Appendix D

Geological Investigation

a dba of
R & R Services
Corporation

GEOLABS-WESTLAKE VILLAGE

Foundation and Soils Engineering, Geology

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February 4, 2004
W.O. 8925

Suncal Companies
21900 Burbank Boulevard, Suite 114
Woodland Hills, California 91367

Attention: Mr. Michael Walline

SUBJECT: Due Diligence Investigation of Borchard Property (bounded on North by Doris Ave, East by Ventura Road, South by Teal Club Road, West by Patterson Road), City of Oxnard, California

Mr. Walline:

In accordance with your request, our firm has undertaken a preliminary study of the geotechnical conditions at the subject property. Our purpose was to evaluate the geotechnical feasibility of developing the site for residential use. We have performed a preliminary assessment of the distribution and engineering characteristics of the earth materials that occur at the site so that we might assess their impact upon the proposed development of the property.

The scope of work for this project included the following tasks:

- mapping of the site and its immediate vicinity,
- logging and sampling of two exploratory borings excavated with a truck-mounted rotary mud auger rig;
- logging of two Cone Penetrometer Test (CPT) soundings,
- selected laboratory testing of the retrieved samples,
- review of previous work which was judged both pertinent to our purpose and readily available to our office,
- soil engineering analysis of the assembled data,
- preparation of this report.

Field data and the approximate locations of exploratory excavations are shown on the enclosed Plot Map (Plate 2). Descriptions of the materials encountered in the exploratory excavations are provided on the enclosed logs (Plates B.1 to B.2, and CPT1 to CPT2). Pertinent laboratory test results are also provided herein. Our findings are presented in the following sections, followed by a discussion of these findings and geotechnical recommendations.

SITE DESCRIPTION

The 118-acre site is an L-shaped property bounded on the north by Doris Avenue, east by Ventura Road, south by Teal Club Road, west by North Patterson Road. The site is accessed by dirt roads on the perimeter of the property. Open drainage ditches skirt these access roads. Residential and agricultural buildings exist near the southwest corner of Ventura Road and Doris Avenue.

The site is generally level, and is currently used for growing celery. Topographic relief in the region is to the southwest. Agricultural property in this area of Oxnard typically has rows of drainage tiles in the subgrade to facilitate drainage. These tiles likely transfer the irrigation water laterally offsite. The tiles may have open ends that allow offsite water to access the site through the drains.

EARTH MATERIALS

The earth materials encountered at the site consist of alluvial fan deposits to the maximum depths explored. The upper two to three feet have been disturbed by agricultural operations. These soils are typically sandy silt and silty sand in a loose condition. Below this upper zone are silt mixtures of clayey silt and silty clay transitioning to predominantly clay by the depth of seven feet. Below seven feet the clay has thin layers of silty clay/clayey silt. These fine-grained materials are medium stiff to very stiff. Silty sand to clean sand was encountered at a depth of 30 feet in CPT1 and 20 feet in CPT2. This sand is approximately 20 feet thick in these soundings and very dense. Below the sand is a thin clay layer approximately two feet thick which is very stiff to hard, underlain by more very dense silty sand/sandy silt.

GROUNDWATER

Groundwater was encountered in our explorations at a depth of approximately eight to ten feet. High historical groundwater is noted at being this same depth range (CGS, SHZR 052). Groundwater and wet soils may impact grading and utility construction at the site.

FAULTING AND SEISMICITY

The subject site contains no known active or potentially active faults, nor is it within an Alquist-Priolo Fault Rupture Hazard Zone. Therefore, the potential for ground rupture is considered very low. However, the property is situated within the seismically active Southern California region and ground shaking is likely to occur due to earthquakes caused by movement along nearby faults.

One method of seismic design is to utilize the Static Force procedure (structures less than five stories) presented in the Uniform Building Code (UBC), which can be used to estimate base shear/on-site acceleration based upon site location, occupancy classifications, and the planned structural system. For the 1997 UBC this site has a Seismic Zone Factor, Z of 0.4 (Tbl 16-I), the Soil Profile Type is considered S_D (Tbl 16-J. The local controlling fault is considered the Oak Ridge (Onshore) Fault and the Seismic Source Type is considered B (Tbl 16-U). The Near Source Factors are estimated as N_a of 1.3 and N_v of 1.6 (Tbl 16-S & 16-T).

Another method of seismic design is to assess the potential on-site ground acceleration based upon a site's proximity to specific, known faults. This relies upon prediction of a maximum earthquake for each fault considered, relationships that characterize the diminution of ground response with distance from the causative event, and relationships that assess impact of site-characteristics upon ground response. One commonly used method of estimating possible on-site accelerations is the probabilistic seismic hazard analysis method. Probabilistic information is discussed below. Analyses summaries are attached in the Seismicity Appendix, Appendix A.

Probabilistic Seismic Hazard Analyses

We have employed the "Simple Prescribed Parameter Value" Method (SPPV) for estimating the peak ground acceleration (PGA) for a 10 percent exceedance probability for an exposure period of 50 years (UBC Design-Basis Earthquake, 475 year return period). As discussed in CGS Seismic Hazard Evaluation Reports, the attenuation relationships of Boore et.al. (1997), Campbell (1997), Sadigh et.al. (1997), and Youngs et.al. (1997) were utilized to generate PGA maps. We have reproduced Figures from Seismic Hazard Evaluation Report 052 (for the Oxnard 7.5 Minute Quadrangles) in Appendix A to illustrate the project location with respect to SPPV PGA values for alluvium conditions. As seen, a peak ground acceleration of 0.62g is estimated for a UBC design-level event. A design earthquake magnitude of M_w=6.9 is the predominant earthquake, per Figure 3.4 of Seismic Hazard Zone Report 052. Figure 3.5 of SHZR 052 indicates the PGA magnitude-weighted to an M_w=7.5 earthquake is estimated as 0.48g (this is referred to as "liquefaction opportunity").

Seismic Discussion

The methodology in the Uniform Building Code has been to protect and preserve life and limb. Building designs using previous UBC codes (pre-1997) has apparently been successful in that regard. With the acceptance of the 1997 UBC, the seismic design of structures has generally become more conservative. On that basis, we recommend minimum structural design be in compliance with the seismic design provisions of the UBC. Though still not performance based, this most recent Building Code will enhance performance over designs based on previous codes.

Design per the UBC (and hence adoption of the philosophy that life and limb need be protected) is commensurate with the local building ordinance. Being that higher standards of design (i.e. that intend to minimize property damage in the case of a much less likely event) have not been adopted by the governing agency (which is responsible for setting such standards), use of a higher acceleration (than provided by the UBC) is discretionary.

LABORATORY TESTING

Undisturbed and bulk samples of soil and rock materials encountered at the site were collected during the course of our fieldwork. Selected laboratory tests completed on the retrieved samples are described below:

Moisture-Density

The field moisture content and dry unit weight were determined for each undisturbed sample. Dry unit weight is expressed in pounds per cubic foot and the moisture content represents a percentage of the dry unit weight. This test data is presented in the attached boring logs.

Consolidation Test

Settlement predictions of the soil's behavior under load are made on the basis of consolidation tests. A one-inch high sample is loaded in a geometric progression and the resulting deformation is recorded at selected time intervals. Porous stones are placed in contact with the sample (top and bottom) to permit addition and release of pore fluid. The sample is inundated at a selected load during the progression. Selected samples had data recorded at timed intervals for specific loads to obtain data for time-rate evaluations. Results are plotted on the enclosed Consolidation-Pressure Curves (Plates C1.025 to C2.10).

Particle Size Analysis

The distribution of various particle sizes in selected representative samples was determined using both mechanical sieves and hydrometer tests. The percentage and distribution of particles larger than a #200 sieve (0.075 mm) are determined using mechanical processes. Particle distributions for fine-grained soils are determined using hydrometer methods. The particle distribution is presented as the relative percentages of sand, silt and clay particles in each sample tested. The results are presented on the attached boring logs and illustrated on Plate PS.1.

HYDROCONSOLIDATION POTENTIAL

Hydroconsolidation is a condition where dry or moist soils undergo settlement upon being wetted. In many cases no additional surcharge load is necessary to trigger the hydroconsolidation.

The subsurface materials at the site are wet due to the shallow groundwater. None of the samples tested experienced significant consolidation upon inundation. Based on our data, we consider the alluvial materials to have a low potential for hydroconsolidation.

LIQUEFACTION POTENTIAL

Liquefaction is a condition where the soil undergoes continued **deformation** at a constant low residual stress due to the build-up of high porewater pressures. The possibility of liquefaction occurring at a given site is dependent upon the occurrence of a significant earthquake in the vicinity; sufficient groundwater to cause high pore pressures; and on the grain size, relative density, and confining pressures of the soil at the site.

The site is located within a State designated Liquefaction Hazard Study Zone. Therefore, as part of investigation we have performed this preliminary analyses of the liquefaction potential on the site. We have performed 2 CPT soundings and 1 deep boring to obtain subsurface data. Based upon our subsurface information, groundwater is present on the site within the upper fifty feet of the soil profile. Only thin zones of coarse-grained soils were encountered in a medium-dense state.

Therefore, only thin zones of material have a potential to liquefy. This is illustrated in our exhibits in Appendix B.

To address the possible impacts of liquefaction, the practice of geotechnical engineering currently has available methods of approximating the potential liquefaction-induced settlement, lateral spreading, and the possibility of surface manifestations.

Liquefaction-Induced Settlement Potential

The potential for liquefaction-induced settlement has been evaluated using the procedures proposed by Tokimatsu and Seed (1987). Our analysis indicates the potential settlement due to a design-level earthquake would be on the order of 1/4 inch or less. Recommended design settlement values are discussed subsequent to the Foundation Systems section of this report.

