Appendix F

Preliminary Geotechnical Report

COOKE PROPERTY
VALLEJO, CALIFORNIA

PRELIMINARY GEOTECHNICAL REPORT

Submitted to
Mr. Jeb Elmore
Lewis Land Developers, LLC
9216 Kiefer Boulevard
Sacramento, CA 95816

Prepared by
ENGEO Incorporated

April 17, 2017

Project No.
13495.000.000

ENGEO
Expect Excellence

Project No.
13495.000.000

April 17, 2017

Mr. Jeb Elmore
Lewis Land Developers, LLC
9216 Kiefer Boulevard
Sacramento, CA 95816

Subject: Cooke Property
Vallejo, California

PRELIMINARY GEOTECHNICAL REPORT

Dear Mr. Elmore:

With your authorization, we prepared this preliminary geotechnical report for the Cooke Property located in Vallejo, California. This report presents our geotechnical observations and preliminary conclusions and recommendations. We include preliminary site grading, drainage, and foundation recommendations for use during land planning.

Based upon our initial assessment, it is our opinion that the proposed residential and commercial development is feasible from a geotechnical standpoint. Design-level explorations should be conducted prior to site development once more detailed land plans have been prepared.

We are pleased to have been of service on this project and are prepared to consult further with you and your design team as the project progresses. If you have any questions regarding this report, please contact us.

Sincerely,

ENGEO Incorporated

Travis Chatters

Mark Gilbert, GE

REGISTERED PROFESSIONAL ENGINEER
MARK M. GILBERT
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GEOTECHNICAL
STATE OF CALIFORNIA

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1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

ENGEO prepared this geotechnical report for preliminary design of the proposed residential and commercial development in Vallejo, California. As outlined in our agreement dated November 1, 2016, Lewis Land Developers, LLC authorized ENGEO to conduct the following scope of services:

The scope of our services included:

- A site visit.
- Review of published geologic maps and readily available geotechnical reports for the site.
- Excavation of eight test pits and one hand auger.
- Preparation of this report identifying potential geotechnical hazards.

For our use, we received the following:

1. Preliminary Site Plan prepared by MacKay & Somps, dated October 26, 2016.
2. Preliminary title report prepared by First American Title Company, dated September 7, 2016, which shows the property limits of the eastern and western parcel as well as approximate locations of the existing gas and sewer lines that are located within the eastern parcel.
3. Jurisdictional Delineation Map, prepared by Olberding Environmental Inc., which shows jurisdictional wetland locations through the eastern parcel.

Grading plans and topographic surveys have not yet been prepared for the project. This report was prepared for the exclusive use of our client and their consultants for preliminary design of this project. If any changes are made in the character, design or layout of the development, we must be contacted to review the preliminary conclusions and recommendations contained in this report to determine whether modifications are necessary. This document may not be reproduced in whole or in part by any means whatsoever, nor may it be quoted or excerpted without our express written consent.

1.2 PROJECT LOCATION AND DESCRIPTION

The subject property is located southeast of the intersection of Turner Parkway and Admiral Callaghan Lane and southeast of Coach Lane in Vallejo, California, as shown on the Vicinity Map, Figure 1 (attached). As shown in Figure 1.2-1, the property is split by Interstate 80 into two parcels, one to the west of Interstate 80, and the other to the east. The eastern approximately 51.3-acre parcel is located south of Turner Parkway and east of Admiral Callaghan Lane. The western approximately 1.5–acre parcel is located

FIGURE 1.2-1: Cooke Property - Eastern & Western Parcels

at the end of Coach Lane. The properties are identified by Assessor's Parcel Numbers (APN) 814-900-10 and 523-202-50 for the eastern and western sites, respectively.

1.3 PROJECT DESCRIPTION

Based on our discussions with you and review of the information provided, we understand that the site is to be developed for residential and commercial use. Based on a conceptual layout provided, as shown in Figure 1.3-1, development is primarily planned on the eastern parcel. Development along the western side is to include a major retail building, shops, a rest area, and a gas station, while the eastern portion is to include residential housing, several driveways, paseos, a recreation center with a pool, and a water quality basin. The central portion of the development center is planned for open space. Development plans for the western parcel are not yet known.

FIGURE 1.3-1: Preliminary Site Plan – Eastern Parcel

No grading plans have been developed at this time; however, the conceptual layout suggests the site will be graded to match the adjacent streets. This would require cuts up to approximately 20 feet and fills up to approximately 12 feet. We anticipate the commercial areas will include typical paved parking, drive aisles, trash enclosures, and exterior flatwork and the retail building and shops will be typical one-story retail construction. We anticipate the residential area to single or multi-family one- to two-story wood-frame structures with associated parking, sidewalks, and underground utilities.

2.0 FINDINGS

2.1 SITE BACKGROUND

Our review of historical aerial photographs and topographic maps indicates that the eastern parcel was unoccupied as far back as 1937 and was used for grazing until the early 1970s. the aerial photographs show that the western parcel had several structures located on site from the mid-1940s to the early 1980s. Parts of the foundations for these structures were visible during our site reconnaissance throughout the western parcel as shown in Photo 2.1-1.

PHOTO 2.1-1: Existing Foundations located in the Western Parcel

2.2 FIELD EXPLORATION

Our field exploration included excavation of eight test pits (TP) on the eastern parcel and one hand auger (TPHA) on the western parcel, as shown on the Site Plan, Figure 2. We performed our field exploration on November 15, 2016. The location and elevations of our explorations are approximate and were located using handheld GPS; they should be considered accurate only to the degree implied by the method used.

An ENGEO representative observed the excavations and logged the subsurface conditions. We retained a Case 590 Backhoe to excavate the test pits to a maximum depth of about 14 feet. Test pits were backfilled loosely with soil removed during excavation; during construction, test pits will need to be excavated and recompacted (unless in planned cut zone). The hand auger was backfilled with site soils. We obtained bulk and baggie soil samples from the test pit and hand auger locations.

We used the field logs to develop the report logs in Appendix A. The logs depict subsurface conditions at the exploration locations for the date of the exploration; however, subsurface conditions may vary with time.

2.3 GEOLOGY AND SEISMICITY

2.3.1 Geology

The site is located within the Coast Ranges geologic province of California, a series of northwest-trending ridges and valleys. Bedrock in the region has been folded and faulted during regional uplift beginning in the Pliocene period, about 4 million years before present. As shown in the Geologic Map of the northeastern San Francisco Bay region (Graymer, 2002), the site is mapped as Late Cretaceous-age undivided sandstone, siltstone, and shale (Ku) consisting of brownish-gray, fine- to coarse-grained, thin bedded to massive sandstone and greenish-gray to black shale and silty shale, in addition to Pleistoncene-age alluvial fan deposits (Qpf) consisting of poorly sorted, moderately to poorly bedded sand, gravel, silt and clay deposited in gently sloping alluvial fans.

2.3.2 Seismicity

The site is located in a region that contains numerous active earthquake faults. The site is not located within a currently designated Alquist-Priolo Earthquake Fault Zone. An active fault is defined by the California Geological Survey as one that has had surface displacement within Holocene time (about the last 11,000 years). We used the United States Geologic Survey (USGS) 2008 National Seismic Hazard Maps Fault Parameters to determine the distances and potential magnitudes of active faults near the subject site. Nearby active faults within 50 miles of the site and their estimated maximum earthquake magnitudes based on the USGS fault database are provided in the following table.

TABLE 2.3.2-1: Regional Faults
Latitude: 38.128607 Longitude: -122.224806

FAULT NAME	APPROXIMATE DISTANCE (MILES)	ESTIMATE OF MAXIMUM MAGNITUDE*
West Napa	2.7	6.7
Green Valley Connected	6.3	6.8
Hayward Rodgers Creek RC+HN+HS	11.1	7.5
Great Valley 5, Pittsburg Kirby Hills	16.5	6.7
Great Valley 4b, Gordon Valley	18.6	6.8
Mount Diablo Thrust	20.1	6.7
Hunting Creek-Berryessa	22.4	7.1
Calaveras CN+CC+CS	24.5	7.0
Greenville Connected	27.2	7.0
N. San Andreas SAO+SAN+SAP+SAS	29.0	7.9
Great Valley 4a, Trout Creek	30.4	6.6
San Gregorio Connected	32.8	7.5
Point Reyes	35.6	6.9
Great Valley 3, Mysterious Ridge	39.9	7.1
Maacama-Garbeville	40.0	7.4
Great Valley 7	46.9	6.9
Monte Vista – Shannon	47.7	6.5

*Based on Ellsworth

Numerous small earthquakes occur every year in the Bay Region, and larger earthquakes have been recorded and can be expected to occur in the future. Figure 4 shows the approximate locations of these faults and significant historic earthquakes recorded within the Bay Region.

2.4 SURFACE CONDITIONS

Since topographic information was not available, we reviewed published USGS topographic maps. According to this information, the eastern parcel site grades range from approximately Elevation 85 to 130 feet above mean sea level, while the western parcel is situated at approximate Elevation 97 feet above mean sea level. The majority of surface drainage for the eastern parcel appears to flow south to north through the center of the site.

At the time of our field exploration, much of the eastern parcel, as shown in Photo 2.4-1, was covered with grasses and tall shrubs. Site topography included a hill, approximately 20 feet in height, covering the western half of the site. The hill sloped to the east into a natural drainage swale that splits the property in a north-south direction; drainage appears to flow towards the north. The eastern side generally sloped downward towards the north with two swales that fed into the center swale. We did not observe any water in the swales during our field exploration.

PHOTO 2.4-1: Eastern Parcel

The western parcel was generally flat with a 6 to 10 foot high 2:1 (horizontal:vertical) slope along the western border, as shown in Photo 2.4-2. The western parcel was covered with grass and several large trees and bushes.

PHOTO 2.4-2: Western Parcel

2.5 SUBSURFACE CONDITIONS

Except for Test Pit 5 (TP-5), our test pit explorations generally encountered stiff to hard lean clays and elastic silts underlain by weak to very strong, highly to slightly weathered siltstone, claystone, and sandstone. Undocumented fill was encountered in TP-5 from 0 to 7 feet below existing grade; the fill generally consisted of clayey sand with some debris.

