November 23, 2020

Fix the City

SUBJECT: Requested Review and Analysis of a Fault Evaluation Report and Related Data for the Properties at 1751 and 1749 Malcolm Avenue, and 1772 Glendon Avenue, Los Angeles California

Fix the City:

Introduction and Purpose
Wilson Geosciences Inc. (WGI) has conducted the requested review and analysis of the following reports:

- Applied Earth Sciences (AES), 2015a, Geological fault study and geotechnical investigation report, proposed multi-residential building project, Lots 11, 19, and 20, Block 15 of Tract 7803, 1749 and 1751 Malcolm Avenue and 1772 Glendon Avenue, Los Angeles, California, dated July 21, 2015.

- Applied Earth Sciences, 2015b, Supplement No. 1, Geotechnical and geologic investigation, Lots 11, 19, and 20, Block 15 of Tract No. 7803, 1749 and 1751 Malcolm Avenue and 1772 Glendon Avenue, Los Angeles, California, dated November 30, 2015.

- Applied Earth Sciences, 2016, Supplement No. 2, Geotechnical and Geologic Investigation, Lots 11, 19, and 20, Block 15, Tract No. 7803, 1749 and 1751 Malcolm Avenue and 1772 Glendon Avenue, Los Angeles, California (Drawing No. 2, SUPP. No. 2), dated January 15, 2016.

In addition, we reviewed environmental boring and cross-section information from the following report for a property south of the subject properties:

- WAYNE PERRY, INC., 2010, SITE ASSESSMENT REPORT, Thrifty Oil Co Station No. 020, 10801 Santa Monica Boulevard, Los Angeles, California 90025, dated December 30, 2010 (Figure 3 – Plot Plan, Figure 4 – Cross Section A-A', and Figure 6 – Geologic Cross Section C-C').

We understand your purpose in requesting this review is to evaluate: 1) the possible presence of active faults that may cross the three subject parcels which proposed to construct two separate apartment buildings, herein referred to as the Malcolm and Glendon Projects (collectively, the Site or the Projects); 2) the validity of the active fault data and conclusions of the subject AES report; 3) active fault surface rupture issues that may exist at each Project site potentially affecting the

development; 4) other active fault related ground surface deformation issues potentially affecting the development; 5) the timing of the project approvals as related to the designation of the State Alquist-Priolo Earthquake Fault Zone (APEFZ) and the City Fault Rupture Study Area (FRSA) encompassing the Projects; and 6) the level of compliance of the fault investigation and the structural design with APEFZ and FRSA standards. A part of the AES report describes the final building design for the Malcolm Project site (a cantilever approach) across the active fault, identified in the northeast corner of the Site, to accommodate one-foot of vertical ground displacement. In addition to this assessment, a structural and geotechnical engineering analysis would be needed to evaluate the design and active fault mitigation measures proposed.

Our primary conclusions are:

- The Site contains one, and possibly two, active earthquake faults one of which was located/identified by the AES field investigations for the Malcolm Project,
- The Malcolm Project site study and design do not meet all APEFZ and City of Los Angeles requirements with regard to study methods and building setback,
- The Glendon Project site was not studied and does not meet APEFZ and City of Los Angeles requirements with regard to study requirements and methods, and
- A proposed cantilever building design for the Malcolm Project site crossing over the Eastern Fault to accommodate one-foot vertical fault offset appears insufficient and vertical offset could approach three- to six-feet.

General Geologic and Santa Monica Fault Setting

The fault of concern at the Site is the Santa Monica Fault. The active, east-west oriented Santa Monica-Hollywood Fault system serves as the southern boundary of the western Transverse Ranges (Santa Monica Mountains) in the area of the Project in the western Los Angeles Basin (Figure 1, Appendix). The fault system is subparallel to and north of Santa Monica Boulevard north of Interstate-10 (I-10) and east of I-405. Data suggests faulting occurred in Holocene time on several strands of the Santa Monica Fault Zone, portions of these fault strands are active, and movement is reverse-left lateral oblique. Pleistocene alluvial fan deposits along the southern margin of the mountains are highly dissected (due to uplift and erosion north of the main fault) and the Holocene alluvial fan deposits are typically found south of a prominent geomorphic scarp. The California Geological Survey (CGS) has prepared a Fault Evaluation Report[1] summarizing the data and studies performed along the fault zone.

The Santa Monica Fault exhibits a strong component of reverse (vertical) motion evidenced by the uplift of the Santa Monica Mountains, the roughly continuous south-facing scarp observed at the surface, and the subsurface investigations

[1] Olson, 2018; FER-259

across the fault[2] . Additionally, an appreciable amount of left-lateral (horizontal) slip is inferred from the east to west left-stepping pattern of the fault traces and the measured offsets of subsurface geologic marker units. Age-dating based on carbon from offset layers indicated definitive evidence for surface rupture on some of these faults between 10,000 and 17,000 years ago, as well as probable evidence for surface rupture on another strike-slip strand between approximately 1,000 and 3,000 years ago consistent with evidence for slip on the main strand in the most recent earthquake approximately 1,000 to 3,000 years before present.

These subsurface investigations referenced above support components of left-lateral (strike-slip) and vertical (dip-slip) motion (oblique-slip) with a calculated slip-rate in the range of approximately 0.5 to 1.0 mm/year for the Santa Monica Fault. Earthquake magnitudes of M_w6.9 to 7.2 on a reverse fault indicate average ground surface displacements on the order of 2 to 5 feet and maximum ground surface displacements on the order of 4 to 10 feet[3]. Based on surface rupture length for the entire 25-mile (40 km) long fault zone from Point Dume to Beverly Hills on a reverse fault, average ground surface displacements on the order of 3 to 8 feet are possible[3]. The precise strike-slip to dip-slip ratio is not known with certainty along this segment of the Santa Monica Fault, however it may be near 1:1.

In addition, for the Metro Purple-Line study east of the Site, a setback zone extending approximately 100 feet north and south of the detected main traces of the faults was established to include areas that may be subject to the ground rupture, folding, secondary faulting, and off-fault distributed deformation (both horizontal and vertical flexural stresses) expected during an earthquake[4].

The Proposed Development of Two Projects at the Subject Site

Figure 2 (Appendix) displays the Site and near Site information from the above two reports, and related information from FER-259. Figure 2 is subdivided with insets labeled Figures 2A, 2B, 2C, and 2D.

The Site is bordered by Malcolm Avenue on the east, Glendon Avenue on the west, existing apartment buildings on the north, and an alley on the south (Figure 2A). The south side of the alley is bordered by commercial buildings including a gas station on the southeast at the corner of Malcolm Avenue and Santa Monica Boulevard. As described in the first of three AES reports[5] dated July 21, 2015:

> "The proposed new building onsite will consist of two separate garden-style multifamily residential buildings, both with two of living space atop one level of semi-subterranean to full subterranean parking garage. The lowest garage level will range from five to ten feet below grade throughout different portions of the proposed new

[2] Parsons Brinkerhoff, 2011; Dolan and Sieh, 1992; Dolan and others, 2000
[3] Wells and Coppersmith, 1994, Figures 11 and 12; Wesnousky, 2008, Figures 7a and 7b
[4] Parsons Brinkerhoff, 2011
[5] AES, 2015a, 2015b, and 2016

> buildings. Please see [AES] Drawings 2 through 4 for a graphical depiction of the proposed new building with respect to the existing ground surface elevations."
>
> "There are existing on-grade apartment buildings onsite, constructed from 1938 through 1944, which will eventually be removed as part of the current project. The project area consists of three adjacent and contiguous lots with a total of 24,560 square feet."

Each of the "two separate garden-style" buildings are separate structures and each has a "structure for human occupancy"[6] requiring study. The Malcolm Project sits on two parcels, 1749 and 1751 Malcolm Avenue. The Glendon Project sits on 1772 Glendon Avenue.

Timing of Project Investigations, APEFZ Technical Studies, and Permitting

Three AES geotechnical and fault investigations were completed exclusively for the Malcolm Project site with dates of July 21, 2015, November 30, 2015, and January 15, 2016. City of Los Angeles Department of Building and Safety (LADBS) Correction Letters were provided on August 19, 2015 and December 29, 2015; only the second letter was provided for this study. No post-January 15, 2016 approval letter correspondence from LADBS was provided. Much of this timing is laid out in your August 3, 2020 LADBS appeal letter. No studies were completed for the Glendon Avenue Project site as required. Discussions below concern only the Malcolm Avenue project fault investigation.