Liquefaction-Induced Surface Manifestations and Lateral Spreading

The zones of liquefiable material are thin and at sufficient depths that surface manifestations from liquefaction of these zones are not anticipated to adversely impact planned structures. These liquefiable materials also have sufficient relative density that lateral spreading is considered unlikely during a Design Level earthquake.

DISCUSSION AND RECOMMENDATIONS

Data from our field exploration, reference reports, laboratory testing, and engineering analyses, coupled with the inferred conditions about our exploratory excavations, are the basis for the following discussion. Preliminary geotechnical recommendations, based upon the presently available data, are presented for your consideration. These recommendations are based on limited data for due diligence purposes. Supplemental subsurface investigation will be necessary during development of the tentative tract map to more thoroughly evaluate the materials within the site.

The proposed development of the property as a residential development is considered feasible from a geotechnical perspective. The near surface alluvial soils appear loose to medium dense and are disturbed. These materials are not considered suitable to support structures or engineered fill. We recommend that areas with disturbed materials and areas to support structures be improved by over excavating the unsuitable materials and replacing them with engineered fill. Based on our subsurface information, this over excavation should remove all existing artificial fill and at least the upper three to four feet of the existing soil profile. Shallow groundwater conditions may require stabilization of the removal bottoms prior to constructing fills. Dewatering may be necessary. Additional investigation should be performed to better define the geotechnical recommendations for grading.

Engineered fill - Compaction Standard

The on-site materials are suitable for use as engineered fill. All roots, organic matter, and other deleterious material should be hand-picked from the soils prior to their use as engineered fill. These materials should be moistened and/or air-dried to near optimum moisture content and compacted to at least 90% of their maximum density as determined using the Modified Proctor Test (ASTM D 1557-00).

Grading - Engineered Fills

The following preliminary recommendations pertain to the placement of, and preparation for, engineered fills. These recommendations and values are preliminary for estimation purposes only. They are recommendations that are typical for development within this area based on our experiences with similar sites in the local area. Supplemental investigation is necessary to develop design recommendations.;

1. The on-site soils are suitable for use as structural fill. Any import materials that are to be

used as structural fill should be approved by this office prior to placement.

2. Shrinkage refers to the lesser volume of fill that results from a given volume of excavation. The shrinkage of the alluvial materials is anticipated to be between 15% and 20%.

3. Subsidence includes the general lowering of the ground due to in-place compaction by construction equipment. Subsidence is anticipated to range from 3.0 to 4.0 tenths of a foot in the alluvial areas.

4. All vegetation, trash debris or other deleterious material should be stripped from the area to be graded. Soils bearing sparse grasses may be thoroughly mixed with at least ten parts clean soil and incorporated into the engineered fill. Other materials should be wasted from the site.

5. Compressible soils that lie within the areas to receive engineered fill should be removed to relatively incompressible material, moisture conditioned, and replaced as properly compacted fill. Portions of the compressible materials that are sufficiently thin may be scarified, watered or air dried to approximately the material's optimum moisture content, and compacted in-place. A combination of removal and recompaction in-place may be used, providing the recommended compaction is obtained throughout the recommended depth interval. Based upon the materials exposed in our exploratory excavations, we anticipate the removals to extend to depths of three to four feet. Final removal bottoms must be field verified by a representative of the geotechnical consultant.

Wet conditions are likely in the removal bottoms. In some cases disking and drying the materials in place or mixing with dried materials may be adequate to sufficiently dry back the materials at the removal bottom in order to support the planned fills. In some cases, other methods such as lime-treating the bottoms or placing rock with geo-fabric into the removal bottoms may be necessary for stabilization.

Drain tiles used during the farming operation may be present within the site. These drains should be located and removed or destroyed in place under the observation of the geotechnical consultant.

6. Exposed surfaces should be scarified, moistened or air dried as appropriate, and compacted to the appropriate percentage of the material's maximum dry density prior to placement of fill (see COMPACTION STANDARD section).

7. We recommend a uniform blanket of compacted fill be created for support of structural footings in the alluvial area. This would be performed with the deep removals, if that option were chosen. If other ground improvement methods are utilized, then the modified ground should be capped with a fill cap that extends at least three feet below the base of proposed footings and five feet beyond their perimeter. Special consideration should be paid to locations where property lines or existing improvements (buildings, retaining walls, fences, power poles, etc.) interfere with the creation of the desired fill cap. Such conditions should be brought to the attention of this office so that the specific site conditions may be evaluated and recommendations provided. Depending upon the circumstances, special excavating techniques may be employed (i.e. slot cutting), alternative foundation designs may be used (i.e. grade beams supported by pad footings or piles), or the compaction standard may be increased.

8. Areas that are to be paved should be scarified to at least 12 inches below the existing or rough grade (whichever is deeper), brought to near the material's optimum moisture content, and compacted to the appropriate relative compaction (see COMPACTION STANDARD section).

9. Fill materials should be placed in thin lifts, watered to near the material's optimum moisture content, and compacted to the appropriate relative compaction prior to placing the next lift.

10. The compaction standard applies to the face of fill slopes. This may be achieved by overfilling the constructed slope and trimming to a compacted finished surface, rolling the slope face with a sheepsfoot, or any method that achieves the desired product.

11. All grading should comply with the grading specifications and requirements of the local governing agency.

Dewatering

The groundwater in our explorations rose to near the ground surface. The clayey nature of the soils will reduce the effectiveness of a well-point dewatering system. Sumps and pumps constructed during grading may be the most effective method of dewatering. Stabilization of the removal bottoms may be necessary before constructing fills.

Grading - Temporary Excavations

Temporary excavations (such as backcuts for retaining wall excavations) may be considered stable if cut vertical, providing they are restricted to a maximum of 5 feet in height, are provided with permanent support as soon as possible, and they are protected from erosion and saturation. Portions of temporary excavations in excess of 5 feet high should be laid down to 1:1 unless specific alternative treatments are evaluated and found acceptable.

Foundation Systems

Foundation systems may consist of either conventional shallow foundations with slabs-on-grade, or post-tensioned foundations. The following sections provide recommendations for both systems. Typical allowable bearing capacity for conventional foundations is on the order of 1500 pounds per square foot. Foundation design criteria are based, in part, upon the expansive properties of the materials anticipated to be present near the finished pad grade. Our preliminary information indicates these materials are in the very low to low expansion index range. Laboratory testing to verify the expansive properties of the near-pad-grade materials should be performed at the completion of rough grading.

Post-Tension Foundations

Different methods are used to account for the potential effects of expansive soils. UBC Standard 18-III, 2001 outlines one method, the Post-Tensioned Institute (PTI) Method that relies upon increased stiffening of post-tension slabs to resist significant soil stresses due to variations caused by climatic conditions. Another method of mitigation, The California Slab Method (Spanability Method) consists of utilizing deepened footings and pre-swelling of the foundation soils. The former attempts to minimize slab deflection in the face of soil movement; the latter attempts to retard soil movement. Recommendations for both Post-Tension design methods will be provided upon further investigation.

Typically, allowable bearing capacity for post-tensioned foundations may be taken as 1000 PSF at pad grade and 1500 PSF at twelve inches embedment and with a minimum width of twelve inches. This may be increased by one-third for short duration loading, such as by wind or seismic forces. Care should be exercised to see that all spoils from the slab subgrade are removed or property compacted.

Corrosion Potential

Soil samples from this area of Oxnard typically indicate a potential for corrosion. This is primarily believed to be a result of the past use of agricultural chemicals and fertilizers. Soils typically contain low to moderate levels of soluble sulfates and low resistivity. During the investigation for the tentative tract map, supplemental testing for corrosion potential should be performed. Near the completion of grading additional testing should be performed to verify the corrosion potential of the soils.

TABLE 19-A-4 REQUIREMENTS FOR CONCRETE EXPOSED TO SULFATE-CONTAINING SOLUTIONS

SULFATE EXPOSURE	WATER-SOLUBLE SULFATE (SO_4) IN SOIL, Percentage by Weight	SULFATE (SO_4) IN WATER, ppm	CEMENT TYPE	Maximum Water-Cementitious Materials Ratio, by Weight, Normal-Weight Aggregate Concrete[1]	Minimum f'c Normal Weight and Lightweight Aggregate Concrete, psi[1]
					x 0.00689 for MPa
Negligible	0.00 - 0.10	0 - 150	--	--	--
Moderate[2]	0.10 - 0.20	150 - 1,500	II, IP(MS), IS(MS)	0.50	4,000
Severe	0.20 - 2.00	1,500 - 10,000	V	0.45	4,500
Very severe	Over 2.00	Over 10,000	V plus pozzolan[3]	0.45	4,500

1 A lower water-cementitious materials ratio or higher strength may be required for low permeability or for protection against corrosion of embedded items or freezing and thawing (Table 19-A-2).
2 Seawater
3 Pozzolan that has been determined by test or service record to improve sulfate resistance when used in concrete containing Type V cement.

Drainage

Positive drainage should be established to carry pad waters away from structures and foundations, and to prevent uncontrolled or sheet flow over manufactured slopes. We recommend as steep a gradient as practical be established around the structures, to the street or other non-erosive drainage devices. Fine-grade fills placed to create pad drainage should be compacted in order to retard infiltration of surface water.

Preserving proper surface drainage is also important. Planters, decorative walls, plants, trees or accumulations of organic matter should not be allowed to retard surface drainage. Area drains and roof gutters (if present) should be kept free of obstruction. Roof gutters (if present) and/or condensation lines from air conditioners should outlet to a non-erodible device, i.e., walkways, patios, driveways, drain lines or splash blocks that direct the water away from the structure. Swales and/or area drains should outlet to the street or acceptable non-erodible device. Positive drainage along the backs of retaining walls should be maintained. Any other measures that will facilitate positive surface drainage should be employed.