We collected and tested representative samples for Plasticity Index (PI) and Expansion Index (EI) that resulted in PI's ranging from 21 to 61 and EI's ranging from 67 to 122. These lab test results indicate soil with moderate to very high plasticity and medium to high shrink/swell potential.

The siltstone and claystone encountered was generally medium strong and moderately weathered, with the exception of TP-1, which encountered highly weathered, medium weak siltstone and claystone. In general, the siltstone and claystone tended to be closely to moderately fractured with thin to very thin bedding. The sandstone encountered was generally strong to very strong and slightly weathered with moderate fractures.

Refusal to backhoe excavation was encountered in two of the eight test pits, as summarized in in Table 2.5-1, below. Refusal occurred in sandstone.

TABLE 2.5-1: Test Pit Depths

TEST PIT	DEPTH OF EXPLORATION (FEET)
TP-1	10
TP-2	10
TP-3	Refusal at 4½ feet
TP-4	10
TP-5	14
TP-6	Refusal at 2½ feet
TP-7	11
TP-8	10
TPHA-1 (Hand Auger)	2½

The test pit logs include the specific subsurface conditions at each location. We include our exploration logs in Appendix A.

2.6 GROUNDWATER CONDITIONS

We did not observe static or perched groundwater in any of our subsurface explorations.

Fluctuations in the level of groundwater may occur due to variations in rainfall, irrigation practice, and other factors not evident at the time of our exploration.

2.7 LABORATORY TESTING

We performed laboratory tests on selected soil samples to evaluate their engineering properties. For this project, we performed moisture content, plasticity index, expansion index, and soil corrosion potential testing. Moisture contents and plasticity indexes are recorded on the test pit logs in Appendix A; other laboratory data is included in Appendix B.

3.0 CONCLUSIONS

From a geotechnical engineering viewpoint, in our opinion, the site is suitable for the proposed residential and commercial development. The primary geotechnical concerns that could affect development on the site: (1) the presence of potentially expansive near-surface soil, (2) the presence of non-engineered fill and, (3) excavatability and processing of the shallow bedrock. We summarize our conclusions below.

3.1 EXPANSIVE SOIL

We observed potentially expansive clay, elastic silt with claystone, and claystone near the surface of the site in the test pits. Our laboratory testing indicates that these soils exhibit moderate to high shrink/swell potential with variations in moisture content. Expansive soils change in volume with changes in moisture. They can shrink or swell and cause heaving and cracking of slabs-on-grade, pavements, and structures founded on shallow foundations. Building damage due to volume changes associated with expansive soils can be reduced by: (1) using a rigid mat foundation that is designed to resist the settlement and heave of expansive soil, (2) deepening the foundations to below the zone of significant moisture fluctuation. Slabs-on-grade also require protection from the potentially damaging effects of expansive soil. This is typically accomplished by placing a blanket of non-expansive fill on the building pad.

Retail buildings may be supported on deepened footings combined with slabs-on-grade underlain by non-expansive fill. Residential structures may be supported on post-tensioned mat foundations. Preliminary foundation recommendations are provided in Section 4.2.

Specific grading recommendations for compaction of expansive soils at the site should be provided in a design-level study. The purpose of these recommendations is to reduce the swell potential of the clay by compacting the soil at a high moisture content and controlling the amount of compaction. Preliminary earthwork recommendations are presented in Section 4.1 of this report.

3.2 EXISTING FILL

Test Pit 5, located in the northeast potion of the eastern parcel, encountered approximately 7 feet of fill with some debris. While the lateral extent of this fill is unknown, review of aerial photos and site observations suggest that this fill may extend along the northern border of the site, parallel to Turner Parkway. The lateral extent and depth of existing fill should be further explored as part of a design-level geotechnical study.

Non-engineered fills can undergo excessive settlement, especially under new fill or building loads. Because the fill contained some debris, we recommend complete removal of the existing fill, as presented in Section 4.1.2.

3.3 EXCAVATABILITY

We used a 590 CASE backhoe during our exploratory work and were able to excavate to the target test pit depth of 10 feet at six of the eight exploration locations. Backhoe refusal was encountered at locations TP-3 and TP-6 at depths of 4½ and 2½ feet below existing grade. Based on these results, it is our opinion that conventional grading equipment will likely be able to excavate the soil, siltstone, and claystone with only moderate effort; however, larger equipment and greater effort will be needed for excavations extending into the sandstone. We recommend further exploration be performed as part of the design level geotechnical study to further evaluate excavatability.

We provide the above excavatability information for general planning purposes only. This information is not intended for bidding purposes.

3.4 FLOODING

The project Civil Engineer should review pertinent information relating to possible flood levels for the subject site based on final pad elevations and provide appropriate design measures for development of the project, if necessary.

3.5 SOIL CORROSION POTENTIAL

As part of this study, we obtained representative soil sample and submitted to a qualified analytical lab for determination of pH, resistivity, sulfate, and chloride. The results are included in Appendix D and summarized in the table below.

TABLE 3.5-1: Corrosivity Test Results

SAMPLE LOCATION	DEPTH (FEET)	PH	RESISTIVITY (OHMS-CM)	CHLORIDE (MG/KG)	SULFATE (MG/KG)
TP-1	1	6.27	0.96	18.1	15.5
TP-6	1	5.86	1.42	27.8	18.9

The 2013 CBC references the 2011 American Concrete Institute Manual, ACI 318-11, Chapter 4, Sections 4.2.1 for structural concrete requirements. ACI Table 4.2.1 provides the following exposure categories and classes, and concrete requirements in contact with soil based upon the exposure risk.

TABLE 3.5-2: ACI Table 4.2.1: Exposure Categories and Classes

			WATER- SOLUBLE SULFATE IN SOIL % BY WEIGHT*	DISSOLVED SULFATE IN WATER MG/KG (PPM)**
S Sulfate	Not applicable	S0	$SO_4 < 0.10$	$SO_4 < 150$
	Moderate	S1	$0.10 \le SO_4 < 0.20$	$150 \le SO_4 \le 1,500$ seawater
	Severe	S2	$0.20 \le SO_4 \le 2.00$	$1,500 \le SO_4 \le 10,000$
	Very severe	S3	$SO_4 > 2.00$	$SO_4 > 10,000$

*Percent sulfate by mass in soil determined by ASTM C1580
**Concentration of dissolved sulfates in water in ppm determined by ASTM D516 or ASTM D4130

In accordance with the criteria presented in the above table, these soils are categorized as the S0 sulfate exposure class. Cement type, water-cement ratio, and concrete strength, are not specified for these ranges. Based on the resistivity measurements, the soils are not considered corrosive to buried metal piping.

3.6 SEISMIC HAZARDS

Potential seismic hazards resulting from a nearby moderate to major earthquake can generally be classified as primary and secondary. The primary effect is ground rupture, also called surface faulting. The common secondary seismic hazards include ground shaking, soil liquefaction, and lateral spreading. These hazards are discussed in the following sections.

Based on our review of topographic and lithologic data, it is our opinion that the risk of regional subsidence or uplift, tsunamis, landslides or seiches occurring at the site is low.

3.6.1 Ground Rupture

As shown on Figure 4, the site is not located within a State of California Earthquake Fault Hazard Zone (1982). Therefore, since no known active faults cross the site, it is our opinion that ground rupture is not likely to occur at the site.

3.6.2 Ground Shaking

An earthquake of moderate to high magnitude generated within the San Francisco Bay Region, similar to those that have occurred in the past, could cause considerable ground shaking at the site. To mitigate the shaking effects, all structures should be designed using sound engineering judgment and the latest California Building Code (CBC) requirements as a minimum. Seismic design provisions of current building codes generally prescribe minimum lateral forces, applied statically to the structure, combined with the gravity forces of dead and live loads. The code-prescribed lateral forces are generally substantially smaller than the expected peak forces that would be associated with a major earthquake. Therefore, structures should be able to: (1) resist minor earthquakes without damage, (2) resist moderate earthquakes without structural damage but with some nonstructural damage, and (3) resist major earthquakes without collapse but with some structural as well as nonstructural damage. Conformance to the current building code recommendations does not constitute any kind of guarantee that significant structural damage would not occur in the event of a maximum magnitude earthquake; however, it is reasonable to expect that a well-designed and well-constructed structure will not collapse or cause loss of life in a major earthquake (SEAOC, 1996).

3.6.3 Ground Lurching

Ground lurching is a result of the rolling motion imparted to the ground surface during energy released by an earthquake. Such rolling motion can cause ground cracks to form. The potential for the formation of these cracks is considered greater at contacts between deep alluvium or fill and bedrock. Such an occurrence is possible at the site as in other locations in the Bay Area Region, but based in the site location, it is our opinion that the offset is expected to be minor.

3.6.4 Liquefaction

The site is not located within a State of California Seismic Hazard Zone (CGS, 2009) for areas that may be susceptible to liquefaction. Soil liquefaction results from loss of strength during cyclic loading, such as imposed by earthquakes. Soil most susceptible to liquefaction is clean, loose, saturated, uniformly graded, fine-grained sand. Empirical evidence indicates that loose to medium dense gravel, silty sand, low-plasticity silt, and some low-plasticity clay are also potentially liquefiable.

As described previously, the surficial soil types include lean clays and elastics silts. Additionally, the soil is underlain by relatively shallow siltstone, claystone, and sandstone. Due to the shallow bedrock at the site, we do not anticipate soil liquefaction to be a concern for development.

3.6.5 Lateral Spreading and Earthquake-Induced Landsliding

Lateral spreading and earthquake-induced landsliding involve lateral ground movements caused by seismic shaking. These lateral ground movements are often associated with a weakening or failure of an embankment or soil mass overlying a layer of liquefied sands or weak soils. Due to shallow bedrock, lateral spreading is unlikely at the site, in our opinion.

3.7 2013 CBC SEISMIC DESIGN PARAMETERS

We provide the 2013 California Building Code (CBC) seismic parameters in Table 3.7-1 below.