In the July 21, 2015 report AES states the following on page 4:

> "According to studies performed by Dolan et al starting in 1998, as well as several other workers, segments of the Santa Monica fault zone are thought to have ruptured in middle Holocene time, and as such the fault is considered active by the state of California as well as the city of Los Angeles and other governmental agencies (Cities of West Hollywood and Santa Monica). Although the Santa Monica fault has not yet been included as an Alquist-Priolo Earthquake Fault zone by the state, based on our correspondence with CGS officials, it is our understanding that the zoning of this fault is currently under way at the state level by the California Geological Survey. The city of Los Angeles, however, has, as of late 2013, already begun requiring fault studies for properties located within the proposed "Fault Rupture Study Area". A map of this study area for west Los Angeles has yet to be released to the public by the city of Los Angeles or by the state of California, but personal conversations with City grading staff, review of city Navigate LA maps online, as well as review of available maps and literature regarding the Santa Monica

[6] WESTLAW, 2020

fault, confirm that the subject property is close to or within the widely defined fault zone."

As stated above, AES acknowledges it was aware of the existing Fault Rupture Study Area and the pending Alquist-Priolo Earthquake Fault Zone zoning efforts by the City of Los Angeles and the California Geological Survey (CGS), respectively. The FRSA was designated in the 1996 (and still applicable) Safety Element of the Los Angeles City General Plan[7] as shown on the Plan's Exhibit A covering the project Site.

FER-259[8] was published on January 5, 2018. As indicated in your appeal letter the construction permit was issued on September 28, 2018 over eight months after FER-259 was published. No documentation was found within the LADBS permit website indicating the FER-259 was considered for this project between its publication date and the issuance of the building permit. The Los Angeles Times and Temblor[9] published copies of the maps in July 2017 after being released early by the CGS. Also, two years and eight months had passed between the AES January 15, 2016 final fault investigation report and the formal publication of FER-259. Many jurisdictions consider this to be such a substantial delay that a complete re-review of the project documents, including technical reports and site development plans, is required to establish that no intervening events have occurred requiring re-evaluation of the project approval. The issuance of the FER-259 eight months before the building permit is a good example of such an intervening event. Even though not recognized by AES as being within an APEFZ, we believe compliance with State of California Building Code[10] should have been mandated.

AES Reports

As mentioned above, the three AES geotechnical and fault investigations were completed with dates of July 21, 2015[11], November 30, 2015[12], and January 15, 2016[13] for the Malcolm Avenue property and no studies were done for the Glendon Avenue property (Figure 2A). Relying just on the reports and the two City correction letters, the process appears routine. My goal here is not to restate what is in these documents, but to focus on a few issues that appear to be outside standard practice and to be in contradiction to standards established by the City Fault Rupture Study Area (FRSA) and by the Alquist-Priolo EFZ Act (APEFZ).

You have argued in your August 3, 2020 LADBS appeal letter the basic premise that FER-259 was issued after the AES reports approvals, but prior to issuance of the building permit, as noted by the dates above. This is a temporally accurate

[7] City of Los Angeles, 1996
[8] Olson, 2018; APEFZ; 2018
[9] Lin II and Rañoa, 2017; Jacobson and Stein, 2017
[10] WESTLAW, 2020, filed 10-18-84
[11] AES, 2015a
[12] AES, 2015b
[13] AES, 2016

argument; however, it is unclear whether the City did not comply with a regulation requiring that they consider the FER-259 after their approval. While I believe it is the correct argument, it is a legal one that requires legal counsel interpretation of City and State laws and regulations. The following subsections discuss specific issues with the AES reports.

Review of Stereographic Aerial Photographs

LADBS building code document P/BC 2020-129[14] (and the 2014 and 2017 versions) states:

"A licensed professional **shall** (emphasis added) conduct research as outlined below. (items 1 and 2 omitted here)

3. Review stereographic aerial photographs and/or historic U.S. Geological Topographical Survey maps to evaluate geomorphic features; contrasts in soil or vegetation; or, lineaments suggestive of faulting."

In none of the AES reports are aerial photographs cited in the references. In the July 21, 2015 report AES states:

> "In the vicinity of the subject lot in the Westwood area, the fault is thought to make a westward bend near the southwest corner of the LDS Church property, roughly parallel with the westward bend in Santa Monica Boulevard at nearly the same location. These bends have been interpreted by other geologic workers, based on their field findings and review of historic aerial photography, as representing the main "pre-urbanization, en-echelon series of escarpments" of the Santa Monica fault zone in this location (Dolan, 2000; AMEC and Parsons-Brinkerhoff, 2011-12; Shannon Wilson 2012)."

AES did not do their own aerial photograph interpretation, but relied on past studies conducted at other sites/locations as stated. This is in conflict with the P/BC 2020-129 mandate, which is repeated from earlier versions (e.g., 2014) of the -129 requirements in existence at the time the AES study was done. FER-259 demonstrates the usefulness of the analysis of historical vertical (1927-1928) and oblique (1921-1938) aerial photographs, along with historic topographic maps, that defined APEFZ fault features crossing the Project Site (FER-259[15], Plate 2 and Figure 2B).

APEFZ Fault Traces Crossing the Project Site

Eastern Fault Trace - FER-259 shows two APEFZ fault traces at the Site, each crossing portions of the proposed development area (Figure 2B). AES focused their studies only on the eastern fault trace entering the Malcolm Project s from the east and crossing a portion of the northcentral section of the Site. The AES reports

[14] City of Los Angeles Department of Building and Safety, 2014
[15] Olsen, 2018

discuss the field investigation along the east side of the Malcolm Project and their interpretation process. After the initial field work (July 21, 2015 report), and at the request of LADBS in the first comment letter, a second round of field investigations were conducted again along the Malcolm Avenue bordering the eastern edge of the Site (November 30, 2015 report). AES (Figure 2A) locates the eastern fault trace between CPT-7 and B-3 (July 21, 2015 report) and between CPT-19 and CPT18 (November 30, 2015 report, see their Drawing No. 1 map and Drawings No. 2 and 3, Cross-sections A-A' and B-B'). These two crossing points provide a possible fault trend eastward from the Site, but the points are only 30 feet apart and they have no data westward within the property Possible investigation areas existed in the north-south driveway/open space between the two Projects, in the open lot between the houses at 1772 Glendon, and along Glendon Avenue. Lacking investigations on the west it cannot be said with certainty that the eastern trace does not veer or left-step to the southwest back into the Site. This left-stepping geometry characterizes this portion of the Santa Monica Fault Zone (FER-259, pages 4, 9, and 31).

Western Fault Trace - FER-259 shows an APEFZ fault trace (Figure 2B) entering the Glendon Project site about midway along the western Site boundary and trending approximately north 84-degrees west. This fault crosses the proposed Glendon Project site development then exits the south side of the Glendon Project site at roughly the boundary driveway between 1751 Malcolm and 1772 Glendon at the alley. Had AES performed analysis of historic aerial photographs and topographic maps as was done for FER-259 and mandated by City of Los Angeles P/BC 2014-129 and 2020-129, they would likely have found this western fault trace entering the Site from the west and crossing a portion of the central section of the Glendon Project Site. No investigation was conducted along Glendon Avenue, along the driveway between the two lots, in the open space between the houses on the lot, or along the adjacent alley on the south similar to the investigation along Malcolm Avenue. Therefore, this western APEFZ trace was not determined to be present or absent as required within a known APEFZ before the final permit was approved.

The AES field investigations (CPTs) along the east side of the Site (Figure 2A) extended quite far to the south (CPT-13) adjacent to the ARCO Station at the northwest corner of Malcolm Avenue and Santa Monica Boulevard. The ARCO site was studied[16] as the Thrifty Oil site, and numerous borings were drilled and logged (Figure 2C). The AES report references the Perry report, but did not provide the boring logs and cross-sections. We obtained these through other sources. Perry cross-section A-A' (Figure 2C and 2D) shows what appears to be a south-to-north lithologic change when compared to AES's CPT-13 through CPT-18. The Perry cross-section A-A' stratigraphic section of clay, silt, silt with sand, sandy silt, silt with clay, and clayey silt seems to correspond to the sag pond deposits of AES north of CPT-18. A projection of the western APEFZ trace (Figure 2A), northwest to southeast from Glendon Avenue, passes just north of Perry

[16] Perry, 2011

cross-section A-A' (their borings SB-3, B-8, and SB-2, B-11, and SB-1) and if continued to the southeast would pass south of CPT-13 into an area not studied by AES. This suggests the presence of the active western fault trace extending to the vicinity of Perry cross-section A-A' before likely stepping left to the eastern trace, with an uplifted fault block in between.