Utility Trench Backfill

Backfill for utility trench excavations should be compacted to at least 90% relative compaction. Where installed in sloping areas, the backfill should be properly keyed and benched.

CONSTRUCTION MONITORING

Finalized grading plans and foundation plans should be submitted to this office. The project Civil Engineer should incorporate the removal recommendations into the grading plans. Additional recommendations may be provided at that time of our review, if such are considered warranted.

Placement of all fill and backfill should be monitored by representatives of this office. This includes our observation of prepared bottoms prior to filling. All excavated slopes, both temporary and permanent, should be observed by a representative of this office. Supplemental recommendations may prove warranted based upon the materials exposed in the actual excavations.

Foundation excavations should be observed by representatives of this office to see if the recommended penetration of proper supporting strata has been achieved. Such observations should be made prior to placing concrete, steel or forms. This office should be notified at least 24 hours prior to placing concrete.

CLOSURE

This geotechnical report has been prepared in accordance with generally accepted engineering practices at this time and location. No other warranties, either express or implied, are made as to the professional advice provided under the terms of our agreement and included in this report.

Thank you for this opportunity to be of service. Please do not hesitate to call if you have any questions regarding this report.

Respectfully submitted,
GEOLABS-WESTLAKE VILLAGE

Lawrence K. Stark
R.C.E. 46240

PROFESSIONAL ENGINEER LAWRENCE K. STARK No. 46240 Exp. 12/31/06 CIVIL STATE OF CALIFORNIA

Ronald Z. Shmerling
C.E.G. 1047
R.C.E. 35444

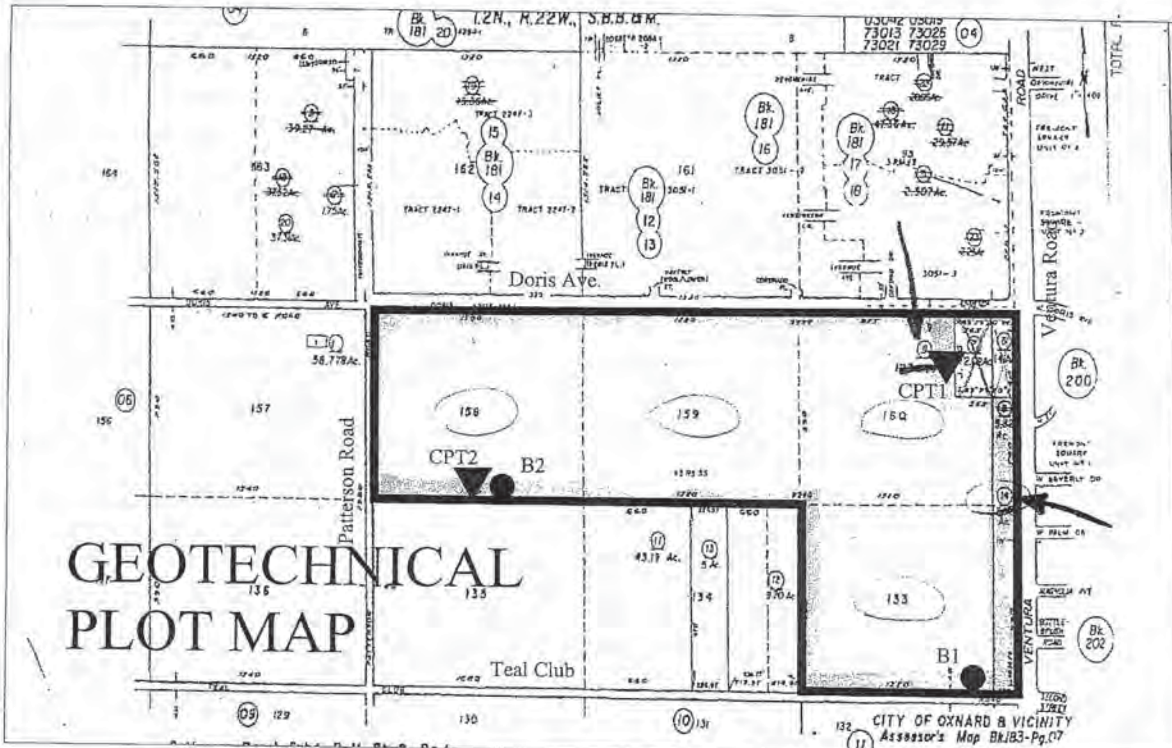
REGISTERED GEOLOGIST RONALD Z. SHMERLING NO. 1047 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER RONALD Z. SHMERLING No. 35444 Exp. 09/30/05 CIVIL STATE OF CALIFORNIA

Enclosures:

Location Map	Plate 1
Plot Map	Plate 2
Boring Logs	Plates B1 to B2
CPT Sounding Logs	Plates CPT1 to CPT2
Consolidation Test Results	Plates C1.025 to C2.10
Particle Size Analyses	Plate PS.1
Seismicity Analyses	Appendix A
Seismic Settlement Analyses	Appendix B

XC: (6) Addressee



Indicates Approx. CPT sounding location

Indicates Approx. Boring location.

Geolabs – Westlake Village	
GEOLOGY AND SOIL ENGINEERING	
DATE 1/04	BY
SCALE NTS	W.O. 8925

PLATE 2

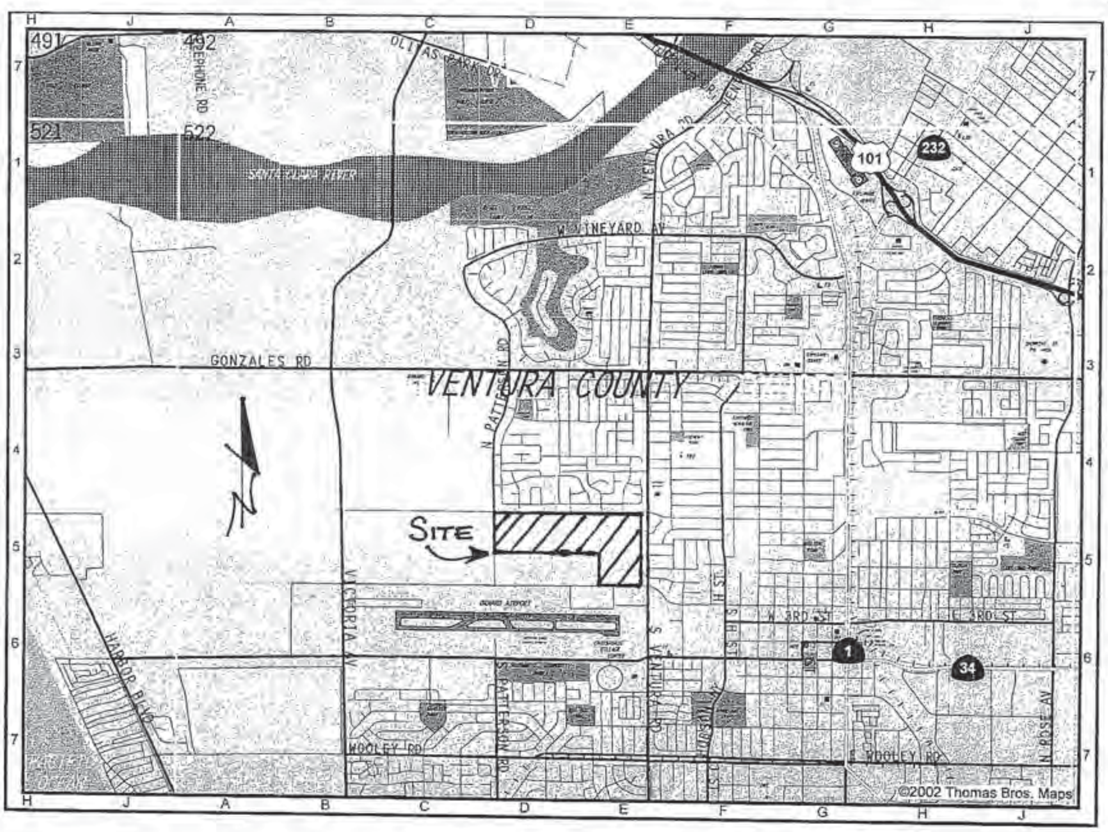


PLATE 1

SURFACE DATA

LOG OF BORING B1

CLIENT: Suncal	PROJECT: Borchard Property	W.O.: 8925
LOCATION: Oxnard	ELEVATION:	DATE: 1/19/04
RIG TYPE:	HAMMER WEIGHTS: 140 lbs.	DROP: 30"

Depth	N	U	B	M	DD	DESCRIPTION	ATTITUDES
40							
45	9/16/30		S			Dark olive gray fine grained sandy clayey SILT, hard, saturated.	
50	50-3"	C		19.6	110.5	Dark olive gray silty medium to coarse grained SAND, very dense, saturated.	
55						Total Depth - 50' Groundwater at 10'	
60							
65							
70							
75							
80							
85							

ADDITIONAL COMMENTS: C = California Split Spoon Sampler
S = Standard Penetration Test
Blows per 6"

SURFACE DATA

LOG OF BORING B1

CLIENT: Suncal	PROJECT: Borchard Property	W.O.: 8925
LOCATION: Oxnard	ELEVATION:	DATE: 1/19/04
RIG TYPE:	HAMMER WEIGHTS: 140 lbs.	DROP: 30"