TABLE 3.7-1: 2013 CBC Seismic Design Parameters

PARAMETER	VALUE
Site Class	D
Mapped MCE_R Spectral Response Acceleration at Short Periods, S_S (g)	1.69
Mapped MCE_R Spectral Response Acceleration at 1-second Period, S_1 (g)	0.61
Site Coefficient, F_A	1.00
Site Coefficient, F_V	1.50
MCE_R Spectral Response Acceleration at Short Periods, S_{MS} (g)	1.69
MCE_R Spectral Response Acceleration at 1-second Period, S_{M1} (g)	0.91
Design Spectral Response Acceleration at Short Periods, S_{DS} (g)	1.13
Design Spectral Response Acceleration at 1-second Period, S_{D1} (g)	0.61
Mapped MCE Geometric Mean (MCE_G) Peak Ground Acceleration, PGA (g)	0.64

4.0 PRELIMINARY RECOMMENDATIONS

4.1 EARTHWORK

The following preliminary recommendations are for initial land planning and preliminary estimating purposes. Final recommendations regarding site grading and foundation construction will be provided after additional site-specific exploration has been undertaken.

4.1.1 Demolition and Stripping

Site development will commence with the removal of buried structures, including abandoned utilities and septic tanks and their leach fields, if any exist. All debris should be removed from any location to be graded, from areas to receive fill or structures, or those areas to serve as borrow. The depth of removal of such materials should be determined by the Geotechnical Engineer in the field at the time of grading.

Existing vegetation and pavements (asphalt concrete/concrete and underlying aggregate base) should be removed from areas to receive fill, or structures, or those areas to serve for borrow. Tree roots should be removed down to a depth of at least 3 feet below existing grade. The actual depth of tree root removal should be determined by the Geotechnical Engineer's representative in the field. Subject to approval by the Landscape Architect, strippings and organically contaminated soil can be used in landscape areas. Otherwise, such soils should be removed from the project site. Any topsoil that will be retained for future use in landscape areas should be stockpiled in areas where it will not interfere with grading operations.

All excavations from demolition and stripping below design grades should be cleaned to a firm undisturbed soil surface determined by the Geotechnical Engineer. This surface should then be scarified, moisture conditioned, and backfilled with compacted engineered fill. The requirements for backfill materials and placement operations are the same as for engineered fill.

No loose or uncontrolled backfilling of depressions resulting from demolition and stripping is permitted.

4.1.2 Existing Fill Removal

We recommend that any existing fill be removed to competent native soil. The excavated soil may be reused as engineered fill provided it meets the requirements under Acceptable Fill. We encountered fill at TP-5 to a depth of approximately 7 feet; the lateral extent and depth of fill is expected to vary.

4.1.3 Acceptable Fill

We anticipate that onsite soil and rock material is suitable as fill material provided it is processed to remove concentrations of organic material, debris, and particles greater than 8 inches in maximum dimension. Boulders larger than 8 inches may be placed in deeper portions of fills provided that:

- They are located at least 2 feet below any planned excavations limits (i.e. for utilities or foundations).

- They are placed individually and not nested together.
- The contractor can achieve acceptable compaction adjacent to the boulders, as evaluated by ENGEO.

Imported fill materials should meet the above requirements and have a plasticity index less than 12 and at least 20 percent passing the No. 200 sieve. Allow ENGEO to sample and test proposed imported fill materials at least 5 days prior to delivery to the site.

4.1.4 Differential Fill Thickness

Differential building movements may result from conditions where building pads have significant differentials in fill thickness. We recommend that the differential fill thickness across any lot or building be no greater than 10 feet. Local subexcavation of soil material and replacement with compacted fill may be needed to achieve this recommendation.

4.1.5 Fill Compaction

For land planning and cost estimating purposes, we provide the following compaction recommendations for general fill areas:

Test Procedures:	ASTM D-1557.
Required Moisture Content:	Not less than 4 percentage points above optimum moisture content for the native expansive clays, elastic silts, or claystone; not less than 1 percentage point above optimum for import and other soil.
Minimum Relative Compaction:	Between 87 and 92 percent for the native expansive clays, elastic silts, or claystone; not less 90 percent for import and other soil.

Relative compaction refers to the in-place dry density of soil expressed as a percentage of the maximum dry density of the same material (ASTM D1557). Additional compaction requirements may be required for deeper fills and retaining wall backfill.

4.1.6 Surface Drainage

The building pads must be positively graded at all times to provide for rapid removal of surface water runoff from the foundation systems and to prevent ponding of water under floors or seepage toward the foundation systems at any time during or after construction. Ponding of stormwater must not be permitted on the building pads during prolonged periods of inclement weather. All surface water should be collected and discharged into the storm drain system. Landscape mounds must not interfere with this requirement.

All roof stormwater should be collected and directed to downspouts. Stormwater from roof downspouts should be directed to a solid pipe that discharges to the street or to an approved outlet or onto an impervious surface, such as pavement that will drain at a 2 percent slope gradient.

Due to the generally high fines content anticipated in the near-surface site materials, the site soils encountered are not expected to have adequate permeability values to handle stormwater infiltration in grassy swales or permeable pavers. Therefore, best management practices should assume that little stormwater infiltration will occur at the site.

4.1.7 Landscaping Considerations

Sprinkler systems should not be installed where they may cause ponding or saturation of foundation soils. Ponding or saturation of foundation soils will cause soil swell, consequent loss of strength, and movement of the foundations and slabs.

Irrigation of landscaped areas should be strictly limited to that necessary to sustain vegetation. Excessive irrigation could result in saturation, weakening, and swelling of foundation soils. The Landscape Architect and prospective owners should be informed of the surface drainage requirements included in this report.

4.1.8 Utilities

Pipe zone backfill (i.e., material beneath and immediately surrounding the pipe) may consist of a well-graded import or native material less than ¾ inch (2 centimeters) in maximum dimension. Trench zone backfill (i.e., material placed between the pipe zone backfill and the ground surface) may consists of native soil compacted in accordance with recommendations for engineered fill. On a preliminary basis, we recommend that trench backfill be compacted to minimum 90 percent relative compaction at a moisture content at least 3 percentage points above optimum (ASTM D1557).

Where import material is used for pipe zone backfill, we recommend that it consist of fine- to medium grained sand or a well-graded mixture of sand and gravel and that this material not be used within 2 feet of finish grades. In general, uniformly graded gravel should not be used for pipe or trench zone backfill due to the potential for migration of (1) soil into the relatively large void spaces present in the type of material; and (2) water along trenches backfilled with this type of material. All utility trenches entering buildings and paved areas must be provided with an impervious seal consisting of native materials or concrete were the trenches pass under structure perimeters or curb lines. The impervious plug should extend at least 3 feet to either side of the crossing. This is to prevent surface water percolation into the sands under foundations and pavements where such water would remain trapped in a perched condition, allowing clays to develop their full expansion potential.

Utility trenches should not be located upslope of any foundation areas unless placement, depth, and backfill material to be used are reviewed by the Geotechnical Engineer. Care should be exercised where utility trenches are located beside foundation areas. Utility trenches constructed parallel to foundations should be located entirely above a plane extending down from the lower edge of the footing at an angle of 45 degrees. Utility companies and Landscape Architects should be made aware of this information.

Utility trenches in areas to be paved should be backfilled to the specifications provided in this report for engineered fil. Compaction of trench backfill by jetting shall not be allowed at this site.

4.2 FOUNDATION DESIGN

4.2.1 Retail Buildings

We anticipate that retail structures may be supported on conventional continuous and isolated spread footings bearing in competent native soil or compacted fill. Minimum footing depths will likely be at least 24 inches and minimum footing widths will likely be in the range of 12 to 18 inches, depending on the structural loading. These footings could be designed to support a maximum allowable dead plus live bearing pressure of 3,500 pounds per square foot (psf). This may be increased by one-third for the short-term effects of wind or seismic loading.

The floor may be constructed with a concrete slab-on-grade and to reduce the risk of structural damage associated with the expansive soil conditions, we recommend that the upper 2 feet of building pad be constructed of non-expansive fill extending to at least 10 feet laterally beyond the building edge. Non-expansive fill is defined as having a plasticity index less than or equal to 12. Onsite soil or imported fill may be used as non-expansive fill provided it meets the recommendations for Acceptable Fill and has a PI less than or equal to 12. As an alternative to importing non-expansive fill, it may be cost effective to lime treat the upper 2 feet of the finished building pad.

4.2.2 Residential Buildings (Post-Tensioned Mat Foundation Design)

We anticipate that single or multi-family one- to two-story wood-frame structures may be supported on post-tensioned mat foundations bearing in compacted fill. A minimum mat thickness of 10 inches should be anticipated for preliminary purposes. A maximum allowable bearing pressure of 1,000 psf for dead-plus-live loads, which may be increased by one third when considering total loads including wind or seismic, could also be incorporated for initial design purposes. We anticipate that structural mats constructed on swelling soils will move differentially; therefore, structural mats may require stiffening to reduce differential movements due to swelling/shrinkage to a value compatible with the type of structure that will be constructed. Additional laboratory testing and engineering analysis should be performed in a design level geotechnical study.

4.3 PAVEMENTS

Based on the relatively high clay content of the near surface soils encountered in our explorations and our experience with nearby developments, we judged an R-value of 5 to be appropriate for preliminary pavement design. Using a preliminary design R-value of 5 and Topic 633 of the Caltrans Highway Design Manual (including the asphalt factor of safety), we developed the following pavement sections presented in Table 4.3-1 below.

TABLE 4.3-1: Preliminary Pavement Sections

TRAFFIC INDEX	HMA (INCHES)	AB (INCHES)
5.0	3	10
6.0	3½	13
7.0	4	15½

Note: HMA – Hot Mix Asphalt
AB – Caltrans Class 2 aggregate base (R-value of 78 or greater)

The above preliminary pavement sections are provided for estimating only. We recommend the actual subgrade material should be tested for R-value and the Traffic Index be confirmed by the Civil Engineer.

5.0 FUTURE STUDIES

A site-specific geotechnical exploration should be performed as part of the design process. The exploration would include borings or test pits and laboratory soil testing to provide data for preparation of specific recommendations for design of grading, foundations, and drainage for the proposed development. The exploration will also allow for more detailed evaluations of the geotechnical issues discussed below and afford the opportunity to provide recommendations regarding techniques and procedures to be implemented during construction to mitigate potential geotechnical/geological hazards.

