City of Los Angeles

REPORT ON APPEAL FROM DETERMINATION OF SUPERINTENDENT OF BUILDING

REFERRED TO THE BBSC WITHOUT RECOMMENDATION FROM THE COMMISSION STAFF

DEPARTMENT STAFF: DANIEL SCHNEIDEREIT

OWNER:

HS Westside Properties LLC
857 S. San Pedro Street, Suite 300
Los Angeles, CA 90014

PETITIONER:

Fix the City
10558 Kinnard Avenue
Los Angeles, CA 90024

BOARD FILE: 210036
C.D.: 5 (Councilmember Paul Koretz)
PLANNING AREA: West Los Angeles
ZONE: [Q]RD1.5-1
BUREAU/DIV.: Inspection/Grading
DISTRICT OFFICE: West Los Angeles
PRIOR BOARD ACTION: No
ORDER: No

JOB ADDRESS: 1751 1-12 – 1759 SOUTH MALCOLM AVENUE &
1772 – 1774 1-6 SOUTH GLENDON AVENUE

EXHIBITS:

EXHIBIT A	ZIMAS Parcel Profile Report with vicinity map
EXHIBIT B	LADBS Special Instruction Memorandum for ZIMAS, July 7, 2015
EXHIBIT C	LADBS Information Bulletin P/BC 2020-129 Surface Fault Rupture Hazard Investigations
EXHIBIT D	Geology/Soils report for the proposed development (including a fault investigation) by Applied Earth Sciences, July 21, 2015.
EXHIBIT E	Department Geology and Soils Report Correction Letter, August 19, 2015.
EXHIBIT F	Addendum response report, Applied Earth Sciences, November 20, 2015
EXHIBIT G	Department Geology and Soils Correction Letter, December 29, 2015
EXHIBIT H	Addendum response report, Applied Earth Sciences, January 15, 2016.
EXHIBIT I	Department Geology and Soils Approval Letter, February 1, 2016
EXHIBIT J	Building Permit No. **16010-20000-02308** submitted June 1, 2016 issued on September 19, 2018, for new apartment building.
EXHIBIT K	Earthquake Fault Zones, A Guide for Government Agencies, Property Owners/Developers, and Geoscience Practitioners for Assessing Fault Rupture Hazards in California: California Geological Survey Special Publication 42, revised 2018.

Job Address: 1751 MALCOLM AVENUE AND 1772 GLENDON AVENUE
Board File: 210036

APPENDIX Appeal package submitted by the appellant

REQUEST:

Determine that the Los Angeles Department of Building and Safety (LADBS) erred or abused its discretion by the issuance of permit number 16010-20000-02308 without compliance with the Alquist-Priolo Earthquake Fault Zoning Act and other City of Los Angeles seismic hazards policies.

REFERRED TO THE BBSC WITHOUT RECOMMENDATION FROM THE COMMISSION STAFF. THE POSITION OF THE DEPARTMENT WHEN AN APPEAL REGARDING ERROR OR ABUSE OF DISCRETION IS BROUGHT FORTH TO THE BOARD OF COMMISSIONERS, WILL ALWAYS UNEQUIVOCALLY BE THAT IT DID NOT COMMIT AN ERROR NOR ABUSED ITS DISCRETION IN THE ACTION APPEALED, OTHERWISE THAT ACTION WOULD HAVE BEEN CORRECTED AND THE APPEAL WITHDRAWN.

BACKGROUND:

The subject of this appeal relates to the investigation for the potential of fault rupture at the site of a proposed multi-family residential development. The permit application was submitted on June 1, 2016. At that time, the site was located in a Preliminary Fault Rupture Study Area (PFRSA), which was established by the City of Los Angeles in July of 2015. PFRSAs were established by the LADBS to provide geologic fault investigations at project sites that are situated on suspected active faults that were not yet addressed and designated as the Alquist-Priolo earthquake fault zone (AP zone) by the California Geological Survey (CGS), (see Exhibit B). AP zones were conceived in the Alquist-Priolo Earthquake Fault Zoning Act, which California created following the destructive 1971 San Fernando earthquake. The LADBS considered sites in the PFRSAs as if they were in an AP zone and required the same type of geologic investigations (see Exhibits B, C and K).

As required by the City, the developers commissioned Applied Earth Sciences, Inc. (AES) to perform a geologic investigation to assess potential fault rupture at the site. A series of reports were prepared between July 21, 2015 and January 15, 2016 (see Exhibit D to H).

The specific site investigation determined that an active fault likely traverses the northeast corner of the site. A setback was recommended, as well as a reinforced foundation to strengthen all of the proposed structures on the site to accommodate minor off-fault deformations. The Department approved the investigation in a letter dated February 1, 2016 (see Exhibit I). The permit for constructing the project was issued on September 28, 2018 (see Appendix J)

Subsequently to approval of the AES's geologic reports, the Fault Evaluation Report (FER 259) was published on January 5, 2018 to establish an A-P zone for the Santa Monica fault.

DISCUSSION:

The appellant alleges that LADBS erred or abused its discretion by issuing the permits without an adequate fault investigation that addresses the AP act. Main points of the appeal are: 1) the State issued the AP earthquake fault zone prior to issuance of the permit 2) protocols relative to the AP act were not followed. To promote their appeal, the appellant hired a geologist, Mr. Ken Wilber, to review and comment on the AES geologic reports and the Department's actions regarding the review and approval of this project, and to raise questions to support their concerns. The primary geologic information used for the appeal is the FER 259 published on January 5, 2018, after the AES's fault reports were approved.

The following are the specific issues identified in the appellant's appeal (Appendix) and the LADBS's corresponding responses.

Issue No. 1:

The permit was issued after the establishment of the AP Zone.

LADBS Response to Issue No. 1:

The LADBS reviews geotechnical reports and plans under the codes and regulations that are current at the time the reports or the permit applications are submitted. This applies to new PFRSA and AP zones as well. In addition, the fault investigation conducted for the proposed development was provided to the CGS to help to formulate the local AP zone map.

Issue No. 2:

The appellant suggests existing protocols established by the State of California (as explained by the CGS relative to the AP Act) and the LADBS's fault investigation policies (IB P/BC 2017-129 [currently IB P/BC 2020-129, Exhibit C]) were not followed by the geologic investigation.

LADBS Response to Issue No. 2:

LADBS reviewed the geologic investigation reports, and fulfilled its role as the Local Jurisdiction per CGS guidelines (see Exhibit K).

Job Address: 1751 MALCOLM AVENUE AND 1772 GLENDON AVENUE
Board File: 210036

CONCLUSION:

LADBS properly complied with all State and Department regulations, policies, and requirements for issuing the permit 16010-20000-02308. The potential earthquake fault issue for the project was dealt with in 2015 and 2016. As a result, LADBS did not err or abuse its discretion by permitting the multi-family development.

OSAMA YOUNAN
General Manager
Superintendent of Building

Recommended by:

Daniel C Schneidereit

Daniel C. Schneidereit
Engineering Geologist II, Grading Division

LAMC:

CHAPTER 1: GENERAL PROVISIONS AND ZONING
ARTICLE 2: SPECIFIC PLANNING – ZONING COMPREHENSIVE ZONING
SECTION 12.26: DEPARTMENT OF BUILDING AND SAFETY

A. Enforcement

3. Vesting of Development Plan. (Amended by Ord. No. 172,492, Eff. 10/10/00.) Whenever plans sufficient for a complete plan check are accepted by the Department of Building and Safety and a fee is paid, a vested right is granted to the project to proceed with its development in substantial compliance with the zoning, and development rules, regulations ordinances and adopted policies of the City of Los Angeles in force on the date that the plan check fee is paid as indicated on a valid building permit application. These rights shall not include exemption from other applications or approvals that may be necessary to entitle the project to proceed (i.e., subdivision, zone, variance, design review board review, etc.) and from subsequent changes in the Building and Safety and Fire regulations found necessary by the City Council to protect the public health and safety and which are applicable on a citywide basis, contained in Chapters V and IX of this Code and policies and standards relating to those chapters or from citywide programs enacted after the application is deemed complete to implement State or Federal mandates.

These rights shall end: (Amended by Ord. No. 182,106, Eff. 5/20/12.)

(a) 18 months after the plan check fee is paid, or if a permit is issued during that time, when the building permit terminates pursuant to Section 98.0602;
(b) When subsequent changes are made to those plans that increase or decrease the height, floor area, or occupant load of the proposed structure by more than five percent:
(c) When the use of the property is changed;
(d) When changes exceed or violate the Zoning Code regulations in force on the date of the plan check fee was paid; or
(e) When the discretionary land use approval for the project terminates under the provisions of Chapter 1 of this Code or any ordinance adopted pursuant to Chapter 1 of this Code.

Exhibit: A

City of Los Angeles
Department of City Planning

6/8/2021
PARCEL PROFILE REPORT

PROPERTY ADDRESSES
1749 S MALCOLM AVE

ZIP CODES
90024

RECENT ACTIVITY
None

CASE NUMBERS
CPC-2014-1457-SP
CPC-19XX-19065
CPC-1987-12142
CPC-13481
ORD-186108
ORD-183497
ORD-171492
ORD-171227
ORD-163205
ORD-163204
ORD-163203
ORD-163187
ORD-161915
ORD-138227
ORD-129279
ORD-123222
DIR-2017-342-DRB-SPP
ENV-2017-343-CE
ENV-2014-1458-EIR-SE-CE
MND-89-260-O

Address/Legal Information	
PIN Number	129B153 355
Lot/Parcel Area (Calculated)	7,393.5 (sq ft)
Thomas Brothers Grid	PAGE 632 - GRID C4
Assessor Parcel No. (APN)	4325023018
Tract	TR 7803
Map Reference	M B 85-59/60 (SHTS 1-2)
Block	15
Lot	20
Arb (Lot Cut Reference)	None
Map Sheet	129B153
Jurisdictional Information	
Community Plan Area	Westwood
Area Planning Commission	West Los Angeles
Neighborhood Council	Westwood
Council District	CD 5 - Paul Koretz
Census Tract #	2655.20
LADBS District Office	West Los Angeles
Planning and Zoning Information	
Special Notes	None
Zoning	[Q]RD1.5-1
Zoning Information (ZI)	ZI-2192 Specific Plan: West Los Angeles Transportation Improvement and Mitigation
	ZI-1447 Specific Plan: Westwood Community Design Review Board
	ZI-1446 Specific Plan: Westwood Community Plan Multiple Family Residential Development Standards
	ZI-2442 Preliminary Fault Rupture Study Area
	ZI-2452 Transit Priority Area in the City of Los Angeles
	ZI-2441 Alquist-Priolo Earthquake Fault Zone
General Plan Land Use	Low Medium II Residential
General Plan Note(s)	Yes
Hillside Area (Zoning Code)	No
Specific Plan Area	WEST LOS ANGELES TRANSPORTATION IMPROVEMENT AND MITIGATION
Subarea	None
Specific Plan Area	WESTWOOD COMMUNITY DESIGN REVIEW BOARD
Subarea	None
Specific Plan Area	WESTWOOD COMMUNITY PLAN MULTIPLE FAMILY RESIDENTIAL DEVELOPMENT STANDARDS
Subarea	None
Special Land Use / Zoning	None
Historic Preservation Review	No
Historic Preservation Overlay Zone	None
Other Historic Designations	None
Other Historic Survey Information	None
Mills Act Contract	None
CDO: Community Design Overlay	None
CPIO: Community Plan Imp. Overlay	None
Subarea	None

CUGU: Clean Up-Green Up	None
HCR: Hillside Construction Regulation	No
NSO: Neighborhood Stabilization Overlay	No
POD: Pedestrian Oriented Districts	None
RFA: Residential Floor Area District	None
RIO: River Implementation Overlay	No
SN: Sign District	No
Streetscape	No
Adaptive Reuse Incentive Area	None
Affordable Housing Linkage Fee	
Residential Market Area	High
Non-Residential Market Area	High
Transit Oriented Communities (TOC)	Tier 3
RPA: Redevelopment Project Area	None
Central City Parking	No
Downtown Parking	No
Building Line	None
500 Ft School Zone	No
500 Ft Park Zone	No
Assessor Information	
Assessor Parcel No. (APN)	4325023018
Ownership (Assessor)	
Owner1	HS WESTSIDE PROPERTIES LLC C/O C/O DAN HARKMAN
Address	857 S SAN PEDRO ST STE 300 LOS ANGELES CA 90014
Ownership (Bureau of Engineering, Land Records)	
Owner	HS WESTSIDE PROPERTIES LLC
Address	857 S SAN PEDRO ST STE 300 LOS ANGELES CA 90014
APN Area (Co. Public Works)*	0.165 (ac)
Use Code	0100 - Residential - Single Family Residence
Assessed Land Val.	$715,921
Assessed Improvement Val.	$2,488
Last Owner Change	10/11/2018
Last Sale Amount	$9
Tax Rate Area	67
Deed Ref No. (City Clerk)	75215
	68296
	3409964
	1860863
	1724488
	162392
	1491
	1038604
Building 1	No data for building 1
Building 2	No data for building 2
Building 3	No data for building 3
Building 4	No data for building 4
Building 5	No data for building 5
Rent Stabilization Ordinance (RSO)	No [APN: 4325023018]
Additional Information	
Airport Hazard	None
Coastal Zone	None
Farmland	Area Not Mapped
Urban Agriculture Incentive Zone	YES

(*) - APN Area is provided "as is" from the Los Angeles County's Public Works, Flood Control, Benefit Assessment.

Very High Fire Hazard Severity Zone	No
Fire District No. 1	No
Flood Zone	Outside Flood Zone
Watercourse	No
Hazardous Waste / Border Zone Properties	No
Methane Hazard Site	Methane Zone
High Wind Velocity Areas	No
Special Grading Area (BOE Basic Grid Map A-13372)	Yes
Wells	None
Seismic Hazards	
Active Fault Near-Source Zone	
Nearest Fault (Distance in km)	0.16579596
Nearest Fault (Name)	Santa Monica Fault
Region	Transverse Ranges and Los Angeles Basin
Fault Type	B
Slip Rate (mm/year)	1.00000000
Slip Geometry	Left Lateral - Reverse - Oblique
Slip Type	Moderately / Poorly Constrained
Down Dip Width (km)	13.00000000
Rupture Top	0.00000000
Rupture Bottom	13.00000000
Dip Angle (degrees)	-75.00000000
Maximum Magnitude	6.60000000
Alquist-Priolo Fault Zone	Yes
Landslide	No
Liquefaction	Yes
Preliminary Fault Rupture Study Area	No
Tsunami Inundation Zone	No
Economic Development Areas	
Business Improvement District	None
Hubzone	Not Qualified
Opportunity Zone	No
Promise Zone	None
State Enterprise Zone	None
Housing	
Direct all Inquiries to	Housing+Community Investment Department
Telephone	(866) 557-7368
Website	http://hcidla.lacity.org
Rent Stabilization Ordinance (RSO)	No [APN: 4325023018]
Ellis Act Property	No
AB 1482: Tenant Protection Act	See Notes
Assessor Parcel No. (APN)	4325023018
Address	1749 MALCOLM AVE
Year Built	1941
Use Code	0100 - Residential - Single Family Residence
Notes	The property is subject to AB 1482 only if the owner is a corporation, limited liability company, or a real estate investment trust.
Public Safety	
Police Information	
Bureau	West
Division / Station	West Los Angeles
Reporting District	855
Fire Information	
Bureau	West

Batallion	9
District / Fire Station	37
Red Flag Restricted Parking	No

(*) - APN Area is provided "as is" from the Los Angeles County's Public Works, Flood Control, Benefit Assessment.

CASE SUMMARIES

Note: Information for case summaries is retrieved from the Planning Department's Plan Case Tracking System (PCTS) database.

Case Number:	CPC-2014-1457-SP
Required Action(s):	SP-SPECIFIC PLAN (INCLUDING AMENDMENTS)
Project Descriptions(s):	SPECIFIC PLAN AMENDMENT
Case Number:	CPC-19XX-19065
Required Action(s):	Data Not Available
Project Descriptions(s):	
Case Number:	CPC-1987-12142
Required Action(s):	Data Not Available
Project Descriptions(s):	PREPARE AND SUBMIT CONCURRENTLY WITH THE SUBJECT PLAN AMENDMENTS THE APPROPRIATE SPECIFIC PLAN ORDINANCE AND ZONE CHANGE ORDINANCES (LANDINI)
Case Number:	DIR-2017-342-DRB-SPP
Required Action(s):	DRB-DESIGN REVIEW BOARD
	SPP-SPECIFIC PLAN PROJECT PERMIT COMPLIANCE
Project Descriptions(s):	PURSUANT TO LAMC 11.5.7 AND 16.50, DESIGN REVIEW BOARD PROCEDURES AND SPECIFIC PLAN PROCEDURES FOR THE CONSTRUCTION OF A 2-STORY AND 3-STORY MULTI-FAMILY DWELLINGS LOCATED IN THE WESTWOOD COMMUNITY DESIGN BOARD AREA.
Case Number:	ENV-2017-343-CE
Required Action(s):	CE-CATEGORICAL EXEMPTION
Project Descriptions(s):	PURSUANT TO LAMC 11.5.7 AND 16.50, DESIGN REVIEW BOARD PROCEDURES AND SPECIFIC PLAN PROCEDURES FOR THE CONSTRUCTION OF A 2-STORY AND 3-STORY MULTI-FAMILY DWELLINGS LOCATED IN THE WESTWOOD COMMUNITY DESIGN BOARD AREA.
Case Number:	ENV-2014-1458-EIR-SE-CE
Required Action(s):	EIR-ENVIRONMENTAL IMPACT REPORT
	SE-STATUTORY EXEMPTIONS
	CE-CATEGORICAL EXEMPTION
Project Descriptions(s):	ENVIRONMENTAL IMPACT REPORT
Case Number:	MND-89-260-O
Required Action(s):	O-METHODS AND CONDITIONS - OIL DRILLING CASES
Project Descriptions(s):	Data Not Available

DATA NOT AVAILABLE

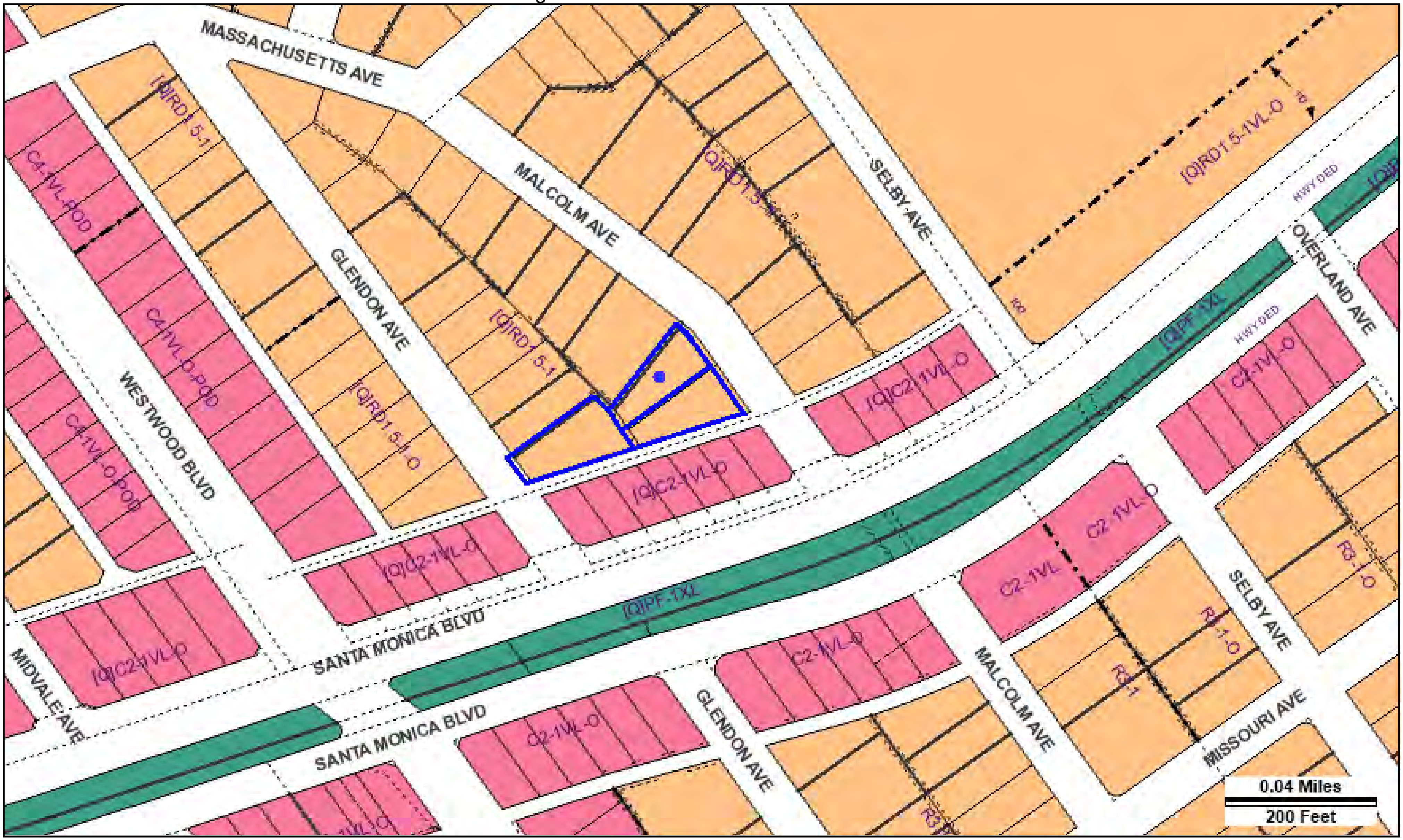
CPC-13481
ORD-186108
ORD-183497
ORD-171492
ORD-171227
ORD-163205
ORD-163204
ORD-163203
ORD-163187
ORD-161915
ORD-138227
ORD-129279
ORD-123222

ZIMAS INTRANET

Generalized Zoning

06/08/2021

City of Los Angeles
Department of City Planning



Address: 1749 S MALCOLM AVE
APN: 4325023018
PIN #: 129B153 355

Tract: TR 7803
Block: 15
Lot: 20
Arb: None

Zoning: [Q]RD1.5-1
General Plan: Low Medium II Residential

LEGEND

GENERALIZED ZONING

- OS, GW
- A, RA
- RE, RS, R1, RU, RZ, RW1
- R2, RD, RMP, RW2, R3, RAS, R4, R5, PVSP
- CR, C1, C1.5, C2, C4, C5, CW, WC, ADP, LASED, CEC, USC, PPSP, MU, NMU
- CM, MR, CCS, UV, UI, UC, M1, M2, LAX, M3, SL, HJ, HR, NI
- P, PB
- PF

GENERAL PLAN LAND USE

LAND USE

RESIDENTIAL

- Minimum Residential
- Very Low / Very Low I Residential
- Very Low II Residential
- Low / Low I Residential
- Low II Residential
- Low Medium / Low Medium I Residential
- Low Medium II Residential
- Medium Residential
- High Medium Residential
- High Density Residential
- Very High Medium Residential

COMMERCIAL

- Limited Commercial
- Limited Commercial - Mixed Medium Residential
- Highway Oriented Commercial
- Highway Oriented and Limited Commercial
- Highway Oriented Commercial - Mixed Medium Residential
- Neighborhood Office Commercial
- Community Commercial
- Community Commercial -Mixed High Residential
- Regional Center Commercial

INDUSTRIAL

- Commercial Manufacturing
- Limited Manufacturing
- Light Manufacturing
- Heavy Manufacturing
- Hybrid Industrial

PARKING

- Parking Buffer

PORT OF LOS ANGELES

- General / Bulk Cargo - Non Hazardous (Industrial / Commercial)
- General / Bulk Cargo - Hazard
- Commercial Fishing
- Recreation and Commercial
- Intermodal Container Transfer Facility Site

LOS ANGELES INTERNATIONAL AIRPORT

- Airport Landside / Airport Landside Support
- Airport Airside
- LAX Airport Northside

OPEN SPACE / PUBLIC FACILITIES

- Open Space
- Public / Open Space
- Public / Quasi-Public Open Space
- Other Public Open Space
- Public Facilities

FRAMEWORK

COMMERCIAL

- Neighborhood Commercial
- General Commercial
- Community Commercial
- Regional Mixed Commercial

INDUSTRIAL

- Limited Industrial
- Light Industrial

CIRCULATION

STREET

- Arterial Mountain Road
- Collector Scenic Street
- Collector Street
- Collector Street (Hillside)
- Collector Street (Modified)
- Collector Street (Proposed)
- Country Road
- Divided Major Highway II
- Divided Secondary Scenic Highway
- Local Scenic Road
- Local Street
- Major Highway (Modified)
- Major Highway I
- Major Highway II
- Major Highway II (Modified)
- Major Scenic Highway
- Major Scenic Highway (Modified)
- Major Scenic Highway II
- Mountain Collector Street
- Park Road
- Parkway
- Principal Major Highway
- Private Street
- Scenic Divided Major Highway II
- Scenic Park
- Scenic Parkway
- Secondary Highway
- Secondary Highway (Modified)
- Secondary Scenic Highway
- Special Collector Street
- Super Major Highway

FREEWAYS

- Freeway
- Interchange
- On-Ramp / Off- Ramp
- Railroad
- Scenic Freeway Highway

MISC. LINES

- Airport Boundary
- Bus Line
- Coastal Zone Boundary
- Coastline Boundary
- Collector Scenic Street (Proposed)
- Commercial Areas
- Commercial Center
- Community Redevelopment Project Area
- Country Road
- DWP Power Lines
- Desirable Open Space
- Detached Single Family House
- Endangered Ridgeline
- Equestrian and/or Hiking Trail
- Hiking Trail
- Historical Preservation
- Horsekeeping Area
- Local Street
- MSA Desirable Open Space
- Major Scenic Controls
- Multi-Purpose Trail
- Natural Resource Reserve
- Park Road
- Park Road (Proposed)
- Quasi-Public
- Rapid Transit Line
- Residential Planned Development
- Scenic Highway (Obsolete)
- Secondary Scenic Controls
- Secondary Scenic Highway (Proposed)
- Site Boundary
- Southern California Edison Power
- Special Study Area
- Specific Plan Area
- Stagecoach Line
- Wildlife Corridor

POINTS OF INTEREST

- Alternative Youth Hostel (Proposed)
- Animal Shelter
- Area Library
- Area Library (Proposed)
- Bridge
- Campground
- Campground (Proposed)
- Cemetery
- HW Church
- City Hall
- Community Center
- Community Library
- Community Library (Proposed Expansion)
- Community Library (Proposed)
- Community Park
- Community Park (Proposed Expansion)
- Community Park (Proposed)
- Community Transit Center
- Convalescent Hospital
- Correctional Facility
- Cultural / Historic Site (Proposed)
- Cultural / Historical Site
- Cultural Arts Center
- DMV DMV Office
- DWP DWP
- DWP Pumping Station
- Equestrian Center
- Fire Department Headquarters
- Fire Station
- Fire Station (Proposed Expansion)
- Fire Station (Proposed)
- Fire Supply & Maintenance
- Fire Training Site
- Fireboat Station
- Health Center / Medical Facility
- Helistop
- Historic Monument
- Historical / Cultural Monument
- Horsekeeping Area
- Horsekeeping Area (Proposed)
- Horticultural Center
- Hospital
- Hospital (Proposed)
- HW House of Worship
- Important Ecological Area
- Important Ecological Area (Proposed)
- Interpretive Center (Proposed)
- Junior College
- MTA / Metrolink Station
- MTA Station
- MTA Stop
- MWD MWD Headquarters
- Maintenance Yard
- Municipal Office Building
- P Municipal Parking lot
- Neighborhood Park
- Neighborhood Park (Proposed Expansion)
- Neighborhood Park (Proposed)
- Oil Collection Center
- Parking Enforcement
- Police Headquarters
- Police Station
- Police Station (Proposed Expansion)
- Police Station (Proposed)
- Police Training site
- PO Post Office
- Power Distribution Station
- Power Distribution Station (Proposed)
- Power Receiving Station
- Power Receiving Station (Proposed)
- C Private College
- E Private Elementary School
- Private Golf Course
- Private Golf Course (Proposed)
- JH Private Junior High School
- PS Private Pre-School
- Private Recreation & Cultural Facility
- SH Private Senior High School
- SF Private Special School
- Public Elementary (Proposed Expansion)
- Public Elementary School
- Public Elementary School (Proposed)
- Public Golf Course
- Public Golf Course (Proposed)
- Public Housing
- Public Housing (Proposed Expansion)
- Public Junior High School
- Public Junior High School (Proposed)
- Public Middle School
- Public Senior High School
- Public Senior High School (Proposed)
- Pumping Station
- Pumping Station (Proposed)
- Refuse Collection Center
- Regional Library
- Regional Library (Proposed Expansion)
- Regional Library (Proposed)
- Regional Park
- Regional Park (Proposed)
- RPD Residential Plan Development
- Scenic View Site
- Scenic View Site (Proposed)
- School District Headquarters
- School Unspecified Loc/Type (Proposed)
- Skill Center
- SS Social Services
- Special Feature
- Special Recreation (a)
- Special School Facility
- Special School Facility (Proposed)
- Steam Plant
- Surface Mining
- Trail & Assembly Area
- Trail & Assembly Area (Proposed)
- UTL Utility Yard
- Water Tank Reservoir
- Wildlife Migration Corridor
- Wildlife Preserve Gate

SCHOOLS/PARKS WITH 500 FT. BUFFER

Existing School/Park Site

Planned School/Park Site

Inside 500 Ft. Buffer

Aquatic Facilities

Beaches

Child Care Centers

Dog Parks

Golf Course

Historic Sites

Horticulture/Gardens

Skate Parks

Other Facilities

Park / Recreation Centers

Parks

Performing / Visual Arts Centers

Recreation Centers

Senior Citizen Centers

Opportunity School

Charter School

Elementary School

Span School

Special Education School

High School

Middle School

Early Education Center

COASTAL ZONE

Coastal Commission Permit Area

Dual Permit Jurisdiction Area

Single Permit Jurisdiction Area

Not in Coastal Zone

TRANSIT ORIENTED COMMUNITIES (TOC)

Tier 1

Tier 2

Tier 3

Tier 4

Note: TOC Tier designation and map layers are for reference purposes only. Eligible projects shall demonstrate compliance with Tier eligibility standards prior to the issuance of any permits or approvals. As transit service changes, eligible TOC Incentive Areas will be updated.

WAIVER OF DEDICATION OR IMPROVEMENT

Public Work Approval (PWA)

Waiver of Dedication or Improvement (WDI)

OTHER SYMBOLS

Lot Line

Tract Line

Lot Cut

Easement

Zone Boundary

Building Line

Lot Split

Community Driveway

Building Outlines 2014

Building Outlines 2008

Airport Hazard Zone

Census Tract

Coastal Zone

Council District

LADBS District Office

Downtown Parking

Fault Zone

Fire District No. 1

Tract Map

Parcel Map

Flood Zone

Hazardous Waste

High Wind Zone

Hillside Grading

Historic Preservation Overlay Zone

Specific Plan Area

Very High Fire Hazard Severity Zone

Wells

Exhibit: B

CITY OF LOS ANGELES
CALIFORNIA

ERIC GARCETTI
MAYOR

DEPARTMENT OF
BUILDING AND SAFETY
201 NORTH FIGUEROA STREET
LOS ANGELES, CA 90012

RAYMOND S. CHAN, C.E., S.E.
GENERAL MANAGER

FRANK BUSH
EXECUTIVE OFFICER

SPECIAL INSTRUCTION MEMORANDUM

CITY OF LOS ANGELES PRELIMINARY FAULT RUPTURE STUDY AREAS

The State of California Alquist-Priolo Earthquake Fault Zoning Act (1972) prohibits the construction of most structures for human occupancy over traces of active faults. The State establishes "Earthquake Fault Zones" along active faults in which geologic investigations are required prior to the construction of projects intended for human occupancy. However, the State has not established zones for all of the active faults in California, including some located in the City of Los Angeles.

The Department of Building and Safety (LADBS) has established "Preliminary Fault Rupture Study Areas" (PFRSA) where active faults may exist and present a potential for surface ground rupture to occur during a local earthquake.

The PFRSAs are intended to act as temporary Earthquake Fault Zones until the State of California Geological Survey establishes permanent Alquist-Priolo Earthquake Fault Zones based, in part, on the geologic investigations produced by City of Los Angeles.

INSTRUCTIONS:

When proposed development is found to be in PFRSA zone, applicants shall be informed to comply with the fault investigation requirements of the Alquist-Priolo Earthquake Fault Zoning Act. For the surface rupture fault investigation requirements, applicants should be referred to LADBS Information Bulletin **P/BC 2014-129**.

For a list of exemptions from investigations in Alquist-Priolo Fault Study Zones, refer to **P/BC 2014-044**.

Please contact the Grading Division of LADBS at (213) 482-0480 for any questions or concerns related to this memorandum.

Daniel C Schneidereit 7/7/2015

Daniel C. Schneidereit
Engineering Geologist

Exhibit: C

SURFACE FAULT RUPTURE HAZARD INVESTIGATIONS

This information bulletin provides a general guideline for conducting surface fault rupture hazard investigations (fault investigation) within the City of Los Angeles. Fault investigation reports submitted to the Los Angeles Department of Building and Safety (LADBS) shall be based upon sufficient geologic data to determine the location or nonexistence of active fault trace(s) on the site. In addition to this Information Bulletin, geologists conducting fault investigations should use California Geological Survey (CGS) Special Publication 42 and Note 49, which provide detailed guidelines and suggested format for fault investigations.

I. AREAS REQUIRING FAULT INVESTIGATIONS

Fault investigations are required by the City of Los Angeles for projects located within an official or preliminary Aquist-Priolo Earthquake Fault Zone (APEFZ); and/or within a City of Los Angeles Preliminary Fault Rupture Study Areas (PFRSA). The PFRSA's have been established along faults considered active within the City boundaries that the CGS has not yet zoned; including the Palos Verdes, and Santa Monica. The City's previous PFRSA for the east Hollywood/West Raymond fault has been superseded by the CGS's preliminary revised APEFZ for the Los Angeles Quadrangle issued December 15, 2016. An official APEFZ for this area is expected in March of 2017. See NavigateLA for the locations of the City PFRSA's. Projects exempted from fault investigations are discussed in P/BC 2017-44.

II. GENERAL REQUIREMENTS

Fault investigations must be conducted by a licensed California Certified Engineering Geologist or Professional Geologist who is experienced with fault investigations, at the discretion of the Grading Division of LADBS.

A. Research

A licensed professional shall conduct research as outlined below.

1. Review published literature and maps regarding regional geology, faults, and other pertinent information.
2. Search City and State records for fault investigation reports for properties in the site vicinity. The geotechnical reports may also provide useful information, including geologic units and groundwater levels.
3. View stereographic aerial photographs and/or old U.S. Geological Survey maps to evaluate geomorphic features, soil or vegetation contrasts, or lineaments suggestive of faulting.
4. Evaluate site-specific maps and plans to assess appropriate scope of the field investigation. A site visit is highly recommended prior to planning the field work.

B. Field Investigation

An important goal of a fault investigation is to directly observe continuous strata of late Pleistocene age to rule out State defined active faults (see Special Publication 42 for further information on definitions, etc.). Direct observation by exploratory trenching is the best method of investigation. However, consultants are encouraged to discuss the proposed scope of work with the Grading Division reviewing geologist prior to conducting the field work. The reviewing geologist shall be invited to observe open trenches.

The following is an outline of various exploratory methods, associated requirements and suggested considerations:

1. **Trenches**: As stated above, trenches are the preferred method of fault exploration. Trench excavation shall be done in a safe manner. The following is required by the Department:
   a) Consulting firms conducting trench exploration are required to have their annual CalOSHA permit current. Proof of the annual permit and notification to CalOSHA of the specific project shall be on site at all times.
   b) Underground Service Alert must be notified at least 2 days prior to excavation. Consideration should also be given for the use of a private utility locator utilizing electromagnetic utility locating techniques and/or ground penetrating radar to map out the location of known or suspected utilities.
   c) Permits from the Department of Public Works are required for excavations in the public right-of-way.
   d) CalOSHA regulations regarding trench safety shall be followed, with appropriate shoring and/or benching, ladders and/or exit ramps, etc.
   e) Trenches left overnight shall be secured by locked fencing. In some cases it may be appropriate to cover the trenches with steel plates or chain link fencing for an added precaution.
   f) The Department's reviewing geologist shall be invited to observe the trench after they are secured; shored or benched; cleaned; and a string line or grid reference system is in place. A completed field log is preferred but not necessary.
   g) For major projects, invitation to CGS geologists and other paleoseismic experts to view trenches is strongly encouraged.
   h) A grading permit is required to backfill the trench with primary or secondary certified fill. Otherwise, backfill will be considered uncertified.
   i) Spoil piles should be protected from erosion during the rainy season and not encroach neighboring property.
   j) Trenches should not remove lateral support from adjoining property, buildings on or off the site, or public right-of-way.

2. **Logging:** Trench walls must be sufficiently cleaned to expose geologic features and to conduct proper logging. A leveled string line with stationing is usually required. The minimum scale for logging is 1 inch = 5 feet. All geologic features should be logged and described in

detail. Emphasis should be placed on defining and describing contacts between recognized geologic units. Use Munsell color chart and notation to describe color. Pedologic development features should be described, if present.

3. **Transects:** Transects of borings and Cone Penetrometer Tests (CPT's): Many properties within the City of Los Angeles are occupied by structures with little room outside the building footprint. As such, there is typically not enough room to trench, especially where significant depth is required to reach Pleistocene sediments. In this case a series of borings, either down-hole logged bucket auger borings or continuous core borings should be used. The borings should be sufficient in number and spacing to allow valid correlations and interpretations. Boring depth must be sufficient to expose geologic features used to support conclusions, which usually requires two or more Pleistocene units or marker beds. Borings should be logged in detail, similar to a fault trench. Intermittently sampled geotechnical borings are not adequate for fault investigations, although they may provide supplemental information.

4. **Cone Penetrometer Testing (CPT):** CPTs can be used to supplement boring transects. They should not be used as the only method of exploration. Continuously cored borings are required to identify and correlate units indicated in CPT soundings.

5. **Data Point Spacing:** For boring/CPT transects, the exploration points should be sufficiently spaced to adequately identify continuous beds (marker beds) of Pleistocene age. While the spacing of the initial exploration may be relatively wide, 25 to even 50 feet apart, depending on the depositional environment, the geologist should plan on additional borings and/or CPTs after the initial exploration where continuous bedding is not clear. Thus, exploration should typically have at least two stages. Discussing the results of the initial exploration with the reviewing City geologist is encouraged and preferable relative to submitting a report that is not supported by sufficient exploration.

6. **Orientation of Exploration:** Trenches and transects should be oriented perpendicular to the regional trend(s) of faulting.

7. **Data Point Location:** Trench terminations, boring, CPT and fault locations should be surveyed by a licensed surveyor.

8. **Groundwater:** If groundwater is encountered in borings, measure the static depth, which usually requires waiting some of time after drilling. However, be careful when groundwater is perched. In that case, the saturated limits may only be able to be determined during drilling.

9. **Geophysical methods:** High resolution seismic reflection, ground penetrating radar, residual gravity and other geophysical surveys may be used as indirect methods to target subsurface exploration or supplement subsurface exploration. However, geophysical methods should **not** be considered as an alternative to subsurface exploration.

C. Age-Dating Techniques

Determining the age of geologic units is critically important in assessing the age of fault activity. The following methods may be used for age-dating.

1. **Radiocarbon (^{14}C) dating:** This isotopic method produces a numerical-age and has optimum resolution in the age range of interest for evaluating active faulting. However, this method depends on the availability and preservation of carbon. It is also subject to errors due to contamination. In general, true detrital carbon is the optimal sample. Bulk samples are likely subject to contamination from organic compounds in groundwater, especially if there is little original carbon in the soil. Testing bulk soil samples with little organic content is not encouraged by the Department. Laboratory documentation should be included in a report that contains radiocarbon dates. A color photograph of the tested sample is also encouraged.
2. **Thermoluminescence (TL) and Optical Stimulated Luminescence (OSL) dating:** TL/OSL dating is a relatively new method of dating late Quaternary sediments. Laboratory documentation should be included in a report that contains TL or OSL dates.
3. **Soil-Profile Development:** The relative age of soils are commonly determined by the degree of soil development. Ages are estimated based on comparisons with other published and dated soil profiles, such as using the Soil Development Index discussed in Harden (1982). All geologists conducting fault investigations within the City should be familiar with the basic principles of soil development, as well as Quaternary climatic cycles upon which chronostratigraphic units are commonly correlated. The glacial and interglacial periods designated by Marine Isotope Stages (MIS), or also referred to as Oxygen Isotope Stages (OIS), is a common reference for delineating chronostratigraphy. Detailed soil profiles should be described using standard procedures and terms such as those provided in the Field Book for Describing and Sampling Soils (available from the National Soil Survey Center's website). In addition, there are experts in this field that should be subcontracted if the project geologist is not experienced and confident to provide adequate descriptions and age estimates.

D. Report Contents

Once the field exploration and geologic analysis are completed, the geologist should carefully assess whether there is enough data to provide definite conclusions and recommendations. Geologic consultants should advise their clients that it is common for additional exploration to be required if data from the initial phase is inconclusive. If there is doubt, the geologist may discuss the results with the Department's geologic reviewer before submitting a report.

The contents of a typical Fault-Rupture Hazard Report are outlined below:

1. **Introduction**
    a. Purpose of investigation
    b. Description of site location, size, configuration and existing conditions
    c. Description of proposed project

2. **Scope of Investigation**

Describe the methods and procedures used to evaluate the fault rupture hazards at the site.

3 **Geologic Setting**

Describe the major geomorphic and geologic features in the area of the site based on published or unpublished literature, maps and reports from nearby sites. The discussion should include the following:

a. Geomorphic and physiographic features of the site area

b. Geologic/stratigraphic units and geochronology

c. Geologic structure

d. Groundwater

e. Geologic history

4. **Site Specific Geology**

Describe the geomorphology and geology of the site based on the data obtained from the field exploration and data analysis. The discussion should include the following:

a. Stratigraphy and Geochronology: Describe the stratigraphic and pedological units. Describe contacts, unconformities, sedimentary environment, and other relationships of the geologic units.

b. Geologic Structure: Describe the attitudes of bedding, fractures, joints, faults, etc. Provide details on the fault features (e.g. gouge, breccia, continuity, flower structures, slickensides, etc.). Discuss folding and warping, if present.

c. Fault Characteristics: Discuss relative displacement of units across faults and include continuity of the thickness of geologic units across faults. Discuss the latest age of unfaulted sediment. Describe the width of fault/deformation zones. If possible, describe features that indicate multiple events and earthquake history.

5. **Conclusions**

a. Provide a specific professional opinion regarding the existence or absence of active, potentially active or inactive faults on the site, per State definitions.

b. Provide an assessment of the probability of minor off-fault ground rupture in areas in close proximity to fault traces.

6. **Recommendations**

a. If an active fault is located on or adjacent to the site, recommend an appropriate structural setback zone (see III and IV).

b. If appropriate, reduced structural setbacks where the possibility of minor off-fault rupture may exist, reinforced foundations can be considered. Provide an estimate of the anticipated horizontal and vertical offsets.

7. **References**

Cite all pertinent published and unpublished literature, reports, documents, maps, aerial photographs, or other information used in support of the investigations, conclusions and professional opinions.

8. **Illustrations**

a. Index or Location Map – Show the site on a USGS 7.5 minute quadrangle map. If in or near an A-P Zone, use the A-P map as a base.

b. Local Fault Map – Show the site on a map with previously mapped fault locations.

c. Geomorphic Map – Show the site on the old (>1930's) USGS topographic map with the prominent geomorphic features labeled, such as alluvial fans, major drainages, uplifted terraces or slopes, possible scarps, flood plains, etc.

d. Geologic Map – Include a detailed site geologic map with immediate vicinity. This map should be at a regular engineering scale, no smaller than 1" = 40'. Include the following:

- All geologic contacts, including buried contacts. Query marks can be used where uncertain. If a thin layer of artificial fill covers the site, it need not be included on the map.
- All geologic structures, including faults, shear zones, and folds. Show attitudes for all bedding and structural features.
- All exploration; trenches, test pits, borings and CPTs. Significant locations, such as active faults, trench limits, borings and CPTs should be surveyed.
- Static groundwater depths with date of reading.
- Locations of Geologic Cross Sections
- Setback zones and buildable areas if needed.

e. Geologic Cross Sections/Transects – In general, include geologic features described above. Include horizontal and vertical scales (these should generally be the same). Show the orientation of the cross section and any intersections with other cross sections. Label all prominent marker beds and paleosols. Indicate the distance and boring or CPT is projected to the cross section. For the PDF version of the report, allow the layers of the drawing to be turned off so that just the raw CPT data can be seen (i.e. tip resistance and/or sleeve friction).

f. Graphic Logs of Exploratory Excavations – For all exploration logs, include date of exploration and indicate the identity of the logger.
   - Trench Logs – Trenches should be logged in detailed at a minimum scale of 1" = 5'. The logs should not be generalized or diagrammatic and should include vertical and horizontal scale (no vertical exaggeration). The bearing of each linear trench or linear trench segment should be indicated. A legend of symbols and detailed description of the recognized units should be presented on each log sheet. Show the entire trench profile. Benches, slopes and shoring should be indicated, but should not obscure geologic details represented on the log. Emphasis should be placed on defining and describing contacts and intervening units. Include bedding and fault attitudes. Show and describe sedimentary structures and paleosols. Include chronostratigraphic data if possible. Show locations of radiocarbon samples.
   - Continuous Core Borings – Include a detailed graphic log and/or photograph of the retrieved core. Include core runs and percent recovery. Indicate prominent marker beds and paleosols, groundwater depth, etc.
   - CPTs – High quality color prints of the CPT logs should be provided as well as the numerical data.

g. Photographs – It is commonly appropriate to include color photographs of trenches, transect locations, etc.

III. SETBACK REQUIREMENTS

Building setbacks from active fault traces are key recommendations provided in fault investigations. The default building setback from an active fault is 50 feet. Reduced setbacks can be considered if the location, trend and nature of a particular fault trace are accurately established by several data points.

Where exploration does not extend 50 feet beyond a property line within a fault investigation zone, an active trace at the property line must be considered present and require a setback. Data from adjacent or nearby sites can be used to possibly reduce a property line setback. Setbacks and buildable areas shall be clearly shown on the geologic map/site plan, and included in the report.

Special/reinforced foundations may be used to mitigate minor ground displacements that could occur near a more significant fault trace. If special foundations are used, the report shall show a special foundation area on the geologic map/site plan.

The amount of anticipated horizontal and vertical offset shall be provided in the report to provide design criteria to the structural engineer.

IV. REQUIREMENTS FOR SINGLE-FAMILY RESIDENCES

The City requires investigations for single-family residences, even if an existing residence is to be replaced. See Information Bulletin P/BC 2017-44 for exemptions. Consultants are encouraged to call the Grading Division's reviewing geologists if considering reducing a fault investigation scope. The requirement to explore 50 feet beyond the property does not apply for single-family residences.

Exhibit: D

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, CA 90024

FOR.

SINANIAN DEVELOPMENT, INC.

PROJECT NO. 15-363-26

JULY 21, 2015

July 21, 2015 Project No. 15-363-26

Sinanian Development, Inc.
18980 Ventura Blvd. Suite 200
Tarzana, CA 91356

Attention: Mr. Sinan Sinanian

Subject: Report of Geologic Fault Study
And Geotechnical Investigation
Proposed Multifamily Residential Building Project
1749-51 Malcolm Avenue and 1772 Glendon Avenue
Los Angeles, CA 90024

Gentlemen:

We are pleased to submit our combined fault investigation and geotechnical investigation report for the proposed residential development project to be located at 1749-51 Malcolm Avenue and 1772 Glendon Avenue, in the Westwood neighborhood of Los Angeles, California.

The scope of this investigation was based in part on our workplan as delineated in our Scope of Work as delineated in our Geologic and Geotechnical Scope of Work Proposals dated March 28 and.June 10, 2015, respectively, as well as preliminary discussions with city grading staff. Summaries of data gathered during our investigation, our analysis of this data, and our conclusions and recommendations are presented in this attached report. The first portion of the report discusses the geologic fault study, and the second portion presents the results of our geotechnical investigation.

Thank you for the opportunity to be of continued service on this project. Please call the undersigned if you have any questions regarding this report.

Respectfully Submitted,

APPLIED EARTH SCIENCES

CERTIFIED ENGINEERING GEOLOGIST
SHANT MINAS
EG # 2607
Exp. 12/16
STATE OF CALIFORNIA

Shant Minas
Engineering Geologist 2607

REGISTERED PROFESSIONAL ENGINEER
CARO J. MINAS
NO. 601
EXP. 12 / 16
GEOTECHNICAL
STATE OF CALIFORNIA

Caro Minas, President
Geotechnical Engineer 601

PART I. GEOLOGIC FAULT STUDY REPORT

Proposed Multi-Residential Building Project

1749-51 Malcolm Avenue and 1772 Glendon Avenue

Los Angeles, California

INTRODUCTION

We are pleased to present this report of geologic fault study for the subject project.

The scope of work performed and reported herein was based on our proposal agreement dated March 28, 2015, which in turn was based on the City of Los Angeles Grading Department's recent requirement for fault studies in this area of Century City and Westwood, in light of the recent zoning of the subject property as being within a Fault Rupture Hazard Study Area.

PRIOR REPORTS AND BACKGROUND

Although a thorough description of the Santa Monica fault zone is beyond this scope of work, a brief description of the fault follows. The so-called Santa Monica fault zone roughly extends from the West Beverly Hills Lineament approximately two miles to the east, near the Los Angeles/Beverly Hills corporate boundary; to the multiple sub-parallel strands of the Malibu fault approximately 10 miles to the west. The Malibu fault, however, is broadly considered the western extension of the Santa Monica fault zone. The Santa Monica fault itself is thought to be the continuation of the Hollywood fault zone to the east, which in turn is considered the western extension of the Raymond fault zone northeast of downtown Los Angeles. As such, although the name of the fault zone changes based on the locality, it is widely considered to be one prominent fault zone extending from the southern foothills of the western Santa Monica Mountains along Pacific Coast Highway, to the Monrovia area in the San Gabriel valley, where it crosses or connects to the Sierra Madre fault zone at the southern foothills of the San Gabriel

Mountains. As such, the total length of this fault zone ranges from 60 to 100 miles long, depending on which faults are included in the broadly defined zone. The fault exhibits both left-lateral strike slip as well as reverse thrusting features along its alignment (Parsons, 2011; Dolan, 2000). Recent research by Kenney (2012-14) indicates that the fault has a significant left-lateral strike-slip component and may also exhibit normal faulting over portions of the zone.

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

PROJECT CONSIDERATIONS

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 buildings. Please see 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.

Because of the existing apartment buildings on-site with onsite tenants, trenching was considered not to be a suitable option for field exploration for this fault study. Prior to organizing field exploration efforts, we have corresponded with Messrs. Wilson and Schneidereit of the city Grading Division regarding a suitable approach for a fault study of the site, which included a combination of Cone Penetrometer soundings and continuous core borings to a maximum depth of 80 feet depth. To this end, and at your request, we performed a fault study of the site in accordance with City of LA standards and correspondence with city officials, CGS Standards, and based on our professional geologic and engineering judgment and expertise.

FIELD EXPLORATION

To determine whether or not a fault exists on, or adjacent to, the subject lots, a total of sixteen (16) holes were advanced, as discussed above. All holes (borings as well as soundings) were drilled in a northwest-southeast alignment, nearly perpendicular to the suspected west/southwest-east/northeast trend of the fault. Prior to advancing the soundings and borings, necessary encroachment and excavation permits were obtained from the city of Los Angeles Public Works Engineering by the owner’s representatives (see attachments).

Test hole spacing ranged from 5 feet (typically between closely spaced CPTs and Borings) to over 25 feet between successive CPTs in the public right of way, due to presence of multiple subsurface utilities, compromised drilling maneuverability, and site access restrictions. This is discussed in the section below in further detail.

CPT soundings were advanced over the course of two workdays, April 21, 2015 (on private property) and May 12, 2015 (on public right of way), by Kehoe Engineering and Testing of Huntington Beach. Of the thirteen CPT soundings, seven were advanced on the subject property (CPT-1 through CPT-7), and six were advanced beyond the northern and southern property boundaries (CPT-8 through CPT-13). The CPT soundings were advanced to depths ranging from 70 to 80 feet, depending on depth to refusal.

A total of three continuous core Borings 1, 2, and 3 were advanced on the subject property to depths of 80 feet each, by Martini Drilling of Huntington Beach. Drilling was conducted on April 23 and April 24, 2015. The continuous core borings were advanced using a hollow-stem auger specially fitted to collect continuous core samples in five-foot intervals. All three Borings were advanced within the confines of the private subject property; see Drawing No. 2 for locations of all test holes advanced onsite.

Continuous sampling resulted in relatively good recovery (average recovery was 88 percent). All samples were photographed with digital color film and the samples were placed in core boxes stored onsite at our facility in Glendale for later study and for review by others if necessary. These samples will be kept until such time that approval for development of the subject lots is attained. Selected pictures taken during field exploration and later detailed logging at our office have been attached in the Appendix.

The samples were preliminarily logged during drilling by the project engineering geologist Shant Minas as well as senior engineering geologist Steve Miller in the field. Completed logs were then prepared after further detailed study and comparison of all of the samples.

See Drawing No. 2 – Geologic Map and Fault Study Plan for the locations of the borings and CPT soundings discussed above, as well as advanced geotechnical borings by AES.

FIELD EXPLORATION LOGISTICAL CHALLENGES

Any part of a fault study report that covers a wide area should also discuss the myriad complexities, challenges, and risks associated with advancing several test holes in densely populated urban areas. Along Malcolm Avenue where our study took place, there were multiple challenges due to the presence of several underground buried utilities, driveway access to nearby buildings, overhead clearance from power lines and trees, and localized topographic humps from landscaping. Use of DIG Alert resulted in only a partial marking of underground utilities; the project also necessitated the use of private ground penetrating radar service to mark those utilities which were not properly marked on the street. Overall, our field exploration work had to contend with the presence of water, gas, electric, street lights, storm drain, sewer, and cable fiberoptic which posed considerable challenges and risks with respect to drilling. The reader of this report may wonder why certain test holes are spaced closer apart than others, for example between CPT-7 and CPT-10. There were multiple challenges due to the presence of several underground buried utilities. Use of DIG Alert resulted in only a partial marking of underground utilities; the project also necessitated the use of private ground penetrating radar service to mark those utilities which were not properly marked on the street, such as water.

In the northeast corner of the subject property, we were limited due to presence of a large tree and surrounding topographic high mound; see Photo 2 attached.

Overall, our field exploration work had to contend with the presence of water, gas, electric, street lights, storm drain, sewer, and fiberoptic cable, all of which together posed considerable challenges and risks with respect to drilling. In our estimation, we have performed a sufficiently detailed site-specific study given the logistical constraints and challenges of drilling in a densely populated urban area such as the subject site.

SITE SURFACE CONDITIONS

The subject site lies on an alluvial fan surface that is part of a larger series of coalesced alluvial fans emanating from the several small drainages at the south edge of the Santa Monica Mountains. The site has an irregular shape, has a surface area of 24,560 square feet. From the north to south property boundary, there is very little elevation difference from north to south property corners. Based on a 2013 topographic survey by J & B Surveyors that we utilized as our site-specific base map, the spot MSE elevation near the northern property boundary is around 225', while the spot MSE elevation at the corresponding southern property boundary is nearly 227.00'. Incidentally, there is a negligible descending slope from south to north, instead of north to south, as is more typically the case across various portions of the wider Hollywood-Santa Monica fault zone. This will be discussed in further detail in later sections.

There is a condominium building (constructed in 1992) to the north along Malcolm Avenue, and another condominium building to the northwest along Glendon Avenue. The property is surrounded on the east, west and south by public rights-of-way Malcolm Avenue, Glendon Avenue, and an adjoining public alley, respectively.

SANTA MONICA FAULT LOCATION

It is now well known in the earth sciences community that starting from Century City through the Veteran's Administration grounds just west of Interstate 405, the Santa Monica fault extends roughly along the alignment of Santa Monica Boulevard (Dolan et al, 1998-2000; AMEC 2011; Parsons 2011-12). The original Pacific-Electric Red Car Line was established over one hundred years ago along what is now Santa Monica Boulevard, using natural breaks and depressions in the ground surface that are now known to be related to the presence of the Santa Monica fault zone underlying the Boulevard of the same name in this location. The large grass lawn in the front yard of the LDS Church at 10777 Santa Monica Boulevard, incidentally just one block (~400 feet) east of the subject site, is known by geologic workers (most recently Dolan et al., 1998, 2000) to be the location of the most prominent and visible fault scarp of the Santa Monica fault zone in this area.

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).

In 2010, Mactec conducted a series of fault studies in this area as part of a region-wide investigation for the proposed Purple Line Metro subway extension. Mactec advanced a seismic line along Selby Avenue, oriented northwest-southeast, which is just one block east of the subject study area. In their seismic line, they encountered a geophysical anomaly and groundwater barrier which they inferred to be the location of the fault trace along Selby (Parsons, 2011). We have shown this barrier and anomaly location in our Drawing No. 1 – Regional Fault Map, with respect to the location of the subject property.

The city of Los Angeles, in their Navigate LA maps, show the main fault location to cut across the northern portion of Lot 20 (1749 Malcolm), part of the subject project area. This data is based on the Department of Conservation, California Geologic Survey Digital Database of Quaternary and Younger Faults from the Fault Activity Map of California, version 2.0, as well as on Bryant, 2005. We have recognized the postulated location of the fault in this area by the CGS and shown it as such on our maps; however, the alignment of the fault is based on a combination of recent regional-scale geologic modeling by Kenney et al. as well as rough discrete data compiled from several older maps at scales generally not suitable enough to depict the fault location accurately at the scale of the subject project. Nonetheless, we have included the Navigate LA fault location in our Drawing No. 1 – Regional Fault Map, and used that location as a basis for our detailed investigation of the subject site and periphery. We have also plotted on our Regional Fault Map the postulated fault traces from geologic and fault maps by Miles Kenney (see references), as well as Mactec's 2010 seismic line fault study along Selby Avenue and location of groundwater and geophysical anomalies.

Our approach to the site-specific fault study was to advance three continuous core borings and thirteen CPT soundings in a northwest-southeast alignment across the site and corresponding public right-of-way along Malcolm Avenue, research of geologic literature, and our professional engineering-geologic judgment, to determine whether an active trace of the fault underlies the subject site.

GEOLOGIC AND SOILS CONDITIONS

Examination of the boring samples indicated that the site is underlain by at least four distinct geologic units to the maximum depths explored.

Af (Artificial Fill): Fill generally consists of sandy silt to silty gravelly sand. It blankets the site and upper 2-4 feet of disturbed soils materials near the ground surface, mainly from original site grading prior to development.

Qa (Recent Alluvium): Native recent alluvium was found in continuous core boreholes Borings 1 and 2 and is thought to underlie minor surficial fill soils in the middle to southern portion of the site, to an approximate depth ranging from six to eight feet below ground surface. It consists of mainly sandy silt to silty gravelly fine sand.

Qsp (Sag Pond Deposits): The northern portion of the study area appeared to have a different native soil material from near the ground surface, below minor surficial fill. This material generally consists of clayey sandy silt to sandy silty clay. We have interpreted this material to be sag pond deposits from left-lateral strike slip motion along the Santa Monica fault as well as minor normal faulting component in this portion of the fault zone. This will be discussed in significant detail below and forms the basis for our conclusion regarding the presence of a fault strand across the subject site.

Qof (Older Alluvial and Fluvial Deposits): This unit generally corresponds to what is considered to be Pleistocene-age fluvial and alluvial granular deposits of mainly gravel and sandy materials. This unit is interfingered throughout the site and vicinity with Estuarine deposits (see below).

Qoe (Estuarine Deposits): This unit consists mainly of sandy silt, clay, and silty very fine sand materials will little gravel. It is also interpreted to be Pleistocene and is thought to be interfingered throughout the area with more granular fluvial and alluvial deposits (Qof).

Paleosols. As part of this fault study, senior engineering geologist Steve Miller was brought on to look through the samples to determine whether paleosols were present. The samples of the soil materials retrieved from the borings were examined for evidence of pedogenic soils that may have developed on the most recent sediments and on older fan surfaces during periods of relative stability (no deposition or erosion). Such evidence would be the presence of darker A horizons and/or argillic (Bt) horizons. Differentiation of these features is generally based on color, texture, and clay content. The samples from the three borings were compared with regard to these characteristics in order to try to correlate the fan surfaces. Although some thin layers displayed evidence of oxidation and incipient soil horizon formation, they were generally not continuous across the site and are thought to exist only in short discontinuous lenses. Well-developed paleosols, furthermore, were not found in the borings, as the depositional environment (rapid alluvial deposition with alternating estuarine fine-grained deposition) does not generally lend itself well to the development of distinct soil horizons. In the absence of easily recognizable, consistent and thick enough soil horizons, silty sandy gravel beds, as well as clayey sandy silt layers, were used as marker beds and for correlation across borings and CPT soundings.

Age of Deposits. A number of layers were found in our Borings 1, 2, and 3 to appear slightly oxidized (see detailed Boring Logs in the Appendix), but these layers were generally not continuous or thick enough to follow or cross-correlate across borings. The native materials as found in our borings correspond to “uplifted and highly dissected older sedimentary units” as described in Parsons 2011 report.

No detrital charcoal or any other organic material was found in any of the sediments underlying the subject site. Therefore, direct age-dating of materials was not possible with the materials encountered in this fault study.

However, studies by Parsons and AMEC (2011) suggest the Holocene-Pleistocene boundary to be at approximately eight to twelve feet below the ground surface. Parsons mentioned in their report that younger alluvium may be “locally present at shallow depths” from eight to ten feet. Hand augering within the depth of utilities, however, makes interpretation and description of younger alluvium difficult. We generally agree with AMEC’s findings that older (Pleistocene) alluvial deposits begin at depths ranging from eight to twelve feet depth across the subject site.

<u>Groundwater</u>

Historically highest groundwater near the subject site is shown on published maps (Figure No. 4) to vary considerably with increasing proximity to the fault zone. At the site location, historic groundwater depth is shown to be approximately 10 to 20 feet below ground surface, although these are historic levels and predate extensive pumping since the original measurements. True current groundwater levels are likely to be lower than what is shown on the historic maps.

Groundwater was encountered in one of the three continuous core borings, in Boring 3, located in the northern portion of the subject site. Along the northern property boundary, groundwater was encountered in our Boring 3 at a depth of 47 feet, whereby groundwater was not detected in Borings 1 and 2 in the middle to southern portion of the subject property. As such, there appears to be a groundwater barrier at around the location of B-3 on the subject site.

It should be noted that, whereas B-1 and B-2 were backfilled with earth since groundwater was not encountered, due to the presence of groundwater at 47 feet depth in B-3, B-3 was concreted up to the ground surface as is required by county law for boreholes that penetrate the local groundwater table.

In recognized fault zones, shallower groundwater levels or springs generally correspond to the presence of faulting. As such, this information is also of significance in our overall fault study, which is discussed further below.

FINDINGS

In order to determine whether a fault extends through the subject site, we have prepared Geologic Cross Section A-A’, drawn roughly parallel to Malcolm Avenue and roughly 70 degrees to the orientation of the main trace of the fault, as shown on Navigate LA. We then present at their respective locations along the section, the profiles of each of the continuous core borings and cone penetrometer soundings, including groundwater data.

As shown in Geologic Cross Section A, starting from the southern end of the study area at CPT-13, the encountered soils units tend to roughly correspond in elevation northward, approximately until the location of Boring 3 and CPT-7. North of B-3, the upper 35 feet of soils appear to be soft, fine-grained silt and clayey materials. Moreover, starting from Boring 3 and extending northward, groundwater was encountered in Boring 3 as well as in CPT-7 through 10, which are all north of B-3. Whereas CPT-1 through CPT-6 and CPT-11 through CPT-13 (south of fault) did not encounter groundwater or significant caving, CPT-7 through CPT-1o all encountered caving in the 2" CPT hole immediately after drilling, in the wet section below 45 feet, such that water rose in the hole to depths of approximately 33 to 35 feet bgs.

Moreover, as mentioned previously, the ground elevation actually drops toward the north portion of the site, as noted in the topographic survey. The ground elevation drops by two feet north along Malcolm in the near vicinity of the property, before beginning to rise again in elevation approximately 50 feet northwest of the project area. This area of the Santa Monica fault exhibits a stronger left-lateral strike slip component, as well as a less prominent normal faulting component, according to referenced publications by fault specialist Miles Kenney, Ph.D. This is in contrary to other parts of this fault zone, particularly in the Hollywood and West Hollywood areas, where the fault is defined by a prominent scarp, higher elevations to the north compared to south of the fault, and reverse faulting (Dolan, 2000).

Based in part on a discussion with retired fault specialist Richard Crook, Jr., we have interpreted these fine-grained soft clayey materials as found in the upper 35 feet of CPT-7 through CPT-10 to be related to sag pond deposits typical of strike-slip fault zones with a normal fault slip component.

In summary, this elevation anomaly, groundwater barrier, break in units around B-3, and presence of sag pond deposits in the north part of the study area, bring us to the conclusion that the fault extends through the subject property, at approximately the location of B-3. This generally corresponds to the fault location as shown on Navigate LA as well as other fault maps by Kenney and Dolan; as well as the groundwater and geophysical anomalies along Selby Avenue as detected by Mactec (now Amec Foster Wheeler) in their 2010 study.

Based on these findings, and our review of prior investigations by others as well as several published and unpublished maps and reports, it is our professional opinion that a prominent strand of the Santa Monica fault zone extends through the northeast portion of the subject site, approximately ten feet south of the location as shown on Navigate LA maps. Please see our Geologic Map and Fault Study Plan – Drawing No. 2, for the location of the fault across the subject site, based on our field exploration and geologic interpretation of the subsurface data.

MITIGATION OF FAULT RUPTURE HAZARD

Since a fault splay was found during our study, it is therefore recommended, that as part of the site development, two forms of mitigation to be utilized.

1. Avoidance. As required by state and city law, no new structure shall be constructed across the active fault splay, as shown on our Geologic Map. The new structures may be as close as ten feet to the fault splay, toward the south (since the proposed basement level is only five feet below ground surface in this location), provided the second mitigation measure is also adopted;
2. A thick slab “mat” foundation should be utilized for the eastern-most building in this project; see Drawing No. 4 through 6 for a graphical depiction. (The western building which will be structurally independent from the eastern building can utilize a conventional foundation without using a 2’ mat, since it is more than 50 feet away from the westward-projected fault trace; see geotechnical engineering recommendations later in this report.) The “mat” should have a thickness of 2 feet. For design, the “mat” should be designed based on a modulus of subgrade reaction of 400 kips per cubic foot. This type of mitigation is considered by the

undersigned to be sufficient mitigation of fault rupture hazard within close proximity of the subject site.

We have included a Geotechnical Site Plan, in which we restrict the footprint of the proposed construction to ten feet south of the fault as shown on our Geologic Map.

Moreover, we have shown in our Geotechnical Cross Section B-B and C-C’, the two-feet thick mat foundation which will be required for the proposed eastern building, due to incidence and proximity of active faulting in the project area.

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PART II. GEOTECHNICAL INVESTIGATION REPORT

Proposed Multi-Residential Building Project

1749-51 Malcolm Avenue and 1772 Glendon Avenue

Los Angeles, California

INTRODUCTION

This report presents the results of a geotechnical investigation for the subject project. During the course of this investigation, the engineering properties of the subsurface materials were evaluated in order to provide recommendations for design and construction of temporary excavations, foundations, grade slabs, and subsurface walls. The investigation included subsurface exploration, soil sampling, laboratory testing, engineering evaluation and analysis, consultation and preparation of this report.

During the course of this investigation, the project plans provided by the client were used as reference. The plans were prepared by the offices of Alajajian Marcoosi, Architects, Inc., and the topographic survey was prepared by J & B Engineers Surveyors, dated 10/8/2013.

The enclosed Geotechnical Site Plan; Drawing No. 4, shows the approximate location of the drilled geotechnical borings in relation to the site boundaries. This drawing also shows the approximate locations of Geotechnical Cross Sections B-B' and C-C'. Drawing Nos. 5 and 6 show the profiles of the Cross Sections B-B' and C-C'.

Figure Nos. 1 through 4 show the associated Site Location Maps, Regional Geologic Map as well as the Historically Highest Groundwater Contour Map of the site. Figure Nos. 5 through 7 show the associated Seismic Hazard Zone Maps.

The attached Appendix I, describes the method of field exploration. Figure Nos. I-1 through I-7 present summaries of the materials encountered at the location of our borings. Figure No. I-8 presents the Uniform Soil Classification System Chart; a guide to the Log of Exploratory Borings. (CPT data used in the fault study is also included in this Appendix.)

The attached Appendix II describes the laboratory testing procedures. Figure Nos. II-1 and II-2 present the results of direct shear and consolidation tests performed on selected undisturbed soil samples.

Appendix III includes selected photographs taken during the fault study, and Appendix IV includes miscellaneous fault maps and permits related to the fault study.

It should be noted that the presented design recommendations for temporary excavation and foundation are based on the provided project plans and assumed structural loading conditions. This office should be consulted if the actual magnitude of the structural loading and excavation depths are different from those used during this investigation. Modifications to the presented design recommendations may then be made to reflect the actual conditions.

PROJECT CONSIDERATIONS

It is our understanding that the proposed project will consist of construction of two separate multifamily residential buildings on the subject sites. One building will face Malcolm Avenue and the other will face Glendon Avenue. See the enclosed Site Plan and Cross Sections; Drawing Nos. 1 through 3, for approximate location on the plan and the profiles of the proposed buildings with respect to present grades.

The proposed buildings are expected to be two-story wood frame structures constructed over parking garage. Due to descending of the site grades from west to east through an approximate elevation of about 8 feet, depths to the garage level will vary for the east and west buildings. The finished grades of the garage of the building facing Glendon Avenue will essentially be established close to the present grade. The finished grade of the garage of the building facing Malcolm Avenue will be established at some 5 feet below grade. The grade between the two buildings will then be raised to provide access. See the enclosed Site Plan and Cross Sections for detail.

The exterior walls of the basement garage will have variable horizontal setbacks from the respective property lines. See the enclosed Site Plan and Cross Sections for the building plan and profile with respect to the existing grades. Maximum depth of excavation to the garage grade of the east building is expected to be on the order of 6 feet. Therefore, total height of excavation to the perimeter wall footing levels of the basement garage of the east building (facing Malcolm Avenue) is expected to be on the order of 8 feet.

As part of the construction of the basement garage of the east building, therefore, excavation will be required. Where adequate horizontal distance beyond the planned line of excavation is available, unsupported, open excavation slopes with gradients as recommended in this report may be used. Where adequate horizontal spacing is not available, temporary shoring should be used. Such shoring should be in a form of cantilevered soldier piles.

Structural loading data was not available at the time of this investigation. For the purpose of this report, it is assumed that the maximum concentrated loads of the interior columns will be on the order of 450 kips, combined dead plus frequently applied live loads. Perimeter and interior wall footings of the structure are expected to exert loads of on the order of 12 kips per lineal foot.

ANTICIPATED SITE GRADING WORK

For the west building facing Glendon Avenue, site grading will involve removal and recompaction of the any surficial fill and disturbed soils generated from demolition of the existing structures. The compacted soils will be used for support of grade slabs only. Because of the fine grained nature and potentially expansive character, when used in the areas of the new compacted fill, the site soils should be placed at some 3 percent higher than the optimum moisture content. Also, the grade slabs for this project should be designed for expansive soil conditions.

For the east building facing Malcolm Avenue, site grading will basically include excavation in order to establish the basement garage grade. As part of the site grading work, slab subgrade will be prepared for the basement garage.

As part of the site grading work, the space between the 2 buildings will be raised by nearly 10 feet. Only the excavated sandy soils should be used for wall backfilling. It is anticipated that, after completion of the site grading work, materials will be exported from the site.

SITE CONDITIONS

SURFACE CONDITIONS

The site of the proposed project is spans between Glendon Avenue and Malcolm Avenue, in west Los Angeles, California. The site is irregular in shape and covers a plan area of about 24,560 square feet. See the enclosed Site Plan; Drawing No. 1 for site shape and location.

At the time of our field investigation, the subject site was occupied by residential buildings. Such structures will be removed from the site. The ground surface of the site was noted to rise from east to west through an average gradient of less than 3 percent. The elevation difference between the east and west sides of the site is about 8 feet.

Existing off-site buildings occur to the sides of the subject site. See the enclosed Site Plan for approximate locations of the existing off-site buildings.

SUBSURFACE CONDITIONS

(**Note:** Subsurface geologic conditions were described in considerable detail in Part I of this combined geologic and geotechnical report. What follows is a description of subsurface conditions strictly from a geotechnical engineering point of view.)

Correlation of the subsoil between the borings was considered to be good. Generally, the site, to the depths explored, was found to be covered by surficial fill underlain by natural deposits of sandy and/or clayey silt, silty gravelly sand, and silty clay soils to the depths explored. Thickness of the surficial fill was found to be less than two feet at the location of our borings. Deeper fill, however, may be present beneath the existing buildings and in old utility lines. For the west building, the existing fill will be automatically removed by the planned basement garage excavations. For the east building, the existing fill should be removed and recompacted for support of grade slabs only.

The upper native soils through which the basement garage excavations will be made for the east building were found to consist of sandy silt and silty sand soils. These soils were found to be generally firm to stiff in-place. The results of our laboratory investigations indicated that these materials were of moderate to high strengths.

For the west building, the sandy silt native soils within the influence zone of the foundation pressure were found to be generally firm to stiff in-place and adequate to receive new fill, structural foundations and grade slabs. The results of our laboratory testing indicated that these materials were of moderate to high strengths and low to moderately compressible.

The soils near the planned foundation levels of the east building facing Malcolm Avenue, were found to consist of generally dense, silty sand soils, although stiff sandy silt soils may also be exposed. The results of our laboratory testing indicated that these materials were of moderate to high strengths and low to moderately compressibility.

The site upper soils, extending locally to the garage level of the east building, were found to be fine grained in nature and potentially expansive. The expansion index of the site upper soils was found to be 46.

During the course of our investigation, no groundwater was found in our borings drilled to a maximum depth of 50 feet. Our fault study borings drilled to depths of 80 feet also did not encounter groundwater.

Caving was not experienced in our open boring (Boring No. 4).

SEISMIC DESIGN CONSIDERATIONS

In accordance with the 2013 California Building Code (CBC 2013), the project site can be classified as site “D”. The mapped spectral accelerations of S_S=2.210 (short period) and S_1 =0.821 (1-second period) can be used for this project. These parameters corresponds to site Coefficients values of F_a =1.00 and F_V =1.5, respectively.

The seismic design parameters would be as follows:

Sms= Fa (Ss) = 1.0 (2.210) = 2.210

Sm1=Fv (S1) = 1.5 (0.821) =1.231

Sds=2/3 (Sms) = 2/3 (2.210) = 1.474 and

Sd1=2/3 (Sm1) = 2/3 (1.231) = 0.821

EVALUATION OF LIQUEFACTION POTENTIAL

As part of our field exploration, one of the geotechnical borings was drilled at the subject site to a maximum depth of 51 feet. No groundwater was encountered. However, the available maps indicate that the historically highest groundwater level at the site was near a depth of about 10 feet. For the purpose of evaluating liquefaction potential, therefore, SPT (Standard Penetration Test) were conducted from a depth of 10 feet.

The results of our liquefaction analysis (using CivilTech program) with lower level peak ground acceleration (PGA) corresponding to 2/3 of PGAm (a value of 0.565g) and the predominant earthquake magnitude of 6.72 with 10% probability of exceedance in 50 years (475-year return period) a factor of safety of greater than 1.1 was obtained for all layers. The corresponding seismic related settlements is found to be 0.02 inches.

The above given magnitudes of settlements should be added to the settlements associated with gravity loading. See FOUNDATION Section of this report. It is estimated that total and differential settlements from all causes would be less than 1.5 inches and 0.75 of one inch respectively.

When using higher level peak ground acceleration value of 0.848g corresponding to PGA based on PGAm (Maximum Considered Earthquake-Geometric Mean, MCEg, adjusted to site effects, ASCE 7-10 Eq. 11.8-1) and the predominant earthquake magnitude of 6.84 2% probability of exceedance in 50 years (2475-year return period) a factor of safety of greater than 1.0 was also obtained for all layers. The corresponding seismic related total settlements, however, was found to be 0.11 inches. See the enclosed Engineering calculations.

Based on the above, therefore, it is our opinion that soil liquefaction will not occur at the subject site.

EVALUATION AND RECOMMENDATIONS

GENERAL

Based on the geotechnical engineering data derived from this investigation, the site is suitable for the proposed development. Conventional spread footing foundation system can be used for support of the proposed buildings. The foundation bearing materials for the west building facing Glendon Avenue are expected to be stiff native soils. For the east building facing Malcolm Avenue, the foundation bearing materials will consist of dense, silty sand soils, although locally stiff sandy silt may also be exposed. 1.

The support system for the east building fronting Malcolm Avenue should be in a form of thick slab, 2’ thick “mat foundation” The “mat” should underlay the entire east building, because of its proximity to the fault. The west building facing Glendon Avenue may utilize conventional foundations as discussed further below, since the western building will be in excess of 50 feet distance from the westward trace of the fault.

For the purpose of this project, we recommend the “mat” to have a minimum thickness of 2-feet. For design, the “mat” should be designed based on a Modulus of Subgrade Reaction of 400 kips per cubic foot.

It is anticipated that the basement garage excavations for the east building will be made through surficial fill and native soils consisting of sandy silt and silty sand soils. The maximum height of excavation to the perimeter wall footing levels of the basement garage are expected to be less than 8 feet.

It is anticipated that the perimeter walls of the basement will have variable horizontal setbacks form the respective property lines. Where adequate horizontal distance beyond the planned line of excavation is available, unsupported, open excavation slopes in accordance with the recommendations of this report may be used. In the areas where space is limited, temporary shoring should be used. Such shoring should be in a form of cantilevered soldier piles.

The grade slabs for the west building can be supported on the finished grades which will consist of properly compacted fill soils. The garage slabs can be supported on the native subgrade, provided that any disturbed soils would be compacted in-place to a relative compaction of at least 90 percent at optimum moisture content. The fine grained soils should be placed at some 3 percent higher than the optimum moisture content. For the purpose of this project, and due to potentially expansive character, the grade slabs should be at least 5 inches and be reinforced with #4 bars placed at every 16 inches on center.

The following sections present our specific recommendations for site grading, site drainage, temporary excavations, foundations, lateral design, grade slabs, basement walls, and observations during construction.

GRADING RECOMMENDATIONS

For the west-building facing Glendon Avenue, site grading will involve removal and recompaction of the any surficial fill and disturbed soils generated from demolition of the existing structures. The compacted soils will be used for support of grade slabs only. Because of the fine grained nature and potentially expansive character, when used in the areas of the new compacted fill, the site soils should be placed at some 3 percent higher than the optimum moisture content. Also, the grade slabs for this project should be designed for expansive soil conditions.

For the east-building facing Malcolm Avenue, site grading will basically include excavation in order to establish the basement garage grade. As part of the site grading work, slab subgrade will be prepared for the basement garage.

As part of the site grading work, the space between the 2 buildings will be raised by nearly 10 feet. Only the excavated sandy soils should be used for wall backfilling. It is anticipated that, after completion of the site grading work, materials will be exported from the site.

Prior to placing any fill, the Soil Engineer should observe the excavation bottoms. The areas to receive compacted fill should be scarified to a depth of about 8 inches, moistened as required to bring to approximately optimum moisture content or higher (for fine grained soils) and compacted to at least 90 percent of the maximum dry density as determined by the ASTM Designation D 1557 Compaction Method.

General guidelines regarding site grading are presented below which may be included in the earthwork specification. It is recommended that all fill be placed under engineering observation and in accordance with the following guidelines:

1. All fill should be granular in nature. Therefore, only the excavated sandy soil from the site may be reused in the areas of compacted fill.

2. Before wall backfilling, subdrain should be installed. The subdrain system should consist of 4-inch diameter perforated pipes embedded in about 1 cubic feet of free draining gravel per foot of pipe. An approved filter fabric should then be wrapped around the free draining gravel in order to reduce the chances of siltation. Non-perforated outlet pipes should then be used to pass through the wall into an interior sump. The subdrain pipes should be laid at a minimum grade of two percent for self-cleaning.

3. The excavated sandy soils from the site are considered to be satisfactory to be reused in the areas of compacted fill and wall backfill provided that rocks larger than 6 inches in diameter are removed.

4. Fill material, approved by the Soil Engineer, should be placed in controlled layers. Each layer should be compacted to at least 90 percent of the maximum unit weight as determined by ASTM designation D 1557 for the material used.

5. The fill material shall be placed in layers which, when compacted, shall not exceed 8 inches per layer. Each layer shall be spread evenly and shall be thoroughly mixed during the spreading to insure uniformity of material in each layer.

6. When moisture content of the fill material is too low to obtain adequate compaction, water shall be added and thoroughly dispersed until the moisture content is near optimum.

7. When the moisture content of the fill material is too high to obtain adequate compaction, the fill material shall be aerated by blading or other satisfactory methods until near optimum moisture condition is achieved.

8. Inspection and field density tests should be conducted by the Soil Engineer during grading work to assure that adequate compaction is attained. Where compaction of less than 90 percent is indicated, additional compactive effort should be made with adjustment of the moisture content or layer thickness, as necessary, until at least 90 percent compaction is obtained.

SITE DRAINAGE

Site drainage should be provided to divert roof and surface waters from the property through nonerodible drainage devices to the street. In no case should the surface waters be allowed to pond adjacent to building or behind the basement garage walls. A minimum slope of one and two percent are recommended for paved and unpaved areas, respectively.

The site drainage recommendations should also include the following:

1. Having positive slope away from the buildings, as recommended above;
2. Installation of roof drains, area drains and catch basins with appropriate connecting lines;
3. Managing landscape watering;
4. Regular maintenance of the drainage devices;
5. Installing waterproofing or damp proofing, whichever appropriate, beneath concrete grade slabs and behind the basement walls.
6. The owners should be familiar with the general maintenance guidelines of the City requirements.

TEMPORARY EXCAVATION

Unshored Excavations: Where space limitations permit, unshored temporary excavation slopes could be used. Based upon the engineering characteristics of the site upper soils, it is our opinion that temporary excavation slopes in accordance with the following table should be used:

Maximum Depth of Cut (Ft)	Maximum Slope Ratio (Horizontal:Vertical)
0-4	Vertical
>4	3/4:1

Water should not be allowed to flow over the top of the excavation in an uncontrolled manner. No surcharge should be allowed within a 45-degree line drawn from the bottom of the excavation. Excavation surfaces should be kept moist but not saturated to retard raveling and sloughing during construction.

It would be advantageous, particularly during wet season construction, to place polyethylene plastic sheeting over the slopes. This will reduce the chances of moisture changes within the soil banks and material wash into the excavation.

Cantilevered Soldier Piles: Cantilevered soldier piles should be as a means of temporary shoring where adequate space is not available to make unsupported, open excavation slopes. Soldier piles consist of structural steel beams encased in slurry mix.

The lateral resistance for cantilevered soldier piles may be assumed to be offered by available passive pressure below the basement level. An allowable passive pressure of 500 pounds per square foot per foot of depth may be used below the basement level for soldier piles having center-to-center spacing of at least 2-1/2 times the pile diameter. Maximum allowable passive pressure should be limited to 3,600 pounds per square foot. The maximum center-to-center spacing of the vertical shafts should be maintained no greater than 10 feet.

For design of temporary support, active pressure on piles may be computed using an equivalent fluid density of 30 pounds per cubic foot. Uniform surcharge may be computed using an active pressure coefficient of 0.30 times the uniform load.

When using cantilevered soldier piles for temporary shoring, the point of fixity (for the purpose of moment calculations), may be assumed to occur at some 2 feet below the base of the excavation. In order to limit local sloughing, it is recommended that lagging be used where fill is exposed between the soldier piles. All wood members left in ground should be pressure treated.

Where off-site buildings occur within a horizontal distance equal to the depth of cut, the allowable lateral deflection at the tops of the piles should be limited to ½ of one inch. In the areas where the shoring system supports public right-of-way, and where off-site buildings occur outside a horizontal distance equal to the depth of excavation, the allowable lateral deflection at the tops of the piles can be increased to one inch.

The temporary shoring should be monitored during the course of basement garage excavation. The report of monitoring should be provided to the Project and Soil Engineers for review and comment. If excessive lateral movements are noted, additional lateral support system in a form of internal bracing may be required.

Caving was not experienced in our open boring. Therefore, it is anticipated that significant caving will not occur during drilling of the shoring piles.

The recommendations presented in this section are for use in design and for cost estimating purposes before construction. The contractor is solely responsible for safety during construction.

MONITORING

The lateral support of the existing off-site buildings should be maintained by the temporary shoring system. The project Structural Engineer should examine the subject site and use appropriate shoring system to secure lateral stability of the off-site improvements assuming appropriate surcharge loads of the off-site buildings (add to the lateral earth pressure). Proper monitoring program should be maintained during basement garage excavation to assure the shoring pile deflections would not exceed the tolerable limits, as recommended in the preceding section.

It is important that the survey of the conditions of the off-site improvements be recorded before installation of the shoring piles and basement garage excavation.

FOUNDATIONS

Conventional spread footing foundation systems can be used to support the proposed buildings. The foundation bearing materials for the west building facing Glendon Avenue are expected to be stiff native soils. For the east building facing Malcolm Avenue, the foundation bearing materials will consist of dense, silty sand soils, although locally stiff sandy silt may also be exposed.

The support system for the east building fronting Malcolm Avenue should be in a form of a 2' thick slab "mat foundation" .

For the purpose of this project, we recommend the "mat" to have a minimum thickness of 2-feet. For design, the "mat" should be designed based on a Modulus of Subgrade Reaction of 400 kips per cubic foot.

Exterior and interior spread footings should be a minimum of 18 inches wide and should be placed at a minimum depth of 24 inches below the lowest adjacent final grades. The recommended allowable maximum bearing pressure for minimum size footings placed in stiff and/or dense native soils can be taken as 2,400 pounds per square foot. This value may be increased at a rate of 100 and 200 pounds per square foot for each additional foot of footing width and depth, to a maximum value of 3,000 pounds per square foot.

The above given values are for the total of dead and frequently applied live loads. For short duration transient loading, such as wind or seismic forces, the given values may be increased by one-third.

Under the allowable maximum soil pressure, footings with assumed collected loads of 450 kips are expected to settle on the order of ¾ of one inch. Wall footings, with loads of about 12 kips per linear foot are expected to settle on the order of 5/8 of one inch. Maximum differential settlements are expected to be on the order of 1/4 of an inch. The major portions of the static loading settlements are expected to occur during construction. The seismic settlements should be added to the above values.

LATERAL DESIGN

Lateral resistance at the base of footings in contact with native soils may be assumed to be the product of the dead load forces and a coefficient of friction of 0.30. Passive pressure on the face of footings may also be used to resist lateral forces. A passive pressure of zero at the finished grades and increasing at a rate of 250 pounds per square foot per foot of depth to a maximum value of 2,000 pounds per square foot may be used for footings poured against native soils.

GRADE SLABS

The grade slabs for the west building can be supported on the finished grades which will consist of properly compacted fill soils. The garage slabs can be supported on the native subgrade, provided that any disturbed soils would be compacted in-place to a relative compaction of at least 90 percent at optimum moisture content. The fine grained soils should be placed at some 3 percent higher than the optimum moisture content. For the purpose of this project, and due to potentially expansive character, the grade slabs should be at least 5 inches and be reinforced with #4 bars placed at every 16 inches on center.

In the areas where moisture sensitive floor covering is used and slab dampness cannot be tolerated, a vapor-barrier should be used beneath the slabs. This normally consists of a 10-mil polyethylene film covered with 2 inches of clean sand.

BASEMENT WALLS

The perimeter walls of the basement garage of the proposed building are expected to be buried to a maximum depth of about 6 feet. Static design of these walls (being restrained against rotation) could be based on an equivalent fluid pressure of 54 pounds per square foot per foot of depth. This assumes that no hydrostatic pressure will occur behind the retaining walls. This will require that proper subdrain be installed behind the basement garage walls.

Subdrain normally consists of 4-inch diameter perforated pipes encased in gravel (at least one cubic foot per lineal foot of the pipes). In order to reduce the chances of siltation and drain clogging, the free-draining gravel should be wrapped in filter fabric proper for the site soils.

In accordance with new City Code requirements, the basement garage walls should be designed not only for static, but also for seismic lateral earth pressures. Basically, during the course of strong ground motion earthquake, an additional lateral earth pressure will be applied to the retaining walls. For this project, the magnitude of the seismic earth pressure can be assumed to be ½ of the static lateral earth pressure value of 54 pounds per square foot per foot of depth, however, in a form of a reverse triangle, where the maximum intensity of 27 pounds per square foot will occur at the top of the wall and the intensity decreases linearly downward to zero at the bottom of the wall. The resultant of the seismic pressure should be applied at a level 0.6 times the wall height above the base of the wall.

In addition to the lateral earth pressure, the basement garage walls should also be designed for any applicable uniform surcharge loads imposed on the adjacent grounds. Uniform surcharge effects may be computed using a coefficient of 0.40 times the assumed uniform loads.

Where adequate space is available, granular fill should be placed and compacted behind the retaining walls (after the subdrain is installed) to a relative compaction of at least 90 percent. At least one field density tests should be taken for each 2 feet of the backfill. The degree of compaction of the wall backfill should be verified by the Soil Engineer.

Where space is limited, free-draining gravel should be placed behind the retaining walls. The gravel should then be capped with at least 18 inch thick site soils also compacted to a relative compaction of at least 90 percent. It should be noted that the backfill placed behind the basement garage walls should be made after the concrete decking is cast. All grading surrounding the building should be such to ensure that water drains freely from the site and does not pond.

ON-SITE STORM WATER INFILTRATION

It is our understanding that, as part of the development of the subject site, the City requires an on-site storm water infiltration system. This normally consists of diversion of the storm water into a system that will allow infiltration into the ground. The infiltration system should normally be kept away from existing and proposed structural foundations and property lines by at least 10 feet. Also, a 10 feet buffer zone for natural infiltration is required from the base of the water dispersing trench and the water level.

The subject project will have a basement garage extending to some 6 feet below grade. Considering that the historically highest groundwater level at the site is near a depth of about 10 feet, use of on-site storm water infiltration system at the subject site would not be feasible.

Based on the above, a system of “capture and use” may be used for this project. This normally consists of a closed system where the water is collected and used in the areas of planters. Any excess water, after going through proper infiltration process, would be diverted to the curb line.

OBSERVATION DURING CONSTRUCTION

The presented recommendations in this report assume that all structural foundations will be established in native soils. All footing excavations should be observed by a representative of this office before reinforcing is placed.

The depths of cantilevered soldier piles should be confirmed by a representative of this office before concrete is placed. It is essential to assure that soldier piles are drilled to proper depths and diameters, and in accordance with the project plans and specifications.

Site grading work, such as wall backfilling, and subgrade preparation for basement slab support, should be conducted under observation and testing by a representative of this firm. All backfill soils should be properly compacted to at least 90 percent relative compaction. For proper scheduling, please notify this office at least 24 hours before any observation work is required.

CLOSURE

The findings and recommendations presented in this report were based on the results of our field and laboratory investigations combined with professional engineering experience and judgment. The report was prepared in accordance with generally accepted engineering principles and practice. We make no other warranty, either express or implied.

It is noted that the conclusions and recommendations presented are based on exploration "window" borings and excavations which is in conformance with accepted engineering practice. Some variations of subsurface conditions are common between "windows" and major variations are possible.

The following plates and appendices are attached and complete this report:

References

Liquefaction Evaluation Calculations

Regional Fault Map – Drawing No. 1

Geologic Map and Fault Study Plan – Drawing No. 2

Geologic Cross Section A-A' – Drawing No. 3

Geotechnical Site Plan – Drawing No. 4

Geotechnical Cross Section B-B' – Drawing No. 5

Geotechnical Cross Section C-C' – Drawing No. 6

Figure No. 1 – Site Vicinity Map

Figure No. 2 – Regional Topographic Map showing fault (Navigate LA)

Figure No. 3 – Regional Geologic Map (Dibblee)

Figure No. 4 – Historically Highest Groundwater Contours

Figure Nos. 5, 6 and 7 – Seismic Hazards Maps

Appendix I – Methods of Field Exploration

Figure Nos. I-1.1 through I-3.3 – Logs of Continuous Core Geologic Borings

Figure No. I-4 through I-7 – Logs of Geotechnical Borings

Figure No. I-8 – Unified Soil Classification System

Cone Penetrometer Report by Kehoe Testing and Engineering

Appendix II – Methods of Laboratory Testing

Figure No. II-1 and II-2

Appendix III – Selected Photographs Taken During Field Exploration

Appendix IV – Miscellaneous Attachments

Geomorphic Terrace Map, Miles Kenney, 2014

Mactec/Parsons Fault Map, 2011

Kenney Right vs. Left Lateral Model, Fault Map, 2014

Street Closure, Encroachment and Excavation Permits

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We appreciate the opportunity to be of continued service on this project. If you have any questions, please do not hesitate to contact the undersigned.

Respectfully Submitted,

APPLIED EARTH SCIENCES

Shant Minas, EG 2607
Project Engineering Geologist

Caro Minas, GE 601
President, Geotechnical Engineer

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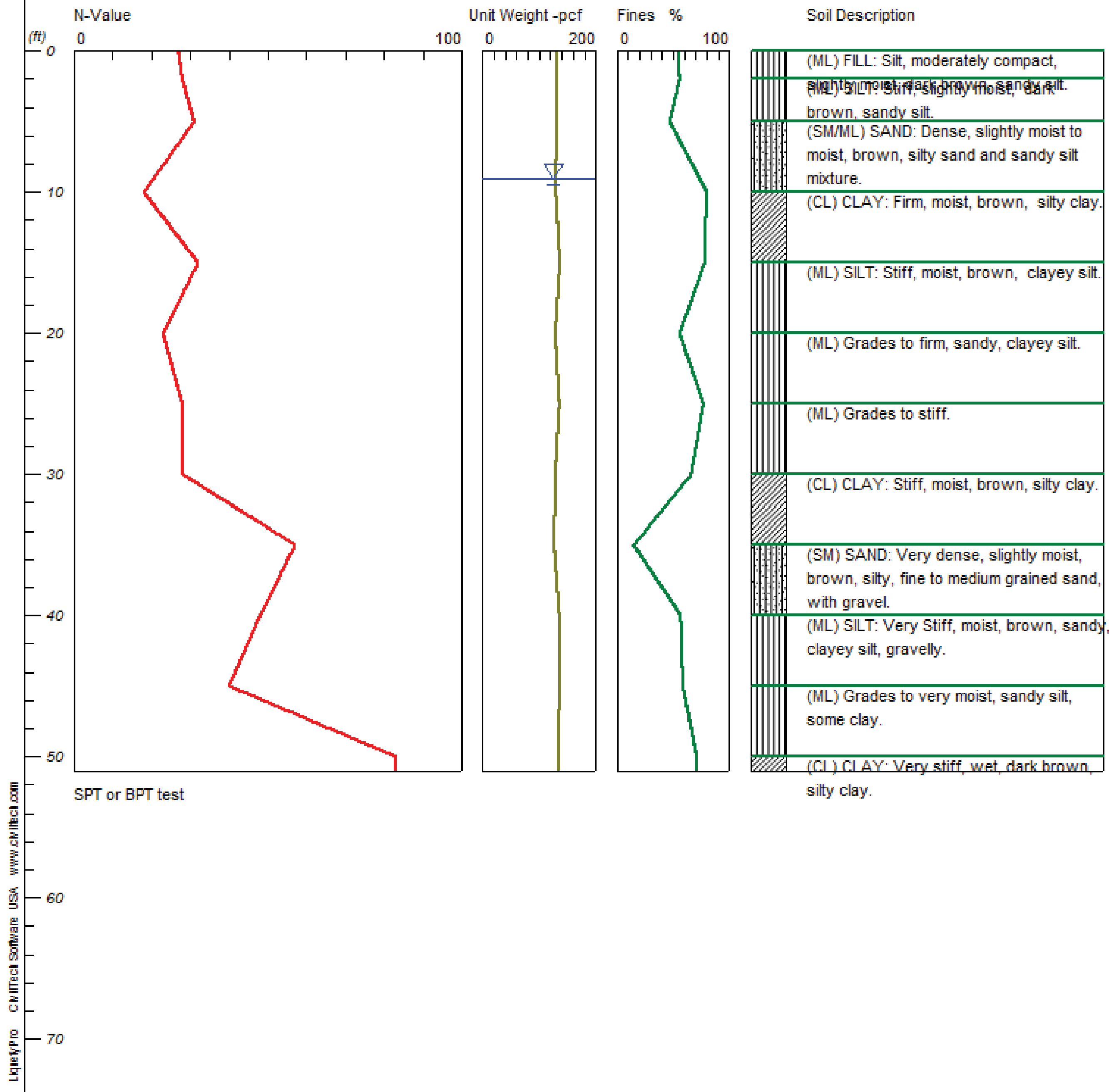
LIQUEFACTION ANALYSIS

1751 Malcolm Ave

Hole No.=1 Water Depth=9 ft

Magnitude=6.84
Acceleration=.848g



LIQUEFACTION ANALYSIS

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Hole No.=1 Water Depth=9 ft

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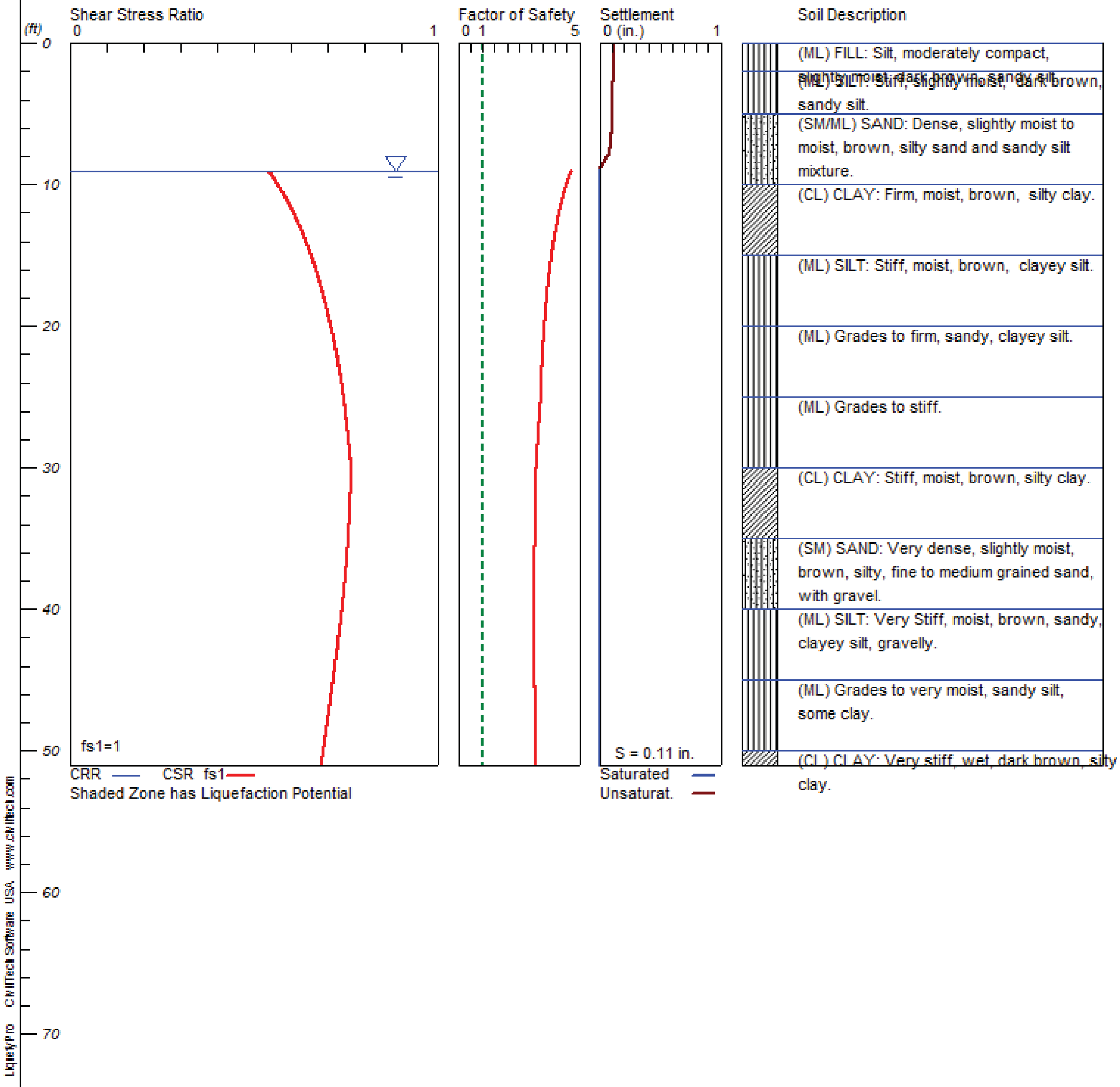
Acceleration=.848g



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LIQUEFACTION ANALYSIS SUMMARY

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Water Table during In-Situ Testing= 55.00 ft
Max. Acceleration= 0.85 g
Earthquake Magnitude= 6.84

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Surface Elev.=
Hole No.=1
Depth of Hole=51.00 ft
Water Table during Earthquake= 9.00 ft
Water Table during In-Situ Testing= 55.00 ft
Max. Acceleration=0.85 g
Earthquake Magnitude=6.84
No-Liquefiable Soils: Based on Analysis

1. SPT or BPT Calculation.
2. Settlement Analysis Method: Ishihara / Yoshimine
3. Fines Correction for Liquefaction: Stark/Olson et al.*
4. Fine Correction for Settlement: During Liquefaction*
5. Settlement Calculation in: All zones*
6. Hammer Energy Ratio, Ce = 1.2
7. Borehole Diameter, Cb= 1
8. Sampling Method, Cs= 1
9. User request factor of safety (apply to CSR) , User= 1
   Plot one CSR curve (fs1=1)
10. Use Curve Smoothing: Yes*

* Recommended Options

In-Situ Test Data:

Depth ft	SPT	gamma pcf	Fines %
0.00	27.00	131.00	55.00
2.00	28.00	131.00	56.00
5.00	31.00	131.00	47.00
10.00	18.00	130.00	80.00
15.00	32.00	137.00	78.00
20.00	23.00	129.00	56.00
25.00	28.00	136.00	77.00
30.00	28.00	129.00	66.00
35.00	57.00	127.00	15.00
40.00	48.00	136.00	57.00

45.00	40.00	136.00	59.00
50.00	83.00	135.00	71.00

Output Results:

Settlement of Saturated Sands=0.00 in.
Settlement of Unsaturated Sands=0.11 in.
Total Settlement of Saturated and Unsaturated Sands=0.11 in.
Differential Settlement=0.054 to 0.071 in.

Depth ft	CRRm	CSRfs	F.S.	S_sat. in.	S_dry in.	S_all in.
0.00	2.53	0.55	5.00	0.00	0.11	0.11
2.00	2.53	0.55	5.00	0.00	0.11	0.11
4.00	2.53	0.55	5.00	0.00	0.10	0.10
6.00	2.53	0.54	5.00	0.00	0.09	0.09
8.00	2.53	0.54	5.00	0.00	0.06	0.06
10.00	2.53	0.57	4.48	0.00	0.00	0.00
12.00	2.53	0.61	4.16	0.00	0.00	0.00
14.00	2.53	0.64	3.94	0.00	0.00	0.00
16.00	2.53	0.67	3.78	0.00	0.00	0.00
18.00	2.53	0.69	3.66	0.00	0.00	0.00
20.00	2.53	0.71	3.56	0.00	0.00	0.00
22.00	2.53	0.73	3.49	0.00	0.00	0.00
24.00	2.53	0.74	3.43	0.00	0.00	0.00
26.00	2.52	0.75	3.37	0.00	0.00	0.00
28.00	2.49	0.76	3.29	0.00	0.00	0.00
30.00	2.46	0.77	3.21	0.00	0.00	0.00
32.00	2.43	0.76	3.19	0.00	0.00	0.00
34.00	2.40	0.76	3.17	0.00	0.00	0.00
36.00	2.38	0.75	3.15	0.00	0.00	0.00
38.00	2.35	0.75	3.14	0.00	0.00	0.00
40.00	2.32	0.74	3.14	0.00	0.00	0.00
42.00	2.30	0.73	3.14	0.00	0.00	0.00
44.00	2.27	0.72	3.15	0.00	0.00	0.00
46.00	2.24	0.71	3.16	0.00	0.00	0.00
48.00	2.22	0.70	3.17	0.00	0.00	0.00
50.00	2.20	0.69	3.19	0.00	0.00	0.00

* F.S.<1, Liquefaction Potential Zone
(F.S. is limited to 5, CRR is limited to 2, CSR is limited to 2)

Units: Unit: qc, fs, Stress or Pressure = atm (1.0581tsf); Unit Weight = pcf; Depth = ft; Settlement = in.

1 atm (atmosphere) = 1 tsf (ton/ft2)

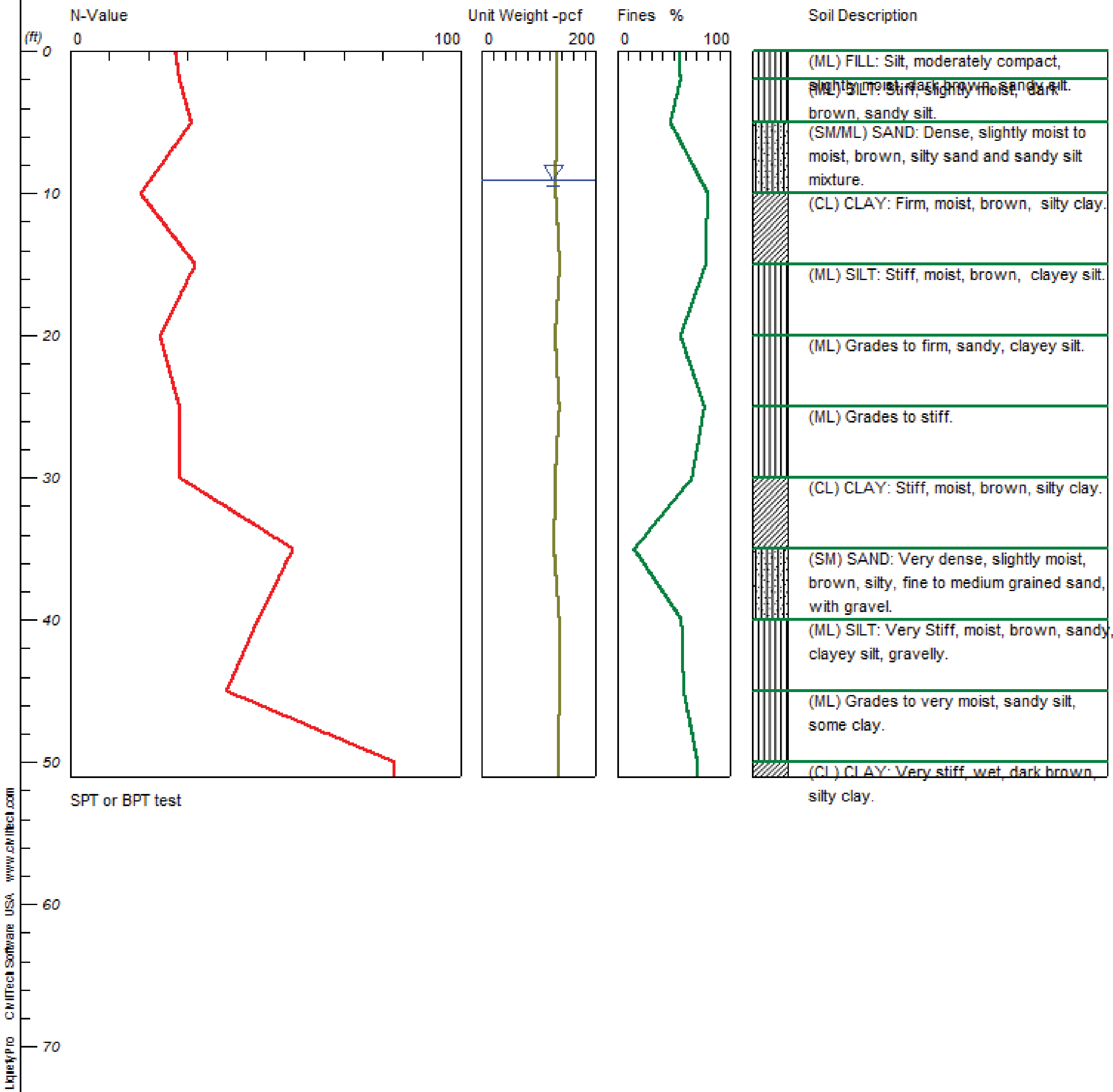
CRRm	Cyclic resistance ratio from soils
CSRsf	Cyclic stress ratio induced by a given earthquake (with user request factor of safety)
F.S.	Factor of Safety against liquefaction, F.S.=CRRm/CSRsf
S_sat	Settlement from saturated sands
S_dry	Settlement from Unsaturated Sands
S_all	Total Settlement from Saturated and Unsaturated Sands
NoLiq	No-Liquefy Soils

LIQUEFACTION ANALYSIS

1751 Malcolm Ave

Hole No.=1 Water Depth=9 ft

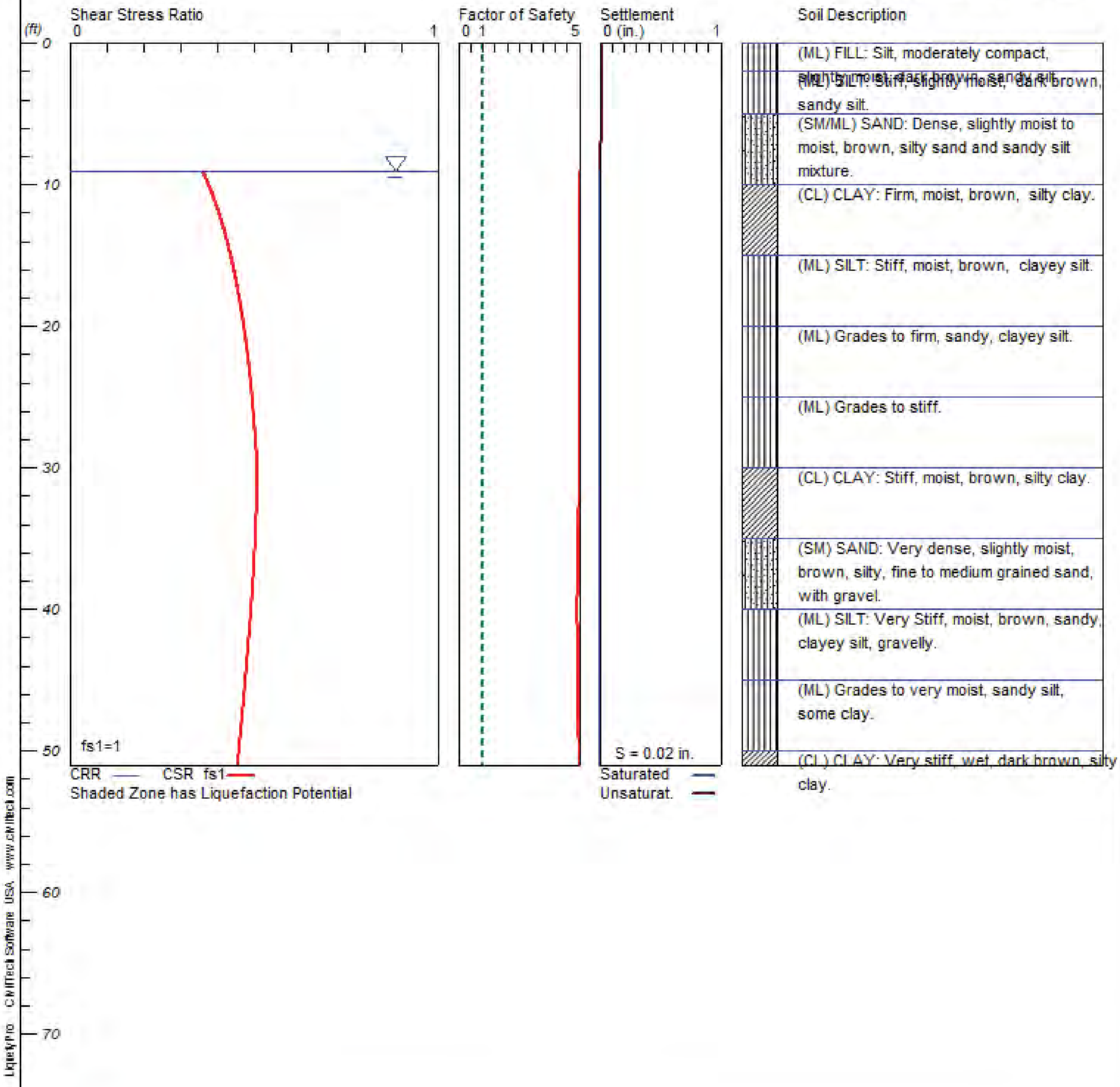
Magnitude=6.72
Acceleration=.565g



LIQUEFACTION ANALYSIS

1751 Malcolm Ave

Hole No.=1 Water Depth=9 ft ***Magnitude=6.72 Acceleration=.565g***



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Water Table during In-Situ Testing= 55.00 ft
Max. Acceleration= 0.56 g
Earthquake Magnitude= 6.72

Input Data:
Surface Elev.=
Hole No.=1
Depth of Hole=51.00 ft
Water Table during Earthquake= 9.00 ft
Water Table during In-Situ Testing= 55.00 ft
Max. Acceleration=0.56 g
Earthquake Magnitude=6.72
No-Liquefiable Soils: Based on Analysis

1. SPT or BPT Calculation.
2. Settlement Analysis Method: Ishihara / Yoshimine
3. Fines Correction for Liquefaction: Stark/Olson et al.*
4. Fine Correction for Settlement: During Liquefaction*
5. Settlement Calculation in: All zones*
6. Hammer Energy Ratio, Ce = 1.2
7. Borehole Diameter, Cb= 1
8. Sampling Method, Cs= 1
9. User request factor of safety (apply to CSR) , User= 1
   Plot one CSR curve (fs1=1)
10. Use Curve Smoothing: Yes*
* Recommended Options

In-Situ Test Data:

Depth ft	SPT	gamma pcf	Fines %
0.00	27.00	131.00	55.00
2.00	28.00	131.00	56.00
5.00	31.00	131.00	47.00
10.00	18.00	130.00	80.00
15.00	32.00	137.00	78.00
20.00	23.00	129.00	56.00
25.00	28.00	136.00	77.00
30.00	28.00	129.00	66.00
35.00	57.00	127.00	15.00
40.00	48.00	136.00	57.00

45.00	40.00	136.00	59.00
50.00	83.00	135.00	71.00

Output Results:

Settlement of Saturated Sands=0.00 in.
Settlement of Unsaturated Sands=0.02 in.
Total Settlement of Saturated and Unsaturated Sands=0.02 in.
Differential Settlement=0.008 to 0.010 in.

Depth ft	CRRm	CSRfs	F.S.	S_sat. in.	S_dry in.	S_all in.
0.00	2.65	0.37	5.00	0.00	0.02	0.02
2.00	2.65	0.37	5.00	0.00	0.01	0.01
4.00	2.65	0.36	5.00	0.00	0.01	0.01
6.00	2.65	0.36	5.00	0.00	0.01	0.01
8.00	2.65	0.36	5.00	0.00	0.00	0.00
10.00	2.65	0.38	5.00	0.00	0.00	0.00
12.00	2.65	0.41	5.00	0.00	0.00	0.00
14.00	2.65	0.43	5.00	0.00	0.00	0.00
16.00	2.65	0.45	5.00	0.00	0.00	0.00
18.00	2.65	0.46	5.00	0.00	0.00	0.00
20.00	2.65	0.47	5.00	0.00	0.00	0.00
22.00	2.65	0.48	5.00	0.00	0.00	0.00
24.00	2.65	0.49	5.00	0.00	0.00	0.00
26.00	2.64	0.50	5.00	0.00	0.00	0.00
28.00	2.61	0.50	5.00	0.00	0.00	0.00
30.00	2.58	0.51	5.00	0.00	0.00	0.00
32.00	2.55	0.51	5.00	0.00	0.00	0.00
34.00	2.52	0.51	4.97	0.00	0.00	0.00
36.00	2.49	0.50	4.95	0.00	0.00	0.00
38.00	2.46	0.50	4.94	0.00	0.00	0.00
40.00	2.43	0.49	4.93	0.00	0.00	0.00
42.00	2.40	0.49	4.94	0.00	0.00	0.00
44.00	2.37	0.48	4.94	0.00	0.00	0.00
46.00	2.35	0.47	4.96	0.00	0.00	0.00
48.00	2.32	0.47	4.98	0.00	0.00	0.00
50.00	2.30	0.46	5.00	0.00	0.00	0.00

* F.S.<1, Liquefaction Potential Zone
(F.S. is limited to 5, CRR is limited to 2,   CSR is limited to 2)

Units: Unit: qc, fs, Stress or Pressure = atm (1.0581tsf); Unit Weight = pcf; Depth = ft; Settlement = in.

1 atm (atmosphere) = 1 tsf (ton/ft2)

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CSRsf	Cyclic stress ratio induced by a given earthquake (with user request factor of safety)
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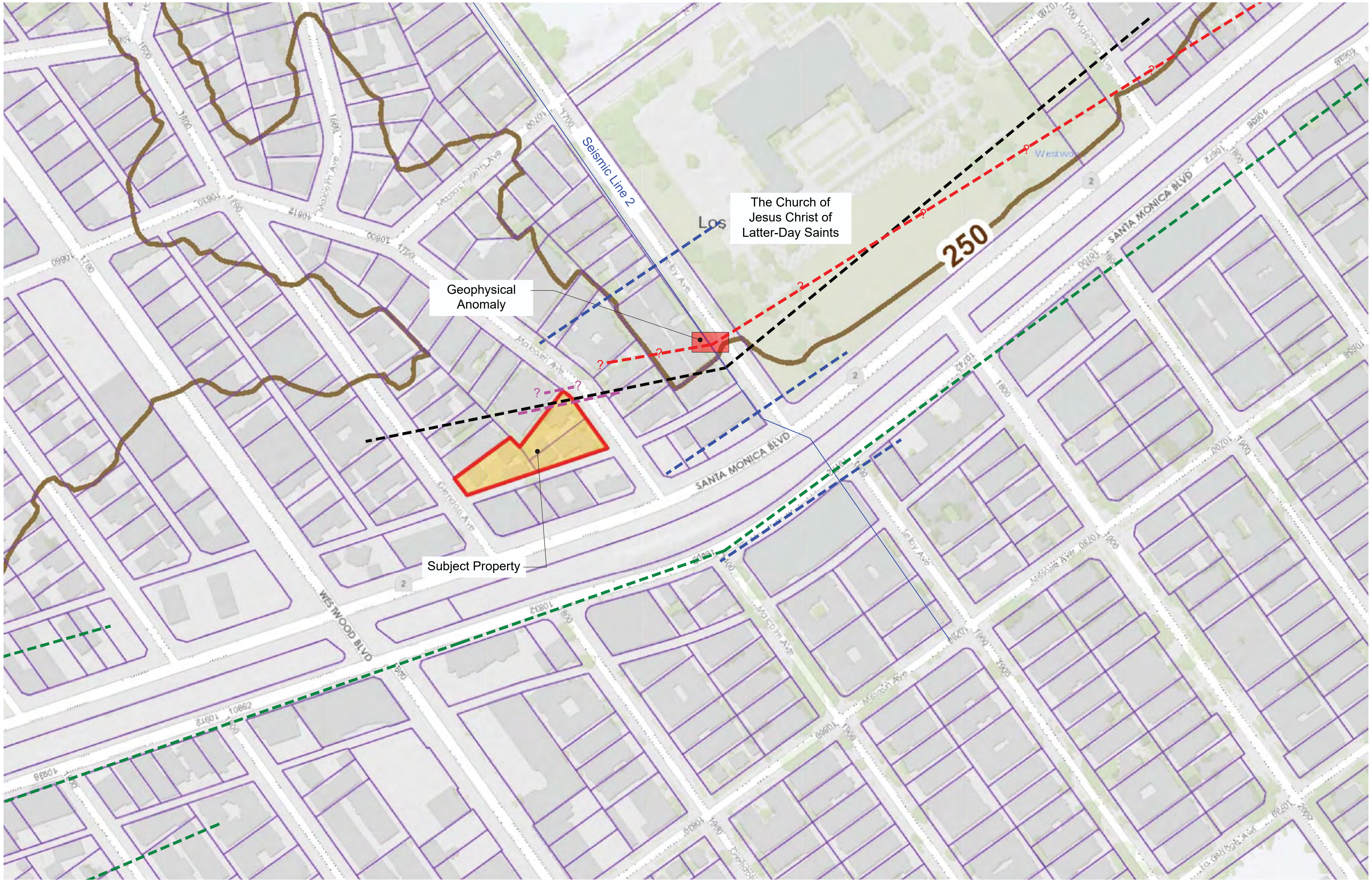


= Fault Location (AES, 2015, Based on Site-specific Investigation)

= Approximate Location of Fault Trace, Navigate LA, & Bryant, 2005

= Inferred Trace of Santa Monica Fault Shown Based on Preliminary Geophysical Data & Interpretation of Geomorphology, Parsons 2011 Metro Fault Study Report

= Fault, Mactec, 2010; Kenney Geomorphic Map

= Fault, Miles Kenney Geo Maps

N

Scale: 1" = 100'

REGIONAL FAULT MAP		PROJECT No: 15-363-26	
DESCRIPTION:	Proposed Multifamily Building	DATE:	07 / 22 / 2015
FOR:	Sinanian Development Inc.	DRAWN BY:	VM
ADDRESS:	1749 & 1751 Malcolm Ave. & 1772 Glendon Ave., Los Angeles, CA 90024	CHECKED BY:	SM
Applied Earth Sciences	GEOTECHNICAL . GEOLOGY . ENVIRONMENTAL ENGINEERING CONSULTANTS www.aessoil.com (818) 552-6000	DRAWING No:	1

U:\VINCE\2015\-M-\1730 MALCOLM AVENUE-FAULT STUDY\DRAWING 1-REGIONAL FAULT MAP.dwg, 7/22/2015 11:04:30 AM

LEGEND

Qa = Recent Alluvium

Qsp = Sag Pond Deposits

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

= Area of Work :
1- Excavation Permit
2- Street Use Permit
3- Traffic Control Plan
4- Encroachment Permit

= Area of Work Within Private Property

= Fault Location (Based on Navigate LA)

= Fault Location (AES, 2015, Based on Site-specific Investigation)

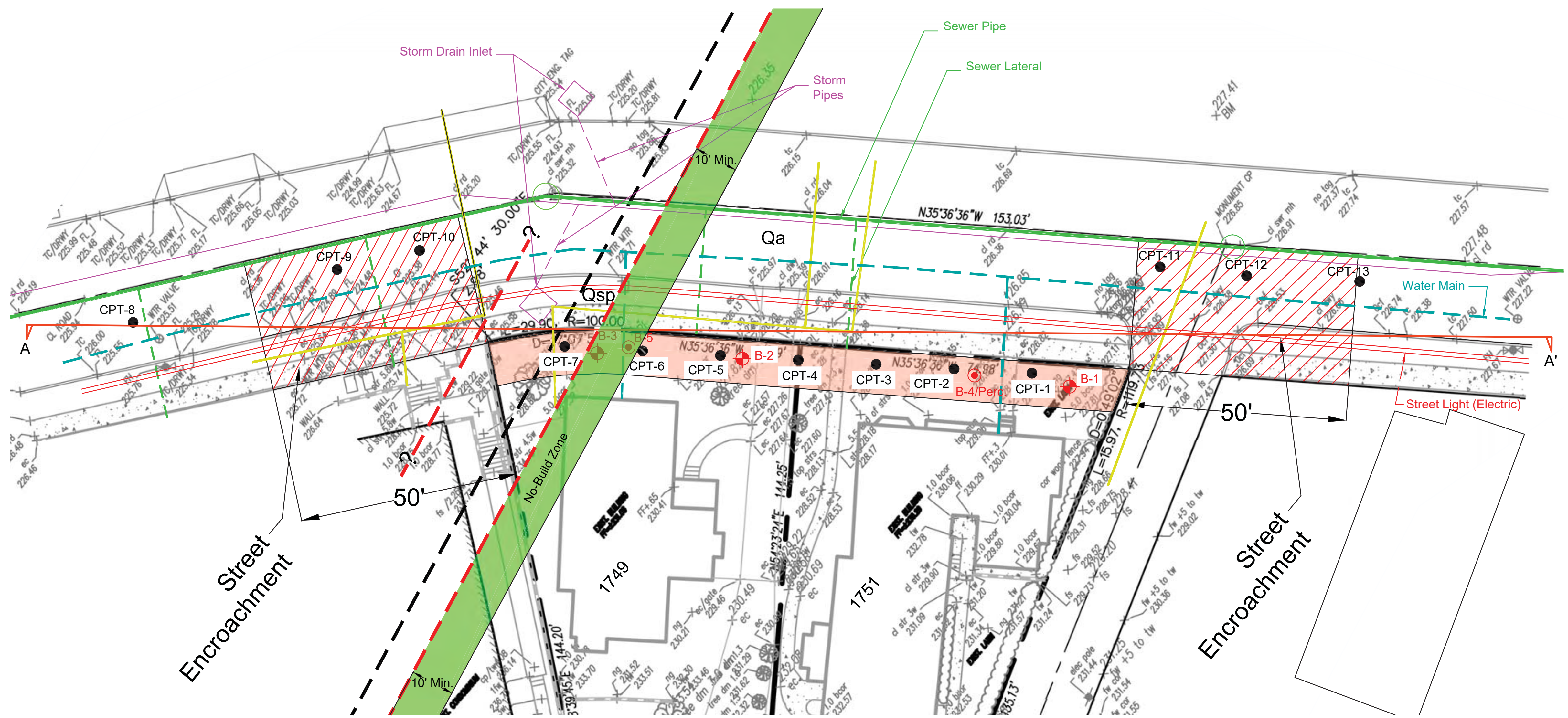
= Area of No-Build Zone

= Sewer Pipe & Lateral (By Navigate LA)

= Storm Drain Inlet & Pipes (By Navigate LA)

= Gas Line (By Field Mapping & Dig Alert)

= Water Line (By Field Mapping & Dig Alert)



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Scale: 1" = 20'

GEOLOGIC MAP & FAULT STUDY PLAN		PROJECT No: 15-363-26
DESCRIPTION:	Proposed Multifamily Building	DATE: 07 / 22 / 2015
FOR:	Sinanian Development Inc.	DRAWN BY: VM
ADDRESS:	1749 & 1751 Malcolm Avenue, Los Angeles, CA 90024	CHECKED BY: SM
Applied Earth Sciences	GEOTECHNICAL . GEOLOGY . ENVIRONMENTAL ENGINEERING CONSULTANTS www.aessoil.com (818) 552-6000	DRAWING No: 2

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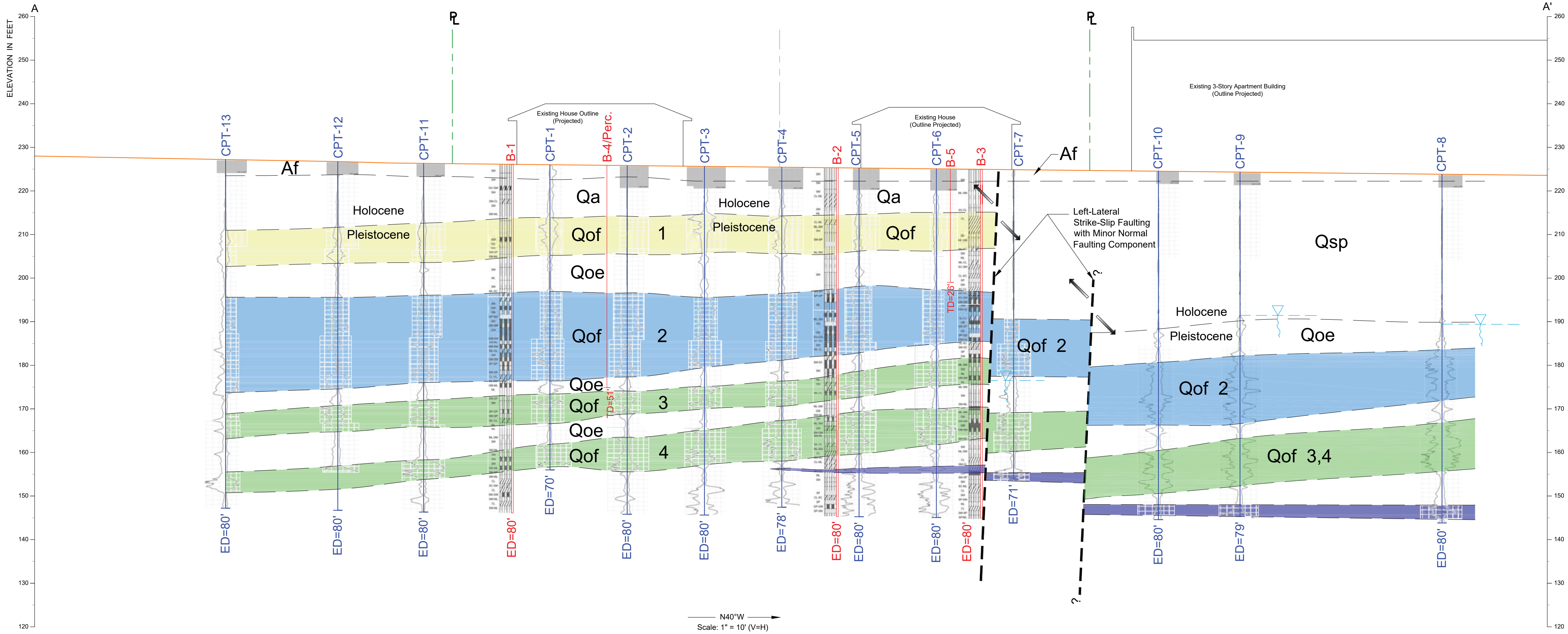


LEGEND

Holocene
- Af = Surficial Fill
- Qa = Recent Alluvium
- Qsp = Sag Pond Deposits

Pleistocene
- Qof = Older Fluvial & Alluvial Deposits
- Qoe = Older Estuarine Deposits

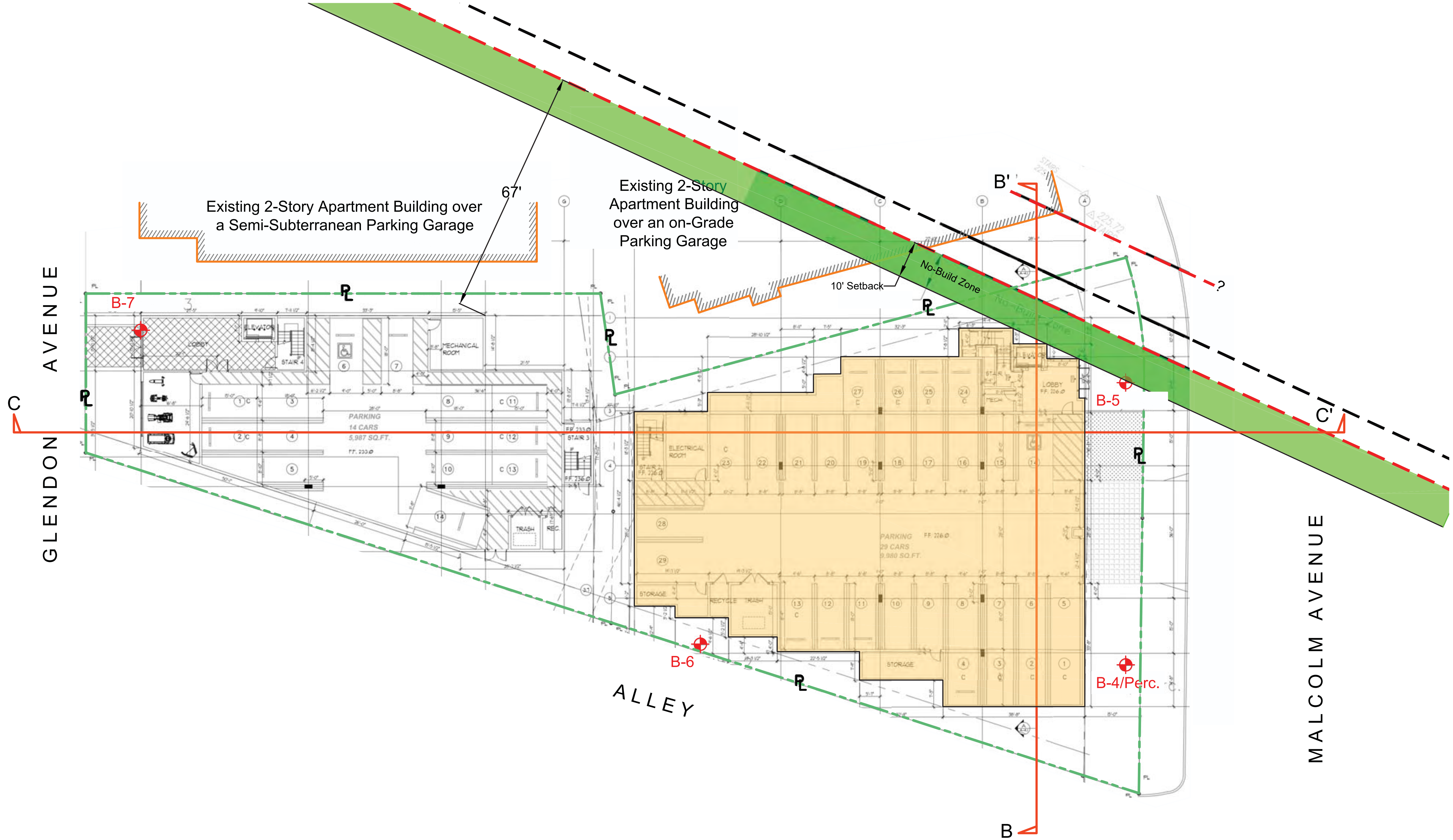
CPT-10 ED=80' = Approximate Location of Proposed CPT Sounding (Approx. every 20', Estimated Depth=80')

B-3 ED=80' = Approximate Location of Proposed Continuous Core Drilling (Estimated Depth=80')

B-7 TD=10' Location of Geotechnical Boring

= Location of Faults, Based on Subsurface Exploration (AES, 2015)

GEOLOGIC CROSS SECTION A-A'		PROJECT No: 15-363-26	
DESCRIPTION:	Proposed Multifamily Building	DATE:	07 / 22 / 2015
FOR:	Sinanian Development Inc.	DRAWN BY:	VM
ADDRESS:	1749 & 1751 Malcolm Ave. & 1772 Glendon Ave., Los Angeles, CA 90024	CHECKED BY:	SM
Applied Earth Sciences	GEOTECHNICAL . GEOLOGY . ENVIRONMENTAL ENGINEERING CONSULTANTS www.aessoil.com (818) 552-6000	DRAWING No:	3



LEGEND:

B-7 = Location & Number 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 Foundatiom

N

Scale: 1" = 30'

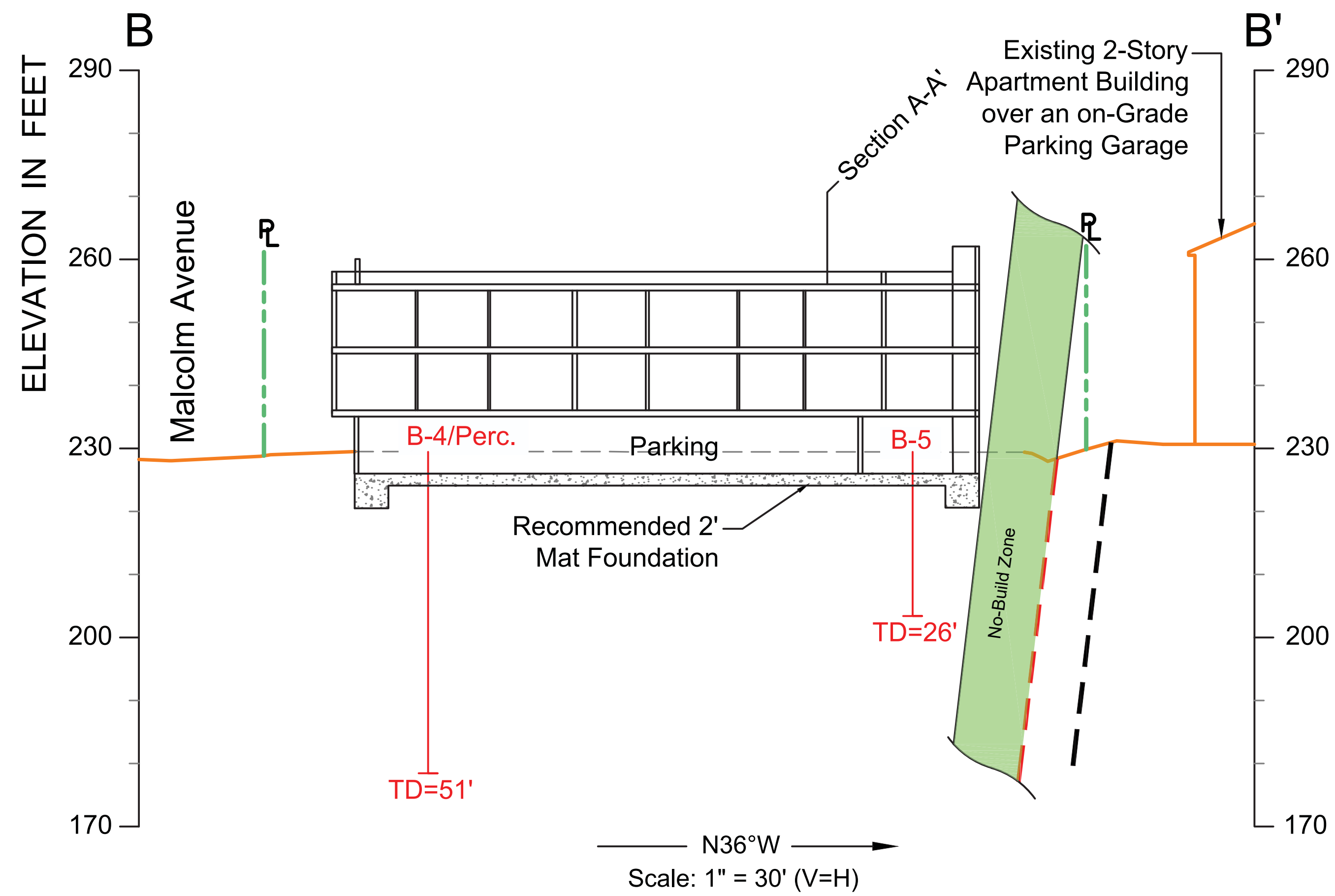
GEOTECHNICAL SITE PLAN

DESCRIPTION:	Proposed Multifamily Residential Building Project
FOR:	Sinanian Development Inc.
ADDRESS:	1749 & 1751 Malcolm Ave. & 1772 Glendon Ave., Los Angeles, CA 90024

Applied Earth Sciences — GEOTECHNICAL . GEOLOGY . ENVIRONMENTAL ENGINEERING CONSULTANTS — www.aessoil.com (818) 552-6000

PROJECT No:	15-363-02
DATE:	07 / 22 / 2015
DRAWN BY:	VM
CHECKED BY:	CM
DRAWING No:	4

U:\VINCE\2015\-M-\1730 MALCOLM AVENUE-FAULT STUDY\DRAWING 4 TO 6-GEOTECHNICAL SITE PLAN & SECTIONS B-B' & C-C'.dwg, 7/22/2015 11:21:04 AM



LEGEND:

B-4 / TD=10' (Projected) = Location & Number of Boring

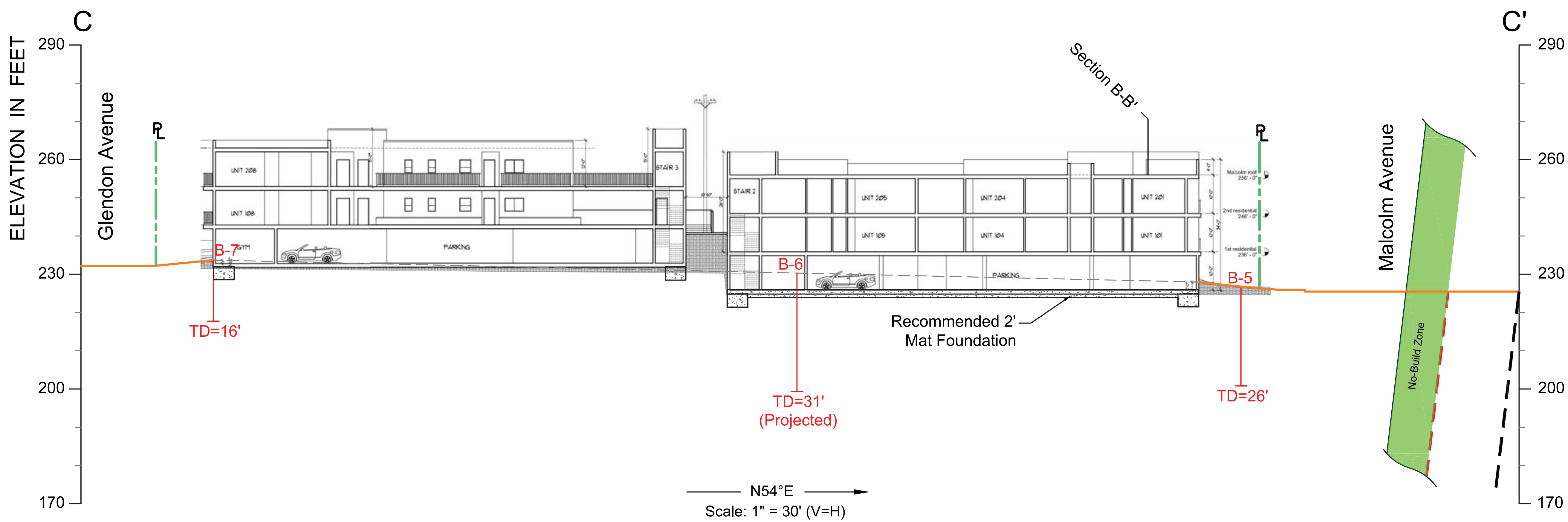
= Fault Location (Based on Navigate LA)

= Fault Location (AES, 2015, Based on Site-specific Investigation)

= Area of No-Build Zone

GEOTECHNICAL CROSS SECTIONS B-B'

DESCRIPTION:	Proposed Multifamily Residential Building Project	PROJECT No:	15-363-02
FOR:	Sinanian Development Inc.	DATE:	07 / 22 / 2015
ADDRESS:	1749 & 1751 Malcolm Ave. & 1772 Glendon Ave., Los Angeles, CA 90024	DRAWN BY:	VM
		CHECKED BY:	CM
Applied Earth Sciences	GEOTECHNICAL . GEOLOGY . ENVIRONMENTAL ENGINEERING CONSULTANTS www.aessoil.com (818) 552-6000	DRAWING No:	5



LEGEND:

B-4 / TD=10' (Projected) = Location & Number of Boring

= Fault Location (Based on Navigate LA)

= Fault Location (AES, 2015, Based on Site-specific Investigation)

= Area of No-Build Zone

GEOTECHNICAL CROSS SECTIONS C-C'

DESCRIPTION:	Proposed Multifamily Residential Building Project	PROJECT No:	15-363-02
FOR:	Sinanian Development Inc.	DATE:	07 / 22 / 2015
ADDRESS:	1749 & 1751 Malcolm Ave. & 1772 Glendon Ave., Los Angeles, CA 90024	DRAWN BY:	VM
		CHECKED BY:	CM
Applied Earth Sciences	GEOTECHNICAL . GEOLOGY . ENVIRONMENTAL ENGINEERING CONSULTANTS www.aessoil.com (818) 552-6000	DRAWING No:	6

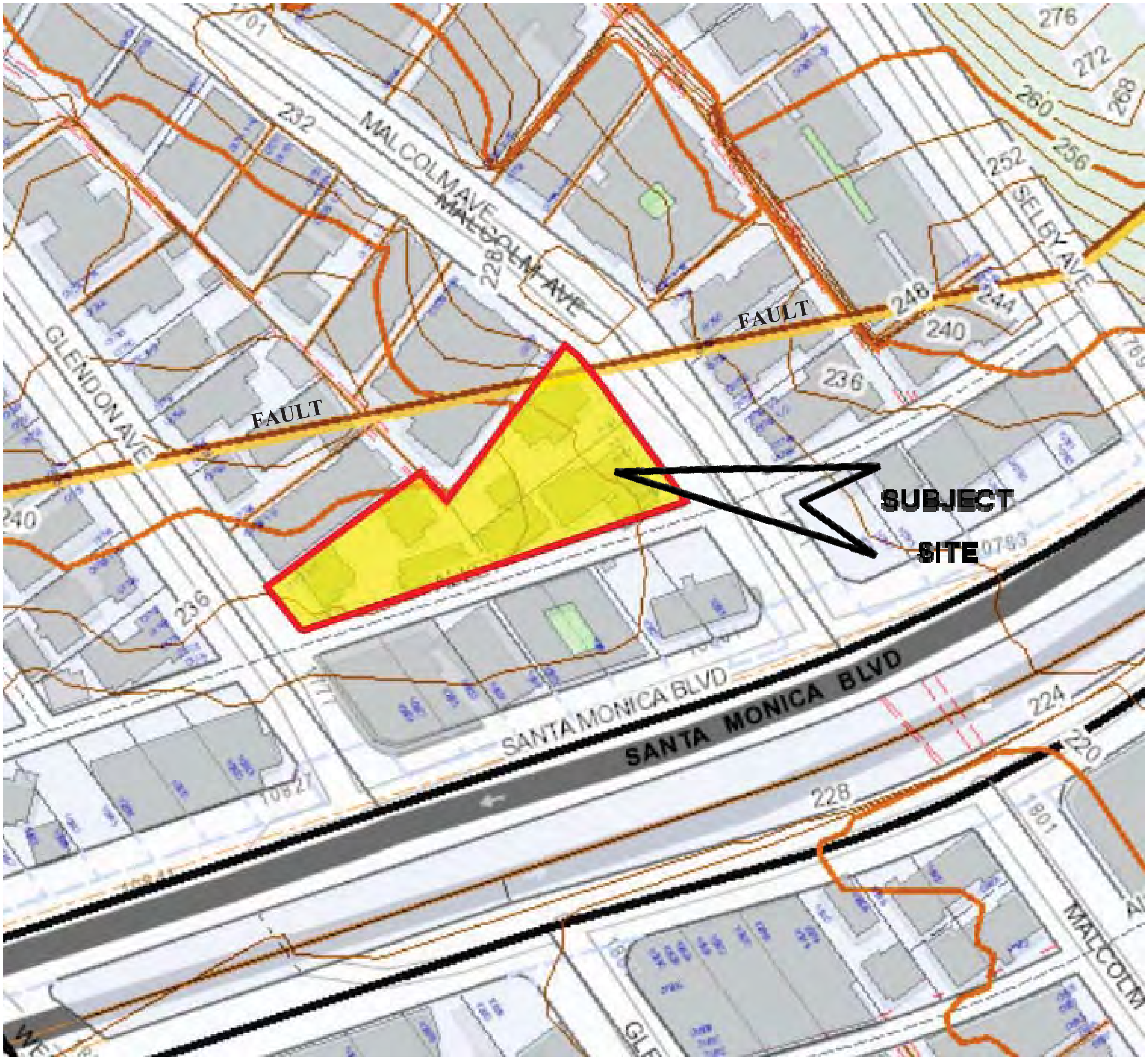
U:\VINCE\2015\-M-\1730 MALCOLM AVENUE-FAULT STUDY\DRAWING 4 TO 6-GEOTECHNICAL SITE PLAN & SECTIONS B-B' & C-C'.dwg, 7/22/2015 11:22:39 AM

Reference: Portion of Google Maps

SITE VICINITY MAP

Proposed Multifamily Residential Building Projectƙ	1749 & 1751 Malcolm Ave. & 1772 Glendon Ave., Los Angeles, CA 90024

FOR	ATE	PROJECT No.
Sinanian Development, Inc.	4+ƙƙ5ƙ11ƙ5ƙ*ƙ4	*/6787618ƙ
APPLIED EARTH SCIENCES GEOTECHNICAL . GEOLOGY . ENVIRONMENTAL ENGINEERING CONSULTANTS		FIGURE No. *ƙ



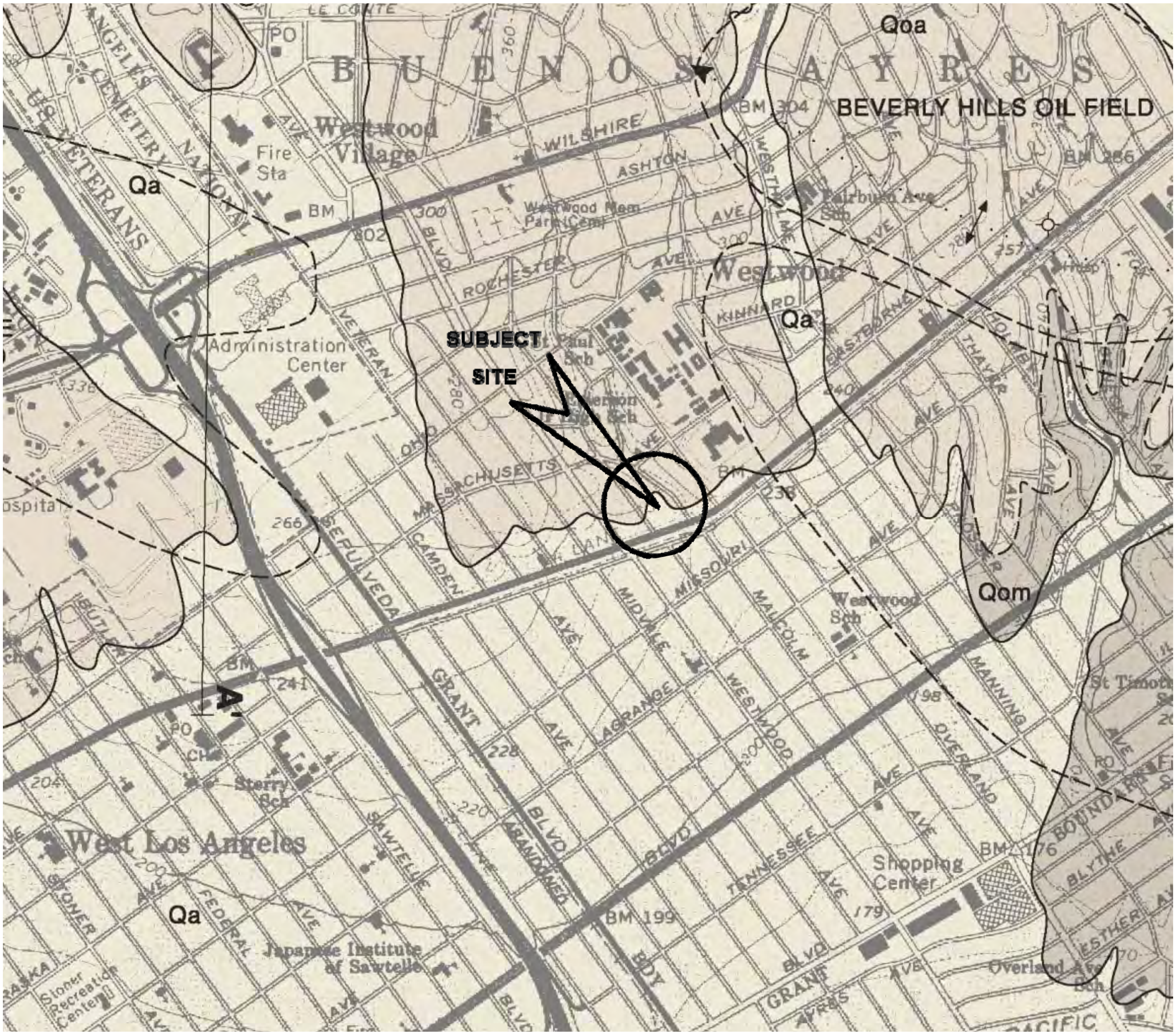
N

Scale 1” = 100’
Reference: Navigate LA Los Angeles Cityķ

REGIONALķTOPOGRAPHIC MAP

Proposed Multifamily Residential Building Projectķ	1749 & 1751 Malcolm Ave. & 1772 Glendon Ave., Los Angeles, CA 90024

FOR Sinanian Development, Inc.	ATE 4+ķķ5ķ11ķ5ķ*14	PROJECT No. */6787618ķ
APPLIED EARTH SCIENCES GEOTECHNICAL . GEOLOGY . ENVIRONMENTAL ENGINEERING CONSULTANTS		FIGURE No. 1ķ



Qa *Alluvial gravel, sand and silt-clay, derived mostly from Santa Monica Mountains; includes gravel and sand of stream channels*

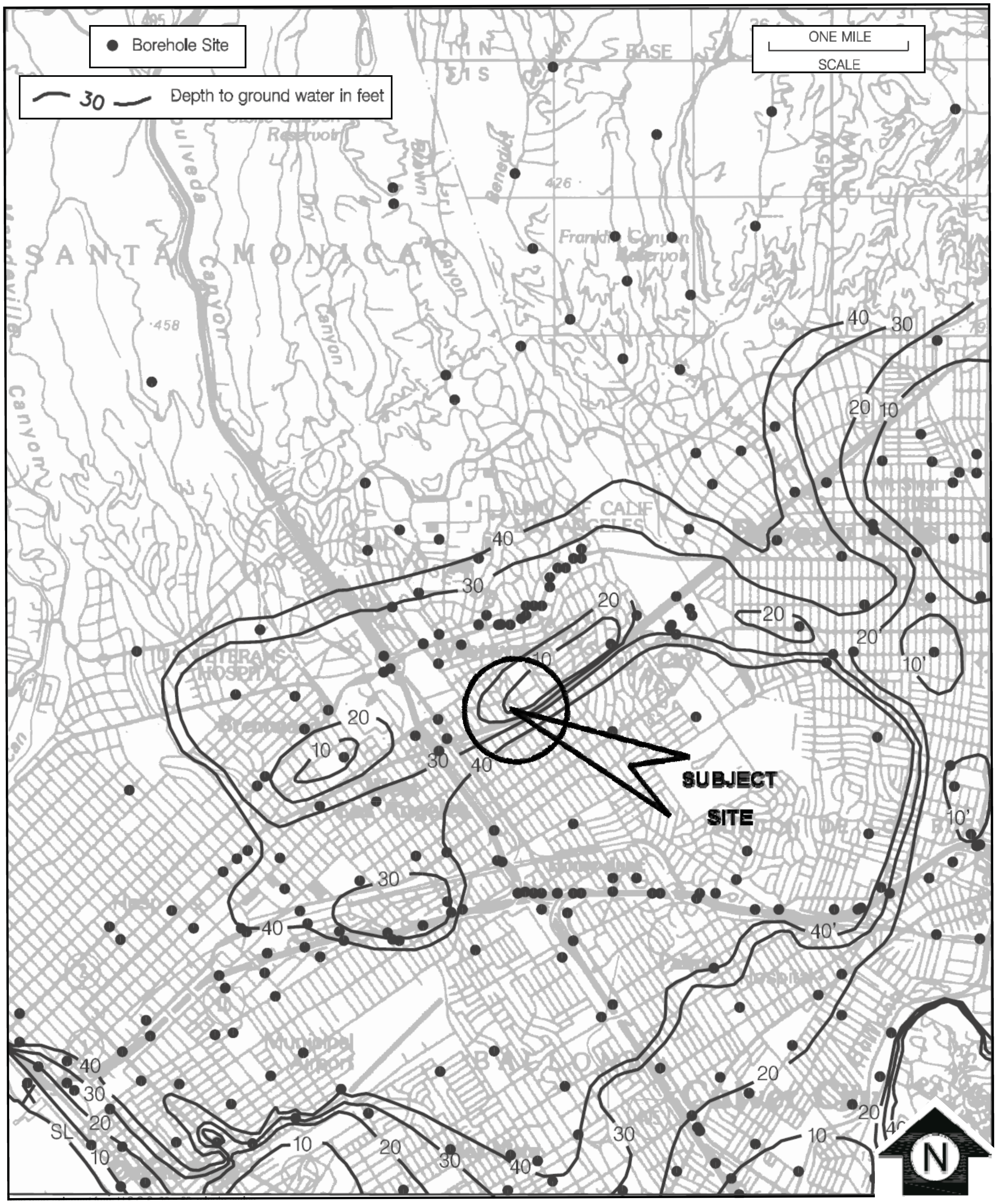
1 | 1/2 | 0 | 1 MILE

1000 | 0 | 1000 | 2000 | 3000 | 4000 | 5000 | 6000 | 7000 FEET

Reference: Dibblee Geologic Map of the Beverly Hills 7.5 Minute Quadrangle

REGIONAL GEOLOGIC MAP

Proposed Multifamily Residential Building Projectǩ	1749 & 1751 Malcolm Ave. & 1772 Glendon Ave., Los Angeles, CA 90024
FOR Sinanian Development, Inc.	ATE 4+ǩǩ5ǩ11ǩ5ǩ*1ǩ4
PROJECT No. */6787618ǩ	
APPLIED EARTH SCIENCES GEOTECHNICAL . GEOLOGY . ENVIRONMENTAL ENGINEERING CONSULTANTS	FIGURE No. 7ǩ

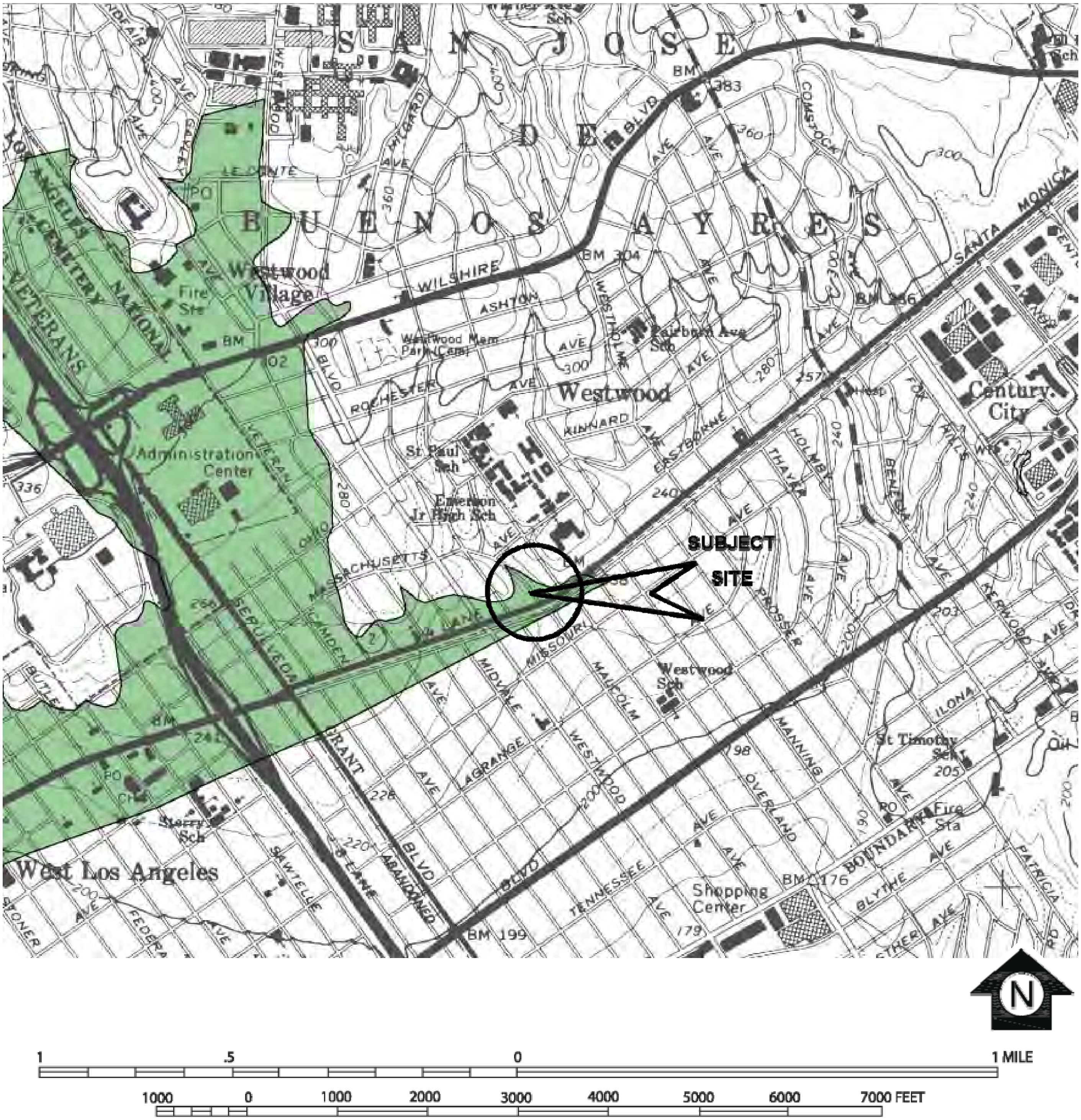


Reference: Beverly Hills 7.5 Minute Quadrangle

HISTORICALLY HIGHEST GROUNDWATER (Contour Map)

Proposed Multifamily Residential Building Projectǩ	1749 & 1751 Malcolm Ave. & 1772 Glendon Ave., Los Angeles, CA 90024

FOR Sinanian Development, Inc.	ATE 4+ǩǩ5ǩ11ǩ5ǩ*1ǩ4	PROJECT No. */6787618ǩ
APPLIED EARTH SCIENCES GEOTECHNICAL . GEOLOGY . ENVIRONMENTAL ENGINEERING CONSULTANTS		FIGURE No. ,ǩ



Reference: Portion of Seismic Hazard Zone Map of The Beverly Hills Quadranglek

SEISMIC HAZARD ZONES MAP

Proposed Multifamily Residential Building Projectk

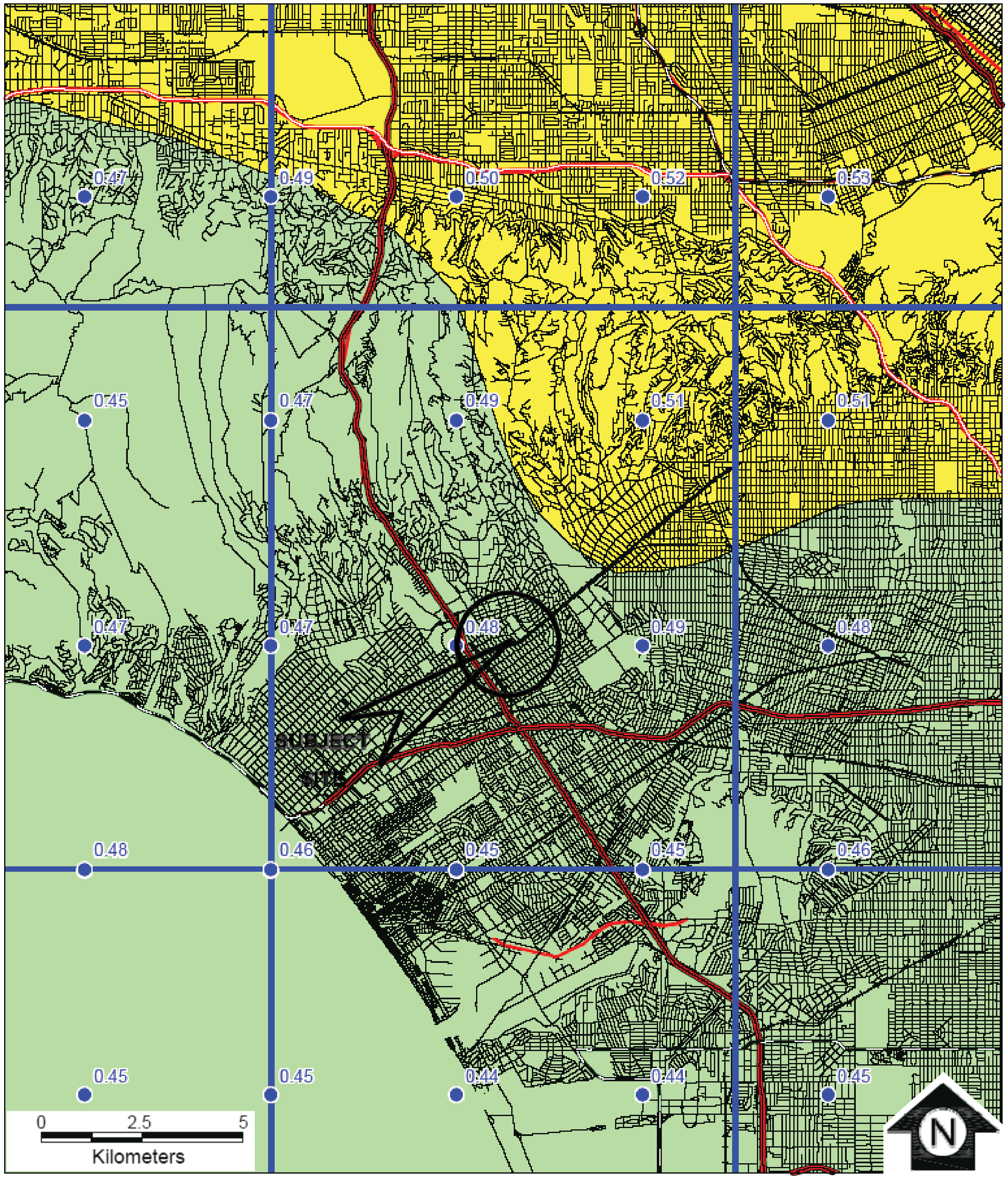
1749 & 1751 Malcolm Ave. & 1772 Glendon Ave., Los Angeles, CA 90024

FOR	ATE	PROJECT No.
Sinanian Development, Inc.	4+kk5k11k5k*14	*/6787618k

APPLIED EARTH SCIENCES
GEOTECHNICAL . GEOLOGY . ENVIRONMENTAL ENGINEERING CONSULTANTS

FIGURE No. /k

ALLUVIUM CONDITIONS

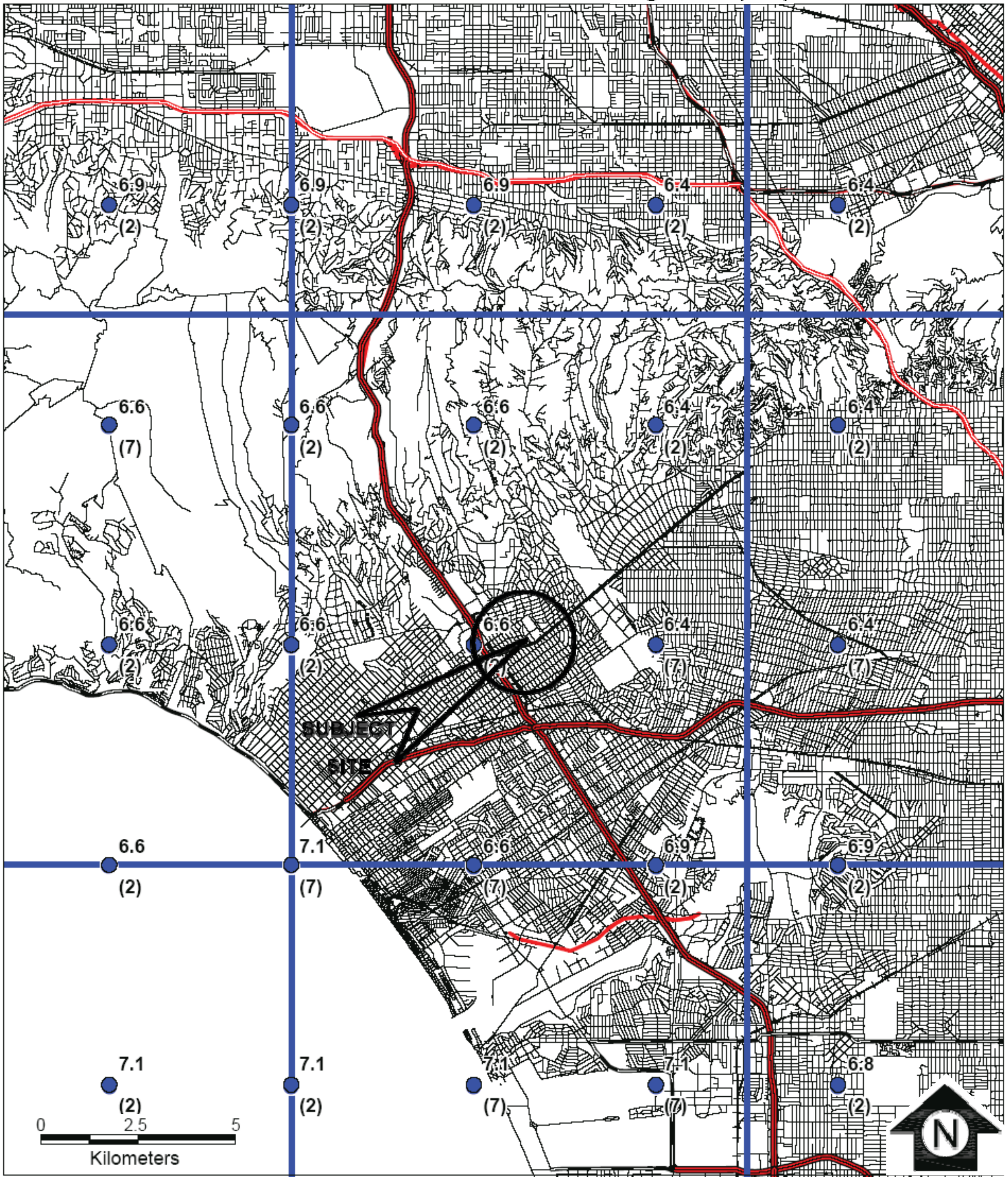


Reference: Beverly Hills 7.5 Minute Quadrangle

SEISMIC HAZARD MAP (Alluvium Conditions)

Proposed Multifamily Residential Building Projectќ	1749 & 1751 Malcolm Ave. & 1772 Glendon Ave., Los Angeles, CA 90024	
FOR Sinanian Development, Inc.	ATE 4+ќќ5ќ11ќ5ќ*ќ4	PROJECT No. */6787618ќ
APPLIED EARTH SCIENCES GEOTECHNICAL . GEOLOGY . ENVIRONMENTAL ENGINEERING CONSULTANTS		FIGURE No. 8ќ

PREDOMINANT EARTHQUAKE Magnitude (Mw)



Reference: Beverly Hills 7.5 Minute Quadrangle

SEISMIC HAZARD MAP (Predominant Earthquake)

Proposed Multifamily Residential Building Projectƙ	1749 & 1751 Malcolm Ave. & 1772 Glendon Ave., Los Angeles, CA 90024

FOR Sinanian Development, Inc.	ATE 4+ƙƙ5ƙ11ƙ5ƙ*14	PROJECT No. */6787618ƙ
APPLIED EARTH SCIENCES GEOTECHNICAL . GEOLOGY . ENVIRONMENTAL ENGINEERING CONSULTANTS		FIGURE No. +ƙ

APPENDIX I

METHOD OF FIELD EXPLORATION

In order to define subsurface conditions, a total of twenty borings were advanced on and offsite. Three of the sixteen borings were advanced using a CME 75 hollow stem drilling rig specially fitted to obtain continuous core samples to a maximum depth of 80 feet. Thirteen of the borings are cone penetrometer soundings advanced using a 30-ton CPT rig to a maximum depth of 80 feet. Finally, four geotechnical borings were advanced with a conventional CME 75 hollow stem auger rig to obtain geotechnical samples for testing. The approximate locations of all of the drilled borings and CPT soundings are shown in the enclosed Geologic Map and Fault Study Plan – Drawing No. 2; geotechnical borings only are shown on the Geotechnical Site Plan – Drawing No. 4.

With the hollow-stem drilling, relatively undisturbed continuous and discrete samples of the subsoils were obtained using a split-tube sampler, to a maximum depth of 80 feet. Some of the samples expanded up to 10 percent of the drilled depth.

Logs of the subsurface materials, as encountered in the borings, were recorded in the field and are presented in Figure Nos. I-1.1 through I-7 within Appendix I.

A brief report prepared by Kehoe Testing and Engineering describing the cone penetrometer testing is also included in this Appendix I and attached to following the boring logs.

Field investigation for this project was conducted from April 21 through May 12, 2015 for the fault study and June 15, 2015 for the geotechnical study. The material excavated from the borings was placed back and tamped/compacted upon completion of the field work. Such material may settle. The owner should periodically inspect these areas and notify this office if the settlement creates a hazard to persons or property.

BORING No. 1

DATE EXCAVATED: 4/23/15. Hole Diameter: 8”. Ground Elevation: ~227’. **LOGGED BY: S, Minas, EG**

DEPTH IN FEET	ELEVATION.		CORE RECOVERY	BOX NO.	MATERIAL TYPE	MATERIAL SYMBOL	MATERIAL DESCRIPTION
							Earth Cover. Upper 5’ Hand Auger for Utilities
			0		SM		**Fill:** Af 0-3’, mixture of sand (SM) and silt, scattered debris, firm, moist, medium brown, topsoil
		7.5YR			SM		**Recent Alluvium (Qa)** @3’ Native soil, silty sand, firm, fine-grained, trace clayey, little to no gravel.
5	222	3/3		1			
					GC-GM		@6’ clayey to silty gravel, sandy, 6” horizon,
		7.5YR	80		SM		@6.5’ grades back to silty fine to very fine sand, scattered fine gravel
		4/2					
		10YR			SM-CL		@9’ grades to more clayey
10	217	4/3			SM		@10’ very fine to fine sand, silty,
							Older Alluvial and Fluvial Deposits (Qof)
		7.5YR	90		SM-ML		And interfingered **Older Estuarine Deposits (Qoe)**
		4/3					Change to fine sand/silt mixture, slightly clayey, trace gravel Brown to yellowish brown, uniform, homogeneous,
15	212			2			
							@16’ buff-colored horizon, grades to siltier, tight, moist
			90				
					GM		@18’ grades to more gravelly, subangular gravel to 3/4”
		7.5YR			ML		6” layer. Back to Silt at 18.5’, brown, sandy
20	207	5/4			SM		@20’ silty sand, grades to less silt, relatively clean sand
		10YR			SM-SP		Light yellowish brown, fine to medium-grained sand
		6/4	98		SM-ML		@22’ grades to siltier, tight, stiff, slightly clayey, brown
							@23’ grades to sand, fine-grained, silty, no gravel
25	202			3	SM		@26’ softer zone, continued sand
		10YR					@27’3” grades to silty, yellowish brown
		5/4	89		ML		
					SM		Sand-silt mixture from 22’ thru 34’
30	197	7.5YR			ML-SC		@31’ stiff, fine sand, silt and clay mixture
		6/8					
		7.5YR			SM		@33’ silty fine sand with scattered slate gravel, subangular up
		5/4	80				to 1.5”, moist.

LOG OF BORING

JOB NAME: Fault Study, 1749-51 Malcolm Avenue, LA. JOB No. 15-363-26

APPLIED EARTH SCIENCES
GEOTECHNICAL ENGINEERING CONSULTANTS

FIGURE NO : I-1.1

BORING No. 1 cont'd

DATE EXCAVATED: 4/23/15. Hole Diameter: 8". Ground Elevation: ~227'. **LOGGED BY: S, Minas, EG**

DEPTH IN FEET	ELEVATION.		CORE RECOVERY	BOX NO.	MATERIAL TYPE	MATERIAL SYMBOL	MATERIAL DESCRIPTION
		7.5YR			ML-SC		@31' stiff, fine-sand, silt and clay mixture
		6/8	80				
		7.5YR			SM		@33' silty fine sand with scattered slate gravel up to 1.5", moist
		5/4			GM		
35	192			4	SM		NR from 34' to 35' Driller: change to dense gravel Abrupt change to gravel, silty, mixed gray, brown
		7.5YR			SP-SM		Grades to sand **Older Fluvial Deposits (Qof)**
		6/3	83		GM		Relatively clean, little silt, scattered gravel
					GM-SM		Prominent gravel marker layer, gravel and coarse sand, slightly silty,
		10YR			GM		
40	187	5/3					
					GM-SM		Interbedded sand and gravel, dense to very dense, slightly silty, trace clayey. NR from 39'2" to 40'
			80		SM/ML		
		10YR			GM-SM		Gravel/sand mixture continued to 41' @41'3" grades to sand, siltier at 42', very moist, slightly clayey,
		5/4			ML-CL		Interbdd silt, gravel-sand sequence. @44' soft,
45	182			5	GM		silt-clay Soft horizon lost during sampling (driller)
					GM-SM		@45' 9" conspicuous gravel lens, blackish blue, 1.5" thick
		7.5YR	99		SP-GP		@46' sand, silty, orange brown, fine to medium grained
		6/6					@47'3" Orange to reddish yellow, illuviated zone, sand-gravel, little to no silt. Oxidized sand-gravel
					SM-SP		@48'6" change to bluish gray silty sand, very moist,
50	177				CL-ML		@49' grayish blue SP sand, medium-grained, fining downward sequence.
					CL-SM		Change to clay-silt @50'. Scattered gravel, interbdd sand
		7.5YR	98		GM-ML		horizons,
		3/2			ML		Grades to gravelly at 52'. Good recovery of core sample.
		7.5YR					@52'2" grades to silt, clean, tight, dense, sandy, slightly clayey, scattered fine gravel.
55	172	4/4		6	SM-SP		
					SM		@55' sand, scattered gravel, Grades to siltier,
		7.5YR	98				
		4/4			SP-GP		
					SM-SP		Sharp change to clean sand and gravel, little to no fines. Another fining downward sequence.
60	167				ML-CL		
					ML		Grades to silty sandy clay at bottom of sample.
			99				Stiff silt, brown to grayish brown, very moist. Good recovery

LOG OF BORING

JOB NAME: Fault Study, 1749-51 Malcolm Ave. JOB No. 15-363-26

APPLIED EARTH SCIENCES
GEOTECHNICAL ENGINEERING CONSULTANTS

FIGURE NO : I-1.2

BORING No. 1 cont'd

DATE EXCAVATED: 4/23/15. Hole Diameter: 8". Ground Elevation: ~227'. **LOGGED BY: S, Minas, EG**

DEPTH IN FEET	ELEVATION.		CORE RECOVERY	BOX NO.	MATERIAL TYPE	MATERIAL DESCRIPTION
		7.5YR			ML	Stiff silt, brown to grayish brown, very moist. Good recovery
		5/4	99			
					ML-SM	This five foot section is fairly uniform, ML-SM sandy silt to silty fine sand, slightly clayey, scattered gravel from 63' - 64'9"
					SM	
65	162			7		@65'9" grades to more silty, brown with blackish grey.
					SM-ML	
			100		SM	Silty, very fine to fine sand,
					GM	Gravelly horizon @ 68'3", 2" thick
					SM	Back to silty sand, moist to very moist, brown,
70	157	10YR			GM-ML	2" gravel band in sandy silt material.
		5/3			SM-SP	@70' sand, slightly silty to relatively clean sand, medium grained, scattered slate gravel. Grades to silty fine sand, very moist, slightly clayey
		7.5YR	99		SM-ML	
		5/4			CL	Grades to clay, silty and sandy, very moist, tight, grey to greyish brown
					SC-SM	
75	152			8	CL	@75' sandy clay, very moist
					SM-GM	
		10YR	98		SM-ML	@76'3" change to silty sand, grades to silty gravel @ 76'8"
						@77'2" grades to sandy silt
		5/3			CL	Interbedded clay layers in 10' thick silt-sand horizon
					SM-ML	
80	147					
						End of Boring at 80'. No Caving. No standing groundwater detected during drilling.

LOG OF BORING

JOB NAME: Fault Study, 1749-51 Malcolm Ave. JOB No. 15-363-26

APPLIED EARTH SCIENCES
GEOTECHNICAL ENGINEERING CONSULTANTS

FIGURE NO : I-1.3

BORING No. 2

DATE EXCAVATED: 4/23/15. Hole Diameter: 8”. Ground Elevation: ~227’. **LOGGED BY: S, Minas, EG**

DEPTH IN FEET	ELEVATION.		CORE RECOVERY	BOX NO.	MATERIAL TYPE	MATERIAL DESCRIPTION
						Earth Cover. Upper 5’ Hand Auger for Utilities
			0		SM	**Fill:** Af 0-3’, mixture of sand (SM) and silt, scattered debris, firm, moist, medium brown, topsoil
					SM	**Recent Alluvium (Qa)** @3’ Native soil, silty sand, firm, fine-grained, trace clayey, little to no gravel.
5	222			1		
					SM	Medium brown silty sand,
		7.5YR 5/3	80		CL-ML	Change to silty clay, blackish brown to light greyish brown
		7.5YR 3/2				Dark brown silty sand
10	217				SM	**Older Alluvial and Fluvial Deposits (Qof)**
					ML	**And interbedded Older Estuarine Deposits (Qoe)**
						Change to fine sand/silt mixture, slightly clayey, trace gravel
			90			Brown to yellowish brown, uniform, homogeneous,
					CL-ML	
					ML-SM	Grades to orange brown @14’
						NR from 14’6” to 15’
15	212			2	SM	
						Grades to silty medium sand, orange brown, scattered gravel.
		7.5YR 7/8	98		SM-SP	Slightly less silty, relatively clean medium sand, slightly moist, medium dense, slightly gravelly. Good recovery
20	207				ML-SM	Sandy silt to silty fine to very fine sand horizon, relatively homogeneous, slightly clayey,
		7.5YR 7/8	98			Reddish brown, scattered fine gravel, trace clay.
25	202			3	SM	Very fine sand, silty, slightly oxidized, orange @25’ coarsening downward sequence.
			89			Slightly less silt, grades to clean sand, with some silt, fining upward.
		7.5YR 7/6				@29’ gravelly
					SM-SP	
30	197				SP-GP	
					ML	@31’ NR below 31’ 3”. Driller says material very soft, likely a clayey silt
			25			

LOG OF BORING

JOB NAME: Fault Study, 1749-51 Malcolm Avenue, LA. JOB No. 15-363-26

APPLIED EARTH SCIENCES
GEOTECHNICAL ENGINEERING CONSULTANTS

FIGURE NO : I-2.1

BORING No. 2 cont'd

DATE EXCAVATED: 4/23/15. Hole Diameter: 8". Ground Elevation: ~227'. **LOGGED BY: S, Minas, EG**

DEPTH IN FEET	ELEVATION.		CORE RECOVERY	BOX NO.	MATERIAL TYPE	MATERIAL SYMBOL	MATERIAL DESCRIPTION
					ML		From 31'3" to 35 no recovery, driller says "soft stuff"
							Likely a silt and clay mixture
			25				
35	192			4	ML-SM		@35' silt, soft to slightly firm, moist to very moist, sandy, scattered fine gravel.
					SM		@35'5" grades to SM
			83				**Older Fluvial Deposits (Qof)** @37' SM-ML fining downward, sequence, orange silt-sand
		10YR			GM		
		6/8			SM-GM		Gravel at 38'3" sandy silty gravel,
40	187				SP-SM		
							Grades to orange oxidized clean sand @39'6". Marker bed.
					SM		Abrupt change to silty fine sand layer, very moist to wet, soft,
		10YR	98		ML-CL		
		5/1					Change to silty clay @ 43' stiff, grey
							Grades to clayey silty sand @44'8"
45	182	5YR		5	SM-SC		Sand silt mixture with some clay, very mosit to wet, stiff
		4/4					Grades to sandier @47'2"
			100		SM		Scattered gravel
		10YR					Yellowish brown. Grades to sandy clayey silt with some gravel, mostly medium brown throughout.
		5/4			ML		
50	177				SM		Sand @50'4", coarsening downward scattered gravel.
		7.5YR					Grades to silty clay, stiff, very moist, grey-brown, slightly sandy to sandy, clay-silt mixture. Little to no gravel.
		6/6	98		ML-CL		
		5YR					Grades to sandy, reddish brown
55	172	4/3		6	ML-SM		3" gravel lens, subangular,
					GM		Change to sandy clayey silt,
			98		SM-ML		@57'10" conspicuous oxidized sand lens, orange, 3" thick
					SP		Uniform silt and fine sand mixture.
					ML-SM		
60	167	7.5YR			SM		Sandier
							Gravelly @61'
		6/6			SM-GM		Grades to silty, fine to medium sand, slightly clayey, medium brown
			99		SM-ML		

LOG OF BORING

JOB NAME: Fault Study, 1749-51 Malcolm Ave. JOB No. 15-363-26

APPLIED EARTH SCIENCES
GEOTECHNICAL ENGINEERING CONSULTANTS

FIGURE NO : I-2.2

BORING No. 2 cont'd

DATE EXCAVATED: 4/23/15. Hole Diameter: 8". Ground Elevation: ~227'. **LOGGED BY: S, Minas, EG**

DEPTH IN FEET	ELEVATION.		CORE RECOVERY	BOX NO.	MATERIAL TYPE	MATERIAL SYMBOL	MATERIAL DESCRIPTION
		10YR	99		SM-ML		Silty fine sand to sandy silt, scattered fine gravel, medium brown
		5/4					
					ML-CL		Interlayered silty sand and silty sandy clay horizons
65	162			7	ML-SM		
					CL		Grades to clay, wet, stiff,
			100		SM-SC		Clayey silty sand,
					CL-ML		Grades to more clayey @68'+
		10YR					Clay, sandy, stiff, olive brown,
70	157	6/4			SC-CL		
					ML		Clayey sandy silt from 71' - 73'
			99		SM		
		10YR					@73' grades to sandy, silty with scattered gravel, orange brown to brown.
		6/4					Clean sand lens, no silt, greyish brown, scattered fine gravel
75	152			8	SP		
					CL-SC		Grades to clayey sand, to sandy clay
		7.5YR	98		SP		Alternating sandy clay and clean sand horizons. Greyish orange clean sand.
		7/1			GP-GM		Gravel lens,
					SP-SM		Change to fine sand, slightly silty to silty, rust color
80	147						
							End of Boring at 80'. No Caving. No standing groundwater detected during drilling.