Depth	N	U	B	M	DD	DESCRIPTION	ATTITUDES
0						Alluvium:	
	3/4/5	C		29.5	91.4	@2.5' - Brown clayey SILT, occasional roots, medium stiff, wet.	
5	3/3/4	C		32.8	91.5	Olive brown silty CLAY, medium stiff, wet.	
10	3/4/5		S			Contact with yellow brown silty fine to medium grained SAND, loose, saturated.	
	5/6/7	C		27.2	94.6	@12.5' - Yellow olive brown fine grained sandy SILT over dark brown fine grained sandy SILT, medium stiff, saturated.	
15	1/1/3		S			Olive gray fine grained sandy clayey SILT, soft, saturated.	
20	5/6/9	C		23.5	104.0	Blue gray to dark olive gray silty CLAY, medium stiff, saturated.	
25	3/3/4		S			Blue gray to dark olive gray silty CLAY, medium stiff, saturated.	
30	10/15/23	C		27.7	96.8	@29.5' - Grades to blue gray to dark olive gray fine grained sandy SILT, hard, saturated.	
35	15/30/35		S			Dark olive gray silty medium to coarse grained SAND, very dense, saturated.	
40	55-6"	C		19.2	111.7	Olive gray gravelly medium to coarse grained SAND, very dense, saturated.	
45							

ADDITIONAL COMMENTS: C = California Split Spoon Sampler
S = Standard Penetration Test
Blows per 6"

SURFACE DATA

LOG OF BORING B2

CLIENT: Suncal	PROJECT: Borchard Property	W.O.: 8925
LOCATION: Oxnard	ELEVATION:	DATE: 1/19/04
RIG TYPE:	HAMMER WEIGHTS: 140 lbs	DROP: 30"

Depth	N	U	B	M	DD	DESCRIPTION	ATTITUDES
40							
45	18/17/6		S			Olive gray slightly silty medium to coarse grianed SAND, medium dense, saturated.	
50	49/50-4"	C		16.0	115.4	Olive gray slightly silty medium to coarse grained SAND, very dense, saturated.	
55						Total Depth - 50' Groundwater at 10-15'	
60							
65							
70							
75							
80							
85							

ADDITIONAL COMMENTS: C = California Split Spoon Sampler
S = Standard Penetration Test
Blows per 6"

SURFACE DATA

LOG OF BORING B2

CLIENT: Suncal	PROJECT: Borchard Property	W.O.: 8925
LOCATION: Oxnard	ELEVATION:	DATE: 1/19/04
RIG TYPE:	HAMMER WEIGHTS: 140 bs.	DROP: 30"

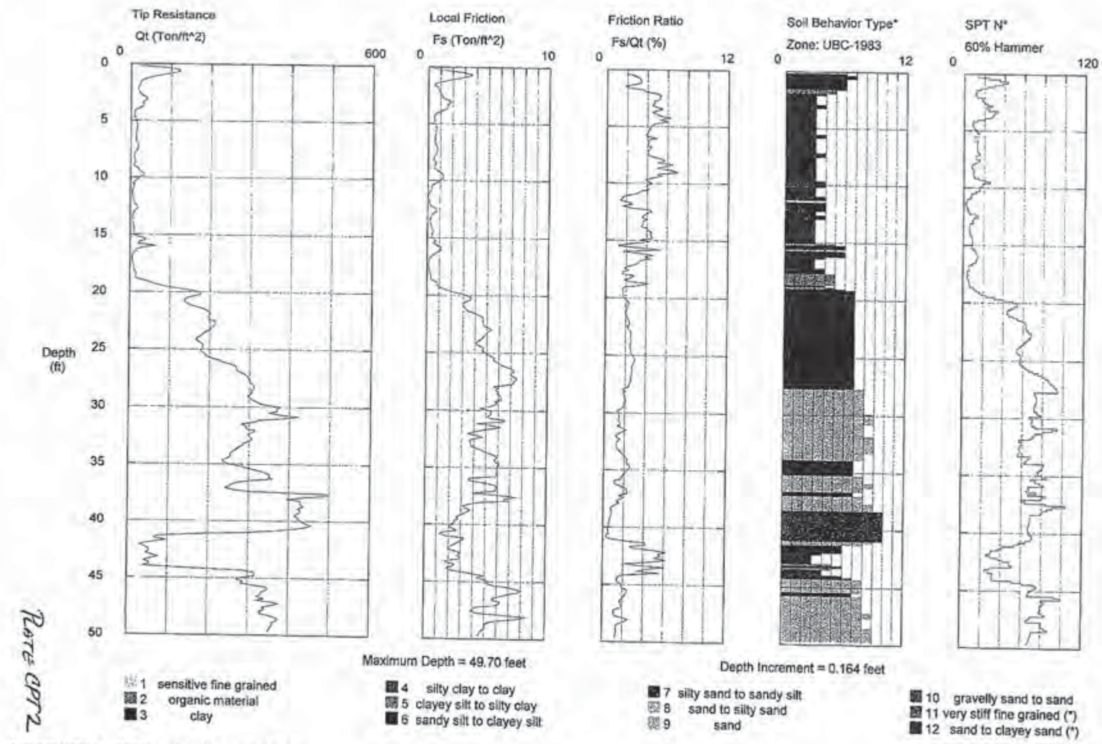
Depth	N	U	B	M	DD	DESCRIPTION	ATTITUDES
0						Alluvium:	
	3/4/5		S			@2.5' - Yellow brown clayey SILT, soft to medium stiff, moist, white specks.	
5	5/5/6	C		22.7	100.4	Yellow light brown fine grained sandy SILT, soft to medium stiff, moist.	
	2/3/4		S			@7.5' - Yellow light brown fine grained sandy SILT, soft to medium stiff, moist, mottled orange.	
10	5/5/4	C		35.0	90.9	Olive brown fine grained sandy SILT, soft to medium stiff, moist, nodules of charcoal (black, angular).	
15	2/33		S			Light olive brown medium grained sandy CLAY, soft, saturated, thin orange stringers, oxidized, loose.	
20	5/6/12	C		20.9	104.2	Olive brown clayey fine grained sandy SILT, stiff, saturated.	
25	18/18/19		S			Blue gray clayey medium to coarse grained SAND over yellow brown medium to coarse grained SAND, dense, saturated.	
30	35/50-5"	C		20.0	108.4	Yellow brown slightly silty medium to coarse grained SAND, very dense, saturated.	
35	28/30/33		S			Yellow brown slightly silty medium to coarse grained SAND with gravelly sand in tip, very dense, saturated.	
40	45/50-4"	C		19.6	108.9	Yellow brown slightly silty medium to coarse grained SAND with gravel, very dense, saturated.	
45							

ADDITIONAL COMMENTS: C = California Split Spoon Sampler
S = Standard Penetration Test
Blows per 6"

