) area.

7.8 Oil Fields & Methane Potential

Based on a review of the California Geologic Energy Management Division (CalGEM) Well Finder Website, the site is approximately 0.68 mile southwest of the Coyote West (ABD) Oil Field but is not located within the boundaries of the oilfield. The nearest well to the site is the American Oilfield Co. Well Number 1 (API: 0405921555), an idle oil and gas production well located approximately 0.42 mile to the northeast. (CalGEM, 2024). However, due to the voluntary nature of record reporting by the oil well drilling companies, wells may be improperly located or not shown on the location map and undocumented wells could be encountered during construction. Any wells encountered during construction will need to be properly abandoned in accordance with the current requirements of the CalGEM.

Since the site is not located within the boundaries of a known oil field, the potential for the presence of methane or other volatile gases at the site is considered low. However, should it be determined that a methane study is required for the proposed development it is recommended that a qualified methane consultant be retained to perform the study and provide mitigation measures as necessary.

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7.9 Subsidence

Subsidence occurs when a large portion of land is displaced vertically, usually due to the withdrawal of groundwater, oil, or natural gas. Soils that are particularly subject to subsidence include those with high silt or clay content. The site is located within an area of known ground subsidence (USGS, 2024). Subsidence related to groundwater pumping commonly occurs in such small magnitudes and over such large areas that it is generally imperceptible at an individual locality. Accordingly, it affects only regionally extensive structures sensitive to slight elevation changes, such as canals and pipelines. The rate of elevation change is usually uniform over a large enough area that it does not result in differential settlements that would cause damage to individual buildings. Therefore, the potential for subsidence to adversely impact the proposed project is considered low.

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8. CONCLUSIONS

It is our opinion that no geologic conditions are known to exist at the site that would preclude redevelopment for the proposed residential development scenario described herein. A comprehensive geotechnical investigation with site-specific explorations will be required to provide conclusions and recommendations for the design and construction of the site. This report is intended to provide an overview of anticipated geologic-seismic hazard and soils information to be used for due-diligence purposes.

1. Based on the available geologic data, no active or potentially active faults with the potential for surface fault rupture are known beneath or projecting toward the project site. Therefore, the potential for surface rupture at the site is considered very low. The site seismicity is typical for this area of Buena Park and Southern California. Structure design should consider the requirements of the California Building Code.

2. The potential for other geologic hazards, such as slope instability, seiches, flooding, inundation, methane/other volatile gases, and subsidence affecting the site are considered low.

3. Groundwater was encountered in prior borings performed at the site at depths of 42 and 44 feet below the existing ground surface. Based on the depth of groundwater in the previous borings, and the proposed development scenario, groundwater is neither expected to have an adverse impact on construction or future site performance.

4. The site is located within an area identified as having a potential for liquefaction and, based on our review of prior geotechnical reports, seismically induced settlements are anticipated to be on the order of 1 inch. This magnitude of seismically induced settlements is considered low to moderate; the potential for liquefaction will have some impact the geotechnical design.

5. Lateral spread occurs as a result of liquefaction induced lateral ground movement and typically occurs due to the presence of a slope comprised of and/or underlain by liquefiable soils. The Brea Creek Channel is located along the southern property line; therefore, the potential for lateral spread will likely need to be evaluated in a comprehensive geotechnical investigation with site-specific borings. However, given that the channel is lined with concrete, the potential for lateral spread is not anticipated to be significant constraint on developing the site.

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6. Up to 5 feet of existing artificial fill was encountered during the prior site investigations for the site. Demolition of the existing structures will likely disturb the upper site soils, resulting in additional artificial fill. The existing fill, in its present condition, is not anticipated to be suitable for direct support of proposed foundations or slabs. The existing fill must be excavated and replaced as compacted fill. Laboratory testing will be required to determine if the existing fill and site soils are suitable for re-use onsite as engineered fill for geotechnical purposes.

7. For the proposed lightly-loaded townhome structures, it is likely that these structures can be supported on shallow foundations underlain by a blanket of newly placed engineered fill. Shallow foundation systems can include conventional spread footings, a post-tensioned foundation system, or a reinforced concrete mat foundation. It is unlikely that ground improvement or deep foundations would be required to support the proposed development concept.

8. Laboratory testing presented in the prior reports (2018), as well as information provided in conversation with City representatives, indicate that soils in the site vicinity can possess low to medium expansion characteristics. Site-specific laboratory testing will be required to evaluate the degree of expansion potential at the site. The potential impacts of expansive soils can be reduced through implementation of proper design considerations.

9. Laboratory testing presented in the prior reports (2018, 1986), indicate that the soils in the site vicinity generally posses a negligible water-soluble sulfate content with respect to corrosion of concrete. It is unlikely that special concrete mix-designs would be required due to geotechnical conditions. Site-specific laboratory testing will be required to confirm the water-soluble sulfate content.

10. These findings should be considered preliminary and are based on a limited set of data. A majority of the borings reviewed as a part of the preparation of this report were performed in the north portion of the site and offsite. Geologic conditions may vary across the site, especially towards the storm channel. A comprehensive design level geotechnical investigation will be required once the project moves beyond the due-diligence phase of the project to provide project specific recommendations for the soil conditions encountered.