LOG OF BORING

JOB NAME: Fault Study, 1749-51 Malcolm Ave. JOB No. 15-363-26

APPLIED EARTH SCIENCES
GEOTECHNICAL ENGINEERING CONSULTANTS

FIGURE NO : I-2.3

BORING No. 3

DATE EXCAVATED: 4/23/15. Hole Diameter: 8”. Ground Elevation: ~227’. **LOGGED BY: S, Minas, EG**

DEPTH IN FEET	ELEVATION.		CORE RECOVERY	BOX NO.	MATERIAL TYPE	MATERIAL SYMBOL	MATERIAL DESCRIPTION
							Earth Cover. Upper 5’ Hand Auger for Utilities
			0				**Fill:** Af 0-3’, mixture of sand (SM) and silt, scattered debris, firm, moist, blackish brown, topsoil
					SM		**Recent Alluvium (Qa)** @3’ Native soil, silt sand mixture, blackish brown to medium brown,
5	222			1			
		10YR			ML-SM		
		3/2	30				Poor recovery, sandy silt to silty sand, clayey, moist, tight.
							Older Alluvial and Fluvial Deposits (Qof)
							And Interbedded **Older Estuarine Deposits (Qoe)**
10	217				SC-CL		Blackish brown with slightly reddish tinge, clayey silty sand from 10’ to 10’8”
			100		CL		Grades to sandy silty clay, very moist, stiff, slightly organic, slightly gravelly, buff-colored fine gravel.
		2.5Y					
		3/1					Mostly uniform clay from 10’8” to 15’ depth, dark grey
15	212			2			
					ML		Change to sandy clayey silt, medium brown, with grey tint, slightly soft @15’ - 15’8” to increased sand content, very moist. Reddish brown at 17’
		5YR	98		ML-SM		
		5/3					
		10YR			ML-SC		Grades to stiff at 19’, brownish yellow
							Slightly clayey to clayey at 19’6”
20	207	6/6			SM		@20’ silty, fine to medium sand, mottled colors.
					ML		Grades to silt, sandy, firm to stiff
			98		ML-CL		Grades to more clayey @21’5”,
							Grades to more sandy,
					SC-SM		Reddish brown, slightly more silty
							Older Estuarine Deposits (Qoe)
							Sandy clay to clayey silty sand with scattered gravel,
25	202	7.5YR		3	CL-SC		brown to orange reddish tint, orange oxidized sandy lens
		4/2			SP		@25’10”
			97		SM		Grades to very moist, soft to firm,
					SC-CL		Clayey gravel horizon, 2” thick,
					GC-CL		Subrounded fine gravel in clay-sand matrix
30	197	7.5YR			GC-GM		Silty sandy gravel @30’, grades to coarser grained,
		4/4			GM-SM		Gravel horizon starting from 29’ to 33’, with various fines amounts
			95		GM		Alternating silty gravel and sandy silt horizons

LOG OF BORING

JOB NAME: Fault Study, 1749-51 Malcolm Avenue, LA. JOB No. 15-363-26

APPLIED EARTH SCIENCES
GEOTECHNICAL ENGINEERING CONSULTANTS

FIGURE NO : I-3.1

BORING No. 3 cont'd

DATE EXCAVATED: 4/23/15. Hole Diameter: 8". Ground Elevation: ~227'. **LOGGED BY: S, Minas, EG**

DEPTH IN FEET	ELEVATION.		CORE RECOVERY	BOX NO.	MATERIAL TYPE	MATERIAL SYMBOL	MATERIAL DESCRIPTION
					GM		
			25		GM-ML		Alternating silty gravel and sandy silt horizons
					CL-SC		Change to clay at 34', blackish clayey sand
35	192	7.5YR		4	GM		Gravel horizon @ 35'4" change to orange sand with scattered gravel.
		6/8			SM-SP		36'9" change to gray SP clean sand,
		5Y	98		ML		Change to silt @37'4", olive to gray
		5/2			SP-SM		Coarsening downward sequence, grades to silty sand and clean sand
		10Y			GM-ML		Gravel-silt and sand mixture. Greenish grey
40	187	3/2			CL-SC		Grades to clayey, change to silt-clay with fine sand.
					SM-SC		Dark grey silt-clay-sand mixture from 40' to 41'5"
		10YR	95		SP		Light orange sand lens @43'5" lamination 1cm to 2cm
		4/4			GM		Gravel zone @ 43'8", followed by light buff-colored sand lens at 43'10"
45	182			5	ML-SM		Change to dark grey silt-sand mixture,
					SM		Grades to bluish gray, fine to very fine sand, Very silty, scattered fine gravel, medium sand
			94		ML		Change to silt,
		5Y			GM-SM		Gravel and sand lens @47'2" to 47'7"
		4/2			ML		Back to sandy gravelly silt, olive grey
50	177				ML-SM		50' - 54' fine sand and silt mixture, trace clay, little to no gravel, very moist, dense, stiff, medium to dark grey
		2.5Y					
		4/3	95		SM		
							Fluvial Deposits (Qof)
					SM-ML		@54' grades to silty gravelly sand, orange brown to grey
55	172			6	GM		Blackish brown coarse gravel horizon in sand silt matrix
					ML-SM		@55'6" change to sand-silt, brown, orange red tinge,
		7.5YR	96		SM		@57' sand, fine-grained, scattered gravel. @57'10" 2cm light tan, sand-gravel lens
		4/3			SM-GM		@58'8" grades to more gravel, slate fragments, orange brown, with dark grey slate, moist dense.
					GM		
60	167				GM-SM		Coarse sand and gravel in fine to medium silty sand matrx to about 60'8"
			99		ML-SM		Grades to silt-sand, fine-grained, scattered gravel

LOG OF BORING

JOB NAME: Fault Study, 1749-51 Malcolm Ave. JOB No. 15-363-26

APPLIED EARTH SCIENCES
GEOTECHNICAL ENGINEERING CONSULTANTS

FIGURE NO : I-3.2

BORING No. 3 cont'd

DATE EXCAVATED: 4/23/15. Hole Diameter: 8". Ground Elevation: ~227'. **LOGGED BY: S, Minas, EG**

DEPTH IN FEET	ELEVATION.		CORE RECOVERY	BOX NO.	MATERIAL TYPE	MATERIAL SYMBOL	MATERIAL DESCRIPTION
					ML-SM		Grades to silt-sand, slightly clayey, @ 60'9"
			99		SM-ML		Blackish grey sand lens at 61'1"
							Mixed sand, silt and scattered gravel, interlayered coarser and finer layers alternate.
					SM		
65	162	7.5YR 4/3		7	ML-SM		Alternating silt and sand, general same color and hue.
			100		CL		Mixed clayey and silty sand horizons, Clay at 67'3" and 67'9"
					SM-CL		wet.
							Gravel at 69'6"
70	157				GM		Relatively clean medium grained sand, slightly silty, @71' grades to silty sand
					SM-SP		
			99		SM		Grades to increased clay, sandy silt
					SC-ML		
		10YR			CL		Clay @ 74' 3" grades to SM-ML,
75	152	6/6		8	SM		coarsens to Sand @75', brown
					SP-SM		
			95		ML		Alternating fine-grained horizons of sand, silty sand, sandy silt, sandy silty clay, and clayey sandy silt form 71' to end of boring @ 80'
					CL		
					SM-SP		
80	147				SP/ML		

End of Boring at 80'. No Caving. Groundwater standing in borehole at 47'. Hole Grouted, Drill cuttings hauled offsite.

LOG OF BORING

JOB NAME: Fault Study, 1749-51 Malcolm Ave. JOB No. 15-363-26

APPLIED EARTH SCIENCES
GEOTECHNICAL ENGINEERING CONSULTANTS

FIGURE NO : I-3.3

Applied Earth Sciences

LOG OF BORING NO.4

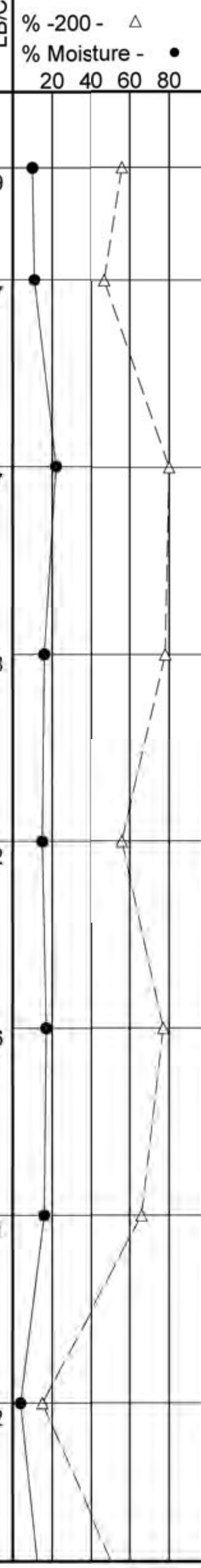
15-363-02

1749-1751 Malcolm Ave, Los Angeles, CA, 90024

Type: Hollow Stem Auger with 140 lb Hammer   Logged by: Marshall

Location: Front Left of 1751 Malcolm Ave

DEPTH, FT	DESCRIPTION OF MATERIAL	SPT BLOWS/FT	BLOWS PER FT	% Moisture	UNIT DRY WT LB/CU FT	% -200
0	(ML) FILL: Silt, moderately compact, slightly moist, dark brown, sandy silt.					
	(ML) SILT: Stiff, slightly moist, dark brown, sandy silt.		36	10	119	56
5	(SM/ML) SAND: Dense, slightly moist to moist, brown, silty sand and sandy silt mixture.		40	11	117	47
10	(CL) CLAY: Firm, moist, brown, silty clay.	18		22	107	80
15	(ML) SILT: Stiff, moist, brown, clayey silt.	32		16	118	78
20	(ML) Grades to firm, sandy, clayey silt.	23		15	112	56
25	(ML) Grades to stiff.	28		17	116	77
30	(CL) CLAY: Stiff, moist, brown, silty clay.	28		16	111	66
35	(SM) SAND: Very dense, slightly moist, brown, silty, fine to medium grained sand, with gravel.	57		4	122	15



COMPLETION DEPTH: 51   DEPTH TO WATER> INITIAL:

DATE: June 15, 2015   FINAL:

LOG OF BORING NO.4

Applied Earth Sciences

15-363-02

1749-1751 Malcolm Ave, Los Angeles, CA, 90024

Type: Hollow Stem Auger with 140 lb Hammer Logged by: Marshall

Location: Front Left of 1751 Malcolm Ave

DEPTH, FT	DESCRIPTION OF MATERIAL	SPT BLOWS/FT	BLOWS PER FT	% Moisture	UNIT DRY WT LB/CU FT	% -200
40	(ML) SILT: Very Stiff, moist, brown, sandy, clayey silt, gravelly.	48		14	119	57
45	(ML) Grades to very moist, sandy silt, some clay.	40		22	111	59
50	(CL) CLAY: Very stiff, very moist, dark brown, silty clay.	83		17	115	71

END @ 51'
NO WATER
NO CAVING
PERCOLATION INSTALLED

Depth scale: 40, 45, 50, 55, 60, 65, 70, 75

Chart legend: % -200 - △ ; % Moisture - ● ; scale 20 40 60 80

COMPLETION DEPTH: 51
DATE: June 15, 2015

DEPTH TO WATER> INITIAL:
FINAL:

Applied Earth Sciences

LOG OF BORING NO.5

15-363-02
1749-1751 Malcolm Ave, Los Angeles, CA, 90024

Type: Hollow Stem Auger with 140 lb Hammer   Logged by: Marshall
Location: Front Left of 1749 Malcolm Ave

DEPTH, FT	DESCRIPTION OF MATERIAL	SPT BLOWS/FT	BLOWS PER FT	% Moisture	UNIT DRY WT LB/CU FT
0	(ML) Fill: Silt, moderately compact, slightly moist, dark brown, sandy silt.				
	(ML) SILT: Stiff, slightly moist, brown, sandy silt.		40	9	108
5	(SM) SAND: Dense, moist, brown, gravelly, silty, fine to coarse grained sand.		36	13	109
10	(ML) SILT: Very stiff, slightly moist, dark brown, sandy silt, some gravel.		45	8	104
15	(CL) CLAY: Very stiff, moist, dark brown, sandy, silty clay.		46	11	120
20	(CL) Grades to brown/grayish brown, some gravel.		30	15	117
25	(CL/SC) Grades to gravelly, silty, sandy clay.		38	13	120
30					
35					

% -200 - △
% Moisture - ●
20 40 60 80

END @ 26'
NO WATER
NO CAVING
METHANE WELL INSTALLED

COMPLETION DEPTH: 26
DATE: June 15, 2015

DEPTH TO WATER> INITIAL:
FINAL:

LOG OF BORING NO.6

Applied Earth Sciences

15-363-02
1749-1751 Malcolm Ave, Los Angeles, CA, 90024

Type: Hollow Stem Auger with 140 lb Hammer   Logged by: Marshall
Location: Rear Left of Property Adjacent to Alley

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SPT BLOWS/FT	BLOWS PER FT	% Moisture	UNIT DRY WT LB/CU FT	% -200 - △ % Moisture - • 20 40 60 80	% -200
0			(ML) Fill: Silt, moderately compact, slightly moist, dark brown, sandy silt.						
			(ML) SILT: Very stiff, moist, brown to dark brown, gravelly, sandy, clayey silt.		48	13	120		
5			(ML) Grades to more sandy.		52	15	119		
10			(SM) SAND: Very dense, moist, brown, silty, fine grained sand.		56	10	124		
15			(ML) SILT: Very stiff, moist, brown, clayey, sandy silt.		50	19	108		
20			(SM) SAND: Very dense, moist, brown, silty, fine grained sand.		68	12	111		
25			(SM) Grades to slightly moist to moist.		48	9	123		
30			(SM) Grades to moist.		70	12	120		
35			END @ 31' NO WATER NO CAVING METHANE WELL INSTALLED						

COMPLETION DEPTH: 31   DEPTH TO WATER> INITIAL:
DATE: June 15, 2015   FINAL:

LOG OF BORING NO.7

Applied Earth Sciences

15-363-02
1749-1751 Malcolm Ave, Los Angeles, CA, 90024

Type: Hand Auger with 50 lb Hammer   Logged by: Marshall
Location: Front Left of Property

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SPT BLOWS/FT	BLOWS PER FT	% Moisture	UNIT DRY WT LB/CU FT	% -200 - △ % Moisture - ● 20 40 60 80	% -200
0			(ML) Fill: Silt, moderately compact, slightly moist, dark brown, sandy silt.						
			(ML) SILT: Stiff, slightly moist, brown, sandy silt.		25	9	105		
5			(ML) Grades to very stiff, moist, gravelly, sandy, clayey silt.		46	13	117		
10			(SM) SAND: Very dense, moist, brown, gravelly, silty, fine to coarse grained sand.		55	10	107		
15			(ML) SILT: Stiff, very moist, brown, sandy silt.		23	25	98		
20			END @ 16' NO WATER NO CAVING HOLE BACKFILLED						
25									
30									
35									

COMPLETION DEPTH: 16
DATE: June 15, 2015

DEPTH TO WATER> INITIAL:
FINAL:

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAME
COARSE GRAINED SOILS (More than 50% of material is LARGER than No. 200 sieve size)	GRAVELS (More than 50% of coarse fraction is LARGER than the No. 4 sieve size)	CLEAN GRAVELS (Little or no fines)	GW	Well graded gravels, gravel - sand mixtures, little or no fines.
			GP	Poorly graded gravels or gravel-sand mixtures, little or no fines.
		GRAVELS WITH FINES (Appreciable amt. of fines)	GM	Silty gravels, gravel-sand-silt mixtures.
			GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (More than 50% of coarse fraction is SMALLER than the No. 4 sieve size)	CLEAN SANDS (Little or no fines)	SW	Well graded sands, gravelly sands, little or no fines.
			SP	Poorly graded sands or gravelly sands, little or no fines.
		SANDS WITH FINES (Appreciable amt. of fines)	SM	Silty sands, sand-silt mixtures.
			SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS (More than 50% of material is SMALLER than No. 200 sieve size)	SILTS AND CLAYS (Liquid limit LESS than 50)		ML	Organic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
			CL	Organic clay of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty clays of low plasticity.
	SILTS AND CLAYS (Liquid limit GREATER than 50)		MH	Organic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH	Organic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS			Pt	Peat and other highly organic soils.

BOUNDARY CLASSIFICATIONS: Soils possessing characteristics of two groups are designated by combinations of group symbols.

PARTICLE SIZE LIMITS

SILT OR CLAY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

NO. 200 NO. 40 NO. 10 NO. 4 $\frac{3}{4}$ in. 3 in. (12 in.)

U. S. STANDARD SIEVE SIZE

UNIFIED SOIL CLASSIFICATION SYSTEM

JOB NAME :	Proposed Multifamily Residential Building Project 1749 & 1751 Malcolm Avenue & 1772 Glendon Avenue Los Angeles, CA 90024	JOB No.	15-363-02
Applied Earth Sciences	GEOTECHNICAL . GEOLOGY . ENVIRONMENTAL ENGINEERING CONSULTANTS www.aessoil.com (818) 552-6000	FIGURE No.	I-8

U:\VINCE\2015\-M-\1730 MALCOLM AVENUE-FAULT STUDY\DRAWING 4 TO 6-GEOTECHNICAL SITE PLAN & SECTIONS B-B' & C-C'.dwg, 7/22/2015 10:58:54 AM

SUMMARY

OF

CONE PENETRATION TEST DATA

Project:

1749 & 1751 Malcolm Avenue
Los Angeles, CA
April 21 & May 12, 2015

Prepared for:

Mr. Shant Minas
Applied Earth Sciences
4742 San Fernando Road
Glendale, CA 91204
Office (818) 552-6000 / Fax (818) 552-6007

Prepared by:

KTE

KEHOE TESTING & ENGINEERING
5415 Industrial Drive
Huntington Beach, CA 92649-1518
Office (714) 901-7270 / Fax (714) 901-7289
www.kehoetesting.com

TABLE OF CONTENTS

SUMMARY
OF
CONE PENETRATION TEST DATA

1. INTRODUCTION

This report presents the results of a Cone Penetration Test (CPT) program carried out for the project located at 1749 & 1751 Malcolm Avenue in Los Angeles, California. The work was performed by Kehoe Testing & Engineering (KTE) on April 21 & May 12, 2015. The scope of work was performed as directed by Applied Earth Sciences personnel.

2. SUMMARY OF FIELD WORK

The fieldwork consisted of performing CPT soundings at 13 locations to determine the soil lithology. Groundwater measurements and hole collapse depths provided in **TABLE 2.1** are for information only. The readings indicate the apparent depth to which the hole is open and the apparent water level (if encountered) in the CPT probe hole at the time of measurement upon completion of the CPT. KTE does not warranty the accuracy of the measurements and the reported water levels may not represent the true or stabilized groundwater levels.

LOCATION	DEPTH OF CPT (ft)	COMMENTS/NOTES:
CPT-1	70	Refusal, groundwater @ 40 ft
CPT-2	80	Groundwater @ 40 ft
CPT-3	80	Groundwater @ 39 ft
CPT-4	76	Refusal, groundwater @ 40 ft
CPT-5	80	Hole open to 80 ft (dry)
CPT-6	80	Groundwater @ 40 ft
CPT-7	71	Refusal, groundwater @ 40 ft
CPT-8	80	Groundwater @ 34 ft
CPT-9	79	Groundwater @ 33 ft
CPT-10	80	Hole open to 10 ft (dry)

LOCATION	DEPTH OF CPT (ft)	COMMENTS/NOTES:
CPT-11	80	Hole open to 8 ft (dry)
CPT-12	71	Refusal, hole open to 29 ft (dry)
CPT-13	80	No cave depth taken

TABLE 2.1 - Summary of CPT Soundings

3. FIELD EQUIPMENT & PROCEDURES

The CPT soundings were carried out by **KTE** using an integrated electronic cone system manufactured by Vertek. The CPT soundings were performed in accordance with ASTM standards (D5778). The cone penetrometers were pushed using a 30-ton CPT rig. The cone used during the program was a 15 cm^2 cone and recorded the following parameters at approximately 2.5 cm depth intervals:

- Cone Resistance (qc)
- Sleeve Friction (fs)
- Dynamic Pore Pressure (u)
- Inclination
- Penetration Speed

At locations CPT-2 & CPT-7, shear wave measurements were obtained at various depths. The shear wave is generated using an air-actuated hammer, which is located inside the front jack of the CPT rig. The cone has a triaxial geophone, which recorded the shear wave signal generated by the air hammer.

The above parameters were recorded and viewed in real time using a laptop computer. Data is stored at the KTE office for future analysis and reference. A complete set of baseline readings was taken prior to each sounding to determine temperature shifts and any zero load offsets. Monitoring base line readings ensures that the cone electronics are operating properly.

4. CONE PENETRATION TEST DATA & INTERPRETATION

The Cone Penetration Test data is presented in graphical form in the attached Appendix. These plots were generated using the CPeT-IT program. Penetration depths are referenced to ground surface. The soil classification on the CPT plots is derived from the attached CPT Classification Chart (Robertson) and presents major soil lithologic changes. The stratigraphic interpretation is based on relationships between cone resistance (qc), sleeve friction (fs), and penetration pore pressure (u). The friction ratio (Rf), which is sleeve friction divided by cone resistance, is a calculated parameter that is used along with cone resistance to infer soil behavior type. Generally, cohesive soils (clays) have high friction ratios, low cone resistance and generate excess pore water pressures. Cohesionless soils (sands) have lower friction ratios, high cone bearing and generate little (or negative) excess pore water pressures.

Tables of basic CPT output from the interpretation program CPeT-IT are provided for CPT data averaged over one foot intervals in the Appendix. Spreadsheet files of the averaged basic CPT output and averaged estimated geotechnical parameters are also included for use in further geotechnical analysis. We recommend a geotechnical engineer review the assumed input parameters and the calculated output from the CPeT-IT program. A summary of the equations used for the tabulated parameters is provided in the Appendix.

It should be noted that it is not always possible to clearly identify a soil type based on qc, fs and u. In these situations, experience, judgement and an assessment of the pore pressure data should be used to infer the soil behavior type.

If you have any questions regarding this information, please do not hesitate to call our office at (714) 901-7270.

Sincerely,

KEHOE TESTING & ENGINEERING

Richard W. Koester, Jr.
General Manager

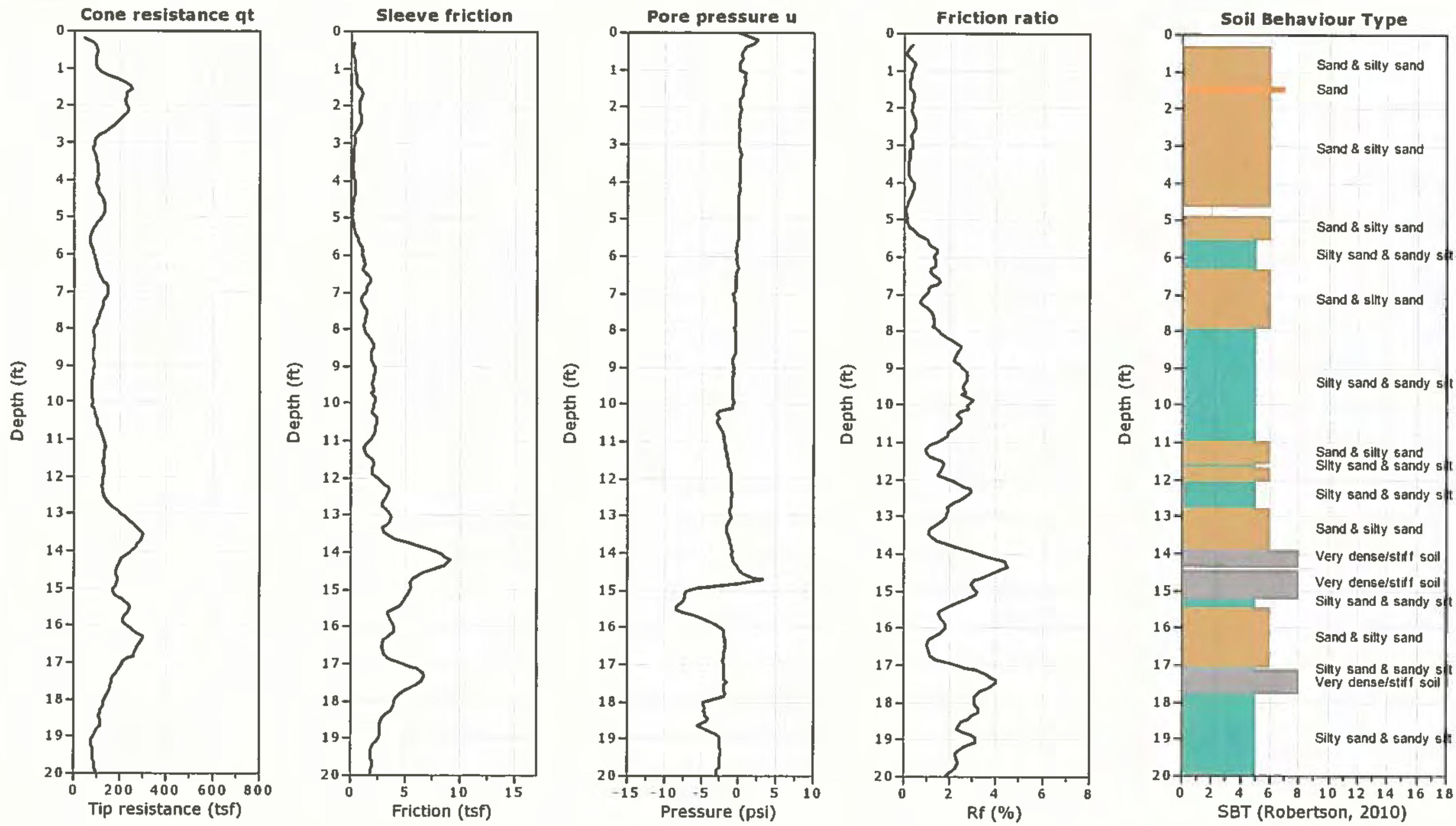
05/22/15-kk-5869

APPENDIX

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-1
Total depth: 69.67 ft, Date: 4/21/2015
Cone Type: Vertek



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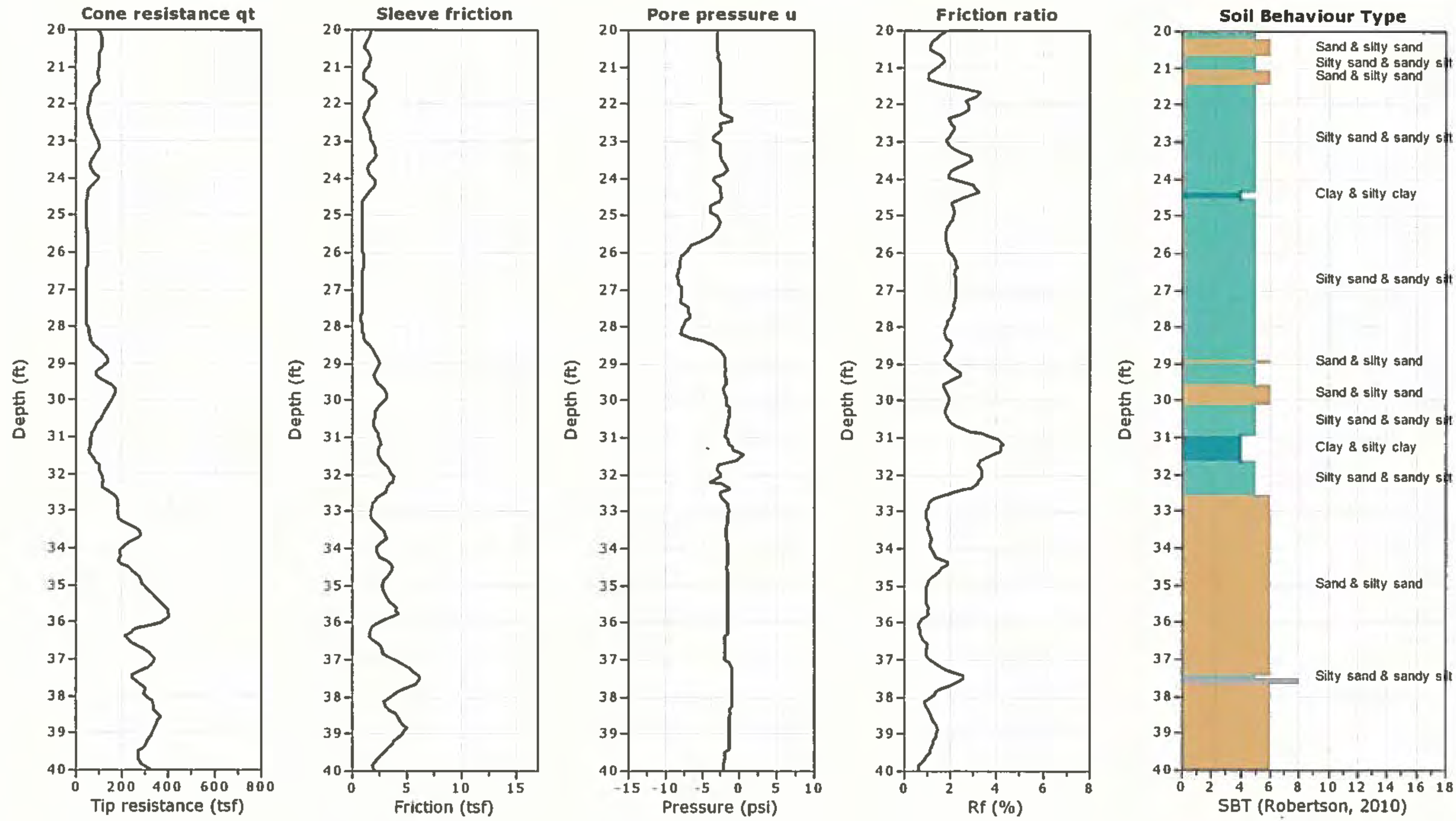
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-1
Total depth: 69.67 ft, Date: 4/21/2015
Cone Type: Vertek



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Project: Applied Earth Sciences
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CPT: CPT-1
Total depth: 69.67 ft, Date: 4/21/2015
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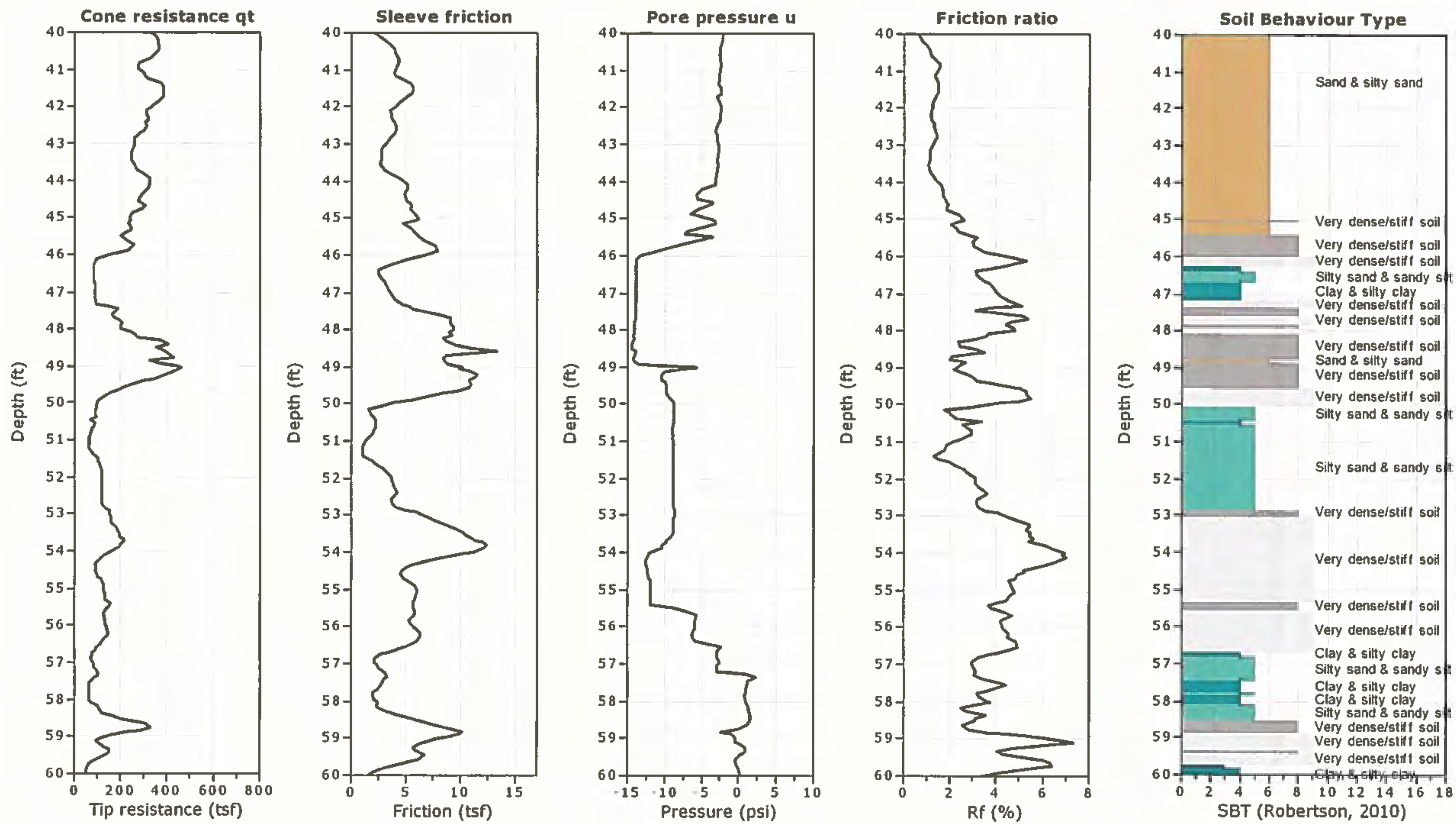

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Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

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Total depth: 69.67 ft, Date: 4/21/2015
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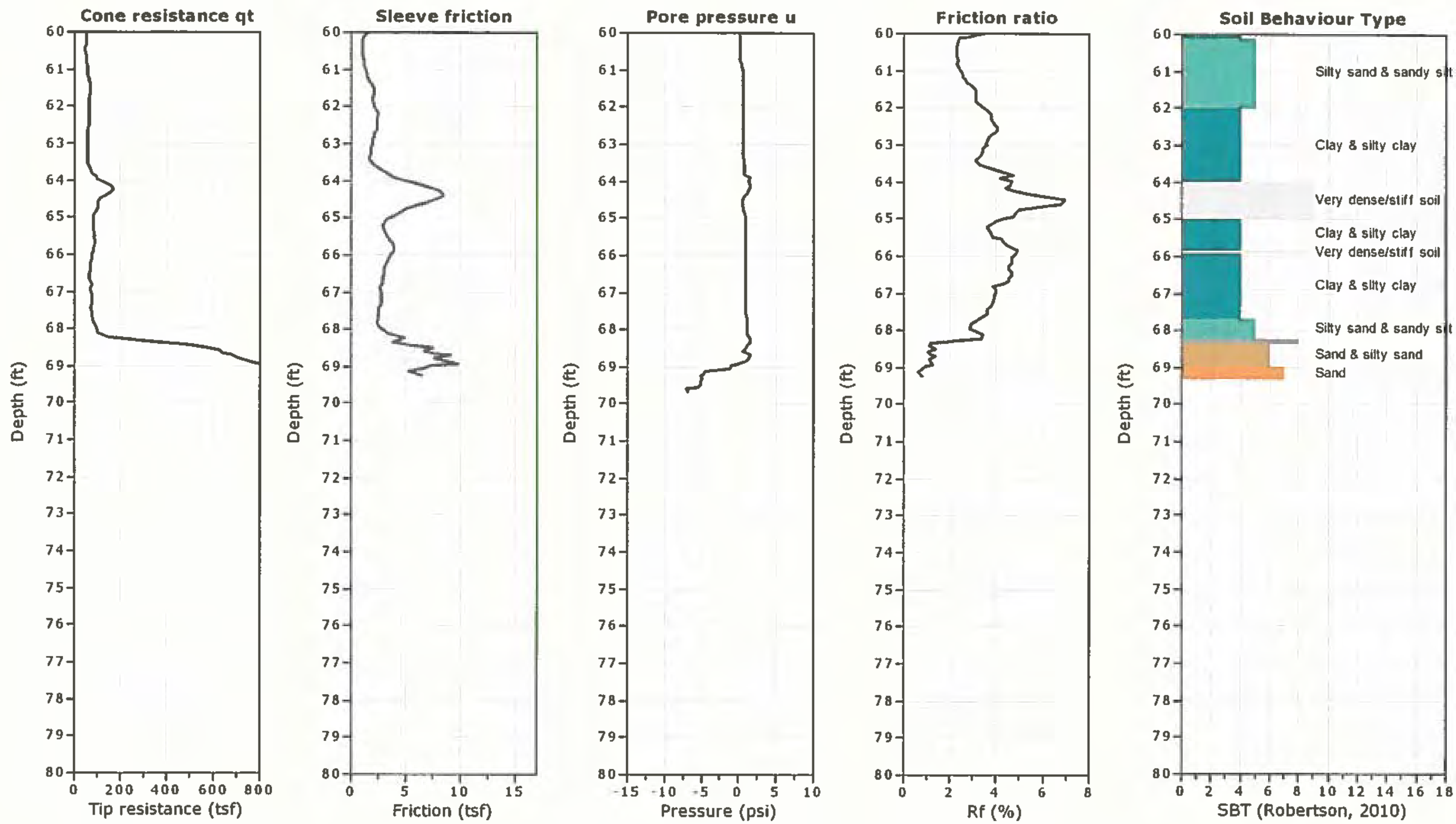

CPeT-IT v.1.7.6.42 - CPTU data presentation & interpretation software - Report created on: 5/15/2015, 8:01:58 AM
Project file: C:\AppliedLosAngeles4-5-15\CPeT Data\Plot Data\Plots w-ha.cpt

Kehoe Testing and Engineering
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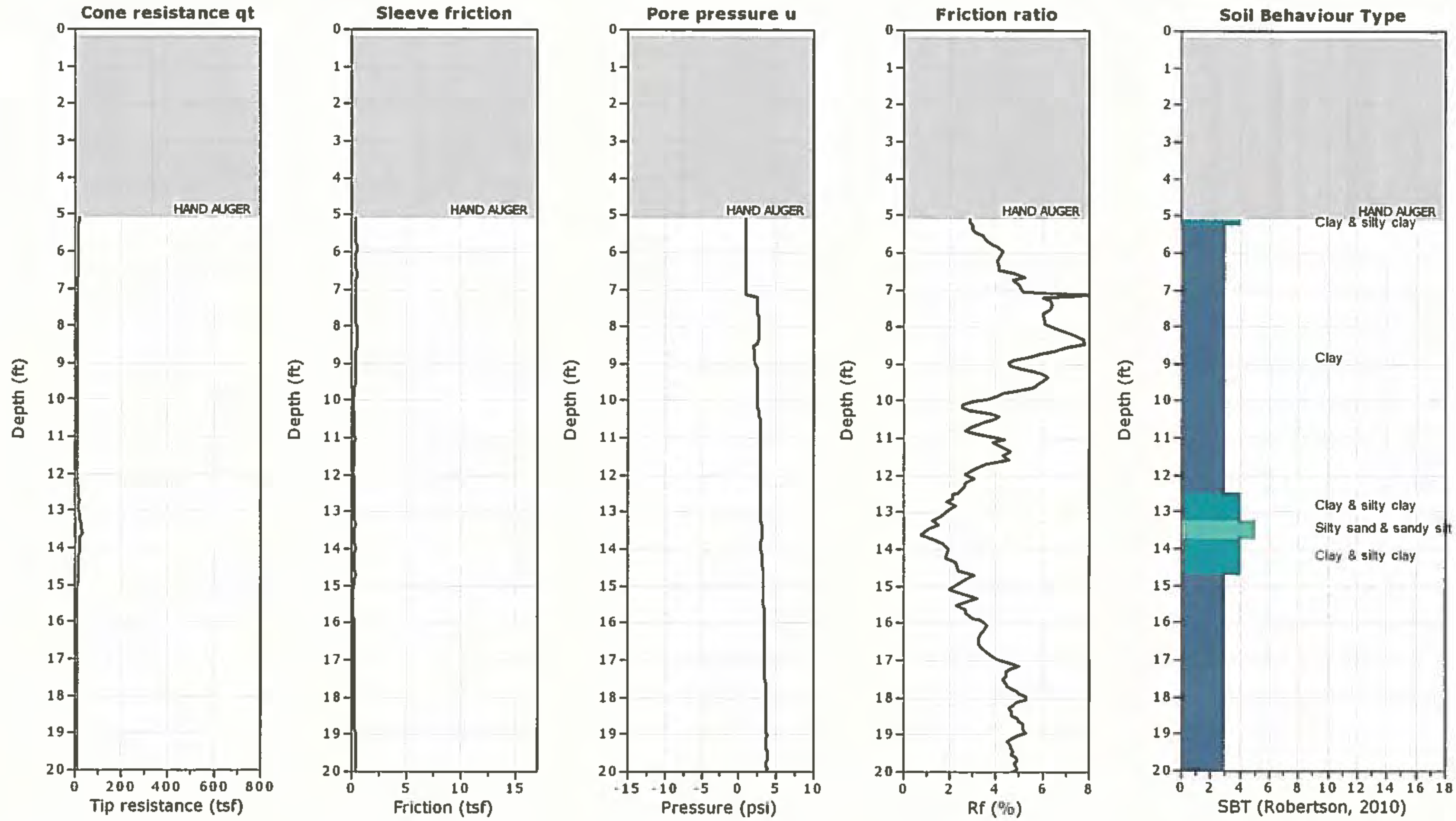
rich@kehoetesting.com
www.kehoetesting.com

Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-2
Total depth: 80.57 ft, Date: 4/21/2015
Cone Type: Vertek



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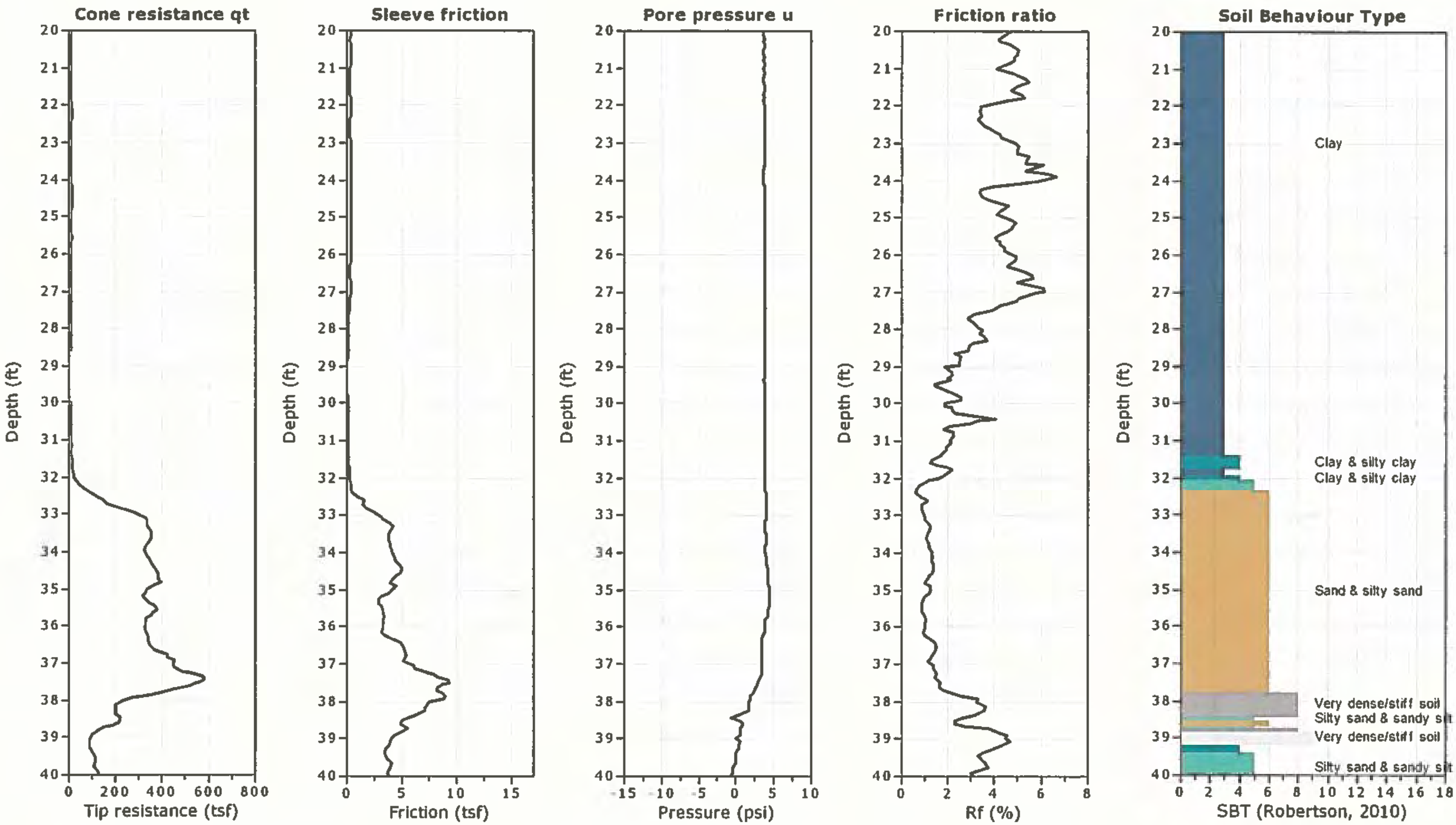
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-2
Total depth: 80.57 ft, Date: 4/21/2015
Cone Type: Vertek



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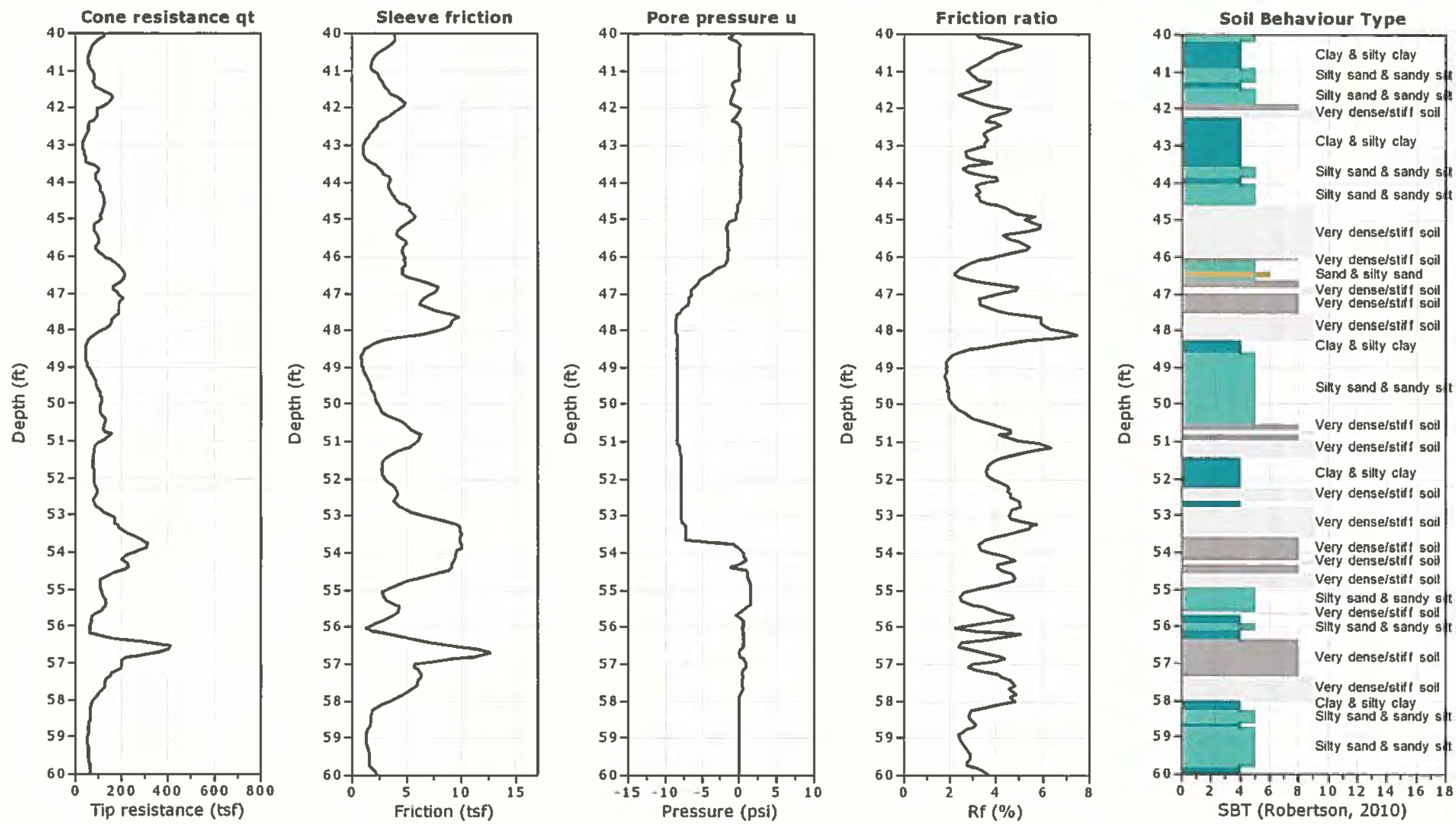
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-2
Total depth: 80.57 ft, Date: 4/21/2015
Cone Type: Vertek



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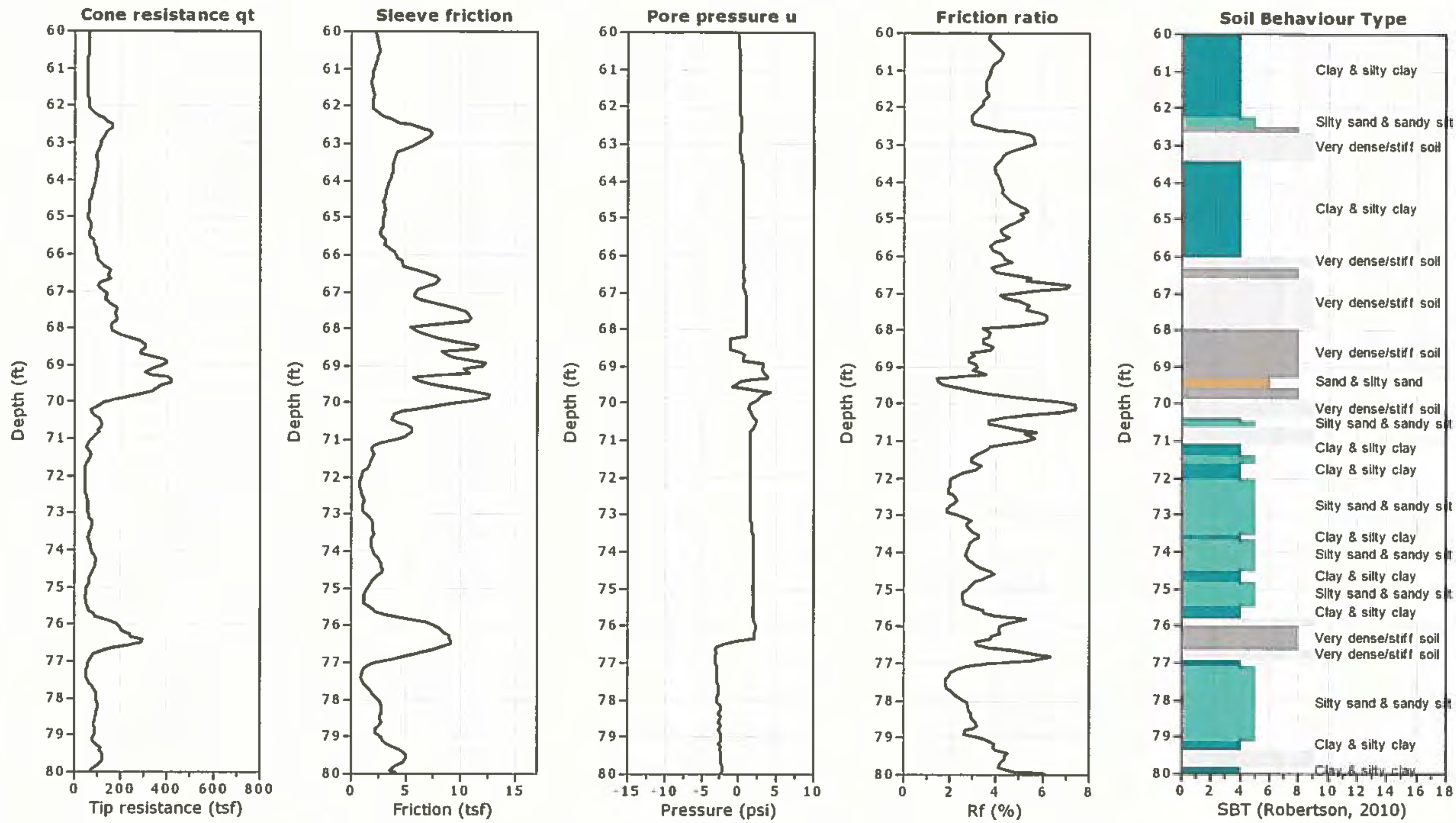
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-2
Total depth: 80.57 ft, Date: 4/21/2015
Cone Type: Vertek



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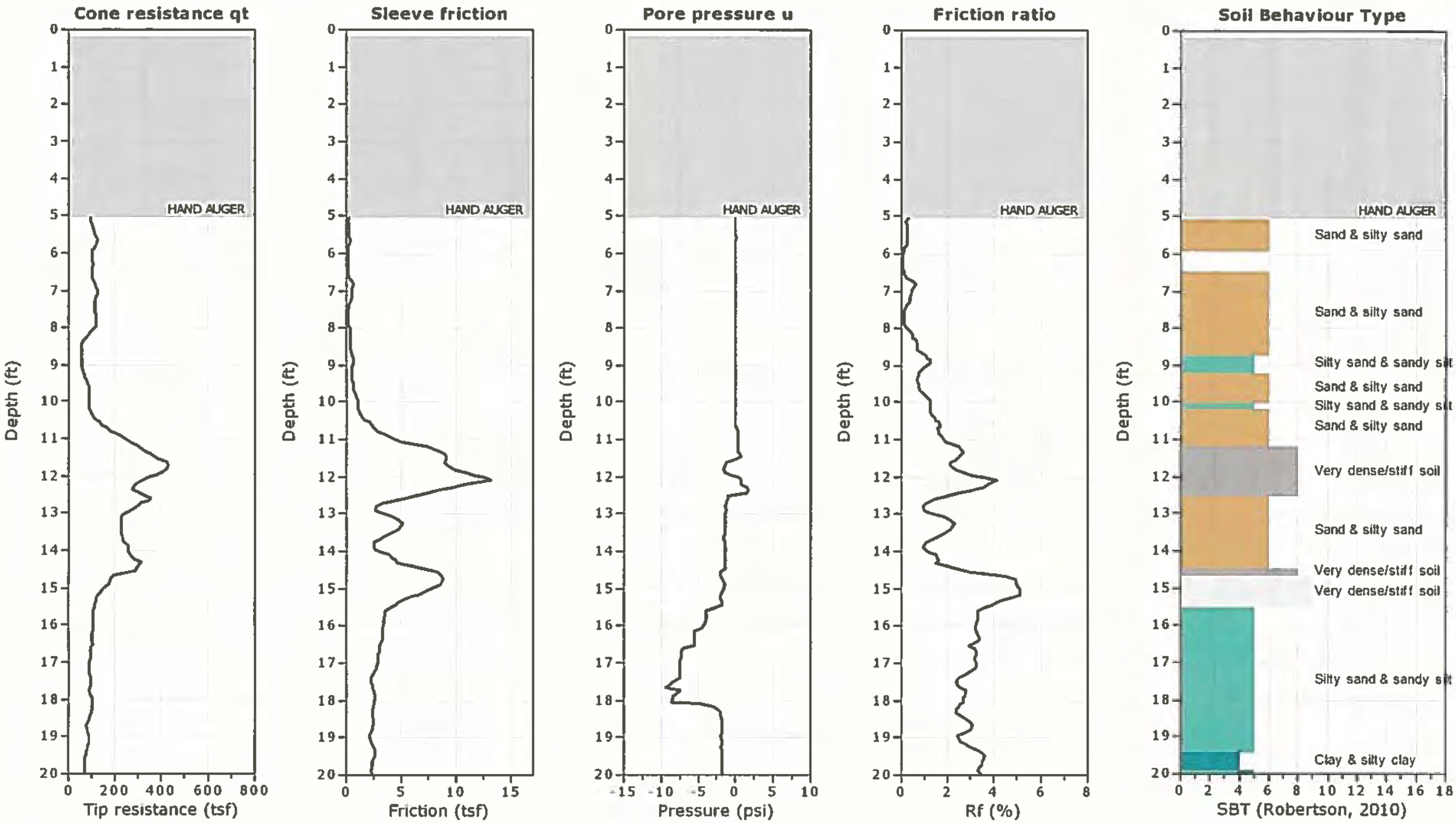
rich@kehoetesting.com
www.kehoetesting.com

Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-3
Total depth: 80.49 ft, Date: 4/21/2015
Cone Type: Vertek



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714-901-7270
rich@kehoetesting.com
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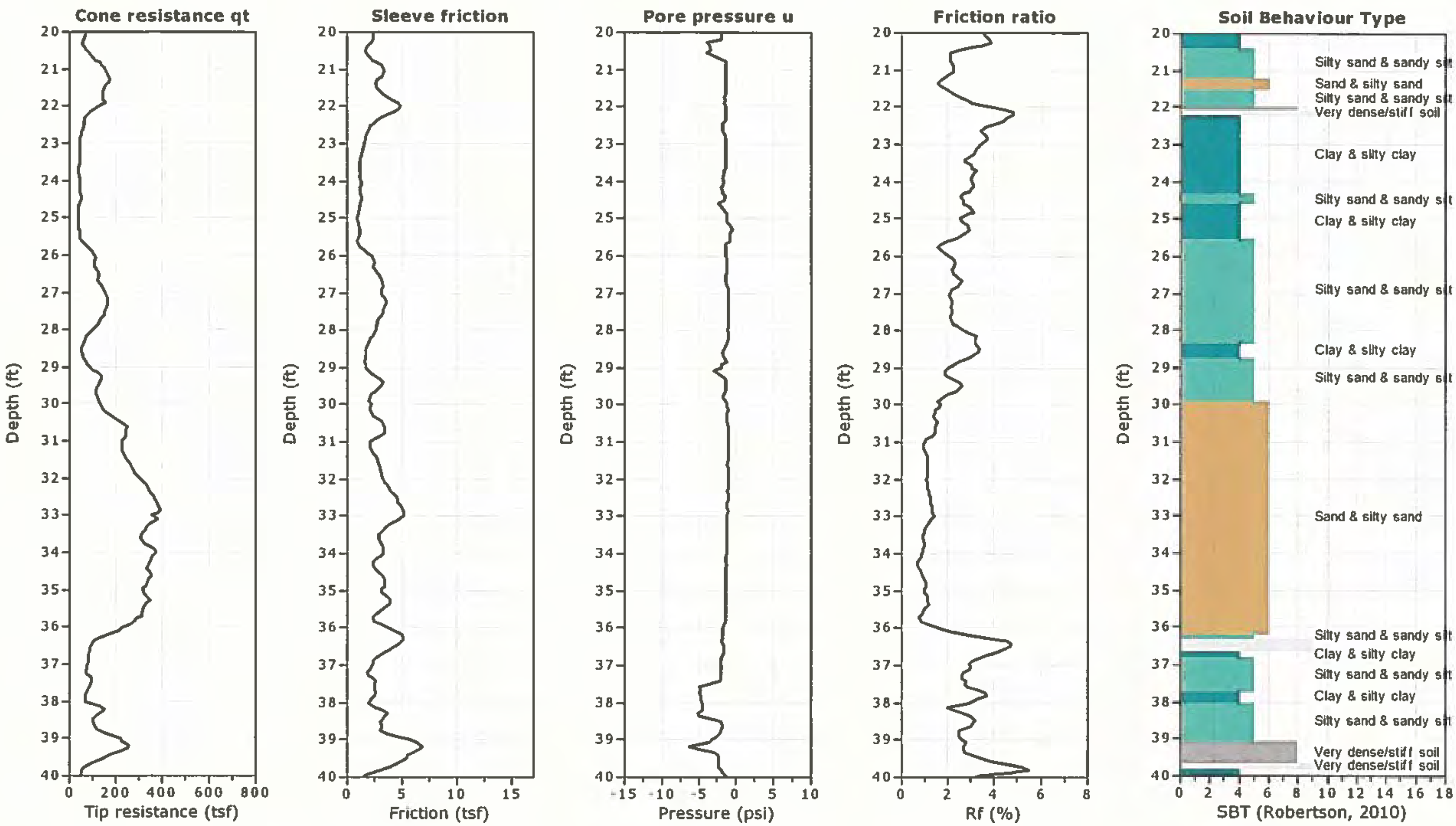
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-3
Total depth: 80.49 ft, Date: 4/21/2015
Cone Type: Vertek



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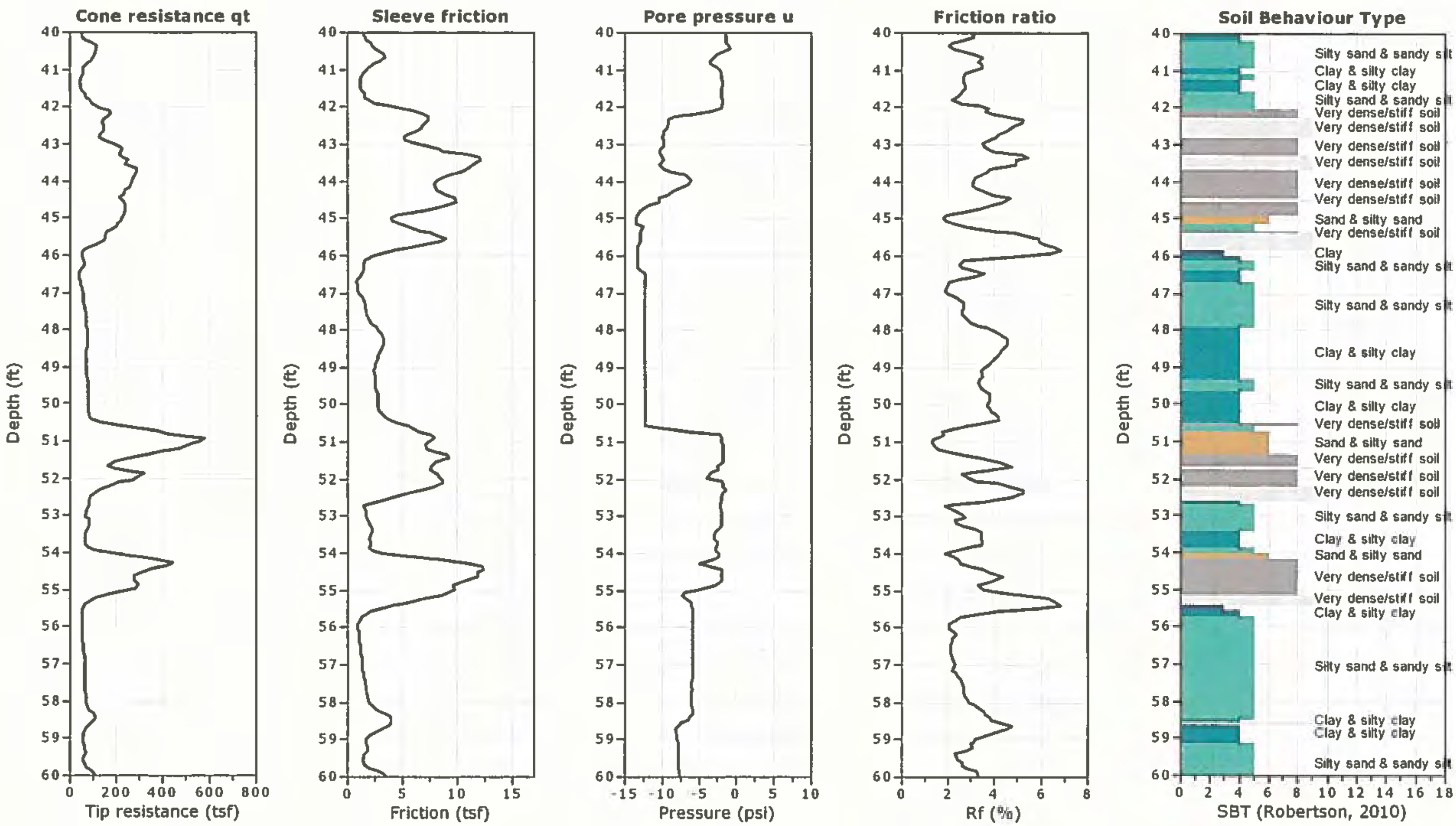
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-3
Total depth: 80.49 ft, Date: 4/21/2015
Cone Type: Vertek



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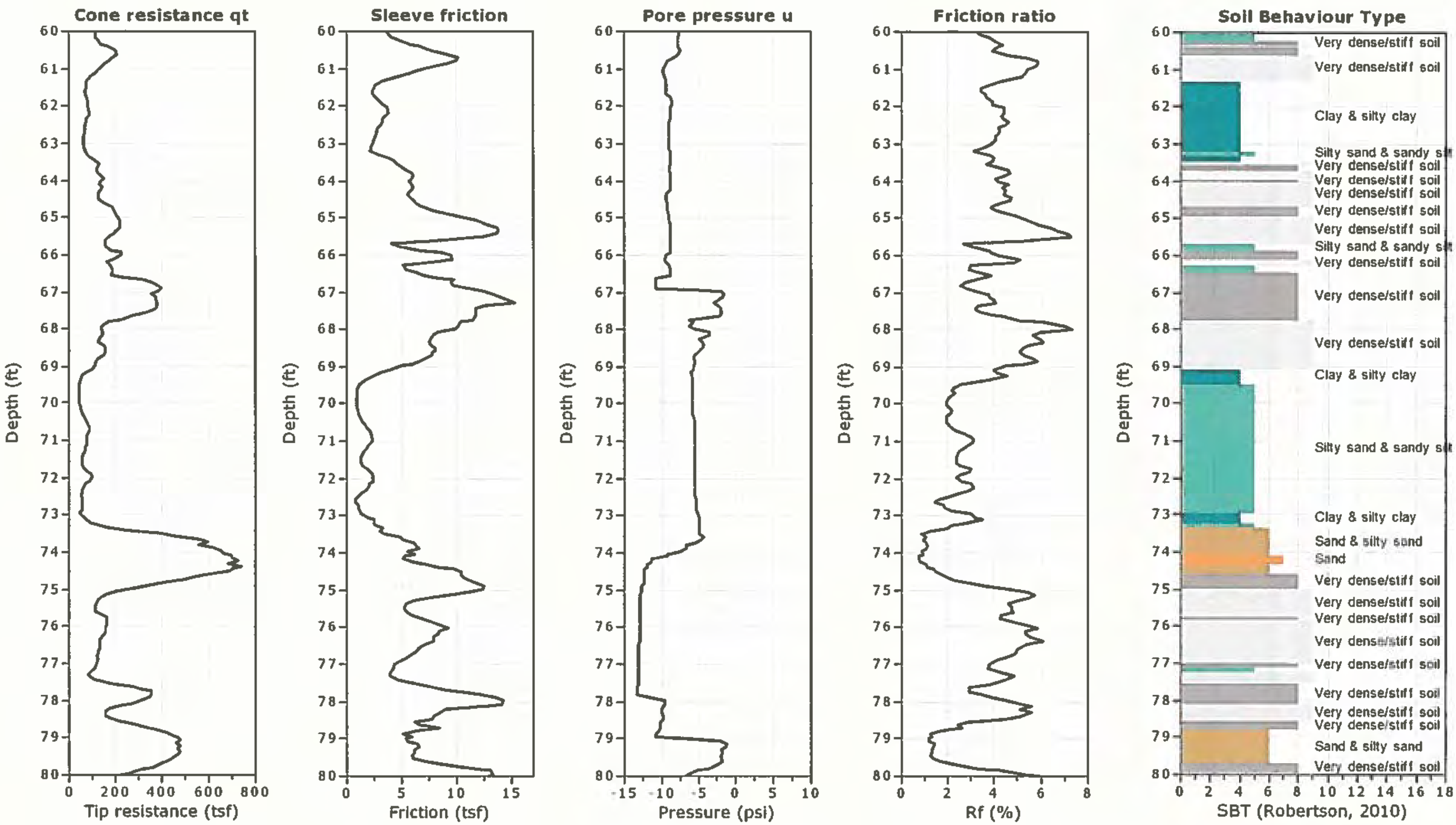
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-3
Total depth: 80.49 ft, Date: 4/21/2015
Cone Type: Vertek



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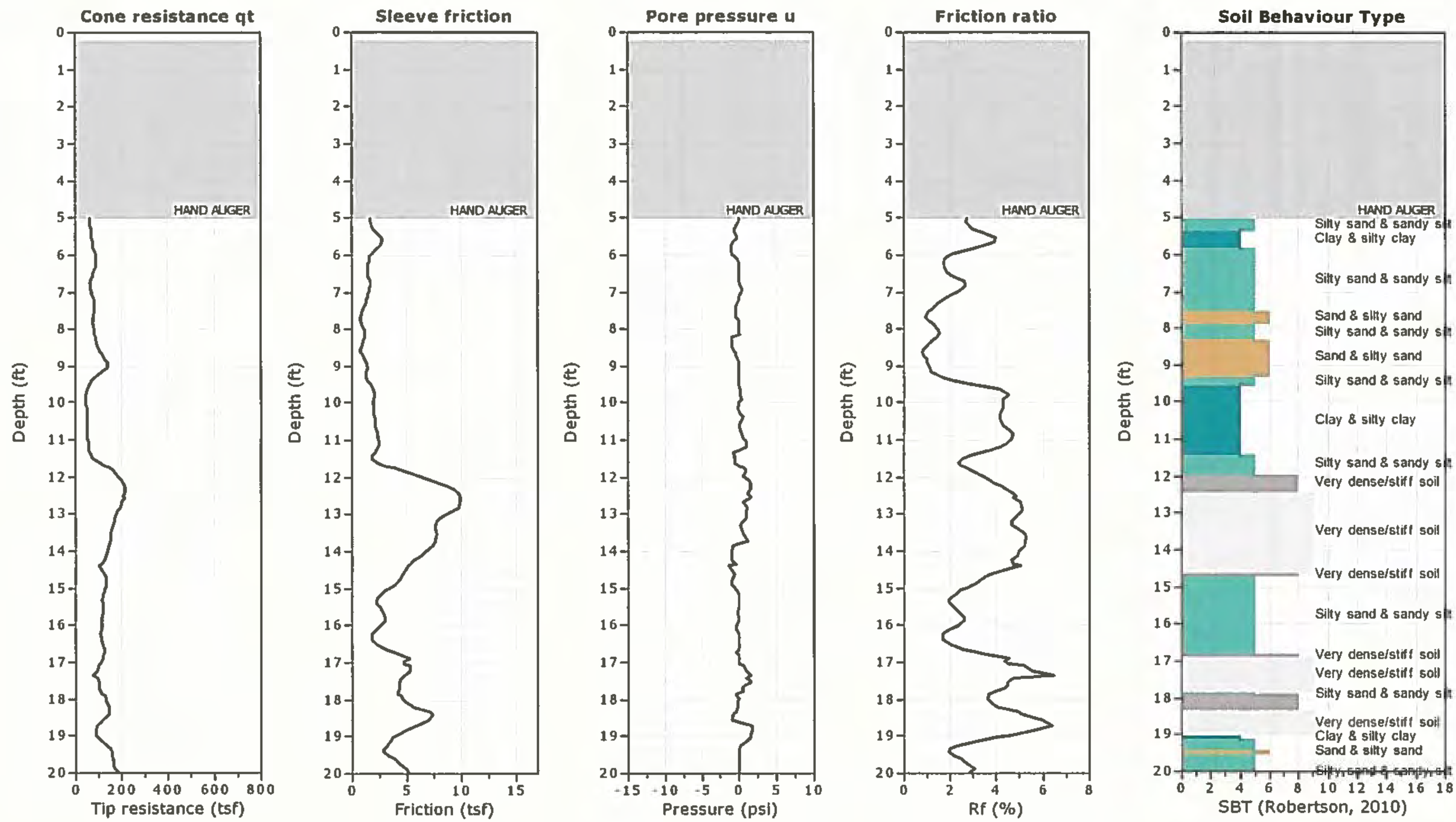
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-4
Total depth: 77.55 ft, Date: 4/21/2015
Cone Type: Vertek



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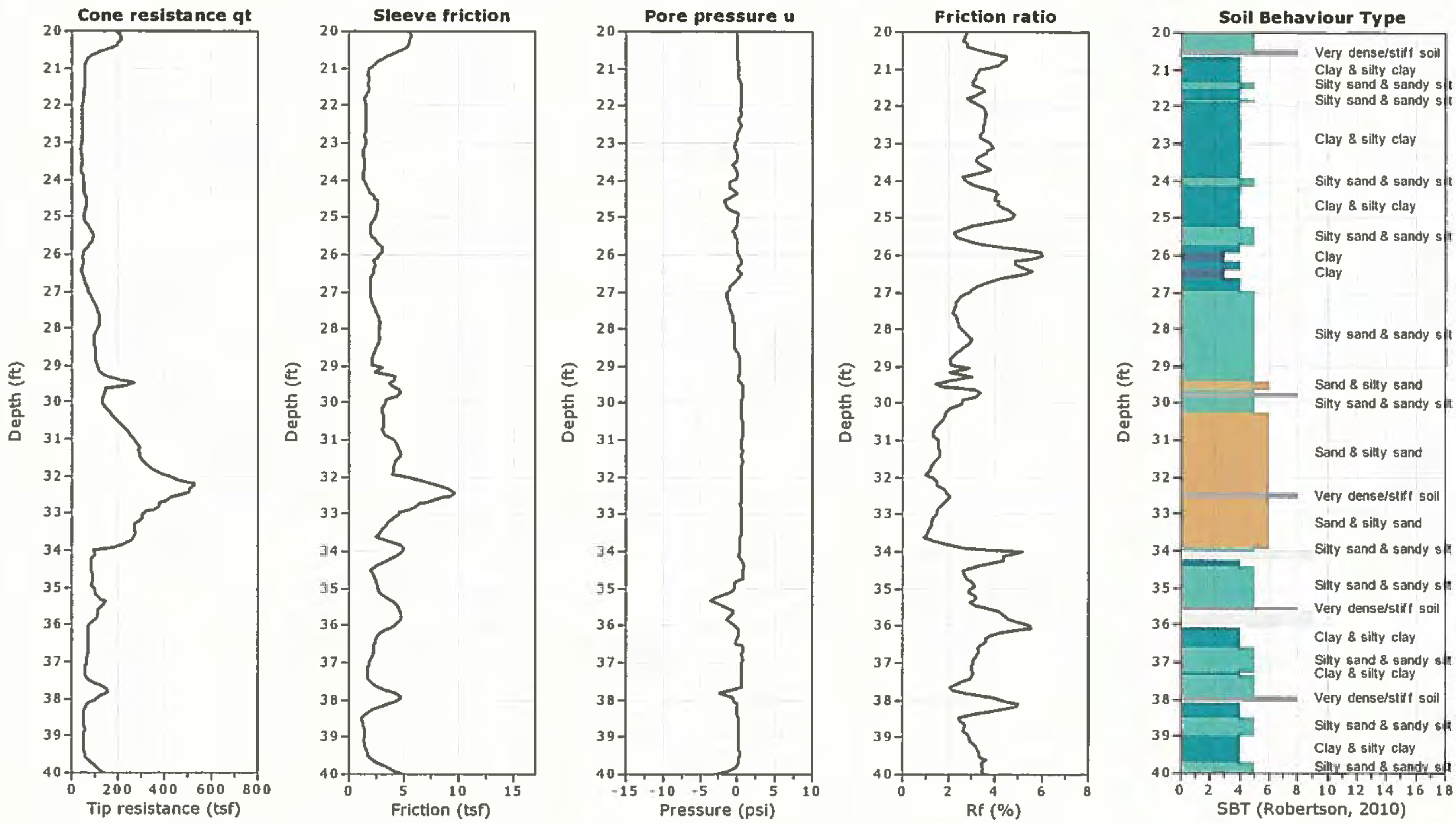
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-4
Total depth: 77.55 ft, Date: 4/21/2015
Cone Type: Vertek



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Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-4
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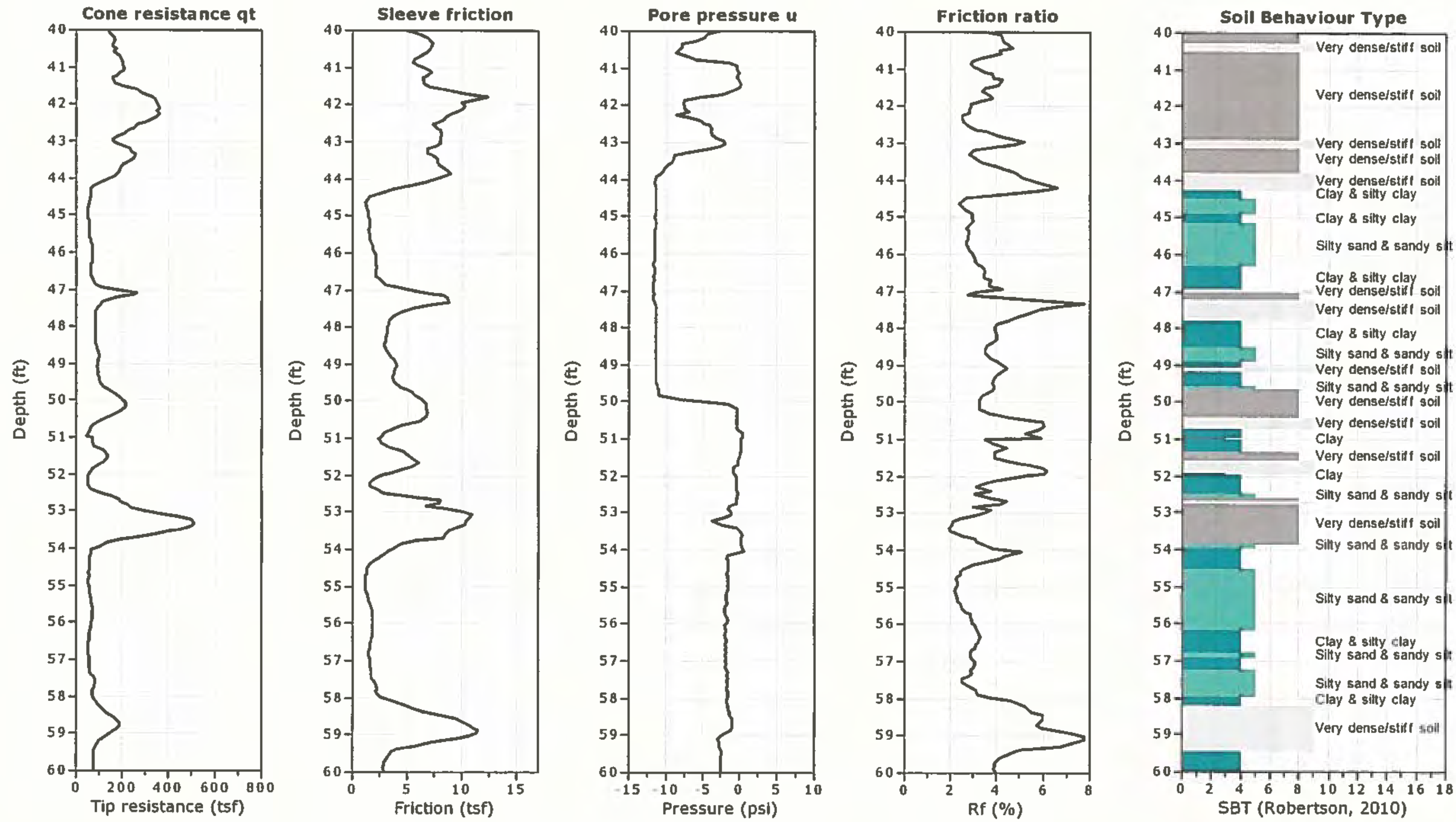
Cone Type: Vertek



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Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-4
Total depth: 77.55 ft, Date: 4/21/2015
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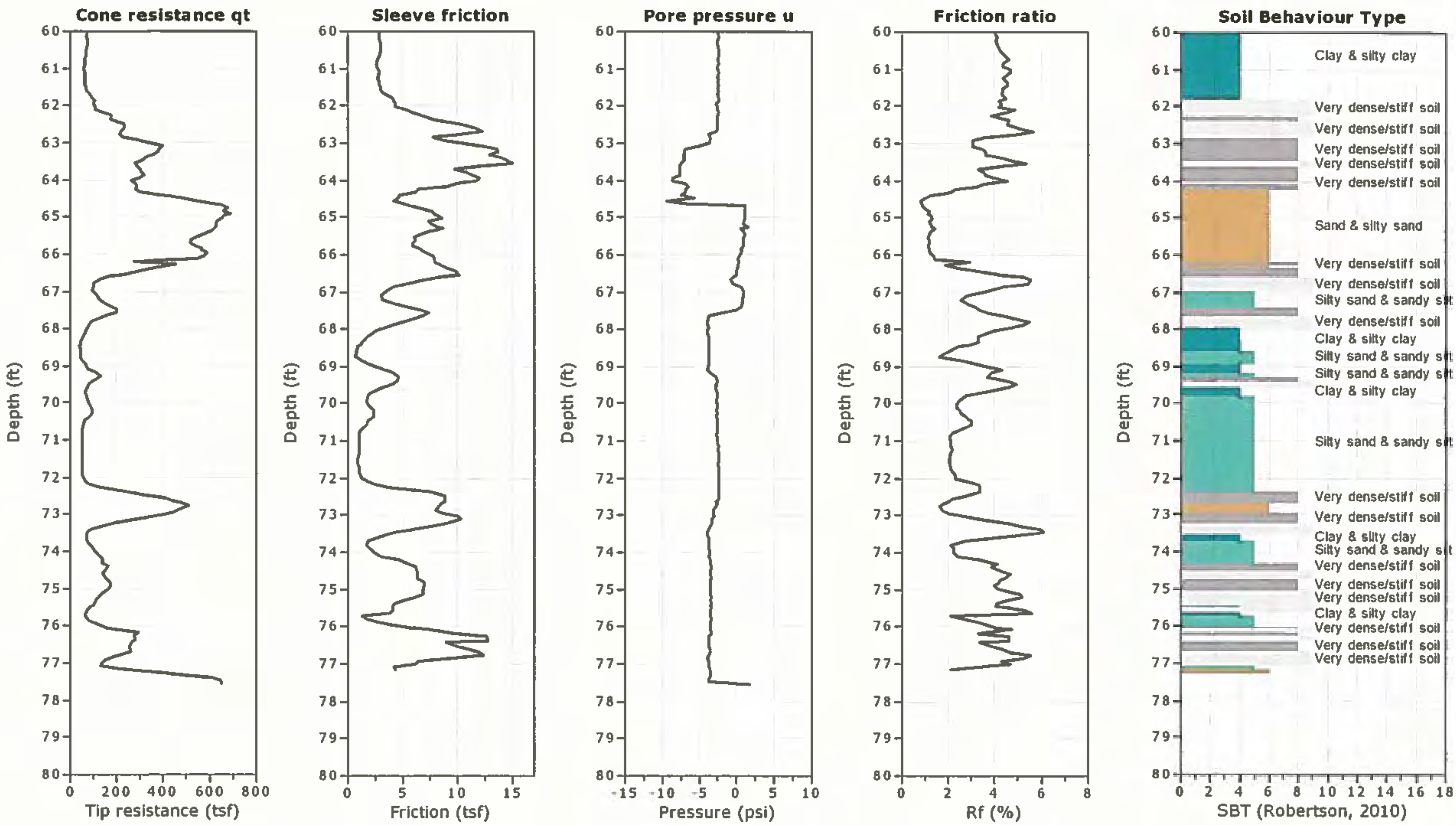

CPeT-IT v.1.7.6.42 - CPTU data presentation & interpretation software - Report created on: 5/15/2015, 8:02:57 AM
Project file: C:\AppliedLosAngeles4-5-15\CPeT Data\Plot Data\Plots w-ha.cpt

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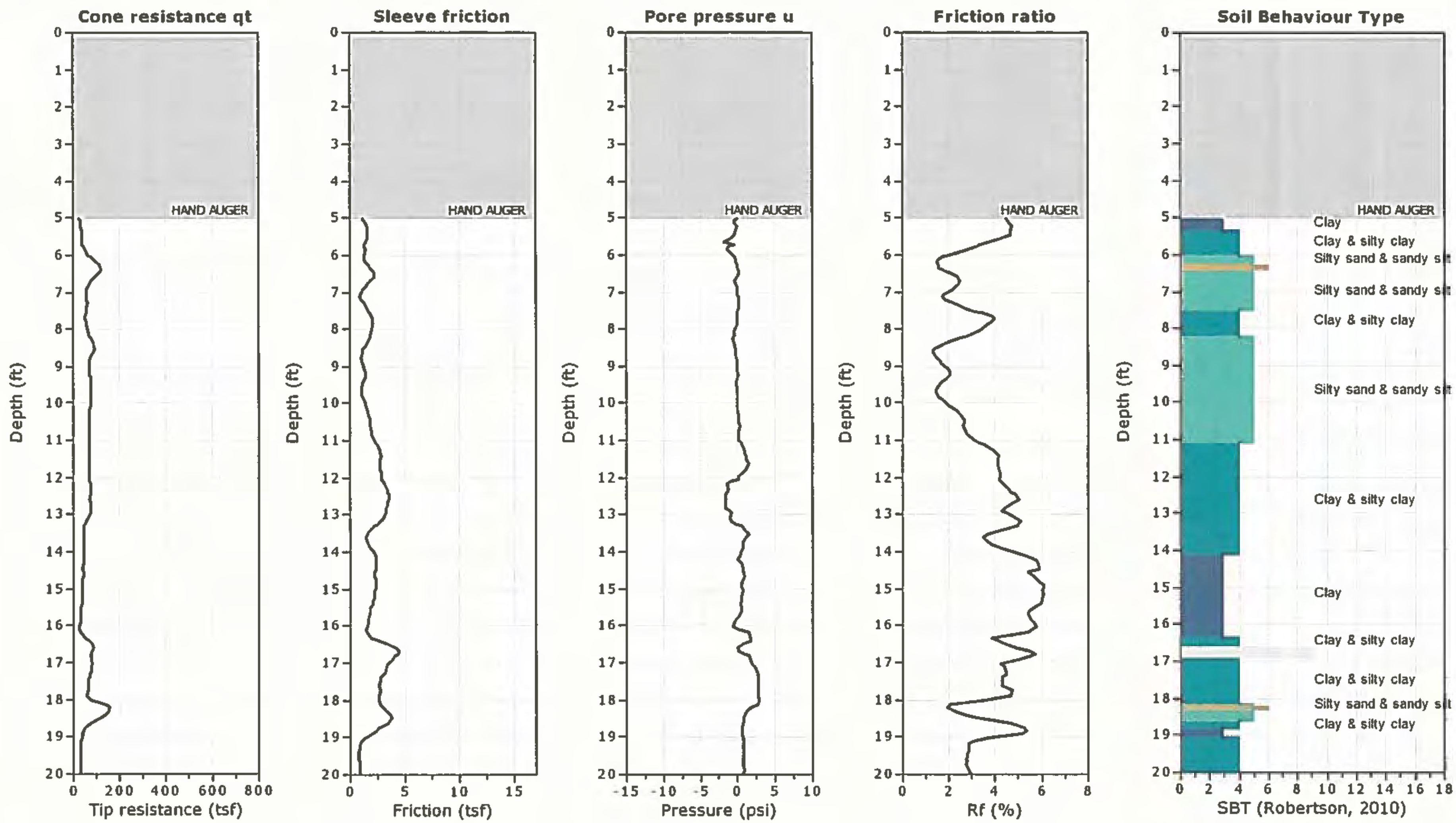
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-5
Total depth: 80.30 ft, Date: 4/21/2015
Cone Type: Vertek



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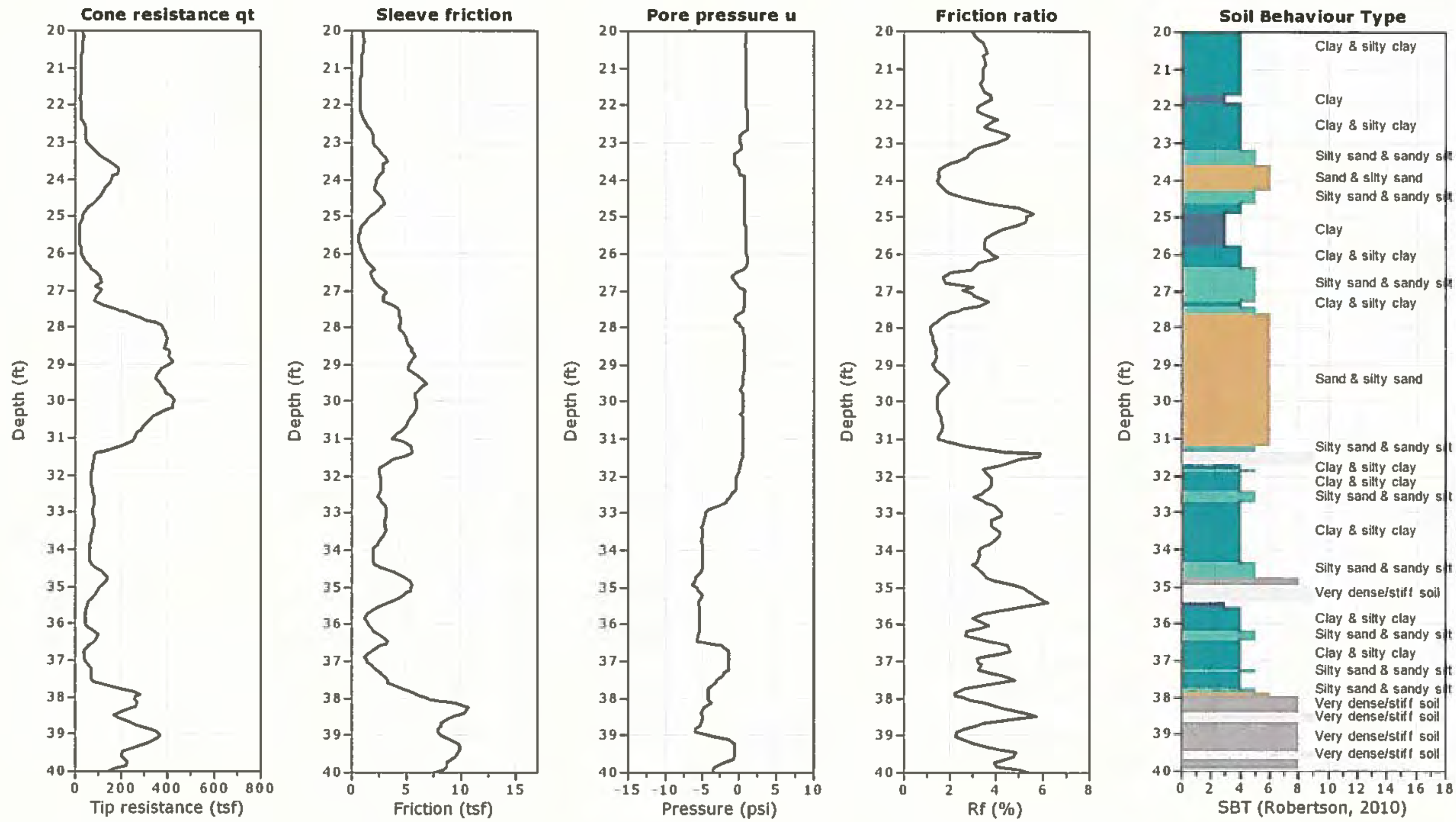
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-5
Total depth: 80.30 ft, Date: 4/21/2015
Cone Type: Vertek



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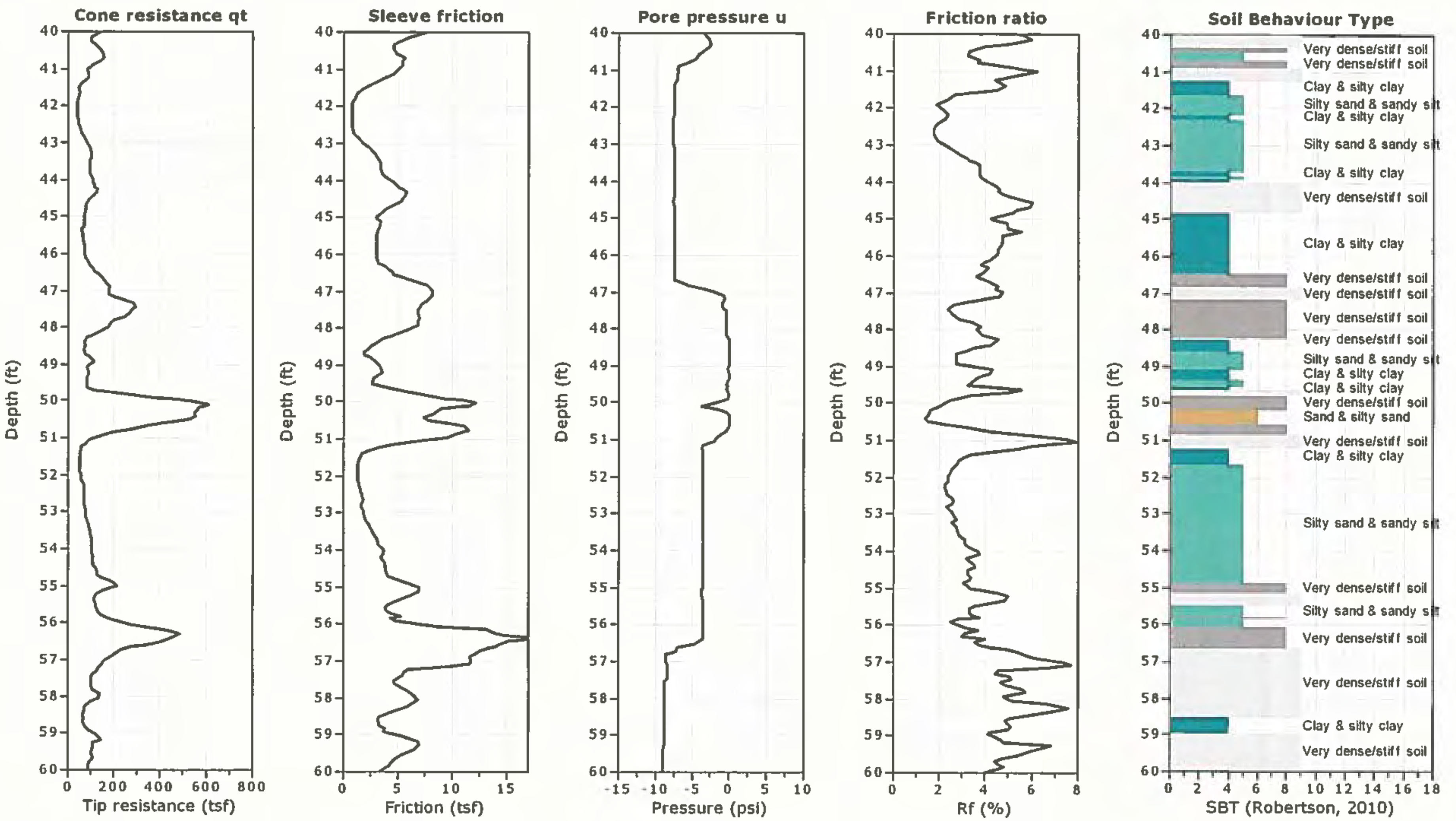
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-5
Total depth: 80.30 ft, Date: 4/21/2015
Cone Type: Vertek



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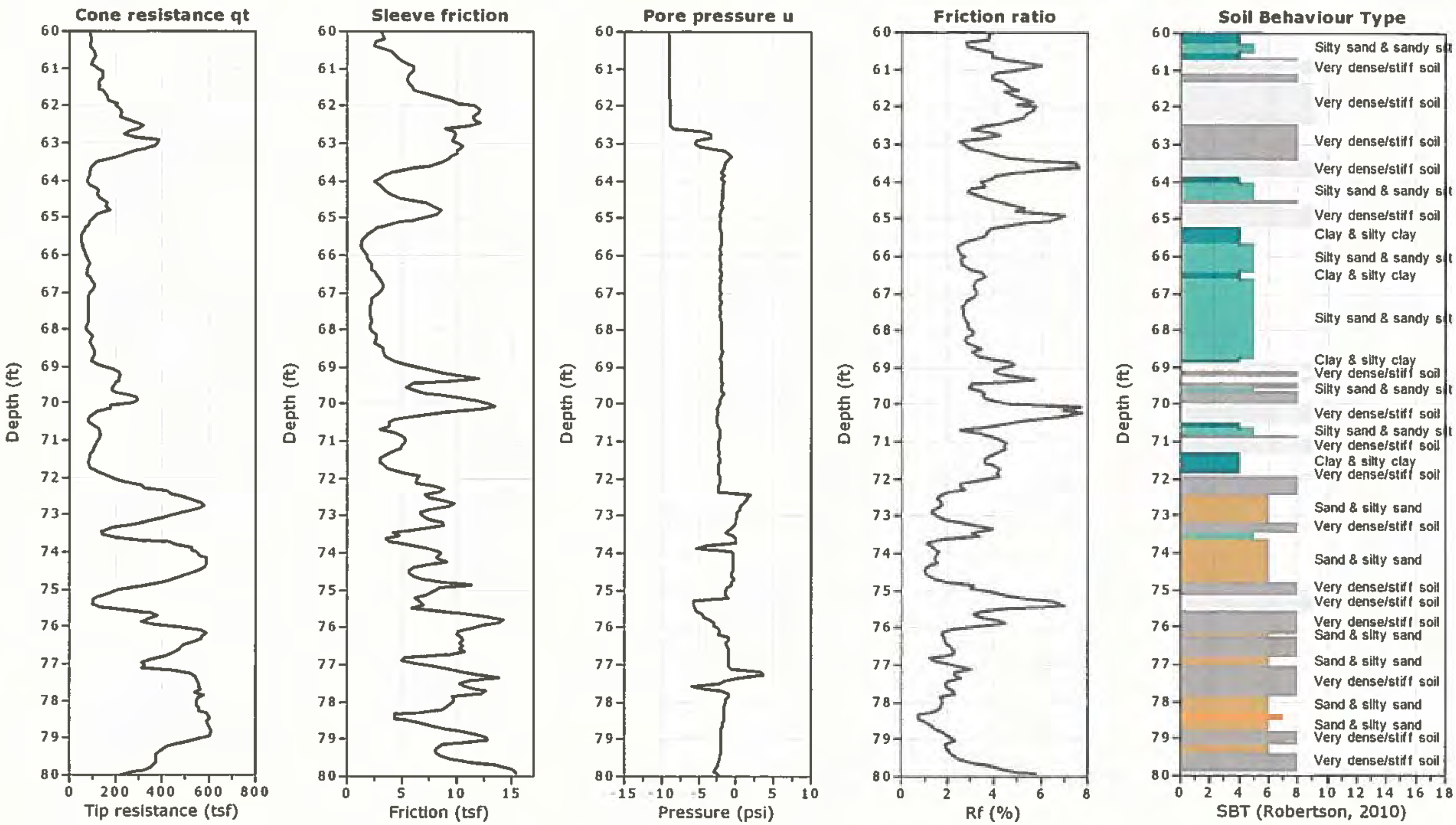
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-5
Total depth: 80.30 ft, Date: 4/21/2015
Cone Type: Vertek



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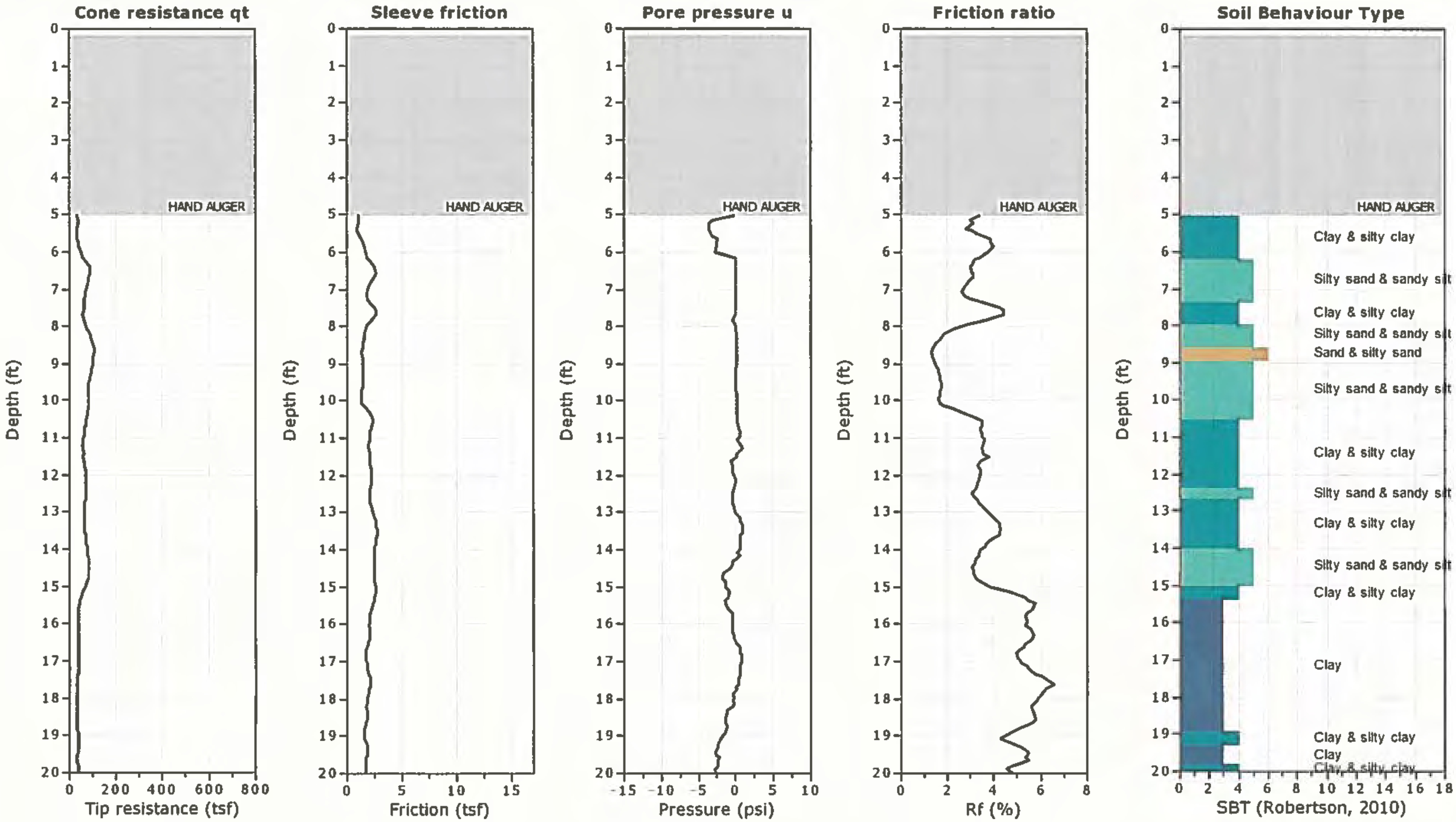
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-6
Total depth: 80.49 ft, Date: 4/21/2015
Cone Type: Vertek



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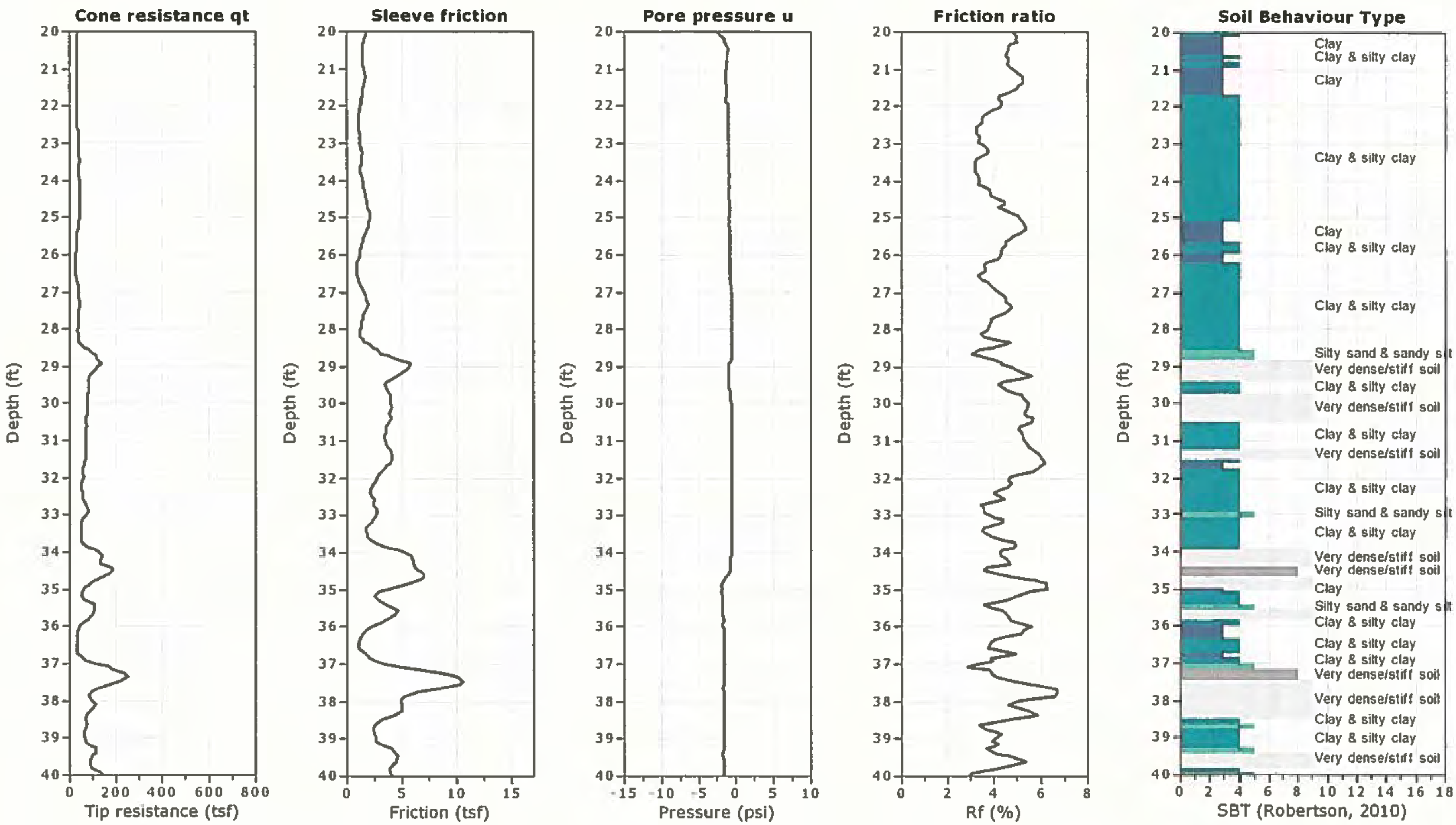
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-6
Total depth: 80.49 ft, Date: 4/21/2015
Cone Type: Vertek



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Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-6
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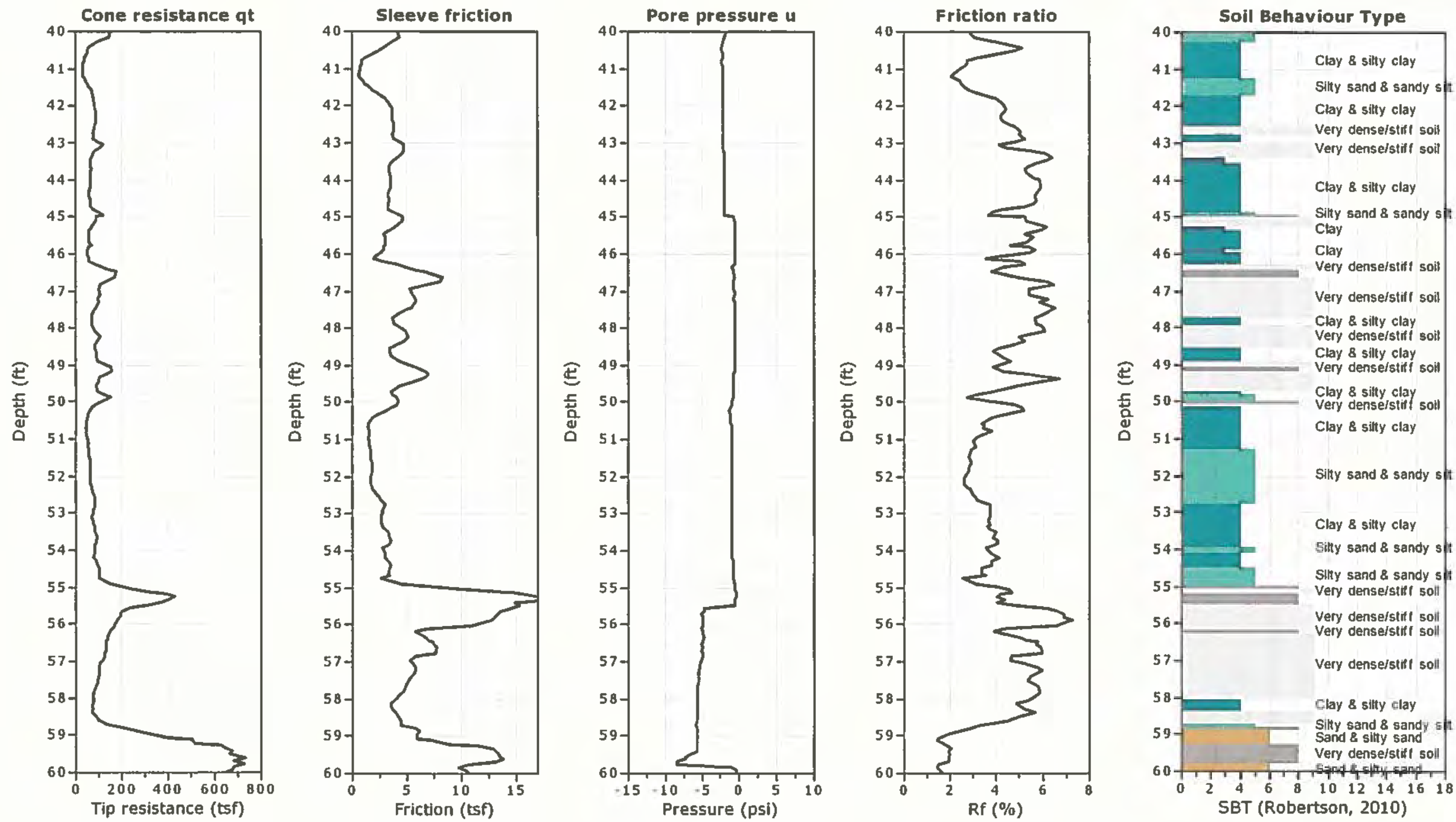

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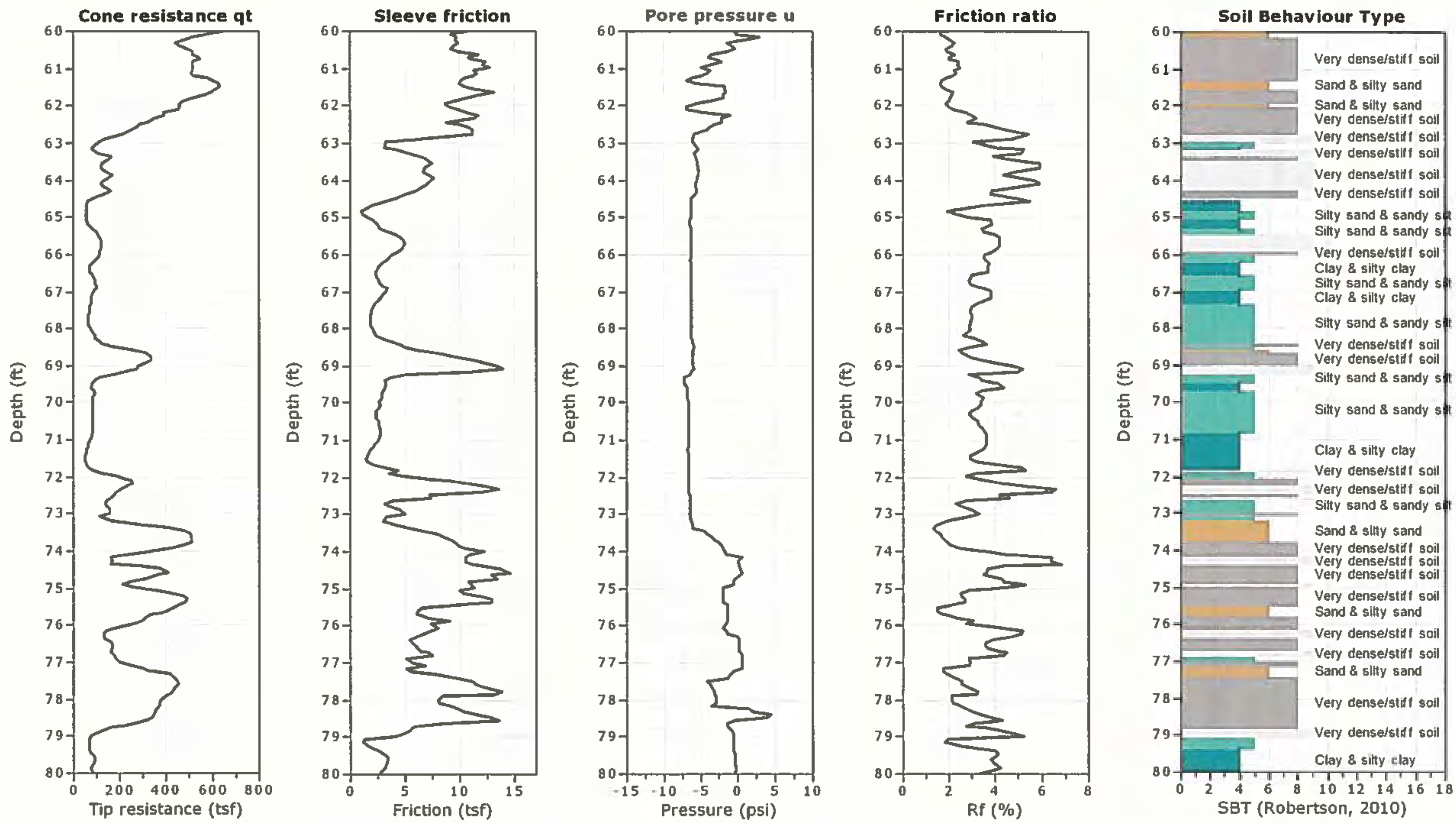
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-6
Total depth: 80.49 ft, Date: 4/21/2015
Cone Type: Vertek



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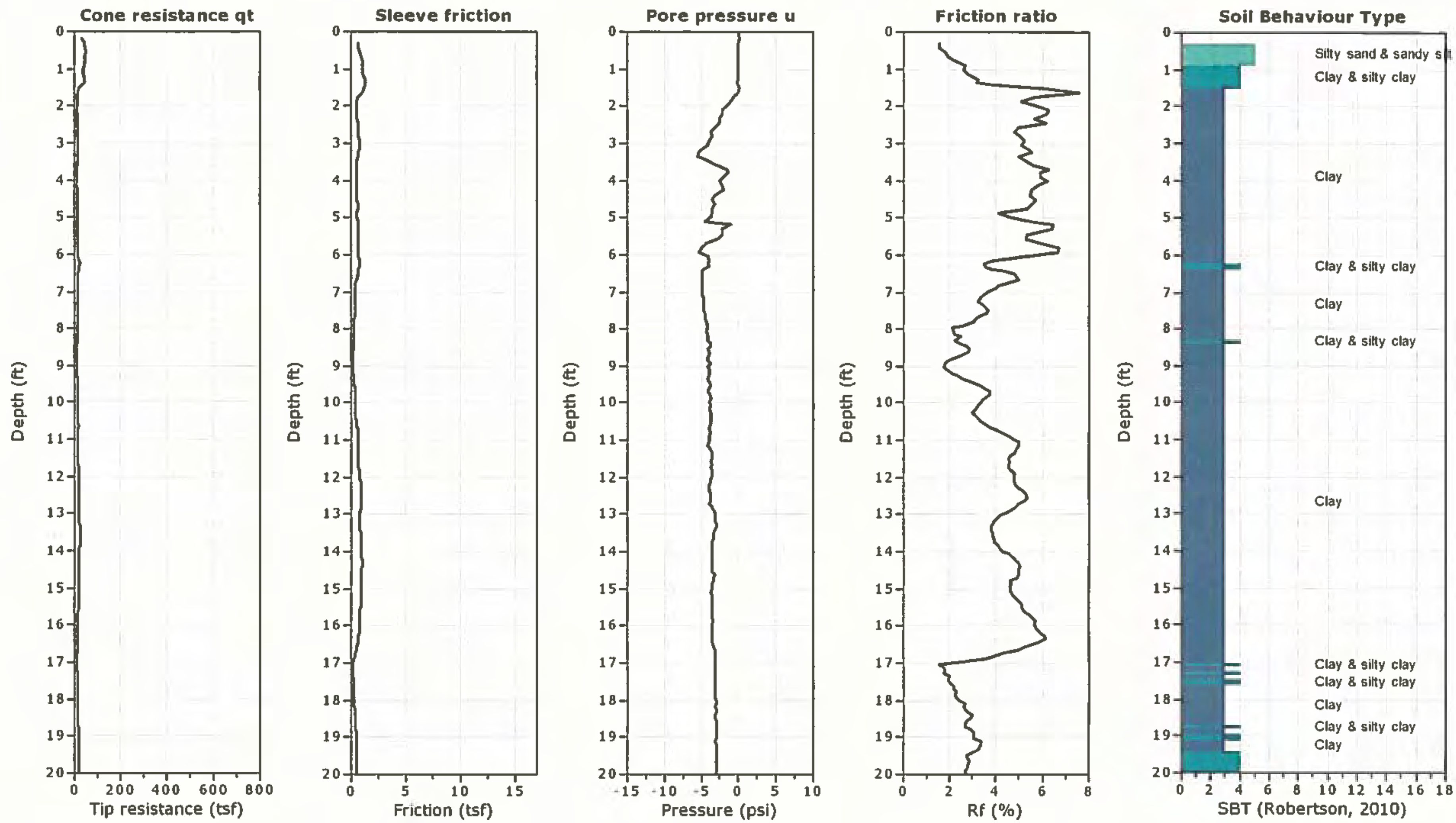
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-7
Total depth: 71.39 ft, Date: 4/21/2015
Cone Type: Vertek



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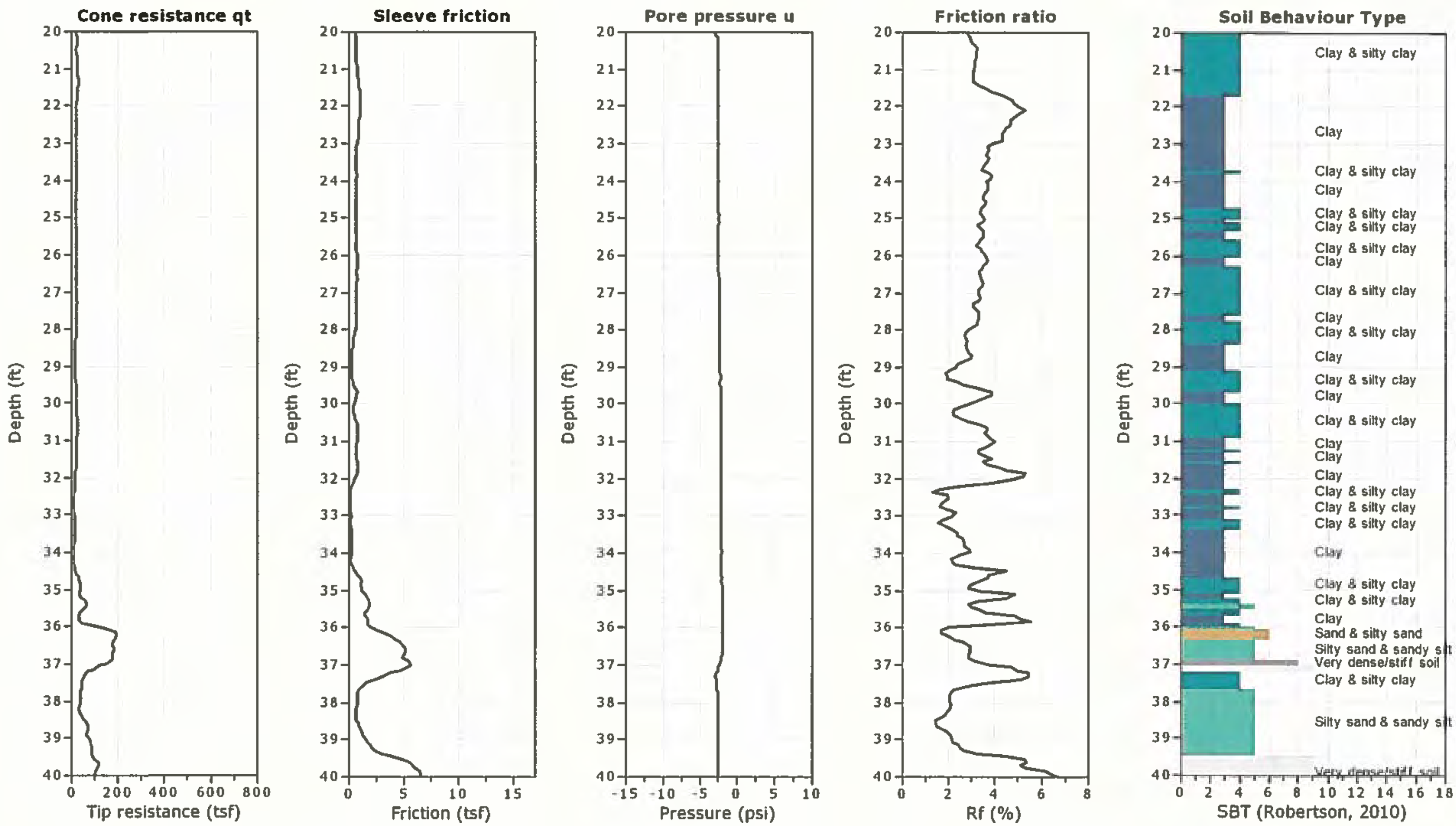
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-7
Total depth: 71.39 ft, Date: 4/21/2015
Cone Type: Vertek



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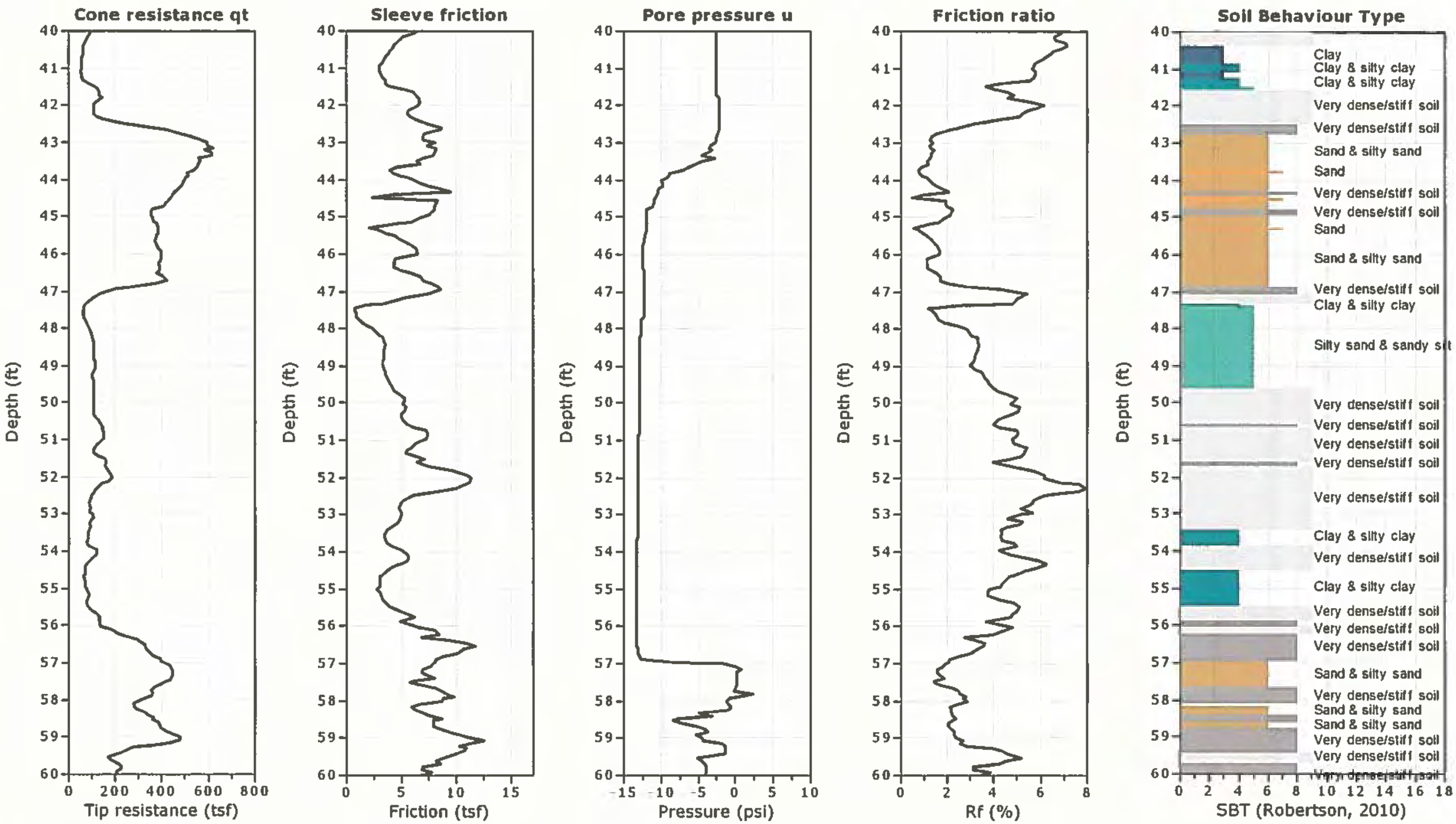
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-7
Total depth: 71.39 ft, Date: 4/21/2015
Cone Type: Vertek



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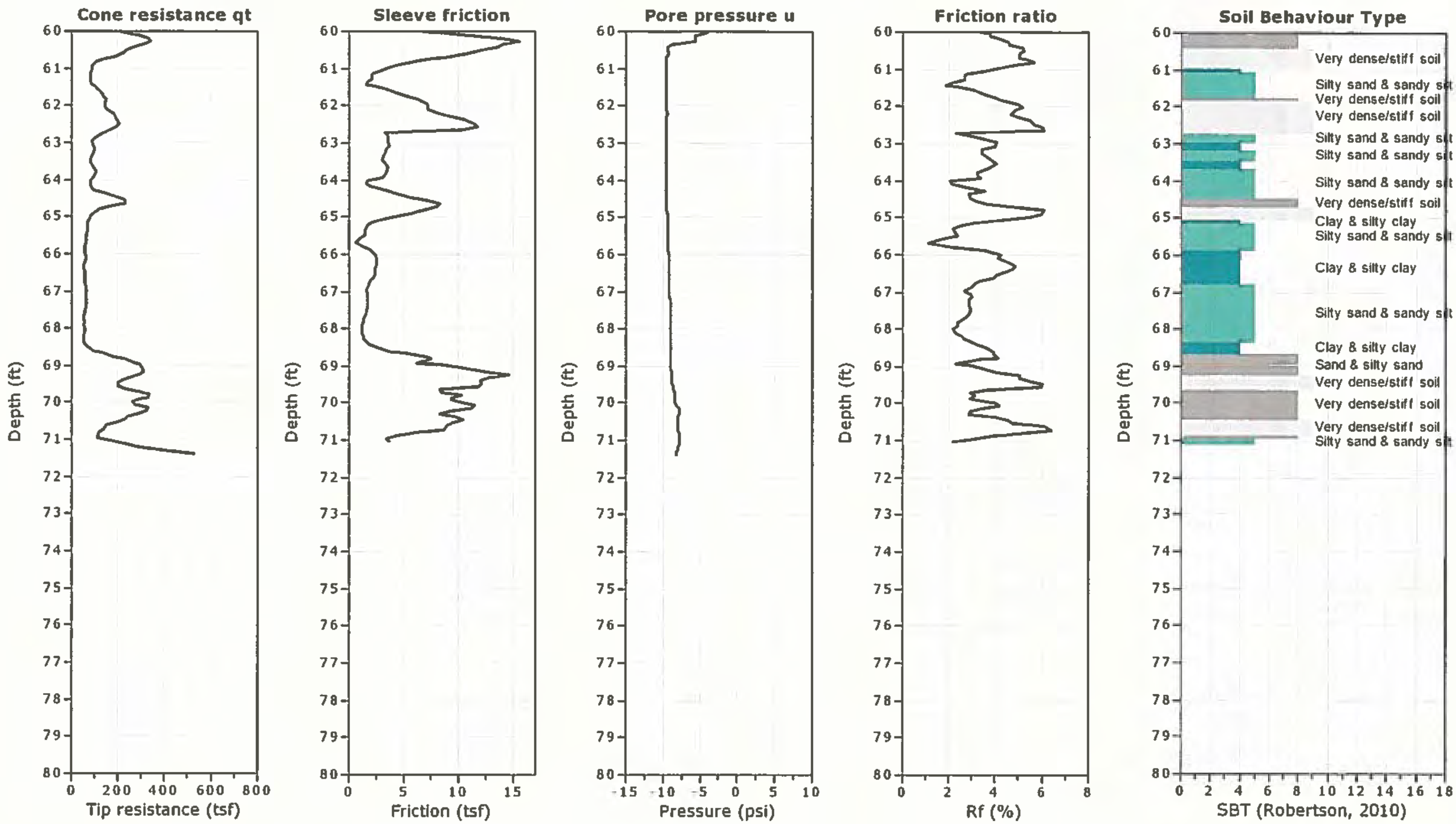
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-7
Total depth: 71.39 ft, Date: 4/21/2015
Cone Type: Vertek



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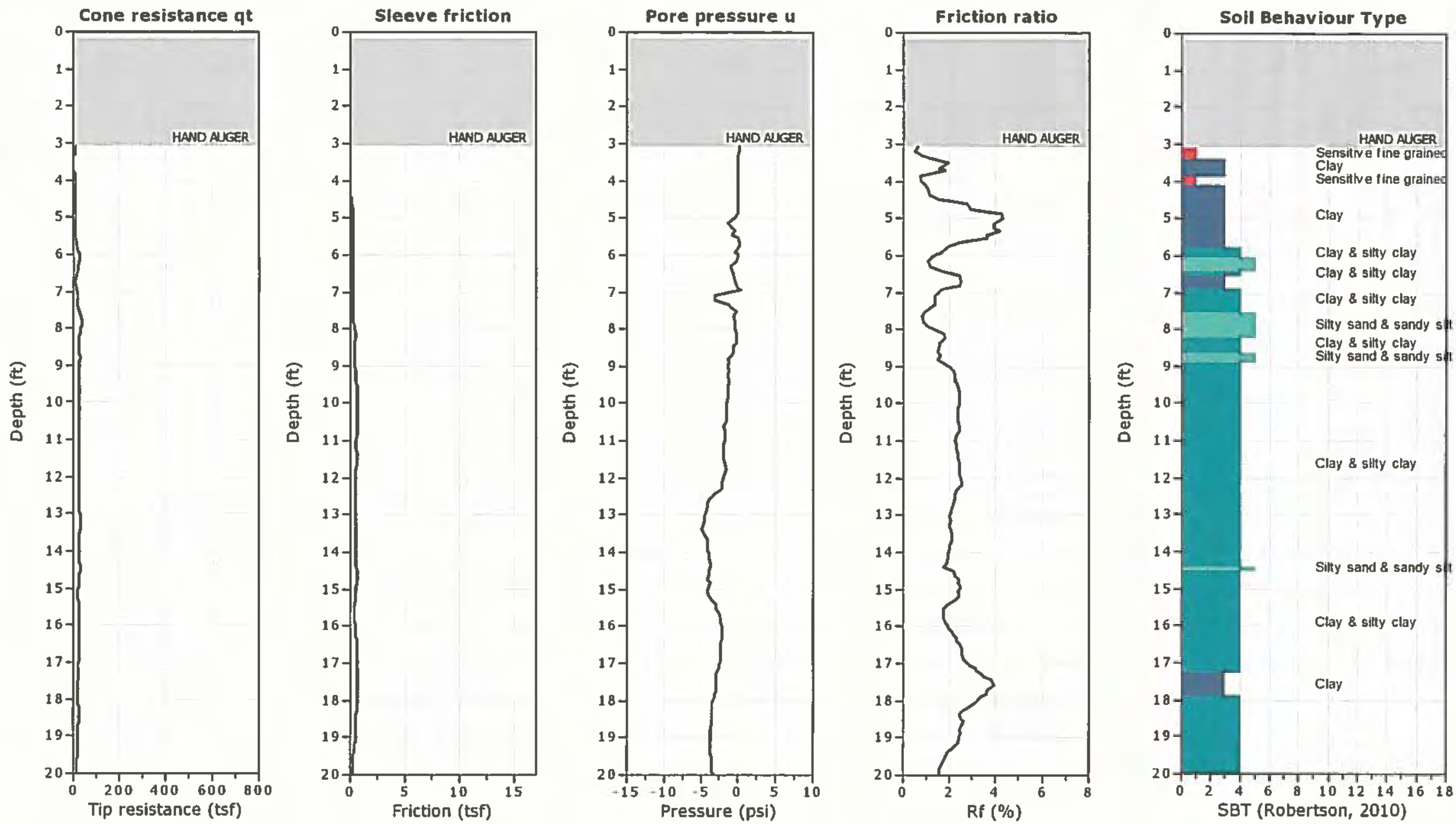
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-8
Total depth: 80.52 ft, Date: 5/12/2015
Cone Type: Vertek



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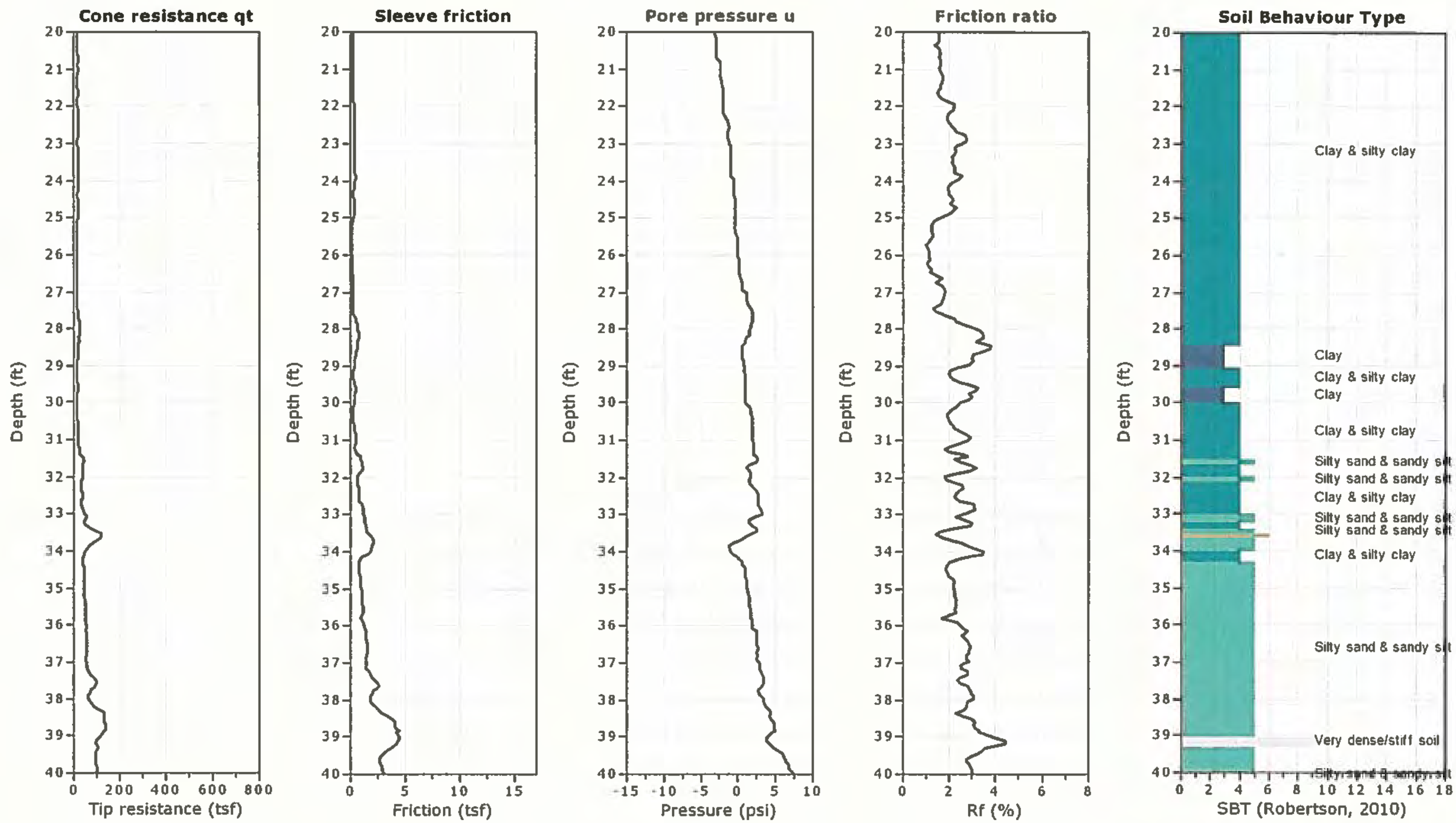
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-8
Total depth: 80.52 ft, Date: 5/12/2015
Cone Type: Vertek



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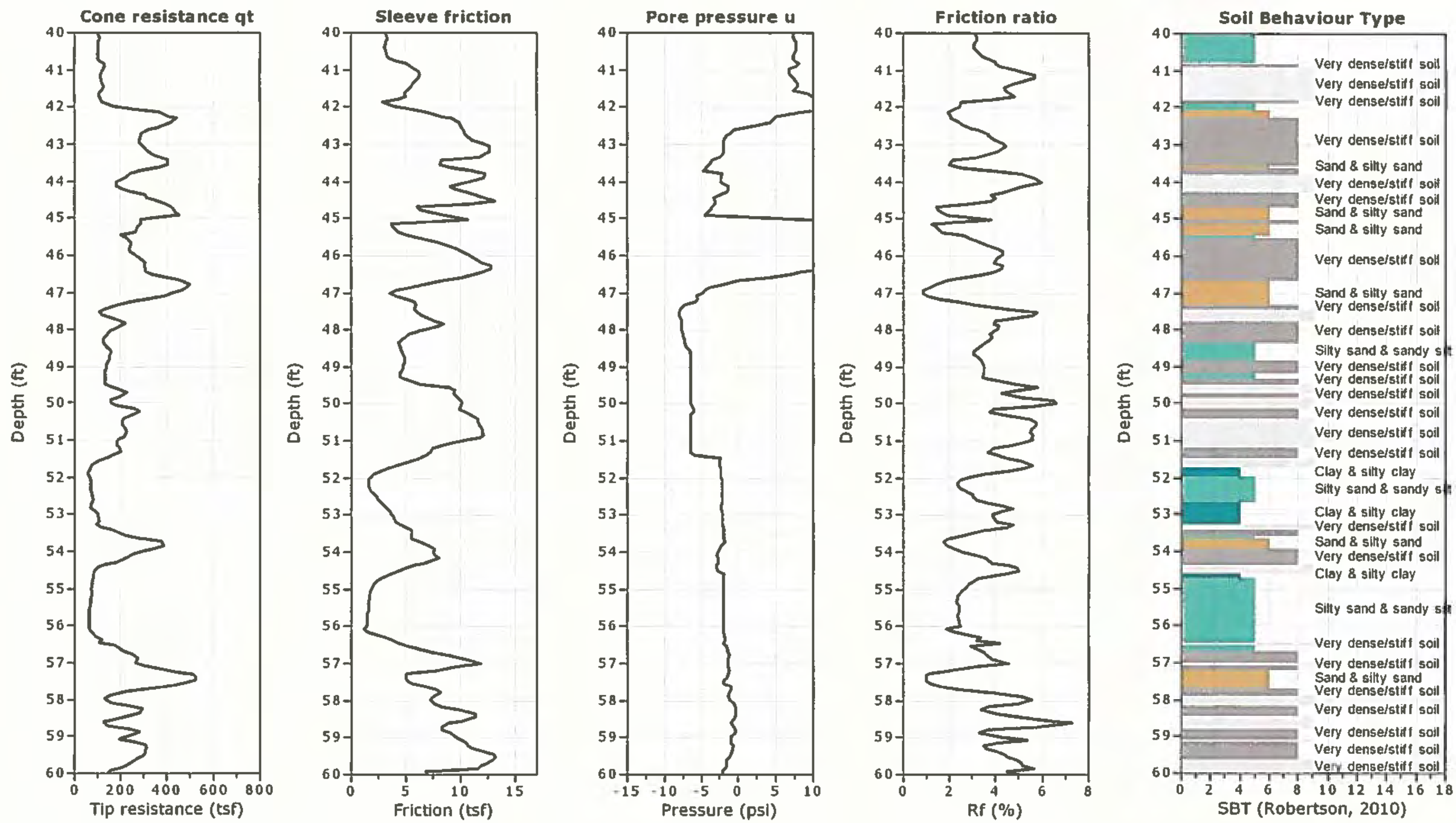
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-8
Total depth: 80.52 ft, Date: 5/12/2015
Cone Type: Vertek



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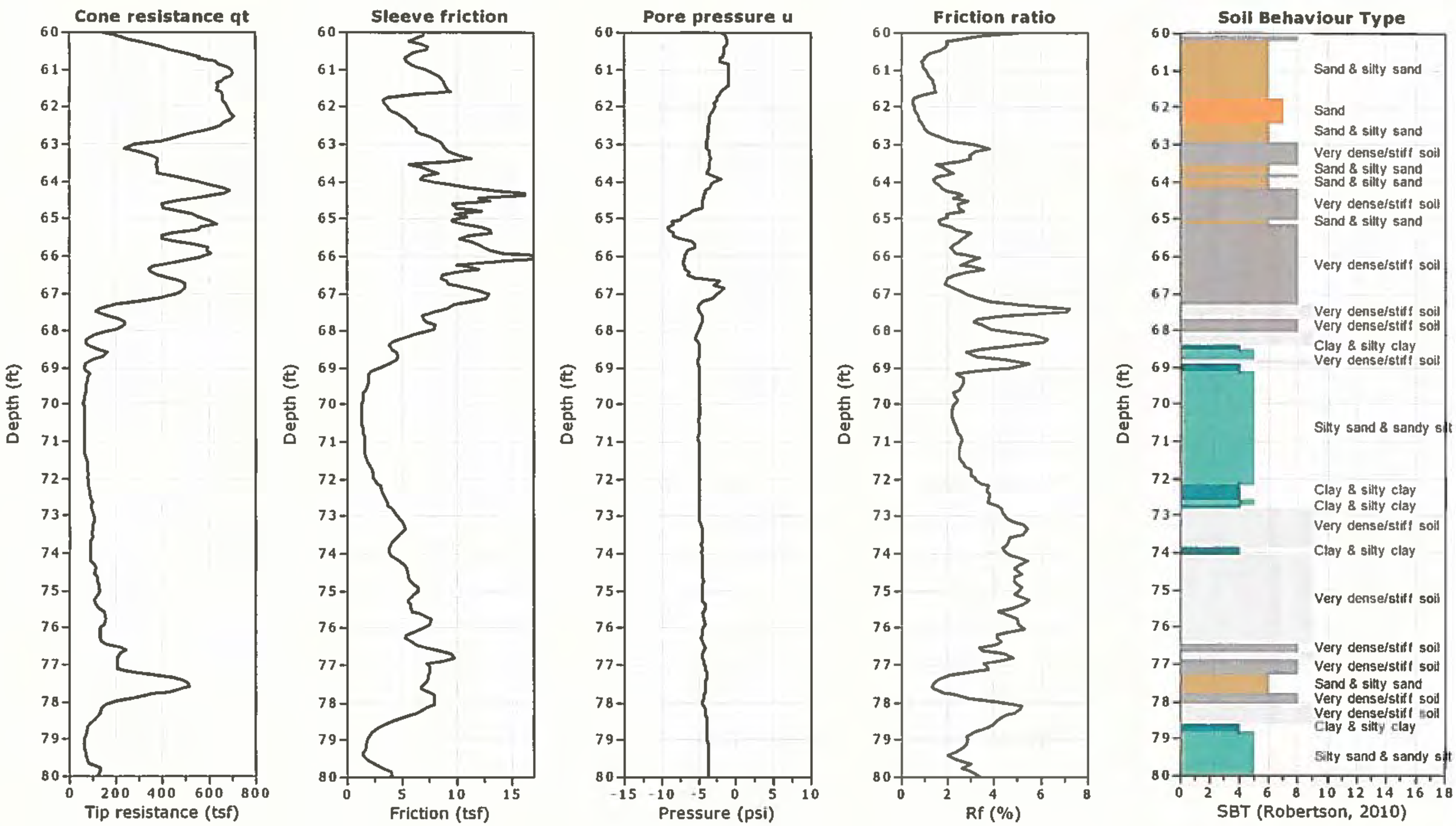
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-8
Total depth: 80.52 ft, Date: 5/12/2015
Cone Type: Vertek



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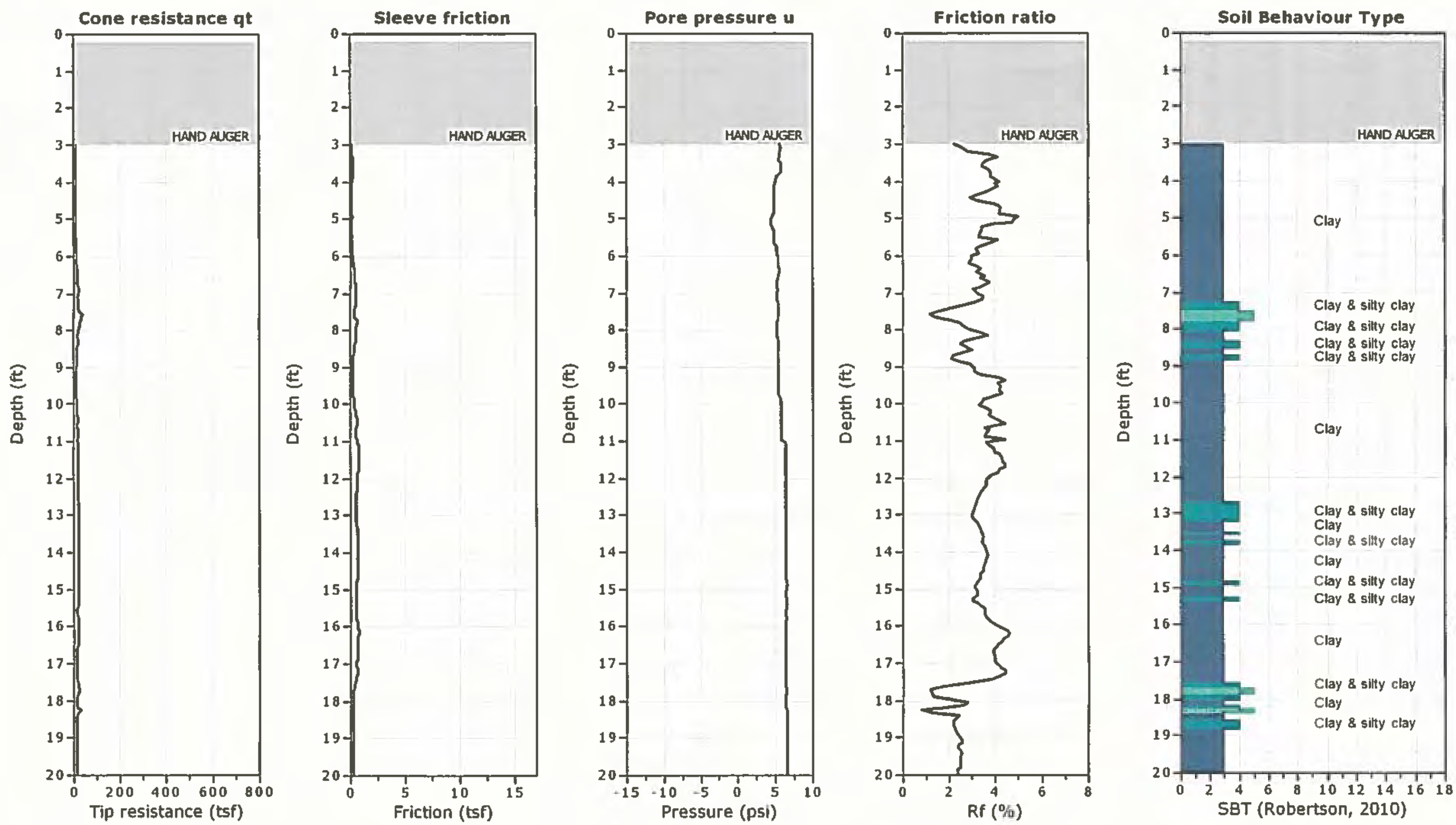
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-9
Total depth: 79.29 ft, Date: 5/12/2015
Cone Type: Vertek



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Project file: C:\AppliedLosAngeles4-5-15\CPeT Data\Plot Data\Plots w-ha.cpt

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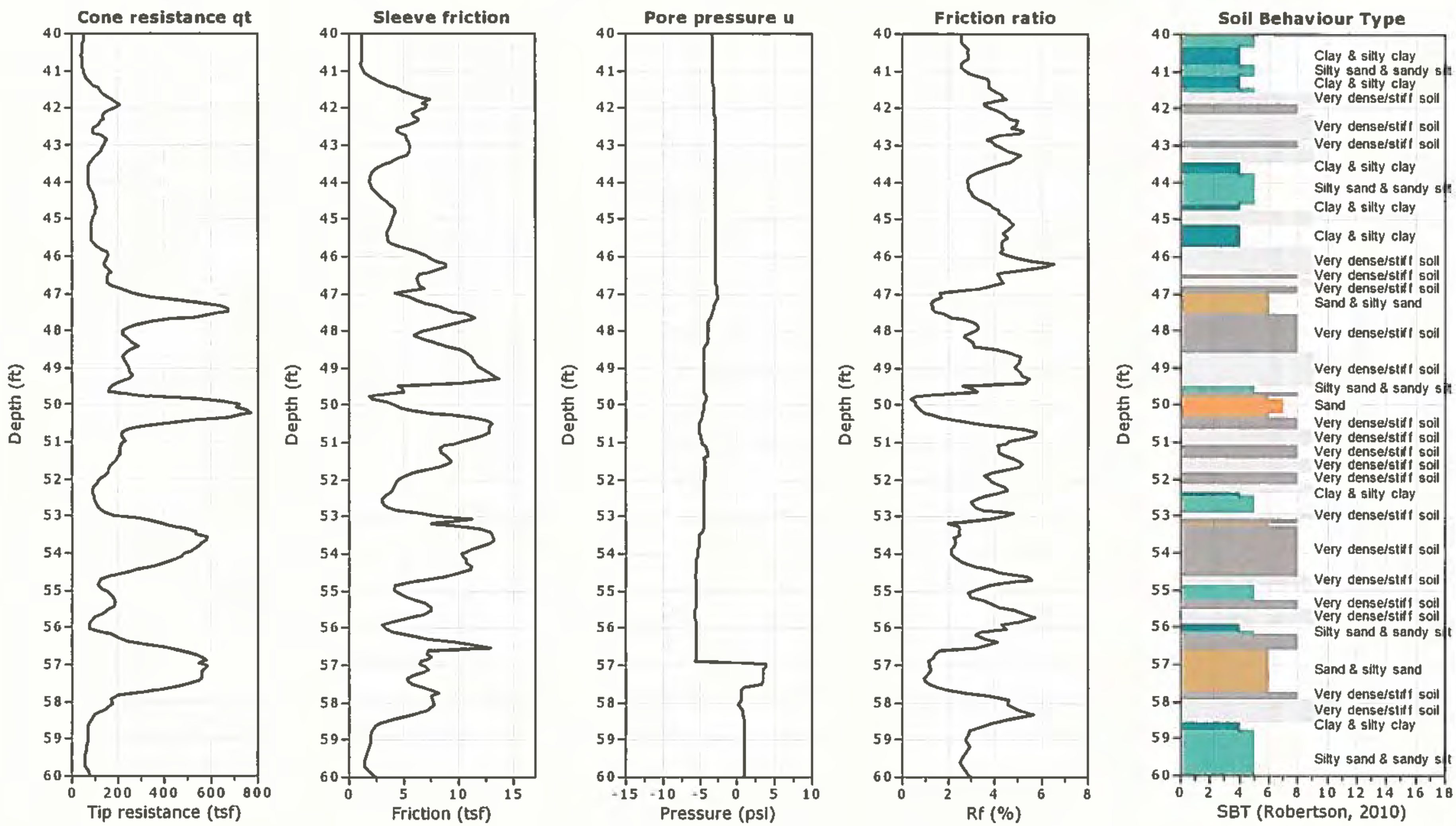
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-9
Total depth: 79.29 ft, Date: 5/12/2015
Cone Type: Vertek



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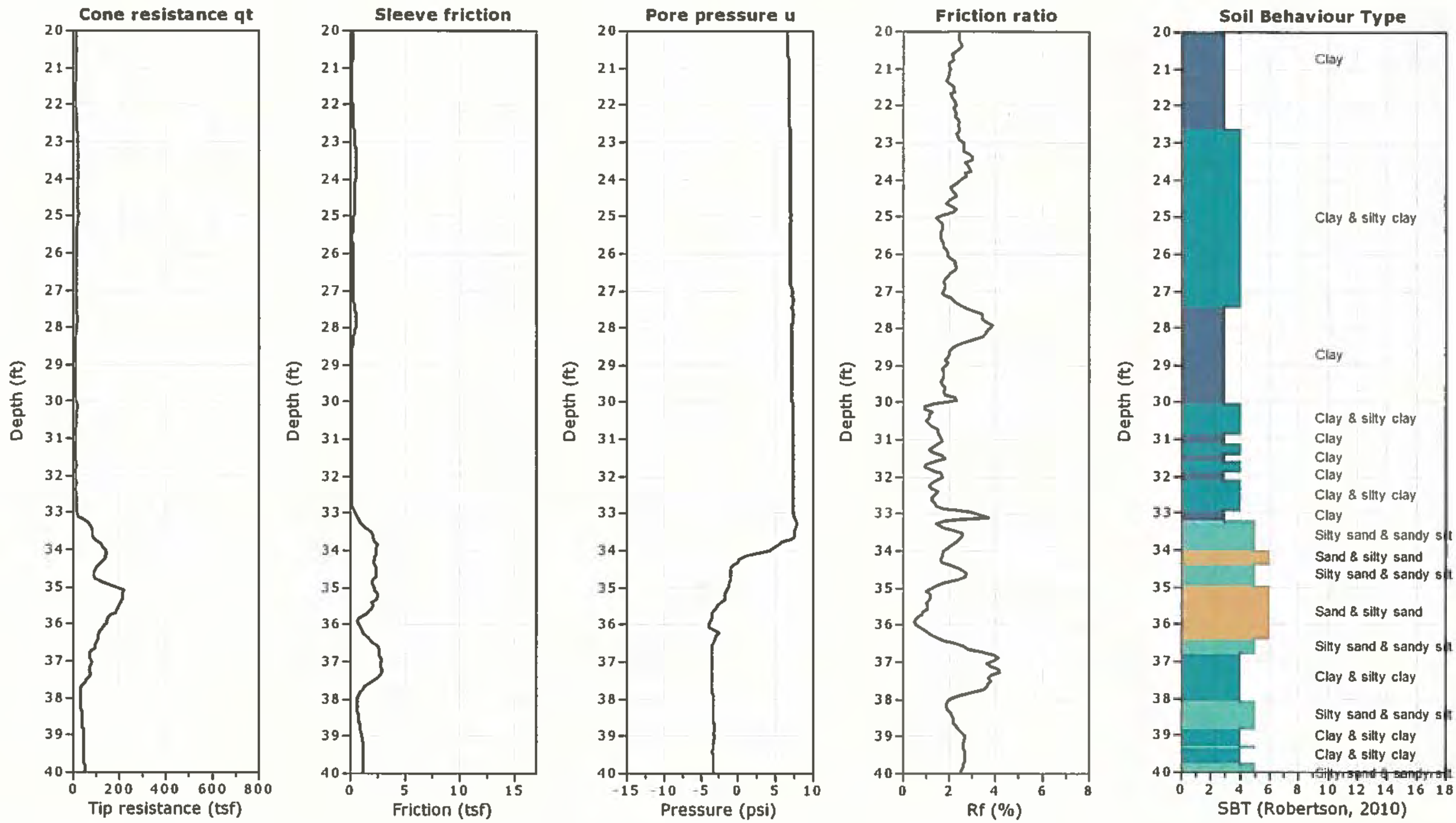
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-9
Total depth: 79.29 ft, Date: 5/12/2015
Cone Type: Vertek



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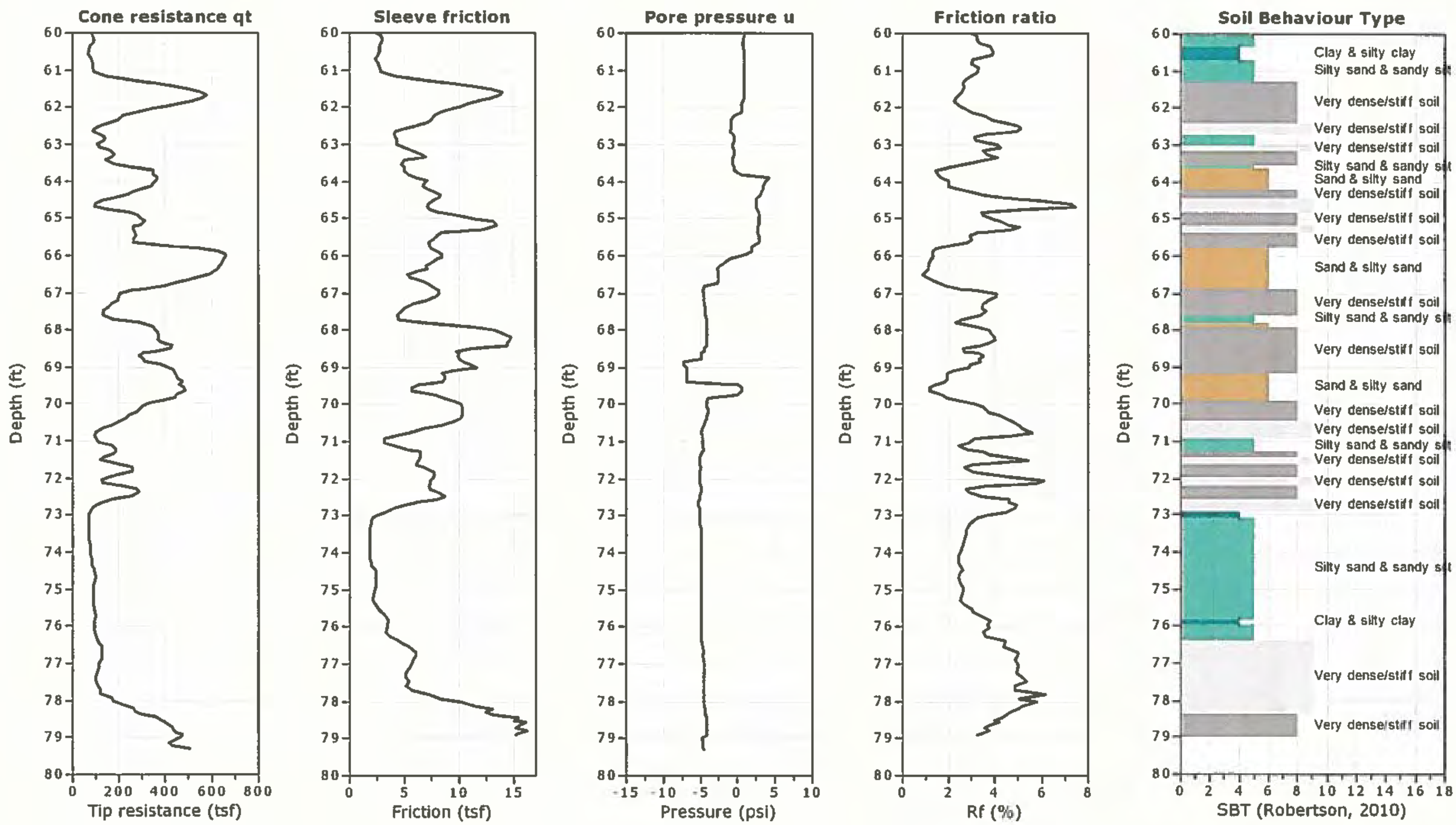
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-9
Total depth: 79.29 ft, Date: 5/12/2015
Cone Type: Vertek



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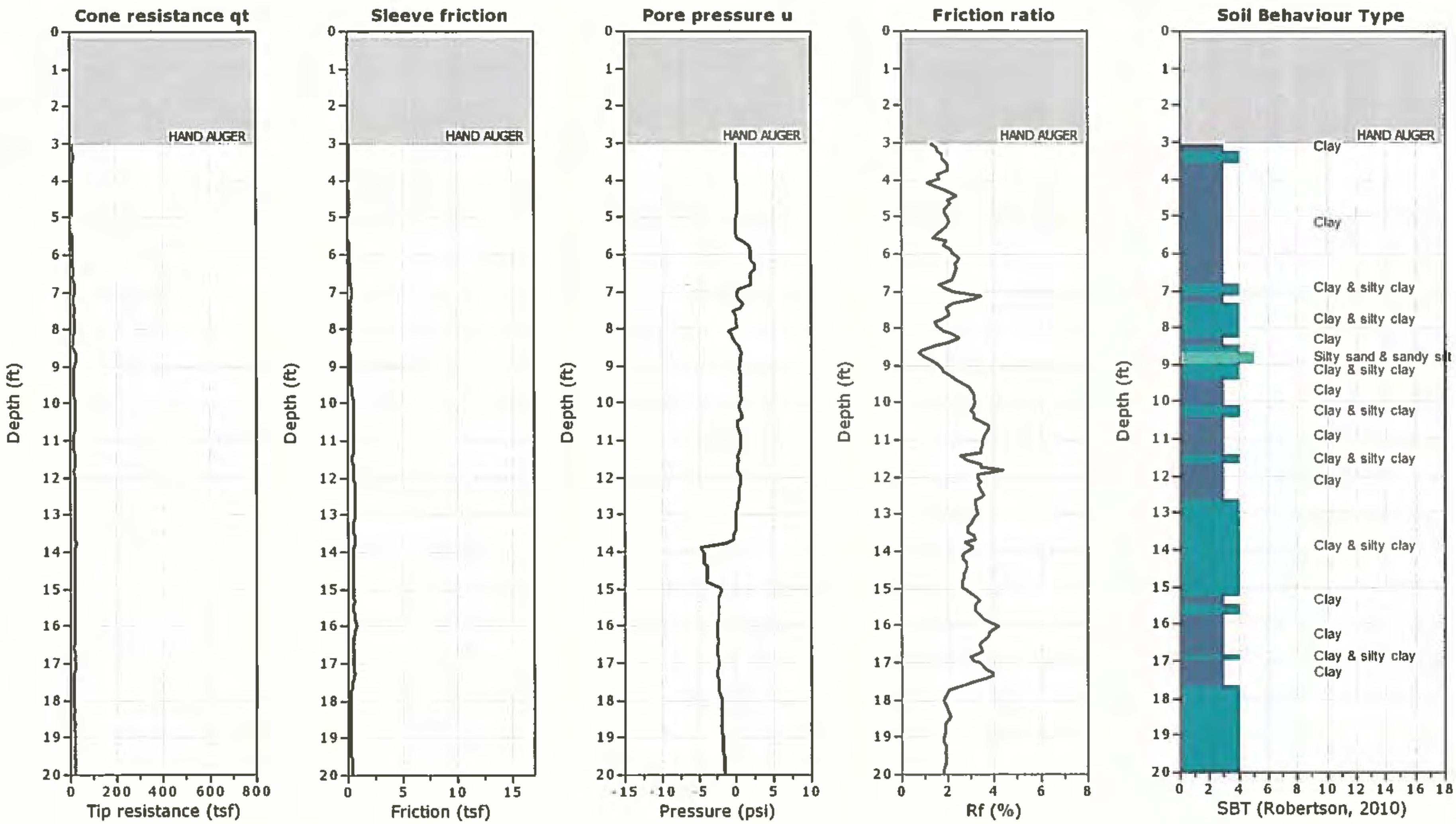
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-10
Total depth: 80.42 ft, Date: 5/12/2015
Cone Type: Vertek



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Project file: C:\AppliedLosAngeles4-5-15\CPeT Data\Plot Data\Plots w-ha.cpt

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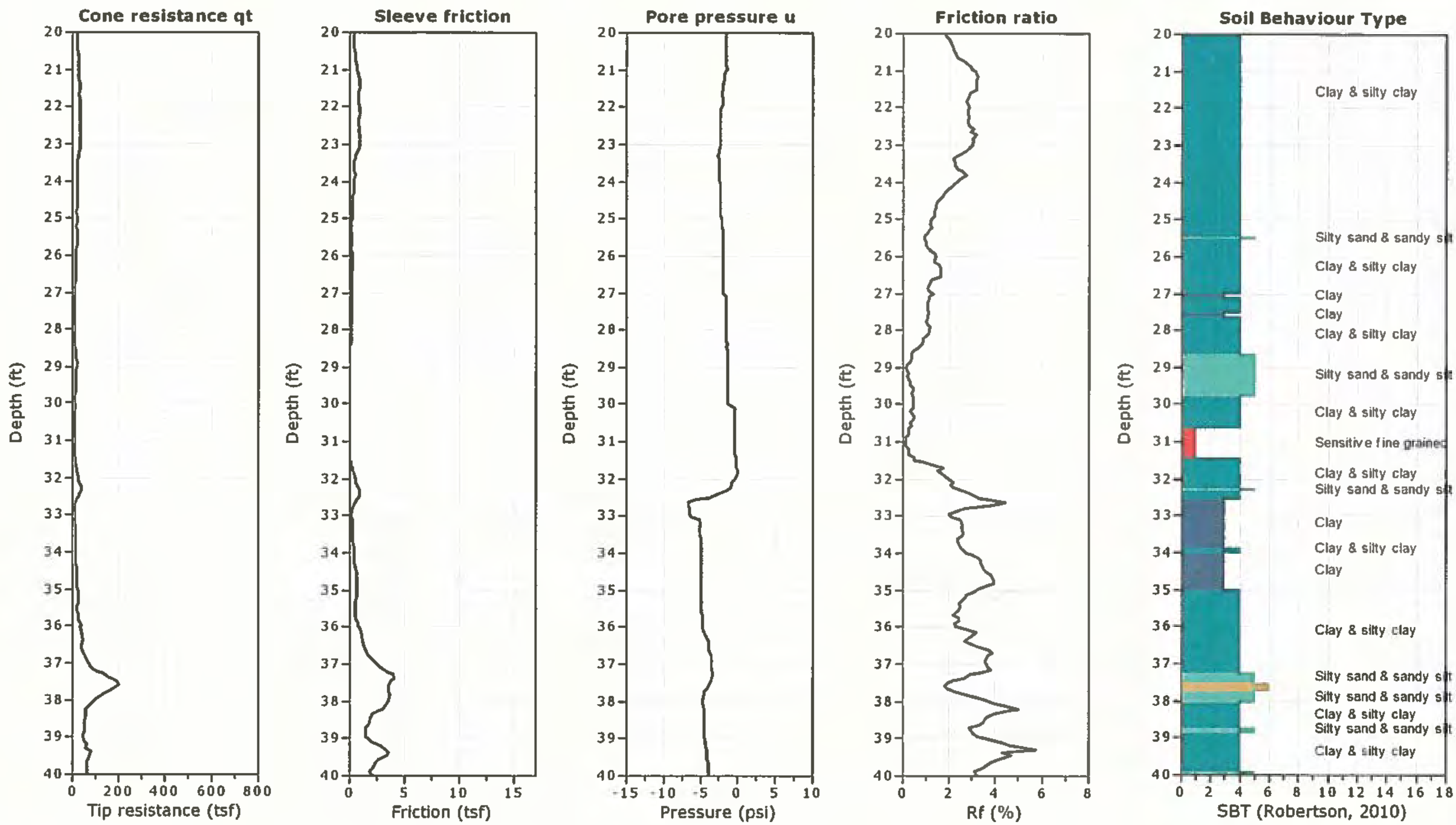
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-10
Total depth: 80.42 ft, Date: 5/12/2015
Cone Type: Vertek



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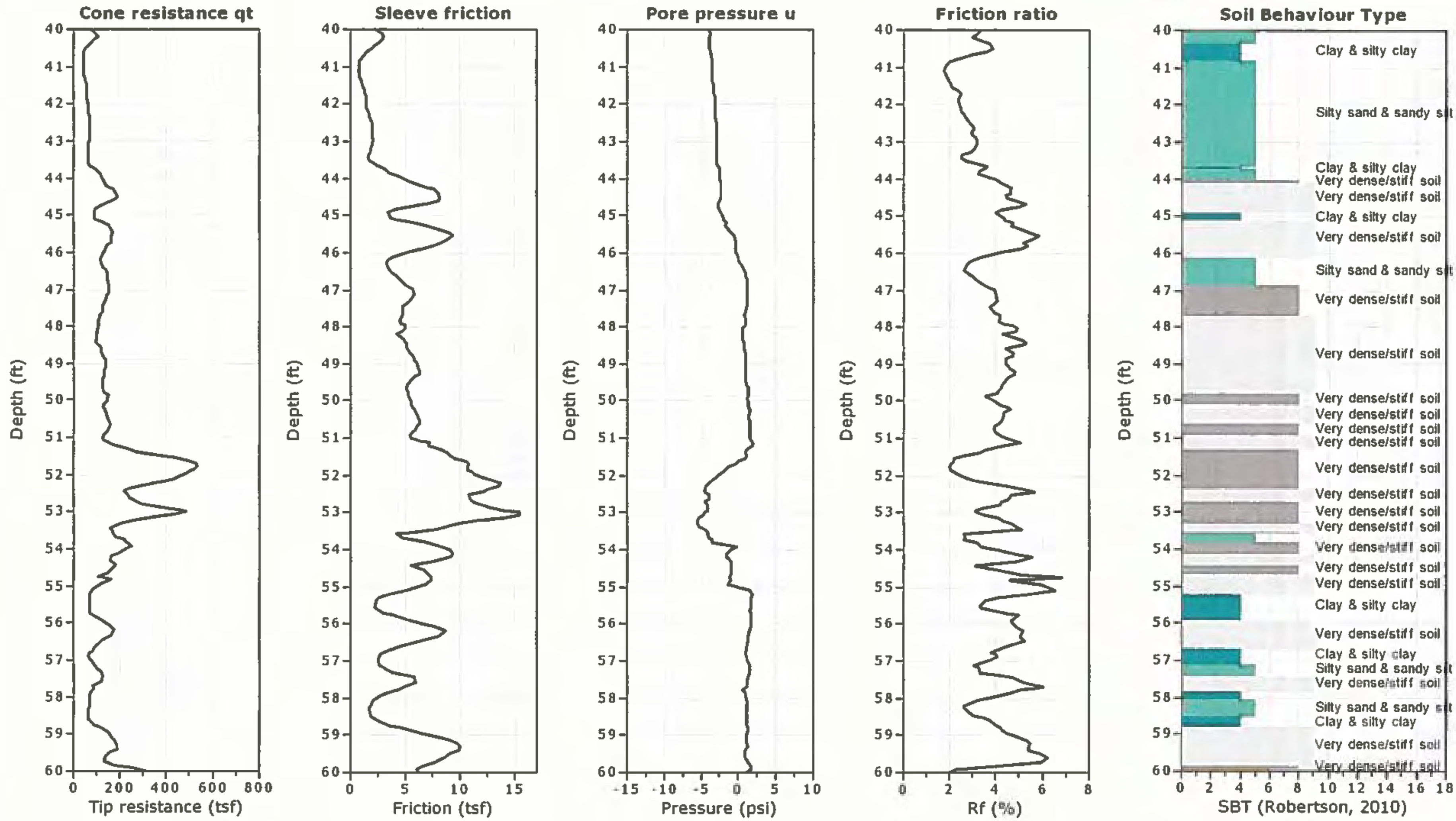
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-10
Total depth: 80.42 ft, Date: 5/12/2015
Cone Type: Vertek



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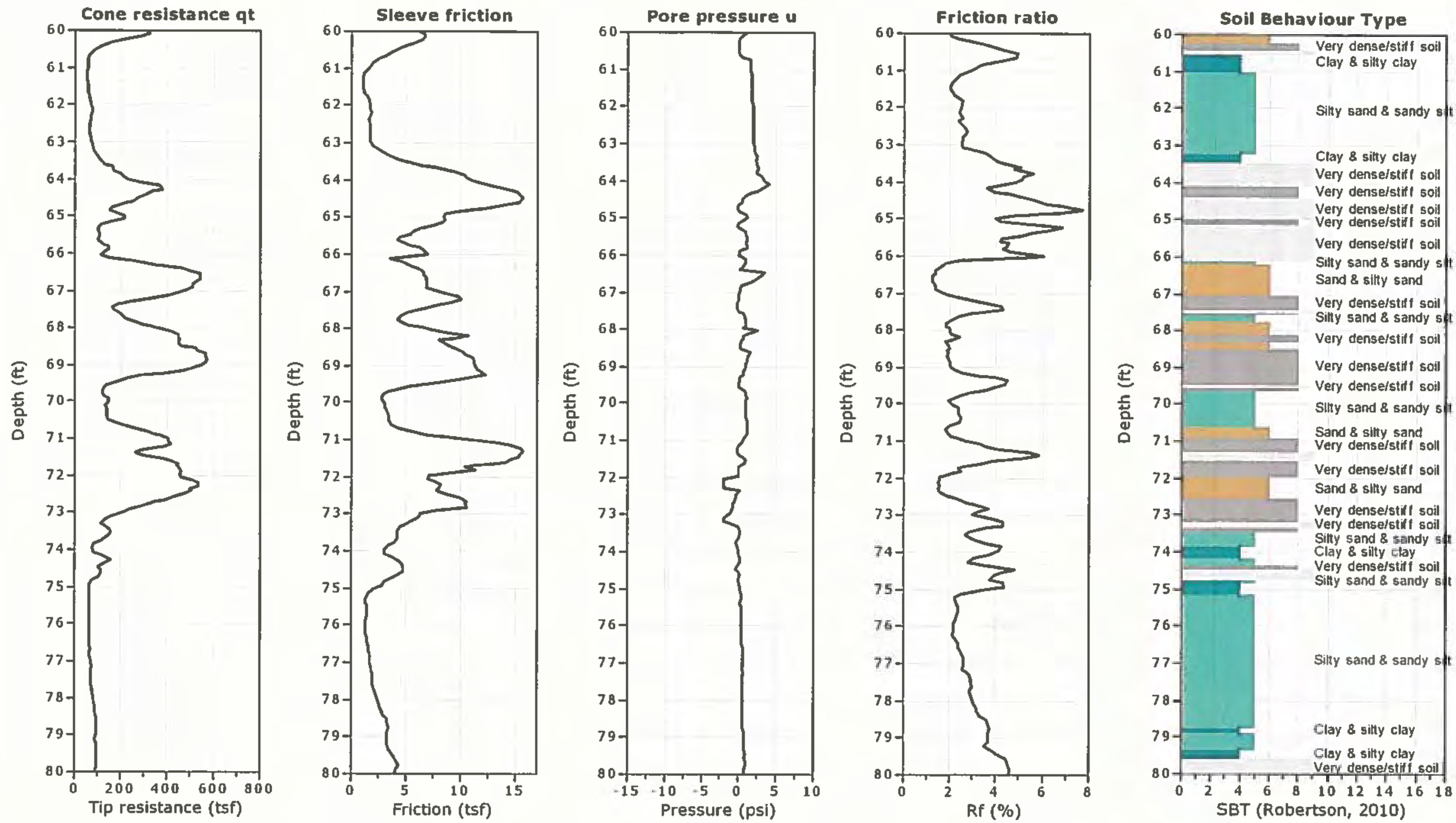
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-10
Total depth: 80.42 ft, Date: 5/12/2015
Cone Type: Vertek



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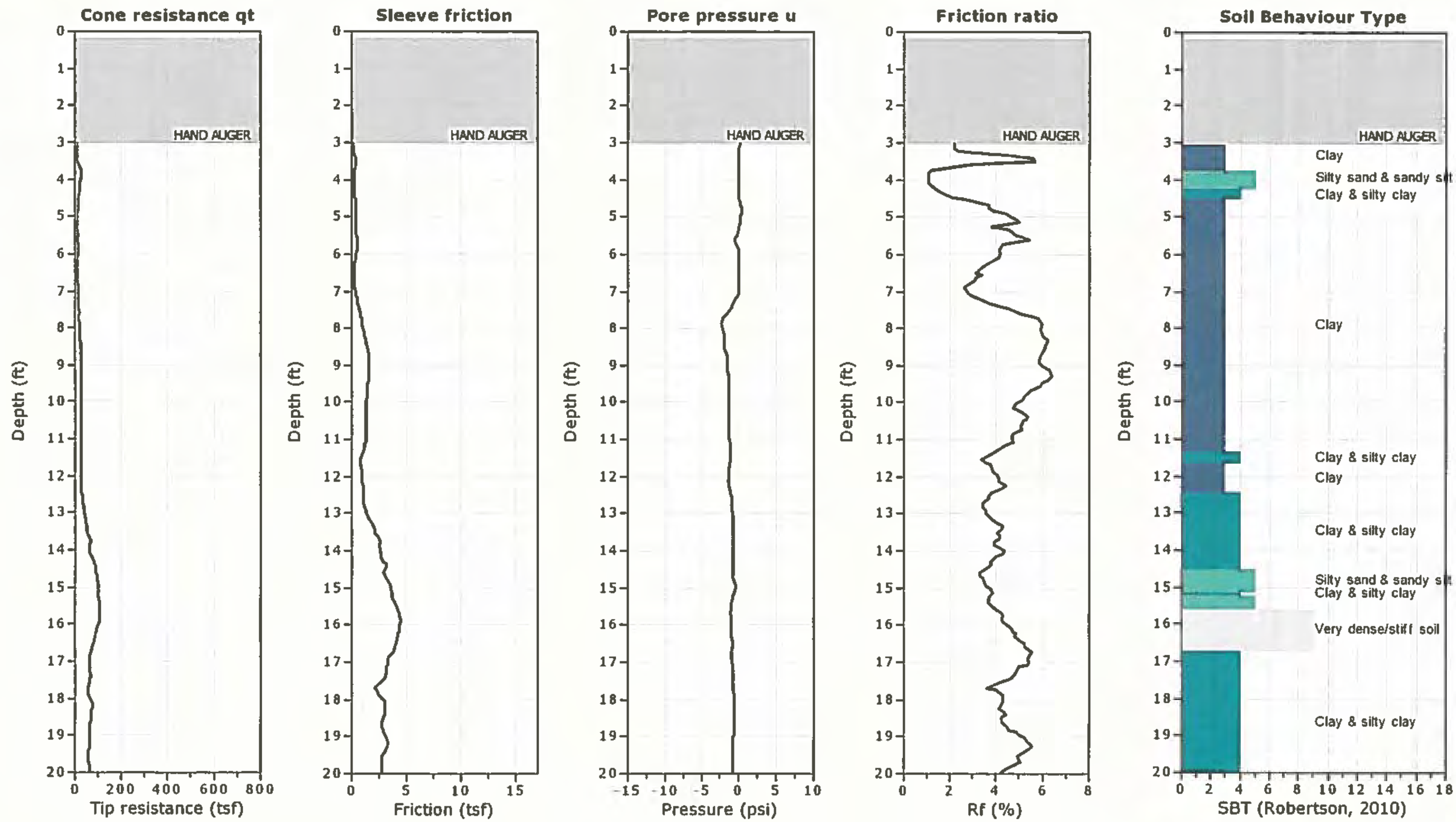
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-11
Total depth: 80.46 ft, Date: 5/12/2015
Cone Type: Vertek



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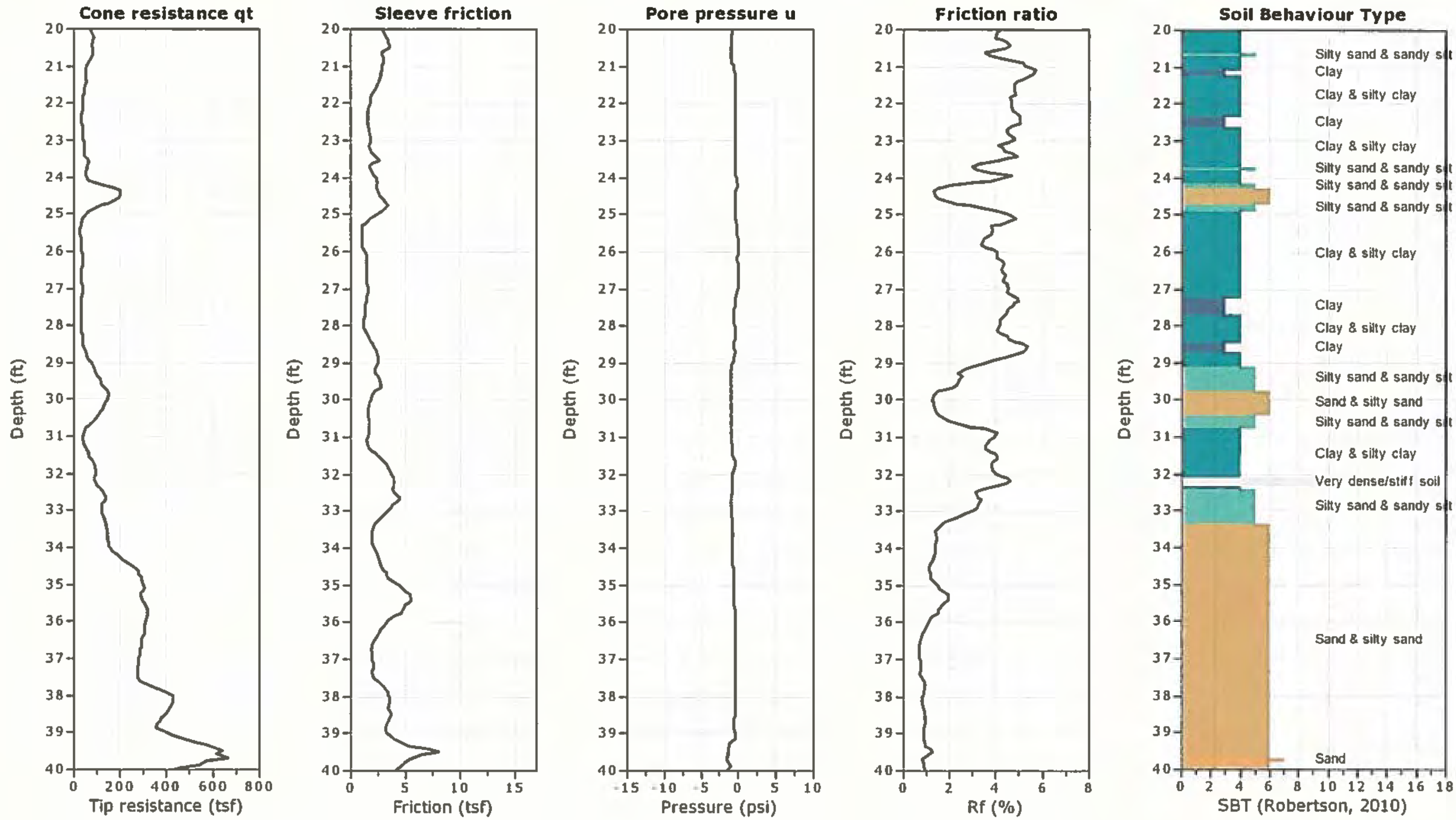
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-11
Total depth: 80.46 ft, Date: 5/12/2015
Cone Type: Vertek



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Project file: C:\AppliedLosAngeles4-5-15\CPeT Data\Plot Data\Plots w-ha.cpt

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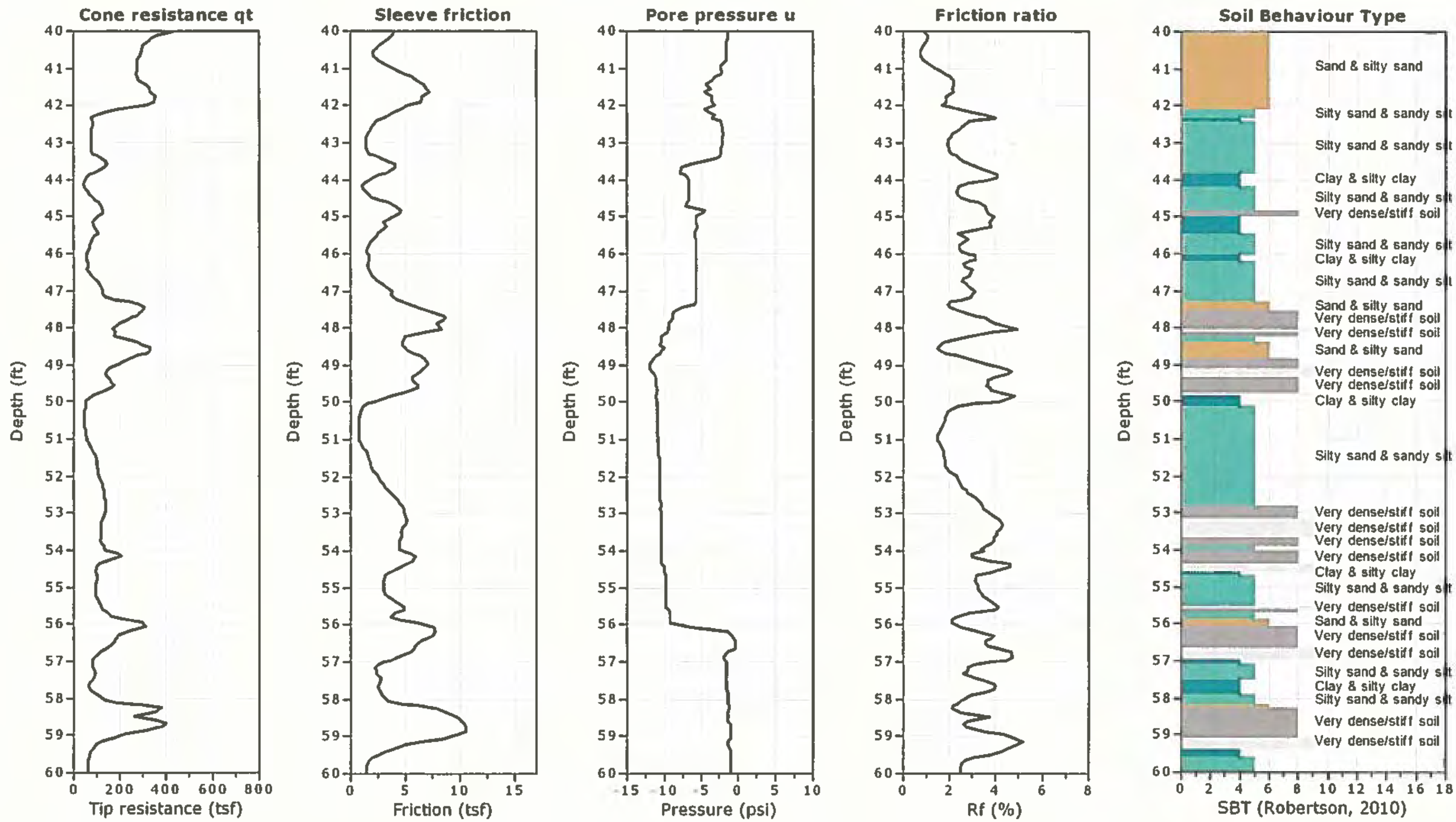
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-11
Total depth: 80.46 ft, Date: 5/12/2015
Cone Type: Vertek