Due to shallow backhoe refusal on sandstone, a seismic refraction survey combined with additional exploration may also be beneficial in refining development costs.

6.0 LIMITATIONS AND UNIFORMITY OF CONDITIONS

This report presents preliminary geotechnical recommendations for design of the improvements discussed in Section 1.3 for the Cooke Property project. If changes occur in the nature or design of the project, we should be allowed to review this report and provide additional recommendations, if any. It is the responsibility of the owner to transmit the information and preliminary recommendations of this report to the appropriate organizations or people involved in design of the project, including but not limited to developers, owners, buyers, architects, engineers, and designers. The preliminary conclusions and recommendations contained in this report are solely professional opinions and are valid for a period of no more than 2 years from the date of report issuance.

We strived to perform our professional services in accordance with generally accepted geotechnical engineering principles and practices currently employed in the area; no warranty is expressed or implied. There are risks of earth movement and property damages inherent in building on or with earth materials. We are unable to eliminate all risks or provide insurance; therefore, we are unable to guarantee or warrant the results of our services.

This report is based upon field and other conditions discovered at the time of report preparation. We developed this report with limited subsurface exploration data. We assumed that our subsurface exploration data is representative of the actual subsurface conditions across the site. Considering possible underground variability of soil, rock, stockpiled material, and groundwater, additional costs may be required to complete the project. We recommend that the owner establish a contingency fund to cover such costs. If unexpected conditions are encountered, notify ENGEO immediately to review these conditions and provide additional and/or modified recommendations, as necessary.

Our services did not include excavation sloping or shoring, soil volume change factors, or a geohazard exploration. In addition, our geotechnical exploration did not include work to determine the existence of possible hazardous materials. If any hazardous materials are encountered during construction, then notify the proper regulatory officials immediately.

This document must not be subject to unauthorized reuse, that is, reusing without written authorization of ENGEO. Such authorization is essential because it requires ENGEO to evaluate the document's applicability given new circumstances, not the least of which is passage of time.

Actual field or other conditions will necessitate clarifications, adjustments, modifications or other changes to ENGEO's documents. Therefore, ENGEO must be engaged to prepare the necessary clarifications, adjustments, modifications or other changes before construction activities commence or further activity proceeds. If ENGEO's scope of services does not include onsite construction observation, or if other persons or entities are retained to provide such services, ENGEO cannot be held responsible for any or all claims arising from or resulting from the performance of such services by other persons or entities, and from any or all claims arising from or resulting from clarifications, adjustments, modifications, discrepancies or other changes necessary to reflect changed field or other conditions.

SELECTED REFERENCES

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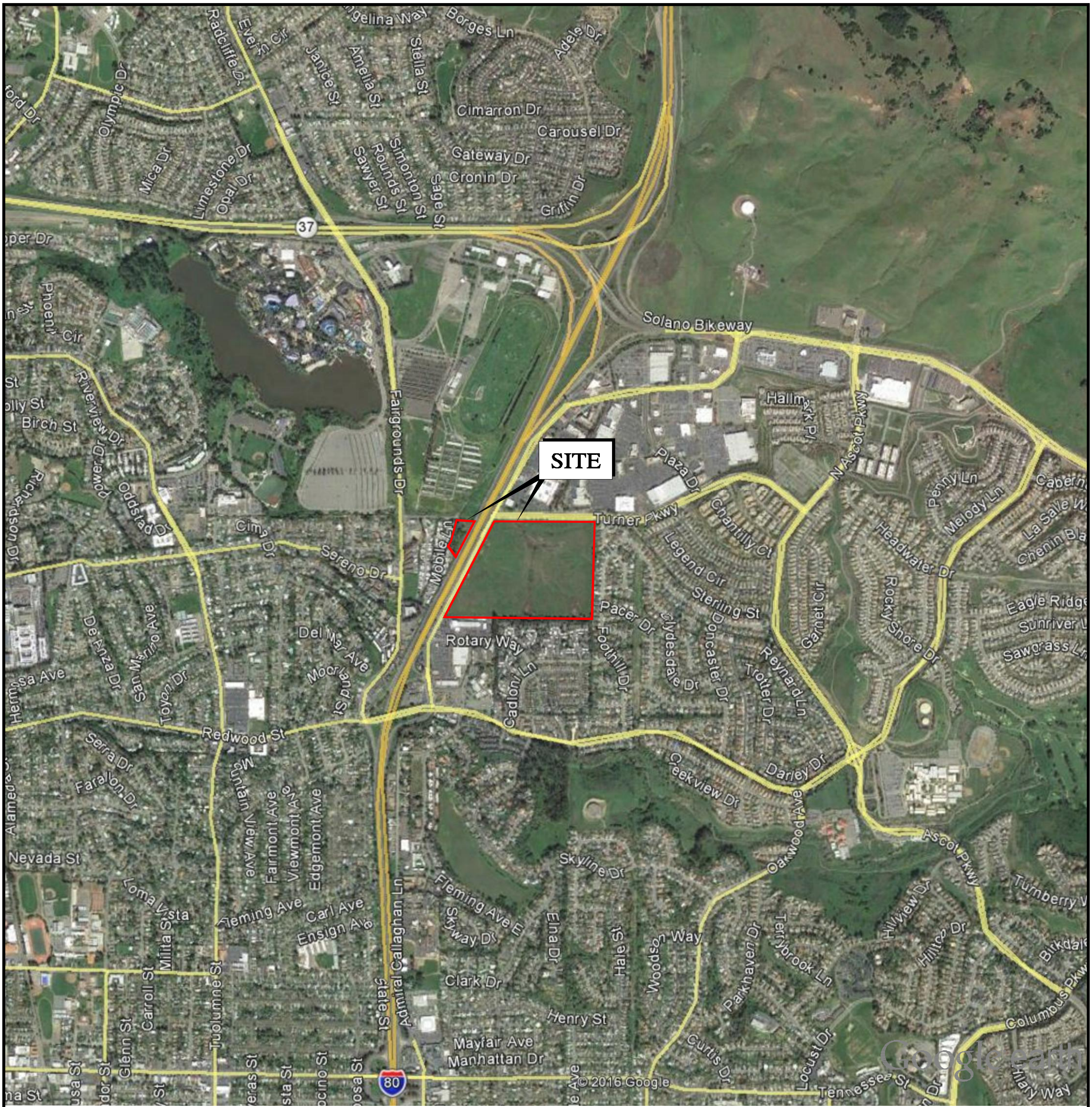
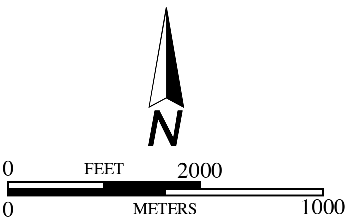
Graymer, R.W., Jones, D.L., and Brabb, E.E., 2002, Geologic map and map database of northeastern San Francisco Bay region, California – most of Solano County and Parts of Napa, Marin, Contra Costa, San Joaquin, Sacramento, Yolo and Sonoma Counties: U.S. Geological Survey, Miscellaneous Field Studies Mao MF-2403, scale 1:100,000.

FIGURES





BASE MAP SOURCE: GOOGLE EARTH MAPPING SERVICE

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VICINITY MAP COOKE PROPERTY VALLEJO, CALIFORNIA	PROJECT NO.: 13495.000.000		FIGURE NO. 1
	SCALE: AS SHOWN		
	DRAWN BY: SRP	CHECKED BY: MMG	

G:\Drafting\DRAFTING2_Dwg_13000 Plus\13495\000\GEX\13495000000-GEX-1-VcinityMap-1116.dwg Plot Date: 11-29-16 spatters

ORIGINAL FIGURE PRINTED IN COLOR

G:\Drafting\DRAFTING2_Dwg_13000 Plus\13495\000\GEX\13495000000-GEX-2-SitePlan-1116.dwg Plot Date:11-29-16 spatters

EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

SITE BOUNDARY

TP-8 10' TEST PIT SHOWING DEPTH TO BOTTOM (ENGEO, 2016)

HA-1 2.5' HAND AUGER SHOWING DEPTH TO BOTTOM (ENGEO, 2016)