Magnitude of Lateral and Vertical Displacements on the Santa Monica Fault

As mentioned in the Santa Monica Fault Setting subsection above, earthquake magnitudes of M_w6.9 to 7.2 with average and maximum ground surface displacements on the order of 2 to 10 feet, are possible for a rupture of the entire 25-mile (40 km) long fault zone from Point Dume to Beverly Hills[17]. In addition, the left-stepover zone encompassing the Project site is an area that would be particularly susceptible to folding, secondary faulting, and off-fault distributed ground deformation (both horizontal and vertical flexural stresses) expected during an earthquake[18]. As summarized in FER-259 related to the Metro Westside Purple Line Extension Project (**emphasis added**):

> "Consequently, the consultants excavated a fault trench along a portion of the transect and observed faulting within the alluvial sediments near the surface (Figure 18). Based on soil-stratigraphic age estimates, the consultants concluded the youngest sediments exposed in this trench range from approximately 30,000 to 60,000 years old (Unit 1), and the oldest unit was estimated at 143,000 to 335,000 years old (Unit 6). Several faults were exposed in the trench and were described as an "**upwardly flowering and stepping zone of faults and fractures about 20 feet wide and having a cumulative ± 3 feet of north side down displacement, and some undetermined lateral offset**"."

The information above suggests that the one-foot vertical offset value assumed by AES for the 1751 Malcolm Avenue development is substantially less than other scientists have suggested.

Faulting in a Stepover Zone

The FER-259 and the above analysis of the active western and eastern fault traces indicates the Site is in a stepover zone between these two fault traces. Studies conducted in such zones indicate movements transferred between two active traces can be significant and complex. This is well documented for the 1992 magnitude (M) 7.3 Landers earthquake[19] in a very detailed report. In the abstract of the report it is stated (**emphasis added**):

> "The magnitude and width of off-fault deformation along the rupture is primarily controlled by the macroscopic structural complexity of the

[17] Wells and Coppersmith, 1994, Figure 11; Wesnousky, 2008, Figure 7
[18] Parsons Brinkerhoff, 2011
[19] Milliner, Dolan, and others, 2015

> fault system, with a weak correlation with the type of near-surface materials through which the rupture propagated. **Both the magnitude and width of distributed deformation are largest in stepovers**, bends, and **at the southern termination of the surface rupture**."

Focusing on the conclusions of the Landers report, it is stated (**emphasis added**):

> "Our analysis indicates that the structural complexity of the fault zone is the dominant control on the magnitude and width of surface deformation. **Off-fault deformation and fault zone widths are largest in stepovers**, kinks, and bends in the faults, as well at the southern termination of the Landers rupture. We also observe a correlation with the type of near-surface material through which the rupture propagated, with surface rupture along bedrock-sediment interfaces generating less off-fault deformation with relatively narrower fault zones, **in contrast to wider, more distributed deformation where the rupture extended through sediments**."

This indicates that the deformation in the area encompassing the Site would the "largest" and more substantial "where the rupture extended through sediments" as is the case at the Site. It is not clear that this has been considered in the mat foundation designs for the development.

Summary and Conclusions

The Santa Monica Fault associated with the project Site was acknowledged to be active prior to the AES studies in 2015 and 2016. AES investigated the segment of the Santa Monica Fault entering the Malcolm Project site from the east (eastern trace). They used CPT soundings and borings to locate an active fault entering the Site on the northeast approximately 25-feet south of the northeast property corner. Two north-northwest CPT and boring transects approximately 30-feet apart provided a single point of a fault orientation that was used in the building/foundation design. It is not possible to establish the direction or trend of the fault absent other reference points. Further, due to the close proximity of these two points, this orientation may represent a very local condition. No studies were done on the east and west sides of the Malcolm Project site nor on the eastern portion of the Glendon Avenue site.

Empirical relationships based on many past earthquakes worldwide suggest that vertical displacement on the Santa Monica Fault for a M_w6.9 to 7.2 would have average and maximum ground surface displacements on the order of 2 and 10 feet rather than the one foot assumed for the building design cantilevered across the fault.

Approximately 9 months prior to a building permit being issued on September 28, 2018 the California Geological Survey designated the Site to be within an Alquist-Priolo Earthquake Fault Zone (APEFZ). The City and AES acknowledged by their actions and report statements that they were aware this Fault Evaluation Report (FER) was in the planning/preparation process. January 8, 2018 FER-259 verified the approximate location of the eastern fault confirmed in a limited area by AES and also identified an active fault entering the west side of the Site (Glendon Avenue side). This western fault was identified using analysis of historic aerial photographs and topographic maps. AES did not evaluate historic aerial photographs or topographic maps for its study as mandated in the City of Los Angeles Surface Fault Rupture Hazard Investigations requirements[20].

The western active fault trace, per FER-259, traverses the 1772 Glendon property and the central portion of the proposed building. Analysis for this report of the current ARCO service station site's 2011 environmental assessment report by Wayne Perry[21] (their cross-section A-A'; our Figure 2D) suggests this western fault trace may cross into the ARCO site before left-stepping north to the eastern active fault trace. Geologic materials south of the western fault trace along Perry's A-A' are very similar to the sag pond deposits north of the eastern fault trace suggesting an uplifted fault block between the two active fault traces. A 2015 study[22] of the magnitude 7.3 Landers earthquake indicates that such locations are where "the magnitude and width of distributed deformation are largest in stepovers, bends, and at the southern termination of the surface rupture". The Site is such a location where such ground deformation, not specifically mentioned by AES, could occur.

Our primary conclusions are:

- The Site contains one, and possibly two, active earthquake faults one of which was located/identified by the AES field investigations,
- The Malcolm Project site study and design do not meet APEFZ and City of Los Angeles requirements with regard to study methods and building setback, and
- The Glendon Project site was not studied and does not meet APEFZ and City of Los Angeles FRSA mandates with regard to study requirements and methods; as such active fault traces must be assumed to be present and no structure can be permitted absent the required studies and findings; and
- The proposed cantilever building design for the Malcolm Project crossing over the eastern active fault trace to accommodate one-foot vertical fault offset appears insufficient and vertical offset could be much greater than one-foot vertical.

References

Applied Earth Sciences (AES), 2015a, Geological fault study and geotechnical investigation report, proposed multi-residential building project, Lots 11, 19,

[20] City of Los Angeles, 1996
[21] Perry, 2011
[22] Milliner, Dolan, and others, 2015

and 20, Block 15 of Tract 7803, 1749 and 1751 Malcolm Avenue and 1772 Glendon Avenue, Los Angeles, California, dated July 21, 2015.

Applied Earth Sciences, 2015b, Supplement No. 1, Geotechnical and geologic investigation, Lots 11, 19, and 20, Block 15 of Tract No. 7803, 1749 and 1751 Malcolm Avenue and 1772 Glendon Avenue, Los Angeles, California, dated November 30, 2015.

Applied Earth Sciences, 2016, Supplement No. 2, Geotechnical and Geologic Investigation, Lots 11, 19, and 20, Block 15, Tract No. 7803, 1749 and 1751 Malcolm Avenue and 1772 Glendon Avenue, Los Angeles, California (Drawing No. 2, SUPP. No. 2), dated January 15, 2016.

California Geological Survey (CGS), 2020, Earthquake Zones of Required Investigation Maps (EZRIMs), http://gmw.conservation.ca.gov/shp/EZRIM/Maps/).

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

California Public Resources Code, amended 1994, Division 2, Chapter 7.5, Section 2621.

City of Los Angeles, 1996, Safety Element of the Los Angeles City General Plan, adopted November 26, 1996.

City of Los Angeles, 2020, INFORMATION BULLETIN / PUBLIC - BUILDING CODE, REFERENCE NO.: LABC 1803.5.11 Effective: 01-01-2020 DOCUMENT NO.: P/BC 2020-129, Previously Issued As: P/BC 2017-129

Dolan, J. F. and Sieh, K., 1992, Tectonic geomorphology of the northern Los Angeles Basin: Seismic hazards and kinematics of young fault movement: *in* Ehlig, P. L., and Steiner, E. A., eds., Engineering geology field trips: Orange County, Santa Monica Mountains, and Malibu, Guidebook and Volume, Assoc. Eng. Geol., pp.B-20 to B-26.

Dolan, J. F., Sieh, K., and Rockwell, T. K., 2000, Late Quaternary activity and seismic potential of the Santa Monica fault system, Los Angeles, California:

Jacobson, David and Ross Stein 2017, State redraws active fault strands in Hollywood, Beverly Hills, and Santa Monica, Posted On July 18, 2017 By Temblor.

Lin II, Rong-Gong, and Raoul Rañoa, 2017, Earthquake fault maps for Beverly Hills, Santa Monica and other Westside areas could bring development restrictions, Los Angeles Times, July 13, 2017, 1:11 PM

Milliner, C. W. D., J. F. Dolan, J. Hollingsworth, S. Leprince, F. Ayoub, and C. G. Sammis (2015), Quantifying near-field and off-fault deformation patterns of the 1992 Mw 7.3 Landers earthquake, Geochem. Geophys. Geosyst., 16, doi:10.1002/2014GC005693.