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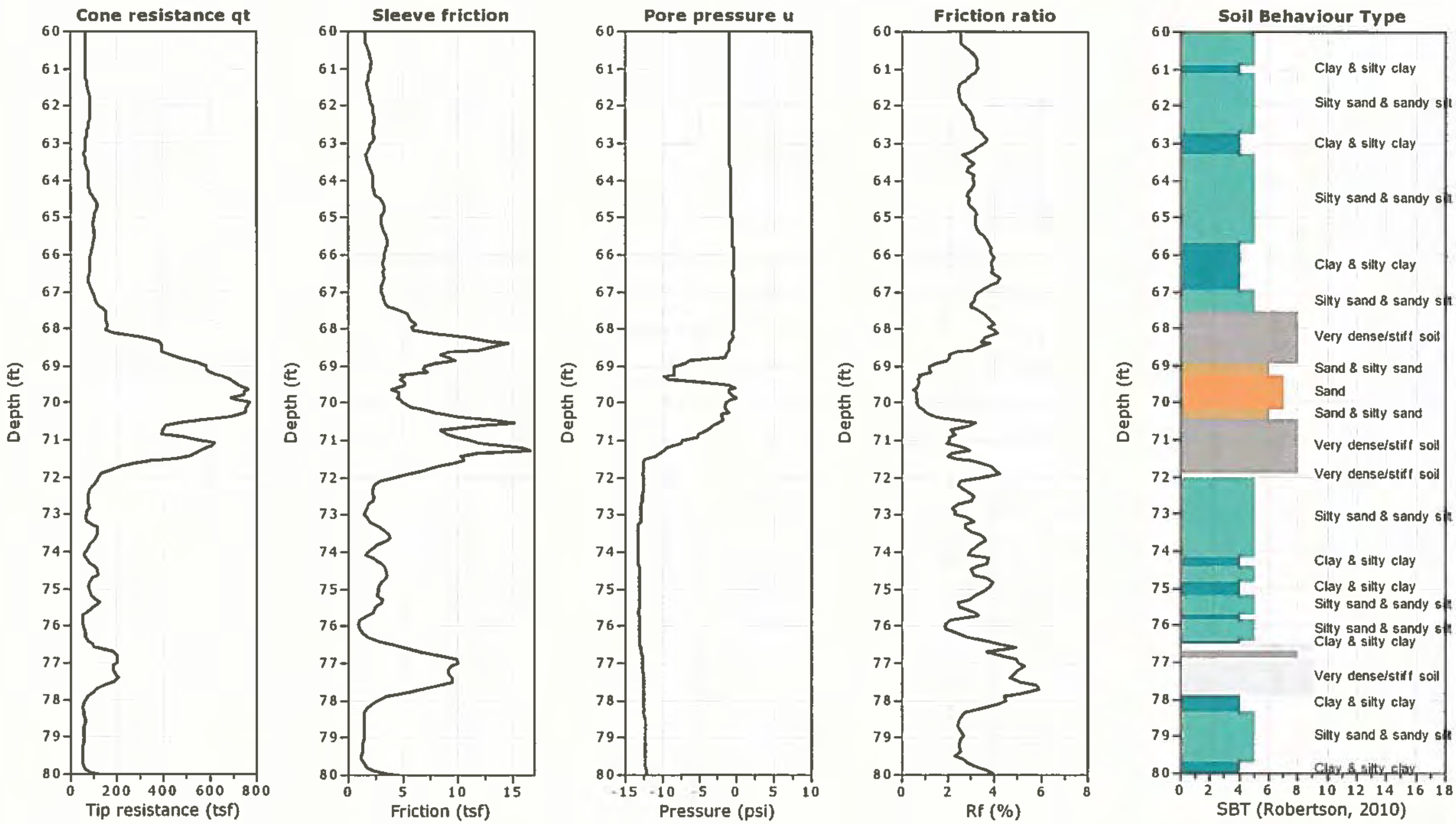
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-11
Total depth: 80.46 ft, Date: 5/12/2015
Cone Type: Vertek



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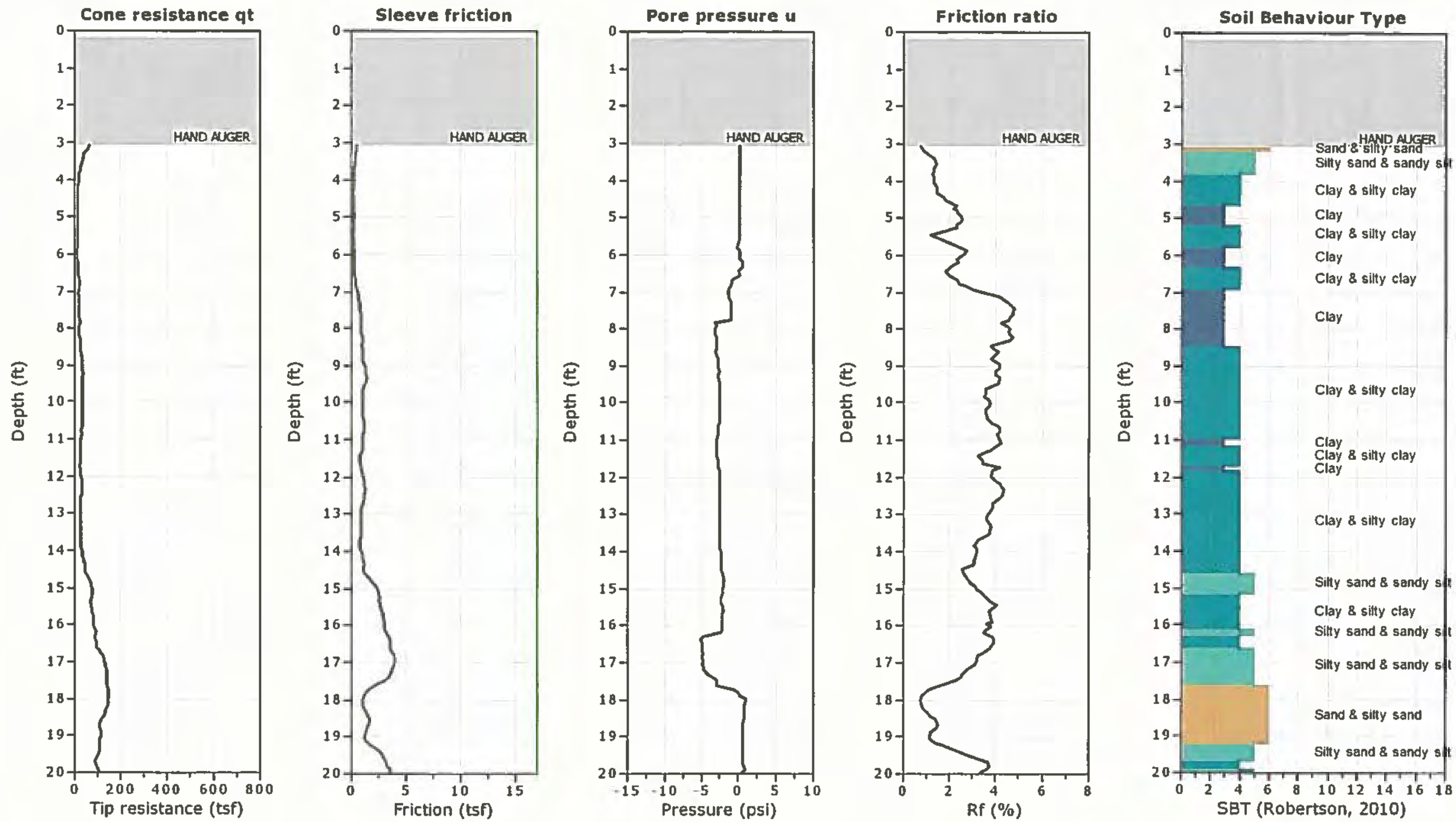
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-12
Total depth: 71.08 ft, Date: 5/12/2015
Cone Type: Vertek



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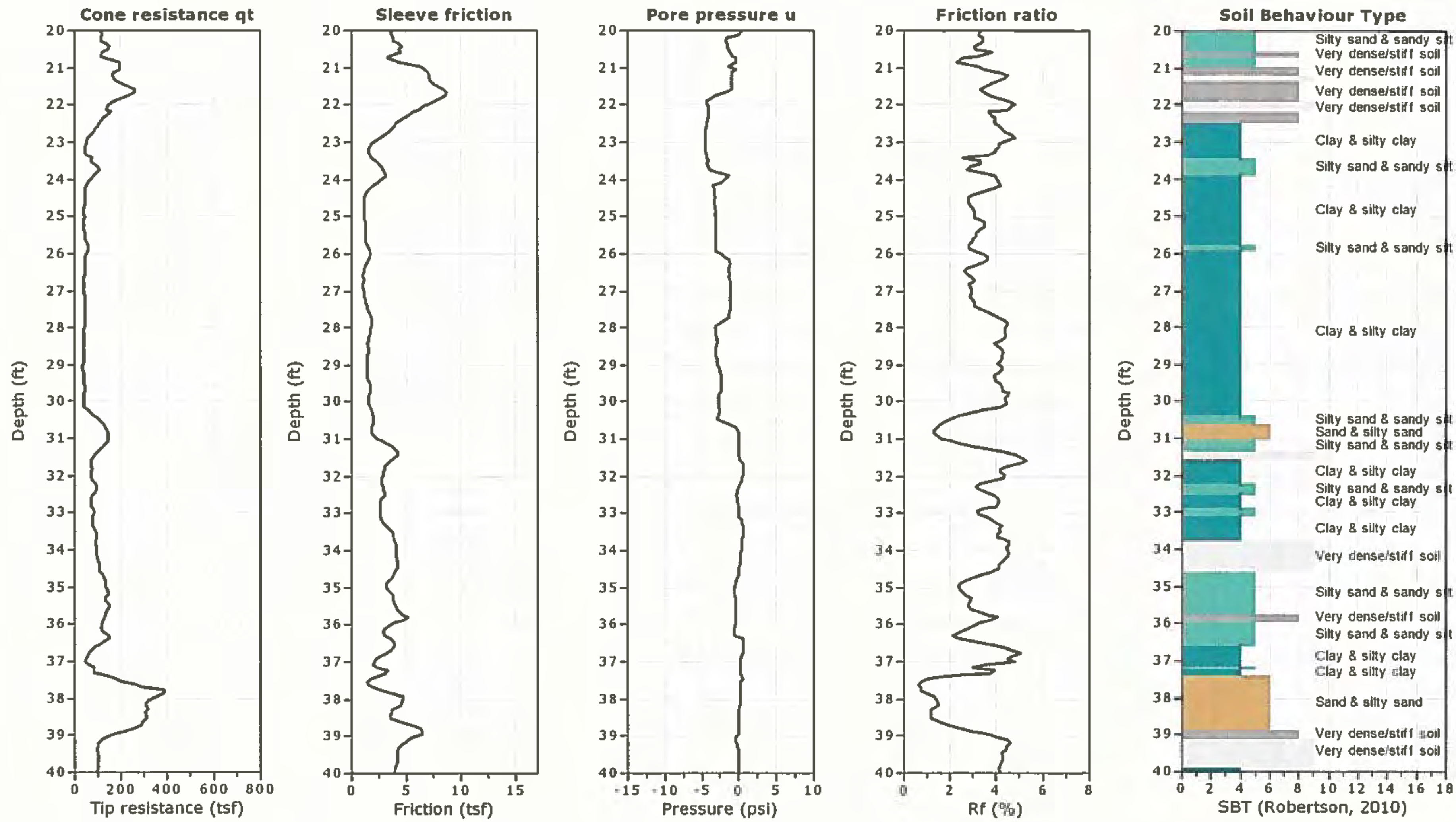
rich@kehoetesting.com
www.kehoetesting.com

Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-12
Total depth: 71.08 ft, Date: 5/12/2015
Cone Type: Vertek



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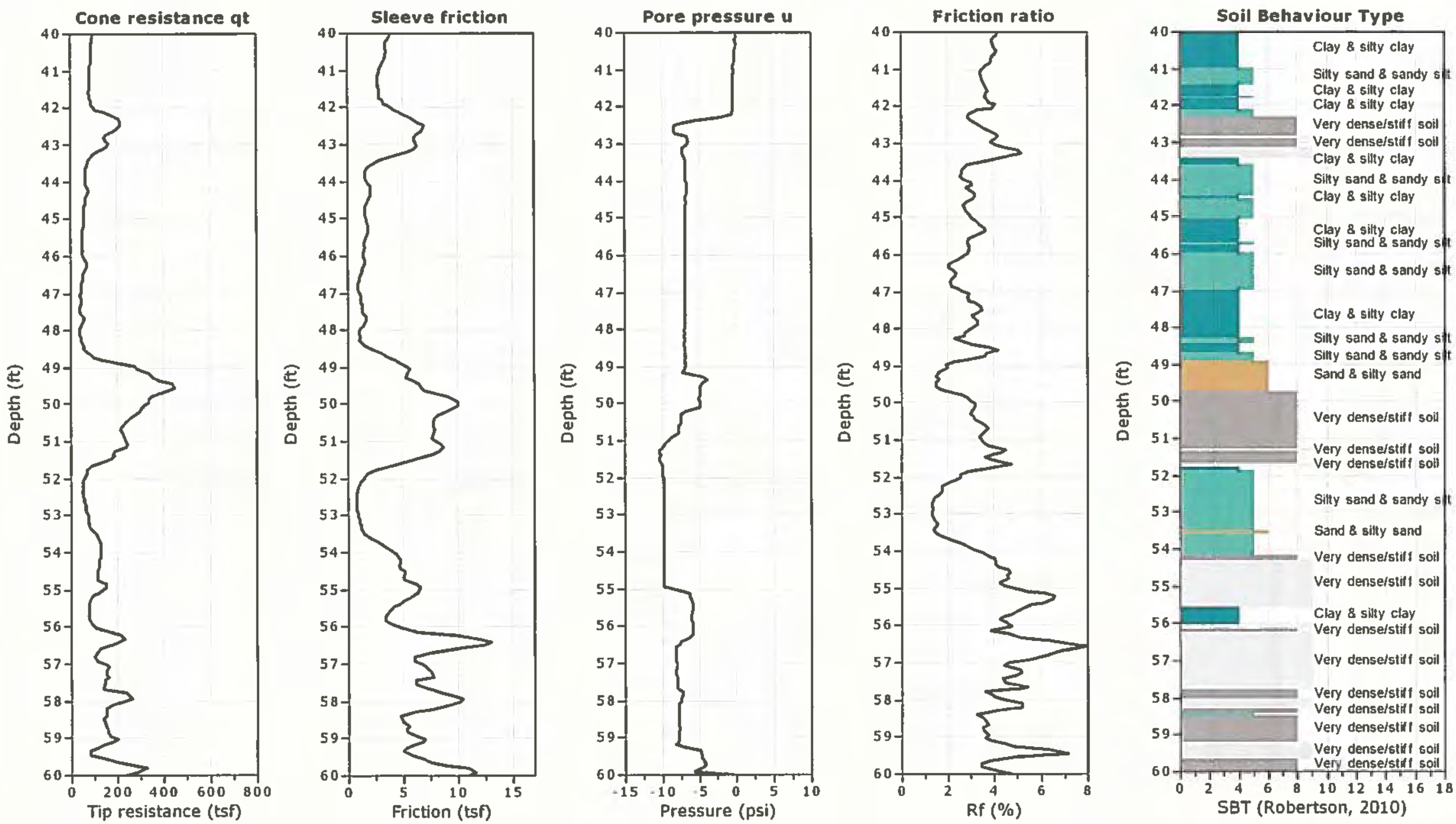

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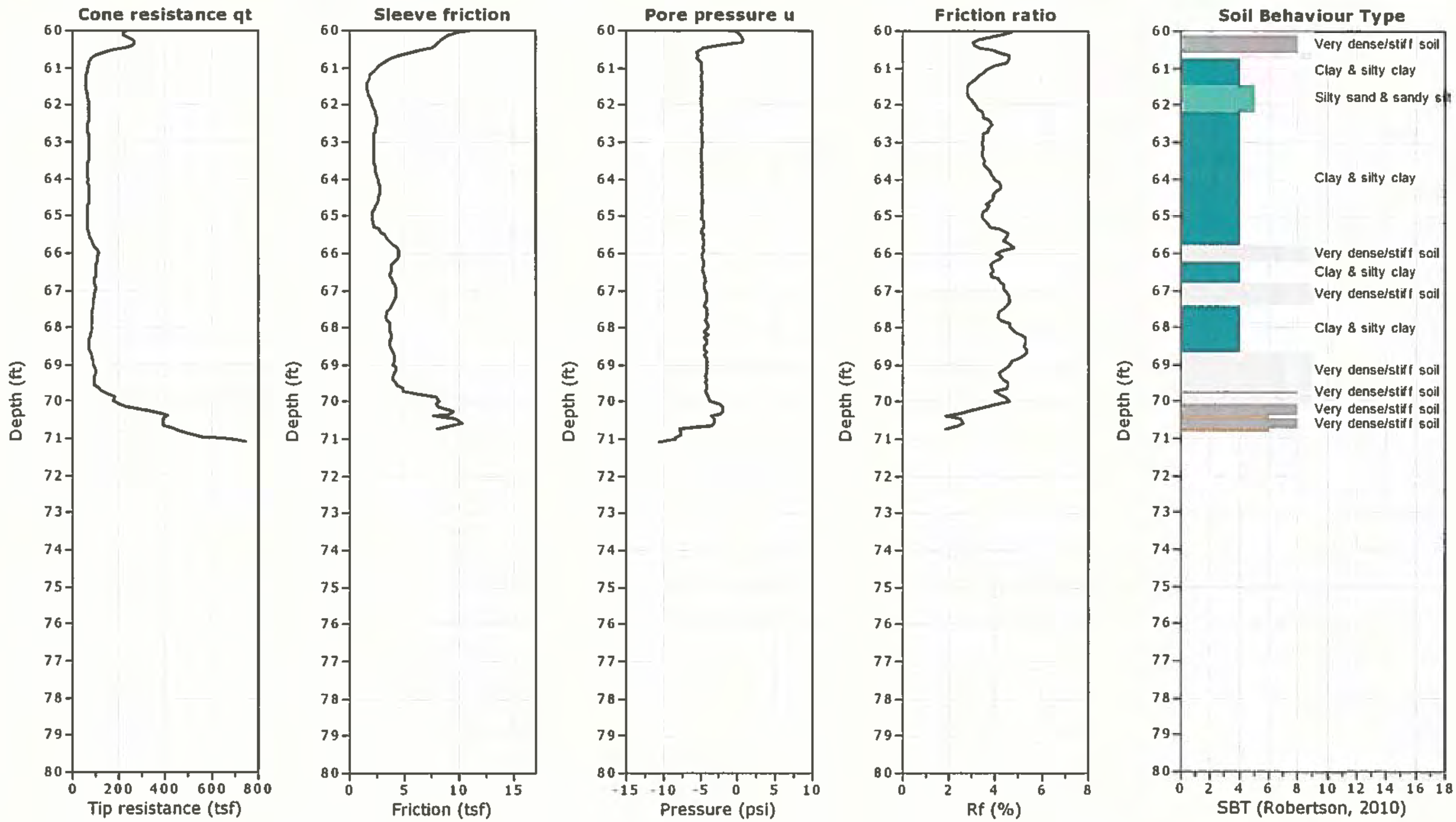

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Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

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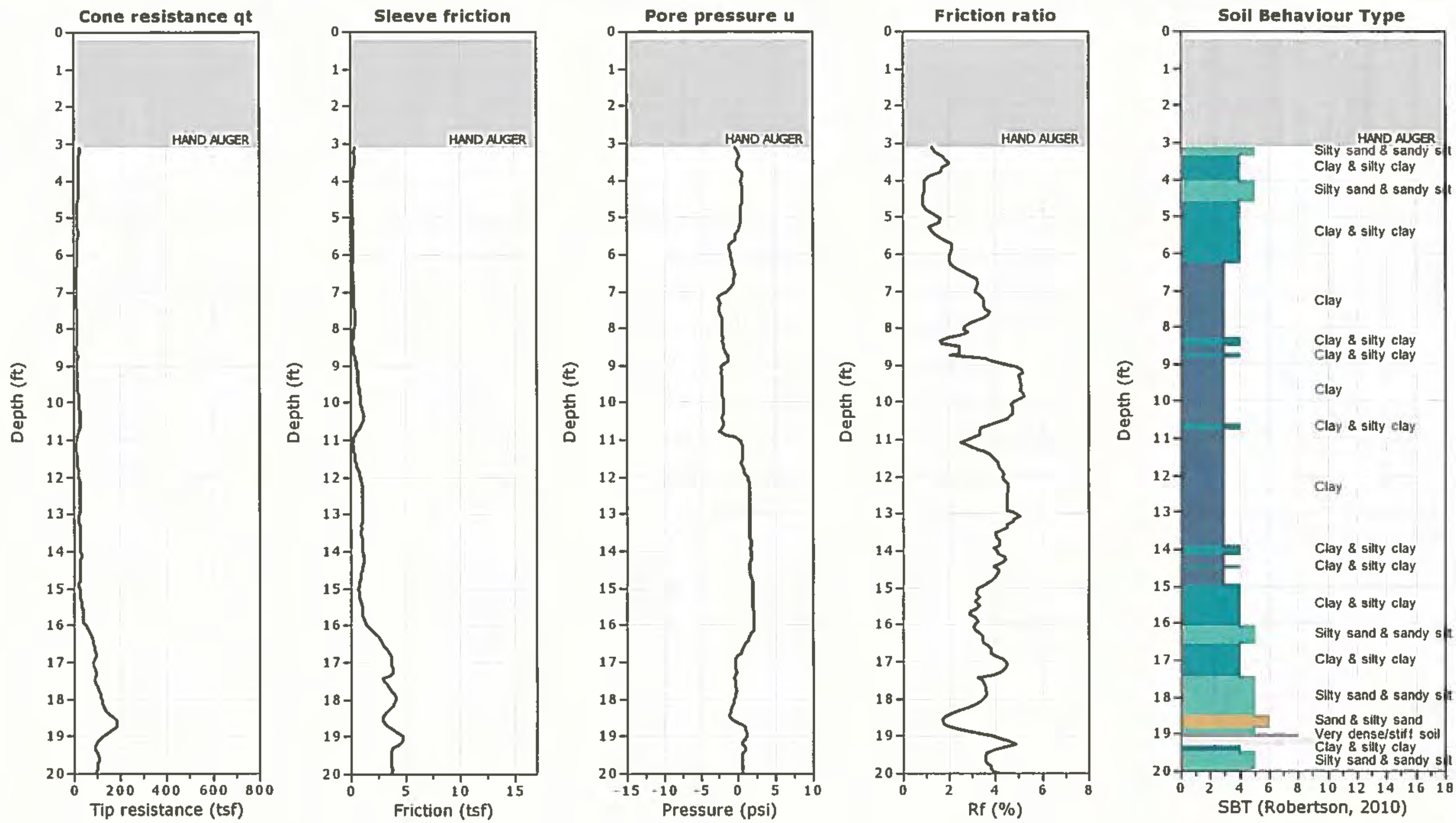
Cone Type: Vertek



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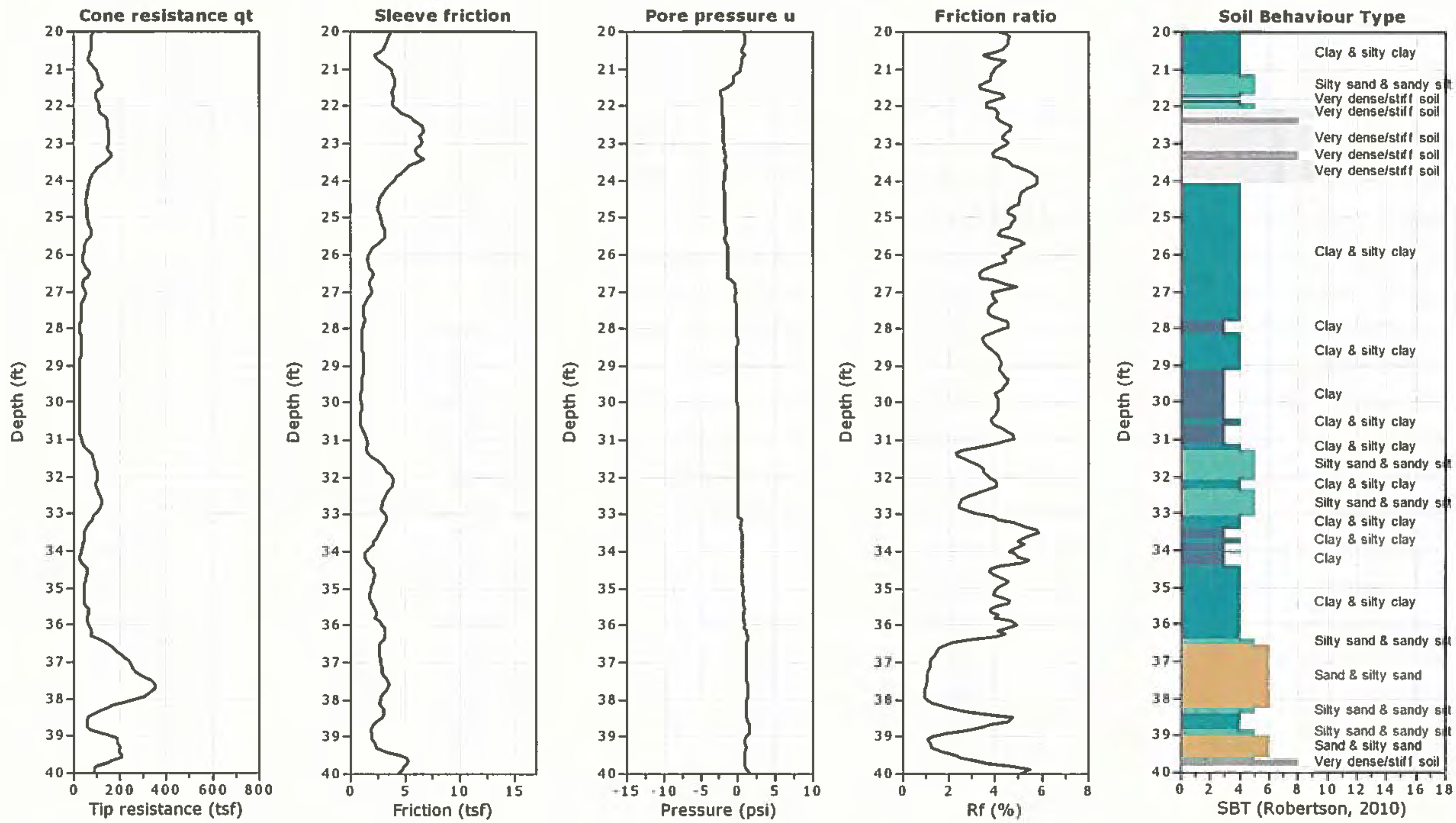

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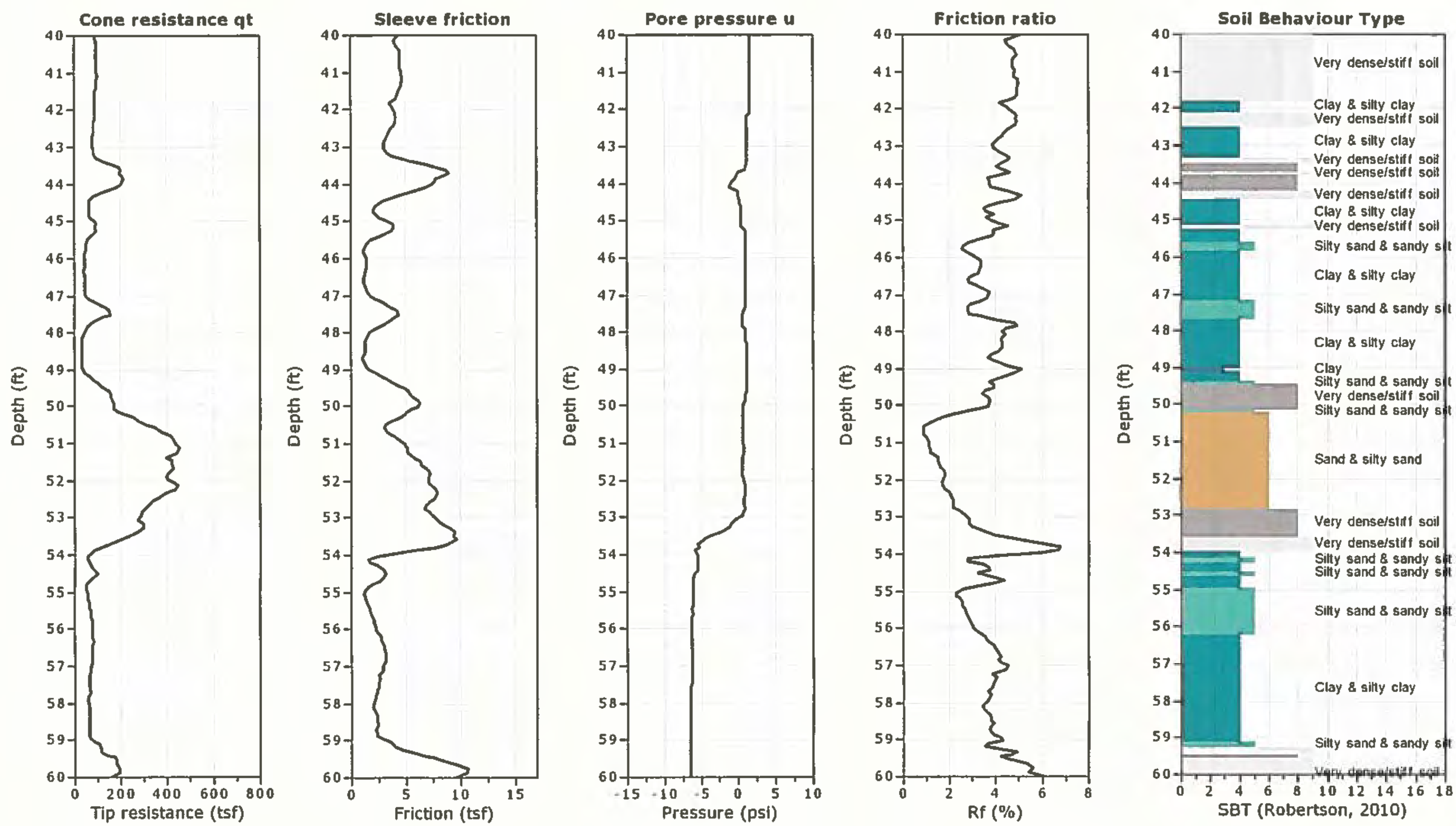

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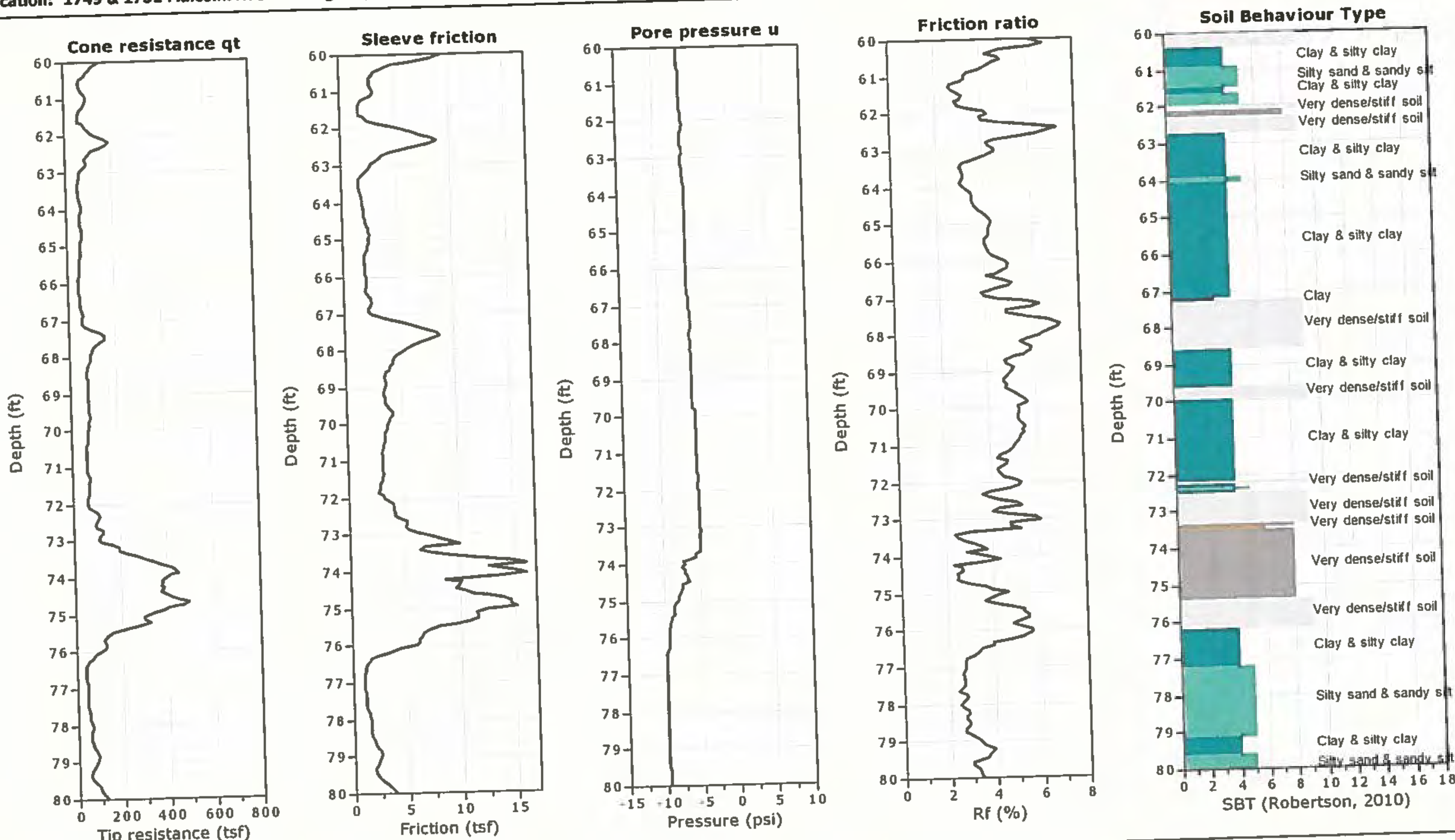

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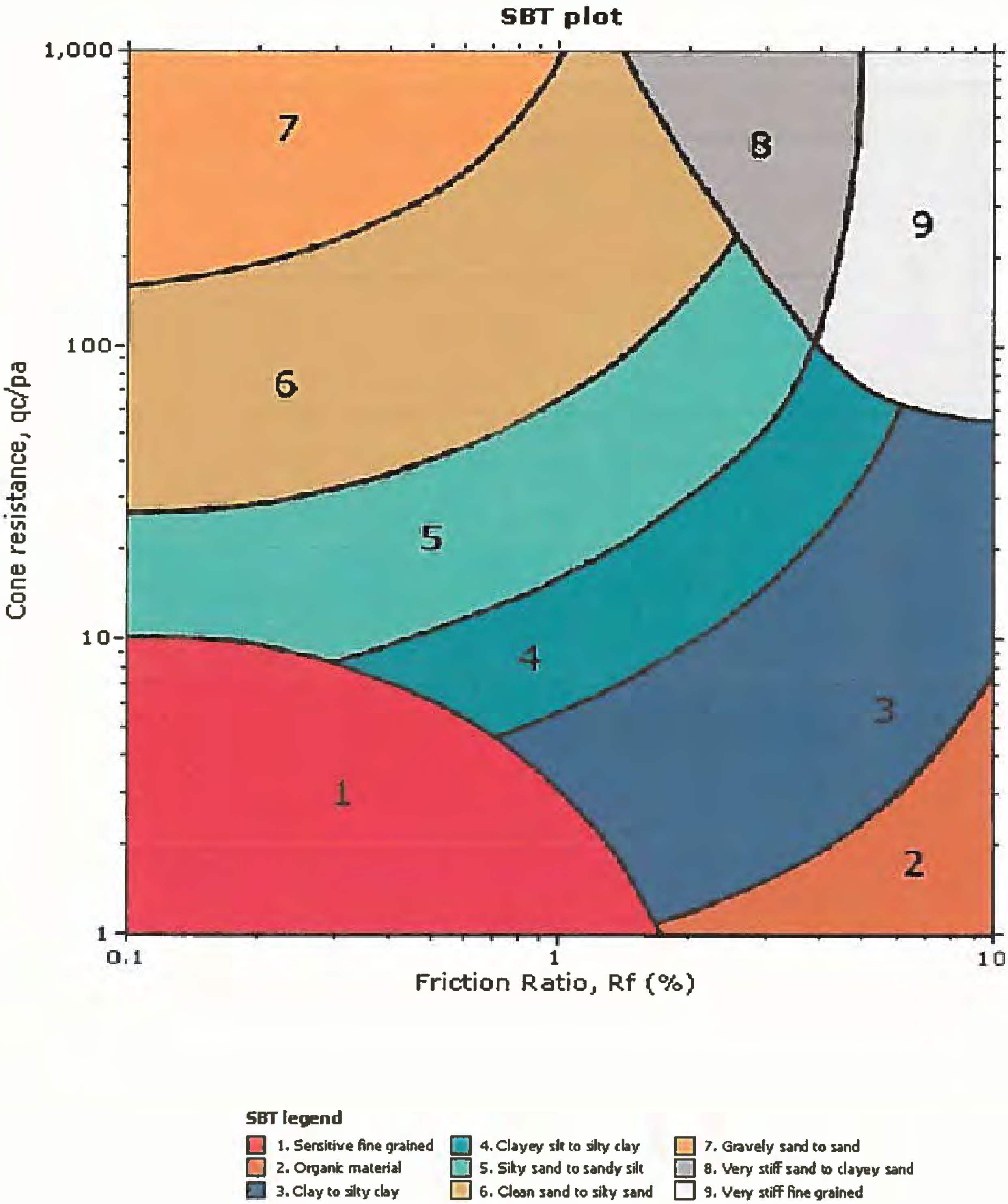


	CPT-1	In situ data										Basic output data								
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	98.2	0.36	0.2	-0.61	98.20245	0.3666	6	1.69475	113.9837	0.05699	0	0.057	1722.1	0.3668	0.0002	7	0.3551	2.8215	1.3124	261.7113
2	225.6	0.78	0.21	-0.89	225.6026	0.3457	6	1.3704	121.6698	0.11783	0	0.1178	1913.7	0.3459	7E-05	7	0.2924	1.8998	1.1491	404.8405
3	86.9	0.34	0	-0.77	86.9	0.3913	6	1.75491	113.2673	0.17446	0	0.1745	497.11	0.392	0	6	0.4189	2.1279	1.4733	174.4066
4	100.3	0.4	0.1	-0.92	100.3012	0.3988	6	1.70392	114.8062	0.23186	0	0.2319	431.59	0.3997	7E-05	6	0.4215	1.8962	1.4679	179.3289
5	118.5	0.15	-0.1	-0.93	118.4988	0.1266	6	1.45693	108.0361	0.28588	0	0.2859	413.5	0.1269	-6E-05	7	0.3475	1.5758	1.2664	176.0482
6	83.2	1.09	-0.29	-1.08	83.19645	1.3102	5	2.06573	121.6852	0.34672	0	0.3467	238.95	1.3156	-3E-04	6	0.5758	1.901	1.8644	148.849
7	142	1.36	-0.74	-1.09	141.9909	0.9578	6	1.80132	124.6083	0.40903	0	0.409	346.14	0.9606	-4E-04	6	0.4993	1.6073	1.6552	215.0702
8	87.7	1.26	-0.62	-1.06	87.69241	1.4368	5	2.07476	122.8741	0.47047	0	0.4705	185.4	1.4446	-5E-04	6	0.6049	1.6328	1.924	134.5975
9	84.1	2.19	-0.69	-1.04	84.09155	2.6043	5	2.26709	126.8166	0.53387	0	0.5339	156.51	2.6209	-6E-04	5	0.6884	1.6014	2.1345	126.4615
10	78.9	2.14	-0.76	-1.17	78.8907	2.7126	5	2.29907	126.4919	0.59712	0	0.5971	131.12	2.7333	-7E-04	5	0.7105	1.5016	2.1848	111.1071
11	127.1	1.77	-1.88	-1.48	127.077	1.3929	6	1.94772	126.2657	0.66025	0	0.6603	191.47	1.4001	-0.001	6	0.5922	1.3222	1.8663	157.9668
12	127.8	2.51	-1.11	-1.81	127.7864	1.9642	5	2.05339	128.8351	0.72467	0	0.7247	175.34	1.9754	-6E-04	6	0.6413	1.2748	1.9871	153.0772
13	200.3	3.66	-1.07	-2.02	200.2869	1.8274	6	1.90231	132.691	0.79102	0	0.791	252.2	1.8346	-4E-04	6	0.5954	1.1891	1.8585	224.1999
14	250.3	7.91	-0.89	-2.34	250.2891	3.1604	8	2.03934	137.28	0.85966	0	0.8597	290.15	3.1712	-3E-04	8	0.6566	1.1461	2.0102	270.1764
15	169.7	5.39	-6.9	-2.14	169.6155	3.1778	8	2.13684	135.1178	0.92721	0	0.9272	181.93	3.1952	-0.003	8	0.7003	1.0969	2.1166	174.8708
16	224.9	3.95	-2.48	-2.06	224.8696	1.7566	6	1.85763	133.5313	0.99398	0	0.994	225.23	1.7644	-8E-04	6	0.602	1.0384	1.8503	219.6956
17	209.7	4.78	-2.08	-2	209.6745	2.2797	6	1.96611	134.7562	1.06136	0	1.0614	196.55	2.2913	-7E-04	6	0.6506	0.998	1.9697	196.7638
18	132.1	3.98	-4.59	-1.77	132.0438	3.0142	5	2.18507	132.2881	1.1275	0	1.1275	116.11	3.0401	-0.003	5	0.7427	0.9539	2.2033	118.025
19	82.2	2.57	-2.5	-1.61	82.1694	3.1277	5	2.33191	127.9309	1.19147	0	1.1915	67.965	3.1737	-0.002	5	0.8091	0.9084	2.3693	69.52295
20	97.9	1.72	-3.06	-1.38	97.86255	1.7576	5	2.09946	125.4188	1.25418	0	1.2542	77.029	1.7804	-0.002	5	0.7271	0.8837	2.1462	80.68755
21	99.7	1.45	-2.68	-1.38	99.6672	1.4548	5	2.03719	124.214	1.31628	0	1.3163	74.719	1.4743	-0.002	5	0.7107	0.8563	2.0953	79.58985
22	55.5	1.54	-2.48	-1.36	55.46964	2.7763	5	2.4148	123.2253	1.3779	0	1.3779	39.257	2.847	-0.003	4	0.8691	0.7949	2.5034	40.63801
23	97.8	1.79	-3.23	-1.32	97.76046	1.831	5	2.11222	125.7082	1.44075	0	1.4408	66.854	1.8584	-0.002	5	0.7545	0.7922	2.1945	72.1163
24	95	2.01	-3.46	-1.23	94.95765	2.1167	5	2.16573	126.4854	1.50399	0	1.504	62.137	2.1508	-0.003	5	0.7828	0.7594	2.2609	67.06775
25	40.6	0.87	-3.17	-1.18	40.5612	2.1449	5	2.44243	118.2835	1.56314	0	1.5631	24.949	2.2309	-0.006	4	0.9099	0.7012	2.5873	25.84182
26	50.5	1	-7.27	-1.15	50.41102	1.9837	5	2.34819	119.8327	1.62305	0	1.6231	30.059	2.0497	-0.011	5	0.8776	0.687	2.4948	31.67566
27	42.1	0.94	-7.75	-1.16	42.00514	2.2378	5	2.44251	118.9351	1.68252	0	1.6825	23.966	2.3312	-0.014	4	0.9253	0.6511	2.613	24.81045
28	50.4	0.9	-7.66	-1.18	50.30624	1.789	5	2.32016	119.0567	1.74205	0	1.7421	27.878	1.8532	-0.011	5	0.8823	0.6441	2.4922	29.56217
29	130.7	2.5	-1.94	-1.2	130.6763	1.9131	5	2.03839	128.8604	1.80648	0	1.8065	71.338	1.9399	-0.001	5	0.7624	0.6651	2.1706	81.00373
30	154.3	2.9	-1.82	-1.32	154.2777	1.8797	6	1.98458	130.3514	1.87165	0	1.8717	81.429	1.9028	-9E-04	5	0.7456	0.6536	2.1182	94.14619
31	64.7	2.47	-1.82	-1.49	64.67772	3.8189	4	2.46619	127.0567	1.93518	0	1.9352	32.422	3.9367	-0.002	4	0.956	0.5615	2.6623	33.29464
32	108	3.62	-2.58	-1.52	107.9684	3.3528	5	2.27633	131.1035	2.00073	0	2.0007	52.964	3.4161	-0.002	4	0.879	0.5712	2.4511	57.20803
33	180.8	1.7	-1.56	-1.57	180.7809	0.9404	6	1.71903	126.8301	2.06415	0	2.0642	86.581	0.9512	-6E-04	6	0.6597	0.6435	1.8686	108.6904
34	197.3	2.3	-1.72	-1.61	197.279	1.1659	6	1.75902	129.2549	2.12878	0	2.1288	91.672	1.1786	-6E-04	6	0.6794	0.6219	1.9123	114.7055
35	290.3	2.8	-1.72	-1.55	290.279	0.9646	6	1.58584	131.6363	2.19459	0	2.1946	131.27	0.9719	-4E-04	6	0.6102	0.6407	1.7226	174.4427
36	367.3	2.39	-1.71	-1.46	367.2791	0.6507	6	1.38995	131.0516	2.26012	0	2.2601	161.5	0.6548	-3E-04	6	0.5353	0.6662	1.5174	229.8046
37	340.3	3.77	-1.91	-1.27	340.2766	1.1079	6	1.58927	134.2003	2.32722	0	2.3272	145.22	1.1156	-4E-04	6	0.6194	0.6137	1.7302	196.015
38	302.9	3.7	-1.15	-1.21	302.8859	1.2216	6	1.6537	133.7793	2.39411	0	2.3941	125.51	1.2313	-3E-04	6	0.6529	0.5868	1.8097	166.6382
39	329.7	4.52	-1.34	-0.73	329.6836	1.371	6	1.67182	135.4508	2.46184	0	2.4618	132.92	1.3813	-3E-04	6	0.6635	0.571	1.8293	176.5932
40	324.8	2.12	-2.2	-0.72	324.7731	0.6528	6	1.4272	129.8745	2.52677	0	2.5268	127.53	0.6579	-5E-04	6	0.5756	0.6059	1.5897	184.5288
41	279.1	4.09	-2.49	-0.92	279.0695	1.4656	6	1.73812	134.3128	2.59393	0.0312	2.5627	107.88	1.4793	-8E-04	6	0.7025	0.5372	1.9188	140.3661
42	329.1	4.02	-2.39	-0.84	329.0708	1.2216	6	1.6319	134.5885	2.66122	0.0624	2.5988	125.6	1.2316	-7E-04	6	0.6601	0.5526	1.803	170.465
43	252.5	3.12	-2.78	-0.67	252.466	1.2358	6	1.70716	132.0876	2.72727	0.0936	2.6337	94.825	1.2493	-0.001	6	0.6999	0.5282	1.9032	124.671
44	324.6	4.85	-3.19	-0.85	324.561	1.4943	6	1.70623	135.9282	2.79523	0.1248	2.6704	120.49	1.5073	-0.001	6	0.6953	0.5254	1.8865	159.763
45	237.7	6.2	-3.82	-0.82	237.6532	2.6088	8	1.98222	136.9649	2.86371	0.156	2.7077	86.711	2.6407	-0.002	5	0.8142	0.4653	2.1944	103.2504
46	155.1	6.83	-13.08	-0.48	154.9399	4.4082	9	2.27526	136.6296	2.93203	0.1872	2.7448	55.38	4.4932	-0.007	4	0.9448	0.4063	2.5317	58.36945
47	87.6	3.59	-13.78	-0.62	87.43133	4.1061	4	2.40267	130.528	2.99729	0.2184	2.7789	30.384	4.2518	-0.014	4	1	0.3808	2.7142	30.38407
48	201.8	9.33	-14.06	-0.78	201.6279	4.6273	9	2.22947	137.28	3.06593	0.2496	2.8163	70.504	4.6988	-0.006	4	0.9254	0.4042	2.4714	75.84249
49	447.1	10.09	-5.91	-1.05	447.0277	2.2571	8	1.78571	137.28	3.13457	0.2808	2.8538	155.55	2.2731	-0.002	6	0.7314	0.484	1.9588	203.0496
50	97.7	3.45	-8.75	-1.29	97.5929	3.5351	5	2.3222	130.5051	3.19982	0.312	2.8878	32.687	3.6549	-0.01	4	0.9947	0.3684	2.6447	32.86032
51	62.6	1.35	-8.9	-1.37	62.49106	2.1603	5	2.30264	122.5525	3.2611	0.3432	2.9179	20.299	2.2793	-0.017	4	1	0.3626	2.6769	20.29883
52	120.8	3.74	-8.84	-1.62	120.6918	3.0988	5	2.21908	131.6138	3.32691	0.3744	2.9525	39.751	3.1866	-0.009	4	0.9534	0.3759	2.5282	41.69721
53	149.8	6.65	-8.61	-2.14	149.6946	4.4424	9	2.28661	136.3502	3.39508	0.4056	2.9895	48.938	4.5455	-0.007	4	0.9744	0.3635	2.5795	50.25759
54	158.7	11.02	-11.84	-2.7	158.5551	6.9503	9	2.43458	137.28	3.46372	0.4368	3.0269	51.237	7.1055	-0.008	3	1	0.3496	2.7186	51.2373
55	126.5	5.99	-11.9	-2.47	126.3543	4.7406	9	2.35255	135.172	3.53131	0.468	3.0633	40.095	4.8769	-0.011	4	1	0.3454	2.6695	40.09489
56	134.3	5.72	-5.9	-2.04	134.2278	4.2614	9	2.29971	134.9819	3.5988	0.4992	3.0996	42.144	4.3788	-0.007	4	0.9951	0.3432	2.6194	42.36768
57	74.8	2.16	-2.79	-1.79	74.76585	2.889	5	2.33495	126.429	3.66201	0.5304	3.1316	22.705	3.0378	-0.01	4	1	0.3379	2.7143	22.70517
58	61.2	2.23	0.92	-1.68	61.21126	3.6431	4	2.46777	126.1744	3.7251	0.5616	3.1635	18.172	3.8792	-0.009	3	1	0.3345	2.8563	18.17169
59	131.4	8.11	-0.55	-1.57	131.3933	6.1723	9	2.43622	137.28	3.79374	0.5928	3.2009	39.863	6.3558	-0.005	3	1	0.3306	2.7546	39.86312
60	47.6	1.6	0.1	-1.65	47.60122	3.3613	4	2.52021	123.1319	3.85531	0.624	3.2313	13.538	3.6575	-0.014	3	1	0.3275	2.9408	13.53815
61	55	1.35	0.38	-1.86	55.00465	2.4543	5	2.38094	122.2413	3.91643	0.6552	3.2612	15.665	2.6425	-0.012	4	1	0.3245	2.8057	15.66533
62	62.7	2.15	0.48	-2.02	62.70588	3.4287	4	2.44152	125.966	3.97941	0.6864	3.293	17.834	3.661	-0.011	3	1	0.3213	2.8468	17.83367
63	54.5	1.96	0.57	-2.16	54.50698	3.5959	4	2.49886	124.9472	4.04188	0.7176	3.3243	15.181	3.8839	-0.013	3	1	0.3183	2.9175	15.18074
64	107.1	4.95	1.29	-2.18	107.1158	4.6212	9	2.38696	133.3737	4.10857	0.7488	3.3598	30.659	4.8055	-0.006	3	1	0.3149	2.7478	30.65899
65	83.3	3.64	0.77	-2.21	83.30942	4.3693	4	2.43682	130.5114	4.17383	0.78	3.3938	23.318	4.5997	-0.009	3	1	0.3118	2.8221	23.31751
66	77	3.65	0.86	-2.32	77.01053	4.7396	4	2.48585	130.3397	4.239	0.8112	3.4278	21.23	5.0157	-0.01	3	1	0.3087	2.8776	21.22982
67	70.4	2.78	0.86	-2.48	70.41053	3.9483	4	2.45185	128.129	4.30306	0.8424	3.4607	19.103	4.2053	-0.012	3	1	0.3058	2.862	19.10255
68	94.6	2.79	1.15	-2.56	94.61408	2.9488	5	2.27178	128.8759	4.3675	0.8736	3.4939	25.83	3.0915	-0.009	4	1	0.3028	2.6757	25.82976
69	828.2	7.31	-1.09	-2.54	828.1867	0.8827	7	1.3005	137.28	4.43614	0.9048	3.5313	233.27	0.8874	-0.001	6	0.5747	0.5003	1.4622	389.4703

	CPT-2	In situ data										Basic output data								
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	18.5	0.17	0.68	-0.12	18.50832	0.9185	5	2.52189	104.4235	0.05221	0	0.0522	353.49	0.9211	0.0027	6	0.5755	5.6493	1.8927	98.53739
2	14.2	0.06	0.68	0.01	14.20832	0.4223	5	2.48997	96.15833	0.10029	0	0.1003	140.67	0.4253	0.0035	6	0.59	4.015	1.9372	53.5336
3	15.2	0.56	0.77	-0.16	15.20942	3.6819	3	2.92187	112.6676	0.15662	0	0.1566	96.107	3.7202	0.0037	4	0.7888	4.5132	2.4433	64.20475
4	14.4	0.51	0.77	-0.34	14.40942	3.5394	3	2.93009	111.8515	0.21255	0	0.2126	66.793	3.5923	0.0039	4	0.8149	3.6988	2.51	49.62752
5	15.8	0.45	0.85	-0.51	15.8104	2.8462	4	2.84128	111.1619	0.26813	0	0.2681	57.965	2.8953	0.0039	4	0.8064	3.0252	2.4797	44.43656
6	10.8	0.46	0.96	-0.64	10.81175	4.2546	3	3.07783	110.3959	0.32333	0	0.3233	32.439	4.3858	0.0066	4	0.9079	2.9339	2.7373	29.08244
7	8.5	0.43	0.96	-0.76	8.51175	5.0518	3	3.20568	109.319	0.37799	0	0.378	21.519	5.2866	0.0085	3	0.9724	2.7208	2.8977	20.91524
8	7.5	0.48	2.68	-0.88	7.5328	6.3721	3	3.30899	109.8259	0.4329	0	0.4329	16.401	6.7607	0.0272	3	1	2.4442	3.0476	16.40072
9	8	0.36	2.15	-0.94	8.02632	4.4853	3	3.19558	107.8757	0.48684	0	0.4868	15.487	4.7749	0.0205	3	1	2.1734	2.9673	15.48657
10	5.5	0.16	2.39	-0.99	5.52925	2.8937	3	3.22491	101.0332	0.53736	0	0.5374	9.2897	3.2052	0.0345	3	1	1.9691	3.0395	9.28974
11	7.8	0.33	2.78	-1	7.83403	4.2124	3	3.18828	107.1799	0.59095	0	0.591	12.257	4.5561	0.0276	3	1	1.7905	3.0334	12.25675
12	6.6	0.18	2.87	-0.89	6.63513	2.7128	3	3.14277	102.3397	0.64212	0	0.6421	9.3332	3.0035	0.0345	3	1	1.6479	3.0219	9.33322
13	15.6	0.29	2.97	-0.3	15.63635	1.8547	4	2.73984	107.9201	0.69608	0	0.6961	21.464	1.9411	0.0143	4	0.8866	1.4496	2.6335	20.46834
14	17.9	0.36	2.98	0.17	17.93648	2.0071	4	2.70913	109.8369	0.75099	0	0.751	22.884	2.0948	0.0125	4	0.8866	1.3552	2.6269	22.01103
15	9.5	0.2	3.2	0.55	9.53917	2.0966	3	2.94985	103.996	0.80299	0	0.803	10.88	2.2893	0.0264	3	0.9933	1.3153	2.9019	10.85942
16	6	0.21	3.35	0.59	6.041	3.4762	3	3.23484	103.2388	0.85461	0	0.8546	6.0687	4.0491	0.0465	3	1	1.2381	3.2494	6.06871
17	5.5	0.23	3.35	0.55	5.541	4.1509	3	3.30854	103.6937	0.90646	0	0.9065	5.1128	4.9627	0.052	3	1	1.1673	3.3608	5.1128
18	4.7	0.25	3.63	-0.22	4.74443	5.2693	3	3.4225	103.9253	0.95842	0	0.9584	3.9503	6.6033	0.069	3	1	1.104	3.5238	3.95026
19	6.5	0.33	3.69	-0.31	6.54517	5.0419	3	3.29717	106.7415	1.01179	0	1.0118	5.4689	5.9638	0.048	3	1	1.0458	3.3833	5.46888
20	7.3	0.34	3.66	-0.39	7.3448	4.6291	3	3.23487	107.2411	1.06541	0	1.0654	5.8939	5.4145	0.042	3	1	0.9931	3.3323	5.89385
21	7.2	0.3	3.64	-0.5	7.24455	4.141	3	3.2118	106.2917	1.11856	0	1.1186	5.4767	4.8972	0.0428	3	1	0.946	3.333	5.47669
22	10.7	0.38	3.72	-0.68	10.74553	3.5364	3	3.03243	108.9829	1.17305	0	1.1731	8.1603	3.9697	0.028	3	1	0.902	3.1389	8.16034
23	7.1	0.35	3.73	-0.81	7.14566	4.8981	3	3.25889	107.3861	1.22674	0	1.2267	4.8249	5.9133	0.0454	3	1	0.8625	3.4252	4.8249
24	6.8	0.41	3.63	-0.96	6.84443	5.9903	3	3.32582	108.4388	1.28096	0	1.281	4.3432	7.3695	0.047	3	1	0.826	3.5183	4.34319
25	8.3	0.37	3.73	-1.08	8.34566	4.4334	3	3.1789	108.1713	1.33505	0	1.3351	5.2512	5.2777	0.0383	3	1	0.7926	3.3666	5.2512
26	8	0.38	3.73	-1.16	8.04566	4.7231	3	3.20793	108.2772	1.38919	0	1.3892	4.7916	5.7087	0.0404	3	1	0.7617	3.4188	4.79163
27	6.3	0.37	3.73	-1.29	6.34566	5.8308	3	3.34518	107.5031	1.44294	0	1.4429	3.3977	7.5468	0.0548	2	1	0.7333	3.6107	3.39773
28	4.6	0.16	3.73	-1.43	4.64566	3.4441	3	3.32896	100.6085	1.49324	0	1.4932	2.1111	5.0755	0.0852	2	1	0.7086	3.688	2.11112
29	2.5	0.05	3.73	-1.58	2.54566	1.9641	3	3.43947	90.63057	1.53856	0	1.5386	0.6546	4.9648	0.2667	2	1	0.6877	4.06	0.65457
30	3.9	0.08	3.73	-1.86	3.94566	2.0276	3	3.27604	95.13842	1.58613	0	1.5861	1.4876	3.3905	0.1138	2	1	0.6671	3.7332	1.4876
31	7.8	0.17	3.82	-1.98	7.84676	2.1665	3	3.02978	102.3305	1.63729	0	1.6373	3.7925	2.7378	0.0443	3	1	0.6463	3.3325	3.79252
32	21.1	0.32	3.92	-1.62	21.14798	1.5132	4	2.58174	109.3768	1.69198	0	1.692	11.499	1.6447	0.0145	4	0.9986	0.6258	2.8046	11.50646
33	298.7	2.9	4.02	-0.56	298.7492	0.9707	6	1.57984	131.9632	1.75796	0	1.758	168.94	0.9765	0.001	6	0.5683	0.7494	1.6671	210.3369
34	322.4	4.16	3.94	-0.39	322.4482	1.2901	6	1.65618	134.7894	1.82536	0	1.8254	175.65	1.2975	0.0009	6	0.6025	0.72	1.7484	218.1681
35	332	4.01	4.3	-0.15	332.0526	1.2076	6	1.62555	134.5922	1.89265	0	1.8927	174.44	1.2146	0.0009	6	0.5962	0.707	1.7234	220.6176
36	326.3	3.26	3.88	-0.03	326.3475	0.9989	6	1.56504	133.0349	1.95917	0	1.9592	165.57	1.005	0.0009	6	0.5791	0.7	1.6702	214.5911
37	446.3	5.95	3.44	-0.05	446.3421	1.3331	6	1.58821	137.28	2.02781	0	2.0278	219.11	1.3391	0.0006	6	0.588	0.6822	1.6852	286.4512
38	243.2	7.6	1.76	-0.12	243.2215	3.1247	8	2.04191	137.28	2.09645	0	2.0965	115.02	3.1519	0.0005	5	0.7804	0.5865	2.1817	133.6528
39	90.7	4.08	0.08	0.64	90.70098	4.4983	9	2.4229	131.5537	2.16223	0	2.1622	40.948	4.6082	7E-05	4	0.9568	0.5047	2.6362	42.23104
40	124.2	3.84	-0.87	0.19	124.1894	3.0921	5	2.21047	131.8766	2.22817	0	2.2282	54.736	3.1485	-5E-04	5	0.8738	0.5217	2.4106	60.12924
41	69.5	1.91	0.09	-0.24	69.5011	2.7482	5	2.34165	125.3508	2.29084	0.0312	2.2596	29.744	2.8418	-4E-04	4	0.9445	0.4884	2.5913	31.02258
42	102.1	4.43	-0.09	-0.34	102.0989	4.3389	9	2.37836	132.4446	2.35706	0.0624	2.2947	43.467	4.4415	-7E-04	4	0.9511	0.4789	2.6045	45.1438
43	30.5	1.05	0.1	-0.22	30.50122	3.4425	4	2.66975	118.9643	2.41655	0.0936	2.323	12.09	3.7387	-0.003	3	1	0.4555	2.9857	12.09011
44	100.4	3.43	0.19	-0.17	100.4023	3.4163	5	2.3029	130.5318	2.48181	0.1248	2.357	41.544	3.5028	-0.001	4	0.9297	0.4749	2.5399	43.95147
45	108.1	5.7	-0.6	-0.13	108.0927	5.2733	9	2.43011	134.4281	2.54903	0.156	2.393	44.105	5.4006	-0.002	4	0.9798	0.4495	2.668	44.8393
46	125.8	4.83	-1.71	0.07	125.7791	3.8401	8	2.28067	133.5859	2.61582	0.1872	2.4286	50.713	3.9216	-0.003	4	0.9221	0.4648	2.511	54.10451
47	181.8	7.43	-6.5	0.2	181.7204	4.0887	8	2.20913	137.28	2.68446	0.2184	2.4661	72.6	4.15	-0.004	4	0.8879	0.4718	2.4159	79.8272
48	111.7	7.67	-8.58	0.3	111.595	6.8731	9	2.51502	136.678	2.7528	0.2496	2.5032	43.481	7.0469	-0.008	3	1	0.4227	2.7626	43.48126
49	54.5	0.99	-8.38	0.55	54.39743	1.8199	5	2.2988	119.9448	2.81277	0.2808	2.532	20.373	1.9192	-0.017	4	0.9693	0.4292	2.6228	20.92639
50	108.7	2.33	-8.29	0.48	108.5985	2.1455	5	2.12957	127.8938	2.87672	0.312	2.5647	41.222	2.2039	-0.009	5	0.8824	0.4578	2.3913	45.74358
51	110.2	5.88	-8.38	0.44	110.0974	5.3407	9	2.42974	134.7005	2.94407	0.3432	2.6009	41.199	5.4875	-0.009	3	1	0.4068	2.6983	41.19909
52	79.5	3	-7.91	0.35	79.40318	3.7782	4	2.40276	128.9794	3.00856	0.3744	2.6342	29.002	3.927	-0.012	4	1	0.4017	2.7058	29.00155
53	149.4	6.83	-7.81	0.19	149.3044	4.5746	9	2.29768	136.5393	3.07683	0.4056	2.6712	54.742	4.6708	-0.007	4	0.9478	0.4157	2.5488	57.45225
54	253.4	9.48	0.47	0.51	253.4058	3.741	8	2.09868	137.28	3.14547	0.4368	2.7087	92.392	3.7881	-0.002	5	0.8574	0.4467	2.3077	105.649
55	107.1	3.14	1.44	0.72	107.1176	2.9314	5	2.23416	130.0433	3.21049	0.468	2.7425	37.888	3.0219	-0.004	4	0.9426	0.4075	2.5258	40.01633
56	63.4	1.41	0.35	0.75	63.40428	2.2238	5	2.30653	122.9061	3.27194	0.4992	2.7727	21.687	2.3448	-0.008	4	0.9949	0.3835	2.6594	21.79356
57	196.8	5.87	0.86	0.8	196.8105	2.9826	8	2.07673	136.1048	3.33999	0.5304	2.8096	68.861	3.0341	-0.002	5	0.8666	0.429	2.3192	78.44541
58	74.1	3.52	-0.08	1.06	74.09902	4.7504	4	2.49746	129.9804	3.40498	0.5616	2.8434	24.863	4.9792	-0.008	3	1	0.3721	2.8247	24.86265
59	52.8	1.28	-0.09	1.36	52.7989	2.4243	5	2.39047	121.7519	3.46586	0.5928	2.8731	17.171	2.5946	-0.012	4	1	0.3683	2.7688	17.17091
60	61.7	2.25	-0.13	1.47	61.69841	3.6468	4	2.4657	126.2591	3.52899	0.624	2.905	20.024	3.868	-0.011	3	1	0.3642	2.823	20.02397
61	55.4	2.08	0.19	1.56	55.40233	3.7544	4	2.50726	125.4217	3.5917	0.6552	2.9365	17.644	4.0146	-0.012	3	1	0.3603	2.8756	17.64367
62	59.7	1.93	0.2	1.73	59.70245	3.2327	4	2.43819	125.0564	3.65423	0.6864	2.9678	18.885	3.4435	-0.012	4	1	0.3565	2.8107	18.88526
63	111.6	6.1	0.14	1.77	111.6017	5.4659	9	2.4343	135.0023	3.72173	0.7176	3.0041	35.911	5.6544	-0.007	3	1	0.3522	2.7489	35.91057
64	86.7	3.59	0.58	1.86	86.7071	4.1404	4	2.40776	130.5077	3.78698	0.7488	3.0382	27.293	4.3295	-0.009	3	1	0.3483	2.7538	27.29267
65	57.5	2.92	0.58	1.91	57.5071	5.0776	4	2.59186	127.9947	3.85098	0.78	3.071	17.472	5.4421	-0.014	3	1	0.3446	2.9644	17.47198
66	95.7	4.11	0.58	1.94	95.7071	4.2944	9	2.39252	131.7383	3.91685	0.8112	3.1057	29.556	4.4776	-0.008	4	1	0.3407	2.7383	29.55589
67	123.3	5.69	0.77	1.71	123.3094	4.6144	9	2.34943	134.7365	3.98422	0.8424	3.1418	37.98	4.7685	-0.007	4	1	0.3368	2.6791	37.97967
68	158.5	5.53	0.9	1.54	158.511	3.4887	8	2.18693	135.1403	4.05179	0.8736	3.1782	48.6	3.5802	-0.005	4	0.9532	0.3505	2.4996	51.16625
69	381.8	12.37	3.16	1.42	381.8387	3.2396	8	1.95641	137.28	4.12043	0.9048	3.2156	117.46	3.2749	-0.002	8	0.8327	0.3963	2.1798	141.4753

70	140.3	9.93	1.76	1.29	140.3215	7.0766	9	2.46975	137.28	4.18907	0.936	3.2531	41.847	7.2944	-0.006	3	1	0.3253	2.7848	41.84741
71	71.7	3.68	1.44	1.13	71.71763	5.1312	4	2.53215	130.226	4.25418	0.9672	3.287	20.524	5.4548	-0.013	3	1	0.3219	2.9129	20.52444
72	42.2	0.87	1.35	1.03	42.21652	2.0608	5	2.41798	118.3811	4.31337	0.9984	3.315	11.434	2.2953	-0.024	4	1	0.3192	2.8837	11.43393
73	59.2	1.41	1.44	1.03	59.21763	2.3811	5	2.34845	122.7395	4.37474	1.0296	3.3451	16.395	2.571	-0.017	4	1	0.3163	2.7827	16.39479
74	72.9	1.95	1.92	1.06	72.9235	2.674	5	2.31851	125.6197	4.43755	1.0608	3.3768	20.282	2.8473	-0.013	4	1	0.3134	2.7353	20.28161
75	52.2	1.43	1.92	1.03	52.2235	2.7382	5	2.42976	122.536	4.49882	1.092	3.4068	14.009	2.9964	-0.02	3	1	0.3106	2.8771	14.00857
76	182.3	7.56	2.2	0.96	182.3269	4.1464	8	2.21337	137.28	4.56746	1.1232	3.4443	51.61	4.2529	-0.005	4	0.9825	0.3136	2.5444	52.68982
77	61.5	2.27	-3.14	0.9	61.46157	3.6934	4	2.47084	126.3145	4.63062	1.1544	3.4762	16.349	3.9943	-0.024	3	1	0.3044	2.8999	16.34851
78	94.7	2.46	-2.85	0.99	94.66512	2.5986	5	2.23109	127.9561	4.69459	1.1856	3.509	25.64	2.7342	-0.015	4	1	0.3015	2.6445	25.63997
79	82.7	2.61	-2.57	1.2	82.66854	3.1572	5	2.33314	128.0587	4.75862	1.2168	3.5418	21.997	3.35	-0.018	4	1	0.2988	2.7517	21.99712
80	65.8	4.05	-2.54	1.49	65.76891	6.1579	3	2.61697	130.7158	4.82398	1.248	3.576	17.043	6.6453	-0.023	3	1	0.2959	3.0303	17.04285

	CPT-3	In situ data										Basic output data								
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	50.5	0.22	0.22	-0.1	50.50269	0.4356	6	1.98659	108.7583	0.05438	0	0.0544	927.71	0.4361	0.0003	6	0.4297	3.5805	1.5069	170.7095
2	28.4	0.12	0.06	0.11	28.40073	0.4225	5	2.20952	102.9193	0.10584	0	0.1058	267.34	0.4241	0.0002	6	0.5174	3.2909	1.7451	88.00188
3	79.4	0.12	0.25	0.13	79.40306	0.1511	6	1.64393	105.4269	0.15855	0	0.1586	499.8	0.1514	0.0002	6	0.3703	2.0195	1.351	151.2438
4	89.5	0.18	0.03	0	89.50037	0.2011	6	1.62909	108.6856	0.2129	0	0.2129	419.4	0.2016	2E-05	6	0.3849	1.8537	1.3793	156.4235
5	91.9	0.38	0.06	-0.07	91.90073	0.4135	6	1.74479	114.2176	0.27	0	0.27	339.37	0.4147	5E-05	6	0.4431	1.8316	1.5211	158.6162
6	100.3	0.1	-0.1	-0.27	100.2988	0.0997	0	1.50917	104.6626	0.32234	0	0.3223	310.16	0.1	-7E-05	6	0.37	1.5524	1.3221	146.6805
7	122.9	0.54	-0.13	-0.33	122.8984	0.4394	6	1.64878	117.4976	0.38108	0	0.3811	321.5	0.4408	-8E-05	6	0.4357	1.5604	1.4894	180.6788
8	111.8	0.28	-0.13	-0.56	111.7984	0.2505	6	1.5729	112.4611	0.43731	0	0.4373	254.65	0.2514	-8E-05	6	0.4157	1.4438	1.4299	151.9516
9	55.7	0.62	-0.13	-0.6	55.69841	1.1131	5	2.15918	116.5782	0.4956	0	0.4956	111.38	1.1231	-2E-04	6	0.6347	1.6184	1.9991	84.43131
10	85.3	1.08	-0.13	-0.66	85.29841	1.2661	5	2.04787	121.6786	0.55644	0	0.5564	152.29	1.2745	-1E-04	6	0.6096	1.4796	1.9251	118.4971
11	241.7	4.38	0.25	-0.84	241.7031	1.8121	6	1.8493	134.4634	0.62367	0	0.6237	386.55	1.8168	7E-05	6	0.5565	1.342	1.777	305.7595
12	359.9	12.13	0	-1.11	359.9	3.3704	8	1.98365	137.28	0.69231	0	0.6923	518.85	3.3769	0	8	0.6193	1.3005	1.9334	441.4823
13	247.4	3.4	-1.38	-1.24	247.3831	1.3744	6	1.74843	132.6669	0.75865	0	0.7587	325.08	1.3786	-4E-04	6	0.5346	1.1947	1.7027	278.4488
14	256.5	3.03	-1.47	-1.14	256.482	1.1814	6	1.68775	131.912	0.8246	0	0.8246	310.04	1.1852	-4E-04	6	0.5192	1.1382	1.6541	275.0093
15	154.2	7.82	-1.65	-0.96	154.1798	5.072	9	2.32664	137.28	0.89324	0	0.8932	171.61	5.1016	-8E-04	9	0.7681	1.139	2.2989	164.9978
16	106.4	3.38	-4.44	-0.91	106.3457	3.1783	5	2.26284	130.5646	0.95853	0	0.9585	109.95	3.2072	-0.003	5	0.7517	1.0771	2.2476	107.281
17	88.7	2.86	-7.32	-0.82	88.6104	3.2276	5	2.32	128.8973	1.02298	0	1.023	85.62	3.2653	-0.006	5	0.7821	1.0268	2.3195	84.99253
18	97.4	2.61	-8.56	-0.74	97.29523	2.6826	5	2.23318	128.456	1.0872	0	1.0872	88.491	2.7129	-0.006	5	0.7571	0.9797	2.2461	89.0762
19	87.7	2.14	-1.92	-0.68	87.6765	2.4408	5	2.23423	126.7494	1.15058	0	1.1506	75.202	2.4733	-0.002	5	0.7661	0.9378	2.2618	76.69018
20	67.9	2.36	-1.85	-0.8	67.87736	3.4769	4	2.42213	126.8411	1.214	0	1.214	54.912	3.5402	-0.002	4	0.8478	0.89	2.4682	56.07299
21	150	3.41	-1.54	-0.8	149.9812	2.2736	5	2.05535	131.4678	1.27973	0	1.2797	116.2	2.2932	-8E-04	5	0.7102	0.8737	2.0987	122.7807
22	132.8	4.87	-1.57	-0.78	132.7808	3.6677	8	2.25051	133.7784	1.34662	0	1.3466	97.603	3.7053	-9E-04	5	0.7932	0.8259	2.3083	102.5925
23	45.7	1.55	-1.38	-0.8	45.68311	3.3929	4	2.53592	122.7993	1.40802	0	1.408	31.445	3.5008	-0.002	4	0.9221	0.7684	2.6391	32.15237
24	42.1	1.25	-1.69	-0.71	42.07931	2.9706	4	2.52276	121.0249	1.46853	0	1.4685	27.654	3.078	-0.003	4	0.9268	0.738	2.6438	28.32541
25	36.7	0.93	-1.28	-0.63	36.68433	2.5351	4	2.52239	118.5265	1.5278	0	1.5278	23.011	2.6453	-0.003	4	0.9375	0.7087	2.6645	23.54554
26	107.6	2.23	-1.36	-0.53	107.5834	2.0728	5	2.1215	127.5499	1.59157	0	1.5916	66.596	2.1039	-9E-04	5	0.7739	0.7291	2.2275	73.03512
27	152.3	3.11	-1.09	-0.21	152.2867	2.0422	5	2.01549	130.8312	1.65699	0	1.657	90.906	2.0647	-5E-04	5	0.7354	0.719	2.1183	102.3612
28	96.8	2.59	-1.18	-0.14	96.78556	2.676	5	2.23393	128.3869	1.72118	0	1.7212	55.232	2.7245	-9E-04	5	0.8339	0.6665	2.3675	59.88119
29	86.2	1.72	-2.14	-0.2	86.17381	1.996	5	2.17757	125.1086	1.78374	0	1.7837	47.311	2.0382	-0.002	5	0.8211	0.6513	2.3274	51.94494
30	132.3	2.21	-1.19	-0.27	132.2854	1.6706	6	1.99175	127.9881	1.84773	0	1.8477	70.594	1.6943	-7E-04	5	0.7487	0.6588	2.1294	81.20986
31	225.3	2.16	-1.09	-0.39	225.2867	0.9588	6	1.65766	129.1192	1.91229	0	1.9123	116.81	0.967	-4E-04	6	0.6171	0.6941	1.7759	146.5185
32	304.2	3.29	-1.09	-0.43	304.1867	1.0816	6	1.61108	132.9304	1.97875	0	1.9788	152.73	1.0887	-3E-04	6	0.5998	0.687	1.7221	196.2095
33	356.5	5.11	-1.19	-0.51	356.4854	1.4334	6	1.66814	136.5391	2.04702	0	2.047	173.15	1.4417	-2E-04	6	0.6246	0.6622	1.779	221.8175
34	370.6	3.23	-1.29	-0.51	370.5842	0.8716	6	1.4843	133.2773	2.11366	0	2.1137	174.33	0.8766	-3E-04	6	0.5589	0.6793	1.598	236.5472
35	318.8	3.05	-1.47	-0.47	318.782	0.9568	6	1.55695	132.4905	2.17991	0	2.1799	145.24	0.9634	-3E-04	6	0.5958	0.6501	1.6864	194.524
36	231.8	3.79	-1.82	-0.37	231.7777	1.6352	6	1.82505	133.3025	2.24656	0	2.2466	102.17	1.6512	-6E-04	6	0.7121	0.585	1.9836	126.9025
37	78.1	2.32	-2.05	-0.36	78.07491	2.9715	5	2.3308	127.0574	2.31009	0	2.3101	32.797	3.0621	-0.002	4	0.9424	0.4791	2.5794	34.30592
38	72.7	2.03	-4.63	-0.14	72.64333	2.7945	5	2.33331	125.9045	2.37304	0	2.373	29.612	2.8889	-0.005	4	0.9527	0.4633	2.5986	30.76608
39	216	5.75	-3.26	-0.19	215.9601	2.6625	5	2.0132	136.1801	2.44113	0	2.4411	87.467	2.693	-0.001	5	0.8042	0.5105	2.2014	103.0191
40	47.2	1.45	-1.57	-0.37	47.18078	3.0733	4	2.49622	122.39	2.50232	0.0312	2.4711	18.08	3.2454	-0.003	4	1	0.4282	2.8096	18.08021
41	55.1	1.73	-2.3	-0.81	55.07185	3.1414	4	2.4543	124.059	2.56435	0.0624	2.502	20.987	3.2948	-0.004	4	1	0.4229	2.763	20.98659
42	117.3	4.24	-2	-0.86	117.2755	3.6154	5	2.2789	132.4619	2.63058	0.0936	2.537	45.189	3.6984	-0.002	4	0.9345	0.4417	2.5301	47.85457
43	186.7	6.5	-9.79	-0.54	186.5802	3.4838	8	2.14527	136.7205	2.69895	0.1248	2.5742	71.434	3.5349	-0.005	5	0.8719	0.4607	2.3625	80.05306
44	265.7	8.16	-6.08	-0.55	265.6256	3.072	8	2.01513	137.28	2.76759	0.156	2.6116	100.65	3.1043	-0.002	5	0.8148	0.4789	2.2081	118.9804
45	220.3	4	-13.52	-0.52	220.1345	1.8171	6	1.87491	133.5714	2.83437	0.1872	2.6472	82.088	1.8408	-0.005	5	0.7699	0.4936	2.0854	101.3747
46	48	2.32	-13.14	-0.59	47.83917	4.8496	4	2.63154	125.8628	2.8973	0.2184	2.6789	16.776	5.1622	-0.026	3	1	0.395	2.9626	16.77622
47	55.6	1.11	-12.27	-0.55	55.44982	2.0018	5	2.31936	120.8287	2.95772	0.2496	2.7081	19.383	2.1146	-0.022	4	0.9968	0.3919	2.6732	19.44088
48	71.9	2.78	-12.27	-0.6	71.74982	3.8746	4	2.4403	128.1749	3.0218	0.2808	2.741	25.074	4.0449	-0.017	4	1	0.386	2.7615	25.07403
49	70.2	2.49	-12.27	-0.57	70.04982	3.5546	4	2.41978	127.3103	3.08546	0.312	2.7735	24.145	3.7184	-0.018	4	1	0.3815	2.7499	24.1447
50	73.8	2.71	-12.18	-0.5	73.65092	3.6795	4	2.41606	128.0521	3.14949	0.3432	2.8063	25.123	3.8439	-0.017	4	1	0.3771	2.7462	25.12269
51	559.7	7.4	-1.95	-0.49	559.6761	1.3222	6	1.53508	137.28	3.21813	0.3744	2.8437	195.68	1.3298	-9E-04	6	0.6271	0.538	1.6861	282.9089
52	276.2	8.63	-2.87	-0.41	276.1649	3.1249	8	2.01252	137.28	3.28677	0.4056	2.8812	94.711	3.1626	-0.002	5	0.8368	0.4325	2.2321	111.537
53	65.1	1.74	-2.08	-0.49	65.07454	2.6739	5	2.35356	124.5083	3.34902	0.4368	2.9122	21.195	2.8189	-0.01	4	1	0.3633	2.7175	21.19535
54	171.1	3.16	-2.52	-0.22	171.0692	1.8472	6	1.94955	131.2316	3.41464	0.468	2.9466	56.897	1.8848	-0.004	5	0.8356	0.4249	2.2207	67.33104
55	253.1	9.52	-5.77	0.29	253.0294	3.7624	8	2.10113	137.28	3.48328	0.4992	2.9841	83.626	3.8149	-0.004	4	0.8831	0.4003	2.341	94.40337
56	47.5	0.92	-5.77	0.74	47.42938	1.9397	5	2.36224	119.0739	3.54281	0.5304	3.0124	14.569	2.0963	-0.022	4	1	0.3513	2.7742	14.56858
57	60.8	1.38	-5.87	0.99	60.72815	2.2724	5	2.32665	122.6436	3.60413	0.5616	3.0425	18.775	2.4158	-0.017	4	1	0.3478	2.7192	18.77515
58	68.2	1.99	-6.06	1.17	68.12583	2.9211	5	2.36658	125.6023	3.66694	0.5928	3.0741	20.968	3.0872	-0.016	4	1	0.3442	2.7456	20.96814
59	55	1.71	-8.03	1.19	54.90171	3.1147	4	2.45267	123.9664	3.72892	0.624	3.1049	16.481	3.3416	-0.023	3	1	0.3408	2.8491	16.4812
60	107.8	3.54	-7.69	1.07	107.7059	3.2867	5	2.27038	130.934	3.79439	0.6552	3.1392	33.101	3.4068	-0.012	4	0.9972	0.3381	2.6208	33.20084
61	131.1	7.05	-9.69	0.84	130.9814	5.3824	9	2.38817	136.4519	3.86261	0.6864	3.1762	40.022	5.546	-0.011	3	1	0.3331	2.7103	40.02214
62	82.5	3.49	-8.7	0.83	82.39351	4.2358	4	2.42966	130.1765	3.9277	0.7176	3.2101	24.443	4.4478	-0.017	3	1	0.3296	2.7971	24.44342
63	62.6	2.37	-9.02	0.8	62.4896	3.7926	4	2.47424	126.6704	3.99103	0.7488	3.2422	18.043	4.0514	-0.024	3	1	0.3264	2.8706	18.04267
64	138.9	5.72	-8.83	0.71	138.7919	4.1213	9	2.27941	135.0635	4.05857	0.78	3.2786	41.095	4.2454	-0.011	4	1	0.3227	2.6192	41.0952
65	209.8	11.09	-9.02	0.55	209.6896	5.2888	9	2.2699	137.28	4.12721	0.8112	3.316	61.991	5.395	-0.007	4	0.9858	0.3243	2.5693	63.0058
66	225	9.24	-9.26	0.55	224.8867	4.1087	8	2.16054	137.28	4.19585	0.8424	3.3535	65.81	4.1869	-0.007	4	0.9449	0.3363	2.4556	70.13287
67	378.2	12.62	-1.9	0.36	378.1767	3.3371	8	1.96975	137.28	4.26449	0.8736	3.3909	110.27	3.3751	-0.003	8	0.8527	0.3704	2.2107	130.9002
68	135.8	10	-5.43	0.28	135.7335	7.3674	9	2.49229	137.28	4.33313	0.9048	3.4283	38.328	7.6103	-0.01	3	1	0.3086	2.824	38.32786
69	110.1	4.78	-5.68	0.49	110.0305	4.3443	9	2.35862	133.1835	4.39972	0.936	3.4637	30.496	4.5252	-0.013	4	1	0.3055	2.7315	30.49635

70	46.1	0.88	-5.77	0.69	46.02938	1.9118	5	2.36827	118.6756	4.45906	0.9672	3.4919	11.905	2.1169	-0.033	4	1	0.303	2.8499	11.90494
71	73.3	2.28	-5.49	0.71	73.2328	3.1134	5	2.36463	126.774	4.52244	0.9984	3.524	19.498	3.3183	-0.02	4	1	0.3003	2.7899	19.49759
72	98.2	2.4	-5.41	0.8	98.13378	2.4456	5	2.20115	127.8632	4.58637	1.0296	3.5568	26.301	2.5655	-0.015	4	1	0.2975	2.6186	26.30119
73	55.9	1.74	-5.04	0.91	55.83831	3.1161	4	2.44757	124.1349	4.64844	1.0608	3.5876	14.268	3.3991	-0.028	3	1	0.2949	2.9033	14.26839
74	660	5.96	-8.74	0.95	659.893	0.9032	6	1.35578	137.28	4.71708	1.092	3.6251	180.73	0.9097	-0.003	6	0.6125	0.4704	1.5496	291.2413
75	246.4	11.97	-12.66	0.66	246.245	4.861	9	2.20286	137.28	4.78572	1.1232	3.6625	65.927	4.9574	-0.008	4	0.9847	0.2945	2.5232	67.19574
76	157.9	9.12	-12.75	0.72	157.7439	5.7815	9	2.36846	137.28	4.85436	1.1544	3.7	41.322	5.9651	-0.014	3	1	0.286	2.7238	41.32193
77	116.3	4.39	-13.04	1.11	116.1404	3.7799	8	2.29664	132.6925	4.92071	1.1856	3.7351	29.777	3.9471	-0.019	4	1	0.2833	2.6988	29.77683
78	307.4	14.25	-9.6	1.08	307.2825	4.6374	9	2.13824	137.28	4.98935	1.2168	3.7726	80.13	4.714	-0.006	9	0.9597	0.2952	2.4431	84.33952
79	464.1	5.39	-7.85	0.88	464.0039	1.1616	6	1.52872	137.28	5.05799	1.248	3.81	120.46	1.1744	-0.004	6	0.7092	0.4031	1.7805	174.8375
80	214.9	12.98	-6.66	0.88	214.8185	6.0423	9	2.31433	137.28	5.12663	1.2792	3.8474	54.502	6.19	-0.008	3	1	0.275	2.6556	54.50182

	CPT-4	In situ data										Basic output data								
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	43.1	0.45	0.01	-1.97	43.10012	1.0441	5	2.23478	113.6079	0.0568	0	0.0568	757.75	1.0455	2E-05	6	0.5107	4.4528	1.7334	181.1392
2	84.9	1.02	-0.01	-2.95	84.89988	1.2014	6	2.03479	121.249	0.11743	0	0.1174	721.99	1.2031	-1E-05	6	0.5027	3.0194	1.6944	241.9364
3	62.3	0.83	-0.09	-3.15	62.2989	1.3323	5	2.16751	118.9858	0.17692	0	0.1769	351.13	1.3361	-1E-04	6	0.5627	2.7357	1.8465	160.6159
4	61.3	0.48	0.01	-3.19	61.30012	0.783	6	2.03828	114.9393	0.23439	0	0.2344	260.53	0.786	1E-05	6	0.5321	2.23	1.7593	128.6971
5	61	1.66	0.01	-3.25	61.00012	2.7213	5	2.379	124.0062	0.29639	0	0.2964	204.81	2.7346	1E-05	5	0.6747	2.3598	2.13	135.3834
6	85.2	1.69	-0.84	-3.39	85.18972	1.9838	5	2.1793	124.9518	0.35887	0	0.3589	236.38	1.9922	-7E-04	6	0.6218	1.9588	1.9828	157.0396
7	67.4	1.53	0.27	-3.48	67.4033	2.2699	5	2.29322	123.6529	0.4207	0	0.4207	159.22	2.2842	0.0003	5	0.6732	1.8606	2.1094	117.7827
8	77.2	1.13	-0.1	-3.62	77.19878	1.4638	5	2.12172	121.7664	0.48158	0	0.4816	159.3	1.4729	-9E-05	6	0.6227	1.6326	1.9693	118.372
9	133.5	1.5	-0.18	-3.7	133.4978	1.1236	6	1.86783	125.1748	0.54417	0	0.5442	244.33	1.1282	-1E-04	6	0.5454	1.4372	1.7582	180.5806
10	46	1.96	-0.01	-3.75	45.99988	4.2609	4	2.60308	124.5333	0.60643	0	0.6064	74.853	4.3178	-2E-05	4	0.8218	1.58	2.4755	67.78322
11	53.2	2.47	0.75	-3.91	53.20918	4.6421	4	2.58601	126.5807	0.66972	0	0.6697	78.449	4.7012	0.001	4	0.8285	1.4607	2.4841	72.53199
12	185.7	6.53	0.78	-4.04	185.7096	3.5162	8	2.14974	136.7428	0.7381	0	0.7381	250.61	3.5303	0.0003	8	0.6823	1.2786	2.0931	223.5141
13	175	8.66	0.87	-4.18	175.0107	4.9483	9	2.2872	137.28	0.80674	0	0.8067	215.94	4.9712	0.0004	9	0.743	1.2233	2.2433	201.394
14	135.3	6.71	-1.04	-4.39	135.2873	4.9598	9	2.35107	136.1691	0.87482	0	0.8748	153.65	4.9921	-6E-04	9	0.7747	1.1588	2.3185	147.2014
15	127.6	3.32	-0.6	-4.53	127.5927	2.602	5	2.1454	130.8778	0.94026	0	0.9403	134.7	2.6214	-3E-04	5	0.7048	1.0868	2.1267	130.0843
16	110.7	2.56	-0.36	-4.57	110.6956	2.3127	5	2.1478	128.6292	1.00457	0	1.0046	109.19	2.3338	-2E-04	5	0.7138	1.0378	2.1426	107.5811
17	106.9	4.51	-0.11	-4.5	106.8987	4.219	9	2.3564	132.6876	1.07092	0	1.0709	98.82	4.2616	-7E-05	9	0.8017	0.9904	2.3652	99.05575
18	129.7	4.72	-0.2	-4.59	129.6976	3.6392	8	2.25407	133.4922	1.13766	0	1.1377	113	3.6714	-1E-04	8	0.7703	0.9457	2.2744	114.9008
19	91.1	3.87	1.44	-4.6	91.11763	4.2473	4	2.4024	131.1782	1.20325	0	1.2033	74.726	4.3041	0.0012	4	0.8368	0.898	2.4407	76.31055
20	186.9	5.36	-0.02	-4.63	186.8998	2.8679	5	2.07599	135.3137	1.27091	0	1.2709	146.06	2.8875	-1E-05	5	0.7157	0.8771	2.1142	153.8722
21	56.5	1.96	0.16	-4.53	56.50196	3.4689	4	2.47679	125.0349	1.33343	0	1.3334	41.374	3.5528	0.0002	4	0.8865	0.8146	2.5549	42.47386
22	45.7	1.55	0.4	-4.59	45.7049	3.3913	4	2.53563	122.8004	1.39483	0	1.3948	31.767	3.4981	0.0007	4	0.9202	0.7755	2.6356	32.4758
23	40.7	1.55	-0.3	-5.04	40.69633	3.8087	4	2.6069	122.5173	1.45609	0	1.4561	26.949	3.95	-6E-04	4	0.9578	0.7365	2.7268	27.31477
24	52.1	1.4	-0.37	-5.42	52.09547	2.6874	5	2.425	122.3749	1.51727	0	1.5173	33.335	2.768	-5E-04	4	0.8924	0.725	2.5473	34.65281
25	50.6	2.37	0.03	-5.89	50.60037	4.6838	4	2.6038	126.1556	1.58035	0	1.5804	31.018	4.8348	4E-05	3	0.9695	0.6778	2.7422	31.40002
26	48.2	2.9	0.15	-6.18	48.20184	6.0164	3	2.69792	127.5139	1.64411	0	1.6441	28.318	6.2288	0.0002	3	1	0.6436	2.8513	28.31793
27	69.4	1.97	-1.32	-6.31	69.38384	2.8393	5	2.35222	125.573	1.70689	0	1.7069	39.649	2.9109	-0.001	4	0.8835	0.6554	2.4999	41.92081
28	109.7	2.78	-0.55	-6.45	109.6933	2.5343	5	2.17992	129.2103	1.7715	0	1.7715	60.921	2.5759	-4E-04	5	0.8161	0.6567	2.3158	66.97832
29	106.5	2.65	0.3	-6.55	106.5037	2.4882	5	2.18258	128.7879	1.83589	0	1.8359	57.012	2.5318	0.0002	5	0.8247	0.6348	2.3305	62.79272
30	129.2	3.32	0.57	-5.39	129.207	2.5695	5	2.1377	130.9085	1.90135	0	1.9014	66.955	2.6079	0.0003	5	0.8108	0.6218	2.2858	74.80775
31	267.3	4.12	0.58	-5	267.3071	1.5413	6	1.76685	134.2612	1.96848	0	1.9685	134.79	1.5527	0.0002	6	0.6611	0.6634	1.8844	166.3566
32	412.2	5.02	0.58	-4.8	412.2071	1.2178	6	1.57414	136.7633	2.03686	0	2.0369	201.37	1.2239	0.0001	6	0.5849	0.6818	1.6758	264.2914
33	310.3	4.52	0.45	-5.04	310.3055	1.4566	6	1.70855	135.303	2.10451	0	2.1045	146.45	1.4666	0.0001	6	0.648	0.6405	1.833	186.5562
34	95	4.88	0.29	-5.19	95.00355	5.1367	9	2.45523	132.9768	2.171	0	2.171	42.76	5.2568	0.0002	4	0.9689	0.4984	2.6669	43.72736
35	90.1	2.65	-0.48	-5.21	90.09412	2.9414	5	2.28523	128.3798	2.23519	0	2.2352	39.307	3.0162	-4E-04	4	0.9126	0.5054	2.51	41.96219
36	74.2	4.04	-0.34	-5.17	74.19584	5.4451	9	2.5424	130.9917	2.30069	0	2.3007	31.249	5.6193	-3E-04	3	1	0.4599	2.7894	31.24945
37	61.3	1.87	0.57	-4.96	61.30698	3.0502	5	2.41219	124.89	2.36313	0	2.3631	24.943	3.1725	0.0007	4	0.9871	0.4524	2.6911	25.20287
38	104.3	4.46	-0.52	-4.71	104.2936	4.2764	9	2.36767	132.5459	2.4294	0	2.4294	41.93	4.3784	-4E-04	4	0.9605	0.4501	2.6125	43.32917
39	48.7	1.4	0.2	-4.51	48.70245	2.8746	4	2.46633	122.2106	2.49051	0	2.4905	18.555	3.0295	0.0003	4	1	0.4249	2.7823	18.55522
40	137.7	4.95	-3	-4.28	137.6633	3.5957	8	2.23414	133.9857	2.5575	0	2.5575	52.827	3.6638	-0.002	4	0.9143	0.4462	2.4741	56.97838
41	204.2	6.45	-0.47	-4.18	204.1943	3.1588	8	2.088	136.884	2.62594	0.0312	2.5947	77.683	3.1999	-3E-04	5	0.849	0.467	2.2998	88.9542
42	352.8	10.2	-7.54	-4	352.7077	2.8919	8	1.92961	137.28	2.69458	0.0624	2.6322	132.97	2.9142	-0.002	5	0.7754	0.4933	2.102	163.1772
43	162.9	8.07	-2.14	-4.03	162.8738	4.9548	9	2.3049	137.28	2.76322	0.0936	2.6696	59.975	5.0403	-0.002	4	0.9471	0.4163	2.547	62.98732
44	146.9	7.8	-11.32	-3.84	146.7614	5.3148	9	2.35548	137.28	2.83186	0.1248	2.7071	53.168	5.4193	-0.007	4	0.9734	0.4008	2.6121	54.5148
45	49.9	1.47	-11.5	-3.71	49.75924	2.9542	4	2.46762	122.62	2.89317	0.156	2.7372	17.122	3.1366	-0.021	4	1	0.3866	2.8192	17.12206
46	69.3	2.04	-11.51	-3.63	69.15912	2.9497	5	2.36502	125.8206	2.95608	0.1872	2.7689	23.91	3.0814	-0.015	4	1	0.3821	2.7007	23.90964
47	177.2	5.61	-11.6	-3.6	177.058	3.1685	8	2.12482	135.5153	3.02384	0.2184	2.8054	62.035	3.2235	-0.006	5	0.8878	0.4208	2.3756	69.2054
48	81.9	3.21	-11.32	-3.38	81.76144	3.9261	4	2.40689	129.5458	3.08861	0.2496	2.839	27.711	4.0802	-0.014	4	1	0.3727	2.7316	27.71132
49	93.3	4.05	-11.32	-3.2	93.16144	4.3473	9	2.40406	131.565	3.1544	0.2808	2.8736	31.322	4.4997	-0.012	4	1	0.3682	2.7214	31.32208
50	199.2	6.46	-5.54	-3.11	199.1322	3.2441	8	2.10372	136.8341	3.22281	0.312	2.9108	67.304	3.2974	-0.004	5	0.8857	0.4081	2.3569	75.55985
51	65	2.45	0.22	-3.21	65.00269	3.7691	4	2.46054	127.0095	3.28632	0.3432	2.9431	20.97	3.9698	-0.005	3	1	0.3595	2.8149	20.96972
52	53.6	2.8	-0.72	-3.42	53.59119	5.2247	4	2.62161	127.5157	3.35008	0.3744	2.9757	16.884	5.5731	-0.008	3	1	0.3556	2.9824	16.88393
53	292.9	10.21	-1.23	-3.46	292.8849	3.486	8	2.04016	137.28	3.41872	0.4056	3.0131	96.069	3.5272	-0.002	5	0.8569	0.4079	2.2687	111.5857
54	79.4	3.47	0.35	-3.58	79.40428	4.37	4	2.45039	130.0444	3.48374	0.4368	3.0469	24.917	4.5706	-0.005	3	1	0.3473	2.7989	24.91699
55	53.2	1.21	-1.63	-3.82	53.18005	2.2753	5	2.36973	121.3579	3.54442	0.468	3.0764	16.134	2.4378	-0.012	4	1	0.3439	2.7749	16.13423
56	64.1	1.91	-1.82	-4.11	64.07772	2.9808	5	2.39155	125.1527	3.60699	0.4992	3.1078	19.458	3.1586	-0.01	4	1	0.3405	2.7772	19.45777
57	53.5	1.62	-1.88	-4.41	53.47699	3.0293	4	2.45247	123.5067	3.66875	0.5304	3.1384	15.871	3.2525	-0.013	3	1	0.3372	2.855	15.87085
58	70.2	2.72	-1.73	-4.58	70.17882	3.8758	4	2.44686	127.9613	3.73273	0.5616	3.1711	20.953	4.0935	-0.01	3	1	0.3337	2.8238	20.95346
59	143.3	10.88	-2.39	-4.86	143.2708	7.594	9	2.49063	137.28	3.80137	0.5928	3.2086	43.468	7.801	-0.005	3	1	0.3298	2.7959	43.46779
60	71.8	2.84	-2.66	-4.94	71.76744	3.9572	4	2.44702	128.3318	3.86553	0.624	3.2415	20.947	4.1825	-0.012	3	1	0.3264	2.8299	20.94746
61	58.5	2.7	-2.66	-5.11	58.46744	4.618	4	2.55652	127.462	3.92927	0.6552	3.2741	16.658	4.9507	-0.016	3	1	0.3232	2.9532	16.65763
62	103.7	4.34	-2.69	-5.25	103.6671	4.1865	9	2.3621	132.3316	3.99543	0.6864	3.309	30.121	4.3543	-0.009	4	1	0.3198	2.724	30.1211
63	338.4	10.2	-3.69	-5.56	338.3548	3.0146	8	1.9542	137.28	4.06407	0.7176	3.3465	99.894	3.0512	-0.003	5	0.8473	0.377	2.202	119.0905
64	265.7	12.44	-8.58	-5.39	265.595	4.6838	9	2.17254	137.28	4.13271	0.7488	3.3839	77.266	4.7579	-0.005	9	0.9451	0.3333	2.4528	82.3549
65	657.8	8.35	1.1	-5.46	657.8135	1.2694	6	1.48641	137.28	4.20135	0.78	3.4214	191.04	1.2775	-0.001	6	0.6472	0.4679	1.6666	289.0333
66	583.5	7.5	0.41	-5.34	583.505	1.2853	6	1.51558	137.28	4.26999	0.8112	3.4588	167.47	1.2948	-0.001	6	0.6661	0.4543	1.7114	248.7183
67	96	3.5	0.77	-5.19	96.00942	3.6455	5	2.33697	130.5705	4.33528	0.8424	3.4929	26.246	3.8179	-0.009	4	1	0.3029	2.73	26.24604
68	70.1	2.87	-3.84	-5.21	70.053	4.0969	4	2.46525	128.3497	4.39945	0.8736	3.5259	18.621	4.3714	-0.018	3	1	0.3001	2.8813	18.62063
69	66.5	2.49	-3.84	-4.82	66.453	3.747	4	2.45213	127.1818	4.46304	0.9048	3.5582	17.422	4.0168	-0.019	3	1	0.2974	2.88	17.42151

70	78.2	1.85	-2.68	-4.65	78.1672	2.3667	5	2.25967	125.4039	4.52574	0.936	3.5897	20.514	2.5122	-0.015	4	1	0.2948	2.6984	20.5144
71	50.5	1.06	-2.66	-4.55	50.46744	2.1004	5	2.36394	120.2618	4.58587	0.9672	3.6187	12.679	2.3103	-0.025	4	1	0.2924	2.8479	12.67911
72	56.4	1.28	-2.47	-4.43	56.36977	2.2707	5	2.35033	121.9115	4.64683	0.9984	3.6484	14.177	2.4747	-0.023	4	1	0.29	2.8246	14.17676
73	393.4	9.81	-3.06	-4.75	393.3626	2.4939	8	1.85036	137.28	4.71547	1.0296	3.6859	105.44	2.5241	-0.003	5	0.8297	0.355	2.1134	130.408
74	105.4	2.35	-3.51	-5.15	105.357	2.2305	5	2.15088	127.8824	4.77941	1.0608	3.7186	27.047	2.3365	-0.013	4	1	0.2845	2.5839	27.04709
75	161.9	6.81	-3.42	-5.68	161.8581	4.2074	8	2.2478	136.7147	4.84777	1.092	3.7558	41.805	4.3373	-0.009	4	1	0.2817	2.6205	41.80512
76	136.7	5.44	-3.42	-6.02	136.6581	3.9807	8	2.27131	134.6585	4.9151	1.1232	3.7919	34.743	4.1293	-0.01	4	1	0.279	2.6631	34.7433
77	133.8	6.26	-3.7	-6.24	133.7547	4.6802	9	2.33348	135.6334	4.98291	1.1544	3.8285	33.635	4.8613	-0.011	3	1	0.2764	2.7225	33.63492

	CPT-5	In situ data										Basic output data								
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	73.4	1.68	-0.11	-0.21	73.39865	2.2889	5	2.26899	124.5451	0.06227	0	0.0623	1177.7	2.2908	-1E-04	8	0.5559	4.8292	1.8412	334.7039
2	47.5	2.29	0.03	-0.61	47.50037	4.821	4	2.63182	125.7502	0.12515	0	0.1252	378.55	4.8338	5E-05	9	0.7066	4.5195	2.2318	202.3549
3	27.4	1.08	0.29	-0.85	27.40355	3.9411	4	2.74346	118.9092	0.1846	0	0.1846	147.45	3.9678	0.0008	4	0.7525	3.7207	2.3504	95.71057
4	23.4	0.85	-0.04	-0.99	23.39951	3.6326	4	2.77239	116.7717	0.24299	0	0.243	95.299	3.6707	-1E-04	4	0.7814	3.1571	2.4175	69.0933
5	27.6	1.22	-0.06	-1.15	27.59927	4.4204	3	2.77441	119.8184	0.3029	0	0.3029	90.118	4.4695	-2E-04	4	0.8066	2.7425	2.4745	70.75003
6	66.7	1.33	-0.62	-1.29	66.69241	1.9942	5	2.25835	122.602	0.3642	0	0.3642	182.12	2.0052	-7E-04	5	0.6476	1.995	2.0498	125.0588
7	56.1	1.1	-0.01	-1.38	56.09988	1.9608	5	2.30964	120.7909	0.42459	0	0.4246	131.13	1.9757	-1E-05	5	0.6769	1.8554	2.1188	97.62508
8	59.3	2.02	-0.43	-1.57	59.29474	3.4067	4	2.45648	125.3732	0.48728	0	0.4873	120.69	3.4349	-5E-04	5	0.7463	1.7837	2.2924	99.13292
9	68.8	1.25	-0.05	-1.79	68.79939	1.8169	5	2.22123	122.224	0.54839	0	0.5484	124.46	1.8315	-5E-05	5	0.671	1.5543	2.0872	100.254
10	73.8	1.41	-0.1	-2.02	73.79878	1.9106	5	2.21336	123.2764	0.61003	0	0.61	119.98	1.9265	-1E-04	5	0.6796	1.4539	2.1019	100.5663
11	71.1	2.25	0.24	-2.23	71.10294	3.1644	5	2.37859	126.6051	0.67333	0	0.6733	104.6	3.1947	0.0003	5	0.7524	1.405	2.2849	93.52139
12	70.2	2.94	0.19	-2.43	70.20233	4.1879	4	2.47173	128.5312	0.7376	0	0.7376	94.177	4.2324	0.0002	4	0.7983	1.3338	2.3966	87.56473
13	70	3.22	-0.89	-2.65	69.98911	4.6007	4	2.50317	129.1894	0.80219	0	0.8022	86.247	4.6541	-9E-04	9	0.8201	1.2549	2.4464	82.05689
14	45	2.15	0.37	-2.76	45.00453	4.7773	4	2.64522	125.157	0.86477	0	0.8648	51.042	4.8709	0.0006	4	0.883	1.195	2.6039	49.85121
15	38	2.29	0.56	-2.86	38.00685	6.0252	3	2.76873	125.2064	0.92738	0	0.9274	39.983	6.1759	0.0011	3	0.9404	1.132	2.7469	39.67029
16	27.3	1.57	-0.71	-2.91	27.29131	5.7528	3	2.85611	121.6366	0.98819	0	0.9882	26.617	5.9689	-0.002	3	0.9855	1.0697	2.8577	26.591
17	78.8	3.48	1.89	-3.09	78.82313	4.415	4	2.45584	130.0475	1.05322	0	1.0532	73.84	4.4747	0.0018	4	0.8382	1.0039	2.463	73.78501
18	78.2	2.68	2.76	-3.25	78.23378	3.4256	5	2.37545	128.1179	1.11728	0	1.1173	69.022	3.4753	0.0026	4	0.8162	0.9566	2.3973	69.7157
19	35.9	1.46	0.64	-3.29	35.90783	4.066	4	2.66587	121.7743	1.17816	0	1.1782	29.478	4.2039	0.0013	4	0.9414	0.9038	2.7185	29.66397
20	33.8	1	0.83	-3.19	33.81016	2.9577	4	2.59277	118.8585	1.23759	0	1.2376	26.319	3.0701	0.0018	4	0.9233	0.8653	2.6635	26.63745
21	26.5	0.91	0.95	-3.08	26.51163	3.4325	4	2.71507	117.5753	1.29638	0	1.2964	19.451	3.6089	0.0027	3	0.9828	0.8191	2.8124	19.51861
22	23.4	0.77	0.95	-3.02	23.41163	3.289	4	2.74471	116.0497	1.3544	0	1.3544	16.286	3.4909	0.0031	3	1	0.7812	2.8649	16.28555
23	49.2	1.95	0.19	-3.04	49.20233	3.9632	4	2.56017	124.6601	1.41673	0	1.4167	33.729	4.0807	0.0003	4	0.9315	0.762	2.6626	34.41086
24	157.7	2.28	0.67	-3.16	157.7082	1.4457	6	1.89367	128.645	1.48106	0	1.4811	105.48	1.4594	0.0003	6	0.6697	0.7984	1.9677	117.8747
25	32.1	1.69	0.67	-3.21	32.1082	5.2635	3	2.77855	122.572	1.54234	0	1.5423	19.818	5.529	0.0016	3	1	0.686	2.9281	19.8178
26	27.7	1.05	0.95	-3.37	27.71163	3.789	4	2.72853	118.7303	1.60171	0	1.6017	16.301	4.0215	0.0026	3	1	0.6606	2.9028	16.30129
27	110.7	2.89	0.67	-3.66	110.7082	2.6105	5	2.18686	129.5167	1.66647	0	1.6665	65.433	2.6504	0.0004	5	0.8074	0.693	2.3049	71.41409
28	376.3	4.32	0.34	-3.82	376.3042	1.148	6	1.57569	135.4422	1.73419	0	1.7342	215.99	1.1533	7E-05	6	0.5613	0.7578	1.6517	268.2684
29	410.9	5.15	0.67	-3.93	410.9082	1.2533	6	1.58527	136.9427	1.80266	0	1.8027	226.95	1.2588	0.0001	6	0.5695	0.7383	1.6648	285.4472
30	425	5.95	0.49	-3.98	425.006	1.4	6	1.61755	137.28	1.8713	0	1.8713	226.12	1.4062	8E-05	6	0.5872	0.7155	1.7025	286.1278
31	252.9	3.87	0.57	-4.14	252.907	1.5302	6	1.779	133.6681	1.93813	0	1.9381	129.49	1.542	0.0002	6	0.664	0.6691	1.8958	158.6923
32	70.3	2.61	-0.27	-4.11	70.2967	3.7128	4	2.43262	127.6633	2.00197	0	2.002	34.114	3.8217	-3E-04	4	0.949	0.546	2.6355	35.24131
33	73.9	3.11	-4.45	-4.05	73.84553	4.2115	4	2.45896	129.0659	2.0665	0	2.0665	34.735	4.3327	-0.004	4	0.9653	0.5241	2.6703	35.55206
34	61.1	1.97	-5.06	-3.86	61.03807	3.2275	4	2.43093	125.2605	2.12913	0	2.1291	27.668	3.3441	-0.006	4	0.9671	0.5085	2.6674	28.31158
35	106.8	5.45	-5.74	-3.54	106.7297	5.1064	9	2.42229	134.069	2.19616	0	2.1962	47.598	5.2136	-0.004	4	0.956	0.4975	2.6297	49.15352
36	43.7	1.57	-5.34	-3.27	43.63464	3.5981	4	2.56794	122.7812	2.25755	0	2.2576	18.328	3.7944	-0.009	3	1	0.4687	2.8473	18.32829
37	44.8	1.43	-1.5	-3.39	44.78164	3.1933	4	2.52413	122.161	2.31863	0	2.3186	18.314	3.3676	-0.003	4	1	0.4564	2.8151	18.3138
38	260	6.78	-4.12	-3.81	259.9496	2.6082	8	1.96042	137.28	2.38727	0	2.3873	107.89	2.6324	-0.001	5	0.7741	0.5327	2.129	129.6606
39	364.1	8.19	-4.01	-4.32	364.0509	2.2497	8	1.82832	137.28	2.45591	0	2.4559	147.23	2.265	-8E-04	5	0.7206	0.5451	1.98	186.2883
40	145.7	7.82	-3.46	-4.51	145.6577	5.3688	9	2.36095	137.28	2.52455	0	2.5246	56.696	5.4635	-0.002	4	0.9575	0.4349	2.5929	58.82931
41	84.5	5.07	-7.01	-4.77	84.4142	6.0061	9	2.54035	132.9681	2.59104	0	2.591	31.579	6.1963	-0.006	3	1	0.4084	2.8164	31.5793
42	38.1	0.76	-7.5	-4.9	38.0082	1.9996	5	2.44523	117.1359	2.64961	0	2.6496	13.345	2.1494	-0.015	4	1	0.3994	2.812	13.34485
43	82.9	1.85	-7.63	-4.86	82.80661	2.2341	5	2.22426	125.5445	2.71238	0	2.7124	29.529	2.3098	-0.007	4	0.9439	0.4112	2.5329	31.12916
44	105.4	4.35	-7.54	-4.86	105.3077	4.1308	9	2.35329	132.3868	2.77857	0	2.7786	36.9	4.2427	-0.005	4	0.9919	0.3838	2.6499	37.1913
45	70.9	2.79	-7.54	-4.97	70.80771	3.9403	4	2.44956	128.169	2.84266	0	2.8427	23.909	4.1051	-0.008	3	1	0.3722	2.7812	23.909
46	68.9	2.99	-7.44	-4.9	68.80893	4.3454	4	2.48948	128.6057	2.90696	0	2.907	22.67	4.537	-0.008	3	1	0.364	2.8273	22.67042
47	174.8	8.28	-1.82	-4.66	174.7777	4.7375	9	2.27172	137.28	2.9756	0	2.9756	57.737	4.8195	-8E-04	4	0.961	0.3702	2.5458	60.11236
48	173.4	6.27	-0.38	-4.06	173.3954	3.616	8	2.17678	136.2782	3.04374	0	3.0437	55.968	3.6806	-2E-04	4	0.9317	0.3737	2.4593	60.15621
49	91.6	3.32	-0.04	-3.85	91.59951	3.6245	5	2.34834	130.0695	3.10877	0	3.1088	28.465	3.7518	-3E-05	4	1	0.3404	2.6986	28.46485
50	526	11.93	-1.79	-3.68	525.9781	2.2682	8	1.75532	137.28	3.17741	0	3.1774	164.54	2.2819	-3E-04	6	0.7399	0.4433	1.9408	219.0152
51	107.3	8.36	-1.92	-3.8	107.2765	7.793	9	2.56956	137.212	3.24602	0	3.246	32.049	8.0361	-0.001	3	1	0.326	2.8938	32.04864
52	54.5	1.28	-3.53	-3.99	54.45679	2.3505	5	2.3715	121.8273	3.30693	0	3.3069	15.467	2.5025	-0.005	4	1	0.32	2.7965	15.46747
53	73.3	1.88	-3.53	-4.12	73.25679	2.5663	5	2.30446	125.3634	3.36961	0	3.3696	20.74	2.6901	-0.004	4	1	0.314	2.7126	20.74041
54	100.5	3.65	-3.63	-4.16	100.4556	3.6335	5	2.3232	130.988	3.43511	0	3.4351	28.244	3.7621	-0.003	4	1	0.308	2.7019	28.24379
55	206	6.99	-3.64	-4.41	205.9555	3.3939	8	2.11167	137.28	3.50375	0	3.5038	57.781	3.4527	-0.001	4	0.9426	0.3235	2.4306	61.89311
56	250.1	7	-3.53	-4.69	250.0568	2.7994	8	1.99534	137.28	3.57239	0	3.5724	68.997	2.8399	-0.001	5	0.8947	0.3367	2.2983	78.42757
57	158.7	11.85	-8.56	-4.9	158.5952	7.4719	9	2.4612	137.28	3.64103	0	3.641	42.558	7.6474	-0.004	3	1	0.2906	2.7954	42.55782
58	134	6.73	-8.68	-5.02	133.8938	5.0264	9	2.35839	136.1656	3.70911	0	3.7091	35.099	5.1696	-0.005	3	1	0.2853	2.7281	35.09861
59	109.7	4.66	-8.78	-5.04	109.5925	4.2521	9	2.35237	132.9877	3.7756	0	3.7756	28.026	4.4038	-0.006	3	1	0.2803	2.7503	28.02649
60	85.8	3.48	-8.97	-4.76	85.69021	4.0611	4	2.40469	130.2512	3.84073	0	3.8407	21.311	4.2517	-0.008	3	1	0.2755	2.8289	21.31092
61	118.8	6.13	-8.97	-4.78	118.6902	5.1647	9	2.39862	135.1884	3.90832	0	3.9083	29.369	5.3406	-0.006	3	1	0.2707	2.7931	29.36857
62	200.4	11.47	-8.87	-4.97	200.2914	5.7267	9	2.30977	137.28	3.97696	0	3.977	49.363	5.8427	-0.003	3	1	0.2661	2.6651	49.36289
63	378.9	10.26	-5.42	-4.95	378.8337	2.7083	8	1.88961	137.28	4.0456	0	4.0456	92.641	2.7376	-0.001	5	0.8757	0.309	2.1895	109.4443
64	76.3	2.63	-1.78	-5.08	76.27821	3.4479	5	2.38494	127.9183	4.10956	0	4.1096	17.561	3.6442	-0.002	3	1	0.2575	2.8507	17.56115
65	104	7.05	-2.14	-5.4	103.9738	6.7806	9	2.52804	135.8887	4.17751	0	4.1775	23.889	7.0644	-0.002	3	1	0.2533	2.9422	23.88896
66	68.9	1.84	-2.17	-5.63	68.87344	2.6716	5	2.33576	125.0555	4.24004	0	4.24	15.244	2.8468	-0.002	4	1	0.2496	2.8343	15.2436
67	88.6	2.88	-2.02	-5.9	88.57528	3.2515	5	2.3225	128.9473	4.30451	0	4.3045	19.577	3.4176	-0.002	4	1	0.2458	2.7965	19.57732
68	72	2.09	-2	-6.25	71.97552	2.9038	5	2.34803	126.0951	4.36756	0	4.3676	15.48	3.0914	-0.002	3	1	0.2423	2.8503	15.47958
69	152.8	6.59	-1.91	-6.52	152.7766	4.3135	9	2.27106	136.3336	4.43572	0	4.4357	33.442	4.4425	-9E-04	4	1	0.2385	2.697	33.44232

70	243.7	13.05	-2.28	-7.19	243.6721	5.3556	9	2.24163	137.28	4.50436	0	4.5044	53.097	5.4564	-7E-04	4	1	0.2349	2.6219	53.0969
71	118.8	5.28	-2.36	-7.33	118.7711	4.4455	9	2.34628	134.0979	4.57141	0	4.5714	24.981	4.6235	-0.001	3	1	0.2315	2.8014	24.98127
72	181.3	7.94	-2.23	-7.45	181.2727	4.3801	9	2.23457	137.28	4.64005	0	4.6401	38.067	4.4952	-9E-04	4	1	0.228	2.6603	38.06695
73	449.2	6.81	0.1	-7.73	449.2012	1.516	6	1.63435	137.28	4.70869	0	4.7087	94.398	1.5321	2E-05	6	0.8239	0.2923	1.9702	122.7797
74	539.6	8.55	-0.54	-7.9	539.5934	1.5845	6	1.61167	137.28	4.77733	0	4.7773	111.95	1.5987	-7E-05	6	0.8103	0.2948	1.9258	149.0182
75	230.2	8.03	-1.46	-8.1	230.1821	3.4885	8	2.09508	137.28	4.84597	0	4.846	46.5	3.5636	-5E-04	4	1	0.2184	2.5276	46.49968
76	453.8	11.69	-2.48	-8.16	453.7696	2.5762	8	1.83353	137.28	4.91461	0	4.9146	91.331	2.6044	-4E-04	5	0.9163	0.2448	2.1882	103.8595
77	315.3	6.75	-1.08	-8.24	315.2868	2.1409	6	1.84283	137.28	4.98325	0	4.9833	62.269	2.1753	-3E-04	5	0.9491	0.2298	2.2628	67.37948
78	550.5	9.82	-1.4	-8.19	550.4829	1.7839	8	1.65321	137.28	5.05189	0	5.0519	107.97	1.8004	-2E-04	6	0.8469	0.2661	1.9882	137.1572
79	561.7	12.81	-1.99	-8.16	561.6756	2.2807	8	1.7451	137.28	5.12053	0	5.1205	108.69	2.3017	-3E-04	5	0.8863	0.2472	2.0836	130.0337
80	222	0	-2.31	-7.94	221.9717	0	0	0	120.9	5.18098	0	5.181	41.844	0	-8E-04	0	1	0.2042	0	0

Depth (ft)	CPT-6 qc (tsf)	In situ data fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	Basic output data ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	48.2	1.05	-0.01	-0.22	48.19988	2.1784	5	2.38941	120.0803	0.06004	0	0.06	801.79	2.1812	-1E-05	6	0.5799	5.2789	1.9017	240.1689
2	45.7	1.69	-0.18	-0.3	45.6978	3.6982	4	2.5618	123.4328	0.12176	0	0.1218	374.32	3.7081	-3E-04	8	0.6771	4.3234	2.1543	186.2217
3	30.4	0.99	0	-0.37	30.4	3.2566	4	2.65504	118.5256	0.18102	0	0.181	166.94	3.2761	0	5	0.723	3.584	2.2678	102.3581
4	21.4	1.06	-3.27	-0.44	21.35998	4.9626	3	2.89082	118.1648	0.2401	0	0.2401	87.962	5.019	-0.011	4	0.8227	3.3881	2.5255	67.62606
5	32.7	1.11	-0.2	-0.59	32.69755	3.3948	4	2.64306	119.5405	0.29987	0	0.2999	108.04	3.4262	-4E-04	5	0.76	2.6072	2.3532	79.82966
6	47.3	1.77	-2.77	-0.65	47.2661	3.7448	4	2.55513	123.8535	0.3618	0	0.3618	129.64	3.7736	-0.004	5	0.7519	2.2409	2.3233	99.33708
7	72.5	1.91	-0.13	-0.69	72.49841	2.6345	5	2.31571	125.4538	0.42453	0	0.4245	169.78	2.6501	-1E-04	5	0.6838	1.8673	2.1366	127.1917
8	71.5	1.81	-0.12	-0.82	71.49853	2.5315	5	2.30775	125.0265	0.48704	0	0.487	145.8	2.5489	-1E-04	5	0.6928	1.7119	2.1523	114.8852
9	97.5	1.44	0.13	-0.96	97.50159	1.4769	5	2.04863	124.1097	0.54909	0	0.5491	176.57	1.4853	0.0001	6	0.6103	1.4924	1.9279	136.7409
10	82	1.32	0.1	-1.08	82.00122	1.6097	5	2.12938	123.0508	0.61062	0	0.6106	133.29	1.6218	9E-05	5	0.649	1.4287	2.0216	109.9
11	58	2.07	0.23	-1.25	58.00282	3.5688	4	2.47759	125.4984	0.67337	0	0.6734	85.138	3.6107	0.0003	4	0.7883	1.428	2.3792	77.36943
12	66.5	2.25	-0.35	-1.41	66.49572	3.3837	4	2.41972	126.4417	0.73659	0	0.7366	89.275	3.4216	-4E-04	5	0.7781	1.3256	2.3437	82.38076
13	62.4	2.35	-0.1	-1.6	62.39878	3.7661	4	2.47245	126.6048	0.79989	0	0.7999	77.009	3.815	-1E-04	4	0.8077	1.2535	2.414	72.97575
14	74	2.54	0.37	-1.73	74.00453	3.4322	5	2.39239	127.5898	0.86369	0	0.8637	84.684	3.4728	0.0004	5	0.7874	1.1734	2.353	81.10704
15	69.5	2.65	-1.34	-1.87	69.4836	3.8139	4	2.44462	127.7462	0.92756	0	0.9276	73.91	3.8655	-0.001	4	0.8165	1.1135	2.4215	72.14538
16	38.2	2.04	-0.48	-2.01	38.19412	5.3411	3	2.72966	124.3725	0.98975	0	0.9898	37.59	5.4832	-9E-04	3	0.9357	1.0645	2.7268	37.42874
17	34.5	1.77	0.67	-2.2	34.5082	5.1292	3	2.74835	123.0862	1.05129	0	1.0513	31.825	5.2904	0.0014	3	0.9533	1.0062	2.7654	31.81506
18	31.8	1.87	-0.32	-2.31	31.79608	5.8812	3	2.81543	123.2887	1.11293	0	1.1129	27.57	6.0946	-8E-04	3	0.9895	0.9512	2.8527	27.58428
19	36.5	1.62	-1.63	-2.45	36.48005	4.4408	4	2.68735	122.5738	1.17422	0	1.1742	30.067	4.5885	-0.003	3	0.9489	0.9059	2.7385	30.22804
20	35.9	1.72	-2.59	-2.47	35.8683	4.7953	4	2.71588	122.9708	1.23571	0	1.2357	28.027	4.9664	-0.005	3	0.9693	0.8604	2.7844	28.16052
21	32.5	1.55	-1.25	-2.39	32.4847	4.7715	3	2.74528	121.9677	1.29669	0	1.2967	24.052	4.9699	-0.003	3	0.9913	0.8175	2.8342	24.0946
22	29.5	1.25	-1.08	-2.46	29.48678	4.2392	4	2.74093	120.1575	1.35677	0	1.3568	20.733	4.4437	-0.003	3	1	0.7799	2.8505	20.7331
23	35.8	1.2	-0.95	-2.5	35.78837	3.353	4	2.61021	120.3312	1.41693	0	1.4169	24.258	3.4913	-0.002	4	0.9557	0.7565	2.7263	24.57328
24	41.4	1.38	-0.94	-2.54	41.38849	3.3343	4	2.56196	121.7084	1.47779	0	1.4778	27.007	3.4577	-0.002	4	0.9434	0.7297	2.6862	27.52298
25	41.5	2.12	-0.92	-2.64	41.48874	5.1098	4	2.69079	124.8558	1.54022	0	1.5402	25.937	5.3068	-0.002	3	1	0.687	2.8302	25.93697
26	27.3	1.18	-0.86	-2.78	27.28947	4.324	3	2.77162	119.547	1.59999	0	1.6	16.056	4.5933	-0.002	3	1	0.6613	2.9444	16.05604
27	37.4	1.55	-0.76	-2.84	37.3907	4.1454	4	2.65892	122.3107	1.66114	0	1.6611	21.509	4.3382	-0.002	3	1	0.637	2.8316	21.509
28	34.1	1.25	-0.76	-2.92	34.0907	3.6667	4	2.65192	120.5114	1.7214	0	1.7214	18.804	3.8617	-0.002	3	1	0.6147	2.8436	18.80405
29	124.4	5.71	-0.95	-3.21	124.3884	4.5905	9	2.34535	134.7834	1.78879	0	1.7888	68.538	4.6574	-6E-04	4	0.8795	0.6302	2.4792	73.01605
30	73.7	4.05	-0.76	-3.47	73.6907	5.4959	9	2.54741	130.9932	1.85429	0	1.8543	38.741	5.6378	-8E-04	3	0.9744	0.5789	2.7209	39.30173
31	65.8	3.43	-0.72	-3.54	65.79119	5.2135	4	2.56177	129.5008	1.91904	0	1.919	33.283	5.3701	-8E-04	3	0.9908	0.5544	2.7544	33.46684
32	58.1	2.69	-0.71	-3.51	58.09131	4.6306	4	2.5593	127.4191	1.98275	0	1.9828	28.298	4.7943	-9E-04	3	1	0.5337	2.7724	28.29898
33	68.1	2.63	-0.76	-3.62	68.0907	3.8625	4	2.45462	127.6414	2.04657	0	2.0466	32.271	3.9822	-8E-04	4	0.9634	0.5296	2.668	33.05872
34	123.4	5.24	-0.76	-3.69	123.3907	4.2467	9	2.32043	134.1353	2.11364	0	2.1136	57.378	4.3207	-5E-04	4	0.9048	0.5347	2.5049	61.28714
35	58.6	3.51	-1.85	-3.69	58.57736	5.9921	3	2.64048	129.3863	2.17833	0	2.1783	25.891	6.2235	-0.002	3	1	0.4857	2.8787	25.89095
36	40.2	2.24	-1.8	-3.8	40.17797	5.5752	3	2.7277	125.1803	2.24092	0	2.2409	16.929	5.9045	-0.003	3	1	0.4722	2.9981	16.92923
37	101.2	3.34	-1.72	-3.86	101.179	3.3011	5	2.2894	130.356	2.3061	0	2.3061	42.875	3.3781	-0.001	4	0.9186	0.4889	2.5169	45.68302
38	99.4	4.84	-1.62	-4.16	99.38017	4.8702	9	2.42496	133.0265	2.37261	0	2.3726	40.886	4.9893	-0.001	4	0.9778	0.4541	2.6653	41.62732
39	65	2.59	-1.72	-4.09	64.97895	3.9859	4	2.47843	127.4152	2.43632	0	2.4363	25.671	4.1412	-0.002	4	1	0.4343	2.7606	25.67095
40	144.2	4.19	-1.79	-3.96	144.1781	2.9061	5	2.14883	132.8788	2.50276	0	2.5028	56.608	2.9575	-9E-04	5	0.8738	0.4713	2.3765	63.10207
41	30.1	0.73	-2.29	-4.03	30.07197	2.4275	4	2.57726	116.27	2.56089	0.0312	2.5297	10.875	2.6535	-0.007	3	1	0.4183	2.9367	10.87526
42	81.9	3.55	-2.24	-4.26	81.87258	4.336	4	2.43918	130.2858	2.62604	0.0624	2.5636	30.912	4.4797	-0.003	4	1	0.4127	2.7242	30.91177
43	99.1	4.44	-2.2	-4.31	99.07307	4.4815	9	2.39749	132.3878	2.69223	0.0936	2.5986	37.089	4.6067	-0.003	4	0.9923	0.41	2.6737	37.34709
44	61.1	3.57	-2	-4.21	61.07552	5.8452	4	2.62048	129.6121	2.75704	0.1248	2.6322	22.155	6.1216	-0.005	3	1	0.402	2.9225	22.15549
45	92.3	4.64	-0.98	-4.17	92.288	5.0277	9	2.45575	132.5371	2.8233	0.156	2.6673	33.541	5.1864	-0.003	3	1	0.3967	2.7431	33.54124
46	49.8	2.57	-0.76	-4.13	49.7907	5.1616	4	2.63936	126.7091	2.88666	0.1872	2.6995	17.375	5.4793	-0.005	3	1	0.392	2.9681	17.37535
47	100.7	5.42	-0.79	-4.43	100.6903	5.3828	9	2.45584	133.8866	2.9536	0.2184	2.7352	35.733	5.5455	-0.003	3	1	0.3869	2.7444	35.7329
48	75.3	4.52	-0.67	-4.56	75.2918	6.0033	9	2.57114	131.8489	3.01953	0.2496	2.7699	26.092	6.2541	-0.004	3	1	0.382	2.8778	26.09176
49	139.5	5.52	-0.69	-4.2	139.4916	3.9572	8	2.26393	134.8153	3.08693	0.2808	2.8061	48.609	4.0468	-0.002	4	0.9503	0.3958	2.5385	51.02279
50	106.5	4.24	-0.97	-3.83	106.4881	3.9817	9	2.33782	132.2265	3.15305	0.312	2.8411	36.372	4.1032	-0.004	4	0.9927	0.3751	2.6445	36.63618
51	50.7	1.54	-1.05	-3.57	50.68715	3.0383	4	2.47016	123.0054	3.21455	0.3432	2.8714	16.533	3.244	-0.009	3	1	0.3685	2.8402	16.53319
52	64.1	1.71	-1.05	-3.51	64.08715	2.6682	5	2.35767	124.3437	3.27672	0.3744	2.9023	20.952	2.812	-0.007	4	1	0.3646	2.7208	20.95233
53	73.4	2.73	-1.05	-3.55	73.38715	3.72	4	2.42062	128.0972	3.34077	0.4056	2.9352	23.864	3.8974	-0.007	4	1	0.3605	2.767	23.86449
54	79.4	2.92	-1.05	-3.53	79.38715	3.6782	4	2.39412	128.7811	3.40516	0.4368	2.9684	25.597	3.843	-0.007	4	1	0.3565	2.7401	25.59728
55	219	9.43	-0.71	-3.5	218.9913	4.3061	8	2.18394	137.28	3.4738	0.468	3.0058	71.701	4.3755	-0.002	4	0.9229	0.3815	2.441	77.70935
56	168.9	11.33	-5.06	-3.5	168.8381	6.7106	9	2.40721	137.28	3.54244	0.4992	3.0432	54.316	6.8544	-0.005	3	1	0.3477	2.6903	54.31564
57	112.1	5.47	-5.2	-3.72	112.0364	4.8823	9	2.39403	134.2142	3.60955	0.5304	3.0792	35.213	5.0449	-0.008	3	1	0.3436	2.7196	35.21324
58	72.8	3.96	-5.63	-3.88	72.73109	5.4447	9	2.54792	130.7967	3.67495	0.5616	3.1134	22.181	5.7345	-0.014	3	1	0.3399	2.9027	22.18067
59	351.1	5.12	-5.73	-4.21	351.0299	1.4586	6	1.67816	136.5158	3.74321	0.5928	3.1504	110.24	1.4743	-0.003	6	0.7231	0.4543	1.8998	149.1099
60	634.6	10.3	-0.44	-4.4	634.5946	1.6231	6	1.58896	137.28	3.81185	0.624	3.1879	197.87	1.6329	-0.001	6	0.6702	0.4775	1.7564	284.6758
61	514	12.84	-4.62	-4.56	513.9435	2.4983	8	1.79745	137.28	3.88049	0.6552	3.2253	158.15	2.5173	-0.002	5	0.7611	0.4282	1.9905	206.3997
62	461.4	8.77	-6.33	-4.48	461.3225	1.9011	6	1.7137	137.28	3.94913	0.6864	3.2627	140.18	1.9175	-0.003	6	0.7359	0.4367	1.9194	188.744
63	99.9	2.94	-5.91	-4.7	99.82766	2.9451	5	2.25586	129.3899	4.01382	0.7176	3.2962	29.068	3.0685	-0.012	4	1	0.321	2.6344	29.06779
64	136.1	7.48	-5.44	-5.01	136.0334	5.4987	9	2.38634	136.9774	4.08231	0.7488	3.3335	39.583	5.6688	-0.009	3	1	0.3174	2.7205	39.58325
65	55.8	1.62	-6.31	-5.26	55.72277	2.9073	5	2.42721	123.607	4.14411	0.78	3.3641	15.332	3.1408	-0.024	3	1	0.3145	2.8578	15.33203
66	109.4	3.93	-6.3	-5.3	109.3229	3.5949	5	2.29618	131.7351	4.20998	0.8112	3.3988	30.927	3.7388	-0.012	4	1	0.3113	2.6708	30.92666
67	88.3	3.3	-6.2	-5.37	88.22411	3.7405	4	2.36935	129.9337	4.27495	0.8424	3.4326	24.457	3.931	-0.015	4	1	0.3083	2.7614	24.45682
68	71.1	2.07	-6.2	-5.43	71.02411	2.9145	5	2.35321	125.9923	4.33794	0.8736	3.4643	19.249	3.1041	-0.02	4	1	0.3054	2.7762	19.2493
69	280.5	13.53	-6.1	-5.66	280.4253	4.8248	9	2.17229	137.28	4.40658	0.9048	3.5018	78.822	4.9018	-0.005	9	0.9532	0.3196	2.4595	83.36546

70	81.1	2.72	-6.68	-5.93	81.01824	3.3573	5	2.35875	128.3116	4.47074	0.936	3.5347	21.656	3.5534	-0.019	4	1	0.2994	2.7733	21.65577
71	69.8	2.51	-6.68	-5.87	69.71824	3.6002	4	2.42523	127.3573	4.53442	0.9672	3.5672	18.273	3.8507	-0.022	3	1	0.2966	2.8524	18.27302
72	204.9	6.26	-6.68	-5.9	204.8182	3.0564	8	2.07548	136.6727	4.60275	0.9984	3.6044	55.548	3.1266	-0.007	5	0.9396	0.3161	2.4101	59.81409
73	143.3	4.97	-6.39	-6.06	143.2218	3.4701	8	2.21144	134.1117	4.66981	1.0296	3.6402	38.062	3.5871	-0.011	4	1	0.2907	2.5923	38.06154
74	335.5	12.13	-1.8	-6.22	335.478	3.6157	8	2.02501	137.28	4.73845	1.0608	3.6777	89.932	3.6675	-0.004	5	0.9033	0.3246	2.3079	101.4457
75	295.6	11.58	-2.06	-6.47	295.5748	3.9178	8	2.08217	137.28	4.80709	1.092	3.7151	78.267	3.9826	-0.004	4	0.9353	0.3089	2.385	84.89647
76	232.8	7.87	-1.75	-6.76	232.7786	3.3809	8	2.081	137.28	4.87573	1.1232	3.7525	60.733	3.4532	-0.005	4	0.9492	0.3007	2.4171	64.77034
77	197.9	5.67	0.57	-6.9	197.907	2.865	8	2.06109	135.8647	4.94366	1.1544	3.7893	50.924	2.9384	-0.006	5	0.9528	0.2966	2.4221	54.08203
78	378.8	8.07	-2.96	-6.92	378.7638	2.1306	8	1.79923	137.28	5.0123	1.1856	3.8267	97.669	2.1592	-0.004	5	0.8236	0.3469	2.0797	122.5252
79	77.3	4	-0.67	-6.84	77.2918	5.1752	9	2.51408	131.0186	5.07781	1.2168	3.861	18.703	5.5391	-0.018	3	1	0.2741	2.9473	18.70339
80	82.4	2.65	-0.38	-6.77	82.39535	3.2162	5	2.34004	128.1619	5.14189	1.248	3.8939	19.84	3.4303	-0.017	4	1	0.2717	2.793	19.83965

	CPT-7	In situ data										Basic output data								
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ā (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	39.5	1.05	-0.08	0.25	39.49902	2.6583	4	2.51136	119.5948	0.0598	0	0.0598	659.55	2.6623	-2E-04	8	0.6156	5.8636	1.9962	218.5547
2	9.8	0.57	-1.77	0.23	9.77834	5.8292	3	3.19593	111.7197	0.11566	0	0.1157	83.546	5.899	-0.013	4	0.8512	6.5818	2.6121	60.10537
3	14.6	0.76	-4.02	0.26	14.5508	5.2231	3	3.03185	114.7941	0.17305	0	0.1731	83.082	5.286	-0.02	4	0.8354	4.5384	2.5686	61.66894
4	8.2	0.5	-2.41	0.25	8.1705	6.1196	3	3.27034	110.3228	0.22822	0	0.2282	34.802	6.2954	-0.022	3	0.9355	4.1996	2.8218	31.52262
5	12.3	0.57	-3.85	0.2	12.25288	4.652	3	3.05834	112.2699	0.28435	0	0.2844	42.091	4.7625	-0.023	4	0.8887	3.2147	2.6921	36.36201
6	12.6	0.7	-4.56	0.11	12.54419	5.5803	3	3.09983	113.8304	0.34127	0	0.3413	35.758	5.7363	-0.027	3	0.9253	2.8491	2.7804	32.85819
7	10.9	0.4	-4.87	0.04	10.84039	3.6899	3	3.04015	109.3797	0.39596	0	0.396	26.378	3.8298	-0.034	4	0.9184	2.4663	2.7555	24.34447
8	9.6	0.2	-4.23	0.01	9.54822	2.0946	3	2.94928	103.9984	0.44795	0	0.448	20.315	2.1977	-0.033	4	0.8989	2.1656	2.698	18.62495
9	7.4	0.13	-4.03	-0.11	7.35067	1.7686	3	3.01021	100.2084	0.49806	0	0.4981	13.759	1.8971	-0.042	4	0.9368	2.0257	2.7887	13.11876
10	10.2	0.34	-3.91	-0.14	10.15214	3.3491	3	3.03887	108.0305	0.55207	0	0.5521	17.389	3.5416	-0.029	3	0.9639	1.8721	2.8544	16.98524
11	14	0.67	-3.95	-0.14	13.95165	4.8023	3	3.02284	113.7693	0.60896	0	0.609	21.911	5.0215	-0.021	3	0.9733	1.7121	2.8725	21.58999
12	17.1	0.82	-3.65	-0.14	17.05532	4.8079	3	2.95586	115.7374	0.66683	0	0.6668	24.577	5.0035	-0.016	3	0.9619	1.5591	2.8354	24.14865
13	19.9	0.83	-3.15	-0.16	19.86144	4.179	3	2.86605	116.1976	0.72493	0	0.7249	26.398	4.3373	-0.012	3	0.9406	1.4272	2.7723	25.81167
14	21.2	0.92	-3.5	-0.16	21.15716	4.3484	3	2.85627	117.105	0.78348	0	0.7835	26.004	4.5156	-0.012	3	0.9488	1.3299	2.7866	25.60691
15	20.6	0.94	-3.62	-0.24	20.55569	4.5729	3	2.88002	117.192	0.84207	0	0.8421	23.411	4.7683	-0.013	3	0.9694	1.2478	2.8336	23.24772
16	13.2	0.75	-3.52	-0.21	13.15692	5.7004	3	3.08976	114.4516	0.8993	0	0.8993	13.63	6.1187	-0.021	3	1	1.1766	3.0792	13.63016
17	8.5	0.11	-3.24	-0.24	8.46034	1.3002	4	2.89306	99.32895	0.94897	0	0.949	7.9153	1.4645	-0.031	4	1	1.115	2.9211	7.91533
18	10.8	0.26	-3.06	-0.29	10.76255	2.4158	3	2.93841	106.2101	1.00207	0	1.0021	9.7403	2.6638	-0.023	3	1	1.0559	2.9774	9.74031
19	17.3	0.53	-3.05	-0.31	17.26267	3.0702	4	2.83026	112.5736	1.05836	0	1.0584	15.311	3.2707	-0.014	3	0.993	0.9998	2.8688	15.31084
20	19.9	0.55	-2.96	-0.33	19.86377	2.7689	4	2.75458	113.1869	1.11495	0	1.115	16.816	2.9335	-0.011	4	0.9723	0.9504	2.8074	16.84023
21	24.2	0.74	-2.67	-0.35	24.16732	3.062	4	2.71441	115.8364	1.17287	0	1.1729	19.605	3.2182	-0.008	4	0.964	0.9055	2.7784	19.67809
22	21	1.03	-2.58	-0.33	20.96842	4.9122	3	2.89391	117.9096	1.23182	0	1.2318	16.022	5.2187	-0.009	3	1	0.859	2.9809	16.02226
23	19.8	0.76	-2.58	-0.35	19.76842	3.8445	3	2.84449	115.5415	1.28959	0	1.2896	14.329	4.1128	-0.01	3	1	0.8205	2.9526	14.32918
24	19.7	0.71	-2.48	-0.37	19.66964	3.6096	3	2.82889	115.0313	1.34711	0	1.3471	13.601	3.875	-0.01	3	1	0.7855	2.9544	13.60137
25	20	0.7	-2.46	-0.37	19.96989	3.5053	3	2.81577	114.9645	1.40459	0	1.4046	13.218	3.7705	-0.01	3	1	0.7533	2.9571	13.21757
26	20.5	0.73	-2.48	-0.38	20.46964	3.5663	3	2.81213	115.3318	1.46226	0	1.4623	12.999	3.8406	-0.009	3	1	0.7236	2.9677	12.99865
27	19.8	0.65	-2.39	-0.37	19.77075	3.2877	4	2.80182	114.3978	1.51946	0	1.5195	12.012	3.5614	-0.009	3	1	0.6964	2.9753	12.01172
28	21	0.6	-2.39	-0.39	20.97075	2.8611	4	2.74451	113.9558	1.57643	0	1.5764	12.303	3.0937	-0.009	3	1	0.6712	2.9309	12.30264
29	11.3	0.26	-2.39	-0.41	11.27075	2.3069	3	2.91069	106.3226	1.6296	0	1.6296	5.9163	2.6968	-0.018	3	1	0.6493	3.163	5.91628
30	16.7	0.47	-2.29	-0.31	16.67197	2.8191	4	2.82023	111.6095	1.6854	0	1.6854	8.892	3.1361	-0.011	3	1	0.6278	3.0498	8.89199
31	19.4	0.76	-2.29	-0.31	19.37197	3.9232	3	2.85687	115.4921	1.74315	0	1.7432	10.113	4.3111	-0.009	3	1	0.607	3.0849	10.11322
32	10.5	0.52	-2.29	-0.45	10.47197	4.9656	3	3.12956	111.2151	1.79875	0	1.7988	4.8218	5.9955	-0.019	3	1	0.5882	3.4289	4.82179
33	9.3	0.2	-2.19	-0.51	9.27319	2.1568	3	2.96674	103.9271	1.85072	0	1.8507	4.0106	2.6945	-0.021	3	1	0.5717	3.308	4.01059
34	8	0.22	-2.14	-0.54	7.97381	2.759	3	3.07913	104.2563	1.90285	0	1.9029	3.1905	3.6238	-0.025	3	1	0.5561	3.4588	3.19046
35	36.2	1.2	-2.1	-0.39	36.1743	3.3173	4	2.60364	120.3574	1.96302	0	1.963	17.428	3.5076	-0.004	3	1	0.539	2.843	17.42783
36	106.9	2.01	-1.91	-0.32	106.8766	1.8807	5	2.09311	126.7738	2.02641	0	2.0264	51.742	1.917	-0.001	5	0.8111	0.5904	2.271	58.49857
37	139.8	5.63	-2.47	-0.2	139.7698	4.0281	8	2.2696	134.9646	2.09389	0	2.0939	65.751	4.0893	-0.001	4	0.8804	0.5483	2.443	71.34515
38	35.2	0.73	-2.67	-0.27	35.16732	2.0758	5	2.48177	116.6517	2.15222	0	2.1522	15.34	2.2111	-0.006	4	1	0.4916	2.7687	15.34002
39	72.7	1.55	-2.58	-0.39	72.66842	2.133	5	2.25092	123.9314	2.21419	0	2.2142	31.819	2.2	-0.003	5	0.9034	0.5132	2.4881	34.17239
40	95.5	6.41	-2.48	-0.47	95.46964	6.7142	9	2.54645	134.9842	2.28168	0	2.2817	40.842	6.8786	-0.002	3	1	0.4637	2.7729	40.84186
41	53.2	3.02	-2.58	-0.56	53.16842	5.6801	4	2.65085	128.0498	2.3457	0.0312	2.3145	21.958	5.9422	-0.004	3	1	0.4572	2.9165	21.95838
42	106.3	6.48	-2.22	-0.73	106.2728	6.0975	9	2.48515	135.3252	2.41337	0.0624	2.351	44.177	6.2392	-0.002	3	0.9969	0.4512	2.7178	44.28793
43	595.7	8.02	-2.77	-0.74	595.6661	1.3464	6	1.52905	137.28	2.48201	0.0936	2.3884	248.36	1.352	-5E-04	6	0.5878	0.6197	1.6397	347.4107
44	498.2	5.97	-9.72	-0.98	498.081	1.1986	6	1.52385	137.28	2.55065	0.1248	2.4259	204.27	1.2048	-0.002	6	0.5931	0.6114	1.6489	286.3045
45	356.1	7.1	-11.83	-1.19	355.9552	1.9946	6	1.78871	137.28	2.61929	0.156	2.4633	143.44	2.0094	-0.003	6	0.7067	0.5504	1.9425	183.7873
46	397.5	6.66	-12.5	-1.38	397.347	1.6761	6	1.69932	137.28	2.68793	0.1872	2.5007	157.82	1.6875	-0.003	6	0.6726	0.5608	1.8482	209.1541
47	163.6	8.15	-12.36	-1.51	163.4487	4.9863	9	2.30634	137.28	2.75657	0.2184	2.5382	63.31	5.0718	-0.007	4	0.935	0.4413	2.5315	67.01775
48	84	2.32	-12.69	-1.57	83.84467	2.767	5	2.28703	127.2313	2.82018	0.2496	2.5706	31.52	2.8633	-0.014	4	0.9528	0.4292	2.5743	32.86846
49	110.7	3.32	-12.81	-1.68	110.5432	3.0034	5	2.23322	130.528	2.88544	0.2808	2.6046	41.333	3.0839	-0.011	4	0.9265	0.4341	2.5003	44.16327
50	108.5	5.16	-12.98	-1.8	108.3411	4.7627	9	2.3943	133.7055	2.9523	0.312	2.6403	39.916	4.8962	-0.012	4	0.9928	0.4034	2.6701	40.17773
51	145.4	7.21	-13.07	-1.82	145.24	4.9642	9	2.33364	136.8681	3.02073	0.3432	2.6775	53.116	5.0696	-0.009	4	0.9629	0.409	2.588	54.97652
52	182.6	11.27	-13.07	-1.81	182.44	6.1774	9	2.35895	137.28	3.08937	0.3744	2.715	66.06	6.2838	-0.007	9	0.9687	0.4014	2.5988	68.03612
53	97.7	5.06	-13.07	-1.78	97.54002	5.1876	9	2.45156	133.3061	3.15602	0.4056	2.7504	34.316	5.3611	-0.014	3	1	0.3847	2.7463	34.31616
54	118.5	5.29	-13.17	-1.8	118.3388	4.4702	9	2.34915	134.1028	3.22308	0.4368	2.7863	41.315	4.5954	-0.012	4	0.9869	0.3846	2.6381	41.84114
55	72.9	2.78	-13.26	-1.64	72.7377	3.822	4	2.43191	128.2083	3.28718	0.468	2.8192	24.635	4.0029	-0.02	4	1	0.3753	2.7642	24.63501
56	139.3	6.57	-13.26	-1.32	139.1377	4.7219	9	2.32661	136.0833	3.35522	0.4992	2.856	47.543	4.8386	-0.011	4	0.9795	0.3781	2.6098	48.51944
57	407	7.89	-3.24	-1.4	406.9603	1.9388	6	1.74809	137.28	3.42386	0.5304	2.8935	139.46	1.9552	-0.002	6	0.7233	0.483	1.9326	184.2203
58	315.3	8.36	-1.1	-1.65	315.2865	2.6516	8	1.92166	137.28	3.4925	0.5616	2.9309	106.38	2.6813	-0.002	5	0.8018	0.4418	2.1341	130.1864
59	475.3	11.46	-4.5	-1.65	475.2449	2.4114	8	1.79882	137.28	3.56114	0.5928	2.9683	158.9	2.4296	-0.002	5	0.7439	0.4643	1.9773	206.9599
60	205.9	6.9	-4.12	-1.63	205.8496	3.352	8	2.10732	137.28	3.62978	0.624	3.0058	67.277	3.4121	-0.005	5	0.8951	0.3928	2.3697	75.06734
61	86.3	3.37	-9.59	-1.89	86.18262	3.9103	4	2.39059	130.0302	3.6948	0.6552	3.0396	27.138	4.0855	-0.016	4	1	0.3481	2.7387	27.13775
62	141.3	7.27	-9.64	-1.9	141.182	5.1494	9	2.35373	136.8597	3.76323	0.6864	3.0768	44.663	5.2904	-0.01	4	1	0.3439	2.6627	44.6625
63	89.8	3.56	-9.61	-2.03	89.68237	3.9696	4	2.38433	130.5286	3.82849	0.7176	3.1109	27.598	4.1466	-0.016	4	1	0.3401	2.7376	27.59784
64	82.1	1.73	-9.54	-1.96	81.98323	2.1102	5	2.20995	125.0294	3.89101	0.7488	3.1422	24.853	2.2153	-0.018	4	0.9871	0.3415	2.5941	25.205
65	76.1	3.88	-9.25	-1.95	75.98678	5.1062	9	2.51433	130.7542	3.95638	0.78	3.1764	22.677	5.3866	-0.02	3	1	0.3331	2.8772	22.67686
66	56.6	2.38	-9.16	-1.95	56.48788	4.2133	4	2.53756	126.4549	4.01961	0.8112	3.2084	16.353	4.5361	-0.028	3	1	0.3298	2.9348	16.35335
67	60	1.65	-9.16	-2.13	59.88788	2.7552	5	2.38848	123.9171	4.08157	0.8424	3.2392	17.229	2.9567	-0.027	4	1	0.3267	2.8015	17.22859
68	56.6	1.22	-9.06	-2.15	56.48911	2.1597	5	2.3351	121.5654	4.14235	0.8736	3.2688	16.014	2.3306	-0.029	4	1	0.3237	2.7663	16.0143
69	293.2	9	-8.97	-2.27	293.0902	3.0707	8	1.99261	137.28	4.21099	0.9048	3.3062	87.375	3.1155	-0.005	5	0.8645	0.3735	2.2522	101.9561

70	260.9	10.39	-8.29	-2.25	260.7985	3.9839	8	2.11568	137.28	4.27963	0.936	3.3436	76.719	4.0504	-0.006	4	0.921	0.3466	2.3935	84.02049
71	151	3.29	-7.92	-2.38	150.9031	2.1802	5	2.03969	131.2206	4.34524	0.9672	3.378	43.385	2.2449	-0.01	5	0.9176	0.3447	2.3826	47.73984

	CPT-8	In situ data										Basic output data								
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ß (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	20.1	0.39	0.3	0.26	20.10367	1.9399	4	2.65989	110.7008	0.05535	0	0.0554	362.21	1.9453	0.0011	5	0.631	6.4349	2.0475	121.9248
2	7.7	0.04	1.66	0.33	7.72032	0.5181	4	2.76931	91.70382	0.1012	0	0.1012	75.286	0.525	0.0157	5	0.6703	4.8219	2.1463	34.72104
3	4.3	0.03	0.17	0.25	4.30208	0.6973	1	3.05211	88.17263	0.14529	0	0.1453	28.611	0.7217	0.0029	5	0.7904	4.8037	2.4449	18.87125
4	4.1	0.03	0.01	0.12	4.10012	0.7317	1	3.07898	88.05536	0.18932	0	0.1893	20.658	0.7671	0.0002	5	0.8267	4.1479	2.5376	15.33091
5	6.3	0.27	-0.37	0.1	6.29547	4.2888	3	3.27061	105.1783	0.24191	0	0.2419	25.025	4.4602	-0.004	3	0.9358	3.9786	2.8211	22.76228
6	23.1	0.32	-0.15	0.07	23.09816	1.3854	5	2.5288	109.592	0.2967	0	0.2967	76.85	1.4034	-5E-04	5	0.7074	2.4583	2.2176	52.9736
7	15.2	0.23	-0.92	0.05	15.18874	1.5143	4	2.70381	106.1532	0.34978	0	0.3498	42.424	1.55	-0.004	5	0.7818	2.3759	2.4044	33.32007
8	32	0.44	-0.36	-0.14	31.99559	1.3752	5	2.40895	112.7168	0.40614	0	0.4061	77.78	1.3929	-8E-04	5	0.7001	1.955	2.1825	58.36522
9	23.9	0.46	-1.4	-0.22	23.88286	1.9261	4	2.5968	112.3288	0.4623	0	0.4623	50.661	1.9641	-0.004	5	0.7805	1.9084	2.3856	42.24031
10	26.7	0.64	-1.62	-0.17	26.68017	2.3988	4	2.61496	115.0154	0.51981	0	0.5198	50.327	2.4465	-0.004	5	0.8025	1.7689	2.4358	43.73456
11	25.8	0.58	-1.82	-0.11	25.77772	2.25	4	2.60995	114.2111	0.57691	0	0.5769	43.682	2.3015	-0.005	5	0.813	1.6374	2.4563	38.99833
12	23.7	0.58	-1.96	-0.05	23.67601	2.4497	4	2.66169	114.0037	0.63392	0	0.6339	36.349	2.5171	-0.006	4	0.8443	1.5412	2.5312	33.56202
13	27.9	0.55	-4.36	0.07	27.84663	1.9751	4	2.54922	114.0108	0.69092	0	0.6909	39.304	2.0254	-0.012	5	0.8142	1.4148	2.445	36.31079
14	24.3	0.47	-4.05	0.11	24.25043	1.9381	4	2.59297	112.5234	0.74718	0	0.7472	31.456	1.9997	-0.012	4	0.8418	1.3403	2.5096	29.77138
15	22.5	0.55	-4.06	0.14	22.45031	2.4499	4	2.68013	113.4855	0.80393	0	0.8039	26.926	2.5408	-0.014	4	0.8858	1.2755	2.6186	26.09444
16	24.8	0.48	-2.29	0.16	24.77197	1.9377	4	2.5854	112.7294	0.86029	0	0.8603	27.795	2.0074	-0.007	4	0.8602	1.1949	2.5445	27.0022
17	21.6	0.6	-2.53	0.2	21.56903	2.7818	4	2.72738	114.0244	0.9173	0	0.9173	22.514	2.9053	-0.009	4	0.9254	1.1413	2.7087	22.27488
18	20.4	0.64	-3.39	0.24	20.35851	3.1437	4	2.77979	114.3558	0.97448	0	0.9745	19.892	3.3017	-0.013	4	0.9564	1.0819	2.7829	19.82028
19	20.4	0.49	-3.72	0.3	20.35447	2.4073	4	2.70979	112.4012	1.03068	0	1.0307	18.749	2.5357	-0.014	4	0.9399	1.025	2.7327	18.71897
20	14.9	0.23	-3.23	0.37	14.86046	1.5477	4	2.71684	106.0999	1.08373	0	1.0837	12.712	1.6695	-0.017	4	0.9568	0.9774	2.7705	12.72547
21	15.9	0.25	-2.38	0.47	15.87087	1.5752	4	2.69647	106.8704	1.13717	0	1.1372	12.957	1.6968	-0.012	4	0.9577	0.9333	2.7664	12.99602
22	15.5	0.34	-1.96	0.55	15.47601	2.197	4	2.78419	109.0588	1.1917	0	1.1917	11.987	2.3802	-0.01	4	1	0.8879	2.8753	11.98654
23	15	0.37	-1.22	0.64	14.98507	2.4691	4	2.82444	109.5989	1.2465	0	1.2465	11.022	2.6932	-0.006	3	1	0.8489	2.9355	11.02176
24	20.7	0.46	-0.66	0.7	20.69192	2.2231	4	2.68369	111.979	1.30248	0	1.3025	14.887	2.3724	-0.002	4	0.9765	0.8164	2.795	14.95948
25	16.7	0.26	-0.46	0.74	16.69437	1.5574	4	2.6752	107.2808	1.35613	0	1.3561	11.31	1.6951	-0.002	4	0.9872	0.7827	2.8166	11.34629
26	10	0.11	0.01	0.76	10.00012	1.1	4	2.79531	99.73677	1.40599	0	1.406	6.1125	1.2799	8E-05	3	1	0.7526	2.994	6.1125
27	13.3	0.24	0.9	0.74	13.31102	1.803	4	2.79231	106.1427	1.45906	0	1.4591	8.123	2.025	0.0055	3	1	0.7252	2.9808	8.12298
28	21.9	0.71	1.57	0.78	21.91922	3.2392	4	2.76276	115.2954	1.51671	0	1.5167	13.452	3.48	0.0055	3	1	0.6976	2.9299	13.45179
29	14.3	0.36	0.74	0.78	14.30906	2.5159	4	2.84556	109.2859	1.57136	0	1.5714	8.1062	2.8263	0.0042	3	1	0.6734	3.0582	8.10619
30	13.1	0.33	0.87	0.8	13.11065	2.517	3	2.87697	108.4359	1.62557	0	1.6256	7.0653	2.8733	0.0055	3	1	0.6509	3.1122	7.06525
31	18.8	0.51	1.93	0.72	18.82362	2.7094	4	2.7676	112.5032	1.68183	0	1.6818	10.192	2.9752	0.0081	3	1	0.6291	2.988	10.19238
32	35.8	0.65	1.59	0.68	35.81946	1.8147	5	2.43968	115.8473	1.73975	0	1.7398	19.589	1.9073	0.0034	4	0.9358	0.6279	2.6334	20.22427
33	45.7	1.2	3.26	0.61	45.7399	2.6235	5	2.45975	120.9296	1.80021	0	1.8002	24.408	2.731	0.0053	4	0.9453	0.6051	2.651	25.12754
34	49.8	1.76	-1.03	0.57	49.78739	3.535	4	2.52149	123.9388	1.86218	0	1.8622	25.736	3.6724	-0.002	4	0.9747	0.5764	2.7206	26.10711
35	43.8	0.97	1.22	0.46	43.81493	2.2139	5	2.42548	119.2678	1.92182	0.0312	1.8906	22.158	2.3154	0.0014	4	0.9452	0.5778	2.6393	22.87439
36	52.4	1.34	1.83	0.39	52.4224	2.5562	5	2.40826	122.0696	1.98285	0.0624	1.9205	26.264	2.6567	0.0014	4	0.9378	0.5718	2.6159	27.25712
37	52.8	1.44	2.76	0.39	52.83378	2.7255	5	2.4247	122.6153	2.04416	0.0936	1.9506	26.038	2.8352	0.0021	4	0.9477	0.5601	2.6384	26.88489
38	62.3	1.87	3.38	0.39	62.34137	2.9996	5	2.40191	124.9308	2.10662	0.1248	1.9818	30.394	3.1045	0.002	4	0.9385	0.5549	2.6103	31.58903
39	116.3	4.31	3.95	0.4	116.3484	3.7044	5	2.2893	132.5623	2.17291	0.156	2.0169	56.609	3.7749	0.0011	4	0.8844	0.5653	2.4632	60.99416
40	101.6	3.07	7.24	0.52	101.6886	3.019	5	2.25865	129.7515	2.23778	0.1872	2.0506	48.499	3.087	0.0034	4	0.8796	0.5588	2.4462	52.52095
41	122.5	5.9	6.69	0.7	122.5819	4.8131	9	2.36566	134.9873	2.30528	0.2184	2.0869	57.635	4.9054	0.0022	4	0.9198	0.5354	2.548	60.86121
42	163.9	3.92	11.93	0.97	164.046	2.3896	5	2.04742	132.7063	2.37163	0.2496	2.122	76.189	2.4246	0.0038	5	0.794	0.5755	2.2143	87.93096
43	287.6	12.63	-1.97	1.85	287.5759	4.3919	8	2.13127	137.28	2.44027	0.2808	2.1595	132.04	4.4295	-0.001	9	0.8171	0.5583	2.2703	150.4455
44	182.7	10.82	-2.39	2.52	182.6708	5.9232	9	2.34313	137.28	2.50891	0.312	2.1969	82.007	6.0057	-0.003	9	0.9129	0.5133	2.5161	87.39652
45	310	10.58	6.6	2.7	310.0808	3.412	8	2.01969	137.28	2.57755	0.3432	2.2344	137.63	3.4406	0.0004	8	0.7792	0.5585	2.1616	162.3182
46	257	10.89	37.4	2.81	257.4578	4.2298	8	2.14093	137.28	2.64619	0.3744	2.2718	112.16	4.2738	0.0091	9	0.8336	0.5289	2.2997	127.371
47	431.4	3.44	-4.94	3.01	431.3395	0.7975	6	1.41329	134.1084	2.71324	0.4056	2.3076	185.74	0.8026	-0.002	6	0.5447	0.654	1.5364	264.9061
48	170.4	6.84	-7.65	3.25	170.3064	4.0163	8	2.21862	136.871	2.78168	0.4368	2.3449	71.443	4.083	-0.006	4	0.8819	0.4957	2.4153	78.48558
49	136.6	4.76	-6.55	3.21	136.5198	3.4867	8	2.22573	133.6789	2.84852	0.468	2.3805	56.152	3.561	-0.007	4	0.8944	0.4842	2.4439	61.17038
50	162	10.1	-6.37	3.35	161.922	6.2376	9	2.39	137.28	2.91716	0.4992	2.418	65.76	6.352	-0.006	9	0.9558	0.4539	2.6018	68.20428
51	189.5	10.26	-6.55	3.49	189.4198	5.4165	9	2.30182	137.28	2.9858	0.5304	2.4554	75.928	5.5033	-0.005	9	0.9214	0.4604	2.5061	81.12327
52	63.6	1.73	-2.35	3.57	63.57124	2.7214	5	2.36616	124.4091	3.048	0.5616	2.4864	24.342	2.8584	-0.012	4	0.9848	0.4311	2.6698	24.65916
53	98.7	3.81	-2.24	3.29	98.67258	3.8613	4	2.34846	131.2582	3.11363	0.5928	2.5208	37.908	3.9871	-0.008	4	0.9662	0.4323	2.616	39.0381
54	285.3	7.43	-2.78	3.23	285.266	2.6046	8	1.93797	137.28	3.18227	0.624	2.5583	110.26	2.634	-0.003	5	0.7788	0.5028	2.12	134.0441
55	71.1	1.86	-2	3.37	71.07552	2.6169	5	2.31974	125.2114	3.24488	0.6552	2.5897	26.193	2.7421	-0.012	4	0.9749	0.4179	2.6304	26.78853
56	60	1.49	-1.9	3.5	59.97674	2.4843	5	2.35699	123.1744	3.30646	0.6864	2.6201	21.629	2.6292	-0.015	4	0.9995	0.404	2.6919	21.63962
57	266.1	11.99	-1.51	3.69	266.0815	4.5061	8	2.15755	137.28	3.3751	0.7176	2.6575	98.855	4.564	-0.003	9	0.8742	0.4471	2.3583	110.9977
58	135.4	7.26	-1.15	4.15	135.3859	5.3625	9	2.37859	136.7473	3.44348	0.7488	2.6947	48.964	5.5024	-0.006	4	0.9849	0.3983	2.644	49.66261
59	217	9.82	-0.98	4.38	216.988	4.5256	9	2.20439	137.28	3.51212	0.78	2.7321	78.136	4.6001	-0.004	9	0.9063	0.4233	2.4315	85.39576
60	142.9	6.98	-1.96	4.52	142.876	4.8854	9	2.33202	136.5909	3.58041	0.8112	2.7692	50.302	5.0109	-0.007	4	0.9727	0.3923	2.6025	51.63978
61	688.6	7.02	-0.95	4.5	688.5884	1.0195	6	1.39284	137.28	3.64905	0.8424	2.8067	244.04	1.0249	-0.001	6	0.5633	0.5772	1.5232	373.647
62	679.1	3.82	-2.82	4.56	679.0655	0.5625	7	1.17484	135.982	3.71704	0.8736	2.8434	237.51	0.5656	-0.002	7	0.4827	0.6205	1.3064	396.0496
63	300.6	8.67	-3.91	4.82	300.5521	2.8847	8	1.96373	137.28	3.78568	0.9048	2.8809	103.01	2.9215	-0.004	5	0.8156	0.4418	2.1765	123.9129
64	537.7	7.5	-2.57	4.68	537.6685	1.3949	6	1.56388	137.28	3.85432	0.936	2.9183	182.92	1.405	-0.002	6	0.6456	0.5195	1.7252	262.0727
65	582.1	10.06	-7.33	4.72	582.0103	1.7285	6	1.63006	137.28	3.92296	0.9672	2.9558	195.58	1.7402	-0.003	6	0.6714	0.5017	1.7884	274.1212
66	581.4	17.46	-6.81	4.93	581.3167	3.0035	8	1.84798	137.28	3.9916	0.9984	2.9932	192.88	3.0243	-0.003	8	0.7583	0.4545	2.0122	248.0009
67	466.7	12.69	-2.39	5.08	466.6708	2.7193	8	1.84897	137.28	4.06024	1.0296	3.0306	152.64	2.7431	-0.003	5	0.769	0.4452	2.0357	194.6424
68	166	7.27	-5.13	5.13	165.9372	4.3812	9	2.25612	137.2537	4.12887	1.0608	3.0681	52.739	4.493	-0.009	4	0.9674	0.357	2.5513	54.60001
69	64.3	2.86	-5.06	5.24	64.23807	4.4522	4	2.51727	128.1128	4.19293	1.092	3.1009	19.364	4.7631	-0.024	3	1	0.3412	2.8927	19.36361

70	58.7	1.33	-5.01	5.42	58.63868	2.2681	5	2.33731	122.2881	4.25407	1.1232	3.1309	17.37	2.4455	-0.027	4	1	0.338	2.7497	17.37044
71	60.2	1.55	-5.11	5.56	60.13745	2.5774	5	2.36713	123.4697	4.31581	1.1544	3.1614	17.657	2.7767	-0.027	4	1	0.3347	2.7766	17.65722
72	78	2.47	-5.06	5.65	77.93807	3.1692	5	2.35172	127.5116	4.37956	1.1856	3.194	23.03	3.3579	-0.021	4	1	0.3313	2.737	23.03049
73	104.1	4.71	-4.97	5.71	104.0392	4.5271	9	2.38772	132.939	4.44603	1.2168	3.2292	30.841	4.7292	-0.016	3	1	0.3277	2.7412	30.84112
74	85.5	3.86	-4.6	5.74	85.4437	4.5176	4	2.44086	131.0025	4.51153	1.248	3.2635	24.799	4.7694	-0.02	3	1	0.3242	2.8129	24.79894
75	126.9	6.46	-4.5	5.76	126.8449	5.0928	9	2.37671	135.7341	4.5794	1.2792	3.3002	37.048	5.2836	-0.013	3	1	0.3206	2.7184	37.04791
76	134.4	7.04	-4.41	5.92	134.346	5.2402	9	2.37231	136.5034	4.64765	1.3104	3.3373	38.864	5.428	-0.013	3	1	0.3171	2.7123	38.86383
77	204.7	7.56	-4.27	5.99	204.6477	3.6942	8	2.14381	137.28	4.71629	1.3416	3.3747	59.244	3.7813	-0.008	4	0.9451	0.3342	2.4534	63.14234
78	183.4	7.93	-4.39	6.05	183.3463	4.3252	8	2.22727	137.28	4.78493	1.3728	3.4121	52.331	4.4411	-0.009	4	0.9849	0.3156	2.5549	53.26567
79	64.8	1.83	-3.91	6.03	64.75214	2.8262	5	2.37199	124.8651	4.84736	1.404	3.4434	17.397	3.0549	-0.028	4	1	0.3073	2.8067	17.39717
80	112.1	3.85	-3.77	5.84	112.0539	3.4359	5	2.2742	131.6448	4.91319	1.4352	3.478	30.805	3.5934	-0.016	4	1	0.3042	2.6605	30.80537

	CPT-9	In situ data										Basic output data								
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	14.2	0.72	0.67	0.24	14.2082	5.0675	3	3.03146	114.3404	0.05717	0	0.0572	247.52	5.088	0.0034	9	0.7581	9.1365	2.3715	122.19
2	6.6	0.21	12.36	0.37	6.75129	3.1105	3	3.16809	103.5099	0.10893	0	0.1089	60.981	3.1615	0.134	4	0.8219	6.4788	2.5338	40.67099
3	3.4	0.08	5.56	0.49	3.46805	2.3068	3	3.35181	94.82374	0.15634	0	0.1563	21.183	2.4157	0.1209	4	0.9006	5.5968	2.7436	17.51706
4	4.3	0.18	4.97	0.78	4.36083	4.1277	3	3.3942	101.316	0.207	0	0.207	20.067	4.3333	0.0862	3	0.9558	4.7562	2.878	18.67167
5	3.9	0.2	4.51	1.07	3.9552	5.0566	3	3.47792	101.8488	0.25792	0	0.2579	14.335	5.4094	0.0878	3	1	4.1025	3.0278	14.33503
6	6.5	0.2	5.25	1.07	6.56426	3.0468	3	3.17352	103.0844	0.30946	0	0.3095	20.212	3.1976	0.0604	4	0.9299	3.137	2.797	18.54363
7	15.6	0.5	5.18	1.09	15.6634	3.1922	3	2.87417	111.9101	0.36542	0	0.3654	41.865	3.2684	0.0244	4	0.8517	2.4733	2.5848	35.75846
8	18	0.54	5.17	1.16	18.06328	2.9895	4	2.80758	112.8209	0.42183	0	0.4218	41.822	3.061	0.0211	4	0.8455	2.1761	2.5611	36.28104
9	9.2	0.28	5.36	1.18	9.26561	3.0219	3	3.04631	106.387	0.47502	0	0.475	18.506	3.1852	0.0439	4	0.9445	2.1306	2.8119	17.70038
10	11.2	0.38	5.64	1.22	11.26903	3.3721	3	3.00361	109.0989	0.52957	0	0.5296	20.28	3.5384	0.0378	4	0.9449	1.9233	2.8069	19.52127
11	17	0.65	6.22	1.25	17.07613	3.8065	3	2.89122	114.0404	0.58659	0	0.5866	28.111	3.9419	0.0272	4	0.9192	1.7199	2.7324	26.80257
12	17.6	0.66	6.31	1.31	17.67723	3.7336	3	2.87424	114.2365	0.64371	0	0.6437	26.462	3.8747	0.0267	4	0.926	1.5844	2.7436	25.50627
13	18.2	0.55	6.41	1.38	18.27846	3.009	4	2.80519	112.984	0.7002	0	0.7002	25.105	3.1289	0.0263	4	0.9123	1.4574	2.7007	24.212
14	19.4	0.71	6.41	1.47	19.47846	3.6451	3	2.83485	115.0075	0.7577	0	0.7577	24.707	3.7926	0.0247	4	0.9356	1.3667	2.755	24.18118
15	16.8	0.53	6.51	1.51	16.87968	3.1399	3	2.84391	112.5188	0.81396	0	0.814	19.738	3.299	0.0292	4	0.9509	1.2833	2.7885	19.48521
16	16.4	0.69	6.41	1.59	16.47846	4.1873	3	2.9292	114.3905	0.87116	0	0.8712	17.916	4.421	0.0296	3	0.995	1.2134	2.8976	17.89826
17	14.6	0.59	6.41	1.67	14.67846	4.0195	3	2.95745	112.9628	0.92764	0	0.9276	14.823	4.2907	0.0336	3	1	1.1406	2.9525	14.82344
18	12.5	0.26	6.41	1.75	12.57846	2.067	4	2.84479	106.5903	0.98094	0	0.9809	11.823	2.2419	0.0398	4	0.9884	1.0777	2.8663	11.81255
19	11.3	0.28	6.51	1.77	11.37968	2.4605	3	2.92253	106.8883	1.03438	0	1.0344	10.001	2.7065	0.0453	3	1	1.0229	2.9717	10.00146
20	9.4	0.23	6.51	1.82	9.47968	2.4262	3	2.98577	105.0034	1.08688	0	1.0869	7.7219	2.7404	0.0559	3	1	0.9735	3.0686	7.72191
21	9.3	0.19	6.62	1.9	9.38103	2.0254	3	2.94824	103.58	1.13867	0	1.1387	7.2386	2.3052	0.0578	3	1	0.9293	3.0527	7.23857
22	8.7	0.2	6.7	1.9	8.78201	2.2774	3	2.99926	103.7943	1.19057	0	1.1906	6.3763	2.6346	0.0636	3	1	0.8887	3.1299	6.37631
23	17.3	0.44	6.79	1.85	17.38311	2.5312	4	2.77804	111.2288	1.24618	0	1.2462	12.949	2.7267	0.0303	3	1	0.8491	2.881	12.94908
24	19.6	0.5	6.98	1.8	19.68544	2.54	4	2.73528	112.4675	1.30242	0	1.3024	14.115	2.7199	0.0273	4	0.9973	0.8129	2.8496	14.12238
25	21.5	0.33	7.03	1.81	21.58605	1.5288	4	2.57669	109.652	1.35724	0	1.3572	14.904	1.6313	0.025	4	0.9435	0.7906	2.7017	15.11535
26	12.5	0.24	6.98	1.81	12.58544	1.907	4	2.82585	106.006	1.41025	0	1.4103	7.9243	2.1476	0.045	3	1	0.7503	3.0031	7.92429
27	12.9	0.21	7.15	1.86	12.98752	1.6169	4	2.77675	105.1057	1.4628	0	1.4628	7.8785	1.8222	0.0447	3	1	0.7233	2.9691	7.87854
28	12.9	0.49	7.08	1.93	12.98666	3.7731	3	2.98286	111.3052	1.51845	0	1.5185	7.5526	4.2727	0.0445	3	1	0.6968	3.1848	7.55257
29	6.6	0.12	7.08	2.01	6.68666	1.7946	3	3.04924	99.39178	1.56815	0	1.5682	3.2641	2.3444	0.0996	3	1	0.6748	3.3567	3.26405
30	10.1	0.17	7.14	2.05	10.18739	1.6687	4	2.87454	102.9672	1.61963	0	1.6196	5.29	1.9842	0.06	3	1	0.6533	3.1379	5.28995
31	7.6	0.13	7.27	2.02	7.68898	1.6907	3	2.98363	100.3181	1.66979	0	1.6698	3.6048	2.1598	0.087	3	1	0.6337	3.3019	3.60476
32	8.5	0.14	7.27	2.05	8.58898	1.63	4	2.9339	101.1303	1.72035	0	1.7204	3.9926	2.0383	0.0762	3	1	0.6151	3.2509	3.99257
33	14.3	0.49	7.44	2.01	14.39107	3.4049	3	2.92041	111.5556	1.77613	0	1.7761	7.1025	3.8843	0.0425	3	1	0.5957	3.1829	7.10247
34	136.8	2.38	4	1.95	136.849	1.7391	6	1.99437	128.6131	1.84044	0.0312	1.8092	74.622	1.7629	0.0019	5	0.7451	0.6705	2.1247	85.55657
35	178	2.2	-1.4	1.92	177.9829	1.2361	6	1.80814	128.6786	1.90478	0.0624	1.8424	95.571	1.2495	-9E-04	6	0.6724	0.6887	1.9298	114.6118
36	139.4	0.8	-3.85	2.12	139.3529	0.5741	6	1.66794	120.68	1.96512	0.0936	1.8715	73.41	0.5823	-0.003	6	0.6261	0.6998	1.8043	90.85893
37	76.5	2.87	-3.54	2.05	76.45667	3.7538	4	2.4116	128.563	2.0294	0.1248	1.9046	39.078	3.8561	-0.005	4	0.928	0.5796	2.5924	40.76591
38	33.9	0.69	-3.35	2.11	33.859	2.0379	5	2.48979	116.1469	2.08747	0.156	1.9315	16.449	2.1718	-0.013	4	0.9837	0.5532	2.7358	16.61162
39	40.9	1.09	-3.26	2.17	40.8601	2.6676	4	2.50126	119.951	2.14745	0.1872	1.9603	19.749	2.8156	-0.011	4	0.9861	0.5444	2.7385	19.91889
40	47.5	1.19	-3.35	2.15	47.459	2.5074	5	2.43471	120.9584	2.20793	0.2184	1.9895	22.745	2.6298	-0.01	4	0.9601	0.5454	2.6662	23.32529
41	49.2	1.31	-3.35	2.17	49.159	2.6648	5	2.44106	121.7472	2.2688	0.2496	2.0192	23.222	2.7938	-0.01	4	0.9653	0.5359	2.6763	23.74865
42	185.1	7	-3.25	2.19	185.0602	3.7826	8	2.17672	137.2428	2.33742	0.2808	2.0566	88.846	3.8309	-0.003	5	0.8345	0.5743	2.3288	99.1746
43	134.1	5.46	-2.87	2.17	134.0649	4.0727	8	2.28423	134.6386	2.40474	0.312	2.0927	62.913	4.147	-0.004	4	0.8874	0.546	2.4617	67.9344
44	68.2	1.89	-2.97	2.05	68.16365	2.7727	5	2.35034	125.2264	2.46736	0.3432	2.1242	30.928	2.8769	-0.008	4	0.934	0.5216	2.5805	32.38347
45	87.3	3.93	-2.87	2.01	87.26487	4.5035	9	2.43396	131.1854	2.53295	0.3744	2.1586	39.254	4.6382	-0.007	4	0.9628	0.5034	2.6524	40.30956
46	152.3	7.19	-3.01	2.02	152.2632	4.7221	9	2.30411	136.963	2.60143	0.4056	2.1958	68.157	4.8042	-0.004	4	0.9025	0.5174	2.4888	73.18344
47	262.2	4.39	-2.77	2.24	262.1661	1.6745	6	1.80069	134.6783	2.66877	0.4368	2.232	116.26	1.6917	-0.002	6	0.6989	0.5935	1.9508	145.5622
48	216.7	6.85	-3.83	2.36	216.6531	3.1617	8	2.07386	137.28	2.73741	0.468	2.2694	94.261	3.2022	-0.003	5	0.812	0.5382	2.2431	108.8029
49	244.5	11.88	-4.41	2.38	244.446	4.86	9	2.20437	137.28	2.80605	0.4992	2.3069	104.75	4.9164	-0.003	9	0.8633	0.5102	2.3716	116.5224
50	719.1	4.23	-4.45	2.59	719.0455	0.5883	7	1.1773	136.8675	2.87448	0.5304	2.3441	305.52	0.5906	-0.001	7	0.4448	0.702	1.2696	475.1605
51	216.4	9.84	-4.71	2.86	216.3424	4.5484	9	2.20692	137.28	2.94312	0.5616	2.3815	89.606	4.6111	-0.004	9	0.8745	0.4919	2.3916	99.20663
52	122.2	4.53	-4.34	2.43	122.1469	3.7087	8	2.27657	133.0452	3.00965	0.5928	2.4169	49.295	3.8023	-0.008	4	0.9211	0.4673	2.5097	52.61518
53	207	8.59	-4.5	1.92	206.9449	4.1509	8	2.18358	137.28	3.07829	0.624	2.4543	83.066	4.2135	-0.005	9	0.8729	0.4798	2.3802	92.44103
54	490.9	10.29	-5.26	1.33	490.8356	2.0964	8	1.73837	137.28	3.14693	0.6552	2.4917	195.72	2.11	-0.002	6	0.6815	0.5578	1.873	257.104
55	140.2	4.25	-5.45	1.2	140.1333	3.0328	5	2.17103	132.9134	3.21338	0.6864	2.527	54.183	3.104	-0.008	5	0.887	0.462	2.408	59.78689
56	75.2	3.27	-5.55	1.46	75.13207	4.3523	4	2.46476	129.4751	3.27812	0.7176	2.5605	28.062	4.5509	-0.016	3	1	0.4132	2.7596	28.06225
57	560.7	6.68	3.83	1.28	560.7469	1.1913	6	1.49526	137.28	3.34676	0.7488	2.598	214.55	1.1984	-9E-04	6	0.5928	0.5872	1.6267	309.3021
58	168	7.69	0.35	1.32	168.0043	4.5773	9	2.26883	137.28	3.4154	0.78	2.6354	62.453	4.6723	-0.005	4	0.9301	0.4279	2.5064	66.5664
59	70.4	1.93	0.96	1.67	70.41175	2.741	5	2.33686	125.4588	3.47813	0.8112	2.6669	25.098	2.8835	-0.011	4	0.9918	0.3998	2.6636	25.2877
60	81.1	2.48	0.77	1.7	81.10942	3.0576	5	2.32852	127.6384	3.54195	0.8424	2.6996	28.734	3.1972	-0.01	4	0.9856	0.3973	2.6454	29.12299
61	89.4	2.83	0.77	1.83	89.40942	3.1652	5	2.31108	128.842	3.60637	0.8736	2.7328	31.398	3.2983	-0.01	4	0.9788	0.3951	2.623	32.0366
62	379.8	9.82	0.45	2.05	379.8055	2.5855	8	1.87147	137.28	3.67501	0.9048	2.7702	135.78	2.6108	-0.002	5	0.763	0.4798	2.0523	170.5594
63	110.1	4.42	-0.67	2.13	110.0918	4.0148	9	2.33159	132.6119	3.74132	0.936	2.8053	37.91	4.1561	-0.009	4	0.9861	0.3823	2.6335	38.42795
64	357.8	7.21	3.71	2.51	357.8454	2.0148	6	1.79122	137.28	3.80996	0.9672	2.8428	124.54	2.0365	-0.002	6	0.7402	0.4812	1.9832	160.9951
65	292	11.26	2.87	2.75	292.0351	3.8557	8	2.07871	137.28	3.8786	0.9984	2.8802	100.05	3.9076	-0.003	8	0.8608	0.4223	2.2954	115.0127
66	657.5	8.44	0.26	3.19	657.5032	1.2836	6	1.49084	137.28	3.94724	1.0296	2.9176	224	1.2914	-0.002	6	0.6109	0.5381	1.6344	332.3916
67	220.2	8.16	-4.63	3.4	220.1433	3.7067	8	2.12771	137.28	4.01588	1.0608	2.9551	73.138	3.7756	-0.006	4	0.8963	0.3983	2.3794	81.35558
68	355.8	13.19	-4.2	3.56	355.7486	3.7077	8	2.02259	137.28	4.08452	1.092	2.9925	117.51	3.7507	-0.004	8	0.8422	0.4166	2.2325	138.4715
69	404.5	11.55	-7.01	4.12	404.4142	2.856	8	1.89636	137.28	4.15316	1.1232	3.03	132.1	2.8856	-0.004	5	0.7922	0.4345	2.0967	164.3753