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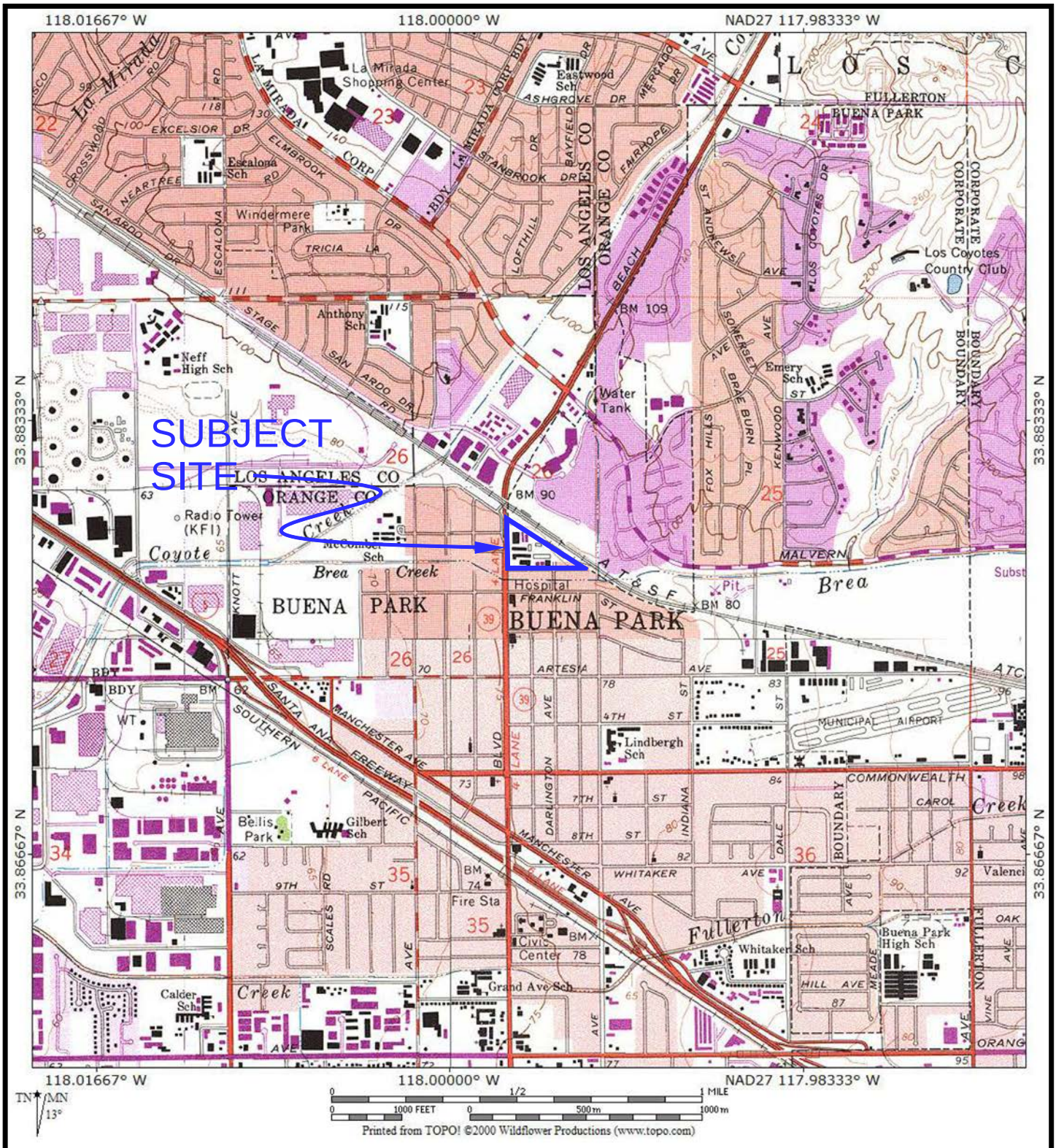

U.S.G.S. TOPOGRAPHIC MAPS, 7.5 MINUTE SERIES, LA HABRA, CA QUADRANGLE

GEOCON WEST, INC.