Geolabs Westlake Village

Operator: Vic & Mike
Sounding: cpt-02
Cone Used: DSG0409

CPT Date/Time: 1/9/2004 1:46:5
Location: Borchard Propert
Job Number: 8925

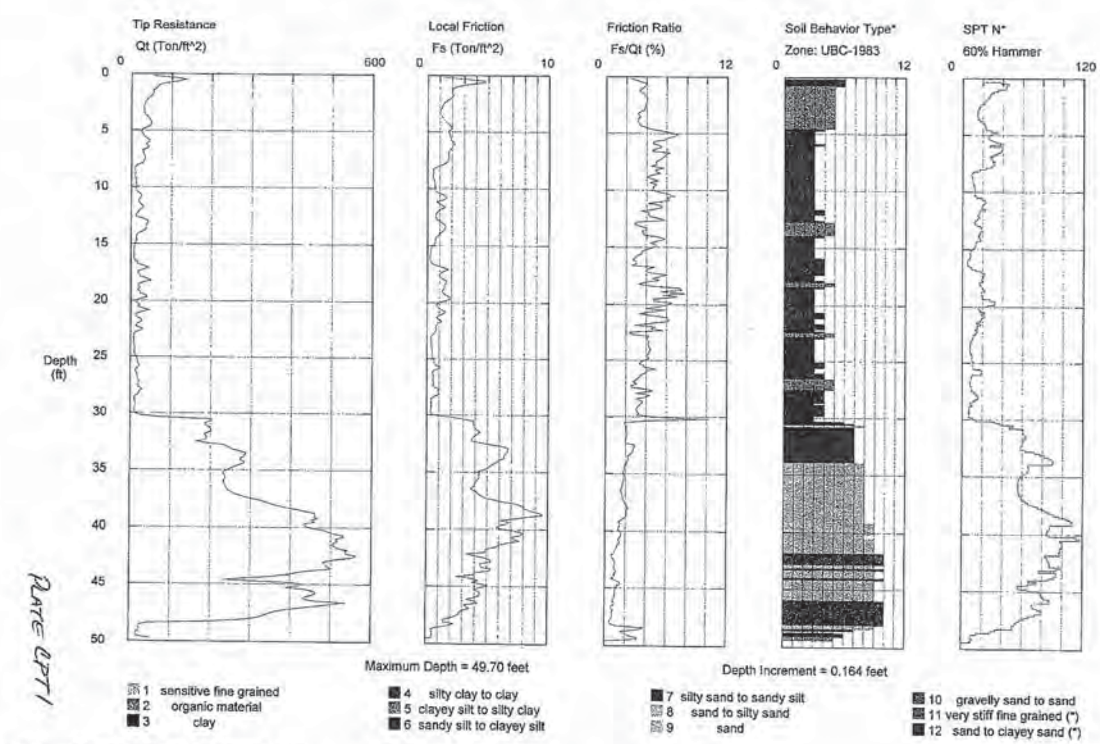


*Soil behavior type and SPT based on data from UBC-1983

Geolabs Westlake Village

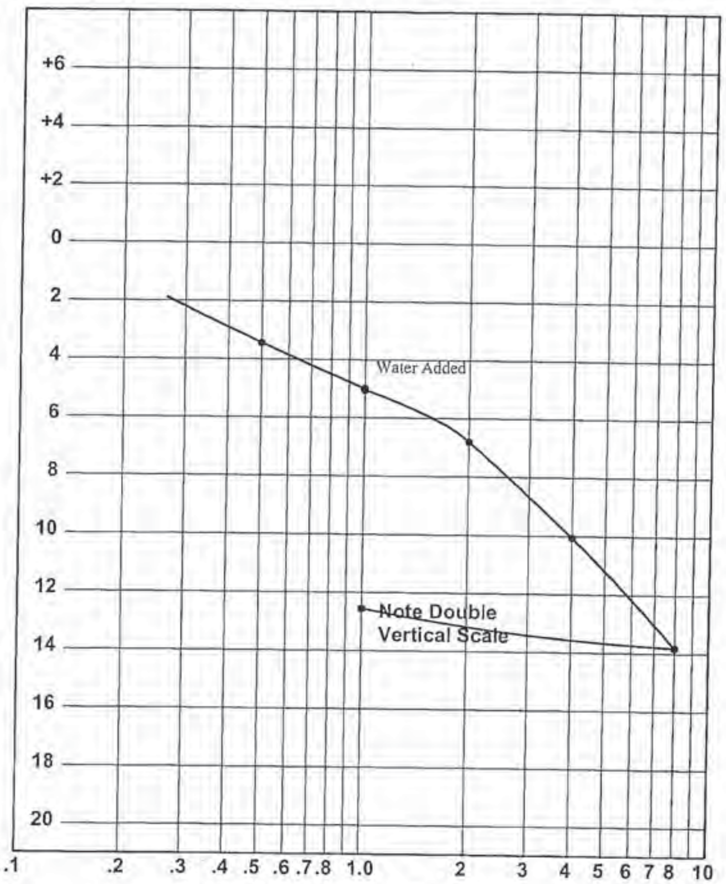
Operator: Vic & Mike
Sounding: cpt-01
Cone Used: DSG0409

CPT Date/Time: 1/9/2004 12:33:
Location: Borchard Propert
Job Number: 8925



*Soil behavior type and SPT based on data from UBC-1983

CONSOLIDATION - PRESSURE CURVE



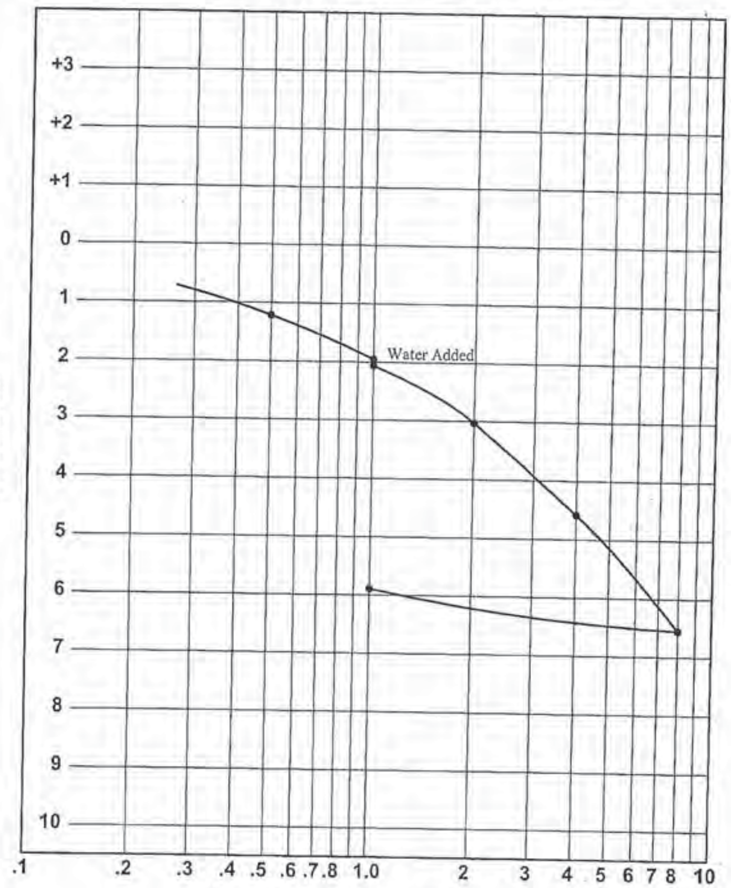
Project	Borchard Property, Oxnard
Location	B1
Depth	5 ft
Material	Alluvium

Geolabs - Westlake Village
GEOLOGY AND SOIL ENGINEERING

DATE 01/04 BY LKS
SCALE W.O. 8925

PLATE C1.05

CONSOLIDATION - PRESSURE CURVE



Project	Borchard Property, Oxnard
Location	B1
Depth	2.5 ft
Material	Alluvium

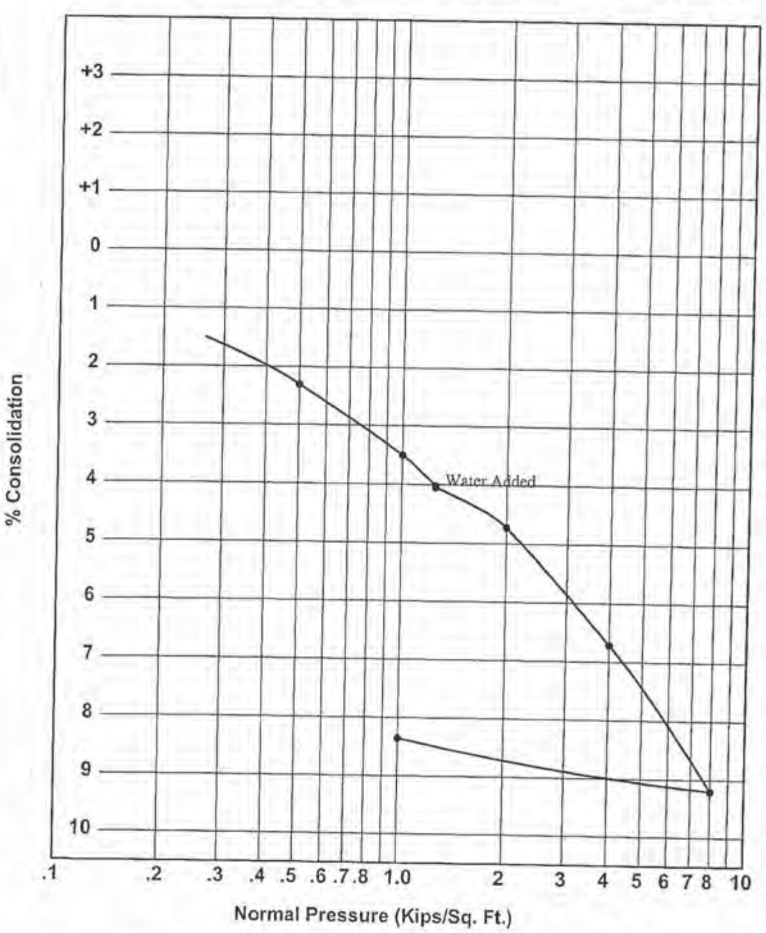
Geolabs - Westlake Village
GEOLOGY AND SOIL ENGINEERING

DATE 01/04 BY LKS
SCALE W.O. 8925

PLATE C1.025

C:\Program Files\ACAD2000\GCONSOL.dwg

CONSOLIDATION - PRESSURE CURVE



Project Borchard Property, Oxnard
Location B1
Depth 12.5 ft
Material Alluvium

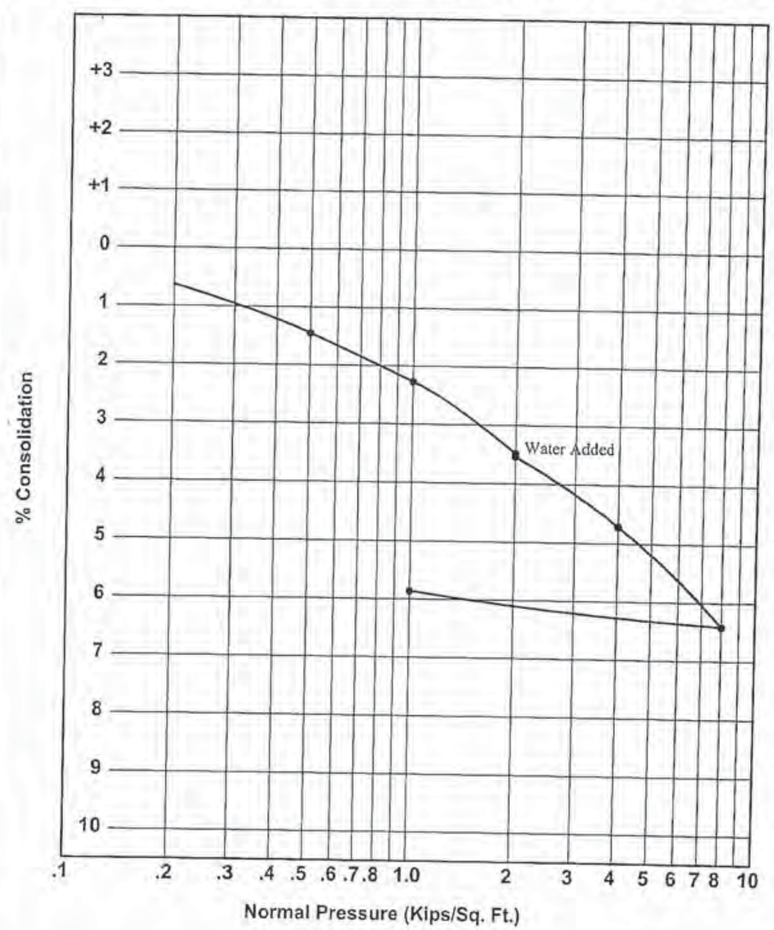
Geolabs - Westlake Village
GEOLOGY AND SOIL ENGINEERING