70	319.9	10.2	-4.19	4.21	319.8487	3.189	8	1.98753	137.28	4.2218	1.1544	3.0674	102.9	3.2317	-0.005	5	0.8389	0.4095	2.2145	122.1493
71	109.5	3.03	-4.69	4.63	109.4426	2.7686	5	2.20933	129.8348	4.28671	1.1856	3.1011	33.909	2.8814	-0.014	4	0.9706	0.3521	2.5555	34.99654
72	136.2	7.5	-5.17	4.94	136.1367	5.5092	9	2.38683	136.9988	4.35521	1.2168	3.1384	41.99	5.6912	-0.012	3	1	0.3372	2.7041	41.98987
73	68.4	2.37	-5.13	5.27	68.33721	3.4681	4	2.41932	126.8886	4.41866	1.248	3.1707	20.159	3.7078	-0.025	3	1	0.3337	2.809	20.15941
74	76	1.88	-4.97	4.83	75.93917	2.4757	5	2.28237	125.4511	4.48138	1.2792	3.2022	22.315	2.6309	-0.023	4	1	0.3304	2.6815	22.31534
75	87.3	2.26	-4.97	4.27	87.23917	2.5906	5	2.2544	127.1364	4.54495	1.3104	3.2346	25.566	2.733	-0.02	4	1	0.3271	2.6453	25.56591
76	94.4	3.48	-4.88	4.05	94.34027	3.6888	5	2.34581	130.4858	4.61019	1.3416	3.2686	27.452	3.8783	-0.019	4	1	0.3237	2.7199	27.4522
77	114.1	5.66	-4.59	3.86	114.0438	4.963	9	2.39507	134.5073	4.67745	1.3728	3.3047	33.095	5.1753	-0.016	3	1	0.3202	2.7466	33.09473
78	173	9.67	-4.4	3.8	172.9461	5.5913	9	2.33457	137.28	4.74609	1.404	3.3421	50.328	5.7491	-0.01	3	1	0.3166	2.6543	50.32786
79	468.2	0	-4.76	3.44	468.1417	0	0	0	120.9	4.80654	1.4352	3.3713	137.43	0	-0.004	0	1	0.3139	0	0

	CPT-10	In situ data											Basic output data							
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ß (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	16.7	0.1	0.18	0.61	16.7022	0.5987	5	2.481	100.2905	0.05015	0	0.0502	332.08	0.6005	0.0008	6	0.5546	5.4263	1.8342	85.39604
2	4.6	0.04	0.1	0.61	4.60122	0.8693	3	3.05974	90.44156	0.09537	0	0.0954	47.248	0.8877	0.0016	5	0.7531	6.1246	2.3627	26.08099
3	6.9	0.08	0	1.22	6.9	1.1594	4	2.9499	96.50159	0.14362	0	0.1436	47.045	1.1841	0	5	0.7661	4.6182	2.3821	29.48846
4	4.4	0.06	0.03	1.41	4.40037	1.3635	3	3.15651	93.29948	0.19027	0	0.1903	22.127	1.4251	0.0005	4	0.8579	4.3575	2.6201	17.33807
5	3.2	0.06	0.03	1.59	3.20037	1.8748	3	3.34141	92.52285	0.23653	0	0.2365	12.531	2.0244	0.0007	4	0.9465	4.1286	2.85	11.56453
6	7.2	0.17	1.91	1.68	7.22338	2.3535	3	3.07911	102.1286	0.28759	0	0.2876	24.117	2.4511	0.0198	4	0.8867	3.1743	2.6871	20.80687
7	18.7	0.4	0.14	1.62	18.70171	2.1388	4	2.70984	110.7098	0.34295	0	0.343	53.532	2.1788	0.0006	5	0.7859	2.4242	2.4158	42.06057
8	18.5	0.31	-0.39	1.7	18.49523	1.6761	4	2.65474	108.8176	0.39736	0	0.3974	45.546	1.7129	-0.002	5	0.7812	2.1491	2.396	36.7585
9	18	0.3	0.35	1.74	18.00428	1.6663	4	2.66316	108.5121	0.45161	0	0.4516	38.867	1.7091	0.0014	5	0.799	1.9743	2.4355	32.75179
10	16.8	0.53	0.38	1.64	16.80465	3.1539	3	2.84662	112.508	0.50787	0	0.5079	32.089	3.2522	0.0017	4	0.8823	1.911	2.6467	29.43281
11	14.7	0.51	0.55	1.62	14.70673	3.4678	3	2.91767	111.9013	0.56382	0	0.5638	25.084	3.6061	0.0028	4	0.9229	1.7878	2.7446	23.89545
12	17.6	0.57	0.48	1.62	17.60588	3.2376	3	2.83744	113.154	0.62039	0	0.6204	27.379	3.3558	0.002	4	0.9069	1.6228	2.6958	26.05066
13	19.3	0.63	0	1.62	19.3	3.2643	4	2.80812	114.1103	0.67745	0	0.6775	27.489	3.383	0	4	0.9087	1.4996	2.6938	26.39203
14	19.2	0.54	-4.43	1.67	19.14578	2.8205	4	2.77217	112.9629	0.73393	0	0.7339	25.087	2.9329	-0.017	4	0.9069	1.3934	2.6825	24.24678
15	20.2	0.54	-2.16	1.73	20.17356	2.6768	4	2.74037	113.0904	0.79048	0	0.7905	24.521	2.7859	-0.008	4	0.9063	1.3025	2.674	23.85964
16	17.9	0.74	-2.68	1.76	17.8672	4.1417	3	2.89895	115.0997	0.84803	0	0.848	20.069	4.348	-0.011	3	0.9785	1.2418	2.8566	19.97371
17	17.1	0.57	-2.49	1.76	17.06952	3.3393	3	2.85629	113.0785	0.90456	0	0.9046	17.87	3.5262	-0.011	3	0.9738	1.1649	2.8373	17.79707
18	15.5	0.28	-2.03	1.77	15.47515	1.8094	4	2.73781	107.6381	0.95838	0	0.9584	15.147	1.9288	-0.01	4	0.9401	1.0975	2.7423	15.05762
19	16	0.29	-1.82	1.83	15.97772	1.815	4	2.72687	107.9728	1.01237	0	1.0124	14.782	1.9378	-0.009	4	0.946	1.0427	2.751	14.74724
20	19.3	0.36	-1.71	1.83	19.27907	1.8673	4	2.66559	110.013	1.06738	0	1.0674	17.062	1.9768	-0.007	4	0.9302	0.9919	2.7029	17.0725
21	23.1	0.7	-1.6	1.84	23.08042	3.0329	4	2.7274	115.3175	1.12504	0	1.125	19.515	3.1883	-0.005	4	0.9616	0.9427	2.7779	19.56135
22	31.3	0.9	-2.2	1.85	31.27307	2.8779	4	2.61089	117.8973	1.18398	0	1.184	25.413	2.9911	-0.005	4	0.9229	0.9015	2.6691	25.63461
23	30.9	0.91	-2.49	1.87	30.86952	2.9479	4	2.62192	117.9465	1.24296	0	1.243	23.836	3.0716	-0.006	4	0.9365	0.86	2.6975	24.08054
24	18.2	0.43	-2.6	1.93	18.16818	2.3668	4	2.74546	111.1683	1.29854	0	1.2985	12.991	2.549	-0.011	4	1	0.8148	2.8631	12.99122
25	16	0.2	-2.2	1.93	15.97307	1.2521	4	2.64301	105.2533	1.35117	0	1.3512	10.822	1.3678	-0.011	4	0.9751	0.7879	2.7854	10.88769
26	14.3	0.2	-2.01	1.95	14.2754	1.401	4	2.7097	104.9793	1.40366	0	1.4037	9.1701	1.5538	-0.011	4	1	0.7538	2.8775	9.17014
27	6.3	0.08	-2.01	1.95	6.2754	1.2748	3	3.005	96.27017	1.45179	0	1.4518	3.3225	1.6585	-0.03	3	1	0.7288	3.2813	3.32252
28	8.2	0.09	-1.63	1.93	8.18005	1.1002	4	2.87348	97.77847	1.50068	0	1.5007	4.4509	1.3474	-0.018	3	1	0.7051	3.1277	4.45089
29	16.4	0.02	-1.53	1.91	16.38127	0.1221	5	2.30071	88.46689	1.54492	0	1.5449	9.6034	0.1348	-0.007	1	0.8727	0.7187	2.4913	10.07755
30	8.7	0.04	-1.32	1.87	8.68384	0.4606	4	2.70417	91.99067	1.59091	0	1.5909	4.4584	0.5639	-0.013	1	1	0.6651	2.9833	4.45841
31	8.2	0.01	-0.41	1.8	8.19498	0.122	1	2.59911	87.36	1.63459	0	1.6346	4.0135	0.1524	-0.005	1	1	0.6473	2.8947	4.01348
32	23.7	0.45	-0.51	1.7	23.69376	1.8992	4	2.59609	112.1486	1.69066	0	1.6907	13.014	2.0452	-0.002	4	1	0.6259	2.8093	13.01446
33	9.2	0.19	-6.33	1.6	9.12252	2.0828	3	2.96491	103.5118	1.74242	0	1.7424	4.2355	2.5745	-0.062	3	1	0.6073	3.2776	4.23554
34	13.3	0.38	-5.07	1.63	13.23794	2.8705	3	2.90608	109.4917	1.79717	0	1.7972	6.366	3.3215	-0.032	3	1	0.5888	3.1844	6.36601
35	22	0.69	-4.97	1.54	21.93917	3.1451	4	2.75445	115.0886	1.85471	0	1.8547	10.829	3.4355	-0.018	3	1	0.5705	3.0025	10.82889
36	34.5	0.82	-4.69	1.29	34.44259	2.3808	4	2.52608	117.4516	1.91344	0	1.9134	17	2.5208	-0.01	4	0.9939	0.555	2.7637	17.0623
37	68.7	2.47	-3.44	1.12	68.65789	3.5976	4	2.42953	127.2024	1.97704	0	1.977	33.728	3.7042	-0.004	4	0.9455	0.5537	2.6294	34.89638
38	94.2	3.54	-4.73	1.07	94.1421	3.7603	4	2.35276	130.6057	2.04234	0	2.0423	45.095	3.8437	-0.004	4	0.9159	0.5475	2.5432	47.65856
39	47.4	1.81	-4.37	1.17	47.34651	3.8229	4	2.56091	124.0211	2.10435	0	2.1044	21.499	4.0007	-0.007	3	1	0.5028	2.8088	21.49934
40	71.1	2.29	-3.83	1.22	71.05312	3.2229	5	2.38456	126.7324	2.16772	0	2.1677	31.778	3.3244	-0.004	4	0.9496	0.5061	2.6162	32.94822
41	41.7	0.74	-3.54	1.2	41.65667	1.7764	5	2.38214	117.1643	2.2263	0.0312	2.1951	17.963	1.8767	-0.007	4	0.9689	0.4931	2.6638	18.37515
42	60.2	1.46	-3.25	1.22	60.16022	2.4269	5	2.34907	123.033	2.28782	0.0624	2.2254	26.005	2.5228	-0.005	4	0.948	0.4942	2.6047	27.0303
43	64.8	2.05	-2.96	1.27	64.76377	3.1654	5	2.40687	125.6962	2.35066	0.0936	2.2571	27.652	3.2846	-0.005	4	0.9715	0.479	2.6629	28.2565
44	122.5	4.76	-2.61	1.29	122.4681	3.8867	8	2.29191	133.414	2.41737	0.1248	2.2926	52.365	3.965	-0.003	4	0.913	0.4937	2.5041	56.0083
45	84.1	3.55	-2.17	1.33	84.07344	4.2225	4	2.42294	130.3505	2.48255	0.156	2.3266	35.07	4.351	-0.004	4	0.9775	0.4629	2.6703	35.69632
46	125.6	5.07	-0.35	1.44	125.5957	4.0368	9	2.29825	133.9372	2.54952	0.1872	2.3623	52.087	4.1204	-0.002	4	0.922	0.4769	2.5192	55.45291
47	146.5	5.69	1.15	1.7	146.5141	3.8836	8	2.24469	135.1571	2.61709	0.2184	2.3987	59.99	3.9542	-9E-04	4	0.901	0.4784	2.459	65.05445
48	104.8	5.06	0.69	1.97	104.8085	4.8279	9	2.40777	133.4814	2.68383	0.2496	2.4342	41.953	4.9547	-0.002	4	0.9767	0.4432	2.6549	42.77435
49	136.3	6.06	0.87	2.26	136.3107	4.4457	9	2.31059	135.442	2.75156	0.2808	2.4708	54.056	4.5373	-0.002	4	0.9355	0.4523	2.5413	57.0945
50	140.3	5.54	1.23	2.34	140.3151	3.9483	8	2.26161	134.8562	2.81898	0.312	2.507	54.845	4.0292	-0.002	4	0.9197	0.4523	2.4948	58.7797
51	127.1	5.76	1.58	2.4	127.1193	4.5312	9	2.3352	134.9002	2.88643	0.3432	2.5432	48.848	4.6365	-0.002	4	0.9545	0.433	2.5824	50.83799
52	475.7	11.35	-2.8	2.56	475.6657	2.3861	8	1.79457	137.28	2.95507	0.3744	2.5807	183.17	2.4011	-0.001	6	0.711	0.5305	1.9393	237.0146
53	478.6	15.46	-4.51	2.72	478.5448	3.2306	8	1.91155	137.28	3.02371	0.4056	2.6181	181.63	3.2512	-0.002	8	0.7589	0.5028	2.0604	225.9759
54	227.3	8.99	-1.07	2.48	227.2869	3.9554	8	2.14409	137.28	3.09235	0.4368	2.6556	84.425	4.0099	-0.002	4	0.8734	0.4477	2.3564	94.85712
55	101.2	6.27	-0.25	2	101.1969	6.1958	9	2.50335	134.9647	3.15984	0.468	2.6918	36.42	6.3955	-0.005	3	1	0.3931	2.7834	36.42016
56	141.7	6.74	1.72	2.11	141.7211	4.7558	9	2.32452	136.3151	3.22799	0.4992	2.7288	50.752	4.8667	-0.003	4	0.9656	0.4006	2.5887	52.43408
57	72.8	2.57	1.2	2.64	72.81469	3.5295	4	2.40609	127.6361	3.29181	0.5304	2.7614	25.177	3.6966	-0.006	4	1	0.3832	2.7344	25.17657
58	67.3	2.41	0.97	2.79	67.31187	3.5804	4	2.43389	126.9741	3.3553	0.5616	2.7937	22.893	3.7682	-0.008	4	1	0.3788	2.7712	22.89315
59	154.2	7.34	1.1	3.03	154.2135	4.7596	9	2.3038	137.1451	3.42387	0.5928	2.8311	53.262	4.8677	-0.003	4	0.9649	0.3869	2.5741	55.13553
60	311.5	6.27	0.99	3.17	311.5121	2.0128	6	1.8232	137.28	3.49251	0.624	2.8685	107.38	2.0356	-0.002	5	0.759	0.4691	2.0294	136.5517
61	54.2	1.57	1.53	3.17	54.21873	2.8957	5	2.43459	123.3109	3.55417	0.6552	2.899	17.477	3.0988	-0.011	4	1	0.365	2.8089	17.47677
62	67.5	1.68	1.82	3.17	67.52228	2.4881	5	2.32024	124.3415	3.61634	0.6864	2.9299	21.811	2.6289	-0.009	4	1	0.3611	2.6891	21.81137
63	72.1	1.76	2.05	3.11	72.12509	2.4402	5	2.29385	124.8428	3.67876	0.7176	2.9612	23.115	2.5714	-0.008	4	1	0.3573	2.6633	23.11471
64	229.2	11.07	3.52	3.19	229.2431	4.8289	9	2.21611	137.28	3.7474	0.7488	2.9986	75.2	4.9092	-0.002	9	0.9332	0.3783	2.4691	80.62286
65	210	8.46	0.92	3.44	210.0113	4.0284	8	2.16918	137.28	3.81604	0.78	3.036	67.916	4.1029	-0.003	4	0.922	0.3784	2.4347	73.73517
66	116.3	7.09	0.02	3.38	116.3002	6.0963	9	2.46215	136.2033	3.88414	0.8112	3.0729	36.583	6.3069	-0.007	3	1	0.3443	2.7776	36.58258
67	475.5	7.98	0.07	3.36	475.5009	1.6782	6	1.66003	137.28	3.95278	0.8424	3.1104	151.6	1.6923	-0.002	6	0.7019	0.4691	1.8493	209.0689
68	343.8	6.83	1.32	3.29	343.8162	1.9865	6	1.79521	137.28	4.02142	0.8736	3.1478	107.95	2.01	-0.002	5	0.7689	0.4325	2.0204	138.8808
69	543.7	11.3	0.75	3.35	543.7092	2.0783	8	1.7149	137.28	4.09006	0.9048	3.1853	169.41	2.0941	-0.002	6	0.7242	0.4502	1.8986	229.5878

70	141.1	2.97	0.77	3.51	141.1094	2.1048	5	2.04705	130.3083	4.15521	0.936	3.2192	42.543	2.1686	-0.006	5	0.908	0.3641	2.3769	47.13103
71	401.1	10.67	0.49	3.01	401.106	2.6601	8	1.87085	137.28	4.22385	0.9672	3.2567	121.87	2.6885	-0.002	5	0.8013	0.4062	2.0922	152.3703
72	454.4	6.7	-0.56	2.13	454.3932	1.4745	6	1.62144	137.28	4.29249	0.9984	3.2941	136.64	1.4886	-0.002	6	0.7037	0.4497	1.8308	191.3016
73	201.9	6.46	-1.41	2.12	201.8827	3.1999	8	2.09543	136.8676	4.36093	1.0296	3.3313	59.292	3.2705	-0.006	5	0.923	0.347	2.4	64.76657
74	76.7	2.88	-0.05	1.66	76.69939	3.7549	4	2.41078	128.5962	4.42523	1.0608	3.3644	21.482	3.9848	-0.015	3	1	0.3145	2.808	21.48187
75	60.4	2.16	0.18	0.61	60.4022	3.576	4	2.46596	125.9086	4.48818	1.092	3.3962	16.464	3.8631	-0.019	3	1	0.3116	2.8885	16.46379
76	62.5	1.35	0.29	0.31	62.50355	2.1599	5	2.30252	122.553	4.54946	1.1232	3.4263	16.915	2.3294	-0.019	4	1	0.3088	2.7468	16.91469
77	67.2	1.75	0.38	0.05	67.20465	2.604	5	2.33552	124.6287	4.61177	1.1544	3.4574	18.104	2.7959	-0.018	4	1	0.306	2.7697	18.10418
78	78.6	2.37	0.48	-0.29	78.60588	3.015	5	2.33338	127.23	4.67539	1.1856	3.4898	21.185	3.2057	-0.016	4	1	0.3032	2.7524	21.18482
79	90	3.3	0.67	-0.52	90.0082	3.6663	5	2.35708	129.9825	4.74038	1.2168	3.5236	24.199	3.8702	-0.014	4	1	0.3003	2.7605	24.19922
80	87.2	3.93	0.67	-0.7	87.2082	4.5065	9	2.43436	131.1839	4.80597	1.248	3.558	23.16	4.7693	-0.015	3	1	0.2974	2.8348	23.1599

Depth (ft)	CPT-11 qc (tsf)	In situ data fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	Basic output data ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	5.7	0.05	0.01	-0.81	5.70012	0.8772	4	2.97539	92.59665	0.0463	0	0.0463	122.12	0.8844	0.0001	5	0.6788	8.3656	2.1616	44.70025
2	5.6	0.16	0	-0.36	5.6	2.8571	3	3.21732	101.0642	0.09683	0	0.0968	56.833	2.9074	0	4	0.8232	7.1602	2.5378	37.23993
3	6.6	0.16	0.26	-0.04	6.60318	2.4231	3	3.11904	101.4661	0.14756	0	0.1476	43.748	2.4785	0.0029	4	0.8296	5.1259	2.5506	31.27364
4	23	0.24	0	0.32	23	1.0435	5	2.46631	107.4766	0.2013	0	0.2013	113.26	1.0527	0	5	0.6524	2.9524	2.0785	63.61514
5	8.2	0.38	0.19	0.33	8.20233	4.6328	3	3.19623	108.3242	0.25546	0	0.2555	31.108	4.7818	0.0017	3	0.9199	3.6962	2.7777	27.76034
6	9.9	0.41	0	0.33	9.9	4.1414	3	3.10155	109.339	0.31013	0	0.3101	30.922	4.2754	0	4	0.9103	3.0561	2.7454	27.69829
7	12.9	0.35	-0.16	0.27	12.89804	2.7136	3	2.90133	108.8265	0.36455	0	0.3646	34.381	2.7925	-9E-04	4	0.8583	2.4959	2.6024	29.56407
8	17.8	1.05	-2.21	0.26	17.77295	5.9079	3	3.0008	117.647	0.42337	0	0.4234	40.98	6.052	-0.009	3	0.9197	2.3221	2.7527	38.07522
9	26.9	1.59	-1.63	0.27	26.88005	5.9152	3	2.86925	121.6922	0.48422	0	0.4842	54.512	6.0237	-0.004	3	0.8905	2.0059	2.6711	50.0403
10	26.5	1.3	-1.44	0.27	26.48237	4.9089	3	2.81838	120.1824	0.54431	0	0.5443	47.653	5.0119	-0.004	4	0.8857	1.8017	2.6489	44.16579
11	27.3	1.27	-1.28	0.37	27.28433	4.6547	3	2.79321	120.0843	0.60435	0	0.6044	44.147	4.7601	-0.003	4	0.8893	1.6456	2.6516	41.49281
12	23.4	0.96	-1.34	0.56	23.3836	4.1054	3	2.80704	117.6605	0.66318	0	0.6632	34.26	4.2253	-0.004	4	0.9059	1.5269	2.6882	32.78574
13	37.3	1.33	-0.86	0.74	37.28947	3.5667	4	2.61508	121.184	0.72377	0	0.7238	50.521	3.6373	-0.002	4	0.847	1.3794	2.5262	47.6691
14	59.7	2.6	-0.77	0.74	59.69058	4.3558	4	2.53176	127.2363	0.78739	0	0.7874	74.808	4.414	-9E-04	4	0.8281	1.2773	2.469	71.10234
15	97.1	3.62	-0.57	0.83	97.09302	3.7284	5	2.34129	130.8445	0.85281	0	0.8528	112.85	3.7614	-4E-04	5	0.7671	1.1799	2.3011	107.3218
16	98.1	4.37	-0.99	0.83	98.08788	4.4552	9	2.39821	132.2471	0.91894	0	0.9189	105.74	4.4973	-7E-04	9	0.7978	1.1191	2.3736	102.7685
17	61.3	3.3	-0.95	0.85	61.28837	5.3844	4	2.59255	129.0452	0.98346	0	0.9835	61.319	5.4722	-0.001	4	0.881	1.0666	2.5841	60.78779
18	66.8	2.85	-0.67	0.89	66.7918	4.267	4	2.49223	128.1822	1.04755	0	1.0476	62.76	4.335	-7E-04	4	0.8518	1.0086	2.4994	62.66682
19	61.9	3.17	-0.73	0.91	61.89106	5.1219	4	2.57344	128.775	1.11194	0	1.1119	54.661	5.2156	-9E-04	4	0.8921	0.9567	2.5973	54.95396
20	67.4	2.84	-0.86	0.95	67.38947	4.2143	4	2.48563	128.1782	1.17603	0	1.176	56.303	4.2892	-9E-04	4	0.867	0.9125	2.5233	57.09974
21	55.1	2.89	-0.67	0.91	55.0918	5.2458	4	2.61485	127.8145	1.23993	0	1.2399	43.431	5.3666	-9E-04	4	0.9267	0.8633	2.672	43.9393
22	37.9	1.77	-0.57	0.91	37.89302	4.671	4	2.69088	123.3144	1.30159	0	1.3016	28.113	4.8372	-0.001	3	0.9688	0.8182	2.7751	28.29496
23	39.6	1.88	-0.51	0.87	39.59376	4.7482	4	2.68236	123.8626	1.36352	0	1.3635	28.038	4.9176	-1E-03	3	0.9739	0.7812	2.7808	28.22383
24	54.1	2.32	-0.33	0.95	54.09596	4.2887	4	2.55607	126.1626	1.4266	0	1.4266	36.919	4.4048	-5E-04	4	0.9299	0.7574	2.6571	37.70151
25	53.6	2.43	-0.47	0.95	53.59425	4.5341	4	2.57641	126.4788	1.48984	0	1.4898	34.973	4.6637	-7E-04	4	0.9462	0.7234	2.692	35.62351
26	33.2	1.34	-0.19	1.13	33.19767	4.0364	4	2.68862	120.9554	1.55032	0	1.5503	20.413	4.2342	-4E-04	3	1	0.6825	2.8419	20.41343
27	34.3	1.55	-0.2	1.26	34.29755	4.5193	4	2.71194	122.1001	1.61137	0	1.6114	20.285	4.7421	-4E-04	3	1	0.6567	2.8762	20.28471
28	28.5	1.19	-0.63	1.45	28.49229	4.1766	4	2.74762	119.7139	1.67123	0	1.6712	16.049	4.4368	-0.002	3	1	0.6331	2.935	16.04872
29	72.5	2.46	-0.81	1.53	72.49009	3.3936	5	2.39491	127.3052	1.73488	0	1.7349	40.784	3.4768	-8E-04	4	0.9023	0.6401	2.546	42.80213
30	144.1	1.79	-1.05	1.57	144.0872	1.2423	6	1.87399	126.6543	1.79821	0	1.7982	79.128	1.258	-5E-04	6	0.6968	0.6911	1.9993	92.9324
31	39.6	1.53	-0.96	1.47	39.58825	3.8648	4	2.61996	122.355	1.85938	0	1.8594	20.291	4.0553	-0.002	3	1	0.5691	2.8318	20.29105
32	92.8	3.82	-0.77	1.39	92.79058	4.1168	4	2.38693	131.1275	1.92495	0	1.925	47.204	4.204	-6E-04	4	0.9162	0.578	2.5587	49.63161
33	117.8	3.41	-0.96	1.46	117.7883	2.895	5	2.2032	130.8785	1.99039	0	1.9904	58.179	2.9448	-6E-04	5	0.8473	0.5855	2.3706	64.07167
34	154	2.12	-0.77	1.45	153.9906	1.3767	6	1.88542	128.0544	2.05441	0	2.0544	73.956	1.3953	-4E-04	5	0.7261	0.6177	2.0443	88.69548
35	297.1	4.31	-0.67	1.4	297.0918	1.4507	6	1.71829	134.8488	2.12184	0	2.1218	139.02	1.4612	-2E-04	6	0.6542	0.6344	1.8471	176.8379
36	308.5	3.29	-0.54	1.54	308.4934	1.0665	6	1.60249	132.9647	2.18832	0	2.1883	139.97	1.0741	-1E-04	6	0.6147	0.6398	1.7352	185.1961
37	280.5	2	-0.54	1.74	280.4934	0.713	6	1.49898	129.0906	2.25287	0	2.2529	123.51	0.7188	-1E-04	6	0.5829	0.6437	1.6432	169.2761
38	424.6	3.52	-0.48	2.05	424.5941	0.829	6	1.43082	134.2382	2.31999	0	2.32	182.02	0.8336	-8E-05	6	0.5526	0.648	1.5556	258.6172
39	392.6	3.29	-0.58	1.97	392.5929	0.838	6	1.45536	133.5527	2.38676	0	2.3868	163.49	0.8431	-1E-04	6	0.5695	0.6292	1.5915	232.0501
40	435.7	4.11	-1.48	1.96	435.6819	0.9434	6	1.46931	135.4349	2.45448	0	2.4545	176.5	0.9487	-3E-04	6	0.5778	0.615	1.6049	251.7962
41	273.9	3.84	-2.33	2.52	273.8715	1.4021	6	1.72781	133.8054	2.52138	0.0312	2.4902	108.97	1.4152	-7E-04	6	0.6926	0.5528	1.9019	141.7647
42	298.2	5.2	-3.36	2.84	298.1589	1.744	6	1.78233	136.2311	2.5895	0.0624	2.5271	116.96	1.7593	-0.001	6	0.7145	0.5369	1.9549	149.9668
43	73.1	1.42	-2.2	2.69	73.07307	1.9433	5	2.22151	123.304	2.65115	0.0936	2.5576	27.535	2.0164	-0.004	4	0.931	0.4397	2.5177	29.26519
44	48.6	1.79	-6.76	2.53	48.51726	3.6894	4	2.54251	123.9994	2.71315	0.1248	2.5884	17.696	3.908	-0.013	3	1	0.4088	2.8672	17.69626
45	101.2	3.91	-5.65	2.72	101.1308	3.8663	4	2.34208	131.5078	2.7789	0.156	2.6229	37.497	3.9755	-0.006	4	0.9724	0.4136	2.6199	38.44813
46	57.5	1.6	-5.74	2.9	57.42974	2.786	5	2.40494	123.5897	2.8407	0.1872	2.6535	20.572	2.931	-0.011	4	1	0.3988	2.7381	20.57248
47	120.8	3.76	-5.66	2.9	120.7307	3.1144	5	2.22067	131.6536	2.90653	0.2184	2.6881	43.831	3.1912	-0.005	4	0.9271	0.4213	2.4915	46.91487
48	174.1	8.23	-9.43	3	173.9846	4.7303	9	2.27226	137.28	2.97517	0.2496	2.7256	62.743	4.8126	-0.005	4	0.9381	0.4116	2.5163	66.52806
49	188.3	7.07	-11.77	2.92	188.1559	3.7575	8	2.17028	137.28	3.04381	0.2808	2.763	66.997	3.8193	-0.006	4	0.9003	0.4214	2.4114	73.72361
50	51.4	1.86	-11	3.4	51.26536	3.6282	4	2.52041	124.4145	3.10601	0.312	2.794	17.237	3.8622	-0.023	3	1	0.3787	2.8729	17.23663
51	55.8	0.84	-10.88	3.67	55.66683	1.509	5	2.23944	118.7989	3.16541	0.3432	2.8222	18.603	1.6	-0.021	4	0.9795	0.3825	2.6137	18.98031
52	108.4	2.48	-10.62	3.88	108.27	2.2906	5	2.15125	128.3429	3.22958	0.3744	2.8552	36.789	2.361	-0.011	5	0.9222	0.4004	2.4572	39.74399
53	131.9	4.98	-10.43	3.91	131.7723	3.7793	8	2.26285	133.9232	3.29654	0.4056	2.8909	44.441	3.8762	-0.009	4	0.9606	0.3808	2.5551	46.23686
54	137.7	4.74	-10.43	4.02	137.5723	3.4455	8	2.21961	133.6669	3.36338	0.4368	2.9266	45.859	3.5318	-0.009	4	0.9461	0.3819	2.5122	48.44158
55	93.1	3	-9.85	4.23	92.97944	3.2265	5	2.306	129.3644	3.42806	0.468	2.9601	30.253	3.35	-0.013	4	0.9981	0.3582	2.6455	30.31346
56	305.4	7.33	-7.45	4.35	305.3088	2.4009	8	1.89231	137.28	3.4967	0.4992	2.9975	100.69	2.4287	-0.003	5	0.7973	0.4359	2.114	124.3466
57	80.8	3.16	-1.74	4.39	80.7787	3.9119	4	2.40916	129.4015	3.5614	0.5304	3.031	25.476	4.0924	-0.008	4	1	0.3491	2.7597	25.47584
58	124.7	2.76	-1.53	4.42	124.6813	2.2136	5	2.09905	129.4698	3.62614	0.5616	3.0645	39.502	2.28	-0.006	5	0.9184	0.3766	2.4207	43.08417
59	197	9.07	-1.06	4.38	196.987	4.6044	9	2.23306	137.28	3.69478	0.5928	3.102	62.313	4.6924	-0.003	4	0.9545	0.3582	2.5127	65.43947
60	60.2	1.51	-0.96	4.54	60.18825	2.5088	5	2.3588	123.2805	3.75642	0.624	3.1324	18.015	2.6758	-0.012	4	1	0.3378	2.76	18.01543
61	63.9	2.07	-1.05	4.71	63.88715	3.2401	4	2.41825	125.734	3.81928	0.6552	3.1641	18.984	3.4461	-0.012	4	1	0.3344	2.8092	18.98429
62	80.4	2.18	-1.04	4.95	80.38727	2.7119	5	2.29332	126.6732	3.88262	0.6864	3.1962	23.936	2.8495	-0.01	4	1	0.3311	2.679	23.93598
63	60.8	2.13	-1.05	5.11	60.78715	3.504	4	2.45769	125.8218	3.94553	0.7176	3.2279	17.609	3.7473	-0.014	3	1	0.3278	2.8574	17.6093
64	74	2.27	-0.86	5.26	73.98947	3.068	5	2.35694	126.7669	4.00891	0.7488	3.2601	21.466	3.2438	-0.012	4	1	0.3246	2.7511	21.46568
65	97	3.07	-0.73	5.48	96.99106	3.1652	5	2.28763	129.6362	4.07373	0.78	3.2937	28.21	3.304	-0.009	4	1	0.3213	2.6652	28.21035
66	86.3	3.35	-0.57	5.7	86.29302	3.8821	4	2.38785	129.9898	4.13873	0.8112	3.3275	24.689	4.0777	-0.01	4	1	0.318	2.7688	24.68929
67	90.4	3.03	-0.48	5.92	90.39412	3.352	5	2.32653	129.3684	4.20341	0.8424	3.361	25.644	3.5155	-0.01	4	1	0.3148	2.7141	25.64428
68	153.5	5.73	-0.53	6.27	153.4935	3.7331	8	2.2189	135.3218	4.27107	0.8736	3.3975	43.922	3.8399	-0.006	4	0.9874	0.316	2.5635	44.56983
69	582	6.94	-8.3	6.43	581.8984	1.1927	6	1.48774	137.28	4.33971	0.9048	3.4349	168.14	1.2016	-0.003	6	0.6537	0.4632	1.6818	252.8065

70	771.2	5.05	-1.44	6.37	771.1824	0.6548	7	1.20103	137.28	4.40835	0.936	3.4724	220.82	0.6586	-0.001	6	0.5352	0.5294	1.3652	383.6651
71	543	11.2	-7.27	6.55	542.911	2.063	8	1.7123	137.28	4.47699	0.9672	3.5098	153.41	2.0801	-0.003	6	0.7487	0.4075	1.9224	207.3584
72	120	3.99	-12.53	6.82	119.8466	3.3293	5	2.24512	132.0701	4.54303	0.9984	3.5446	32.529	3.4604	-0.016	4	1	0.2985	2.632	32.52912
73	64.8	1.51	-12.74	6.78	64.64406	2.3359	5	2.31496	123.4547	4.60475	1.0296	3.5752	16.793	2.515	-0.032	4	1	0.296	2.7687	16.79349
74	61.2	1.65	-13.2	7.2	61.03843	2.7032	5	2.37679	123.9635	4.66674	1.0608	3.6059	15.633	2.927	-0.036	4	1	0.2934	2.8327	15.63303
75	76.8	2.76	-13.11	7.86	76.63953	3.6013	4	2.39753	128.2829	4.73088	1.092	3.6389	19.761	3.8382	-0.028	3	1	0.2908	2.8252	19.76122
76	52.1	0.97	-13.11	8.23	51.93953	1.8676	5	2.32139	119.6827	4.79072	1.1232	3.6675	12.856	2.0573	-0.044	4	1	0.2885	2.8151	12.85578
77	195.6	9.9	-12.63	8.44	195.4454	5.0654	9	2.26992	137.28	4.85936	1.1544	3.705	51.441	5.1945	-0.011	4	1	0.2856	2.6152	51.44079
78	59.2	2.62	-12.53	9.03	59.04663	4.4372	4	2.54086	127.2659	4.92299	1.1856	3.7374	14.482	4.8408	-0.039	3	1	0.2831	2.9935	14.48166
79	54.6	1.41	-12.34	9.13	54.44896	2.5896	5	2.39998	122.5347	4.98426	1.2168	3.7675	13.129	2.8505	-0.043	3	1	0.2809	2.8872	13.12946
80	118	4.16	-12.11	9.26	117.8518	3.5299	5	2.26946	132.3345	5.05043	1.248	3.8024	29.666	3.6879	-0.019	4	1	0.2783	2.6802	29.66562

	CPT-12	In situ data										Basic output data									
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	27.6	0.05	0.26	-0.44	27.60318	0.1811	5	2.10847	96.44403	0.04822	0	0.0482	571.42	0.1815	0.0007	6	0.4411	3.9055	1.539	101.7046
2	22.6	0.48	0.19	-0.2	22.60233	2.1237	4	2.64096	112.5058	0.10447	0	0.1045	215.34	2.1335	0.0006	5	0.6701	4.7187	2.1346	100.3299
3	62.4	0.51	0.06	0.32	62.40073	0.8173	6	2.04207	115.4263	0.16219	0	0.1622	383.74	0.8194	7E-05	6	0.5118	2.6112	1.7125	153.5903
4	17.8	0.23	0.1	0.71	17.80122	1.2921	4	2.60925	106.5403	0.21546	0	0.2155	81.62	1.3079	0.0004	5	0.7038	3.0649	2.2123	50.93878
5	11.5	0.29	0.1	0.65	11.50122	2.5215	3	2.92456	107.171	0.26904	0	0.269	41.749	2.5819	0.0006	4	0.8305	3.1183	2.5429	33.10195
6	8.7	0.22	0.19	0.63	8.70233	2.5281	3	3.0267	104.4695	0.32128	0	0.3213	26.087	2.625	0.0016	4	0.8838	2.8674	2.6748	22.71208
7	15.7	0.55	-1.43	0.64	15.6825	3.5071	3	2.89844	112.6104	0.37758	0	0.3776	40.534	3.5936	-0.007	4	0.8647	2.4376	2.6171	35.25809
8	20.7	0.95	-3.15	0.69	20.66144	4.5979	3	2.87988	117.282	0.43622	0	0.4362	46.364	4.6971	-0.011	4	0.8787	2.1785	2.6464	41.64084
9	30.5	1.29	-2.77	0.71	30.4661	4.2342	4	2.73012	120.4677	0.49646	0	0.4965	60.367	4.3044	-0.007	4	0.8423	1.8916	2.5433	53.57734
10	29.1	1.09	-2.58	0.75	29.06842	3.7498	4	2.70996	119.1205	0.55602	0	0.556	51.28	3.8229	-0.007	4	0.8474	1.7251	2.5492	46.48503
11	26.5	1.11	-2.92	0.79	26.46426	4.1943	3	2.77273	119.0246	0.61553	0	0.6155	41.994	4.2942	-0.008	4	0.8837	1.6141	2.6355	39.43002
12	26.9	1.03	-2.68	0.86	26.8672	3.8337	4	2.74199	118.5142	0.67479	0	0.6748	38.816	3.9324	-0.007	4	0.8843	1.4885	2.63	36.84649
13	25.9	0.94	-2.68	0.85	25.8672	3.634	4	2.73926	117.7526	0.73366	0	0.7337	34.258	3.74	-0.008	4	0.8947	1.3877	2.6504	32.96165
14	28.4	0.9	-2.49	0.88	28.36952	3.1724	4	2.67051	117.6597	0.79249	0	0.7925	34.798	3.2636	-0.007	4	0.8799	1.2896	2.6044	33.61039
15	73.6	2.34	-2.2	0.9	73.57307	3.1805	5	2.36997	126.9754	0.85598	0	0.856	84.952	3.218	-0.002	5	0.7778	1.1793	2.3286	81.04208
16	81.9	3.04	-2.2	0.94	81.87307	3.7131	4	2.38829	129.151	0.92056	0	0.9206	87.939	3.7553	-0.002	4	0.7941	1.1169	2.3637	85.45305
17	127.4	3.97	-4.83	0.98	127.3409	3.1176	5	2.20637	132.1813	0.98665	0	0.9867	128.06	3.142	-0.003	5	0.7338	1.0527	2.1972	125.702
18	142.4	1.07	0.76	0.88	142.4093	0.7514	6	1.7318	122.8607	1.04808	0	1.0481	134.88	0.7569	0.0004	6	0.5604	1.0054	1.7345	134.313
19	110	1.24	0.48	0.84	110.0059	1.1272	6	1.9312	123.3099	1.10973	0	1.1097	98.128	1.1387	0.0003	6	0.6444	0.9698	1.9475	99.80447
20	110.6	3.63	0.4	0.79	110.6049	3.282	5	2.26249	131.1825	1.17532	0	1.1753	93.106	3.3172	0.0003	5	0.7788	0.9214	2.292	95.29481
21	193.7	6.44	-1.23	0.77	193.6849	3.325	8	2.11937	136.7438	1.2437	0	1.2437	154.73	3.3465	-5E-04	8	0.7291	0.8889	2.1528	161.6587
22	148.1	7.05	-4.27	0.65	148.0477	4.762	9	2.31407	136.7506	1.31207	0	1.3121	111.84	4.8046	-0.002	9	0.8127	0.8396	2.3637	116.434
23	49.3	2.08	-4.59	0.73	49.24382	4.2239	4	2.57963	125.1343	1.37464	0	1.3746	34.823	4.3452	-0.007	4	0.9331	0.7833	2.6722	35.4379
24	68.8	2.8	-1.99	0.49	68.77564	4.0712	4	2.46857	128.1241	1.4387	0	1.4387	46.804	4.1582	-0.002	4	0.8947	0.7596	2.5632	48.34298
25	40.4	1.22	-3.25	0.24	40.36022	3.0228	4	2.54128	120.7454	1.49907	0	1.4991	25.923	3.1394	-0.006	4	0.9389	0.721	2.6717	26.4814
26	50.6	1.71	-2.55	-0.08	50.56879	3.3815	4	2.50316	123.7659	1.56096	0	1.561	31.396	3.4892	-0.004	4	0.9286	0.697	2.6369	32.28036
27	37.9	1.11	-1.24	-0.37	37.88482	2.9299	4	2.5528	119.8996	1.62091	0	1.6209	22.373	3.0609	-0.002	4	0.9614	0.6636	2.7157	22.74396
28	40.7	1.76	-3.19	-0.23	40.66095	4.3285	4	2.64585	123.4449	1.68263	0	1.6826	23.165	4.5153	-0.006	3	1	0.6288	2.8189	23.16513
29	34.9	1.44	-2.95	-0.13	34.86389	4.1304	4	2.67988	121.6014	1.74343	0	1.7434	18.997	4.3478	-0.006	3	1	0.6069	2.8732	18.9973
30	34.9	1.54	-2.77	-0.16	34.8661	4.4169	4	2.6999	122.0928	1.80448	0	1.8045	18.322	4.658	-0.006	3	1	0.5864	2.9045	18.322
31	143.8	2.48	0	-0.11	143.8	1.7246	6	1.9771	129.0351	1.86899	0	1.869	75.94	1.7473	0	5	0.7437	0.655	2.1137	87.85962
32	65.8	2.85	0.33	-0.17	65.80404	4.331	4	2.50137	128.1459	1.93307	0	1.9331	33.041	4.4621	0.0004	4	0.9688	0.5578	2.6962	33.6694
33	80.8	2.59	-0.15	-0.27	80.79816	3.2055	5	2.34472	127.9466	1.99704	0	1.997	39.459	3.2868	-1E-04	4	0.9115	0.5605	2.5371	41.74116
34	92.4	4.1	0.29	-0.29	92.40355	4.4371	9	2.41317	131.6349	2.06286	0	2.0629	43.794	4.5384	0.0002	4	0.9417	0.5333	2.6086	45.53256
35	134	3.19	-0.67	-0.35	133.9918	2.3807	5	2.10224	130.7049	2.12821	0	2.1282	61.96	2.4192	-4E-04	5	0.82	0.5638	2.2818	70.26291
36	115.7	3.52	-0.52	-0.41	115.6936	3.0425	5	2.22472	131.0671	2.19374	0	2.1937	51.738	3.1013	-3E-04	5	0.8784	0.5271	2.4248	56.53695
37	46.3	2.13	0.19	-0.16	46.30233	4.6002	4	2.62485	125.1579	2.25632	0	2.2563	19.521	4.8359	0.0003	3	1	0.469	2.8943	19.52115
38	335.3	4.54	0.14	-0.11	335.3017	1.354	6	1.66314	135.5243	2.32408	0	2.3241	143.27	1.3635	3E-05	6	0.6479	0.6006	1.8054	189.0097
39	147.6	5.77	-0.3	0.21	147.5963	3.9093	8	2.24511	135.2772	2.39172	0	2.3917	60.711	3.9737	-2E-04	4	0.8998	0.4801	2.4569	65.87863
40	94.4	3.9	-0.19	0.15	94.39767	4.1315	4	2.38335	131.321	2.45738	0	2.4574	37.414	4.2419	-2E-04	4	0.9725	0.4407	2.6408	38.2903
41	83.3	2.9	-0.35	0.23	83.29572	3.4816	5	2.36242	128.8481	2.52181	0.0312	2.4906	32.431	3.5903	-7E-04	4	0.9723	0.435	2.636	33.20982
42	97.9	3.93	-0.57	0.34	97.89302	4.0146	4	2.36369	131.4657	2.58754	0.0624	2.5251	37.743	4.1236	-0.001	4	0.9712	0.4297	2.6289	38.69928
43	158.3	6.24	-6.55	0.59	158.2198	3.9439	8	2.23054	136.0197	2.65555	0.0936	2.562	60.721	4.0112	-0.004	4	0.9092	0.4475	2.4602	65.79671
44	63.3	1.75	-6.76	0.94	63.21726	2.7682	5	2.37308	124.4796	2.71779	0.1248	2.593	23.332	2.8926	-0.01	4	0.9981	0.4088	2.6911	23.37226
45	56.6	1.69	-6.79	1.31	56.51689	2.9903	5	2.4313	123.951	2.77977	0.156	2.6238	20.481	3.1449	-0.012	4	1	0.4033	2.7586	20.48092
46	53.7	1.48	-6.88	1.6	53.61579	2.7604	5	2.42382	122.8516	2.84119	0.1872	2.654	19.131	2.9148	-0.013	4	1	0.3987	2.7616	19.13141
47	40.3	1.07	-6.88	2	40.21579	2.6607	4	2.50571	119.7767	2.90108	0.2184	2.6827	13.909	2.8675	-0.019	3	1	0.3944	2.8684	13.90949
48	39.2	1.17	-7.03	2.26	39.11395	2.9913	4	2.54839	120.3627	2.96126	0.2496	2.7117	13.332	3.2363	-0.021	3	1	0.3902	2.9142	13.33231
49	279.4	5.56	-6.83	2.45	279.3164	1.9906	6	1.84567	136.5617	3.02954	0.2808	2.7487	100.51	2.0124	-0.003	5	0.7604	0.4839	2.048	126.3422
50	323.7	10.09	-5.07	2.27	323.6379	3.1177	8	1.97646	137.28	3.09818	0.312	2.7862	115.05	3.1478	-0.002	5	0.8094	0.4568	2.172	138.366
51	235.9	8.22	-9.21	2.3	235.7873	3.4862	8	2.08921	137.28	3.16682	0.3432	2.8236	82.384	3.5337	-0.004	5	0.8663	0.4273	2.3169	93.93502
52	54.7	1.38	-9.85	2.47	54.57944	2.5284	5	2.39216	122.3832	3.22801	0.3744	2.8536	17.995	2.6874	-0.021	4	1	0.3708	2.7615	17.99523
53	70.5	0.93	-9.85	2.79	70.37944	1.3214	5	2.12397	120.1156	3.28807	0.4056	2.8825	23.276	1.3862	-0.017	5	0.9326	0.3927	2.4809	24.90256
54	125.3	4.06	-9.7	3.36	125.1813	3.2433	5	2.22439	132.3036	3.35422	0.4368	2.9174	41.758	3.3326	-0.009	4	0.9507	0.3813	2.5253	43.90178
55	134.5	6.52	-8.38	3.57	134.3974	4.8513	9	2.34491	135.9428	3.42219	0.468	2.9542	44.335	4.978	-0.008	4	0.9976	0.3591	2.6449	44.44552
56	103.1	4.82	-6.02	3.62	103.0263	4.6784	9	2.40157	133.0841	3.48874	0.4992	2.9895	33.295	4.8424	-0.009	3	1	0.3539	2.7244	33.29532
57	141.6	6.68	-8.04	3.47	141.5016	4.7208	9	2.32229	136.2459	3.55686	0.5304	3.0265	45.58	4.8425	-0.008	4	0.9945	0.3516	2.6269	45.84225
58	235.2	10.28	-7.49	3.65	235.1083	4.3725	8	2.17348	137.28	3.6255	0.5616	3.0639	75.552	4.4409	-0.005	4	0.9217	0.3753	2.4305	82.11021
59	186.3	6.97	-7.75	4.23	186.2051	3.7432	8	2.17145	137.2264	3.69411	0.5928	3.1013	58.85	3.819	-0.006	4	0.9332	0.3666	2.4562	63.2305
60	230.1	10.79	-0.45	4.79	230.0945	4.6894	9	2.20435	137.28	3.76275	0.624	3.1388	72.109	4.7673	-0.003	9	0.941	0.3594	2.4725	76.88387
61	66.2	2.48	-4.88	5.18	66.14027	3.7496	4	2.45375	127.1408	3.82632	0.6552	3.1711	19.65	3.9799	-0.016	3	1	0.3337	2.8372	19.65043
62	67.9	2.11	-4.9	5.19	67.84002	3.1103	5	2.38734	126.0205	3.88933	0.6864	3.2029	19.966	3.2994	-0.016	4	1	0.3304	2.7803	19.96629
63	65.6	2.24	-4.78	5.29	65.54149	3.4177	4	2.4272	126.3739	3.95252	0.7176	3.2349	19.039	3.637	-0.017	3	1	0.3271	2.8229	19.03879
64	65	2.56	-4.82	5.35	64.941	3.942	4	2.47508	127.3285	4.01618	0.7488	3.2674	18.646	4.2019	-0.018	3	1	0.3238	2.8698	18.64636
65	61.1	2.08	-4.75	5.46	61.04186	3.4075	4	2.44773	125.6582	4.07901	0.78	3.299	17.267	3.6515	-0.02	3	1	0.3207	2.857	17.26663
66	108.8	4.45	-4.69	5.58	108.7426	4.0922	9	2.34141	132.6314	4.14533	0.8112	3.3341	31.372	4.2544	-0.011	4	1	0.3174	2.7042	31.37169
67	95.8	4.24	-4.29	5.73	95.74749	4.4283	9	2.40276	131.9672	4.21131	0.8424	3.3689	27.171	4.6321	-0.013	3	1	0.3141	2.7751	27.17084
68	80.9	3.76	-4.06	5.81	80.85031	4.6506	4	2.46592	130.6757	4.27665	0.8736	3.4031	22.501	4.9103	-0.015	3	1	0.3109	2.8526	22.50147
69	88.2	4.04	-4.11	5.92	88.14969	4.5831	9	2.43703	131.412	4.34236	0.9048	3.4376	24.38	4.8206	-0.014	3	1	0.3078	2.8214	24.37991

70	182.7	8.06	-3.29	6.11	182.6597	4.4126	9	2.23542	137.28	4.411	0.936	3.475	51.295	4.5218	-0.007	4	0.9941	0.3067	2.5697	51.65813
71	650.3	0	-8.43	6.51	650.1968	0	0	0	120.9	4.47145	0.9672	3.5043	184.27	0	-0.002	0	1	0.302	0	0

	CPT-13	In situ data										Basic output data								
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	31.6	0.96	-3.32	-0.24	31.55936	3.0419	4	2.62342	118.3918	0.0592	0	0.0592	532.13	3.0476	-0.008	8	0.6462	6.4447	2.0767	191.8616
2	6	0.03	2.63	-0.15	6.03219	0.4973	1	2.86467	88.99704	0.10369	0	0.1037	57.173	0.506	0.0319	5	0.6982	5.0621	2.2189	28.36277
3	30.3	0.44	-0.46	-0.37	30.29437	1.4524	5	2.44193	112.5836	0.15999	0	0.16	188.36	1.4601	-0.001	5	0.6349	3.3184	2.0372	94.50512
4	17.6	0.17	0.33	-0.03	17.60404	0.9657	5	2.55133	104.3013	0.21214	0	0.2121	81.984	0.9775	0.0014	5	0.6807	2.9859	2.1517	49.07791
5	12.4	0.19	0.31	0.02	12.40379	1.5318	4	2.78195	104.2612	0.26427	0	0.2643	45.937	1.5651	0.0018	5	0.7764	2.936	2.403	33.68435
6	11.1	0.23	-1.01	0	11.08764	2.0744	4	2.89189	105.3856	0.31696	0	0.317	33.981	2.1354	-0.007	4	0.8357	2.7383	2.5497	27.87376
7	8.1	0.25	-1.56	0	8.08091	3.0937	3	3.1014	105.2241	0.36957	0	0.3696	20.866	3.242	-0.015	4	0.9287	2.6563	2.786	19.35837
8	12.1	0.32	-2.18	-0.02	12.07332	2.6505	3	2.91919	108.0097	0.42358	0	0.4236	27.503	2.7468	-0.013	4	0.8826	2.2435	2.6584	24.7012
9	12	0.54	-2.19	0.06	11.97319	4.5101	3	3.05797	111.818	0.47949	0	0.4795	23.971	4.6982	-0.014	3	0.952	2.1245	2.8316	23.07741
10	19.4	0.91	-2.08	0.06	19.37454	4.6969	3	2.90708	116.8104	0.53789	0	0.5379	35.019	4.831	-0.008	3	0.9146	1.8567	2.726	33.0535
11	8.3	0.22	0.11	0.1	8.30135	2.6502	3	3.05499	104.3544	0.59007	0	0.5901	13.068	2.853	0.001	3	0.9803	1.7727	2.8932	12.91905
12	20.9	0.9	1.25	0	20.9153	4.3031	3	2.85711	116.9162	0.64853	0	0.6485	31.25	4.4408	0.0044	4	0.9212	1.5698	2.7304	30.06819
13	22.7	1.11	1.49	-0.05	22.71824	4.8859	3	2.86632	118.6524	0.70785	0	0.7079	31.095	5.0431	0.0049	3	0.9374	1.4577	2.7658	30.32166
14	27.8	1.11	1.63	-0.03	27.81995	3.9899	4	2.7421	119.1465	0.76743	0	0.7674	35.251	4.1031	0.0043	4	0.9024	1.3362	2.6665	34.16247
15	22.1	0.72	1.83	-0.02	22.1224	3.2546	4	2.76093	115.4203	0.82514	0	0.8251	25.811	3.3807	0.0062	4	0.9206	1.2573	2.7075	25.30615
16	50.1	1.54	2.12	0.12	50.12595	3.0723	4	2.477	122.9783	0.88663	0	0.8866	55.536	3.1276	0.0031	4	0.8226	1.1566	2.4426	53.82073
17	83.8	3.67	-0.55	0.2	83.79327	4.3798	4	2.43599	130.5856	0.95192	0	0.9519	87.026	4.4302	-5E-04	9	0.8166	1.0902	2.419	85.35426
18	117.2	4.03	-0.65	0.29	117.192	3.4388	5	2.26217	132.0885	1.01796	0	1.018	114.12	3.4689	-4E-04	5	0.759	1.0298	2.2595	113.0651
19	122.8	4.74	1.05	0.27	122.8129	3.8595	8	2.28875	133.3901	1.08466	0	1.0847	112.23	3.8939	0.0006	8	0.7773	0.9809	2.2993	112.8484
20	90.1	3.71	0.53	0.33	90.10649	4.1174	4	2.39515	130.8421	1.15008	0	1.1501	77.348	4.1706	0.0004	4	0.8273	0.9334	2.4224	78.46965
21	90.5	3.59	0.29	0.43	90.50355	3.9667	4	2.38154	130.6122	1.21538	0	1.2154	73.465	4.0207	0.0002	4	0.8304	0.8913	2.4224	75.21202
22	110.3	3.91	-2.19	0.64	110.2732	3.5457	5	2.28918	131.7189	1.28124	0	1.2812	85.067	3.5874	-0.001	5	0.8019	0.8578	2.3392	88.35458
23	146.2	6.55	-1.83	0.38	146.1776	4.4809	9	2.29564	136.1814	1.34933	0	1.3493	107.33	4.5226	-9E-04	9	0.8099	0.8213	2.3519	112.4096
24	69.1	4	-1.83	0.05	69.0776	5.7906	9	2.5828	130.7446	1.41471	0	1.4147	47.828	5.9117	-0.002	3	0.9352	0.7622	2.6726	48.73708
25	57.6	2.78	-1.8	-0.13	57.57797	4.8282	4	2.57529	127.6382	1.47853	0	1.4785	37.943	4.9555	-0.002	4	0.9431	0.7294	2.6855	38.67186
26	38.8	1.68	-1.51	-0.26	38.78152	4.332	4	2.66078	122.9891	1.54002	0	1.54	24.182	4.5111	-0.003	3	0.9914	0.6893	2.8037	24.26094
27	50.6	2.04	-0.28	-0.34	50.59657	4.0319	4	2.55696	125.0584	1.60255	0	1.6026	30.573	4.1638	-4E-04	4	0.9546	0.6728	2.7	31.15485
28	26.2	1.13	-0.27	-0.44	26.1967	4.3135	3	2.78413	119.1305	1.66211	0	1.6621	14.761	4.6057	-8E-04	3	1	0.6366	2.9734	14.76106
29	27.8	1.17	-0.27	-0.56	27.7967	4.2091	4	2.75785	119.5296	1.72188	0	1.7219	15.143	4.4871	-8E-04	3	1	0.6145	2.9576	15.14323
30	24.2	1.02	-0.22	-0.61	24.19731	4.2154	3	2.80334	118.1875	1.78097	0	1.781	12.587	4.5503	-7E-04	3	1	0.5941	3.024	12.58656
31	32.9	1.49	-0.08	-0.7	32.89902	4.529	4	2.72567	121.7097	1.84183	0	1.8418	16.862	4.7976	-2E-04	3	1	0.5745	2.9403	16.86215
32	102	3.82	-0.17	-0.73	101.9979	3.7452	5	2.32907	131.3582	1.90751	0	1.9075	52.472	3.8166	-1E-04	4	0.8901	0.5918	2.4922	55.98128
33	93	3.14	-0.17	-0.71	92.99792	3.3764	5	2.32076	129.6986	1.97236	0	1.9724	46.151	3.4496	-1E-04	4	0.8962	0.5723	2.5	49.23131
34	30.9	1.43	0.5	-0.79	30.90612	4.6269	3	2.75178	121.2566	2.03299	0	2.033	14.202	4.9527	0.0013	3	1	0.5205	3.0063	14.20234
35	45	1.82	0.69	-0.81	45.00845	4.0437	4	2.5937	123.9379	2.09495	0	2.095	20.484	4.2411	0.0012	3	1	0.5051	2.8412	20.48422
36	63.2	3.01	0.75	-0.77	63.20918	4.762	4	2.54369	128.4474	2.15918	0	2.1592	28.275	4.9304	0.0009	3	1	0.4901	2.781	28.27465
37	238.6	2.8	1.17	-0.75	238.6143	1.1734	6	1.70588	131.1582	2.22476	0	2.2248	106.25	1.1845	0.0004	6	0.6636	0.6107	1.8589	136.433
38	261.1	2.72	1.17	-0.85	261.1143	1.0417	6	1.64117	131.1659	2.29034	0	2.2903	113.01	1.0509	0.0003	6	0.6426	0.6088	1.7955	148.9281
39	154.4	2.01	1.07	-0.87	154.4131	1.3017	6	1.86713	127.6713	2.35418	0	2.3542	64.591	1.3219	0.0005	5	0.749	0.5494	2.0669	78.95191
40	86	4.36	1.36	-0.52	86.01665	5.0688	9	2.47764	131.91	2.42013	0	2.4201	34.542	5.2155	0.0012	3	1	0.4372	2.7358	34.54215
41	96.5	4.62	1.5	-0.13	96.51836	4.7867	9	2.42693	132.6148	2.48644	0.0312	2.4552	38.299	4.9132	0.0008	4	0.9883	0.4352	2.6828	38.67899
42	85.9	3.99	1.36	0.3	85.91665	4.644	9	2.44855	131.2583	2.55207	0.0624	2.4897	33.484	4.7862	0.0004	4	1	0.425	2.7191	33.48423
43	77.5	2.99	1.17	0.71	77.51432	3.8574	4	2.41644	128.8962	2.61652	0.0936	2.5229	29.687	3.9921	-1E-04	4	0.9991	0.4197	2.7028	29.71067
44	200.7	7.51	-1.05	0.99	200.6872	3.7421	8	2.15318	137.28	2.68516	0.1248	2.5604	77.334	3.7929	-0.001	4	0.8714	0.463	2.3631	86.63881
45	87.4	3.39	0.31	1.07	87.40379	3.8786	4	2.38392	130.1078	2.75021	0.156	2.5942	32.632	4.0046	-0.002	4	0.9913	0.4111	2.6713	32.88753
46	45.4	1.44	0.88	1.11	45.41077	3.1711	4	2.51763	122.2461	2.81133	0.1872	2.6241	16.234	3.3803	-0.003	3	1	0.4032	2.8574	16.23373
47	49.3	1.76	0.88	1.24	49.31077	3.5692	4	2.5274	123.9153	2.87329	0.2184	2.6549	17.491	3.79	-0.003	3	1	0.3986	2.8628	17.4913
48	40.7	1.74	0.79	1.34	40.70967	4.2742	4	2.64164	123.3642	2.93497	0.2496	2.6854	14.067	4.6063	-0.005	3	1	0.394	2.9896	14.06684
49	33.8	1.65	1.14	1.38	33.81395	4.8796	3	2.7395	122.5229	2.99623	0.2808	2.7154	11.349	5.3541	-0.006	3	1	0.3897	3.1032	11.3491
50	164.4	6.04	0.59	1.43	164.4072	3.6738	8	2.19579	135.8749	3.06417	0.312	2.7522	58.624	3.7436	-0.002	4	0.9136	0.4176	2.4478	63.67363
51	437	4.88	0.61	1.45	437.0075	1.1167	6	1.52874	136.6988	3.13252	0.3432	2.7893	155.55	1.1248	-7E-04	6	0.6281	0.544	1.6951	223.0683
52	411.2	7.09	0.69	1.63	411.2085	1.7242	6	1.70202	137.28	3.20116	0.3744	2.8268	144.34	1.7377	-8E-04	6	0.6997	0.5028	1.8788	193.8839
53	279.2	7.66	0.12	1.7	279.2015	2.7435	8	1.96204	137.28	3.2698	0.4056	2.8642	96.338	2.7761	-0.001	5	0.8155	0.4439	2.1783	115.771
54	62.2	3.11	-5.67	1.8	62.1306	5.0056	4	2.56485	128.6446	3.33412	0.4368	2.8973	20.293	5.2894	-0.014	3	1	0.3652	2.9076	20.29338
55	52.4	1.2	-6.1	1.77	52.32534	2.2933	5	2.37727	121.2577	3.39475	0.468	2.9268	16.718	2.4525	-0.019	4	1	0.3615	2.7639	16.7184
56	75.8	2.3	-6.19	1.68	75.72423	3.0373	5	2.34684	126.9195	3.45821	0.4992	2.959	24.422	3.1827	-0.013	4	1	0.3576	2.7025	24.42236
57	66.8	2.97	-6.29	1.7	66.72301	4.4512	4	2.50619	128.4815	3.52245	0.5304	2.9921	21.123	4.6993	-0.016	3	1	0.3536	2.8604	21.12282
58	59	2.1	-6.38	1.79	58.92191	3.564	4	2.47241	125.642	3.58527	0.5616	3.0237	18.301	3.795	-0.018	3	1	0.3499	2.8479	18.30113
59	79.3	3.4	-6.38	1.82	79.22191	4.2917	4	2.44509	129.8896	3.65022	0.5928	3.0574	24.717	4.499	-0.014	3	1	0.3461	2.7969	24.71749
60	156.7	9.53	-6.38	1.92	156.6219	6.0847	9	2.38875	137.28	3.71886	0.624	3.0949	49.406	6.2327	-0.007	3	1	0.3419	2.6859	49.40552
61	92	3.05	-6.19	1.88	91.92423	3.318	5	2.31838	129.4575	3.78359	0.6552	3.1284	28.174	3.4604	-0.012	4	1	0.3382	2.6787	28.17448
62	129.9	5.48	-6.1	1.8	129.8253	4.2211	9	2.30504	134.587	3.85088	0.6864	3.1645	39.809	4.3501	-0.009	4	1	0.3344	2.6365	39.8089
63	61.3	2.74	-6.19	1.67	61.22423	4.4754	4	2.53297	127.6819	3.91472	0.7176	3.1971	17.925	4.7811	-0.02	3	1	0.331	2.9191	17.92535
64	60.1	1.89	-6	1.59	60.02656	3.1486	4	2.42842	124.9164	3.97718	0.7488	3.2284	17.361	3.372	-0.021	3	1	0.3278	2.8337	17.36146
65	56.9	2.42	-6	1.58	56.82656	4.2586	4	2.53915	126.5914	4.04047	0.78	3.2605	16.19	4.5845	-0.023	3	1	0.3245	2.9411	16.18969
66	42.9	2.06	-6	1.59	42.82656	4.8101	4	2.66238	124.7231	4.10284	0.8112	3.2916	11.764	5.3197	-0.032	3	1	0.3215	3.0893	11.76428
67	55.3	2.36	-5.71	1.76	55.23011	4.273	4	2.54872	126.3382	4.16601	0.8424	3.3236	15.364	4.6216	-0.025	3	1	0.3184	2.9609	15.36407
68	86.7	5.45	-5.62	1.86	86.63121	6.291	9	2.54932	133.5601	4.23279	0.8736	3.3592	24.529	6.6142	-0.016	3	1	0.315	2.914	24.52929
69	71.5	3.52	-5.62	1.94	71.43121	4.9278	4	2.51991	129.8909	4.29773	0.9048	3.3929	19.786	5.2433	-0.02	3	1	0.3119	2.9132	19.78628

70	71.6	3.77	-5.14	2.01	71.53709	5.27	4	2.5417	130.3966	4.36293	0.936	3.4269	19.602	5.6123	-0.019	3	1	0.3088	2.936	19.60185
71	61.8	3.11	-5.14	1.96	61.73709	5.0375	4	2.56875	128.6291	4.42724	0.9672	3.46	16.563	5.4266	-0.023	3	1	0.3058	2.981	16.56333
72	64.4	3.38	-5.05	1.99	64.33819	5.2535	4	2.57063	129.3389	4.49191	0.9984	3.4935	17.131	5.6478	-0.023	3	1	0.3029	2.9814	17.13069
73	114.3	6.91	-4.97	2.01	114.2392	6.0487	9	2.4639	135.9716	4.5599	1.0296	3.5303	31.068	6.3002	-0.013	3	1	0.2997	2.8265	31.06798
74	396.4	14.96	-7.15	2.19	396.3125	3.7748	8	2.00812	137.28	4.62854	1.0608	3.5677	109.78	3.8194	-0.004	8	0.8804	0.343	2.2614	126.9651
75	322.2	15.46	-8.18	2.52	322.0999	4.7998	9	2.14194	137.28	4.69718	1.092	3.6052	88.041	4.8708	-0.005	9	0.9448	0.3141	2.4242	94.21074
76	106.5	6.01	-9.34	2.38	106.3857	5.6493	9	2.4582	134.7768	4.76457	1.1232	3.6414	27.907	5.9141	-0.018	3	1	0.2906	2.84	27.9074
77	41.3	1.09	-9.73	2.64	41.1809	2.6469	4	2.49647	119.9701	4.82455	1.1544	3.6702	9.906	2.9981	-0.051	3	1	0.2883	3.0001	9.90595
78	64.6	1.56	-9.82	3	64.4798	2.4194	5	2.32625	123.6868	4.8864	1.1856	3.7008	16.103	2.6177	-0.032	4	1	0.2859	2.7936	16.10286
79	76.4	2.49	-9.73	3.23	76.2809	3.2643	5	2.36747	127.5182	4.95015	1.2168	3.7334	19.106	3.4908	-0.027	4	1	0.2834	2.8105	19.10634
80	114.7	3.85	-9.51	3.51	114.5836	3.36	5	2.26055	131.6992	5.016	1.248	3.768	29.078	3.5138	-0.018	4	1	0.2808	2.6728	29.07841

1749 & 1751 Malcolm Ave
Los Angeles, CA

CPT Shear Wave Measurements

CPT-2	Tip Depth (ft)	Geophone Depth (ft)	Travel Distance (ft)	S-Wave Arrival (msec)	S-Wave Velocity from Surface (ft/sec)	Interval S-Wave Velocity (ft/sec)
	20.10	19.10	19.74	22.79	866.33	
	40.22	39.22	39.54	39.80	993.40	1163.66
	60.00	59.00	59.21	50.62	1169.73	1818.30
	80.08	79.08	79.24	63.45	1248.82	1560.91

CPT-7						
	20.07	19.07	19.71	29.49	668.52	
	40.03	39.03	39.35	65.56	600.20	544.34
	60.02	59.02	59.23	76.70	772.25	1784.78
	71.34	70.34	70.52	85.17	827.96	1332.48

Shear Wave Source Offset = 5 ft

S-Wave Velocity from Surface = Travel Distance/S-Wave Arrival
Interval S-Wave Velocity = (Travel Dist2-Travel Dist1)/(Time2-Time1)

Presented below is a list of formulas used for the estimation of various soil properties. The formulas are presented in SI unit system and assume that all components are expressed in the same units.

:: Unit Weight, g (kN/m³) ::

$$g = g_w \cdot \left(0.27 \cdot \log(R_f) + 0.36 \cdot \log(\frac{q_t}{p_a}) + 1.236\right)$$

where g_w = water unit weight

:: Permeability, k (m/s) ::

$I_c < 3.27$ and $I_c > 1.00$ then $k = 10^{0.952-3.04 \, I_c}$

$I_c \leq 4.00$ and $I_c > 3.27$ then $k = 10^{-4.52-1.37 \, I_c}$

:: N_{SPT} (blows per 30 cm) ::

$$N_{60} = \left(\frac{q_c}{P_a}\right) \cdot \frac{1}{10^{1.1268-0.2817 \cdot I_c}}$$

$$N_{1(60)} = Q_{tn} \cdot \frac{1}{10^{1.1268-0.2817 \, I_c}}$$

:: Young's Modulus, Es (MPa) ::

$$(q_t - \sigma_v) \cdot 0.015 \cdot 10^{0.55 \cdot I_c + 1.68}$$

(applicable only to $I_c < I_{c\_cutoff}$)

:: Relative Density, Dr (%) ::

$$100 \cdot \sqrt{\frac{Q_{tn}}{k_{DR}}}$$

(applicable only to SBT_n: 5, 6, 7 and 8 or $I_c < I_{c\_cutoff}$)

:: State Parameter, ψ ::

$$\psi = 0.56 - 0.33 \cdot \log(Q_{tn,cs})$$

:: Peak drained friction angle, φ (°) ::

$$\varphi = 17.60 + 11 \cdot \log(Q_{tn})$$

(applicable only to SBT_n: 5, 6, 7 and 8)

:: 1-D constrained modulus, M (MPa) ::

If $I_c > 2.20$
$\alpha = 14$ for $Q_{tn} > 14$
$\alpha = Q_{tn}$ for $Q_{tn} \leq 14$
$M_{CPT} = \alpha \cdot (q_t - \sigma_v)$

If $I_c \leq 2.20$
$M_{CPT} = (q_t - \sigma_v) \cdot 0.0188 \cdot 10^{0.55 \, I_c + 1.68}$

:: Small strain shear Modulus, Go (MPa) ::

$$G_0 = (q_t - \sigma_v) \cdot 0.0188 \cdot 10^{0.55 \, I_c + 1.68}$$

:: Shear Wave Velocity, Vs (m/s) ::

$$V_s = \left(\frac{G_0}{\rho}\right)^{0.50}$$

:: Undrained peak shear strength, Su (kPa) ::

$N_{kt} = 10.50 + 7 \cdot \log(F_r)$ or user defined

$$S_u = \frac{(q_t - \sigma_v)}{N_{kt}}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Remolded undrained shear strength, Su(rem) (kPa) ::

$S_{u(rem)} = f_s$ (applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Overconsolidation Ratio, OCR ::

$$k_{OCR} = \left[\frac{Q_{tn}^{0.20}}{0.25 \cdot (10.50 + 7 \cdot \log(F_r))}\right]^{1.25}$$ or user defined

$$OCR = k_{OCR} \cdot Q_{tn}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: In situ Stress Ratio, Ko ::

$$K_0 = (1 - \sin\varphi') \cdot OCR^{\sin\varphi'}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Soil Sensitivity, S_t ::

$$S_t = \frac{N_S}{F_r}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Effective Stress Friction Angle, φ' (°) ::

$$\varphi' = 29.5° \cdot B_q^{0.121} \cdot (0.256 + 0.336 \cdot B_q + \log Q_t)$$

(applicable for $0.10 < B_q < 1.00$)

References

• Robertson, P.K., Cabal K.L., Guide to Cone Penetration Testing for Geotechnical Engineering, Gregg Drilling & Testing, Inc., 5th Edition, November 2012
• Robertson, P.K., Interpretation of Cone Penetration Tests - a unified approach., Can. Geotech. J. 46(11): 1337–1355 (2009)

APPENDIX II

LABORATORY TESTING PROCEDURES

Moisture Density

The moisture-density information provides a summary of soil consistency for each stratum and can also provide a correlation between soils found on this site and other nearby sites. The tests were performed using ASTM D 2216-04 Laboratory Determination of water content Test Method. The dry unit weight and field moisture content were determined for each undisturbed sample, and the results are shown on log of exploratory borings.

Shear Tests

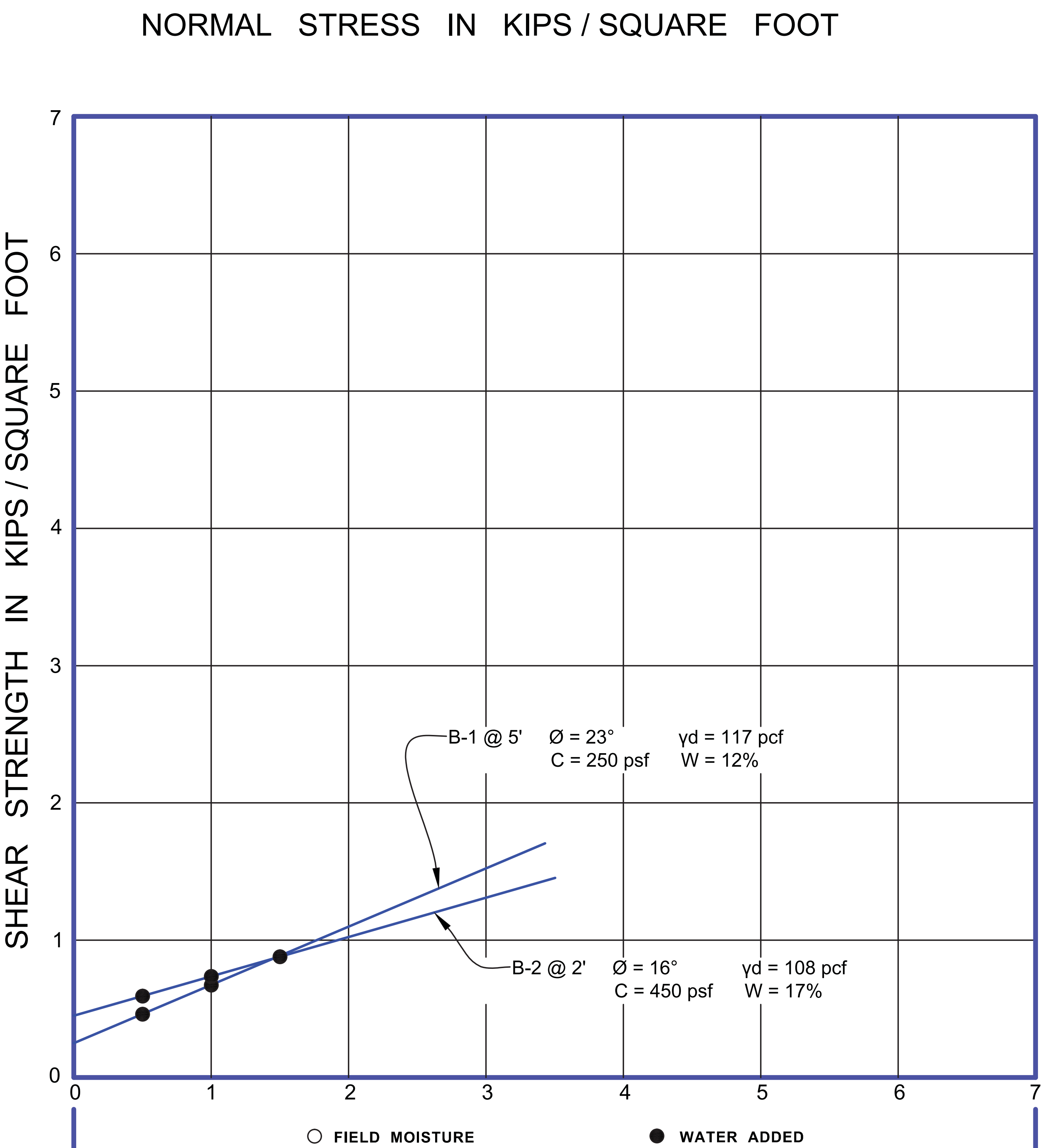
Shear tests were made with a direct shear machine at a constant rate of strain. The machine is designed to test the materials without completely removing the samples from the brass rings. The rate of shear was determined through determination of the rate of consolidation of the foundation bearing materials. Considering that such soils are fine grained in nature with a t90 value of less than 27 seconds, the rate of shearing was selected as 0.005 inches per minute.

A range of normal stresses was applied vertically, and the shear strength was progressively determined at each load in order to determine the internal angle of friction and the cohesion. The tests were performed using ASTM D 3080-04 Laboratory Direct Shear Test Method. The Ultimate shear strength results of direct shear tests are presented on Figure No. II-1 within this Appendix.

Consolidation

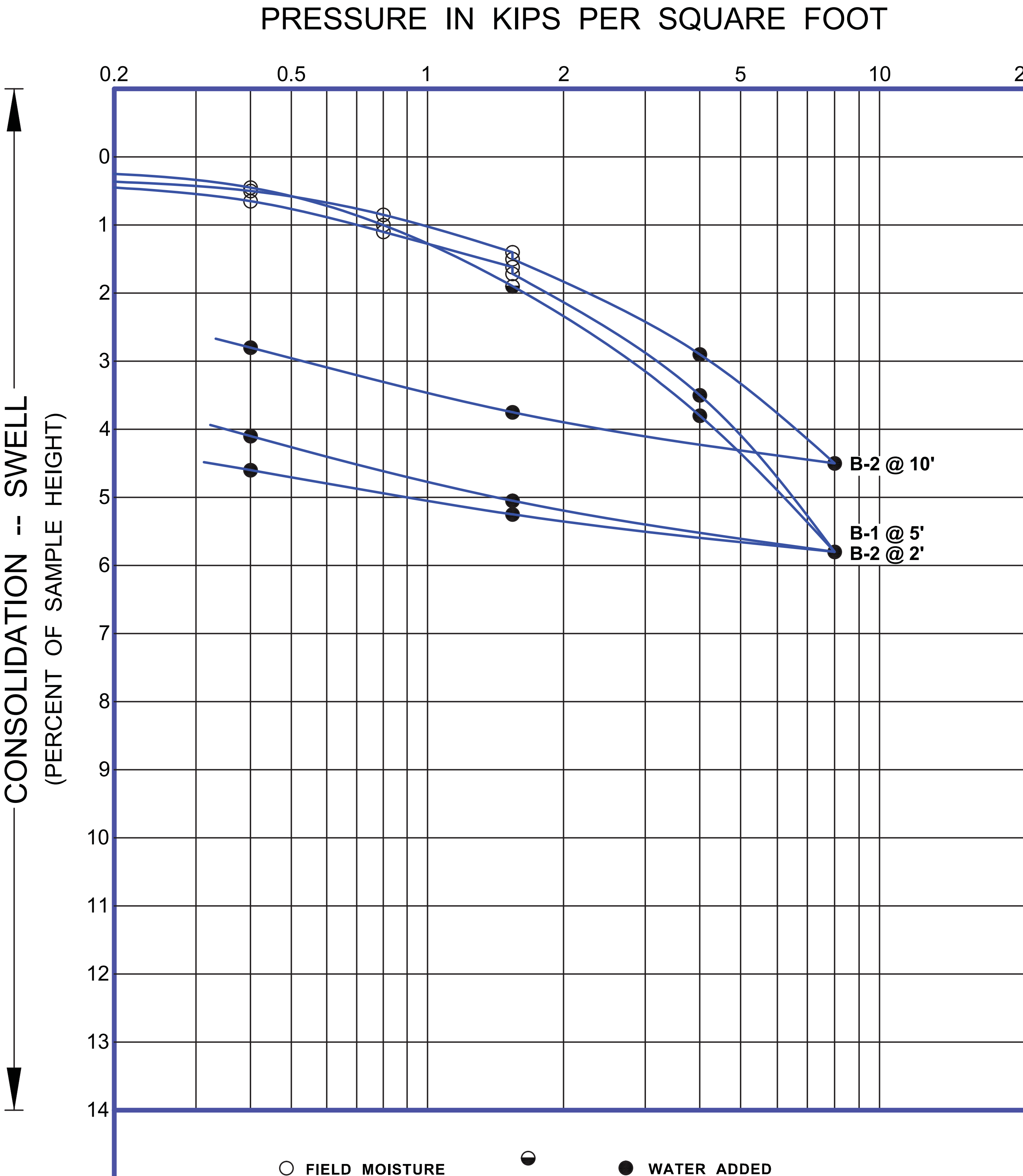
The apparatus used for the consolidation tests is designed to receive the undisturbed brass ring of soil as it comes from the field. Loads were applied to the test specimen in several increments, and the resulting deformations were recorded at time intervals. Porous stones were placed in contact with the top and bottom of the specimen to permit the ready addition or release of water. ASTM D 2435-04 Laboratory Consolidation Test Method.

Undisturbed specimens were tested at the field and added water conditions. The test results are shown on Figure No. II-2 within this Appendix.



DIRECT SHEAR TESTS

JOB NAME :	Proposed Multifamily Residential Building Project 1749 & 1751 Malcolm Avenue & 1772 Glendon Avenue Los Angeles, CA 90024	JOB No. 15-363-02
Applied Earth Sciences	GEOTECHNICAL . GEOLOGY . ENVIRONMENTAL ENGINEERING CONSULTANTS www.aessoil.com (818) 552-6000	FIGURE No. II - 1



SWELL - CONSOLIDATION TESTS

JOB NAME :	Proposed Multifamily Residential Building Project 1749 & 1751 Malcolm Avenue & 1772 Glendon Avenue Los Angeles, CA 90024	JOB No. 15-363-02
Applied Earth Sciences	GEOTECHNICAL . GEOLOGY . ENVIRONMENTAL ENGINEERING CONSULTANTS — www.aessoil.com (818) 552-6000	FIGURE No. II - 2

U:\VINCE\2015\-M-\1730 MALCOLM AVENUE-FAULT STUDY\DRAWING 4 TO 6-GEOTECHNICAL SITE PLAN & SECTIONS B-B' & C-C'.dwg, 7/22/2015 3:25:33 PM

APPENDIX III

SELECTED PHOTOGRAPHS TAKEN DURING FIELD EXPLORATION AND OFFICE DETAILED STUDY

Photo 1- Boring 3 drilling, April 24, 2015, 1749 Malcolm Avenue

Photo 2: Shant Minas, Engineering Geologist, Logging Core Samples from B-3. Note Large Tree and surrounding earth mound which complicated drilling in the area north of B-3.

Photo 3: CPT testing in street, May 12, 2015. View is to south along Malcolm Avenue.

Photo 4: CPT testing, May 12, 2015. In this photo, CPT-11 is being advanced while location for CPT-13 is being hand augered upper five feet for utilities.

Photo 5: Detailed Core Sample Logging in Office, May 19, 2015, Steve Miller, senior geologist alongside Shant Minas.

Appendix IV – Miscellaneous Attachments

Geomorphic Terrace Map (Miles Kenney)

Mactec Geophysical Anomaly Map

Kenney Right vs. Left Lateral Model, Fault Map, 2014

Street Closure, Encroachment and Excavation Permits

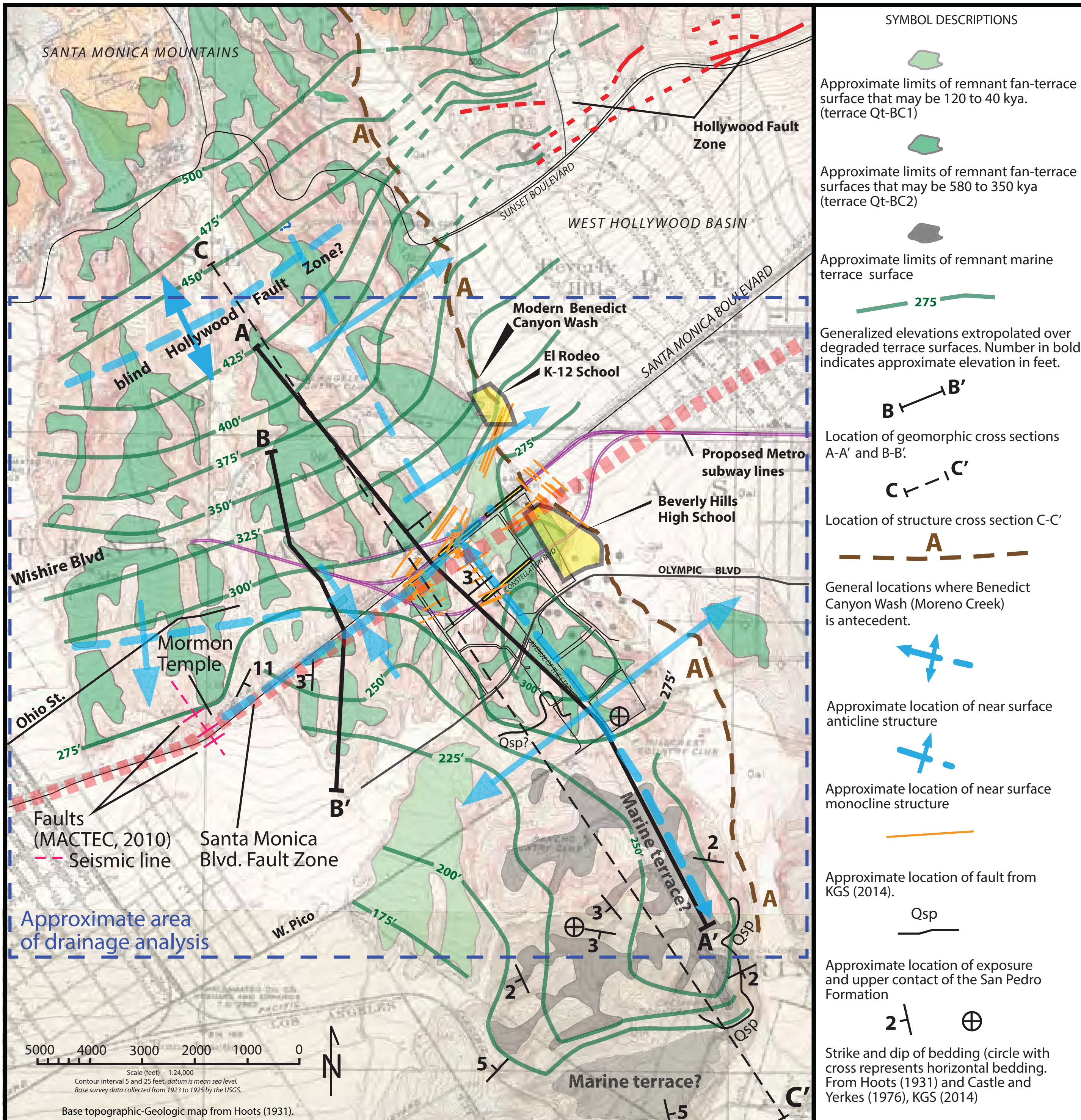
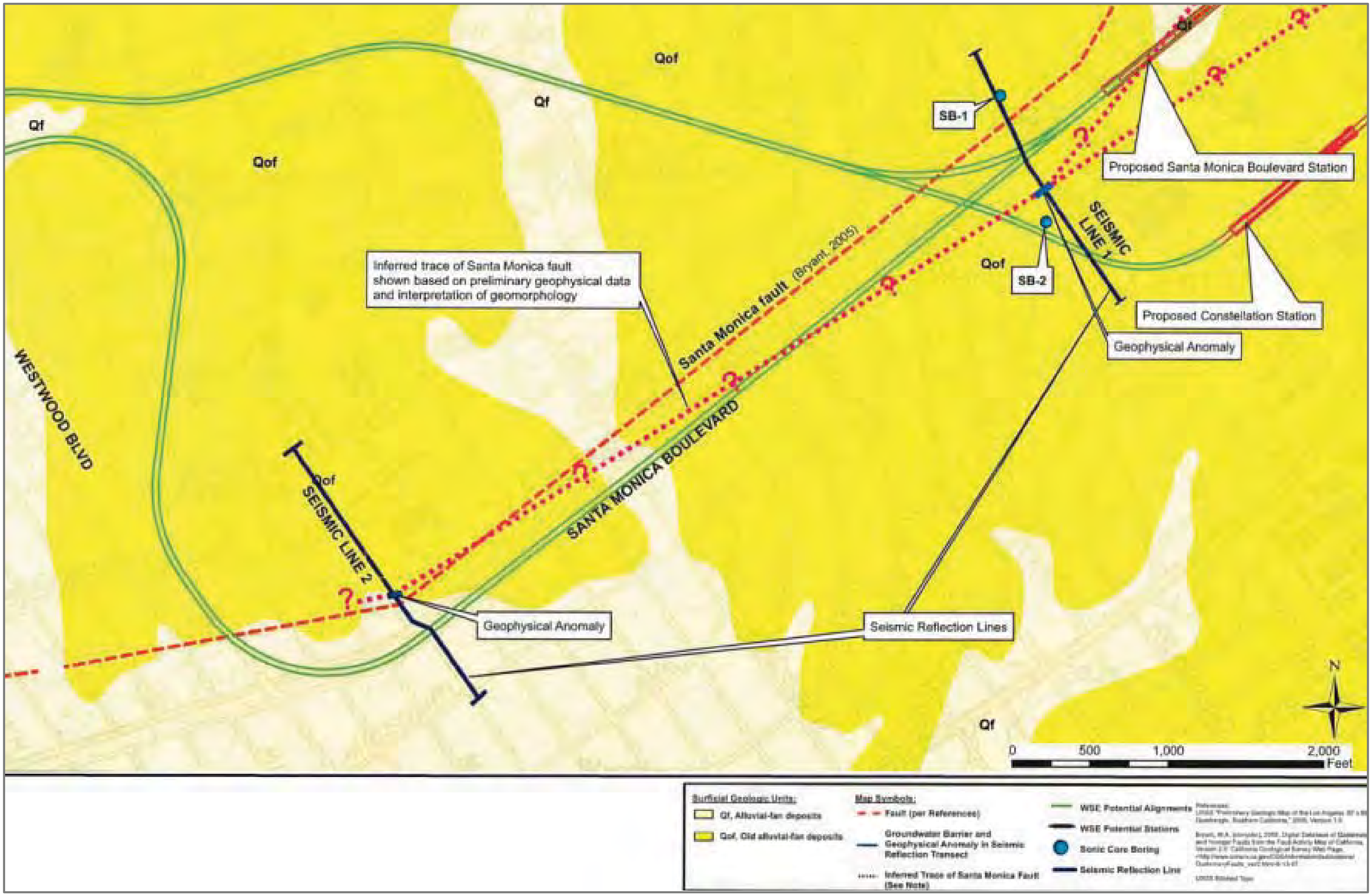

SANTA MONICA MOUNTAINS
WEST HOLLYWOOD BASIN
SUNSET BOULEVARD
SANTA MONICA BOULEVARD
Hollywood Fault Zone
blind Hollywood Fault Zone?
Modern Benedict Canyon Wash
El Rodeo K-12 School
Proposed Metro subway lines
Beverly Hills High School
OLYMPIC BLVD
Wishire Blvd
Mormon Temple
Ohio St.
Faults (MACTEC, 2010)
Seismic line
Santa Monica Blvd. Fault Zone
Approximate area of drainage analysis
W. Pico
Marine terrace?
Qsp
Qsp?
500′
475′
450′
425′
400′
375′
350′
325′
300′
275′
250′
225′
200′
175′
A
A′
B
B′
C
C′
5000 4000 3000 2000 1000 0
Scale (feet) - 1:24,000
Contour interval 5 and 25 feet, datum is mean sea level.
Base survey data collected from 1923 to 1925 by the USGS.
Base topographic-Geologic map from Hoots (1931).
SYMBOL DESCRIPTIONS
Approximate limits of remnant fan-terrace surface that may be 120 to 40 kya. (terrace Qt-BC1)
Approximate limits of remnant fan-terrace surfaces that may be 580 to 350 kya (terrace Qt-BC2)
Approximate limits of remnant marine terrace surface
275
Generalized elevations extropolated over degraded terrace surfaces. Number in bold indicates approximate elevation in feet.
Location of geomorphic cross sections A-A′ and B-B′.
Location of structure cross section C-C′
General locations where Benedict Canyon Wash (Moreno Creek) is antecedent.
Approximate location of near surface anticline structure
Approximate location of near surface monocline structure
Approximate location of fault from KGS (2014).
Approximate location of exposure and upper contact of the San Pedro Formation
Strike and dip of bedding (circle with cross represents horizontal bedding. From Hoots (1931) and Castle and Yerkes (1976), KGS (2014)

Figure 7: Fault Studies during Draft EIS/EIR



City of Los Angeles
Dept. of Public Works
Bureau of Engineering
78-3.652 (R9-89)

APPLICATION / PERMIT FOR EXCAVATION

IN OR ADJACENT TO PUBLIC STREETS
UNDER CHAPTER 6, ARTICLE 2, LOS ANGELES MUNICIPAL CODE

THIS PERMIT IS NOT VALID UNLESS REGISTER VALIDATED OR RECEIPT SHOWN

JOB ADDRESS
1751 Malcolm Ave

PROPERTY OWNER/CONTRACTOR/AGENT FOR
Harkham Family Enterprises, LP (Dan Harkham)

ADDRESS
857 S San Pedro St #300

CITY **Los Angeles**

STATE	CA	ZIP CODE	90014
TELEPHONE	310-553-6900		

Purpose of Excavation
Soilboring

WORK ORDER NO.	LIAB. INS. C.A. NO.	INSURANCE EXPIRES
	78807	2015-06-19 00:00:00.0
"A" PERMIT NO.	SURETY BOND C.A. NO.	MISC. RECEIPT NO.
WAIVER REC. NO.	MISC. CASH BOND NO.	

RECEIPT NO.

This permit is for the CPT-boring at six locations on Malcolm Ave. (CPT-1, CPT-2, CPT-3, CPT-8, CPT-9, CPT-10) Call for pre inspection before any work is done. Traffic Control per watch manual and back fill per Green Book standards

	QTY	RATE	SUBTOTAL
E-permit Excavation	1	$425.00	$425.00
A-Permit Basic Fee	0	$265.00	$0.00
Revocable Permit	0	$0.00	$0.00
E-Permit Special Eng Fee	0.00	$145.00	$0.00
Special Insp Reg Rate / Hr (4 hrs min.)	8	$95.00	$760.00
Tie-Back (Less than 20 ft. below street surface)	0	$605.00	$0.00
Tie Back (20 ft. or more below street surface)	0	$605.00	$0.00
Left De-Tensioned Anc Rods/Ea	0	$2,040.00	$0.00
Street Damage Restoratn-SDRF	0	$0.00	$0.00
Slurry Seal Damage Restrtn Fee-SSDRF	0 sq. ft.		
SDRF/SSDRF Eng Admin	0	$18.00	$0.00
2% SURCHARGE			$23.70
7% SURCHARGE			$82.95
TOTAL			$1,291.65

BY **Oscar Gutierrez**
DATE **04/21/2015**

BUREAU OF ENGINEERING

NOTICE TO PERMITTEE

PERMIT MUST BE ON JOB AT ALL TIMES.
THIS PERMIT EXPIRES 6 MONTHS FROM ISSUANCE UNLESS WORK HAS COMMENCED. (LAMC 62.02)
KEEP SIDEWALKS AND GUTTERS CLEAR.

INSPECTION IS REQUIRED

I hereby agree to observe all requirements of the Municipal Code of the City of Los Angeles, all amendments thereto, and any special requirements made part of this permit.

Call Bureau of Contract Administration for inspection prior to commencing work: (213) 485-5080.

X

PRINT NAME

Harkham Family Enterprises, LP (Dan Harkham)

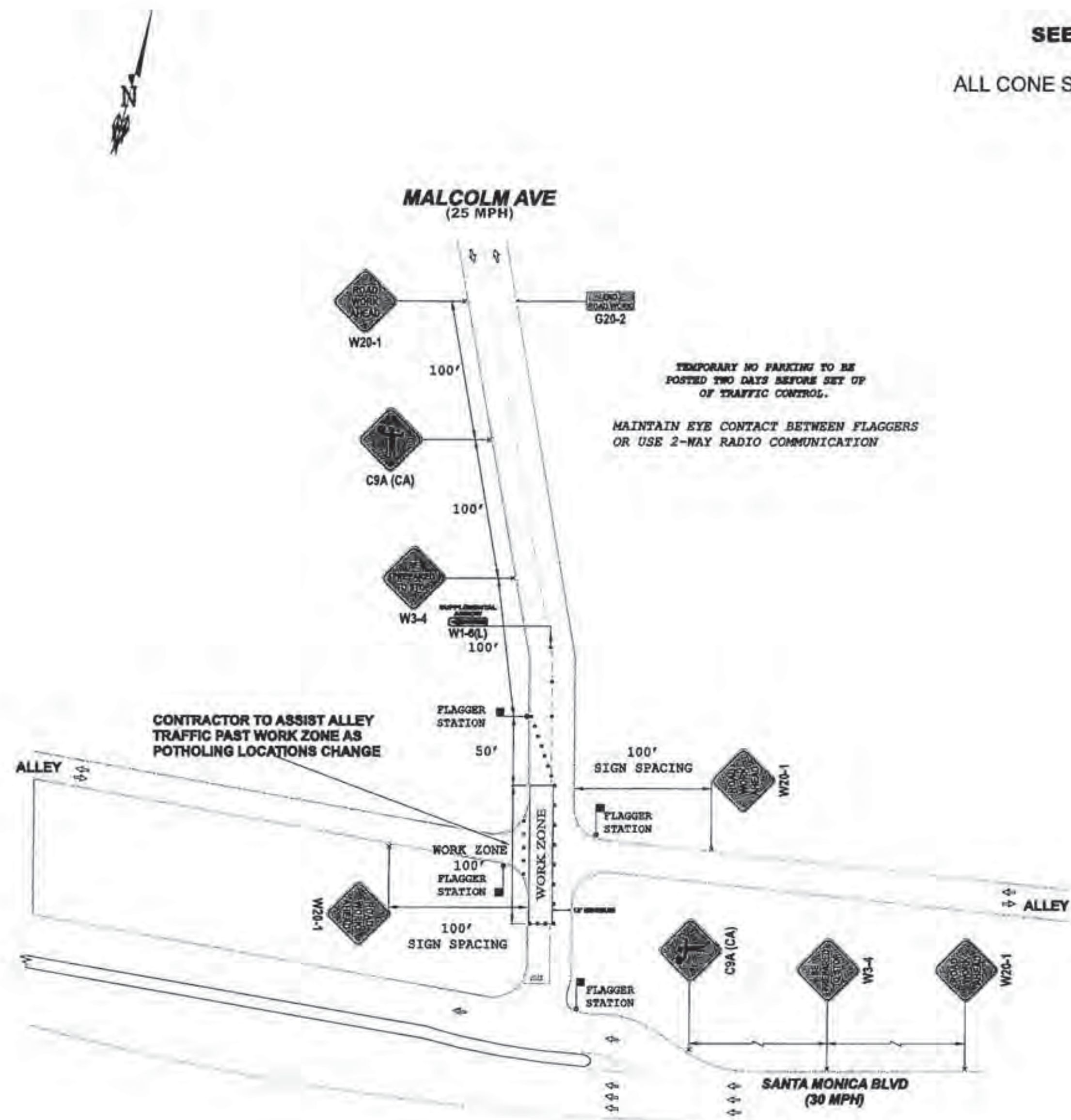
STREETS AFFECTED

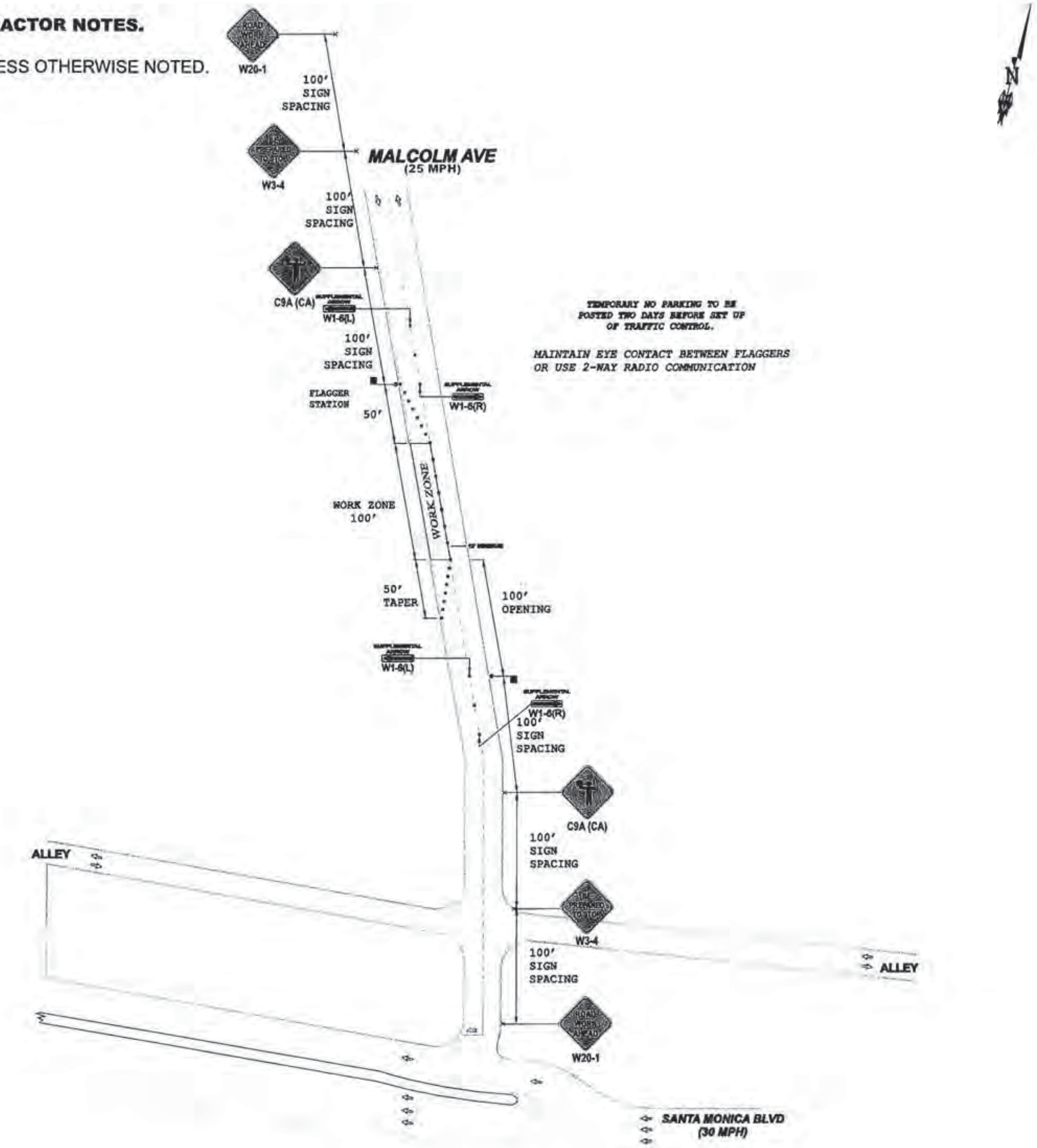
JOB ADDRESS
1751 Malcolm Ave

SPECIAL DEPOSIT PERMIT NO.
E-1585-0023

SEE PAGE ONE FOR CONTRACTOR NOTES.

ALL CONE SPACING SHALL BE 25' UNLESS OTHERWISE NOTED.





DIGALERT 1-800-227-2600

CITY OF LOS ANGELES

TEMPORARY TRAFFIC CONTROL PLAN

PROJECT NAME: 1751 MALCOLM AVENUE

PRIME CONTRACTOR: SINANIAN

PHONE: (818) 679-3404

DATE: 4-16-2015 | TPSI LICENSE #: 787313 C31/D42 | BRANCH: INLAND EMPIRE

NOTES:

ORIGINAL

REVIEW BY CITY STAFF		
OFFICE	INITIAL	DATE
ENGINEERING DIVISION MANAGER		
LAND DEVELOPMENT		
PLANNING		
TRANSPORTATION		
PARKS AND COMMUNITY SERVICES		
SPECIAL DISTRICTS		
STORM WATER MANAGEMENT PRGM		

NO.	DESCRIPTION OF REVISION	DATE	CITY APPROVED

CITY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS

RECOMMENDED BY:

ENGINEER, TRAFFIC DIVISION | DATE | APPROVED BY:

TRAFFIC DIVISION | DATE | PERMIT ENGINEER OPERATIONS SUPPORT DIVISION | DATE

SEAL

TPR TRAFFIC SOLUTIONS
TPR TRAFFIC SOLUTIONS
10783 POPLAR AVE
FONTANA, CA 92337
t: (855) 328-5953 f: (909) 350-8950
Calif. Contractors Lic.
787313 C31 / D42
Toll free: 866-537-1260

APPROVED BY: TRAFFIC ENGINEER

DATE:
RCE NO.

DESIGNED: CP
DRAWN: CP
CHECKED:

NOT TO SCALE

RECOMMENDED:
SHEET 2 OF 2
DRAWING NO. 15 - 038

Exhibit: E

CITY OF LOS ANGELES
CALIFORNIA

ERIC GARCETTI
MAYOR

DEPARTMENT OF
BUILDING AND SAFETY
201 NORTH FIGUEROA STREET
LOS ANGELES, CA 90012

RAYMOND S. CHAN, C.E., S.E.
GENERAL MANAGER

FRANK BUSH
EXECUTIVE OFFICER

GEOLOGY AND SOILS REPORT CORRECTION LETTER

August 19, 2015

LOG # 89430
SOILS/GEOLOGY FILE - 2
LIQ/PFRSA

Sinan Sinanian
18980 Ventura Boulevard, Suite 200
Tarzana, CA 91356

TRACT:	7803
BLOCK:	15
LOT(S):	20 / 19 / 11
LOCATION:	1749 & 1751 Malcolm Ave. And 1772 Glendon Ave.

CURRENT REFERENCE REPORT/LETTER(S)	REPORT No.	DATE(S) OF DOCUMENT	PREPARED BY
Geology/Soils Report	15-363-26	07/21/2015	Applied Earth Sciences
Oversized Doc(s).	"	"	"

The Grading Division of the Department of Building and Safety has reviewed the referenced report that provides recommendations for a proposed multi-unit residential development with a parking garage. According to the report, the site is relatively flat and occupied by existing residential structures.

The earth materials at the subsurface exploration locations consist of up to 4 feet of uncertified fill underlain by recent and older alluvium, sag pond and estuarine deposits. The consultants recommend to support the proposed structures on conventional foundations bearing on native undisturbed soils.

The site is located within a City of Los Angeles Preliminary Fault Rupture Study Area designated for the Santa Monica fault. The report includes the results of a fault rupture investigation that consisted of a transect of continuous core borings and cone penetrometer test soundings in Malcolm Avenue on the east side of the property. An active fault splay was identified through the northeastern corner of the property. The consultants recommend that proposed buildings be setback at least 10 feet from the fault splay and that a reinforced (thick mat) foundation be used to support the eastern building.

The site is located in a designated liquefaction hazard zone as shown on the "Seismic Hazard Zones" map issued by the State of California.

The review of the subject report can not be completed at this time and will be continued upon submittal of an addendum to the report which shall include, but not be limited to, the following:

(Note: Numbers in parenthesis ( ) refer to applicable sections of the 2014 City of LA Building Code. P/BC numbers refer the applicable Information Bulletin. Information Bulletins can be accessed on the internet at LADBS.ORG.)

1. The proposed 10-ft. setback from the active fault splay appears small given that the fault was identified at only one location and there is no direct evidence of the orientation of the fault. In addition, the fault trace may be closer to B-3 than estimated. Additional exploration is required to determine the fault's trend in at least two locations to warrant the recommended reduced setback. Alternatively, a larger setback could be recommended.

2. Provide more detailed discussion on the stratigraphic correlation from CPT-13 to B-3. The upper soils of CPT-11 to CPT-13 appear more fine-grained than the soils observed from CPT1 and B-1. It seams like Qof-1is missing from CPT-2 (back to fine-grained) and the top of Qof-2 appears to be lower.

3. What is the purple marker bed shown at depth on the northern portion of Cross Section A-A'.

The geologist and soils engineer shall prepare a report containing the corrections indicated in this letter. The report shall be in the form of an itemized response. It is recommended that once all correction items have been addressed in a response report, to contact the report review engineer and/or geologist to schedule a verification appointment to demonstrate compliance with all the corrections. Do not schedule an appointment until all corrections have been addressed. Bring three copies of the response report, including one unbound wet-signed original for microfilming in the event that the report is found to be acceptable.

DANIEL C. SCHNEIDEREIT	GLEN RAAD
Engineering Geologist I	Geotechnical Engineer I

DCS/GR:dcs/gr
Log No. 89430
213-482-0480

cc: Applied Earth Sciences, Project Consultant
WL District Office

Exhibit: F

November 30, 2015 15-363-26

Sinanian Development
18980 Ventura Boulevard, Suite 200
Tarzana, CA 91356

Subject: Supplement No. 1
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

Gentlemen:

INTRODUCTION

We are pleased to submit this Supplement No. 1 report responding to the City comments. The original report of geotechnical and geological investigation report for the subject project was issued by this office on July 21, 2015.

This submittal is in response to comments in a Geology and Soils Report Correction Letter dated August 19, 2015 by the Grading Section Of the Department of Building and Safety of the City of Los Angeles (Log # 89430). For convenience, we have enclosed a copy of the City Review Letter with this Supplement No. 1 report. Our responses also incorporate verbal discussion of the comments between the undersigned geologist and Mr. Schneidereit of LADBS as well as with Mr. Brian Olson of the California Geologic Survey.

Our responses follow the original order of comments.

RESPONSE TO THE COMMENTS

1. In order to respond to this comment, and as requested, additional exploration was advanced along Malcolm Avenue. Seven additional Cone Penetrometer soundings were advanced along the street, CPT-14 through CPT-20, on October

6, 2015. Prior to advancing the CPTs, necessary traffic control, encroachment and excavation permits were retrieved for drilling in the public right-of-way.

See the Drawing No. 1 for the locations of the new CPTs. The new CPTs were advanced in the street between old CPTs 8-10 on the north and CPTs 11-13 on the south along the same alignment. These additional CPTs have allowed for better resolution of the fault location and orientation.

We have revised the main geologic cross section A to include the new CPTs along the street, and have removed the projected geologic Borings 1 through 3. We have included a new geologic cross section B, through the geologic borings and previously advanced CPTs which were advanced through the east portion of the subject property. We have identified the fault location based on cross correlation of CPT logs and boring logs in each of these north-south sections, as well as numerous east-west sections between the two main transects, and this has given us a better resolution of the fault location and orientation.

Based on the additional exploration, by having two transects of geologic data, one along the street and one along the eastern property, we have been able to determine that the location of the faults are essentially the same as previously reported, as is the orientation of the fault.

In order to determine this, we have included new short geologic sections C, D, E, F and G which are extended subparallel to the fault trace, between CPTs and borings on private property and CPTs on the street. These additional sections serve to present positive cross-correlation (or lack thereof) of subsurface geology between the two main north-south transects. Subsurface profiles as depicted in sections C and D, which are south of the fault, appear to match up reasonably well at the same or similar elevations. Section E, which extends parallel and just north of the mapped fault, also matches subsurface layers reasonably well. However, in sections F (between CPT 19 and B-3) and G (between CPT-6 and

CPT-19), both of which cross the projected fault, subsurface layers appears to be disrupted or disturbed. Our interpretation of the subsurface structure essentially locks in the orientation of the fault from the street to the east portion of the property, and this orientation is essentially the same as what was previously reported. Please see attached Drawings for graphical depiction.

2. Since we have provided additional CPT data in the street, our transects A and B have more suitable orientations for cross comparison of subsurface data. CPT-11 through CPT-13 are reasonably similar to new CPTs 14 through 19. The entire upper 10-15 feet across the transect, until the fault, appears to be fine-grained soils.

   Regarding the comment about Qof-1 missing from CPT-2, it is possible that the area was previously excavated for one utility or another. As can be seen from Drawing 1, and is typically the case in urban environments, the upper ground surface in public streets can be significantly disturbed due to excavation and backfill associated with utilities. Below 30 feet, the layers appear to match up with CPT-1, Boring 1, and CPT-3.

   Other than possible man-made disturbance of subsurface layers, it should be noted that typically during alluvial deposition, some braiding is likely, resulting in lenticular layers that do not extend for long distances in any direction.

3. The purple marker bed served only to show the offset of layers in the northern part of the site in our original report, between CPT-10 and Boring 3. There are several such minor layers that can be traced with reasonable certainty across borings or CPTs, which appear to be offset at the same location by the fault. There is no other significance to this purple layer.

ADDITIONAL GEOLOGIC CONSIDERATIONS

The subsurface layers as shown in sections A and B appear to be folded due to the proximity to the fault zone. This is more pronounced in the southern portion of the study area. Folding of subsurface strata near faults is common and well documented in the literature.

As part of our supplemental investigation, and during a meeting with Mr. Schneidereit of LADBS prior to commencing additional field work, we were asked to utilize information from the gasoline station south of the site to augment our data and provide additional discussion of the stratigraphic correlation of the southern portion of the study area. For the Site Assessment Report of the south-adjacent gas station, we reached out to Mr. Brian Olson of the CGS, who provided us with a Site Assessment Report for 10801 Santa Monica Boulevard prepared by Wayne Perry in 2011.

As part of his effort, Wayne Perrry advanced three environmental borings and utilized boring log information from several other prior sources, logs of which were not all included in his report. However, we were able to interpret soil log information for Boring TDD-3, advanced in the northeast corner of the gas station to depth of approximately 30 feet, from cross section C-C’ of Perry’s report, and include our reinterpreted log of TDD-3 in our Geologic Cross Section B-B’. This log was advanced in support of an environmental assessment report presumably by an environmental specialist and therefore is of limited use to us in our current fault study. Nevertheless, we have extended our interpretation of subsurface structure in transect B to include the boring information from TDD-3. The geologic data from TDD-3 is sufficiently similar to our Boring Log 1, advanced in the southeast portion of the site, and hence, does not provide any supporting data that would indicate the presence of a fault in the southern portion of the study area.

REVISED ENGINEERED MITIGATION RECOMMENDATIONS

The city asked us to provide additional exploration to get better resolution of the fault orientation, or recommend a larger setback. We have provided additional exploration and felt have made a reasonably accurate geologic interpretation of the subsurface conditions. However, in light of the city's request, and due to the nature of the profession and variability of subsurface conditions, we are revising our setback recommendation to 20 feet (originally we recommended ten feet). The 20 feet setback will affect the northeast portion of the proposed new building as it was previously designed. Either the design needs to be revised to stay outside of the 20 feet setback zone, or the building structure be designed so that any portion extending into the No-Build Zone is structurally cantilevered so that its foundation stays outside of the no-build zone. Based on recent correspondence with the clients and project architect and engineer, they will be pursuing the latter option, i.e. the building footprint will stay the same, and the portion of the building within the No-Build-Zone will be structurally cantilevered.

In addition, for the same reasoning, we are revising our mat foundation recommendation to include the entire project area. Previously we had recommended only the eastern building to utilize a 24" mat foundation. At the current time, we are recommending the western building to also utilize a 24" mat foundation.

See our Drawings Nos. 9, 10 and 11, Geotechnical Site Plan and Cross Sections, for graphical depictions of the engineered mitigation.

-oOo-

Thank you for the opportunity to be of continued service on this project. Should you have any questions regarding this Supplement No. 1, or wish to discuss the project further, please do not hesitate to call us.

Respectfully Submitted,

APPLIED EARTH SCIENCES

Shant Minas
Engineering Geologist
EG 2607

CERTIFIED ENGINEERING GEOLOGIST
SHANT MINAS
EG # 2607
Exp. 12 / 16
STATE OF CALIFORNIA

Caro J. Minas, President,
Geotechnical Engineer
GE 601

REGISTERED PROFESSIONAL ENGINEER
CARO J. MINAS
NO. 601
EXP. 12 / 16
GEOTECHNICAL
STATE OF CALIFORNIA

Steven Miller
Senior Engineering Geologist
EG 1303

CERTIFIED ENGINEERING GEOLOGIST
STEVEN B. MILLER
No. 1303
Exp. 7-31-17
STATE OF CALIFORNIA

SM/CJM/la

Enclosure: Drawing No. 1 - Fault Study Field Exploration Plan (Phase II)
Drawing No. 2 - Geologic Cross Section A
Drawing No. 3 - Geologic Cross Section B
Drawing Nos. 4 through 8 - Geologic Cross Sections C through G
Drawing No. 9 - Geotechnical Site Plan
Drawing No. 10 and 11 - Geotechnical Cross Sections H and I
Summary of Cone Penetration Data by Kehoe Engineering for new CPTs 14 through 20
Copy of City Correction Letter (Log No. 89430)
Site Assessment Report for 10801 Santa Monica Blvd., Wayne Perry, 2011

Distribution: (4)

Qa = Recent Alluvium

Qsp = Sag Pond Deposits

CPT-18 =Location of New CPT Soundings (Oct. 2015)

CPT-13 = Location of Previously Advanced CPTs (Apr. 2015 By AES)

B-3 = Approximate Location of Continuous Core Drilling

B-7 = Approximate Location of Geotechnical Boring

SB-3 = Location of Boring (By Wayne Perry, Inc.)

= Area of Work :
1- Excavation Permit
2- Street Use Permit
3- Traffic Control Plan
4- Encroachment Permit

= Area of Work Within Private Property

= Fault Location (Based on Navigate LA)

= Fault Location (AES, 2015, Based on Site-specific Investigation)

= Area of No-Build Zone

= Sewer Pipe & Lateral (By Navigate LA)

= Storm Drain Inlet & Pipes (By Navigate LA)

= Gas Line (By Field Mapping & Dig Alert)

= Water Line (By Field Mapping & Dig Alert)

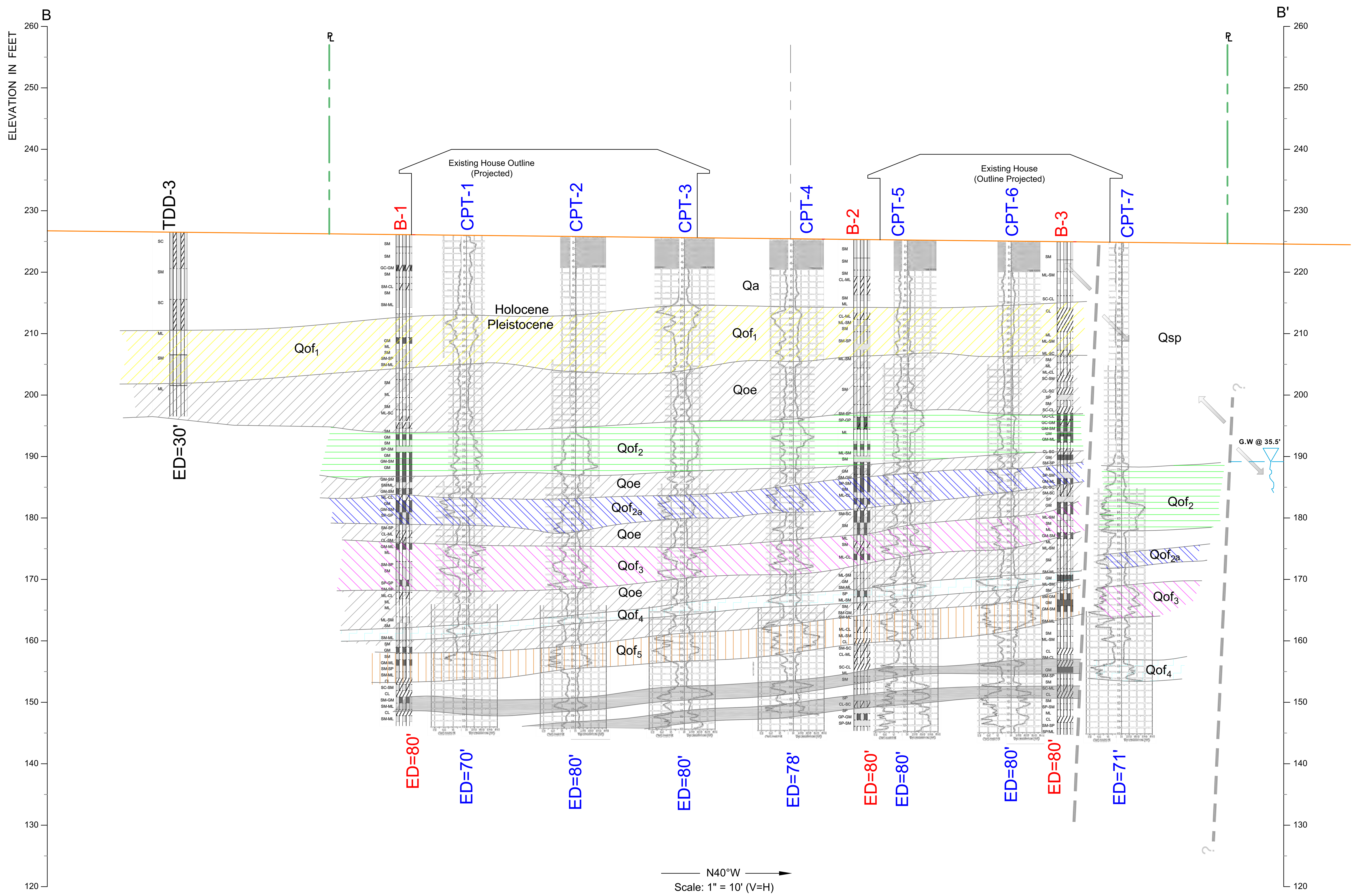
= Electrical Line (By Field Mapping & Dig Alert)

FAULT STUDY FIELD EXPL. PLAN PHASE II	PROJECT No: 15-363-26
DESCRIPTION: Proposed Multifamily Building	DATE: 11 / 30 / 2015
FOR: Sinanian Development	DRAWN BY: ZS
ADDRESS: 1749 & 1751 Malcolm Avenue, Los Angeles, CA 90024	CHECKED BY: SM
Applied Earth Sciences — GEOTECHNICAL . GEOLOGY . ENVIRONMENTAL ENGINEERING CONSULTANTS — www.aessoil.com (818) 552-6000	DRAWING No: 1 / SUPP. No: 1

CPT-13 = Location of Previously Advanced CPTs (Apr. 2015 By AES) TD=80'

CPT-20 =Location of New CPT Soundings (Oct. 2015 By AES) TD=80'

GEOLOGIC CROSS SECTION A-A'		PROJECT No:	15-363-26
DESCRIPTION:	Proposed Multifamily Building	DATE:	11 / 30 / 2015
FOR:	Sinanian Development	DRAWN BY:	ZS
ADDRESS:	1749 & 1751 Malcolm Ave. & 1772 Glendon Ave., Los Angeles, CA 90024	CHECKED BY:	SM
Applied Earth Sciences	GEOTECHNICAL . GEOLOGY . ENVIRONMENTAL ENGINEERING CONSULTANTS www.aessoil.com (818) 552-6000	DRAWING No: 2	SUPP. No: 1



LEGEND

Holocene
- Af = Surficial Fill
- Qa = Recent Alluvium
- Qsp = Sag Pond Deposits

Pleistocene
- Qof = Older Fluvial & Alluvial Deposits
- Qoe = Older Estuarine Deposits

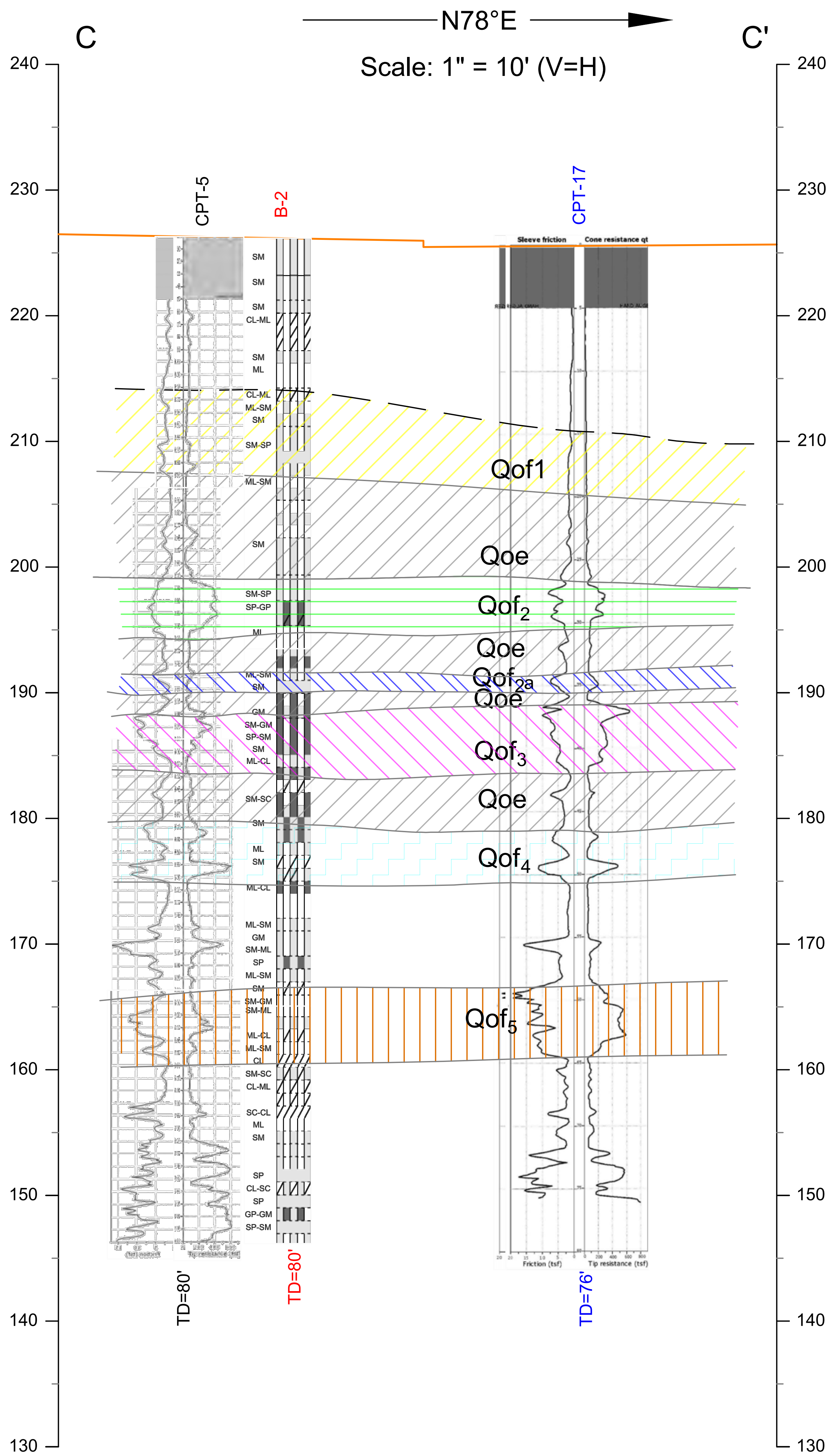
CPT-10 / ED=80' = Approximate Location of Proposed CPT Sounding (Approx. every 20', Estimated Depth=80')

B-3 / ED=80' = Approximate Location of Proposed Continuous Core Drilling (Estimated Depth=80')

B-7 / TD=10' Location of Geotechnical Boring

= Location of Faults, Based on Subsurface Exploration (AES, 2015)

GEOLOGIC SECTION B-B'		PROJECT No: 15-363-26	
DESCRIPTION:	Proposed Multifamily Building	DATE:	11 / 30 / 2015
FOR:	Sinanian Development	DRAWN BY:	ZS
ADDRESS:	1749 & 1751 Malcolm Ave. & 1772 Glendon Ave., Los Angeles, CA 90024	CHECKED BY:	SM
Applied Earth Sciences	GEOTECHNICAL . GEOLOGY . ENVIRONMENTAL ENGINEERING CONSULTANTS www.aessoil.com (818) 552-6000	DRAWING No: 3	SUPP. No: 1



CPT-13

TD=80'

= Location of Previously Advanced CPTs (Apr. 2015 By AES)

CPT-20

TD=80'

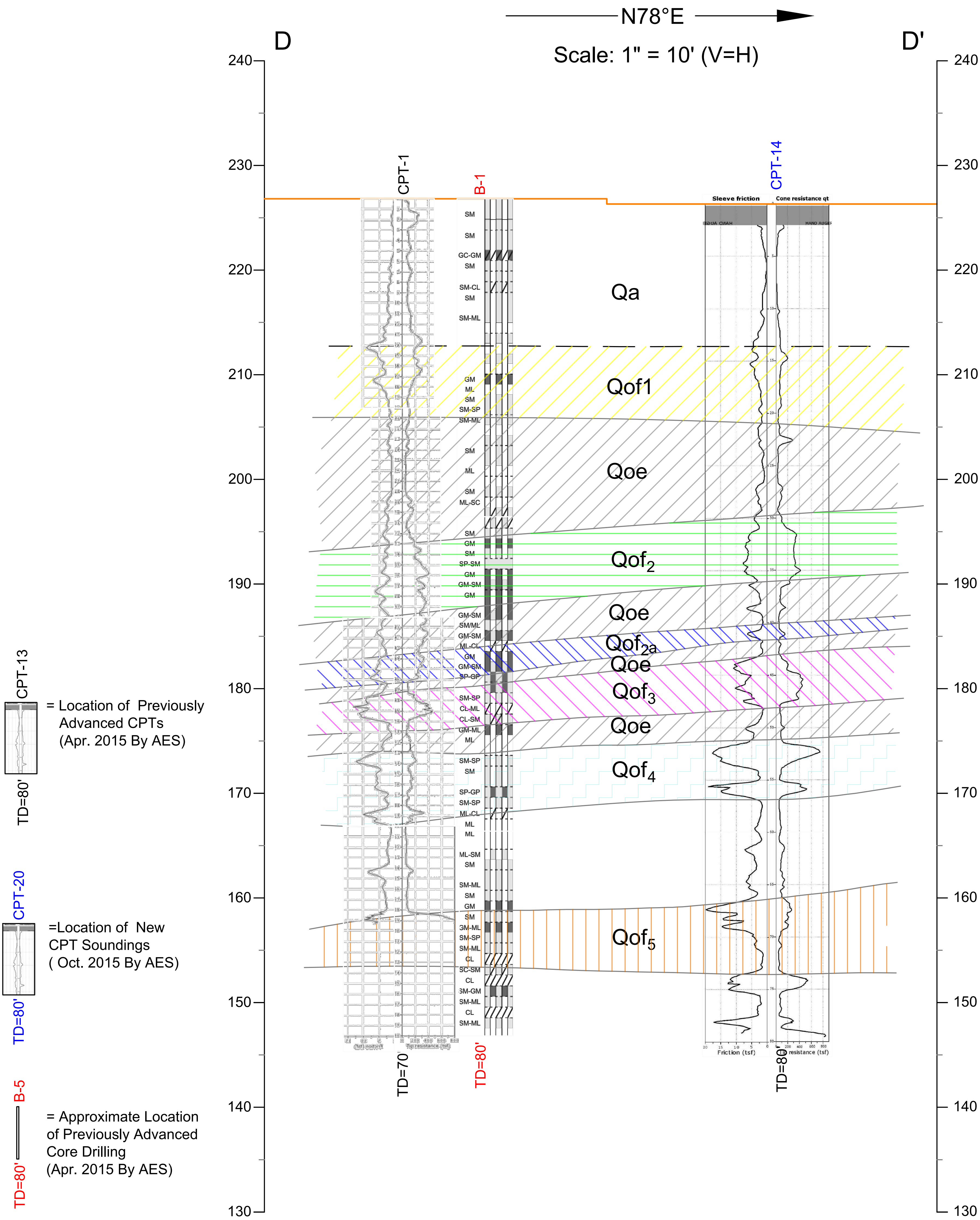
=Location of New CPT Soundings (Oct. 2015 By AES)

B-5

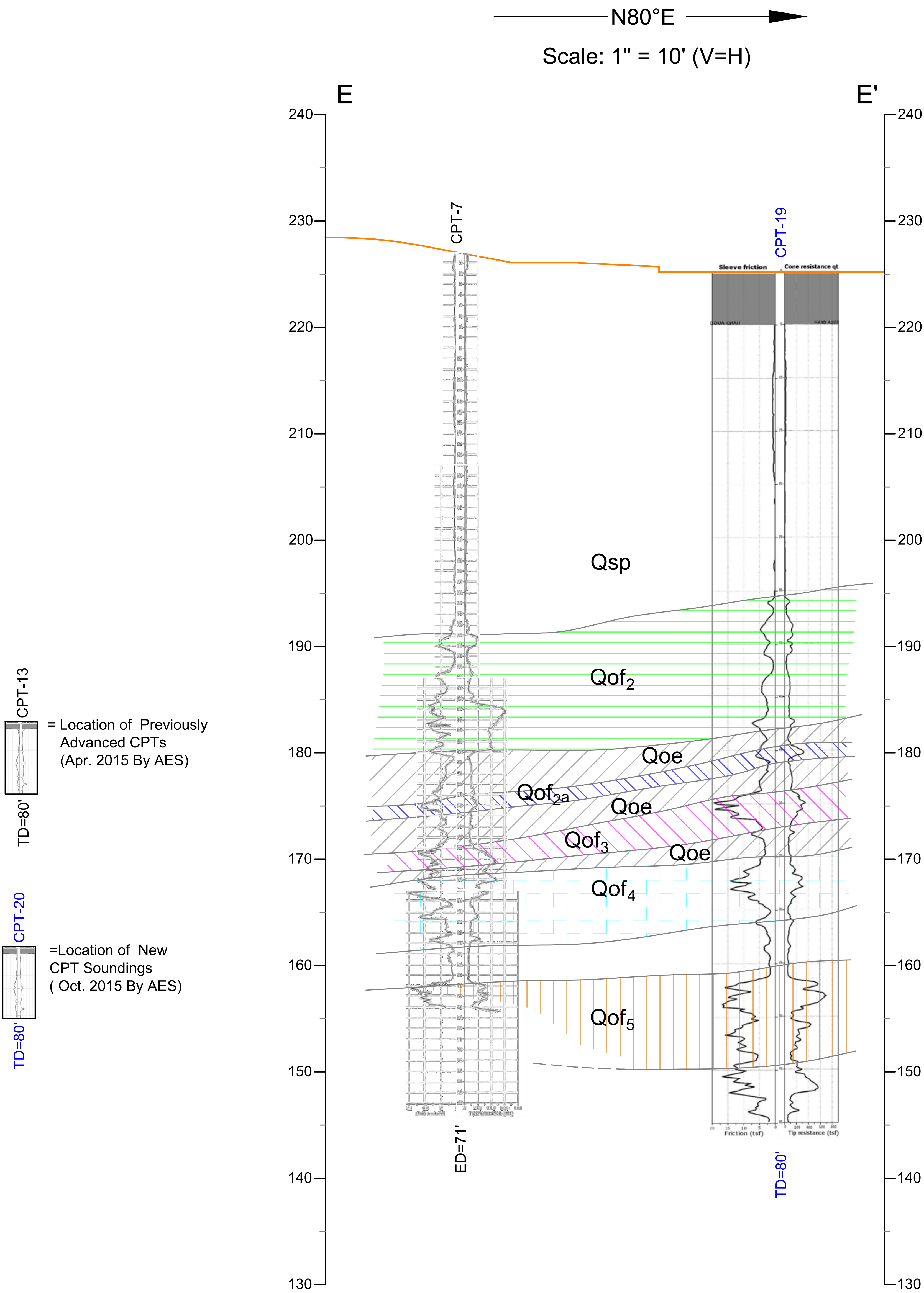
TD=80'

= Approximate Location of Previously Advanced Core Drilling (Apr. 2015 By AES)

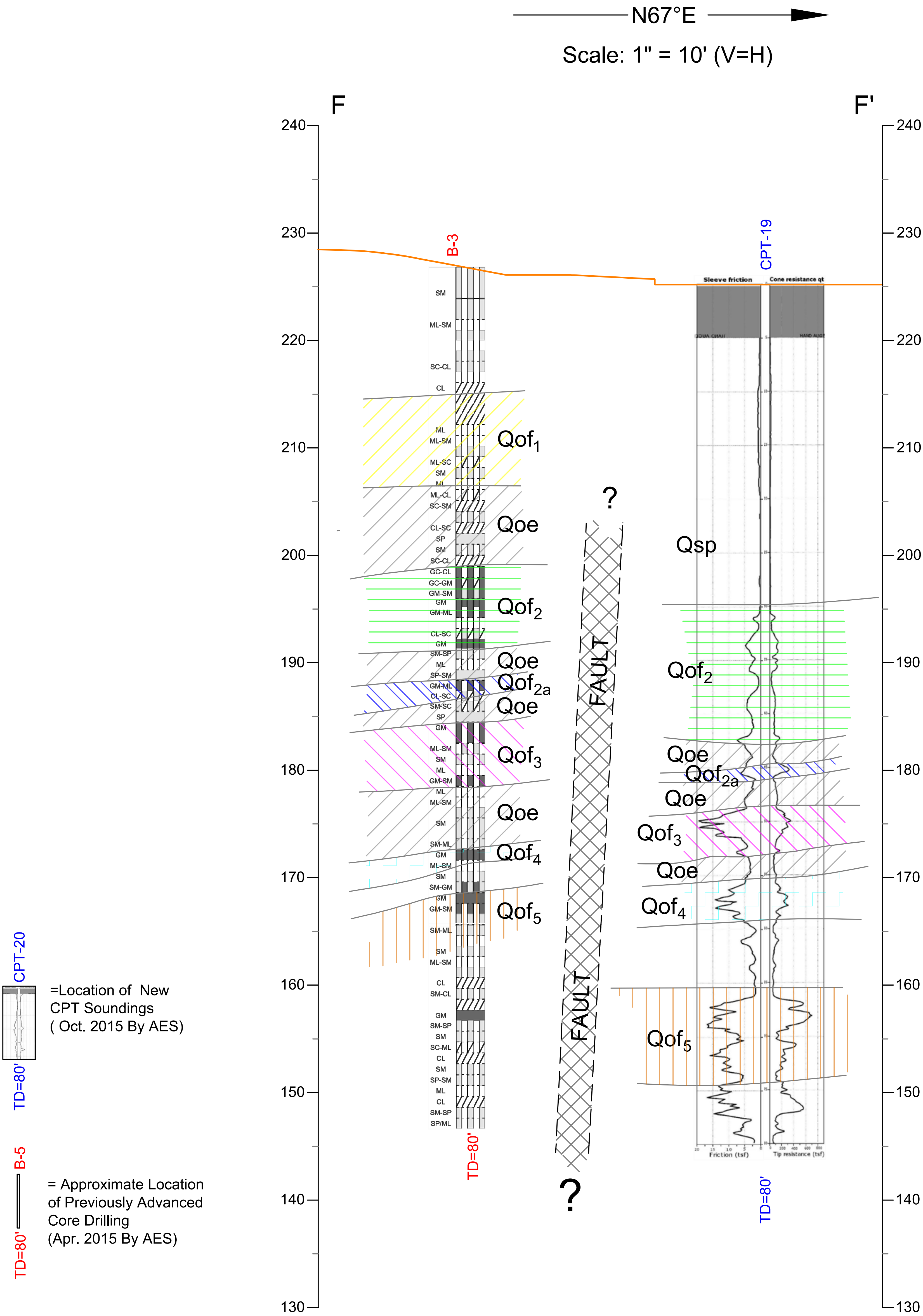
GEOLOGIC CROSS SECTION C-C'		PROJECT No: 15-363-26	
DESCRIPTION:	Proposed Multifamily Building	DATE:	11 / 30 / 2015
FOR:	Sinanian Development	DRAWN BY:	ZS
ADDRESS:	1749 & 1751 Malcolm Ave. & 1772 Glendon Ave., Los Angeles, CA 90024	CHECKED BY:	SM
Applied Earth Sciences	GEOTECHNICAL . GEOLOGY . ENVIRONMENTAL ENGINEERING CONSULTANTS www.aessoil.com (818) 552-6000	DRAWING No: 4	SUPP. No: 1



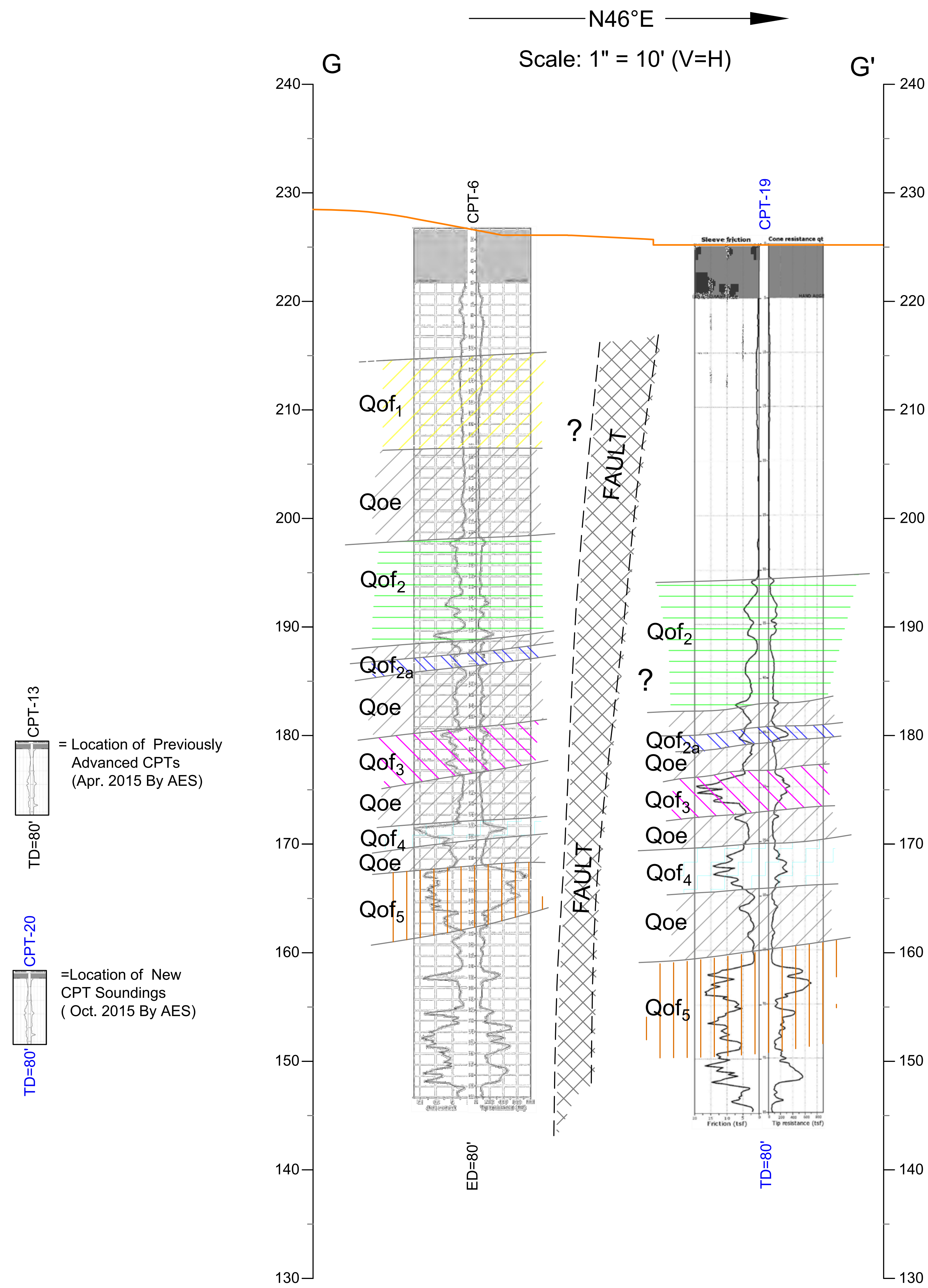
GEOLOGIC CROSS SECTION D-D'		PROJECT No:	15-363-26
DESCRIPTION:	Proposed Multifamily Building	DATE:	11 / 30 / 2015
FOR:	Sinanian Development	DRAWN BY:	ZS
ADDRESS:	1749 & 1751 Malcolm Ave. & 1772 Glendon Ave., Los Angeles, CA 90024	CHECKED BY:	SM
Applied Earth Sciences	GEOTECHNICAL . GEOLOGY . ENVIRONMENTAL ENGINEERING CONSULTANTS www.aessoil.com (818) 552-6000	DRAWING No: 5	SUPP. No: 1



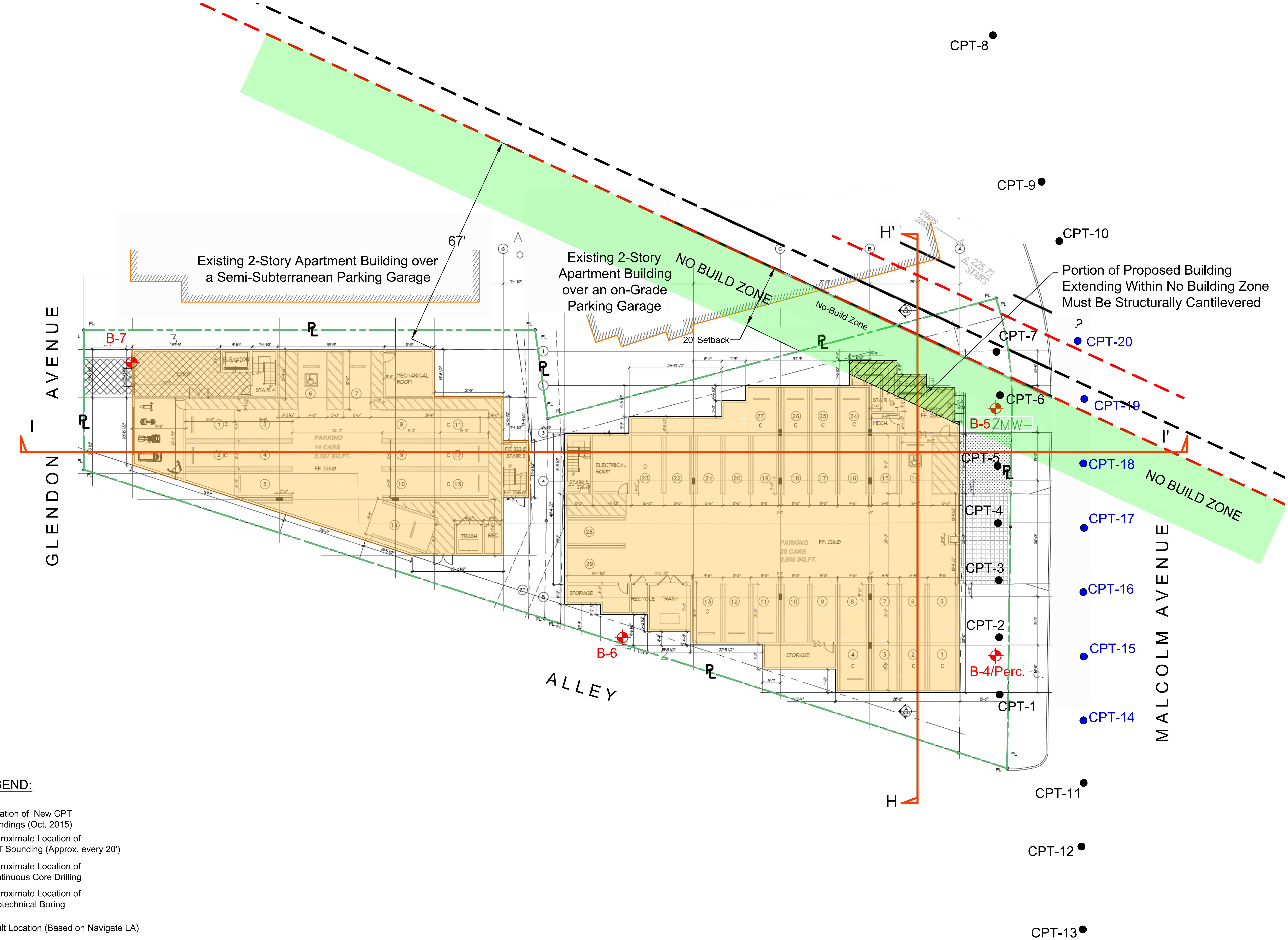
GEOLOGIC CROSS SECTION E-E'		PROJECT No: 15-363-26	
DESCRIPTION:	Proposed Multifamily Building	DATE:	11 / 30 / 2015
FOR:	Sinanian Development	DRAWN BY:	ZS
ADDRESS:	1749 & 1751 Malcolm Ave. & 1772 Glendon Ave., Los Angeles, CA 90024	CHECKED BY:	SM
Applied Earth Sciences	GEOTECHNICAL . GEOLOGY . ENVIRONMENTAL ENGINEERING CONSULTANTS www.aessoil.com (818) 552-6000	DRAWING No: 6	SUPP. No: 1



GEOLOGIC CROSS SECTION F-F'		PROJECT No: 15-363-26	
DESCRIPTION:	Proposed Multifamily Building	DATE:	11 / 30 / 2015
FOR:	Sinanian Development	DRAWN BY:	ZS
ADDRESS:	1749 & 1751 Malcolm Ave. & 1772 Glendon Ave., Los Angeles, CA 90024	CHECKED BY:	SM
Applied Earth Sciences — GEOTECHNICAL . GEOLOGY . ENVIRONMENTAL ENGINEERING CONSULTANTS	www.aessoil.com (818) 552-6000	DRAWING No: 7	SUPP. No: 1



GEOLOGIC CROSS SECTION G-G'		PROJECT No: 15-363-26	
DESCRIPTION:	Proposed Multifamily Building	DATE:	11 / 30 / 2015
FOR:	Sinanian Development	DRAWN BY:	ZS
ADDRESS:	1749 & 1751 Malcolm Ave. & 1772 Glendon Ave., Los Angeles, CA 90024	CHECKED BY:	SM
Applied Earth Sciences	GEOTECHNICAL . GEOLOGY . ENVIRONMENTAL ENGINEERING CONSULTANTS www.aessoil.com (818) 552-6000	DRAWING No: 8	SUPP. No: 1



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)

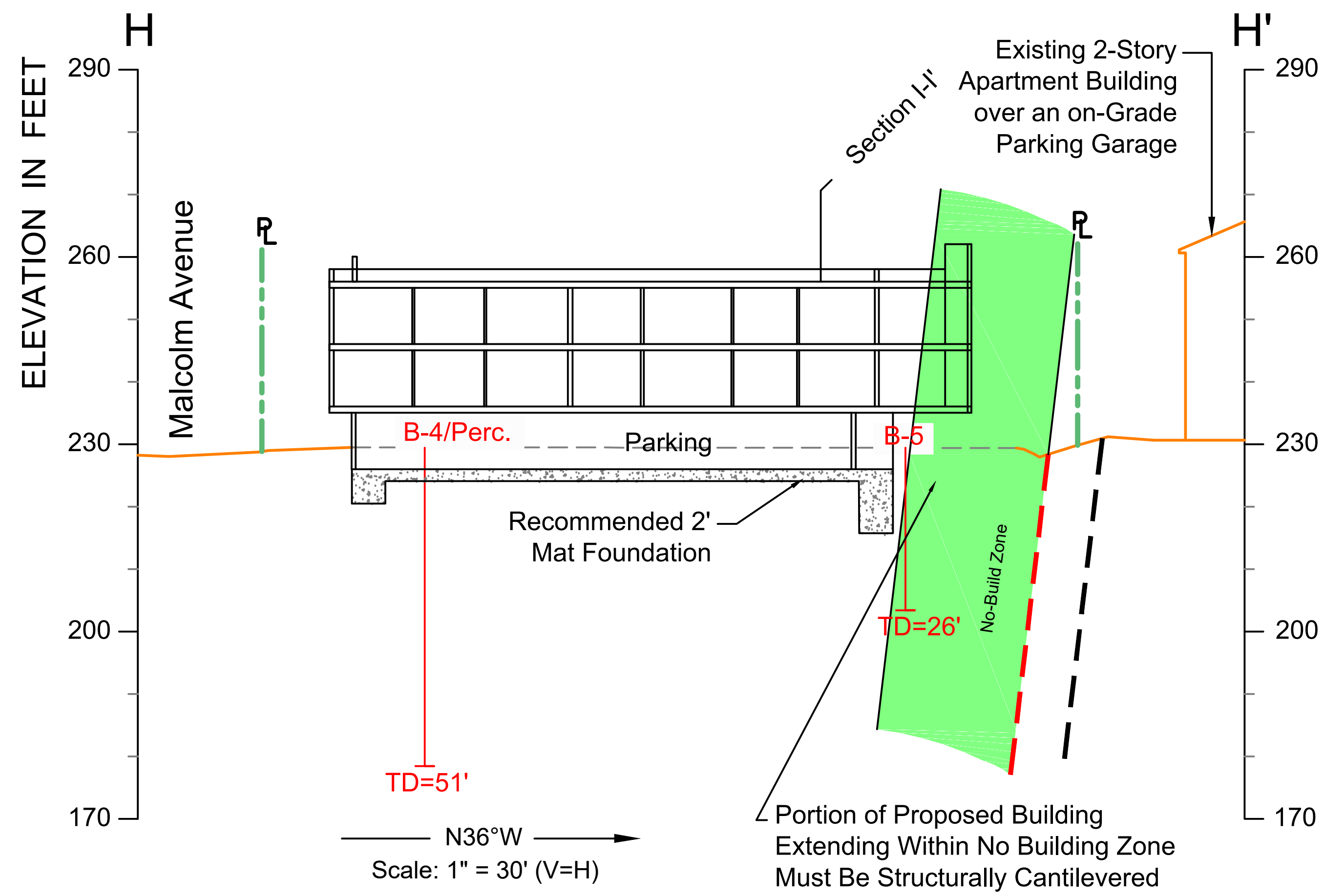
= Fault Location (AES, 2015, Based on Site-specific Investigation)

= Area of No-Build Zone

= Area of 2' Mat Foundatiom

Scale: 1" = 20'

GEOTECHNICAL SITE PLAN		PROJECT No: 15-363-02	
DESCRIPTION:	Proposed Multifamily Building	DATE:	11 / 30 / 2015
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: 9	SUPP. No: 1



LEGEND:

B-4 / TD=10' (Projected) = Location & Number of Boring

= Fault Location (Based on Navigate LA)

= Fault Location (AES, 2015, Based on Site-specific Investigation)

= Area of No-Build Zone

GEOTECHNICAL CROSS SECTIONS H-H'		PROJECT No:	15-363-26
DESCRIPTION:	Proposed Multifamily Building	DATE:	11 / 30 / 2015
FOR:	Sinanian Development	DRAWN BY:	ZS
ADDRESS:	1749 & 1751 Malcolm Avenue, Los Angeles, CA 90024	CHECKED BY:	SM
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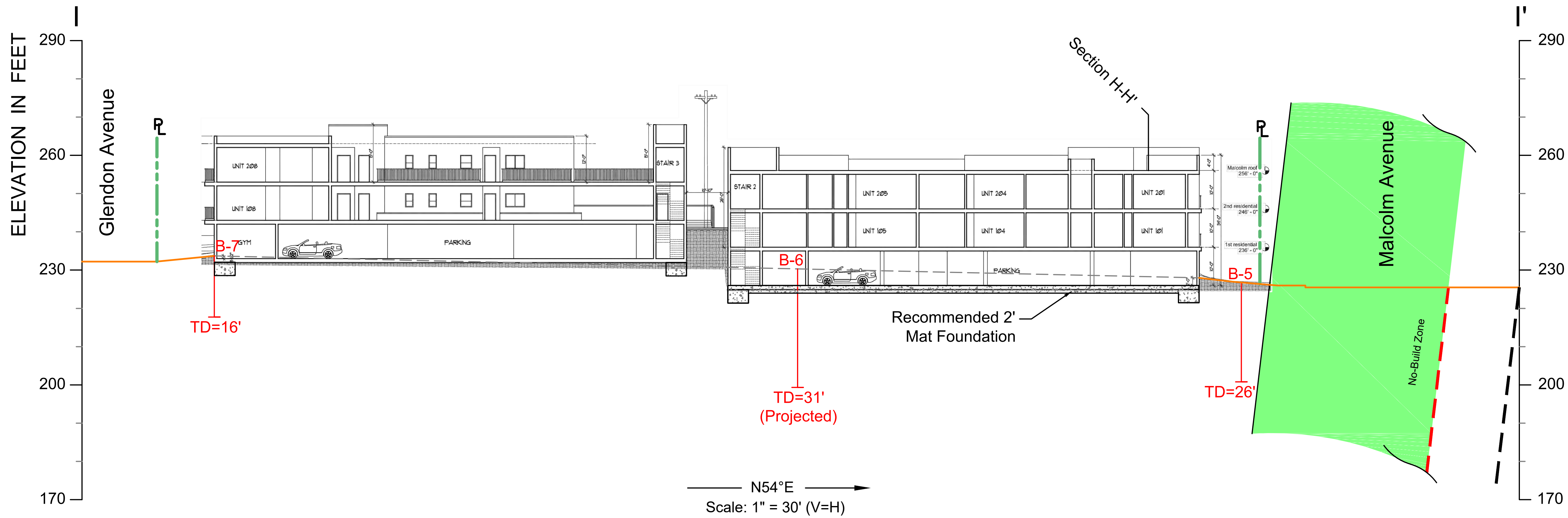

LEGEND:

B-4 TD=10' (Projected) = Location & Number of Boring

= Fault Location (Based on Navigate LA)

= Fault Location (AES, 2015, Based on Site-specific Investigation)

= Area of No-Build Zone

GEOTECHNICAL CROSS SECTIONS I-I'

DESCRIPTION:	Proposed Multifamily Building	PROJECT No:	15-363-26
FOR:	Sinanian Development	DATE:	11 / 30 / 2015
ADDRESS:	1749 & 1751 Malcolm Avenue, Los Angeles, CA 90024	DRAWN BY:	ZS
		CHECKED BY:	SM
		DRAWING No: 11	SUPP. No: 1

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SUMMARY

OF

CONE PENETRATION TEST DATA

Project:

1749 & 1751 Malcolm Avenue
Los Angeles, CA
October 6, 2015

Prepared for:

Mr. Shant Minas
Applied Earth Sciences
4742 San Fernando Road
Glendale, CA 91204
Office (818) 552-6000 / Fax (818) 552-6007

Prepared by:

KEHOE TESTING & ENGINEERING
5415 Industrial Drive
Huntington Beach, CA 92649-1518
Office (714) 901-7270 / Fax (714) 901-7289
www.kehoetesting.com

TABLE OF CONTENTS

SUMMARY

OF

CONE PENETRATION TEST DATA

1. INTRODUCTION

This report presents the results of a Cone Penetration Test (CPT) program carried out for the project located at 1749 & 1751 Malcolm Avenue in Los Angeles, California. The work was performed by Kehoe Testing & Engineering (KTE) on October 6, 2015. The scope of work was performed as directed by Applied Earth Sciences personnel.

2. SUMMARY OF FIELD WORK

The fieldwork consisted of performing CPT soundings at seven locations to determine the soil lithology. Groundwater measurements and hole collapse depths provided in **TABLE 2.1** are for information only. The readings indicate the apparent depth to which the hole is open and the apparent water level (if encountered) in the CPT probe hole at the time of measurement upon completion of the CPT. KTE does not warranty the accuracy of the measurements and the reported water levels may not represent the true or stabilized groundwater levels.

LOCATION	DEPTH OF CPT (ft)	COMMENTS/NOTES:
CPT-14	80	Refusal, groundwater @ 42 ft
CPT-15	66	Refusal, groundwater @ 42 ft
CPT-16	75	Refusal, hole open to 41 ft (dry)
CPT-17	76	Refusal, hole open to 40 ft (dry)
CPT-18	80	Hole open to 35 ft (dry)
CPT-19	80	Groundwater @ 47 ft
CPT-20	66	Refusal, groundwater @ 60 ft

TABLE 2.1 - Summary of CPT Soundings

3. FIELD EQUIPMENT & PROCEDURES

The CPT soundings were carried out by **KTE** using an integrated electronic cone system manufactured by Vertek. The CPT soundings were performed in accordance with ASTM standards (D5778). The cone penetrometers were pushed using a 30-ton CPT rig. The cone used during the program was a 15 cm^2 cone and recorded the following parameters at approximately 2.5 cm depth intervals:

- Cone Resistance (qc)
- Sleeve Friction (fs)
- Dynamic Pore Pressure (u)
- Inclination
- Penetration Speed

The above parameters were recorded and viewed in real time using a laptop computer. Data is stored at the KTE office for future analysis and reference. A complete set of baseline readings was taken prior to each sounding to determine temperature shifts and any zero load offsets. Monitoring base line readings ensures that the cone electronics are operating properly.

4. CONE PENETRATION TEST DATA & INTERPRETATION

The Cone Penetration Test data is presented in graphical form in the attached Appendix. These plots were generated using the CPeT-IT program. Penetration depths are referenced to ground surface. The soil classification on the CPT plots is derived from the attached CPT Classification Chart (Robertson) and presents major soil lithologic changes. The stratigraphic interpretation is based on relationships between cone resistance (qc), sleeve friction (fs), and penetration pore pressure (u). The friction ratio (Rf), which is sleeve friction divided by cone resistance, is a calculated parameter that is used along with cone resistance to infer soil behavior type. Generally, cohesive soils (clays) have high friction ratios, low cone resistance and generate excess pore water pressures. Cohesionless soils (sands) have lower friction ratios, high cone bearing and generate little (or negative) excess pore water pressures.

Tables of basic CPT output from the interpretation program CPeT-IT are provided for CPT data averaged over one foot intervals in the Appendix. Spreadsheet files of the averaged basic CPT output and averaged estimated geotechnical parameters are also included for use in further geotechnical analysis. We recommend a geotechnical engineer review the assumed input parameters and the calculated output from the CPeT-IT program. A summary of the equations used for the tabulated parameters is provided in the Appendix.

It should be noted that it is not always possible to clearly identify a soil type based on qc, fs and u. In these situations, experience, judgement and an assessment of the pore pressure data should be used to infer the soil behavior type.

If you have any questions regarding this information, please do not hesitate to call our office at (714) 901-7270.