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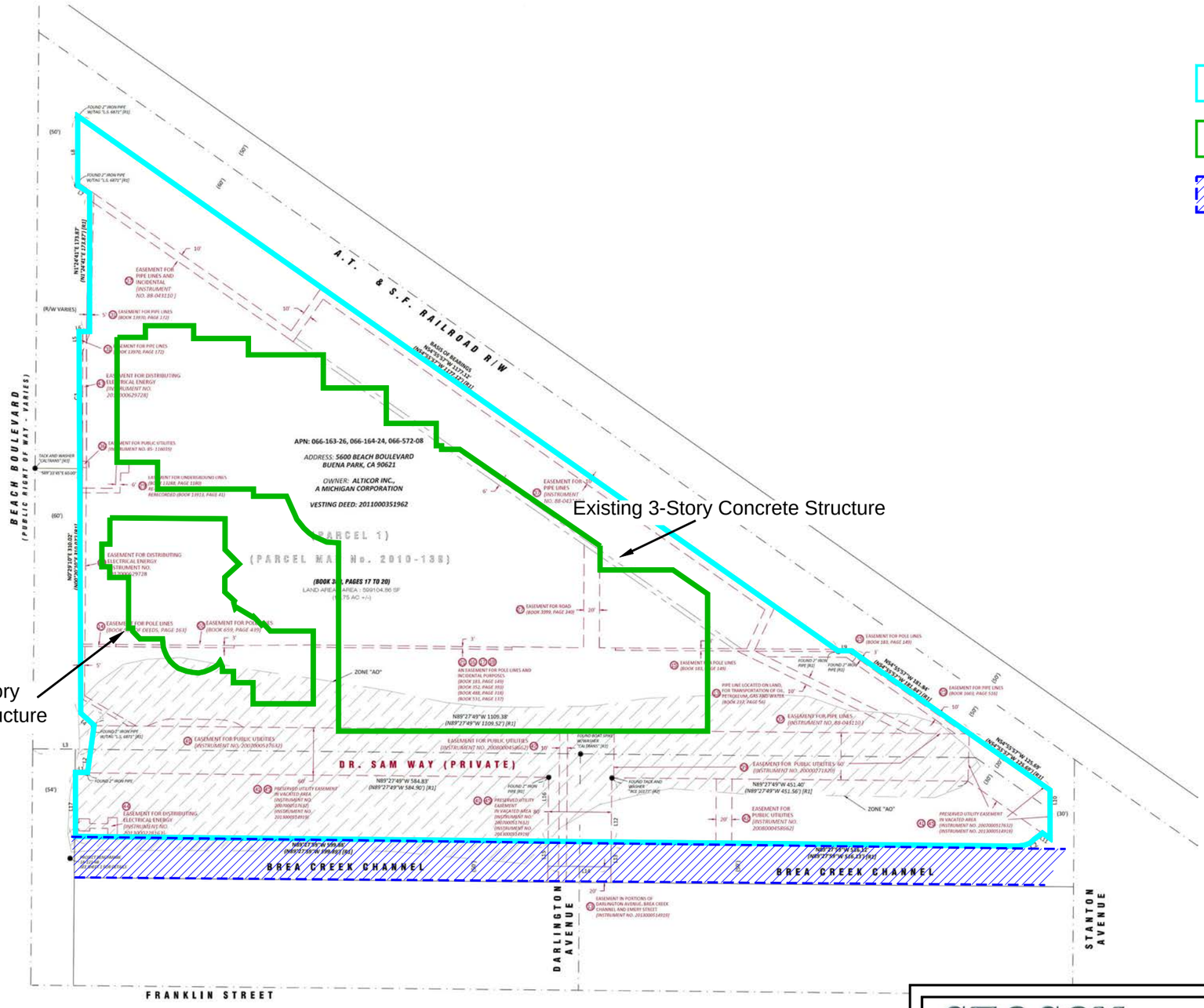
VICINITY MAP

5600 BEACH BOULEVARD
BUENA PARK, CALIFORNIA

JULY 2024	PROJECT NO. W1953-88-01	FIG. 1



LEGEND

- Property Limits
- Approximate Location of Existing Structures
- Location of Brea Creek

0 150' 300'