DATE 01/04 BY LKS
SCALE W.O. 8925

PLATE C1.125

C:\Program Files\ACAD2000\GCONSOL.dwg

CONSOLIDATION - PRESSURE CURVE



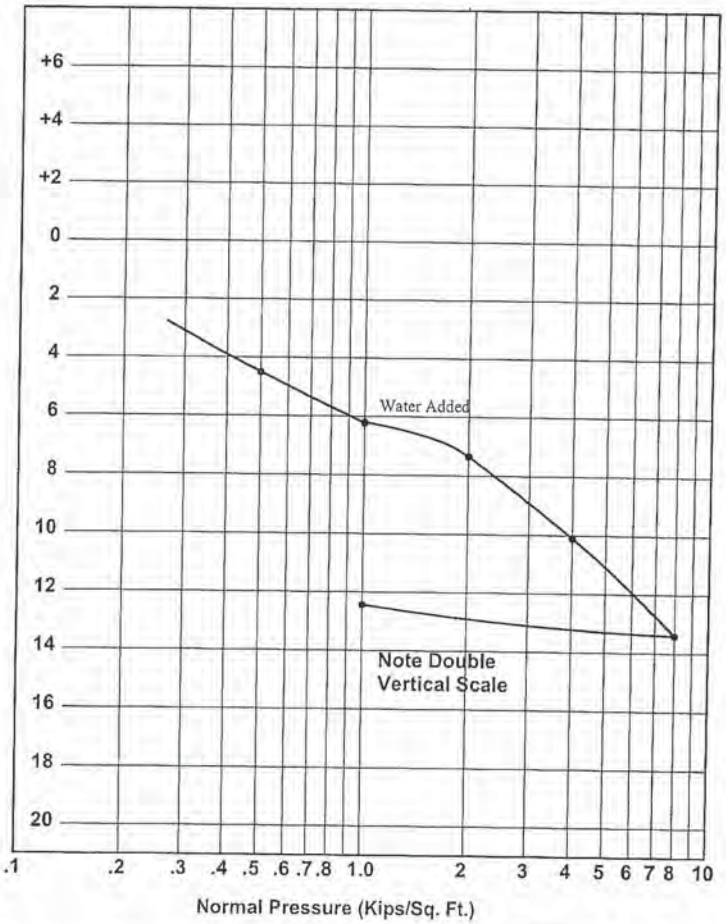
Project Borchard Property, Oxnard
Location B1
Depth 20 ft
Material Alluvium

Geolabs - Westlake Village
GEOLOGY AND SOIL ENGINEERING

DATE 01/04 BY LKS
SCALE W.O. 8925

PLATE C1.20

CONSOLIDATION - PRESSURE CURVE



Project	Borchard Property, Oxnard
Location	B2
Depth	10 ft
Material	Alluvium

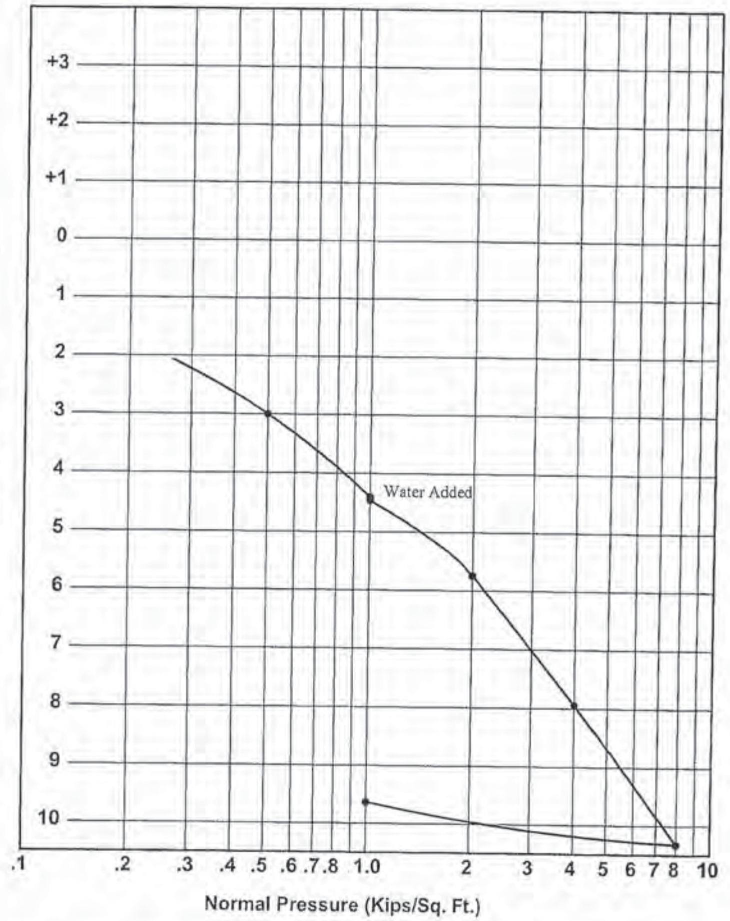
Geolabs - Westlake Village
GEOLOGY AND SOIL ENGINEERING