Olson, Brian, 2018, CALIFORNIA GEOLOGICAL SURVEY FAULT EVALUATION REPORT FER 259 THE HOLLYWOOD, SANTA MONICA and NEWPORT-INGLEWOOD FAULTS in the Beverly Hills and Topanga 7.5' Quadrangles Los Angeles County, California January 5, 2018 (revised).

Parsons Brinkerhoff, 2011, Century City Area Fault Investigation Report, Westside Subway Extension Project, Contract No. PS-4350-2000, dated October 14, 2011.

Wells D, L. and K. J. Coppersmith, 1994, New Empirical Relationships among Magnitude, Rupture Length, Rupture Width, Rupture Area, and Surface Displacement, Bulletin of the Seismological Society of America, Vol. 84, No. 4, pp. 974-1002, August 1994.

Wesnousky, S.G., 2008, Displacement and geometrical characteristics of earthquake surface ruptures: Issues and implications for seismic-hazard analysis and the process of earthquake rupture, *Bull. Seism. Soc. Am.* **98**, 1609-1632.

WESTLAW, 2020, Barclays Official California Code of Regulations, Title 14. Natural Resources, Division 2. Department of Conservation, Chapter 8. Mining and, Geology, Subchapter 1. State Mining and Geology Board, Article 3. Policies and Criteria of the State Mining and Geology Board with Reference to the Alquist-Priolo Earthquake Fault Zoning Act, filed 10-18-84. https://govt.westlaw.com/calregs/Document/I4F706B40D48511DEBC02831C6D6C108E?viewType=FullText&originationContext=documenttoc&transitionType=DocumentItem&contextData=(sc.Default)&bhcp=1

Limitations and Closure

The intent of this report is to advise Fix the City (Client) on engineering geological information/data related to the 1749/1751 Malcolm Avenue and 1772 Glendon Avenue Sites. It should be understood that our engineering geologic consulting provides professional opinions and the contents of this report do not provide all the information needed for the Project and further investigation may be required. Any errors or omissions noted by any party reviewing this report, and/or any other engineering geologic aspect of the project, should be reported to WGI in a timely fashion. Only the Client can authorize subsequent use of this report. The Client

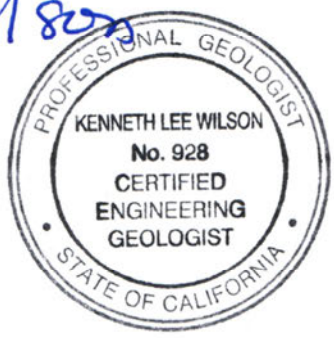
should consider any transferring of information or other-directed use of this report by the Client as "advice by the Client".

Our firm should be notified of any pertinent change in project plans or if subsurface conditions are encountered which differ from those described herein, since this may indicate a need for a re-evaluation of our results and conclusions. This report has been prepared for use on the subject Project Site only, and not for other projects or parties other than the current Client and current Project. This report may not contain sufficient information for other parties or other purposes. The interpretations and conclusions presented herein are professional judgments and opinions. These opinions have been derived in accordance with current standards of practice, and no warranty is expressed or implied.

If you have any questions about the content of this report, please contact the undersigned at your convenience.

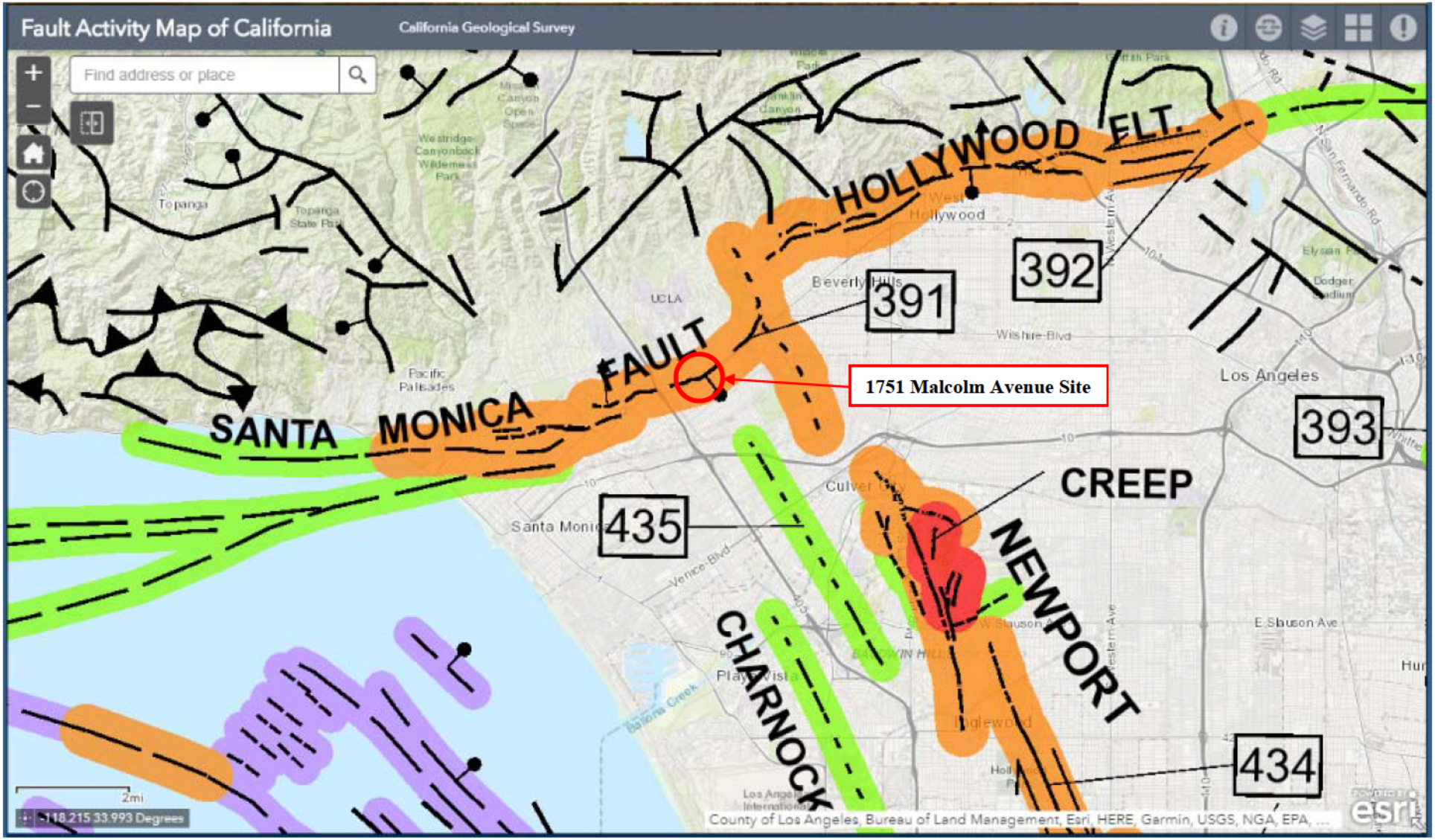
Sincerely,
WILSON GEOSCIENCES INC.

Kenneth Wilson
Principal Geologist
P.G. #3175, C.E.G. #928
(626) 791-1589



APPENDIX

Figures 1 and 2



SYMBOL EXPLANATION

Fault traces on land are indicated by solid lines where well located, by dashed lines where approximately located or inferred, and by dotted lines where concealed by younger rocks or by lakes or bays. Fault traces are queried where continuation or existence is uncertain. All offshore faults based on seismic reflection profile records are shown as solid lines where well defined, dashed where inferred, queried where uncertain.

FAULT CLASSIFICATION COLOR CODE
(Indicating Recency of Movement)

Fault along which historic (last 200 years) displacement has occurred.

Holocene fault displacement (during past 11,700 years) without historic record.

Late Quaternary fault displacement (during past 700,000 years).

Quaternary fault (age undifferentiated).