N

0 FEET 400

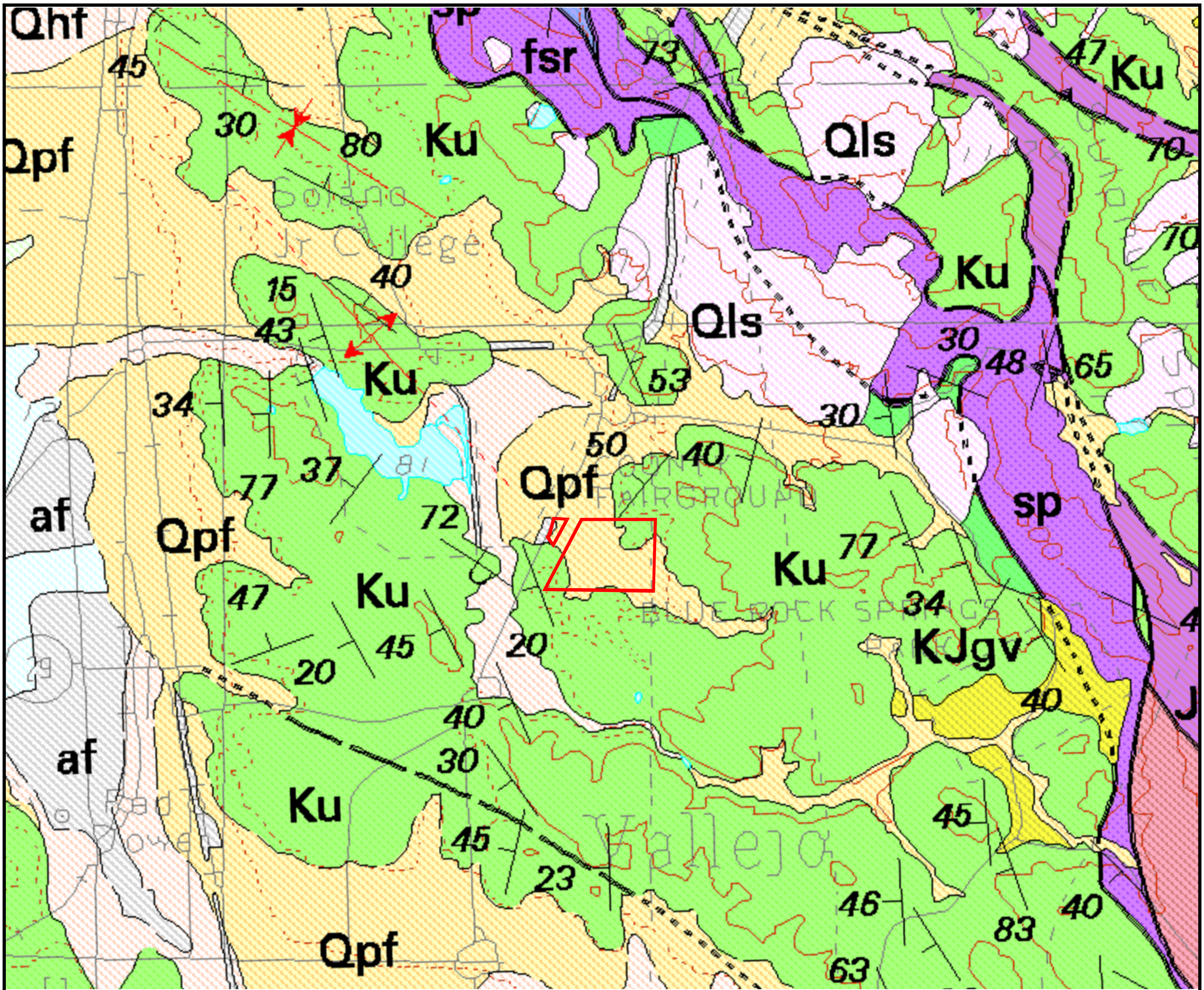
0 METERS 200

BASE MAP SOURCE: GOOGLE EARTH MAPPING SERVICE

ENGEO Expect Excellence

SITE PLAN COOKE PROPERTY VALLEJO, CALIFORNIA	PROJECT NO.: 13495.000.000		FIGURE NO. 2
	SCALE: AS SHOWN		
	DRAWN BY: SRP	CHECKED BY: MMG	

ORIGINAL FIGURE PRINTED IN COLOR



EXPLANATION

SITE BOUNDARY

GEOLOGIC CONTACT-DASHED WHERE GRADATIONAL OR APPROXIMATELY LOCATED

FAULT-DASHED WHERE INFERRED, DOTTED WHERE CONCEALED, QUERIED WHERE EXISTENCE IS DOUBTFUL. SAWTEETH ARE ON UPPER PLATE OF LOW ANGLE THRUST FAULT.

AXIS OF FOLD

ANTICLINE SYNCLINE

STRIKE AND DIP OF STRATA

INCLINED

Qhf ALLUVIAL FAN DEPOSITS (HOLOCENE)

Qls LANDSLIDE DEPOSITS (HOLOCENE AND PLEISTOCENE)

Qpf ALLUVIAL FAN DEPOSITS (LATE PLEISTOCENE)

Ku UNDIVIDED SANDSTONE, SILTSTONE AND SHALE (LATE CRETACEOUS)

Kjgv MASSIVE SANDSTONE AND SHALE (EARLY CRETACEOUS AND LATE JURASSIC)

N

0 FEET 2000

0 METERS 1000

BASE MAP SOURCE: GRAYMER, 2001

ENGEO Expect Excellence	REGIONAL GEOLOGY MAP COOKE PROPERTY VALLEJO, CALIFORNIA	PROJECT NO.: 13495.000.000 SCALE: AS SHOWN DRAWN BY: SRP CHECKED BY: MMG	FIGURE NO. 3

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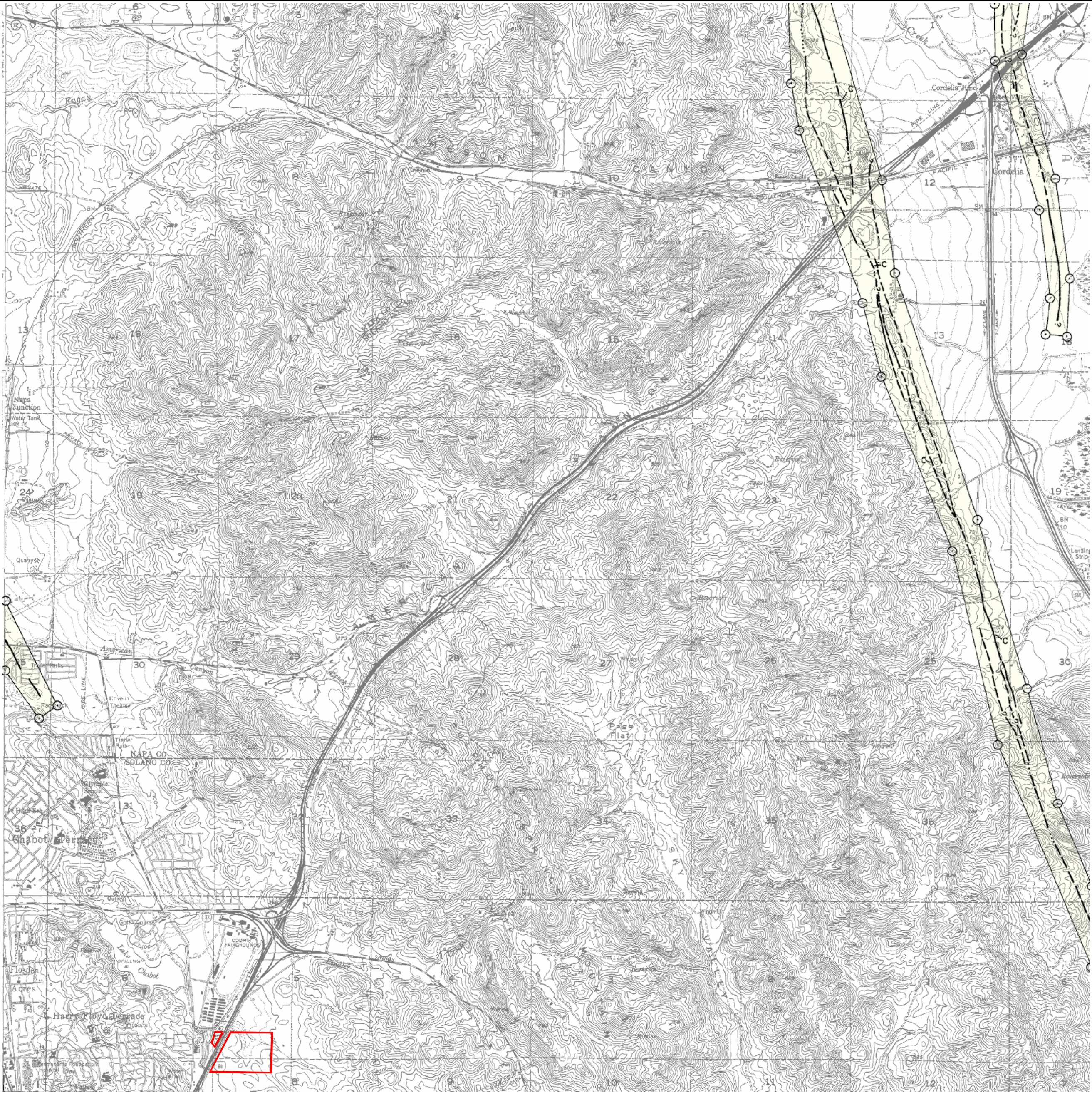
ORIGINAL FIGURE PRINTED IN COLOR



EXPLANATION

SITE BOUNDARY

1906 C

FAULTS CONSIDERED TO HAVE BEEN ACTIVE DURING HOLOCENE TIME AND TO HAVE A RELATIVELY HIGH POTENTIAL FOR SURFACE RUPTURE; SOLID LINE WHERE ACCURATELY LOCATED, LONG DASH WHERE APPROXIMATELY LOCATED, SHORT DASH WHERE INFERRED, DOTTED WHERE CONCEALED; QUERY (?) INDICATES ADDITIONAL UNCERTAINTY. EVIDENCE OF HISTORIC OFFSET INDICATED BY YEAR OF EARTHQUAKE-ASSOCIATED EVENT OR C FOR DISPLACEMENT CAUSED BY CREEP OR POSSIBLE CREEP

EARTHQUAKE FAULT ZONE BOUNDARIES; DELINEATED AS STRAIGHT-LINE SEGMENTS THAT CONNECT ENCIRCLED TURNING POINTS SO AS TO DEFINE EARTHQUAKE FAULT ZONE SEGMENTS