Sincerely,

KEHOE TESTING & ENGINEERING

Richard W. Koester, Jr.
General Manager

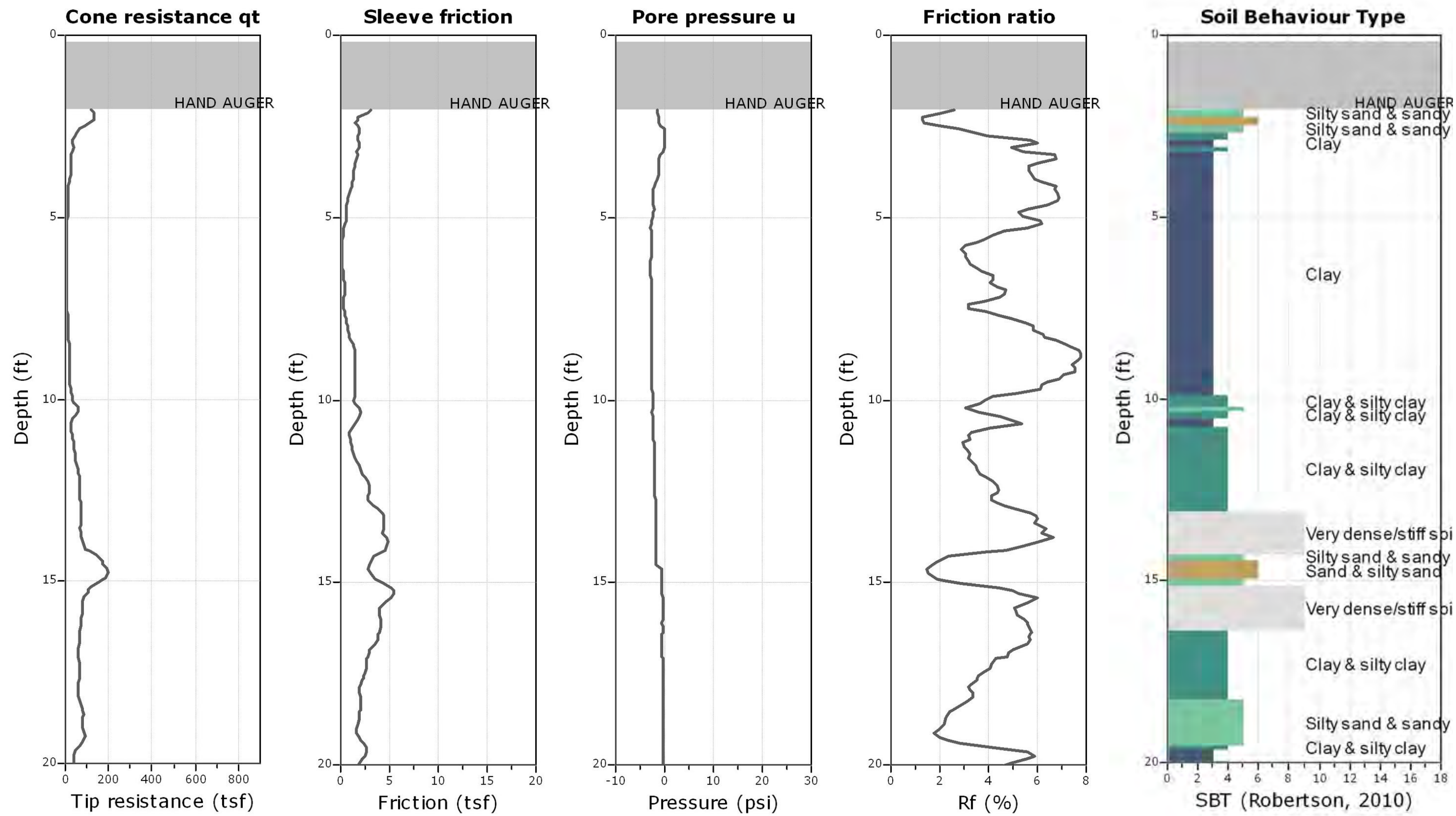
10/08/15-ms-5869-2

APPENDIX

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-14
Total depth: 79.54 ft, Date: 10/6/2015
Cone Type: Vertek



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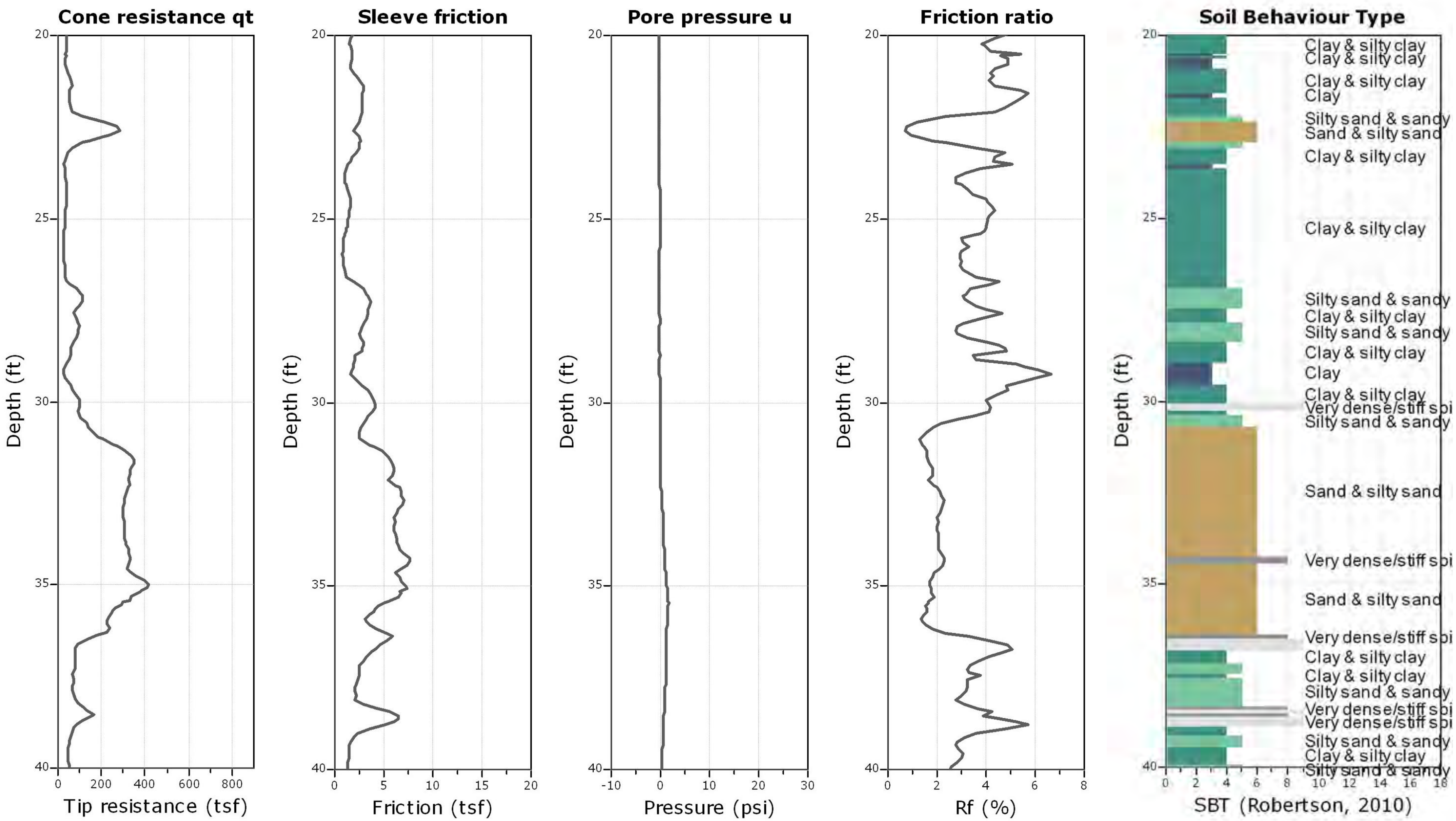
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-14
Total depth: 79.54 ft, Date: 10/6/2015
Cone Type: Vertek



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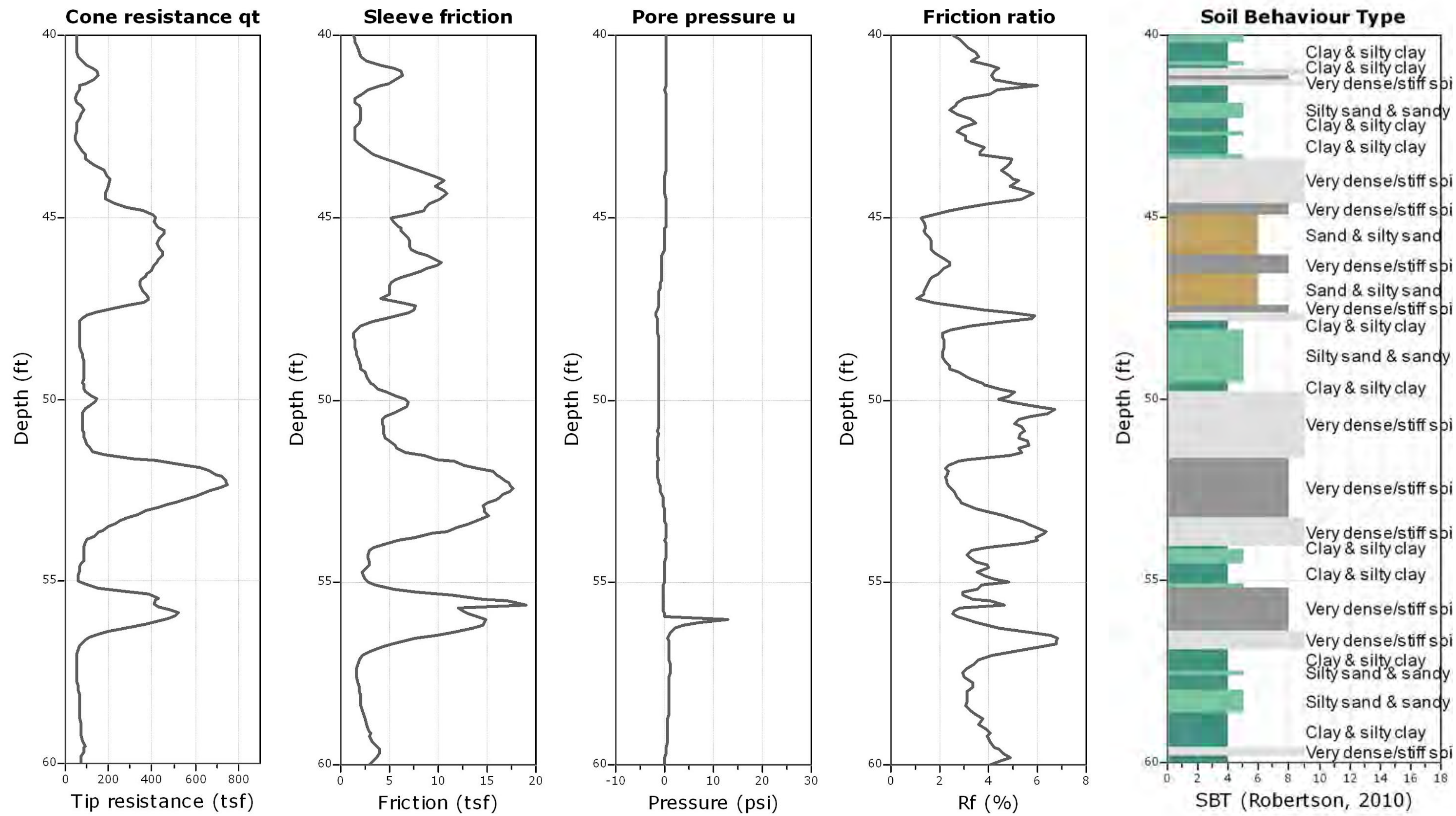
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-14
Total depth: 79.54 ft, Date: 10/6/2015
Cone Type: Vertek



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Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-14
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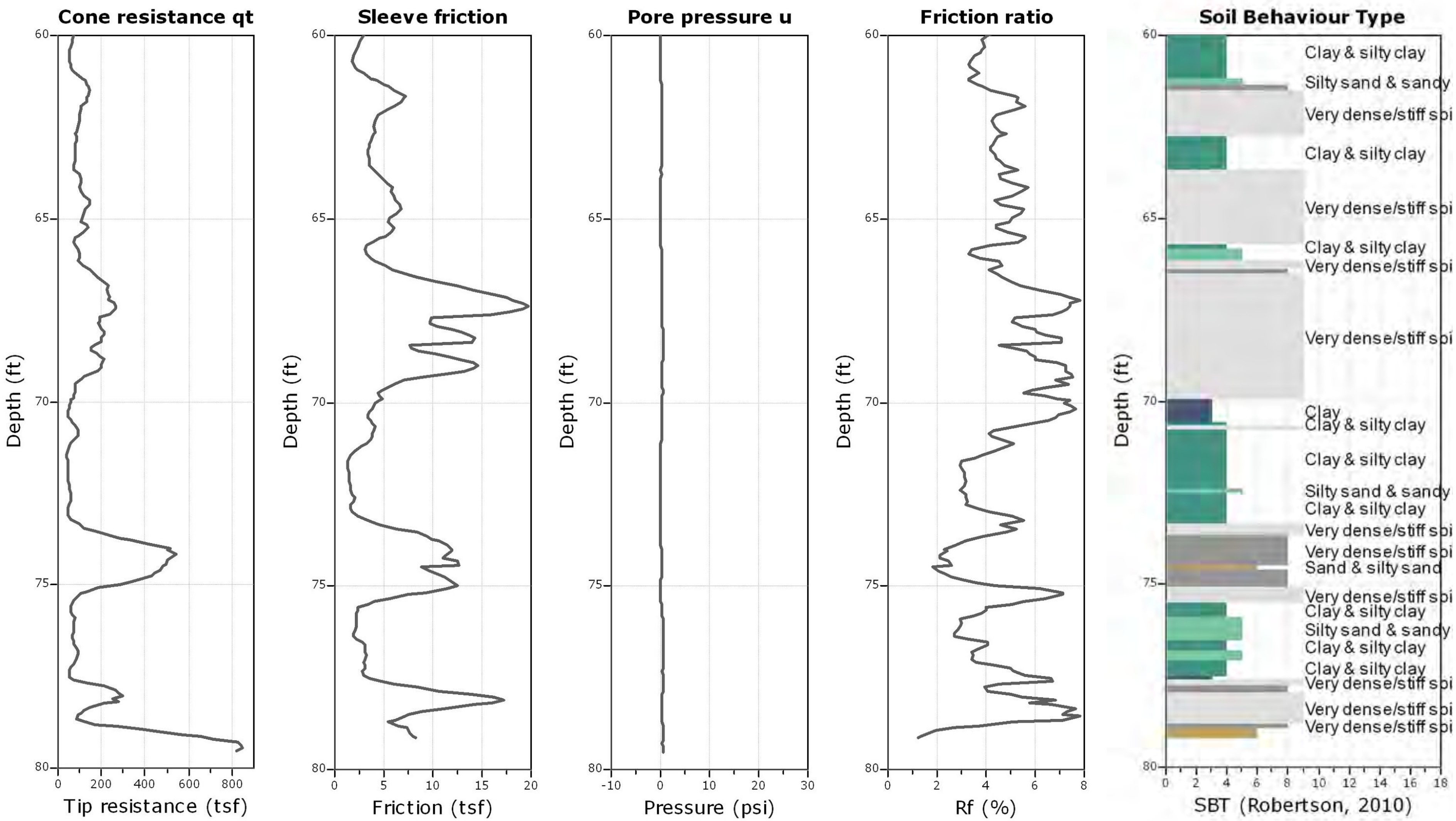
Cone Type: Vertek



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Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

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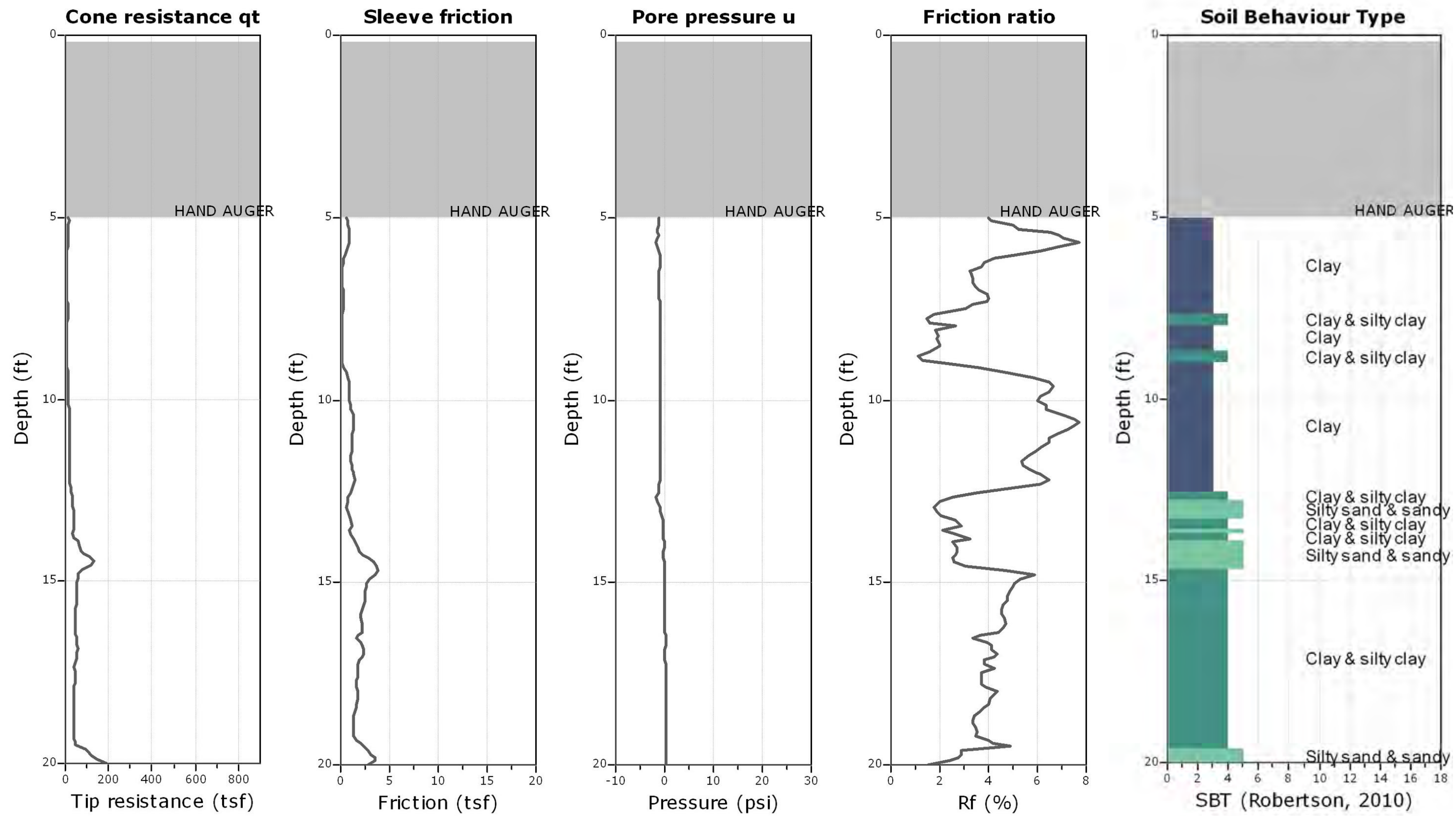

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Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-15
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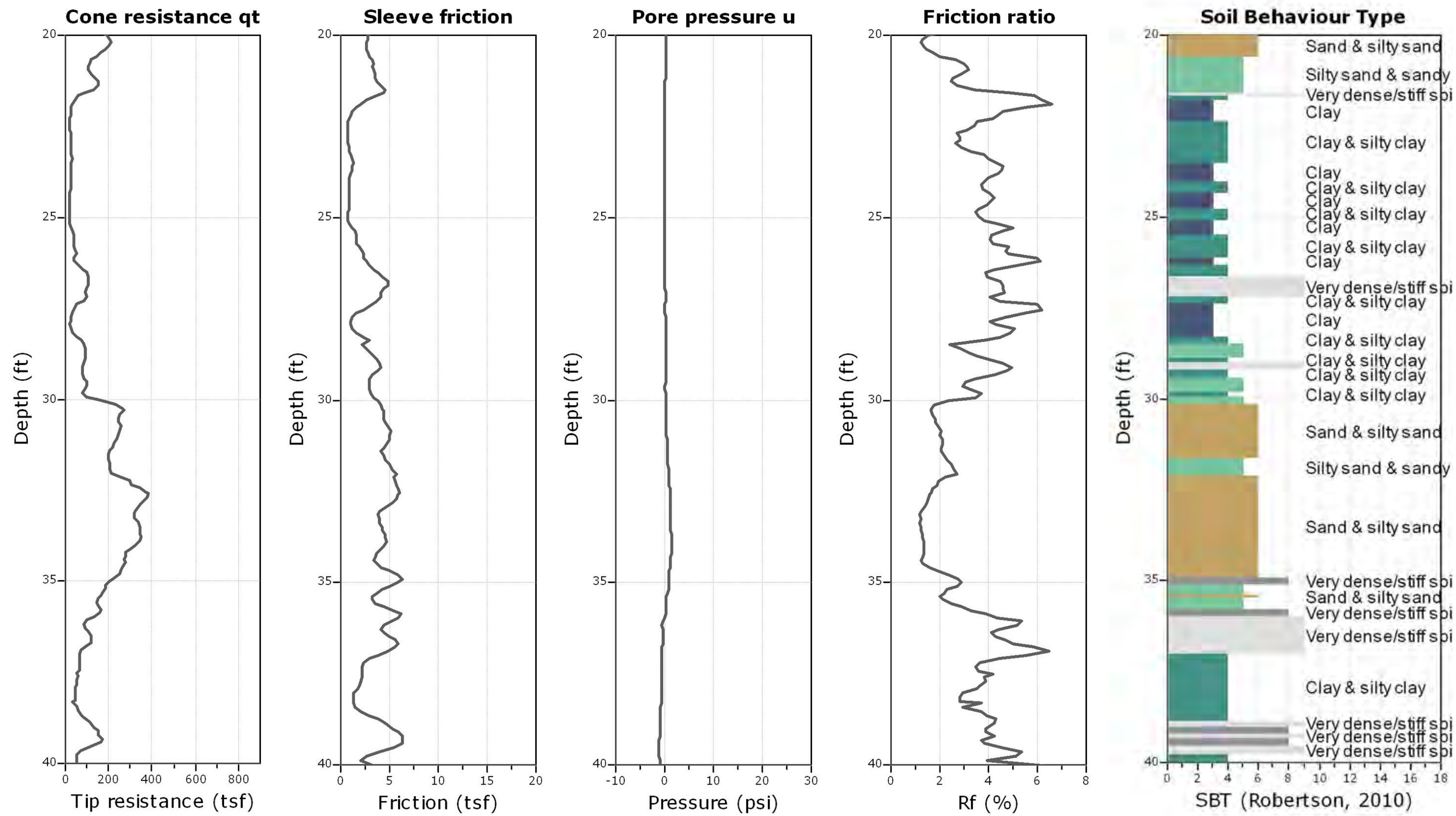
Cone Type: Vertek



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CPT: CPT-15

Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

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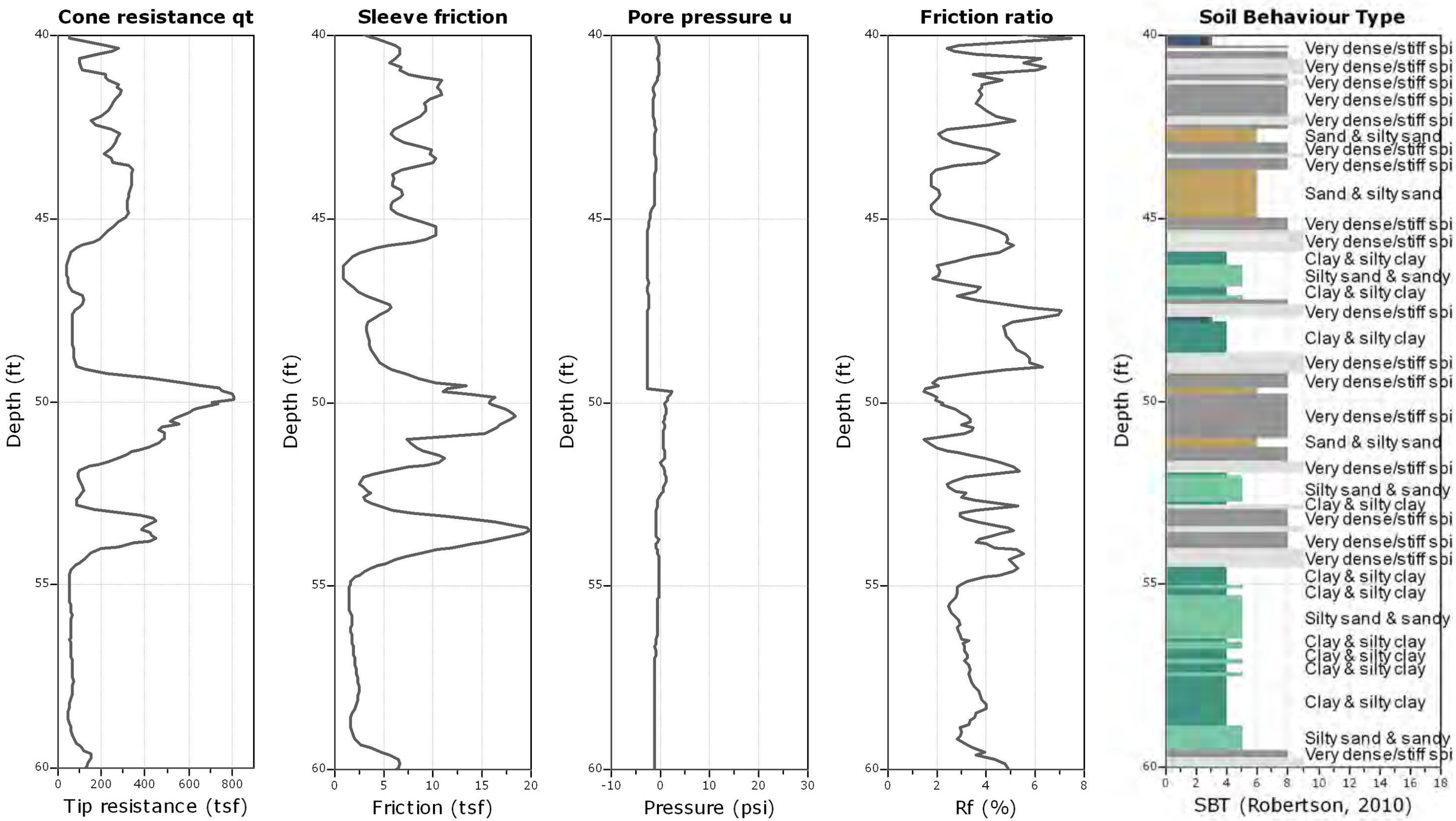

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Project: Applied Earth Sciences
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CPT: CPT-15
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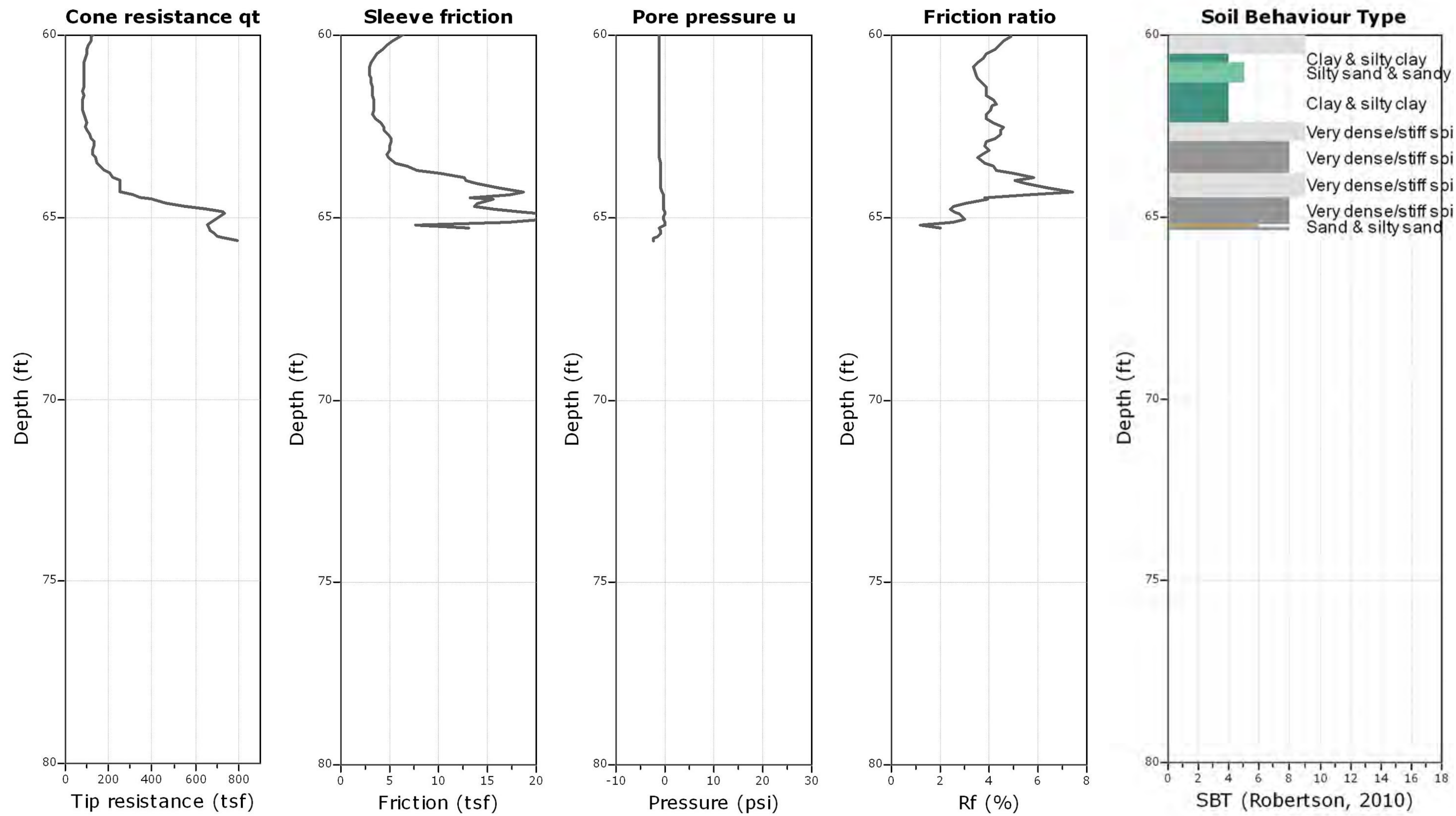

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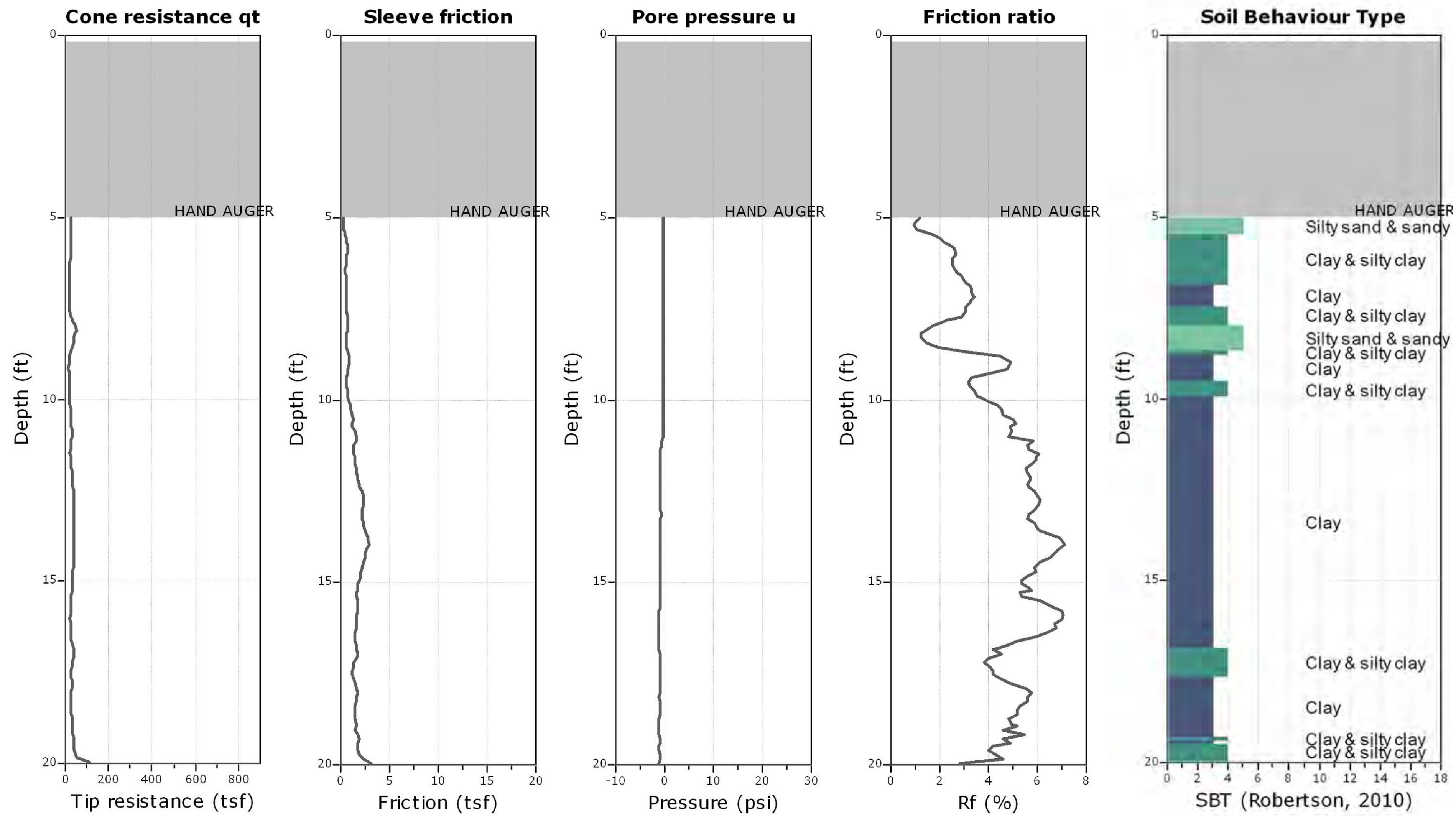
CPT: CPT-16

Total depth: 74.91 ft, Date: 10/6/2015

Cone Type: Vertek

Project: Applied Earth Sciences

Location: 1749 & 1751 Malcolm Ave Los Angeles, CA



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CPT: CPT-16
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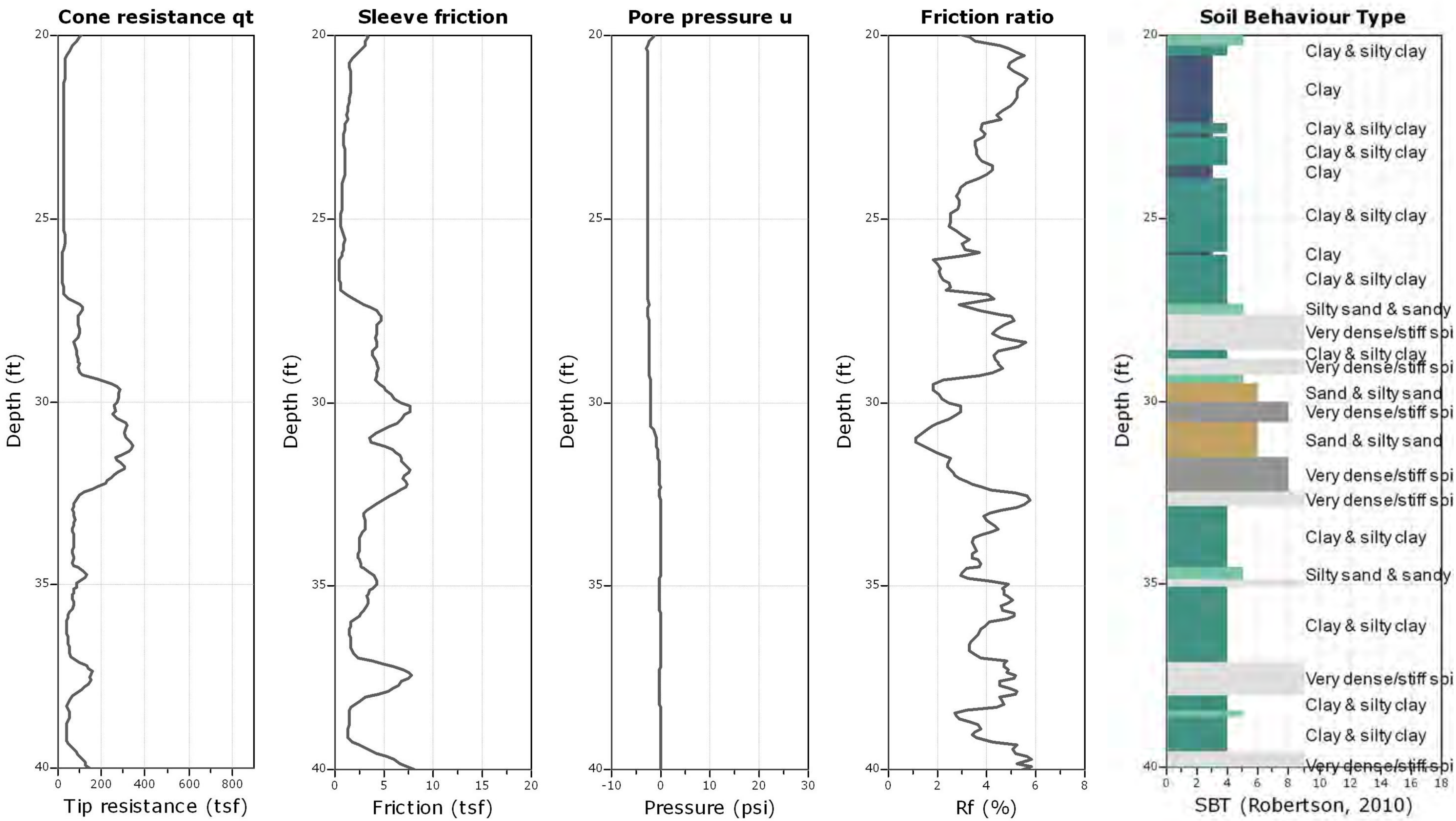
Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA



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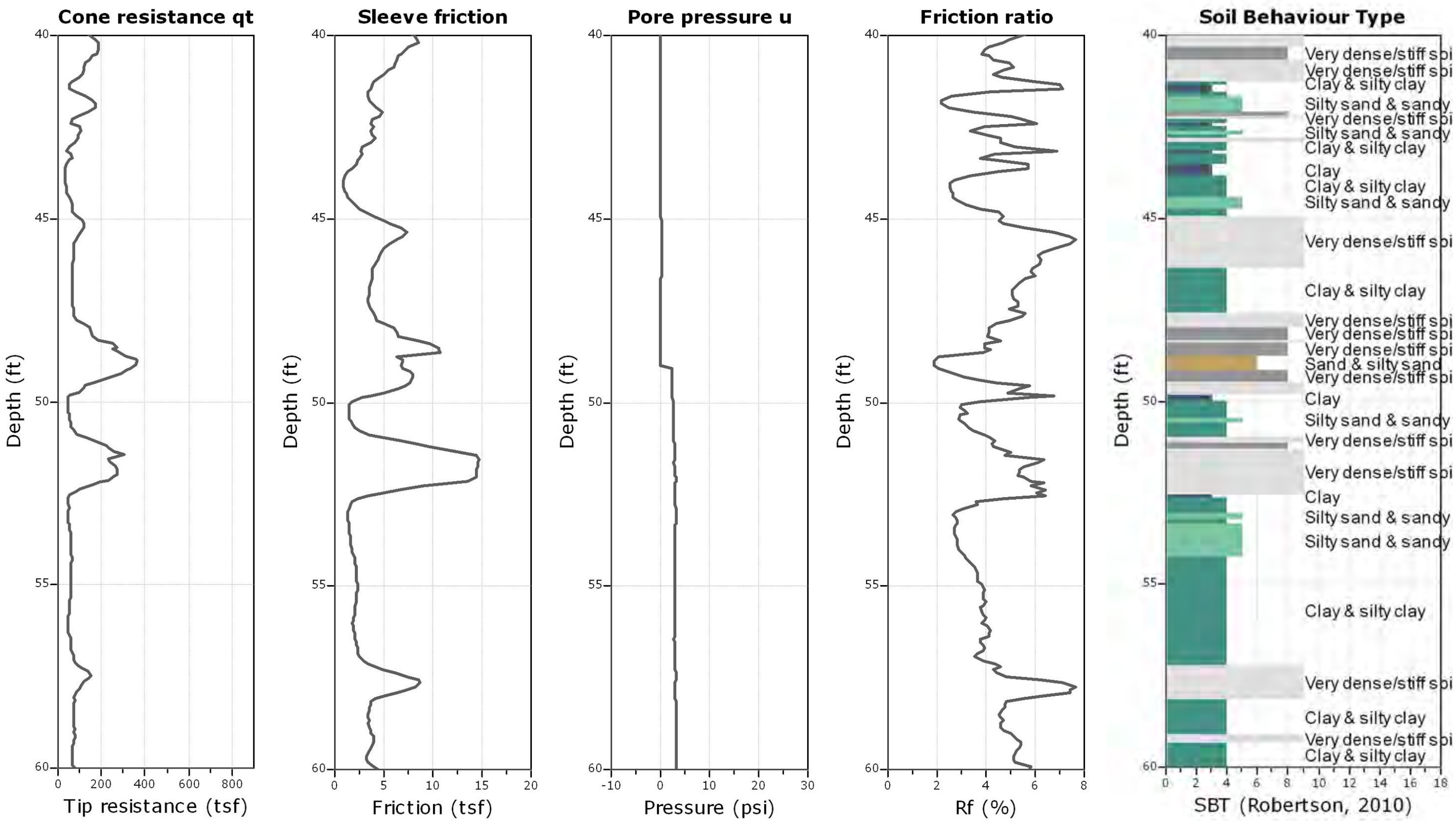
Project: **Applied Earth Sciences**
Location: **1749 & 1751 Malcolm Ave Los Angeles, CA**



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Project: **Applied Earth Sciences**
Location: **1749 & 1751 Malcolm Ave Los Angeles, CA**

CPT: CPT-16
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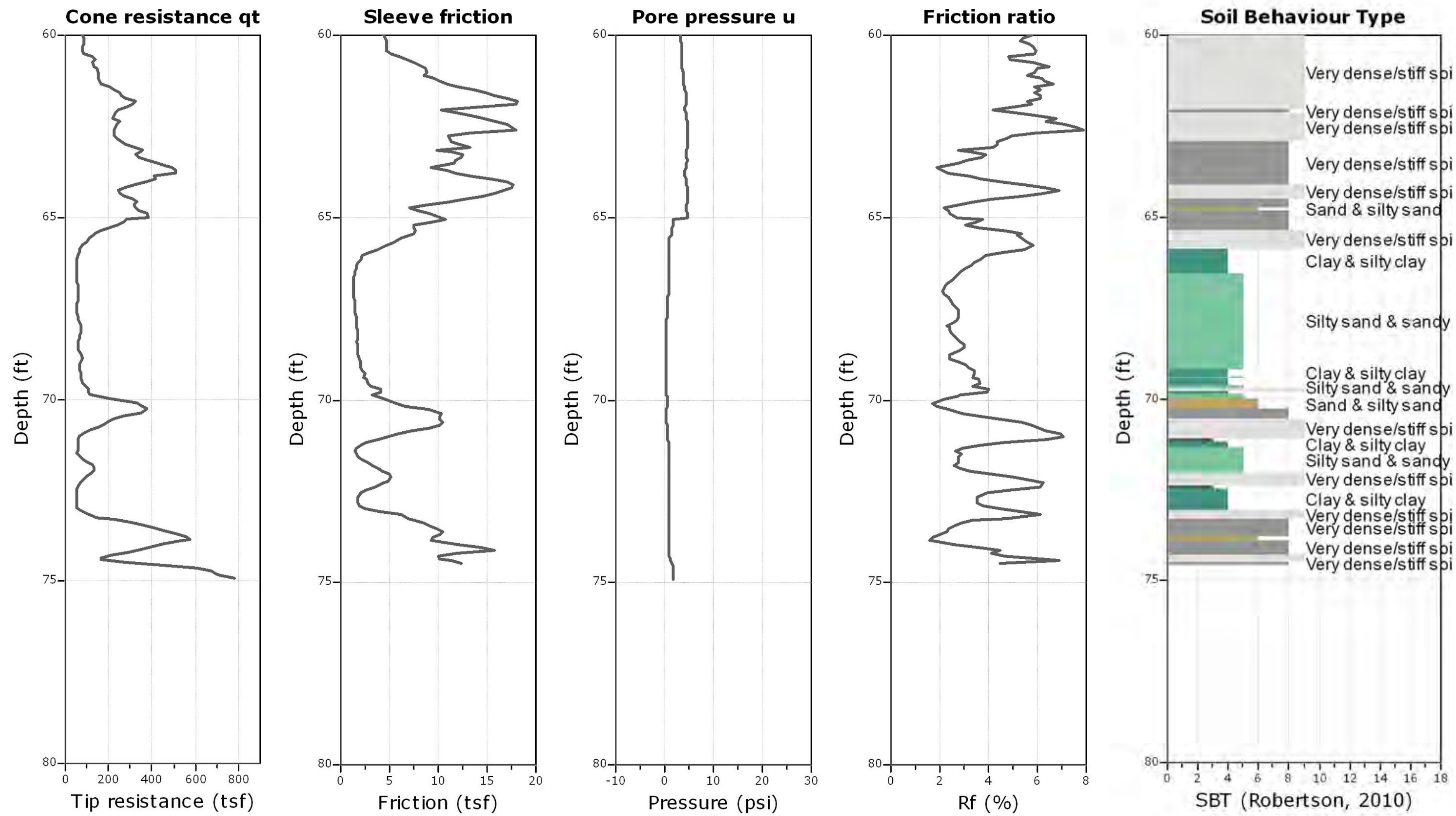

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Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

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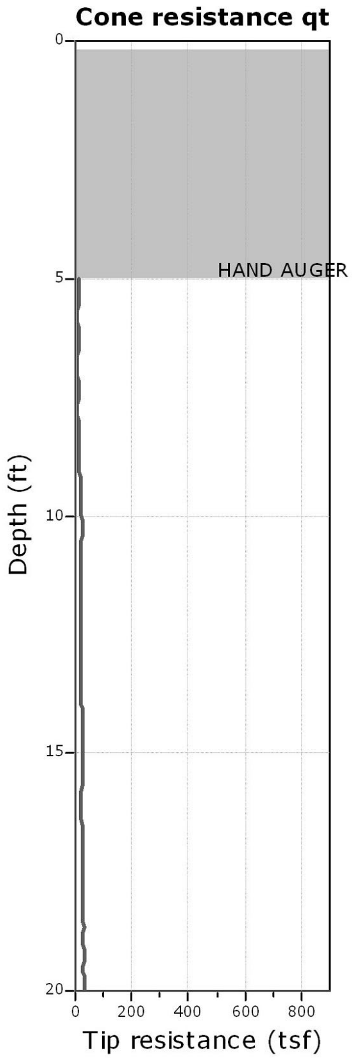

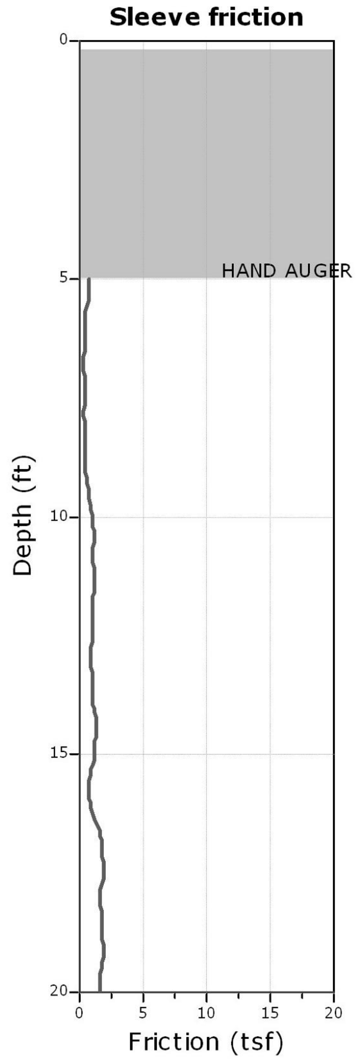

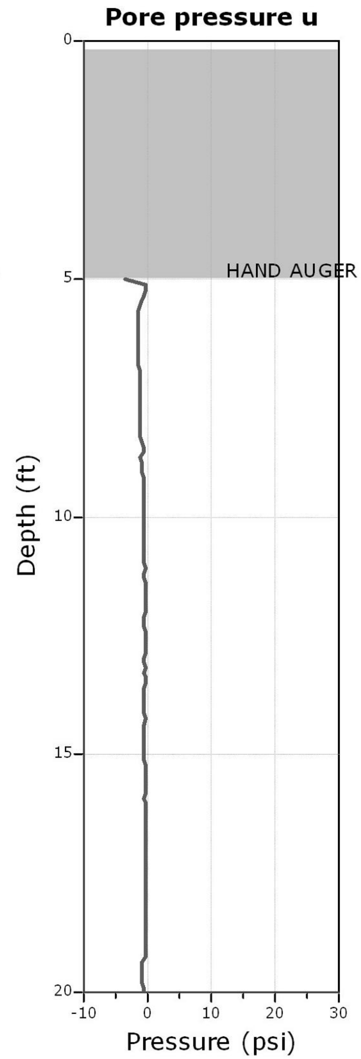

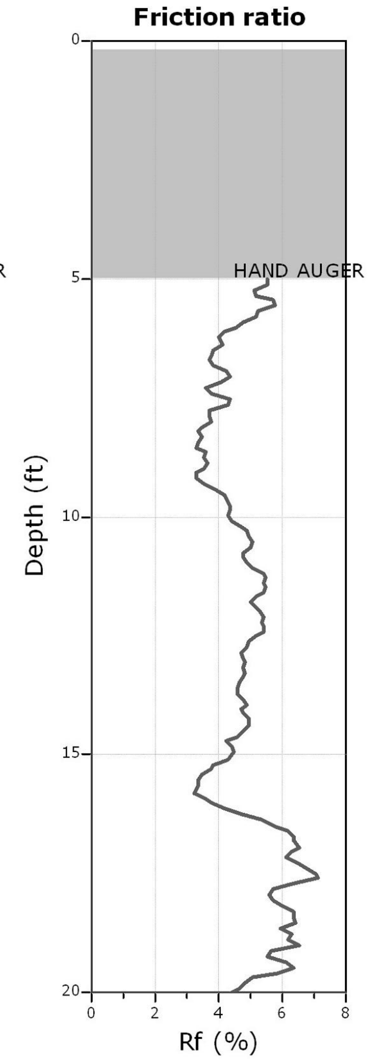

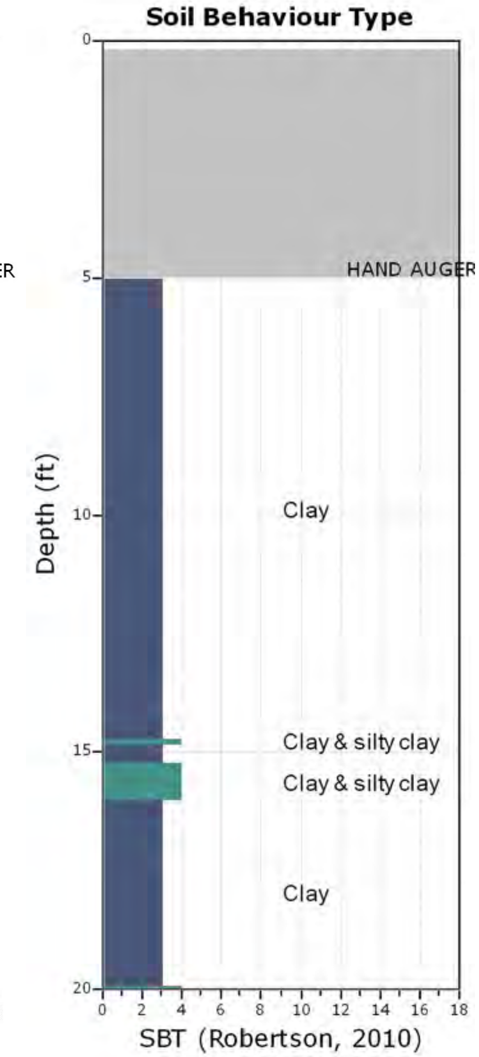

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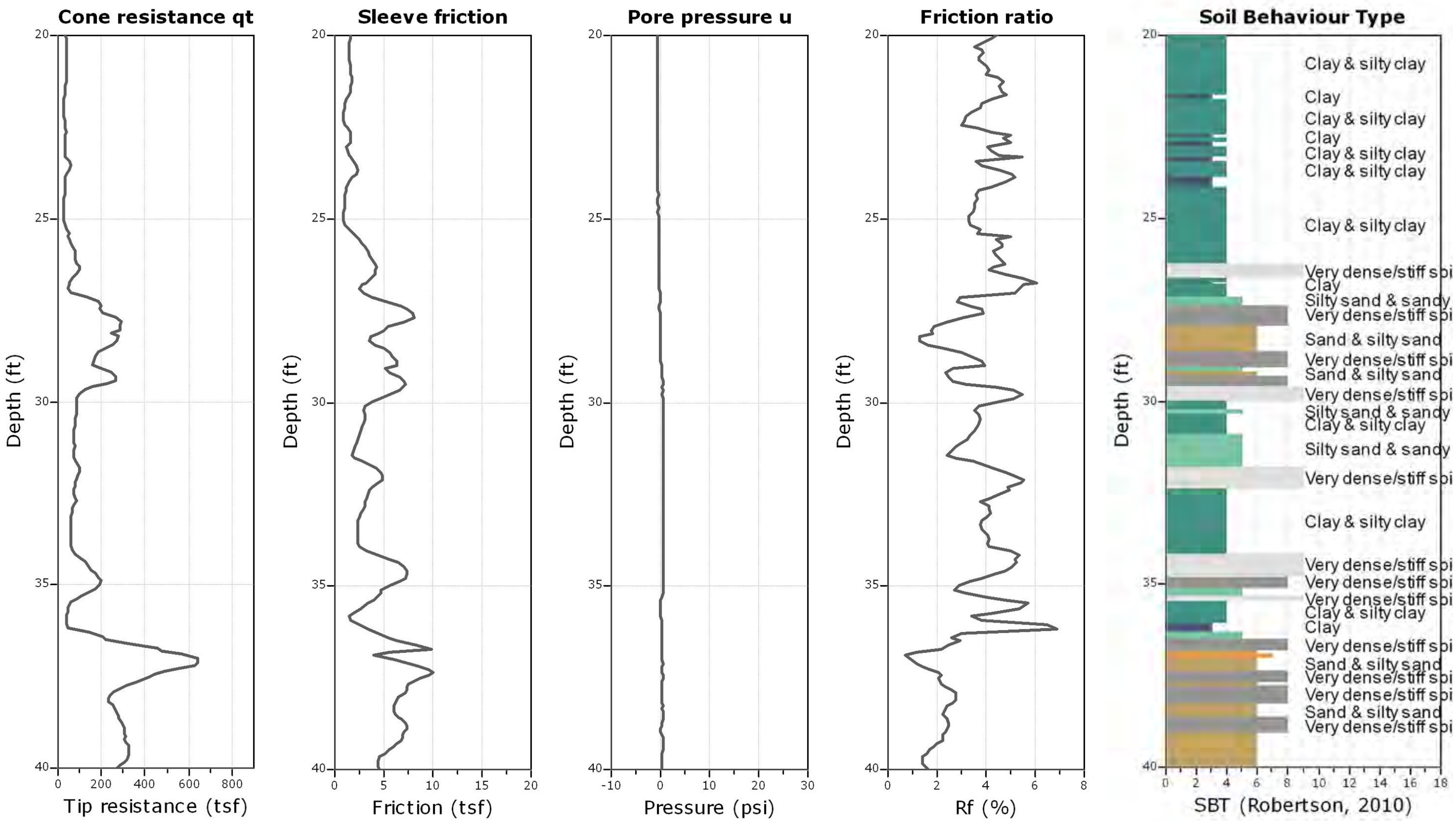
CPT: CPT-17
Total depth: 76.08 ft, Date: 10/6/2015
Cone Type: Vertek

Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA



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Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

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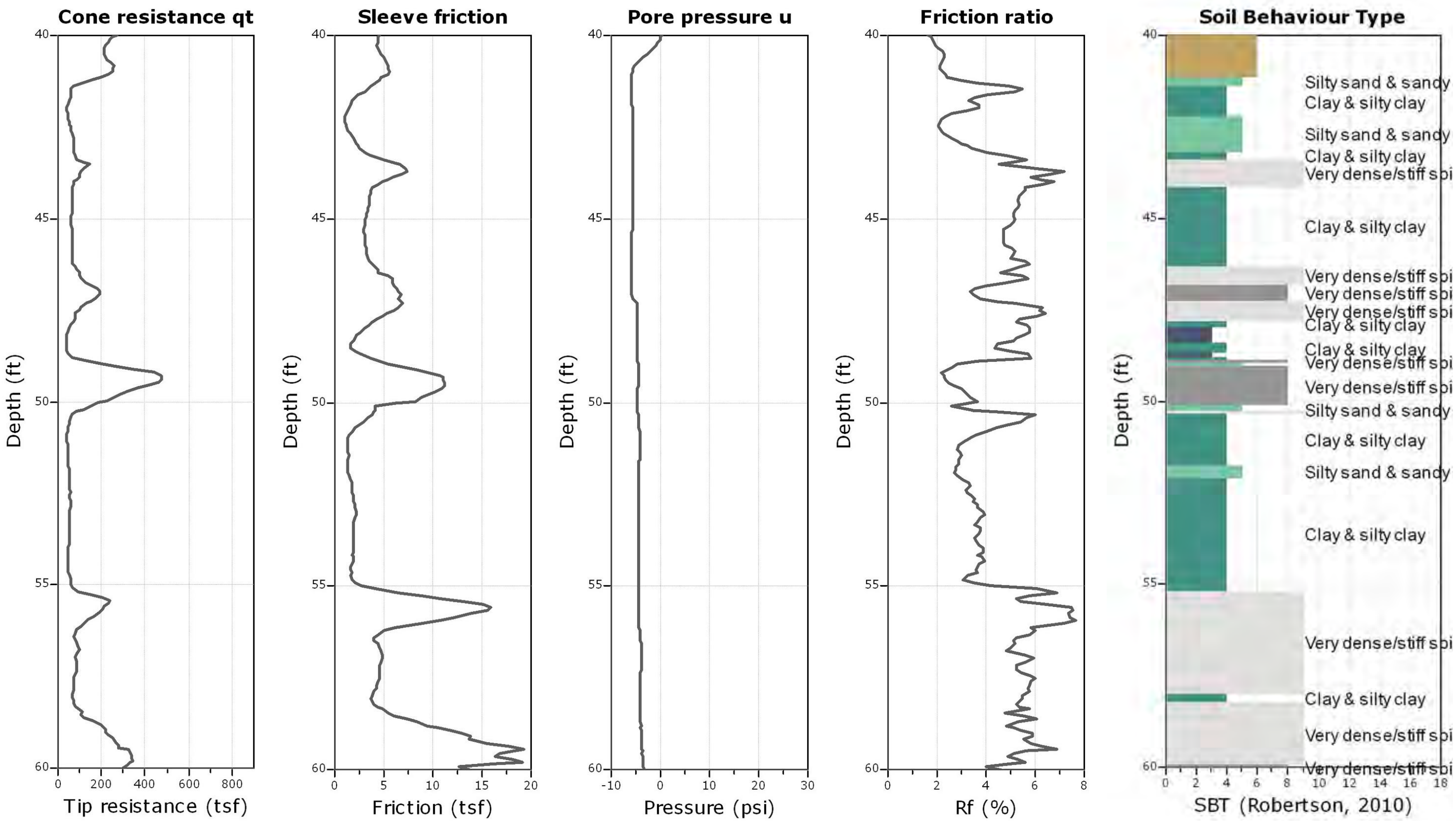

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CPT: CPT-17
Total depth: 76.08 ft, Date: 10/6/2015
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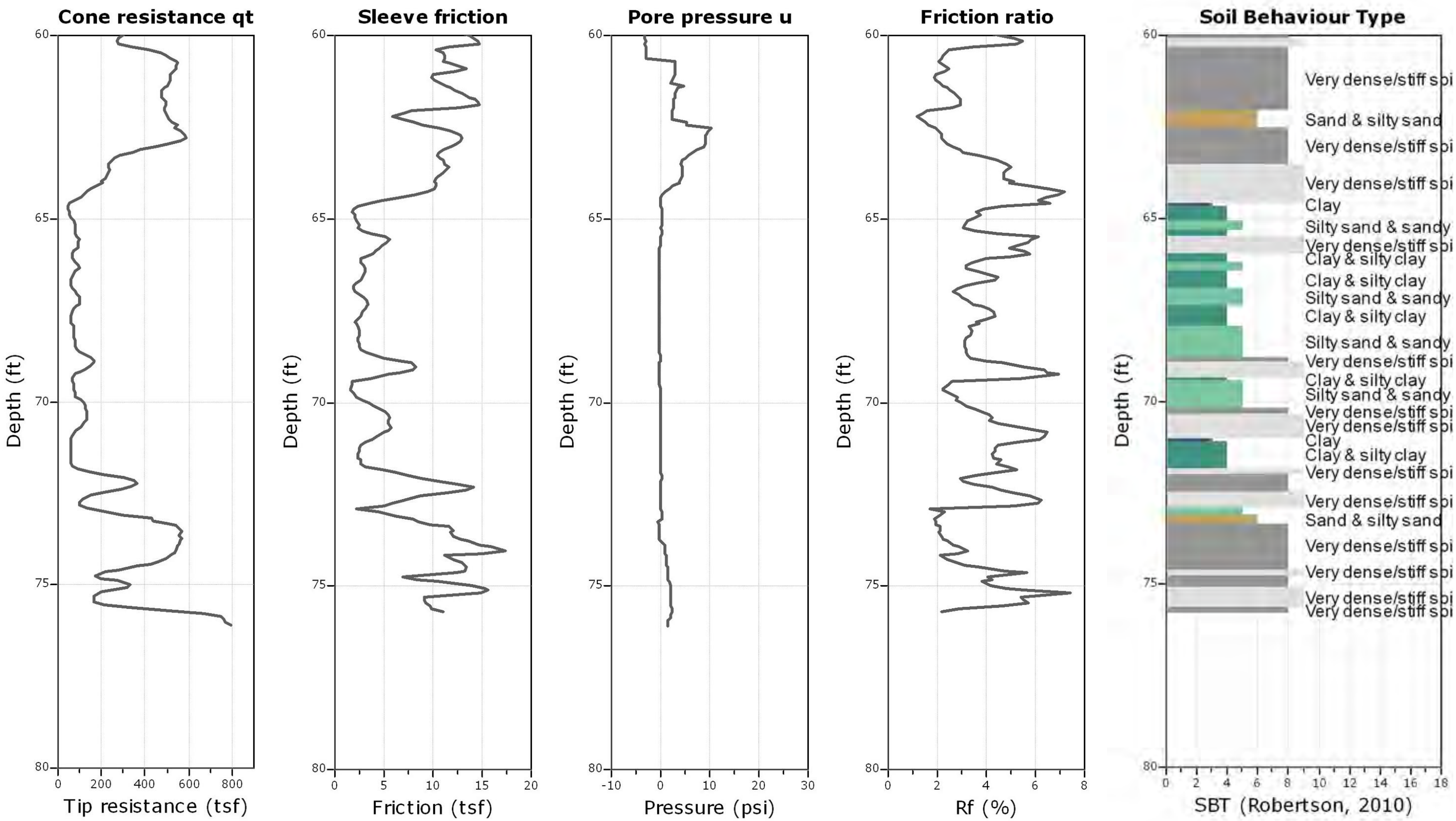

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Project: **Applied Earth Sciences**
Location: **1749 & 1751 Malcolm Ave Los Angeles, CA**

CPT: CPT-18
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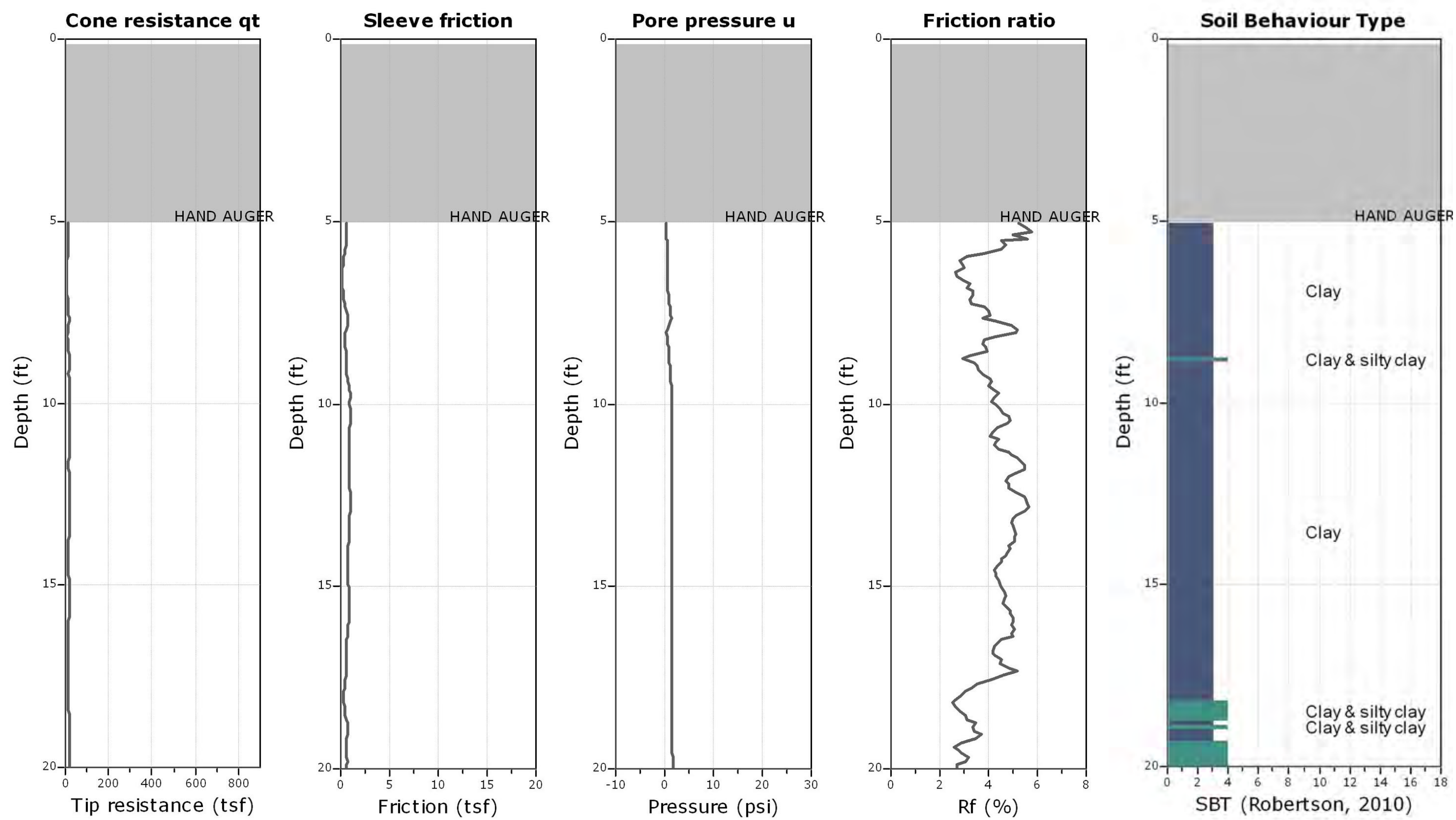

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Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-18
Total depth: 80.27 ft, Date: 10/6/2015
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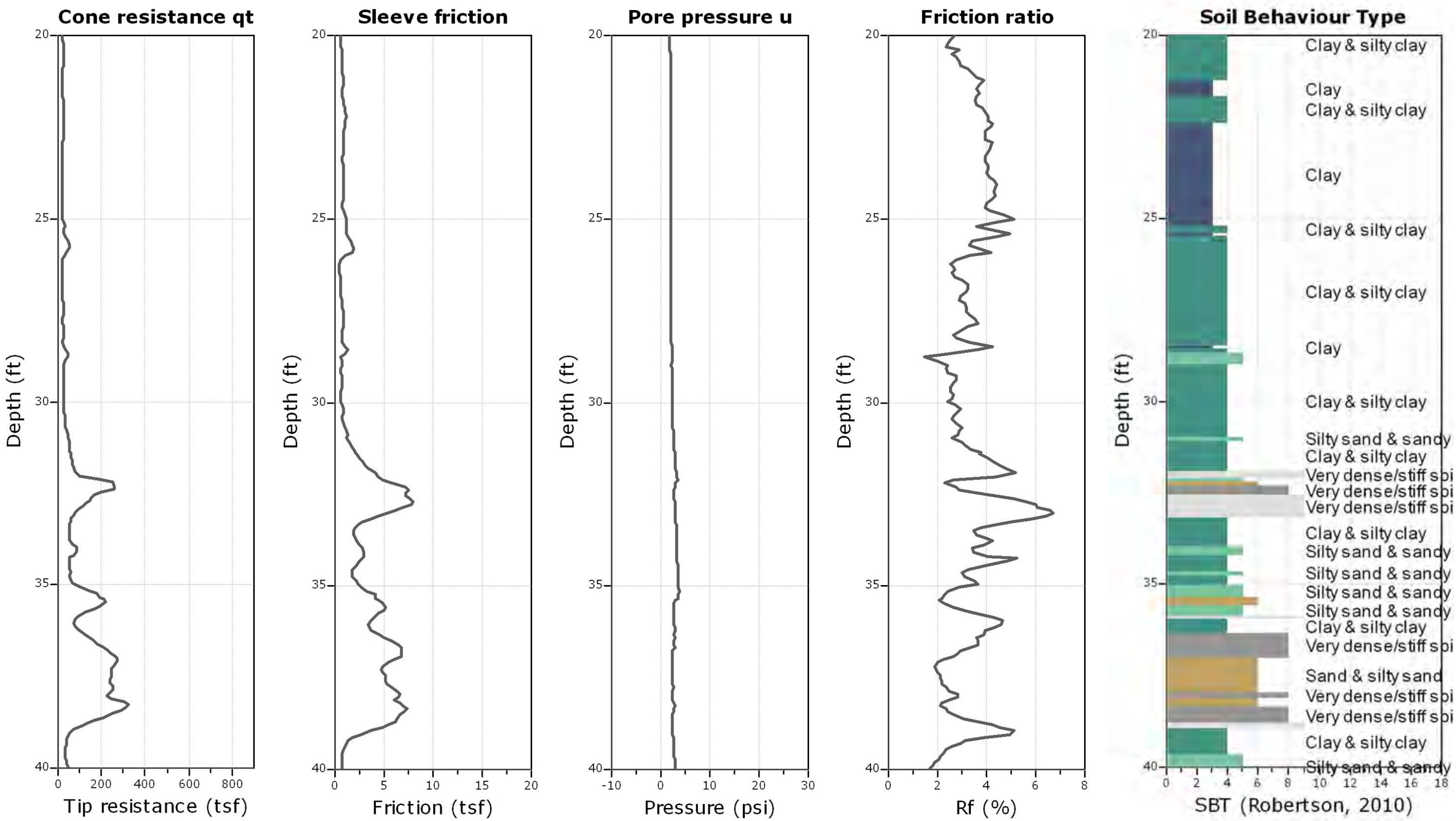

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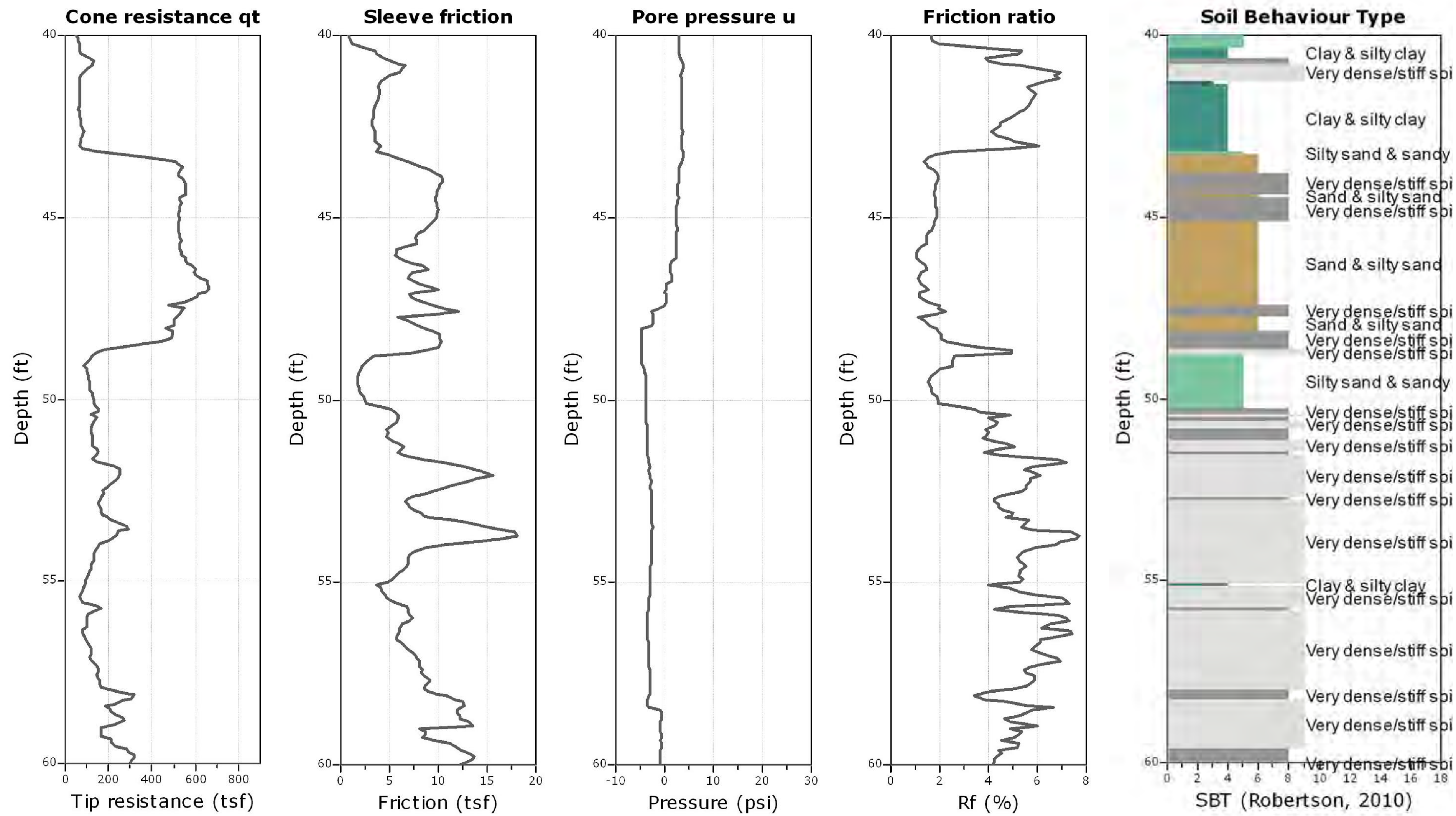

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Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

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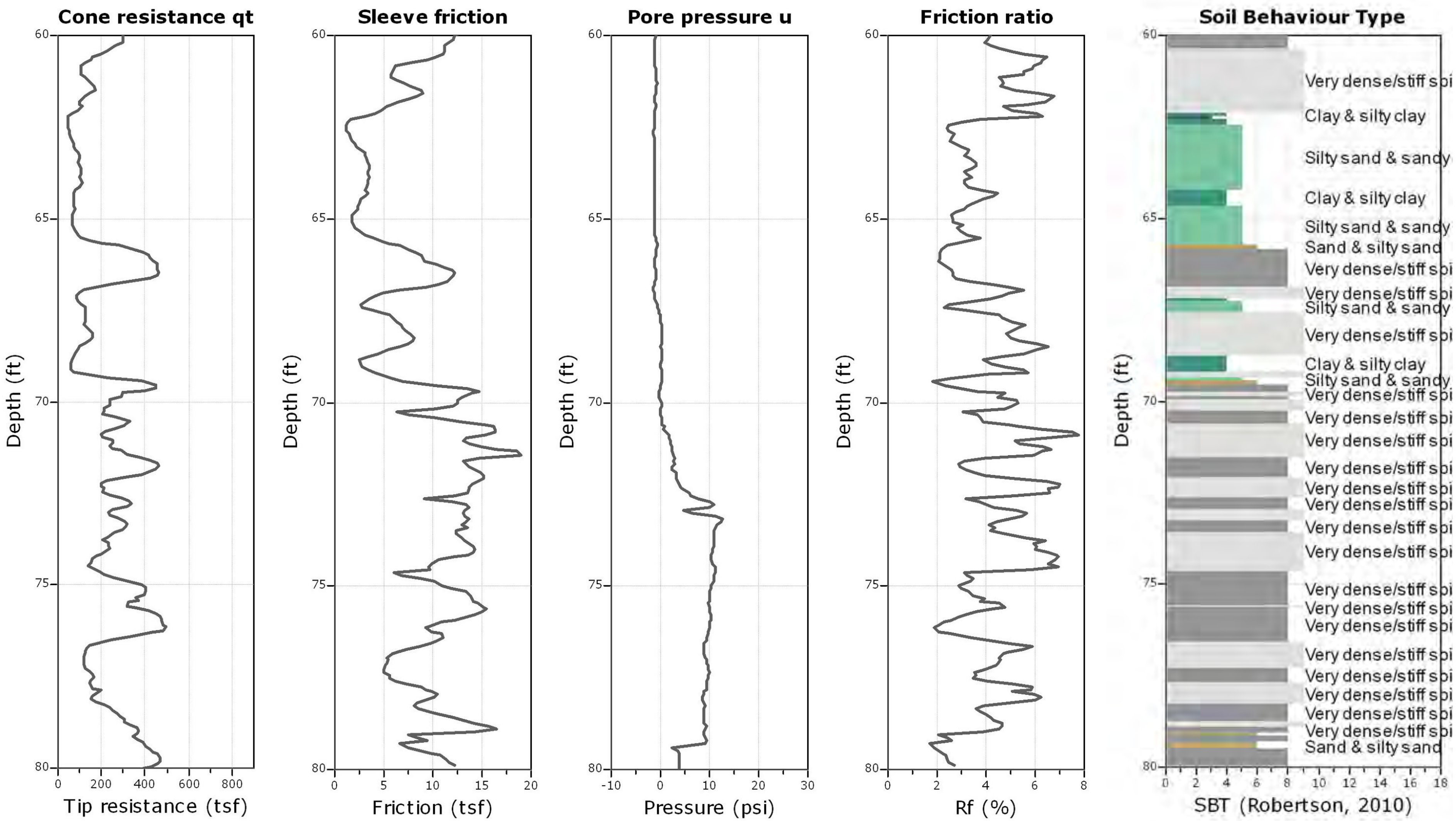

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Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

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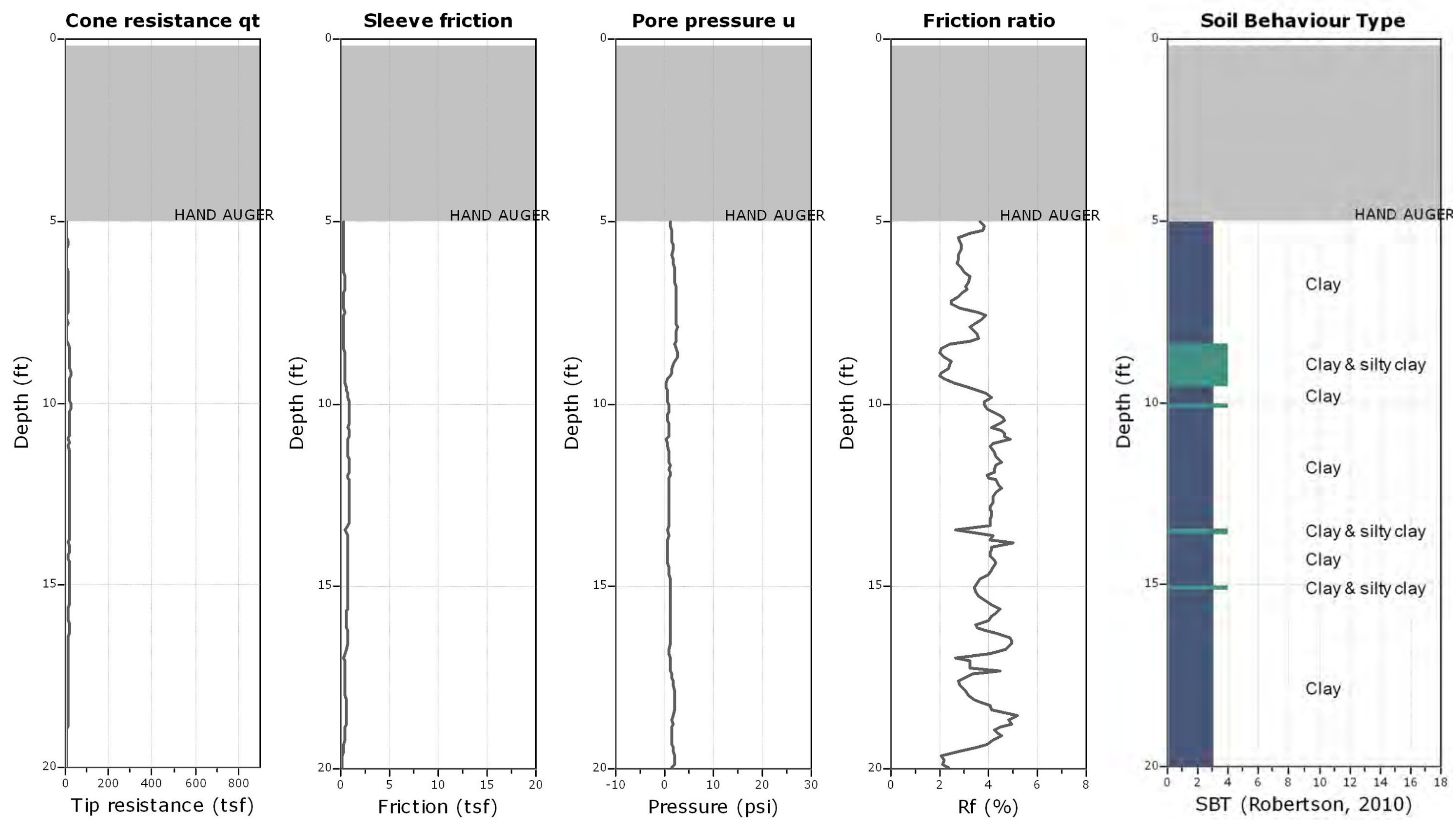

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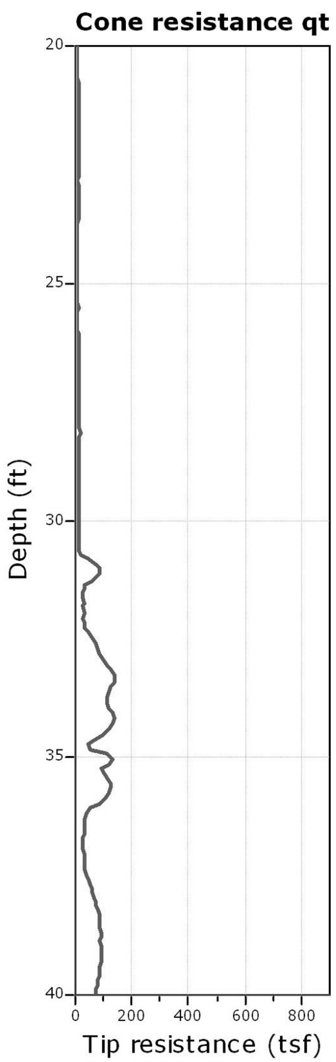
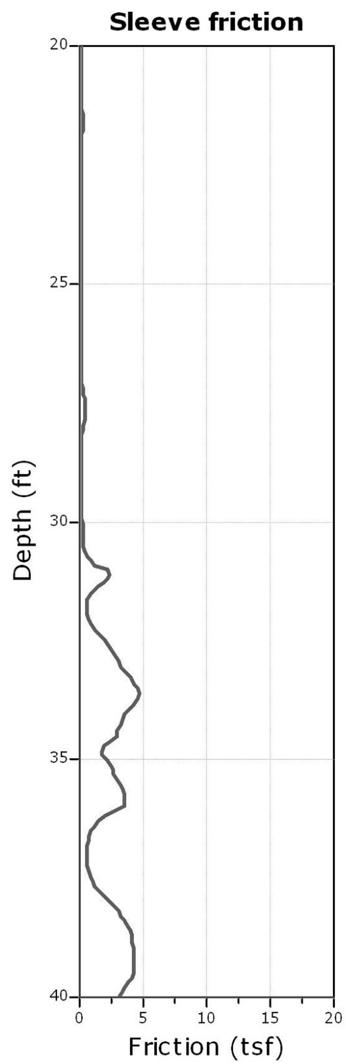
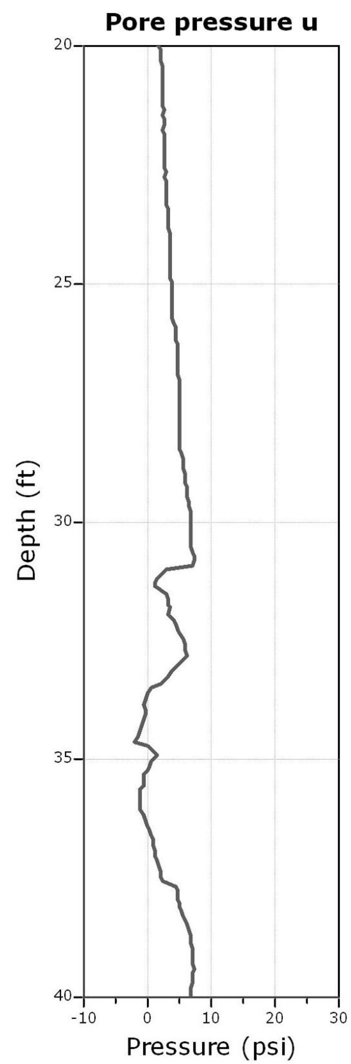
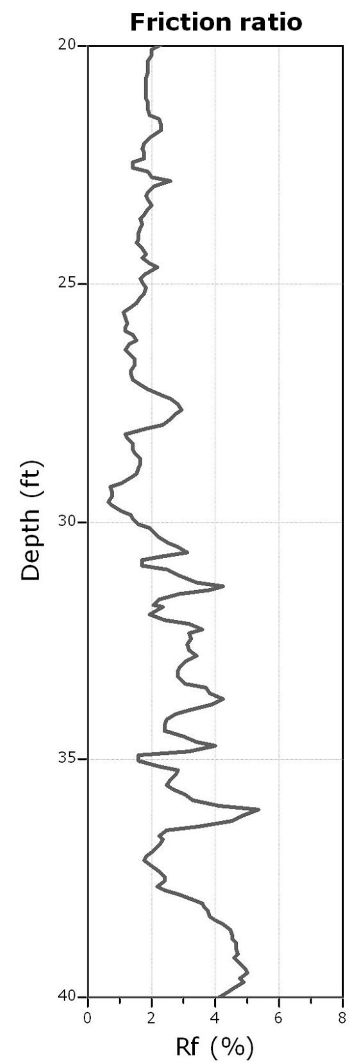
Project: **Applied Earth Sciences**
Location: **1749 & 1751 Malcolm Ave Los Angeles, CA**

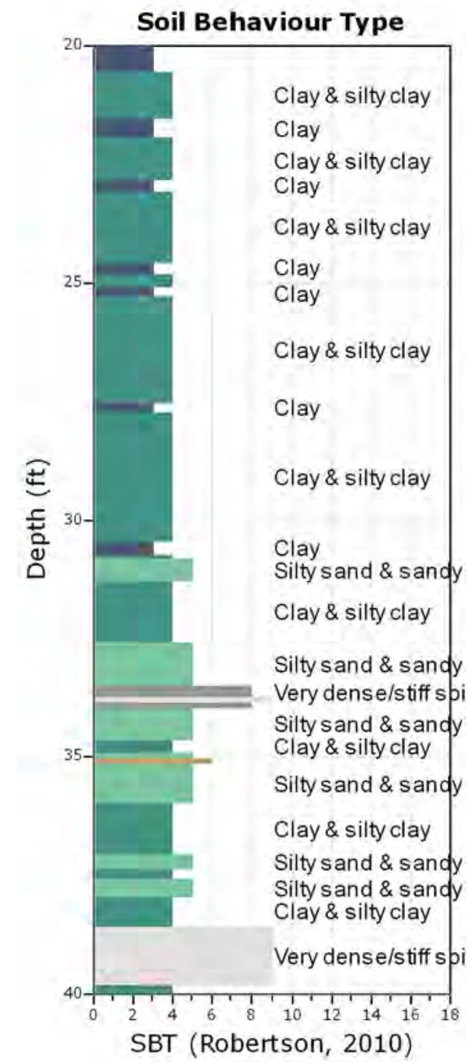
CPT: CPT-19
Total depth: 80.21 ft, Date: 10/6/2015
Cone Type: Vertek











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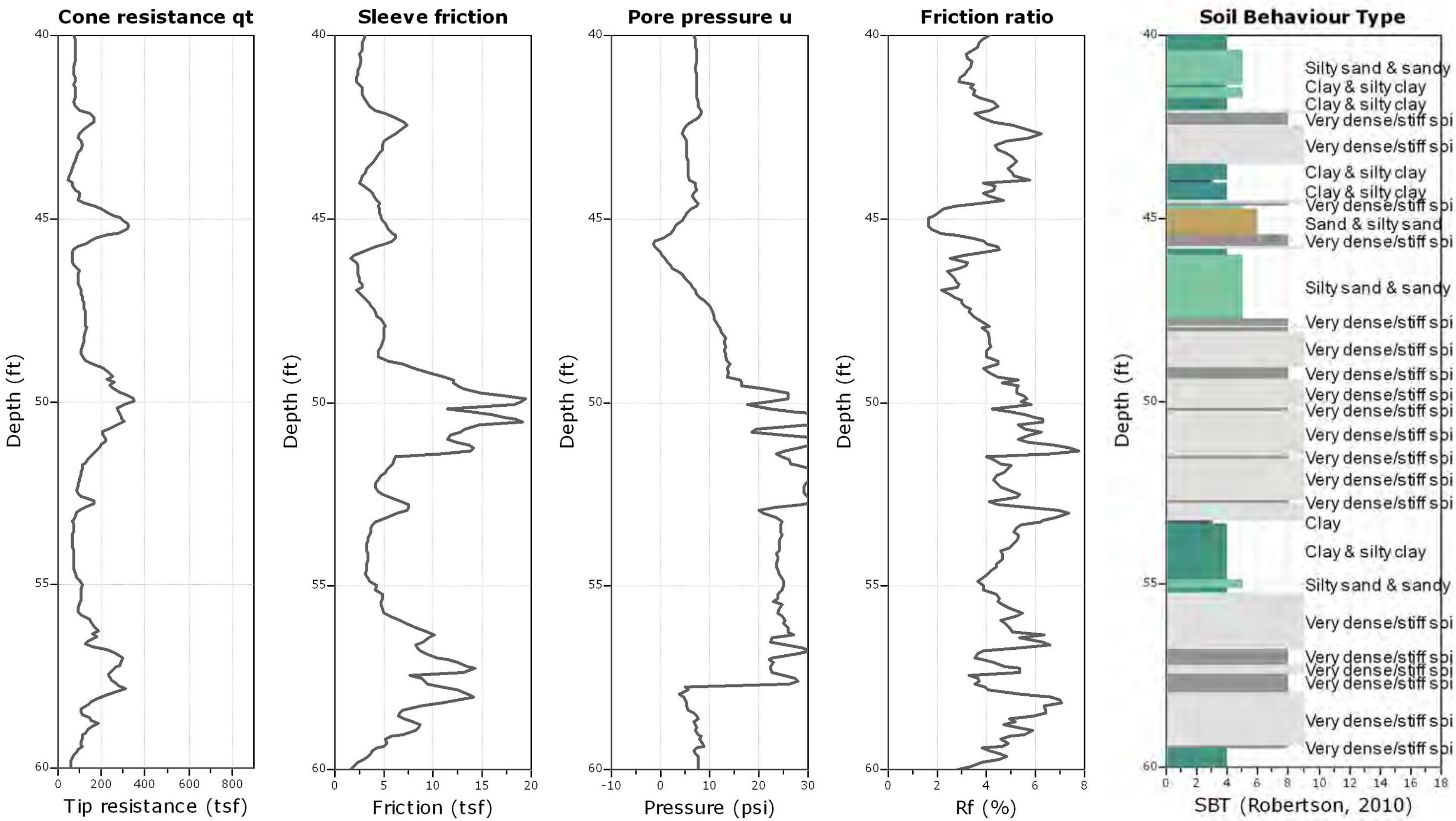
rich@kehoetesting.com
www.kehoetesting.com

Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-19
Total depth: 80.21 ft, Date: 10/6/2015
Cone Type: Vertek



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Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-19
Total depth: 80.21 ft, Date: 10/6/2015
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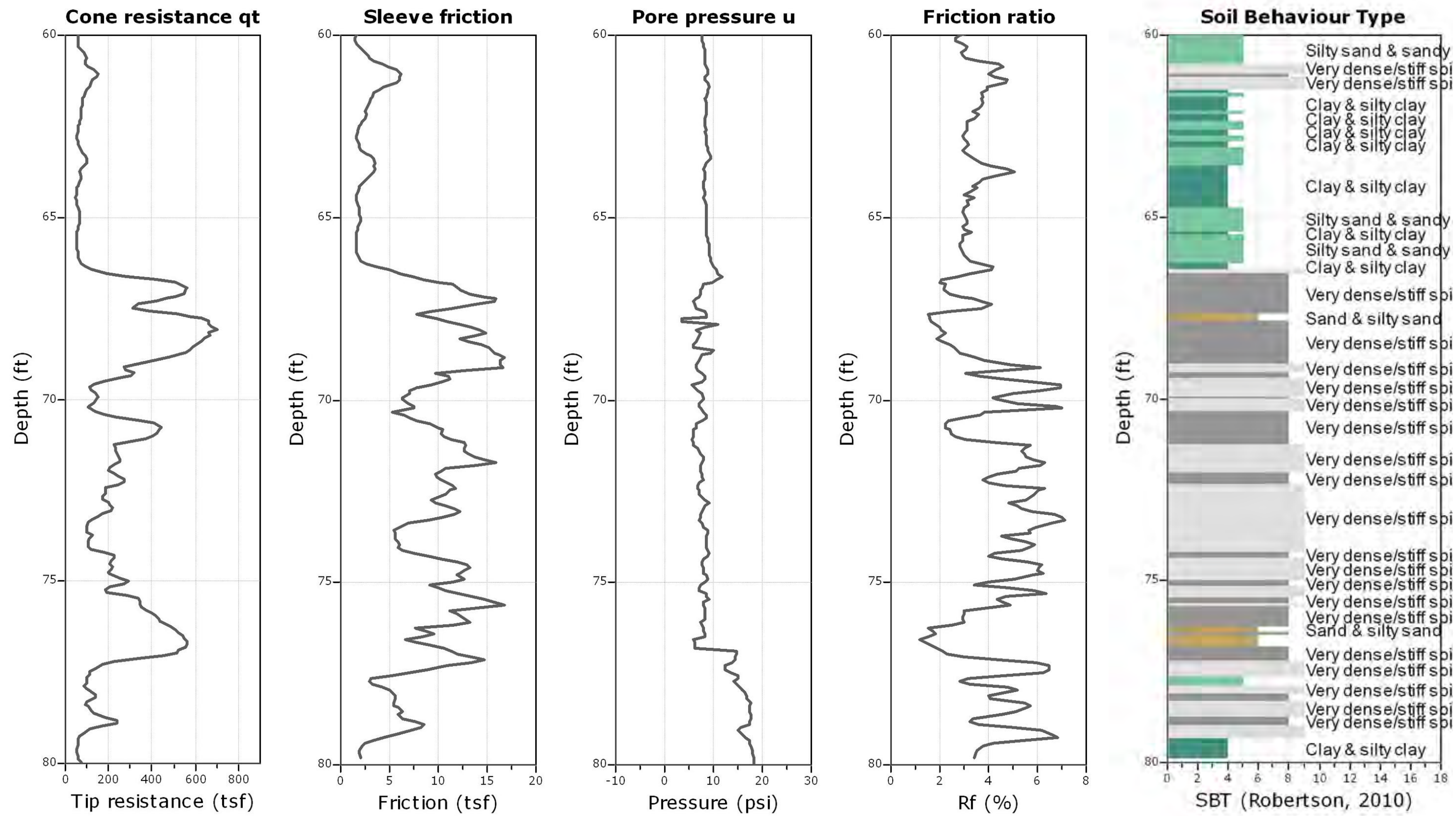

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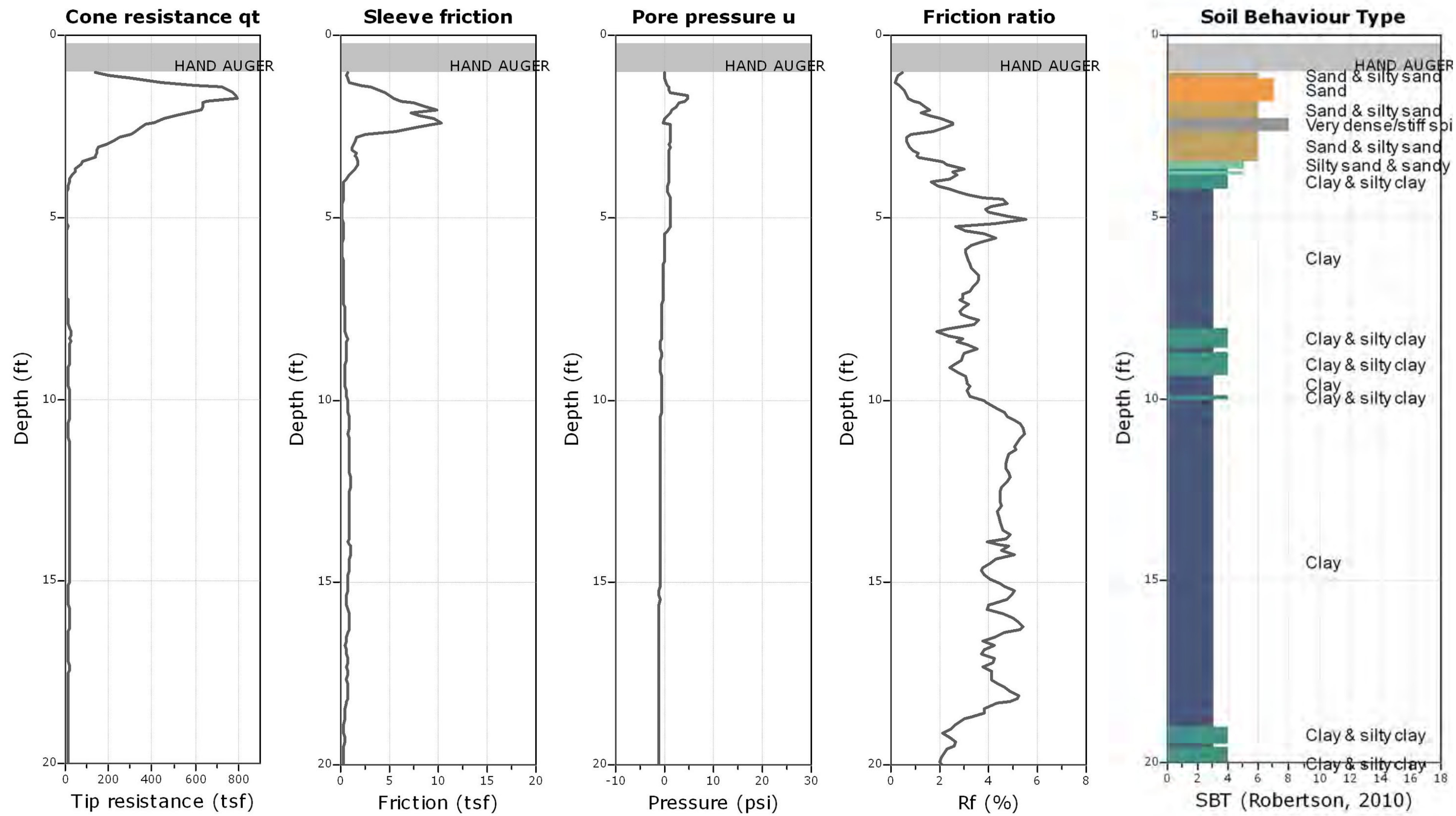
CPT: CPT-20
Total depth: 66.26 ft, Date: 10/6/2015
Cone Type: Vertek

Project: Applied Earth Sciences
Location: 1749 & 1751 Malcolm Ave Los Angeles, CA



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Project: **Applied Earth Sciences**
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CPT: CPT-20
Total depth: 66.26 ft, Date: 10/6/2015
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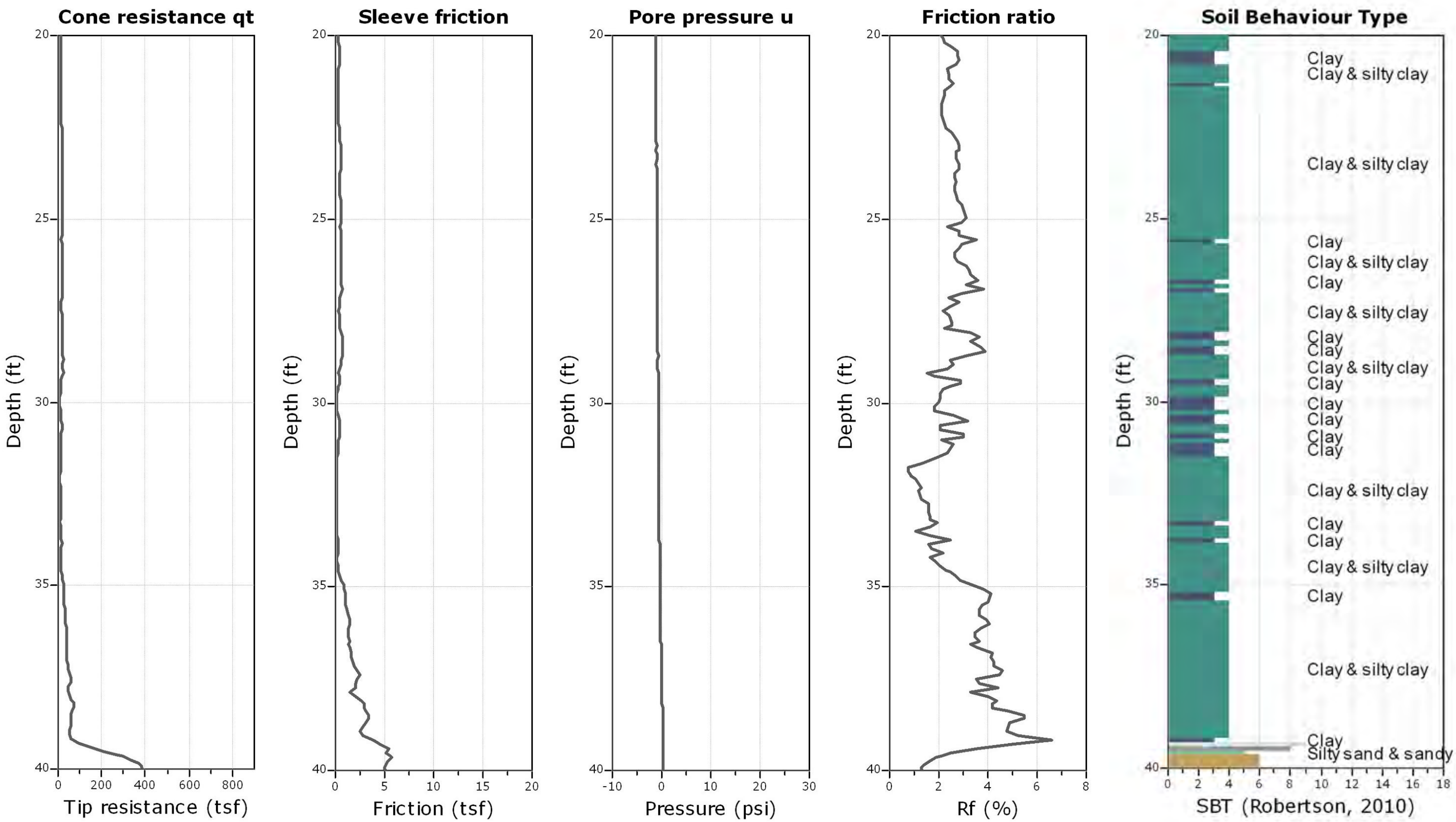

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Location: 1749 & 1751 Malcolm Ave Los Angeles, CA

CPT: CPT-20
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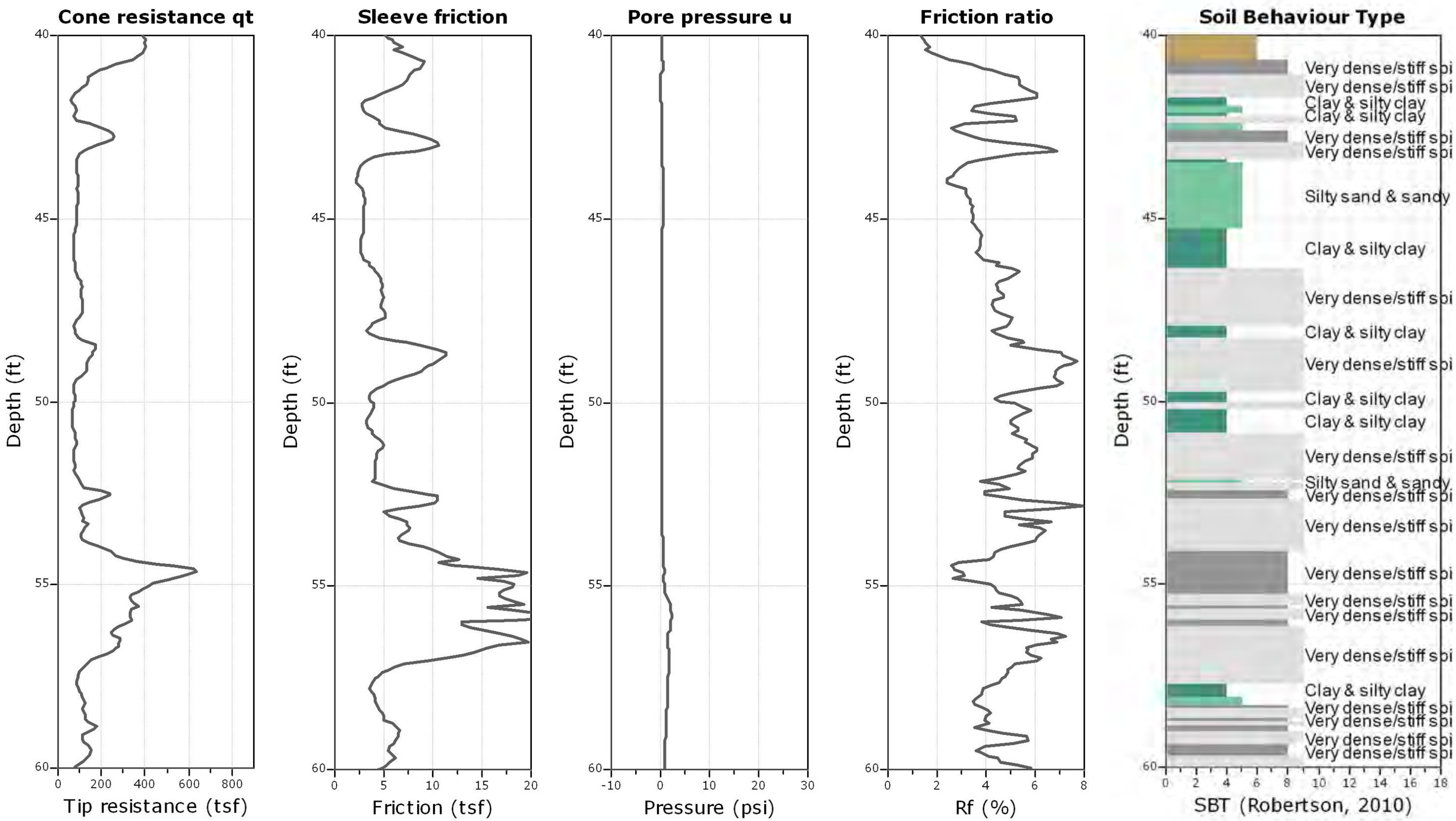

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CPT: CPT-20
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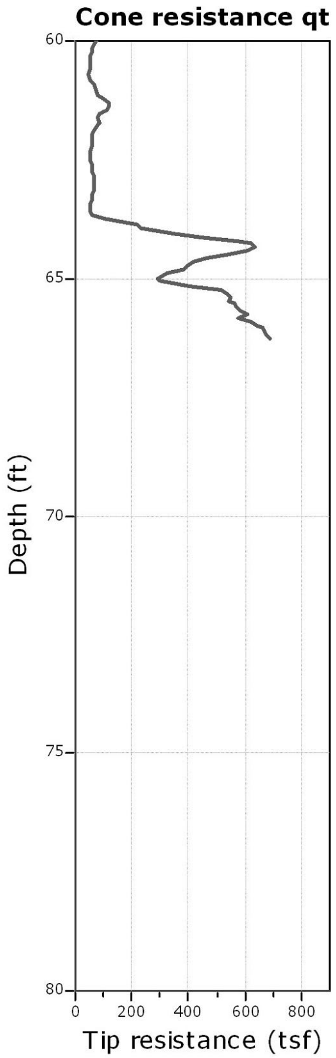

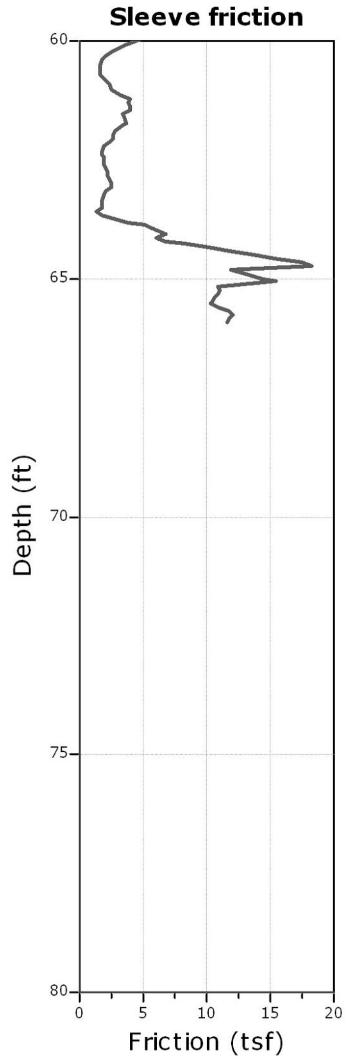

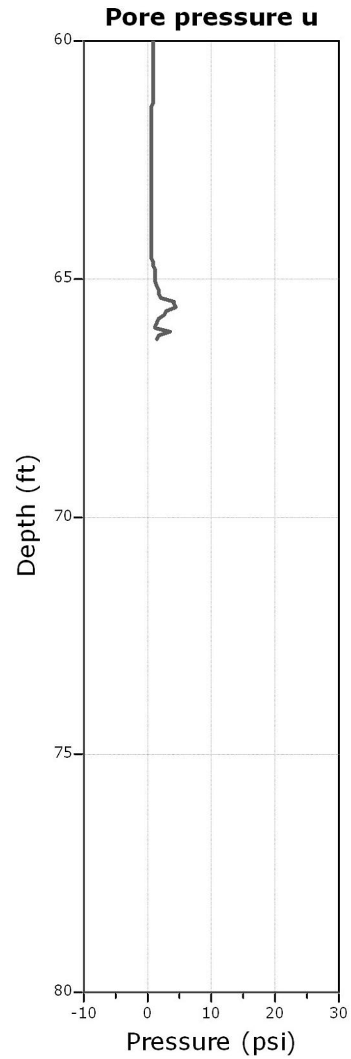

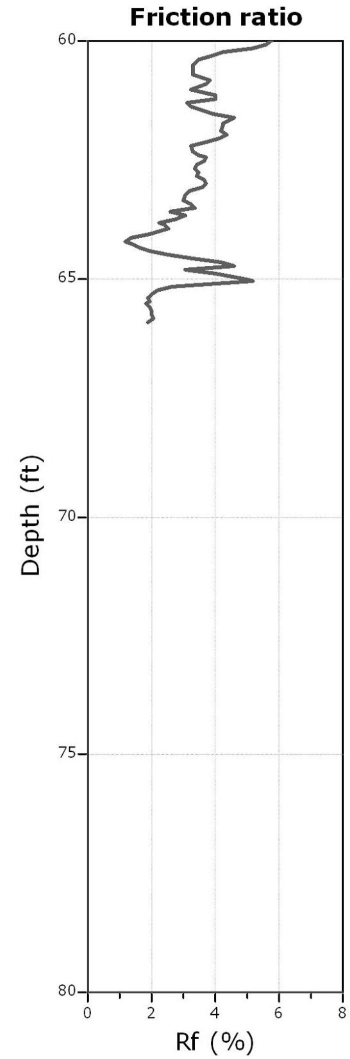

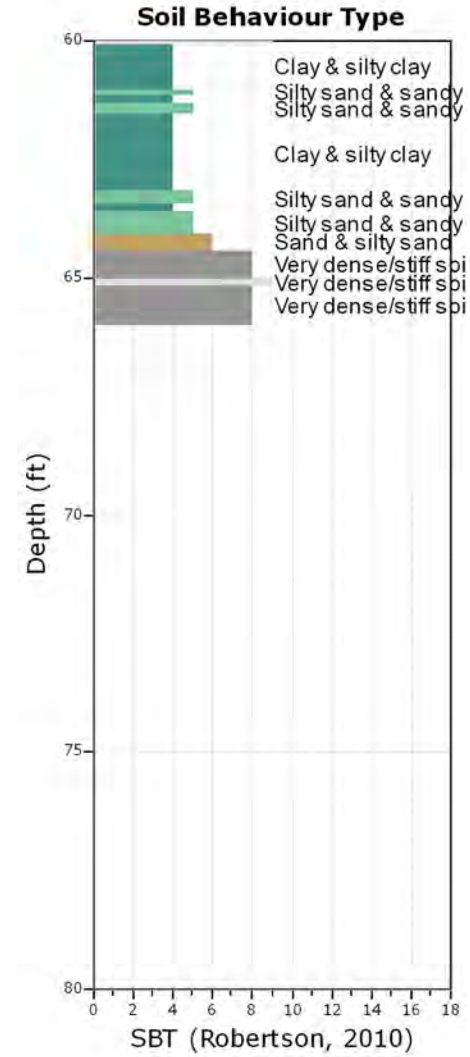

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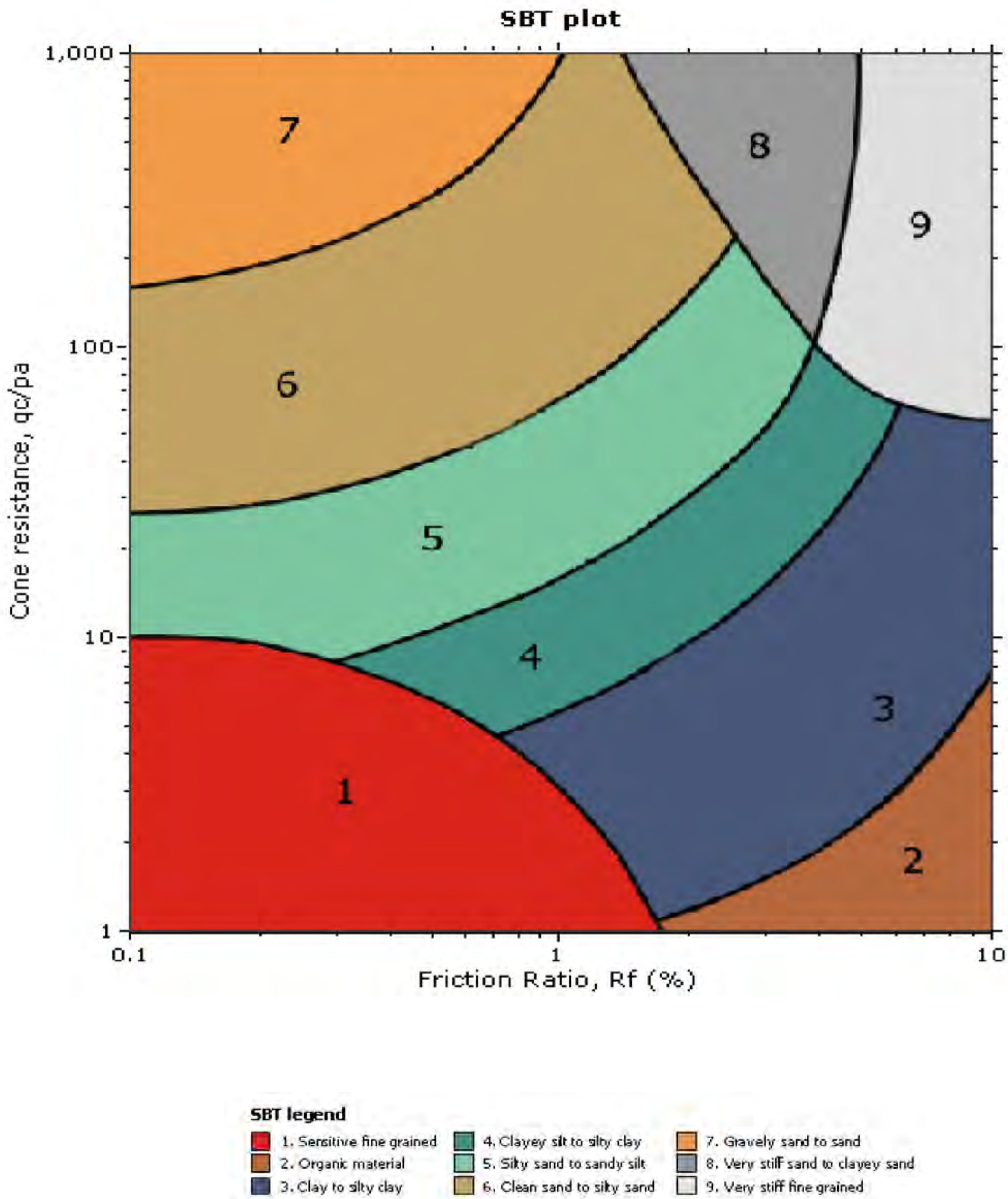

	CPT-14	In situ data										Basic output data								
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	8.7	0.21	0.01	-0.16	8.70012	2.4138	3	3.01607	104.1285	0.05206	0	0.0521	166.1	2.4283	8E-05	5	0.7187	8.7116	2.2789	71.20101
2	103.4	2.97	-1.25	-0.43	103.385	2.8728	5	2.2377	129.5495	0.11684	0	0.1168	883.85	2.876	-9E-04	8	0.5854	3.632	1.9146	354.4714
3	33.1	1.88	0.13	-0.51	33.1016	5.6795	3	2.79236	123.4258	0.17855	0	0.1786	184.39	5.7103	0.0003	9	0.7753	3.9729	2.4095	123.6157
4	20	1.22	-1.61	-0.39	19.9803	6.106	3	2.97261	119.0305	0.23807	0	0.2381	82.927	6.1797	-0.006	9	0.8511	3.5595	2.5998	66.41344
5	10.3	0.58	-2.48	-0.29	10.2696	5.6477	3	3.17072	111.9665	0.29405	0	0.2941	33.925	5.8142	-0.018	3	0.9311	3.2945	2.8018	31.06013
6	5.9	0.17	-2.81	-0.35	5.86561	2.8983	3	3.20341	101.6208	0.34486	0	0.3449	16.009	3.0793	-0.037	3	0.9552	2.918	2.855	15.22485
7	8.7	0.4	-2.74	-0.43	8.66646	4.6155	3	3.17599	108.8338	0.39928	0	0.3993	20.705	4.8384	-0.024	3	0.9687	2.5704	2.8852	20.08257
8	12.1	0.71	-2.58	-0.48	12.0684	5.8831	3	3.12738	113.8399	0.4562	0	0.4562	25.454	6.1143	-0.016	3	0.9715	2.2644	2.8861	24.8509
9	19.9	1.47	-2.58	-0.57	19.8684	7.3987	3	3.03127	120.3808	0.51639	0	0.5164	37.476	7.5961	-0.01	3	0.9564	1.9859	2.839	36.32087
10	35.1	1.33	-2.43	-0.65	35.0703	3.7924	4	2.65273	121.0344	0.57691	0	0.5769	59.79	3.8558	-0.005	4	0.8321	1.6565	2.5063	54.00048
11	30.5	0.96	-2.2	-0.72	30.4731	3.1503	4	2.64487	118.3063	0.63606	0	0.6361	46.909	3.2175	-0.005	4	0.84	1.5334	2.5196	43.24023
12	61	2.21	-1.97	-0.72	60.9759	3.6244	4	2.46731	126.0991	0.69911	0	0.6991	86.22	3.6664	-0.002	4	0.7896	1.3871	2.3781	79.01857
13	75.1	3.88	-1.82	-0.74	75.0777	5.168	9	2.5217	130.7249	0.76447	0	0.7645	97.209	5.2211	-0.002	9	0.8217	1.3062	2.4551	91.73522
14	88.3	4.7	-1.75	-0.84	88.2786	5.3241	9	2.48722	132.5228	0.83073	0	0.8307	105.27	5.3746	-0.001	9	0.8191	1.2192	2.4403	100.7589
15	159.2	4.15	-0.53	-0.93	159.194	2.6069	5	2.08512	133.0502	0.89726	0	0.8973	176.42	2.6217	-2E-04	5	0.6769	1.1181	2.0589	167.2694
16	74.9	4.07	-0.46	-1.04	74.8944	5.4343	9	2.53914	131.0687	0.96279	0	0.9628	76.789	5.5051	-5E-04	9	0.8575	1.0843	2.5248	75.76234
17	57.8	2.76	-0.53	-1.02	57.7935	4.7756	4	2.57068	127.5945	1.02659	0	1.0266	55.297	4.862	-7E-04	4	0.8792	1.0269	2.5739	55.09498
18	59.3	1.95	-0.46	-1.09	59.2944	3.2887	4	2.44558	125.1151	1.08915	0	1.0892	53.441	3.3502	-6E-04	4	0.8404	0.976	2.4644	53.6883
19	81.2	1.64	-0.46	-1.02	81.1944	2.0198	5	2.19973	124.6149	1.15145	0	1.1515	69.515	2.0489	-4E-04	5	0.7535	0.9383	2.2285	70.97852
20	38.1	1.82	-0.38	-0.98	38.0954	4.7775	4	2.69612	123.5312	1.21322	0	1.2132	30.4	4.9346	-7E-04	3	0.9576	0.8772	2.7567	30.57693
21	44.3	1.87	-0.38	-0.92	44.2954	4.2217	4	2.61181	124.0973	1.27527	0	1.2753	33.734	4.3468	-6E-04	4	0.9328	0.8402	2.6838	34.15986
22	59.9	2.83	-0.46	-0.92	59.8944	4.725	4	2.55682	127.8649	1.3392	0	1.3392	43.724	4.8331	-6E-04	4	0.9171	0.8057	2.6347	44.58587
23	87.8	2.51	-0.38	-0.94	87.7954	2.8589	5	2.28373	127.9196	1.40316	0	1.4032	61.57	2.9054	-3E-04	5	0.8167	0.7941	2.3628	64.8387
24	38.2	1.06	-0.23	-1	38.1972	2.7751	4	2.53459	119.5824	1.46295	0	1.463	25.11	2.8856	-5E-04	4	0.9323	0.7393	2.6588	25.66685
25	34.1	1.38	-0.15	-1.02	34.0982	4.0471	4	2.68088	121.2359	1.52357	0	1.5236	21.38	4.2364	-3E-04	3	0.999	0.6947	2.8267	21.38813
26	27.3	0.79	-0.23	-1	27.2972	2.8941	4	2.65792	116.6118	1.58188	0	1.5819	16.256	3.0721	-6E-04	4	1	0.6689	2.8317	16.25622
27	98.1	3.16	-0.23	-0.93	98.0972	3.2213	5	2.29014	129.8752	1.64681	0	1.6468	58.568	3.2763	-2E-04	4	0.8466	0.6876	2.4104	62.68128
28	95.7	2.67	-0.23	-0.94	95.6972	2.7901	5	2.25063	128.582	1.7111	0	1.7111	54.927	2.8409	-2E-04	5	0.8393	0.668	2.3831	59.33788
29	35.2	1.91	-0.26	-1.08	35.1968	5.4266	3	2.75953	123.6914	1.77295	0	1.773	18.852	5.7145	-6E-04	3	1	0.5968	2.9538	18.85213
30	100.2	4.08	-0.04	-1.11	100.2	4.0719	9	2.36203	131.7966	1.83885	0	1.8389	53.49	4.148	-3E-05	4	0.8954	0.6097	2.5149	56.67257
31	201.6	2.54	-0.08	-1.22	201.599	1.2599	6	1.7775	130.034	1.90386	0	1.9039	104.89	1.2719	-3E-05	6	0.6644	0.6769	1.901	127.7493
32	328.2	5.84	0.15	-1.34	328.202	1.7794	6	1.76605	137.28	1.9725	0	1.9725	165.39	1.7902	3E-05	6	0.6573	0.6641	1.8741	204.7362
33	299	6.37	0.52	-1.46	299.006	2.1304	6	1.85359	137.28	2.04114	0	2.0411	145.49	2.145	0.0001	6	0.6988	0.6318	1.9744	177.3288
34	323.4	6.7	0.83	-1.67	323.41	2.0717	6	1.82485	137.28	2.10978	0	2.1098	152.29	2.0853	0.0002	6	0.6922	0.6202	1.9487	188.3271
35	416.6	7.25	1.31	-1.74	416.616	1.7402	6	1.70253	137.28	2.17842	0	2.1784	190.25	1.7494	0.0002	6	0.6458	0.6273	1.8181	245.7029
36	225.5	3.27	1.37	-1.76	225.517	1.45	6	1.79189	132.1559	2.2445	0	2.2445	99.475	1.4646	0.0004	6	0.6998	0.5908	1.9516	124.6676
37	78	3.06	1.29	-1.9	78.0158	3.9223	4	2.42001	129.0813	2.30904	0	2.309	32.787	4.0419	0.0012	4	0.9763	0.4668	2.6691	33.40048
38	72.1	2.13	0.99	-1.42	72.1121	2.9537	5	2.35278	126.2385	2.37216	0	2.3722	29.399	3.0542	0.001	4	0.9602	0.4606	2.6187	30.35939
39	64.3	2.31	0.53	-1.06	64.3065	3.5922	4	2.44855	126.5527	2.43544	0	2.4354	25.404	3.7336	0.0006	4	1	0.4345	2.7343	25.40448
40	52.5	1.32	0.46	-1.1	52.5056	2.514	5	2.40288	121.9635	2.49642	0	2.4964	20.032	2.6395	0.0007	4	1	0.4239	2.7196	20.03237
41	146.1	6.24	0.3	-1.25	146.104	4.2709	9	2.27881	135.8254	2.56433	0	2.5643	55.975	4.3472	0.0002	4	0.9301	0.439	2.5152	59.54802
42	77.1	1.95	0.23	-1.67	77.1028	2.5291	5	2.28428	125.7556	2.62721	0	2.6272	28.348	2.6183	0.0002	4	0.9601	0.4176	2.5865	29.39561
43	56.6	1.96	0.23	-1.92	56.6028	3.4627	4	2.47569	125.0392	2.68973	0.0312	2.6585	20.279	3.6355	-3E-04	3	1	0.398	2.8016	20.27928
44	202.8	10.66	0.15	-2.04	202.802	5.2564	9	2.27515	137.28	2.75837	0.0624	2.696	74.201	5.3288	-3E-04	9	0.9312	0.4186	2.5019	79.13154
45	414.5	5.11	0.23	-1.9	414.503	1.2328	6	1.5772	136.9069	2.82682	0.0936	2.7332	150.62	1.2413	-2E-04	6	0.6436	0.5429	1.7429	211.2417
46	451.2	8.31	-0.46	-2.01	451.194	1.8418	6	1.7064	137.28	2.89546	0.1248	2.7707	161.8	1.8537	-4E-04	6	0.6938	0.5128	1.8703	217.2752
47	360.2	4.94	-1.06	-2.28	360.187	1.3715	6	1.6498	136.3167	2.96362	0.156	2.8076	127.23	1.3829	-7E-04	6	0.6821	0.514	1.8347	173.5156
48	64.6	1.86	-1.41	-2.42	64.5827	2.88	5	2.37858	124.9777	3.02611	0.1872	2.8389	21.683	3.0216	-0.005	4	1	0.3727	2.7284	21.68318
49	84.2	1.94	-1.14	-2.57	84.1861	2.3044	5	2.22872	125.9324	3.08908	0.2184	2.8707	28.25	2.3922	-0.004	4	0.9626	0.3826	2.5627	29.32527
50	146	6.71	-1.16	-2.89	145.986	4.5963	9	2.30499	136.3547	3.15725	0.2496	2.9077	49.122	4.6979	-0.002	4	0.9741	0.3736	2.589	50.4242
51	86	4.47	-1.34	-3.21	85.9836	5.1987	9	2.48629	132.0914	3.2233	0.2808	2.9425	28.126	5.4011	-0.005	3	1	0.3596	2.81	28.12584
52	675.7	15.76	-1.41	-3.29	675.683	2.3325	8	1.72136	137.28	3.29194	0.312	2.9799	225.64	2.3439	-6E-04	8	0.7032	0.4828	1.8694	306.8024
53	417.6	14.64	0	-3.34	417.6	3.5058	8	1.96924	137.28	3.36058	0.3432	3.0174	137.28	3.5342	-8E-04	8	0.8177	0.4245	2.1651	166.1876
54	88.2	4	0.23	-3.57	88.2028	4.535	9	2.43333	131.3407	3.42625	0.3744	3.0519	27.779	4.7183	-0.004	3	1	0.3467	2.7735	27.77874
55	62.8	2.8	-0.11	-3.72	62.7987	4.4587	4	2.52435	127.9024	3.4902	0.4056	3.0846	19.227	4.7211	-0.007	3	1	0.343	2.8925	19.22726
56	489.8	14.59	8.22	-3.78	489.901	2.9782	8	1.87525	137.28	3.55884	0.4368	3.122	155.78	3	0.0003	8	0.7845	0.4279	2.0649	196.6932
57	52.6	2.13	0.99	-4.05	52.6121	4.0485	4	2.54639	125.4695	3.62158	0.468	3.1536	15.535	4.3478	-0.008	3	1	0.3355	2.9403	15.53491
58	62.9	1.97	0.98	-4.25	62.912	3.1314	5	2.41236	125.3342	3.68424	0.4992	3.185	18.596	3.3261	-0.007	4	1	0.3322	2.8066	18.59558
59	73.5	2.83	0.61	-4.43	73.5075	3.85	4	2.43119	128.3644	3.74843	0.5304	3.218	21.678	4.0568	-0.007	3	1	0.3288	2.81	21.67759
60	72.4	2.92	0.15	-4.62	72.4018	4.0331	4	2.4506	128.5565	3.8127	0.5616	3.2511	21.097	4.2572	-0.008	3	1	0.3255	2.8326	21.09718
61	74.7	2.71	0.15	-4.82	74.7018	3.6278	4	2.40736	128.0867	3.87675	0.5928	3.284	21.567	3.8263	-0.008	3	1	0.3222	2.7953	21.56706
62	103.8	5.46	0.23	-4.92	103.803	5.26	9	2.43985	134.0146	3.94376	0.624	3.3198	30.08	5.4677	-0.006	3	1	0.3187	2.7928	30.08025
63	82.6	3.52	0.23	-5.11	82.6028	4.2614	4	2.43093	130.2454	4.00888	0.6552	3.3537	23.435	4.4787	-0.008	3	1	0.3155	2.8128	23.43515
64	105.7	5.22	0.15	-5.28	105.702	4.9384	9	2.4133	133.7299	4.07574	0.6864	3.3893	29.984	5.1365	-0.007	3	1	0.3122	2.7749	29.98401
65	109.8	5.34	0.1	-5.52	109.801	4.8633	9	2.39798	133.989	4.14274	0.7176	3.4251	30.848	5.054	-0.007	3	1	0.3089	2.7611	30.84796
66	99.3	3.47	0.23	-5.71	99.3028	3.4944	5	2.31348	130.5898	4.20803	0.7488	3.4592	27.49	3.649	-0.008	4	1	0.3059	2.7019	27.49014
67	228.5	15.28	0.3	-6.02	228.504	6.687	9	2.33937	137.28	4.27667	0.78	3.4967	64.126	6.8145	-0.003	9	1	0.3026	2.6424	64.12583
68	196.7	11.66	0.58	-6.57	196.707	5.9276	9	2.32664	137.28	4.34531	0.8112	3.5341	54.43	6.0615	-0.004	3	1	0.2994	2.6491	54.43002

69	202.1	14.59	0.46	-7.03	202.106	7.219	9	2.39451	137.28	4.41395	0.8424	3.5716	55.352	7.3802	-0.004	3	1	0.2963	2.7096	55.35176
70	59.2	4.25	0.33	-7.34	59.204	7.1786	3	2.69737	130.812	4.47936	0.8736	3.6058	15.177	7.7662	-0.016	3	1	0.2935	3.1131	15.17703
71	82.3	3.72	0.23	-7.43	82.3028	4.5199	4	2.45147	130.6408	4.54468	0.9048	3.6399	21.363	4.7841	-0.011	3	1	0.2907	2.8619	21.36284
72	46.6	1.45	0.08	-7.59	46.601	3.1115	4	2.50381	122.3598	4.60586	0.936	3.6699	11.443	3.4528	-0.022	3	1	0.2883	2.9843	11.44325
73	44.6	1.88	0.08	-7.71	44.601	4.2152	4	2.60922	124.1531	4.66793	0.9672	3.7007	10.791	4.7079	-0.024	3	1	0.2859	3.0857	10.79057
74	512.6	11.89	0.24	-7.91	512.603	2.3195	8	1.76899	137.28	4.73657	0.9984	3.7382	135.86	2.3412	-0.002	5	0.791	0.3685	2.0051	176.8735
75	267.2	12.34	-0.06	-8.18	267.199	4.6183	9	2.16593	137.28	4.80521	1.0296	3.7756	69.497	4.7029	-0.004	4	0.9767	0.2887	2.4879	71.58802
76	73.9	2.2	0.61	-8.33	73.9075	2.9767	5	2.34779	126.5351	4.86848	1.0608	3.8077	18.132	3.1866	-0.015	4	1	0.2779	2.8037	18.1315
77	88.2	3.01	0.61	-8.4	88.2075	3.4124	5	2.33938	129.2602	4.93311	1.092	3.8411	21.68	3.6146	-0.013	4	1	0.2755	2.7776	21.67975
78	289	15.38	0.46	-8.59	289.006	5.3217	9	2.20352	137.28	5.00175	1.1232	3.8786	73.224	5.4154	-0.004	9	0.9967	0.274	2.5274	73.54125
79	461.7	7.67	0.63	-8.8	461.708	1.6612	6	1.66253	137.28	5.07039	1.1544	3.916	116.61	1.6797	-0.002	6	0.7692	0.3655	1.9253	157.7234

	CPT-15	In situ data										Basic output data								
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	23.4	0.56	0.67	-0.33	23.4082	2.3923	4	2.65942	113.7192	0.05686	0	0.0569	410.68	2.3982	0.0021	5	0.6402	6.4991	2.0699	143.4278
2	75.6	2.13	0.59	-0.41	75.6072	2.8172	5	2.32371	126.3539	0.12004	0	0.12	628.87	2.8217	0.0006	8	0.6066	3.7443	1.9695	267.1259
3	28.5	1.27	-1.16	-0.37	28.4858	4.4584	3	2.76677	120.1894	0.18013	0	0.1801	157.14	4.4867	-0.003	9	0.7609	3.8464	2.3725	102.8957
4	21.9	0.91	-3.11	-0.33	21.8619	4.1625	3	2.83312	117.105	0.23868	0	0.2387	90.594	4.2084	-0.01	4	0.801	3.296	2.469	67.3557
5	16.1	0.64	-1.3	-0.29	16.0841	3.9791	3	2.92355	113.781	0.29557	0	0.2956	53.416	4.0536	-0.006	4	0.8479	2.9487	2.5841	43.9989
6	8.6	0.44	-1.04	-0.31	8.58727	5.1239	3	3.20631	109.5088	0.35033	0	0.3503	23.512	5.3418	-0.009	3	0.9632	2.8998	2.8762	22.57387
7	6.7	0.24	-1.08	-0.39	6.68678	3.5892	3	3.20559	104.4636	0.40256	0	0.4026	15.611	3.8191	-0.012	3	0.9783	2.574	2.9106	15.2872
8	6.5	0.16	-1	-0.5	6.48776	2.4662	3	3.12955	101.4231	0.45327	0	0.4533	13.313	2.6514	-0.012	3	0.967	2.2699	2.8741	12.94543
9	8	0.18	-0.93	-0.29	7.98862	2.2532	3	3.03191	102.7925	0.50467	0	0.5047	14.829	2.4052	-0.009	4	0.9471	2.0162	2.8155	14.26032
10	15.7	0.95	-0.85	-0.29	15.6896	6.055	3	3.04852	116.6106	0.56297	0	0.563	26.869	6.2803	-0.004	3	0.9723	1.8469	2.8754	26.40354
11	18.2	1.2	-0.85	-0.25	18.1896	6.5972	3	3.02538	118.6806	0.62231	0	0.6223	28.229	6.8309	-0.003	3	0.9784	1.6809	2.8842	27.90681
12	22.1	1.33	-0.93	-0.27	22.0886	6.0212	3	2.93646	119.9069	0.68227	0	0.6823	31.375	6.2131	-0.003	3	0.9586	1.5229	2.8247	30.81004
13	37	0.64	-0.87	-0.51	36.9894	1.7302	5	2.41605	115.8122	0.74017	0	0.7402	48.974	1.7656	-0.002	5	0.7741	1.3187	2.3337	45.17588
14	64.7	1.76	-0.09	-1.06	64.6989	2.7203	5	2.36059	124.5778	0.80246	0	0.8025	79.625	2.7545	-1E-04	5	0.7658	1.2359	2.3036	74.63205
15	53.7	2.73	0.06	-1.11	53.7007	5.0837	4	2.61224	127.3354	0.86613	0	0.8661	61.001	5.1671	8E-05	4	0.8708	1.1905	2.5717	59.44314
16	45.8	2.13	0.14	-1.04	45.8017	4.6505	4	2.63152	125.1314	0.9287	0	0.9287	48.318	4.7467	0.0002	4	0.8881	1.1228	2.6093	47.61778
17	52.5	2.3	0.14	-0.9	52.5017	4.3808	4	2.57172	126.0262	0.99171	0	0.9917	51.941	4.4652	0.0002	4	0.8747	1.0583	2.5665	51.5206
18	40	1.73	0.29	-0.82	40.0036	4.3246	4	2.65063	123.2793	1.05335	0	1.0534	36.978	4.4416	0.0005	4	0.9154	1.0041	2.6657	36.96341
19	39	1.37	0.36	-0.78	39.0044	3.5124	4	2.59622	121.5105	1.1141	0	1.1141	34.01	3.6157	0.0007	4	0.9043	0.9544	2.6289	34.17801
20	182.9	3	0.29	-0.72	182.904	1.6402	6	1.89143	131.0145	1.17961	0	1.1796	154.05	1.6509	0.0001	6	0.6354	0.9333	1.9151	160.2817
21	109.8	3.43	0.39	-0.69	109.805	3.1237	5	2.2481	130.7501	1.24499	0	1.245	87.198	3.1596	0.0003	5	0.7818	0.8806	2.2912	90.34703
22	27.6	1.49	-0.02	-0.66	27.5998	5.3986	3	2.83351	121.2813	1.30563	0	1.3056	20.139	5.6667	-5E-05	3	1	0.8104	2.9301	20.13909
23	27.7	0.73	0.06	-0.63	27.7007	2.6353	4	2.62739	116.0697	1.36366	0	1.3637	19.314	2.7718	0.0002	4	0.959	0.7841	2.7414	19.51557
24	23.7	0.9	-0.09	-0.62	23.6989	3.7976	4	2.78061	117.2209	1.42227	0	1.4223	15.663	4.0401	-3E-04	3	1	0.744	2.9175	15.66271
25	21.2	0.77	-0.17	-0.6	21.1979	3.6324	3	2.80542	115.8074	1.48018	0	1.4802	13.321	3.9051	-6E-04	3	1	0.7149	2.9636	13.32122
26	49.6	2.41	-0.17	-0.6	49.5979	4.8591	4	2.62137	126.2293	1.54329	0	1.5433	31.138	5.0151	-3E-04	3	0.9717	0.693	2.7526	31.4721
27	95.1	4.34	0.16	-0.62	95.102	4.5635	9	2.41476	132.1213	1.60935	0	1.6094	58.093	4.6421	0.0001	4	0.8903	0.6884	2.5302	60.82875
28	23.3	1.08	0.25	-0.63	23.3031	4.6346	3	2.84283	118.5139	1.66861	0	1.6686	12.966	4.992	0.0008	3	1	0.6341	3.0391	12.96557
29	86.2	3.96	0.29	-0.7	86.2036	4.5938	9	2.44398	131.2112	1.73421	0	1.7342	48.708	4.6881	0.0003	4	0.9177	0.6355	2.5865	50.72991
30	141.9	3.68	0.42	-0.79	141.905	2.5933	5	2.11468	131.8904	1.80016	0	1.8002	77.829	2.6266	0.0002	5	0.7896	0.6573	2.2426	87.0383
31	244.7	5.03	0.47	-0.84	244.706	2.0555	6	1.8902	135.506	1.86791	0	1.8679	130	2.0713	0.0001	5	0.7007	0.6715	2.001	154.1105
32	210.2	5.77	0.82	-0.96	210.21	2.7449	8	2.03076	136.1397	1.93598	0	1.936	107.58	2.7704	0.0003	5	0.7639	0.6304	2.1583	124.0772
33	331.7	4.22	1.12	-1.02	331.714	1.2722	6	1.64397	134.9632	2.00346	0	2.0035	164.57	1.2799	0.0002	6	0.613	0.6762	1.7537	210.6973
34	323.6	4.39	1.43	-1.27	323.618	1.3565	6	1.67282	135.1919	2.07106	0	2.0711	155.26	1.3653	0.0003	6	0.6304	0.6548	1.7912	198.9942
35	204	5.83	0.89	-1.49	204.011	2.8577	8	2.05255	136.1424	2.13913	0	2.1391	94.371	2.888	0.0003	5	0.7923	0.5725	2.2077	109.227
36	125.5	5.77	0	-1.48	125.5	4.5976	9	2.34359	134.8816	2.20657	0	2.2066	55.876	4.6799	0	4	0.9229	0.5075	2.541	59.1346
37	68	3.7	-0.55	-1.49	67.9933	5.4417	4	2.56659	130.1356	2.27164	0	2.2716	28.931	5.6298	-6E-04	3	1	0.4658	2.8138	28.93137
38	46.3	1.37	-0.62	-1.67	46.2924	2.9595	4	2.49109	121.9283	2.3326	0	2.3326	18.846	3.1165	-0.001	4	1	0.4536	2.7846	18.84582
39	135.2	5.29	-1	-1.55	135.188	3.9131	8	2.26817	134.4275	2.39982	0	2.3998	55.333	3.9838	-5E-04	4	0.9119	0.4739	2.4877	59.47098
40	53.4	3.23	-0.88	-1.55	53.3892	6.0499	3	2.67012	128.5518	2.46409	0	2.4641	20.667	6.3426	-0.001	3	1	0.4294	2.9551	20.66689
41	165.3	6.79	-0.39	-1.84	165.295	4.1078	8	2.23405	136.7445	2.53246	0	2.5325	64.27	4.1717	-2E-04	4	0.9062	0.4535	2.456	69.75284
42	241	9.38	-1.38	-2.07	240.983	3.8924	8	2.12477	137.28	2.6011	0	2.6011	91.646	3.9349	-4E-04	9	0.8587	0.4619	2.3247	104.0633
43	257.5	8.05	-1.15	-2.02	257.486	3.1264	8	2.02878	137.28	2.66974	0.0312	2.6385	96.575	3.1591	-5E-04	5	0.8233	0.4713	2.2269	113.4985
44	337.1	6.12	-1.15	-2.15	337.086	1.8156	6	1.76696	137.28	2.73838	0.0624	2.676	124.94	1.8304	-4E-04	6	0.7179	0.5137	1.9454	162.3248
45	301.8	7.85	-2.11	-2.28	301.774	2.6013	8	1.92451	137.28	2.80702	0.0936	2.7134	110.18	2.6257	-8E-04	5	0.7851	0.4774	2.1172	134.898
46	53.5	2.01	-2.47	-2.28	53.4698	3.7591	4	2.51845	125.0847	2.86957	0.1248	2.7448	18.435	3.9723	-0.006	3	1	0.3855	2.858	18.43515
47	71.8	2.43	-2.43	-2.43	71.7703	3.3858	5	2.39714	127.191	2.93316	0.156	2.7772	24.787	3.5301	-0.005	4	1	0.381	2.7265	24.78684
48	67.9	3.18	-2.44	-2.49	67.8701	4.6854	4	2.51794	129.023	2.99767	0.1872	2.8105	23.082	4.9019	-0.006	3	1	0.3765	2.8439	23.08239
49	83.4	5.04	-2.6	-2.59	83.3682	6.0455	9	2.54592	132.8942	3.06412	0.2184	2.8457	28.219	6.2762	-0.005	3	1	0.3718	2.8547	28.21923
50	723.6	15.73	1.08	-3	723.613	2.1738	8	1.68172	137.28	3.13276	0.2496	2.8832	249.89	2.1833	-2E-04	8	0.6786	0.5065	1.8166	344.8978
51	487.6	7.32	0.58	-3.65	487.607	1.5012	6	1.61258	137.28	3.2014	0.2808	2.9206	165.86	1.5111	-5E-04	6	0.6674	0.5079	1.7821	232.497
52	94.3	3.42	1.05	-3.95	94.3129	3.6262	5	2.34024	130.3578	3.26658	0.312	2.9546	30.815	3.7563	-0.003	4	1	0.3581	2.6733	30.8153
53	245.5	7.2	-0.77	-3.93	245.491	2.9329	8	2.01665	137.28	3.33522	0.3432	2.992	80.934	2.9733	-0.002	5	0.8522	0.4124	2.2589	94.37231
54	220	10.84	-0.74	-3.93	219.991	4.9275	9	2.23283	137.28	3.40386	0.3744	3.0295	71.494	5.0049	-0.002	9	0.9434	0.3707	2.4923	75.88213
55	52.2	1.49	-0.39	-3.77	52.1952	2.8547	5	2.44231	122.8354	3.46528	0.4056	3.0597	15.927	3.0577	-0.009	3	1	0.3458	2.8375	15.9265
56	61.3	1.79	-0.67	-3.85	61.2918	2.9205	5	2.39896	124.5695	3.52756	0.4368	3.0908	18.689	3.0988	-0.008	4	1	0.3424	2.7859	18.68931
57	63.3	2.03	-1.08	-3.98	63.2868	3.2076	4	2.41799	125.5682	3.59035	0.468	3.1224	19.119	3.4005	-0.009	4	1	0.3389	2.8031	19.11909
58	63.7	2.41	-1.15	-4.09	63.6859	3.7842	4	2.46788	126.8391	3.65377	0.4992	3.1546	19.03	4.0145	-0.01	3	1	0.3354	2.8503	19.03024
59	60.6	1.82	-1.21	-4	60.5852	3.004	5	2.41116	124.6628	3.7161	0.5304	3.1857	17.851	3.2003	-0.011	4	1	0.3321	2.8102	17.85138
60	127.8	6.24	-1.08	-3.82	127.787	4.8831	9	2.36004	135.4987	3.78385	0.5616	3.2223	38.483	5.0321	-0.005	4	1	0.3284	2.6917	38.48337
61	86.3	2.96	-1.08	-3.52	86.2868	3.4304	5	2.34743	129.0839	3.84839	0.5928	3.2556	25.322	3.5906	-0.008	4	1	0.325	2.7243	25.32211
62	80.6	3.32	-1.08	-3.36	80.5868	4.1198	4	2.4268	129.7571	3.91327	0.624	3.2893	23.31	4.3301	-0.009	3	1	0.3217	2.8048	23.31021
63	131.3	5.03	-1.13	-3.24	131.286	3.8313	8	2.26855	133.9873	3.98026	0.6552	3.3251	38.287	3.9511	-0.006	4	1	0.3182	2.6194	38.28679
64	251.7	12.76	-0.85	-3.28	251.69	5.0697	9	2.21397	137.28	4.0489	0.6864	3.3625	73.648	5.1526	-0.003	9	0.9611	0.3292	2.4979	77.03465
65	707.7	20.62	-0.41	-3.2	707.695	2.9137	8	1.8036	137.28	4.11754	0.7176	3.3999	206.94	2.9307	-0.001	8	0.765	0.4095	1.9792	272.267

	CPT-16	In situ data										Basic output data								
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	26.4	0.62	0.01	0.37	26.4001	2.3485	4	2.61297	114.7573	0.05738	0	0.0574	459.1	2.3536	3E-05	5	0.6292	6.2585	2.0409	155.8117
2	23	0.39	-0.14	0.56	22.9983	1.6958	4	2.57869	111.0289	0.11289	0	0.1129	202.72	1.7041	-4E-04	5	0.6528	4.31	2.0877	93.21841
3	38.7	0.77	-0.29	0.53	38.6965	1.9899	5	2.43781	117.2753	0.17153	0	0.1715	224.59	1.9987	-5E-04	5	0.6459	3.239	2.066	117.9285
4	25.1	0.85	-0.29	0.49	25.0965	3.3869	4	2.72956	116.9424	0.23	0	0.23	108.11	3.4183	-8E-04	5	0.7624	3.2012	2.3697	75.23145
5	26.2	0.31	-0.29	0.47	26.1965	1.1834	5	2.44604	109.6667	0.28484	0	0.2848	90.971	1.1964	-8E-04	5	0.6772	2.4319	2.1349	59.55461
6	25.2	0.67	-0.29	0.48	25.1965	2.6591	4	2.66207	115.211	0.34244	0	0.3424	72.579	2.6957	-8E-04	5	0.7738	2.3941	2.3839	56.23494
7	17.6	0.58	-0.29	0.51	17.5965	3.2961	3	2.84238	113.2799	0.39908	0	0.3991	43.092	3.3726	-0.001	4	0.8518	2.2946	2.5805	37.29325
8	46.1	0.77	-0.22	0.63	46.0973	1.6704	5	2.33104	117.7022	0.45793	0	0.4579	99.664	1.6871	-4E-04	5	0.6889	1.7806	2.146	76.80372
9	16.8	0.82	-0.29	0.62	16.7965	4.882	3	2.96522	115.7001	0.51578	0	0.5158	31.565	5.0367	-0.001	3	0.9298	1.9505	2.7687	30.01217
10	22	0.84	-0.29	0.67	21.9965	3.8188	3	2.80692	116.5343	0.57405	0	0.5741	37.318	3.9211	-1E-03	4	0.8863	1.7194	2.647	34.8116
11	32.5	1.59	-0.38	0.68	32.4954	4.893	3	2.75275	122.1549	0.63513	0	0.6351	50.164	4.9906	-9E-04	4	0.8816	1.5683	2.6276	47.22078
12	29.9	1.66	-0.9	0.67	29.889	5.5539	3	2.8171	122.2662	0.69626	0	0.6963	41.928	5.6864	-0.002	3	0.9174	1.468	2.7146	40.50246
13	37.8	2.23	-0.82	0.61	37.79	5.901	3	2.76392	124.9981	0.75876	0	0.7588	48.805	6.022	-0.002	3	0.9097	1.3533	2.6869	47.36105
14	40	2.86	-0.9	0.57	39.989	7.152	3	2.80805	126.9567	0.82224	0	0.8222	47.634	7.3021	-0.002	3	0.9376	1.2668	2.7526	46.89111
15	34.6	1.85	-0.9	0.6	34.589	5.3485	3	2.76043	123.4153	0.88394	0	0.8839	38.13	5.4888	-0.002	3	0.9302	1.1821	2.7253	37.6543
16	23	1.62	-1.05	0.59	22.9872	7.0474	3	2.97096	121.4474	0.94467	0	0.9447	23.334	7.3495	-0.003	3	1	1.1201	2.9616	23.33356
17	39.1	1.75	-0.97	0.48	39.0881	4.4771	4	2.66835	123.307	1.00632	0	1.0063	37.843	4.5954	-0.002	4	0.9149	1.047	2.6702	37.68131
18	29.7	1.71	-0.97	0.41	29.6881	5.7599	3	2.83025	122.4669	1.06756	0	1.0676	26.809	5.9747	-0.002	3	0.9884	0.9913	2.8555	26.81222
19	32.4	1.61	-1.05	0.34	32.3872	4.9711	3	2.75856	122.2382	1.12867	0	1.1287	27.695	5.1506	-0.002	3	0.9701	0.9393	2.8	27.74832
20	104.4	3.29	-1.25	0.28	104.385	3.1518	5	2.26533	130.3217	1.19384	0	1.1938	86.436	3.1883	-9E-04	5	0.7825	0.9099	2.2993	88.73554
21	31.1	1.59	-2.57	0.23	31.0685	5.1177	3	2.78032	122.0454	1.25486	0	1.2549	23.759	5.3331	-0.006	3	0.9987	0.8434	2.8594	23.76372
22	27.2	1.3	-2.53	0.17	27.169	4.7849	3	2.80267	120.2448	1.31498	0	1.315	19.661	5.0282	-0.007	3	1	0.8047	2.9032	19.66117
23	27	0.95	-2.57	0.15	26.9685	3.5226	4	2.71672	117.9317	1.37395	0	1.374	18.629	3.7117	-0.007	3	0.9954	0.7711	2.8354	18.65109
24	25	0.82	-2.57	0.11	24.9685	3.2841	4	2.72271	116.6671	1.43228	0	1.4323	16.433	3.484	-0.008	3	1	0.7388	2.8613	16.43273
25	24	0.61	-2.57	0.11	23.9685	2.545	4	2.66751	114.4027	1.48948	0	1.4895	15.092	2.7136	-0.008	4	0.9969	0.7111	2.8253	15.10766
26	21.7	0.67	-2.57	0.11	21.6685	3.092	4	2.75407	114.8431	1.5469	0	1.5469	13.008	3.3298	-0.009	3	1	0.684	2.9302	13.0077
27	27	0.76	-2.49	0.13	26.9695	2.818	4	2.65469	116.2991	1.60505	0	1.6051	15.803	2.9963	-0.007	4	1	0.6592	2.835	15.80289
28	97.4	4.27	-2.41	-0.08	97.3705	4.3853	9	2.39487	132.0598	1.67108	0	1.6711	57.268	4.4619	-0.002	4	0.8895	0.666	2.5203	60.23529
29	96.5	4.38	-2.26	-0.08	96.4723	4.5402	9	2.40912	132.2233	1.73719	0	1.7372	54.533	4.6234	-0.002	4	0.9026	0.6392	2.5466	57.23044
30	270.8	6.69	-2.03	0.04	270.775	2.4707	8	1.93102	137.28	1.80583	0	1.8058	148.94	2.4873	-5E-04	5	0.7089	0.6846	2.0303	174.0209
31	319.2	3.52	-0.9	0.02	319.189	1.1028	6	1.60466	133.5422	1.8726	0	1.8726	169.45	1.1093	-2E-04	6	0.587	0.7153	1.702	214.4994
32	256.9	7.03	-0.36	-0.08	256.896	2.7365	8	1.98067	137.28	1.94124	0	1.9412	131.34	2.7574	-1E-04	5	0.7414	0.6377	2.0987	153.6521
33	70.7	2.99	-0.06	0.02	70.6993	4.2292	4	2.47287	128.6718	2.00558	0	2.0056	34.251	4.3527	-6E-05	4	0.9646	0.5397	2.6763	35.0348
34	69.7	2.49	-0.06	0.11	69.6993	3.5725	4	2.42285	127.2981	2.06923	0	2.0692	32.684	3.6818	-6E-05	4	0.9533	0.5276	2.6385	33.72277
35	85.8	4.1	-0.29	0.02	85.7965	4.7788	9	2.45852	131.4539	2.13496	0	2.135	39.187	4.9007	-3E-04	4	0.9689	0.5066	2.6714	40.05242
36	40.3	1.65	-0.06	-0.14	40.2993	4.0944	4	2.63175	122.9509	2.19643	0	2.1964	17.348	4.3304	-1E-04	3	1	0.4817	2.9022	17.3476
37	71	3.22	-0.09	-0.26	70.9989	4.5353	4	2.4944	129.2243	2.26104	0	2.261	30.401	4.6845	-9E-05	3	1	0.468	2.7429	30.40093
38	75.5	3.58	-0.29	-0.28	75.4965	4.7419	4	2.4916	130.1496	2.32612	0	2.3261	31.456	4.8927	-3E-04	3	1	0.4549	2.7452	31.45597
39	36.8	1.26	0.02	-0.09	36.8002	3.4239	4	2.60733	120.7562	2.3865	0	2.3865	14.42	3.6613	4E-05	3	1	0.4434	2.9193	14.42019
40	143.7	7.92	0.02	-0.02	143.7	5.5115	9	2.37368	137.28	2.45514	0	2.4551	57.53	5.6073	1E-05	4	0.9559	0.4473	2.5972	59.70651
41	115.8	4.9	-0.06	-0.07	115.799	4.2315	9	2.33598	133.4896	2.52188	0	2.5219	44.918	4.3257	-4E-05	4	0.9548	0.4364	2.5859	46.71588
42	164.4	4.49	-0.01	-0.14	164.4	2.7312	5	2.09246	133.7049	2.58873	0	2.5887	62.506	2.7748	0	5	0.8567	0.4647	2.3207	71.05947
43	63.9	3.23	-0.08	-0.18	63.899	5.0549	4	2.55998	128.9901	2.65323	0	2.6532	23.083	5.2738	-9E-05	3	1	0.3988	2.8653	23.08349
44	32.4	0.77	0.02	-0.23	32.4002	2.3765	4	2.54622	116.8422	2.71165	0	2.7117	10.949	2.5936	5E-05	3	1	0.3902	2.9288	10.94853
45	102.2	4.72	0.22	-0.29	102.203	4.6183	9	2.39931	132.9111	2.77811	0	2.7781	35.789	4.7473	0.0002	4	1	0.3809	2.696	35.78862
46	73.5	4.5	0.24	-0.44	73.5029	6.1222	9	2.58434	131.7579	2.84399	0	2.844	24.845	6.3686	0.0002	3	1	0.3721	2.8985	24.84505
47	69.2	3.47	0.17	-0.5	69.2021	5.0143	4	2.53462	129.7089	2.90884	0	2.9088	22.79	5.2343	0.0002	3	1	0.3638	2.8672	22.79027
48	148.5	6.13	0.08	-0.54	148.501	4.1279	8	2.26268	135.7349	2.97671	0	2.9767	48.888	4.2124	4E-05	4	0.9637	0.3691	2.5526	50.76083
49	354.3	6.79	0.28	-0.63	354.303	1.9164	6	1.77505	137.28	3.04535	0	3.0454	115.34	1.9331	6E-05	6	0.7507	0.4522	1.9855	150.1218
50	47.1	1.43	2.6	-0.56	47.1318	3.034	4	2.49273	122.2858	3.10649	0	3.1065	14.172	3.2481	0.0043	3	1	0.3406	2.8938	14.17205
51	137.8	5.89	2.75	-0.38	137.834	4.2733	9	2.29386	135.2609	3.17412	0	3.1741	42.424	4.374	0.0015	4	0.9977	0.3342	2.6179	42.53197
52	268.8	14.44	3.09	-0.24	268.838	5.3713	9	2.22196	137.28	3.24276	0	3.2428	81.904	5.4369	0.0008	9	0.9504	0.345	2.4844	86.58588
53	48.6	1.23	3.13	-0.43	48.6383	2.5289	5	2.42922	121.2602	3.30339	0	3.3034	13.724	2.7131	0.005	4	1	0.3203	2.8591	13.72376
54	61	1.76	3.05	-0.56	61.0373	2.8835	5	2.39637	124.4357	3.36561	0	3.3656	17.136	3.0518	0.0038	4	1	0.3144	2.8117	17.1356
55	60.3	2.34	2.97	-0.78	60.3364	3.8783	4	2.49175	126.4916	3.42885	0	3.4289	16.597	4.1119	0.0038	3	1	0.3086	2.9028	16.59665
56	47.3	1.8	2.9	-1.12	47.3355	3.8026	4	2.55936	123.98	3.49084	0	3.4908	12.56	4.1054	0.0048	3	1	0.3031	2.9972	12.5599
57	74.6	2.8	2.95	-1.43	74.6361	3.7515	4	2.41841	128.3236	3.55501	0	3.555	19.995	3.9392	0.003	3	1	0.2976	2.8285	19.99465
58	78.2	4.85	3.05	-1.75	78.2373	6.1991	9	2.57158	132.4582	3.62123	0	3.6212	20.605	6.4999	0.0029	3	1	0.2922	2.9633	20.60515
59	75.6	3.67	3.33	-1.73	75.6408	4.8519	4	2.49864	130.3359	3.6864	0	3.6864	19.519	5.1005	0.0033	3	1	0.287	2.9097	19.51885
60	77.8	4.46	3.28	-1.76	77.8402	5.7297	9	2.5463	131.8324	3.75232	0	3.7523	19.745	6.0199	0.0032	3	1	0.282	2.9542	19.74454
61	148.8	8.96	3.72	-1.81	148.846	6.0197	9	2.39696	137.28	3.82096	0	3.821	37.955	6.1783	0.0019	3	1	0.2769	2.7602	37.95502
62	276.5	12.97	4.18	-1.68	276.551	4.6899	9	2.16444	137.28	3.8896	0	3.8896	70.1	4.7568	0.0011	4	0.9834	0.278	2.4915	71.63631
63	284.9	12.26	4.64	-1.66	284.957	4.3024	8	2.1254	137.28	3.95824	0	3.9582	70.991	4.363	0.0012	4	0.9731	0.277	2.4555	73.55751
64	393.8	16.5	4.39	-1.57	393.854	4.1894	8	2.04989	137.28	4.02688	0	4.0269	96.806	4.2327	0.0008	9	0.9351	0.2866	2.3456	105.5853
65	381.4	10.24	4.55	-1.36	381.456	2.6845	8	1.88479	137.28	4.09552	0	4.0955	92.14	2.7136	0.0009	5	0.8777	0.3049	2.1885	108.7272
66	60.3	2.54	0.85	-0.75	60.3104	4.2116	4	2.51798	127.0907	4.15906	0	4.1591	13.501	4.5235	0.0011	3	1	0.2544	2.9986	13.50095
67	62.2	1.33	0.77	-1.19	62.2094	2.1379	5	2.30104	122.4323	4.22028	0	4.2203	13.741	2.2935	0.001	4	1	0.2507	2.8171	13.74059
68	70	1.65	0.47	-1.47	70.0058	2.357	5	2.29262	124.2978	4.28243	0	4.2824	15.347	2.5105	0.0005	4	1	0.2471	2.8	15.34721

69	69.5	2.05	0.47	-1.91	69.5058	2.9494	5	2.36347	125.8686	4.34536	0	4.3454	14.995	3.1461	0.0005	3	1	0.2435	2.8659	14.99538
70	215.8	4.58	0.62	-2.44	215.808	2.1223	6	1.93372	134.5137	4.41262	0	4.4126	47.907	2.1666	0.0002	5	0.9552	0.2556	2.3504	51.07018
71	69.6	4.9	0.62	-2.92	69.6076	7.0395	9	2.64639	132.2481	4.47874	0	4.4787	14.542	7.5236	0.0007	3	1	0.2363	3.1175	14.54176
72	124.9	4.81	1	-3.22	124.912	3.8507	8	2.28346	133.5387	4.54551	0	4.5455	26.48	3.9961	0.0006	4	1	0.2328	2.7402	26.48033
73	63	3.04	0.77	-3.29	63.0094	4.8247	4	2.54885	128.5123	4.60977	0	4.6098	12.669	5.2055	0.001	3	1	0.2295	3.0584	12.66867
74	435.3	12.97	0.77	-3.35	435.309	2.9795	8	1.898	137.28	4.67841	0	4.6784	92.046	3.0119	0.0001	5	0.924	0.2532	2.238	103.0513

	CPT-17	In situ data										Basic output data								
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	46.6	2.42	-0.04	-0.17	46.5995	5.1932	4	2.66096	126.1075	0.06305	0	0.0631	738.04	5.2002	-6E-05	9	0.6823	6.8501	2.1749	301.2728
2	8.2	0.32	0.23	-0.25	8.20282	3.9011	3	3.15273	107.0669	0.11659	0	0.1166	69.358	3.9574	0.0021	4	0.829	6.2246	2.5528	47.56906
3	13.6	0.75	-0.67	-0.27	13.5918	5.518	3	3.06987	114.5309	0.17385	0	0.1739	77.18	5.5895	-0.004	4	0.848	4.6249	2.6013	58.64866
4	15.7	0.95	-0.6	-0.27	15.6927	6.0538	3	3.0484	116.6111	0.23216	0	0.2322	66.595	6.1447	-0.003	3	0.8707	3.7461	2.652	54.73643
5	13.7	0.75	-3.42	-0.35	13.6581	5.4912	3	3.06689	114.5428	0.28943	0	0.2894	46.19	5.6101	-0.018	3	0.8963	3.1959	2.7112	40.37873
6	10.8	0.5	-1.52	-0.27	10.7814	4.6376	3	3.10143	110.9991	0.34493	0	0.3449	30.257	4.7909	-0.01	3	0.9244	2.8185	2.7778	27.79933
7	8.9	0.38	-1.29	-0.27	8.88421	4.2773	3	3.14777	108.519	0.39919	0	0.3992	21.256	4.4785	-0.011	3	0.9584	2.5453	2.8579	20.4111
8	11	0.42	-1.14	-0.35	10.9861	3.823	3	3.04455	109.7692	0.45407	0	0.4541	23.194	3.9879	-0.008	3	0.939	2.213	2.7999	22.02756
9	13.9	0.49	-0.83	-0.37	13.8898	3.5278	3	2.94197	111.4692	0.50981	0	0.5098	26.245	3.6622	-0.004	4	0.918	1.9548	2.7378	24.71895
10	22.8	0.98	-0.6	-0.42	22.7927	4.2996	3	2.82858	117.7489	0.56868	0	0.5687	39.08	4.4097	-0.002	4	0.8935	1.7416	2.6668	36.5799
11	22.3	1.09	-0.51	-0.45	22.2938	4.8893	3	2.87263	118.4733	0.62792	0	0.6279	34.504	5.031	-0.002	3	0.923	1.6187	2.7375	33.14443
12	20.1	1.06	-0.46	-0.47	20.0944	5.2751	3	2.92827	118.0158	0.68693	0	0.6869	28.253	5.4618	-0.002	3	0.9562	1.5115	2.8179	27.72301
13	19.1	0.91	-0.53	-0.53	19.0935	4.766	3	2.91603	116.7747	0.74531	0	0.7453	24.618	4.9596	-0.002	3	0.9638	1.4018	2.8307	24.30773
14	23.2	1.1	-0.53	-0.56	23.1935	4.7427	3	2.85101	118.6366	0.80463	0	0.8046	27.825	4.9132	-0.002	3	0.9508	1.2974	2.7893	27.45248
15	27.1	1.21	-0.53	-0.62	27.0935	4.466	3	2.78335	119.7131	0.86449	0	0.8645	30.34	4.6132	-0.001	3	0.936	1.2082	2.743	29.95036
16	21.5	0.8	-0.48	-0.66	21.4941	3.722	3	2.80749	116.1209	0.92255	0	0.9226	22.299	3.8889	-0.002	3	0.9569	1.1402	2.7907	22.16715
17	27.5	1.76	-0.46	-0.69	27.4944	6.4013	3	2.88617	122.4906	0.98379	0	0.9838	26.947	6.6389	-0.001	3	0.9961	1.0752	2.8862	26.9396
18	27.6	1.56	-0.41	-0.72	27.595	5.6532	3	2.84739	121.6168	1.0446	0	1.0446	25.417	5.8756	-0.001	3	0.9917	1.0128	2.8671	25.41401
19	28.6	1.86	-0.46	-0.74	28.5944	6.5048	3	2.87897	122.9906	1.1061	0	1.1061	24.852	6.7665	-0.001	3	1	0.9566	2.9169	24.85156
20	36	1.59	-0.76	-0.76	35.9907	4.4178	4	2.69001	122.4041	1.1673	0	1.1673	29.832	4.5659	-0.002	3	0.9489	0.911	2.7396	29.98239
21	41	1.66	-0.61	-0.78	40.9925	4.0495	4	2.6231	123.0367	1.22882	0	1.2288	32.359	4.1747	-0.001	4	0.9313	0.87	2.6855	32.69366
22	26.2	0.97	-0.61	-0.8	26.1925	3.7034	4	2.74049	118.013	1.28783	0	1.2878	19.339	3.8949	-0.002	3	0.9916	0.823	2.836	19.37063
23	30.4	1.24	-0.56	-0.81	30.3932	4.0799	4	2.72	120.1726	1.34791	0	1.3479	21.548	4.2692	-0.001	3	0.9906	0.7868	2.8257	21.59757
24	31.2	1.51	-0.53	-0.84	31.1935	4.8408	3	2.76235	121.6774	1.40875	0	1.4088	21.143	5.0697	-0.001	3	1	0.7511	2.882	21.14268
25	28.5	0.94	-0.46	-0.82	28.4944	3.2989	4	2.68004	117.9885	1.46774	0	1.4677	18.414	3.4781	-0.001	3	0.9945	0.7222	2.8214	18.44664
26	80.1	3.53	-0.3	-0.9	80.0963	4.4072	4	2.45074	130.191	1.53284	0	1.5328	51.254	4.4932	-3E-04	4	0.8975	0.717	2.5588	53.23836
27	54.5	2.81	-0.17	-1.1	54.4979	5.1562	4	2.61247	127.5827	1.59663	0	1.5966	33.133	5.3118	-2E-04	3	0.9736	0.67	2.7508	33.49529
28	286.9	5.21	-0.1	-1.29	286.899	1.816	6	1.8063	136.1512	1.66471	0	1.6647	171.34	1.8266	-3E-05	6	0.6472	0.7458	1.8859	201.0461
29	167.3	6.06	0.24	-1.18	167.303	3.6222	8	2.18638	135.9417	1.73268	0	1.7327	95.557	3.6601	0.0001	5	0.8078	0.6714	2.2976	105.0603
30	84.9	3.81	0.61	-1	84.9075	4.4872	4	2.44036	130.8917	1.79812	0	1.7981	46.22	4.5843	0.0005	4	0.924	0.6127	2.5952	48.12089
31	73.6	2.38	0.68	-0.78	73.6083	3.2333	5	2.37503	127.1006	1.86167	0	1.8617	38.539	3.3172	0.0007	4	0.9095	0.5982	2.5489	40.5605
32	93.6	4.84	0.61	-0.51	93.6075	5.1705	9	2.46145	132.8805	1.92811	0	1.9281	47.549	5.2793	0.0005	4	0.9448	0.5673	2.6337	49.15011
33	64	2.68	0.68	-0.25	64.0083	4.187	4	2.49858	127.6284	1.99193	0	1.9919	31.134	4.3214	0.0008	4	0.9754	0.5395	2.7063	31.62267
34	64.8	3.07	0.76	-0.05	64.8093	4.737	4	2.53477	128.6528	2.05625	0	2.0563	30.518	4.8922	0.0009	3	0.9967	0.5157	2.754	30.58523
35	189.2	5.15	0.53	-0.09	189.206	2.7219	5	2.05454	135.0512	2.12378	0	2.1238	88.089	2.7528	0.0002	5	0.7933	0.5754	2.2122	101.7348
36	40	2.02	0.23	-0.15	40.0028	5.0496	4	2.6982	124.4133	2.18599	0	2.186	17.3	5.3415	0.0004	3	1	0.484	2.9623	17.29966
37	640.8	5.98	0.46	-0.23	640.806	0.9332	6	1.37445	137.28	2.25463	0	2.2546	283.22	0.9365	5E-05	6	0.5164	0.6766	1.4689	408.3362
38	240.4	6.52	0.38	-0.35	240.405	2.7121	8	1.99336	137.28	2.32327	0	2.3233	102.48	2.7386	0.0001	5	0.7829	0.5402	2.1602	121.5557
39	306.5	7.02	0.23	-0.47	306.503	2.2904	6	1.87413	137.28	2.39191	0	2.3919	127.14	2.3084	5E-05	5	0.7371	0.5482	2.0313	157.5448
40	269.3	4.5	0.27	-0.52	269.303	1.671	6	1.79301	134.9249	2.45937	0	2.4594	108.5	1.6864	7E-05	6	0.7153	0.547	1.9655	137.9477
41	246.6	5.63	-5.72	-0.63	246.53	2.2837	6	1.92561	136.3487	2.52754	0	2.5275	96.537	2.3074	-0.002	5	0.7748	0.5093	2.1135	117.4472
42	41.8	1.43	-5.69	-0.67	41.7304	3.4268	4	2.56745	121.9889	2.58854	0	2.5885	15.121	3.6534	-0.01	3	1	0.4088	2.9024	15.1212
43	73.4	2.33	-5.62	-0.64	73.3312	3.1774	5	2.37064	126.936	2.65201	0	2.652	26.651	3.2966	-0.006	4	0.9977	0.3999	2.6826	26.70893
44	71.6	4.83	-5.54	-0.45	71.5322	6.7522	9	2.62487	132.2094	2.71811	0	2.7181	25.317	7.0189	-0.006	3	1	0.3893	2.9224	25.31688
45	61.5	3.16	-5.69	-0.31	61.4304	5.144	4	2.57699	128.7336	2.78248	0	2.7825	21.078	5.3881	-0.007	3	1	0.3803	2.9007	21.07757
46	65.6	3.33	-5.79	-0.3	65.5291	5.0817	4	2.55451	129.2746	2.84712	0	2.8471	22.016	5.3125	-0.007	3	1	0.3716	2.8826	22.01597
47	193.8	6.56	-5.92	-0.29	193.728	3.3862	8	2.12583	136.8794	2.91555	0	2.9156	65.446	3.4379	-0.002	5	0.8952	0.4036	2.3812	72.78472
48	51.6	2.99	-4.55	-0.25	51.5443	5.8008	3	2.66665	127.9011	2.97951	0	2.9795	16.3	6.1567	-0.007	3	1	0.3551	3.0225	16.29962
49	235.2	6.29	-4.48	-0.36	235.145	2.6749	8	1.99379	137.0444	3.04803	0	3.048	76.147	2.7101	-0.001	5	0.8496	0.407	2.2451	89.27692
50	206.5	8	-4.55	-0.6	206.444	3.8751	8	2.15909	137.28	3.11667	0	3.1167	65.239	3.9345	-0.002	4	0.9252	0.3681	2.433	70.72876
51	41.4	1.38	-4.17	-0.56	41.349	3.3375	4	2.56254	121.7061	3.17752	0	3.1775	12.013	3.6153	-0.008	3	1	0.333	2.9792	12.01296
52	51.9	1.48	-4.25	-0.62	51.848	2.8545	5	2.4444	122.7699	3.23891	0	3.2389	15.008	3.0447	-0.006	3	1	0.3267	2.8571	15.00787
53	55.9	2.21	-4.4	-0.65	55.8461	3.9573	4	2.52127	125.8848	3.30185	0	3.3019	15.914	4.206	-0.006	3	1	0.3205	2.9231	15.9136
54	48.8	1.9	-4.48	-0.66	48.7452	3.8978	4	2.5579	124.4472	3.36407	0	3.3641	13.49	4.1868	-0.007	3	1	0.3145	2.9779	13.48993
55	63.1	2.82	-4.48	-0.66	63.0452	4.473	4	2.52423	127.964	3.42805	0	3.4281	17.391	4.7302	-0.005	3	1	0.3087	2.9261	17.39095
56	130.7	9.67	-4.28	-0.87	130.648	7.4016	9	2.50307	137.28	3.49669	0	3.4967	36.363	7.6051	-0.002	3	1	0.3026	2.8391	36.36319
57	83.2	4.88	-3.95	-1.43	83.1517	5.8688	9	2.53651	132.6519	3.56302	0	3.563	22.337	6.1315	-0.004	3	1	0.297	2.9204	22.33741
58	68.6	3.71	-4.02	-1.84	68.5508	5.4121	4	2.56248	130.1752	3.62811	0	3.6281	17.894	5.7145	-0.004	3	1	0.2916	2.9707	17.89437
59	220.2	12.58	-3.95	-2.06	220.152	5.7142	9	2.28802	137.28	3.69675	0	3.6968	58.553	5.8118	-0.001	4	1	0.2862	2.6145	58.5528
60	301.2	13.59	-3.34	-2.3	301.159	4.5126	8	2.13194	137.28	3.76539	0	3.7654	78.981	4.5697	-8E-04	9	0.9566	0.2969	2.4356	83.45796
61	527.9	11.02	2.88	-2.4	527.935	2.0874	8	1.72229	137.28	3.83403	0	3.834	136.7	2.1027	0.0004	6	0.7788	0.3669	1.961	181.7418
62	490.5	10.74	2.56	-2.28	490.531	2.1895	8	1.75523	137.28	3.90267	0	3.9027	124.69	2.207	0.0004	5	0.8002	0.3519	2.0088	161.8351
63	472.4	12.05	9.05	-2.18	472.511	2.5502	8	1.82163	137.28	3.97131	0	3.9713	117.98	2.5718	0.0014	5	0.833	0.3323	2.0865	147.1418
64	202.5	10.19	3.84	-2.26	202.547	5.0309	9	2.25922	137.28	4.03995	0	4.04	49.136	5.1333	0.0014	4	1	0.2619	2.6249	49.13605
65	62.9	2.15	0.23	-2.54	62.9028	3.418	4	2.4396	125.9736	4.10293	0	4.1029	14.331	3.6565	0.0003	3	1	0.2579	2.9211	14.33118
66	64	3.29	-0.25	-2.65	63.9969	5.1409	4	2.56505	129.1285	4.1675	0	4.1675	14.356	5.499	-3E-04	3	1	0.2539	3.0319	14.3562
67	78.5	2.12	-0.23	-2.55	78.4972	2.7007	5	2.29921	126.411	4.2307	0	4.2307	17.554	2.8546	-2E-04	4	1	0.2501	2.7858	17.55417
68	71.9	2.41	-0.3	-2.66	71.8963	3.3521	5	2.39344	127.1348	4.29427	0	4.2943	15.742	3.565	-3E-04	3	1	0.2464	2.8821	15.74238

69	153.2	8.23	-0.33	-2.84	153.196	5.3722	9	2.3489	137.28	4.36291	0	4.3629	34.113	5.5297	-2E-04	3	1	0.2425	2.7576	34.11324
70	115.9	3.5	0	-3.21	115.9	3.0198	5	2.22174	131.0297	4.42843	0	4.4284	25.172	3.1398	0	4	1	0.2389	2.6887	25.17183
71	60.7	3.68	0	-3.38	60.7	6.0626	3	2.63426	129.8192	4.49334	0	4.4933	12.509	6.5473	0	3	1	0.2355	3.1266	12.5089
72	212.5	7.54	0.23	-3.38	212.503	3.5482	8	2.12019	137.28	4.56198	0	4.562	45.581	3.626	8E-05	4	1	0.2319	2.5391	45.58131
73	206.7	4.65	0.24	-3.32	206.703	2.2496	6	1.9652	134.5196	4.62924	0	4.6292	43.652	2.3011	9E-05	5	0.9904	0.2318	2.4143	44.27582
74	542.7	16.94	0.97	-3.3	542.712	3.1214	8	1.87524	137.28	4.69788	0	4.6979	114.52	3.1486	0.0001	5	0.9046	0.2596	2.1847	132.0152
75	329.2	14.34	1.92	-3.3	329.224	4.3557	8	2.10017	137.28	4.76652	0	4.7665	68.07	4.4197	0.0004	4	1	0.222	2.4819	68.07006
76	769.7	0	1.52	-3.58	769.719	0	0	0	120.9	4.82697	0	4.827	158.46	0	0.0001	0	1	0.2192	0	0

	CPT-18	In situ data										Basic output data								
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	31	1.74	0.41	0.2	31.005	5.612	3	2.80888	122.7	0.06135	0	0.0614	504.38	5.6231	0.001	9	0.7167	7.6984	2.2649	225.1333
2	20.1	1.04	4.1	0.18	20.1502	5.1612	3	2.92109	117.8832	0.12029	0	0.1203	166.51	5.1922	0.0147	9	0.7792	5.4428	2.4225	103.0309
3	15.5	0.94	4.71	0.18	15.5577	6.042	3	3.05068	116.5126	0.17855	0	0.1786	86.134	6.1122	0.0221	9	0.8476	4.5185	2.5992	65.67381
4	11	0.65	1.58	0.18	11.0193	5.8987	3	3.15868	112.9721	0.23503	0	0.235	45.884	6.0273	0.0106	3	0.9041	3.8968	2.7388	39.71671
5	12.1	0.65	0.49	0.17	12.106	5.3692	3	3.10123	113.2015	0.29163	0	0.2916	40.511	5.5018	0.003	3	0.9074	3.2201	2.7401	35.95359
6	10.5	0.32	0.68	0.16	10.5083	3.0452	3	3.003	107.6711	0.34547	0	0.3455	29.417	3.1487	0.0048	4	0.8869	2.6986	2.6797	25.91975
7	8.8	0.29	0.86	0.14	8.81053	3.2915	3	3.08523	106.521	0.39873	0	0.3987	21.096	3.4475	0.0074	4	0.9349	2.4904	2.7951	19.79839
8	10.8	0.56	0.45	0.14	10.8055	5.1825	3	3.13024	111.8338	0.45465	0	0.4547	22.767	5.4102	0.0031	3	0.971	2.2711	2.8851	22.21644
9	17.1	0.61	1.08	0.12	17.1132	3.5645	3	2.8728	113.581	0.51144	0	0.5114	32.461	3.6743	0.0047	4	0.8933	1.9145	2.6751	30.03814
10	22.3	0.94	1.42	0.1	22.3174	4.212	3	2.82966	117.3926	0.57013	0	0.5701	38.144	4.3224	0.0047	4	0.8941	1.7383	2.6681	35.72614
11	19.1	0.84	1.47	0.06	19.118	4.3938	3	2.89274	116.1922	0.62823	0	0.6282	29.432	4.5431	0.0057	3	0.9299	1.6238	2.7555	28.37453
12	17.6	0.85	1.52	0	17.6186	4.8245	3	2.94604	116.0796	0.68627	0	0.6863	24.673	5.02	0.0065	3	0.9626	1.517	2.8347	24.27628
13	17.8	0.94	1.52	-0.06	17.8186	5.2754	3	2.96755	116.8435	0.74469	0	0.7447	22.927	5.5055	0.0064	3	0.9833	1.4125	2.882	22.79317
14	16.1	0.79	1.52	-0.11	16.1186	4.9012	3	2.98002	115.3269	0.80236	0	0.8024	19.089	5.1579	0.0072	3	1	1.3188	2.9201	19.08911
15	17.9	0.81	1.52	-0.14	17.9186	4.5204	3	2.92222	115.7681	0.86024	0	0.8602	19.83	4.7484	0.0064	3	0.9897	1.2274	2.8847	19.78765
16	15.9	0.79	1.52	-0.19	15.9186	4.9628	3	2.98766	115.2965	0.91789	0	0.9179	16.343	5.2664	0.0073	3	1	1.1528	2.9769	16.34265
17	13.2	0.6	1.43	-0.24	13.2175	4.5394	3	3.0259	112.83	0.9743	0	0.9743	12.566	4.9007	0.0084	3	1	1.086	3.0446	12.56612
18	12.1	0.34	1.44	-0.3	12.1176	2.8058	3	2.93188	108.4622	1.02853	0	1.0285	10.781	3.0661	0.0094	3	1	1.0288	2.9754	10.78146
19	19.3	0.68	1.49	-0.35	19.3182	3.52	3	2.82815	114.6715	1.08587	0	1.0859	16.791	3.7296	0.0059	3	0.9956	0.9745	2.8722	16.79247
20	22.2	0.6	1.67	-0.37	22.2204	2.7002	4	2.70926	114.097	1.14292	0	1.1429	18.442	2.8466	0.0057	4	0.9582	0.9288	2.7669	18.50138
21	22.2	0.73	1.9	-0.35	22.2233	3.2849	4	2.76192	115.5323	1.20068	0	1.2007	17.509	3.4725	0.0065	3	0.9881	0.8826	2.8382	17.53521
22	26.2	1.01	1.9	-0.26	26.2233	3.8515	4	2.75126	118.3115	1.25984	0	1.2598	19.815	4.0459	0.0055	3	0.9912	0.8412	2.8385	19.84522
23	21.8	0.91	2.02	-0.26	21.8247	4.1696	3	2.83416	117.1008	1.31839	0	1.3184	15.554	4.4377	0.0071	3	1	0.8026	2.9456	15.55407
24	19.7	0.86	2.05	-0.24	19.7251	4.3599	3	2.88019	116.4406	1.37661	0	1.3766	13.329	4.687	0.008	3	1	0.7686	3.0126	13.32874
25	22.7	1.16	2.05	-0.22	22.7251	5.1045	3	2.87891	118.9755	1.4361	0	1.4361	14.824	5.4488	0.0069	3	1	0.7368	3.0187	14.82419
26	32.2	1.2	1.91	-0.22	32.2234	3.724	4	2.67457	120.0753	1.49614	0	1.4961	20.538	3.9053	0.0045	3	0.9941	0.7087	2.8165	20.58006
27	20.9	0.66	2.05	-0.22	20.9251	3.1541	4	2.77132	114.6479	1.55346	0	1.5535	12.47	3.407	0.0076	3	1	0.6811	2.9508	12.46999
28	25.2	0.77	2.13	-0.26	25.2261	3.0524	4	2.69909	116.2317	1.61158	0	1.6116	14.653	3.2607	0.0065	3	1	0.6566	2.8833	14.65305
29	27.7	0.67	2.14	-0.35	27.7262	2.4165	4	2.60373	115.4443	1.6693	0	1.6693	15.609	2.5713	0.0059	4	0.9957	0.6351	2.7994	15.64009
30	26.8	0.66	2.43	-0.41	26.8297	2.46	4	2.61975	115.2541	1.72693	0	1.7269	14.536	2.6292	0.007	4	1	0.6127	2.8309	14.53614
31	46.1	1.05	2.68	-0.51	46.1328	2.276	5	2.41626	119.9734	1.78691	0	1.7869	24.817	2.3678	0.0044	4	0.9268	0.6153	2.6038	25.7874
32	99.9	4.55	3.32	-0.61	99.9406	4.5527	9	2.40048	132.5881	1.85321	0	1.8532	52.929	4.6387	0.0024	4	0.9118	0.5999	2.5561	55.61162
33	84.8	5.69	3.01	-0.83	84.8368	6.707	9	2.57691	133.8244	1.92012	0	1.9201	43.183	6.8623	0.0026	3	0.9907	0.5541	2.7543	43.42203
34	83.7	2.88	3.26	-1.06	83.7399	3.4392	5	2.35692	128.8104	1.98452	0	1.9845	41.196	3.5227	0.0029	4	0.9138	0.5629	2.5449	43.49021
35	79.5	2.49	3.57	-1	79.5437	3.1304	5	2.34176	127.6203	2.04833	0	2.0483	37.833	3.2131	0.0033	4	0.9166	0.5458	2.5441	39.97628
36	76.6	3.53	2.78	-0.94	76.634	4.6063	4	2.47779	130.0832	2.11338	0	2.1134	35.261	4.7369	0.0027	4	0.9768	0.5088	2.695	35.83205
37	270.6	6.06	2.43	-0.97	270.63	2.2392	6	1.89562	137.1147	2.18193	0	2.1819	123.03	2.2574	0.0007	5	0.7297	0.5897	2.038	149.6172
38	230.2	6.67	2.43	-1.15	230.23	2.8971	8	2.02762	137.28	2.25057	0	2.2506	101.3	2.9257	0.0008	5	0.7904	0.5507	2.1889	118.6568
39	62.7	3.17	2.4	-1.29	62.7294	5.0535	4	2.56519	128.8078	2.31498	0	2.315	26.097	5.2471	0.0029	3	1	0.4571	2.8249	26.0972
40	50.2	0.84	2.96	-1.62	50.2362	1.6721	5	2.30211	118.5485	2.37425	0	2.3743	20.159	1.7551	0.0045	4	0.9536	0.4627	2.6006	20.92995
41	90.6	6.22	3.47	-1.89	90.6425	6.8621	9	2.56749	134.6375	2.44157	0	2.4416	36.125	7.0521	0.0028	3	1	0.4334	2.8168	36.12468
42	62.8	3.47	3.54	-2.01	62.8433	5.5217	4	2.59366	129.4739	2.50631	0	2.5063	24.074	5.751	0.0042	3	1	0.4222	2.8777	24.07408
43	68.3	4.04	3.57	-2.27	68.3437	5.9113	4	2.59265	130.7913	2.5717	0	2.5717	25.575	6.1424	0.0039	3	1	0.4114	2.8785	25.57528
44	548.7	10.45	2.96	-2.38	548.736	1.9044	8	1.67915	137.28	2.64034	0	2.6403	206.83	1.9136	0.0004	6	0.6671	0.5433	1.8167	280.415
45	524.3	9.83	2.51	-2.52	524.331	1.8748	8	1.68208	137.28	2.70898	0	2.709	192.55	1.8845	0.0004	6	0.6749	0.5302	1.8286	261.3751
46	536.4	5.66	2.46	-2.84	536.43	1.0551	6	1.45981	137.28	2.77762	0	2.7776	192.13	1.0606	0.0003	6	0.5941	0.5636	1.6076	284.2507
47	655.7	9.84	0.2	-2.99	655.702	1.5007	6	1.55212	137.28	2.84626	0	2.8463	229.37	1.5072	2E-05	6	0.6288	0.5368	1.6904	331.1801
48	484.4	8.24	-3.57	-3.28	484.356	1.7012	6	1.66126	137.28	2.9149	0	2.9149	165.17	1.7115	-5E-04	6	0.6857	0.4992	1.8311	227.1156
49	99.6	2.51	-4.53	-3.3	99.5446	2.5215	5	2.20665	128.2259	2.97901	0	2.979	32.415	2.5993	-0.003	4	0.9581	0.3709	2.5373	33.85115
50	128.7	2.53	-3.87	-3.39	128.653	1.9665	5	2.05179	128.9096	3.04347	0	3.0435	41.272	2.0142	-0.002	5	0.8944	0.3887	2.3631	46.14473
51	123.7	4.77	-3.49	-3.27	123.657	3.8574	8	2.28674	133.4529	3.1102	0	3.1102	38.759	3.957	-0.002	4	0.9937	0.3425	2.6138	39.02465
52	253.7	14.78	-3.16	-3.14	253.661	5.8267	9	2.26508	137.28	3.17884	0	3.1788	78.797	5.9006	-9E-04	9	0.9633	0.3466	2.5268	82.03942
53	162.6	7.42	-2.58	-3.29	162.568	4.5642	9	2.27583	137.28	3.24748	0	3.2475	49.06	4.6573	-0.001	4	0.9919	0.3288	2.5917	49.50654
54	155.5	10.12	-2.81	-3.38	155.466	6.5095	9	2.41513	137.28	3.31612	0	3.3161	45.882	6.6514	-0.001	3	1	0.3191	2.7283	45.88183
55	91.8	4.88	-2.96	-3.45	91.7638	5.318	9	2.47639	132.8922	3.38256	0	3.3826	26.128	5.5215	-0.002	3	1	0.3128	2.8397	26.12848
56	101.2	7.29	-3.49	-3.62	101.157	7.2066	9	2.5565	136.0667	3.4506	0	3.4506	28.316	7.4611	-0.003	3	1	0.3067	2.9072	28.31589
57	120.2	7.69	-3.26	-3.72	120.16	6.3998	9	2.47122	136.8774	3.51903	0	3.519	33.146	6.5929	-0.002	3	1	0.3007	2.8211	33.14576
58	238.9	8.98	-2.99	-3.72	238.863	3.7595	8	2.11395	137.28	3.58767	0	3.5877	65.579	3.8168	-9E-04	4	0.9445	0.3156	2.4255	70.17383
59	179.2	7.94	-0.97	-3.94	179.188	4.4311	9	2.24154	137.28	3.65631	0	3.6563	48.008	4.5234	-4E-04	4	1	0.2894	2.5917	48.00786
60	297.4	12.4	-0.99	-4.2	297.388	4.1696	8	2.10448	137.28	3.72495	0	3.725	78.837	4.2225	-2E-04	4	0.9433	0.3051	2.4052	84.67041
61	105.8	5.87	-0.98	-4.47	105.788	5.5488	9	2.45342	134.5906	3.79225	0	3.7923	26.896	5.7551	-7E-04	3	1	0.279	2.8432	26.89584
62	100.9	4.97	-1.03	-4.74	100.887	4.9263	9	2.42485	133.2571	3.85888	0	3.8589	25.144	5.1222	-8E-04	3	1	0.2742	2.8295	25.14423
63	73.8	2.16	-1.21	-4.98	73.7852	2.9274	5	2.34306	126.3968	3.92208	0	3.9221	17.813	3.0918	-0.001	4	1	0.2698	2.8018	17.81279
64	109	3.41	-1.1	-5.11	108.987	3.1288	5	2.25074	130.6891	3.98742	0	3.9874	26.333	3.2477	-8E-04	4	1	0.2654	2.6831	26.33259
65	65.8	1.74	-1.06	-5.18	65.787	2.6449	5	2.34687	124.5348	4.04969	0	4.0497	15.245	2.8184	-0.001	4	1	0.2613	2.8317	15.24496
66	415.2	8.83	-0.99	-5.3	415.188	2.1268	8	1.77857	137.28	4.11833	0	4.1183	99.815	2.1481	-2E-04	5	0.8346	0.3217	2.0723	124.9642
67	103.1	5.16	-1.31	-5.49	103.084	5.0056	9	2.4246	133.5842	4.18512	0	4.1851	23.631	5.2175	-1E-03	3	1	0.2528	2.8547	23.63106
68	134.5	6.99	0.43	-5.62	134.505	5.1968	9	2.36906	136.4541	4.25335	0	4.2534	30.623	5.3665	0.0002	3	1	0.2488	2.7816	30.62339

69	60.1	2.72	0.15	-5.77	60.1018	4.5257	4	2.54197	127.5832	4.31714	0	4.3171	12.922	4.8759	0.0002	3	1	0.2451	3.0338	12.92168
70	236.5	12.57	0.28	-5.55	236.503	5.3149	9	2.2452	137.28	4.38578	0	4.3858	52.925	5.4154	9E-05	4	1	0.2413	2.6204	52.92507
71	225.1	12.82	1.79	-5.78	225.122	5.6947	9	2.28186	137.28	4.45442	0	4.4544	49.539	5.8097	0.0006	3	1	0.2375	2.6623	49.539
72	361.6	15.22	3.26	-6.26	361.64	4.2086	8	2.06819	137.28	4.52306	0	4.5231	78.955	4.2619	0.0007	4	0.987	0.2384	2.4225	80.46363
73	234.2	13.05	6.34	-6.26	234.278	5.5703	9	2.26492	137.28	4.5917	0	4.5917	50.022	5.6817	0.002	3	1	0.2304	2.6523	50.02198
74	238	14.31	10.71	-6.46	238.131	6.0093	9	2.2901	137.28	4.66034	0	4.6603	50.097	6.1293	0.0033	3	1	0.2271	2.6764	50.09737
75	386.4	11.16	10.31	-6.57	386.526	2.8873	8	1.90979	137.28	4.72898	0	4.729	80.736	2.923	0.0019	5	0.9409	0.2445	2.2729	88.2122
76	475.2	10.83	10.08	-6.58	475.323	2.2785	8	1.77688	137.28	4.79762	0	4.7976	98.075	2.3017	0.0015	5	0.8824	0.2635	2.1134	117.1638
77	117.4	5.38	9.23	-6.62	117.513	4.5782	9	2.35925	134.2092	4.86472	0	4.8647	23.156	4.7759	0.0059	3	1	0.2175	2.8353	23.15615
78	168	10.46	8.76	-6.55	168.107	6.2222	9	2.38038	137.28	4.93336	0	4.9334	33.076	6.4103	0.0039	3	1	0.2145	2.813	33.07558
79	367.3	12.43	8.88	-6.51	367.409	3.3832	8	1.98088	137.28	5.002	0	5.002	72.452	3.4299	0.0018	5	0.9938	0.2136	2.379	73.15034
80	383.8	0	3.74	-6.22	383.846	0	0	0	120.9	5.06245	0	5.0625	74.822	0	0.0007	0	1	0.209	0	0

	CPT-19	In situ data										Basic output data								
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	19.2	0.65	8.74	-0.22	19.307	3.3667	4	2.8163	114.3399	0.05717	0	0.0572	336.71	3.3767	0.0327	8	0.6929	7.5525	2.1981	137.4009
2	4.8	0.06	1.27	-0.25	4.81554	1.246	3	3.10439	93.51938	0.10393	0	0.1039	45.335	1.2735	0.0194	5	0.7825	6.1457	2.4265	27.36586
3	8.9	0.5	-1.37	-0.29	8.88323	5.6286	3	3.21938	110.5268	0.15919	0	0.1592	54.802	5.7313	-0.011	3	0.8824	5.3195	2.6935	43.85855
4	7.2	0.48	1.56	-0.32	7.21909	6.649	3	3.33491	109.7222	0.21405	0	0.2141	32.726	6.8522	0.016	3	0.9499	4.5625	2.8612	30.20525
5	8.7	0.32	1.23	-0.31	8.71506	3.6718	3	3.11609	107.2147	0.26766	0	0.2677	31.56	3.7882	0.0105	4	0.8962	3.4273	2.7142	27.36214
6	8.4	0.23	1.65	-0.27	8.4202	2.7315	3	3.05688	104.7144	0.32002	0	0.32	25.312	2.8394	0.0147	4	0.8942	2.9133	2.7021	22.30214
7	11.4	0.32	2.26	-0.21	11.4277	2.8002	3	2.95236	107.8756	0.37396	0	0.374	29.559	2.895	0.0147	4	0.8788	2.4943	2.6547	26.05708
8	9.1	0.3	2.27	-0.23	9.12778	3.2867	3	3.07218	106.8553	0.42738	0	0.4274	20.357	3.4481	0.0188	4	0.9395	2.3437	2.8042	19.27156
9	18.6	0.43	1.55	-0.27	18.619	2.3095	4	2.73061	111.2281	0.483	0	0.483	37.549	2.371	0.0062	4	0.8331	1.922	2.5209	32.94241
10	23	0.89	0.8	-0.25	23.0098	3.8679	3	2.79554	117.0672	0.54153	0	0.5415	41.49	3.9611	0.0026	4	0.8743	1.7961	2.6213	38.13856
11	16.4	0.77	0.5	-0.23	16.4061	4.6934	3	2.96208	115.1824	0.59912	0	0.5991	26.384	4.8713	0.0023	3	0.9487	1.7153	2.8086	25.62417
12	19.9	0.79	1.01	-0.27	19.9124	3.9674	3	2.85075	115.8425	0.65704	0	0.657	29.306	4.1028	0.0038	4	0.9205	1.5505	2.7274	28.21613
13	20.3	0.84	0.91	-0.27	20.3111	4.1357	3	2.85569	116.3399	0.71521	0	0.7152	27.399	4.2866	0.0033	3	0.9347	1.4421	2.7579	26.70679
14	17	0.7	0.61	-0.29	17.0075	4.1158	3	2.91384	114.5728	0.7725	0	0.7725	21.016	4.3117	0.0027	3	0.9689	1.3564	2.8407	20.81123
15	19.8	0.68	1.2	-0.27	19.8147	3.4318	4	2.81266	114.7334	0.82987	0	0.8299	22.877	3.5818	0.0046	4	0.9416	1.2571	2.7619	22.5544
16	15.4	0.58	1.29	-0.26	15.4158	3.7624	3	2.923	112.9572	0.88635	0	0.8864	16.393	3.9919	0.0064	3	0.9963	1.193	2.8991	16.38191
17	13.2	0.39	1.09	-0.27	13.2133	2.9516	3	2.91374	109.6772	0.94118	0	0.9412	13.039	3.1779	0.0064	3	1	1.1242	2.9173	13.03906
18	14.9	0.47	1.9	-0.31	14.9233	3.1495	3	2.88753	111.3393	0.99685	0	0.9969	13.97	3.3749	0.0098	3	1	1.0615	2.9088	13.97035
19	9.7	0.41	1.59	-0.35	9.71946	4.2183	3	3.11272	109.2941	1.0515	0	1.0515	8.2434	4.7301	0.0132	3	1	1.0063	3.1801	8.24342
20	8.2	0.18	1.69	-0.35	8.22069	2.1896	3	3.01483	102.8623	1.10293	0	1.1029	6.4535	2.5289	0.0171	3	1	0.9594	3.1162	6.45348
21	10.4	0.19	2.42	-0.35	10.4296	1.8217	4	2.88508	103.8384	1.15485	0	1.1549	8.0311	2.0486	0.0188	3	1	0.9162	2.9876	8.03114
22	10.8	0.19	2.66	-0.36	10.8326	1.754	4	2.86251	103.9309	1.20682	0	1.2068	7.9761	1.9739	0.0199	3	1	0.8768	2.9819	7.97614
23	10.6	0.21	2.99	-0.35	10.6366	1.9743	4	2.89589	104.6186	1.25913	0	1.2591	7.4476	2.2394	0.023	3	1	0.8404	3.0356	7.4476
24	8.8	0.14	3.42	-0.38	8.84186	1.5834	4	2.91675	101.2011	1.30973	0	1.3097	5.7509	1.8587	0.0327	3	1	0.8079	3.0925	5.75092
25	8.7	0.15	3.72	-0.37	8.74553	1.7152	3	2.93794	101.6792	1.36057	0	1.3606	5.4279	2.0312	0.0363	3	1	0.7777	3.1331	5.42786
26	9.3	0.11	4.33	-0.35	9.353	1.1761	4	2.83438	99.5736	1.41035	0	1.4104	5.6317	1.3849	0.0393	3	1	0.7502	3.0411	5.63167
27	13.4	0.19	4.85	-0.37	13.4594	1.4117	4	2.73345	104.4604	1.46258	0	1.4626	8.2025	1.5838	0.0291	4	1	0.7235	2.9239	8.20246
28	15.6	0.34	5.05	-0.33	15.6618	2.1709	4	2.77699	109.0879	1.51713	0	1.5171	9.3233	2.4037	0.0257	3	1	0.6974	2.969	9.32333
29	10.6	0.16	5.77	-0.38	10.6706	1.4994	4	2.83398	102.6367	1.56845	0	1.5685	5.8033	1.7578	0.0456	3	1	0.6746	3.0774	5.80331
30	15	0.22	6.76	-0.31	15.0827	1.4586	4	2.69803	105.8108	1.62135	0	1.6214	8.3026	1.6343	0.0362	4	1	0.6526	2.9259	8.30258
31	86.1	2.09	3.52	-0.25	86.1431	2.4262	5	2.23768	126.5334	1.68462	0	1.6846	50.135	2.4746	0.003	5	0.8331	0.6788	2.3702	54.18051
32	30	0.62	3.72	-0.16	30.0455	2.0635	4	2.53423	115.0728	1.74215	0	1.7422	16.246	2.1906	0.0095	4	0.977	0.6144	2.7417	16.43342
33	108	3.18	4.79	0.01	108.059	2.9429	5	2.23295	130.1573	1.80723	0	1.8072	58.792	2.9929	0.0033	5	0.8412	0.6374	2.3759	64.00906
34	124.7	3.72	-0.38	0.05	124.695	2.9833	5	2.19734	131.6542	1.87306	0	1.8731	65.573	3.0288	-2E-04	5	0.8314	0.622	2.3433	72.2028
35	128.3	1.93	0.97	0.09	128.312	1.5042	6	1.96829	126.9225	1.93652	0	1.9365	65.259	1.5272	0.0006	5	0.7496	0.6357	2.1208	75.92025
36	72.6	3.27	-1.17	0.06	72.5857	4.505	4	2.48589	129.391	2.00122	0	2.0012	35.271	4.6328	-0.001	4	0.9684	0.5395	2.6869	35.98771
37	29.5	0.55	1.27	0.04	29.5155	1.8634	4	2.51387	114.1528	2.05829	0	2.0583	13.34	2.0031	0.0033	4	1	0.5141	2.7953	13.33982
38	68.5	2.41	4.95	-0.09	68.5606	3.5151	4	2.42261	127.019	2.1218	0	2.1218	31.312	3.6274	0.0054	4	0.9598	0.5128	2.649	32.20101
39	92	4.29	6.95	-0.15	92.0851	4.6587	9	2.43053	131.9579	2.18778	0	2.1878	41.091	4.7721	0.0056	4	0.9621	0.4971	2.647	42.23659
40	75.7	3.15	6.83	-0.17	75.7836	4.1566	4	2.44725	129.2226	2.25239	0	2.2524	32.646	4.2839	0.0067	4	0.9812	0.4765	2.6892	33.11381
41	72.5	2.31	7.17	-0.27	72.5878	3.1824	5	2.37418	126.8481	2.31582	0	2.3158	30.344	3.2872	0.0074	4	0.9618	0.4708	2.63	31.26618
42	94.2	3.83	8.09	-0.3	94.299	4.0616	4	2.37794	131.1859	2.38141	0	2.3814	38.598	4.1668	0.0063	4	0.9624	0.4581	2.6234	39.79415
43	113	4.89	5.39	-0.25	113.066	4.3249	9	2.34983	133.4163	2.44812	0	2.4481	45.185	4.4206	0.0035	4	0.9532	0.4495	2.5909	46.99365
44	59.7	2.55	6.57	-0.13	59.7804	4.2656	4	2.52465	127.0979	2.51167	0	2.5117	22.801	4.4527	0.0083	3	1	0.4213	2.82	22.80109
45	286.5	4.74	4.5	-0.2	286.555	1.6541	6	1.77356	135.4566	2.5794	0	2.5794	110.09	1.6692	0.0011	6	0.7168	0.528	1.9544	141.7012
46	63.3	1.96	0.37	-0.23	63.3045	3.0961	5	2.40697	125.3121	2.64205	0	2.6421	22.96	3.231	0.0004	4	1	0.4005	2.7274	22.96037
47	105.6	2.49	7.16	-0.58	105.688	2.356	5	2.16735	128.3134	2.70621	0	2.7062	38.054	2.4179	0.005	5	0.9129	0.4243	2.4513	41.29766
48	129.3	4.99	12.04	-0.63	129.447	3.8549	8	2.27438	133.8945	2.77316	0.0312	2.742	46.199	3.9392	0.0066	4	0.9501	0.4047	2.5458	48.44852
49	166.3	7.22	14.01	-0.43	166.471	4.3371	9	2.25171	137.211	2.84176	0.0624	2.7794	58.873	4.4124	0.0058	4	0.9366	0.4047	2.5055	62.59101
50	343.7	19.2	21.27	-0.45	343.96	5.582	9	2.18771	137.28	2.9104	0.0936	2.8168	121.08	5.6297	0.0042	9	0.8921	0.4175	2.3835	134.5738
51	216	11.53	35.7	-0.39	216.437	5.3272	9	2.26552	137.28	2.97904	0.1248	2.8542	74.786	5.4015	0.0115	9	0.9401	0.3934	2.5057	79.36528
52	104.6	4.67	32.23	-0.41	104.995	4.4479	9	2.37924	132.8989	3.04549	0.156	2.8895	35.283	4.5807	0.0212	4	1	0.3662	2.6896	35.2827
53	91	6.6	20.54	-0.51	91.2514	7.2328	9	2.5841	135.0877	3.11303	0.1872	2.9258	30.124	7.4882	0.0147	3	1	0.3616	2.8898	30.12419
54	68.8	3.27	24.11	-0.48	69.0951	4.7326	4	2.51609	129.2708	3.17767	0.2184	2.9593	22.275	4.9608	0.023	3	1	0.3576	2.8588	22.2749
55	109	4.16	24.79	-0.37	109.303	3.8059	5	2.31545	132.1508	3.24374	0.2496	2.9941	35.422	3.9223	0.0145	4	0.9979	0.3542	2.6409	35.49835
56	150	7.36	25.25	-0.1	150.309	4.8966	9	2.32026	137.1025	3.3123	0.2808	3.0315	48.49	5.0069	0.0105	4	0.9918	0.3521	2.6183	48.91121
57	295.2	11.16	22.23	0.14	295.472	3.777	8	2.06842	137.28	3.38094	0.312	3.0689	95.177	3.8207	0.0044	8	0.8723	0.395	2.3021	109.0451
58	219.6	13.99	4.52	0	219.655	6.3691	9	2.32934	137.28	3.44958	0.3432	3.1064	69.601	6.4707	-8E-05	9	0.9871	0.3454	2.5988	70.57774
59	131.6	7.57	7.41	-0.18	131.691	5.7483	9	2.41022	136.9858	3.51807	0.3744	3.1437	40.772	5.9061	0.0012	3	1	0.3366	2.7246	40.77167
60	58	1.66	7.75	-0.51	58.0949	2.8574	5	2.40897	123.8871	3.58001	0.4056	3.1744	17.173	3.045	0.0028	4	1	0.3333	2.8104	17.17321
61	144.5	6.02	8.77	-0.76	144.607	4.163	9	2.27242	135.5376	3.64778	0.4368	3.211	43.899	4.2707	0.0014	4	0.9927	0.3322	2.5983	44.2591
62	75.2	2.7	8.65	-1	75.3059	3.5854	4	2.40124	128.0792	3.71182	0.468	3.2438	22.071	3.7713	0.0022	4	1	0.3262	2.7835	22.0709
63	60	1.89	8.67	-1.06	60.1061	3.1444	4	2.42761	124.9196	3.77428	0.4992	3.2751	17.2	3.3551	0.0022	3	1	0.3231	2.8356	17.20014
64	67.1	2.49	8.13	-1.31	67.1995	3.7054	4	2.44527	127.209	3.83789	0.5304	3.3075	19.157	3.9298	0.0009	3	1	0.3199	2.8422	19.15704
65	65.9	2.02	8.58	-1.39	66.005	3.0604	5	2.39063	125.6347	3.9007	0.5616	3.3391	18.599	3.2526	0.0009	4	1	0.3169	2.8005	18.5991
66	56.8	1.67	9.14	-1.43	56.9119	2.9344	5	2.42342	123.8809	3.96264	0.5928	3.3698	15.713	3.154	0.0012	3	1	0.314	2.8503	15.71267
67	558.3	12.25	7.43	-1.34	558.391	2.1938	8	1.73096	137.28	4.03128	0.624	3.4073	162.7	2.2098	-2E-04	6	0.7466	0.4177	1.9297	218.8222
68	674.6	13.42	8.17	-1.3	674.7	1.989	8	1.65803	137.28	4.09992	0.6552	3.4447	194.67	2.0012	-1E-04	6	0.714	0.4305	1.8395	272.8583

69	350.1	16.29	6.53	-1.35	350.18	4.6519	8	2.11332	137.28	4.16856	0.6864	3.4822	99.367	4.7079	-6E-04	9	0.9197	0.3344	2.373	109.3423
70	145.6	6.34	8.11	-1.3	145.699	4.3514	9	2.2861	135.9349	4.23653	0.7176	3.5189	40.2	4.4818	-9E-04	4	1	0.3007	2.6426	40.20049
71	399.2	10.63	5.76	-1.45	399.271	2.6624	8	1.87212	137.28	4.30517	0.7488	3.5564	111.06	2.6914	-9E-04	5	0.8266	0.3671	2.1212	137.0458
72	215.5	9.85	7.58	-1.55	215.593	4.5688	9	2.20937	137.28	4.37381	0.78	3.5938	58.773	4.6634	-0.001	4	0.9866	0.2993	2.5369	59.74426
73	214.9	11.72	7.92	-1.65	214.997	5.4512	9	2.2756	137.28	4.44245	0.8112	3.6313	57.984	5.5663	-0.001	4	1	0.2914	2.6031	57.98402
74	103.8	5.88	8.62	-1.65	103.906	5.659	9	2.46493	134.5593	4.50973	0.8424	3.6673	27.103	5.9157	-0.002	3	1	0.2885	2.8491	27.10304
75	284.6	10.51	8.09	-1.65	284.699	3.6916	8	2.06786	137.28	4.57837	0.8736	3.7048	75.611	3.752	-0.001	4	0.9305	0.3116	2.3734	82.4953
76	428.5	12.59	8.33	-1.75	428.602	2.9375	8	1.89555	137.28	4.64701	0.9048	3.7422	113.29	2.9697	-7E-04	5	0.8479	0.3427	2.1542	137.2947
77	480.8	12.68	14.57	-1.76	480.978	2.6363	8	1.83108	137.28	4.71565	0.936	3.7797	126.01	2.6624	0.0002	5	0.821	0.3516	2.0788	158.2654
78	106.7	5.14	16.18	-1.94	106.898	4.8083	9	2.40113	133.6444	4.78247	0.9672	3.8153	26.765	5.0335	0.0019	3	1	0.2773	2.8045	26.76495
79	148.5	7.99	15.54	-2.3	148.69	5.3736	9	2.35624	137.28	4.85111	0.9984	3.8527	37.335	5.5548	0.0008	3	1	0.2746	2.7317	37.3345
80	76.1	0	18.18	-2.23	76.3225	0	0	0	120.9	4.91156	1.0296	3.882	18.396	0	0.0039	0	1	0.2726	0	0

	CPT-20	In situ data										Basic output data								
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	134	0.83	0.15	0.25	134.002	0.6194	6	1.70115	120.8538	0.06043	0	0.0604	2216.6	0.6197	8E-05	6	0.3693	2.8783	1.3601	364.3555
2	631.5	9.4	1.86	-1.38	631.523	1.4885	6	1.55613	137.28	0.12907	0	0.1291	4892	1.4888	0.0002	8	0.4019	2.3292	1.4307	>1,000
3	187.9	1.3	0.99	-2.11	187.912	0.6918	6	1.6166	124.9616	0.19155	0	0.1916	980.02	0.6925	0.0004	6	0.3964	1.9688	1.4084	349.2899
4	19.9	0.35	0.99	-1.48	19.9121	1.7577	4	2.6393	109.8857	0.24649	0	0.2465	79.782	1.7798	0.0036	5	0.7297	2.8953	2.2774	53.81177
5	3.6	0.17	1.14	-1.45	3.61395	4.704	3	3.49353	100.4396	0.29671	0	0.2967	11.18	5.1247	0.0247	3	1	3.5661	3.0964	11.18007
6	6.2	0.19	-0.15	-1.47	6.19816	3.0654	3	3.19599	102.5692	0.34799	0	0.348	16.811	3.2478	-0.002	3	0.9543	2.8899	2.8523	15.97795
7	8.1	0.26	-0.3	-1.48	8.09633	3.2113	3	3.10968	105.5158	0.40075	0	0.4008	19.203	3.3786	-0.003	4	0.9438	2.5001	2.8185	18.18284
8	14.8	0.39	-0.56	-1.46	14.7932	2.6364	4	2.84536	109.9527	0.45573	0	0.4557	31.46	2.7202	-0.003	4	0.8665	2.0749	2.612	28.11455
9	17.5	0.48	-0.83	-1.38	17.4898	2.7445	4	2.79657	111.8804	0.51167	0	0.5117	33.182	2.8272	-0.004	4	0.8647	1.8744	2.6001	30.07544
10	17.7	0.67	-0.76	-1.38	17.6907	3.7873	3	2.87785	114.3484	0.56884	0	0.5688	30.099	3.9131	-0.003	4	0.9102	1.7593	2.7107	28.46835
11	15.3	0.81	-0.83	-1.36	15.2898	5.2976	3	3.0193	115.3811	0.62653	0	0.6265	23.404	5.524	-0.004	3	0.9764	1.6681	2.8785	23.11657
12	19.6	0.94	-0.92	-1.32	19.5887	4.7987	3	2.90953	117.0745	0.68507	0	0.6851	27.594	4.9726	-0.004	3	0.9487	1.5104	2.7983	26.98473
13	20.5	0.9	-0.96	-1.28	20.4883	4.3928	3	2.86974	116.8658	0.7435	0	0.7435	26.556	4.5582	-0.004	3	0.9459	1.3962	2.7838	26.05372
14	21.5	1.05	-0.99	-1.28	21.4879	4.8865	3	2.88443	118.11	0.80256	0	0.8026	25.774	5.0761	-0.003	3	0.9632	1.3051	2.8222	25.5134
15	17.8	0.77	-0.99	-1.28	17.7879	4.3288	3	2.91264	115.3797	0.86025	0	0.8603	19.678	4.5488	-0.004	3	0.9861	1.2265	2.8752	19.62116
16	17.9	0.9	-1.06	-1.28	17.887	5.0316	3	2.95288	116.5347	0.91852	0	0.9185	18.474	5.3039	-0.005	3	1	1.152	2.9388	18.47382
17	15.7	0.58	-1.06	-1.24	15.687	3.6973	3	2.91237	112.9998	0.97502	0	0.975	15.089	3.9424	-0.005	3	1	1.0852	2.9236	15.08899
18	15.1	0.74	-1.06	-1.26	15.087	4.9049	3	3.00233	114.6872	1.03236	0	1.0324	13.614	5.2652	-0.005	3	1	1.0249	3.0374	13.61411
19	14.5	0.35	-1.06	-1.32	14.487	2.416	4	2.83114	109.1099	1.08691	0	1.0869	12.329	2.6119	-0.006	3	1	0.9735	2.8879	12.32857
20	15.6	0.33	-1.06	-1.34	15.587	2.1172	4	2.77263	108.8578	1.14134	0	1.1413	12.657	2.2844	-0.005	4	0.9881	0.9279	2.8455	12.66819
21	14.3	0.34	-1.06	-1.32	14.287	2.3798	4	2.83242	108.8639	1.19578	0	1.1958	10.948	2.5972	-0.006	3	1	0.8849	2.9291	10.94791
22	13.3	0.28	-1.06	-1.28	13.287	2.1073	4	2.82935	107.2662	1.24941	0	1.2494	9.6347	2.326	-0.006	3	1	0.8469	2.9493	9.63465
23	18.5	0.52	-1	-1.24	18.4878	2.8127	4	2.78359	112.6014	1.30571	0	1.3057	13.159	3.0264	-0.004	3	1	0.8104	2.9016	13.15917
24	17.6	0.47	-0.99	-1.15	17.5879	2.6723	4	2.78777	111.74	1.36158	0	1.3616	11.917	2.8965	-0.004	3	1	0.7771	2.9256	11.91726
25	18.4	0.58	-0.99	-1.13	18.3879	3.1543	4	2.81558	113.3872	1.41827	0	1.4183	11.965	3.4179	-0.004	3	1	0.7461	2.9661	11.96498
26	20.2	0.54	-0.91	-1.15	20.1889	2.6747	4	2.73991	113.0922	1.47482	0	1.4748	12.689	2.8855	-0.004	3	1	0.7175	2.9024	12.68904
27	20.5	0.64	-0.91	-1.15	20.4889	3.1237	4	2.7759	114.3714	1.532	0	1.532	12.374	3.3761	-0.003	3	1	0.6907	2.9512	12.37389
28	18.4	0.42	-0.9	-1.15	18.389	2.284	4	2.73222	111.0256	1.58752	0	1.5875	10.583	2.4998	-0.004	3	1	0.6665	2.9321	10.58348
29	20.4	0.53	-0.83	-1.16	20.3898	2.5993	4	2.72901	112.9796	1.64401	0	1.644	11.403	2.8273	-0.003	3	1	0.6436	2.9353	11.40252
30	8.5	0.17	-0.76	-1.15	8.4907	2.0022	3	2.98282	102.5229	1.69527	0	1.6953	4.0085	2.5017	-0.008	3	1	0.6242	3.2922	4.00847
31	13.2	0.31	-0.7	-1.09	13.1914	2.35	4	2.85806	107.9934	1.74927	0	1.7493	6.5411	2.7093	-0.004	3	1	0.6049	3.1269	6.54113
32	9	0.08	-0.68	-1.13	8.99168	0.8897	4	2.79683	97.14738	1.79784	0	1.7978	4.0014	1.1121	-0.007	3	1	0.5885	3.1349	4.00138
33	10.6	0.18	-0.53	-1.11	10.5935	1.6992	4	2.86384	103.4808	1.84958	0	1.8496	4.7275	2.0586	-0.004	3	1	0.5721	3.1884	4.72752
34	15.6	0.29	-0.46	-1.13	15.5944	1.8597	4	2.74146	107.9135	1.90354	0	1.9035	7.1923	2.1182	-0.002	3	1	0.5559	3.0362	7.19231
35	24.4	0.87	-0.38	-1.08	24.3954	3.5663	4	2.75338	117.0435	1.96206	0	1.9621	11.434	3.8782	-0.001	3	1	0.5393	3.0146	11.43355
36	36.2	1.48	-0.23	-1.01	36.1972	4.0887	4	2.665	121.8934	2.023	0	2.023	16.893	4.3308	-5E-04	3	1	0.523	2.9111	16.89278
37	41.1	1.71	-0.08	-0.99	41.099	4.1607	4	2.6305	123.2602	2.08464	0	2.0846	18.715	4.383	-2E-04	3	1	0.5076	2.8804	18.71521
38	51.6	2.09	0.08	-0.93	51.601	4.0503	4	2.55241	125.2835	2.14728	0	2.1473	23.031	4.2262	0.0001	3	1	0.4928	2.8018	23.03089
39	53.2	2.63	0.26	-0.95	53.2032	4.9433	4	2.60603	127.0396	2.2108	0	2.2108	23.065	5.1576	0.0004	3	1	0.4786	2.859	23.06516
40	385.7	5.12	0.3	-0.95	385.704	1.3274	6	1.62131	136.7455	2.27917	0	2.2792	168.23	1.3353	6E-05	6	0.6247	0.6192	1.7501	224.3772
41	178.1	7.91	0.28	-0.98	178.103	4.4412	9	2.24383	137.28	2.34781	0	2.3478	74.859	4.5006	0.0001	9	0.8899	0.492	2.4363	81.72597
42	82.8	2.88	0.3	-0.94	82.8037	3.4781	5	2.36381	128.783	2.4122	0	2.4122	33.327	3.5825	0.0003	4	0.9644	0.4517	2.6249	34.3197
43	173.2	10.49	0.29	-0.91	173.204	6.0565	9	2.36355	137.28	2.48084	0	2.4808	68.816	6.1445	0.0001	9	0.9492	0.4454	2.5763	71.86259
44	92.3	2.22	0.61	-1.01	92.3075	2.405	5	2.21412	127.1435	2.54441	0	2.5444	35.279	2.4732	0.0005	4	0.9183	0.4468	2.4859	37.90129
45	85.9	2.98	0.53	-0.95	85.9065	3.4689	5	2.35233	129.1224	2.60897	0	2.609	31.927	3.5775	0.0005	4	0.9801	0.4129	2.6419	32.50719
46	74.3	2.75	0.38	-1.01	74.3047	3.701	4	2.41534	128.1809	2.67306	0	2.6731	26.798	3.8391	0.0004	4	1	0.3958	2.7248	26.79756
47	105.6	4.8	0.3	-1.07	105.604	4.5453	9	2.38509	133.1139	2.73962	0	2.7396	37.547	4.6664	0.0002	4	0.999	0.3866	2.6757	37.58228
48	76.2	3.45	0.3	-1.09	76.2037	4.5273	4	2.47369	129.9017	2.80457	0	2.8046	26.171	4.7003	0.0003	3	1	0.3773	2.7913	26.17123
49	133	9.64	0.37	-1.27	133.005	7.2479	9	2.49118	137.28	2.87321	0	2.8732	45.291	7.4079	0.0002	3	1	0.3683	2.7672	45.29123
50	78	3.79	0.46	-1.55	78.0056	4.8586	4	2.49048	130.6465	2.93854	0	2.9385	25.546	5.0488	0.0004	3	1	0.3601	2.8202	25.54575
51	80.2	4.53	0.38	-1.58	80.2047	5.6481	9	2.53329	132.0193	3.00454	0	3.0045	25.694	5.8679	0.0004	3	1	0.3522	2.8633	25.69444
52	83.5	4.17	0.38	-1.58	83.5047	4.9937	9	2.48075	131.5117	3.0703	0	3.0703	26.198	5.1844	0.0003	3	1	0.3446	2.8201	26.19755
53	106.2	5.07	0.38	-1.56	106.205	4.7738	9	2.40038	133.5282	3.13706	0	3.1371	32.855	4.9191	0.0003	3	1	0.3373	2.7333	32.85478
54	211	9.86	0.67	-1.3	211.008	4.6728	9	2.2226	137.28	3.2057	0	3.2057	64.823	4.7449	0.0002	4	0.9566	0.3464	2.5053	68.0196
55	426.9	18.41	0.88	-1.21	426.911	4.3124	8	2.04617	137.28	3.27434	0	3.2743	129.38	4.3457	0.0002	9	0.8674	0.3754	2.2637	150.2963
56	335.5	12.84	2.05	-0.8	335.525	3.8268	8	2.04666	137.28	3.34298	0	3.343	99.367	3.8654	0.0004	8	0.8824	0.3624	2.2946	113.7622
57	174.5	10.99	1.67	-0.23	174.52	6.2973	9	2.37617	137.28	3.41162	0	3.4116	50.155	6.4228	0.0007	3	1	0.3102	2.6914	50.15464
58	106.9	4.03	1.44	-0.31	106.918	3.7693	5	2.31823	131.8647	3.47756	0	3.4776	29.745	3.896	0.001	4	1	0.3043	2.6953	29.74504
59	141.6	6.51	1.08	-0.7	141.613	4.597	9	2.31269	136.0592	3.54559	0	3.5456	38.941	4.7151	0.0006	4	1	0.2984	2.668	38.9407
60	77	4.46	0.91	-0.9	77.0111	5.7914	9	2.55284	131.8062	3.61149	0	3.6115	20.324	6.0763	0.0009	3	1	0.293	2.9477	20.32392
61	71.6	2.38	0.83	-1.06	71.6102	3.3236	5	2.39193	127.0335	3.67501	0.0312	3.6438	18.644	3.5033	0.0004	3	1	0.2904	2.8198	18.64401
62	61	2.62	0.71	-1.09	61.0087	4.2945	4	2.5208	127.3457	3.73868	0.0624	3.6763	15.578	4.5748	-2E-04	3	1	0.2878	2.9534	15.57825
63	65.5	2.42	0.68	-1.11	65.5083	3.6942	4	2.45188	126.9382	3.80215	0.0936	3.7086	16.639	3.9218	-7E-04	3	1	0.2853	2.889	16.6389
64	287	6.13	0.6	-1.09	287.007	2.1358	6	1.86434	137.28	3.87079	0.1248	3.746	75.584	2.165	-3E-04	5	0.8537	0.3399	2.1687	90.94115
65	293.5	14.53	1.22	-1.19	293.515	4.9503	9	2.17264	137.28	3.93943	0.156	3.7834	76.538	5.0177	-2E-04	9	0.9748	0.2888	2.482	79.03482
66	647.6	0	1.12	-1.32	647.614	0	0	0	120.9	3.99988	0.1872	3.8127	168.81	0	-2E-04	0	1	0.2775	0	0

Presented below is a list of formulas used for the estimation of various soil properties. The formulas are presented in SI unit system and assume that all components are expressed in the same units.