Plan: 2021 Alta/NSPS Land Title Survey, prepared by Partner

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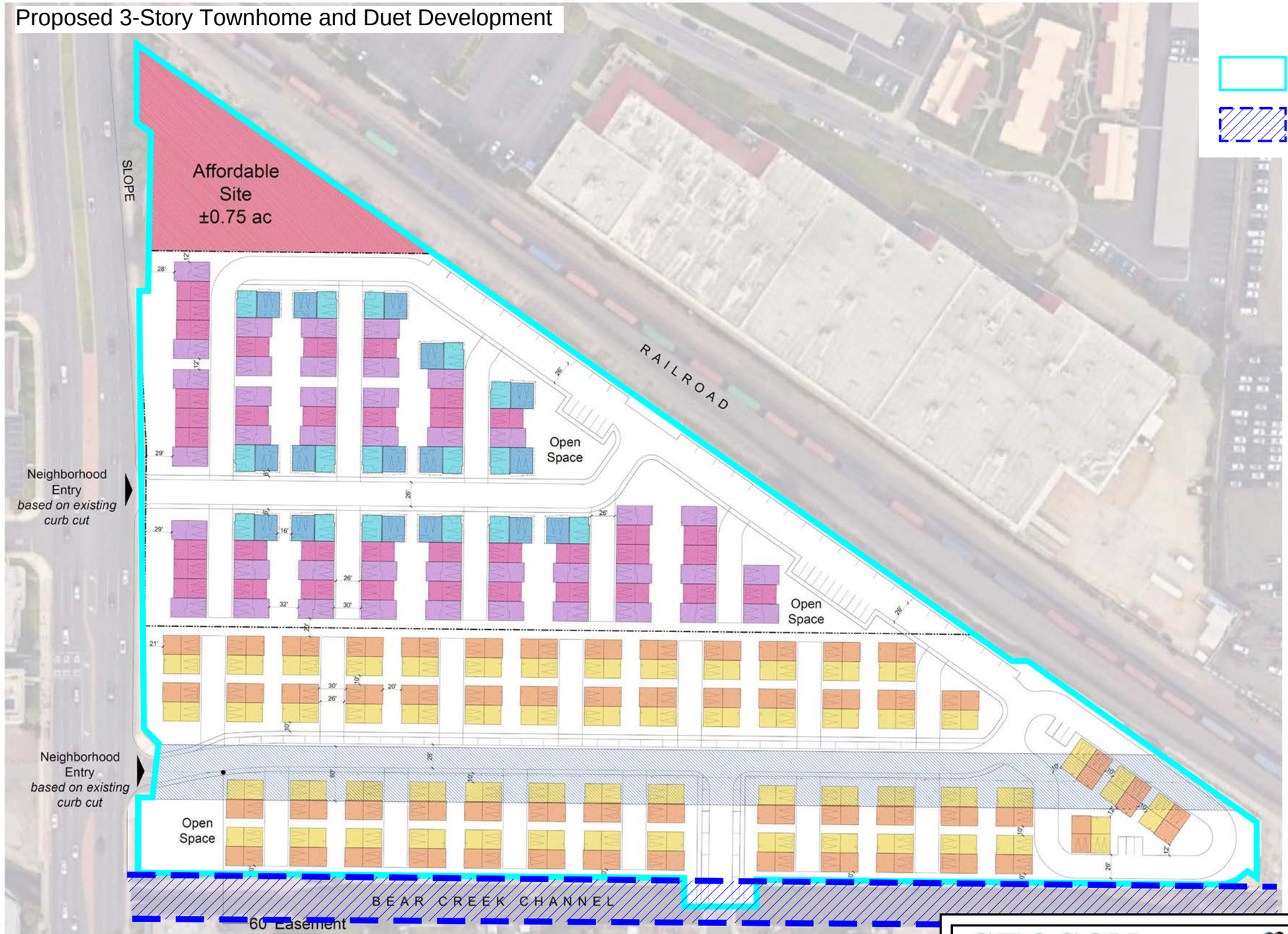
SITE PLAN - EXISTING CONDITIONS

5600 BEACH BOULEVARD
BUENA PARK, CALIFORNIA

JULY 2024	PROJECT NO. W1953-88-01	FIG. 2A

Proposed 3-Story Townhome and Duet Development



LEGEND

Limits of Proposed Development

Location of Brea Creek Channel

0 120' 240'

Plan: Conceptual Density Study, Prepared by KTGY Architecture and Planning

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SITE PLAN - CONCEPTUAL

5600 BEACH BOULEVARD
BUENA PARK, CALIFORNIA

JULY 2024	PROJECT NO. W1953-88-01	FIG. 2B

LEGEND

QUATERNARY — ? — ? — Holocene

af / Qg / Qa

SURFICIAL SEDIMENTS
undissected alluvial deposits
af *artificial fill, some recent areas may not be shown*
Qg *gravel and sand of major stream channels*
Qa *alluvial gravel, sand and silt of valleys and floodplains*

Qls

LANDSLIDE DEBRIS
see also landslides mapped by Tan, 1988

Qae
Qoa

OLDER SURFICIAL SEDIMENTS
Qae *slightly elevated and locally dissected alluvial gravel and sand, on north side of Puente Hills*
Qoa *elevated, dissected remnants of alluvial sand and gravel*