N

0 MILES 1

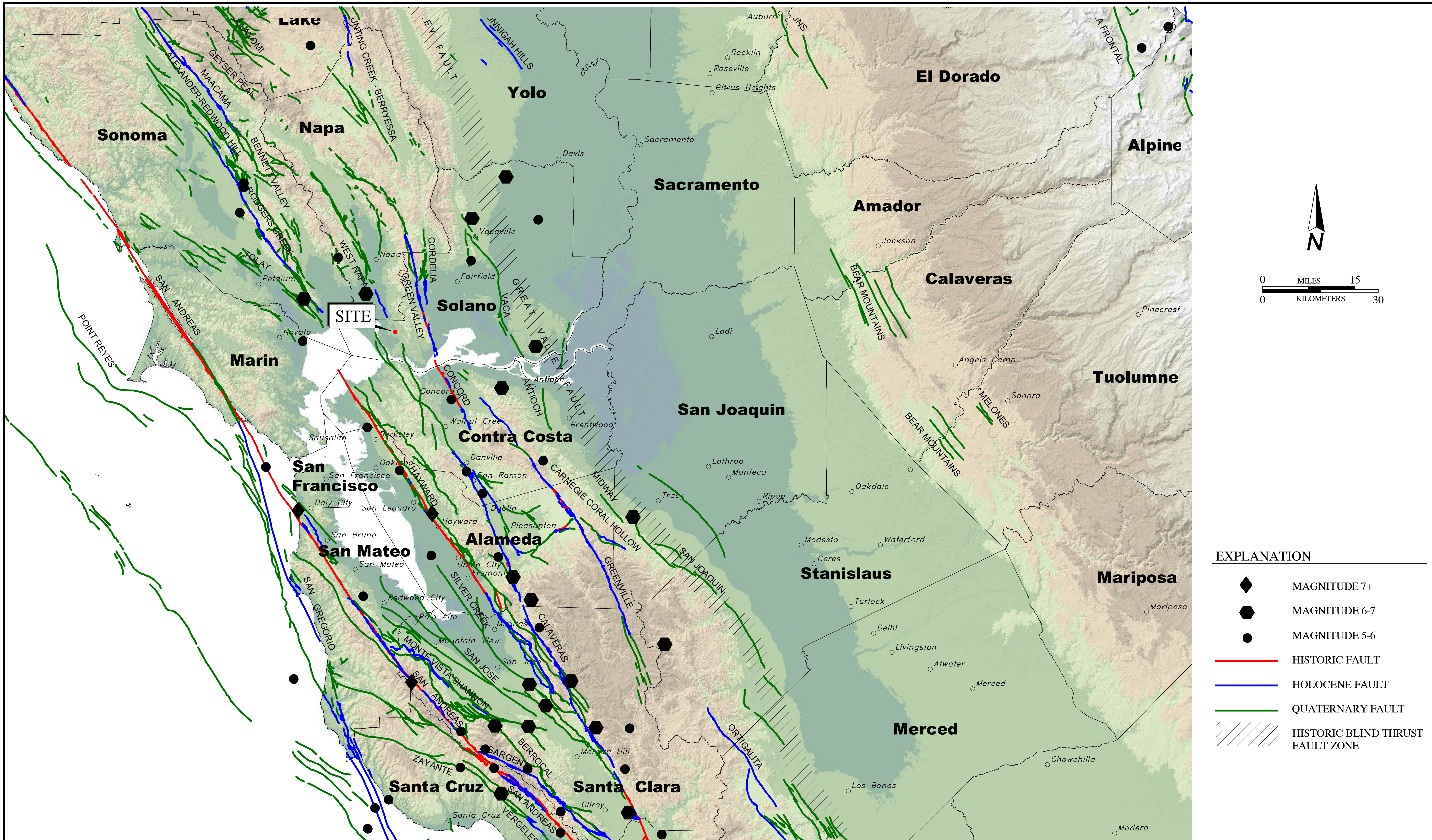
0 KILOMETERS 2

BASE MAP SOURCE: CDMG, 1993

ENGEO Expect Excellence	EARTHQUAKE FAULT ZONE MAP COOKE PROPERTY VALLEJO, CALIFORNIA	PROJECT NO.: 13495.000.000 SCALE: AS SHOWN DRAWN BY: SRP — CHECKED BY: MMG	FIGURE NO. 4

G:\Drafting\DRAFTING2_Dwg_13000 Plus\13495\000\GEX\13495000000-GEX-4-SpecialStdudiesZone-1116.dwg Plot Date: 11-29-16 spatters

ORIGINAL FIGURE PRINTED IN COLOR



BASE MAP SOURCE:

COLOR HILLSHADE IMAGE BASED ON THE NATIONAL ELEVATION DATASET (NED) AT 30 METER RESOLUTION
U.S.G.S. QUATERNARY FAULT DATABASE, NOVEMBER, 2010
U.S.G.S. HISTORIC EARTHQUAKE DATABASE (1800–2000)

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REGIONAL FAULTING AND SEISMICITY COOKE PROPERTY VALLEJO, CALIFORNIA	PROJECT NO.: 13495.000.000		FIGURE NO 5
	SCALE: AS SHOWN		
	DRAWN BY: SRP	CHECKED BY: MMG	

ORIGINAL FIGURE PRINTED IN COLOR

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APPENDIX A

TEST PIT LOGS

KEY TO BORING LOGS

MAJOR TYPES			DESCRIPTION
COARSE-GRAINED SOILS MORE THAN HALF OF MAT'L LARGER THAN #200 SIEVE	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE	CLEAN GRAVELS WITH LESS THAN 5% FINES	GW - Well graded gravels or gravel-sand mixtures
			GP - Poorly graded gravels or gravel-sand mixtures
		GRAVELS WITH OVER 12 % FINES	GM - Silty gravels, gravel-sand and silt mixtures
			GC - Clayey gravels, gravel-sand and clay mixtures
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDS WITH LESS THAN 5% FINES	SW - Well graded sands, or gravelly sand mixtures
			SP - Poorly graded sands or gravelly sand mixtures
		SANDS WITH OVER 12 % FINES	SM - Silty sand, sand-silt mixtures
			SC - Clayey sand, sand-clay mixtures
FINE-GRAINED SOILS MORE THAN HALF OF MAT'L SMALLER THAN #200 SIEVE	SILTS AND CLAYS LIQUID LIMIT 50 % OR LESS		ML - Inorganic silt with low to medium plasticity
			CL - Inorganic clay with low to medium plasticity
			OL - Low plasticity organic silts and clays
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50 %		MH - Elastic silt with high plasticity
			CH - Fat clay with high plasticity
			OH - Highly plastic organic silts and clays
	HIGHLY ORGANIC SOILS		PT - Peat and other highly organic soils

For fine-grained soils with 15 to 29% retained on the #200 sieve, the words "with sand" or "with gravel" (whichever is predominant) are added to the group name.

For fine-grained soil with >30% retained on the #200 sieve, the words "sandy" or "gravelly" (whichever is predominant) are added to the group name.

GRAIN SIZES

U.S. STANDARD SERIES SIEVE SIZE: 200, 40, 10, 4 — CLEAR SQUARE SIEVE OPENINGS: 3/4 ", 3", 12"

SILTS AND CLAYS	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

RELATIVE DENSITY

SANDS AND GRAVELS	BLOWS/FOOT (S.P.T.)
VERY LOOSE	0-4
LOOSE	4-10
MEDIUM DENSE	10-30
DENSE	30-50
VERY DENSE	OVER 50

CONSISTENCY

SILTS AND CLAYS	STRENGTH*
VERY SOFT	0-1/4
SOFT	1/4-1/2
MEDIUM STIFF	1/2-1
STIFF	1-2
VERY STIFF	2-4
HARD	OVER 4

SAMPLER SYMBOLS

Modified California (3" O.D.) sampler

California (2.5" O.D.) sampler

S.P.T. - Split spoon sampler

Shelby Tube

Continuous Core

Bag Samples

Grab Samples

NR No Recovery

MOISTURE CONDITION

Dry	Dusty, dry to touch
Moist	Damp but no visible water
Wet	Visible freewater

LINE TYPES

Solid - Layer Break

Dashed - Gradational or approximate layer break

GROUND-WATER SYMBOLS

Groundwater level during drilling

Stabilized groundwater level

(S.P.T.) Number of blows of 140 lb. hammer falling 30" to drive a 2-inch O.D. (1-3/8 inch I.D.) sampler

* Unconfined compressive strength in tons/sq. ft., asterisk on log means determined by pocket penetrometer

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TEST PIT LOG 1-TP1

Cooke Property
Vallejo, California
13495.000.000

Logged By: Nick Broussard
Logged Date: 11/15/2016
Equipment: CASE 590 Backhoe

Depth (Feet)	Description	Depth of Test (Feet)	Plasticity Index	Expansion Index	Laboratory Moisture Content%	Unconfined Compression (Tsf) *field approx
0 – 2½	ELASTIC SILT (MH) dark brown, stiff, moist, high plasticity	1	52		22.4	2.0*
						4.0*
2	Very stiff					
2½ – 4	ELASTIC SILT WITH CLAYSTONE (MH), dark brown, hard, moist, small fragments up to ½“	3	46		14.8	4.5*
4	Very weak					
4 – 10	SILTSTONE & CLAYSTONE, greenish brown, highly weathered, medium weak, closely fractured, slickendsided claystone					
6	Very thin bedding					
10	Bottom of test pit at 10 feet. No groundwater encountered.					

TEST PIT LOG 1-TP2

Cooke Property
Vallejo, California
13495.000.000

Logged By: Nick Broussard
Logged Date: 11/15/2016
Equipment: CASE 590 Backhoe

Depth (Feet)	Description	Depth of Test (Feet)	Plasticity Index	Expansion Index	Laboratory Moisture Content%	Unconfined Compression (Tsf) *field approx
0 – 1	LEAN CLAY (CL) dark brown, stiff to very stiff, moist, medium plasticity	0		80	21.1	2.75*
1 – 5	LEAN CLAY WITH GRAVEL (CL) grayish brown, very stiff, moist, medium plasticity, fragments of very weak claystone throughout					2.5* 4.5*
5 – 10	SILTSTONE dark gray, medium strong, moderately weathered, moderately to closely fractured, thin bedding					
10	Bottom of test pit at 10 feet. No groundwater encountered.					

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TEST PIT LOG 1-TP3

Cooke Property
Vallejo, California
13495.000.000

Logged By: Nick Broussard
Logged Date: 11/15/2016
Equipment: CASE 590 Backhoe

Depth (Feet)	Description	Depth of Test (Feet)	Plasticity Index	Expansion Index	Laboratory Moisture Content%	Unconfined Compression (Tsf) *field approx
0 – ½	LEAN CLAY (CL) dark brown, stiff, moist, low to medium plasticity, 4” topsoil with roots and organics					
½ - 1½	ELASTIC SILT (MH) dark grayish brown, very stiff, moist, high plasticity (residual soil)	1	45		18.8	2.0*
1½ - 4½	SANDSTONE yellowish brown to red, strong to very strong, slightly weathered, moderately fractured, thinly bedded					
4½	Refusal to excavation at 4½ feet. No groundwater encountered.					