FIGURE 1 – Regional Fault Map (California Geological Survey, 2010)

FIGURE 2 – Summary of 1749/1751 Malcolm Avenue and 1772 Glendon Avenue Fault Information Based on AES Reports and Related Data

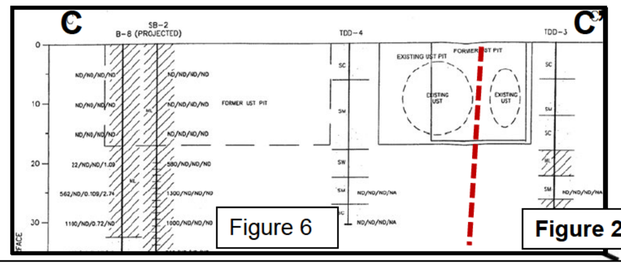


Figure 6

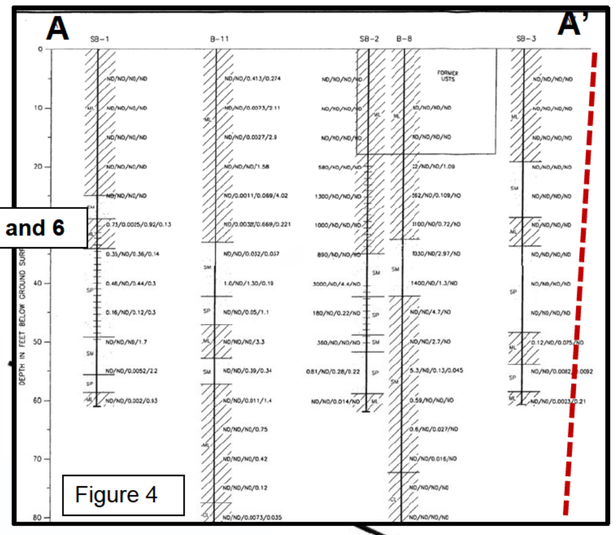


Figure 4

Figure 2D – Perry Figures 4 and 6

Figures 4 and 6 – Geologic Cross Sections A-A' and C-C' from Perry (2010) with red dashed line showing a projection of the APEFZ Western Trace; see below Figure 3.

CL, ML — CLAY, SILT, SILT WITH SAND, SANDY SILT, SILT WITH CLAY, CLAYEY SILT

SM, SP — FINE–TO COARSE GRAINED SAND, SAND WITH SILT, SILTY SAND. GRAVELLEY SAND

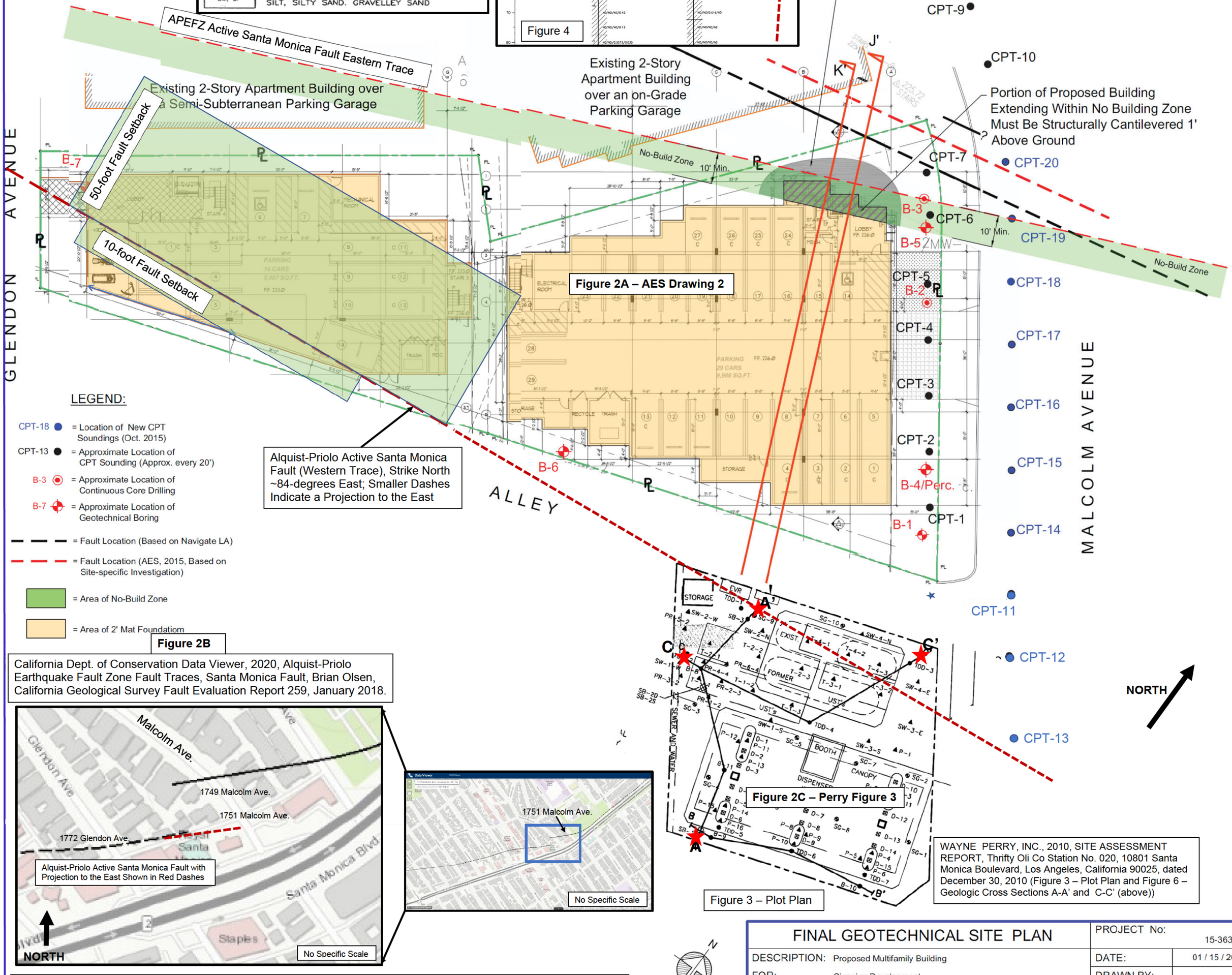


Figure 2A – AES Drawing 2

Figure 2C – Perry Figure 3

Figure 3 – Plot Plan

WAYNE PERRY, INC., 2010, SITE ASSESSMENT REPORT, Thrifty Oli Co Station No. 020, 10801 Santa Monica Boulevard, Los Angeles, California 90025, dated December 30, 2010 (Figure 3 – Plot Plan and Figure 6 – Geologic Cross Sections A-A' and C-C' (above))

LEGEND:

- CPT-18 = Location of New CPT Soundings (Oct. 2015)
- CPT-13 = Approximate Location of CPT Sounding (Approx. every 20')
- B-3 = Approximate Location of Continuous Core Drilling
- B-7 = Approximate Location of Geotechnical Boring
- = Fault Location (Based on Navigate LA)
- = Fault Location (AES, 2015, Based on Site-specific Investigation)
- = Area of No-Build Zone
- = Area of 2' Mat Foundation

Figure 2B

California Dept. of Conservation Data Viewer, 2020, Alquist-Priolo Earthquake Fault Zone Fault Traces, Santa Monica Fault, Brian Olsen, California Geological Survey Fault Evaluation Report 259, January 2018.

Alquist-Priolo Active Santa Monica Fault (Western Trace), Strike North ~84-degrees East; Smaller Dashes Indicate a Projection to the East

Scale: 1" = 20'

FINAL GEOTECHNICAL SITE PLAN		PROJECT No: 15-363-02	
DESCRIPTION:	Proposed Multifamily Building	DATE:	01 / 15 / 2016
FOR:	Sinanian Development	DRAWN BY:	ZS
ADDRESS:	1749 & 1751 Malcolm Ave. & 1772 Glendon Ave., Los Angeles, CA 90024	CHECKED BY:	CM
Applied Earth Sciences	GEOTECHNICAL . GEOLOGY . ENVIRONMENTAL ENGINEERING CONSULTANTS www.aessoil.com (818) 552-6000	DRAWING No: 2	SUPP. No: 2

DISCLOSURE: This figure was constructed using the Applied Earth Sciences (AES) Report: Supplement No. 2, Geotechnical and Geologic Investigation, Lots 11, 19, and 20, Block 15, Tract No. 7803, 1749 and 1751 Malcolm Avenue and 1772 Glendon Avenue, Los Angeles, California (Drawing No. 2, SUPP. No. 2), dated January 15, 2016.

RESUME

KENNETH WILSON
Principal Engineering Geologist

EDUCATION

University of California at Riverside, B.S. Geological Sciences, 1967
University of California at Riverside, M.S. Geological Sciences, 1972

PROFESSIONAL REGISTRATIONS

Professional Geologist, California, #3175 [Issued 1-08-1974; Expires 2-28-2021]
Certified Engineering Geologist, California, #928 [Issued 1-08-1974; Expires 2-28-2021]

PROFESSIONAL SUMMARY

Kenneth Wilson is responsible for management, technical supervision and performance of engineering geology, geotechnical, environmental impact, and environmental geology projects, and is a Registered Geologist (#3175) and Certified Engineering Geologist (#928) in California. He performs and supervises environmental assessments for commercial, industrial and government projects covering the disciplines of hydrogeology, engineering geology, geology, hydrology, seismicity, tectonics, faulting, mineral resources, and waste management. Geotechnical studies include fault evaluations, ground failure assessments, slope stability and foundation materials characterization, liquefaction potential, flooding hazards and site selection. The emphasis of his work is on defining geologic and geotechnical conditions, and hazards, which may affect the feasibility and design of any type of development project. Mr. Wilson has over 30 years of technical performance and project experience in critical facilities studies, radioactive/mixed/hazardous waste management, energy plant site licensing, impacts to surface and groundwater resources, waste disposal site development, dams and reservoirs and numerous other engineered structures. Specialized experience is in engineering geology in support of geotechnical studies, site selection/evaluation, seismic safety, integration of multidisciplinary technical teams, project management, and EIRs, EAs, and EISs.