--UNCONFORMITY--

Qlhc
Qlh

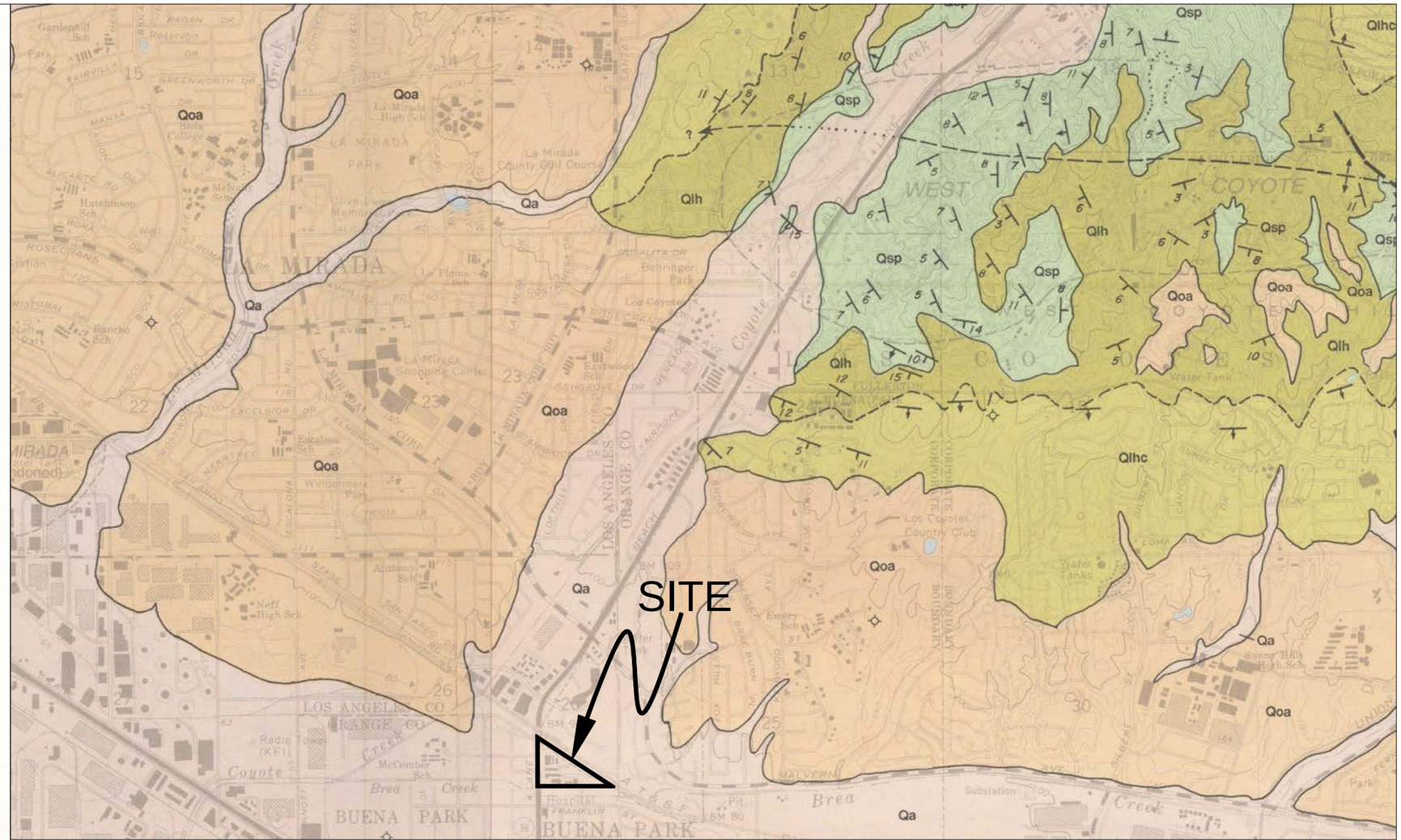
LA HABRA FORMATION
(of Yerkes, 1972)
terrestrial, weakly indurated; Pleistocene age, includes Coyote Hills Formation of Yerkes, 1972 (in Coyote Hills)
Qlh *tan to light gray sandstone and pebble conglomerate, vaguely bedded; includes abundant siliceous shale pebbles south of Puente Hills;*
Qlhc *similar to* **Qlh**, *but includes interbedded siltstone in middle part of unit*

-LOCAL UNCONFORMITY-

Qsp

SAN PEDRO FORMATION
(of Yerkes, 1972, in Coyote Hills)
shallow marine clastic, weakly indurated; early Pleistocene age
Qsp *sandstone, tan to light gray, soft, vaguely bedded, contains molluscan fossils, locally pebbly; base unexposed*

Pleistocene



NORTH

0 2000' 4000'

Reference: Dibblee, T. W., Jr., 2001, Geologic Map of the Whittier and La Habra Quadrangles (Western Puente Hills), Los Angeles and Orange Counties, California, Dibblee Foundation Map #DF-74

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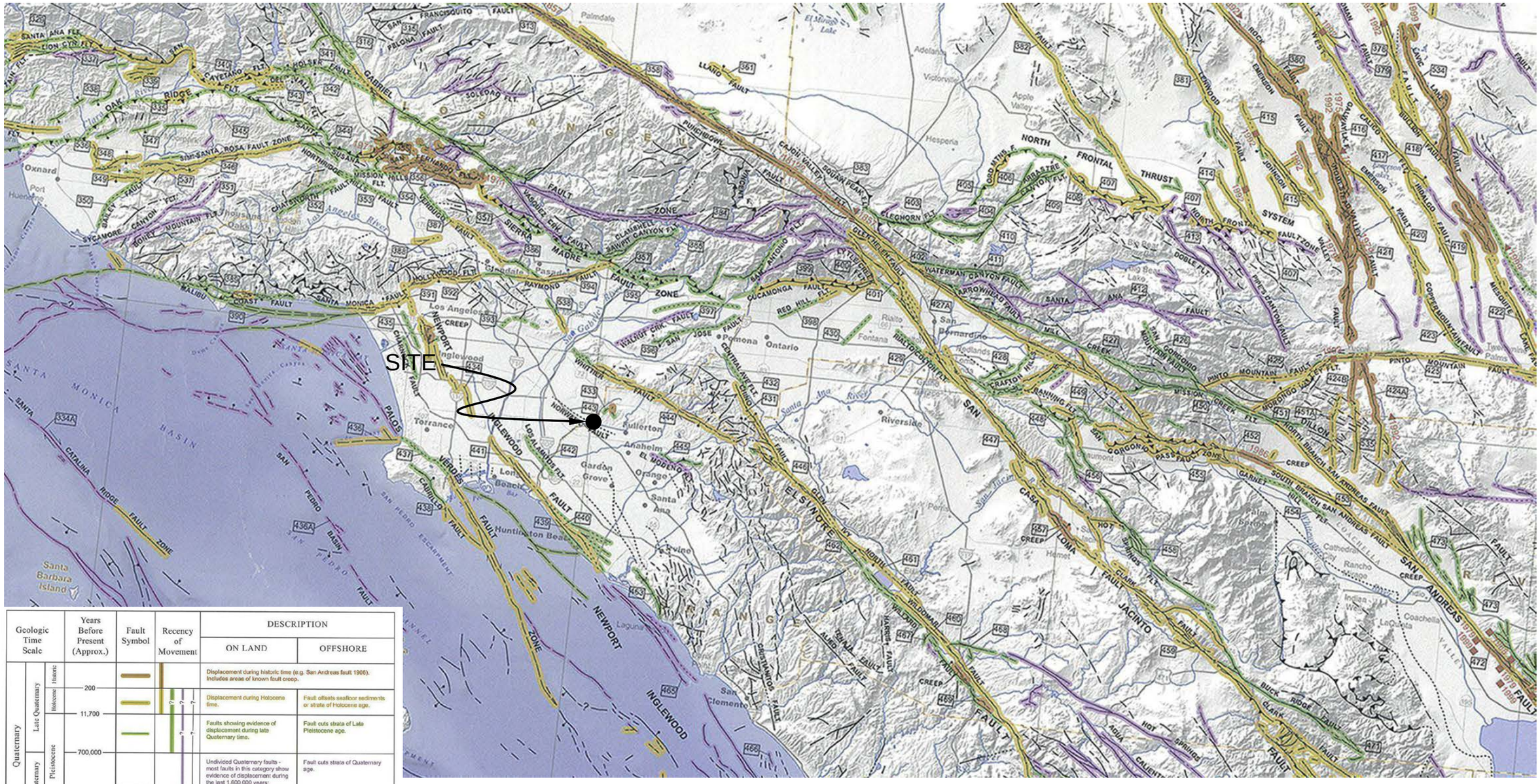
GEOLOGIC MAP