DATE 01/04 BY LKS
SCALE W.O. 8925

PLATE C2.10

C:\Program Files\ACAD2000\GCONSOL.dwg

CONSOLIDATION - PRESSURE CURVE



Project	Borchard Property, Oxnard
Location	B2
Depth	5 ft
Material	Alluvium

Geolabs - Westlake Village
GEOLOGY AND SOIL ENGINEERING

DATE 01/04 BY LKS
SCALE W.O. 8925

PLATE C2.05

C:\Program Files\ACAD2000\GCONSOL.dwg

APPENDIX A

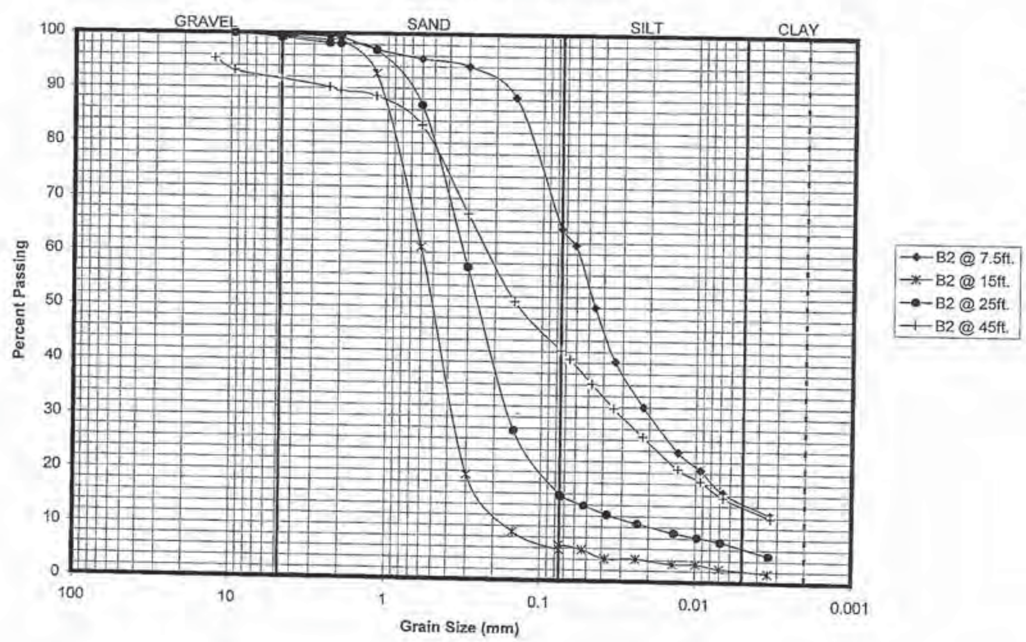
SEISMICITY ANALYSES

GEOLABS - WESTLAKE VILLAGE

Suncal Companies

W.O. 8925

PARTICLE SIZE ANALYSIS



GEOLABS-WESTLAKE VILLAGE

PLATE PS.1

SUMMARY OF FAULT PARAMETERS

Page 2

ABBREVIATED FAULT NAME	APPROX. DISTANCE (km)	SOURCE TYPE (A,B,C)	MAX. MAG. (Mw)	SLIP RATE (mm/yr)	FAULT TYPE (SS,DS,BT)
GARLOCK (East)	161.7	A	7.3	7.00	SS
RINCONADA	171.7	B	7.3	1.00	SS
LENWOOD-LOCKHART-OLD WOMAN SPRGS	173.9	B	7.3	0.60	SS
NORTH FRONTAL FAULT ZONE (West)	176.9	B	7.0	1.00	DS
HELENDALE - S. LOCKHARDT	181.2	B	7.1	0.60	SS
ELSINORE-TEMECULA	181.5	B	6.8	5.00	SS
SAN JACINTO-SAN JACINTO VALLEY	181.8	B	6.9	12.00	SS
So. SIERRA NEVADA	185.7	B	7.1	0.10	DS
GRAVEL HILLS - HARPER LAKE	198.6	B	6.9	0.60	SS
ROSE CANYON	202.4	B	6.9	1.50	SS
LITTLE LAKE	211.2	B	6.7	0.70	SS
BLACKWATER	214.9	B	6.9	0.60	SS
SAN JACINTO-ANZA	216.5	A	7.2	12.00	SS
NORTH FRONTAL FAULT ZONE (East)	220.1	B	6.7	0.50	DS
ELSINORE-JULIAN	221.3	A	7.1	5.00	SS
LANDERS	226.2	B	7.3	0.60	SS
CALICO - HIDALGO	227.2	B	7.1	0.60	SS
PINTO MOUNTAIN	228.5	B	7.0	2.50	SS
JOHNSON VALLEY (Northern)	233.6	B	6.7	0.60	SS
SAN ANDREAS (Creeping)	235.7	B	5.0	34.00	SS
TANK CANYON	238.9	B	6.5	1.00	DS
OWENS VALLEY	247.4	B	7.6	1.50	SS
EMERSON So. - COPPER MTN.	247.5	B	6.9	0.60	SS
BURNT MTN.	257.3	B	6.5	0.60	SS
PANAMINT VALLEY	257.3	B	7.2	2.50	SS
EUREKA PEAK	258.3	B	6.5	0.60	SS
PISGAH-BULLION MTN.-MESQUITE LK	258.8	B	7.1	0.60	SS
SAN JACINTO-COYOTE CREEK	261.2	B	6.8	4.00	SS
OWL LAKE	264.8	B	6.5	2.00	SS
EARTHQUAKE VALLEY	266.4	B	6.5	2.00	SS
INDEPENDENCE	274.9	B	6.9	0.20	DS
ELSINORE-COYOTE MOUNTAIN	295.2	B	6.8	4.00	SS
DEATH VALLEY (South)	297.5	B	6.9	4.00	SS
SAN JACINTO - BORREGO	298.2	B	6.6	4.00	SS
HUNTER MTN. - SALINE VALLEY	299.9	B	7.0	2.50	SS
DEATH VALLEY (Graben)	301.5	B	6.9	4.00	DS
BIRCH CREEK	310.2	B	6.5	0.70	DS
PALO COLORADO - SUR	320.2	B	7.0	3.00	SS
MONTEREY BAY - TULARCITOS	321.8	B	7.1	0.50	DS
ORTIGALITA	324.2	B	6.9	1.00	SS
CALAVERAS (So.of Calaveras Res)	324.7	B	6.2	15.00	SS
WHITE MOUNTAINS	329.6	B	7.1	1.00	SS
SUPERSTITION MTN. (San Jacinto)	330.3	B	6.6	5.00	SS
ELMORE RANCH	334.3	B	6.6	1.00	SS
BRAWLEY SEISMIC ZONE	335.2	B	6.5	25.00	SS
SUPERSTITION HILLS (San Jacinto)	336.5	B	6.6	4.00	SS

SUMMARY OF FAULT PARAMETERS

Page 3

ABBREVIATED FAULT NAME	APPROX. DISTANCE (km)	SOURCE TYPE (A,B,C)	MAX. MAG. (Mw)	SLIP RATE (mm/yr)	FAULT TYPE (SS,DS,BT)
DEATH VALLEY (Northern)	336.6	A	7.2	5.00	SS
QUIEN SABE	339.0	B	6.5	1.00	SS
ROUND VALLEY (E. of S.N.Mtns.)	342.6	B	6.8	1.00	DS
ELSINORE-LAGUNA SALADA	346.8	B	7.0	3.50	SS
DEEP SPRINGS	352.4	B	6.6	0.80	DS
ZAYANTE-VERGELES	355.1	B	6.8	0.10	SS
FISH SLOUGH	357.4	B	6.6	0.20	DS
SAN ANDREAS (1906)	360.1	A	7.9	24.00	SS
SARGENT	361.3	B	6.8	3.00	SS
IMPERIAL	363.4	A	7.0	20.00	SS
HILTON CREEK	364.6	B	6.7	2.50	DS
DEATH VALLEY (N. of Cucamongo)	373.1	A	7.0	5.00	SS
HARTLEY SPRINGS	382.3	B	6.6	0.50	DS
SAN GREGORIO	396.2	A	7.3	5.00	SS
MONTE VISTA - SHANNON	410.2	B	6.5	0.40	DS
HAYWARD (SE Extension)	412.4	B	6.5	3.00	SS
MONO LAKE	414.7	B	6.6	2.50	DS
GREENVILLE	415.6	B	6.9	2.00	SS
HAYWARD (Total Length)	432.7	A	7.1	9.00	SS
CALAVERAS (No.of Calaveras Res)	432.7	B	6.8	6.00	SS
ROBINSON CREEK	442.9	B	6.5	0.50	DS
ANTELOPE VALLEY	479.2	B	6.7	0.80	DS
CONCORD - GREEN VALLEY	482.5	B	6.9	6.00	SS
GENOA	499.3	B	6.9	1.00	DS
RODGERS CREEK	519.3	A	7.0	9.00	SS
WEST NAPA	521.7	B	6.5	1.00	SS
POINT REYES	533.3	B	6.8	0.30	DS
HUNTING CREEK - BERRYESSA	546.8	B	6.9	6.00	SS
MAACAMA (South)	582.5	B	6.9	9.00	SS
COLLAYOMI	600.9	B	6.5	0.60	SS
BARTLETT SPRINGS	607.2	A	7.1	6.00	SS
MAACAMA (Central)	625.4	A	7.1	9.00	SS
MAACAMA (North)	683.8	A	7.1	9.00	SS
ROUND VALLEY (N. S.F.Bay)	693.3	B	6.8	6.00	SS
BATTLE CREEK	735.4	B	6.5	0.50	DS
LAKE MOUNTAIN	751.1	B	6.7	6.00	SS
GARBERVILLE-BRICELAND	766.2	B	6.9	9.00	SS
MENDOCINO FAULT ZONE	819.5	A	7.4	35.00	DS
LITTLE SALMON (Onshore)	830.2	A	7.0	5.00	DS
CASCADIA SUBDUCTION ZONE	831.3	A	8.3	35.00	DS
MAD RIVER	835.3	B	7.1	0.70	DS
McKINLEYVILLE	845.3	B	7.0	0.60	DS
FICKLE HILL	846.8	B	6.9	0.60	DS
TRINIDAD	847.4	B	7.3	2.50	DS
TABLE BLUFF	850.9	B	7.0	0.60	DS
LITTLE SALMON (Offshore)	863.6	B	7.1	1.00	DS
BIG LAGOON - BALD MTN.FLT.ZONE	884.5	B	7.3	0.50	DS

****

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*
* U B C S E I S
*
* Version 1.03
*
****

COMPUTATION OF 1997
UNIFORM BUILDING CODE
SEISMIC DESIGN PARAMETERS

JOB NUMBER: 8925 DATE: 01-20-2004

JOB NAME: Borchard Prop.

FAULT-DATA-FILE NAME: CDMGUBCR.DAT

SITE COORDINATES:
SITE LATITUDE: 34.2056
SITE LONGITUDE: 119.2006

UBC SEISMIC ZONE: 0.4

UBC SOIL PROFILE TYPE: SD

NEAREST TYPE A FAULT:
NAME: SAN ANDREAS - 1857 Rupture
DISTANCE: 71.9 km

NEAREST TYPE B FAULT:
NAME: OAK RIDGE (Onshore)
DISTANCE: 1.4 km

NEAREST TYPE C FAULT:
NAME:
DISTANCE: 99999.0 km

SELECTED UBC SEISMIC COEFFICIENTS:
Na: 1.3
Nv: 1.6
Ca: 0.57
Cv: 1.02
Ts: 0.716
To: 0.143

****
* CAUTION: The digitized data points used to model faults are *
* limited in number and have been digitized from small- *
* scale maps (e.g., 1:750,000 scale). Consequently, *
* the estimated fault-site-distances may be in error by *
* several kilometers. Therefore, it is important that *
* the distances be carefully checked for accuracy and *
* adjusted as needed, before they are used in design. *
****