PROFESSIONAL EXPERIENCE

Wilson Geosciences, Engineering and Environmental Geology [1989-Present]
Principal Engineering Geologist: Responsible for all management, technical and marketing activities for engineering geology, environmental impact, and environmental geology projects. Performs and supervises environmental assessments for commercial, industrial and government projects covering the disciplines of hydrogeology, engineering geology, geology, hydrology, seismicity, tectonics, faulting, mineral resources, and waste management. Geotechnical studies include fault evaluations, ground failure assessments, slope stability and foundation materials characterization, liquefaction potential, flooding hazards and site selection.

The Earth Technology Corporation [1974-1989]
Corporate Vice President: Mr. Wilson worked from late-1987 to mid-1989 for the Chairman/CEO and the President/COO performing the following tasks: assisting in evaluation of several potential acquisitions; management of pre-acquisition due diligence; evaluation of four new office geographic expansion options; managed preparation of corporate health and safety program and H/S technical procedures. In 1989 was principal-in-charge for start-up of environmental engineering and hydrogeology portion of Technical Assistance Contract with DOE/Nevada Operations, Environmental Safety and Health Branch.

Vice President; Director, Program Management: Mr. Wilson reported to the President of the Western Division (1985-1987) and was responsible for business development, project execution and strategic planning for market areas related to radioactive (high, mixed, and low-level) waste management programs, energy and mineral resources, geophysics and offshore technology. Emphasis was on geosciences, engineering, environmental, and program management disciplines for site selection, site evaluation/characterization, site remediation and specialized advanced technology considerations in hydrologic modeling, rock mechanics testing and geophysical exploration.

Vice President, Associate and Senior Manager: Mr. Wilson had numerous challenging technical and management responsibilities and assignments during the period 1974-1988. There was a wide range of projects for which he had a technical role, either performance, supervisory, or management in scope. A substantial portion of the time he was Program Manager for the Missile-X (MX) ICBM, Siting and Characterization Studies in the Western and Midwestern

United States: for United States Air Force, Ballistic Missile Office, and the Southern Region Geologic Project Manager (SRGPM) in Mississippi, Louisiana, Texas, Georgia, South Carolina, Virginia, Maryland for the Office of Nuclear Waste Isolation (ONWI) and the Office of Crystalline Repository Development (OCRD). These projects were national in scope and involved most geologic, geotechnical, geophysical, environmental, and hydrologic disciplines

Converse Consultants (formerly Converse, Davis and Associates) [1970-1974]

Staff and Project Geologist: Conducted and supervised investigations in southern, central, and northern California, southern Nevada, and eastern Washington. Groundwater and related studies included permeability, transmissibility, and storage coefficient studies at Searles Lake, California; earth dam projects at Yucaipa, Littlerock, and Anaheim, California; groundwater contamination (hydrocarbons) evaluation in the Glendale, California area; wastewater and water treatment facilities in Solvang, Lompoc, Victorville, Thousand Oaks, and Sylmar, California. Numerous earthquake and fault risk studies were performed for earth dams and reservoirs, high-and low-rise buildings, hospitals and schools, proposed nuclear power plant sites, water storage tanks, and large-diameter pipelines. Landslide and other slope failure studies were performed in rock and soil terrains. Offshore studies planned and conducted include coastal geophysical (seismic reflection, side scan sonar, fathometer), sampling and scuba investigations near Monterey and Dana Point, California.

RELEVANT PROJECTS IN LOS ANGELES COUNTY

Development and Re-development CEQA Projects

- Proposed Pacoima/Panorama City Redevelopment Plan Amendment/ Expansion Area, 7,136 Acre Project Area, I-210 Freeway and Sunland Boulevard, I-210 on the north, the I-5/I-405 on the west, and Victory Boulevard on the south, City of Los Angeles, California
- Geology and Soils Section Little Tokyo Redevelopment Plan
- Geologic Input Arts and Crafts Center for the Social Hall Upgrades for the Avalon Gardens Housing Development
- Sakaida & Sons Surface Mine Project EIR near Pacoima Canyon, Los Angeles County, California
- Geology/Seismicity/Geotechnical Conditions and CEQA Checklist Analysis 8601 Wilshire Boulevard Development
- Fault Investigation--Proposed Stonebridge Estates Development Site, 12400 Big Tujunga Canyon Road
- Geology Conditions La Placita Project EIR
- Geologic Input to Eugene Debs Park Framework Plan
- City Dock No. 1 Marine Research Center Project EIR, Port of Los Angeles (Port) at Berths 56-60 and 70-71, Los Angeles, California
- Hsi Lai Buddhist Community Center 20,000-square-foot Multipurpose Facility MND, Hacienda Heights, Los Angeles County, California
- Kenneth Hahn Recreation Area EIR, Baldwin Hills
- Geologic Description of the MTA Exposition Corridor Transit Project Phase II Project Area
- Geology, Soils, Seismic and Groundwater Environmental Impact Statement for the expansion of Los Angeles International Airport
- Geology and Soils Section West Los Angeles College Facilities Master Plan Draft EIR

- ***Fault Activity and Earthquake Evaluations (Technical and CEQA Documents)***
- Geotechnical, Geologic and Earthquake Assessment for University in Southern California
- Evaluation of Surface Faulting at the Blue Star Trailer Park Following the 1971 San Fernando Earthquake
- Geologic and Fault Assessment for the Van Nuys Boulevard Corridor for Transportation Projects
- Fault Rupture Study Area (FRSA) Report for the Canoga Transportation Corridor Lassen Street/Railroad Overcrossing, Chatsworth
- Fault Investigation Los Angeles County Fire Department (LACFD) Barton Heliport Pacoima Facility, Verdugo Fault, Pacoima
- Fault Investigation Los Angeles Mission College Main Campus, San Fernando Fault, Sylmar
- Fault Investigation Los Angeles Mission College Health/Fitness and Athletics Complex and East Campus Building, San Fernando Fault, Sylmar
- Post-Earthquake Damage and Fault Assessment Los Angeles County Juvenile Hall, Sylmar
- Surface Faulting Potential Evaluation, Holy Cross Hospital, Mission Hills
- Fault and Earthquake Evaluation for a Bridge Extension West of Ballona Creek Centerline

- Fault Investigation Review to Support an EIR for the 2935± Acre AERA-Master Planned Community, near Diamond Bar, Counties of Los Angeles and Orange, California

OTHER RELEVANT ENGINEERING GEOLOGY RELATED PROJECTS (2008 to Present)