5600 BEACH BOULEVARD

BUENA PARK, CALIFORNIA

JULY 2024 | PROJECT NO. W1953-88-01 | FIG. 3

Reference: Jennings, C.W. and Bryant, W. A., 2010, Fault Activity Map of California, California Geological Survey Geologic Data Map No. 6.



Geologic Time Scale			Years Before Present (Approx.)	Fault Symbol	Recency of Movement	DESCRIPTION: ON LAND	DESCRIPTION: OFFSHORE
Quaternary	Late Quaternary	Historic	200			Displacement during historic time (e.g. San Andreas fault 1906). Includes areas of known fault creep.	
		Holocene			? ? ?	Displacement during Holocene time.	Fault offsets seafloor sediments or strata of Holocene age.
		Pleistocene	11,700		? ?	Faults showing evidence of displacement during late Quaternary time.	Fault cuts strata of Late Pleistocene age.
	Early Quaternary		700,000		?	Undivided Quaternary faults - most faults in this category show evidence of displacement during the last 1,600,000 years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age.	Fault cuts strata of Quaternary age.
Pre-Quaternary			1,600,000*			Faults without recognized Quaternary displacement or showing evidence of no displacement during Quaternary time. Not necessarily inactive.	Fault cuts strata of Pliocene or older age.
			4.5 billion (Age of Earth)				

* Quaternary now recognized as extending to 2.6 Ma (Walker and Geissman, 2009). Quaternary faults in this map were established using the previous 1.8 Ma criterion.