TEST PIT LOG 1-TP4

Cooke Property
Vallejo, California
13495.000.000

Logged By: Nick Broussard
Logged Date: 11/15/2016
Equipment: CASE 590 Backhoe

Depth (Feet)	Description	Depth of Test (Feet)	Plasticity Index	Expansion Index	Laboratory Moisture Content%	Unconfined Compression (Tsf) *field approx
0 – 4	LEAN CLAY (CL) dark brown, stiff to very stiff, moist, low to medium plasticity	1		67	18.3	2.0* 2.5*
2	Hard					4.5+*
4 – 6½	LEAN CLAY WITH SAND (CL) yellowish brown mottled with black, hard, moist, low to medium plasticity, low cohesion, fine sand	5			20.3	4.25*
6	Grades to sandy					
6½ - 10	CLAYEY SAND WITH GRAVEL (SC) orange brown, hard, moist, some sub-rounded cobble up to 8”, black charcoal, fine to coarse grained sand					
10	Bottom of test pit at 10 feet. No groundwater encountered.					

TEST PIT LOG 1-TP5

Cooke Property Vallejo, California 13495.000.000	Logged By: Nick Broussard Logged Date: 11/15/2016 Equipment: CASE 590 Backhoe

Depth (Feet)	Description	Depth of Test (Feet)	Plasticity Index	Expansion Index	Laboratory Moisture Content%	Unconfined Compression (Tsf) *field approx
0 – 1	CLAYEY SAND (SC) dark brown, moist [Fill]	1			17.1	
1 – 3	CLAYEY SAND (SC) brown, medium dense, moist, some plastic trash bags [Fill]					
3 – 7	CLAYEY GRAVEL AND SAND (SC) Siltstone, fragments up to 8” max.[Fill]	5			12.9	
4½	Pieces of trash bags					
7 – 8½	SILTY CLAY (CL) dark brown, very stiff, moist, medium plasticity [Native]	8	21		12.7	4.0*
8½ - 14	LEAN CLAY WITH SAND (CL) yellowish brown, very stiff, moist, medium plasticity	9			22.2	3.5* 4.5+*
14	Bottom of test pit at 14 feet. No groundwater encountered.					

TEST PIT LOG 1-TP6

Cooke Property Vallejo, California 13495.000.000	Logged By: Nick Broussard Logged Date: 11/15/2016 Equipment: CASE 590 Backhoe

Depth (Feet)	Description	Depth of Test (Feet)	Plasticity Index	Expansion Index	Laboratory Moisture Content%	Unconfined Compression (Tsf) *field approx
0 – 1	LEAN CLAY (CL) dark brown, stiff, moist, medium plasticity	0			24.7	
1 – 2½	SANDSTONE greenish gray and brown, strong to very strong, slightly weathered, moderately fractured					
2	Angular boulders up to 24” near bedrock surface					
2½	Excavation refusal at 2½ feet. Backhoe teeth smoking on sandstone. No groundwater encountered.					

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TEST PIT LOG 1-TP7

Cooke Property
Vallejo, California
13495.000.000

Logged By: Nick Broussard
Logged Date: 11/15/2016
Equipment: CASE 590 Backhoe

Depth (Feet)	Description	Depth of Test (Feet)	Plasticity Index	Expansion Index	Laboratory Moisture Content%	Unconfined Compression (Tsf) *field approx
0 –7	LEAN CLAY (CL) dark brown, very stiff, moist, medium plasticity	3		122	20.5	2.25*
2	Grades to yellowish brown, hard					4.5+*
7 – 11	SILTSTONE AND CLAYSTONE greenish brown to brown, medium strong, moderately weathered, closely fractured, very thin bedding					
11	Bottom of test pit at 11 feet. No groundwater encountered.					

TEST PIT LOG 1-TP8

Cooke Property Vallejo, California 13495.000.000	Logged By: Nick Broussard Logged Date: 11/15/2016 Equipment: CASE 590 Backhoe

Depth (Feet)	Description	Depth of Test (Feet)	Plasticity Index	Expansion Index	Laboratory Moisture Content%	Unconfined Compression (Tsf) *field approx
0 – 1½	ELASTIC SILT (MH) dark brown, very stiff, moist, high plasticity	1	49		21.8	2.25*
1½ - 6	Grades to with gravel size rock fragments, yellowish brown, hard, high plasticity, 40% highly weathered Siltstone/Claystone fragments					4.5+*
		3	39		16.0	4.5+*
6 – 10	SILTSTONE AND CLAYSTONE grayish brown, medium strong, moderately weathered, closely to moderately fractured, very thin bedding					
10	Bottom of test pit at 10 feet. No groundwater encountered.					

TEST PIT LOG 1-TPHA1

Cooke Property Vallejo, California 13495.000.000	Logged By: Nick Broussard Logged Date: 11/15/2016 Equipment: Hand Auger

Depth (Feet)	Description	Depth of Test (Feet)	Plasticity Index	Expansion Index	Laboratory Moisture Content%	Unconfined Compression (Tsf) *field approx
0 – 1	LEAN CLAY (CL) dark brown, stiff, moist, medium plasticity	0			24.2	
1 – 2 ½	ELASTIC SILT (MH) olive brown, hard, high plasticity, fine to medium grained sand	1	61		13.5	
2½	Bottom of test pit at 2½ feet. No groundwater encountered.					

APPENDIX B

LABORATORY ANALYSIS

EXPANSION INDEX TEST REPORT
ASTM D4829

PROJECT NAME: Cooke Property
REPORT DATE: 11/18/2016

PROJECT NO.: 13495.000.000 PH001
SAMPLE DATE: 11/15/2016

CLIENT: Lewis Acquistion Company, LLC
TESTED BY: R.Montalvo

SAMPLE ID: 1-TP2@0-1
REVIEWED BY: M. Gilbert

SAMPLE DESCRIPTION: Dark brown CLAY

SAMPLE SOURCE: Native

Sample ID	Soil Description	Initial Dry Density (pcf)	Initial Moisture Content (%)	Final Moisture Content (%)	Expansion Index
1-TP2@0-1	Dark brown CLAY	99.1	13.4	28.2	80

*Soil was visually classified (per ASTM D2488) immediately after EI test was complete.

CLASSIFICATION OF EXPANSIVE SOIL

Expansion Index	Potential Expansion
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
Above 130	Very High

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EXPANSION INDEX TEST REPORT
ASTM D4829

PROJECT NAME:	Cooke Property	**REPORT DATE:**	11/18/2016
PROJECT NO.:	13495.000.000 PH001	**SAMPLE DATE:**	11/15/2016
CLIENT:	Lewis Acquistion Company, LLC	**TESTED BY:**	R.Montalvo
SAMPLE ID:	1-TP4@1	**REVIEWED BY:**	M. Gilbert
SAMPLE DESCRIPTION:	Dark brown CLAY		
SAMPLE SOURCE:	Native		

Sample ID	Soil Description	Initial Dry Density (pcf)	Initial Moisture Content (%)	Final Moisture Content (%)	Expansion Index
1-TP4@1	Dark brown CLAY	99.7	13.3	28.1	67

*Soil was visually classified (per ASTM D2488) immediately after EI test was complete.

CLASSIFICATION OF EXPANSIVE SOIL

Expansion Index	Potential Expansion
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
Above 130	Very High

EXPANSION INDEX TEST REPORT
ASTM D4829

PROJECT NAME: Cooke Property
REPORT DATE: 11/18/2016

PROJECT NO.: 13495.000.000 PH001
SAMPLE DATE: 11/15/2016

CLIENT: Lewis Acquistion Company, LLC
TESTED BY: R.Montalvo

SAMPLE ID: 1-TP7@3
REVIEWED BY: M. Gilbert

SAMPLE DESCRIPTION: Yellowish brown CLAY

SAMPLE SOURCE: Native

Sample ID	Soil Description	Initial Dry Density (pcf)	Initial Moisture Content (%)	Final Moisture Content (%)	Expansion Index
1-TP7@3	Yellowish brown CLAY	92.1	14.8	36.0	122

*Soil was visually classified (per ASTM D2488) immediately after EI test was complete.

CLASSIFICATION OF EXPANSIVE SOIL

Expansion Index	Potential Expansion
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
Above 130	Very High

MOISTURE CONTENT DETERMINATION

ASTM D2216

BORING/SAMPLE ID	1-TP1@1	1-TP1@3	1-TP2@0	1-TP2@3	1-TP3@1	1-TP4@1	1-TP4@5	1-TP5@1
DEPTH (ft)	1	3	0	3	1	1	4	1
Method A or B	B	B	B	B	B	B	B	B
%MOISTURE	22.4	14.8	21.1	22.8	18.8	18.3	20.3	17.1

BORING/SAMPLE ID	1-TP5@5	1-TP5@8	1-TP5@9	1-TP6@0	1-TP7@1	1-TP7@3	1-TP8@1	1-TP8@3
DEPTH (ft)	5	8	9	0	1	3	1	3
Method A or B	B	B	B	B	B	B	B	B
%MOISTURE	12.9	12.7	22.2	24.7	19.1	20.5	21.8	16.0

BORING/SAMPLE ID	HA1@0	HA1@1						
DEPTH (ft)	0	1						
Method A or B	B	B						
%MOISTURE	24.2	13.5						