- **Technical Memorandum-Fault Location Investigation near Pier 4 of the La Loma Bridge Site, City of Pasadena, California-Hollow-Stem Auger/Coring/Sonic Drilling And Seismic Refraction Techniques:** *The La Loma Bridge crosses over the north-to-south trending Arroyo Seco channel, which has a central rectangular concrete drainage approximately 50 feet wide and 15 feet deep. The channel narrows naturally at the bridge due to natural exposures of Topanga Formation sandstone on the west abutment and Quartz Diorite granitic basement rock on the east abutment. Young alluvium in the channel estimated to have been on the order of zero to 20 feet thick. Surface runoff and underground flow/seepage within alluvium, bedrock layers, and fractures has saturated the fill/alluvium to within 15 to 20 feet of the ground surface. Geologic, geotechnical, faulting, and seismic conditions at the La Loma Bridge were investigated by Wilson Geosciences Inc. in 2004 and in 2007-2008 with Hushmand Associates, Inc.. The 2004 investigations were in support of an EIR/EIS related to the bridge rehabilitation and to early design considerations. Investigations in 2007-2008 included field studies to locate the active Eagle Rock fault and to assess its ground rupture potential.* (City of Pasadena)
- **Fault Rupture Study Area Report for the Canoga Transportation Corridor Lassen Street/Railroad Overcrossing, Chatsworth, California, for Diaz-Yourman & Associates (2009):** The Canoga Transportation Corridor Project Draft EIR identified the Fault Rupture Study Areas, an area where fault rupture potential exists, within the project area, but did not identify the underlying basic source data for the fault locations within the FRSAs. Wilson Geosciences Inc. prepared a study to identify the potential for fault rupture through the grade separation area (bridge site) within the FRSA. The study determined if there was evidence for a fault or faults within the bridge site using (a) geologic and topographic map analysis, (b) analysis of information from multiple geotechnical borings, and (c) geophysical data (seismic refraction and electrical resistivity) collected within and near the proposed bridge location. Evidence for Holocene warping of geologic features is also considered. It was determined that no evidence existed within the grade separation area for active folds or faults.
- **Eldorado-Ivanpah 230 kV Transmission Line Proponents Environmental Assessment (PEA)—Geology, Mineral Resources, and Soils Section, near Primm, Nevada along the California-Nevada Border for Southern California Edison (2008-2010):** Wilson Geosciences Inc. prepared the Geology, Mineral Resources, and Soils, and the Hydrology and Water Quality sections of the PEA for the Transmission Line extending across the California-Nevada border. These sections formed the basis for the Draft and Final EIR/EIS, which required substantial detail describing the existing environment, potential impacts of the primary and alternative routes, applicant proposed measures to reduce potential impacts, and necessary mitigation measures. Mr. Wilson performed all of the collection and compilation of existing data, conducted an extensive field reconnaissance, prepared all report text and graphics, the later in coordination with the Southern California Edison (SCE) GIS department. Mr. Wilson's report sections were reviewed by SCE staff, management, and legal department, by the SCE editorial consultant, and by the SCE engineering geologist.
- **Geotechnical and Engineering Geology Feasibility Evaluation for the Rubio Canyon Altadena Crest Trail Project, County of Los Angeles, CA:** The Rubio Canyon Altadena Crest Trail (Rubio ACT) is a proposed multi-use (equestrian, hiking, and mountain biking) trail located in the community of Altadena east of Rubio Canyon and East Loma Alta Drive. Rubio ACT is proposed within the undeveloped area (study area) consisting of steep hillsides vegetated primarily with coastal sage shrub and chaparral, and containing some existing undeveloped user-created multi-use trails. Pertinent data from the available geologic maps and site-specific geologic and geotechnical data gathered for this report constitutes the basis for the geotechnical and geologic feasibility analysis in this report. Based on a review of available geologic, and geotechnical data and findings from field exploration for this study, the proposed trail is considered feasible from a geotechnical standpoint provided that our recommendations presented in this report are followed and incorporated in the planning, design, and construction of the project. (Sapphos Environmental, Inc.)
- **Geologic Characterization Report for the Proposed Caithness Soda Mountain Solar Facility Project Site near Baker, San Bernardino County, CA:** *The Soda Mountain Solar Project will include installation, operation, and maintenance of approximately 1.*5 million polycrystalline silicon solar photovoltaic (PV) panels for a 350 megawatt (MW) solar electric power generating facility. The proposed Project area is on BLM federal lands with the project right-of-way consisting of 4,397 acres. This geologic characterization study and report assisted in meeting several project objectives: 1) provide necessary geologic (mapping and units descriptions), geophysical (TEM electrical and seismic reflection), and groundwater data to assist the BLM in their evaluation of the Plan of Development (POD) to be submitted prior to initiation of NEPA analysis; 2) provide information to support the preparation of the National Environmental Policy Act (NEPA) analysis for Geology, Soils, and

Mineral Resources; and 3) provide analysis of all data applicable to project design and construction cost-estimation. (Panorama Environmental, Inc.)LADWP River Supply Conduit Improvement Upper Reach Project EIR, San Fernando Valley, CA: EIR review for 11,900 feet of pipeline through Burbank with TBM drilling through groundwater barriers in unstable alluvium (Impact Sciences)

- **Technical Review Opinion Letter Considering a Draft Technical Memorandum and Other Materials Related to Geologic Hazards and Hydrogeologic Conditions at the Proposed Anaheim Regional Transportation Intermodal Center (ARTIC) - Phase 1 Project Site, Orange County, California for Diaz-Yourman & Associates (2010):** Wilson Geosciences Inc. conducted a technical review and prepared a second opinion regarding the technical analyses and conclusions from the Kleinfelder West, Inc. (KWI) specifically related to fill materials placed in a previous quarry identified by KWI within the project site. These conclusions address the probable lateral and vertical extent of quarry fill, groundwater levels, geologic hazards, and the location of river alluvium in the area of the proposed buildings. In addition, information was provided for the El Modeno fault. Borings, CPT soundings, vintage topographic maps, and aerial photographs were utilized to evaluate the KWI findings and to make recommendations, e.g., changes to the lateral extent and vertical thickness of the unsuitable quarry fill materials and alluvium beneath the site.
- **Gerald Desmond Bridge, Analysis of Drilling Results, Long Beach, CA:** Boring logs and selected subsurface samples were used to define the subsurface geologic formation encountered during geotechnical drilling. A description of the nature, thickness, age, and hydrogeologic characteristics of the Gaspur aquifer were provided with this information from a directional drill site near the west side of the Gerald Desmond Bridge. (Diaz-Yourman)
- **DEIR/IS Review and Fault Activity Investigation at La Loma Bridge, Pasadena, Los Angeles County, California (2 Separate Projects)n:** Wilson Geosciences Inc. (WGI) previously investigated the La Loma Bridge with Hushmand Associates, Inc. (HAI). Geologic, geotechnical, faulting, and seismic conditions at the La Loma Bridge were investigated by WGI in 2004 and in 2007-2008 with HAI. The 2004 investigations were in support of an EIR/EIS related to the bridge rehabilitation and to early design considerations. Investigations in 2007-2008 included field studies to locate the active Eagle Rock fault and to assess its ground rupture potential. Phase 1 consisted of the following tasks: Task 1 – Review of Existing Data and Geologic Maps; Task 2 – Review Seismic Refraction Survey and Results; Task 3 – Review DY&A Boring Logs; Task 4 – Test Pits; Task 5 – Phase 1 Geologic Report. Phase 2 consisted of: Task 1 - Geologic Studies; Task 2 -Seismic Fault Rupture Analysis; Task 3 – Probabilistic Seismic Hazard Assessment (Ground Motions); and Task 4 – Report and Appendices. WGI performed an engineering geology assessment to determine the location and probable fault displacement characteristics of the Eagle Rock fault previously mapped as passing through the bridge site. Geologic mapping, detailed cut exposure logging, seismic refraction geophysics, and hollow-stem auger, rotary core, and sonic core drilling techniques were used to obtain field data. An engineering geology and fault analysis was performed, including a probabilistic fault displacement hazard assessment. A report was prepared describing the scope, investigation, and analysis was completed.
- **Engineering Geology, Geotechnical, Seismic, and Hydrogeology Review for SR-710 Tunnel Geotechnical Reports, South Pasadena/Pasadena Area, Los Angeles County, California (2 Separate Projects):** WGI performed reviews of selected portions of (1) the "Draft Final Geotechnical Summary Report SR-710 Tunnel Technical Study Los Angeles County, California, prepared for the California Department of Transportation by CH2M HILL, March 2010, Volume I of V"; (2) Volumes II through V of the same draft report, (3) the October 2009 draft geotechnical summary report, (4) selected portions of the March 2015 DEIR/S, and (5) several technical appendices supporting the March 2015 DEIR/IS that relate to geology, seismic, soils, and Raymond fault groundwater barrier issues. The focus of the report reviews was to evaluate the soundness of the technical conclusions, and to provide an opinion on the relative acceptability of the various proposed alignments based on Caltrans technical factors and the conditions present in each alignment.
- **State Street Bridge Evaluation: Preliminary Conclusions Regarding San Jacinto Fault Displacement Characteristics, San Bernardino, San Bernardino County, California:** WGI prepared a report to evaluate the general geologic conditions related to the active San Jacinto fault zone (SJFZ) at the proposed State Street bridge site in the City of San Bernardino, California. In conjunction with a plan to perform fault trenching at the site this study was to determine the characteristics of the SJFZ that passes through or near proposed bridge structures by evaluating the potential for fault displacement at the proposed bridge locations, as well as earthquake probability and recurrence intervals, San Jacinto fault slip rates, and estimated fault displacement magnitude. The study was based on 1) regional geologic maps of the area (e.g., Morton and Miller, 2006), 2) identified photo-lineations near and projecting toward the proposed bridge, and 3) recently published fault displacement and earthquake recurrence data developed on the SJFZ (e.g., Rockwell and others, 2008; Salisbury and others, 2012; Onderdonk and others, 2013). Estimated fault displacements for the SJFZ were determined using the Caltrans

Strike_Slip_Offset_8 Excel Spreadsheet and fault segment values from the USGS for a 975-year exceedance value.