:: Unit Weight, g (kN/m³) ::

$$g = g_w \cdot \left(0.27 \cdot \log(R_f) + 0.36 \cdot \log(\frac{q_t}{p_a}) + 1.236\right)$$

where g_w = water unit weight

:: Permeability, k (m/s) ::

$I_c < 3.27$ and $I_c > 1.00$ then $k = 10^{0.952-3.04 \cdot I_c}$

$I_c \leq 4.00$ and $I_c > 3.27$ then $k = 10^{-4.52-1.37 \cdot I_c}$

:: N$_{SPT}$ (blows per 30 cm) ::

$$N_{60} = \left(\frac{q_c}{P_a}\right) \cdot \frac{1}{10^{1.1268-0.2817 \cdot I_c}}$$

$$N_{1(60)} = Q_{tn} \cdot \frac{1}{10^{1.1268-0.2817 \cdot I_c}}$$

:: Young's Modulus, Es (MPa) ::

$$(q_t - \sigma_v) \cdot 0.015 \cdot 10^{0.55 \cdot I_c + 1.68}$$

(applicable only to $I_c < I_{c\_cutoff}$)

:: Relative Density, Dr (%) ::

$$100 \cdot \sqrt{\frac{Q_{tn}}{k_{DR}}}$$

(applicable only to SBT$_n$: 5, 6, 7 and 8 or $I_c < I_{c\_cutoff}$)

:: State Parameter, ψ ::

$$\psi = 0.56 - 0.33 \cdot \log(Q_{tn,cs})$$

:: Peak drained friction angle, φ (°) ::

$$\varphi = 17.60 + 11 \cdot \log(Q_{tn})$$

(applicable only to SBT$_n$: 5, 6, 7 and 8)

:: 1-D constrained modulus, M (MPa) ::

If $I_c > 2.20$

$\alpha = 14$ for $Q_{tn} > 14$

$\alpha = Q_{tn}$ for $Q_{tn} \leq 14$

$M_{CPT} = \alpha \cdot (q_t - \sigma_v)$

If $I_c \leq 2.20$

$M_{CPT} = (q_t - \sigma_v) \cdot 0.0188 \cdot 10^{0.55 \cdot I_c + 1.68}$

:: Small strain shear Modulus, Go (MPa) ::

$$G_0 = (q_t - \sigma_v) \cdot 0.0188 \cdot 10^{0.55 \cdot I_c + 1.68}$$

:: Shear Wave Velocity, Vs (m/s) ::

$$V_s = \left(\frac{G_0}{\rho}\right)^{0.50}$$

:: Undrained peak shear strength, Su (kPa) ::

$N_{kt} = 10.50 + 7 \cdot \log(F_r)$ or user defined

$$S_u = \frac{(q_t - \sigma_v)}{N_{kt}}$$

(applicable only to SBT$_n$: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Remolded undrained shear strength, Su(rem) (kPa) ::

$S_{u(rem)} = f_s$ (applicable only to SBT$_n$: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Overconsolidation Ratio, OCR ::

$$k_{OCR} = \left[\frac{Q_{tn}^{0.20}}{0.25 \cdot (10.50 \cdot +7 \cdot \log(F_r))}\right]^{1.25}$$ or user defined

$OCR = k_{OCR} \cdot Q_{tn}$

(applicable only to SBT$_n$: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: In situ Stress Ratio, Ko ::

$$K_O = (1 - \sin\varphi') \cdot OCR^{\sin\varphi'}$$

(applicable only to SBT$_n$: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Soil Sensitivity, S$_t$ ::

$$S_t = \frac{N_S}{F_r}$$

(applicable only to SBT$_n$: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Effective Stress Friction Angle, φ' (°) ::

$$\varphi' = 29.5° \cdot B_q^{0.121} \cdot \left(0.256 + 0.336 \cdot B_q + \log Q_t\right)$$

(applicable for $0.10 < B_q < 1.00$)

References

- Robertson, P.K., Cabal K.L., Guide to Cone Penetration Testing for Geotechnical Engineering, Gregg Drilling & Testing, Inc., 5th Edition, November 2012
- Robertson, P.K., Interpretation of Cone Penetration Tests - a unified approach., Can. Geotech. J. 46(11): 1337–1355 (2009)

CITY OF LOS ANGELES
CALIFORNIA

ERIC GARCETTI
MAYOR

DEPARTMENT OF
BUILDING AND SAFETY
201 NORTH FIGUEROA STREET
LOS ANGELES, CA 90012

RAYMOND S. CHAN, C.E., S.E.
GENERAL MANAGER

FRANK BUSH
EXECUTIVE OFFICER

GEOLOGY AND SOILS REPORT CORRECTION LETTER

August 19, 2015

LOG # 89430
SOILS/GEOLOGY FILE - 2
LIQ/PFRSA

Sinan Sinanian
18980 Ventura Boulevard, Suite 200
Tarzana, CA 91356

TRACT:	7803
BLOCK:	15
LOT(S):	20 / 19 / 11
LOCATION:	1749 & 1751 Malcolm Ave. And 1772 Glendon Ave.

CURRENT REFERENCE REPORT/LETTER(S)	REPORT No.	DATE(S) OF DOCUMENT	PREPARED BY
Geology/Soils Report	15-363-26	07/21/2015	Applied Earth Sciences
Oversized Doc(s).	"	"	"

The Grading Division of the Department of Building and Safety has reviewed the referenced report that provides recommendations for a proposed multi-unit residential development with a parking garage. According to the report, the site is relatively flat and occupied by existing residential structures.

The earth materials at the subsurface exploration locations consist of up to 4 feet of uncertified fill underlain by recent and older alluvium, sag pond and estuarine deposits. The consultants recommend to support the proposed structures on conventional foundations bearing on native undisturbed soils.

The site is located within a City of Los Angeles Preliminary Fault Rupture Study Area designated for the Santa Monica fault. The report includes the results of a fault rupture investigation that consisted of a transect of continuous core borings and cone penetrometer test soundings in Malcolm Avenue on the east side of the property. An active fault splay was identified through the northeastern corner of the property. The consultants recommend that proposed buildings be setback at least 10 feet from the fault splay and that a reinforced (thick mat) foundation be used to support the eastern building.

The site is located in a designated liquefaction hazard zone as shown on the "Seismic Hazard Zones" map issued by the State of California.

The review of the subject report can not be completed at this time and will be continued upon submittal of an addendum to the report which shall include, but not be limited to, the following:

(Note: Numbers in parenthesis ( ) refer to applicable sections of the 2014 City of LA Building Code. P/BC numbers refer the applicable Information Bulletin. Information Bulletins can be accessed on the internet at LADBS.ORG.)

1. The proposed 10-ft. setback from the active fault splay appears small given that the fault was identified at only one location and there is no direct evidence of the orientation of the fault. In addition, the fault trace may be closer to B-3 than estimated. Additional exploration is required to determine the fault's trend in at least two locations to warrant the recommended reduced setback. Alternatively, a larger setback could be recommended.

2. Provide more detailed discussion on the stratigraphic correlation from CPT-13 to B-3. The upper soils of CPT-11 to CPT-13 appear more fine-grained than the soils observed from CPT1 and B-1. It seams like Qof-1is missing from CPT-2 (back to fine-grained) and the top of Qof-2 appears to be lower.

3. What is the purple marker bed shown at depth on the northern portion of Cross Section A-A'.

The geologist and soils engineer shall prepare a report containing the corrections indicated in this letter. The report shall be in the form of an itemized response. It is recommended that once all correction items have been addressed in a response report, to contact the report review engineer and/or geologist to schedule a verification appointment to demonstrate compliance with all the corrections. Do not schedule an appointment until all corrections have been addressed. Bring three copies of the response report, including one unbound wet-signed original for microfilming in the event that the report is found to be acceptable.

DANIEL C. SCHNEIDEREIT	GLEN RAAD
Engineering Geologist I	Geotechnical Engineer I

DCS/GR:dcs/gr
Log No. 89430
213-482-0480

cc: Applied Earth Sciences, Project Consultant
WL District Office

THRIFTY OIL CO.

January 5, 2011 O-1174

City of Los Angeles Fire Department
Environmental Unit- Underground Storage Tanks
Attn: Eloy Luna, Engineering Geologist Associate IV
221 North Figueroa Street, Suite 1500
Los Angeles, CA 90012

RE: **Former Thrifty Station No. 020 (ARCO #9517)**
10801 Santa Monica Boulevard
Los Angeles, California 90025

Subject: **Site Assessment Report & Proposed Remedial Action**

Dear Mr. Luna:

Enclosed, please find a copy of the *Site Assessment Report* (SAR), dated December 30, 2010, and prepared by Wayne Perry , Inc. (Wayne Perry) (**Attachment A**) for Thrifty Oil Co. (Thrifty) Station No. 020, located at 10801 Santa Monica Boulevard, Los Angeles, California (**Figure 1**). The SAR summarizes the site assessment activities conducted at the site on November 16 through 18, 2010, and proposes a 36-hour continuous mobile high vacuum dual-phase extraction (HVDPE) event using the newly installed wells SB-1, SB-2S and SB-2D as extraction point. The site assessment activities were conducted in response to the City of Los Angeles Fire Department (LAFD) letter, dated June 9, 2010.

Thrifty will implement the HVDPE event upon approval from the LAFD.

Should you have any questions regarding the enclosed documents, please contact Simon Tregurtha at (562) 921-3581 Ext. 260, or Chris at Ext. 390.

Sincerely,

Simon Tregurtha
Project Manager

Chris Panaitescu
General Manager
Environmental Affairs

cc: BP West Coast Products LLC, Mr. John Skance
File

REQUIRED INFORMATION FORM

INSTRUCTIONS: This form is to be filled out completely and must be the first page of any document, including all reports, submitted to the Los Angeles Fire Department (LAFD) Underground Storage Tank Unit (UST). To ensure accuracy this form must be completed on the computer or typed out. **Hand printing or writing will not be accepted.** The correct LAFD **Facility I.D. No.** and **Division 5 Permit No.** must be included for the submittal to be processed.
**** (SOME INFORMATION MAY ALREADY BE PRE-ENTERED FOR YOUR CONVENIENCE)**

PLEASE NOTE THAT AN ACCOMPANYING INTRODUCTORY LETTER ON YOUR COMPANY LETTERHEAD CANNOT BE SUBSTITUTED FOR THIS FORM.

Today's Date: 1/5/2011

Mail to: City of Los Angeles Fire Department
Environmental Unit – Underground Storage Tanks
Attn: Eloy Luna, Engineering Geologist Associate IV
221 North Figueroa Street, Suite 1500
Los Angeles, CA., 90012

Report Title
(Please select the applicable title from the drop down menu)

Site Assessment Report & Proposed Remedial Action

LAFD Facility I.D. No. 26137

LAFD Division 5 Permit No.
LAFD Site Assessment Permit No. 24288

Site/Facility Name: Former Thrifty Oil Station No. 020

Site Address: 10801 Sant Monica Blvd. **City/State/Zip: Los Angeles, CA,**

Site Facility Description: Former Thrifty Oil Station No. 020

Tank Owner/Tank Operator/Responsible Party Contact Information

Contact Name and Title:
Simon Tregurtha / Project Geologist

Contact Phone No.
(562) 921-3581 Ext. 260
Company Name:
Thrifty Oil Co.
Company Address:
13116 Imperial Highway
City/State/Zip: Los Angeles, CA,
Santa Fe Springs, CA 90670

Consultant Information

Contact Name and Title:
Simon Tregurtha / Project Geologist

Contact Phone No.
(562) 921-3581 Ext. 260
Company Name:
Thrifty Oil Co.
Company Address:
13116 Imperial Highway
City/State/Zip: Los Angeles, CA,
Santa Fe Springs, CA 90670

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SS# 020

SITE ASSESSMENT REPORT

THRIFTY OIL CO STATION NO. 020
10801 SANTA MONICA BOULEVARD
LOS ANGELES, CALIFORNIA 90025

December 30, 2010

SUBMITTED TO:

Thrifty Oil Co.
13116 Imperial Highway
Santa Fe Springs, California 90670
Attention: Mr. Chris Panaitescu

PREPARED BY:

WAYNE PERRY, INC.
8281 Commonwealth Avenue
Buena Park, California 90621
(714) 826-0352

LOS ANGELES FIRE DEPT. FACILITY ID: 26137
PERMIT NO. 24288
WPI PROJECT: 10.184

WARRANTY STATEMENT

This Site Assessment Report has been prepared by Wayne Perry, Inc. (WPI) for the exclusive use of Thrifty Oil Co., as it pertains to Thrifty Oil Co Station No. 020 located at 10801 Santa Monica Boulevard, California. Our professional services have been performed using that degree of care and skill ordinarily exercised under similar circumstances by other geologists, hydrogeologists, and engineers practicing in this field. No other warranty, express or implied, is made as to the professional advice in this report.

Should you have questions or require additional information, please contact Eric Floyd at (714) 826-0352.

PREPARED BY:

Kristine Wulff
Staff Scientist

Eric Floyd
California Professional Geologist 7520

REGISTERED LICENSED GEOLOGIST
ERIC D. FLOYD
Exp 12/12
NO. 7520
STATE OF CALIFORNIA

December 30, 2010

WPI PROJECT NO. 10.184

TABLE OF CONTENTS

1.0 INTRODUCTION

In correspondence dated June 9, 2010, the Los Angeles Fire Department (LAFD) requested that additional assessment activities be conducted at Thrifty Station No. 020 located at 10801 Santa Monica Boulevard in Los Angeles, California (herein referred to as the "Site")to define the distribution of impacted soils, and submittal of a remedial action plan (RAP). The *Site Assessment Workplan and Remedial Action Plan* dated August 3, 2010 proposed the installation of three soil borings advanced to delineate the vertical extent of contaminants. If contaminant concentrations detected in soil samples were equal to or greater than those detected by previous investigations, the borings would be converted to vapor extraction wells. The workplan also specified that if detected concentrations were consistent with previous investigation results (both depths and concentrations), the threat to groundwater quality would be considered minimal, and interim remedial actions (IRA) by soil vapor extraction would be used to eliminate any potential impact to groundwater.

This report documents boring / well installation and sampling procedures, and discusses results obtained from the laboratory analysis of soil samples. Conclusions and recommendations based on these and data from previous investigations are also discussed.

2.0 BACKGROUND

2.1 Site Description

The Site is a retail gasoline sales facility that is owned by Thrifty and has been operated by ARCO Products Co. since April 22, 1997. The Site is located at the northwest corner of Santa Monica Boulevard and Malcolm Avenue in Los Angeles, California, at an approximate elevation is 255 feet above mean sea level. Local topography slopes gently to the southwest (USGS, 1966).

Residential properties are located north of the site. An Enterprise Rental Car is located east of the site, across Malcolm Avenue. South of the site, is Santa Monica Boulevard followed by a mix of commercial and multi-family residential. A motel is located adjacent to the site on the west. A site vicinity map is included as Figure 2.

Improvements on site include a double contained underground storage tank (UST) system consisting of two 20,000-gallon USTs (one of which is divided into two 10,000-gallon sections) containing gasoline, and associated product piping. The UST system was installed in October 1997. Additional features of the Site include three dispenser islands under a canopy and a kiosk. Main features of the Site are shown on the plot plan provided as Figure 3. Thrifty does not currently have any plans to alter the use of the property.

2.2 Site History

Date	Activity/Method	No. of Wells, Borings or Samples	Report Date	Consultant	Comments
6/97 & 7/97	Baselining Subsurface Investigation Report	7 Soil Borings (TDD-1 through TDD-7)	12/22/97	Pacific Environmental Group, Inc.	Total petroleum hydrocarbons as gasoline (TPH-G), benzene, and methyl tert butyl ether (MTBE) were detected in the soil samples at maximum concentrations of 1,200 mg/kg, 2,300 µg/kg, and 22,000 µg/kg, respectively, in the samples from TDD-5-15'.
10/97	UST Replacement Activities	Soil Samples	4/10/98	Tait Environmental Services	Four USTs were removed and replaced with two double walled USTs. TPH-G, total petroleum hydrocarbons as diesel (TPH-D), benzene and MTBE were detected in soil samples collected from beneath the USTs, the side walls and beneath the product piping at maximum concentrations of 19,000 mg/kg, 890 mg/kg, 30,000 µg/kg, and 270, 000 µg/kg, respectively. Approximately 1,278 tons of hydrocarbon-impacted soil was excavated and removed from the Site.
9/07	Agency Correspondence	--	9/18/07	LAFD	In response to the 4/10/98 report, LAFD requested that a workplan for additional site assessment be submitted.
9/08	Workplan for Site Assessment	--	9/8/08	Thrifty	Thrifty proposed installation of three soil borings. The borings would be converted to wells if groundwater was encountered.
12/08	Agency Correspondence	--	12/12/08	LAFD	LAFD approved the 9/8/08 workplan.

Date	Activity/Method	No. of Wells, Borings or Samples	Report Date	Consultant	Comments
3/09	Additional Site Assessment Report and Request for Closure	4 Soil Borings (B-8 through B-11)	3/11/09	GeoHydrologic Consultants Inc. (GHC)	TPH-G, TPH-D, benzene, MTBE and TBA were detected in soil samples at maximum concentrations of 1,400 mg/kg, 1,090 mg/kg, 3.8j µg/kg, 4.7 mg/kg , and 4.02 mg/kg, respectively. Groundwater was not encountered. GHC concluded that the lateral and vertical extent of contamination was defined and closure was requested.
6/10	Agency Correspondence	--	6/9/10	LAFD	LAFD denied the request for closure and requested additional assessment in the area of boring B-8 and the dispenser islands. LAFD also requested submittal of a RAP.
8/10	Additional Site Assessment Workplan and Remedial Action Plan	--	8/3/10	WPI	Three soil borings were proposed. If contaminant concentrations detected in soil samples were equal to or greater than those detected by previous investigations, the borings would be converted to vapor extraction wells. If detected concentrations were consistent with previous investigation results (both depths and concentrations), IRA by soil vapor extraction would be used.

Historical soil analytical data are provided in Appendix A.

2.3 Geology

The Site is located on the Hollywood Piedmont Slope, and is underlain by Holocene-age alluvium, followed by Pleistocene-age deposits of the Lakewood Formation (CDWR, 1961). Soil types encountered beneath the Site during previous site assessment activities consisted predominantly of silty, clayey sand from the ground surface to depths of 30 feet beneath ground surface (bgs) underlain by predominantly silty sand to a depth of approximately 55 feet bgs. From 55 feet to 65 feet bgs, the soil type consisted of clayey sand with gravel. Below a depth of 65 feet, the majority of sediments encountered consisted of sandy silt and silt, with lesser amounts of lean clay and silty sand, to a total depth of 90 feet bgs, the maximum depth explored. Geologic cross sections are provided as Figures 4 through 6.

2.4 Hydrogeology

The site is located within the Santa Monica Sub-basin of the Central Groundwater Basin of the Los Angeles – San Gabriel Hydrologic Unit (CRWQCB-LAR, 1994). The regional Ballona Aquifer (groundwater expected at 70 to 80 feet bgs) occurs within the Lakewood Formation deposits (CDWR, 1961). Groundwater was encountered at the nearby Exxon Mobil Oil Corporation Service Station, located at 10857 Santa Monica Blvd. (430 feet southwest of the site), at a depth of approximately 118 feet during the March 2010 groundwater monitoring event. Based on the local topographic gradient of the area, groundwater is expected to flow toward the southwest. Historically, groundwater has not been encountered beneath the Site to a total depth of 90 feet (the maximum depth explored). However, during this investigation, soils at or near saturation were encountered at depths of about 55 to 59 feet (drilling of SB-2 and SB-3). The existence of water at these locations and depths appears to be due to perched conditions, as the sandy layer where groundwater was encountered is underlain by finer grained sediments at both locations. Although indications of moisture were observed at SB-1, there was no indication of saturated soils, suggesting that the observed water bearing sediments are localized and of limited extent.

2.5 Potential Sensitive Receptors

According to the Los Angeles Department of Public Works, Water Resources Department, there are no active wells within a 1-mile radius of the site (DPW, 2010). However, there are six schools / child care centers within a 1/2-mile radius of the site (Google Earth, 2010). These are listed below.

Summary of Potential Sensitive Receptors

Facility/Sensitive Receptor	Distance from Site (feet)	Direction from Site
Emerson Middle School	415	Northeast
Global Montessori School of Westwood	940	Southwest
Westwood Charter School	1,100	Southeast
Chalk Preschool	1,305	South
Pacific Western University	1,370	Northwest
Creative Center for Children	2,600	Northeast

The locations of these schools / child care centers are shown on Figure 1.

3.0 HYDROCARBON DISTRIBUTION

3.1 Soil

In January 2009 four soil boring (B-8 through B-11) were advanced to depths ranging from 85 to 95 feet bgs. Soil samples were collected at 5-foot intervals, and (according to laboratory analytical results) only minor to trace hydrocarbon concentrations were detected in borings B-9, B-10, and B-11. Hydrocarbon concentrations detected in boring B-8 were significantly higher.

Elevated TPH-G concentrations (>1,000 mg/kg) were limited to boring B-8 at depths between 30 to 40 feet. TPH-D concentrations greater than 10 mg/kg were only detected in boring B-8 up to 45 feet and B-11 up to 40 feet. Benzene was only detected at trace levels in borings B-9 (30 feet) and B-11 (25 and 30 feet). MTBE was detected at concentrations greater than 1,000 µg/kg between 35 and 50 feet in boring B-8, at 45 feet in boring B-9, and at 40 feet in boring B-11. TBA was detected at concentrations greater than 1,000 µg/kg at 20 and 25 feet in boring B-8, from 60 to 75 feet in B-9, and from 10 to 25 feet and 45 to 50 feet in B-11.

Soil analytical data are summarized in Table 1. Isoconcentration plots showing the distribution of hydrocarbons in soil are provided as Figures 5 through 8. Groundwater was not encountered during the investigation to the maximum depth drilled of 95 feet.

Based on previous investigations, it appears that the maximum soil concentrations are limited to the 25 to 45 foot interval for TPH-G / benzene, toluene, ethylbenzene and xylenes (BTEX), and 25 to 55 feet for MTBE. Below these depths, the concentrations were either non-detect or at low levels, which should not pose a significant threat to the groundwater quality.

4.0 SITE INVESTIGATION ACTIVITIES

The LAFD required additional site assessment to further define the vertical and lateral extent of petroleum hydrocarbons in soils underlying the site, specifically in the area of soil boring B-8 and the product dispenser. In a June 2010 telephone conversation with Thrifty, LAFD Inspector Luna stated that the hydrocarbon plume was not vertically defined in the area of soil borings B-8 and B-9. In response, it was proposed (in the August 2010 Workplan) that three borings be drilled and sampled at the locations shown on Figure 3. Selected soil samples would be analyzed by a California certified mobile analytical laboratory.

If petroleum fuel contaminant concentrations detected in the soil samples were equal to or greater than those detected during the 2009 investigation, the boring(s) would be converted to SVE well(s). Also, if detected concentrations were consistent with those detected during previous investigations (in both depth and concentration), the threat to groundwater quality would be considered minimal, and interim remedial actions (IRAs) by soil vapor extraction would be sufficient to eliminate any potential impact to groundwater. The proposed borings were advanced and sampled on November 16th, 17th, and 18th, 2010. Procedures and findings are discussed below.

4.1 Pre-Field Activities

Pre-field activities included the following:

- Preparing a site-specific Health and Safety Plan (HASP),
- Coordinating and scheduling subcontractors for soil boring drilling and laboratory analysis.
- Notifying Underground Service Alert (USA) and performing an underground utility clearance for the planned drilling locations.
- Obtaining any necessary permits.

4.2 Field Procedures

Underground Services Alert was notified of pending drilling activities at the station at least 48 hours prior to commencement of work. A geophysical utility locator was also used for borehole clearance. Prior to drilling, all borehole locations were hand augered to a depth of approximately 5 feet.

All drilling, soil sampling, and well installation activities were performed in accordance with WPI's site-specific HASP and under the direct supervision of a California Professional Geologist. The borings were drilled using a truck-mounted, hollow stem auger rig, operated by Test America Drilling Corporation, a California licensed C-57 contractor. The workplan specified that soil samples would be collected at 5-foot intervals to 90 feet bgs and that samples would be collected at 2.5-foot intervals from 90 feet to the terminal depth in each boring (estimated to be 110 feet). The borings were to be advanced until TPH-G was below detection limits in four consecutive samples (20 feet) and MTBE was below its detection limit in eight consecutive samples (40 feet) or to a maximum depth of 110 feet bgs.

Undisturbed soil samples were obtained from all borings using a modified California split-spoon sampler lined with three 6-inch long by 2-inch diameter brass tubes. The sampler was lowered to the target depth and driven 18 inches into the soil by the repeated drop of a 140-pound hammer from a height of approximately 30 inches.

After the sampler was driven to the desired depth, it was retrieved and the tubes were removed. The tube nearest the sampler toe was commonly selected for laboratory analysis. An aliquot of soil was collected from this tube and preserved using EPA Method 5035. The tube was preserved by sealing each end with Teflon sheets and plastic end caps. Select tubes and all preserved soil aliquots were labeled with a unique number, and recorded on a chain-of-custody form.

A field headspace test was conducted on a portion of soil from each sample interval with a portable photo-ionization detector (PID) calibrated to hexane. The soil was placed in a ZipLoc® bag, and allowed to sit undisturbed for approximately 10 minutes. The PID probe was inserted into the bag and the organic vapor emission from the soil into the bag headspace was measured. This reading was recorded on a soil boring log maintained for each sampling location and used to select soil samples for analysis by an on-site mobile laboratory.

Soil in the remaining tubes was examined in the field for observable signs of petroleum hydrocarbons and soil classification. Soil was classified in general accordance with the Unified Soil Classification System. Soil classifications and descriptions, including blow counts, grain size, subordinate constituents, color, density, and moisture content were recorded on each boring log.

Samples with headspace measurements greater than 5 ppmv were submitted to the mobile laboratory for analysis. Samples with PID readings less than 5 ppmv were submitted to a stationary California certified laboratory for analysis.

All samples were analyzed for TPH-G using modified EPA Method 8015B and for BTEX, the fuel oxygenate compounds and ethanol using EPA Method 8260B. Method detection limits were set in accordance with the California Water Quality Control Board – Los Angeles Region's (CRWQCB-LAR) UST Program analytical requirements (CRWQCB-LAR, 2005).

Samples SB-2D5, SB-2D15, SB-3D5 through SB-3D45, and SB-3D55 were analyzed by Associated Laboratories, a fixed laboratory. Samples SB-1D5 through SB-1D60, SB2-5D, SB2-D20 through SB2D60, and SB3-D50 and SB3-D60 were analyzed by an on-site mobile laboratory operated by American Analytics.

4.3 Boring / Well Installations

Boring sample results and well installation details for SB-1, SB-2, and SB-3 are discussed in order of installation below. Samples collected from these borings were labeled by boring number and depth. For example the 15-foot sample from boring SB-3 was labeled as SB-3D15.

4.3.1 Boring SB-2

Boring SB-2 was installed on November 16, 2010 at the location shown on Figure 3. High concentrations of volatile organic compounds (VOCs) were measured in the breathing space adjacent to the drill rig at a depth of about 35 feet bgs. VOC concentrations exceeded HASP guidelines for Level D work, and the drill crew was instructed to don full-face air purifying respirators with organic vapor cartridges. VOC concentrations varied widely over the next 5-foot interval. As a precautionary measure, the boring was halted at 45 feet bgs and allowed to vent. Auger were left in the hole, and covered with a metal plate. The plate was sealed with a cold patch asphalt cover, and the crew set up on SB-3.

Once advancement was re-initiated at SB-2, increasing moisture was noted at 50 feet bgs, and appeared to increase in the 55-foot sample. The boring was advanced in 2.5-foot intervals to a depth of 60 feet bgs, with both moisture and clay content continued to increase. At 60 feet bgs, drilling was halted for the day. Augers were left in the hole, just below the ground surface. The hole was covered with a steel plate, and sealed with an asphalt cold patch. The following morning when drilling resumed, approximately two feet of water was measured in the auger.

Since groundwater was not expected to be encountered at this depth, WPI was not prepared to install groundwater monitoring wells during this phase of investigation (groundwater monitoring well permits had not been obtained and there were no provisions for groundwater sampling) and did not want to advance the boring further through a potential confining layer. Therefore the boring was terminated at 62 feet bgs. Results from the SB-2 soil sample laboratory analyses are summarized below.

Chemical	SB-2D5	SB-2D10	SB-2D15	SB-2D20	SB-2D25	SB-2D30	SB-2D35	SB-2D40	SB-2D45	SB-2D50	SB-2D55	SB-2D60
benzene	ND	No Recovery	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
toluene	ND		ND	ND	1	35	ND	14	ND	2.4	0.0027	0.0029
ethyl benzene	ND		ND	4.3	35	25	21	64	1	3.7	0.0093	ND
m,p xylenes	ND		ND	25	100	81	16	220	2.3	12	0.032	ND
o-xylene	ND		ND	19	41	35	60	110	1.1	4.3	0.014	ND
MTBE	ND		ND	ND	ND	ND	28	4.4	0.22	ND	0.28	0.014
TBA	ND		ND	ND	ND	ND	ND	ND	ND	ND	0.22	ND
ETBE	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TAME	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DIPE	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethanol	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TPH (GRO)	ND		ND	580	1300	1000	890	3000	180	360	0.81	ND

All concentrations are in mg/kg. Samples collected from 20-60 feet were sampled by the mobile laboratory.

The boring was sealed with bentonite chips from 51 to 62 feet. A dual nested vapor extraction well was set in the boring with screened intervals from 20 to 35 feet bgs (SB-2S) and 40 to 50 feet bgs (SB-2D). A well construction diagram is provided on the SB-2 boring log (Appendix B). Laboratory reports and chain-of-custody documentation are provided as Appendix C.

4.3.2 Boring SB-3

Boring SB-3 was the second boring to be advanced on November 17, 2010. This boring was drilled and sampled as previously described at 5-foot intervals to a depth of 50 feet with no indication of impacted soils from field headspace testing. After 50 feet, the boring was advanced in 2.5-foot intervals to a depth of 60.5 feet bgs. As with SB-2, there were indications of increasing moisture over this depth interval, and soils were at or near saturation at 59 feet bgs. As a precautionary measure, the boring was terminated at 60.5 feet bgs.

The 50 foot sample from SB-3 was analyzed by the mobile laboratory. All other samples were transported under chain-of-custody to Associated Laboratories for analysis. Results are summarized below.

Chemical	SB-3D5	SB-3D10	SB-3D15	SB-3D20	SB-3D25	SB-3D30	SB-3D35	SB-3D40	SB-3D45	SB-3D50	SB-3D55	SB-3D60
benzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
toluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	**0.0049**	ND	ND
ethyl benzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
m,p xylenes	ND	ND	ND	ND	ND	ND	ND	ND	ND	**0.0039**	ND	ND
o-xylene	ND	ND	ND	ND	ND	ND	ND	ND	ND	**0.0017**	ND	ND
MTBE	ND	ND	ND	ND	ND	ND	ND	ND	ND	**0.075**	**0.0082**	ND
TBA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**0.0092j**	ND
ETBE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TAME	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DIPE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethanol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TPH (GRO)	ND	ND	ND	ND	ND	ND	ND	ND	ND	**0.12**	ND	ND

All concentrations are in mg/kg.
"j" – Flag indicating the value is between the practical quantitation limit and the method detection limit.

Based on the PID field tests and the mobile laboratory results, a vapor extraction well was not set in this boring. The boring was abandoned by tremie grouting to the surface with neat cement. The grout was allowed to settle for approximately four hours then topped off to within 6-inches of the surface. The remaining borehole was filled with concrete and finished at the surface to match existing grade. The boring log is provided in Appendix B. Laboratory reports and chain-of-custody documentation are provided as Appendix C.

4.2.3 Boring SB-1

Boring SB-1 was the final boring to be advanced on November 18, 2010. This boring was also drilled and sampled at 5- foot intervals to a depth of 50 feet with no indication of impacted soils from field headspace testing. All of the soil samples from SB-1 were analyzed by the mobile laboratory. Results are summarized below.

Chemical	SB-1D5	SB-1D10	SB-1D15	SB-1D20	SB-1D25	SB-1D30	SB-1D35	SB-1D40	SB-1D45	SB-1D50	SB-1D55	SB-1D60
benzene	ND	ND	ND	ND	ND	**0.0025**	ND	ND	ND	ND	ND	ND
toluene	**0.0012**	**0.0013**	**0.0015**	ND	**0.0014**	ND	**0.0037**	**0.0016**	**0.0022**	ND	**0.0014**	**0.0017**
ethyl benzene	ND	ND	ND	ND	ND	**0.041**	ND	ND	ND	ND	ND	ND
m,p xylenes	ND	ND	ND	ND	ND	**0.052**	**0.0067**	**0.0067**	**0.0022**	ND	ND	ND
o-xylene	ND	ND	ND	ND	ND	**0.0077**	ND	ND	ND	ND	ND	ND
MTBE	ND	ND	ND	**0.098**	**0.033**	**0.92**	**0.36**	**0.68**	**0.124**	ND	**0.0052**	**0.002**
TBA	ND	ND	ND	**0.11**	**0.11**	**0.13**	**0.14**	**0.3**	**0.3**	ND	**2.2**	**0.93**
ETBE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TAME	ND	ND	ND	ND	ND	**0.0048**	ND	**0.0049**	ND	ND	ND	ND
DIPE	ND	ND	ND	ND	ND	**0.0057**	ND	**0.0028**	ND	ND	ND	ND

Chemical	SB-1D5	SB-1D10	SB-1D15	SB-1D20	SB-1D25	SB-1D30	SB-1D35	SB-1D40	SB-1D45	SB-1D50	SB-1D55	SB-1D60
Ethanol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TPH (GRO)	ND	ND	ND	ND	ND	**0.73**	**0.35**	**0.46**	**0.16**	ND	ND	ND

After 50 feet, the boring was advanced in 2.5-foot intervals to a depth of 60.5 feet bgs. As with SB-1 and SB-2 both moisture and clay content increased over this depth interval, however, the amount of moisture was much less than observed at SB-2. As a precautionary measure, the boring was terminated at 60.5 feet bgs.

A vapor extraction well was set in boring SB-1, with a screened interval of 30 to 50 feet bgs. The interval from 51 to 60.5 feet bgs was sealed with bentonite chips. A well construction diagram is provided on the SB-1 boring log (Appendix B). Laboratory reports and chain-of-custody documentation are provided as Appendix C.

4.4 Disposal of Investigation Derived Wastes

Soil generated from the borings and sample decontamination water was placed in DOT approved 55-gallon drums. These drums were sealed and labeled as they were filled and upon completion of each work day. Analytical results from the soil analyses will be used to select an appropriate off-site disposal facility for these wastes. Manifest documenting transportation and the off-site disposal of these wastes will be provided under separate cover if requested.

5.0 CONCLUSIONS

The following conclusions are based on the results of this investigation:

- Elevated concentrations of petroleum fuel contaminants were detected on the west side of the western most dispenser islands and the western end of the UST pit. The highest concentrations were detected adjacent to the western most dispenser island.

- The most highly impacted depth interval is approximately 25 to 40 feet bgs. Isoconcentration maps for TPH-G/GRO, benzene, MTBE, and TBA are provided as Figures 7, 8, 9, and 10, respectively.

- Benzene was only detected in one soil sample (SB-1D30 at a concentration of 0.0025 mg/kg). This may indicate an older release, and/or active natural degradation of contaminants.

- Soils at or near saturation were encountered at depths of about 55 to 59 feet during drilling of SB-2 and SB-3. The existence of water at these locations and depths appears to be due to perched conditions, as the sandy layer where groundwater was encountered is underlain by finer grained sediments at both locations. Although indications of moisture were observed at SB-1, there was no indication of saturated soils, suggesting that the observed water bearing sediments are localized and of limited extent.

- Sediments observed at terminal depth generally consisted of silty sands with trace amounts of clay, comprising a potential confining layer. The existence of these finer grained sediments may prohibit or retard the downward migration of contaminants.

6.0 RECOMMENDATIONS

A mobile vacuum extraction event is recommended to evaluate the effectiveness of vapor extraction at the site. Objectives of the test would include evaluating vapor flow rates, mass removal rates and contaminant rebound. Extraction should be performed with a mobile SVE rig capable of extracting vapors at 250 standard cubic feet per minute (scfm) and achieving a vacuum of at least 12 inches of mercury (inches Hg). Extraction wells should be sealed at the surface to prevent intrusion of atmospheric air.

The test should utilize SB-1, SB-2S and SB-2D, and be conducted for 36 hours (twelve hours at each well), or until vapor phase contaminant concentrations become asymptotic at low levels. Well head vacuums, extracted vapor flow rates and contaminant vapor concentration (as measured with a PID calibrated to hexane) should be measured periodically as described below.

As extraction is conducted on each well, influent contaminant vapor concentrations should be measured with the PID at the beginning of extraction and every hour thereafter. Other parameters such as manifold applied vacuum (inches of Hg), vapor system flow rate (scfm), system flow temperature (degrees Fahrenheit) and extraction wellhead vacuum should be recorded every hour.

Influent contaminant vapor samples for laboratory analysis should be collected one hour, 6 hours and at the end of extraction for each well. These samples should be analyzed for total petroleum hydrocarbons as gasoline using modified EPA method 8015B, and for benzene, toluene, ethyl benzene, total xylenes and the fuel oxygenates using EPA method 8260B.

After the test is completed, a report will be prepared that documents test procedures and provides an evaluation of SVE effectiveness, including mass removal rates, and total mass removed from each well.

7.0 REFERENCES

Additional Site Assessment Report, Request for Closure, 2009. Prepared by GeoHydrologic Consultants, Inc. for Thrifty Oil Co. Station No. 020. 11 March.

CDWR (California Department of Water Resources), 1961. Bulletin No. 104, Planned Utilization of the Groundwater Basing of the Coastal Plain of the Los Angeles, Appendix A, Groundwater Geology. April 1998.

CRWQCB-LAR (California Regional Water Quality Control Board – Los Angeles Region), 1994. Basin Plan for the Costal Watersheds of Los Angeles and Ventura Counties, 13 June.

CRWQCB-LAR, 2005. General Laboratory Testing Requirements for Petroleum Hydrocarbon Impacted Sites (Table 1), 5 January.

CRWQCB-LAR, 2010. GeoTracker 2010, http://geotracker.swrcb,ca.gov/search.asp.

GoogleEarth, 2010, accessed on July 12, 2010.

Site Assessment Workplan and Remedial Action Plan, 2010. Prepared by Wayne Perry, Inc. for Thrifty Oil Co. Station No. 020. 3 August.

TABLES

Exhibit: G

CITY OF LOS ANGELES
CALIFORNIA

ERIC GARCETTI
MAYOR

DEPARTMENT OF
BUILDING AND SAFETY
201 NORTH FIGUEROA STREET
LOS ANGELES, CA 90012

RAYMOND S. CHAN, C.E., S.E.
GENERAL MANAGER

FRANK BUSH
EXECUTIVE OFFICER

GEOLOGY AND SOILS REPORT CORRECTION LETTER

December 29, 2015

LOG # 89430-01R
SOILS/GEOLOGY FILE - 2
LIQ/PFRSA
Revised to correct owner

Sinanian Development
18980 Ventura Boulevard, Suite 200
Tarzana, CA 91356

TRACT:	7803
BLOCK:	15
LOTS:	20 / 19 / 11
LOCATION:	1749 & 1751 Malcolm Avenue and 1772 Glendon Avenue

CURRENT REFERENCE REPORT/LETTER	REPORT No.	DATE OF DOCUMENT	PREPARED BY
Addendum Report No. 1	15-363-26	11/30/2015	Applied Earth Sciences
Oversized Docs.	"	"	"

PREVIOUS REFERENCE REPORT/LETTER(S)	REPORT No.	DATE OF DOCUMENT	PREPARED BY
Dept. Correction Letter	89430	08/19/2015	LADBS
Geology/Soils Report	15-363-26	07/21/2015	Applied Earth Sciences

The Grading Division of the Department of Building and Safety has reviewed the referenced report that provides recommendations for a proposed multi-unit residential development with a parking garage. According to the report, the site is relatively flat and occupied by existing residential structures.

The earth materials at the subsurface exploration locations consist of up to 4 feet of uncertified fill underlain by recent and older alluvium, sag pond and estuarine deposits. The consultants recommend to support the proposed structures on conventional foundations bearing on native undisturbed soils.

The site is located within a City of Los Angeles Preliminary Fault Rupture Study Area designated for the Santa Monica fault. The report includes the results of a fault rupture investigation that consisted of two transect of continuous core borings and cone penetrometer test soundings in Malcolm Avenue on the east side of the property. Active fault splays were identified through the northeastern corner of the property. The consultants recommend that proposed buildings be setback at least 20 feet from the fault splay and that a reinforced (thick mat) foundation be used to support the proposed structures.

The site is located in a designated liquefaction hazard zone as shown on the "Seismic Hazard Zones" map issued by the State of California.

The review of the subject report can not be completed at this time and will be continued upon submittal of an addendum to the report which shall include, but not be limited to, the following:

(Note: Numbers in parenthesis ( ) refer to applicable sections of the 2014 City of LA Building Code. P/BC numbers refer the applicable Information Bulletin. Information Bulletins can be accessed on the internet at LADBS.ORG.)

1. The southern most fault closest to the proposed habitable structures identified by the consultants appears to be located between continuous core boring B-3 and CPT-7 in transect B-B' and between CPT-18 and CPT-10 in transect A-A'. As no direct evidence of the orientation of the fault has been provided, the most conservative orientation of the fault trace appears to be a fault that is located just north of B-3 and just south of CPT-19. Provide a revised possible fault orientation and setback; or, provide additional exploration to confirm the fault's trend as interpreted by the consultant.

2. As no exploration has been performed west of transect B-B' to identify the fault trend, the consultants should provide an opinion as to possible variability (non-linear, flowering, etc.) in the fault trend west of transect B-B', with appropriate setback.

3. As the consultants recommend building a cantilevered structure within the "No-Build Zone", the consultants shall provide recommendations as to the maximum vertical and horizontal offset of the fault; and, a recommendation for vertical and horizontal space to be maintained below the cantilevered structure. Provide a plan that depicts the required space maintained below the cantilevered structure. Note: The current plan appears to show a lobby with doorways in the cantilevered area. No at grade structures can be connected to the cantilevered section of the proposed building.

The geologist and soils engineer shall prepare a report containing the corrections indicated in this letter. The report shall be in the form of an itemized response. It is recommended that once all correction items have been addressed in a response report, to contact the report review engineer and/or geologist to schedule a verification appointment to demonstrate compliance with all the corrections. Do not schedule an appointment until all corrections have been addressed. Bring three copies of the response report, including one unbound wet-signed original for microfilming in the event that the report is found to be acceptable.

CASEY LEE JENSEN	GLEN RAAD
Engineering Geologist Associate II	Geotechnical Engineer I

CLJ/GR:clj/gr
Log No. 89430-01R
213-482-0480

cc: Applied Earth Sciences, Project Consultant
WL District Office

Exhibit: H

January 15, 2016 15-363-26

Sinanian Development
18980 Ventura Boulevard, Suite 200
Tarzana, CA 91356

Subject: 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

Gentlemen:

INTRODUCTION

We are pleased to submit this Supplement No. 2 report responding to the City comments. The original report of geotechnical and geological investigation report for the subject project was issued by this office on July 21, 2015. A Supplement No. 1 report was prepared dated November 30, 2015 in response to a city correction letter dated August 19, 2015.

This submittal is in response to comments in a Geology and Soils Report Correction Letter dated December 29, 2015 by the Grading Section Of the Department of Building and Safety of the City of Los Angeles (Log # 89430-01). For convenience, we have enclosed a copy of the City Review Letter with this Supplement No. 2 report. Our responses also incorporate verbal discussion of the comments between the undersigned geologist and Mr. Schneidereit of LADBS during a meeting on 1/13/16.

Our responses follow the original order of comments.

RESPONSE TO THE COMMENTS

1. We have hereby revised the fault orientation to reflect the most conservative orientation, based on that fact that direct evidence or observation of the actual orientation of the fault with the exploration methods used is not possible. The revised fault orientation passes through B-3 and CPT-19.

However, now that the most conservative possible fault orientation is being used as a basis for engineering design of the buildings, we have reduced the no-build setback from twenty to ten feet, as was originally recommended in our 7/21/15 original report. This reduction in setback back to ten feet, based on the most conservative possible fault orientation, was discussed and verbally agreed upon with Mr. Schneidereit of LADBS in our meeting on 1/13/16.

2. Based on the presence of abundant fine-grained sag pond deposits north of the two faults encountered during our exploration, it is our opinion that the main trace of the Santa Monica fault lies north of the study area. This corresponds to the geomorphic and topographic evidence of the main trace being along the south-facing escarpment that forms the front lawn of the LDS temple, the northwestward projection of which extends north of the study area. The project area is likely located on the south part of a localized zone of transtension along the generally left-lateral strike-slip fault zone, related to the northwestward bend in the main fault trace one block east of the study area (Miles Kenney, 2014; Scott Lindvall, personal communication, Richard Crook, Jr., personal communication). It is therefore the opinion of the undersigned that the possibility of flower structures or non-linear variability west of the encountered fault is minute, since we consider this fault to be a splay of the main fault north of the project area. Furthermore, it is our opinion that any non-variability west of the study area (B-3) to the north property limit (a span of 50 feet) will be within the established ten-feet setback zone.

3. Based on our correspondence with the aforementioned fault specialists, and our prior experience along the Hollywood and Santa Monica fault zones, it is the opinion of the

undersigned that the maximum vertical offset along this fault for a single earthquake event is 12 inches. We have depicted the cantilevered portion of the building as such: the area around the proposed new building which will be cantilevered within the setback zone shall be subject to minor grading/shaving of the ground surface, confined to the subject property, such that the cantilevered part of the proposed building will have a minimum of 12 inches clearance above the finished ground surface. Any appurtenant stair or bridge structures that provide access to the lower lobby level of the main building shall be structurally separate from the main building. We have revised our drawings to reflect this requirement; see revised Geotechnical Site Plan and new Geotechnical Cross Sections J and K attached.

In addition, to address off-fault deformation we have recommended a 2-feet thick mat slab foundation for both proposed new buildings, as previously discussed in prior Supplemental Report No. 1. Structural engineering plans for the proposed buildings shall be subject to our review and official stamp and signature approval to ensure that the requirements as set forth in our reports are adhered. Lastly, continuous deputy inspection by a geologist representative of this office during the grading phase of the course of construction shall be required.

-o0o-

Thank you for the opportunity to be of continued service on this project. Should you have any questions regarding this Supplement No. 1, or wish to discuss the project further, please do not hesitate to call us.

Respectfully Submitted,

APPLIED EARTH SCIENCES

Shant Minas
Engineering Geologist
EG 2607

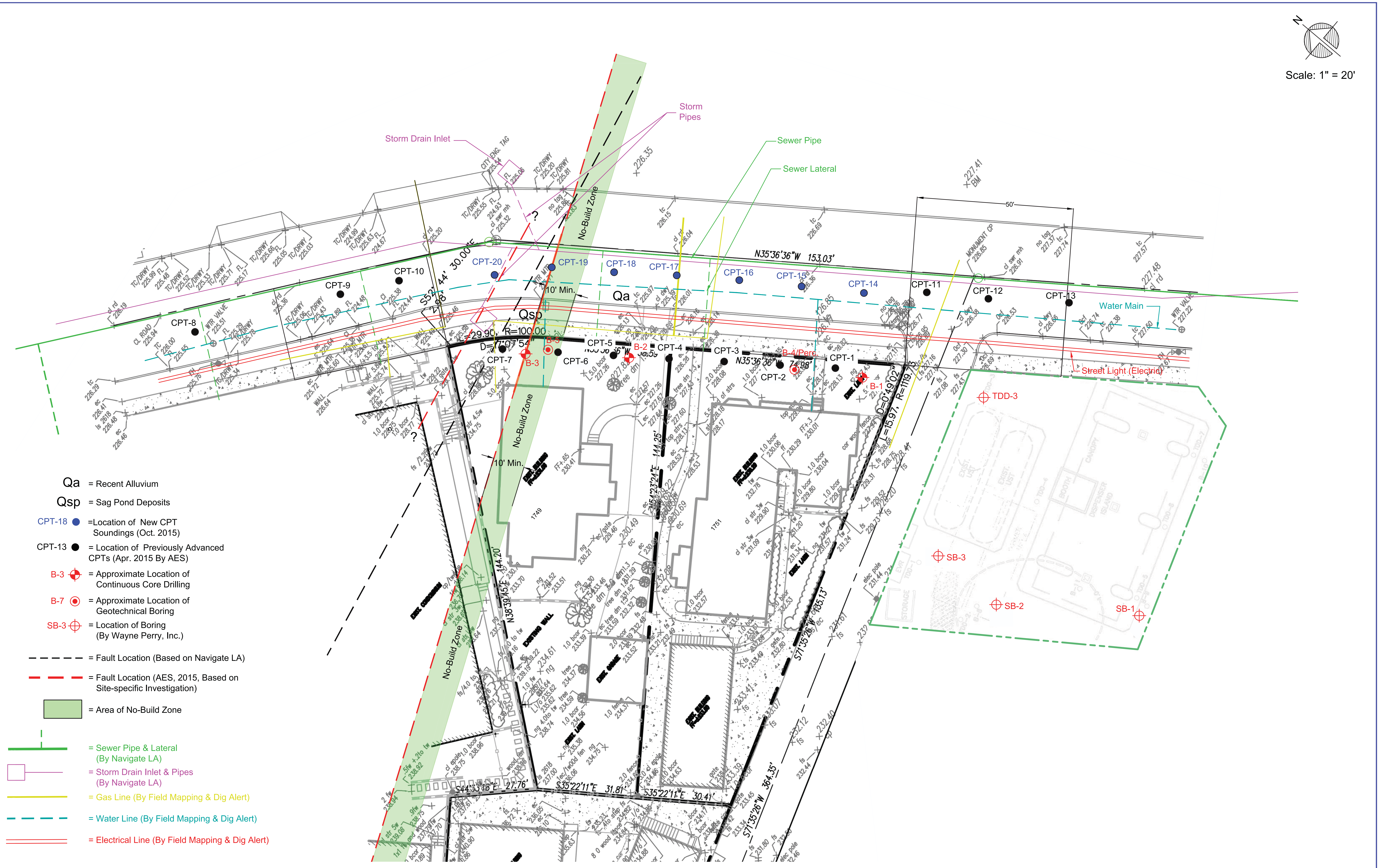
Caro J. Minas, President,
Geotechnical Engineer
GE 601

Steven Miller
Senior Engineering Geologist
EG 1303

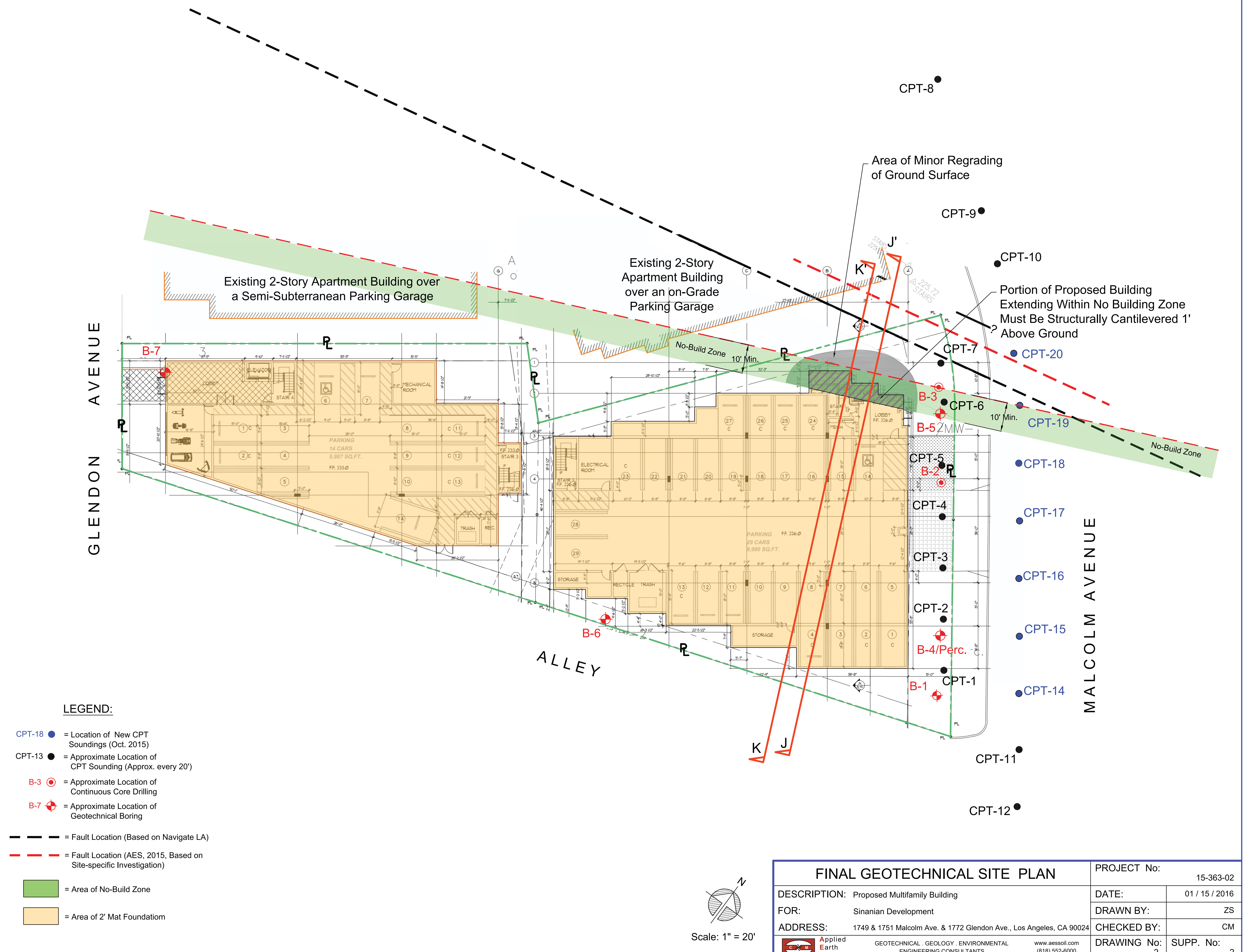
SM/CJM/la

Enclosure: Drawing No. 1 - Final Geologic Map
Drawing No. 2 - Final Geotechnical Site Plan
Drawing Nos. 3 and 4 - Geologic Cross Sections J and K

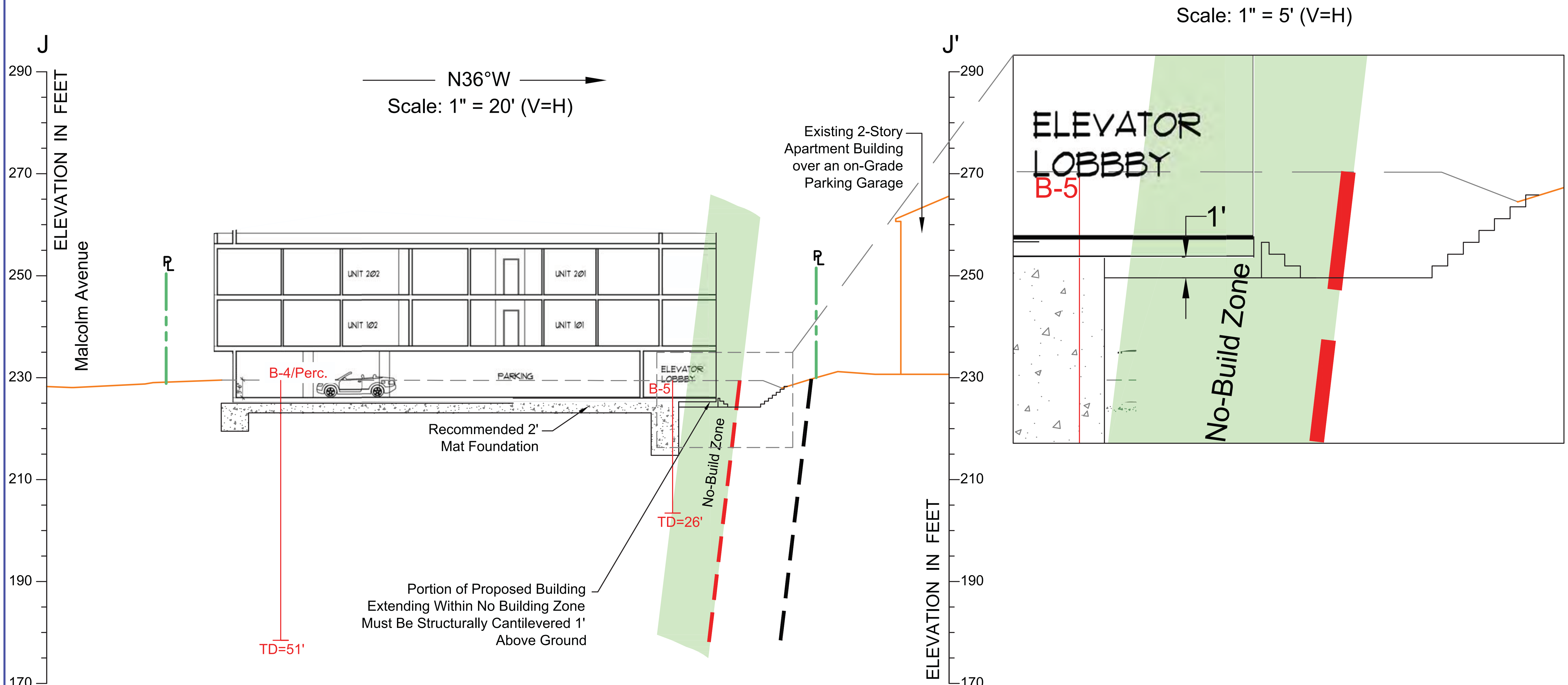
Copy of City Correction Letter (Log No. 89430-01)



FINAL GEOLOGIC MAP		PROJECT No: 15-363-26	
DESCRIPTION:	Proposed Multifamily Building	DATE:	01 / 15 / 2016
FOR:	Sinanian Development	DRAWN BY:	ZS
ADDRESS:	1749 & 1751 Malcolm Avenue, Los Angeles, CA 90024	CHECKED BY:	SM
Applied Earth Sciences	GEOTECHNICAL . GEOLOGY . ENVIRONMENTAL ENGINEERING CONSULTANTS www.aessoil.com (818) 552-6000	DRAWING No: 1	SUPP. No: 2



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



LEGEND:

B-4 TD=10' (Projected) = Location & Number of Boring

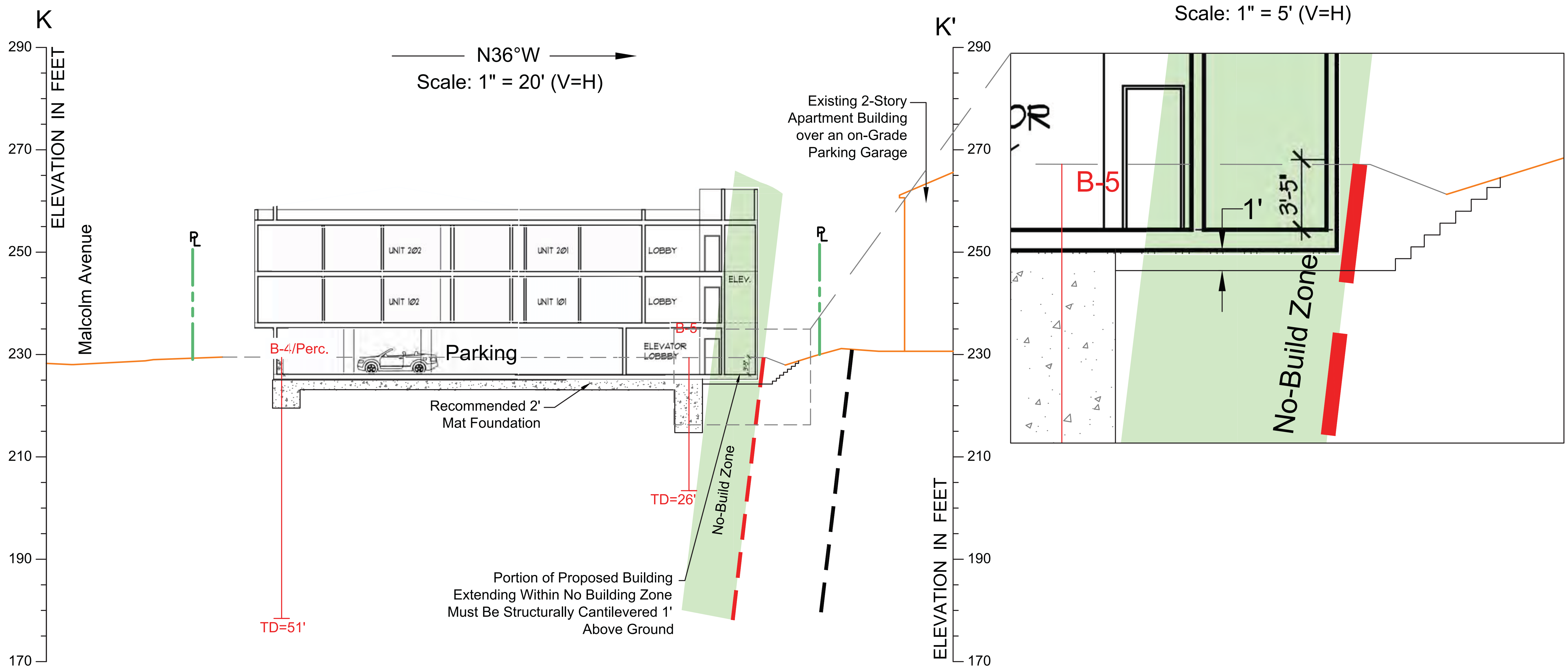
= Fault Location (Based on Navigate LA)

= Fault Location (AES, 2015, Based on Site-specific Investigation)

= Area of No-Build Zone

GEOTECHNICAL CROSS SECTION J-J'

DESCRIPTION:	Proposed Multifamily Building	PROJECT No:	15-363-26
FOR:	Sinanian Development	DATE:	01 / 15 / 2016
ADDRESS:	1749 & 1751 Malcolm Avenue, Los Angeles, CA 90024	DRAWN BY:	ZS
		CHECKED BY:	SM
Applied Earth Sciences	GEOTECHNICAL . GEOLOGY . ENVIRONMENTAL ENGINEERING CONSULTANTS www.aessoil.com (818) 552-6000	DRAWING No: 3	SUPP. No: 2



LEGEND:

B-4 | TD=10' (Projected) = Location & Number of Boring

= Fault Location (Based on Navigate LA)

= Fault Location (AES, 2015, Based on Site-specific Investigation)

= Area of No-Build Zone

GEOTECHNICAL CROSS SECTION K-K'

DESCRIPTION:	Proposed Multifamily Building
FOR:	Sinanian Development
ADDRESS:	1749 & 1751 Malcolm Avenue, Los Angeles, CA 90024
PROJECT No:	15-363-26
DATE:	01 / 15 / 2016
DRAWN BY:	ZS
CHECKED BY:	SM
DRAWING No:	4
SUPP. No:	2

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CITY OF LOS ANGELES

CALIFORNIA

ERIC GARCETTI
MAYOR

DEPARTMENT OF
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201 NORTH FIGUEROA STREET
LOS ANGELES, CA 90012

RAYMOND S. CHAN, C.E., S.E.
GENERAL MANAGER

FRANK BUSH
EXECUTIVE OFFICER

GEOLOGY AND SOILS REPORT CORRECTION LETTER

December 29, 2015

LOG # 89430-01
SOILS/GEOLOGY FILE - 2
LIQ/PFRSA

Ben Neman
458 N. Doheny Drive, Unit 691674
West Hollywood, CA 90069

TRACT:	7803
BLOCK:	15
LOTS:	20 / 19 / 11
LOCATION:	1749 & 1751 Malcolm Avenue and 1772 Glendon Avenue

CURRENT REFERENCE REPORT/LETTER	REPORT No.	DATE OF DOCUMENT	PREPARED BY
Addendum Report No. 1	15-363-26	11/30/2015	Applied Earth Sciences
Oversized Docs.	``	``	``

PREVIOUS REFERENCE REPORT/LETTER(S)	REPORT No.	DATE OF DOCUMENT	PREPARED BY
Dept. Correction Letter	89430	08/19/2015	LADBS
Geology/Soils Report	15-363-26	07/21/2015	Applied Earth Sciences

The Grading Division of the Department of Building and Safety has reviewed the referenced report that provides recommendations for a proposed multi-unit residential development with a parking garage. According to the report, the site is relatively flat and occupied by existing residential structures.

The earth materials at the subsurface exploration locations consist of up to 4 feet of uncertified fill underlain by recent and older alluvium, sag pond and estuarine deposits. The consultants recommend to support the proposed structures on conventional foundations bearing on native undisturbed soils.

The site is located within a City of Los Angeles Preliminary Fault Rupture Study Area designated for the Santa Monica fault. The report includes the results of a fault rupture investigation that consisted of two transect of continuous core borings and cone penetrometer test soundings in Malcolm Avenue on the east side of the property. Active fault splays were identified through the northeastern corner of the property. The consultants recommend that proposed buildings be setback at least 20 feet from the fault splay and that a reinforced (thick mat) foundation be used to support the proposed structures.

The site is located in a designated liquefaction hazard zone as shown on the "Seismic Hazard Zones" map issued by the State of California.

The review of the subject report can not be completed at this time and will be continued upon submittal of an addendum to the report which shall include, but not be limited to, the following:

(Note: Numbers in parenthesis ( ) refer to applicable sections of the 2014 City of LA Building Code. P/BC numbers refer the applicable Information Bulletin. Information Bulletins can be accessed on the internet at LADBS.ORG.)

1. The southern most fault closest to the proposed habitable structures identified by the consultants appears to be located between continuous core boring B-3 and CPT-7 in transect B-B' and between CPT-18 and CPT-10 in transect A-A'. As no direct evidence of the orientation of the fault has been provided, the most conservative orientation of the fault trace appears to be a fault that is located just north of B-3 and just south of CPT-19. Provide a revised possible fault orientation and setback; or, provide additional exploration to confirm the fault's trend as interpreted by the consultant.

2. As no exploration has been performed west of transect B-B' to identify the fault trend, the consultants should provide an opinion as to possible variability (non-linear, flowering, etc.) in the fault trend west of transect B-B', with appropriate setback.

3. As the consultants recommend building a cantilevered structure within the "No-Build Zone", the consultants shall provide recommendations as to the maximum vertical and horizontal offset of the fault; and, a recommendation for vertical and horizontal space to be maintained below the cantilevered structure. Provide a plan that depicts the required space maintained below the cantilevered structure. Note: The current plan appears to show a lobby with doorways in the cantilevered area. No at grade structures can be connected to the cantilevered section of the proposed building.

The geologist and soils engineer shall prepare a report containing the corrections indicated in this letter. The report shall be in the form of an itemized response. It is recommended that once all correction items have been addressed in a response report, to contact the report review engineer and/or geologist to schedule a verification appointment to demonstrate compliance with all the corrections. Do not schedule an appointment until all corrections have been addressed. Bring three copies of the response report, including one unbound wet-signed original for microfilming in the event that the report is found to be acceptable.

CASEY LEE JENSEN
Engineering Geologist Associate II

GLEN RAAD
Geotechnical Engineer I

CLJ/GR:clj/gr
Log No. 89430-01
213-482-0480

cc: Applied Earth Sciences, Project Consultant
WL District Office

Exhibit: I

CITY OF LOS ANGELES
CALIFORNIA

ERIC GARCETTI
MAYOR

DEPARTMENT OF
BUILDING AND SAFETY
201 NORTH FIGUEROA STREET
LOS ANGELES, CA 90012

RAYMOND S. CHAN, C.E., S.E.
GENERAL MANAGER

FRANK BUSH
EXECUTIVE OFFICER

GEOLOGY AND SOILS REPORT APPROVAL LETTER

February 1, 2016

LOG # 89430-02
SOILS/GEOLOGY FILE - 2
LIQ/PFRSA

Sinanian Development
18980 Ventura Boulevard, Suite 200
Tarzana, CA 91356

TRACT:	7803
BLOCK:	15
LOT(S):	20 / 19 / 11
LOCATION:	1749 & 1751 Malcolm Avenue and 1772 Glendon Avenue

CURRENT REFERENCE REPORT/LETTER(S)	REPORT No.	DATE(S) OF DOCUMENT	PREPARED BY
Supplemental Report	15-363-26	01/15/2016	Applied Earth Sciences
Oversized Doc(s).	"	"	"

PREVIOUS REFERENCE REPORT/LETTER(S)	REPORT No.	DATE(S) OF DOCUMENT	PREPARED BY
Dept. Correction Letter	89430-01	12/29/2015	LADBS
Addendum Report No. 1	15-363-26	11/30/2015	Applied Earth Sciences
Dept. Correction Letter	89430	08/19/2015	LADBS
Geology/Soils Report	15-363-26	07/21/2015	Applied Earth Sciences

The Grading Division of the Department of Building and Safety has reviewed the referenced report that provides recommendations for a proposed multi-unit residential development with a partially subterranean parking garage. According to the report, the site is relatively flat and occupied by existing residential structures.

The earth materials at the subsurface exploration locations consist of up to 4 feet of uncertified fill underlain by recent and older alluvium, sag pond and estuarine deposits. The consultants recommend to support the proposed structures on mat foundations bearing in native undisturbed soils.

The site is located within a City of Los Angeles Preliminary Fault Rupture Study Area designated for the Santa Monica fault. The reports include the results of a fault rupture investigation that consisted of two transect of three continuous core borings and 20 cone penetrometer test soundings in Malcolm Avenue on the east side of the property. Active fault splays were identified through the northeastern corner of the property. The consultants recommend that proposed buildings be setback at least 10 feet from the closest fault splay and that a reinforced (thick mat) foundation be used to support the proposed buildings. A portion of the northeast corner of the northeast building will be cantilevered over the setback area with at least 1 foot separating the bottom of the building with the ground surface.

The site is located in a designated liquefaction hazard zone as shown on the "Seismic Hazard Zones" map issued by the State of California. The Liquefaction study included as a part of the reports demonstrates that the site does not possess a liquefaction potential. This satisfies the requirement of the 2014 Los Angeles City Building Code Section 1802.2.7.

The referenced reports are acceptable, provided the following conditions are complied with during site development:

(Note: Numbers in parenthesis ( ) refer to applicable sections of the 2014 City of LA Building Code. P/BC numbers refer the applicable Information Bulletin. Information Bulletins can be accessed on the internet at LADBS.ORG.)

1. The geologist and soils engineer shall review and approve the detailed plans prior to issuance of any permits. This approval shall be by signature on the plans that clearly indicates the geologist and soils engineer have reviewed the plans prepared by the design engineer and that the plans include the recommendations contained in their reports. (7006.1)

2. All recommendations of the reports that are in addition to or more restrictive than the conditions contained herein shall be incorporated into the plans.

3. A copy of the subject and appropriate referenced reports and this approval letter shall be attached to the District Office and field set of plans. Submit one copy of the above reports to the Building Department Plan Checker prior to issuance of the permit. (7006.1)

4. A grading permit shall be obtained. (106.1.2)

5. The project engineering geologist shall observe all final removal excavations to verify that the conclusions of the current fault investigation are correct and that no fault trace or evidence of ground deformation are exposed in the over-excavation. A supplemental report that summarizes the geologist's observations shall be submitted to the Grading Division of the Department upon completion of the over excavations. If evidence of faulting is observed, the Grading Division shall be notified and a site meeting scheduled.

6. All man-made fill shall be compacted to a minimum 90 percent of the maximum dry density of the fill material per the latest version of ASTM D 1557. Where cohesionless soil having less than 15 percent finer than 0.005 millimeters is used for fill, it shall be compacted to a minimum of 95 percent relative compaction based on maximum dry density (D1556). Placement of gravel in lieu of compacted fill is allowed only if complying with Section 91.7011.3 of the Code. (7011.3)

7. Existing uncertified fill shall not be used for support of footings, concrete slabs or new fill. (1809.2)

8. Drainage in conformance with the provisions of the Code shall be maintained during and subsequent to construction. (7013.12)

9. The applicant is advised that the approval of this report does not waive the requirements for excavations contained in the State Construction Safety Orders enforced by the State Division of Industrial Safety. (3301.1)

10. The soils engineer shall review and approve the shoring and/or underpinning plans prior to issuance of the permit. (3307.3.2)

11. Prior to the issuance of the permits, the soils engineer and/or the structural designer shall evaluate the surcharge loads used in the report calculations for the design of the retaining walls and shoring. If the surcharge loads used in the calculations do not conform to the actual surcharge loads, the soil engineer shall submit a supplementary report with revised recommendations to the Department for approval.

12. Unsurcharged temporary excavation may be cut vertical up to 4 feet. Excavations over 4 feet shall be trimmed back at a uniform gradient not exceeding 3/4:1 (horizontal to vertical), from top to bottom of excavation, as recommended.

13. Shoring shall be designed for a minimum EFP of 30 PCF; all surcharge loads shall be included into the design, as recommended.

14. Shoring shall be designed for a maximum lateral deflection of 1 inch, provided there are no structures within a 1:1 plane projected up from the base of the excavation. Where a structure is within a 1:1 plane projected up from the base of the excavation, shoring shall be designed for a maximum lateral deflection of ½ inch, or to a lower deflection determined by the consultant that does not present any potential hazard to the adjacent structure.

15. A shoring monitoring program shall be implemented to the satisfaction of the soils engineer.

16. All foundations shall derive entire support from native undisturbed soils, as recommended and approved by the geologist and soils engineer by inspection.

17. Footings supported on approved compacted fill or expansive soil shall be reinforced with a minimum of four (4) ½-inch diameter (#4) deformed reinforcing bars. Two (2) bars shall be placed near the bottom and two (2) bars placed near the top.

18. The mat foundations for both proposed new buildings shall be a minimum of two feet thick, as recommended on page 5 of the 11/30/2015 report and page 3 of the 01/15/2016 report.

19. No footings are to be constructed in the "No-Build" area as shown on the Final Geotechnical Site Plan included in the 01/15/2016 report. The southern boundary of the "No-Build" area shall be marked by a licenced surveyor at the start of construction.

20. The foundation/slab design shall satisfy all requirements of the Information Bulletin P/BC 2014-116 "Foundation Design for Expansive Soils" (1803.5.3). Note: Soils with an Expansion Index greater than 20 are considered to be expansive, in accordance with Section 1803.5.3 of the 2014 LABC.

21. Conventional slabs placed on approved compacted fill shall be at least 3½ inches thick and shall be reinforced with ½-inch diameter (#4) reinforcing bars spaced maximum of 16 inches on center each way.

22. Concrete floor slabs placed on expansive soil shall be placed on a 4-inch fill of coarse aggregate or on a moisture barrier membrane. The slabs shall be at least 3½ inches thick and shall be reinforced with ½-inch diameter (#4) reinforcing bars spaced maximum of 16 inches on center each way.

23. The seismic design shall be based on a Site Class D as recommended. All other seismic design parameters shall be reviewed by LADBS building plan check.

24. Retaining walls shall be designed for the lateral earth pressures specified in the section titled "Basement Walls" starting on page 29 of the 07/21/2015 report. All surcharge loads shall be included into the design.

25. Retaining walls higher than 6 feet shall be designed for lateral earth pressure due to earthquake motions as specified on page 29 of the 07/21/2015 report (1803.5.12).

26. All retaining walls shall be provided with a standard surface backdrain system and all drainage shall be conducted to the street in an acceptable manner and in a non-erosive device. (7013.11)

27. With the exception of retaining walls designed for hydrostatic pressure, all retaining walls shall be provided with a subdrain system to prevent possible hydrostatic pressure behind the wall. Prior to issuance of any permit, the retaining wall subdrain system recommended in the soil report shall be incorporated into the foundation plan which shall be reviewed and approved by the soils engineer of record. (1805.4)

28. Installation of the subdrain system shall be inspected and approved by the soils engineer of record and the City grading/building inspector. (108.9)

29. Basement walls and floors shall be waterproofed/damp-proofed with an L.A. City approved "Below-grade" waterproofing/damp-proofing material with a research report number. (104.2.6)

30. Prefabricated drainage composites (Miradrain, Geotextiles) may be only used in addition to traditionally accepted methods of draining retained earth.

31. The structures shall be connected to the public sewer system. (P/BC 2014-027)

32. All roof and pad drainage shall be conducted to the street in an acceptable manner. (7013.10)

33. An on-site storm water infiltration system at the subject site shall not be implemented, as recommended.

34. All concentrated drainage shall be conducted in an approved device and disposed of in a manner approved by the LADBS. (7013.10)

35. Any recommendations prepared by the geologist and/or the soils engineer for correction of geological hazards found during grading shall be submitted to the Grading Division of the Department for approval prior to utilization in the field. (7008.3)

36. The geologist and soils engineer shall inspect all excavations to determine that conditions anticipated in the report have been encountered and to provide recommendations for the correction of hazards found during grading. (7008 & 1705.6)

37. Prior to the pouring of concrete, a representative of the consulting soils engineer shall inspect and approve the footing excavations. He/She shall post a notice on the job site for the LADBS Building Inspector and the Contractor stating that the work so inspected meets the conditions of the report, but that no concrete shall be poured until the City Building Inspector has also inspected and approved the footing excavations. A written certification to this effect shall be filed with the Grading Division of the Department upon completion of the work. (108.9 & 7008.2)

38. Prior to excavation, an initial inspection shall be called with LADBS Inspector at which time sequence of construction, shoring, protection fences and dust and traffic control will be scheduled. (108.9.1)

39. Installation of shoring shall be performed under the inspection and approval of the soils engineer and deputy grading inspector. (1705.6)

40. Prior to the placing of compacted fill, a representative of the soils engineer shall inspect and approve the bottom excavations. He/She shall post a notice on the job site for the City Grading Inspector and the Contractor stating that the soil inspected meets the conditions of the report, but that no fill shall be placed until the LADBS Grading Inspector has also inspected and approved the bottom excavations. A written certification to this effect shall be included in the final compaction report filed with the Grading Division of the Department. All fill shall be placed under the inspection and approval of the soils engineer. A compaction report together with the approved soil report and Department approval letter shall be submitted to the Grading Division of the Department upon completion of the compaction. In addition, an Engineer's Certificate of Compliance with the legal description as indicated in the grading permit and the permit number shall be included. (7011.3)

41. No footing/slab shall be poured until the compaction report is submitted and approved by the Grading Division of the Department.

DANIEL C. SCHNEIDEREIT
Engineering Geologist I

GLEN RAAD
Geotechnical Engineer I

Log No. 89430-02
213-482-0480

cc: Applied Earth Sciences, Project Consultant
WL District Office

Exhibit: J

Los Angeles Department of Building and Safety

Certificate Information: 1751 S MALCOLM AVE 90024

Application / Permit

16010-20000-02308

Plan Check / Job No.

B16VN07299

Group

Building

Type

Bldg-New

Sub-Type

Apartment

Primary Use

(5) Apartment

Work Description

(N) 3-STORY TYPE V-A 18-UNIT APARTMENT OVER TYPE 1-A BASEMENT GARAGE (NFPA-13 FIRE SPRINKLERS THROUGHOUT)

Permit Issued

Issued on 9/28/2018

Issuing Office

Valley

Current Status

Issued on 9/28/2018

Certificate of Occupancy

Pending

Permit Application Status History

Submitted	6/1/2016	APPLICANT
Disabled Access Plans Picked Up	7/7/2016	APPLICANT
Green Plans Picked Up	7/7/2016	APPLICANT
Assigned to Plan Check Engineer	7/14/2016	NILOOFAR MEHRAIN
Corrections Issued	7/28/2016	NILOOFAR MEHRAIN
Reviewed by Supervisor	8/5/2016	STEVEN KIM
Building Plans Picked Up	8/12/2016	APPLICANT
Applicant returned to address corrections	12/8/2016	NILOOFAR MEHRAIN
Applicant returned to address corrections	12/20/2016	NILOOFAR MEHRAIN
Applicant returned to address corrections	12/21/2016	NILOOFAR MEHRAIN
Applicant returned to address corrections	7/19/2017	NILOOFAR MEHRAIN
Applicant returned to address corrections	8/21/2017	NILOOFAR MEHRAIN
Applicant returned to address corrections	8/22/2017	NILOOFAR MEHRAIN
Applicant returned to address corrections	2/27/2018	NILOOFAR MEHRAIN
Plan Check Approved	5/16/2018	NILOOFAR MEHRAIN
Issued	9/28/2018	LADBS
Permit Closed-Status Void	9/18/2020	PAUL DAVIDSON
Re-Activate Permit	9/22/2020	PAUL DAVIDSON

Permit Application Clearance Information

Tract Map conditions	Cleared	10/11/2016	TREVOR MARTIN
Address approval	Cleared	1/3/2017	LEE GUILBEAUX
Eng Process Fee Ord 176,300	Cleared	1/3/2017	LEE GUILBEAUX
Sewer availability	Cleared	1/3/2017	LEE GUILBEAUX
DAS Clearance	Cleared	5/24/2017	NILOOFAR MEHRAIN
Green Code	Cleared	6/28/2017	MICHAEL AYERS
Specific Plan	Cleared	7/6/2017	EDER ROMERO
Hydrant and Access approval	Cleared	7/25/2017	ROBERT DUFF

Fire Marshall Fire Life Safety	Cleared	8/7/2017	MENOA AGHAJANI
"Q" conditions	Cleared	8/11/2017	TRACY WILLIAMS
Frnt yard landscape/Water mgmt	Cleared	8/11/2017	TRACY WILLIAMS
Miscellaneous	Cleared	8/11/2017	TRACY WILLIAMS
Opn space landscape/Water mgmt	Cleared	8/11/2017	TRACY WILLIAMS
Specific Plan	Cleared	8/11/2017	TRACY WILLIAMS
Specific Plan	Cleared	8/11/2017	TRACY WILLIAMS
Low Impact Development	Cleared	5/15/2018	AMMAR ELTAWIL
Roof/Waste drainage to street	Cleared	5/15/2018	CELINA MORENO
Stormwater Pollution Mitigatn	Cleared	5/15/2018	AMMAR ELTAWIL
GPI Written Notices	Cleared	5/16/2018	NILOOFAR MEHRAIN
Grading Pre-Inspection	Cleared	5/16/2018	NILOOFAR MEHRAIN
Permit	Cleared	5/16/2018	ANDREW SLUSSER
Highway dedication	Cleared	5/22/2018	CHRISTOPHER LAW
Housing rent stabilization	Cleared	9/24/2018	CHARLES GARCIA
Demo/Removal of Rental Units	Cleared	9/25/2018	EDWARD JACOBS

Contact Information

Architect	Alajajian, Aram Movses; Lic. No.: C14897	1412 NORTH LOUISE STREET GLENDALE, CA 91207
Contractor	Sinanian Development Inc; Lic. No.: 455273-B	18980 VENTURA BLVD SUITE 200 TARZANA, CA 91356
Engineer	Ekmekji, Samir Dikran; Lic. No.: S2289	4314 GAYLE DR TARZANA, CA 91356
Engineer	Minas, Caro Jolfaie; Lic. No.: GE601	4742 SAN FERNANDO RD GLENDALE, CA 91204

Inspector Information

DERRICK SPENCER, (310) 914-3919	Office Hours: 7:00-8:00 AM MON-FRI

Pending Inspections

No Data Available.

Inspection Request History

Pre-Inspection	11/15/2018	Approved	DERRICK SPENCER
Pre-Inspection	11/19/2018	Partial Approval	DERRICK SPENCER
SWPPP-Const. Storm Water	12/4/2018	Completed	DERRICK SPENCER
Excavation/Setback/Form/Re-Bar	1/8/2019	Not Ready for Inspection	DERRICK SPENCER
Deputy Methane Barrier	3/22/2019	Approved	DERRICK SPENCER
Deputy Methane Barrier	4/4/2019	Approved	DERRICK SPENCER
Deputy Methane Barrier	4/5/2019	Approved	DERRICK SPENCER
Deputy Methane Barrier	4/8/2019	Approved	DERRICK SPENCER
Deputy Methane Barrier	4/10/2019	Approved	DERRICK SPENCER
METHANE-Barrier	4/11/2019	Conditional Approval	SORIN CIRSTOIU
Deputy Methane Barrier	4/16/2019	Approved	DERRICK SPENCER
Deputy Methane Barrier	4/23/2019	Approved	DERRICK SPENCER
Deputy Reinf. Concrete	4/24/2019	Approved	DERRICK SPENCER
Deputy Methane Barrier	4/25/2019	Approved	DERRICK SPENCER
Excavation/Setback/Form/Re-Bar	4/25/2019	Partial Approval	DERRICK SPENCER
Deputy Methane Barrier	4/30/2019	Approved	DERRICK SPENCER
Green Building Rough	4/30/2019	Not Ready for Inspection	DERRICK SPENCER
METHANE-Rough	4/30/2019	Approved	DERRICK SPENCER
Reinforced Concrete Frame	4/30/2019	Partial Approval	DERRICK SPENCER
Verify Sprinkler Sign Off	4/30/2019	Approved	DERRICK SPENCER
Deputy Methane Barrier	5/1/2019	Approved	DERRICK SPENCER
Excavation/Setback/Form/Re-Bar	5/9/2019	Partial Approval	DERRICK SPENCER
Excavation/Setback/Form/Re-Bar	5/13/2019	Partial Approval	DANIEL MC AULIFFE

Deputy Reinf. Concrete	5/14/2019	Conditional Approval	DANIEL MC AULIFFE
Deputy Methane Barrier	5/22/2019	Approved	DERRICK SPENCER
SWPPP-Const. Storm Water	5/30/2019	Completed	DERRICK SPENCER
Green Building Rough	6/7/2019	Not Ready for Inspection	DERRICK SPENCER
Reinforced Concrete Frame	6/7/2019	Partial Approval	DERRICK SPENCER
Masonry Wall/Backfill	6/11/2019	Partial Approval	DERRICK SPENCER
Reinforced Masonry Frame	6/25/2019	Approved	DERRICK SPENCER
Green Building Rough	6/26/2019	Not Ready for Inspection	DERRICK SPENCER
Reinforced Concrete Frame	6/26/2019	Partial Approval	DERRICK SPENCER
Green Building Rough	8/2/2019	Not Ready for Inspection	DERRICK SPENCER
Reinforced Concrete Frame	8/2/2019	Partial Approval	DERRICK SPENCER
Deputy Reinf. Concrete	8/7/2019	Approved	DERRICK SPENCER
Deputy Reinf. Concrete	8/26/2019	Approved	DERRICK SPENCER
Excavation/Setback/Form/Re-Bar	8/26/2019	Partial Approval	DERRICK SPENCER
Deputy Reinf. Concrete	8/27/2019	Approved	DERRICK SPENCER
Deputy Reinf. Concrete	8/28/2019	Approved	DERRICK SPENCER
Green Building Rough	9/9/2019	Not Ready for Inspection	DERRICK SPENCER
Reinforced Concrete Frame	9/9/2019	Partial Approval	DERRICK SPENCER
Floor/Roof Diaphrgm/Shear Wall	9/18/2019	Partial Approval	DERRICK SPENCER
Drywall Nailing	9/23/2019	Not Ready for Inspection	DERRICK SPENCER
Green Building Rough	9/23/2019	Not Ready for Inspection	DERRICK SPENCER
Footing/Foundation/Slab	9/25/2019	Partial Approval	DERRICK SPENCER
METHANE-Barrier	9/25/2019	Approved	DERRICK SPENCER
METHANE-Subgrade	9/25/2019	Approved	DERRICK SPENCER
Floor/Roof Diaphrgm/Shear Wall	10/16/2019	Partial Approval	DERRICK SPENCER
Green Building Rough	10/16/2019	Not Ready for Inspection	DERRICK SPENCER
Masonry Wall/Backfill	10/16/2019	Partial Approval	DERRICK SPENCER
Wood Frame	10/16/2019	Partial Approval	DERRICK SPENCER
Floor/Roof Diaphrgm/Shear Wall	10/31/2019	Partial Approval	DERRICK SPENCER
Footing/Foundation/Slab	1/15/2020	Partial Approval	DERRICK SPENCER
Excavation/Setback/Form/Re-Bar	1/28/2020	Partial Approval	DERRICK SPENCER
Footing/Foundation/Slab	2/7/2020	Partial Approval	DERRICK SPENCER
Excavation/Setback/Form/Re-Bar	2/19/2020	Not Ready for Inspection	DERRICK SPENCER
Insulation	2/19/2020	Not Ready for Inspection	DERRICK SPENCER
Green Building Rough	3/26/2020	Approved	DERRICK SPENCER
Wood Frame	3/26/2020	Partial Approval	DERRICK SPENCER
Footing/Foundation/Slab	4/17/2020	Partial Approval	DERRICK SPENCER
Wood Frame	5/5/2020	Partial Approval	DERRICK SPENCER
Interior/Exterior Lathing	6/9/2020	Partial Approval	DERRICK SPENCER
Insulation	6/15/2020	Partial Approval	DERRICK SPENCER
Insulation	7/31/2020	Partial Approval	DERRICK SPENCER
Interior/Exterior Lathing	7/31/2020	Partial Approval	DERRICK SPENCER
Insulation	9/1/2020	Approved	DERRICK SPENCER
T-Bar Ceiling	9/1/2020	Partial Approval	DERRICK SPENCER
Drywall Nailing	9/16/2020	Conditional Approval	PAUL DAVIDSON
Pre-Inspection	9/18/2020	Partial Inspection	PAUL DAVIDSON
Drywall Nailing	9/23/2020	Approved	DERRICK SPENCER
Final	3/26/2021	Not Ready for Inspection	DERRICK SPENCER
Footing/Foundation/Slab	3/26/2021	Approved	DERRICK SPENCER
Green Building Final	3/26/2021	Not Ready for Inspection	DERRICK SPENCER
Reinforced Concrete Frame	3/26/2021	Approved	DERRICK SPENCER
SGSOV-Seismic Gas S/O Valve	3/26/2021	SGSOV Approved	DERRICK SPENCER
Smoke Detectors	3/26/2021	Approved	DERRICK SPENCER

Wood Frame	3/26/2021	Approved	DERRICK SPENCER
Final	5/19/2021	Not Ready for Inspection	DERRICK SPENCER
Green Building Final	5/19/2021	Approved	DERRICK SPENCER

Exhibit: K

SPECIAL PUBLICATION 42
Revised 2018

EARTHQUAKE FAULT ZONES

A GUIDE FOR GOVERNMENT AGENCIES, PROPERTY OWNERS / DEVELOPERS, AND GEOSCIENCE PRACTITIONERS FOR ASSESSING FAULT RUPTURE HAZARDS IN CALIFORNIA

DEPARTMENT OF CONSERVATION
CALIFORNIA GEOLOGICAL SURVEY

STATE OF CALIFORNIA
EDMUND G. BROWN, JR.
GOVERNOR

THE NATURAL RESOURCES AGENCY
JOHN LAIRD
SECRETARY FOR RESOURCES

DEPARTMENT OF CONSERVATION
DAVID BUNN
DIRECTOR

CALIFORNIA GEOLOGICAL SURVEY
JOHN G. PARRISH, *PH.D.*
STATE GEOLOGIST

CALIFORNIA GEOLOGICAL SURVEY
JOHN G. PARRISH, PH.D.
STATE GEOLOGIST

SPECIAL PUBLICATION 42

EARTHQUAKE FAULT ZONES

A GUIDE FOR GOVERNMENT AGENCIES, PROPERTY OWNERS / DEVELOPERS, AND GEOSCIENCE PRACTITIONERS FOR ASSESSING FAULT RUPTURE HAZARDS IN CALIFORNIA

Revised 2018

California Department of Conservation
California Geological Survey
801 K Street, MS 12-31
Sacramento, CA 95814

Photo: Cottage destroyed by surface fault rupture on the Kekerengu Fault during the Mw 7.8 2016 Kaikoura earthquake, New Zealand. Approximately 10 meters of right-lateral fault displacement occurred under this house, tearing it from its foundation. Photo credit: VML 190573, Julian Thomson, GNS Science / Earthquake Commission

PREFACE

The purpose of the Alquist-Priolo Earthquake Fault Zoning Act is to regulate development near active faults so as to mitigate the hazard of surface fault rupture. The stated intent of the Act is to *"…provide policies and criteria to assist cities, counties, and state agencies in the exercise of their responsibility to prohibit the location of developments and structures for human occupancy across the trace of active faults."* The Act also requires the State Geologist to compile maps delineating earthquake fault zones and to submit maps to all affected cities, counties and state agencies for review and comment. For the last 44 years, Special Publication 42 has been the vehicle by which the State Geologist, through the California Geological Survey, has informed affected agencies and the general public how and where Alquist-Priolo Earthquake Fault Zones are prepared.

This is the twelfth revision of Special Publication 42, which was first issued in December 1973 as an "Index to Maps of Special Studies Zones." Explanatory text was added in 1975 and subsequent revisions were made between 1976 - 2007. Since 2007, five supplements to Special Publication 42 have been issued to show the locations, names, and release dates of Earthquake Fault Zone maps released between 2012 - 2017.

This latest version of Special Publication 42 represents a significant departure from previous versions. Rather than serve simply as a source of background information and an index of 7.5-minute quadrangle maps containing Earthquake Fault Zones, this revised document is specifically intended to provide state-of-the-practice guidelines for affected permitting agencies and their reviewers, as well as for geoscience consulting practitioners representing property owners and developers. Such guidance has previously been presented in California Geological Survey Note 41, "General Guidelines for Reviewing Geologic Reports" and Note 49, "Guidelines for Evaluating the Hazard of Surface Fault Rupture," which traditionally have been included as appendices to Special Publication 42. The information presented in those notes has been significantly updated, expanded, and incorporated into this new version. As with the zone maps themselves, it is anticipated that this document will continue to be revised as major advances in the sciences associated with surface fault rupture occur. Background material regarding the California Geological Survey's Fault Evaluation and Zoning Program, which made up the bulk of previous versions of Special Publication 42, has been updated and now appears in Appendix C.

Maps of Earthquake Fault Zones are now available in multiple formats. Most recently, these maps have been made available through a web application (https://maps.conservation.ca.gov/cgs/earthquakezones/app/) that allows users to navigate to an individual parcel and determine whether or not it is affected by any of CGS's regulatory zones (fault rupture, soil liquefaction, or earthquake landslides). Institutional users, such as cities and counties, can access the zone maps on their systems through an interactive web map service:
(https://spatialservices.conservation.ca.gov/arcgis/rest/services/CGS_Earthquake_Hazard_Zones)

Those who prefer geographic information files (GIS) or portable document format (PDF) versions of maps, or wish to see how the zone maps were prepared through the associated fault evaluation report, can download these from the CGS Information Warehouse: (http://maps.conservation.ca.gov/cgs/informationwarehouse/).

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ACKNOWLEDGEMENTS

In 2016, the California Geological Survey convened an expert panel to focus on the development of an update to Special Publication 42. The intent was to prepare a guidance document for fault rupture hazards similar to CGS Special Publication 117A, which addresses hazards from soil liquefaction and earthquake-triggered landslides. This panel was composed of geoscience researchers, consultants and reviewers, as well as representatives of state, regional and local government agencies. Their willing participation in the preparation of this document significantly improved its quality and is greatly appreciated.

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- Dana Brechwald – Association of Bay Area Governments
- Dr. Alan Hull – Golder Associates Inc.
- Scott Lindvall – Lettis Consultants International, Inc.
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SECTION 1: DEFINITIONS AND ACRONYMS

1.1 Definitions

Notes: Hyperlinks for references to statutes and regulations are linked to either the California Public Resources Code as published on the leginfo.legislature.gov website or the California Code of Regulations as published on the website maintained by Thomas Reuters Westlaw under the authority of the California Office of Administrative Law. Appendices A and B in this document are excerpts from the California Public Resources Code and California Code of Regulations.

Text in *italics* are terms that are defined in this section.

Alquist–Priolo Earthquake Fault Zoning Act: State of California law that addresses the hazard of *surface fault rupture* to *structures for human occupancy*. The provisions of the law are codified in the California Public Resources Code, Division 2, Chapter 7.5. In this document, the Alquist-Priolo Earthquake Fault Zoning Act will be abbreviated to "A-P Act."

Earthquake Fault Zones: Regulatory zones (also known as A-P Zones) that encompass traces of *Holocene-active faults* to address hazards associated with *surface fault rupture*. Earthquake Fault Zones are delineated by the State Geologist and implemented by *lead agencies* through permitting, inspection and land-use planning activities. (California Public Resources Code Division 2, Chapter 7.5, Section 2621.).

Earthquake Fault Zone Map: A map depiction of regulatory Earthquake Fault Zones. Traditionally prepared as paper printed products on a 7.5-minute topographic base, the authoritative Earthquake Fault Zone maps are now the geographic information system (GIS) representations available through the California Geological Survey's website (http://www.conservation.ca.gov/cgs). Portable document format (PDF) and web services are also available.

Earthquake Zones of Required Investigation Map: When an *Earthquake Fault Zone Map* is displayed or released with other regulatory seismic hazard zones as delineated under the Seismic Hazards Mapping Act, it is collectively referred to as an Earthquake Zones of Required Investigation Map (EZRIM). Site-specific investigations are required for certain developments within the zones depicted on these maps and, if the potential for the hazard is found to exist, plans to mitigate the hazard must be provided prior to a *lead agency* issuing a permit for construction.

fault: A shear or zone of closely associated shears across which earth materials on one side have been displaced with respect to those on the other side because of tectonic forces. A fault is distinguished from those fractures or shears caused by landsliding or other gravity-driven surficial failures.

> **age-undetermined fault:** A *fault* whose age of most recent movement is not known or is unconstrained by dating methods or by limitations in stratigraphic resolution.

Holocene-active fault: A *fault* that has had surface displacement within *Holocene* time (the last 11,700 years)**.** (California Code of Regulations, Title 14, Division 2, Section 3601.(a)) See Section 2 for more details.

pre-Holocene fault: A *fault* whose recency of past movement is older than 11,700 years, and thus does not meet the criteria of *Holocene-active fault* as defined in the *State Mining and Geology Board* regulations (California Code of Regulations, Title 14, Division 2, Section 3601.(a)). See Section 3 on Geochronology.

fault investigation: A geologic investigation conducted by a *project geologist* designed to identify the location, recency, and nature of faulting at a *project* site (California Code of Regulations, Title 14, Division 2, Section 3603.(d)).

fault investigation report: A report produced by a *project geologist* that addresses the potential for *surface fault rupture* for a *project* (California Code of Regulations, Title 14, Division 2, Section 3603.(d)).

fault trace: The line formed by the intersection of a fault and the earth's surface. It is the representation of a fault as depicted on a map, including maps of *Earthquake Fault Zones* (California Code of Regulations, Title 14, Division 2, Section 3601.(b)).

fault-related (tectonic) ground deformation: Surface and near-surface deformation caused by fault rupture at depth or at some horizontal distance away from the fault that is not expressed as discrete surface faulting, including both brittle (fissures and tension cracks) and non-brittle (folding, warping, or tilting) deformation. Although not specifically addressed by the A-P Act, for the purposes of these Guidelines fault-related deformation encompasses any deformation that may impact the ability of a *structure for human occupancy* to perform as engineered in terms of life-safety and serviceability.

lead agency: The city, county, or state agency with the authority to approve *projects* and exercise "…their responsibility to prohibit the location of developments and structures for human occupancy across the trace of active faults" (California Public Resources Code, Division 2, Chapter 7.5, Section 2621.5.(a).

mitigation: The act of reducing the hazard of *surface fault rupture* either through avoidance or engineered design. Under the *Alquist–Priolo Earthquake Fault Zoning Act*, the only mitigation allowed for *Holocene-active faults* is avoidance.

owner/developer: The party seeking permits to undertake a *project* as defined in the *Alquist–Priolo Earthquake Fault Zoning Act* (California Public Resources Code, Division 2, Chapter 7.5, Sections 2621.6.(a)).

professional geologist: A person licensed in the State of California with the Board for Professional Engineers, Land Surveyors, and Geologists as a geologist and entitled to practice geology in California, and use the title "Professional Geologist (PG)."

project geologist: A *professional geologist* in the State of California who is retained by an *owner/developer* and charged with conducting a *fault investigation* and producing a *fault investigation report*.

reviewing geologist: A *professional geologist* in the State of California who is an agent of the *lead agency* and charged with reviewing the *fault investigation report* produced for a *project* by the *project geologist.*

project: Any *structures for human occupancy*, or any subdivision of land that contemplates the eventual construction of *structures for human occupancy*. For a structure in existence prior to May 4, 1975, if an addition or alteration to that structure exceeds 50% of the value of that structure, then it is considered a *project*. Unless a *lead agency* imposes more stringent requirements, single family frame dwellings are exempt unless part of a permitted development of four or more dwellings (California Public Resources Code, Division 2, Chapter 7.5, Section 2621.6.).

setback: The mitigation technique for *surface fault rupture* that avoids placing structures across traces of *Holocene-active faults* and may include *age-undetermined faults*.

single-family dwelling: A single family dwelling is a residence that houses one family or household, or one that is designed for one family only.

State Geologist: The head of the California Geological Survey.

State Mining and Geology Board: The state entity responsible for developing regulations that provide guidance to *lead agencies* and the geologic community in complying with the *Alquist-Priolo Earthquake Fault Zoning Act*. The State Mining and Geology Board, together with the *State Geologist*, also participates in the review process of *Earthquake Fault Zone Maps*.

story: "That portion of a building included between the upper surface of any floor and the upper surface of the floor next above, except that the topmost story shall be that portion of the building included between the upper surface of the topmost floor and the ceiling or roof above. For purpose of the Act and this subchapter, the number of stories in a building is equal to the number of distinct floor levels, provided that any levels that differ from each other by less than two feet shall be considered as one distinct level" (California Code of Regulations Title 14, Division 2, Section 3601.(f)).

structure for human occupancy: "any structure used or intended for supporting or sheltering any use or occupancy, which is expected to have a human occupancy rate of more than 2,000 person-hours per year" (California Code of Regulations, Title 14, Division 2, Section 3601 (e)).

surface fault rupture: The displacement on a *fault* that occurs at the surface of the earth.

waiver: If a *lead agency* finds that no undue hazard of surface fault rupture exists for a *project*, a waiver of the requirement of a *fault investigation* may be granted by the *lead* *agency* with the approval of the *State Geologist* (California Public Resources Code, Division 2, Chapter 7.5, Section 2623.(a))

1.2 Acronyms

A-P Act: Alquist – Priolo Earthquake Fault Zoning Act

CCR: California Code of Regulations

CGS: California Geological Survey

CPRC: California Public Resources Code

EFZ: Earthquake Fault Zone

EZRIM: Earthquake Zones of Required Investigation Map

GIS: Geographic Information System

lidar: Light Detection and Ranging

SMGB: State Mining and Geology Board

SECTION 2: INTRODUCTION (FOR ALL AUDIENCES)

Note: Terms in *italics* are defined in Section 1, Definitions and Acronyms

2.1 Section Outline

2.2 Objectives of these Guidelines

The objectives of these Guidelines are two-fold:

1. To promote uniform and effective statewide implementation of the evaluation and mitigation elements of the *Alquist-Priolo Earthquake Fault Zoning Act*.
2. To assist affected parties in the evaluation and mitigation of *surface fault rupture* hazard for *projects* within designated *Earthquake Fault Zones*.

2.3 How to use these Guidelines

This document is intended to assist multiple audiences: *Lead agencies*, *project geologists and reviewing geologists*, as well as property *owners/developers*. Each audience has a different role with respect to the *A-P Act* and this publication is designed with sections targeted to these specific audiences so that pertinent information can be easily accessed as indicated by the section titles. *Lead agencies* will find these Guidelines useful for understanding how to implement the *A-P Act* and associated regulations. *Owners/developers* will find this document useful to understand how the *A-P Act* applies to them for their *projects* within *EFZs*. Finally, for *professional geologists*, which includes the *project geologist* and *reviewing geologist,* these Guidelines are intended to summarize the current state-of-practice for *fault investigations* conducted under the *A-P Act*.

This document is not necessarily designed to be read linearly, but rather the reader should be directed to the sections based on who they represent within the structure of the *A-P Act*: *Lead agency* (Section 3)*, owner/developer* (Section 4)*, and professional* *geologists* (Sections 5 and 6). Flow charts and illustrative figures are utilized in this document in order to simplify the seemingly complex language of the *A-P Act* and associated regulations. Terminology specific to the *A-P Act* and regulations are defined in Section 1: Definitions and Acronyms and defined terms are *italicized* throughout the document for easy reference.

The methods, procedures, and references contained herein are those that the Technical Advisory Panel compiled for this update and believe are currently representative of quality state-of-practice. *Surface fault rupture* hazard assessment and *mitigation* is an evolving field and it is recognized that additional approaches and methods will be developed.

2.4 What is *surface fault rupture* and why is it a hazard?

Surface fault rupture is the result of *fault* movement that breaks to the surface of the earth either suddenly during earthquakes (Figure 2-1), or slowly due to a process known as fault creep, and is the result of tectonic movement that originates deep in the Earth. *Surface fault rupture* is different from other types of earthquake-related ground deformation, such as that caused by soil liquefaction or earthquake-triggered landslides. The energy released during an earthquake is a direct result of fault rupture at depth, and when that rupture extends to the ground surface it manifests as displacements expressed as fractures, fissures and related tectonic deformation. The release of energy during an earthquake will also cause shaking which can trigger liquefaction and landslides.

Surface fault rupture poses a hazard to structures and infrastructure because the displacement that occurs, where one side of the fault moves relative to the other, can severely damage buildings (Figure 2-2). In extreme cases, this damage can result in the structural collapse of a building, potentially resulting in injuries or loss of life. In less extreme cases, structural damage may render a building uninhabitable and require costly repairs (Figure 2-2b). This hazard became widely recognized following the 1971 San Fernando (also known as the Sylmar) earthquake, where damage to many buildings was attributed to *surface fault rupture* (Youd and Olsen, 1971; Yerkes, 1973). Since 1971, other earthquakes around the world have continued to demonstrate the potential for extensive damage to structures caused by *surface fault rupture* and the hazard it poses to life and property.

2.5 The *Alquist-Priolo Earthquake Fault Zoning Act*

The purpose of the *Alquist-Priolo Earthquake Fault Zoning Act* (hereafter referred to simply as the "*A-P Act*") is to address the hazard of *surface fault rupture* through the regulation of development in areas near *Holocene-active faults*. As a result of the 1971 San Fernando earthquake and the recognition that *surface fault rupture* poses a hazard to structures, the *Alquist-Priolo Earthquake Fault Zoning Act* was signed into law on December 22, 1972, and went into effect on March 7, 1973. The complete text of the *A-P Act* is provided in Appendix A and relevant portions are included throughout the body of this document.

Figure 2-1. Example of *surface fault rupture* from the M 6.0 August 24, 2014 South Napa earthquake. Displacement at this location was about 0.5 meters (1.6 feet).

Figure 2-2a-b. 2a. Impact of *surface fault rupture* on a home during the November 14, 2016 M 7.8 Kaikoura earthquake, New Zealand. Fault displacement at this location was about 10 meters (33 feet) of horizontal offset. Photo credit: Pilar Villamor, GNS Science / Earthquake Commission. 2b. House damaged by surface rupture during the August 14, 2014 M 6.0 South Napa earthquake. Total displacement on the fault was less than 1 foot, yet even relatively modest amounts of fault offset required expensive (>$100,000) repairs including the replacement of the foundation of the house. Red arrows show relative trend of faulting and sense of horizontal movement.

The purpose of the *A-P Act* is to prevent the construction of *structures for human occupancy* across traces of active faults (California Public Resources Code (CPRC), Division 2, Chapter 7, Section 2621.5). For purposes of the *A-P Act*, active faults are defined by the *State Mining and Geology Board (SMGB)* as those faults that have *"…had surface displacement during Holocene time…"*[(1)] (California Code of Regulations (CCR), Title 14, Division 2, Section 3601 (a)). In order to provide clarity regarding the term active fault, this document uses the term *Holocene-active fault* to describe faults that are specifically regulated by the *A-P Act*. Additionally, this document considers the Holocene as the geological epoch that began 11,700 years before present, as defined by the International Commission on Stratigraphy (http://www.stratigraphy.org).

It is important to note that the *A-P Act* only addresses the hazard of *surface fault rupture* for *Holocene-active faults*; faults that have moved prior to the Holocene, referred to in this document as *Pre-Holocene faults*, may also have the potential to rupture but are not addressed by the *A-P Act*. Additional discussion regarding *Holocene-active faults,* as well as *pre-Holocene faults,* can be found in Section 5. Additionally, the *A-P Act* only addresses the hazard of *surface fault rupture* and not other types of earthquake-caused ground deformation such as from liquefaction and earthquake-induced landslides. These other types of earthquake-induced hazards are addressed by the Seismic Hazards Mapping Act (CPRC , Division 2, Chapter 7.8, Sections 2690 – 2699.6).

2.6 Rationale for zoning *Holocene-active Faults*

The decision to include *Holocene-active faults* in *Earthquake Fault Zones* (*EFZ*) was made in the 1970's soon after the zoning program started. The concept is based on the observation that faults that have shown relatively recent rupture are typically those with short recurrence intervals (the time elapsed between significant earthquakes) and therefore have a higher likelihood of rupturing again in the near-future. This approach is deterministic and provides a relatively simple metric and reasonable threshold for *project geologists* conducting *fault investigations* and *lead agencies* reviewing those investigations, but it is not perfect. In particular, some faults and fault systems with long recurrence intervals are problematic using this deterministic approach. For example, a fault with a 12,000 to 13,000-year recurrence interval that has not ruptured in the Holocene might not be included in an *EFZ*, while a fault that has a 30,000-year recurrence that ruptured 500 years ago would be included. In the former case, where the fault might be near failure and more likely to produce a large earthquake, the *A-P Act* does not account for a higher probability that the fault might rupture in the near future. In the latter case, the *A-P Act* is similarly blind to relative probability; some might consider the fault unlikely to produce another earthquake, therefore is unlikely to be a significant hazard for structures built on or near it. In the administration of the *A-P Act*, a *lead agency* might prohibit the construction of *structures for human occupancy* across the latter fault that

[1] The current SMGB regulations states that the Holocene epoch is "…about the last 11,000 years" (CCR, Title 14, Division 2, Section 3601 (a)). However, while the SMGB definition has been essentially unchanged since 1974, the age of the Holocene epoch has since been refined through geological studies (e.g., Walker and others, 2009) and is currently recognized as starting about 11,700 years ago. A recommendation to update the SMGB definition of Holocene has been forwarded by the SP42 Technical Advisory Panel to the SMGB for consideration.

ruptured 500 years ago, while there would be no such prohibition, or even the requirement for a *fault investigation* for that matter, across the potentially more dangerous former fault that has not ruptured in the Holocene.

The state-of-the-science in paleoseismic work in California is such that there is rarely enough detailed knowledge of the recurrence intervals of faults that rupture frequently, and even less for those with moderate to long recurrence intervals. To develop this higher level of information on any given fault requires detailed paleoseismic research at sites with ideal stratigraphic conditions that allow the recognition and dating of multiple earthquake events. The ability to develop site-specific data to address earthquake recurrence is difficult, as most sites where development is proposed are not amenable to these types of studies. Additionally, such detailed paleoseismic studies are beyond the scope and cost constraints of most development projects. In summary, the Holocene-active age criteria provide a practical approach to addressing fault rupture hazards for public safety.

2.7 Roles and responsibilities under the *Alquist – Priolo Earthquake Fault Zoning Act*

Three entities are responsible for the administration and implementation of the *A-P Act*: The *State Geologist*, the *lead agency,* and the *State Mining and Geology Board*. The property *owner/developer* represents a fourth group that is impacted most directly by the *A-P Act*. Figure 2-3 summarizes the roles and responsibilities of each of these groups.

The *State Geologist* (Chief of the California Geological Survey) is required by the *A-P Act* to delineate *Earthquake Fault Zones* (*EFZ*) along known *Holocene-active faults* in California. The *EFZs* are distributed as *Earthquake Fault Zone maps* (Figure 2-4), as well as Geographic Information System (GIS) shapefiles. The zones are regulatory in nature, and are one class of *Earthquake Zones of Required Investigation*, which include other geologic hazards such as liquefaction and earthquake-induced landslides (Figure 2-4c). Any proposed *projects* within these *EFZ* must address the potential for *surface fault rupture* through a *fault investigation* prior to a permit being issued by the *lead agency*. The *EFZs* are intended to encompass *Holocene-active* and potentially *Holocene-active faults* that may exist in the vicinity of the mapped faults used to establish the *EFZs*. The *EFZs* are provided by *CGS* to affected *lead agencies* in the form of GIS Shapefiles, which constitute the official regulatory *EFZs*. CGS also provides an interactive web application that uses a statewide parcel database to identify individual properties affected by *EFZ*s (https://maps.conservation.ca.gov/cgs/earthquakezones/app/) and provides *EFZ*s as GIS web services to lead agencies and other institutional users: https://spatialservices.conservation.ca.gov/arcgis/rest/services/CGS_Earthquake_Hazard_Zones.

Other products CGS produces include digital images of the *EFZ* maps, provided on a 1:24,000-scale U.S. Geological Survey topographic base map in a portable document format (PDF), which can be used as reference maps by interested parties without access

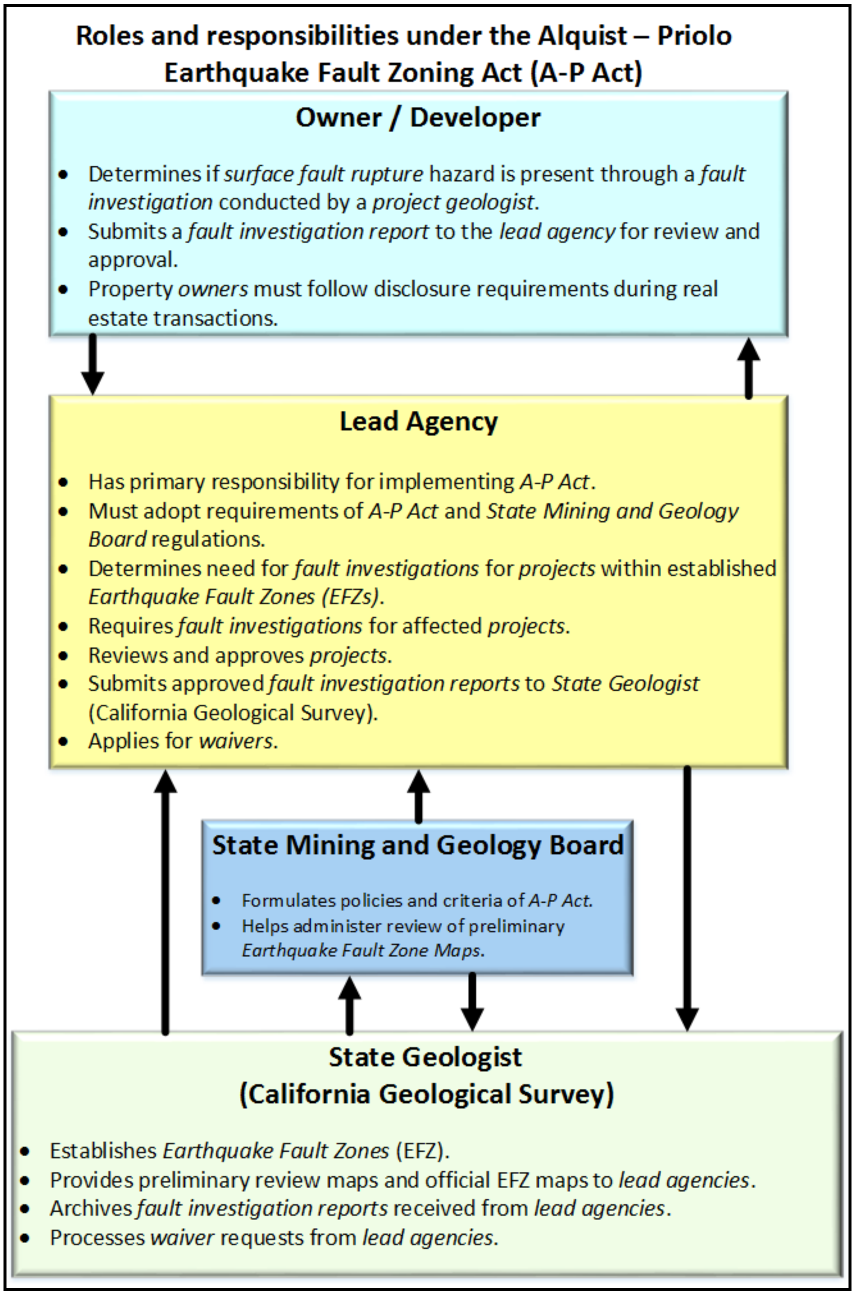

Figure 2-3. Bulleted items represent the primary roles and responsibilities of the four groups engaged in the *Alquist - Priolo Earthquake Fault Zoning Act*.

to a GIS platform. Appendix C describes the criteria and methods CGS uses to compile *Earthquake Fault Zone Maps*.

Lead agencies affected by the *EFZs* must regulate certain development *projects* within the zones. Before a *project* within an *EFZ* can be permitted, the *lead agency* must require a *fault investigation*. Section 3 more fully describes the role of the *lead agency* in the implementation of the *A-P Act*. Section 5 is a discussion regarding the current state-of-practice for *fault investigations* as applied to the *A-P Act* and will be of interest to the *reviewing geologists* for local *lead agencies*. Both the *project geologist* retained by the *owner/developer* and the *reviewing geologist* representing the *lead agency* should be familiar with Section 5 in order to have a common frame of reference during the review process.

Owner/Developers are the group most directly impacted by the *A-P Act* as they bear the cost of site-specific *fault investigations* and may be required to revise development plans to avoid construction on *Holocene-active fault* traces. If a *project* proposed by an *owner/developer* is located within an *EFZ*, a *fault investigation* will need to be conducted by a *project geologist*, and the *fault investigation report,* produced as part of this study, will need to be reviewed by the *lead agency's reviewing geologist*. *Owner/Developers* are referred to Section 4 of this document, which contains additional information pertinent to the *owner/developer* of *projects* within *Earthquake Fault Zones*.

Finally, the *State Mining and Geology Board* (SMGB) provides additional regulations (Policies and Criteria) to guide *lead agencies* in their implementation of the *A-P Act* (CCR, Title 14, Div. 2, Chapter 8.1.3). These regulations are included in Appendix B and are incorporated where appropriate in the body of this document. The SMGB also plays a role in the review of preliminary *Earthquake Fault Zone Maps*, and is responsible for receiving public review comments, forwarding these comments to the *State Geologist* for consideration of changes to the *Earthquake Fault Zone Maps*, as well as conducting public hearings regarding the preliminary review maps. The Geohazards Committee of the SMGB assisted in the development of this revision to Special Publication 42.

2.8 Uses and Limitations of *Earthquake Fault Zone Maps*

Earthquake Fault Zones (EFZ) are delineated to define those areas where *fault investigations* are required prior to building *structures for human occupancy*. The *Earthquake Fault Zone maps* include both the *EFZ* (Figure 2-4a) as well as the mapped traces of faults that are used to delineate zone boundaries (Figure 2-4b). These fault traces are plotted as accurately as the sources of data permit; however, no degree of the relative potential for future surface displacement or hazard is implied for the faults shown on the *EFZ maps*.

Fault traces shown on *Earthquake Fault Zone maps* are not mapped at a scale suitable to meet the requirement for site-specific *fault investigations*, nor should the faults depicted be used as the basis for defining building *setback* requirements. *Lead agencies* must require *owners/developers* with *projects* within the *EFZ* to determine if a potential hazard from any *fault,* whether heretofore recognized or not, exists with regard to proposed structures.

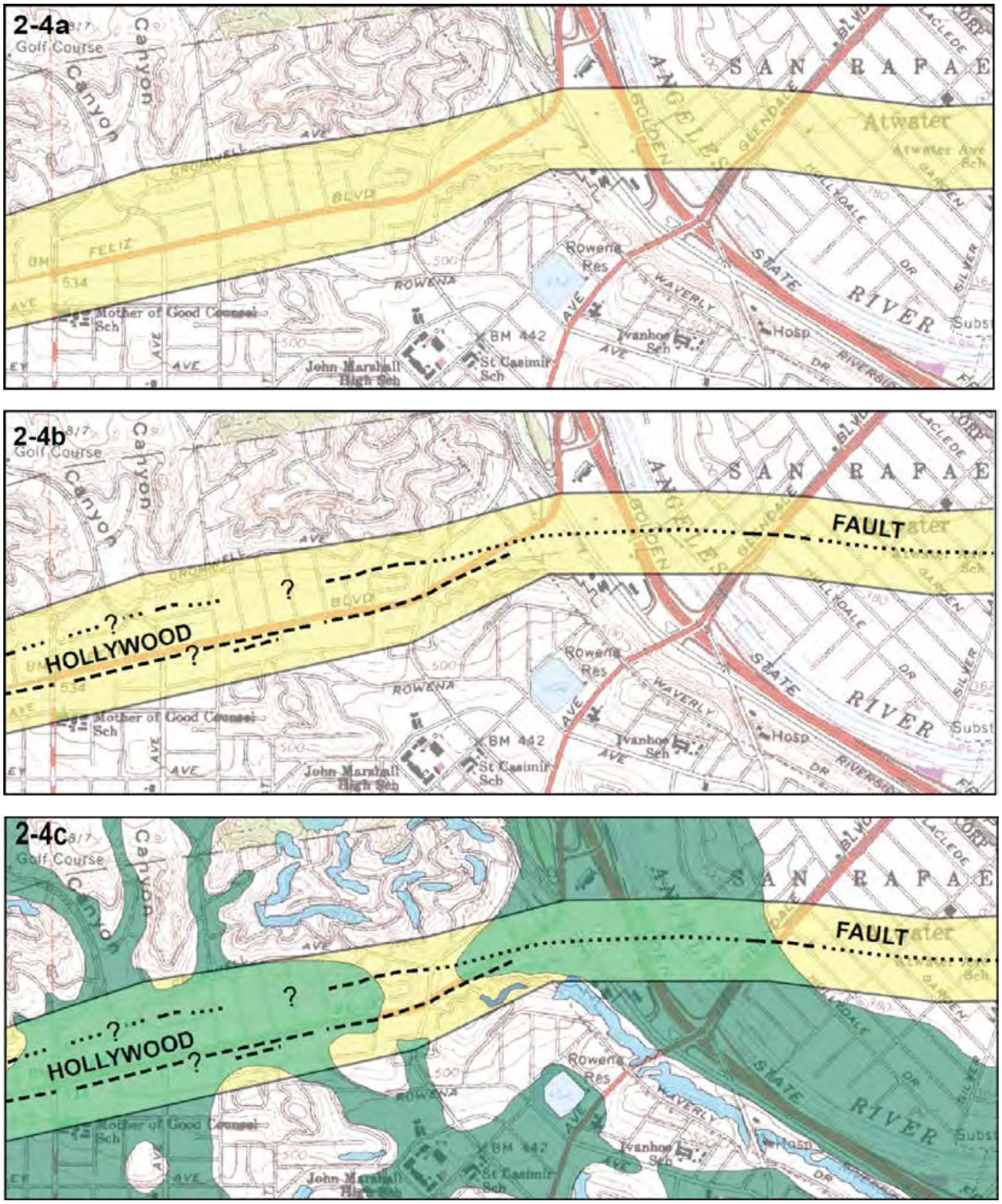

Figure 2-4. Portion of and *Earthquake Fault Zone* (EFZ) map on the Hollywood Fault from the Hollywood 7.5-minute Quadrangle. 4a. EFZ is shown as the yellow polygon. This is the default view for recent EFZ maps, available as downloadable files in Portable Document Format (pdf). 4b. *Earthquake Fault Zone* map showing both EFZ (yellow polygon) and faults (black lines). Faults can be toggled on using the layer control in Adobe Acrobat®. Solid lines - Accurately located; Long dashed lines - Approximately located; Short dash lines - Inferred; Dotted lines - Concealed. 4c. Map showing all *Earthquake Zones of Required Investigation*. Blue areas are zones for earthquake-induced landslides; Dark green areas are for liquefaction zones. Lighter green areas are zones with overlapping *Earthquake Fault Zones* and liquefaction zones.

Faults with the potential to rupture the ground surface, which include both *Holocene-active* and *pre-Holocene faults*, may exist outside the *EFZ* depicted on an *Earthquake Fault Zone map*. If a *Holocene-active* fault is found outside of an EFZ, for example, during a site-specific geologic investigation, that fault must still be avoided according to the *A-P Act*. *Pre-Holocene faults* outside of established *Earthquake Fault Zones* are not regulated by the *A-P Act*, although an evaluation by a *project geologist,* which may include a *fault investigation,* is recommended for all critical and significant developments proposed outside established *EFZs,* where there is an indication from available mapping and geologic data that *surface fault rupture* presents a potential hazard to a *project*.

2.9 How to determine if a *project* is regulated by the *Alquist – Priolo Earthquake Fault Zoning Act*?

Determining if a *project* is regulated by the *A-P Act* requires asking a number of questions, the first of which is "Is the *project* located within a regulatory *Earthquake Fault Zone*?" This question is best answered by contacting the *lead agency* (typically the local city or county) which can determine if a parcel within its jurisdiction is located within an *Earthquake Fault Zone (EFZ)*. Alternatively, the CGS regulatory zone web service (https://cadoc.maps.arcgis.com/apps/webappviewer/index.html) can provide guidance if a parcel is in, or near an *Earthquake Fault Zone*. If the answer is "yes," then several additional questions must be asked in order to determine if the *project* is regulated by the *A-P Act*. The subsequent questions are dependent on additional criteria such as the type of development, characteristics of the proposed or existing structure, the value of existing structures if they are being renovated, as well as consideration of any local regulations. Plate 1 is a flow chart intended to aid the *owner/developer* and the *lead agency* in determining if a *project* is regulated by the *A-P Act*.

2.10 Relationship of these Guidelines to Local General Plans and Permitting Ordinances

The CPRC, Division 2, Section 2621.5 describes the purpose of the *A-P Act* is to provide for the adoption and administration of zoning laws, ordinances, rules, and regulations by cities and counties in implementation of the general plan that is in effect. Similarly, the CCR, Title 14, Division 2, Chapter 8.1, Section 3603 directs affected *lead agencies* to provide for disclosure of delineated *Earthquake Fault Zones (EFZ)* to the public and that such disclosure may be by reference in general plans, specific plans, property maps, or other appropriate local maps. Cities and counties should consider the information presented in these guidelines when adopting or revising these plans and ordinances.

It is recognized that lead agencies need to develop local policies and regulations regarding the A-P Act and existing policies and regulations should be routinely reviewed and, if necessary, updated. Appendix D provides web links to several *lead agency* implementations of the *A-P Act* and is provided to assist *lead agencies* in these responsibilities.

2.11 Relationship of these Guidelines to the CEQA Process and Other Site Investigation Requirements

Nothing in these guidelines is intended to negate, supersede, or duplicate any requirements of the California Environmental Quality Act (CEQA) or other state laws and regulations. At the discretion of the *lead agency*, some or all of the investigations required by the *A-P Act* may occur either before, concurrent with, or after the CEQA process or other processes that require site investigations.

For hospitals, public schools, and essential service buildings, additional requirements are prescribed by the California Building Code (California Code of Regulations (CCR), Title 24). For such structures, the requirements of the *A-P Act* apply, with additional requirements specific to these types of structures specified in CCR Title 24.

2.12 References

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SECTION 3: GUIDELINES FOR LEAD AGENCIES

Note: Terms in *italics* are defined in Section 1, Definitions and Acronyms

3.1 Section Outline

3.2 *Lead agency* responsibilities under the *Alquist - Priolo Earthquake Fault Zoning Act*

This section is intended to provide an overview regarding the role of affected *lead agencies*, which are responsible for the implementation and enforcement of the *Alquist-Priolo Earthquake Fault Zoning Act* (*A-P Act*) within their jurisdictions. This section is not meant to be comprehensive but is intended to highlight the more important roles and responsibilities of *lead agencies*. *Lead agencies* should review and understand the text of the *Alquist-Priolo Earthquake Fault Zoning Act*, as well as the policies and criteria of the *State Mining and Geology Board* (SMGB), which are reproduced in Appendices A and B of this document. Nothing within this document is intended to supersede either the *A-P Act* or the policies of the SMGB.

Lead agencies (Cities, Counties and State agencies) have three primary responsibilities under the *A-P Act* which include:

1. Responsibility for adoption and administration of zoning laws, ordinances, rules, and regulations in the General Plan of any city or county affected (California Public Resources Code (CPRC), Division 2, Chapter 7.5, Section 2621.5).
2. Regulating specified "*projects*" within *Earthquake Fault Zones* (CPRC, Division 2, Chapter 7.5, Section 2623).
3. Other administrative requirements under the *A-P Act* such as posting public notices of new *Earthquake Fault Zone Maps* (CPRC, Division 2, Chapter 7.5, Sections 2621.9 and 2622 (d)), initiating *waiver* requests (Section 2623), and filing approved *fault investigation reports* with the *State Geologist* (Section 2625).

In practice, these specific requirements can be described as a linear progression starting from when: 1) The Preliminary Earthquake Fault Zone (EFZ) maps are released to the *lead agency* by the *State Geologist*; 2) The enforcement of the *A-P Act* by the *lead* *agency* once Official *EFZ Maps* are released; and 3) Compliance by the *lead agency* with other administrative requirements of the *A-P Act*. These topics are discussed in further detail in the following sections.

3.3 *Lead agency* roles and responsibilities in the review of Preliminary *EFZ* Maps and release of Official *EFZ* Maps

As provided in the *A-P Act*, a *lead agency* is responsible for the implementation and administration of the *A-P Act* and associated *SMGB* regulations. This is done through the adoption of a local ordinance into the *lead agency*'s general plan. Appendix D contains links to examples of local ordinances by some lead agencies in California and Utah, another state with significant fault rupture hazards. The examples in Appendix D are intended to assist other lead agencies in developing or updating their safety elements, ordinances, policies, and other documents to better implement the *A-P Act*.

A *lead agency*'s role in the day-to-day administration of the *A-P Act* typically begins upon issuance of Preliminary *Earthquake Fault Zone Maps* by the *State Geologist*. The *State Geologist* is required to provide an affected *lead agency* proposed new and revised *EFZ Maps* for its review and comment prior to the issuance of the Official *Earthquake Fault Zone maps*. These Preliminary *EFZ Maps* are released to the *lead agency* and the public to solicit technical comments on the proposed *EFZ*s. Once the Preliminary *EFZ Maps* are issued, the *lead agency* has 90 days to submit all technical comments to the *SMGB*, which then forwards those comments to the *State Geologist* for consideration in revisions to the Official *Earthquake Fault Zone Maps*. In practice, the *lead agency* will typically have its *reviewing geologist* review the Preliminary *EFZ Maps* as well as the supporting materials such as CGS Fault Evaluation Reports that justify the establishment of the *EFZ*s. CPRC, Division 2, Chapter 7.5, Sections 2622 (b) and (c) of the *A-P Act* describe the requirements of the review and comment period and issuance of the Official *Earthquake Fault Zone Maps*.

The *SMGB* also has additional regulations regarding the review of Preliminary *EFZ Maps*, which are in Section 3602 of the California Code of Regulations (CCR), Title 14, Division 2, Chapter 8.1.3 (see Appendix B). *SMGB* regulations require that the *lead agency* give public notice of receipt of the Preliminary *EFZ Map*s to property *owners* within the proposed *EFZ*s by reasonable means of communication within 45 days following the issuance of Preliminary *EFZ Maps*. CCR, Title 14, Division 2, Chapter 8.1.3, Section 3602 also suggests the *lead agency* give notice to *professional geologists* who conduct *fault investigations*. This provision is intended to solicit additional technical comments from *professional geologists* who are familiar with the local area and may be aware of additional data that should be considered for the establishment of the *EFZ*s. All public comments should be sent directly to the *SMGB* by the end of the 90-day public comment period. The *SMGB* is then responsible for forwarding the comments to the *State Geologist* for consideration in any revisions to the proposed *EFZ*s. Finally, during the 90-day comment period, the *SMGB* is required to hold at least one public hearing on the proposed *EFZ Maps*. This public meeting is typically, but not required to be, conducted in a local jurisdiction affected by the proposed *EFZ*.

After the 90-day public comment period and upon receipt of the comments by the *State Geologist*, the *State Geologist* has 90 days to consider the comments, incorporate necessary revisions, and release the Official *Earthquake Fault Zone Maps* to the *lead agency* affected by the *Earthquake Fault Zones*. Upon receipt of the Official maps, the *lead agency* is required to post a public notice at the county recorder, county assessor, and county planning commission offices, identifying the location of the *EFZ map* and effective date (CPRC, Division 2, Chapter 7.5, Section 2622 (d), see Appendix A).

3.4 When is a *project* subject to the *Alquist-Priolo Earthquake Fault Zoning Act*?

The *lead agency* ultimately is responsible for determining whether a *project* lies within an *Earthquake Fault Zone*. When the Official *EFZ*s are released, the *State Geologist* provides the *lead agency* with GIS files of *Earthquake Fault Zones*, which the *lead agency* can overlay with its official parcel boundary maps to determine whether a *project* lies within an *EFZ*. Alternatively, the *lead agency* can access CGS's GIS web services for the most recent version of the *EFZ*: https://spatialservices.conservation.cagov/arcgis/rest/services/CGS_Earthquake_Hazard_Zones. With certain exceptions, a *project* located within an *Earthquake Fault Zone* and regulated by the *A-P Act* generally includes new *structures for human occupancy*, as well as subdivisions of land that will eventually include *structures for human occupancy*. *Projects* exempted by the *A-P Act* are dependent on additional criteria such as the type of development, characteristics of the proposed or existing structure, and the value of existing structures if they are being renovated. Plate 1 is a decision flow chart intended to aid *lead agencies* and *owner/developers* in determining if a *project* within an *EFZ* requires a *fault investigation* under the provisions of the *A-P Act*.

3.5 *Lead agency* roles and responsibilities in the implementation and enforcement of the *Alquist-Priolo Earthquake Fault Zoning Act*

Once an Official *Earthquake Fault Zone Map* is released by the *State Geologist*, the primary role of the affected *lead agency* is to require and review *fault investigations* that address the hazard of *surface fault rupture* for any proposed *projects* within *EFZ*s before issuing a construction permit. The approval of those *projects* must be in accordance with the policies and criteria established by the *SMGB* (CPRC, Division 2, Chapter 7.5, Section 2623 (a)). *SMGB* regulations require that *fault investigation reports* must be prepared by a *professional geologist* registered in the State of California (CCR, Title 14, Division 2, Chapter 8.1.3, Section 3603 (d)), referred to in this document as the *project geologist*. These reports must also be reviewed by the *lead agency* (or its designee) and this review must be conducted by a *professional geologist* registered in the State of California, referred to in this document as the *reviewing geologist*. Plate 2 is a decision flow chart to help determine if a *fault investigation report* meets the minimum requirements of the *A-P Act*. Sections 5 and 6 in this publication, intended for *project geologists* and *reviewing geologists*, discuss in further detail the technical aspects and expectations of *fault investigations* and the content of *fault investigation reports*.

The *A-P Act* contains other important provisions relevant to the *lead agency*. First, a *lead agency* may impose and collect reasonable fees on individual *projects* in order to recover the costs of administering and complying with the *A-P Act* (CPRC, Division 2, Chapter 7.5, Section 2625). Second, a *lead agency* may establish policies and criteria that are more stringent than those of the *A-P Act* and the policies of the *SMGB*. A *lead agency* may simply adopt the minimum standards required by the *A-P Act* and *SMGB* regulations, as well as impose additional requirements, often included in the General Plan or local ordinances. Appendix D includes several ordinances, guidelines and other documents from *lead agencies* around the state that represent their implementation of the *A-P Act*. A *lead agency* that lacks local ordinances regarding geologic hazards in general and earthquake hazards in particular, or whose ordinances have become outdated, is encouraged to use the information contained in this publication to prepare or update these documents.

Enforcement of the *A-P Act* is solely the responsibility of the *lead agency*. Failure to comply with the requirements of the *A-P Act* can, under some circumstances, incur liability on the part of the *lead agency* in the event of earthquake-related injuries or death (CPRC, Division 2, Chapter 7.5, Section 2621.8).

3.6 *Fault investigation report* filing requirements

CCR, Title 14, Division 2, Chapter 8.1.3, Section 3603 (f) requires cities and counties to submit one copy of each approved *fault investigation report* to the *State Geologist* within 30 days of report approval and the *State Geologist* is required to place these reports "on open file." These reports of site-specific *surface fault rupture* hazard investigations serve several purposes: CGS uses the information provided in these reports to revise existing *EFZ Maps* when enough new information becomes available. When evaluating the requirements for a new *project* within an *EFZ*, *lead agencies*, *owner/developers*, and *project geologists* can refer to *fault investigation reports* that have been submitted to CGS using an online map service:

https://spatialservices.conservation.ca.gov/arcgis/rest/services/CGS

In some cases, the body of existing *fault investigation reports* in an area could provide the basis for the *waiver* process (see below).

Fault Investigation Reports in digital formats, such as a portable document file (PDF), can be sent by email to SHMP@Conservation.ca.gov if they are no larger than 10 MB. Larger files can be uploaded by the *lead agency* to a CGS server following the instructions described at:
http://www.conservation.ca.gov/cgs/rghm/ap/Pages/Index.aspx

Reports can also be sent by mail to:

California Department of Conservation
California Geological Survey
Attn: Earthquake Fault Zone Reports
801 K Street, MS 12-31
Sacramento, CA 95814-3531

3.7 *Waiver* process: What is it? When should it be initiated? And how?

The *A-P Act* contains a provision for a *waiver* process by which the requirement for *fault investigation reports* can be waived for *projects*, with approval of the *State Geologist* (CPRC Division 2, Chapter 7.5, Section 2623). To initiate the *waiver* process, the *lead agency* must first find that no undue hazard related to *surface fault rupture* exists for a *project*. If this is the case, then the *lead agency* is responsible for initiating the *waiver* request and provide supporting documentation to the *State Geologist*, who will direct CGS staff to conduct a review of the supporting data and recommend the *waiver* request be approved or denied based on the findings of the review.

In practice, the *waiver* process is typically only initiated for *projects* where enough locally-generated geologic data exists in the surrounding area to ensure that the site is effectively "cleared" of *Holocene-active faults* and *age-undetermined faults*. Supporting documents submitted by the *lead agency* may include *fault investigation reports* conducted for other *projects* in the surrounding vicinity and these reports should demonstrably show that faults do not project to the site of interest. If a *lead agency* is interested in initiating the *waiver* process, they are encouraged to contact the Seismic Hazards Program Manager at the California Geological Survey to discuss the process and requirements prior to submitting a *waiver* request (SHMP@conservation.ca.gov).

3.8 Safety element updates and local hazard mitigation plans

A *lead agency* should use the most up-to-date *EFZ* data for updates to its General Plan Safety Element, as well as in other land use planning and zoning documents. The California Office of Emergency Services (Cal OES), in cooperation with the California Natural Resources Agency and CGS, have built a convenient online map service (http://myplan.calema.ca.gov) to assist the *lead agency* in preparing these updates. The *lead agencies* can use this website to display various earthquake, fire and flood hazards, upload local map information, and prepare custom maps for use in local jurisdiction planning documents, such as General Plan Safety Elements and Local Hazard Mitigation Plans.

CGS also has a variety of online map services in addition to those provided to Cal OES for the MyPlan website. *Lead agencies* are encouraged to contact the CGS Seismic Hazard Program Manager (SHMP@conservation.ca.gov) to see what custom products can be prepared to assist in updating these important planning documents.

SECTION 4: GUIDELINES FOR PROPERTY OWNERS AND DEVELOPERS

Note: Terms in *italics* are terms defined in Section 1, Definitions and Acronyms

4.1 Section Outline

4.2 Objectives of this section

Within the framework of the *Alquist-Priolo Earthquake Fault Zoning Act* (*A-P Act*), it is the *owner/developer* who is most directly affected by the regulations associated with the *A-P Act*. The *owner/developer* (or their agent) must work with the local *lead agency* in order to understand if the *project* is subject to the *A-P Act* and, if it is, how to comply with the law. Furthermore, it is the *owner/developer* who must hire a *project geologist* to conduct the *fault investigation*, and submit a *fault investigation report* to the *lead agency* for review. Therefore, it is important that the *owner/developer* have a basic understanding of the *A-P Act* to ensure compliance and to facilitate approval of the *project* by the *lead agency*.

4.3 Is my *project* regulated by the *Alquist-Priolo Earthquake Fault Zoning Act*?

Determining if a *project* is regulated by the *A-P Act* requires first asking: "Is the *project* located within a regulatory *Earthquake Fault Zone*?" This question is best answered by contacting the *lead agency* (typically the local city or county, or other permitting entity) that can determine if a parcel within their jurisdiction is located within an *Earthquake Fault Zone* (*EFZ*). *Lead agencies* should be the first place to go for this information because they will have the most up-to-date parcel information and can identify any local hazards or zones not addressed by the *EFZ*. *EFZ*s are provided by CGS to affected *lead agencies* in the form of geographic information system (GIS) shapefiles, which constitute the official *EFZ*s. These GIS files, as well as portable document format (PDF) files for those without GIS software, are available for download from the CGS Information Warehouse (http://maps.conservation.ca.gov/cgs/informationwarehouse/). CGS also provides an interactive web application that uses a statewide parcel database to identify individual properties affected by EFZs: https://maps.conservation.ca.gov/cgs/earthquakezones/app/This web application provides a convenient, though possibly less up-to-date, way to determine if a project site is regulated by the *A-P Act*. Because this information may not be up-to-date, the *lead agency* should always make the final determination if a *project* is within and *Earthquake Fault Zone*. Figure 4.1 shows examples of hypothetical *projects* within, outside, and near an *Earthquake Fault Zone* as depicted on an *Earthquake Fault Zone Map*.

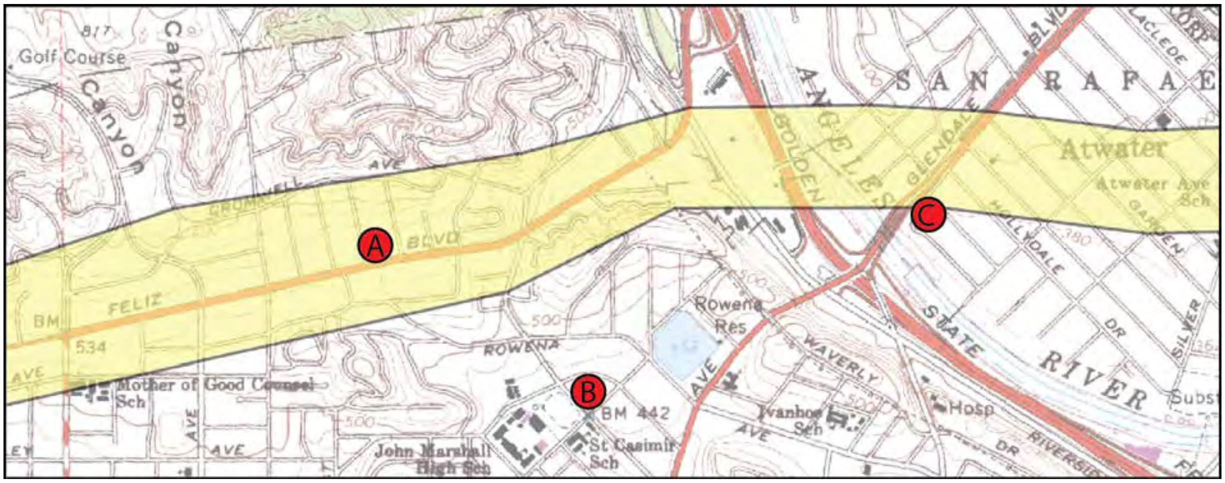

Figure 4-1. Illustration of *projects* (red circles) in, outside, or near, an *Earthquake Fault Zone (EFZ),* shown as the yellow shaded area. Site A (red circle with letter A) is within the *EFZ*, Site B is outside of the *EFZ* and Site C is near the *EFZ*. In this example, Site A would be regulated by the *A-P Act* and Site B is not regulated by the *A-P Act*. For Site C the *lead agency* should be consulted to determine if the *project* is located within the *EFZ*. The *EFZ* map is a portion of the Hollywood 7.5-minute Quadrangle *Earthquake Zones of Required Investigation Map*.

With certain exceptions, a *project* located within an *Earthquake Fault Zone* and regulated by the *A-P Act* generally includes new *structures for human occupancy* and subdivisions of land that will eventually include *structures for human occupancy*. Structures exempted by the *A-P Act* are dependent on additional criteria such as the type of development, characteristics of the proposed or existing structure, and the value of existing structures if they are being renovated. Plate 1 is a decision flow chart intended to aid *owners/developers* and *lead agencies* in determining if a *project* is regulated by the *A-P Act*.

4.4 What does it mean when a *project* is regulated by the *A-P Act*?

Earthquake Fault Zones are regulatory zones that address the hazard of *surface fault rupture* and are just one type of regulatory zone that address earthquake-related geologic hazards. Other types of regulatory zones address the potential for liquefaction and seismically-induced landslides, which are regulated by the Seismic Hazards Mapping Act. Collectively, these hazard zones are referred to as “Earthquake Zones of Required Investigation.” Within Earthquake Zones of Required Investigation, geologic investigations are required prior to the construction of buildings or, prior to the subdivision of land for certain types of developments referred to in this document as “*projects.*” If a site-specific *fault investigation* finds a geologic hazard exists, appropriate mitigation measures must be proposed in the report prior to project approval by the *lead agency*.

The *A-P Act* addresses the hazard of *surface fault rupture* and, because the *A-P Act* explicitly prohibits the construction of *structures for human occupancy* across traces of *Holocene-active faults*, the only mitigation the *A-P Act* allows for is avoidance. This means that if a *Holocene-active fault* is found during a *fault investigation*, a *structure for human occupancy* will not be allowed to be built across that fault.

4.5 Steps that the *owner/developer* should take if their *projec*t is regulated by the *A-P Act*.

If a proposed *project* is regulated by the *A-P Act*, the *owner/developer* should discuss with the *lead agency* the scope of the *project* and identify what will be required by the *lead agency* to meet the requirements of the *A-P Act*. Additionally, *lead agencies* are able to enact regulations that are more restrictive than the minimum standard of the *A-P Act*. For example, *lead agencies* may establish their own regulatory hazard zones, as well as have additional regulations that include structures that are exempted by the *A-P Act*. It is always best to check with the local *lead agency* to determine what additional local requirements may exist.

The *owner/developer* will also need to retain, at his or her expense, the services of a *professional geologist*. A *professional geologist* who is the agent of the *owner/developer* is known as the *project geologist*. The *project geologist* is responsible for conducting the *fault investigation*, preparing the *fault investigation report*, as well as interacting with the *lead agency*'s *reviewing geologist* during the review of the *fault investigation report*. Early in the process, the *project geologist* will also work with the *owner/developer*, as well as the *lead agency*, to develop the scope of the *fault investigation* for the *project*. Finally, based on the results of the *fault investigation*, the *project geologist* will designate areas where structures can be located, as well as recommending *setbacks* from faults with the potential for *surface fault rupture*.

The *owner/developer* should be aware that in addition to bearing the cost of the *fault investigation*, the *owner/developer* may also be responsible for costs incurred by the *lead agency* for administering the *A-P Act* for individual *projects*, which can include expenses related to the review of the *fault investigation report*. Because the *fault investigation report* will be reviewed by the *lead agency*, it is recommended that the *project geologist* consult with the *reviewing geologist* regarding the scope of the *project* before the *fault investigation* begins, as well as during the *fault investigation*. Review of field exposures by the *reviewing geologist*, in conjunction with the *project geologist*, can aid the review of the *fault investigation report* by allowing the *reviewing geologist* to be more familiar with the *project* and identifying potential areas of disagreement prior to the review of the final *fault investigation report*. A collaborative approach between the *project geologist* and *reviewing geologist* can save the *owner/developer* time and money by minimizing multiple iterations of review comments and responses. Finally, the *owner/developer* should consider allowing the *project geologist* to invite geologists from the California Geological Survey to attend field reviews. While CGS does not play a role in the review of a *project* by a *lead agency*, site visits can help improve and inform updates to existing *Earthquake Fault Zone Maps* if important data regarding fault locations and activity are found at a site.

4.6 Real estate disclosure requirements

The *A-P Act* requires that all real estate parcel transactions within an *Earthquake Fault Zon*e be disclosed by the seller to prospective buyers before the sales process is complete (California Public Resources Code (CPRC) Division 2, Chapter 7.5, Section 2621.9). The real estate agent representing the property owner is legally bound to present this information to the buyer. When no realtor is involved in a transaction, the seller must inform the buyer directly. This is usually done at the time an offer is made or accepted. As part of the Natural Hazards Disclosure Act, this information is presented in a "Natural Hazard Disclosure Statement," which also includes other types of State-mapped and local hazard zones.

SECTION 5: GUIDELINES FOR GEOSCIENCE PRACTITIONERS (PROJECT AND REVIEWING GEOLOGISTS): EVALUATING THE HAZARD OF SURFACE FAULT RUPTURE

Note: Terms in *italics* are defined in Section 1, Definitions and Acronyms

5.1 Section Outline

5.2 Introduction

The purpose of this section is to provide guidance to *project geologists*, *reviewing geologists*, and *lead agencies* that have approval authority over *projects* based on *fault investigations* and *fault investigation reports*.

For the purposes of the *A-P Act*, an active fault is defined as one which has "had surface displacement within Holocene time" (the last 11,700 years). This definition does not mean that faults lacking evidence for surface displacement within Holocene time are necessarily inactive. A fault may only be presumed to be inactive based on satisfactory geologic evidence; however, the evidence necessary to prove inactivity sometimes is difficult to obtain and locally may not exist. By virtue that fault investigations are required by the *A-P Act* to assess the recency of fault movement implies that faults within an EFZ are presumed to be active until determined otherwise.

Terms such as "potentially active" and "inactive" have been commonly used in the past to describe faults that do not meet the SMGB definition of "active fault." However, these terms have the potential to cause confusion from a regulatory perspective, as they are not defined in the *A-P Act*, and may have other non-regulatory meanings in the scientific literature or in other regulatory environments. In order to avoid these issues, introduced below are terms that provide added precision when used in classifying faults regulated by the *A-P Act.* Faults are classified into three categories on the basis of the absolute age of their most recent movement and are shown on Figure 5.1 on a hypothetical trench log:

1) *Holocene-active faults*: Faults that have moved during the past 11,700 years. This age boundary is an absolute age (number of years before present) and is not a radiocarbon (^{14}C) age determination, which requires calibration in order to derive an absolute age.

2) *Pre-Holocene faults*: Faults that have not moved in the past 11,700 years, thus do not meet the criteria of "*Holocene-active fault*" as defined in the *A-P Act* and SMGB regulations. This class of fault may be still capable of surface rupture, but is not regulated under the *A-P Act*. Depending on available site-specific and regional data such as proximity to other active faults, average recurrence, variability in recurrence, the timing of the most recent surface rupturing earthquake, and case studies from other surface rupturing earthquakes, the *project geologist* may, but is not required to, recommend *setbacks*. Engineered solutions can also be considered by a licensed engineer operating within his or her field of practice.

3) *Age-undetermined faults*: Faults where the recency of fault movement has not been determined. Faults can be "age-undetermined" if the fault in question has simply not been studied in order to determine its recency of movement. Faults can also be age-undetermined due to limitations in the ability to constrain the timing of the recency of faulting. Examples of such faults are instances where datable materials are not present in the geologic record, or where evidence of recency of movement does not exist due to stripping (either by natural or anthropogenic processes) of Holocene-age deposits. Within the framework of the *A-P Act*, *age-undetermined faults* within regulatory *Earthquake Fault Zones* are considered Holocene-active until proved otherwise.

It is worth reiterating that a *project* located outside of an *Earthquake Fault Zone* is still regulated by the *A-P Act* if a *Holocene-active fault* is found at that site. This can happen if a *lead agency* has established its own regulatory zone requiring an assessment of *surface fault rupture* hazard or in a situation where a *Holocene-active fault* is discovered during a geologic investigation for that *project*. If located outside of an *Earthquake Fault Zone*, *age-undetermined faults* are not regulated by the *A-P Act*. However, the *project geologist* may want to consider all available data and provide recommendations regarding whether *setbacks* or other engineered solutions should be considered in the placement or design of a structure crossing these faults.

5.3 Items to Consider in the Site Investigation Study

The following concepts are provided to help focus the *fault investigation*:

1. The fact that a *project* lies within a designated *Earthquake Fault Zone* does not necessarily indicate that a hazard requiring *mitigation* is present at that site. Instead, it indicates that regional (that is, not site-specific) information suggests that the probability of a hazard is great enough to warrant a site-specific investigation. However, the working premise for the planning and execution of a site investigation within an *Earthquake Fault Zone* (EFZ) is that ***the suitability of the site must be demonstrated***. This premise will persist until either: (a) the *fault investigation* satisfactorily demonstrates the absence of *surface fault rupture* hazard, or (b) the site investigation satisfactorily defines the *surface fault rupture* hazard and provides a suitable *setback* recommendation for its *mitigation*.

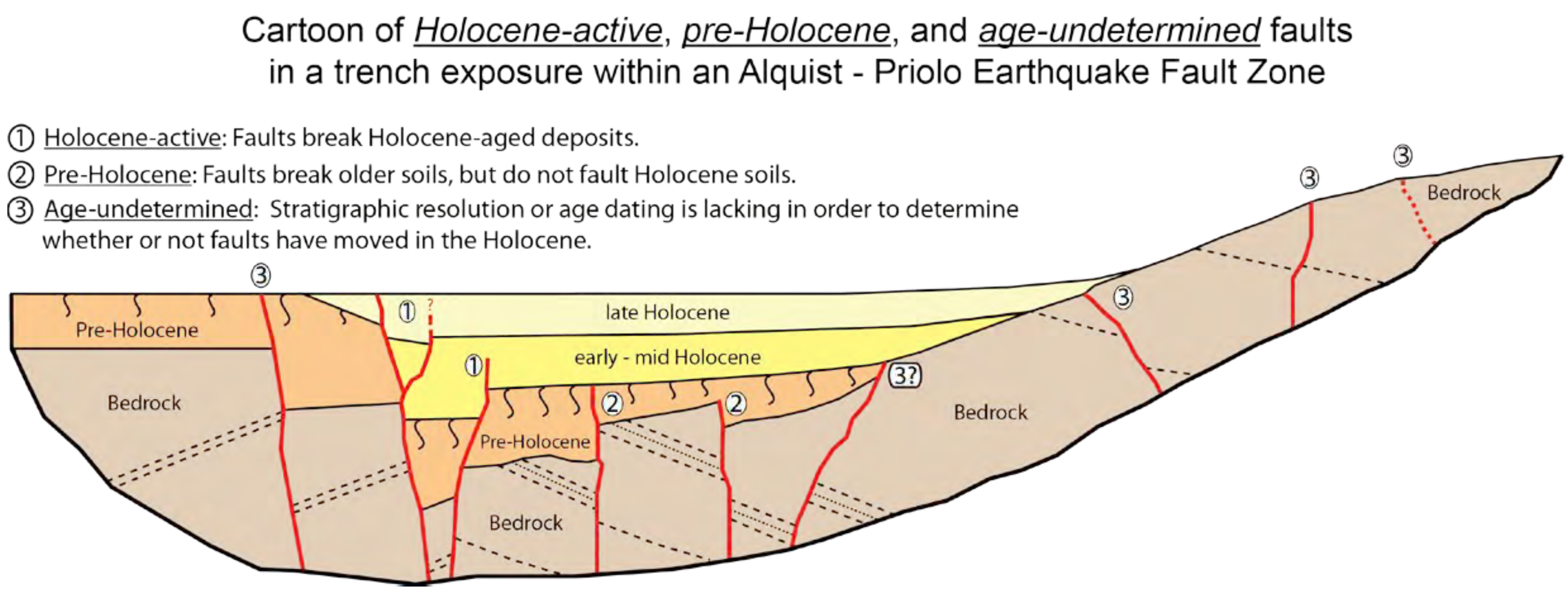

Figure 5-1. Fault classifications in a hypothetical trench log where *Holocene-active faults* break Holocene-age deposits and *pre-Holocene faults* break pre-Holocene age deposits, but not Holocene age deposits. The recency of movement for *age-undetermined faults* are unconstrained due to a lack of overlying deposits to determine the timing of the most recent fault displacement.

2. The fact that a *project* lies outside a mapped *EFZ* does not necessarily mean that the site is free from seismic or other geologic hazards, nor does it preclude *lead agencies* from adopting regulations or procedures that require site-specific fault and/or geologic investigations and mitigation of seismic or other geologic hazards. It is not always possible for CGS geologists mapping at a regional scale to identify all *Holocene-active faults*; not all faults, including *Holocene-active faults,* meet the criteria of well-defined. Furthermore, in California there have been examples of *faults* that were understood to be *pre-Holocene* that have ruptured in historical time. These instances of faulting underscore the importance of considering the *surface fault rupture* hazard to *projects*, even when they are not regulated by the *A-P Act*. It is the responsibility of the *project geologist* to inform his or her client and the *lead agency* of the presence of a *Holocene-active fault* on a site and it is the responsibility of the *lead agency* to prohibit *structures for human occupancy* across the trace of *Holocene-active faults*, whether that fault is found inside or outside of an *EFZ*.

3. *Lead agencies* have the right to approve, and the obligation to reject, a proposed *project* based on the findings contained in the *fault investigation report* and the *lead agency's* technical review. The task of the *owner/developer's project geologist* is to demonstrate, to the satisfaction of the *lead agency,* which is advised by the *lead agency*'s *reviewing geologist*, that:

   - The site-specific *fault investigation* is sufficiently thorough;
   - The findings regarding *surface fault rupture* hazards are valid and persuasive; and,
   - Any proposed *setbacks* are sufficient to account for both *Holocene-active fault traces* and *fault-related ground deformation*.

5.4 Site-Specific *Fault Investigations*

The primary purpose of a site-specific *fault investigation* is to determine the presence or absence of existing faults and evaluate the recency of their past activity, which can be a deceptively difficult geologic task. Most faults are complex, consisting of multiple breaks and can exhibit both brittle and plastic (e.g. folding) deformation. The evidence for identifying *Holocene-active fault* traces sometimes is subtle or obscure and the evidence necessary to conclude the lack of Holocene activity may be difficult to obtain and locally may not exist. A basic assumption in this discussion is that a *fault investigation* is being conducted because of the presence of an *A-P Earthquake Fault Zone* (EFZ), a *lead agency's* requirement for it based on local information, or some other regional evidence of *Holocene-active faulting* on or near the site. A *project geologist* ideally will have a high level of experience in conducting *fault investigations* and will be familiar with and employ the current state-of-the-practice techniques. Because the existing literature on conducting fault investigations is quite robust (e.g. see, Lund and others, 2016, and McCalpin, 2009), these guidelines will only briefly cover the topic.

Whenever a *fault investigation* is initiated, the *project geologist* should contact the *lead agency* and its *reviewing geologist*. The purpose for this initial contact is three-fold:

1. The *lead agency* may have records of previous *fault investigations* on or in the vicinity of the *project* site that can be useful to the site investigation and the *fault investigation report*.

2. The *lead agency or reviewing geologist* can inform the *project geologist* of local ordinances, such as differences in exemptions to *projects* than what are specified in the *A-P Act*, or specified *setbacks* from *Holocene-active faults*.

3. The *reviewing geologist* can inform the *project geologist* about local investigations, reporting requirements, and expectations. The *project geologist* can inform the *reviewing geologist* what investigation methods are to be used and when those methods will be conducted, and both parties can discuss how to handle possible complications that can arise from investigation results, such as how the *lead agency* will want to handle *age-undetermined faults* or *fault-related ground deformation*.

It is highly recommended that the *project geologist* consult with the *reviewing geologist* regarding the scope of the *project* before the *fault investigation* begins, as well as during the *fault investigation*. Review of field exposures by the *reviewing geologist*, in conjunction with the *project geologist*, can aid the review of the *fault investigation report* by allowing the *reviewing geologist* to be more familiar with the *project* and identifying potential areas of disagreement prior to review of the *fault investigation report*. A collaborative approach between the *project geologist* and *reviewing geologist* can save the *owner/developer* time and money by minimizing multiple iterations of review comments and responses. Finally, the *owner/developer* should consider allowing the *project geologist* to invite geologists from the California Geological Survey to attend field reviews. While CGS does not play a role in the review of a *project* by a *lead agency*, site visits can help improve and inform updates to existing *Earthquake Fault Zone maps* if important data regarding fault locations and activity exist at a site.

Surficial Investigations

Surficial geologic and geomorphic mapping should be conducted early in the investigation and include an area surrounding the immediate vicinity of the *project* site. The purpose of the surficial mapping is to identify fault-related geomorphic features and should begin with a compilation of existing literature on the local geology and any previous fault-related studies in the area. In particular, previous *fault investigation reports* on the current and nearby sites should be sought out and the results incorporated. CGS maintains an online database of *fault investigations* that *lead agencies* submit as part of the *A-P Act*:

https://spatialservices.conservation.ca.gov/arcgis/rest/services/CGS/

Observations, measurements and mapping ideally employ the use of both remotely sensed imagery and field-based work. This work can provide a sense of past fault movement and is critical for locating fault trenches and other subsurface investigations in order to yield the most beneficial results.

The traditional remote sensing technique for *fault investigations* has been the use of stereo-paired aerial photography. Ideally, multiple sets of variable vintage photographs, including pre-development photos, are used to interpret fault-related geomorphic features, vegetation and soil contrasts, lineaments, and other features of possible fault origin. Lidar-based (Light Detection and Ranging) imagery (e.g. hillshade and slopeshade maps, topographic profiles) processed from high-resolution elevation measurements has become an important tool for geomorphic interpretation. Most *EFZ*s have had lidar flown as part of the B4 Project at OpenTopography (http://www.opentopography.org/) and other important lidar elevation datasets for California are also available through this organization. In addition, a number of counties have had lidar elevation data flown and have made them available (e.g. Los Angeles County - https://egis3.lacounty.gov/dataportal/tag/lidar/). The USGS also hosts some lidar datasets for California (https://nationalmap.gov/3DEP/). Another recent technique that has been employed in geomorphic interpretation is photogrammetric-based “structure-from-motion” (Westoby and others, 2012). This method uses multiple, overlapping photographs to create 3-dimensional models of the ground surface that, when coupled with high-precision ground control, can provide accurate, high resolution imagery for fault investigations.

Field-based surficial observations include mapping the distribution of geologic and soil units, geomorphic features indicative of possible faulting, springs, deformation of engineered structures due to fault creep, and any other features or anomalies identified with remote sensing techniques.

Subsurface Investigations

Subsurface *fault investigations* are primarily conducted through the use of fault trenches to expose *fault traces* and their effects on shallow stratigraphic units. However, other methodologies are often used, either in conjunction with trenching or as substitutes where trenching is not feasible. In some cases, it will be necessary to extend some of the investigative methods well beyond the site or property being investigated. These can be broken into two broad categories: 1) physically drilling and sampling subsurface geologic materials, and 2) using geophysical techniques to measure subsurface material properties. The subsurface methods are discussed in more detail below.

Trenching

Trenching is the most common type of subsurface fault investigation and offers several advantages over other methods including direct observation of subsurface geologic relationships and the ability to easily sample geologic materials for chronologic dating (Taylor and Cluff, 1973; Hatheway and Leighton, 1979; McCalpin, 2009b). Trenches excavated for the purpose of determining recency of fault activity should be excavated as orthogonal to the trend of a mapped fault as feasible because faulting relations become increasingly difficult to identify and measure if the exposure is oblique to the local trend of faults. Siting trench locations should also consider possible projections of nearby mapped faults and possible unmapped splay faults, to ensure that areas within, and close to, the building footprint are not affected by *Holocene-active faults*.

Trench walls should be cleaned to expose key stratigraphic and structural relations including marker horizons and faults. While cleaning of trench walls can be labor and time intensive, fault-related features can be subtle and often require careful and repeated scraping in order to create an exposure that can be interpreted with confidence. Techniques to clean trench exposures typically include scraping, picking, and brushing. In general, faults, especially those with minor apparent displacements, are most readily identifiable when the trench wall is scraped as smooth as possible. In some investigations, pressure washing with water or using a leaf blower has been successful in etching mappable layers with subtle differences in grain size. The *project geologist* should consider and employ the cleaning technique that will best create an interpretable exposure.

Stratigraphic and structural relations should be logged at a scale appropriate to record the characteristics that demonstrate the presence or absence of faulting. The *project geologist* should consider whether or not the stratigraphic relations are adequate to resolve whether faulting can be confidently identified within the exposed section. Observations regarding continuity of key units, ability to identify key marker horizons and degree of bioturbation that may obscure faulting relations should be recorded on the logs. Care should be taken to document even minor faulting: Faults with small apparent offsets, especially vertical offsets along dominantly strike slip faults, can have significant true net displacements.

Photographic documentation of trench exposures is now a common practice and offers the advantage of the visual documentation of trench exposures that provides additional objective documentation of geologic relationships in a subsurface exposure. Photographs of key geologic relationships provide supporting documentation that aids in the review of the *fault investigation report*. Furthermore, with the advent of modern easy to use, affordable structure-from-motion (e.g. softcopy photogrammetry) software, ortho-rectified photo-mosaiced trench logs can be quickly produced. These type of trench logs offer the advantage of giving the *project geologist* a synoptic view of the structural and stratigraphic relations, which may not be readily apparent in a narrow slot trench.

Where the ability to preclude Holocene faulting through trenching is limited by high groundwater or thick Holocene deposits, borings can be used to supplement trenching. However, in many cases, trenching to the maximum feasible depth will still be valuable in order to make direct observations regarding the character of subsurface deposits. It also provides the opportunity to collect samples for dating to constrain the age of shallow materials and develop a comprehensive chronologic model.

Drilling and Sampling

Large-diameter borings, which can be accessed and logged by a geologist, can provide a detailed picture of subsurface stratigraphy and opportunities for the selection of age-datable samples. Small-diameter borings that capture continuous core also can provide stratigraphy and material for age dating. The cone penetrometer test (CPT) measures a deposit's resistance to penetration, or tip resistance, and the granular nature of soils, or sleeve friction, as it is pushed into the ground (Grant and others, 1997; Edelman and others, 1996). Generally, the CPT is not used to collect soil samples but the continuous measurement of "soil behavior" provides a reliable stratigraphic section. Because of the relatively low cost of the CPT, this tool is frequently used in urban environments where trenching and other drilling methods are difficult. However, CPT is best done in conjunction with one or more continuously logged borings to correlate CPT results with on-site materials. As with boring transects, CPT borings should be appropriately spaced in order to address the type of faulting that is anticipated. For example, strike-slip faults may require borings that are more closely spaced than other types of faulting (normal faulting, reverse faulting). Some *lead agencies* may specify minimum requirements for the spacing of borings along transects for *fault investigations*. The *project geologist* should check with the *lead agency* for any requirements when planning a *fault investigation* for a *project*.

All three of these boring methods can be used to measure ground water levels useful for identifying fault-related ground water barriers, but large-diameter borings are often susceptible to collapse and typically cannot safely be downhole logged below the water table. Without the continuous exposure provided by a trench, direct observation of a fault in any of these drilling methods may not be possible, and the reliable identification of faulting is more uncertain. The strength of these methods lies in creating a stratigraphic cross-section across a faulted area with a line of closely spaced borings and/or CPT soundings that provides evidence of faulting through vertical separation of stratigraphic units. Because the spacing required to prepare an adequate cross-section depends on the stratigraphy, type of faulting, ground water conditions, and presence of local infrastructure, it is recommended that the *project geologist* consult with the *reviewing geologist* to see if the *lead agency* has requirements for this type of investigation and to assist in the development of an appropriate exploration plan. Caution should be exercised when employing these methods on strike-slip faults, as two-dimensional cross-sections may not provide adequate resolution if a fault has little-to-no vertical separation. Both the *project geologist* and the *reviewing geologist* should also be aware that geologic cross-sections are often non-unique interpretations of data, and that multiple working hypotheses should be considered when working with these types of subsurface data. For example, distinguishing channel margins from faulting without the advantage of direct observation can be challenging and may require deeper or additional more closely spaced borings. It is the responsibility of the *project geologist* to provide both the interpretation of the feature in question and the data that supports the interpretation, as well as an explicit discussion regarding the uncertainties in interpretation.

Geophysical Techniques

Geophysical methods provide a non-invasive way to measure certain properties of subsurface deposits that can help locate fault traces. Chase and Chapman (1976), Stephenson and others (1995), Cai and others (1996), and McCalpin (2009) provide examples of the use of seismic reflection, seismic refraction, magnetic, gravity, electrical resistivity, and ground penetrating radar methods in fault studies. Because geophysical methods alone can only provide a range of alternative interpretation for what exists in the subsurface, they should be used to guide and/or augment geologic data derived from mapping, trenching, and drilling in fault investigations (Chase and Chapman, 1976). While geophysical methods have value in locating potential faults and connections between mapped faults, they rarely provide information on the recency of activity unless accompanied by a subsurface investigation method that retrieves samples for dating.