N

0 12 24 Miles

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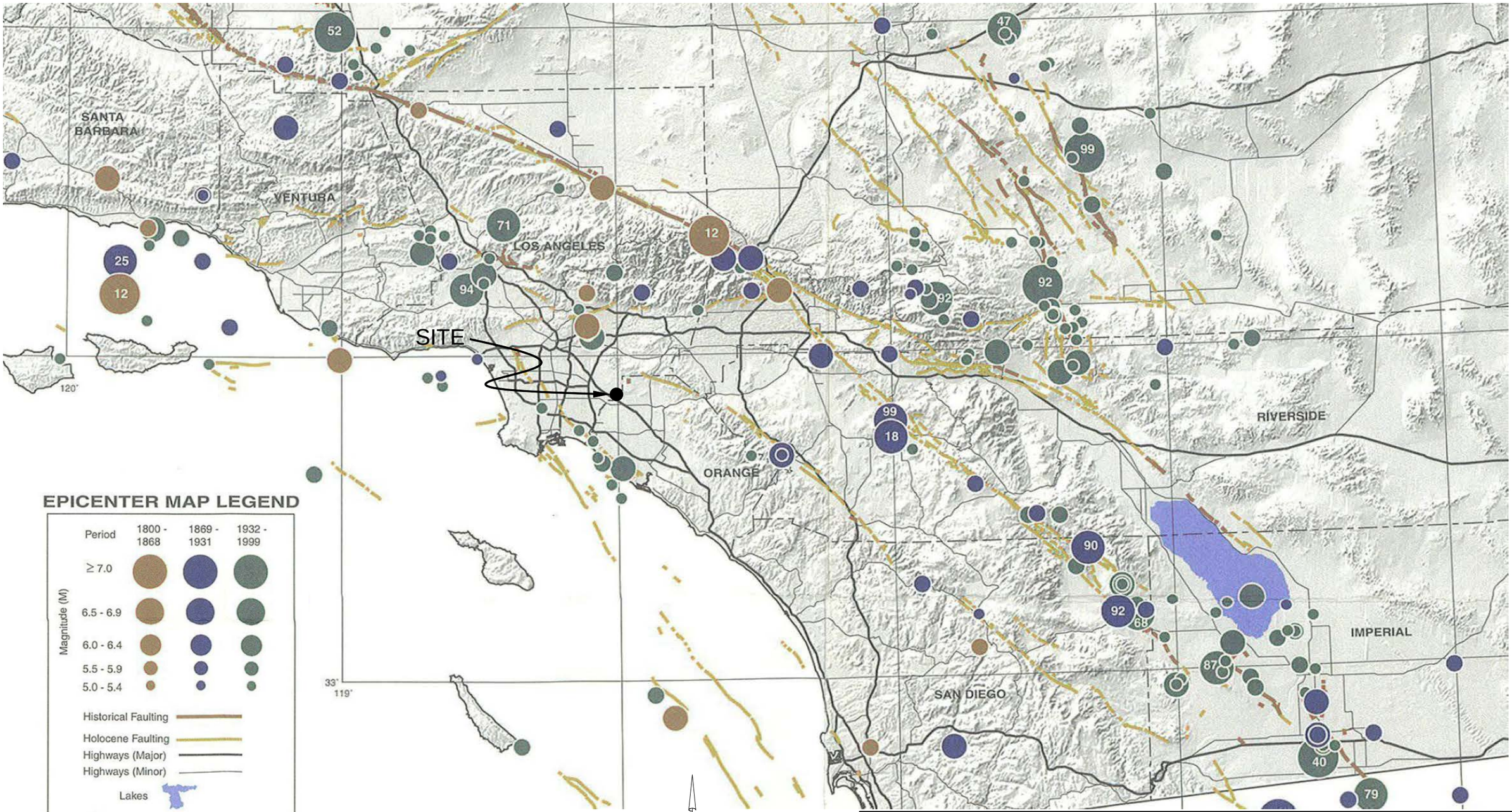
REGIONAL FAULT MAP

5600 BEACH BOULEVARD

BUENA PARK, CALIFORNIA

JUNE 2024 | PROJECT NO. W1953-88-01 | FIG. 4



EPICENTER MAP LEGEND

Period	1800 - 1868	1869 - 1931	1932 - 1999
≥ 7.0			
6.5 - 6.9			
6.0 - 6.4			
5.5 - 5.9			
5.0 - 5.4			

Magnitude (M)

- Historical Faulting
- Holocene Faulting
- Highways (Major)
- Highways (Minor)
- Lakes
- 65 — Last two digits of M ≥ 6.5 earthquake year

Reference: Toppozada, T., Branum, D., Petersen, M., Hallstrom, C., Cramer, C., and Reichle, M., 2000, Epicenters and Areas Damaged by M≥5 California Earthquakes, 1800 - 1999, California Geological Survey, Map Sheet 49.