- **Geologic and Fault Hazard Evaluation for Caltrans Modifications to Interstate 710, Long Beach, Los Angeles County, California:** WGI performed the work for this project, which resulted in a series of alignment geologic maps and text sections for the DYA preliminary design report using available data and project specific subsurface investigations. Caltrans plans a series of modifications to the I-710 freeway infrastructure from the coast at Ocean Boulevard north to Interstate 5. We evaluated geologic and fault conditions and hazards for the Southern and Central segments that pass through Long Beach. The alignment is affected by the active Newport-Inglewood fault zone (NIFZ), by underlying non-engineered artificial fill, natural low-density alluvial deposits, shallow groundwater, liquefiable soils, and settlement/expansive soils. Estimates were made of the potential movements on the NIFZ and plans include potentially performing field studies to locate the faults crossing of the alignment.
- **A Geologic Evaluation of the Booster Pump Site at the Southeast Corner of the Oak Knoll Reservoir, Pasadena, California:** The California-American Water Company proposes to construct a small single-story lightly loaded building that encloses a skid-mounted booster water pump located within the Raymond Fault APEFZ. The planned area of the building will be less than 400 square feet. The building is assumed unoccupied except for occasional maintenance and repairs. Grading would be required to provide a level building pad at the southeast corner of the Oak Knoll Reservoir site. Geologic mapping, two previous borings, and two current hand-auger boring were used to analyze the conditions at the proposed Booster Pump Site. Recommendations were made by the geotechnical engineers. (Diaz-Yourman)
- **SDG&E Pipeline Replacement, Carlton Oaks Drive/San Diego River, Santee, CA:** Considered HDD process through two alluvial and two bedrock geologic formations passing under the San Diego River (Diaz-Yourman)
- **Port of Long Beach, Cemera Long Beach LLC Construction Aggregate Terminal, 1710 Pier B Street, Long Beach, CA:** DEIR Geology and Soils Section Based on a field inspection, review of project area-specific data (subsurface and surface material descriptions, aerial photographs) and regional data, Mr. Wilson prepared the Geology and Soils section of the Environmental Impact Report. (ICF Jones & Stokes)
- **SCGC Delivery Systems Reliability Project Adelanto to Moreno Valley to Whitewater, CA:** Evaluation extended over 100 miles crossing the San Andreas, San Jacinto, and Banning active fault zones (Dudek)
- **Banning Unified School District (BUSD), Generic Stage 3 Large Diameter Pipeline Site-Selection Analysis for High-Pressure Liquid Petroleum and Natural Gas Pipelines, BUSD, Banning, CA:** Examined the potential impacts and consequences of pipeline ruptures associated with the active San Gorgonio Pass Fault Zone to aid in selecting potential sites for District school facilities (BUSD)
- **SDG&E MSA PSEP Line 33-120 Section 3, Geology, Fault/Earthquake, and Groundwater Considerations Section for Geotechnical Report, San Diego, CA:** Researched and documented the stated conditions including sections of the pipeline crossing or lying very near the active Rose Canyon fault zone, and lying within artificial fill and liquefaction prone geologic deposits (Diaz-Yourman)
- **Geologic and Hydrogeologic Peer Review of Technical Reports and EIR Sections for the Puente Hills Solid Waste Facility, Los Angeles County, CA:** Third-party technical review of the ADEIR sections prepared by the County Sanitation Districts and MBA covering geology, engineering geology, soils engineering, facilities design, groundwater, earthquakes, and faulting. The location of the project is along the active Whittier fault and Whittier Heights fault, and adjacent to the epicenter of the 1987 Whittier earthquake on the buried Elysian Park Thrust fault. (Michael Brandman Associates)
- **SCGC Pipelines, Engineering Geology Investigation Cajon Pass Area and Loma Linda Hills, CA:** Considerations included potential natural gas pipeline locations within the San Andreas and San Jacinto fault zones (Diaz-Yourman)

REPRESENTATIVE PUBLIC SCHOOL GEOLOGICAL HAZARD ASSESSMENT PROJECTS (2000 to Present): Performed well over 200 geological hazard, pipeline safety, and linear critical facilities projects for school districts and planning, environmental, engineering, firms in compliance with California Department of Education requirements under Title 5, California Code of Regulations, Division 1, Chapter 13, Subchapter 1, School Facilities Construction, Article 2, School Sites, § 14010, Standards for School Site Selection. Districts for which natural gas (over 50%), liquid petroleum, water pipeline, or railroad studies (all with geological hazard and fault considerations) were performed include:

- Los Angeles Unified School District (33 Sites)
- Moreno Valley Unified School District (2 Sites)
- Lynwood Unified School District
- Orange County Department of Education (2 Sites)
- Brea Olinda Unified School District
- Beaumont Unified School District (2 Sites)

- Montebello Unified School District (2 Sites)
- Ontario-Montclair School District (3 Sites)
- Santa Maria-Bonita School District
- Blythe-Palo Verde Unified School District (2 Sites)
- Anaheim City School District (2 Sites)
- Placentia-Yorba Linda Unified School District
- Antelope Valley Unified HSD (3 Sites)
- Perris Elementary School District (3 Sites)
- Hawthorne School District
- Castaic Union School District (2 Sites)
- Corona-Norco Unified School District (2 Sites)
- Oakland Unified School District (7 Sites)
- Whittier Union High School District (2 Sites)
- Colton Unified School District (2 Sites)
- Etiwanda School District (3 Sites)
- Banning Unified School District (3 Sites)
- Redlands Unified School District
- Fairfax School District
- Capistrano Unified School District (2 Sites)
- Fontana Unified School District (4 Sites)
- William S. Hart School District (2 Sites)
- Riverside Community College District
- Alvord (Riverside) School District (2 sites)
- Huntington Beach Union High School District
- Chaffey Joint Union High School District (2 Sites)
- Adelanto School District (2 Sites)
- Snowline Joint Unified School District (2 Sites)
- Pomona School District (3 Sites)
- Menifee Union School District
- Hemet Elementary School District
- Rialto Unified School District (2 Sites)
- San Bernardino City Unified School District (2 Sites)
- Desert Sands Unified School District (3 Sites)
- Santa Ana Unified School District
- Riverside Unified School District
- Temecula Valley High School
- Vista Unified School District
- Santa Barbara Community Academy
- Santa Paula Union High School District
- Jurupa Unified School District
- Tulare, Selma, and Visalia Districts (4 Sites)
- Banning and Snowline--District Site Screening Evaluations
- Oro Grande Elementary School District
- Riverside City College - Pipeline hazard risks for potential campus development
- West Los Angeles Community College – Geology, seismic, and soils section for the Facilities Master Plan near the Newport-Inglewood fault zone
- Los Angeles Mission College – Geologic and seismic hazards evaluation (including seismic refraction geophysical surveys) for college expansion and new construction approximately 1100-feet north of the 1971 San Fernando earthquake fault rupture
- College of the Canyons – Geology, seismic, and soils study (per Note 48 checklist)

GENERAL PLAN EXPERIENCE-GEOLOGY, SEISMIC, AND SOILS

Wilson Geosciences Inc. has been responsible for the geology, seismic, and soils [safety element technical background report and/or EIR section] portions of the following General Plan updates:

- Arcadia
- Rosemead
- San Marcos
- Laguna Hills
- Azusa
- Claremont
- South El Monte
- Ontario SOI Amendment
- Chino
- Riverside
- City of Los Angeles Framework
- Huntington Beach
- San Clemente
- California City
- American Canyon

PROFESSIONAL ORGANIZATIONS

Member Association of Engineering Geologist, National Section
Member Association of Engineering Geologist, Southern California Section

COURSES, SEMINARS, WORKSHOPS, AND LOCAL TECHNICAL PUBLICATION

Seismic Interpretation for Geologists, by the Oil and Gas Consultants International, Inc., Intensive Short Course, Houston, Texas
Engineering Geophysics Short Course, Colorado School of Mines, Office of Continuing Education, Golden, Colorado
Technical Writing Seminar, Earth Technology Corporation, Long Beach, California
Fundamentals of Ground-Water Monitoring Well Design, Construction, and Development, Las Vegas, Nevada
Field Practices for Collecting Representative Ground-Water Samples, Las Vegas, Nevada
New Developments in Earthquake Ground Motion Estimation and Implications for Engineering Design Practice, Seminar organized by Applied Technology Council and funded by U.S. Geological Survey, Los Angeles, California
Seismic Hazards Analysis, Course sponsored by Association of Engineering Geologists, Los Angeles, California

Publication: Payne C. M., and Wilson, K. L., 1974, Age dating recent movement on the Raymond fault, Los Angeles County, California [abs.]: Geological Society of America Abstracts with Programs, v. 6, no. 3, p. 234-235.