5.5 Geochronology (Age-Dating) Methods

Estimating the age of fault activity relies on dating geologic units that predate and postdate faulting (Pierce, 1986; Birkeland and others, 1991; Rutter and Catto, 1995; McCalpin, 2009a). Site-specific *fault investigations* expose the fault zone at the *project* site to determine which *fault traces* are *active. However, t*he evaluation of a *fault* may not be limited to information derived solely from a *project* site, especially if higher-quality relevant information exists elsewhere. It is common that structural relationships pertaining to *fault* rupture timing exist onsite while quantitative chronologic data may be better defined offsite, or the opposite situation may exist. When there is a potential to acquire quantitative chronological data at the site of interest, it should be obtained. All chronological data pertaining to the project from on- and offsite sources should be considered and reported in the investigation, and a comprehensive case for the chronology of faulting specific to the project should be the presented.

There are many Quaternary age-dating methods that can be applied to characterizing fault activity (Noller and others, 2000; Lettis and Kelson, 2000; Preusser et al, 2008; McCalpin, 2009) but only a subset of these are applicable to deposits in the late Pleistocene to present age range (roughly the last 130,000 years). Table 5-1 provides a list of the most commonly used methods, their age and uncertainty ranges, the property measured and sample material, and criteria for choosing a methodology. Because accuracy and precision are valued criteria in fault investigations, quantitative (chronometric) dating methods are preferred if samples for dating can be obtained. Radiocarbon (^{14}C) dating is the most widely used dating method and the *project geologist* should use it when possible or justify why it was not used. Radiocarbon dating has proven to be very reliable and cost effective, and is the most widely understood and applied method for active fault characterization. Relative dating methods, such as soil profile development index, are prone to subjectivity and significantly greater uncertainty. Ideally, relative dating methods are used to complement quantitative dating methods, or when they are the only methods that can be utilized. Often the relative methods provide chronology guidance during the initial phase of fault investigations. Other methods that have been used in *fault investigations* but will not be covered in these guidelines include: landform development, stratigraphic correlation of rocks/minerals/fossils, archeological artifacts, historical records, tephrochronology, fault scarp modeling, paleomagnetism, dendrochronology, and rock and mineral weathering.

Geochronology Uncertainty

The *project geologist* should understand the uncertainty associated with any age determination in the evaluation of fault activity. All sources of uncertainty should be considered and addressed in the *fault investigation report*. The three primary sources of uncertainty in age determinations are:

Context Uncertainty

Context uncertainty generally represents the largest uncertainty in dating fault activity, and consists of the generally poorly known relationship of the chronologic measurement of an individual sample to the faulting event of interest. For example, a ^{14}C date derived from a detrital charcoal sample may have a considerable inherited age because it was either reworked from an older sedimentary unit or because it was derived from older wood that does not represent the deposit age, such as the core of a long-lived tree. For all quantitative dating methods, the context uncertainty can be thought of as the unknown age difference between the event of interest and the dated samples.

Laboratory Uncertainty

There are inherent laboratory uncertainties associated with each quantitative dating method that need to be considered in any chronological assessment. These uncertainties are difficult to reduce, although, dating of additional samples can improve accuracy and confidence.

Chronologic Modeling Uncertainty

All chronological data must be interpreted to assess the age of faulting. In general, this requires some extrapolation or interpolation, or bracketing of the event of interest. How the data are related to the event of interest is a “chronologic model.” The type of model used will influence the chronological result. For example, when evaluating a scatter of different sample ages from one geologic unit, a decision must be made as to how to use the results. One may have sample ages from two different sample types, or different dating methods, or there may be stratigraphically inconsistent results. A careful consideration of each chronological constraint must go into the development of the chronologic model.

Common Dating Methods for Determining Fault Activity

Radiocarbon Dating (^{14}C)

Radiocarbon dating is by far the most common age-dating method applied to *fault investigations* because it is accurate within an age-range extending to 50,000 years before present, and datable samples are generally available. With fast laboratory turn-around times possible (days to about a week), it is often feasible to get results while the field work is ongoing and thus provide valuable guidance for completing the investigation. Radiocarbon dating consists of an isotopic method based on measuring the ratio of unstable ^{14}C isotope to stable ^{12}C in organic compounds (Taylor and others, 1992). The method is based on the fact that all living organisms exchange carbon with the surrounding environment, a small fraction of which is the unstable isotope ^{14}C as opposed to the stable ^{12}C isotope (Trumbore, 2000). When an organism dies, the exchange of fixed carbon between the organism and the environment stops and the amount of ^{14}C starts decreasing at a known rate due to radioactive decay. This ^{14}C decay provides a clock that is used to calculate a quantitative age.

Table 5-1. Most Applicable Age Dating Methods for Fault Activity Investigations.

Method	Age Range / Uncertainty Range	Property Measured / Sample Materials	Application Criteria
Radiocarbon Dating	0 to 50,000 years 2 to 5%	^{14}C Organic matter	Most favored method due to its proven reliability to provide objective results. • multiple sample analyses allow an increase in confidence and accuracy • fast turn around • single dates can be misleading due to the difficulty in evaluating the context uncertainty
Luminescence	100 to 100,000 years Greater than 10%	Luminescence Quartz or Feldspar Crystals	Often suitable where sand-size material exists and when little C-14 dateable material can be found. Often requires research level effort to properly integrate all aspects of the method. Can provide reliable age estimate if done correctly. • strict sampling protocol • may complement ^{14}C well, as it can help assess context uncertainty
Cosmogenic nuclide	1,000 to 2,000,000 years Greater than 10%	^{10}Be, ^{26}Al, ^{36}Cl Quartz Feldspars Carbonates	Unique for its ability to date surfaces or burial events. Often requires research level effort to properly integrate all aspects of the method. Can provide reliable age estimate if done correctly. • strongly influenced by sampling protocol • accurate results are model dependent
Soil Profile Development Index (SDI)	500 to 500,000 Greater than 30%	Numerous Alteration of parent material	Requires quantitative dating of similar soil profiles in the area as calibration. Significant expertise is required for SDI age estimates.

In the case of plant material, where the original amount of ^{14}C in the atmosphere has varied through time, an additional calibration with known age samples from tree rings provides an accurate calendar age correction called “dendrocalibration” (Stuiver and others, 1993). Radiocarbon dating can be more challenging with other types of samples; aquatic-based (marine or fresh water) organisms, such as invertebrate shells, can obtain carbon from water with a significant “reservoir effect,” resulting in a lag time (biasing the sample to be older than its true age by several hundred years or more) that requires a correction factor. In this case, the resulting ages may be too old and are termed “apparent ages." These apparent ages can be calibrated but are associated with additional uncertainties.

Currently, two laboratory methods are used in radiocarbon dating (Trumbore, 2000): decay counting, and the more recent Accelerator Mass Spectrometry (AMS) measurement. The main difference of concern to the practitioner is that AMS methods can be more readily used because the sample size requirement is orders of magnitude less: 0.2 to 2 milligrams with AMS versus 3 grams with decay counting of carbon remaining after pretreatment. Because normal pretreatment procedures remove 25% to 80% of the original sample material, a sample larger than 3 grams is required for the decay counting method, which can be difficult to obtain. The most common sample type used for ^{14}C dating is detrital charcoal, which is most commonly found in sand to clay-sized sediments.

^{14}C Sample Contamination

Sample contamination is a process that can shift ^{14}C age-dating results. However, the phenomenon is widely misunderstood and in some investigations has erroneously been used to justify the rejection of otherwise valid results or to justify not using ^{14}C dating at all. The process of sample contamination consists of adding material of a different age to the carbonaceous sample after deposition. In general, as carbonaceous material in the ground gets older, samples become increasingly susceptible to "rejuvenation contamination," due mostly to younger plant roots penetrating the older deposited material. In almost all cases, contaminant material can be visually detected with a microscope and all samples are physically and chemically pretreated to remove contaminant compounds. These pretreatment procedures are very effective and provide reliable results. Sample contamination in which laboratory results of younger material return older dates is relatively rare.

A common misconception is that ground water contamination of detrital charcoal is a contributes to radiocarbon ages that do not represent the true age of the sample. In reality, nearly all detrital charcoal experiences some degree of wetting from ground water and standard laboratory pretreatments have been proven to be highly effective in removing contamination from this source. Research by Pigati and others (2007) has shown that contamination can significantly affect samples that are already very old, while the impact of contamination for samples less than 20 ka old, which includes the time frame of interest for most *A-P Act* triggered fault investigations, is negligible.

It is useful to examine samples with a microscope in order to assess their composition prior to submitting to a laboratory for dating and communicate to the laboratory the objective of what event one is trying to date, which may influence the laboratory procedures. For example, samples often contain multiple carbon fractions that can be of different ages. If one does not know with certainty what carbon fraction to measure, they can instruct the laboratory to preserve various extracted carbon fractions for potential dating after initial results are evaluated.

One type of contamination from which samples and laboratories cannot recover is the introduction of artificial ^{14}C into a sample. Artificial ^{14}C is used in biological research as a tracer. The concentration of artificial ^{14}C can be 100,000 times more than bio-based materials and the laboratory detection methods are simply overwhelmed by the abundance. Because the ^{14}C tracer is not visible it is very difficult to avoid and easily spread unintentionally. The only remedy is complete avoidance of any sources, or facilities where ^{14}C tracers have been used (Zermeno and others, 2004). Some laboratories will request information regarding sample storage prior to submission in order to screen samples that may have been exposed to ^{14}C tracer, as this type of contamination can be detrimental to a dating laboratory's operations.

Radiocarbon Sample Collection

The following sample collection procedures, or "best practices", will facilitate obtaining accurate chronologic age control of faulting:

- Collect multiple samples from layers of interest.
- Collect more samples than anticipated for laboratory testing. This practice provides a back-up if laboratory results or development of the chronologic model could benefit from additional laboratory determinations after trenches are backfilled.
- Individual samples are preferable to bulk or combined samples. Bulk or combined samples result in average ages with increased context uncertainties.
- Bulk samples of organic-bearing sediments should be collected, especially when individual organic samples are not discernable in the field. Bulk samples can be sieved and microscopically inspected to find individual samples. As such, bulk samples also provide a backup to individual samples. However, dating bulk samples may introduce larger contextual uncertainties due to the mixing of organic materials that may have different ages.
- Minimize the context uncertainty by collecting organic material formed in place (*in situ*). These sample materials, such as peat, are preferable to samples that are often associated with significant context uncertainty such as detrital charcoal.
- Sample storage and transport must avoid contaminating samples. Contact with artificial ^{14}C will render samples useless and cause expensive damage to laboratory facilities. If there is any question about the integrity of the samples, communication with the dating laboratory is essential.

Considerations in Evaluating Radiocarbon Results

A large body of published research related to dating of samples and development of chronologic models applied to paleoseismic studies exists in the literature (e.g. Scharer et al, 2011). Listed below are several guidelines a *project geologist* and *reviewing geologist* should keep in mind when evaluating results obtained from radiocarbon dating:

- Several dates may be required to identify a representative depositional age of a stratigraphic layer.
- Several individual detrital charcoal samples from a single layer may result in a spread of ages of several hundred years or more. This spread may

indicate that either the source of charcoal is derived from long-lived trees or that depositional reworking is significant. If bioturbation does not affect the area from which the sample was collected from, then the youngest age is the most representative of the deposit age.

- Results from bulk sample dating are usually more difficult to interpret because they generally consist of an unknown mixture of various-aged organic materials. Bulk sample ages may be significantly older than the depositional age of the layer. However, bulk sample dating results, in the absence of other quantitative dates, can be valuable as limiting ages in context with other chronological data.
- Consider the sample context, sample material, and other chronological information when assessing the age of faulting. Considerations include:

    - Are radiocarbon sample ages within individual units consistent with each other?
    - Are radiocarbon ages from successive layers in the correct stratigraphic age order?
    - Do layers that have been correlated across the site exhibit consistent ages?
    - Are different sample materials providing consistent results?
    - Which samples are outliers?
    - Is there consistency with other dating methods? If not, then what are the possible explanations for the inconsistencies?

Luminescence Dating

Luminescence techniques (Forman, 2000, Preusser and others, 2008) measure the time since mineral grains were exposed to sunlight (Optically Stimulated Luminescence - OSL; Infrared stimulated luminescence - IRSL) or heat (Thermoluminescence - TL). The luminescence signal accumulates in minerals such as feldspars and quartz, being induced by naturally occurring radioactivity from the material surrounding the sample. The radioactivity excites electrons within the minerals, which are trapped in defects within the crystal lattice. The controlling factors are the dose rate and the time since exposure. The dose rate varies at each sample site and thus requires, in order of preference, either an in-place measurement, or a sample for neutron activation measurement. Another controlling parameter is the number of crystal defects within the mineral grains which has a significant influence on the suitability of this method. The effective age range of luminescence dating methods is from hundreds of years to more than 100,000 years, depending on the number of crystal defects and the local dose rate. Considerable research-level effort is required for these methods and involving an expert will likely improve the potential for successful outcomes.

<u>Considerations in Luminescence Sample Collection</u>

Luminescence methods require a particular prescribed sampling protocol, which includes detailed information about the geological context, depositional history, environment, and hydrological conditions (moisture content). The various methods and laboratories have sampling protocols, and it is recommended that the *project geologist* consult with an expert before samples are collected. In particular, samples need to be collected in a fashion that prevents the sediment from being exposed to light during sampling and transport to the laboratory. In addition, the dose rate must be determined at each individual sample location, either by in-place measurement or by taking a bulk sample for laboratory measurement.

Cosmogenic Nuclide Methods

Cosmogenic nuclide dating methods, mostly surface exposure applications (e.g., Ivy-Ochs and Kober, 2008, Benedetti and Van der Woerd, 2014) have been applied to characterize fault activity. These radio isotopic methods use isotopes such as ^{10}Be, ^{26}Al, or ^{36}Cl, as an accumulation clock, with a secondary decay clock based on the half-life decays of these same isotopes. Using multiple isotopes can improve the accuracy of these applications. The isotopes are measured by accelerator mass spectrometry (AMS). As with luminescence dating, considerable research-level effort is required for these methods and involving an expert will likely improve the potential for successful outcomes.

Soil Profile Development Dating

Soils result from the chemical and physical alteration of sediments and rocks at Earth's surface, and are strongly influenced by the interaction of the soil parent material with organic compounds and water. Many factors control the degree of soil development, of which time since deposition is perhaps the most significant to fault studies (Birkeland, 1984, 1990, Rockwell, 2000, Sauer and others, 2014). Soil profiles consist of horizons, which are the characteristic layers that distinguish one type of soil from another, and they form in relatively stable (non-erosional) conditions during times of non-deposition of sediments.

There are many measures of the strength of a soil profile, such as thickness and amount of alteration as measured by accumulation or depletion of chemical elements compared to the original parent material. Field description procedures have standards that should be used (*Schoeneberger, Wysocki, Benham, and Soil Survey Staff, 2012*). Regardless of whether one uses soils to arrive at an age estimate, every practitioner using trenches for investigating faults should have a basic understanding of soil formation (Birkeland, 1984. Borchardt, 2010, Rockwell, 2000) as they can inform on the general age of the sediment exposed in the trench, as well as provide mappable horizons to evaluate the presence or absence of faulting.

To obtain an age estimate for a soil, a semi-quantitative soil development index (SDI) has been developed (Harden, 1982) and refined by McFadden and Weldon (1987), McFadden (1988), Rockwell and others, (1985, 1994), and Birkeland and others (1991). However, the rate of soil-profile development must be locally calibrated by quantitative dating methods before reliable age estimates can be made. Poor application or lack of this crucial step has often downgraded the useful application of this method and made it unreliable. In practice, and in light of the availability and improvements of quantitative dating methods, soils expertise is a valuable complement to fault investigations.

Chronological Modeling

To assess the age of fault activity, the *project geologist* should develop a chronological model that considers all relevant chronological data and the relative uncertainties associated with the methods used. This can be as simple as bracketing the age of the most recent fault activity between quantitative dates but can become a complicated undertaking when several chronological inputs, including uncalibrated ^{14}C dates, are considered. To the extent possible, the *project geologist* should have a working chronological model before the trench is closed so that it can be presented to the *reviewing geologist* and discussed in the field.

Chronological modeling software such as Oxcal (Bronk Ramsey, 1994) provides an efficient web-based tool that provides a controlled method to incorporate multiple types of chronological data. A primer for paleoseismic applications using Oxcal is provided by Lienkaemper and Bronk Ramsey (2009). Another, ^{14}C-specific, online calibration tool is CALIB (Stuiver and others, 2017).

5.6 Contents of *Fault Investigation Reports*

The following topics should be considered and addressed in detail where essential to support opinions, conclusions, and recommendations, in any *fault investigation*. It is not expected that all of the topics or investigative methods outlined below will be necessary in a single investigation.

I. Text.
   A. Purpose and scope of investigation; description of proposed development.
   B. Geologic and tectonic setting, including seismicity and historical accounts of earthquakes.
   C. Site description and conditions, including dates of site visits and observations. Include information on geologic units, graded and filled areas, vegetation, existing structures, and other factors that may affect the choice of investigative methods and the interpretation of data.
   D. Methods of investigation.
      1. Review of published and unpublished literature, maps, and records concerning geologic units, faults, ground-water barriers, and other factors.
      2. Surficial investigations
         a. Geomorphic interpretation: description of methods used and findings.
         b. Field-based observations: description of methods used and findings.
      3. Subsurface investigations.
         a. Trenching and other exposures providing detailed and direct observation of continuously exposed geologic units, soils, faults, and geologic structures.
         b. Borings and cone penetrometer testing (CPT) providing measurements and physical samples of geologic units and

ground water at specific locations. The number and spacing of borings and CPT soundings should be sufficient to adequately image site stratigraphy.

c. Geophysical investigations: description of equipment and techniques used, data processing methods, and findings; supporting data should be presented.

4. Fault Activity and Chronology: description of methods used and findings. If radiometric dating (especially 14C) is not used, the report should state reasons why.
5. Other methods should be discussed when special conditions permit or requirements for critical structures demand a more intensive investigation, such as aerial reconnaissance overflights, and microseismicity monitoring.

E. Conclusions.

1. Location and existence (or absence) of all faults on or adjacent to the site; ages of past rupture events where determined or estimated.
2. Type of faults and nature of anticipated offset including sense and magnitude of displacement, if possible.
3. Distribution of primary and secondary faulting (fault zone width) and *fault-related ground deformation*.
4. Probability of, or relative potential for, future surface displacement. The likelihood of future ground rupture seldom can be stated quantitatively, but may be stated in semi-quantitative terms such as low, moderate, or high, or in terms of slip rates determined for specific fault segments.
5. Degree of confidence in and limitations of data and conclusions, including a discussion regarding stratigraphic resolution and ability to confidently identify faulting within the exposed stratigraphic section.

F. Recommendations.

1. Setback distances of proposed structures from *Holocene-active* or *age-undetermined faults*. The setback distance generally will depend on the quality of data, type and complexity of fault(s), and extent and severity of *fault-related ground deformation* encountered at the site. Lead agency regulations may dictate minimum distances (e.g., see Appendix D).
2. Additional measures (e.g., strengthened foundations, ground improvement, flexible utility connections) to accommodate warping and distributed deformation associated with faulting.
3. Limitations of the investigation; need for additional studies.

II. References.

A. Literature and records cited or reviewed; citations should be complete.

B. Aerial photographs, lidar data or other imagery used in geologic and geomorphic interpretations - list type, date, scale, source, and index numbers.

C. Other sources of information, including well records, personal communications, and other data sources.

III. Illustrations -- these are essential to the understanding of the report and to reduce the length of text.
   A. Regional location maps - identify site locality, significant faults, geographic features, regional geology, seismic epicenters, and other pertinent data; 1:24,000 scale is recommended. If the site investigation is done in compliance with the Alquist-Priolo Act, show site location on the appropriate Official Map of Earthquake Fault Zones.
   B. Site development map - show site boundaries, existing and proposed structures, graded areas, streets, exploratory trenches, borings, geophysical traverses, locations of faults, and other data; recommended scale is 1:2,400 (1 inch equals 200 feet), or larger.
   C. Site geologic and geomorphic maps - show distribution of geologic and/or soil units, faults and other structures, geomorphic features, aerial photographic lineaments, and springs; on topographic map 1:24,000 scale or larger; can be combined with III(A) or III(B).
   D. Geologic cross-sections, if needed, to provide 3-dimensional picture.
   E. Logs of exploratory trenches and borings – show details of observed features and conditions; should not be generalized or diagrammatic. Logs should be drawn on mosaicked and rectified color photographs whenever possible. Trench logs should show topographic profile and geologic structure at a 1:1 horizontal to vertical scale; scale should be 1:60 (1 inch = 5 feet) or larger.
   F. Geophysical data and geologic interpretations.

IV. Appendices: Supporting data not included above (e.g., water well data, photographs, aerial photographs, lab reports).

V. Authentication: Geologic reports require both the *Project geologist's* signature and must be stamped with his or her seal, per the Geologist and Geophysicist Act (Business and Professions Code section 7800-7887).

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SECTION 6: GUIDELINES FOR GEOSCIENCE PRACTITIONERS (REVIEWING AND PROJECT GEOLOGISTS): REVIEWING SITE-INVESTIGATION REPORTS

Note: Terms in *italics* are terms defined in Section 1, Definitions and Acronyms

6.1 Section Outline

6.2 Objectives of this section

The purpose of this section is to provide general guidance to *lead agencies* that have approval authority over *projects* and for those geologists (*reviewing geologists*) who review *fault investigation reports* on behalf of those agencies. *Project geologists* will also find this section useful as a guide to the expectations of the *lead agency* review process. These general guidelines are modified from an article titled, "Geologic Review Process" by Hart and Williams (1978).

The geologic review is a critical part of the evaluation process of a proposed development. The *reviewing geologist* ensures compliance with existing laws, regulations, ordinances, codes, policies, standards, and technically sound practice, helping to assure that significant geologic factors (hazards and geologic processes) are properly considered, and potential problems are mitigated prior to project development. In addition to geologic reports for tentative tracts and site development, a reviewer may also evaluate Environmental Impact Reports, Seismic Safety and Public Safety Elements of General Plans, reclamation plans, as-graded geologic reports, and final, as-built geologic maps and reports. Generally, the reviewer acts at the discretion or request of, and on behalf of a *lead agency* -- city, county, regional, state, federal -- not only to protect the government's interest but also to protect the interest of the community at large. Because the *A-P Act* requires that the *lead agency* "…prohibit the location of developments and structures for human occupancy across the trace of active faults.", it is important to recognize that the *reviewing geologist*, as the *lead agency's* technical representative, is assessing the *lead agency's* exposure to liability resulting from non-compliance with the requirements of the *A-P Act* and regulations. Examples of the review process in a state agency are described by Stewart and others (1976). Review at the local level has been discussed by Leighton (1975), Berkland (1992), Larson (1992; 2015), and others. Grading codes, inspections, and the review process are discussed in detail by Scullin (1983). Nelson and Christenson (1992) and Lund and others (2016) specifically discuss review guidelines for reports on surface faulting.

The review process will be streamlined if the expectations of the *lead agency* are clear and consistently applied. As noted in Section 5, discussions between the *project* *geologist* and the *lead agency*'s *reviewing geologist* during all phases of a *project* can benefit all parties involved. Some *lead agencies* may also choose to publish required minimum standards for surface fault rupture hazard studies. Appendix D contains examples of state, county, and city policies, actions, guidelines and ordinances to assist the *reviewing geologist* in developing clear expectations of what constitutes a thorough fault investigation. These examples can also be used to update *lead agency* ordinance documents or guidelines.

6.3 The Reviewer

Qualifications

In order to make appropriate evaluations of geologic reports, the reviewer should be an experienced geologist familiar with the investigative methods employed and the techniques available to the profession. Even so, the reviewer must know his or her limitations, and at times ask for the opinions of others more qualified in specialty fields (e.g., paleoseismology, radiometric dating, soils, geophysics, ground water, foundation and seismic engineering, seismology). With respect to the *A-P Act*, the *reviewing geologist* is required by the State Mining and Geology Board (SMGB) to be licensed by the Board for Professional Engineers, Land Surveyors, and Geologists in order to review *fault investigation reports*. The SMGB also certifies engineering geologists and hydrogeologists, and licenses geophysicists and engineers. Local and regional agencies may have additional requirements.

The reviewer has an ethical obligation to ensure a *fault investigation report* has thoroughly addressed the potential for *surface fault rupture* for any *fault investigation* triggered by the *A-P Act* or local regulations. Like any review process, there is a certain "give-and-take" involved between the *reviewing geologist* and *project geologist*. The reviewer should bear in mind that some *project geologists* are not accomplished writers, and almost all are working with restricted budgets. Also, the reviewer may by limited by his or her agency's policies, procedures, and fee structures. The mark of a good reviewer is the ability to sort out the important from the insignificant and to make constructive comments and recommendations and maintain a professional tone.

If there is clear evidence of incompetence or misrepresentation in a report, this fact should be reported to the reviewing agency or licensing board. California Civil Code Section 47 provides an immunity for statements made "in the initiation or course of any other proceedings authorized by law." Courts have interpreted this section as providing immunity to letters of complaint written to provide a public agency or board, including licensing boards, with information that the public board or agency may want to investigate (see King v. Borges, 28 Cal. App. 3d 27 [1972]; and Brody v. Montalbano, 87 Cal. App. 3d 725 [1978]). Clearly, the reviewer needs to have the support of his or her agency in order to carry out these duties.

A reviewer may be employed full time by the *lead agency* or serve as a contractor to the *lead agency*. Also, one reviewing agency (such as a city) may contract with another agency (such as a county) to perform geologic reviews. The best reviews generally are performed by experienced reviewers. The use of multiple, part-time reviewers by a given agency may contribute to an inconsistent treatment of development projects because different reviewers may have different standards or levels of experience. The primary purpose of the review procedure should always be kept in mind -- namely, to assure the adequacy of geologic investigations.

Other Review Functions

Aside from his or her duties as a reviewer, the *reviewing geologist* also must interpret the geologic data reported to other agency personnel who regulate development (e.g., planners, engineers, and inspectors). Also, the *reviewing geologist* sometimes is called upon to make investigations for his or her own agency. This is common where a city or county employs only one geologist. In fact, some reviewers routinely divide their activities between reviewing the reports of others and performing one or several other tasks for the employing agency (such as advising other agency staff and boards on geologic matters; making public presentations) (see Leighton, 1975).

Conflict of Interest

In cases where a *reviewing geologist* also must perform geologic investigations, he or she should never be placed in the position of reviewing his or her own report, for that is no review at all. A different type of conflict commonly exists in a jurisdiction where the geologic review is performed by a consulting geologist who also is practicing commercially (performing geologic investigations) within the same jurisdictional area. Such situations should be avoided.

6.4 Geologic Review

The Report

The critical item in evaluating specific site investigations for adequacy is the resulting geologic report. A report that is incomplete or poorly written cannot be evaluated and should not be approved. As an expediency, some reviewers accept inadequate or incomplete reports based on familiarity or direct experience at, or near a site. However, unless good reasons can be provided in writing, it is recommended that a report not be accepted until it presents the pertinent facts correctly and completely.

The reviewer performs four principal functions in the technical review:

1. Identifies any known potential hazards and impacts that are not addressed in the consultant's report. The reviewer should require investigation of the potential hazards and impacts;
2. Determines whether the report contains sufficient data to support and is consistent with the stated conclusions;
3. Determines whether the conclusions identify the potential impact of known and reasonable anticipated geologic processes and site conditions; and,

4. Determines whether the recommendations are consistent with the conclusions and can reasonably be expected to mitigate those anticipated earthquake-related problems that could have a significant impact on the proposed development. The included recommendations also should address the need for additional geologic and engineering investigations (including any site inspections to be made as site remediation proceeds).

The conclusions presented in the report regarding the geologic hazards must be separate from and supported by the investigative data. An indication regarding the level of confidence in the conclusions should be provided. Recommendations based on the conclusions should be made to mitigate those geology-related issues that would have an impact on the proposed development. Recommendations also should be made concerning the need for additional geologic investigations if necessary.

Report Guidelines and Standards

A *project geologist* may save a great deal of time and avoid misunderstandings, if he or she contacts the *reviewing geologist* at the initiation of the investigation. The reviewer should not only be familiar with the local geology and sources of information, but also should be able to provide specific guidelines for investigative reports and procedures to be followed. Guidelines and check-lists for geologic or geotechnical reports have been prepared by a number of reviewing agencies and are available to assist the reviewer in his or her evaluation of reports (e.g., CGS Notes 41, 48; California Geological Survey, 1997; 1997; 2013). A reviewer also may wish to prepare his or her own guidelines or check-lists for specific types of reviews.

If a reviewer has questions about an investigation, these questions must be communicated in writing to the *project geologist* for response. After the reviewer is satisfied that the investigation and resulting conclusions are adequate, this should be clearly indicated in writing to the *lead agency* so that the proposed development application may be processed promptly. One of the more important responsibilities of the reviewer should be implementation of requirements assuring report recommendations are incorporated and appropriate consultant inspections are made.

A significant challenge the reviewer faces is the identification of standards. These questions must be asked: “Are the methods of investigation appropriate for a given site?” and, “Was the investigation conducted according to existing standards of practice?” Answers to these questions lie in the report being reviewed. For example, a nearby mapped fault should be portrayed on a geologic map of the site. The conclusion that a hazard is absent, where previously reported or suspected, should be documented by stating which investigative steps were taken and precisely what was observed. The reviewer must evaluate each investigative step according to existing standards. It should be recognized that existing standards of practice generally set minimum requirements (Keaton, 1993). Often the reviewer is forced to clarify the standards, or even introduce new ones, for a specific purpose. If the *project geologist* concludes that fault is absent, this conclusion should be based on the <u>evidence of absence</u> and not the absence of evidence for *surface fault rupture* hazard.

Scope of Review

The scope of the review is determined primarily by the need to assure that an investigation and resulting conclusions are supported by the geologic data developed during the investigation. The reviewer may wish to check cited references or other sources of data, such as aerial photographs and unpublished records. Reviewers also may inspect the development site and examine excavations and borehole samples. Field reviews of trench exposures and inspection of cores and samples are of value and may help to identify and resolve different interpretations. Also, if the reviewer is not familiar with the general site conditions, a brief field visit provides perspective and a visual check on the reported conditions.

As important as reviewing a report for completeness, the reviewing geologist should keep in mind that the conclusions in the report must be data driven in order for the report to be technically sound. Primary questions the *reviewing geologist* should ask during the course of the review are:

1. Are the conclusions in the *fault investigation report* reasonable given the data presented?
2. Is there a clear distinction between data and observations versus interpretations and/or models?
3. If a conclusion is model driven, are there alternative models that also satisfy the available data?
4. If one model is preferred over others, what supporting data allow the alternative models to be down-weighted or rejected?

Review Records

For each report and development project reviewed, a clear, concise, and logical written record should be developed. This review record should be as detailed as is necessary, depending upon the complexity of the project, the geology, and the quality and completeness of the reports submitted. At a minimum, the record should:

1. Identify the project, permits, applicant, consultants, reports, and plans reviewed;
2. Include a clear statement of the requirements to be met by the parties involved, data required, and the plan, phase, project, or report being considered;
3. Contain summaries of the reviewer's field observations, associated literature and aerial photographic review, and oral communications with the applicant and the consultant;
4. Contain copies of any pertinent written correspondence; and,
5. The reviewer's name and California Professional Geologist license number(s), with expiration dates and stamped with his or her seal.

The report, plans, and review record should be kept in perpetuity to document that compliance with local requirements was achieved and for reference during future development, remodeling, or rebuilding. Such records also can be a valuable resource for land-use planning and real estate disclosure. In addition, the Policies and Criteria of the *State Mining and Geology Board* (Appendix B) requires that copies of all approved *fault investigation reports* be submitted to the *State Geologist* within 30 days of project approval (CCR, Title 14, Division 2, Chapter 8.1.3, 3603(f)).

Appeals

In cases where the reviewer is not able to approve a geologic report, or can accept it only on a conditional basis, the developer may wish to appeal the review decision or recommendations. However, every effort should be made to resolve problems informally prior to making a formal appeal. An appeal should be handled through existing local procedures (such as a hearing by a County Board of Supervisors or a City Council) or by a specially appointed Technical Appeals and Review Panel comprised of geoscientists, engineers, and other appropriate professionals. Adequate notice should be given to allow time for both sides to prepare their cases. After an appropriate hearing, the appeals decision should be in writing as part of the permanent record.

Another way to remedy conflicts between the investigator and the reviewer is by means of a third party review. Such a review can take different paths ranging from the review of existing reports to in-depth field investigations. Third party reviews are usually done by consultants not normally associated with the reviewing/permitting agency.

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APPENDIX A: ALQUIST-PRIOLO EARTHQUAKE FAULT ZONING ACT

CALIFORNIA PUBLIC RESOURCES CODE

DIVISION 2. Geology, Mines and Mining

CHAPTER 7.5 Earthquake Fault Zones

2621. This chapter shall be known and may be cited as the Alquist-Priolo Earthquake Fault Zoning Act.

2621.5. (a) It is the purpose of this chapter to provide for the adoption and administration of zoning laws, ordinances, rules, and regulations by cities and counties in implementation of the general plan that is in effect in any city or county. The Legislature declares that this chapter is intended to provide policies and criteria to assist cities, counties, and state agencies in the exercise of their responsibility to prohibit the location of developments and structures for human occupancy across the trace of active faults. Further, it is the intent of this chapter to provide the citizens of the state with increased safety and to minimize the loss of life during and immediately following earthquakes by facilitating seismic retrofitting to strengthen buildings, including historical buildings, against ground shaking.

(b) This chapter is applicable to any project, as defined in Section 2621.6, which is located within a delineated earthquake fault zone, upon issuance of the official earthquake fault zones maps to affected local jurisdictions, except as provided in Section 2621.7.

(c) The implementation of this chapter shall be pursuant to policies and criteria established and adopted by the Board.

2621.6. (a) As used in this chapter, “project” means either of the following:

(1) Any subdivision of land which is subject to the Subdivision Map Act, (Division 2 (commencing with Section 66410) of Title 7 of the Government Code), and which contemplates the eventual construction of structures for human occupancy.

(2) Structures for human occupancy, with the exception of either of the following:

(A) Single-family wood-frame or steel-frame dwellings to be built on parcels of land for which geologic reports have been approved pursuant to paragraph (1).

(B) A single-family wood-frame or steel-frame dwelling not exceeding two stories when that dwelling is not part of a development of four or more dwellings.

(b) For the purposes of this chapter, a mobilehome whose body width exceeds eight feet shall be considered to be a single-family wood-frame dwelling not exceeding two stories.

2621.7. This chapter, except Section 2621.9, shall not apply to any of the following:

(a) The conversion of an existing apartment complex into a condominium.

(b) Any development or structure in existence prior to May 4, 1975, except for an alteration or addition to a structure that exceeds the value limit specified in subdivision (c).

(c) An alteration or addition to any structure if the value of the alteration or addition does not exceed 50 percent of the value of the structure.

(d) (1) Any structure located within the jurisdiction of the City of Berkeley or the City of Oakland which was damaged by fire between October 20, 1991, and October 23, 1991, if granted an exemption pursuant to this subdivision.

(2) The city may apply to the State Geologist for an exemption and the State Geologist shall grant the exemption only if the structure located within the earthquake fault zone is not situated upon a trace of an active fault line, as delineated in an official earthquake fault zone map or in more recent geologic data, as determined by the State Geologist.

(3) When requesting an exemption, the city shall submit to the State Geologist all of the following information:

(A) Maps noting the parcel numbers of proposed building sites that are at least 50 feet from an identified fault and a statement that there is not any more recent information to indicate a geologic hazard.

(B) Identification of any sites within 50 feet of an identified fault.

(C) Proof that the property owner has been notified that the granting of an exemption is not any guarantee that a geologic hazard does not exist.

(4) The granting of an exemption does not relieve a seller of real property or an agent for the seller of the obligation to disclose to a prospective purchaser that

the property is located within a delineated earthquake fault zone, as required by Section 2621.9.

(e) (1) Alterations which include seismic retrofitting, as defined in Section 8894.2 of the Government Code, to any of the following listed types of buildings in existence prior to May 4, 1975:

(A) Unreinforced masonry buildings, as described in subdivision (a) of Section 8875 of the Government Code.

(B) Concrete tilt-up buildings, as described in Section 8893 of the Government Code.

(C) Reinforced concrete moment resisting frame buildings as described in Applied Technology Council Report 21 (FEMA Report 154).

(2) The exemption granted by paragraph (1) shall not apply unless a city or county acts in accordance with all of the following:

(A) The building permit issued by the city or county for the alterations authorizes no greater human occupancy load, regardless of proposed use, than that authorized for the existing use permitted at the time the city or county grants the exemption. This may be accomplished by the city or county making a human occupancy load determination that is based on, and no greater than, the existing authorized use, and including that determination on the building permit application as well as a statement substantially as follows: "Under subparagraph (A) of paragraph (2) of subdivision (e) of Section 2621.7 of the Public Resources Code, the occupancy load is limited to the occupancy load for the last lawful use authorized or existing prior to the issuance of this building permit, as determined by the city or county."

(B) The city or county requires seismic retrofitting, as defined in Section 8894.2 of the Government Code, which is necessary to strengthen the entire structure and provide increased resistance to ground shaking from earthquakes.

(C) Exemptions granted pursuant to paragraph (1) are reported in writing to the State Geologist within 30 days of the building permit issuance date.

(3) Any structure with human occupancy restrictions under subparagraph (A) of paragraph (2) shall not be granted a new building permit that allows an increase in human occupancy unless a geologic report, prepared pursuant to subdivision (d) of Section 3603 of Title 14 of the California Code of Regulations in effect on January 1, 1994, demonstrates that the structure is not on the trace of an active fault, or the requirement of a geologic report has been waived pursuant to Section 2623.

(4) A qualified historical building within an earthquake fault zone that is exempt pursuant to this subdivision may be repaired or seismically retrofitted using the State Historical Building Code, except that, notwithstanding any provision of that building code and its implementing regulations, paragraph (2) shall apply.

2621.8. Notwithstanding Section 818.2 of the Government Code, a city or county which knowingly issues a permit that grants an exemption pursuant to subdivision (e) of Section 2621.7 that does not adhere to the requirements of paragraph (2) of subdivision (e) of Section 2621.7, may be liable for earthquake-related injuries or deaths caused by failure to so adhere.

2621.9. (a) A person who is acting as an agent for a transferor of real property that is located within a delineated earthquake fault zone, or the transferor, if he or she is acting without an agent, shall disclose to any prospective transferee the fact that the property is located within a delineated earthquake fault zone.

(b) Disclosure is required pursuant to this section only when one of the following conditions is met:

(1) The transferor, or the transferor's agent, has actual knowledge that the property is within a delineated earthquake fault zone.

(2) A map that includes the property has been provided to the city or county pursuant to Section 2622, and a notice has been posted at the offices of the county recorder, county assessor, and county planning agency that identifies the location of the map and any information regarding changes to the map received by the county.

(c) In all transactions that are subject to Section 1103 of the Civil Code, the disclosure required by subdivision (a) of this section shall be provided by either of the following means:

(1) The Local Option Real Estate Transfer Disclosure Statement as provided in Section 1102.6a of the Civil Code.

(2) The Natural Hazard Disclosure Statement as provided in Section 1103.2 of the Civil Code.

(d) If the map or accompanying information is not of sufficient accuracy or scale that a reasonable person can determine if the subject real property is included in a delineated earthquake fault hazard zone, the agent shall mark "Yes" on the Natural Hazard Disclosure Statement. The agent may mark "No" on the Natural Hazard Disclosure Statement if he or she attaches a report prepared pursuant to subdivision (c) of Section 1103.4 of the Civil Code that verifies the property is not in the hazard zone. Nothing in this subdivision is intended to limit or abridge any existing duty of the transferor or the transferor's agents to exercise reasonable care in making a determination under this subdivision.

(e) For purposes of the disclosures required by this section, the following persons shall not be deemed agents of the transferor:

(1) Persons specified in Section 1103.11 of the Civil Code.

(2) Persons acting under a power of sale regulated by Section 2924 of the Civil Code.

(f) For purposes of this section, Section 1103.13 of the Civil Code shall apply.

(g) The specification of items for disclosure in this section does not limit or abridge any obligation for disclosure created by any other provision of law or that may exist in order to avoid fraud, misrepresentation, or deceit in the transfer transaction.

2622. (a) In order to assist cities and counties in their planning, zoning, and building-regulation functions, the State Geologist shall delineate, by December 31, 1973, appropriately wide earthquake fault zones to encompass all potentially and recently active traces of the San Andreas, Calaveras, Hayward, and San Jacinto Faults, and such other faults, or segments thereof, as the State Geologist determines to be sufficiently active and well-defined as to constitute a potential hazard to structures from surface faulting or fault creep. The earthquake fault zones shall ordinarily be one-quarter mile or less in width, except in circumstances which may require the State Geologist to designate a wider zone.

(b) Pursuant to this section, the State Geologist shall compile maps delineating the earthquake fault zones and shall submit the maps to all affected cities, counties, and state agencies, not later than December 31, 1973, for review and comment. Concerned jurisdictions and agencies shall submit all comments to the State Mining and Geology Board for review and consideration within 90 days. Within 90 days of such review, the State Geologist shall provide copies of the official maps to concerned state agencies and to each city or county having jurisdiction over lands lying within any such zone.

(c) The State Geologist shall continually review new geologic and seismic data and shall revise the earthquake fault zones or delineate additional earthquake fault zones when warranted by new information. The State Geologist shall submit all revised maps and additional maps to all affected cities, counties, and state agencies for their review and comment. Concerned jurisdictions and agencies shall submit all comments to the State Mining and Geology Board for review and consideration within 90 days. Within 90 days of that review, the State Geologist shall provide copies of the revised and additional official maps to concerned state agencies and to each city or county having jurisdiction over lands lying within the earthquake fault zone.

(d) In order to ensure that sellers of real property and their agents are adequately informed, any county that receives an official map pursuant to this section shall post a notice within five days of receipt of the map at the offices of the county recorder, county assessor, and county planning commission, identifying the location of the map and the effective date of the notice.

2623. (a) The approval of a project by a city or county shall be in accordance with policies and criteria established by the State Mining and Geology Board and the findings of the State Geologist. In the development of such policies and criteria, the State Mining and Geology Board shall seek the comment and advice of affected cities, counties, and state agencies. Cities and counties shall require, prior to the approval of a project, a geologic report defining and delineating any hazard of surface fault rupture. If the city or county finds that no undue hazard of that kind exists, the geologic report on the hazard may be waived, with the approval of the State Geologist.

(b) After a report has been approved or a waiver granted, subsequent geologic reports shall not be required, provided that new geologic data warranting further investigations is not recorded.

(c) The preparation of geologic reports that are required pursuant to this section for multiple projects may be undertaken by a geologic hazard abatement district.

2624. Notwithstanding any provision of this chapter, cities and counties may do any of the following:

(1) Establish policies and criteria which are stricter than those established by this chapter.

(2) Impose and collect fees in addition to those required under this chapter.

(3) Determine not to grant exemptions authorized under this chapter.

2625. (a) Each applicant for approval of a project may be charged a reasonable fee by the city or county having jurisdiction over the project.

(b) Such fees shall be set in an amount sufficient to meet, but not to exceed, the costs to the city or county of administering and complying with the provisions of this chapter.

(c) The geologic report required by Section 2623 shall be in sufficient detail to meet the criteria and policies established by the State Mining and Geology Board for individual parcels of land.

2630. In carrying out the provisions of this chapter, the State Geologist and the board shall be advised by the Seismic Safety Commission.

SIGNED INTO LAW DECEMBER 22, 1972; AMENDED SEPTEMBER 16, 1974, MAY 4, 1975, SEPTEMBER 28, 1975, SEPTEMBER 22, 1976, SEPTEMBER 27, 1979, SEPTEMBER 21, 1990, JULY 29, 1991, AUGUST 16, 1992, JULY 25, 1993, OCTOBER 7, 1993, AND OCTOBER 7, 1997.

APPENDIX B: POLICIES AND CRITERIA OF THE STATE MINING AND GEOLOGY BOARD

With Reference to the Alquist-Priolo Earthquake Fault Zoning Act

Disclaimer: The excerpted text from the California Code of Regulations, Title 14, Division 2 is for informational purposes only and may not the most current version of the regulations. For the most current version of the regulations, please refer to the online version of the California Code of Regulations:

https://govt.westlaw.com/SiteList

3600. Purpose.

It is the purpose of this subchapter to set forth the policies and criteria of the State Mining and Geology Board, hereinafter referred to as the “Board,” governing the exercise of city, county, and state agency responsibilities to prohibit the location of developments and structures for human occupancy across the trace of active faults in accordance with the provisions of Public Resources Code Section 2621 et seq. (Alquist-Priolo Earthquake Fault Zoning Act). The policies and criteria set forth herein shall be limited to potential hazards resulting from surface faulting or fault creep within earthquake fault zones delineated on maps officially issued by the State Geologist.

NOTE: Authority cited: Section 2621.5, Public Resources Code. Reference: Sections 2621-2630, Public Resources Code.

3601. Definitions.

The following definitions as used within the Act and herein shall apply:

(a) An “active fault” is a fault that has had surface displacement within Holocene time (about the last 11,000 years), hence constituting a potential hazard to structures that might be located across it.

(b) A “fault trace” is that line formed by the intersection of a fault and the earth’s surface, and is the representation of a fault as depicted on a map, including maps of earthquake fault zones.

(c) A “lead agency” is the city or county with the authority to approve projects.

(d) “Earthquake fault zones” are areas delineated by the State Geologist, pursuant to the Alquist-Priolo Earthquake Fault Zoning Act (Public Resources Code Section 2621 et seq.) and this subchapter, which encompass the traces of active faults.

(e) A “structure for human occupancy” is any structure used or intended for supporting or sheltering any use or occupancy, which is expected to have a human occupancy rate of more than 2,000 person-hours per year.

(f) “Story” is that portion of a building included between the upper surface of any floor and the upper surface of the floor next above, except that the topmost story shall be that portion of a building included between the upper surface of the topmost floor and the ceiling or roof above. For the purpose of the Act and this subchapter, the number of stories in a building is equal to the number of distinct floor levels, provided that any levels that differ from each other by less than two feet shall be considered as one distinct level.

NOTE: Authority cited: Section 2621.5, Public Resources Code. Reference: Sections 2621-2630, Public Resources Code.

3602. Review of Preliminary Maps.

(a) Within 45 days from the issuance of proposed new or revised preliminary earthquake fault zone map(s), cities and counties shall give notice of the Board’s announcement of a ninety (90) day public comment period to property owners within the area of the proposed zone. The notice shall be by publication, or other means reasonably calculated to reach as many of the affected property owners as feasible. Cities and counties may also give notice to consultants who may conduct geologic studies in fault zones. The notice shall state that its purpose is to provide an opportunity for public comment including providing to the Board geologic information that may have a bearing on the proposed map(s).

(b) The Board shall also give notice by mail to those California Registered Geologists and California Registered Geophysicists on a list provided by the State Board of Registration for Geologists and Geophysicists. The notice shall indicate the affected jurisdictions and state that its purpose is to provide an opportunity to present written technical comments that may have a bearing on the proposed zone map(s) to the Board during a 90-day public comment period.

(c) The Board shall receive public comments during the 90-day public comment period. The Board shall conduct at least one public hearing on the proposed zone map(s) during the 90-day public comment period.

(d) Following the end of the 90-day public comment period, the Board shall forward its comments and recommendations with supporting data received to the State Geologist for consideration prior to the release of official earthquake fault zone map(s).

NOTE: Authority cited: Section 2621.5, Public Resources Code. Reference: Section 2622, Public Resources Code.

3603. Specific Criteria.

The following specific criteria shall apply within earthquake fault zones and shall be used by affected lead agencies in complying with the provisions of the Act:

(a) No structure for human occupancy, identified as a project under Section 2621.6 of the Act, shall be permitted to be placed across the trace of an active fault.

Furthermore, as the area within fifty (50) feet of such active faults shall be presumed to be underlain by active branches of that fault unless proven otherwise by an appropriate geologic investigation and report prepared as specified in Section 3603(d) of this subchapter, no such structures shall be permitted in this area.

(b) Affected lead agencies, upon receipt of official earthquake fault zones maps, shall provide for disclosure of delineated earthquake fault zones to the public. Such disclosure may be by reference in general plans, specific plans, property maps, or other appropriate local maps.

(c) No change in use or character of occupancy, which results in the conversion of a building or structure from one not used for human occupancy to one that is so used, shall be permitted unless the building or structure complies with the provisions of the Act.

(d) Application for a development permit for any project within a delineated earthquake fault zone shall be accompanied by a geologic report prepared by a geologist registered in the State of California, which is directed to the problem of potential surface fault displacement through the project site, unless such report is waived pursuant to Section 2623 of the Act. The required report shall be based on a geologic investigation designed to identify the location, recency, and nature of faulting that may have affected the project site in the past and may affect the project site in the future. The report may be combined with other geological or geotechnical reports.

(e) A geologist registered in the State of California, within or retained by each lead agency, shall evaluate the geologic reports required herein and advise the lead agency.

(f) One (1) copy of all such geologic reports shall be filed with the State Geologist by the lead agency within thirty (30) days following the report's acceptance. The State Geologist shall place such reports on open file.

NOTE: Authority cited: Section 2621.5, Public Resources Code. Reference: Sections 2621.5, 2622, 2623, and 2625(c), Public Resources Code.

ADOPTED NOVEMBER 23, 1973; REVISED JULY 1, 1974, AND JUNE 26, 1975.
CODIFIED IN CALIFORNIA CODE OF REGULATIONS JANUARY 31, 1979;
REVISED OCTOBER 18, 1984, JANUARY 5, 1996, AND APRIL 1, 1997.

APPENDIX C: THE CALIFORNIA GEOLOGICAL SURVEY'S FAULT EVALUATION AND ZONING PROGRAM

C.1 Fault Evaluation and Zoning Program

The Fault Evaluation and Zoning Program was initiated in early 1976 for the purpose of evaluating those "other faults" identified in the Act as "sufficiently active and well-defined" (see definitions below) after it was recognized that effective future zoning could not rely solely on the limited fault data of others. Justification of this program is discussed in more detail in Special Publication 47 of the Division of Mines and Geology (1976; also see Hart, 1978).

The program originally was scheduled over a 10-year period. The state was divided into 10 regions or work areas, with one region scheduled for evaluation each year. However, the work in some regions was extended because of heavy workloads. Fault evaluation work includes interpretation of aerial photographs and limited field mapping, as well as the use of other geologists' works. A list of faults to be evaluated in a target region was prepared and priorities assigned. The list included potentially active faults not yet zoned, as well as previously zoned faults or fault-segments that warranted zone revisions (change or deletion). Faults also were evaluated in areas outside of scheduled regions, as the need arose (e.g., to map fault rupture immediately after an earthquake). The fault evaluation work was completed in early 1991. The work is summarized for each region in Open-File Reports (OFR) 77-8, 78-10, 79-10, 81-3, 83-10, 84-52, 86-3, 88-1, 89-16, and 91-9.

For each fault evaluated by CGS since 1976 a Fault Evaluation Report (FER) has been prepared, summarizing data on the location, recency of activity, sense and magnitude of displacement, and providing recommendations for or against zoning. FERs that resulted in *Earthquake Fault Zones (EFZ)* are available through the Information warehouse on the CGS web page (http://maps.conservation.ca.gov/cgs/informationwarehouse/). FERs that did not recommend *EFZs* be delineated are available from CGS by request.

Faults zoned since 1976 are considered to meet the criteria of "sufficiently active and well-defined" (see Definitions below). Many other faults do not appear to meet the criteria and have not been zoned. It is important to note that it is sometimes difficult to distinguish between slightly active faults and inactive ones, because the surface features formed as a result of minor, infrequent rupture are easily obliterated by geologic processes (erosion, sedimentation, mass wasting) or human activities. Even large scale fault-rupture can be obscured in complex geologic terranes or high-energy environments. Recent fault-rupture is challenging to detect where it is distributed as numerous breaks or warps in broad zones of deformation. As a consequence of these problems, it is not possible to identify and zone all active faults in California. For the most part, rupture on faults not identified as active is expected to be minor.

Under the AP Act (Sec. 2622), the State Geologist has an on-going responsibility to review "new geologic and seismic data" in order to revise *EFZ* and to delineate new zones "when warranted by new information." Much of this new information comes to the State Geologist through fault investigation reports triggered as a result of existing *EFZs*, but also from fault investigations conducted where zones have not been delineated. These investigation reports are used to update existing zones as well as prepare new *EFZs*. They have also been used to file waivers and are often sought by *project geologists* when designing site-specific fault investigations. In accordance with the policies and Criteria of the State Mining and Geology Board (California Code of Regulations, Title 14, Division 2, Section 3603(f)), these reports are available on the CGS website: (https://spatialservices.conservation.ca.gov/arcgis/rest/services/CGS).

C.2 Fault Zoning Criteria

A major objective of CGS's continuing Fault Evaluation and Zoning Program is to evaluate the hundreds of remaining potentially active faults in California for zoning consideration. However, it became apparent as the program progressed that there are so many potentially active (i.e., Quaternary) faults in the state (Jennings, 1975) that it would be meaningless to zone all of them. In late 1975, the State Geologist made a policy decision to zone only those potentially active faults that have a relatively high potential for ground rupture. To facilitate this, the terms "sufficiently active" and "well-defined," from Section 2622 of the Act, were defined for application in zoning faults other than the four named in the Act. These two terms constitute the present criteria used by the State Geologist in determining if a given fault should be zoned under the Alquist-Priolo Act.

Sufficiently active. A fault is deemed sufficiently active if there is evidence of Holocene surface displacement along one or more of its segments or branches. Holocene surface displacement may be directly observable or inferred; it need not be present everywhere along a fault to qualify that fault for zoning.

Well-defined. A fault is considered well-defined if its trace is clearly detectable by a trained geologist as a physical feature at or just below the ground surface. The fault may be identified by direct observation or by indirect methods (e.g., geomorphic evidence or geophysical techniques). The critical consideration is that the fault, or some part of it, can be located in the field with sufficient precision and confidence to indicate that the required site-specific investigations would meet with some success.

Determining if a fault is sufficiently active and well-defined is sometimes a matter of experienced judgment. However, these definitions provide standard, workable guidelines for establishing *Earthquake Fault Zones* under the Act.

The evaluation of faults for zoning purposes is done with the realization that not all active faults can be identified as active. Furthermore, certain faults considered to be active at depth, because of known seismic activity, are so poorly defined at the surface that zoning becomes too uncertain. Although the map explanation indicates that "potentially active" (i.e., Quaternary) faults are identified and zoned (with exceptions) on the Official Maps of Earthquake Fault Zones until 1988, this is basically true only for those maps issued July 1, 1974 and January 1, 1976. Even so, all of the principal faults zoned in 1974 and 1976 were active during Holocene time, if not historically. Beginning with the maps of January 1, 1977, all faults zoned meet the criteria of "sufficiently active and well-defined."

C.3 Delineating the Earthquake Fault Zones

Earthquake Fault Zones are delineated on U.S. Geological Survey topographic base maps at a scale of 1:24,000 (1 inch equals 2,000 feet). On older Earthquake Fault Zone maps, the zone boundaries are straight-line segments defined by turning points. Most of the turning points were intended to coincide with locatable features on the ground (e.g., bench marks, roads, streams). Neither the turning points nor the connecting zone boundaries have been surveyed to verify their mapped locations. EFZ maps prepared as of 2012 or later, and those revised/combined with Seismic Hazard Zone Maps, do not portray turning points. This change was made because the GIS data that serve as the official zone maps and modern GPS technology has made the need to locate cultural features in the field to identify zone boundaries obsolete.

Locations of Earthquake Fault Zone boundaries are controlled by the position of fault traces shown on the Official Maps of Earthquake Fault Zones. With few exceptions, the faults shown on the 1974 and 1976 Earthquake Fault Zones maps were not field-checked during the compilation of these maps. However, nearly all faults zoned since January 1, 1977 have been evaluated in the field or on aerial photographs to verify that they do meet the criteria of being sufficiently active and well defined.

Zone boundaries on early maps were positioned about 660 feet (200 meters) away from the fault traces to accommodate imprecise locations of the faults and possible existence of active branches. The policy since 1977 is to position the EFZ boundary about 500 feet (150 meters) away from major active faults and about 200 to 300 feet (60 to 90 meters) away from well-defined, minor faults. Exceptions to this policy exist where faults are locally complex or where faults are not vertical.

C.4 Products of the A-P Program

Reports listed in this Appendix that are publications of the California Geological Survey are available from the California Geological Survey website:
http://www.conservation.ca.gov/cgs/publications/Pages/index.aspx

For more information on the A-P Program at CGS please go to the CGS website:
http://www.conservation.ca.gov/cgs/rghm/ap/Pages/Index.aspx

Earthquake Fault Zone Maps are available as GIS Shapefiles or GeoPDF files and Fault Evaluation Reports are available as PDF files, all downloadable from the CGS Information Warehouse:
http://maps.conservation.ca.gov/cgs/informationwarehouse/

Earthquake Fault Zones are available as web-based services that can be viewed on your GIS platform or in Google Earth from the following URL:
https://spatialservices.conservation.ca.gov/arcgis/rest/services/CGS_Earthquake_Hazard_Zones

and associated metadata can be found at:
https://maps.conservation.ca.gov/cgs/metadata/SHP_Fault_Zones.html

The CGS web application that allows one to determine if a parcel lies within Earthquake Fault Zones or Seismic Hazard Zones can be found here:
https://maps.conservation.ca.gov/cgs/earthquakezones/app/

Fault Investigation Reports prepared by *project geologists* can be found at:
https://spatialservices.conservation.ca.gov/arcgis/rest/services/CGS

APPENDIX D: MODEL ORDINANCE AND EXAMPLES OF LEAD AGENCY IMPLEMENTATION OF THE ALQUIST-PRIOLO EARTHQUAKE FAULT ZONING ACT

Appendix D contains examples of approaches to implementation of the *A-P Act* by some *lead agencies* in California as links to the jurisdiction's websites. The examples in this Appendix are intended to assist other *lead agencies* in developing or updating their safety elements, ordinances, policies, and other documents to better implement the *A-P Act* within their jurisdictions. This is not an exhaustive compilation but simply the results from an internet search of lead agencies known to have earthquake fault zones within their jurisdictions. These links were last tested in December, 2017.

California State Agencies

The California Department of General Services, Division of the State Architect, has been responsible for overseeing school construction in California since the 1933 Long Beach earthquake, which destroyed or severely damaged many school buildings in Los Angeles and Orange counties. The provisions for addressing fault rupture hazards are found in the California Administrative Code 2016, Group 1 Safety of Construction of Public Schools, Article 3 Approval of Drawings and Specifications, 4-1317 Plans, specifications, calculations and other data, (e) Site Data.

https://up.codes/viewer/california/ca-administrative-code-2016/chapter/group_1/safety-of-construction-of-public-schools#4-317

California Counties

Alameda County:

Safety Element; see Chapter 1: Natural Hazards.
https://www.acgov.org/cda/planning/generalplans/documents/SafetyElementAmendmentFinal.pdf

Municipal Code, Chapter 15.36; see Section 15.36.240 – Preliminary grading plans, and Section 15.36.320 – Geotechnical/geologic investigation required.
https://library.municode.com/ca/alameda_county/codes/code_of_ordinances?nodeId=TIT15BUCO_CH15.36GRERSECO_ARTVPERE

Alpine County:

Safety Element; see Section B – Seismic, page 44.
http://www.alpinecountyca.gov/DocumentCenter/View/51

Butte County:

Health and Safety Element; see Section III – Seismic and Geologic Hazards, page 299.
http://www.buttegeneralplan.net/products/2012-11-06_GPA_ZO_Adopted/General_Plan_Seperate_Chapters/11_Health_Safety_PRR.pdf

Butte County Code; see Section 20-255 – Filing and processing.
https://library.municode.com/ca/butte_county/codes/code_of_ordinances?nodeId=CH20SU_ARTXESREVETEMARESU_20-255FIPR

Contra Costa County:

Safety Element; see page 10-7.
http://www.co.contra-costa.ca.us/DocumentCenter/View/30920

Contra Costa County Code; see Section 92-4.035 - Geologic hazard or potentially hazardous soil conditions.
https://library.municode.com/ca/contra_costa_county/codes/ordinance_code?nodeId=TIT9SU_DIV92GEPR_CH92-4DE_92-4.035GEHAPOHASOCO

Humboldt County:

Safety Element, see page 14-2.
http://www.humboldtgov.org/DocumentCenter/Home/View/61990

Title III, Land Use and Development, Division 3, Building Regulations, Chapter 6 – Geologic Hazards.
http://www.humboldtgov.org/DocumentCenter/Home/View/210

Imperial County:

Seismic and Public Safety Element.
http://www.icpds.com/CMS/Media/Seismic-and-Public-Safety-Element.pdf

County of Imperial, California – Codified Ordinances; see Title 9 – Land Use Code sections 91502.00 - Standards for residential dwelling unit in special studies zones, 91502.01 – Application Requirements, 91502.02 – Approvals, 90803.02 - Tentative map to conform to rules of planning director, planning commission and the board of supervisors, 91701.01 - General standards.

https://library.municode.com/ca/imperial_county/codes/code_of_ordinances?nodeId=COUNTY_IMPERIAL_CALIFORNIACOOR

Inyo County:

Inyo County Plans, Laws, and Ordinances, see Alquist-Priolo Earthquake Fault Zoning Act.
http://inyoplanning.org/plans_laws.htm

Los Angeles County:

Safety Element.
http://planning.lacounty.gov/assets/upl/project/gp_web90-safety-element.pdf

Los Angeles County, California – Code of Ordinances; see Title 26 – Building Code sections 111 – Engineering Geology and Soils Engineering Reports, 112 – Earthquake Fault Maps, 113 – Earthquake Faults.
https://library.municode.com/CA/los_angeles_county/codes/code_of_ordinances?nodeId=TIT26BUCO_CH1AD_S111ENGESOENRE

County of Los Angeles Department of Public Works, Manual for Preparation of Geotechnical Reports.
http://dpw.lacounty.gov/gmed/permits/docs/manual.pdf

Marin County:

Marin Countywide Plan; see Chapter 2 – The Natural Systems and Agriculture Element, section 2.6 – Environmental Hazards (EH).
https://www.marincounty.org/~/media/files/departments/cd/planning/currentplanning/publications/county-wide-plan/cwp_2015_update.pdf

Mendocino County:

Health and Safety; see 8-13 – Mendocino County 2008-2010 Phase I Strategic Plan.
https://www.mendocinocounty.org/home/showdocument?id=11881

Merced County:

Health and Safety Element.
http://web2.co.merced.ca.us/pdfs/planning/generalplan/DraftGP/MCGPU_2030/MCGPU_2030GP_Part_II-10_HEALTH_SAFETY_PRD_2012-11-30.pdf

Mono County:

Safety Element, see II. Issues/Opportunities/Constraints – Seismic Hazards.
https://www.monocounty.ca.gov/sites/default/files/fileattachments/planning_division/page/9617/safety_element_final_12.08.15.pdf

Monterey County:

Safety Element.
http://www.co.monterey.ca.us/home/showdocument?id=45806

2007 General Plan DEIR, Geology, Soils, and Seismicity; see 4.4.3.2 State Regulations.
http://www.co.monterey.ca.us/home/showdocument?id=43992

Napa County:

Napa County General Plan; see Safety Element.
http://www.countyofnapa.org/GeneralPlan/

Napa County, California – Code of Ordinances, see Title 15 – Buildings and Construction section 15.08.050 Building Permit-Geologic Hazard report.
https://library.municode.com/ca/napa_county/codes/code_of_ordinances?nodeId=TIT15BUCO_CH15.08BUEXPE

Riverside County:

Safety Element, see S-7 Hazard Specific Issues and Policies.
http://planning.rctlma.org/Portals/0/genplan/general_Plan_2017/elements/OCT17/Ch06_Safety_DEC2016.pdf?ver=2017-10-06-093651-757

Ordinance of the County of Riverside; AP Earthquake Fault Zoning Act.
http://www.rivcocob.org/ords/500/547.7.pdf

San Diego County:

Safety Element, see 7-11 – Geological Hazards.
http://www.sandiegocounty.gov/pds/gpupdate/docs/BOS_Aug2011/C.1-6_Safety.pdf

Geologic Hazards Guidelines for Determining Significance; see 2.0 Existing Regulations and Standards and 4.0 Guidelines for Determining Significance.
http://www.sandiegocounty.gov/dplu/docs/Geologic_Hazards_Guidelines.pdf

San Benito County:

Seismic Safety/Safety Elements.
http://cosb.us/wp-content/uploads/SBC-ExistingGP-Seismic.pdf

2035 General Plan Update 2015 Revised DEIR, Geology, Soils, and Mineral Resources; see 10.1.2 Regulatory Setting.
http://cosb.us/wp-content/uploads/10-Geology-Soils-Mineral-Resources.pdf

Santa Clara County:

Santa Clara County General Plan; see Part 2: Countywide Issues and Policies, I-7 – Safety and Noise Chapter.
https://www.sccgov.org/sites/dpd/DocsForms/Documents/GP_Book_A.pdf

Santa Clara County, California – Code of Ordinances; see Title C – Construction, Development, and Land Use, Division C12 – Subdivisions and Land Development, Chapter IV. Geologic Provisions Article 2 – County Geologic Hazard Zones.
https://library.municode.com/ca/santa_clara_county/codes/code_of_ordinances?nodeId=TITCCODELAUS_DIVC12SULADE_CHIVGEPR_ART2COGEHAZO

Santa Cruz County:

Santa Cruz County General Plan; Chapter 6: Public Safety and Noise, see Page 6-3 – Seismic Hazards.
http://www.sccoplanning.com/Portals/2/County/Planning/policy/1994GeneralPlan/chapter6.pdf?ver=2011-03-02-000000-000

Santa Cruz County Geologic Hazards; see 16.10.050 – Requirements for Geologic Assessment and 16.10.105 – Notice of Geologic Hazards in Cases of Dangerous Conditions.
http://www.codepublishing.com/CA/SantaCruzCounty/html/SantaCruzCounty16/SantaCruzCounty1610.html

Shasta County:

General Plan, Public Safety Group, Seismic and Geologic Hazards.
https://www.co.shasta.ca.us/docs/libraries/resource-management-docs/docs/51seismic.pdf?sfvrsn=0

San Luis Obispo County:

San Luis Obispo County General Plan, Safety Element; see Chapter 5 page 17 – Geologic and Seismic Hazards.
http://www.slocounty.ca.gov/getattachment/893b6c58-7550-4113-911c-3ef46d22b7c8/Safety-Element.aspx

San Luis Obispo County Code, Title 22 – Land Use Ordinance, Article 3 – Site Planning and Project Design Standards, Chapter 22.14 – Combining Designation Standards, 22.14.070 – Geologic Study Areas.
https://library.municode.com/ca/san_luis_obispo_county/codes/county_code?nodeId=TIT22LAUSOR_ART3SIPLPRDEST_CH22.14CODEST_22.14.070GESTARGS

San Luis Obispo County Code, Title 23 – Coastal Land Use, Chapter 23.07 – Combining Designation Standards, 23.07.080 – Geologic Study Areas.

https://library.municode.com/ca/san_luis_obispo_county/codes/county_code?nodeId=TIT23COZOLAUS_CH23.07CODEST_23.07.080GESTARGS

San Luis Obispo County Code, Title 23 – Coastal Land Use, Chapter 23.07 – Combining Designation Standards, 23.07.084 – Application Content – Geologic and Soils Report.
https://library.municode.com/ca/san_luis_obispo_county/codes/county_code?nodeId=TIT23COZOLAUS_CH23.07CODEST_23.07.084APCOEOSORERE

San Luis Obispo County Code, Title 23 – Coastal Land Use, Chapter 23.07 – Combining Designation Standards, 23.07.086 – Geologic Study Area Special Standards.
https://library.municode.com/ca/san_luis_obispo_county/codes/county_code?nodeId=TIT23COZOLAUS_CH23.07CODEST_23.07.086GESTARSPST

County Guidelines for Engineering Geology Reports.
http://www.slocounty.ca.gov/getattachment/f58bc2f2-cb40-45b8-8fb8-f19fc804ffec/Guidelines-for-Engineering-Geology-Reports.aspx

Ventura County:

Ventura County General Plan Goals, Policies and Programs; see Chapter 2 on Hazards, Page 29.
http://venturawatershed.org/wp-content/uploads/2015/04/VCPD_Gen_Plan_2013.pdf

California Cities

City of Walnut Creek:

General Plan, Chapter 6 Safety and Noise.
http://www.walnut-creek.org/home/showdocument?id=5010

Municipal Code, Title 9 Building Regulations, Chapter 9 Site Development; 9-9.06 Soils and Engineering Geology Report, c.6.
http://www.codepublishing.com/CA/WalnutCreek/#!/WalnutCreek09/WalnutCreek0909.html

Municipal Code, Title 10 Planning and Zoning, Chapter 1 Subdivisions; 10-1.702 Requirements and Procedures, 2.c.
http://www.codepublishing.com/CA/WalnutCreek/#!/WalnutCreek10/WalnutCreek1001.html

Municipal Code, Title 10 Planning and Zoning, Chapter 2 Zoning; 10-2.3.402 Definitions, D. High Risk Area; 10-2.3.407 Property Development Standards, G. Creek, Landslide, and Fault-Line Setbacks.
http://www.codepublishing.com/CA/WalnutCreek/#!/WalnutCreek10/WalnutCreek1002C.html

City of Los Angeles:

General Plan, Safety Element.
https://planning.lacity.org/cwd/gnlpln/saftyelt.pdf

City of Los Angeles Preliminary Fault Rupture Study Areas.
http://geohub.lacity.org/datasets/9a1a1c350c9043a2b2fce10c0530f769_2?geometry=-118.819%2C33.731%2C-117.717%2C33.902

Information Bulletin / Public – Building Code, Surface Fault Rupture Hazard Investigations.
https://www.ladbs.org/docs/default-source/publications/information-bulletins/building-code/ib-p-bc2014-129surfacefaultrupturehazardinvestigations.pdf?sfvrsn=13

Information Bulletin / Public – Building Code, Exemptions from Liquefaction, Earthquake Induced Landslide, and Fault-Rupture Hazard Zone Investigations.
http://www.ladbs.org/docs/default-source/publications/information-bulletins/building-code/exemptions-from-liquefaction-earthquake-induced-landslide-and-faullt-rupture-hazard-zone-investigations-ib-p-bc2014-044.pdf?sfvrsn=19

City of Los Angeles Municipal Code, Chapter IX Building Regulations, Article 1 Buildings (Building Code); 91.106.4. Permits Issuance, Exceptions, 4.
http://library.amlegal.com/nxt/gateway.dll?f=templates&fn=default.htm&vid=amlegal:la_all_mc

City of Los Angeles Municipal Code, Chapter I General Provisions and Zoning, Article 3 Specific Plan – Zoning Supplemental Use Districts; Section 13.04. "RPD" Residential Planned Development Districts, C. Requirements for Filing, 3. Preliminary Geological and Soils Engineering Reports.
http://library.amlegal.com/nxt/gateway.dll?f=templates&fn=default.htm&vid=amlegal:la_all_mc

City of Santa Monica:

Guidelines for Geotechnical Reports; 3.3.1 Fault Rupture Hazards, page 21.
https://www.smgov.net/uploadedFiles/Departments/PCD/Permits/Guidelines-for-Geotechnical-Reports.pdf

City of San Diego:

General Plan, Public Facilities, services and Safety Element; Q. Seismic Safety, PF -66.
https://www.sandiego.gov/sites/default/files/pf_2015.pdf

San Diego Municipal Code, Chapter 14: General Regulations, Article 5: Building Regulations, §145.1803 Local Additions and Modifications to Section 1803 "Geotechnical

Investigations" of the California Building Code.
http://docs.sandiego.gov/municode/MuniCodeChapter14/Ch14Art05Division18.pdf

City of San Diego Guidelines for Geotechnical Reports.
https://www.sandiego.gov/sites/default/files/legacy/development-services/pdf/industry/geoguidelines.pdf

City of Rancho Cucamonga:

General Plan Chapter 8: Public Health and Safety; Seismic Hazards, page PS-12. Goal PS-6: Minimize the potential damage to structures and loss of life that may result from earthquakes and other seismic hazards, page PS-53.
https://www.cityofrc.us/civicax/filebank/blobdload.aspx?BlobID=6819

Rancho Cucamonga Municipal Code, **Title 16 Subdivisions**, Chapter 16.16 Tentative Maps – Five or more Parcels, 16.16.030 Accompanying data and Reports, C. Engineering Geology and/or Seismic Safety Report. Chapter 16.20, Tentative Parcel Maps – Four or Less Parcels, 16.20.030 Contents, T. Engineering Geology and/or Seismic Safety Report. **Title 17 Development Code**, Article VII. Design Standards and Guidelines, Chapter 17.122 Design Provisions by Development Type, 17.122.020 Hillside Development, K. Public Safety, 1.i.
http://qcode.us/codes/ranchocucamonga/

Town of Woodside:

General Plan, Natural Hazards and Safety Element.
https://www.woodsidetown.org/sites/default/files/fileattachments/5_natural_hazards_and_safety_element_4.pdf

General Plan 2012 Maps.
https://www.woodsidetown.org/planning/general-plan-2012-maps-0

Municipal Code, § 153.153 Seismic Safety.
https://www.woodsidetown.org/municipalcode/%C2%A7-153153-seismic-safety

Municipal Code, § 153.301 Limitations Applicable to Alterations, Additions, Replacement, or Paved Area and Surface Coverage.
https://www.woodsidetown.org/municipalcode/%C2%A7-153301-limitations-applicable-alterations-additions-replacement-or-paved-area-and-su

Municipal Code, § 151.20 Permits Required.
https://www.woodsidetown.org/municipalcode/%C2%A7-15120-permits-required

Geotechnical / Soils Report Requirements Matrix.
https://www.woodsidetown.org/building/geotechnicalsoils-report-requirements-matrix

Plate 1

IS MY PROJECT REGULATED BY THE ALQUIST – PRIOLO EARTHQUAKE FAULT ZONING ACT?

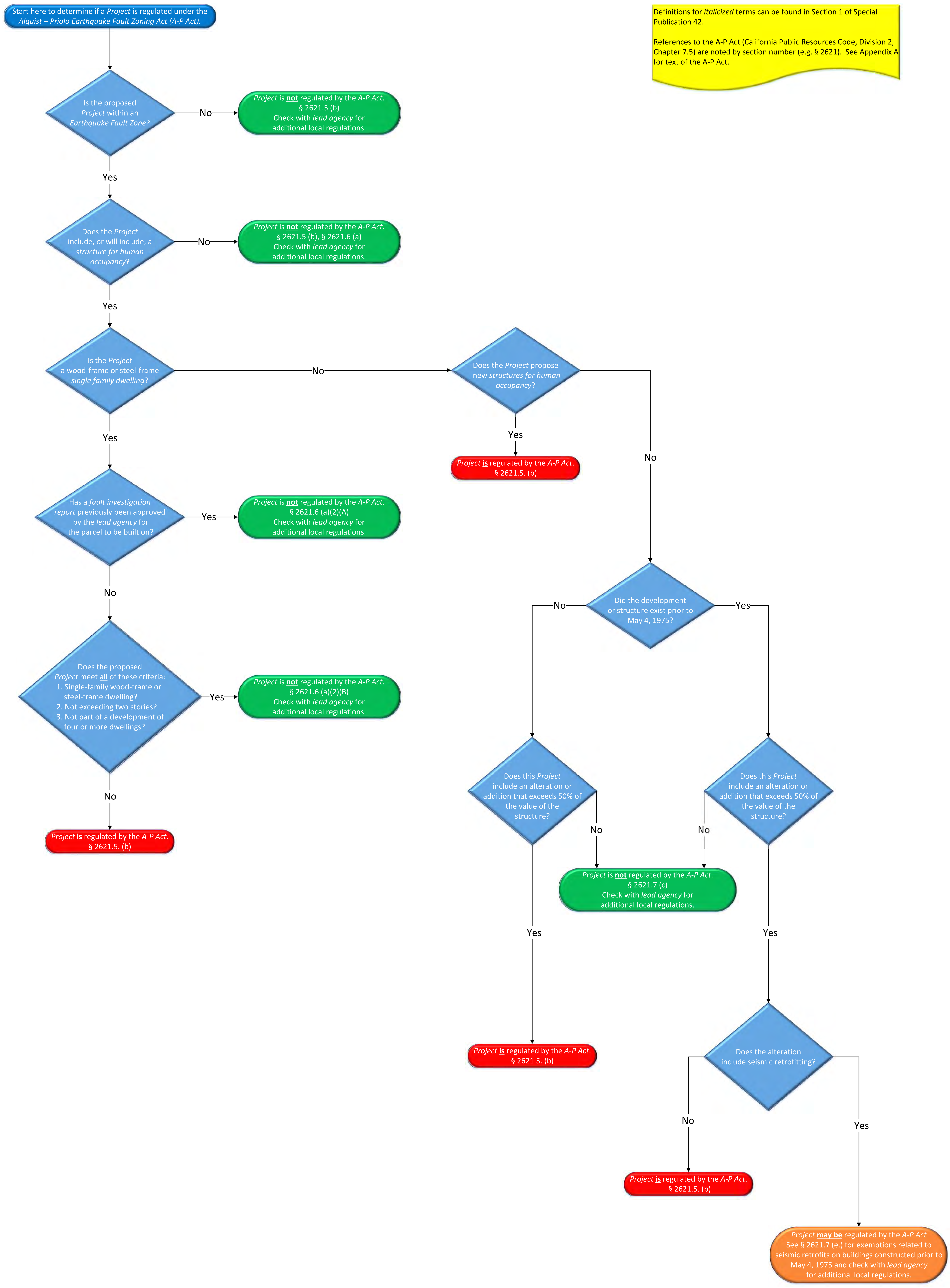
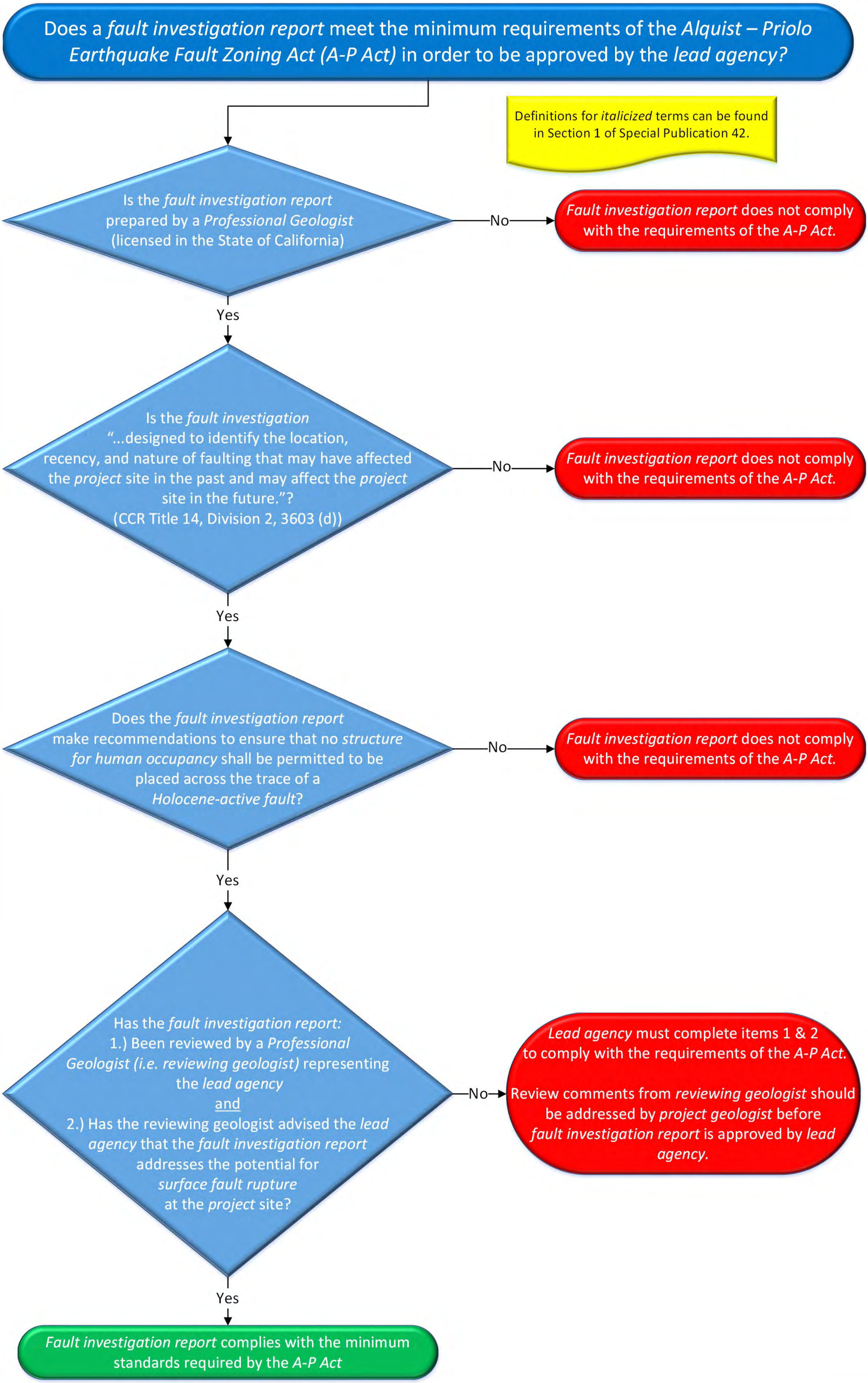


Plate 2


Does a *fault investigation report* meet the minimum requirements of the *Alquist – Priolo Earthquake Fault Zoning Act (A-P Act)* in order to be approved by the *lead agency?*
Definitions for *italicized* terms can be found in Section 1 of Special Publication 42.
Is the *fault investigation report* prepared by a *Professional Geologist* (licensed in the State of California)
No
Fault investigation report does not comply with the requirements of the *A-P Act.*
Yes
Is the *fault investigation* "...designed to identify the location, recency, and nature of faulting that may have affected the *project* site in the past and may affect the *project* site in the future."? (CCR Title 14, Division 2, 3603 (d))
No
Fault investigation report does not comply with the requirements of the *A-P Act.*
Yes
Does the *fault investigation report* make recommendations to ensure that no *structure for human occupancy* shall be permitted to be placed across the trace of a *Holocene-active fault*?
No
Fault investigation report does not comply with the requirements of the *A-P Act.*
Yes
Has the *fault investigation report:* 1.) Been reviewed by a *Professional Geologist (i.e. reviewing geologist)* representing the *lead agency* and 2.) Has the reviewing geologist advised the *lead agency* that the *fault investigation report* addresses the potential for *surface fault rupture* at the *project* site?
No
Lead agency must complete items 1 & 2 to comply with the requirements of the *A-P Act.*
Review comments from *reviewing geologist* should be addressed by *project geologist* before *fault investigation report* is approved by *lead agency.*
Yes
Fault investigation report complies with the minimum standards required by the *A-P Act*

Appendix A

210036

MOD # 27500

S-Paul Kertez

LA DBS

REQUEST FOR MODIFICATION OF BUILDING ORDINANCES

UNDER AUTHORITY OF L.A.M.C. SECTION 98.0403

Westwood

PERMIT APP. #: 16010-20000-02308

DATE: 9/28/2018

For City Dept. Use Only

Grading

JOB ADDRESS: 1751 Malcolm Av. & 1772 Glendon Av.

Tract: 7803

Block: 15

Lot: 20,19, 11

Owner: Harkham Family Enterprises

Address: 957 San Pedro St. #300

City: LA State: CA Zip: 90014 Phone:

Petitioner: Fix the City

Address: 10558 Kinnard Ave

City: LA State: CA Zip: 90024 Phone: 310-497-5550

REQUEST (SUBMIT PLANS OR ADDITIONAL SHEETS AS NECESSARY)

CODE SECTIONS:

Revocation of temporary or permanent Certificate of Occupancy

JUSTIFICATION (SUBMIT PLANS OR ADDITIONAL SHEETS AS NECESSARY)

Seismic Hazard, violation of Alquist Priolo Act and City regulations

See attached appeal with exhibits. Fee already paid August 2020

See consultant's report on failure to comply with seismic regulations.

Laura Lake, Ph.D — (signature) — Secy. Fix the City

Owner/Petitioner Name (Print) (Signature) Position

FOR CITY DEPARTMENT'S USE ONLY BELOW THIS LINE

Concurrences required from the following Department(s)

			Approved	Denied
☐ Los Angeles Fire Department	Print Name	Sign	☐	☐
☐ Public Works Bureau of Engineering	Print Name	Sign	☐	☐
☐ Department of City Planning	Print Name	Sign	☐	☐
☐ Other	Print Name	Sign	☐	☐

DEPARTMENT ACTION

Reviewed by: (Staff) (print) Sign Date

☐ GRANTED ☐ DENIED

Action taken by: (Supervisor) (print) Sign Date

CONDITIONS OF APPROVAL:

FEES

Appeal Processing Fee.... (No. of Items) =	1	\$ 130 + \$ 39 /addl	\$ 130.00
Inspection Fee .... (No of Insp.) =	X	\$ 84	\$ -
Research Fee ..... (Total Hours Worked) =	7 X	\$ 104	\$ 728.00
Subtotal			\$ 858.00
Surcharge (One Stop)	\$ 338.00 X	3%	\$ 25.74
Surcharge (Systems Development)	\$ 338.00 X	6%	\$ 51.48
Total Fees			\$ 935.22

Fees verified by:

Print and Sign: Daniel Schneidereit (signature)

For Cashiers Use Only

(PROCESS ONLY WHEN FEES ARE VERIFIED)

Los Angeles Department of Building and Safety
Metro 4th Floor 12/17/2020 10:38:49 AM
User ID: [illegible]
Receipt Ref Nbr: 2020352001-42
Transaction ID: 2020352001-42-1
BOARD APPLIC FEE $130.00
SYSTEMS DEV SURCH $51.48
DEV SERV CENTER SURCH $25.74
RESEARCH FEE $728.00
Amount Paid: $935.22
Request Date: 9/28/2018
PCIS Number: 16010-20000-02308
Comments: 1751 MALCOLM AVE. & 1772 GLENDON AVE.

Permit App #: | Job Address:

CONDITIONS OF APPROVAL (Continued from Page 1)

CITY OF LOS ANGELES
BOARD OF BUILDING AND SAFETY/DISABLED ACCESS COMMISSION APPEAL FORM

(Must be Attached to the Modification Request Form, Page 1)

AFFIDAVIT – LADBS BOARD OF BUILDING AND SAFETY COMMISSIONERS – RESOLUTION NO. 832-93

I, ______________________ do state and swear as follows:
(Print or Type Name of the Person Signing this Form)

1. The name and mailing address of the owner of the property (as defined in the resolution 832-93) at ______________ as shown on the appeal application (LADBS Com 31) are correct, and
2. The owner of the property as shown on the appeal application will be made aware of the appeal and will receive a copy of the appeal.

I declare under PENALTY OF PERJURY that the forgoing is true and correct.

Owner's Name(s) ______________________ (Please Type or Print) ______________________ (Please Type or Print)

Owner's Signature(s) ______________________ (Please Sign) (Two Officers' Signatures Required for Corporations)

Name of Corporation ______________________ (Please Print Name of Corporation) ______________________ (Please Type or Print)

Dated this ________ day of ______________________ 20______

CALIFORNIA ALL-PURPOSE ACKNOWLEDGEMENT——————SIGNATURE(S) MUST BE NOTARIZED

State of CALIFORNIA County of ______________ on ______________

before me, ______________________ (Name, Title of Officer (e.g. Jane Doe, Notary Public)), personally appeared ______________________ (Name(s) of Signer(s))

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument in person(s), or the entity upon behalf of which the person(s) acted, executed the instrument. **I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing is true and correct.**

WITNESS my hand and official seal. Signature

As a covered entity under Title II of the Americans with Disabilities Act, the City of Los Angeles does not discriminate on the basis of disability and, upon request, will provide reasonable accommodation to ensure equal access to its programs, services and activities.

APPEAL OF DEPARTMENT ACTION TO THE BOARD OF BUILDING AND SAFETY COMMISSIONERS/DISABLED ACCESS APPEALS COMMISSION

Applicant's Name ______________________ Applicant's Title ______________________

Signature ______________________ Date ______________________

FEES **(DEPARTMENT USE ONLY)**

Board Fee .... (No. of Items)	X	$354.00	=
Inspection Fee .... (No of Insp.) =	X	$84.00	=
Research Fee ... (Total Hours Worked) =	X	$104.00	=
Subtotal			=
Development Services Center Surcharge	X	3%	=
Systems Development Surcharge	X	6%	=
Total Fees			=

Fees verified by:

Print and Sign ______________________

For Cashiers Use Only

(PROCESS ONLY WHEN FEES ARE VERIFIED)

Permit App #: 16010-20000-02308 | Job Address: 1751 Malcolm Ave + 1772 Glendon Ave.

CONDITIONS OF APPROVAL (Continued from Page 1)

CITY OF LOS ANGELES
BOARD OF BUILDING AND SAFETY/DISABLED ACCESS COMMISSION APPEAL FORM

(Must be Attached to the Modification Request Form, Page 1)

AFFIDAVIT – LADBS BOARD OF BUILDING AND SAFETY COMMISSIONERS – RESOLUTION NO. 832-93

I, Laura Lake do state and swear as follows:
(Print or Type Name of the Person Signing this Form)

1. The name and mailing address of the owner of the property (as defined in the resolution 832-93) at 1751 Malcolm Av. & 1772 Glendon Av. as shown on the appeal application (LADBS Com 31) are correct, and
2. The owner of the property as shown on the appeal application will be made aware of the appeal and will receive a copy of the appeal.

I declare under PENALTY OF PERJURY that the forgoing is true and correct.

Owner's Name(s) Harkham Family Enterprises (Please Type or Print) ______ (Please Type or Print)

Owner's Signature(s) [signature] (Please Sign) (Two Officers' Signatures Required for Corporations)

Name of Corporation Fix The City (Please Print Name of Corporation) Laura Lake and Michael Eveloff (Please Type or Print)

Dated this 16 day of April 2021

CALIFORNIA ALL-PURPOSE ACKNOWLEDGEMENT------------------------SIGNATURE(S) MUST BE NOTARIZED

State of CALIFORNIA County of Los Angeles on 4/16/2021

before me, Melvin Khor Ruiz (Name, Title of Officer (e.g. Jane Doe, Notary Public)) personally appeared Laura Lake & Michael Eveloff (Name(s) of Signer(s))

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument in person(s), or the entity upon behalf of which the person(s) acted, executed the instrument. **I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing is true and correct.**

The appropriate California notary form is attached.

WITNESS my hand and official seal. Signature [signature]

As a covered entity under Title II of the Americans with Disabilities Act, the City of Los Angeles does not discriminate on the basis of disability and, upon request, will provide reasonable accommodation to ensure equal access to its programs, services and activities.

APPEAL OF DEPARTMENT ACTION TO THE BOARD OF BUILDING AND SAFETY COMMISSIONERS/DISABLED ACCESS APPEALS COMMISSION

Fix The City (Laura Lake, Ph.D.) — Applicant's Name
Board Secretary — Applicant's Title
[signature] — Signature
4/15/21 — Date

FEES (DEPARTMENT USE ONLY)

Board Fee .... (No. of Items)	1	X	$354 +$215/addl	=	354.00
Inspection Fee .... (No of Insp.) =		X	84.00	=	0.00
Research Fee ... (Total Hours Worked) =	2	X	104.00	=	208.00
Subtotal				=	562.00
Development Services Center Surcharge		X	.03	=	16.86
Systems Development Surcharge		X	.06	=	33.72
Total Fees				=	612.58

Fees verified by:

Print and Sign Mui Lay [signature] 4/27/21

For Cashiers Use Only
(PROCESS ONLY WHEN FEES ARE VERIFIED)

Los Angeles Department of Building and Safety
Met... 2021 9:04:14 AM
User ID: dbarrozo
Receipt Ref Nbr: 2021118001-55
Transaction ID: 2021118001-55-1
BOARD APPLIC FEE $354.00
SYSTEMS DEV SURCH $33.72
DEV SERV CENTER SURCH $16.86
RESEARCH FEE $208.00
Amount Paid: $612.58
Request Date: 04/16/2021
PCIS Number: 16010-20000-02308
Comments: Board Appeal for 1751 Malcolm Ave & 1772 Glendon Ave

Permit App #: 16016 - 20000 - 02308 | Job Address: 1751 Malcolm Ave + 1772 Glendon Ave

CONDITIONS OF APPROVAL (Continued from Page 1)

CITY OF LOS ANGELES
BOARD OF BUILDING AND SAFETY/DISABLED ACCESS COMMISSION APPEAL FORM

(Must be Attached to the Modification Request Form, Page 1)

AFFIDAVIT – LADBS BOARD OF BUILDING AND SAFETY COMMISSIONERS – RESOLUTION NO. 832-93

I, Laura Lake do state and swear as follows:
(Print or Type Name of the Person Signing this Form)

1. The name and mailing address of the owner of the property (as defined in the resolution 832-93) at 1751 Malcolm Av. & 1772 Glendon Av. as shown on the appeal application (LADBS Com 31) are correct, and
2. The owner of the property as shown on the appeal application will be made aware of the appeal and will receive a copy of the appeal.

I declare under PENALTY OF PERJURY that the forgoing is true and correct.

Owner's Name(s) Harkham Family Enterprises (Please Type or Print) ____ (Please Type or Print)

Owner's Signature(s) [signature] (Please Sign) (Two Officers' Signatures Required for Corporations)

Name of Corporation Fix The City (Please Print Name of Corporation) Laura Lake and Michael Eveloff (Please Type or Print)

Dated this 16 day of April 2021

CALIFORNIA ALL-PURPOSE ACKNOWLEDGEMENT------------------------SIGNATURE(S) MUST BE NOTARIZED

State of CALIFORNIA County of Los Angeles on 4/16/2021

before me, Mehran Khorramian (Name, Title of Officer (e.g. Jane Doe, Notary Public)) personally appeared Laura Lake Eveloff (Name(s) of Signer(s))

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument in person(s), or the entity upon behalf of which the person(s) acted, executed the instrument. **I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing is true and correct.**

The appropriate California notary form is attached.

WITNESS my hand and official seal. Signature [signature]

As a covered entity under Title II of the Americans with Disabilities Act, the City of Los Angeles does not discriminate on the basis of disability and, upon request, will provide reasonable accommodation to ensure equal access to its programs, services and activities.

APPEAL OF DEPARTMENT ACTION TO THE BOARD OF BUILDING AND SAFETY COMMISSIONERS/DISABLED ACCESS APPEALS COMMISSION

Fix The City (Laura Lake, Ph.D.) — Applicant's Name

Board Secretary — Applicant's Title

[signature] — Signature

4/15/21 — Date

FEES (DEPARTMENT USE ONLY)

Board Fee .... (No. of Items)	1	X	$354 +$215/addl	=	354.00
Inspection Fee .... (No of Insp.) =		X	84.00	=	0.00
Research Fee ... (Total Hours Worked) =	2	X	104.00	=	208.00
Subtotal..........				=	562.00
Development Services Center Surcharge		X	.03	=	16.86
Systems Development Surcharge		X	.06	=	33.72
Total Fees..........				=	612.58

Fees verified by:

Print and Sign Mui Lay [signature] 4/27/21

For Cashiers Use Only
(PROCESS ONLY WHEN FEES ARE VERIFIED)

Appeal to LADBS RFM 27500 (Denied)

MOD # 27500

LADBS

REQUEST FOR MODIFICATION OF BUILDING ORDINANCES

UNDER AUTHORITY OF L.A.M.C. SECTION 98.0403

PERMIT APP. #: 16010-20000-02308	DATE: 9/28/2018	For City Dept. Use Only
JOB ADDRESS: 1751 Malcolm Av. & 1772 Glendon Av.		Grading
Tract: 7803	Block: 15 Lot: 20,19, 11	
Owner: Harkham Family Enterprises	Petitioner: Fix the City	
Address: 957 San Pedro St. #300	Address: 10558 Kinnard Ave	
City LA State CA Zip 90014 Phone	City LA State CA Zip 90024 Phone 310-497-5550	

REQUEST (SUBMIT PLANS OR ADDITIONAL SHEETS AS NECESSARY) — CODE SECTIONS:

Revocation of temporary or permanent Certificate of Occupancy

JUSTIFICATION (SUBMIT PLANS OR ADDITIONAL SHEETS AS NECESSARY)

Seismic Hazard, violation of Alquist Priolo Act and City regulations

See attached appeal with exhibits. Fee already paid August 2020

See consultant's report on failure to comply with seismic regulations.

Laura Lake, Ph.D — [signature] — Secy. Fix the City

Owner/Petitioner Name (Print) — (Signature) — Petition

EMAIL: LAURA.LAKE@GMAIL.COM

FOR CITY DEPARTMENT'S USE ONLY BELOW THIS LINE

Concurrences required from the following Department(s)

Department	Print Name	Sign	Approved	Denied
☐ Los Angeles Fire Department			☐	☐
☐ Public Works Bureau of Engineering			☐	☐
☐ Department of City Planning			☐	☐
☐ Other:			☐	☐

DEPARTMENT ACTION

~~☒ GRANTED~~ ☒ DENIED

Daniel Schneidereit [signature] 12/28/2020

Reviewed by: (Staff) (print) — Sign — Date

T. Adolfo Acosta [signature] 12/29/2020

Action taken by: (Supervisor) (print) — Sign — Date

~~CONDITIONS OF APPROVAL~~

REQUEST NOT JUSTIFIED.

FEES

Appeal Processing Fee ... (No. of items) = 1	$ 130 + $ 39 /add		$ 130.00
Inspection Fee ... (No of Insp.) =	x	$ 84	$
Research Fee ... (Total Hours Worked) = 7	x	$ 104	$ 728.00
Subtotal			$ 858.00
Surcharge (One Stop)	$ 858.00 x	3%	$ 25.74
Surcharge (Systems Development)	$ 858.00 x	6%	$ 51.48
Total Fees			$ 935.22

Fees verified by:

Print and Sign: Daniel Schneidereit [signature]

For Cashiers Use Only

(PROCESS ONLY WHEN FEES ARE VERIFIED)

Los Angeles Department of Building and Safety
Metro 4th Floor 12/17/2020 10:38:47 AM
User ID: jbitanacol
Receipt Ref Nbr: 2020352001-42
Transaction ID: 2020352001-42-1
BOARD APPLIC FEE $130.00
SYSTEMS DEV SURCH $51.48
DEV SERV CENTER SURCH $25.74
RESEARCH FEE $728.00
Amount Paid: $935.22
Request Date: 9/28/2018
PCIS Number: 16010-20000-02308
Comments: 1751 HALCOLM AVE. & 1772 GLENDON AVE.

FIX THE CITY

Laura Lake, Ph.D., Board Secretary, Fix the City

10558 Kinnard Avenue, LA, CA 90024

Laura@FixTheCity.org and Laura.Lake@gmail.com

Cell 310-497-5550

CERTIFIED MAIL/RETURN RECEIPT and Email: Eric.Jakeman@lacity.org

August 3, 2020

RE: REVOCATTION OF **BUILDING PERMIT APPLICATION #16010-20000-02308** AND CERTIFICATE OF OCCUPANCY/TEMPORARY CERTIFICATE OF OCCUPANCY FOR **1751 MALCOLM AVENUE/1772 GLENDON AVENUE**, DUE TO LOCATION IN A NO-BUILD FAULT AREA PER CGS FER 259, LOCALITY 10 (JANUARY 5, 2018).

APPEAL TO BOARD OF BUILDING AND SAFETY COMMISSIONERS

Eric Jakeman, LADBS Seismic Safety Manager

Board of Building and Safety Commissioners

201 N. Figueroa Street, Suite 1030

Los Angeles, CA 90012

Dear Mr. Jakeman and Board of Building and Safety Commissioners:

This is an urgent safety matter. This appeal package and Appeal Form supplements Fix the City's Appeal to the Board of Building and Safety Commissioners (Form PC-Build.Mod 00 (Rev.09-11-2019). We incorporate by reference all LADBS documents for this permit including meeting notes, emails and any other printed material regarding how CGS FER 259 Locality 10 was ignored. We request a written report and consideration by the Board of Building and Safety Commissioners.

In July 2017, the applicant indemnified the City (DIR-2017-342-DRB-SPP, ENV-2017-343-CE).

Fix the City is a nonprofit advocacy organization for public safety and services in Los Angeles. We respectfully call upon the Building and Safety Commission to revoke all approvals for **Building Permit #16010-20000-02308 and deny a Certificate of Occupancy and or revoke any Temporary Certificate of Occupancy for 1751 Malcolm Avenue/1772 Glendon Avenue,** as authorized by LAMC 98.0302.(1(b)(2). Attached is **Exhibit A**, a copy of the building permit application, dated September 28, 2918.

This 18-unit *luxury* rental project is located within the Santa Monica Fault and mapped in accordance with the Alquist Priolo Act. To our knowledge, there are no affordable

units in this project. The project is also located in a Liquefaction Zone and a Methane Zone. Two 2015 geological consultants' seismic investigations were submitted to LADBS for seismic approval. We do not have access to those studies which should be on file in LADBS as well as CGS, which included them as "Locality 10, 1751 Malcolm Avenue" in FER 259, pp. 26-27 and cited below. **Exhibit B** contains FER 259 pages 26-27.

LADBS twice **denied** approval after each study was reviewed. Exhibit B includes the two denials as shown in **Exhibit C,** obtained through LADBS Public Records Act Request19-16472, May 23, 2019.

On January 27, 2016, Daniel Schneidereit of LADBS submitted these expert reports to the California Geological Survey (CGS) as shown in **Exhibit D.** After review, CGS published the results of the study in FER 259 (Fault Evaluation Report 259). This study is the statutory authority to determine seismic hazards.

The Alquist Priolo Act established primacy over cities regarding seismic safety. The City of Los Angeles is required to follow this state law under California Public Resources Code Section 2623(c)(1) (see **Exhibit E**): the city may "establish policies and criteria which are stricter than those established by this chapter." There is no statutory authority to waive state standards and criteria.

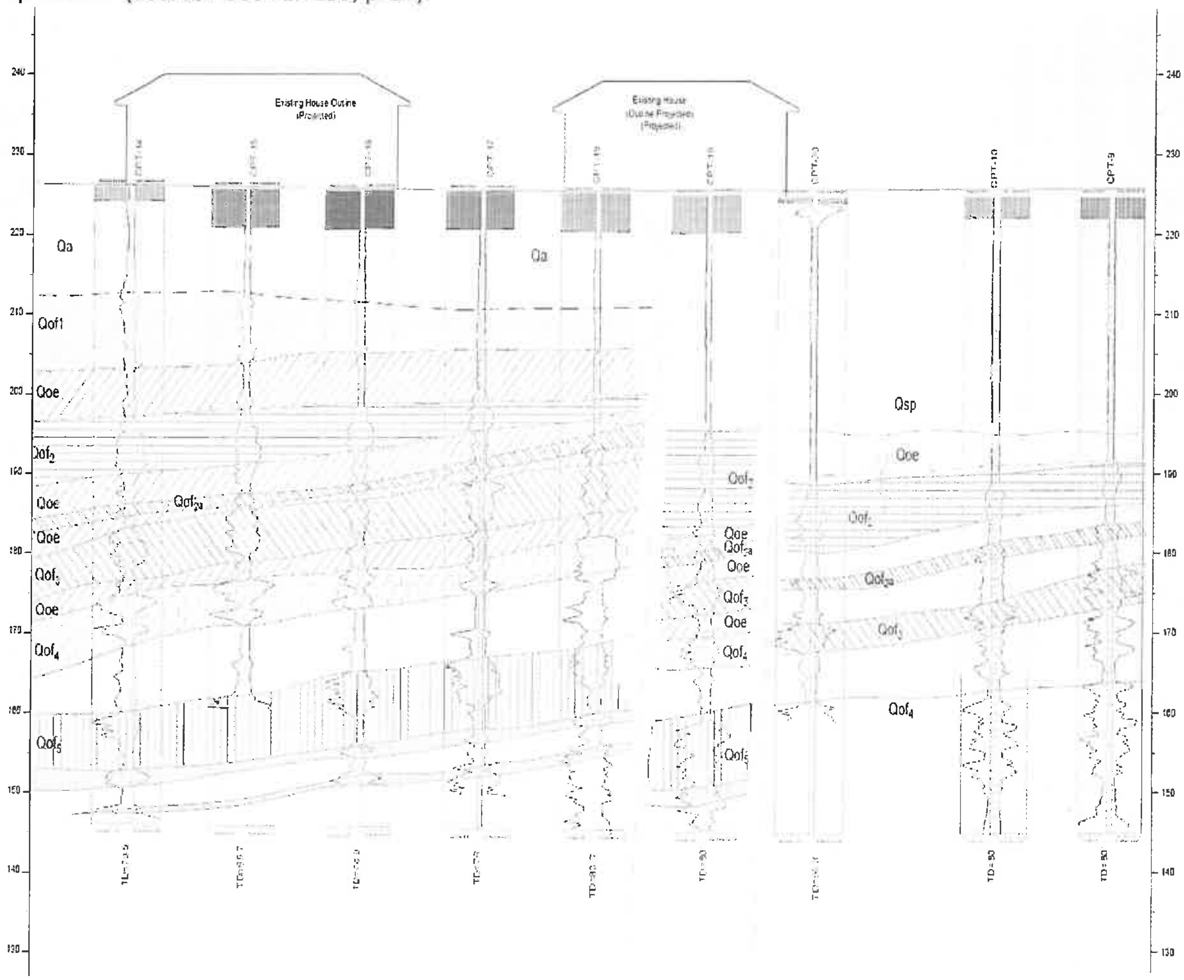
The applicant's response to the second denial on December 29, 2015) was an email on January 4, 2016, from Shant Minas, to Daniel Schneidereit and Casey Jensen, objecting to switching review from Daniel Schneidereit to Casey Jensen, and requesting a meeting with the developer and Schneidereit (**Exhibit D**, p. 2/75).[1] There are no new studies referenced in the emails, only a request for a meeting with the developer and Schneidereit. It is not known if this meeting occurred. However, just a few weeks later, on February 1, 2016, LADBS approved the seismic study (**Exhibit F**). Was the basis for this reversal without new substantial evidence to our knowledge, the requested meeting between Schneidereit and the developer?

When a new application was submitted in September 2018 (Exhibit A), CGS FER 259 Locality 10 was the official geological authority. It was published nine months prior to the 2018 building permit application. Instead of consulting this report, LADBS ignored it and relied on the February 1, 2016 approval. Again, the basis for approval in 2016 and the failure to consult CGS FER 259 Locality 10 in 2018 remain unexplained. Finally, the

[1] "a meeting with Dan [Schneidereit], with client present, to discuss and finalize our response. There have been multiple changes to the building plans already made due to the presence of the fault in the NE portion of the property as previously reported by us, and I would like to minimize any additional future changes by having another meeting." ***Note the fault is in the CENTER of the site, not the northeast.***

mischaracterization of the fault lying in the northeastern area of the site is contradicted by Figure 16 in CGS FER 259, p. 27. The December 29, 2015 denial summary from LADBS (Exhibit C) incorrectly claims the fault was in the **northeastern** portion of the site, when the fault rupture study on page 27 of FER 259 shows it running through the center of the site between *CPT 18 and CPT 19 as shown below.*

CGS FER 259, Figure 16 - Portion of geologic cross section A-A' constructed along Malcolm Avenue by AES (2015b, Drawing 2) looking west. Note the thick sequence of Holocene "sag pond" deposits (Qsp) faulted against broadly folded Pleistocene older fan (Qof) and older estuarine (Qoe) deposits in apparent north-side-down vertical separation. (Source: CGS FER 259, p. 27).



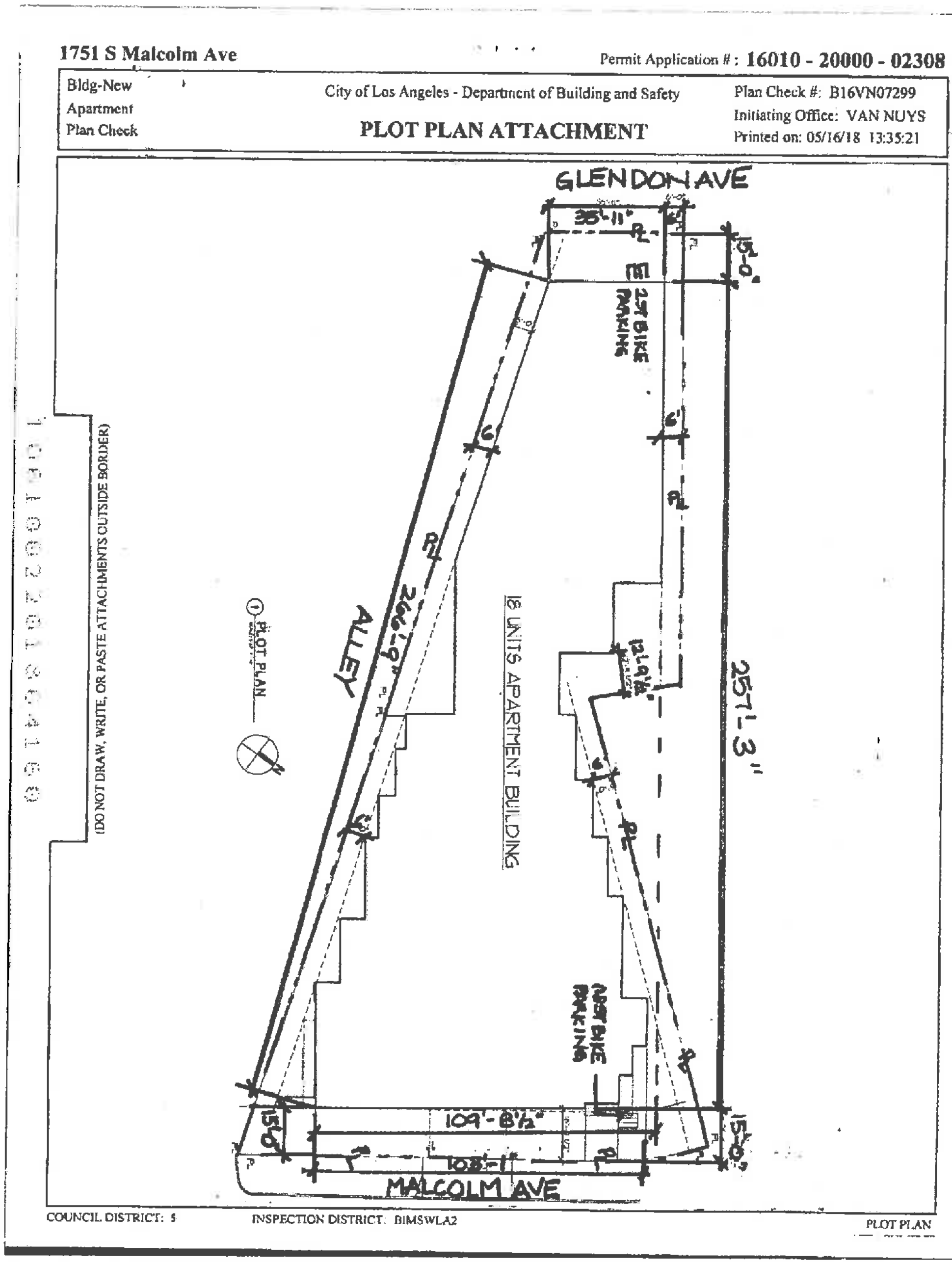
In the absence of new substantial evidence in 2018, LADBS violated the clear language of CGS FER 259, the ultimate authority on fault rupture studies within the Santa Monica Fault. Approval was arbitrary and capricious, not supported by substantial evidence, and directly in conflict with CGS FER 259 and constituted a gross, prejudicial abuse of authority.

1751 Malcolm Avenue is built over the active fault viewed from Malcolm Ave. (Source: Fix the City).

Our concern is not speculative: the two 2015 consultant reports found physical evidence of an active strand of the Santa Monica Fault, as published in CGS FER 259 (pp. 26-27):

> **"Locality 10 - 1749-1751 Malcolm Avenue**
>
> "A combined fault study and geotechnical investigation was performed for a proposed residential development at 1749-1751 Malcolm and 1772 Glendon Avenues by Applied Earth Sciences (2015a, b). The fault investigation consisted of a single transect along Malcolm Avenue constructed from 20 CPTs and three continuous core borings drilled to a maximum depth of about 80 feet. Spacing of CPTs/borings varied from 5 feet (between CPT/boring pairs) to over 25 feet in the public right-of-way, where numerous utilities were located. In their borings, the consultants identified both Holocene alluvium and "sag pond" deposits, along with Pleistocene alluvial and estuarine sediments.
>
> No well-developed paleosols were identified in the core samples, thus the consultants used various gravel and silt layers to correlate between CPTs/borings and look for stratigraphic anomalies that would suggest faulting. Their analysis indicated a thick sequence of Holocene silt and clay (interpreted as "sag pond deposits) was juxtaposed against the older Pleistocene sedimentary package between CPT-18 and CPT-19 (Figure 16). Additionally, they note groundwater was encountered in one boring north of CPT-18 and not in either of the borings down gradient to the south. Based on these findings, they interpret an active strand of the Santa Monica Fault trends through the **immediate vicinity of CPT-18 and CPT-19. Consequently, the consultants established a "no build zone"** (emphasis added).

CPT-18 and CPT-19 are NOT in the northeastern portion of the site. They are on the right side of the garage entrance shown in the photo above. The plot plan attached to the building permit, shown on the next page, shows that the entire site was built over with a few zig-zags on the northern boundary and not around CPT 18 and CPT 19.



LADBS grossly abused its authority and put the lives of the 18 families at risk, in violation of the very laws and regulations enacted to protect human life. Approval approve the site, both state law and city laws were violated, as well as the adopted policies and procedures in LADBS publications mandating CGS reports as stated on the first page of both publications (P/BC 2020-113, P/BC 2020-129) included in **Exhibit G.**

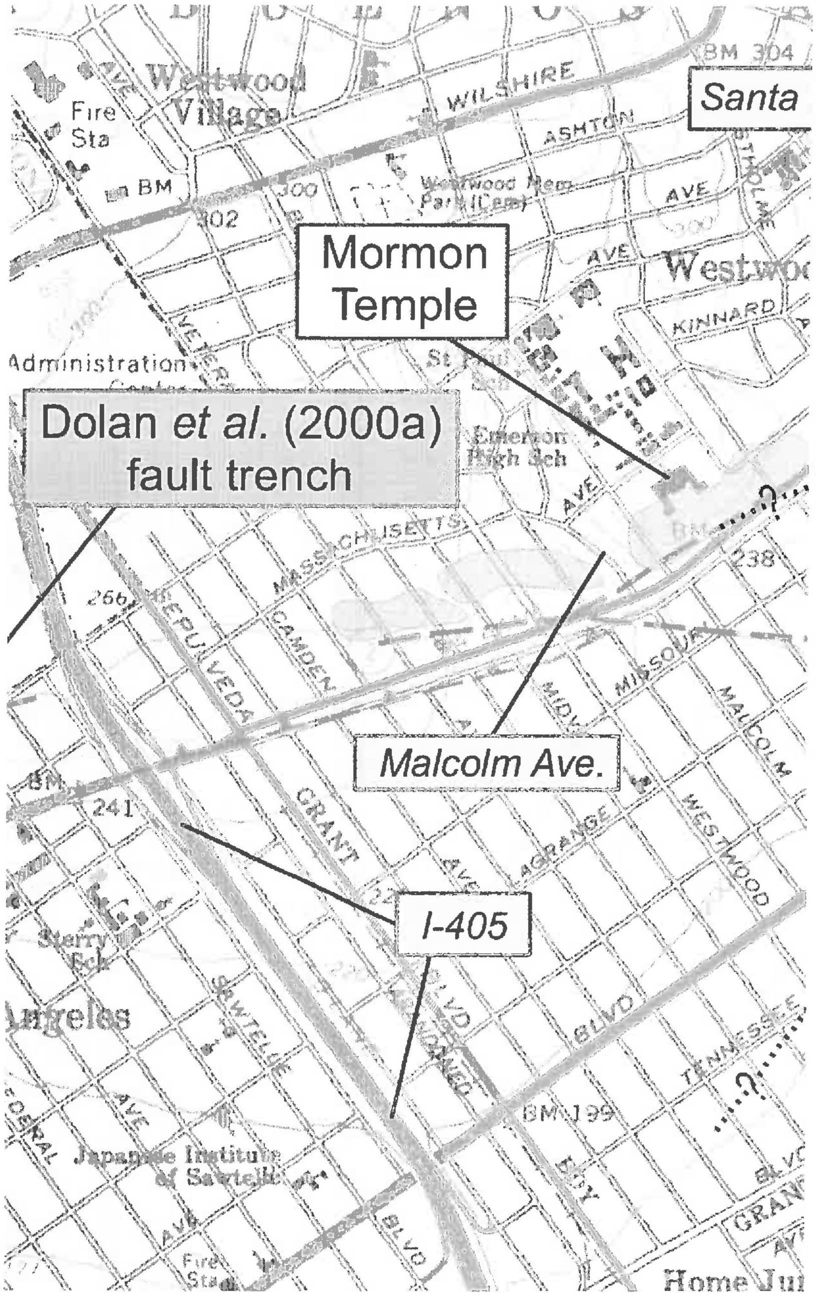


Plate 1, CGS FER 259 (subsection showing Malcolm Avenue site).

In addition to violating CPR Section 2623(c)(1), LADBS violated LAMC 91.106.4.1. Exception 4:

> "4. The department shall have the authority to withhold permits on projects located within a Special (Fault) Studies Zone established under Chapter 7.5, Division 2, of the California Public Resources Code. Permits may be issued if it

can be demonstrated through accepted geologic seismic studies that the proposed structure will be located in a safe manner and **not over or astraddle the trace of an active fault.** Acceptable geologic seismic studies shall meet the criteria as set forth in rules and regulations established by the Superintendent of Building to assure that such studies are based on sufficient geologic data to determine the location or nonexistence of the active fault trace on a site. Prior to approval of a project, a geologic report defining and delineating any hazard of surface fault rupture shall be required. If the city finds that no undue hazard of this kind exists, the geologic report on such hazard may be waived, with approval of the state geologist."

This project has been built over/astraddle an active fault. On the basis of Locality 10, FER 259, Fix the City requests that LADBS revoke all approvals and temporary Certificate of Occupancy or permanent CofO. Please note LADBS Public Records Act Request PR 19-16472, May 23, 2019, (Exhibit D), shows Mr. Schneidereit's knowledge and awareness of FER 259.

Please determine if there was a meeting between the applicant and Mr. Schneidereit, during January 2016, and any meeting notes, a third surface fault rupture study for this site that could support seismic approval in 2016. The study, if it exists, would have been conducted between December 29, 2015 and February 1, 2016.

Note that documented in the Public Records Act request (Exhibit D), the very studies that were ignored for 1751 Malcolm building permit application in 2018, were sent to consultants for nearby projects by Mr. Schneidereit and that the week before LADBS reversed its two seismic denials, on January 27, 2016, Daniel Schneidereit, LADBS Engineering Geologist I, sent these consultants reports to the state (to Brian Olson, the author of the CGS FER 259). CGS reviewed the studies and then included them in FER 259.

FER 259 is binding upon the City. It cannot under state law, impose weaker conditions. **The no-build area is required, and it is in the center of the site, not the northeastern edge, based on Figure 16 in FER 259**. Based on his sending the 2016 studies to CGS, and his two previous denials, Mr. Schneidereit was clearly aware of the role of CGS in regulating surface rupture fault investigations and of the recommendation for a no-build area.

Upon receipt of a new building permit application in 2018, the City (LADBS) was obligated to consult FER 259, which would have required a no build area in the center of the site. He failed to issue a new review under the 2018 FER 259 report. Instead, he relied upon his sudden approval in 2016, and his misrepresentation in 2015 of where the fault was on the site. It is not as he stated, in the northeastern area. As far as we know, his 2016 approval was not based on a new study. Even if it was, he was required to consult FER 259 in 2018 to approve the new building permit application.

The 2018 building permit application was required to be processed under current laws and regulations and must be **revoked along with any Certificate of Occupancy.**

IMMEDIATE CORRECTIVE ACTION REQUIRED

State and City laws protecting human life must be obeyed in order to protect the 18 families slated to live at 1751 Malcolm Avenue. LADBS does not have authority to override CGS's reports. It must follow FER 259 and CGS Special Publication 42 and Note 49, as well as California Resources Code Section 2623(c)(1) (Exhibit E). These state publications provide the requirements for surface rupture investigations. It appears that these procedures were followed and the results willfully and prejudicially ignored by LADBS.

Any google search for seismic information at this address yields the state report. Approval for seismic safety for this project on February 1, 2016, was contradicted by the two site investigations conducted in 2015, and prohibited by FER 259, which was published nine months prior to the new building permit application and could not lawfully be ignored.

The failure to follow state requirements and the city's own Building Code, and its policies and procedures (Exhibit F) is a significant, substantial abuse of authority that imperils public safety, the first priority of local government under the California Constitution (Art. XIII, Section 35).

LADBS unlawfully ignored the 2018 state report and instead recycled its unexplained and unsupported approval in early 2016, despite two reports and CGS FER 259. Keep in mind that those studies were not just nearby sites, *they were for this exact property.*

New permit applications must conform with current law and regulation. Whatever the basis of the City's geologist ignoring the 2015 study, the 2018 state report could not be lawfully ignored. Based on the consultant's reports forwarded to CGS by Mr. Schneidereit, city staff knew full well that this was a no-build site approximately in the center of the site. In fact, they sent those studies to other developers seeking seismic investigations for new projects (see emails from LADBS and consultants, attached, 75 pp.).

There are ample staff emails in Exhibit D that show that staff communicated with the developer and representative, and demanded that only Daniel Schneidereit should review the project. Do clients choose the staff or does the manager?

Finally, there is no subsequent 2018 approval by Schneidereit. Instead, the old approval was used, despite the CGS report being published nine months prior to the submission of the current building permit application. The City does not have authority to ignore this vital state law. LADBS Seismic staff have failed to uphold city and state laws designed to protect public safety. CGS FER 259 pp. 26-27 are attached.

LADBS Document No. P/BC 2020-129 states a research requirement for surface fault rupture studies to "Search City and State records for fault investigation reports for properties in the site vicinity." This very site was studied in CGS FER 259! Had LADBS staff studied the current state study at the time of the current permit application. knowing it was within a fault study zone, it would have been prohibited from issuing any approvals. For example, a mat foundation cannot be substituted for a no-build area, and there is no evidence that LADBS consulted either CGS FER 259 or the two reports it had received. There is no evidence in the record supporting approval.

The application for this project's building permit and certificate of occupancy was filed on September 28, 2018, nine months after CGS FER 259 Locality 10, 1749-1751 Malcolm Avenue designated a no-build area on January 5, 2018.

This approval violated both CGS regulations, the Alquist Priolo Act, and LADBS P/BC 2020-113 and LADBS P/BC-2020-129 which specific the requirements for seismic investigations.

We enclose the Appeal form, payment of $130, and supporting documentation.

Sincerely,

Laura Lake

Laura Lake, Ph.D.

Board Secretary, Fix the City

LIST OF EXHIBITS

A Building permit application #16010-20000-02308 for 1751 Malcolm Avenue/1772 Glendon Avenue, submitted September 28, 2018

B California Geological Survey FER 259, pp. 26-27 (January 5, 2018).

C LADBS denials of seismic safety in 2015 and letter dated December 29, 2015.

D LADBS Public Records Act response PR19-16472, p. 1 of 75 pages of emails, transmitting second surface fault rupture study for 1751 Malcolm Avenue to CGS, from Daniel Schneidereit to Brian Olson, author of FER 259, dated January 27, 2016.

E California Public Resources Code Section 2623(a)-(c)

F LADBS Document Report soils & geology file approved, February 1, 2016.

G LADBS Information Bulletin/Public-Building Code, P/BC 2017-113 (previously issued as P/BC 2014-113; P/BC 2020-113, "Contents of Reports for Submittal to LADBS Grading Division," and P/BC 2020-129 "Surface Fault Rupture Hazard Investigations.

FIX THE CITY

Laura Lake, Ph.D., Board Secretary, Fix the City

10558 Kinnard Avenue, LA, CA 90024

Laura@FixTheCity.org and Laura.Lake@gmail.com

Cell 310-497-5550

CERTIFIED MAIL/RETURN RECEIPT

Email: Daniel.Schneidereit@lacity.org

Second mailing to replace lost certified, return receipt package, at the request of Daniel Schneidereit, LADBS

November 10, 2020

RE: REVOCATTION OF **BUILDING PERMIT APPLICATION #16010-20000-02308** AND CERTIFICATE OF OCCUPANCY/TEMPORARY CERTIFICATE OF OCCUPANCY FOR **1751 MALCOLM AVENUE & 1772 GLENDON AVENUE**

Daniel Schneidereit, LADBS Seismic Safety Manager

201 N. Figueroa Street, 12th Floor

Los Angeles, CA 90012

Dear Mr. Schneidereit:

Fix the City is a nonprofit advocacy organization for public safety and services in Los Angeles. We respectfully call upon the Building and Safety Commission to revoke all approvals for **Building Permit #16010-20000-02308 and deny a Certificate of Occupancy and or revoke any Temporary Certificate of Occupancy for 1751 Malcolm Avenue/1772 Glendon Avenue,** as authorized by LAMC 98.0302.(1(b)(2).

This appeal package and Appeal Form supplements Fix the City's Appeal to the Board of Building and Safety Commissioners (Form PC-Build.Mod 00 (Rev.09-11-2019), which is attached. The fee has already been paid. Proof of receipt of the original appeal has been provided. You have stated to me that you never received this appeal, and requested that I resubmit, without a new fee, with you as the recipient. This mailing constitutes Fix the City's response.

In addition, our board has hired a licensed geologist, Kenneth Wilson (Wilson Geosciences, Inc), to review the record. He concluded in his attached report (Exhibit H), that the seismic approvals do not follow state and city requirements. We therefore repeat our request to revoke the certificate of occupancy or temporary occupancy based on the substantial evidence in the record. Mr. Wilson's c.v. is attached in Exhibit I.

Mr. Wilson's review, which is enclosed, flags several errors in the approval process for this building that support a revocation. The key safety concerns addressed in this complaint are:

- There is no evidence in the record supporting the reduction from 10 to 20-feet no-build area in the absence of additional data points to determine fault orientation, other than a private meeting between Mr. Schneidereit and the applicant. No new investigation was provided to support reducing the no-build area.
- A one-foot cantilever does not mitigate an estimated 3-6-foot displacement.
- The no-build area for 1751 Malcolm does not conform with the data points between CPT 18 and 19 per CGS FER 259.
- The cantilevered structure at 1751 Malcolm over the no-build area violates LAMC 91.106.4.1 Exception 4.[1]
- There is a **second fault** line along the alley for both 1772 Glendon and 1751 Malcolm that was not investigated (see Figures 1 and 2). Under the Alquist Priolo Act Section 3603(a), the City lacks authority to waive a 50-foot no-build zone from the property line for 1772 Glendon and 1751 Malcolm along the southern boundary of the site in the absence of a fault investigation. *None was conducted for the southern fault.*

> "The following specific criteria shall apply within earthquake fault zones and shall be used by affected lead agencies in complying with the provisions of the Act: (a) No structure for human occupancy, identified as a project under Section 2621.6 of the Act, shall be permitted to be placed across the trace of an active fault."
>
> "Furthermore, as the area within fifty (50) feet of such active faults shall be presumed to be underlain by active branches of that fault unless proven otherwise by an appropriate geologic investigation and report prepared as specified in Section 3603(d) of this subchapter, no such structures shall be permitted in this area." ((Alquist Priolo Act, Section 3603(a))

---

[1] In addition to violating CPR Section 2623(c)(1), LADBS violated LAMC 91.106.4.1. Exception 4: "4. The department shall have the authority to withhold permits on projects located within a Special (Fault) Studies Zone established under Chapter 7.5, Division 2, of the California Public Resources Code. Permits may be issued if it can be demonstrated through accepted geologic seismic studies that the proposed structure will be located in a safe manner and ***not over or astraddle the trace of an active fault.*** Acceptable geologic seismic studies shall meet the criteria as set forth in rules and regulations established by the Superintendent of Building to assure that such studies are based on sufficient geologic data to determine the location or nonexistence of the active fault trace on a site. Prior to approval of a project, a geologic report defining and delineating any hazard of surface fault rupture shall be required. If the city finds that no undue hazard of this kind exists, the geologic report on such hazard may be waived, with approval of the state geologist." (emphasis added).

- There was no investigation of the southern fault along the alley. Therefore, there must be a 50-foot no-build area along the alley fault line for 1772 Glendon and 1751 Malcolm.

We incorporate by reference all LADBS documents for this permit including meeting notes, emails and any other printed material regarding project approval.

Attached is **Exhibit A**, a copy of the building permit application, dated September 28, 2918. We request a written report from LADBS in response to this complaint. ***On the basis of Locality 10, FER 259, and the failure to conduct investigations of the southern fault, Fix the City requests that LADBS revoke all approvals and temporary Certificate of Occupancy or permanent CofO.***

Please note LADBS Public Records Act Request PR 19-16472, May 23, 2019, ***(Exhibit D), shows Mr. Schneidereit's knowledge and awareness of FER 259.*** *Yet when the building permit application was filed in 2018, there is no evidence in the record that LADBS consulted and complied with FER 259. Instead, LADBS relied upon the 2016 approval.*

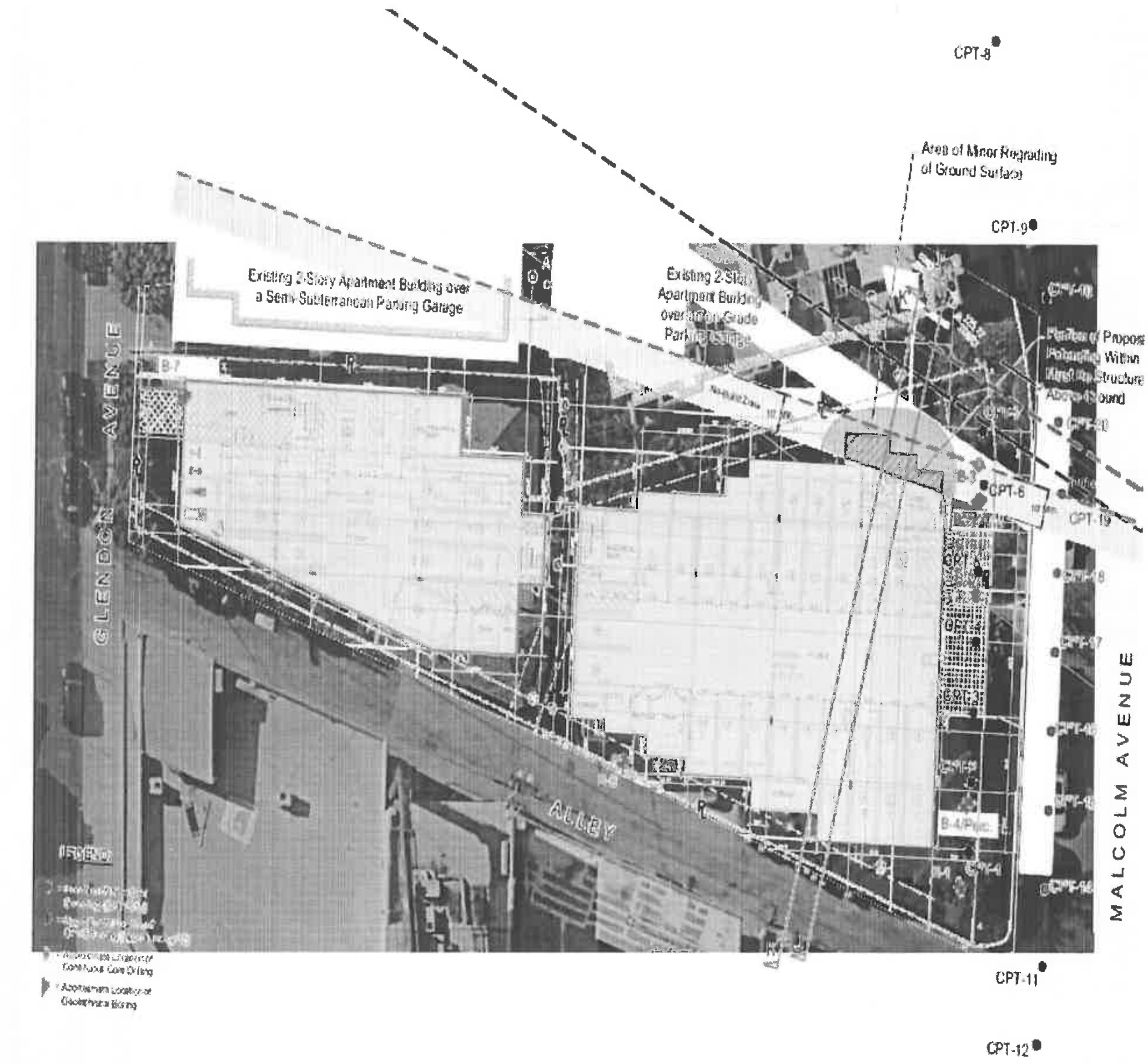


Figure 1. Fault line at southern boundary of 1772 Glendon Avenue not investigated – requires 50-foot setback.

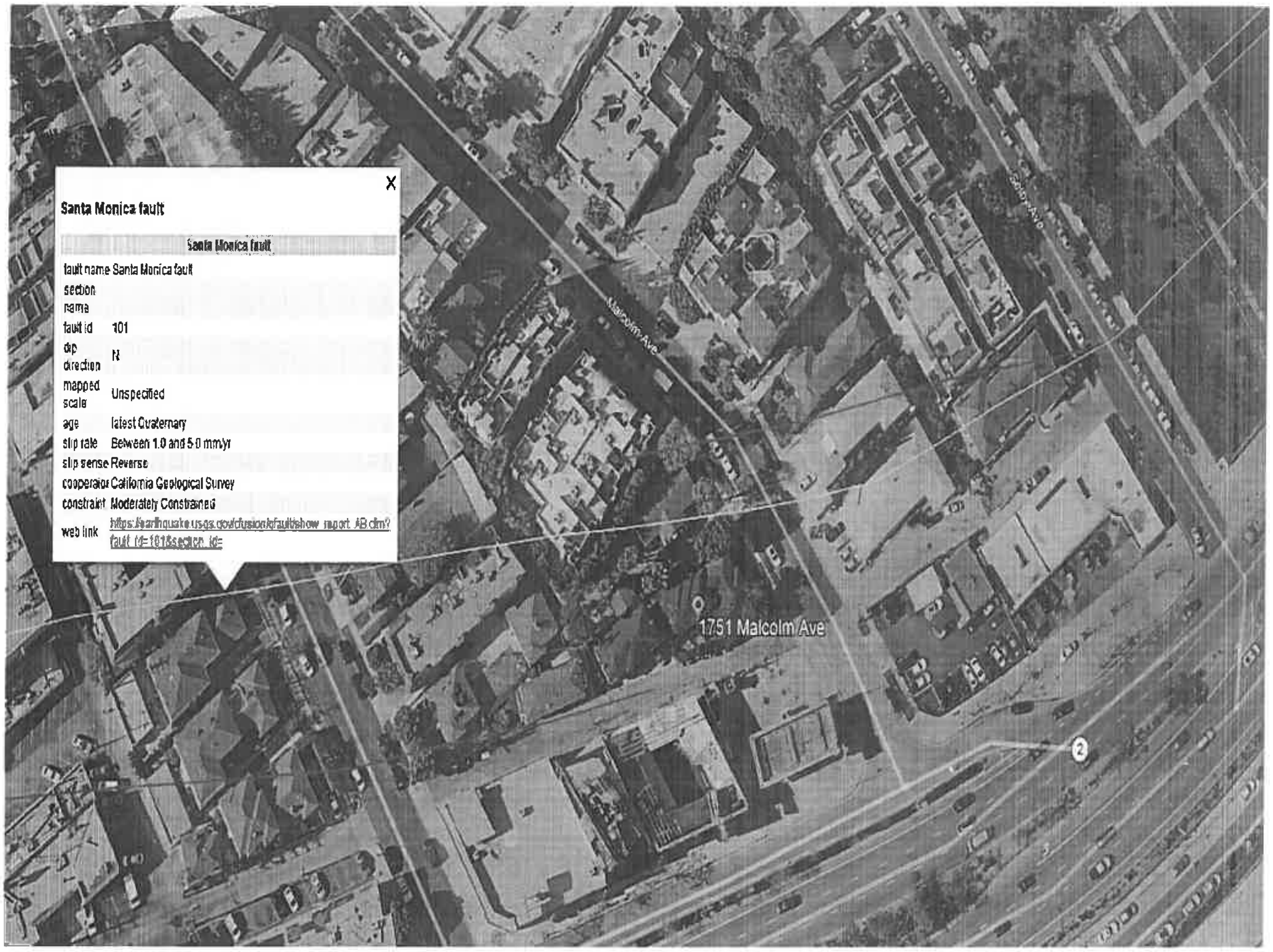


Figure 2 Entire site within Santa Monica Fault Zone with second red fault line at south

The City does not have authority to waive the study and waive the required 50-foot setback. Under **California Resources Code Section 2623** the City may impose stricter requirements, but may not substitute weaker local requirements.

Furthermore, with *only one point of measurement*, it was impossible to determine the trend line for the fault on 1751 Malcolm, as admitted in the August 19, 2015 Correction letter signed by Daniel Schneidereit: *""Additional exploration is required to determine the fault's trend in at least two locations to warrant the recommended reduced setback "* [from 20-feet to 10-feet].

Please note that the second report and Correction Letter signed by Casey Jensen on December 29, 2015, recommended a setback "of ***at least*** 20 feet from the fault splay..." (emphasis added). Yet without additional physical investigation, and only a meeting on January 13, 2016 with the applicant, on February 1, 2016, Daniel Schneidereit reduced the 20-foot setback to ten-feet and allowed the structure over the fault by cantilevering the elevator and lobby area over the no-build zone. This approval was therefore

arbitrary and capricious and a gross abuse of authority, putting the public at risk, in violation of state and city laws.

This approval clearly violates AP because it is a building for human occupancy over a known fault. No build means no build. Placing an elevator and lobby --- escape routes, over a known fault is in direct violation of state law enacted to protect public safety.

Based on CGS and USGS fault lines within the AP Fault Map for this site, the ***City failed to require an investigation of the fault on the southern boundary*** of 1772 Glendon Avenue and 1751 Malcolm Avenue *as shown above in Figures 1 and 2*. ***This was a gross prejudicial abuse of authority***.

Background

In July 2017, the applicant indemnified the City (DIR-2017-342-DRB-SPP, ENV-2017-343-CE).

This 18-unit *luxury* rental project is located within the Santa Monica Fault and mapped in accordance with the Alquist Priolo Act. To our knowledge, there are no affordable units in this project. The project is also located in a Liquefaction Zone and a Methane Zone. Two 2015 geological consultants' seismic investigations were submitted to LADBS for seismic approval. We do not have access to those studies which should be on file in LADBS as well as CGS, which included them as "Locality 10, 1751 Malcolm Avenue" in FER 259, pp. 26-27 and cited below. **Exhibit B** contains FER 259 pages 26-27.

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a meeting with the developer and Schneidereit (**Exhibit D**, p. 2/75).[2] There are no new studies referenced in the emails, only a request for a meeting with the developer and Schneidereit. It is not known if this meeting occurred. However, just a few weeks later, on February 1, 2016, LADBS approved the seismic study (**Exhibit F**). Was the basis for this reversal without new substantial evidence to our knowledge, the requested meeting between Schneidereit and the developer?

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The December 29, 2015 denial summary from LADBS (Exhibit C) incorrectly claims the fault was in the **northeastern** portion of the site, when the fault rupture study on page 27 of FER 259 shows it running through the center of the site between *CPT 18 and CPT 19 as shown below in Figure 3.*

[2] "a meeting with Dan [Schneidereit], with client present, to discuss and finalize our response. There have been multiple changes to the building plans already made due to the presence of the fault in the NE portion of the property as previously reported by us, and I would like to minimize any additional future changes by having another meeting." ***Note the fault is in the CENTER of the site, not the northeast.****, and there is a second fault along the southern boundary of the property that is never addressed.*

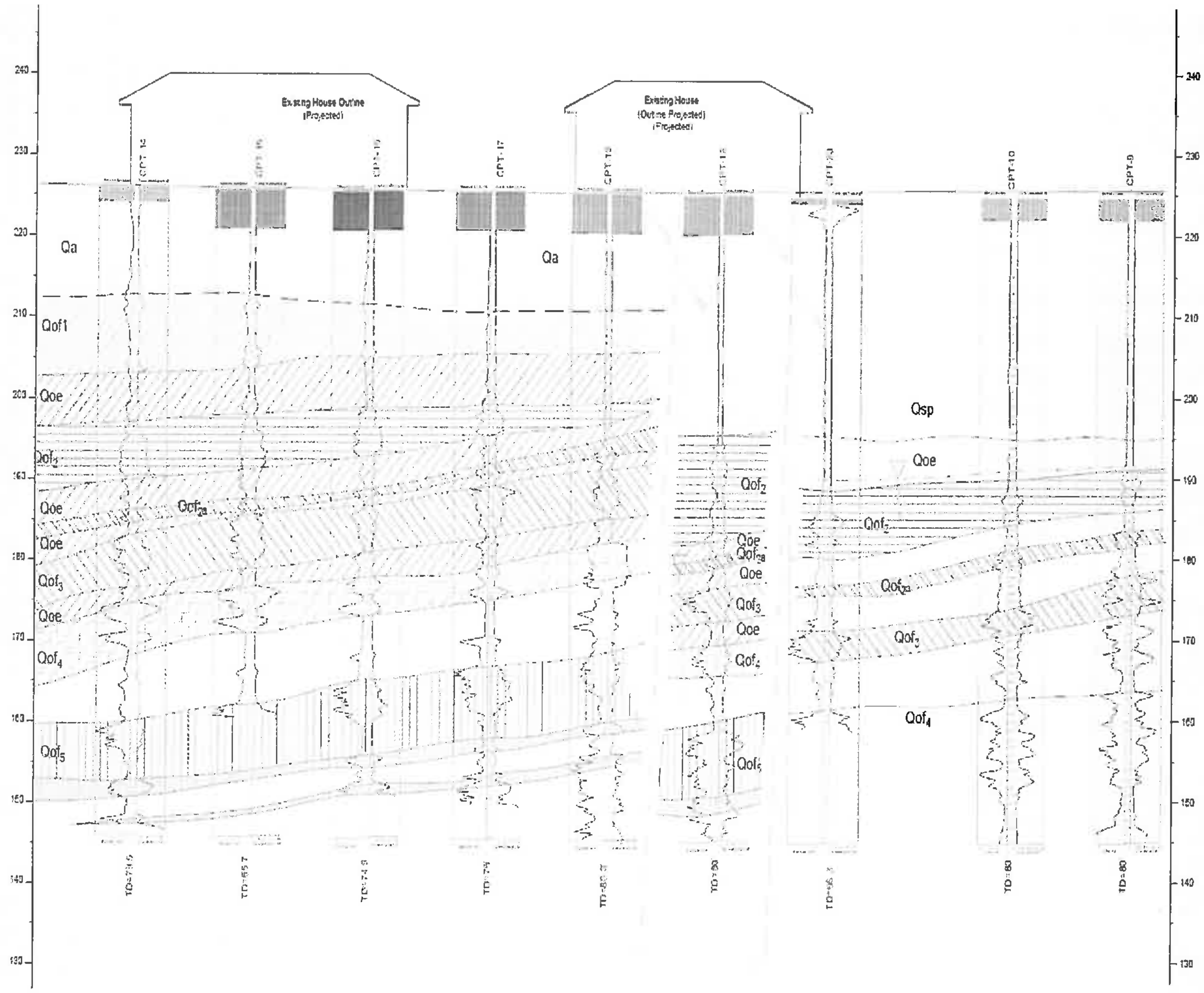


Figure 3 CGS Figure 16: Portion of geologic cross section A-A" constructed along Malcolm Avenue by AES (2015b), Drawing 2) looking west. Note the thick sequence oF Holocene "sag pond" deposits (Qsp) faulted against broadly folded Pleistocene older fan (Qof) and older estuarine (Qoe) deposits in apparent north-south-sown vertical separation. Source: CGS FER 259, p. 27.

In the absence of new substantial evidence in 2018, LADBS violated the clear language of CGS FER 259, the ultimate authority on fault rupture studies within the Santa Monica Fault. Approval was arbitrary and capricious, not supported by substantial evidence, and directly in conflict with CGS FER 259 and constituted a gross, prejudicial abuse of authority.

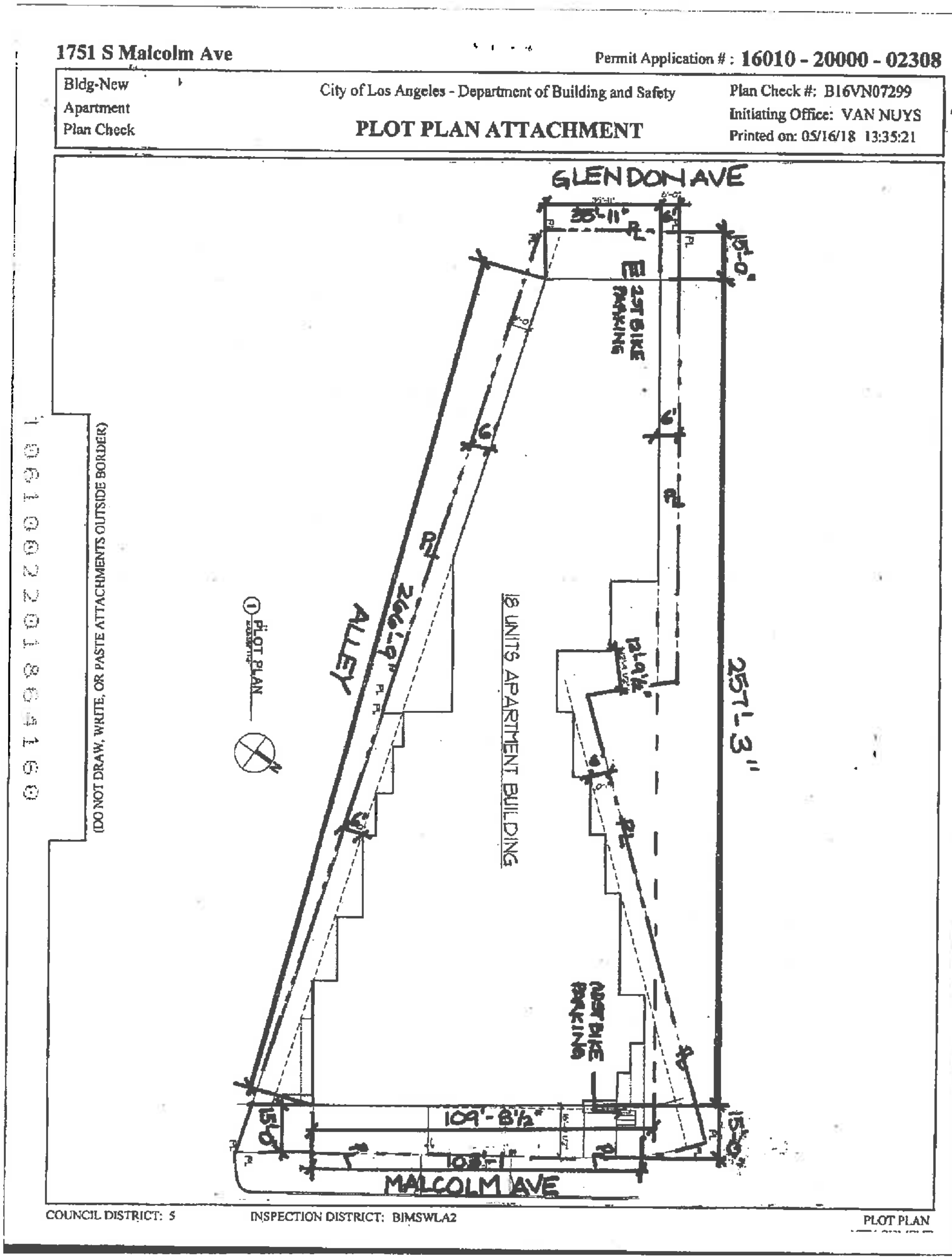
1751 Malcolm Avenue is built over the active fault viewed from Malcolm Ave. (Source: Fix the City).

Our concern is not speculative: the two 2015 consultant reports found physical evidence of an active strand of the Santa Monica Fault, as published in CGS FER 259 (pp. 26-27):

> **"Locality 10 - 1749-1751 Malcolm Avenue**
>
> "A combined fault study and geotechnical investigation was performed for a proposed residential development at 1749-1751 Malcolm and 1772 Glendon Avenues by Applied Earth Sciences (2015a, b). The fault investigation consisted of a single transect along Malcolm Avenue constructed from 20 CPTs and three continuous core borings drilled to a maximum depth of about 80 feet. Spacing of CPTs/borings varied from 5 feet (between CPT/boring pairs) to over 25 feet in the public right-of-way, where numerous utilities were located. In their borings, the consultants identified both Holocene alluvium and "sag pond" deposits, along with Pleistocene alluvial and estuarine sediments.
>
> No well-developed paleosols were identified in the core samples, thus the consultants used various gravel and silt layers to correlate between CPTs/borings and look for stratigraphic anomalies that would suggest faulting. Their analysis indicated a thick sequence of Holocene silt and clay (interpreted as "sag pond deposits) was juxtaposed against the older Pleistocene sedimentary package between CPT-18 and CPT-19 (Figure 16). Additionally, they note groundwater was encountered in one boring north of CPT-18 and not in either of the borings down gradient to the south. Based on these findings, they interpret an active strand of the Santa Monica Fault trends through the

immediate vicinity of CPT-18 and CPT-19. Consequently, the consultants established a "no build zone" (emphasis added).

CPT-18 and CPT-19 are NOT in the northeastern portion of the site. They are on the right side of the garage entrance shown in the photo above. The plot plan attached to the building permit, shown on the next page, shows that the entire site was built over with a few zig-zags on the northern boundary and not around CPT 18 and CPT 19.



LADBS grossly abused its authority and put the lives of the 18 families at risk, in violation of the very laws and regulations enacted to protect human life. Approval approve the site, both state law and city laws were violated, as well as the adopted policies and procedures in LADBS publications mandating CGS reports as stated on the first page of both publications (P/BC 2020-113, P/BC 2020-129) included in **Exhibit G.**

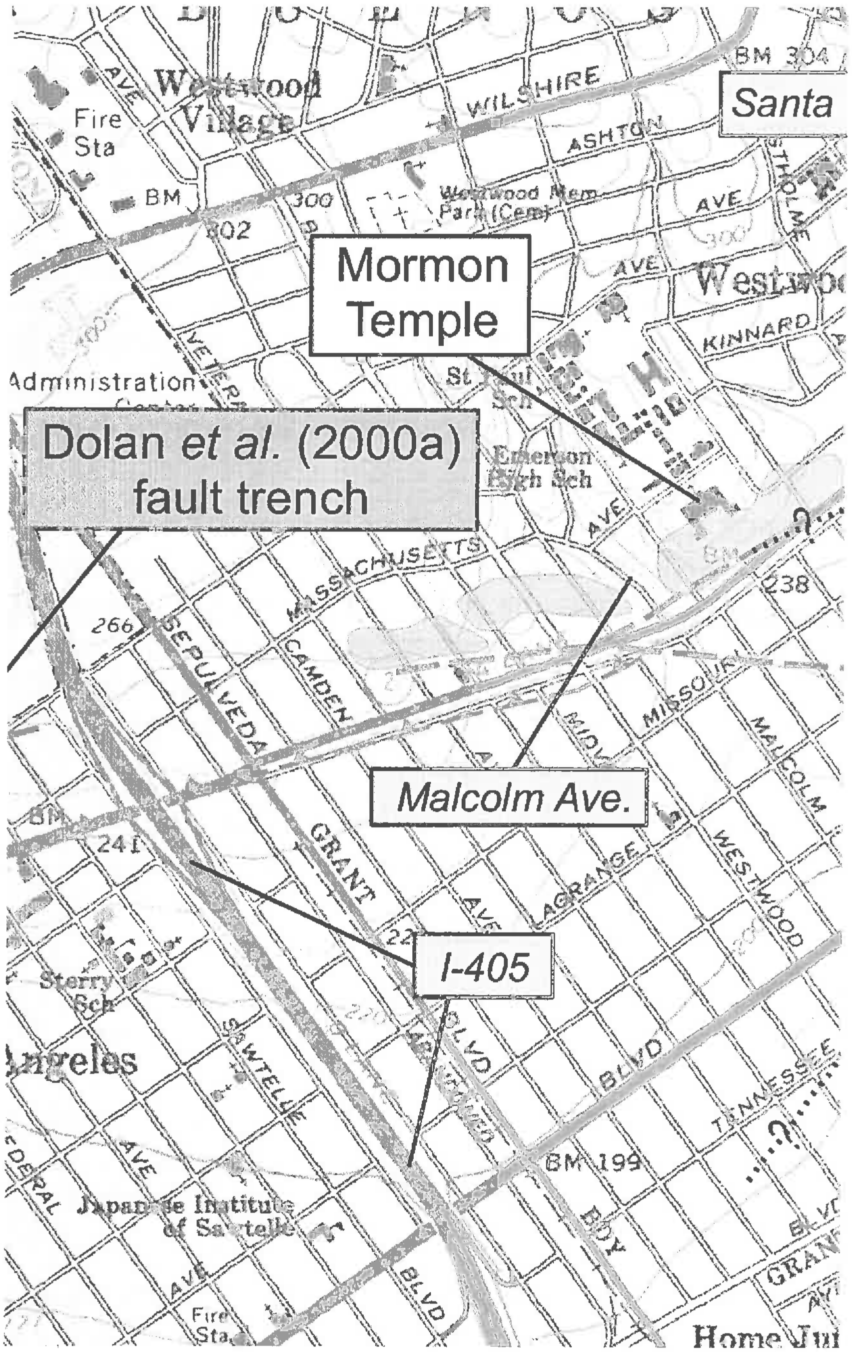


Plate 1, CGS FER 259 (subsection showing Malcolm Avenue site).

Please determine if there was a meeting between the applicant and Mr. Schneidereit, during January 2016, and any meeting notes, a third surface fault rupture study for this site that could support seismic approval in 2016. The study, if it exists, would have been conducted between December 29, 2015 and February 1, 2016.

Note that documented in the Public Records Act request (Exhibit D), the very studies that were ignored for 1751 Malcolm building permit application in 2018, were sent to consultants for nearby projects by Mr. Schneidereit and that the week before LADBS reversed its two seismic denials, on January 27, 2016, Daniel Schneidereit, LADBS Engineering Geologist I, sent these consultants reports to the state (to Brian Olson, the author of the CGS FER 259). CGS reviewed the studies and then included them in FER 259.

FER 259 is binding upon the City. It cannot under state law, impose weaker conditions. **The no-build area is required, and it is in the center of the site, not the northeastern edge, based on Figure 16 in FER 259**. Based on his sending the 2016 studies to CGS, and his two previous denials, Mr. Schneidereit was clearly aware of the role of CGS in regulating surface rupture fault investigations and of the recommendation for a no-build area.

Upon receipt of a new building permit application in 2018, the City (LADBS) was obligated to consult FER 259, which would have required a no build area in the center of the site. He failed to issue a new review under the 2018 FER 259 report. Instead, he relied upon his sudden approval in 2016, and his misrepresentation in 2015 of where the fault was on the site. It is not as he stated, in the northeastern area. As far as we know, his 2016 approval was not based on a new study. Even if it was, he was required to consult FER 259 in 2018 to approve the new building permit application.

The 2018 building permit application was required to be processed under current laws and regulations and must be **revoked along with any Certificate of Occupancy.**

IMMEDIATE CORRECTIVE ACTION REQUIRED

State and City laws protecting human life must be obeyed in order to protect the 18 families slated to live at 1751 Malcolm Avenue. LADBS does not have authority to override CGS's reports. It must follow FER 259 and CGS Special Publication 42 and Note 49, as well as California Resources Code Section 2623(c)(1) (Exhibit E). These state publications provide the requirements for surface rupture investigations. It appears that these procedures were followed and the results willfully and prejudicially ignored by LADBS.

Any google search for seismic information at this address yields the state report. Approval for seismic safety for this project on February 1, 2016, was contradicted by the two site investigations conducted in 2015, and prohibited by FER 259, which was published nine months prior to the new building permit application and could not lawfully be ignored.

The failure to follow state requirements and the city's own Building Code, and its policies and procedures (Exhibit F) is a significant, substantial abuse of authority that imperils public safety, the first priority of local government under the California Constitution (Art. XIII, Section 35).

LADBS unlawfully ignored the 2018 state report and instead recycled its unexplained and unsupported approval in early 2016, despite two reports and CGS FER 259. Keep in mind that those studies were not just nearby sites, *they were for this exact property.*

New permit applications must conform with current law and regulation. Whatever the basis of the City's geologist ignoring the 2015 study, the 2018 state report could not be lawfully ignored. Based on the consultant's reports forwarded to CGS by Mr. Schneidereit, city staff knew full well that this was a no-build site approximately in the center of the site. In fact, they sent those studies to other developers seeking seismic investigations for new projects (see emails from LADBS and consultants, attached, 75 pp.).

There are ample staff emails in Exhibit D that show that staff communicated with the developer and representative, and demanded that only Daniel Schneidereit should review the project. Do clients choose the staff or does the manager?

Finally, there is no subsequent 2018 approval by Schneidereit. Instead, the old approval was used, despite the CGS report being published nine months prior to the submission of the current building permit application. The City does not have authority to ignore this vital state law. LADBS Seismic staff have failed to uphold city and state laws designed to protect public safety. CGS FER 259 pp. 26-27 are attached.

LADBS Document No. P/BC 2020-129 states a research requirement for surface fault rupture studies to "Search City and State records for fault investigation reports for properties in the site vicinity." This very site was studied in CGS FER 259! Had LADBS staff studied the current state study at the time of the current permit application. knowing it was within a fault study zone, it would have been prohibited from issuing any approvals. For example, a mat foundation cannot be substituted for a no-build area, and there is no evidence that LADBS consulted either CGS FER 259 or the two reports it had received. There is no evidence in the record supporting approval.

The application for this project's building permit and certificate of occupancy was filed on September 28, 2018, nine months after CGS FER 259 Locality 10, 1749-1751 Malcolm Avenue designated a no-build area on January 5, 2018.

This approval violated both CGS regulations, the Alquist Priolo Act, and LADBS P/BC 2020-113 and LADBS P/BC-2020-129 which specific the requirements for seismic investigations.

There is additional physical evidence of an active surface fault at this site, as shown in the photos below:

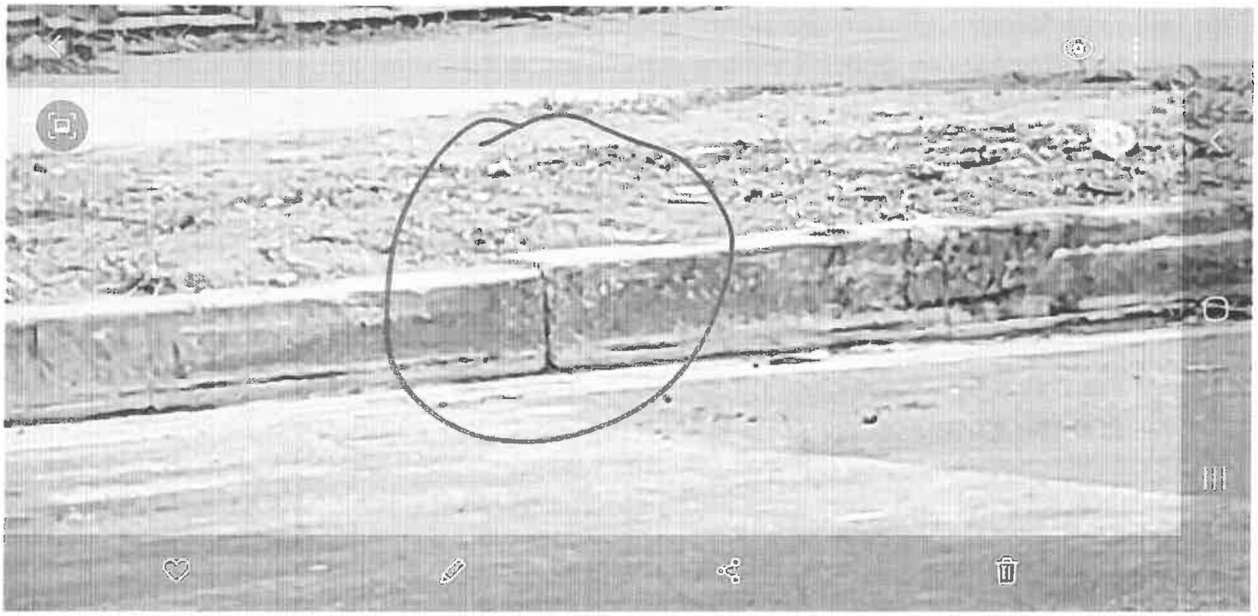


Figure 4 broken curb at fault between CPT 18 and 19

Figure 5 rupture on Malcolm curb in front of no-build area

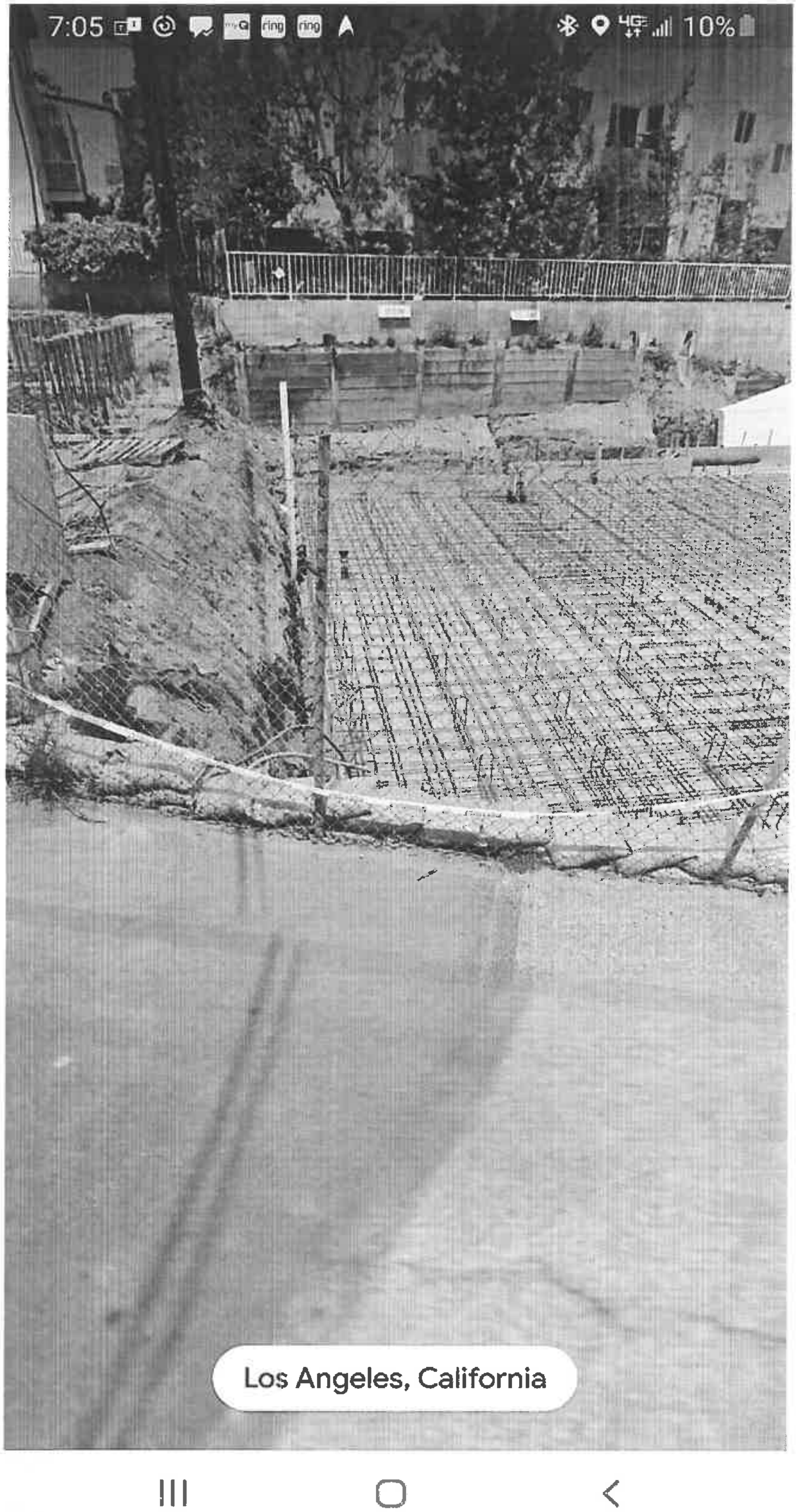


Figure 6 Fault in alley visible

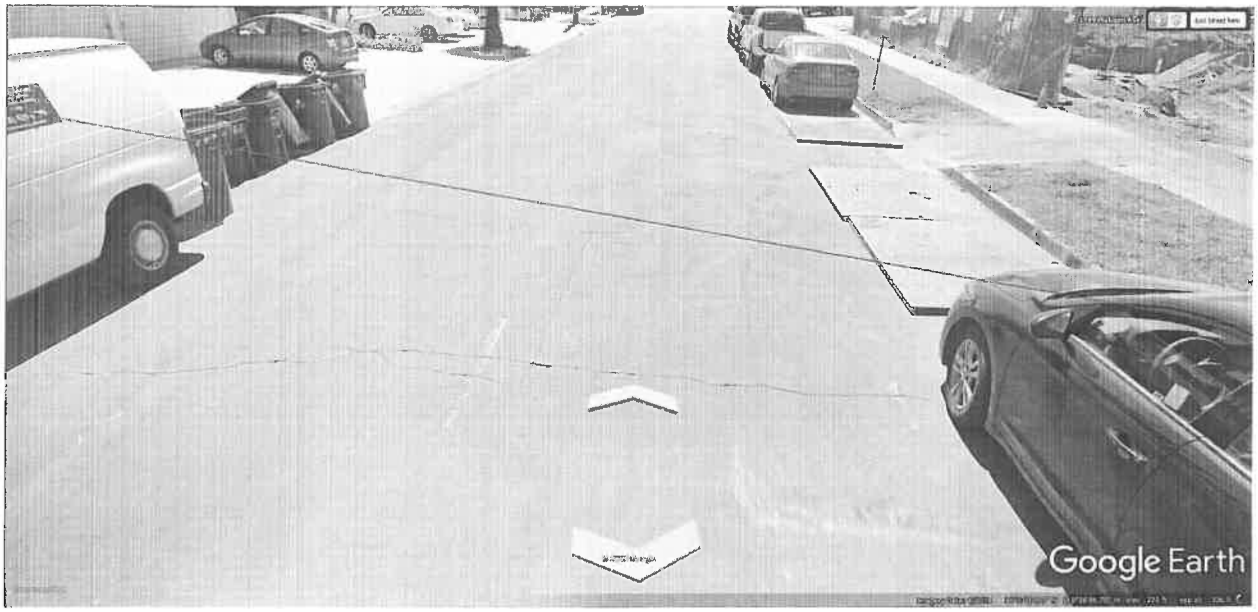


Figure 7 Fault runs across Malcolm into site. Roadway cracks from surface faulting run into site.

We already paid the appeal fee.

Sincerely,

Laura Lake

Laura Lake, Ph.D.

Board Secretary, Fix the City

LIST OF EXHIBITS

A Building permit application #16010-20000-02308 for 1751 Malcolm Avenue/1772 Glendon Avenue, submitted September 28, 2018

B California Geological Survey FER 259, pp. 26-27 (January 5, 2018).

C LADBS denials of seismic safety in 2015 and letter dated December 29, 2015.

D LADBS Public Records Act response PR19-16472, p. 1 of 75 pages of emails, transmitting second surface fault rupture study for 1751 Malcolm Avenue to CGS, from Daniel Schneidereit to Brian Olson, author of FER 259, dated January 27, 2016.

E California Public Resources Code Section 2623(a)-(c)

F LADBS Document Report soils & geology file approved, February 1, 2016.

G LADBS Information Bulletin/Public-Building Code, P/BC 2017-113 (previously issued as P/BC 2014-113; P/BC 2020-113, "Contents of Reports for Submittal to LADBS Grading Division," and P/BC 2020-129 "Surface Fault Rupture Hazard Investigations.

H. Report by Wilson Geosciences on 1751 Malscom Ave. and 1772 Glendon Ave.

I. Kenneth Wilson's c.v.

Report from Wilson Geosciences & Resume

1751 Malcolm Ave. & 1772 Glendon Avenue

RFM 27500

November 23, 2020

Fix the City
10558 Kinnard Avenue
Los Angeles, CA 90024

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

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[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

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[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.

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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

Kenneth Wilson
Principal Geologist
P.G. #3175, C.E.G. #928
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PROFESSIONAL GEOLOGIST
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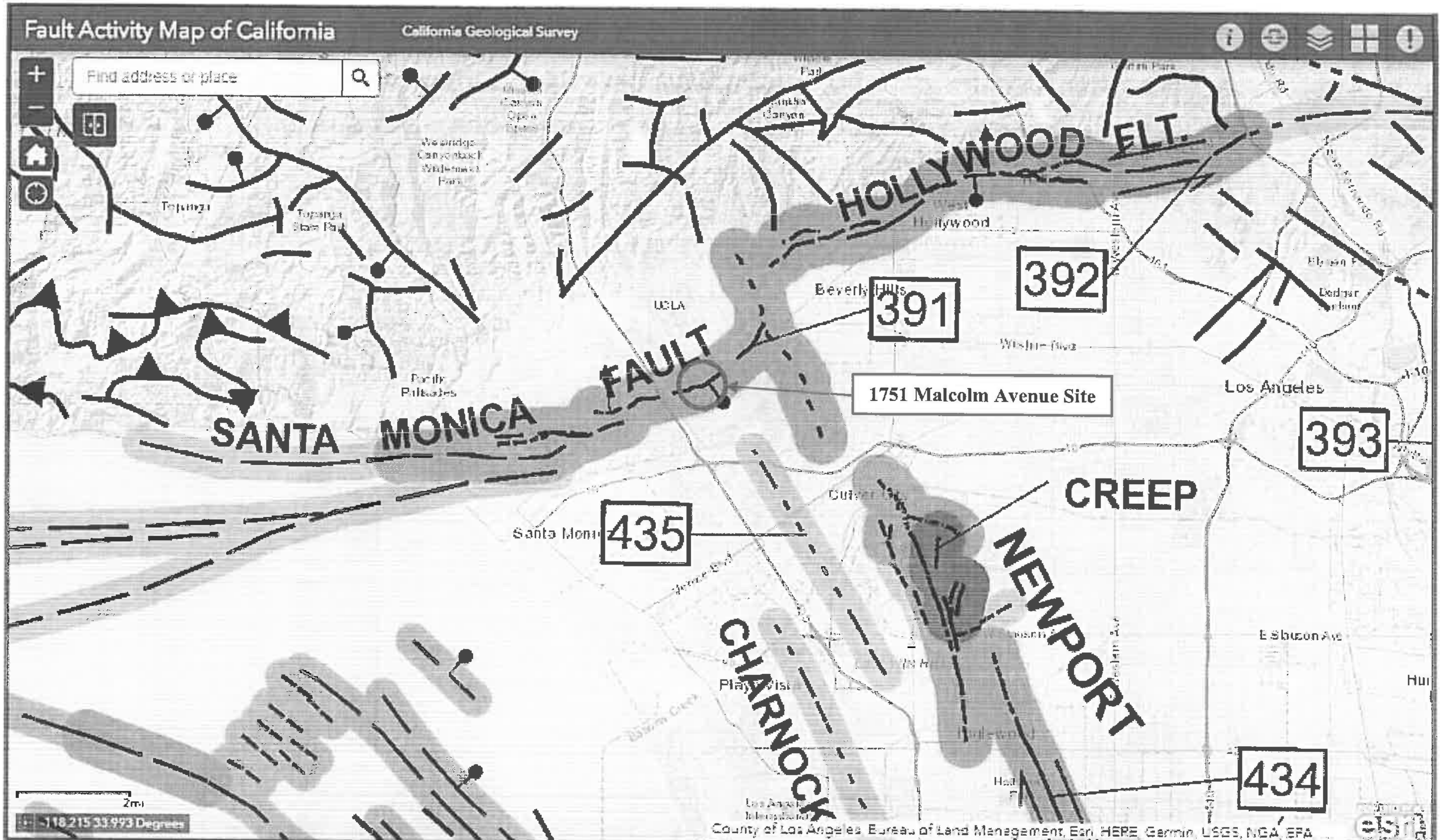
No. 928
CERTIFIED
ENGINEERING
GEOLOGIST
STATE OF CALIFORNIA

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)

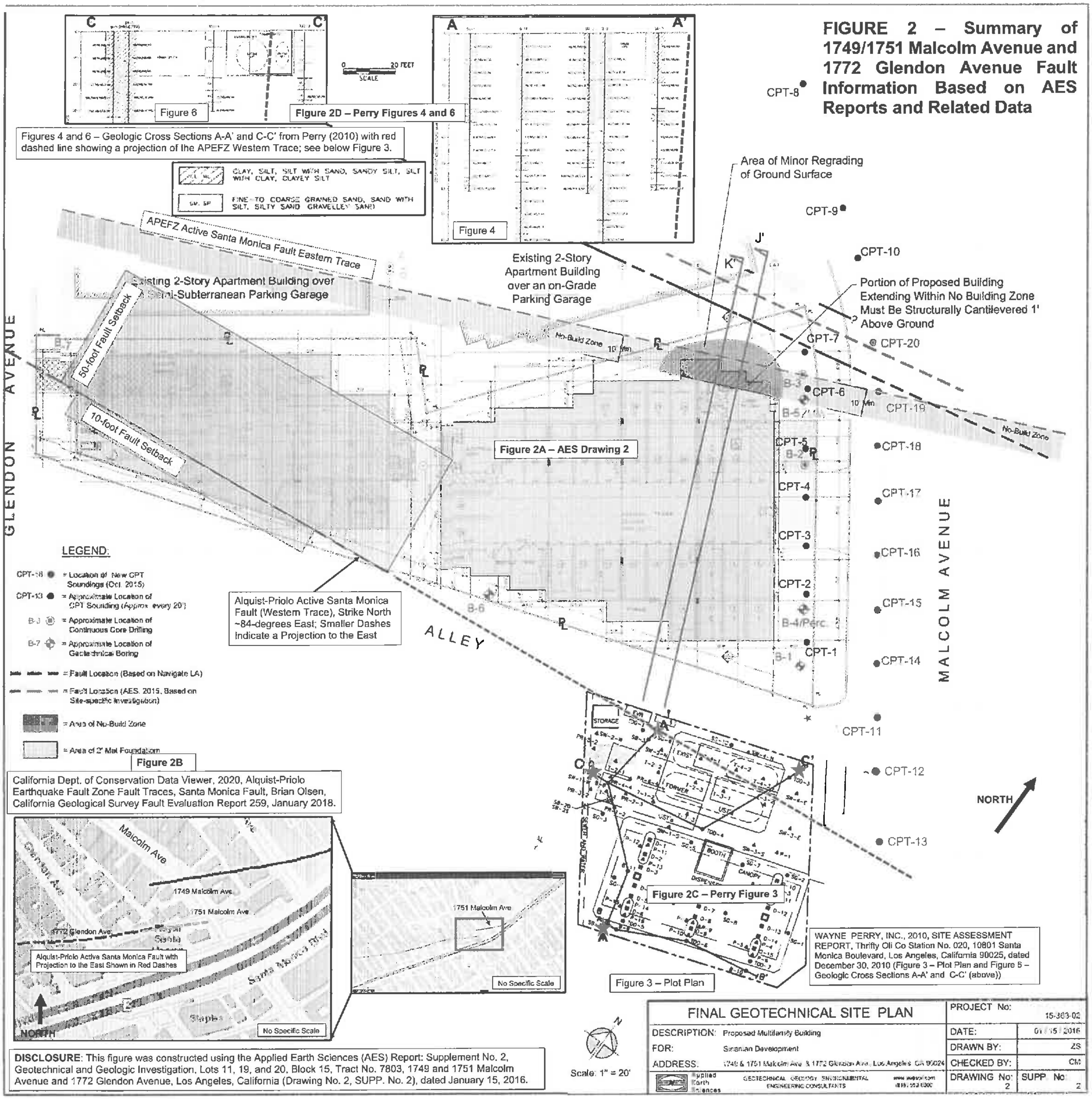


FIGURE 2 – Summary of 1749/1751 Malcolm Avenue and 1772 Glendon Avenue Fault Information Based on AES Reports and Related Data
Figure 6
Figure 2D – Perry Figures 4 and 6
Figure 4
Figures 4 and 6 – Geologic Cross Sections A-A' and C-C' from Perry (2010) with red dashed line showing a projection of the APEFZ Western Trace; see below Figure 3.
CLAY, SILT, SILT WITH SAND, SANDY SILT, SILT WITH CLAY, CLAYEY SILT
FINE TO COARSE GRAINED SAND, SAND WITH SILT, SILTY SAND, GRAVELLEY SAND
20 FEET
SCALE
APEFZ Active Santa Monica Fault Eastern Trace
Existing 2-Story Apartment Building over Semi-Subterranean Parking Garage
Existing 2-Story Apartment Building over an on-Grade Parking Garage
Area of Minor Regrading of Ground Surface
Portion of Proposed Building Extending Within No Building Zone Must Be Structurally Cantilevered 1' Above Ground
50-foot Fault Setback
10-foot Fault Setback
No-Build Zone
Figure 2A – AES Drawing 2
GLENDON AVENUE
MALCOLM AVENUE
ALLEY
CPT-1
CPT-2
CPT-3
CPT-4
CPT-5
CPT-6
CPT-7
CPT-8
CPT-9
CPT-10
CPT-11
CPT-12
CPT-13
CPT-14
CPT-15
CPT-16
CPT-17
CPT-18
CPT-19
CPT-20
B-1
B-2
B-3
B-4/Perc.
B-5
B-6
B-7
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
Alquist-Priolo Active Santa Monica Fault (Western Trace), Strike North ~84-degrees East; Smaller Dashes Indicate a Projection to the East
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.
Malcolm Ave
1749 Malcolm Ave
1751 Malcolm Ave
1772 Glendon Ave
Santa Monica Blvd
Alquist-Priolo Active Santa Monica Fault with Projection to the East Shown in Red Dashes
NORTH
No Specific Scale
Figure 2C – Perry Figure 3
Figure 3 – Plot Plan
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 and Figure 5 – Geologic Cross Sections A-A' and C-C' (above))
NORTH
Scale: 1" = 20'
FINAL GEOTECHNICAL SITE PLAN
DESCRIPTION: Proposed Multifamily Building
FOR: Sinanian Development
ADDRESS: 1749 & 1751 Malcolm Ave & 1772 Glendon Ave, Los Angeles, CA 90024
Applied Earth Sciences
GEOTECHNICAL GEOLOGY ENVIRONMENTAL ENGINEERING CONSULTANTS
PROJECT No: 15-303-02
DATE: 01/15/2016
DRAWN BY: ZS
CHECKED BY: CM
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.

FIX THE CITY

Appeal to Los Angeles City Building & Safety Commission

RFM 27500

(1751 Malcolm Ave. & 1772 Glendon Ave.)

Appeal and Justification April 16, 2021

Submitted by Fix The City

Laura Lake, Ph.D., Board Secretary

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT **CIVIL CODE § 1189**

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California)
County of Los Angeles)

On 04/16/2021 before me, Mehran Khorramian, Notary Public,
Date Here Insert Name and Title of the Officer

personally appeared Michael Eveloff & Laura Lake
Name(s) of Signer(s)

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

MEHRAN KHORRAMIAN
COMM. # 2308819
NOTARY PUBLIC - CALIFORNIA
LOS ANGELES COUNTY
MY COMM. EXP. NOV. 9, 2023

Signature
Signature of Notary Public

Place Notary Seal Above

OPTIONAL

Though this section is optional, completing this information can deter alteration of the document or fraudulent reattachment of this form to an unintended document.

Description of Attached Document
Title or Type of Document: Appeal Form
Document Date: N/A Number of Pages: 17
Signer(s) Other Than Named Above: N/A

Capacity(ies) Claimed by Signer(s)

Signer's Name:
☐ Corporate Officer — Title(s):
☐ Partner — ☐ Limited ☐ General
☐ Individual ☐ Attorney in Fact
☐ Trustee ☐ Guardian or Conservator
☐ Other:
Signer Is Representing:

Signer's Name:
☐ Corporate Officer — Title(s):
☐ Partner — ☐ Limited ☐ General
☐ Individual ☐ Attorney in Fact
☐ Trustee ☐ Guardian or Conservator
☐ Other:
Signer Is Representing:

SUPPLEMENTAL APPLICATION FOR APPEALS

RFM27500

TYPE OF APPEAL:

- [x] BUILDING CODE APPEAL
- [ ] ZONING CODE APPEAL
- [ ] INSPECTION / CODE ENFORCEMENT APPEAL

PROJECT TYPE:

- [ ] ONE OR TWO FAMILY RESIDENTIAL
- [x] MULTI-FAMILY RESIDENTIAL
- [ ] COMMERCIAL/INDUSTRIAL

PERMIT APPLICATION: 16010-2000-02308		
ADDRESS: 1751 Malcolm Ave. & 1772 Glendon Avenue		ZIP: 90024
TRACT: 7803	BLK: 15	LOT: 20 19 11
OWNER NAME: Harkham Family Enterprises	OWNER ADDRESS: 957 San Pedro St. #300, LA, CA	ZIP: 90014

APPLICATION INFORMATION:

NAME: Laura Lake, Ph.D.	ADDRESS: 10558 Kinnard Avenue	ZIP: 90024
EMAIL: Laura.Lake@gmail.com	APPLICANT SIGNATURE:	DATE: 4/15/21

ISSUES:	VIOLATION:	CODE SECTION:
1. See Attached Justification for	Alquist Priolo Act	
RFM 27500	LADBS Seismic Regulations	
Expert Report Provided by Fix		
the City's consultant, Wilson Geosciences		
2.		
3.		

- FOR ADDITIONAL ISSUES, ATTACH TO THIS APPLICATION
- ATTACH ALL APPLICABLE EXHIBITS AND EVIDENCE TO THIS APPLICATION

April 16, 2021

Justification

Appeal to Board of Building and Safety Commissioners #RFM 27500

RE: Seismic Hazards at 1751 Malcolm Avenue and 1772 Glendon Avenue Require Revocation of Building Permit and Certificates of Occupancy

Fix the City is a nonprofit advocacy organization that focuses on public safety and adequate infrastructure in Los Angeles. We are appealing to the Board of Building and Safety Commissioners to enforce the Alquist Priolo Act by reversing the decision by staff regarding issuance of building permits for 1751 Malcolm Avenue and 1772 Glendon Avenue, in spite of documented seismic hazards, in violation of the Alquist Priolo Act and the City's own published regulations.

We incorporate by reference our appeal to LADBS and the report from Wilson Geosciences, Inc. submitted with Fix the City's request for modification.

Seismic hazards are not limited to mega-projects or to Hollywood. This 18-unit luxury Westwood project has been built over a known active fault, contrary to the statement made by B & S as long ago as 2013: **"The city will not permit the construction of new buildings on top of active faults**" (Emphasis added, *LA Weekly*, August 7, 2013, link provided below).

In fact, it is a violation of state law to build over or across a known fault. But that is exactly what B & S authorized for 1751 Malcolm, and it totally ignored the second fault cross the site of 1772 Glendon running along the alley to the south.

We have expended considerable funds to present expert testimony to you, so that you understand exactly which regulations have been violated, and how they were violated. We are prepared to exhaust all remedies to protect public safety and enforce the Alquist Priolo Act.

Fix the City respectfully requests that the Board read our original filing, our consultant's report, and act to stop human occupancy over a known active fault within the Alquist Priolo Fault Zone just north of Santa Monica Boulevard in Westwood. We also request a review of all other new projects during the past few years that are within the Santa Monica Fault Zone.

On December 29, 2020, we received a denial of our appeal regarding seismic hazards for 1751 Malcolm Avenue and 1772 Glendon Avenue. The detailed appeal accompanied by a report from a licensed geologist, was denied with three words: "Request Not Justified," without any further elaboration.

On January 27, 2021, I called Daniel Schneidereit to request an explanation for the denial. He said he would send me an email, which he did send. It was extremely brief and ignored all the points we had so carefully raised and documented.

> "Hi Laura,
>
> As we just spoke about, the reason the request of RFM 27500 was denied is because the permit application(s) was submitted to the Department in 2016. The fault investigation was reviewed based on the City standards of that time period, which was prior to the establishment of the AP Zone in that area."

This explanation is inaccurate and ignores many of the other objections. The seismic study was approved in 2016, but the building permit application was submitted in 2018, and Santa Monica Boulevard was an AP Study Zone long before the 2016 seismic approval. Irregularities in seismic approvals are not new to B & S (see https://www.laweekly.com/millennium-hollywood-fault-coverup-emails-show-city-knew/)

Note that our consultant commented that the time elapsed between the seismic study and the building permit warranted a second look. The study was approved in 2015, the Santa Monica Fault was a known Fault Zone requiring study.

The FER 259 was approved many months prior to the issuance of the Building Permit(s). It is the failure to reassess the seismic approval in light of the new state report, prior to the building permit approval, that we challenge. It is also the private meeting that reversed the 20-foot no-build zone, and proposed a one-foot cantilevered portion of the building that we dispute. Our goal is to have the City comply with established state law which prohibits building over or across an active fault.

The denial of our appeal was a prejudicial abuse of authority given the significant seismic hazards on this site. Under the Alquist Priolo Act, the city does not have authority to weaken state regulations regarding adequate seismic investigation and mitigation. Compounding the errors in this review, staff ignored published city regulations during their review. Those publications are included in our original appeal.

- The determination is arbitrary, capricious and without merit as it does not address any of the substantive issues raised in our appeal.
- The determination is arbitrary, capricious and without merit as it has nothing to do with the absence of any study for the unstudied 1772 Glendon building (there is a second fault that was never investigated).
- The determination is arbitrary, capricious and without merit as the building permit(s) was/were issued on 5/16/18 and 9/28/18. Plans were returned for corrections on 2/27/18. FER 259 was published on 1/5/18. There was ample opportunity to check FER 259 prior to the issuance of the building permit.
- The determination failed to address the inadequacy of a 1-foot cantilever over the no-build area and failed to explain why after a private meeting between Mr. Schneidereit and the applicant, the 20-foot no-build area was reduced to 10-feet.
- No investigation was ever made for the fault running along the southern boundary of the site and crossing the footprint of 1772 Glendon Avenue.