N

0 20 40 Miles

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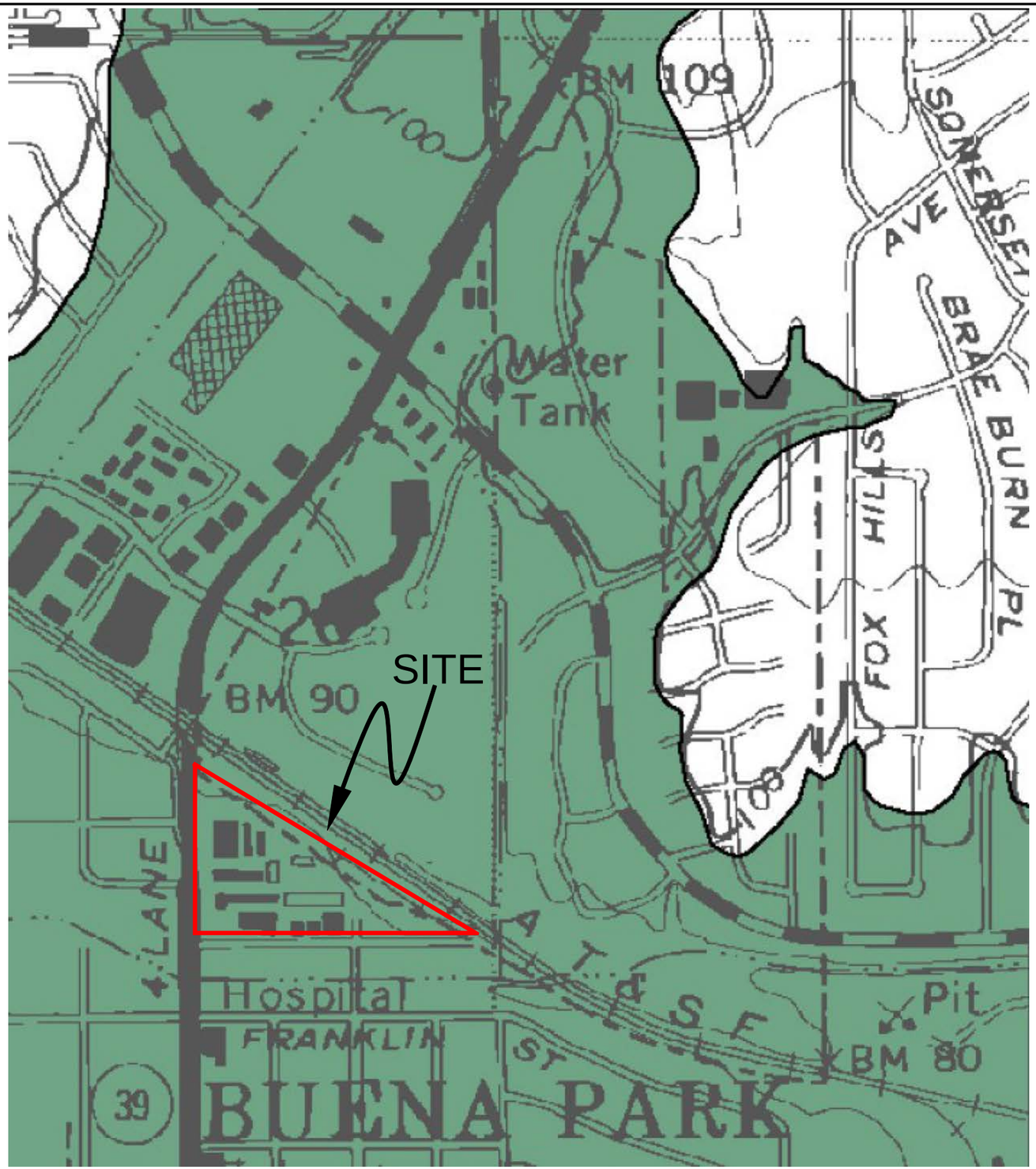
REGIONAL SEISMICITY MAP

5600 BEACH BOULEVARD
BUENA PARK, CALIFORNIA

JULY 2024 | PROJECT NO. W1953-88-01 | FIG.5



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.

Earthquake-Induced Landslides

Areas where previous occurrence of landslide movement, or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

NORTH

0 500' 1000'

Reference: Seismic Hazard Evaluation of the La Habra 7.5-minute Quadrange, Los Angeles County, California. California Department of Conservation Division of Mines and Geology Open-File Report 97-17

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SEISMIC HAZARD MAP

5600 BEACH BOULEVARD

BUENA PARK, CALIFORNIA

JULY 2024	PROJECT NO. W1953-88-01	FIG. 6

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4. *California Geologic Energy Management Division, 2024, CalGEM Resources Well Finder, http://maps.conservation.ca.gov.doggr/index.html#close.*

5. *California Geological Survey, 2024a, CGS Information Warehouse, Regulatory Map Portal, http://maps.conservation.ca.gov/cgs/informationwarehouse/index.html?map=regulatorymaps.*

6. *California Geological Survey, 2024b, Earthquake Zones of Required Investigation, https://maps.conservation.ca.gov/cgs/EQZApp/app/.*

7. *California Geological Survey, 2018, Earthquake Fault Zones, A Guide for Government Agencies, Property Owners/Developers, and Geoscience Practitioners for Assessing Fault Rupture Hazards in California, Special Publication 42, Revised 2018.*

8. *California Geological Survey, 1991, Earthquake Zones of Required Investigation La Habra Quadrangle, Official Map, Released: November 1, 1991*

9. *California Geological Survey, 2012, Geologic Compilation of Quaternary Surficial Deposits in Southern California, Santa Ana 30' X 60' Quadrangle, A Project for the Department of Water Resources by the California Geological Survey, Compiled from existing sources by Trinda L. Bedrossian, CEG and Peter D. Roffers, CGS Special Report 217, Plate 16, Scale 1:100,000.*

10. *Dibblee, T. W., Jr., 2001, Geologic Map of the Whittier and La Habra Quadrangles (Western Puente Hills), Los Angeles and Orange Counties, California, Dibblee Foundation Map # DF-74.*

11. *FEMA, 2024, Online Flood Hazard Maps, http://www.esri.com/hazards/index.html.*

12. *Jennings, C. W. and Bryant, W. A., 2010, Fault Activity Map of California, California Geological Survey Geologic Data Map No. 6.*

13. *Los Angeles County Department of Public Works, 2024, Flood Zone Determination Website, http://dpw.lacounty.gov/apps/wmd/floodzone/map.htm.*

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14. *Toppozada, T., Branum, D., Petersen, M, Hallstrom, C., and Reichle, M., 2000, Epicenters and Areas Damaged by M> 5 California Earthquakes, 1800 – 1999, California Geological Survey, Map Sheet 49.*

15. U.S. Geological Survey Landslide Hazard Program, 2023a, U.S. Landslide Inventory, from USGS web site: https://usgs.maps.arcgis.com/apps/webappviewer/index.html?id=ae120962f459434b8c904b456c82669d.Risk Engineering, *EZ-FRISK*, 2016.

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