BORING/SAMPLE ID								
DEPTH (ft)								
Method A or B								
%MOISTURE								

BORING/SAMPLE ID								
DEPTH (ft)								
Method A or B								
%MOISTURE								

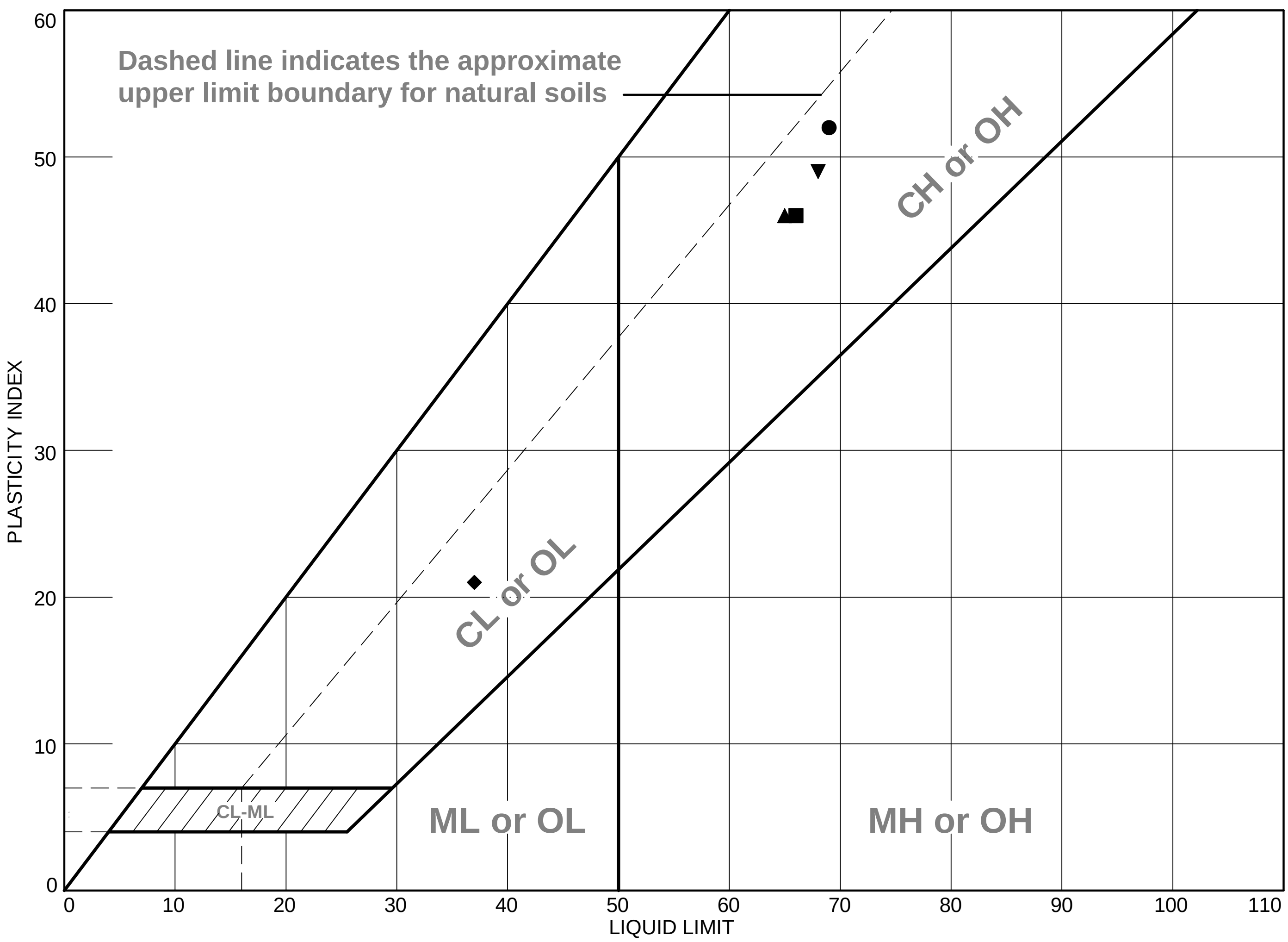
PROJECT NAME: Cooke Property
PROJECT NUMBER: 13495.000.000
CLIENT: Lewis Aquistion Company, LLC
PHASE NUMBER: 001

DATE: 11/21/16

ENGEO INCORPORATED

Tested by: R. Montalvo   Reviewed by: M. Gilbert

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	See exploration logs	69	17	52			
■	See exploration logs	66	20	46			
▲	See exploration logs	65	19	46			
◆	See exploration logs	37	16	21			
▼	See exploration logs	68	19	49			

Project No. 13495.000.000 **Client:** Lewis Acquistion Company, LLC

Project: Cooke Property

● **Source of Sample:** GEX **Depth:** 1 feet **Sample Number:** 1-TP1@1

■ **Source of Sample:** GEX **Depth:** 3 feet **Sample Number:** 1-TP1@3

▲ **Source of Sample:** GEX **Depth:** 1 feet **Sample Number:** 1-TP3@1

◆ **Source of Sample:** GEX **Depth:** 8 feet **Sample Number:** 1-TP5@8

▼ **Source of Sample:** GEX **Depth:** 1 feet **Sample Number:** 1-TP8@1

ENGEO INCORPORATED

Remarks:

● Tested per ASTM D4318 Wet Method

■ Tested per ASTM D4318 Wet Method

▲ Tested per ASTM D4318 Wet Method

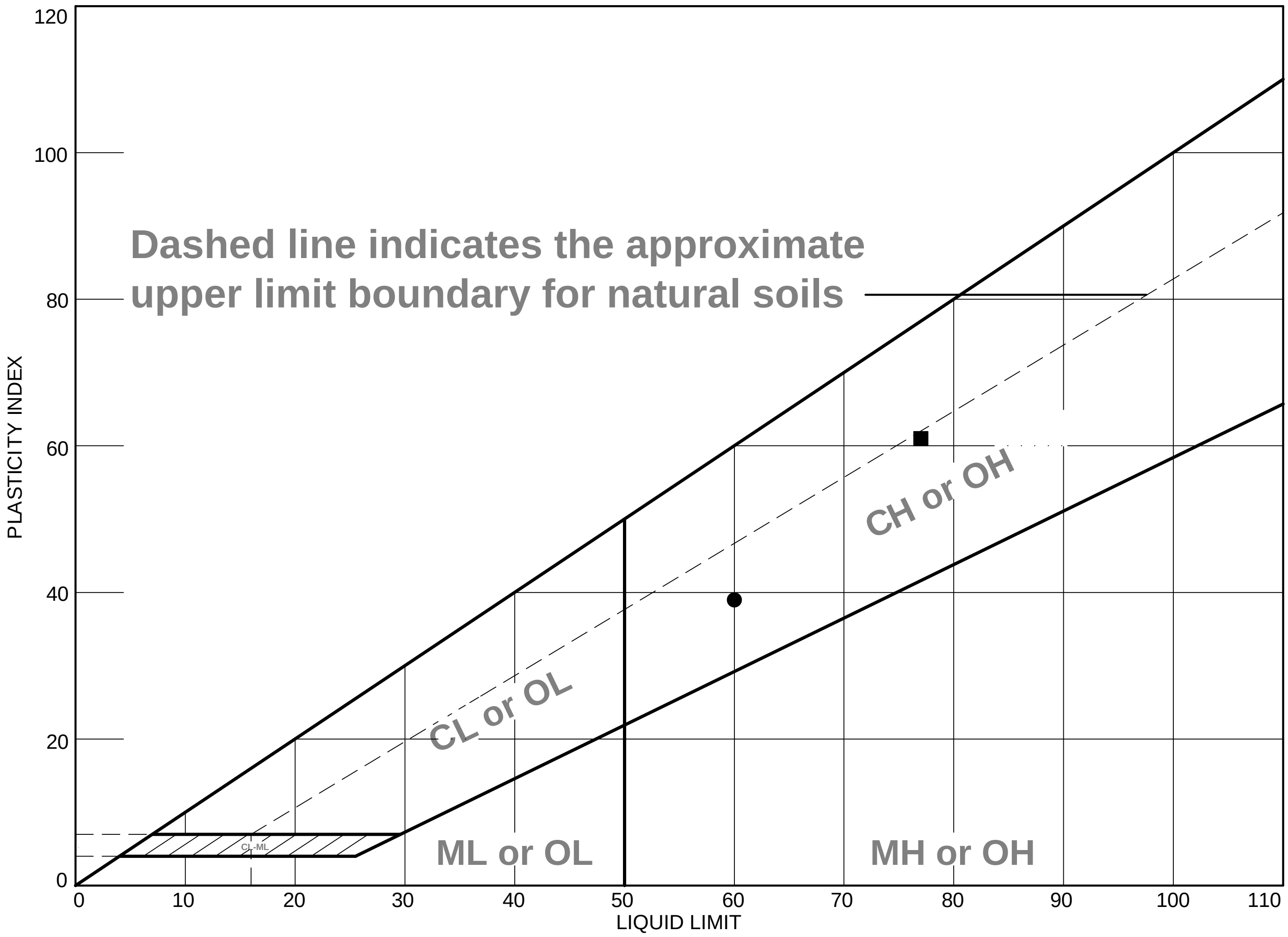
◆ Tested per ASTM D4318 Wet Method

▼ Tested per ASTM D4318 Wet Method

Figure

Tested By: R. Montalvo **Checked By:** M. Gilbert

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	See exploration logs	60	21	39			
■	See exploration logs	77	16	61			

Project No. 13495.000.000 **Client:** Lewis Acquistion Company, LLC

Project: Cooke Property

●**Source of Sample:** GEX **Depth:** 3 feet **Sample Number:** 1-TP8@3

■**Source of Sample:** GEX **Depth:** 1 feet **Sample Number:** 1-HA1@1

Remarks:

●Tested per ASTM D4318 Wet Method

■Tested per ASTM D4318 Wet Method

Figure

Tested By: R. Montalvo **Checked By:** M. Gilbert

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 11/23/2016
Date Submitted 11/18/2016

To: Nick Broussard
Engeo, Inc.
2213 Plaza Dr.
Rocklin, CA 95765

From: Gene Oliphant, Ph.D. \ Randy Horney RA
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 13495.000.000 PH001 Site ID : 1-TP1@1FT.
Thank you for your business.

* For future reference to this analysis please use SUN # 73233-152831.

EVALUATION FOR SOIL CORROSION

Soil pH	6.27		
Minimum Resistivity	0.96	ohm-cm (x1000)	
Chloride	18.1 ppm	00.00181	%
Sulfate	15.5 ppm	00.00155	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

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2213 Plaza Dr.
Rockin, CA 95765

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 13495.000.000 PH001 Site ID : 1-TP6@0-1FT.
Thank you for your business.

* For future reference to this analysis please use SUN # 73233-152832.

EVALUATION FOR SOIL CORROSION

Soil pH	5.86	
Minimum Resistivity	1.42 ohm-cm (x1000)	
Chloride	27.8 ppm	00.00278 %
Sulfate	18.9 ppm	00.00189 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

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