We and our consultant stand ready to discuss the review of this site and seek compliance with state regulations which have primacy over city authority.

Most importantly, the reduced no-build zone, the 1-foot cantilever, and the lack of investigation of the second fault on this site are of great concern.

Sincerely,

Laura Lake, Ph.D.

FIX THE CITY

310-497-5550

Laura@FixTheCity.org

Attached: Appeal Form

FIX THE CITY

Appeal to Los Angeles City Building & Safety Commission

RFM 27500

(1751 Malcolm Ave. & 1772 Glendon Ave.)

Appeal and Justification April 16, 2021

Submitted by Fix The City

Laura Lake, Ph.D., Board Secretary

Permit App #:	Job Address:

CONDITIONS OF APPROVAL (Continued from Page 1)

CITY OF LOS ANGELES
BOARD OF BUILDING AND SAFETY/DISABLED ACCESS COMMISSION APPEAL FORM

(Must be Attached to the Modification Request Form, Page 1)

AFFIDAVIT – LADBS BOARD OF BUILDING AND SAFETY COMMISSIONERS – RESOLUTION NO. 832-93

I, Laura Lake do state and swear as follows:
(Print or Type Name of the Person Signing this Form)

1. The name and mailing address of the owner of the property (as defined in the resolution 832-93) at 1751 Malcolm Av. & 1772 Glendon Av. as shown on the appeal application (LADBS Com 31) are correct, and
2. The owner of the property as shown on the appeal application will be made aware of the appeal and will receive a copy of the appeal.

I declare under PENALTY OF PERJURY that the forgoing is true and correct.

Owner's Name(s) Harkham Family Enterprises (Please Type or Print) ______ (Please Type or Print)

Owner's Signature(s) ______ (Please Sign) (Two Officers' Signatures Required for Corporations)

Name of Corporation Fix The City (Please Print Name of Corporation) Laura Lake and Michael Eveloff (Please Type or Print)

Dated this 16 day of April 20 21

CALIFORNIA ALL-PURPOSE ACKNOWLEDGEMENT——————SIGNATURE(S) MUST BE NOTARIZED

State of CALIFORNIA County of Los Angeles on 4/16/2021 Eveloff

before me, Mehran Khorramian (Name, Title of Officer (e.g. Jane Doe, Notary Public)) personally appeared Laura Lake & Michael (Name(s) of Signer(s))

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument in person(s), or the entity upon behalf of which the person(s) acted, executed the instrument. **I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing is true and correct.**

The appropriate California notary form is attached.

WITNESS my hand and official seal. Signature ______

As a covered entity under Title II of the Americans with Disabilities Act, the City of Los Angeles does not discriminate on the basis of disability and, upon request, will provide reasonable accommodation to ensure equal access to its programs, services and activities.

APPEAL OF DEPARTMENT ACTION TO THE BOARD OF BUILDING AND SAFETY COMMISSIONERS/DISABLED ACCESS APPEALS COMMISSION

Fix The City (Laura Lake, Ph.D.) — Applicant's Name

Board Secretary — Applicant's Title

Signature ______

4/15/21 — Date

FEES (DEPARTMENT USE ONLY)

Board Fee .... (No. of Items)	1	X	$354 +$215/addl	=	354.00
Inspection Fee .... (No of Insp.) =		X	84.00	=	0.00
Research Fee ... (Total Hours Worked) =	2	X	104.00	=	208.00
Subtotal..........				=	562.00
Development Services Center Surcharge		X	.03	=	16.86
Systems Development Surcharge		X	.06	=	33.72
Total Fees..........				=	612.58

Fees verified by:

Print and Sign ______

For Cashiers Use Only
(PROCESS ONLY WHEN FEES ARE VERIFIED)

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT **CIVIL CODE § 1189**

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California)
County of Los Angeles)

On 04/16/2021 before me, Mehran Khorramian, Notary Public,
Date *Here Insert Name and Title of the Officer*

personally appeared Michael Everoff & Laura Lake
Name(s) of Signer(s)

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

MEHRAN KHORRAMIAN
COMM. # 2308819
NOTARY PUBLIC - CALIFORNIA
LOS ANGELES COUNTY
MY COMM. EXP. NOV. 9, 2023

Signature ______
Signature of Notary Public

Place Notary Seal Above

OPTIONAL

Though this section is optional, completing this information can deter alteration of the document or fraudulent reattachment of this form to an unintended document.

Description of Attached Document

Title or Type of Document: Appeal Form
Document Date: N/A Number of Pages: 17
Signer(s) Other Than Named Above: ______

Capacity(ies) Claimed by Signer(s)

Signer's Name: ______
☐ Corporate Officer — Title(s): ______
☐ Partner — ☐ Limited ☐ General
☐ Individual ☐ Attorney in Fact
☐ Trustee ☐ Guardian or Conservator
☐ Other: ______
Signer Is Representing: ______

Signer's Name: ______
☐ Corporate Officer — Title(s): ______
☐ Partner — ☐ Limited ☐ General
☐ Individual ☐ Attorney in Fact
☐ Trustee ☐ Guardian or Conservator
☐ Other: ______
Signer Is Representing: ______

SUPPLEMENTAL APPLICATION FOR APPEALS · RFM27500

TYPE OF APPEAL:

- [x] BUILDING CODE APPEAL
- [ ] ZONING CODE APPEAL
- [ ] INSPECTION / CODE ENFORCEMENT APPEAL

PROJECT TYPE:

- [ ] ONE OR TWO FAMILY RESIDENTIAL
- [x] MULTI-FAMILY RESIDENTIAL
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TRACT: 7803	BLK: 15	LOT: 20 19 11
OWNER NAME: Harkham Family Enterprises	OWNER ADDRESS: 957 San Pedro St. #300, LA, CA	ZIP: 90014

APPLICATION INFORMATION:

NAME: Laura Lake, Ph.D.	ADDRESS: 10558 Kinnard Avenue	ZIP: 90024
EMAIL: Laura.Lake@gmail.com	APPLICANT SIGNATURE:	DATE: 4/15/21

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RFM 27500	LADBS Seismic Regulations	
Expert Report Provided by Fix		
the City's consultant, Wilson Geosciences		
2.		
3.		

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FIX THE CITY

April 16, 2021

Justification

Appeal to Board of Building and Safety Commissioners #RFM 27500

RE: Seismic Hazards at 1751 Malcolm Avenue and 1772 Glendon Avenue Require Revocation of Building Permit and Certificates of Occupancy

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In fact, it is a violation of state law to build over or across a known fault. But that is exactly what B & S authorized for 1751 Malcolm, and it totally ignored the second fault cross the site of 1772 Glendon running along the alley to the south.

We have expended considerable funds to present expert testimony to you, so that you understand exactly which regulations have been violated, and how they were violated. We are prepared to exhaust all remedies to protect public safety and enforce the Alquist Priolo Act.

Fix the City respectfully requests that the Board read our original filing, our consultant's report, and act to stop human occupancy over a known active fault within the Alquist Priolo Fault Zone just north of Santa Monica Boulevard in Westwood. We also request a review of all other new projects during the past few years that are within the Santa Monica Fault Zone.

On December 29, 2020, we received a denial of our appeal regarding seismic hazards for 1751 Malcolm Avenue and 1772 Glendon Avenue. The detailed appeal accompanied by a report from a licensed geologist, was denied with three words: "Request Not Justified," without any further elaboration.

On January 27, 2021, I called Daniel Schneidereit to request an explanation for the denial. He said he would send me an email, which he did send. It was extremely brief and ignored all the points we had so carefully raised and documented.

> "Hi Laura,
>
> As we just spoke about, the reason the request of RFM 27500 was denied is because the permit application(s) was submitted to the Department in 2016. The fault investigation was reviewed based on the City standards of that time period, which was prior to the establishment of the AP Zone in that area."

This explanation is inaccurate and ignores many of the other objections. The seismic study was approved in 2016, but the building permit application was submitted in 2018, and Santa Monica Boulevard was an AP Study Zone long before the 2016 seismic approval. Irregularities in seismic approvals are not new to B & S (see https://www.laweekly.com/millennium-hollywood-fault-coverup-emails-show-city-knew/)

Note that our consultant commented that the time elapsed between the seismic study and the building permit warranted a second look. The study was approved in 2015, the Santa Monica Fault was a known Fault Zone requiring study.

The FER 259 was approved many months prior to the issuance of the Building Permit(s). It is the failure to reassess the seismic approval in light of the new state report, prior to the building permit approval, that we challenge. It is also the private meeting that reversed the 20-foot no-build zone, and proposed a one-foot cantilevered portion of the building that we dispute. Our goal is to have the City comply with established state law which prohibits building over or across an active fault.

The denial of our appeal was a prejudicial abuse of authority given the significant seismic hazards on this site. Under the Alquist Priolo Act, the city does not have authority to weaken state regulations regarding adequate seismic investigation and mitigation. Compounding the errors in this review, staff ignored published city regulations during their review. Those publications are included in our original appeal.

- The determination is arbitrary, capricious and without merit as it does not address any of the substantive issues raised in our appeal.
- The determination is arbitrary, capricious and without merit as it has nothing to do with the absence of any study for the unstudied 1772 Glendon building (there is a second fault that was never investigated).
- The determination is arbitrary, capricious and without merit as the building permit(s) was/were issued on 5/16/18 and 9/28/18. Plans were returned for corrections on 2/27/18. FER 259 was published on 1/5/18. There was ample opportunity to check FER 259 prior to the issuance of the building permit.
- The determination failed to address the inadequacy of a 1-foot cantilever over the no-build area and failed to explain why after a private meeting between Mr. Schneidereit and the applicant, the 20-foot no-build area was reduced to 10-feet.
- No investigation was ever made for the fault running along the southern boundary of the site and crossing the footprint of 1772 Glendon Avenue.

We and our consultant stand ready to discuss the review of this site and seek compliance with state regulations which have primacy over city authority.

Most importantly, the reduced no-build zone, the 1-foot cantilever, and the lack of investigation of the second fault on this site are of great concern.

Sincerely,

Laura Lake, Ph.D.

FIX THE CITY

310-497-5550

Laura@FixTheCity.org

Attached: Appeal Form

Appeal to LADBS RFM 27500 (Denied)

MOD # 27500

LADBS

REQUEST FOR MODIFICATION OF BUILDING ORDINANCES

UNDER AUTHORITY OF L.A.M.C. SECTION 98.0403

PERMIT APP. #: 16010-20000-02308

DATE: 9/28/2018

For City Dept. Use Only: Grading

JOB ADDRESS: 1751 Malcolm Av. & 1772 Glendon Av.

Tract: 7803

Block: 15

Lot: 20,19, 11

Owner: Harkham Family Enterprises

Address: 957 San Pedro St. #300

City: LA State: CA Zip: 90014 Phone:

Petitioner: Fix the City

Address: 10558 Kinnard Ave.

City: LA State: CA Zip: 90024 Phone: 310-497-5560

REQUEST (SUBMIT PLANS OR ADDITIONAL SHEETS AS NECESSARY)

CODE SECTIONS:

Revocation of temporary or permanent Certificate of Occupancy

JUSTIFICATION (SUBMIT PLANS OR ADDITIONAL SHEETS AS NECESSARY)

Seismic Hazard, violation of Alquist Priolo Act and City regulations

See attached appeal with exhibits. Fee already paid August 2020

See consultant's report on failure to comply with seismic regulations

Laura Lake, Ph.D — Owner/Petitioner Name (Print)

(Signature)

Secy. Fix the City — Position

FOR CITY DEPARTMENT'S USE ONLY BELOW THIS LINE

Concurrences required from the following Department(s)

	Print Name	Sign	Approved	Denied
☐ Los Angeles Fire Department			☐	☐
☐ Public Works Bureau of Engineering			☐	☐
☐ Department of City Planning			☐	☐
☐ Other			☐	☐

DEPARTMENT ACTION

~~☐ GRANTED~~ ☒ DENIED

Reviewed by: (Staff) (print): Daniel Schneidereit Sign: Date: 12/27/2020

Action taken by: (Supervisor) (print): J. Adolfo Acosta Sign: Date: 12/29/2020

~~CONDITIONS OF APPROVAL~~

REQUEST NOT JUSTIFIED.

FEES

Appeal Processing Fee ... (No. of Items) =	1	$ 130 + $ 35 /addl	$ 130.00
Inspection Fee ... (No. of Insp.) =		x $ 84	$
Research Fee ... (Total Hours Worked) =	7	x $ 104	$ 728.00
Subtotal			$ 858.00
Surcharge (Dev Serv)	$ 858.00	x 3%	$ 25.74
Surcharge (Systems Development)	$ 858.00	x 6%	$ 51.48
Total Fees			$ 935.22

Fees verified by:

Print and Sign: Daniel Schneidereit

For Cashiers Use Only

(PROCESS ONLY WHEN FEES ARE VERIFIED)

Los Angeles Department of Building and Safety
Metro 4th Floor 12/17/2020 10:38:47 AM
User ID: jbitanzcol
Receipt Ref Nbr: 2020352001-42
Transaction ID: 2020352001-42-1
BOARD APPLIC FEE $130.00
SYSTEMS DEV SURCH $51.48
DEV SERV CENTER SURCH $25.74
RESEARCH FEE $728.00
Amount Paid: $935.22
Request Date: 9/28/2018
PCIS Number: 16010-20000-02308
Comments: 1751 MALCOLM AVE. & 1772 GLENDON AVE.

EMAIL: LAURA.LAKE@GMAIL.COM

FIX THE CITY

Laura Lake, Ph.D., Board Secretary, Fix the City

10558 Kinnard Avenue, LA, CA 90024

Laura@FixTheCity.org and Laura.Lake@gmail.com

Cell 310-497-5550

CERTIFIED MAIL/RETURN RECEIPT and Email: Eric.Jakeman@lacity.org

August 3, 2020

RE: REVOCATTION OF **BUILDING PERMIT APPLICATION #16010-20000-02308** AND CERTIFICATE OF OCCUPANCY/TEMPORARY CERTIFICATE OF OCCUPANCY FOR **1751 MALCOLM AVENUE/1772 GLENDON AVENUE**, DUE TO LOCATION IN A NO-BUILD FAULT AREA PER CGS FER 259, LOCALITY 10 (JANUARY 5, 2018).

APPEAL TO BOARD OF BUILDING AND SAFETY COMMISSIONERS

Eric Jakeman, LADBS Seismic Safety Manager

Board of Building and Safety Commissioners

201 N. Figueroa Street, Suite 1030

Los Angeles, CA 90012

Dear Mr. Jakeman and Board of Building and Safety Commissioners:

This is an urgent safety matter. This appeal package and Appeal Form supplements Fix the City's Appeal to the Board of Building and Safety Commissioners (Form PC-Build.Mod 00 (Rev.09-11-2019). We incorporate by reference all LADBS documents for this permit including meeting notes, emails and any other printed material regarding how CGS FER 259 Locality 10 was ignored. We request a written report and consideration by the Board of Building and Safety Commissioners.

In July 2017, the applicant indemnified the City (DIR-2017-342-DRB-SPP, ENV-2017-343-CE).

Fix the City is a nonprofit advocacy organization for public safety and services in Los Angeles. We respectfully call upon the Building and Safety Commission to revoke all approvals for **Building Permit #16010-20000-02308 and deny a Certificate of Occupancy and or revoke any Temporary Certificate of Occupancy for 1751 Malcolm Avenue/1772 Glendon Avenue,** as authorized by LAMC 98.0302.(1(b)(2). Attached is **Exhibit A**, a copy of the building permit application, dated September 28, 2918.

This 18-unit *luxury* rental project is located within the Santa Monica Fault and mapped in accordance with the Alquist Priolo Act. To our knowledge, there are no affordable

units in this project. The project is also located in a Liquefaction Zone and a Methane Zone. Two 2015 geological consultants' seismic investigations were submitted to LADBS for seismic approval. We do not have access to those studies which should be on file in LADBS as well as CGS, which included them as "Locality 10, 1751 Malcolm Avenue" in FER 259, pp. 26-27 and cited below. **Exhibit B** contains FER 259 pages 26-27.

LADBS twice **denied** approval after each study was reviewed. Exhibit B includes the two denials as shown in **Exhibit C,** obtained through LADBS Public Records Act Request19-16472, May 23, 2019.

On January 27, 2016, Daniel Schneidereit of LADBS submitted these expert reports to the California Geological Survey (CGS) as shown in **Exhibit D.** After review, CGS published the results of the study in FER 259 (Fault Evaluation Report 259). This study is the statutory authority to determine seismic hazards.

The Alquist Priolo Act established primacy over cities regarding seismic safety. The City of Los Angeles is required to follow this state law under California Public Resources Code Section 2623(c)(1) (see **Exhibit E**): the city may "establish policies and criteria which are stricter than those established by this chapter." There is no statutory authority to waive state standards and criteria.

The applicant's response to the second denial on December 29, 2015) was an email on January 4, 2016, from Shant Minas, to Daniel Schneidereit and Casey Jensen, objecting to switching review from Daniel Schneidereit to Casey Jensen, and requesting a meeting with the developer and Schneidereit (**Exhibit D**, p. 2/75).[1] There are no new studies referenced in the emails, only a request for a meeting with the developer and Schneidereit. It is not known if this meeting occurred. However, just a few weeks later, on February 1, 2016, LADBS approved the seismic study (**Exhibit F**). Was the basis for this reversal without new substantial evidence to our knowledge, the requested meeting between Schneidereit and the developer?

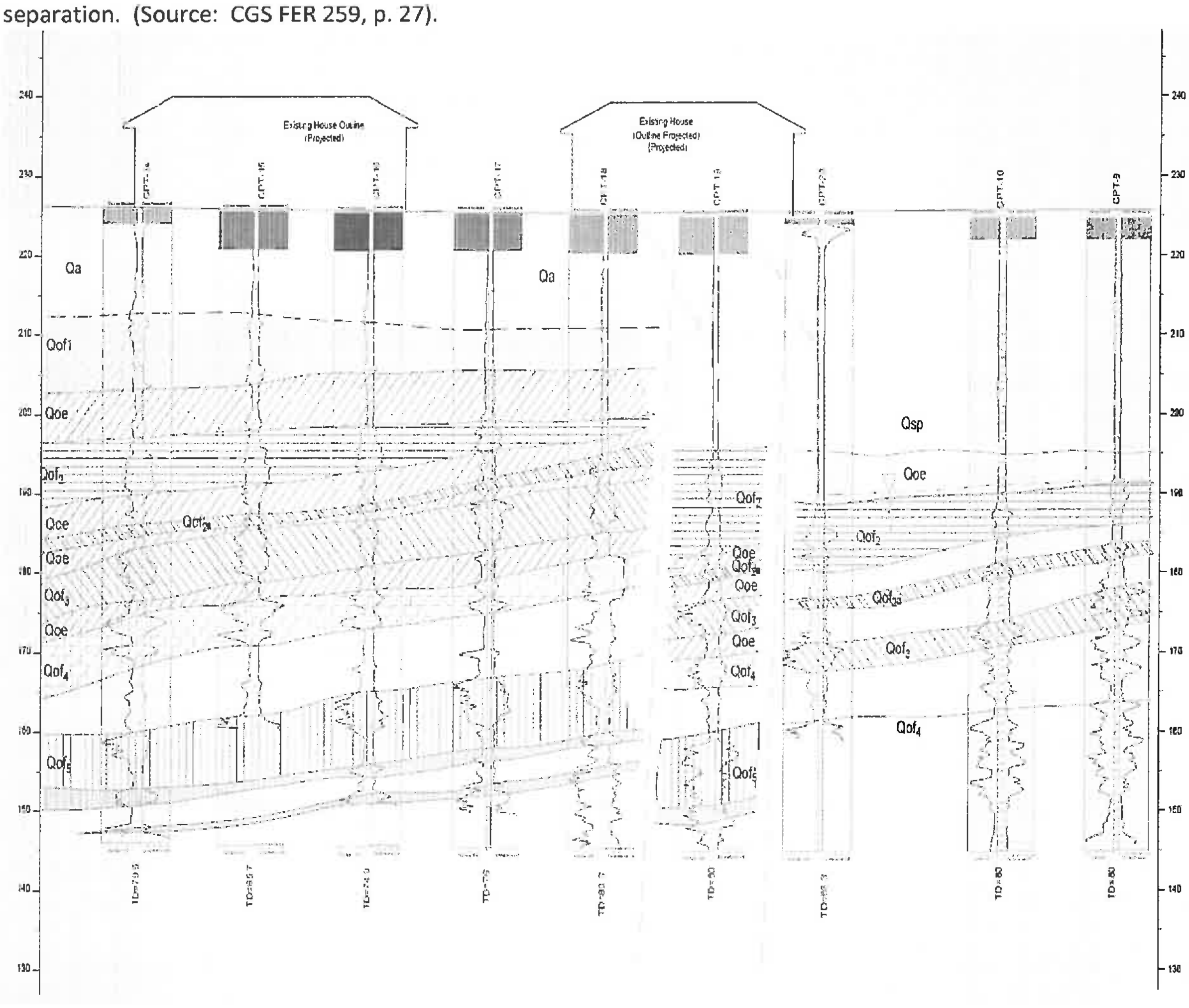
When a new application was submitted in September 2018 (Exhibit A), CGS FER 259 Locality 10 was the official geological authority. It was published nine months prior to the 2018 building permit application. Instead of consulting this report, LADBS ignored it and relied on the February 1, 2016 approval. Again, the basis for approval in 2016 and the failure to consult CGS FER 259 Locality 10 in 2018 remain unexplained. Finally, the

---

[1] "a meeting with Dan [Schneidereit], with client present, to discuss and finalize our response. There have been multiple changes to the building plans already made due to the presence of the fault in the NE portion of the property as previously reported by us, and I would like to minimize any additional future changes by having another meeting." ***Note the fault is in the CENTER of the site, not the northeast.***

mischaracterization of the fault lying in the northeastern area of the site is contradicted by Figure 16 in CGS FER 259, p. 27. The December 29, 2015 denial summary from LADBS (Exhibit C) incorrectly claims the fault was in the **northeastern** portion of the site, when the fault rupture study on page 27 of FER 259 shows it running through the center of the site between *CPT 18 and CPT 19 as shown below.*

CGS FER 259, Figure 16 - Portion of geologic cross section A-A' constructed along Malcolm Avenue by AES (2015b, Drawing 2) looking west. Note the thick sequence of Holocene "sag pond" deposits (Qsp) faulted against broadly folded Pleistocene older fan (Qof) and older estuarine (Qoe) deposits in apparent north-side-down vertical separation. (Source: CGS FER 259, p. 27).



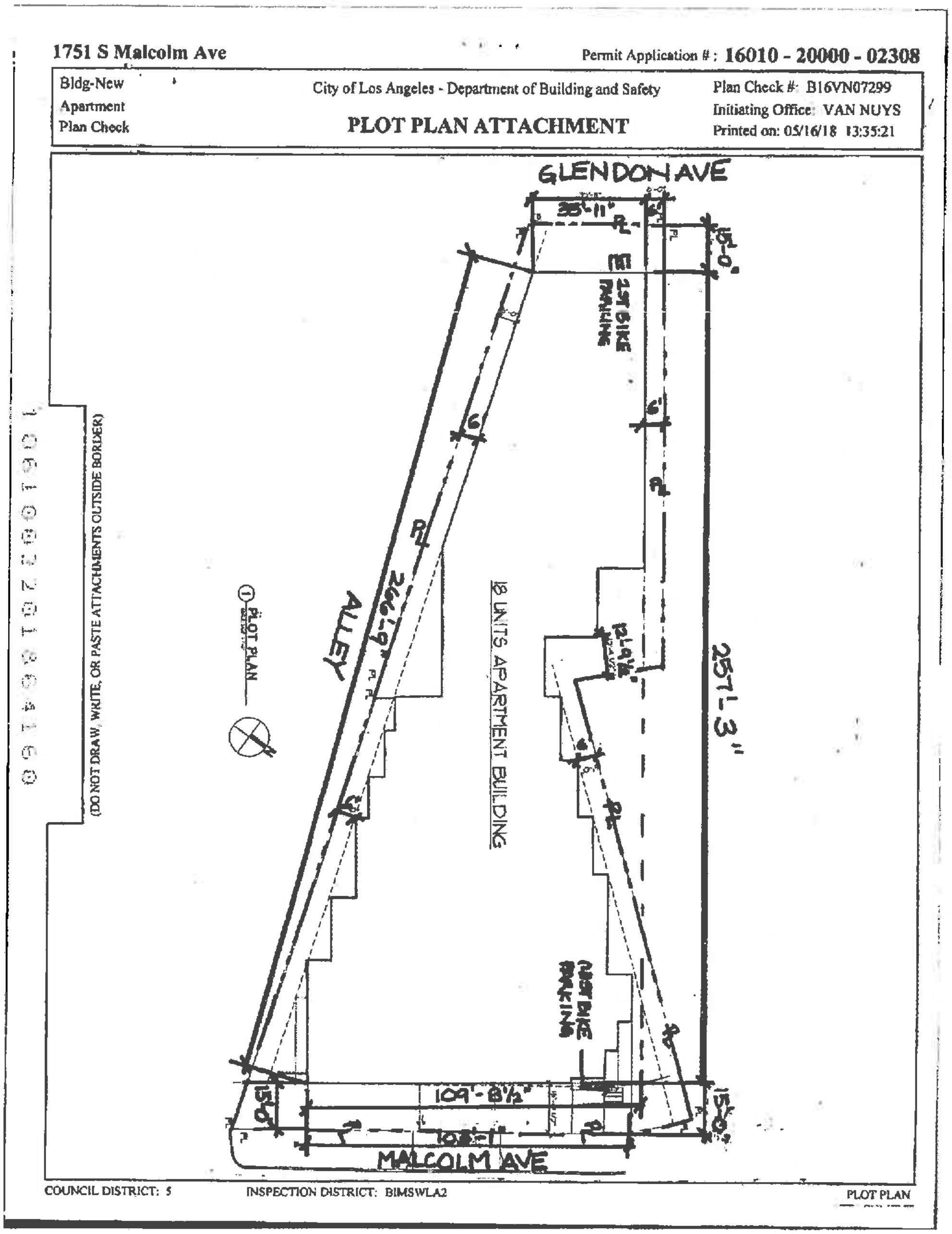
In the absence of new substantial evidence in 2018, LADBS violated the clear language of CGS FER 259, the ultimate authority on fault rupture studies within the Santa Monica Fault. Approval was arbitrary and capricious, not supported by substantial evidence, and directly in conflict with CGS FER 259 and constituted a gross, prejudicial abuse of authority.

1751 Malcolm Avenue is built over the active fault viewed from Malcolm Ave. (Source: Fix the City).

Our concern is not speculative: the two 2015 consultant reports found physical evidence of an active strand of the Santa Monica Fault, as published in CGS FER 259 (pp. 26-27):

> **"Locality 10 - 1749-1751 Malcolm Avenue**
>
> "A combined fault study and geotechnical investigation was performed for a proposed residential development at 1749-1751 Malcolm and 1772 Glendon Avenues by Applied Earth Sciences (2015a, b). The fault investigation consisted of a single transect along Malcolm Avenue constructed from 20 CPTs and three continuous core borings drilled to a maximum depth of about 80 feet. Spacing of CPTs/borings varied from 5 feet (between CPT/boring pairs) to over 25 feet in the public right-of-way, where numerous utilities were located. In their borings, the consultants identified both Holocene alluvium and "sag pond" deposits, along with Pleistocene alluvial and estuarine sediments.
>
> No well-developed paleosols were identified in the core samples, thus the consultants used various gravel and silt layers to correlate between CPTs/borings and look for stratigraphic anomalies that would suggest faulting. Their analysis indicated a thick sequence of Holocene silt and clay (interpreted as "sag pond deposits) was juxtaposed against the older Pleistocene sedimentary package between CPT-18 and CPT-19 (Figure 16). Additionally, they note groundwater was encountered in one boring north of CPT-18 and not in either of the borings down gradient to the south. Based on these findings, they interpret an active strand of the Santa Monica Fault trends through the **immediate vicinity of CPT-18 and CPT-19. Consequently, the consultants established a "no build zone"** (emphasis added).

CPT-18 and CPT-19 are NOT in the northeastern portion of the site. They are on the right side of the garage entrance shown in the photo above. The plot plan attached to the building permit, shown on the next page, shows that the entire site was built over with a few zig-zags on the northern boundary and not around CPT 18 and CPT 19.



LADBS grossly abused its authority and put the lives of the 18 families at risk, in violation of the very laws and regulations enacted to protect human life. Approval approve the site, both state law and city laws were violated, as well as the adopted policies and procedures in LADBS publications mandating CGS reports as stated on the first page of both publications (P/BC 2020-113, P/BC 2020-129) included in **Exhibit G.**

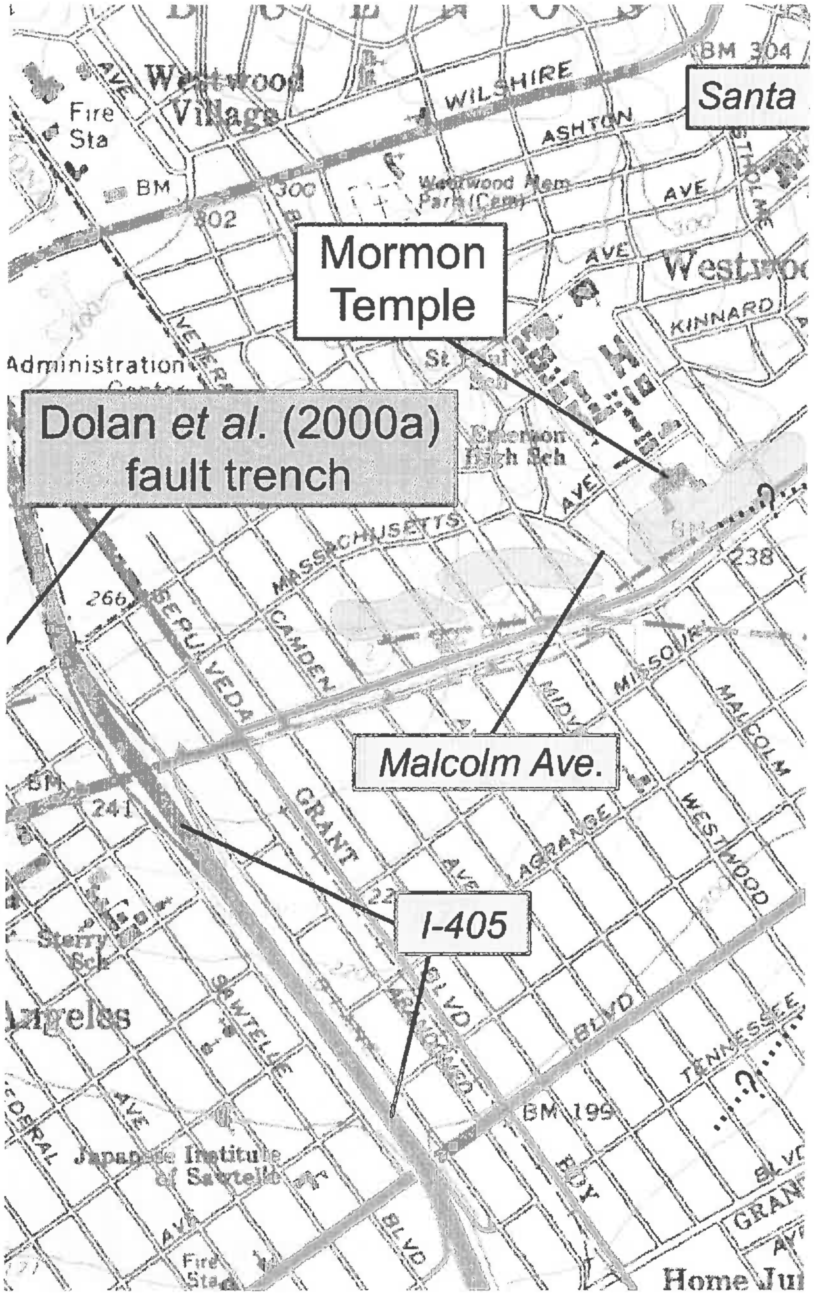


Plate 1, CGS FER 259 (subsection showing Malcolm Avenue site).

In addition to violating CPR Section 2623(c)(1), LADBS violated LAMC 91.106.4.1. Exception 4:

> "4. The department shall have the authority to withhold permits on projects located within a Special (Fault) Studies Zone established under Chapter 7.5, Division 2, of the California Public Resources Code. Permits may be issued if it

can be demonstrated through accepted geologic seismic studies that the proposed structure will be located in a safe manner and **not over or astraddle the trace of an active fault.** Acceptable geologic seismic studies shall meet the criteria as set forth in rules and regulations established by the Superintendent of Building to assure that such studies are based on sufficient geologic data to determine the location or nonexistence of the active fault trace on a site. Prior to approval of a project, a geologic report defining and delineating any hazard of surface fault rupture shall be required. If the city finds that no undue hazard of this kind exists, the geologic report on such hazard may be waived, with approval of the state geologist."

This project has been built over/astraddle an active fault. On the basis of Locality 10, FER 259, Fix the City requests that LADBS revoke all approvals and temporary Certificate of Occupancy or permanent CofO. Please note LADBS Public Records Act Request PR 19-16472, May 23, 2019, (Exhibit D), shows Mr. Schneidereit's knowledge and awareness of FER 259.

Please determine if there was a meeting between the applicant and Mr. Schneidereit, during January 2016, and any meeting notes, a third surface fault rupture study for this site that could support seismic approval in 2016. The study, if it exists, would have been conducted between December 29, 2015 and February 1, 2016.

Note that documented in the Public Records Act request (Exhibit D), the very studies that were ignored for 1751 Malcolm building permit application in 2018, were sent to consultants for nearby projects by Mr. Schneidereit and that the week before LADBS reversed its two seismic denials, on January 27, 2016, Daniel Schneidereit, LADBS Engineering Geologist I, sent these consultants reports to the state (to Brian Olson, the author of the CGS FER 259). CGS reviewed the studies and then included them in FER 259.

FER 259 is binding upon the City. It cannot under state law, impose weaker conditions. **The no-build area is required, and it is in the center of the site, not the northeastern edge, based on Figure 16 in FER 259**. Based on his sending the 2016 studies to CGS, and his two previous denials, Mr. Schneidereit was clearly aware of the role of CGS in regulating surface rupture fault investigations and of the recommendation for a no-build area.

Upon receipt of a new building permit application in 2018, the City (LADBS) was obligated to consult FER 259, which would have required a no build area in the center of the site. He failed to issue a new review under the 2018 FER 259 report. Instead, he relied upon his sudden approval in 2016, and his misrepresentation in 2015 of where the fault was on the site. It is not as he stated, in the northeastern area. As far as we know, his 2016 approval was not based on a new study. Even if it was, he was required to consult FER 259 in 2018 to approve the new building permit application.

The 2018 building permit application was required to be processed under current laws and regulations and must be **revoked along with any Certificate of Occupancy.**

IMMEDIATE CORRECTIVE ACTION REQUIRED

State and City laws protecting human life must be obeyed in order to protect the 18 families slated to live at 1751 Malcolm Avenue. LADBS does not have authority to override CGS's reports. It must follow FER 259 and CGS Special Publication 42 and Note 49, as well as California Resources Code Section 2623(c)(1) (Exhibit E). These state publications provide the requirements for surface rupture investigations. It appears that these procedures were followed and the results willfully and prejudicially ignored by LADBS.

Any google search for seismic information at this address yields the state report. Approval for seismic safety for this project on February 1, 2016, was contradicted by the two site investigations conducted in 2015, and prohibited by FER 259, which was published nine months prior to the new building permit application and could not lawfully be ignored.

The failure to follow state requirements and the city's own Building Code, and its policies and procedures (Exhibit F) is a significant, substantial abuse of authority that imperils public safety, the first priority of local government under the California Constitution (Art. XIII, Section 35).

LADBS unlawfully ignored the 2018 state report and instead recycled its unexplained and unsupported approval in early 2016, despite two reports and CGS FER 259. Keep in mind that those studies were not just nearby sites, *they were for this exact property.*

New permit applications must conform with current law and regulation. Whatever the basis of the City's geologist ignoring the 2015 study, the 2018 state report could not be lawfully ignored. Based on the consultant's reports forwarded to CGS by Mr. Schneidereit, city staff knew full well that this was a no-build site approximately in the center of the site. In fact, they sent those studies to other developers seeking seismic investigations for new projects (see emails from LADBS and consultants, attached, 75 pp.).

There are ample staff emails in Exhibit D that show that staff communicated with the developer and representative, and demanded that only Daniel Schneidereit should review the project. Do clients choose the staff or does the manager?

Finally, there is no subsequent 2018 approval by Schneidereit. Instead, the old approval was used, despite the CGS report being published nine months prior to the submission of the current building permit application. The City does not have authority to ignore this vital state law. LADBS Seismic staff have failed to uphold city and state laws designed to protect public safety. CGS FER 259 pp. 26-27 are attached.

LADBS Document No. P/BC 2020-129 states a research requirement for surface fault rupture studies to "Search City and State records for fault investigation reports for properties in the site vicinity." This very site was studied in CGS FER 259! Had LADBS staff studied the current state study at the time of the current permit application. knowing it was within a fault study zone, it would have been prohibited from issuing any approvals. For example, a mat foundation cannot be substituted for a no-build area, and there is no evidence that LADBS consulted either CGS FER 259 or the two reports it had received. There is no evidence in the record supporting approval.

The application for this project's building permit and certificate of occupancy was filed on September 28, 2018, nine months after CGS FER 259 Locality 10, 1749-1751 Malcolm Avenue designated a no-build area on January 5, 2018.

This approval violated both CGS regulations, the Alquist Priolo Act, and LADBS P/BC 2020-113 and LADBS P/BC-2020-129 which specific the requirements for seismic investigations.

We enclose the Appeal form, payment of $130, and supporting documentation.

Sincerely,

Laura Lake

Laura Lake, Ph.D.

Board Secretary, Fix the City

LIST OF EXHIBITS

A Building permit application #16010-20000-02308 for 1751 Malcolm Avenue/1772 Glendon Avenue, submitted September 28, 2018

B California Geological Survey FER 259, pp. 26-27 (January 5, 2018).

C LADBS denials of seismic safety in 2015 and letter dated December 29, 2015.

D LADBS Public Records Act response PR19-16472, p. 1 of 75 pages of emails, transmitting second surface fault rupture study for 1751 Malcolm Avenue to CGS, from Daniel Schneidereit to Brian Olson, author of FER 259, dated January 27, 2016.

E California Public Resources Code Section 2623(a)-(c)

F LADBS Document Report soils & geology file approved, February 1, 2016.

G LADBS Information Bulletin/Public-Building Code, P/BC 2017-113 (previously issued as P/BC 2014-113; P/BC 2020-113, "Contents of Reports for Submittal to LADBS Grading Division," and P/BC 2020-129 "Surface Fault Rupture Hazard Investigations.

Laura Lake, Ph.D., Board Secretary, Fix the City

10558 Kinnard Avenue, LA, CA 90024

Laura@FixTheCity.org and Laura.Lake@gmail.com

Cell 310-497-5550

CERTIFIED MAIL/RETURN RECEIPT

Email: Daniel.Schneidereit@lacity.org

Second mailing to replace lost certified, return receipt package, at the request of Daniel Schneidereit, LADBS

November 10, 2020

RE: REVOCATTION OF **BUILDING PERMIT APPLICATION #16010-20000-02308** AND CERTIFICATE OF OCCUPANCY/TEMPORARY CERTIFICATE OF OCCUPANCY FOR **1751 MALCOLM AVENUE & 1772 GLENDON AVENUE**

Daniel Schneidereit, LADBS Seismic Safety Manager

201 N. Figueroa Street, 12th Floor

Los Angeles, CA 90012

Dear Mr. Schneidereit:

Fix the City is a nonprofit advocacy organization for public safety and services in Los Angeles. We respectfully call upon the Building and Safety Commission to revoke all approvals for **Building Permit #16010-20000-02308 and deny a Certificate of Occupancy and or revoke any Temporary Certificate of Occupancy for 1751 Malcolm Avenue/1772 Glendon Avenue,** as authorized by LAMC 98.0302.(1(b)(2).

This appeal package and Appeal Form supplements Fix the City's Appeal to the Board of Building and Safety Commissioners (Form PC-Build.Mod 00 (Rev.09-11-2019), which is attached. The fee has already been paid. Proof of receipt of the original appeal has been provided. You have stated to me that you never received this appeal, and requested that I resubmit, without a new fee, with you as the recipient. This mailing constitutes Fix the City's response.

In addition, our board has hired a licensed geologist, Kenneth Wilson (Wilson Geosciences, Inc), to review the record. He concluded in his attached report (Exhibit H), that the seismic approvals do not follow state and city requirements. We therefore repeat our request to revoke the certificate of occupancy or temporary occupancy based on the substantial evidence in the record. Mr. Wilson's c.v. is attached in Exhibit I.

Mr. Wilson's review, which is enclosed, flags several errors in the approval process for this building that support a revocation. The key safety concerns addressed in this complaint are:

- There is no evidence in the record supporting the reduction from 10 to 20-feet no-build area in the absence of additional data points to determine fault orientation, other than a private meeting between Mr. Schneidereit and the applicant. No new investigation was provided to support reducing the no-build area.
- A one-foot cantilever does not mitigate an estimated 3-6-foot displacement.
- The no-build area for 1751 Malcolm does not conform with the data points between CPT 18 and 19 per CGS FER 259.
- The cantilevered structure at 1751 Malcolm over the no-build area violates LAMC 91.106.4.1 Exception 4.[1]
- There is a **second fault** line along the alley for both 1772 Glendon and 1751 Malcolm that was not investigated (see Figures 1 and 2). Under the Alquist Priolo Act Section 3603(a), the City lacks authority to waive a 50-foot no-build zone from the property line for 1772 Glendon and 1751 Malcolm along the southern boundary of the site in the absence of a fault investigation. *None was conducted for the southern fault.*

> "The following specific criteria shall apply within earthquake fault zones and shall be used by affected lead agencies in complying with the provisions of the Act: (a) No structure for human occupancy, identified as a project under Section 2621.6 of the Act, shall be permitted to be placed across the trace of an active fault."
>
> "Furthermore, as the area within fifty (50) feet of such active faults shall be presumed to be underlain by active branches of that fault unless proven otherwise by an appropriate geologic investigation and report prepared as specified in Section 3603(d) of this subchapter, no such structures shall be permitted in this area." ((Alquist Priolo Act, Section 3603(a))

---

[1] In addition to violating CPR Section 2623(c)(1), LADBS violated LAMC 91.106.4.1. Exception 4: "4. The department shall have the authority to withhold permits on projects located within a Special (Fault) Studies Zone established under Chapter 7.5, Division 2, of the California Public Resources Code. Permits may be issued if it can be demonstrated through accepted geologic seismic studies that the proposed structure will be located in a safe manner and ***not over or astraddle the trace of an active fault.*** Acceptable geologic seismic studies shall meet the criteria as set forth in rules and regulations established by the Superintendent of Building to assure that such studies are based on sufficient geologic data to determine the location or nonexistence of the active fault trace on a site. Prior to approval of a project, a geologic report defining and delineating any hazard of surface fault rupture shall be required. If the city finds that no undue hazard of this kind exists, the geologic report on such hazard may be waived, with approval of the state geologist." (emphasis added).

- There was no investigation of the southern fault along the alley. Therefore, there must be a 50-foot no-build area along the alley fault line for 1772 Glendon and 1751 Malcolm.

We incorporate by reference all LADBS documents for this permit including meeting notes, emails and any other printed material regarding project approval.

Attached is **Exhibit A**, a copy of the building permit application, dated September 28, 2918. We request a written report from LADBS in response to this complaint. ***On the basis of Locality 10, FER 259, and the failure to conduct investigations of the southern fault, Fix the City requests that LADBS revoke all approvals and temporary Certificate of Occupancy or permanent CofO.***

Please note LADBS Public Records Act Request PR 19-16472, May 23, 2019, ***(Exhibit D), shows Mr. Schneidereit's knowledge and awareness of FER 259.*** *Yet when the building permit application was filed in 2018, there is no evidence in the record that LADBS consulted and complied with FER 259. Instead, LADBS relied upon the 2016 approval.*

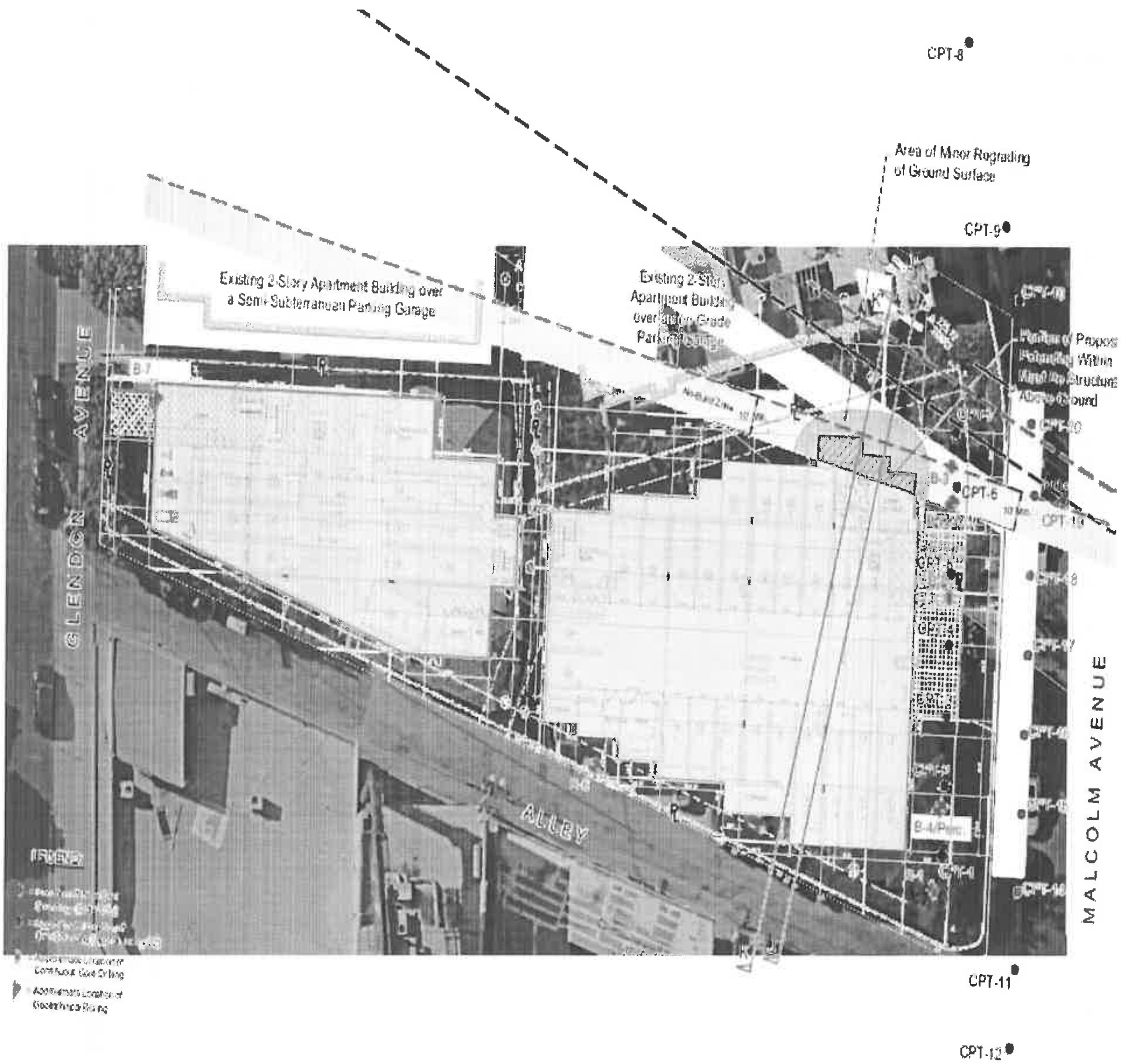


Figure 1. Fault line at southern boundary of 1772 Glendon Avenue not investigated – requires 50-foot setback.

Figure 2 Entire site within Santa Monica Fault Zone with second red fault line at south

The City does not have authority to waive the study and waive the required 50-foot setback. Under **California Resources Code Section 2623** the City may impose stricter requirements, but may not substitute weaker local requirements.

Furthermore, with *only one point of measurement*, it was impossible to determine the trend line for the fault on 1751 Malcolm, as admitted in the August 19, 2015 Correction letter signed by Daniel Schneidereit: *""Additional exploration is required to determine the fault's trend in at least two locations to warrant the recommended reduced setback "* [from 20-feet to 10-feet].

Please note that the second report and Correction Letter signed by Casey Jensen on December 29, 2015, recommended a setback "of ***at least*** 20 feet from the fault splay..." (emphasis added). Yet without additional physical investigation, and only a meeting on January 13, 2016 with the applicant, on February 1, 2016, Daniel Schneidereit reduced the 20-foot setback to ten-feet and allowed the structure over the fault by cantilevering the elevator and lobby area over the no-build zone. This approval was therefore

arbitrary and capricious and a gross abuse of authority, putting the public at risk, in violation of state and city laws.

This approval clearly violates AP because it is a building for human occupancy over a known fault. No build means no build. Placing an elevator and lobby --- escape routes, over a known fault is in direct violation of state law enacted to protect public safety.

Based on CGS and USGS fault lines within the AP Fault Map for this site, the ***City failed to require an investigation of the fault on the southern boundary*** of 1772 Glendon Avenue and 1751 Malcolm Avenue *as shown above in Figures 1 and 2.* ***This was a gross prejudicial abuse of authority***.

Background

In July 2017, the applicant indemnified the City (DIR-2017-342-DRB-SPP, ENV-2017-343-CE).

This 18-unit *luxury* rental project is located within the Santa Monica Fault and mapped in accordance with the Alquist Priolo Act. To our knowledge, there are no affordable units in this project. The project is also located in a Liquefaction Zone and a Methane Zone. Two 2015 geological consultants' seismic investigations were submitted to LADBS for seismic approval. We do not have access to those studies which should be on file in LADBS as well as CGS, which included them as "Locality 10, 1751 Malcolm Avenue" in FER 259, pp. 26-27 and cited below. **Exhibit B** contains FER 259 pages 26-27.

LADBS twice **denied** approval after each study was reviewed. Exhibit B includes the two denials as shown in **Exhibit C,** obtained through LADBS Public Records Act Request19-16472, May 23, 2019.

On January 27, 2016, Daniel Schneidereit of LADBS submitted these expert reports to the California Geological Survey (CGS) as shown in **Exhibit D.** After review, CGS published the results of the study in FER 259 (Fault Evaluation Report 259). This study is the statutory authority to determine seismic hazards.

The Alquist Priolo Act established primacy over cities regarding seismic safety. The City of Los Angeles is required to follow this state law under California Public Resources Code Section 2623(c)(1) (see **Exhibit E**): the city may "establish policies and criteria which are stricter than those established by this chapter." There is no statutory authority to waive state standards and criteria.

The applicant's response to the second denial on December 29, 2015) was an email on January 4, 2016, from Shant Minas, to Daniel Schneidereit and Casey Jensen, objecting to switching review from Daniel Schneidereit to Casey Jensen, and requesting

a meeting with the developer and Schneidereit (**Exhibit D**, p. 2/75).[2] There are no new studies referenced in the emails, only a request for a meeting with the developer and Schneidereit. It is not known if this meeting occurred. However, just a few weeks later, on February 1, 2016, LADBS approved the seismic study (**Exhibit F**). Was the basis for this reversal without new substantial evidence to our knowledge, the requested meeting between Schneidereit and the developer?

When a new application was submitted in September 2018 (Exhibit A), CGS FER 259 Locality 10 was the official geological authority. It was published nine months prior to the 2018 building permit application. Instead of consulting this report, LADBS ignored it and relied on the February 1, 2016 approval. Again, the basis for approval in 2016 and the failure to consult CGS FER 259 Locality 10 in 2018 remain unexplained. Finally, the mischaracterization of the fault lying in the northeastern area of the site is contradicted by Figure 16 in CGS FER 259, p. 27.

The December 29, 2015 denial summary from LADBS (Exhibit C) incorrectly claims the fault was in the **northeastern** portion of the site, when the fault rupture study on page 27 of FER 259 shows it running through the center of the site between *CPT 18 and CPT 19 as shown below in Figure 3.*

[2] "a meeting with Dan [Schneidereit], with client present, to discuss and finalize our response. There have been multiple changes to the building plans already made due to the presence of the fault in the NE portion of the property as previously reported by us, and I would like to minimize any additional future changes by having another meeting." ***Note the fault is in the CENTER of the site, not the northeast.****, and there is a second fault along the southern boundary of the property that is never addressed.*

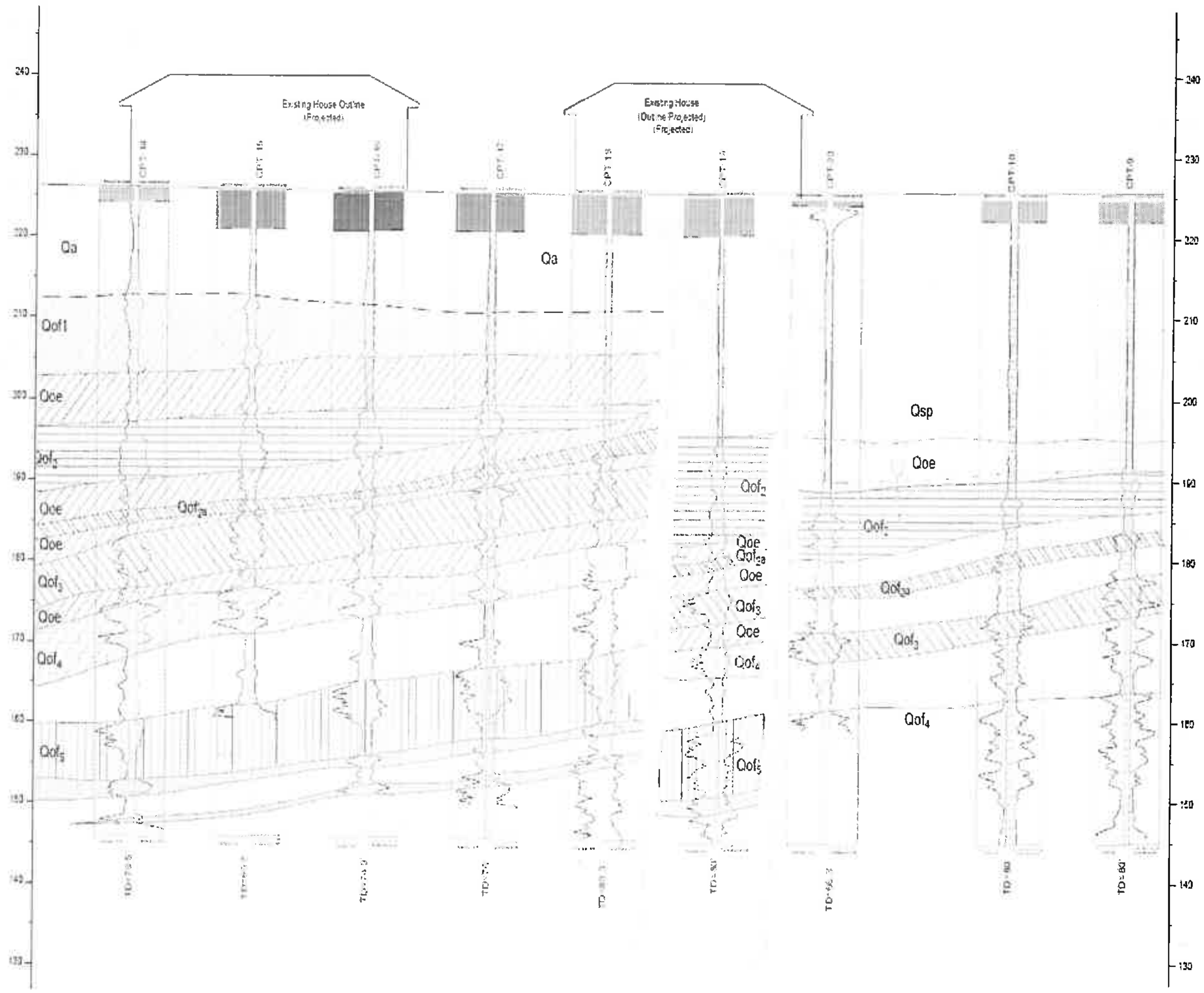
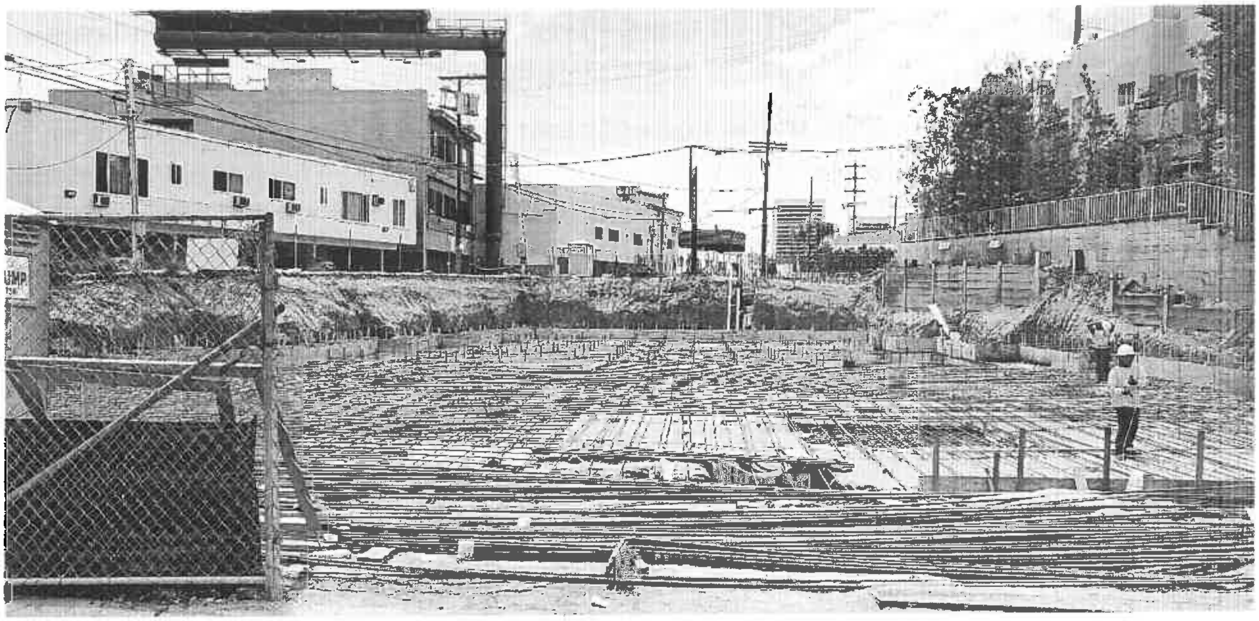


Figure 3 *CGS Figure 16: Portion of geologic cross section A-A" constructed along Malcolm Avenue by AES (2015b), Drawing 2) looking west. Note the thick sequence oF Holocene "sag pond" deposits (Qsp) faulted against broadly folded Pleistocene older fan (Qof) and older estuarine (Qoe) deposits in apparent north-south-sown vertical separation. Source: CGS FER 259, p. 27.*

In the absence of new substantial evidence in 2018, LADBS violated the clear language of CGS FER 259, the ultimate authority on fault rupture studies within the Santa Monica Fault. Approval was arbitrary and capricious, not supported by substantial evidence, and directly in conflict with CGS FER 259 and constituted a gross, prejudicial abuse of authority.



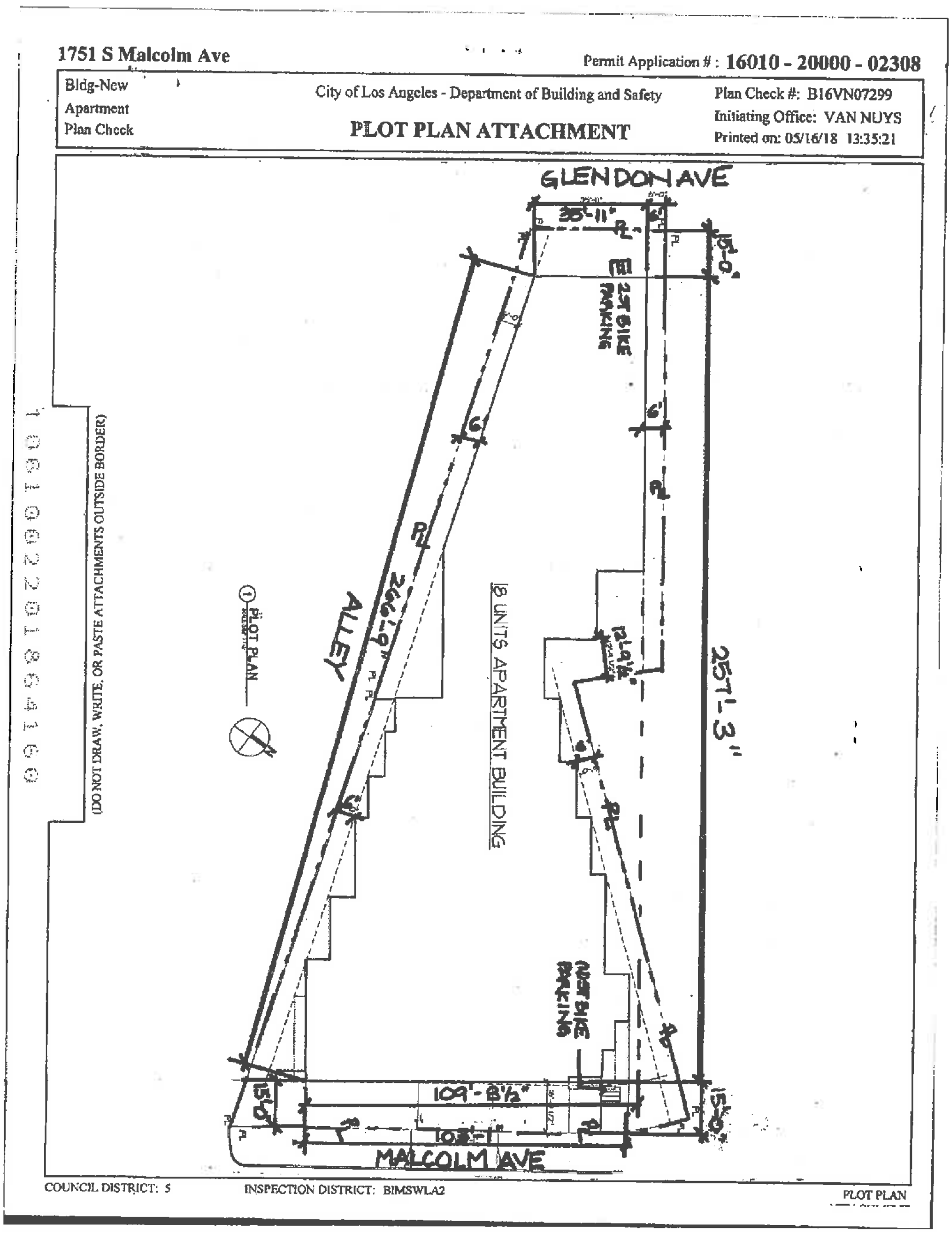
1751 Malcolm Avenue is built over the active fault viewed from Malcolm Ave. (Source: Fix the City).

Our concern is not speculative: the two 2015 consultant reports found physical evidence of an active strand of the Santa Monica Fault, as published in CGS FER 259 (pp. 26-27):

> **"Locality 10 - 1749-1751 Malcolm Avenue**
>
> "A combined fault study and geotechnical investigation was performed for a proposed residential development at 1749-1751 Malcolm and 1772 Glendon Avenues by Applied Earth Sciences (2015a, b). The fault investigation consisted of a single transect along Malcolm Avenue constructed from 20 CPTs and three continuous core borings drilled to a maximum depth of about 80 feet. Spacing of CPTs/borings varied from 5 feet (between CPT/boring pairs) to over 25 feet in the public right-of-way, where numerous utilities were located. In their borings, the consultants identified both Holocene alluvium and "sag pond" deposits, along with Pleistocene alluvial and estuarine sediments.
>
> No well-developed paleosols were identified in the core samples, thus the consultants used various gravel and silt layers to correlate between CPTs/borings and look for stratigraphic anomalies that would suggest faulting. Their analysis indicated a thick sequence of Holocene silt and clay (interpreted as "sag pond deposits) was juxtaposed against the older Pleistocene sedimentary package between CPT-18 and CPT-19 (Figure 16). Additionally, they note groundwater was encountered in one boring north of CPT-18 and not in either of the borings down gradient to the south. Based on these findings, they interpret an active strand of the Santa Monica Fault trends through the

immediate vicinity of CPT-18 and CPT-19. Consequently, the consultants established a "no build zone" (emphasis added).

CPT-18 and CPT-19 are NOT in the northeastern portion of the site. They are on the right side of the garage entrance shown in the photo above. The plot plan attached to the building permit, shown on the next page, shows that the entire site was built over with a few zig-zags on the northern boundary and not around CPT 18 and CPT 19.



LADBS grossly abused its authority and put the lives of the 18 families at risk, in violation of the very laws and regulations enacted to protect human life. Approval approve the site, both state law and city laws were violated, as well as the adopted policies and procedures in LADBS publications mandating CGS reports as stated on the first page of both publications (P/BC 2020-113, P/BC 2020-129) included in **Exhibit G.**

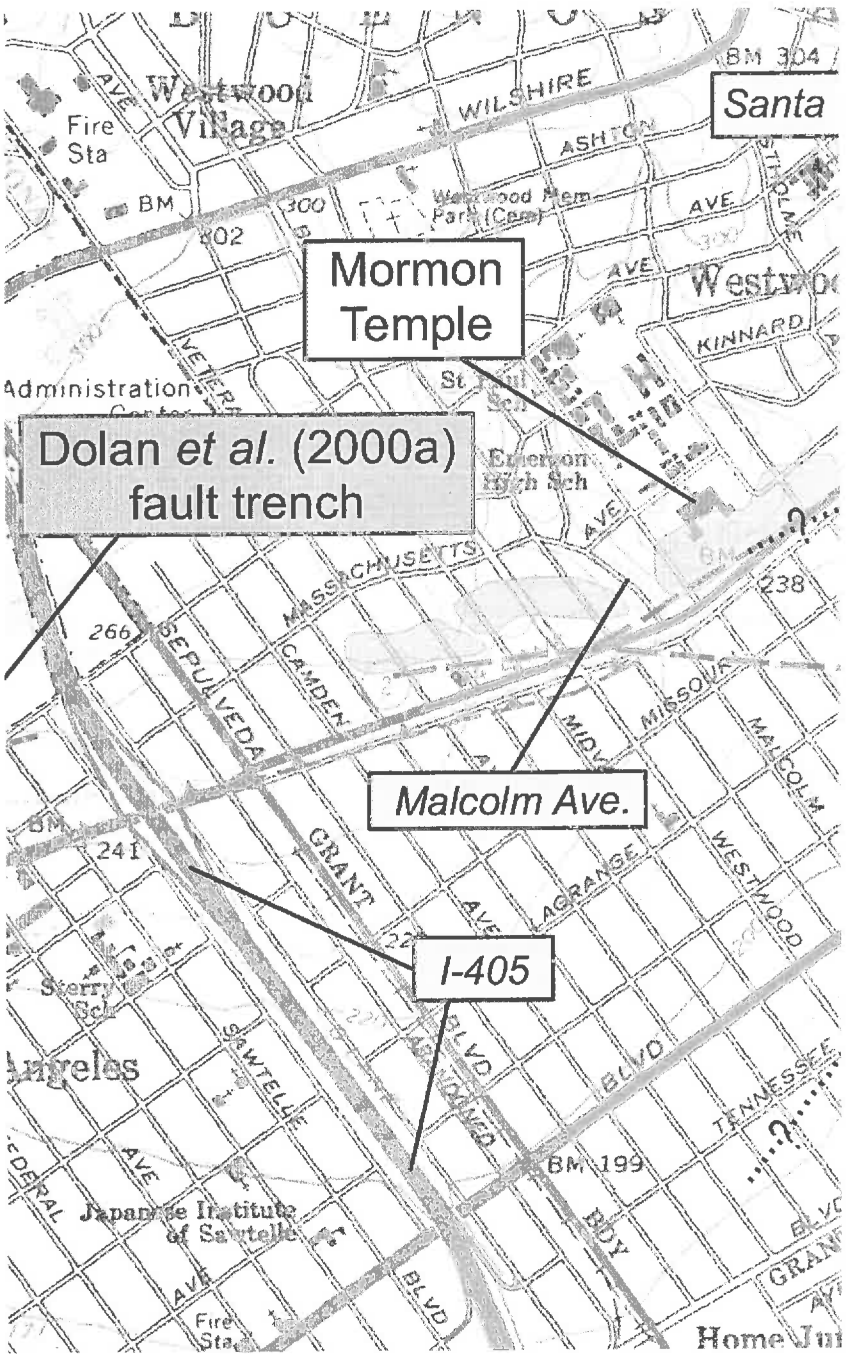


Plate 1, CGS FER 259 (subsection showing Malcolm Avenue site).

Please determine if there was a meeting between the applicant and Mr. Schneidereit, during January 2016, and any meeting notes, a third surface fault rupture study for this site that could support seismic approval in 2016. The study, if it exists, would have been conducted between December 29, 2015 and February 1, 2016.

Note that documented in the Public Records Act request (Exhibit D), the very studies that were ignored for 1751 Malcolm building permit application in 2018, were sent to consultants for nearby projects by Mr. Schneidereit and that the week before LADBS reversed its two seismic denials, on January 27, 2016, Daniel Schneidereit, LADBS Engineering Geologist I, sent these consultants reports to the state (to Brian Olson, the author of the CGS FER 259). CGS reviewed the studies and then included them in FER 259.

FER 259 is binding upon the City. It cannot under state law, impose weaker conditions. **The no-build area is required, and it is in the center of the site, not the northeastern edge, based on Figure 16 in FER 259**. Based on his sending the 2016 studies to CGS, and his two previous denials, Mr. Schneidereit was clearly aware of the role of CGS in regulating surface rupture fault investigations and of the recommendation for a no-build area.

Upon receipt of a new building permit application in 2018, the City (LADBS) was obligated to consult FER 259, which would have required a no build area in the center of the site. He failed to issue a new review under the 2018 FER 259 report. Instead, he relied upon his sudden approval in 2016, and his misrepresentation in 2015 of where the fault was on the site. It is not as he stated, in the northeastern area. As far as we know, his 2016 approval was not based on a new study. Even if it was, he was required to consult FER 259 in 2018 to approve the new building permit application.

The 2018 building permit application was required to be processed under current laws and regulations and must be **revoked along with any Certificate of Occupancy.**

IMMEDIATE CORRECTIVE ACTION REQUIRED

State and City laws protecting human life must be obeyed in order to protect the 18 families slated to live at 1751 Malcolm Avenue. LADBS does not have authority to override CGS's reports. It must follow FER 259 and CGS Special Publication 42 and Note 49, as well as California Resources Code Section 2623(c)(1) (Exhibit E). These state publications provide the requirements for surface rupture investigations. It appears that these procedures were followed and the results willfully and prejudicially ignored by LADBS.

Any google search for seismic information at this address yields the state report. Approval for seismic safety for this project on February 1, 2016, was contradicted by the two site investigations conducted in 2015, and prohibited by FER 259, which was published nine months prior to the new building permit application and could not lawfully be ignored.

The failure to follow state requirements and the city's own Building Code, and its policies and procedures (Exhibit F) is a significant, substantial abuse of authority that imperils public safety, the first priority of local government under the California Constitution (Art. XIII, Section 35).

LADBS unlawfully ignored the 2018 state report and instead recycled its unexplained and unsupported approval in early 2016, despite two reports and CGS FER 259. Keep in mind that those studies were not just nearby sites, *they were for this exact property.*

New permit applications must conform with current law and regulation. Whatever the basis of the City's geologist ignoring the 2015 study, the 2018 state report could not be lawfully ignored. Based on the consultant's reports forwarded to CGS by Mr. Schneidereit, city staff knew full well that this was a no-build site approximately in the center of the site. In fact, they sent those studies to other developers seeking seismic investigations for new projects (see emails from LADBS and consultants, attached, 75 pp.).

There are ample staff emails in Exhibit D that show that staff communicated with the developer and representative, and demanded that only Daniel Schneidereit should review the project. Do clients choose the staff or does the manager?

Finally, there is no subsequent 2018 approval by Schneidereit. Instead, the old approval was used, despite the CGS report being published nine months prior to the submission of the current building permit application. <u>The City does not have authority to ignore this vital state law</u>. LADBS Seismic staff have failed to uphold city and state laws designed to protect public safety. CGS FER 259 pp. 26-27 are attached.

LADBS Document No. P/BC 2020-129 states a <u>research requirement</u> for surface fault rupture studies to "Search City and State records for fault investigation reports for properties in the site vicinity." This very site was studied in CGS FER 259! Had LADBS staff studied the current state study at the time of the current permit application. knowing it was within a fault study zone, it would have been prohibited from issuing any approvals. For example, a mat foundation cannot be substituted for a no-build area, and there is no evidence that LADBS consulted either CGS FER 259 or the two reports it had received. There is no evidence in the record supporting approval.

The application for this project's building permit and certificate of occupancy was filed on September 28, 2018, nine months <u>after</u> CGS FER 259 Locality 10, 1749-1751 Malcolm Avenue designated a no-build area on January 5, 2018.

This approval violated both CGS regulations, the Alquist Priolo Act, and LADBS P/BC 2020-113 and LADBS P/BC-2020-129 which specific the requirements for seismic investigations.

There is additional physical evidence of an active surface fault at this site, as shown in the photos below:

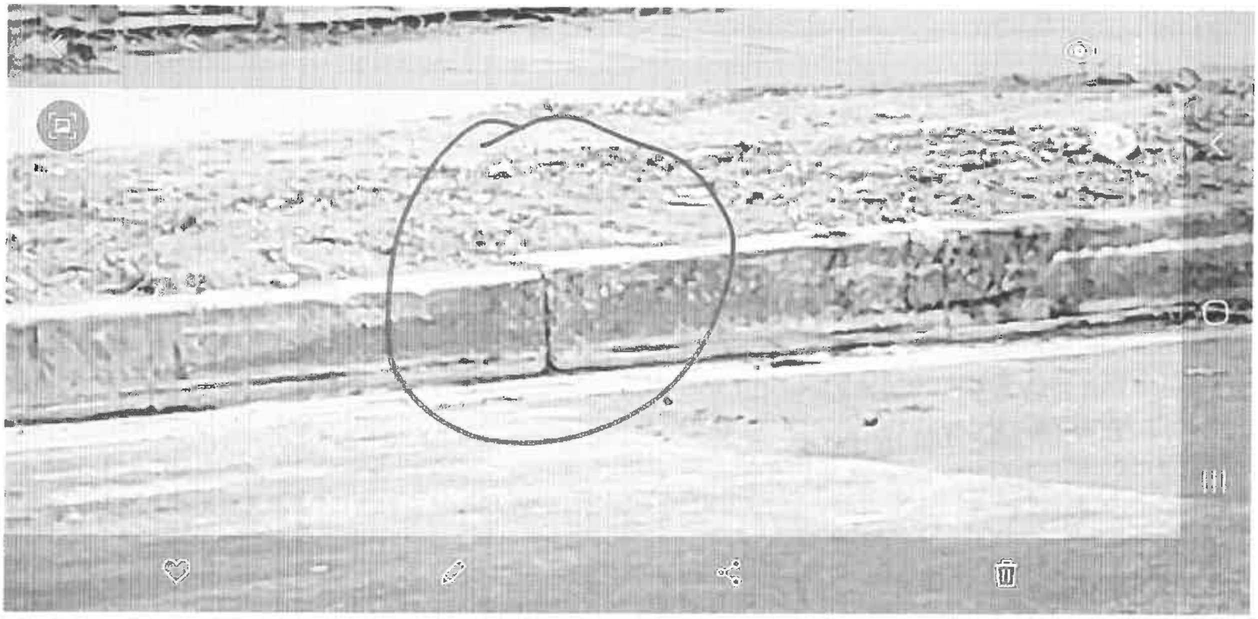


Figure 4 broken curb at fault between CPT 18 and 19

Figure 5 rupture on Malcolm curb in front of no-build area

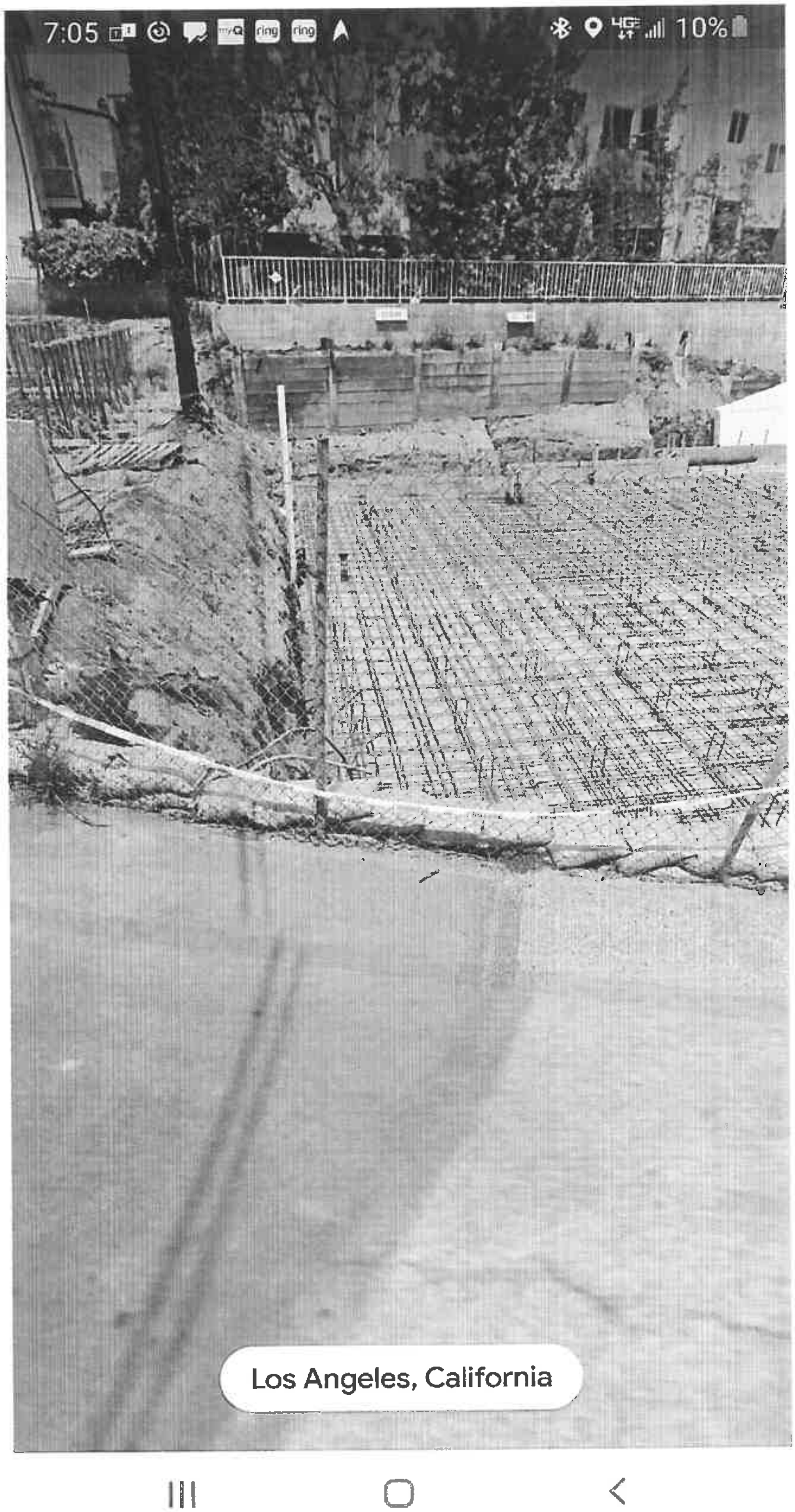


Figure 6 Fault in alley visible

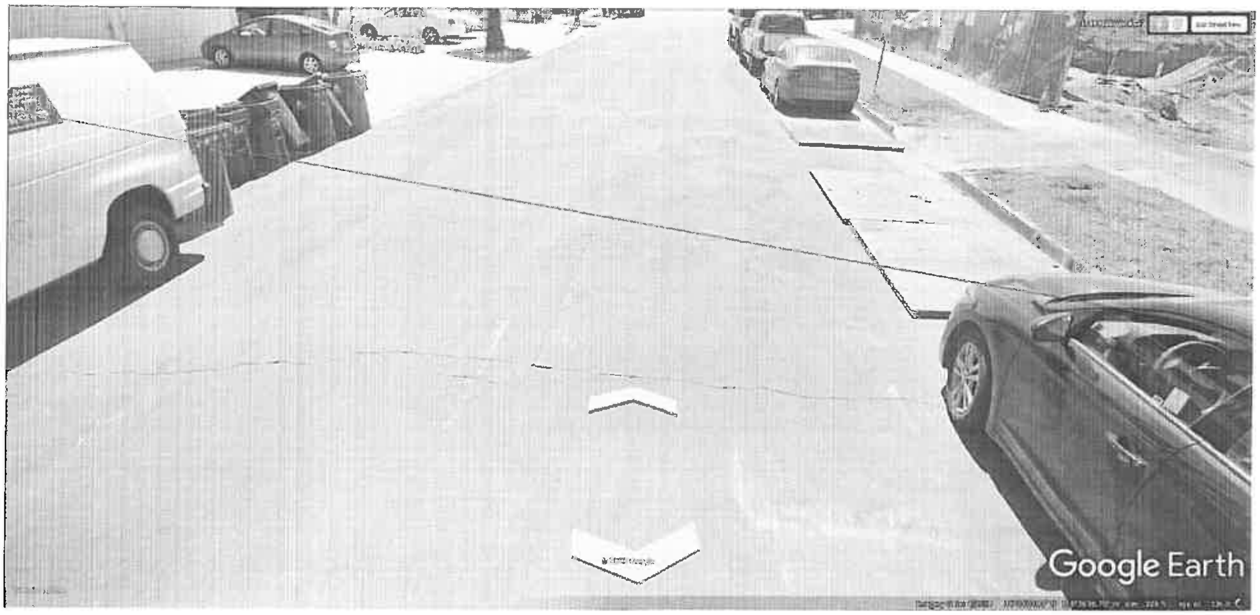


Figure 7 Fault runs across Malcolm into site. Roadway cracks from surface faulting run into site.

We already paid the appeal fee.

Sincerely,

Laura Lake

Laura Lake, Ph.D.

Board Secretary, Fix the City

LIST OF EXHIBITS

A Building permit application #16010-20000-02308 for 1751 Malcolm Avenue/1772 Glendon Avenue, submitted September 28, 2018

B California Geological Survey FER 259, pp. 26-27 (January 5, 2018).

C LADBS denials of seismic safety in 2015 and letter dated December 29, 2015.

D LADBS Public Records Act response PR19-16472, p. 1 of 75 pages of emails, transmitting second surface fault rupture study for 1751 Malcolm Avenue to CGS, from Daniel Schneidereit to Brian Olson, author of FER 259, dated January 27, 2016.

E California Public Resources Code Section 2623(a)-(c)

F LADBS Document Report soils & geology file approved, February 1, 2016.

G LADBS Information Bulletin/Public-Building Code, P/BC 2017-113 (previously issued as P/BC 2014-113; P/BC 2020-113, "Contents of Reports for Submittal to LADBS Grading Division," and P/BC 2020-129 "Surface Fault Rupture Hazard Investigations.

H. Report by Wilson Geosciences on 1751 Malscom Ave. and 1772 Glendon Ave.

I. Kenneth Wilson's c.v.

Report from Wilson Geosciences & Resume

1751 Malcolm Ave. & 1772 Glendon Avenue
RFM 27500

November 23, 2020

Fix the City
10558 Kinnard Avenue
Los Angeles, CA 90024

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

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[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

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[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.

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[22] Milliner, Dolan, and others, 2015

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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

PROFESSIONAL GEOLOGIST
KENNETH LEE WILSON
No. 928
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

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Principal Geologist
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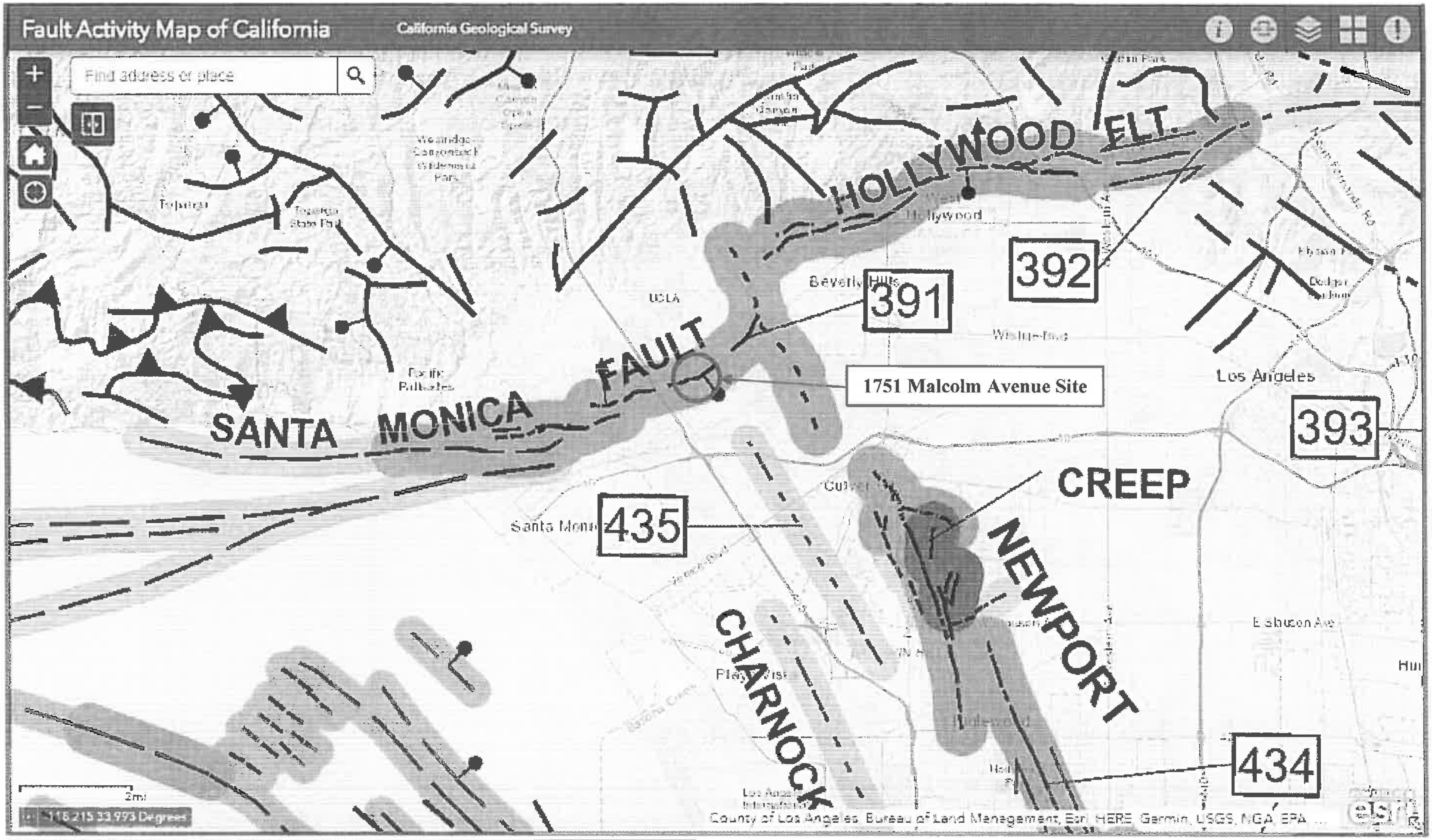
APPENDIX

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

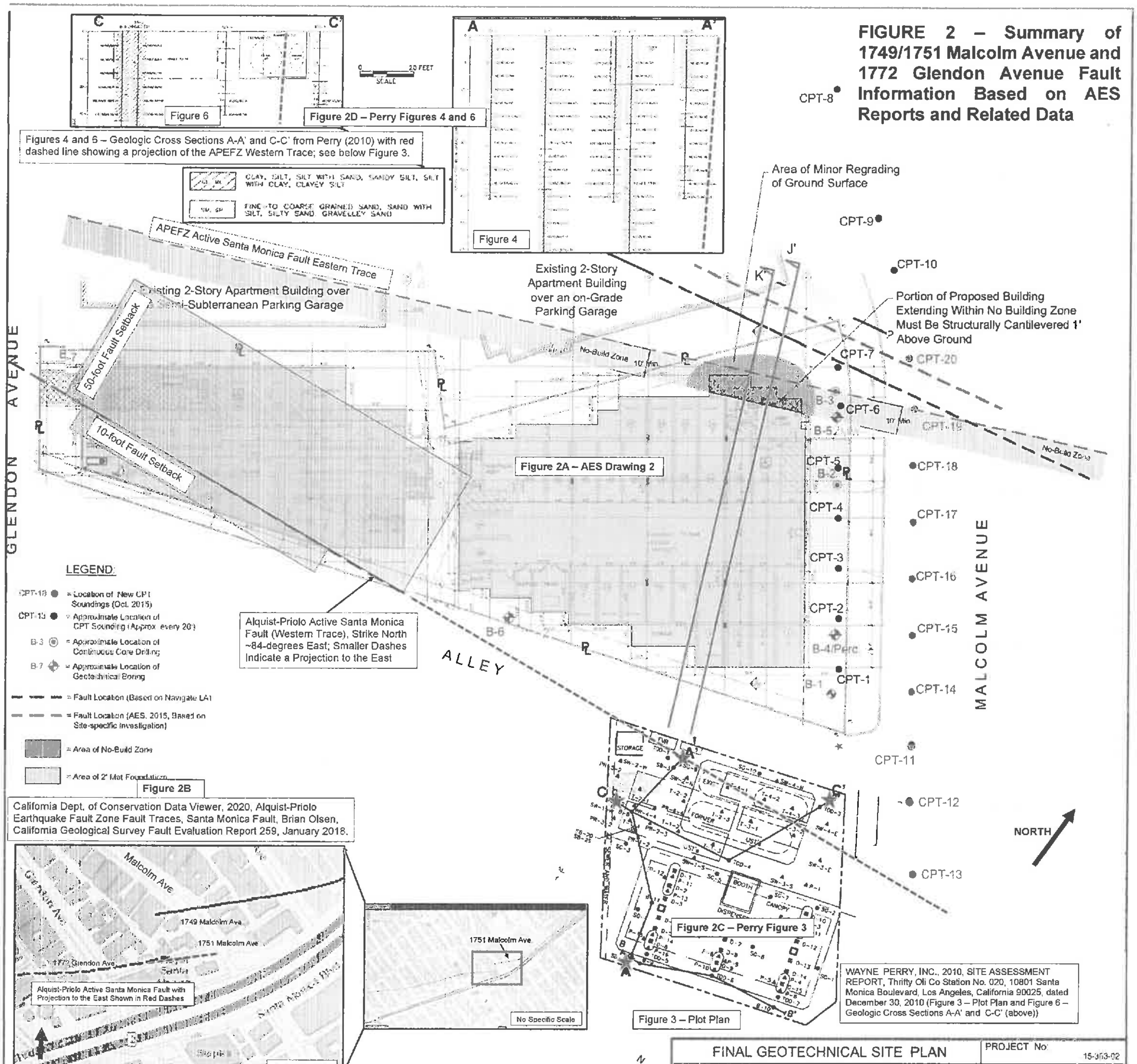
Holocene fault displacement (during past 11,700 years) without historic record

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



FINAL GEOTECHNICAL SITE PLAN		PROJECT No: 15-353-02
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	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.

FIX THE CITY

Appeal to Los Angeles City Building & Safety Commission

RFM 27500

(1751 Malcolm Ave. & 1772 Glendon Ave.)

Appeal and Justification April 16, 2021

Submitted by Fix The City

Laura Lake, Ph.D., Board Secretary

Permit App #:	Job Address:

CONDITIONS OF APPROVAL (Continued from Page 1)

CITY OF LOS ANGELES
BOARD OF BUILDING AND SAFETY/DISABLED ACCESS COMMISSION APPEAL FORM

(Must be Attached to the Modification Request Form, Page 1)

AFFIDAVIT – LADBS BOARD OF BUILDING AND SAFETY COMMISSIONERS – RESOLUTION NO. 832-93

I, Laura Lake do state and swear as follows:
(Print or Type Name of the Person Signing this Form)

1. The name and mailing address of the owner of the property (as defined in the resolution 832-93) at 1751 Malcolm Av. & 1772 Glendon Av. as shown on the appeal application (LADBS Com 31) are correct, and
2. The owner of the property as shown on the appeal application will be made aware of the appeal and will receive a copy of the appeal.

I declare under PENALTY OF PERJURY that the forgoing is true and correct.

Owner's Name(s) Harkham Family Enterprises (Please Type or Print) ______ (Please Type or Print)

Owner's Signature(s) (Please Sign) (Two Officers' Signatures Required for Corporations)

Name of Corporation Fix The City (Please Print Name of Corporation) Laura Lake and Michael Eveloff (Please Type or Print)

Dated this 16 day of April 2021

CALIFORNIA ALL-PURPOSE ACKNOWLEDGEMENT——————**SIGNATURE(S) MUST BE NOTARIZED**

State of CALIFORNIA County of Los Angeles on 4/16/2021

before me, Mehrn Khorramian (Name, Title of Officer (e.g. Jane Doe, Notary Public)) personally appeared Laura Lake & Michael Eveloff (Name(s) of Signer(s))

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument in person(s), or the entity upon behalf of which the person(s) acted, executed the instrument. **I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing is true and correct.**

The appropriate California notary form is attached.

WITNESS my hand and official seal. Signature

As a covered entity under Title II of the Americans with Disabilities Act, the City of Los Angeles does not discriminate on the basis of disability and, upon request, will provide reasonable accommodation to ensure equal access to its programs, services and activities.

APPEAL OF DEPARTMENT ACTION TO THE BOARD OF BUILDING AND SAFETY COMMISSIONERS/DISABLED ACCESS APPEALS COMMISSION

Fix The City (Laura Lake, Ph.D.)	
Applicant's Name	Board Secretary
	Applicant's Title
Signature	4/15/21
	Date

FEES (DEPARTMENT USE ONLY)

Board Fee .... (No. of Items)	1	X $354 +$215/addl	=	354.00
Inspection Fee .... (No of Insp.) =		X 84.00	=	0.00
Research Fee ... (Total Hours Worked) =	2	X 104.00	=	208.00
Subtotal..........			=	562.00
Development Services Center Surcharge		X .03	=	16.86
Systems Development Surcharge		X .06	=	33.72
Total Fees..........			=	612.58

Fees verified by:

Print and Sign ______

For Cashiers Use Only
(PROCESS ONLY WHEN FEES ARE VERIFIED)

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT **CIVIL CODE § 1189**

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California)
County of Los Angeles)

On 04/16/2021 before me, Mehran Khorramian, Notary Public,
Date *Here Insert Name and Title of the Officer*

personally appeared Michael Eveloff & Laura Lake
Name(s) of Signer(s)

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

MEHRAN KHORRAMIAN
COMM. # 2308819
NOTARY PUBLIC - CALIFORNIA
LOS ANGELES COUNTY
MY COMM. EXP. NOV. 9, 2023

Signature ________________
Signature of Notary Public

Place Notary Seal Above

OPTIONAL

Though this section is optional, completing this information can deter alteration of the document or fraudulent reattachment of this form to an unintended document.

Description of Attached Document
Title or Type of Document: Appeal Form
Document Date: N/A Number of Pages: 17
Signer(s) Other Than Named Above: N/A

Capacity(ies) Claimed by Signer(s)

Signer's Name: ________________
☐ Corporate Officer — Title(s): ________________
☐ Partner — ☐ Limited ☐ General
☐ Individual ☐ Attorney in Fact
☐ Trustee ☐ Guardian or Conservator
☐ Other: ________________
Signer Is Representing: ________________

Signer's Name: ________________
☐ Corporate Officer — Title(s): ________________
☐ Partner — ☐ Limited ☐ General
☐ Individual ☐ Attorney in Fact
☐ Trustee ☐ Guardian or Conservator
☐ Other: ________________
Signer Is Representing: ________________

SUPPLEMENTAL APPLICATION FOR APPEALS

RFM27500

TYPE OF APPEAL:
- [x] BUILDING CODE APPEAL
- [ ] ZONING CODE APPEAL
- [ ] INSPECTION / CODE ENFORCEMENT APPEAL

PROJECT TYPE:
- [ ] ONE OR TWO FAMILY RESIDENTIAL
- [x] MULTI-FAMILY RESIDENTIAL
- [ ] COMMERCIAL/INDUSTRIAL

PERMIT APPLICATION: 16010-2000-02308			
ADDRESS: 1751 Malcolm Ave. & 1772 Glendon Avenue			ZIP: 90024
TRACT: 7803	BLK: 15	LOT: 20 19 11	
OWNER NAME: Harkham Family Enterprises	OWNER ADDRESS: 957 San Pedro St. #300, LA, CA		ZIP: 90014

APPLICATION INFORMATION:

NAME: Laura Lake, Ph.D.	ADDRESS: 10558 Kinnard Avenue	ZIP: 90024
EMAIL: Laura.Lake@gmail.com	APPLICANT SIGNATURE:	DATE: 4/15/21

ISSUES:	VIOLATION:	CODE SECTION:
1. See Attached Justification for	Alquist Priolo Act	
RFM 27500	LADBS Seismic Regulations	
Expert Report Provided by Fix		
the City's consultant, Wilson Geosciences		
2.		
3.		

- FOR ADDITIONAL ISSUES, ATTACH TO THIS APPLICATION
- ATTACH ALL APPLICABLE EXHIBITS AND EVIDENCE TO THIS APPLICATION

FIX THE CITY

April 16, 2021

Justification

Appeal to Board of Building and Safety Commissioners #RFM 27500

RE: Seismic Hazards at 1751 Malcolm Avenue and 1772 Glendon Avenue Require Revocation of Building Permit and Certificates of Occupancy

Fix the City is a nonprofit advocacy organization that focuses on public safety and adequate infrastructure in Los Angeles. We are appealing to the Board of Building and Safety Commissioners to enforce the Alquist Priolo Act by reversing the decision by staff regarding issuance of building permits for 1751 Malcolm Avenue and 1772 Glendon Avenue, in spite of documented seismic hazards, in violation of the Alquist Priolo Act and the City's own published regulations.

We incorporate by reference our appeal to LADBS and the report from Wilson Geosciences, Inc. submitted with Fix the City's request for modification.

Seismic hazards are not limited to mega-projects or to Hollywood. This 18-unit luxury Westwood project has been built over a known active fault, contrary to the statement made by B & S as long ago as 2013: **"The city will not permit the construction of new buildings on top of active faults"** (Emphasis added, *LA Weekly*, August 7, 2013, link provided below).

In fact, it is a violation of state law to build over or across a known fault. But that is exactly what B & S authorized for 1751 Malcolm, and it totally ignored the second fault cross the site of 1772 Glendon running along the alley to the south.

We have expended considerable funds to present expert testimony to you, so that you understand exactly which regulations have been violated, and how they were violated. We are prepared to exhaust all remedies to protect public safety and enforce the Alquist Priolo Act.

Fix the City respectfully requests that the Board read our original filing, our consultant's report, and act to stop human occupancy over a known active fault within the Alquist Priolo Fault Zone just north of Santa Monica Boulevard in Westwood. We also request a review of all other new projects during the past few years that are within the Santa Monica Fault Zone.

On December 29, 2020, we received a denial of our appeal regarding seismic hazards for 1751 Malcolm Avenue and 1772 Glendon Avenue. The detailed appeal accompanied by a report from a licensed geologist, was denied with three words: "Request Not Justified," without any further elaboration.

On January 27, 2021, I called Daniel Schneidereit to request an explanation for the denial. He said he would send me an email, which he did send. It was extremely brief and ignored all the points we had so carefully raised and documented.

"Hi Laura,

As we just spoke about, the reason the request of RFM 27500 was denied is because the permit application(s) was submitted to the Department in 2016. The fault investigation was reviewed based on the City standards of that time period, which was prior to the establishment of the AP Zone in that area."

This explanation is inaccurate and ignores many of the other objections. The seismic study was approved in 2016, but the building permit application was submitted in 2018, and Santa Monica Boulevard was an AP Study Zone long before the 2016 seismic approval. Irregularities in seismic approvals are not new to B & S (see https://www.laweekly.com/millennium-hollywood-fault-coverup-emails-show-city-knew/)

Note that our consultant commented that the time elapsed between the seismic study and the building permit warranted a second look. The study was approved in 2015, the Santa Monica Fault was a known Fault Zone requiring study.

The FER 259 was approved many months prior to the issuance of the Building Permit(s). It is the failure to reassess the seismic approval in light of the new state report, prior to the building permit approval, that we challenge. It is also the private meeting that reversed the 20-foot no-build zone, and proposed a one-foot cantilevered portion of the building that we dispute. Our goal is to have the City comply with established state law which prohibits building over or across an active fault.

The denial of our appeal was a prejudicial abuse of authority given the significant seismic hazards on this site. Under the Alquist Priolo Act, the city does not have authority to weaken state regulations regarding adequate seismic investigation and mitigation. Compounding the errors in this review, staff ignored published city regulations during their review. Those publications are included in our original appeal.

- The determination is arbitrary, capricious and without merit as it does not address any of the substantive issues raised in our appeal.
- The determination is arbitrary, capricious and without merit as it has nothing to do with the absence of any study for the unstudied 1772 Glendon building (there is a second fault that was never investigated).
- The determination is arbitrary, capricious and without merit as the building permit(s) was/were issued on 5/16/18 and 9/28/18. Plans were returned for corrections on 2/27/18. FER 259 was published on 1/5/18. There was ample opportunity to check FER 259 prior to the issuance of the building permit.
- The determination failed to address the inadequacy of a 1-foot cantilever over the no-build area and failed to explain why after a private meeting between Mr. Schneidereit and the applicant, the 20-foot no-build area was reduced to 10-feet.
- No investigation was ever made for the fault running along the southern boundary of the site and crossing the footprint of 1772 Glendon Avenue.

We and our consultant stand ready to discuss the review of this site and seek compliance with state regulations which have primacy over city authority.

Most importantly, the reduced no-build zone, the 1-foot cantilever, and the lack of investigation of the second fault on this site are of great concern.

Sincerely,

Laura Lake, Ph.D.

FIX THE CITY

310-497-5550

Laura@FixTheCity.org

Attached: Appeal Form

Appeal to LADBS RFM 27500 (Denied)

MOD # 27500

LADBS

REQUEST FOR MODIFICATION OF BUILDING ORDINANCES

UNDER AUTHORITY OF L.A.M.C. SECTION 98.0403

PERMIT APP. #: 16010-20000-02308	DATE: 9/28/2018	For City Dept. Use Only Grading
JOB ADDRESS: 1751 Malcolm Av. & 1772 Glendon Av.		
Tract: 7803	Block: 15 Lot: 20,19, 11	
Owner: Harkham Family Enterprises	Petitioner: Fix the City	
Address: 957 San Pedro St. #300	Address: 10558 Kinnard Ave.	
City LA State CA Zip 90014 Phone	City LA State CA Zip 90024 Phone 310-497-5560	

REQUEST (SUBMIT PLANS OR ADDITIONAL SHEETS AS NECESSARY) — CODE SECTIONS:

Revocation of temporary or permanent Certificate of Occupancy

JUSTIFICATION (SUBMIT PLANS OR ADDITIONAL SHEETS AS NECESSARY)

Seismic Hazard, violation of Alquist Priolo Act and City regulations

See attached appeal with exhibits. Fee already paid August 2020

See consultant's report on failure to comply with seismic regulations.

Laura Lake, Ph.D — (Signature) — Secy. Fix the City

Owner/Petitioner Name (Print) — (Signature) — Position

EMAIL: LAURA.LAKE@GMAIL.COM

FOR CITY DEPARTMENT'S USE ONLY BELOW THIS LINE

Concurrences required from the following Department(s)

	Print Name	Sign	Approved	Denied
☐ Los Angeles Fire Department			☐	☐
☐ Public Works Bureau of Engineering			☐	☐
☐ Department of City Planning			☐	☐
☐ Other			☐	☐

DEPARTMENT ACTION

Daniel Schneidereit — (Sign) — 12/27/2020

Reviewed by: (Staff) (print) — Sign — Date

~~GRANTED~~ ☒ DENIED

J. Adolfo Acosta — (Sign) — 12/29/2020

Action taken by: (Supervisor) (print) — Sign — Date

~~CONDITIONS OF APPROVAL~~

REQUEST NOT JUSTIFIED.

FEES

Appeal Processing Fee ... (No. of Items) =	1	$ 130 - $ 65 /add)		$ 130.00
Inspection Fee ... (No. of Insp.) =		x	$ 84	$ -
Research Fee ... (Total Hours Worked) =	7	x	$ 104	$ 728.00
Subtotal ...				$ 858.00
Surcharge (One Stop) ...	$ 858.00	x	3%	$ 25.74
Surcharge (Systems Development) ...	$ 858.00	x	6%	$ 51.48
Total Fees ...				$ 935.22

Fees verified by:

Print and Sign: Daniel Schneidereit (Signature)

For Cashiers Use Only

(PROCESS ONLY WHEN FEES ARE VERIFIED)

Los Angeles Department of Building and Safety
Metro 4th Floor 12/17/2020 10:[illegible] AM
User ID: jbitanzcol
Receipt Ref Nbr: 2020352001-42
Transaction ID: 2020352001-42-1
BOARD APPLIC FEE $130.00
SYSTEMS DEV SURCH $51.48
DEV SERV CENTER SURCH $25.74
RESEARCH FEE $728.00
Amount Paid: $935.22
Request Date: 9/28/2018
PCIS Number: 16010-20000-02308
Comments: 1751 MALCOLM AVE. & 1772 GLENDON AVE.

FIX THE CITY

Laura Lake, Ph.D., Board Secretary, Fix the City

10558 Kinnard Avenue, LA, CA 90024

Laura@FixTheCity.org and Laura.Lake@gmail.com

Cell 310-497-5550

CERTIFIED MAIL/RETURN RECEIPT and Email: Eric.Jakeman@lacity.org

August 3, 2020

RE: REVOCATTION OF **BUILDING PERMIT APPLICATION #16010-20000-02308** AND CERTIFICATE OF OCCUPANCY/TEMPORARY CERTIFICATE OF OCCUPANCY FOR **1751 MALCOLM AVENUE/1772 GLENDON AVENUE**, DUE TO LOCATION IN A NO-BUILD FAULT AREA PER CGS FER 259, LOCALITY 10 (JANUARY 5, 2018).

APPEAL TO BOARD OF BUILDING AND SAFETY COMMISSIONERS

Eric Jakeman, LADBS Seismic Safety Manager

Board of Building and Safety Commissioners

201 N. Figueroa Street, Suite 1030

Los Angeles, CA 90012

Dear Mr. Jakeman and Board of Building and Safety Commissioners:

This is an urgent safety matter. This appeal package and Appeal Form supplements Fix the City's Appeal to the Board of Building and Safety Commissioners (Form PC-Build.Mod 00 (Rev.09-11-2019). We incorporate by reference all LADBS documents for this permit including meeting notes, emails and any other printed material regarding how CGS FER 259 Locality 10 was ignored. We request a written report and consideration by the Board of Building and Safety Commissioners.

In July 2017, the applicant indemnified the City (DIR-2017-342-DRB-SPP, ENV-2017-343-CE).

Fix the City is a nonprofit advocacy organization for public safety and services in Los Angeles. We respectfully call upon the Building and Safety Commission to revoke all approvals for **Building Permit #16010-20000-02308 and deny a Certificate of Occupancy and or revoke any Temporary Certificate of Occupancy for 1751 Malcolm Avenue/1772 Glendon Avenue,** as authorized by LAMC 98.0302.(1(b)(2). Attached is **Exhibit A**, a copy of the building permit application, dated September 28, 2918.

This 18-unit *luxury* rental project is located within the Santa Monica Fault and mapped in accordance with the Alquist Priolo Act. To our knowledge, there are no affordable

units in this project. The project is also located in a Liquefaction Zone and a Methane Zone. Two 2015 geological consultants' seismic investigations were submitted to LADBS for seismic approval. We do not have access to those studies which should be on file in LADBS as well as CGS, which included them as "Locality 10, 1751 Malcolm Avenue" in FER 259, pp. 26-27 and cited below. **Exhibit B** contains FER 259 pages 26-27.

LADBS twice **denied** approval after each study was reviewed**.** Exhibit B includes the two denials as shown in **Exhibit C,** obtained through LADBS Public Records Act Request19-16472, May 23, 2019.

On January 27, 2016, Daniel Schneidereit of LADBS submitted these expert reports to the California Geological Survey (CGS) as shown in **Exhibit D.** After review, CGS published the results of the study in FER 259 (Fault Evaluation Report 259). This study is the statutory authority to determine seismic hazards.

The Alquist Priolo Act established primacy over cities regarding seismic safety. The City of Los Angeles is required to follow this state law under California Public Resources Code Section 2623(c)(1) (see **Exhibit E**): the city may "establish policies and criteria which are stricter than those established by this chapter." There is no statutory authority to waive state standards and criteria.

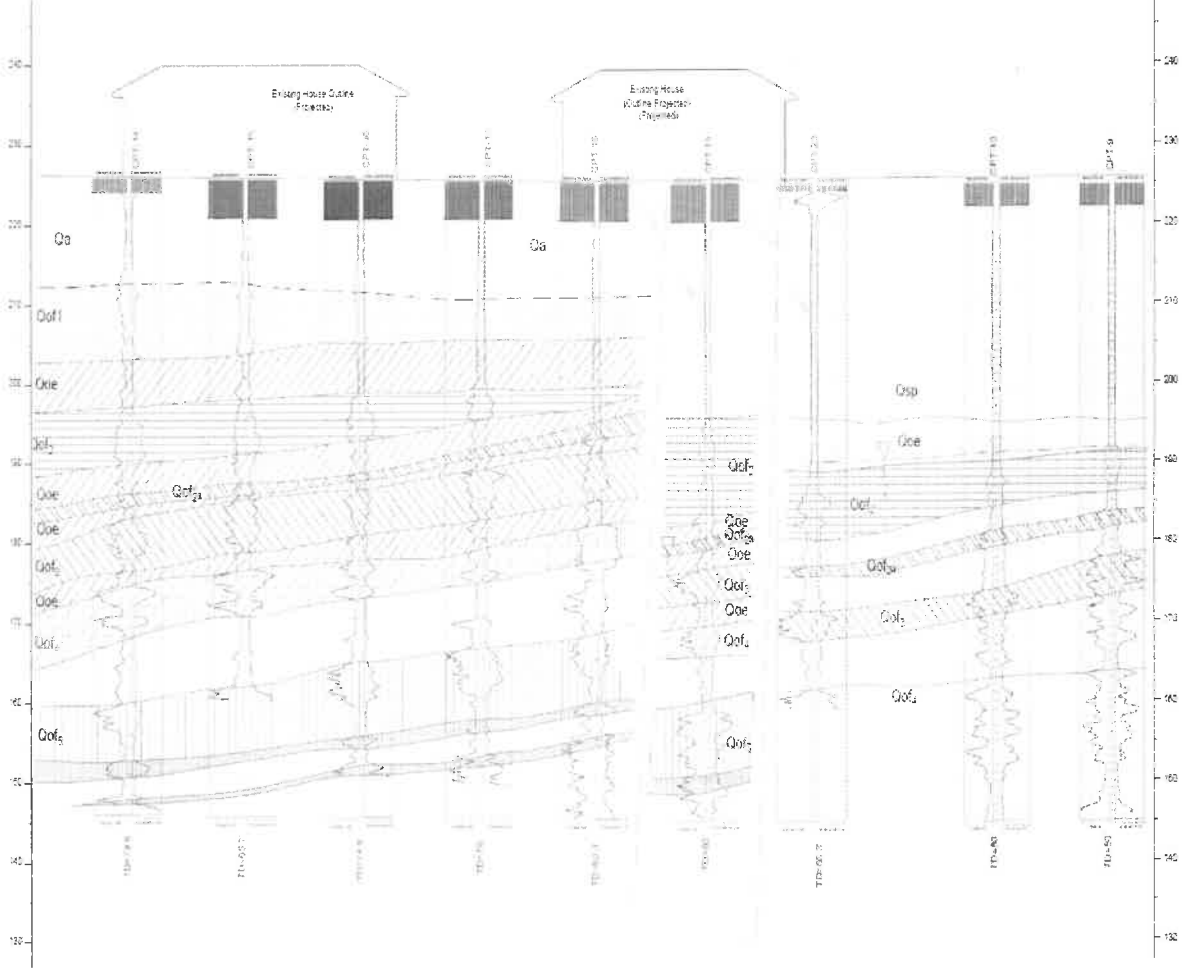
The applicant's response to the second denial on December 29, 2015) was an email on January 4, 2016, from Shant Minas, to Daniel Schneidereit and Casey Jensen, objecting to switching review from Daniel Schneidereit to Casey Jensen, and requesting a meeting with the developer and Schneidereit (**Exhibit D**, p. 2/75).[1] There are no new studies referenced in the emails, only a request for a meeting with the developer and Schneidereit. It is not known if this meeting occurred. However, just a few weeks later, on February 1, 2016, LADBS approved the seismic study (**Exhibit F**). Was the basis for this reversal without new substantial evidence to our knowledge, the requested meeting between Schneidereit and the developer?

When a new application was submitted in September 2018 (Exhibit A), CGS FER 259 Locality 10 was the official geological authority. It was published nine months prior to the 2018 building permit application. Instead of consulting this report, LADBS ignored it and relied on the February 1, 2016 approval. Again, the basis for approval in 2016 and the failure to consult CGS FER 259 Locality 10 in 2018 remain unexplained. Finally, the

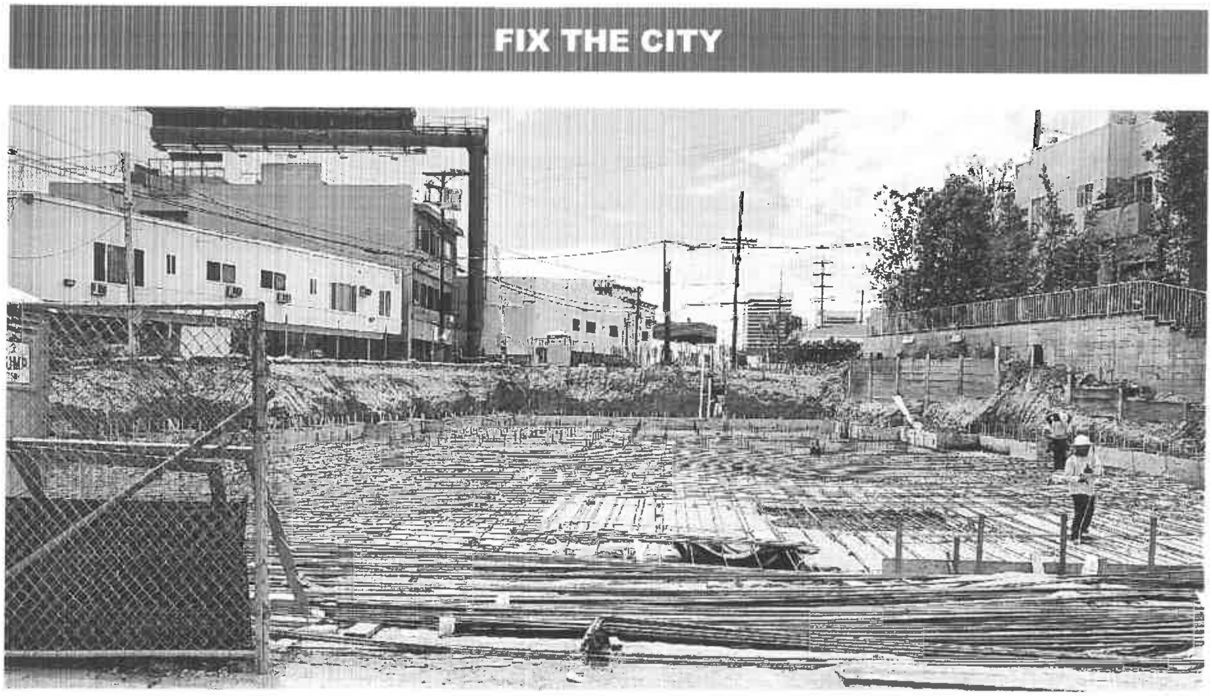
[1] "a meeting with Dan [Schneidereit], with client present, to discuss and finalize our response. There have been multiple changes to the building plans already made due to the presence of the fault in the NE portion of the property as previously reported by us, and I would like to minimize any additional future changes by having another meeting." ***Note the fault is in the CENTER of the site, not the northeast.***

mischaracterization of the fault lying in the northeastern area of the site is contradicted by Figure 16 in CGS FER 259, p. 27. The December 29, 2015 denial summary from LADBS (Exhibit C) incorrectly claims the fault was in the **northeastern** portion of the site, when the fault rupture study on page 27 of FER 259 shows it running through the center of the site between *CPT 18 and CPT 19 as shown below.*

CGS FER 259, Figure 16 - Portion of geologic cross section A-A' constructed along Malcolm Avenue by AES (2015b, Drawing 2) looking west. Note the thick sequence of Holocene "sag pond" deposits (Qsp) faulted against broadly folded Pleistocene older fan (Qof) and older estuarine (Qoe) deposits in apparent north-side-down vertical separation. (Source: CGS FER 259, p. 27).



In the absence of new substantial evidence in 2018, LADBS violated the clear language of CGS FER 259, the ultimate authority on fault rupture studies within the Santa Monica Fault. Approval was arbitrary and capricious, not supported by substantial evidence, and directly in conflict with CGS FER 259 and constituted a gross, prejudicial abuse of authority.



1751 Malcolm Avenue is built over the active fault viewed from Malcolm Ave. (Source: Fix the City).

Our concern is not speculative: the two 2015 consultant reports found physical evidence of an active strand of the Santa Monica Fault, as published in CGS FER 259 (pp. 26-27):

"Locality 10 - 1749-1751 Malcolm Avenue

"A combined fault study and geotechnical investigation was performed for a proposed residential development at 1749-1751 Malcolm and 1772 Glendon Avenues by Applied Earth Sciences (2015a, b). The fault investigation consisted of a single transect along Malcolm Avenue constructed from 20 CPTs and three continuous core borings drilled to a maximum depth of about 80 feet. Spacing of CPTs/borings varied from 5 feet (between CPT/boring pairs) to over 25 feet in the public right-of-way, where numerous utilities were located. In their borings, the consultants identified both Holocene alluvium and "sag pond" deposits, along with Pleistocene alluvial and estuarine sediments.

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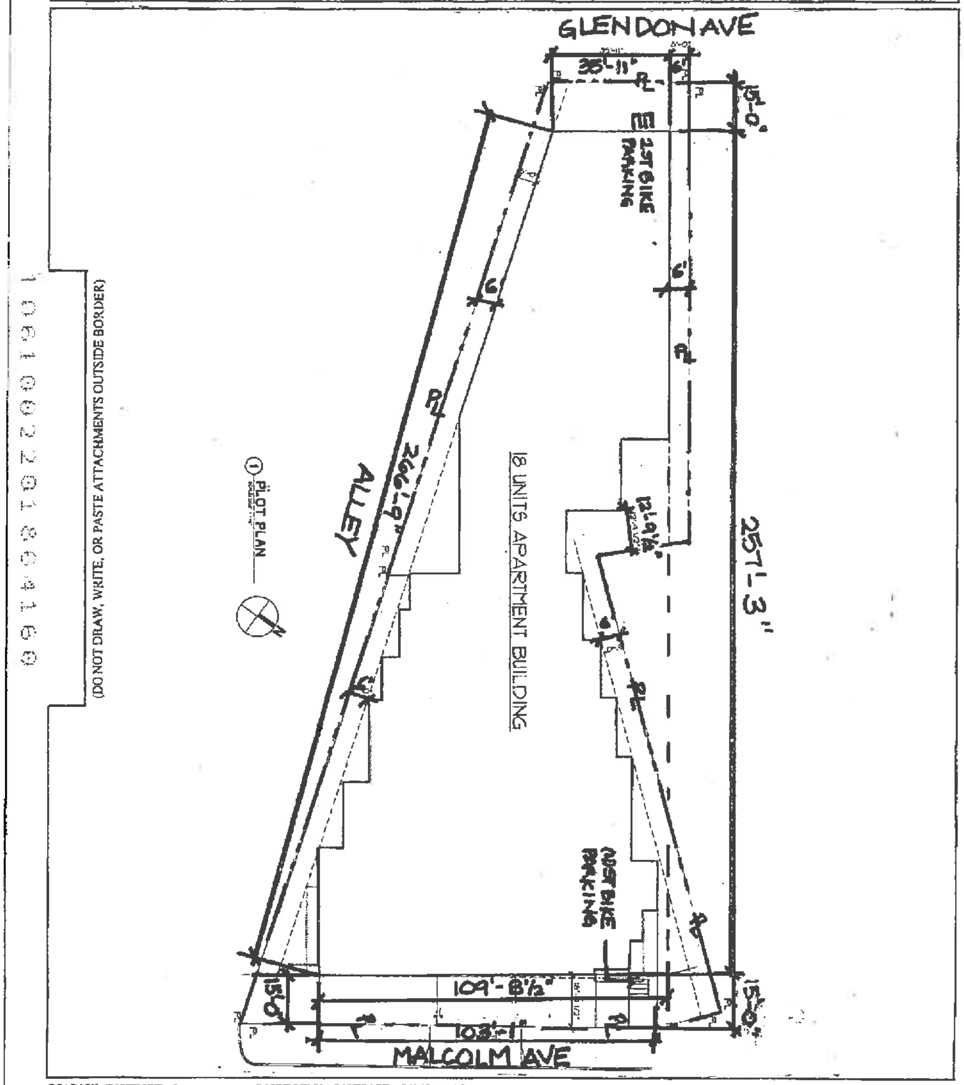
CPT-18 and CPT-19 are NOT in the northeastern portion of the site. They are on the right side of the garage entrance shown in the photo above. The plot plan attached to the building permit, shown on the next page, shows that the entire site was built over with a few zig-zags on the northern boundary and not around CPT 18 and CPT 19.

1751 S Malcolm Ave Permit Application # : **16010 - 20000 - 02308**

Bldg-New Apartment Plan Check	City of Los Angeles - Department of Building and Safety **PLOT PLAN ATTACHMENT**	Plan Check #: B16VN07299 Initiating Office: VAN NUYS Printed on: 05/16/18 13:35:21



COUNCIL DISTRICT: 5 INSPECTION DISTRICT: BIMSWLA2 PLOT PLAN

LADBS grossly abused its authority and put the lives of the 18 families at risk, in violation of the very laws and regulations enacted to protect human life. Approval approve the site, both state law and city laws were violated, as well as the adopted policies and procedures in LADBS publications mandating CGS reports as stated on the first page of both publications (P/BC 2020-113, P/BC 2020-129) included in **Exhibit G.**

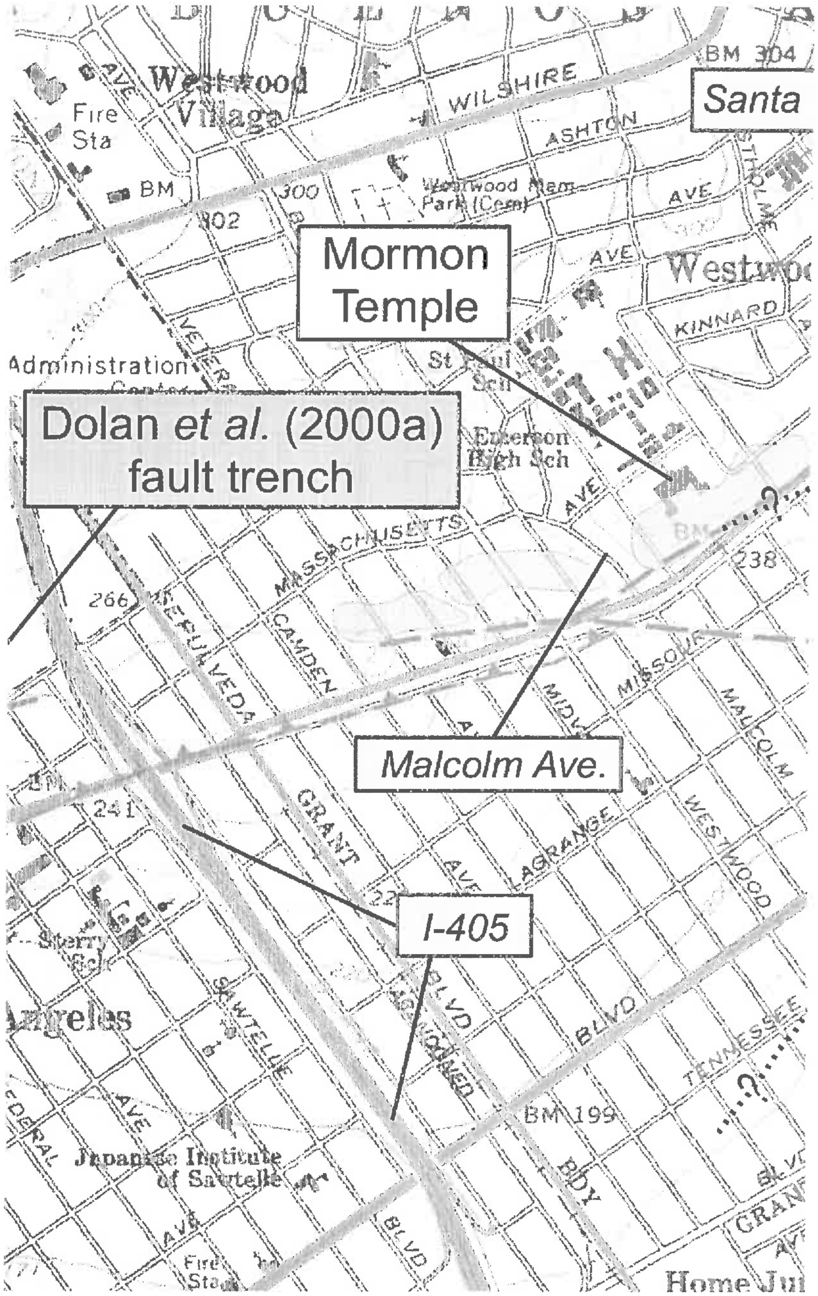


Plate 1, CGS FER 259 (subsection showing Malcolm Avenue site).

In addition to violating CPR Section 2623(c)(1), LADBS violated LAMC 91.106.4.1. Exception 4:

> "4. The department shall have the authority to withhold permits on projects located within a Special (Fault) Studies Zone established under Chapter 7.5, Division 2, of the California Public Resources Code. Permits may be issued if it

can be demonstrated through accepted geologic seismic studies that the proposed structure will be located in a safe manner and **not over or astraddle the trace of an active fault.** Acceptable geologic seismic studies shall meet the criteria as set forth in rules and regulations established by the Superintendent of Building to assure that such studies are based on sufficient geologic data to determine the location or nonexistence of the active fault trace on a site. Prior to approval of a project, a geologic report defining and delineating any hazard of surface fault rupture shall be required. If the city finds that no undue hazard of this kind exists, the geologic report on such hazard may be waived, with approval of the state geologist."

This project has been built over/astraddle an active fault. On the basis of Locality 10, FER 259, Fix the City requests that LADBS revoke all approvals and temporary Certificate of Occupancy or permanent CofO. Please note LADBS Public Records Act Request PR 19-16472, May 23, 2019, (Exhibit D), shows Mr. Schneidereit's knowledge and awareness of FER 259.

Please determine if there was a meeting between the applicant and Mr. Schneidereit, during January 2016, and any meeting notes, a third surface fault rupture study for this site that could support seismic approval in 2016. The study, if it exists, would have been conducted between December 29, 2015 and February 1, 2016.

Note that documented in the Public Records Act request (Exhibit D), the very studies that were ignored for 1751 Malcolm building permit application in 2018, were sent to consultants for nearby projects by Mr. Schneidereit and that the week before LADBS reversed its two seismic denials, on January 27, 2016, Daniel Schneidereit, LADBS Engineering Geologist I, sent these consultants reports to the state (to Brian Olson, the author of the CGS FER 259). CGS reviewed the studies and then included them in FER 259.

FER 259 is binding upon the City. It cannot under state law, impose weaker conditions. **The no-build area is required, and it is in the center of the site, not the northeastern edge, based on Figure 16 in FER 259**. Based on his sending the 2016 studies to CGS, and his two previous denials, Mr. Schneidereit was clearly aware of the role of CGS in regulating surface rupture fault investigations and of the recommendation for a no-build area.

Upon receipt of a new building permit application in 2018, the City (LADBS) was obligated to consult FER 259, which would have required a no build area in the center of the site. He failed to issue a new review under the 2018 FER 259 report. Instead, he relied upon his sudden approval in 2016, and his misrepresentation in 2015 of where the fault was on the site. It is not as he stated, in the northeastern area. As far as we know, his 2016 approval was not based on a new study. Even if it was, he was required to consult FER 259 in 2018 to approve the new building permit application.

The 2018 building permit application was required to be processed under current laws and regulations and must be **revoked along with any Certificate of Occupancy.**

IMMEDIATE CORRECTIVE ACTION REQUIRED

State and City laws protecting human life must be obeyed in order to protect the 18 families slated to live at 1751 Malcolm Avenue. LADBS does not have authority to override CGS's reports. It must follow FER 259 and CGS Special Publication 42 and Note 49, as well as California Resources Code Section 2623(c)(1) (Exhibit E). These state publications provide the requirements for surface rupture investigations. It appears that these procedures were followed and the results willfully and prejudicially ignored by LADBS.

Any google search for seismic information at this address yields the state report. Approval for seismic safety for this project on February 1, 2016, was contradicted by the two site investigations conducted in 2015, and prohibited by FER 259, which was published nine months prior to the new building permit application and could not lawfully be ignored.

The failure to follow state requirements and the city's own Building Code, and its policies and procedures (Exhibit F) is a significant, substantial abuse of authority that imperils public safety, the first priority of local government under the California Constitution (Art. XIII, Section 35).

LADBS unlawfully ignored the 2018 state report and instead recycled its unexplained and unsupported approval in early 2016, despite two reports and CGS FER 259. Keep in mind that those studies were not just nearby sites, *they were for this exact property.*

New permit applications must conform with current law and regulation. Whatever the basis of the City's geologist ignoring the 2015 study, the 2018 state report could not be lawfully ignored. Based on the consultant's reports forwarded to CGS by Mr. Schneidereit, city staff knew full well that this was a no-build site approximately in the center of the site. In fact, they sent those studies to other developers seeking seismic investigations for new projects (see emails from LADBS and consultants, attached, 75 pp.).

There are ample staff emails in Exhibit D that show that staff communicated with the developer and representative, and demanded that only Daniel Schneidereit should review the project. Do clients choose the staff or does the manager?

Finally, there is no subsequent 2018 approval by Schneidereit. Instead, the old approval was used, despite the CGS report being published nine months prior to the submission of the current building permit application. The City does not have authority to ignore this vital state law. LADBS Seismic staff have failed to uphold city and state laws designed to protect public safety. CGS FER 259 pp. 26-27 are attached.

LADBS Document No. P/BC 2020-129 states a research requirement for surface fault rupture studies to "Search City and State records for fault investigation reports for properties in the site vicinity." This very site was studied in CGS FER 259! Had LADBS staff studied the current state study at the time of the current permit application. knowing it was within a fault study zone, it would have been prohibited from issuing any approvals. For example, a mat foundation cannot be substituted for a no-build area, and there is no evidence that LADBS consulted either CGS FER 259 or the two reports it had received. There is no evidence in the record supporting approval.

The application for this project's building permit and certificate of occupancy was filed on September 28, 2018, nine months after CGS FER 259 Locality 10, 1749-1751 Malcolm Avenue designated a no-build area on January 5, 2018.

This approval violated both CGS regulations, the Alquist Priolo Act, and LADBS P/BC 2020-113 and LADBS P/BC-2020-129 which specific the requirements for seismic investigations.

We enclose the Appeal form, payment of $130, and supporting documentation.

Sincerely,

Laura Lake

Laura Lake, Ph.D.

Board Secretary, Fix the City

LIST OF EXHIBITS

A Building permit application #16010-20000-02308 for 1751 Malcolm Avenue/1772 Glendon Avenue, submitted September 28, 2018

B California Geological Survey FER 259, pp. 26-27 (January 5, 2018).

C LADBS denials of seismic safety in 2015 and letter dated December 29, 2015.

D LADBS Public Records Act response PR19-16472, p. 1 of 75 pages of emails, transmitting second surface fault rupture study for 1751 Malcolm Avenue to CGS, from Daniel Schneidereit to Brian Olson, author of FER 259, dated January 27, 2016.

E California Public Resources Code Section 2623(a)-(c)

F LADBS Document Report soils & geology file approved, February 1, 2016.

G LADBS Information Bulletin/Public-Building Code, P/BC 2017-113 (previously issued as P/BC 2014-113; P/BC 2020-113, "Contents of Reports for Submittal to LADBS Grading Division," and P/BC 2020-129 "Surface Fault Rupture Hazard Investigations.

FIX THE CITY

Laura Lake, Ph.D., Board Secretary, Fix the City

10558 Kinnard Avenue, LA, CA 90024

Laura@FixTheCity.org and Laura.Lake@gmail.com

Cell 310-497-5550

CERTIFIED MAIL/RETURN RECEIPT

Email: Daniel.Schneidereit@lacity.org

Second mailing to replace lost certified, return receipt package, at the request of Daniel Schneidereit, LADBS

November 10, 2020

RE: REVOCATTION OF **BUILDING PERMIT APPLICATION #16010-20000-02308** AND CERTIFICATE OF OCCUPANCY/TEMPORARY CERTIFICATE OF OCCUPANCY FOR **1751 MALCOLM AVENUE & 1772 GLENDON AVENUE**

Daniel Schneidereit, LADBS Seismic Safety Manager

201 N. Figueroa Street, 12th Floor

Los Angeles, CA 90012

Dear Mr. Schneidereit:

Fix the City is a nonprofit advocacy organization for public safety and services in Los Angeles. We respectfully call upon the Building and Safety Commission to revoke all approvals for **Building Permit #16010-20000-02308 and deny a Certificate of Occupancy and or revoke any Temporary Certificate of Occupancy for 1751 Malcolm Avenue/1772 Glendon Avenue,** as authorized by LAMC 98.0302.(1(b)(2).

This appeal package and Appeal Form supplements Fix the City's Appeal to the Board of Building and Safety Commissioners (Form PC-Build.Mod 00 (Rev.09-11-2019), which is attached. The fee has already been paid. Proof of receipt of the original appeal has been provided. You have stated to me that you never received this appeal, and requested that I resubmit, without a new fee, with you as the recipient. This mailing constitutes Fix the City's response.

In addition, our board has hired a licensed geologist, Kenneth Wilson (Wilson Geosciences, Inc), to review the record. He concluded in his attached report (Exhibit H), that the seismic approvals do not follow state and city requirements. We therefore repeat our request to revoke the certificate of occupancy or temporary occupancy based on the substantial evidence in the record. Mr. Wilson's c.v. is attached in Exhibit I.

Mr. Wilson's review, which is enclosed, flags several errors in the approval process for this building that support a revocation. The key safety concerns addressed in this complaint are:

- There is no evidence in the record supporting the reduction from 10 to 20-feet no-build area in the absence of additional data points to determine fault orientation, other than a private meeting between Mr. Schneidereit and the applicant. No new investigation was provided to support reducing the no-build area.
- A one-foot cantilever does not mitigate an estimated 3-6-foot displacement.
- The no-build area for 1751 Malcolm does not conform with the data points between CPT 18 and 19 per CGS FER 259.
- The cantilevered structure at 1751 Malcolm over the no-build area violates LAMC 91.106.4.1 Exception 4.[1]
- There is a **second fault** line along the alley for both 1772 Glendon and 1751 Malcolm that was not investigated (see Figures 1 and 2). Under the Alquist Priolo Act Section 3603(a), the City lacks authority to waive a 50-foot no-build zone from the property line for 1772 Glendon and 1751 Malcolm along the southern boundary of the site in the absence of a fault investigation. *None was conducted for the southern fault.*

> "The following specific criteria shall apply within earthquake fault zones and shall be used by affected lead agencies in complying with the provisions of the Act: (a) No structure for human occupancy, identified as a project under Section 2621.6 of the Act, shall be permitted to be placed across the trace of an active fault."
>
> "Furthermore, as the area within fifty (50) feet of such active faults shall be presumed to be underlain by active branches of that fault unless proven otherwise by an appropriate geologic investigation and report prepared as specified in Section 3603(d) of this subchapter, no such structures shall be permitted in this area." ((Alquist Priolo Act, Section 3603(a))

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[1] In addition to violating CPR Section 2623(c)(1), LADBS violated LAMC 91.106.4.1. Exception 4: "4. The department shall have the authority to withhold permits on projects located within a Special (Fault) Studies Zone established under Chapter 7.5, Division 2, of the California Public Resources Code. Permits may be issued if it can be demonstrated through accepted geologic seismic studies that the proposed structure will be located in a safe manner and ***not over or astraddle the trace of an active fault.*** Acceptable geologic seismic studies shall meet the criteria as set forth in rules and regulations established by the Superintendent of Building to assure that such studies are based on sufficient geologic data to determine the location or nonexistence of the active fault trace on a site. Prior to approval of a project, a geologic report defining and delineating any hazard of surface fault rupture shall be required. If the city finds that no undue hazard of this kind exists, the geologic report on such hazard may be waived, with approval of the state geologist." (emphasis added).

- There was no investigation of the southern fault along the alley. Therefore, there must be a 50-foot no-build area along the alley fault line for 1772 Glendon and 1751 Malcolm.

We incorporate by reference all LADBS documents for this permit including meeting notes, emails and any other printed material regarding project approval.

Attached is **Exhibit A**, a copy of the building permit application, dated September 28, 2918. We request a written report from LADBS in response to this complaint. ***On the basis of Locality 10, FER 259, and the failure to conduct investigations of the southern fault, Fix the City requests that LADBS revoke all approvals and temporary Certificate of Occupancy or permanent CofO.***

Please note LADBS Public Records Act Request PR 19-16472, May 23, 2019, ***(Exhibit D), shows Mr. Schneidereit's knowledge and awareness of FER 259.*** *Yet when the building permit application was filed in 2018, there is no evidence in the record that LADBS consulted and complied with FER 259. Instead, LADBS relied upon the 2016 approval.*

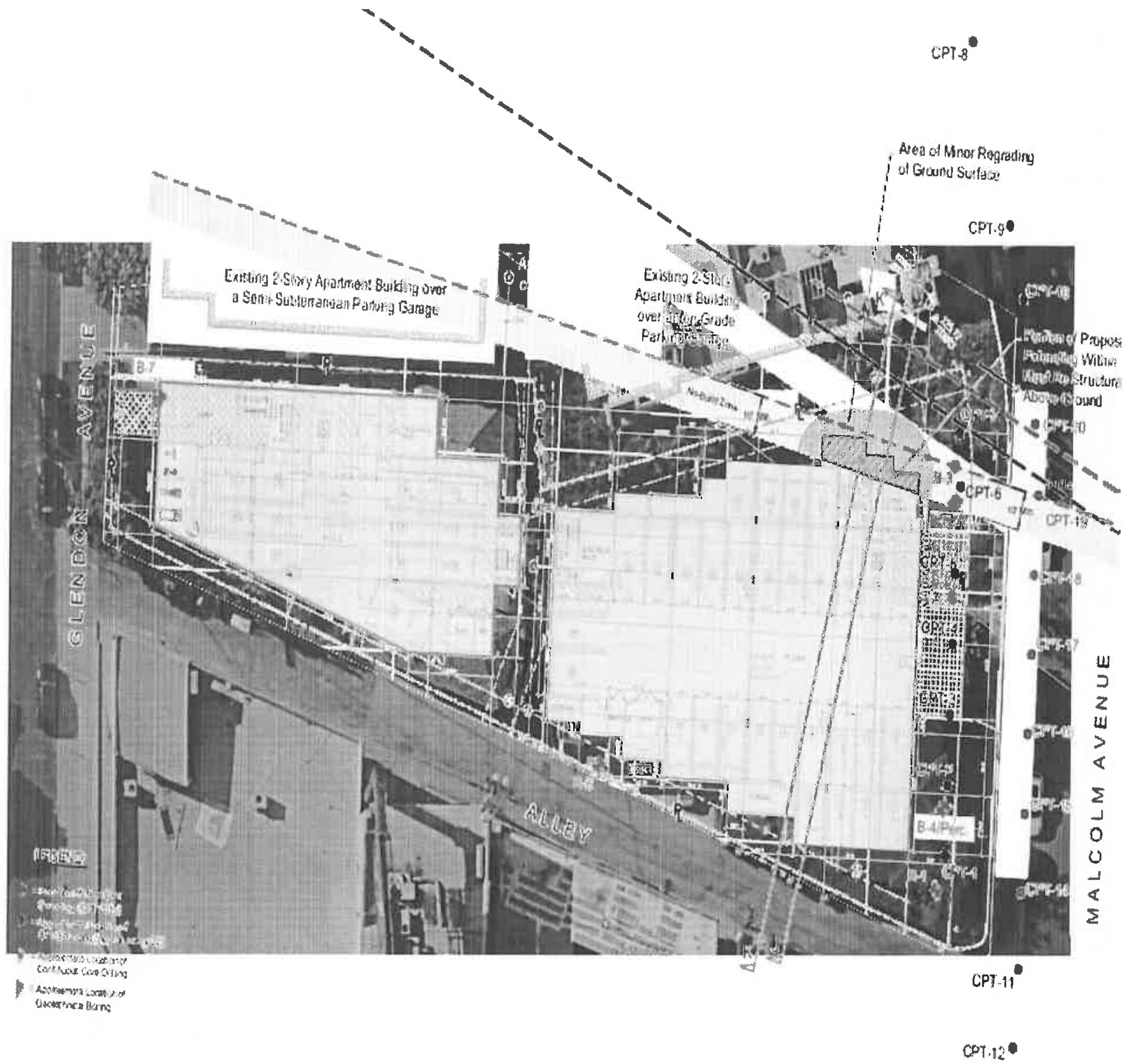

Figure 1. Fault line at southern boundary of 1772 Glendon Avenue not investigated – requires 50-foot setback.

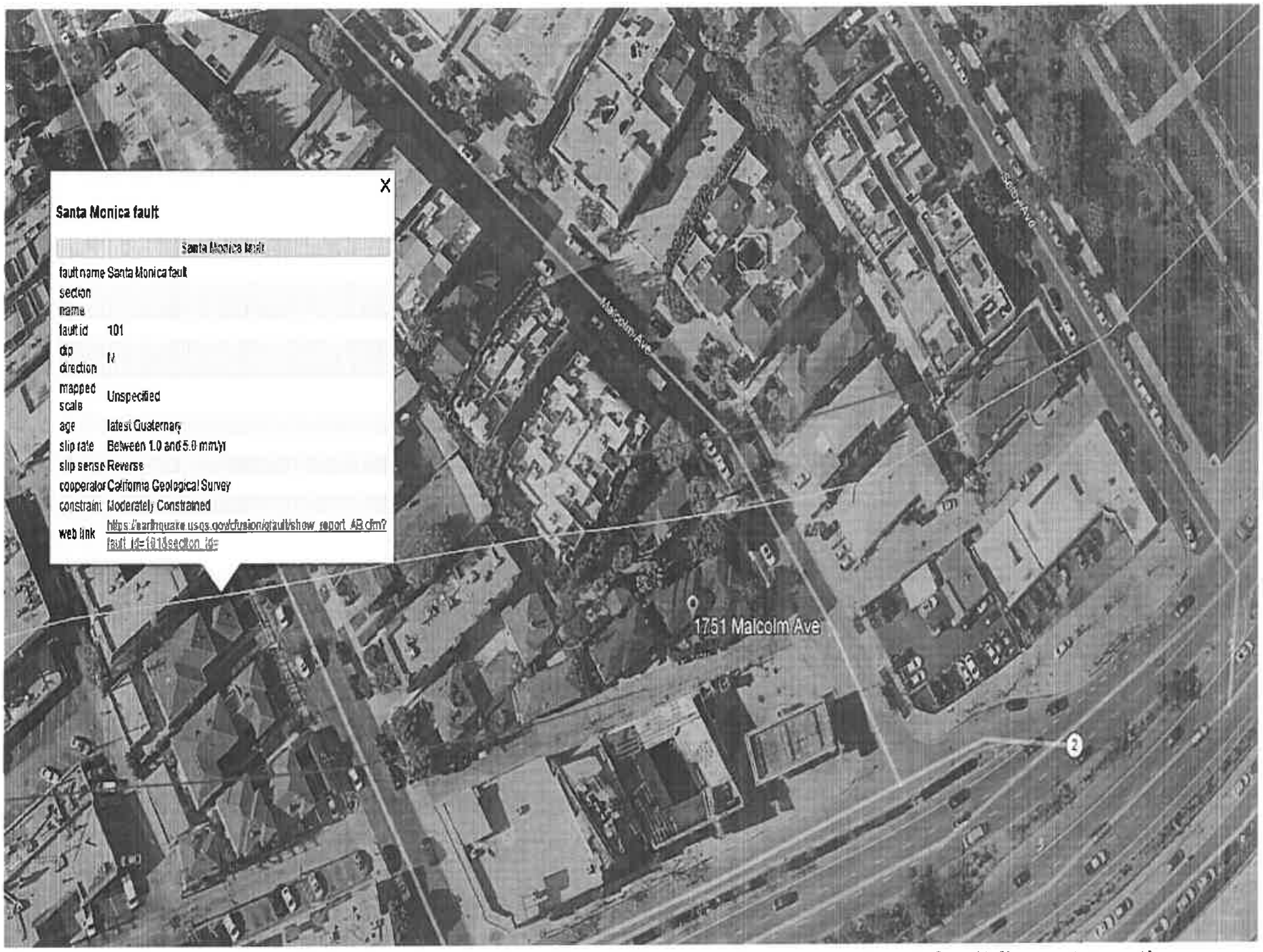

Figure 2 Entire site within Santa Monica Fault Zone with second red fault line at south

The City does not have authority to waive the study and waive the required 50-foot setback. Under **California Resources Code Section 2623** the City may impose stricter requirements, but may not substitute weaker local requirements.

Furthermore, with *only one point of measurement*, it was impossible to determine the trend line for the fault on 1751 Malcolm, as admitted in the August 19, 2015 Correction letter signed by Daniel Schneidereit: *""Additional exploration is required to determine the fault's trend in at least two locations to warrant the recommended reduced setback "* [from 20-feet to 10-feet].

Please note that the second report and Correction Letter signed by Casey Jensen on December 29, 2015, recommended a setback "of ***at least*** 20 feet from the fault splay..." (emphasis added). Yet without additional physical investigation, and only a meeting on January 13, 2016 with the applicant, on February 1, 2016, Daniel Schneidereit reduced the 20-foot setback to ten-feet and allowed the structure over the fault by cantilevering the elevator and lobby area over the no-build zone. This approval was therefore

arbitrary and capricious and a gross abuse of authority, putting the public at risk, in violation of state and city laws.

This approval clearly violates AP because it is a building for human occupancy over a known fault. No build means no build. Placing an elevator and lobby --- escape routes, over a known fault is in direct violation of state law enacted to protect public safety.

Based on CGS and USGS fault lines within the AP Fault Map for this site, the ***City failed to require an investigation of the fault on the southern boundary*** of 1772 Glendon Avenue and 1751 Malcolm Avenue *as shown above in Figures 1 and 2.* ***This was a gross prejudicial abuse of authority***.

Background

In July 2017, the applicant indemnified the City (DIR-2017-342-DRB-SPP, ENV-2017-343-CE).

This 18-unit *luxury* rental project is located within the Santa Monica Fault and mapped in accordance with the Alquist Priolo Act. To our knowledge, there are no affordable units in this project. The project is also located in a Liquefaction Zone and a Methane Zone. Two 2015 geological consultants' seismic investigations were submitted to LADBS for seismic approval. We do not have access to those studies which should be on file in LADBS as well as CGS, which included them as "Locality 10, 1751 Malcolm Avenue" in FER 259, pp. 26-27 and cited below. **Exhibit B** contains FER 259 pages 26-27.

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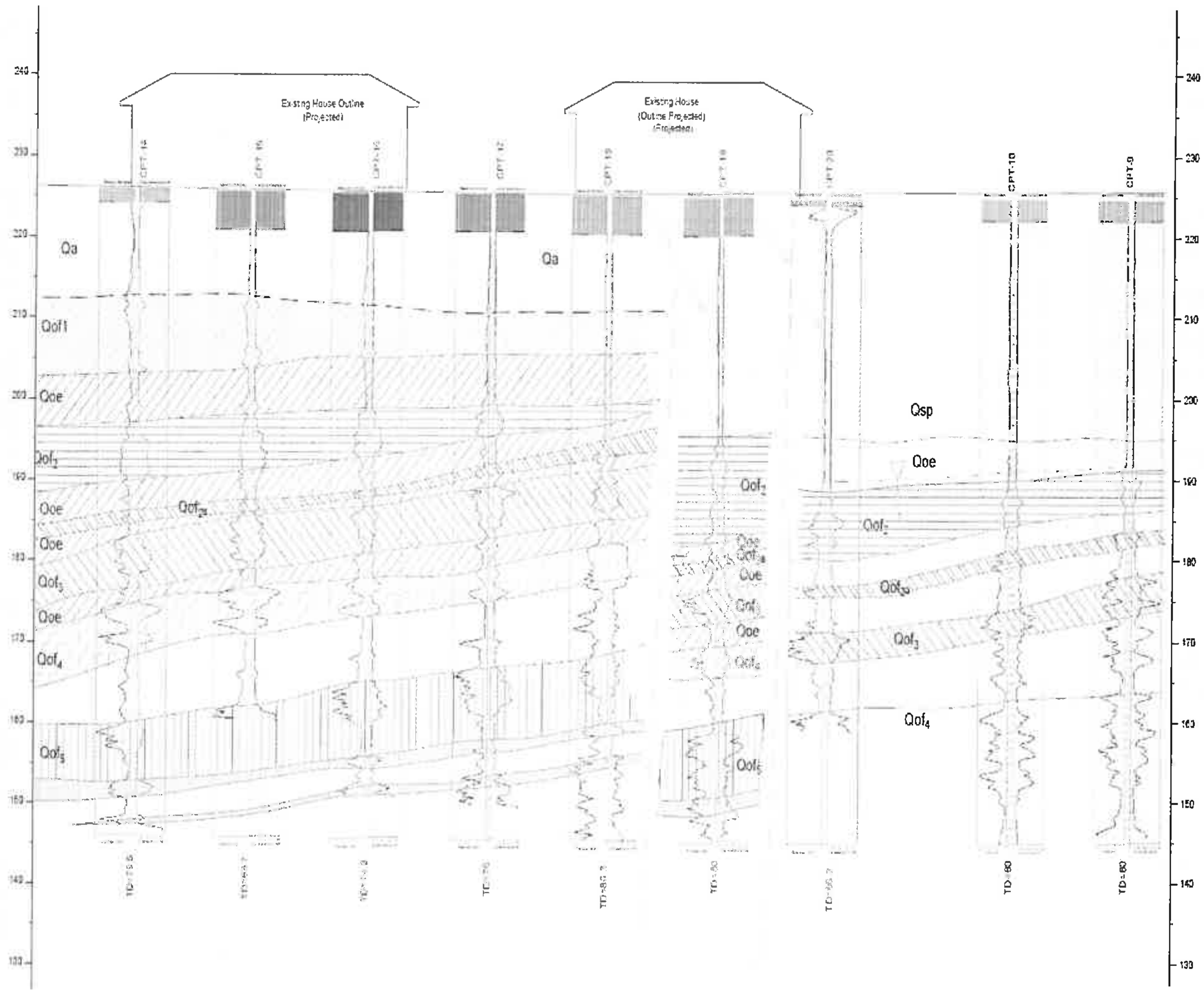

Figure 3 CGS Figure 16: Portion of geologic cross section A-A" constructed along Malcolm Avenue by AES (2015b), Drawing 2) looking west. Note the thick sequence oF Holocene "sag pond" deposits (Qsp) faulted against broadly folded Pleistocene older fan (Qof) and older estuarine (Qoe) deposits in apparent north-south-sown vertical separation. Source: CGS FER 259, p. 27.

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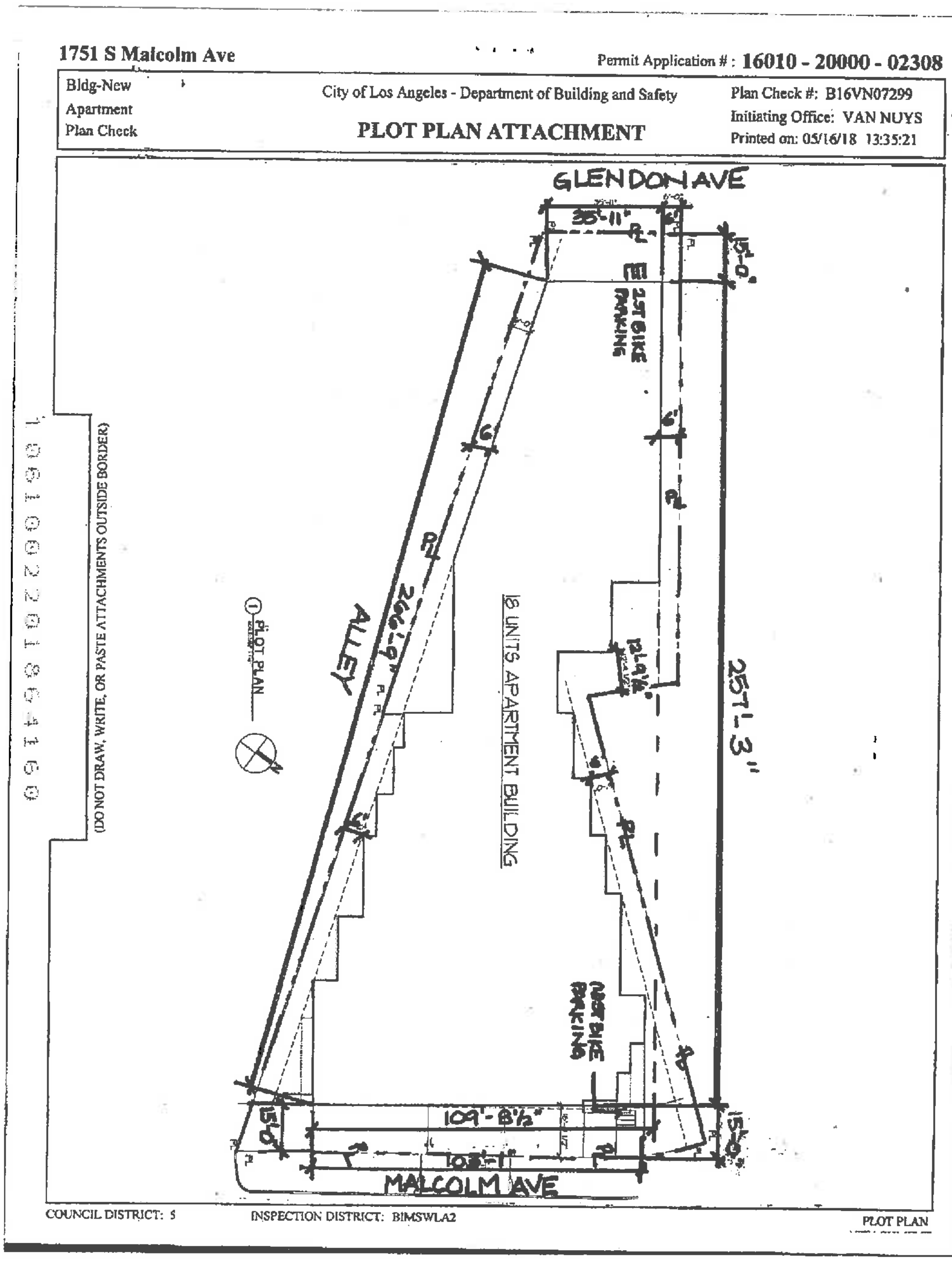
> **immediate vicinity of CPT-18 and CPT-19. Consequently, the consultants established a "no build zone"** (emphasis added).

CPT-18 and CPT-19 are NOT in the northeastern portion of the site. They are on the right side of the garage entrance shown in the photo above. The plot plan attached to the building permit, shown on the next page, shows that the entire site was built over with a few zig-zags on the northern boundary and not around CPT 18 and CPT 19.



LADBS grossly abused its authority and put the lives of the 18 families at risk, in violation of the very laws and regulations enacted to protect human life. Approval approve the site, both state law and city laws were violated, as well as the adopted policies and procedures in LADBS publications mandating CGS reports as stated on the first page of both publications (P/BC 2020-113, P/BC 2020-129) included in **Exhibit G.**

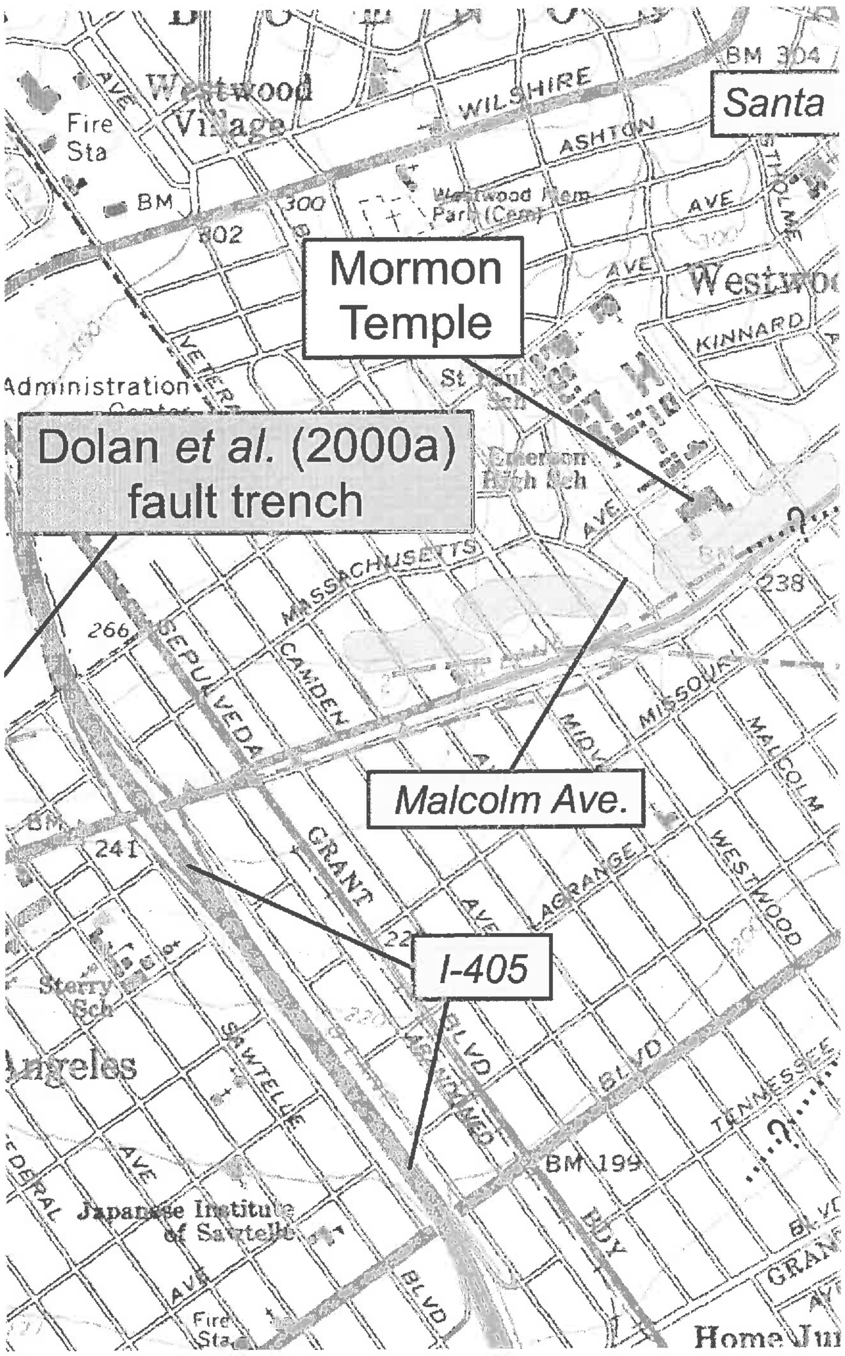


Plate 1, CGS FER 259 (subsection showing Malcolm Avenue site).

Please determine if there was a meeting between the applicant and Mr. Schneidereit, during January 2016, and any meeting notes, a third surface fault rupture study for this site that could support seismic approval in 2016. The study, if it exists, would have been conducted between December 29, 2015 and February 1, 2016.

Note that documented in the Public Records Act request (Exhibit D), the very studies that were ignored for 1751 Malcolm building permit application in 2018, were sent to consultants for nearby projects by Mr. Schneidereit and that the week before LADBS reversed its two seismic denials, on January 27, 2016, Daniel Schneidereit, LADBS Engineering Geologist I, sent these consultants reports to the state (to Brian Olson, the author of the CGS FER 259). CGS reviewed the studies and then included them in FER 259.

FER 259 is binding upon the City. It cannot under state law, impose weaker conditions. **The no-build area is required, and it is in the center of the site, not the northeastern edge, based on Figure 16 in FER 259**. Based on his sending the 2016 studies to CGS, and his two previous denials, Mr. Schneidereit was clearly aware of the role of CGS in regulating surface rupture fault investigations and of the recommendation for a no-build area.

Upon receipt of a new building permit application in 2018, the City (LADBS) was obligated to consult FER 259, which would have required a no build area in the center of the site. He failed to issue a new review under the 2018 FER 259 report. Instead, he relied upon his sudden approval in 2016, and his misrepresentation in 2015 of where the fault was on the site. It is not as he stated, in the northeastern area. As far as we know, his 2016 approval was not based on a new study. Even if it was, he was required to consult FER 259 in 2018 to approve the new building permit application.

The 2018 building permit application was required to be processed under current laws and regulations and must be **revoked along with any Certificate of Occupancy.**

IMMEDIATE CORRECTIVE ACTION REQUIRED

State and City laws protecting human life must be obeyed in order to protect the 18 families slated to live at 1751 Malcolm Avenue. LADBS does not have authority to override CGS's reports. It must follow FER 259 and CGS Special Publication 42 and Note 49, as well as California Resources Code Section 2623(c)(1) (Exhibit E). These state publications provide the requirements for surface rupture investigations. It appears that these procedures were followed and the results willfully and prejudicially ignored by LADBS.

Any google search for seismic information at this address yields the state report. Approval for seismic safety for this project on February 1, 2016, was contradicted by the two site investigations conducted in 2015, and prohibited by FER 259, which was published nine months prior to the new building permit application and could not lawfully be ignored.

The failure to follow state requirements and the city's own Building Code, and its policies and procedures (Exhibit F) is a significant, substantial abuse of authority that imperils public safety, the first priority of local government under the California Constitution (Art. XIII, Section 35).

LADBS unlawfully ignored the 2018 state report and instead recycled its unexplained and unsupported approval in early 2016, despite two reports and CGS FER 259. Keep in mind that those studies were not just nearby sites, *they were for this exact property*.

New permit applications must conform with current law and regulation. Whatever the basis of the City's geologist ignoring the 2015 study, the 2018 state report could not be lawfully ignored. Based on the consultant's reports forwarded to CGS by Mr. Schneidereit, city staff knew full well that this was a no-build site approximately in the center of the site. In fact, they sent those studies to other developers seeking seismic investigations for new projects (see emails from LADBS and consultants, attached, 75 pp.).

There are ample staff emails in Exhibit D that show that staff communicated with the developer and representative, and demanded that only Daniel Schneidereit should review the project. Do clients choose the staff or does the manager?

Finally, there is no subsequent 2018 approval by Schneidereit. Instead, the old approval was used, despite the CGS report being published nine months prior to the submission of the current building permit application. The City does not have authority to ignore this vital state law. LADBS Seismic staff have failed to uphold city and state laws designed to protect public safety. CGS FER 259 pp. 26-27 are attached.

LADBS Document No. P/BC 2020-129 states a research requirement for surface fault rupture studies to "Search City and State records for fault investigation reports for properties in the site vicinity." This very site was studied in CGS FER 259! Had LADBS staff studied the current state study at the time of the current permit application. knowing it was within a fault study zone, it would have been prohibited from issuing any approvals. For example, a mat foundation cannot be substituted for a no-build area, and there is no evidence that LADBS consulted either CGS FER 259 or the two reports it had received. There is no evidence in the record supporting approval.

The application for this project's building permit and certificate of occupancy was filed on September 28, 2018, nine months after CGS FER 259 Locality 10, 1749-1751 Malcolm Avenue designated a no-build area on January 5, 2018.

This approval violated both CGS regulations, the Alquist Priolo Act, and LADBS P/BC 2020-113 and LADBS P/BC-2020-129 which specific the requirements for seismic investigations.

There is additional physical evidence of an active surface fault at this site, as shown in the photos below:

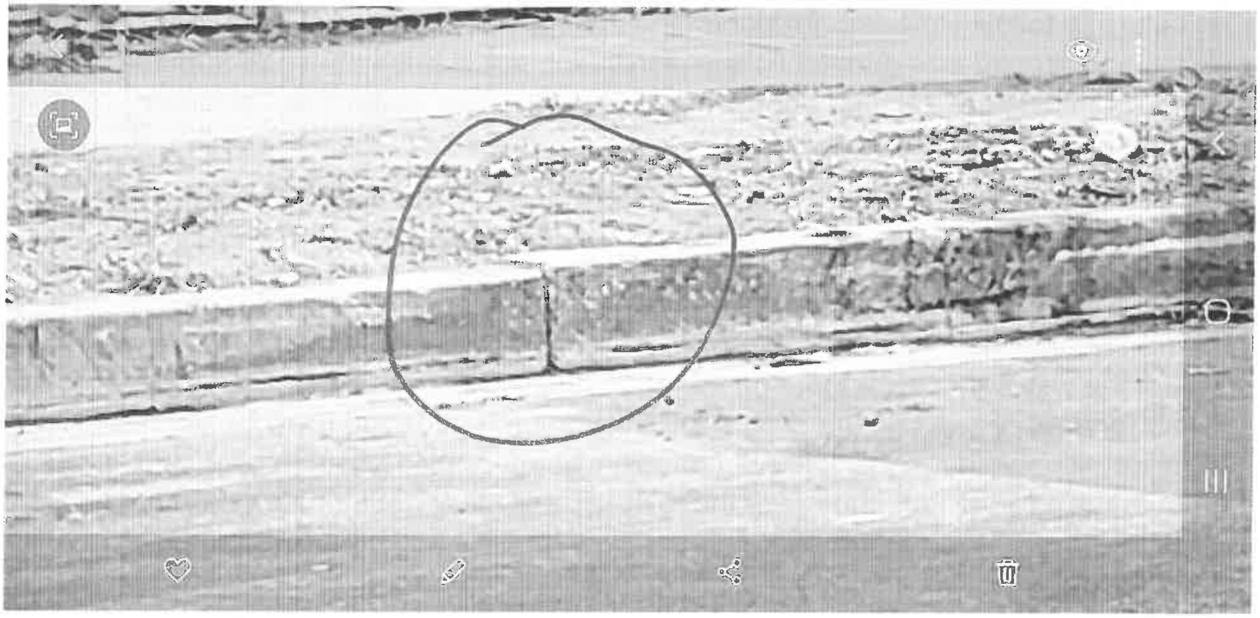


Figure 4 broken curb at fault between CPT 18 and 19

Figure 5 rupture on Malcolm curb in front of no-build area

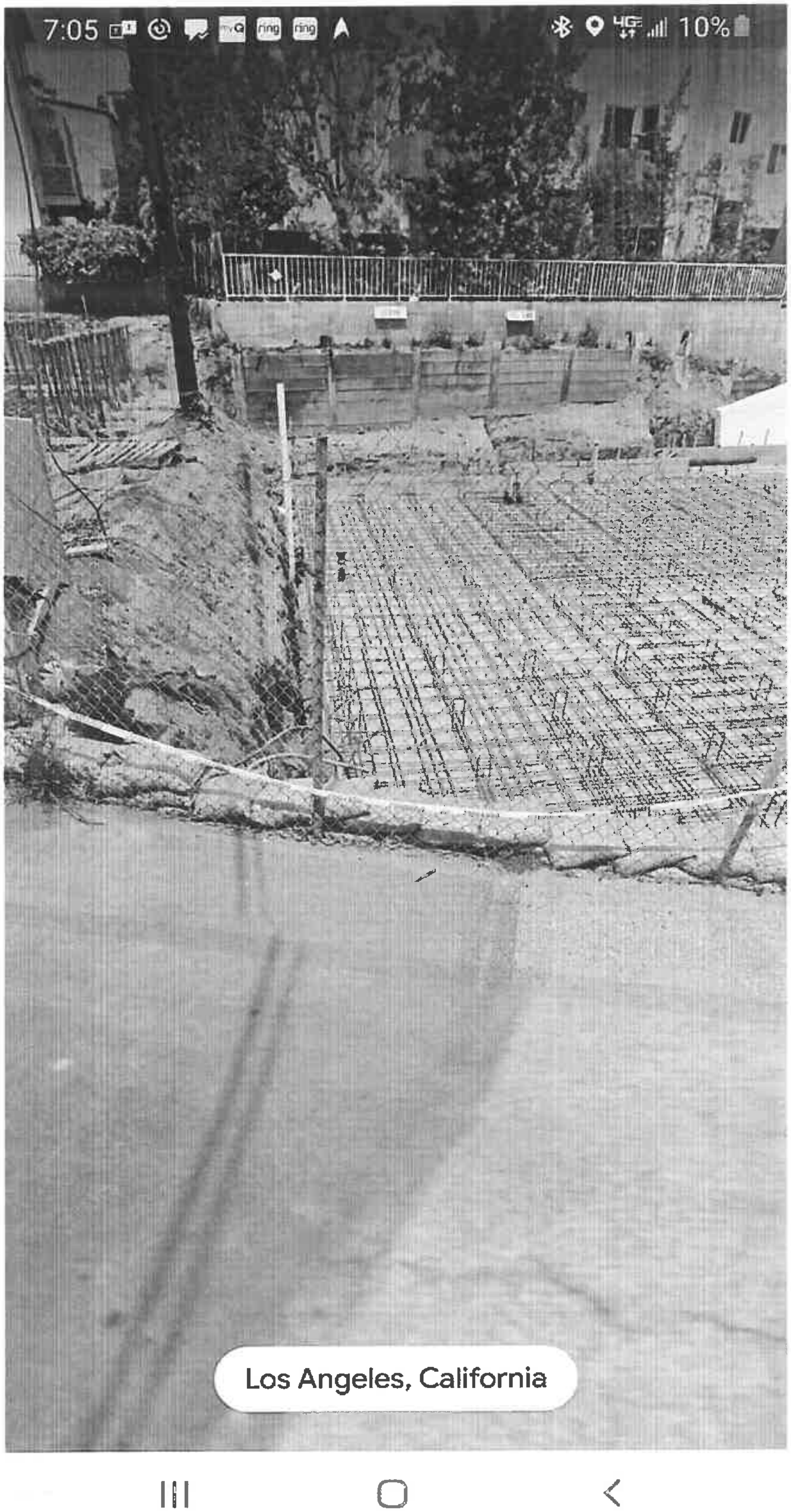


Figure 6 Fault in alley visible

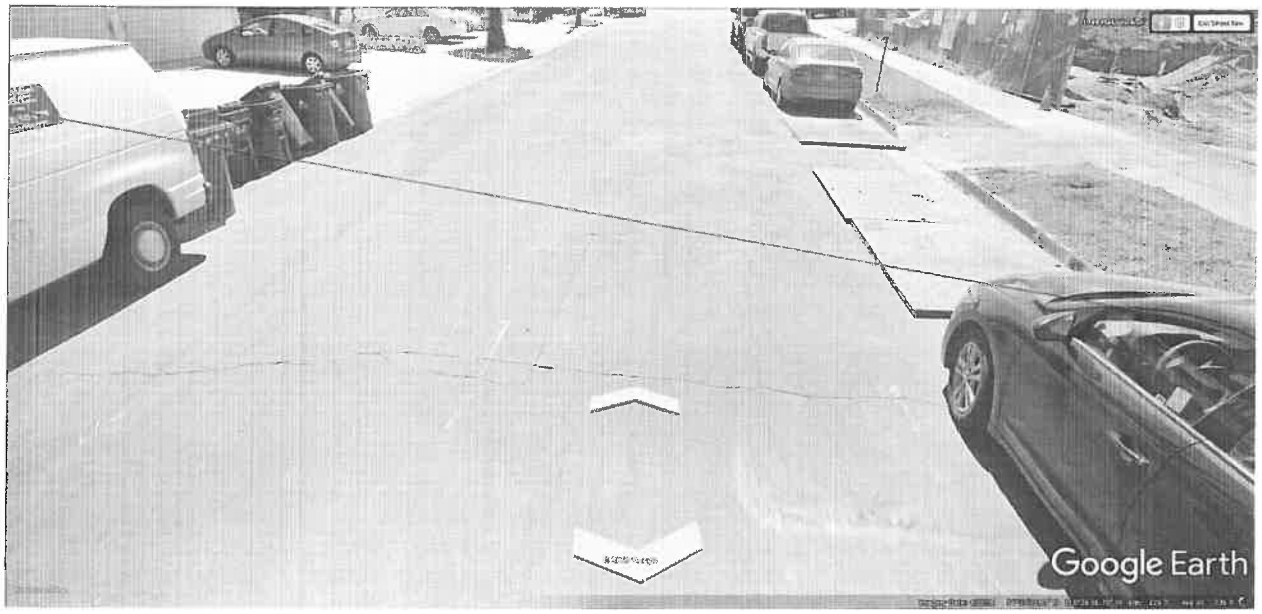


Figure 7 Fault runs across Malcolm into site. Roadway cracks from surface faulting run into site.

We already paid the appeal fee.

Sincerely,

Laura Lake

Laura Lake, Ph.D.

Board Secretary, Fix the City

LIST OF EXHIBITS

A Building permit application #16010-20000-02308 for 1751 Malcolm Avenue/1772 Glendon Avenue, submitted September 28, 2018

B California Geological Survey FER 259, pp. 26-27 (January 5, 2018).

C LADBS denials of seismic safety in 2015 and letter dated December 29, 2015.

D LADBS Public Records Act response PR19-16472, p. 1 of 75 pages of emails, transmitting second surface fault rupture study for 1751 Malcolm Avenue to CGS, from Daniel Schneidereit to Brian Olson, author of FER 259, dated January 27, 2016.

E California Public Resources Code Section 2623(a)-(c)

F LADBS Document Report soils & geology file approved, February 1, 2016.

G LADBS Information Bulletin/Public-Building Code, P/BC 2017-113 (previously issued as P/BC 2014-113; P/BC 2020-113, "Contents of Reports for Submittal to LADBS Grading Division," and P/BC 2020-129 "Surface Fault Rupture Hazard Investigations.

H. Report by Wilson Geosciences on 1751 Malscom Ave. and 1772 Glendon Ave.

I. Kenneth Wilson's c.v.

Report from Wilson Geosciences & Resume

1751 Malcolm Ave. & 1772 Glendon Avenue

RFM 27500

November 23, 2020

Fix the City
10558 Kinnard Avenue
Los Angeles, CA 90024

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

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[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

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[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.

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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

PROFESSIONAL GEOLOGIST
KENNETH LEE WILSON
No. 928
CERTIFIED
ENGINEERING
GEOLOGIST
STATE OF CALIFORNIA

Kenneth Wilson
Principal Geologist
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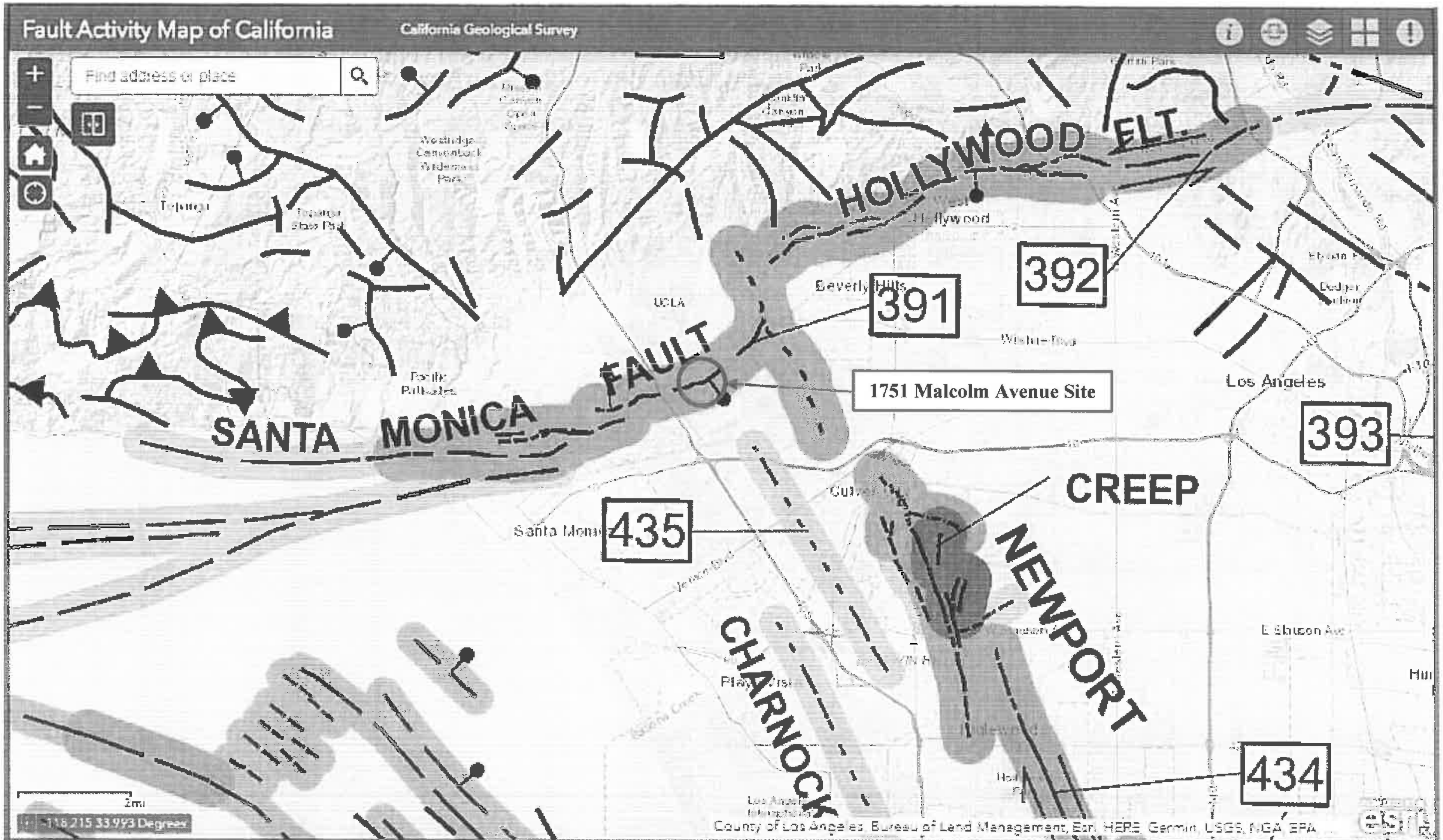
APPENDIX

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)

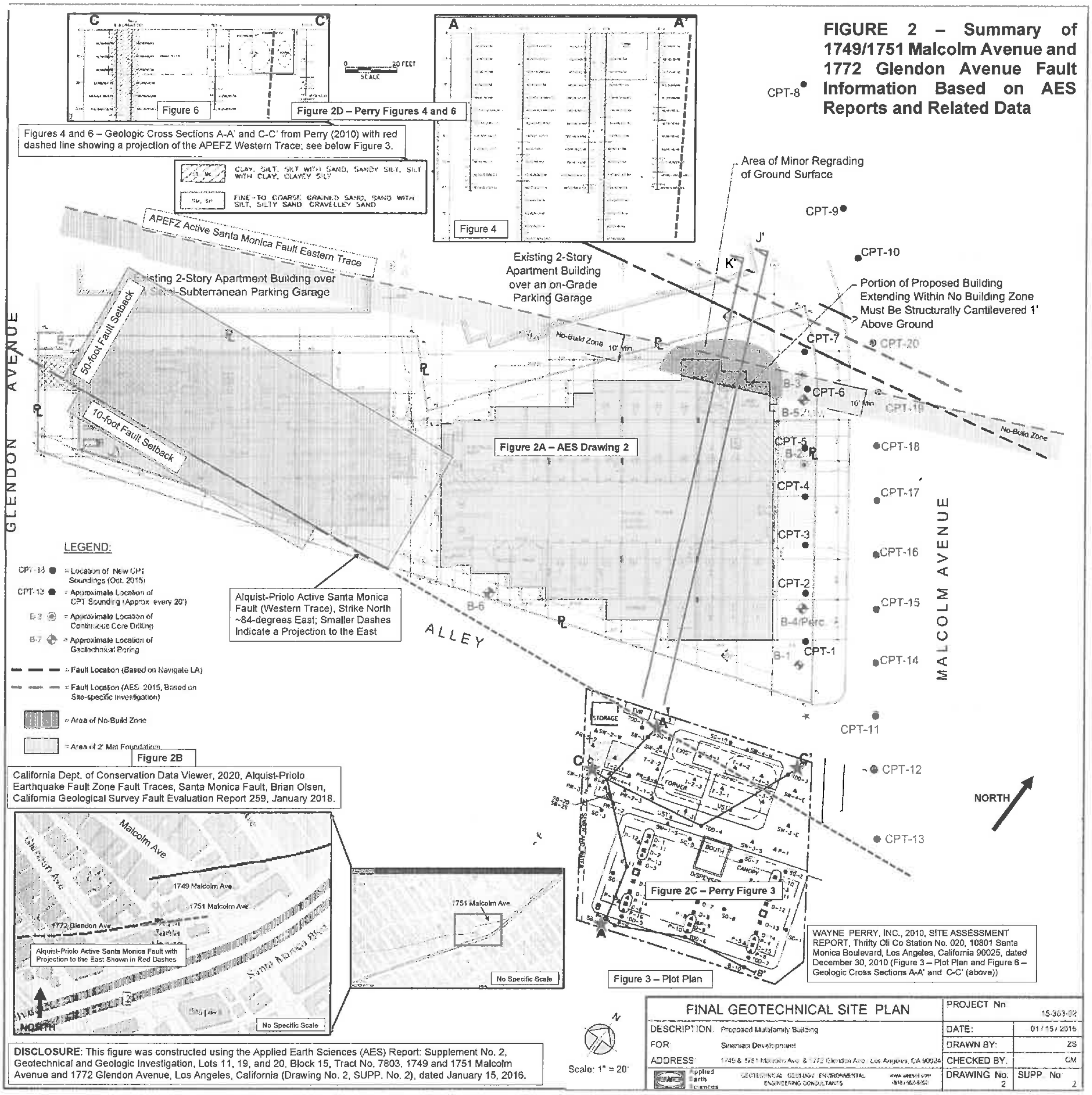


FIGURE 2 – Summary of 1749/1751 Malcolm Avenue and 1772 Glendon Avenue Fault Information Based on AES Reports and Related Data
Figure 6
Figure 2D – Perry Figures 4 and 6
Figure 4
Figures 4 and 6 – Geologic Cross Sections A-A' and C-C' from Perry (2010) with red dashed line showing a projection of the APEFZ Western Trace; see below Figure 3.
CLAY, SILT, SILT WITH SAND, SANDY SILT, SILT WITH CLAY, CLAYEY SILT
FINE-TO COARSE GRAINED SAND, SAND WITH SILT, SILTY SAND, GRAVELLEY SAND
APEFZ Active Santa Monica Fault Eastern Trace
Existing 2-Story Apartment Building over a Semi-Subterranean Parking Garage
Existing 2-Story Apartment Building over an on-Grade Parking Garage
Area of Minor Regrading of Ground Surface
Portion of Proposed Building Extending Within No Building Zone Must Be Structurally Cantilevered 1' Above Ground
50-foot Fault Setback
10-foot Fault Setback
No-Build Zone
Figure 2A – AES Drawing 2
GLENDON AVENUE
MALCOLM AVENUE
ALLEY
CPT-1 CPT-2 CPT-3 CPT-4 CPT-5 CPT-6 CPT-7 CPT-8 CPT-9 CPT-10 CPT-11 CPT-12 CPT-13 CPT-14 CPT-15 CPT-16 CPT-17 CPT-18 CPT-19 CPT-20
B-1 B-2 B-3 B-4/Perc B-5 B-6 B-7
LEGEND:
= Location of New CPT Soundings (Oct. 2015)
= Approximate Location of CPT Sounding (Approx. every 20')
= Approximate Location of Continuous Core Drilling
= 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
Alquist-Priolo Active Santa Monica Fault (Western Trace), Strike North ~84-degrees East; Smaller Dashes Indicate a Projection to the East
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.
Malcolm Ave
1749 Malcolm Ave
1751 Malcolm Ave
1772 Glendon Ave
Santa Monica Blvd
Alquist-Priolo Active Santa Monica Fault with Projection to the East Shown in Red Dashes
No Specific Scale
NORTH
Figure 2C – Perry Figure 3
Figure 3 – Plot Plan
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 and Figure 6 – Geologic Cross Sections A-A' and C-C' (above))
NORTH
Scale: 1" = 20'
FINAL GEOTECHNICAL SITE PLAN
DESCRIPTION: Proposed Multifamily Building
FOR: Sherman Development
ADDRESS: 1749 & 1751 Malcolm Ave & 1772 Glendon Ave, Los Angeles, CA 90024
PROJECT No. 15-303-02
DATE: 01/15/2016
DRAWN BY: ZS
CHECKED BY: CM
DRAWING No. 2
SUPP. No. 2
Applied Earth Sciences
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.