SUMMARY OF FAULT PARAMETERS

Page 1

ABBREVIATED FAULT NAME	APPROX. DISTANCE (km)	SOURCE TYPE (A,B,C)	MAX. MAG. (Mw)	SLIP RATE (mm/yr)	FAULT TYPE (SS,DS,BT)
OAK RIDGE (Onshore)	1.4	B	6.9	4.00	DS
SIMI-SANTA ROSA	8.2	B	6.7	1.00	DS
VENTURA - PITAS POINT	9.8	B	6.8	1.00	DS
ANACAPA-DUME	14.8	B	7.3	3.00	DS
RED MOUNTAIN	19.3	B	6.8	2.00	DS
M.RIDGE-ARROYO PARIDA-SANTA ANA	26.2	B	6.7	0.40	DS
SAN CAYETANO	27.3	B	6.8	6.00	DS
MALIBU COAST	28.7	B	6.7	0.30	DS
SANTA YNEZ (East)	34.3	B	7.0	2.00	SS
SANTA CRUZ ISLAND	37.6	B	6.8	1.00	DS
SANTA SUSANA	43.4	B	6.6	5.00	DS
HOLSER	46.3	B	6.5	0.40	DS
SANTA YNEZ (West)	50.4	B	6.9	2.00	SS
SANTA MONICA	51.3	B	6.6	1.00	DS
BIG PINE	53.6	B	6.7	0.80	SS
SAN GABRIEL	59.8	B	7.0	1.00	SS
PALOS VERDES	64.7	B	7.1	3.00	SS
SIERRA MADRE (San Fernando)	67.2	B	6.7	2.00	DS
SANTA ROSA ISLAND	68.0	B	6.9	1.00	DS
PLEITO THRUST	71.4	B	6.8	2.00	DS
SAN ANDREAS - 1857 Rupture	71.9	A	7.8	34.00	SS
HOLLYWOOD	72.0	B	6.5	1.00	DS
VERDUGO	73.0	B	6.7	0.50	DS
GARLOCK (West)	74.1	A	7.1	6.00	SS
NEWPORT-INGLEWOOD (L.A.Basin)	76.9	B	6.9	1.00	SS
SIERRA MADRE (Central)	83.5	B	7.0	3.00	DS
RAYMOND	89.9	B	6.5	0.50	DS
LOS ALAMOS-W. BASELINE	92.5	B	6.8	0.70	DS
WHITE WOLF	93.1	B	7.2	2.00	DS
CLAMSHELL-SAWPIT	105.0	B	6.5	0.50	DS
LIONS HEAD	109.7	B	6.6	0.02	DS
ELSINORE-WHITTIER	111.5	B	6.8	2.50	SS
SAN LUIS RANGE (S. Margin)	119.3	B	7.0	0.20	DS
SAN JOSE	121.2	B	6.5	0.50	DS
SAN JUAN	125.9	B	7.0	1.00	SS
CASMALIA (Orcutt Frontal Fault)	127.5	B	6.5	0.25	DS
CUCAMONGA	131.1	A	7.0	5.00	DS
CHINO-CENTRAL AVE. (Elsinore)	131.8	B	6.7	1.00	DS
NEWPORT-INGLEWOOD (Offshore)	136.6	B	6.9	1.50	SS
ELSINORE-GLEN IVY	149.0	B	6.8	5.00	SS
LOS OSOS	149.3	B	6.8	0.50	DS
SAN ANDREAS - Southern	154.4	A	7.4	24.00	SS
HOSGRI	155.4	B	7.3	2.50	SS
SAN JACINTO-SAN BERNARDINO	155.7	B	6.7	12.00	SS
CORONADO BANK	156.7	B	7.6	3.00	SS
CLEGHORN	160.1	B	6.5	3.00	SS

OXNARD 7.5 MINUTE QUADRANGLE AND PORTIONS OF ADJACENT QUADRANGLES

10% EXCEEDANCE IN 50 YEARS PEAK GROUND ACCELERATION

1998

PREDOMINANT EARTHQUAKE

Magnitude (Mw)

(Distance (km))

Base map from GDT

0 1.5 3 Miles

Department of Conservation
California Geological Survey

Figure 3.4

OXNARD 7.5 MINUTE QUADRANGLE AND PORTIONS OF ADJACENT QUADRANGLES

10% EXCEEDANCE IN 50 YEARS PEAK GROUND ACCELERATION (g)

1998

ALLUVIUM CONDITIONS

Base map from GDT

0 1.5 3 Miles

Department of Conservation
California Geological Survey

Figure 3.3

DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS, STATE GEOLOGIST

STATE OF CALIFORNIA—GRAY DAVIS, GOVERNOR
THE RESOURCES AGENCY—MARY D. NICHOLS, SECRETARY
DEPARTMENT OF CONSERVATION—DARRYL YOUNG, DIRECTOR

Oxnard Quadrangle Plate 1.1
SEISMIC HAZARD ZONE REPORT 052

Base map enlarged from U.S.G.S. 30 x 60-minute series

OXNARD QUADRANGLE

SCALE

Lithologic contact
See Geologic Conditions section in report for descriptions of the units.

Plate 1.1 Quaternary geologic map of the Oxnard 7.5-minute Quadrangle, California, from William Lettis & Associates, 2000.

OXNARD 7.5 MINUTE QUADRANGLE AND PORTIONS OF ADJACENT QUADRANGLES

10% EXCEEDANCE IN 50 YEARS MAGNITUDE-WEIGHTED PSEUDO-PEAK ACCELERATION (g) FOR ALLUVIUM

2001

LIQUEFACTION OPPORTUNITY

Department of Conservation
California Geological Survey

Figure 3.5

APPENDIX B

LIQUEFACTION / SEISMIC SETTLEMENT ANALYSES

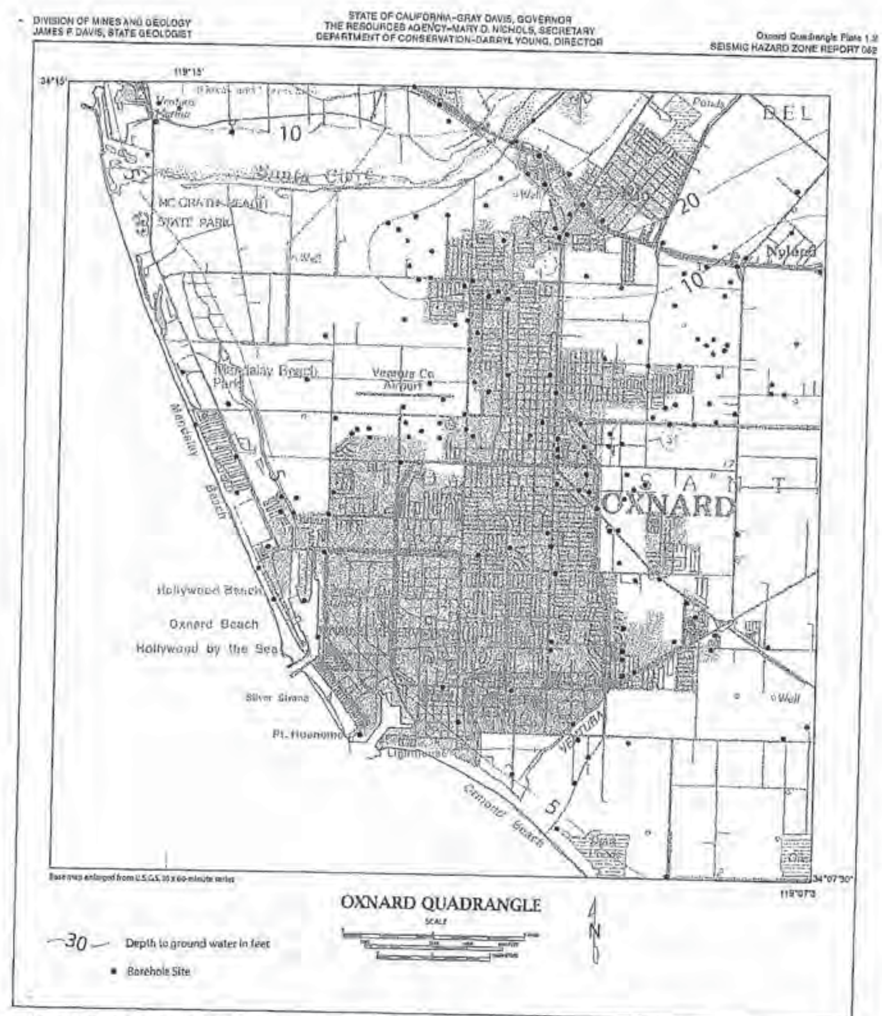

Plate 1.2 Depth to historically highest groundwater and borehole locations, Oxnard 7.5-minute quadrangle, California

Fines Content Correction: $(N_1)_{60cs} = \alpha + \beta(N_1)_{60}$

Where:

$\alpha = 0$	for	$FC \le 5\%$
$\alpha = e^{(1.76-(190/FC^2))}$	for	$5\% < FC < 35\%$
$\alpha = 5.0$	for	$FC \ge 35\%$
$\beta = 1.0$	for	$FC \le 5\%$
$\beta = [0.99 + (FC^{1.5}/1000)]$	for	$5\% < FC < 35\%$
$\beta = 1.2$	for	$FC \ge 35\%$

FC = *Fines Content*

Corrections to SPT N value: $(N_1)_{60} = N_{field} C_n C_e C_b C_r C_s$

Where: $C_n = 2.2/(1.2 + \sigma'_{vo}/P_a)$ for overburden normalization

Other Correction factors per Table 2 (Youd, 2001)

Liquefaction Safety Factor: $FS = (CRR_{7.5}/CSR)MSF$

Where: MSF is Magnitude Scaling Factor (Revised Idriss)

$$MSF = 10^{2.24}/M_w^{2.56}$$

CPT Analysis

The reduction of CPT data consisted of interpreting the soil behavior types encountered and assigning stratagraphic layers to the different soils. The depth ranges for the layers were assigned based upon material type differences such as grain size distribution and penetration resistance. Once soil layers were assigned to the sounding profile, thin sand layers were evaluated for the applicability of a correction for thin sand layers between soft clay layers. After applying a thin layer correction (if necessary), the profile data is normalized to approximately one atmosphere, evaluated, and material types and engineering characteristics are determined. The following correlations were used within these analyses.

Thin Layer Correction, K_H:

$$K_H = \frac{1}{4} \times [((\frac{H}{d_c})/17) - 1.77]^2 + 1.0$$

Overburden Normalization: iterative procedure proposed by Robertson and Wride (1997).

$q_{c1N} = C_Q(q_c/P_a)$ where: $C_Q = (P_a/\sigma'_{vo})^n$ but not greater than 1.7

n varies from 0.5 to 1 by soil type.
this requires an iterative process

APPENDIX B
LIQUEFACTION AND SEISMIC SETTLEMENT ANALYSIS

This geotechnical investigation included analysis of the liquefaction potential and potential seismically induced settlement at the subject site. The liquefaction analysis addressed the alluvium below the shallow groundwater. The analysis of seismic settlement encompassed both saturated and unsaturated soils.

Field Investigation

These analyses used data retrieved from Standard Penetration Tests (SPT) in borings drilled using a hollow-stem auger and from the Cone Penetrometer Test (CPT) soundings. Samples were driven with a 140 lb. automatic safety hammer lifted 30 inches. The estimated efficiency of the hammer is approximately 90 percent. Drilling rod was used to allow the hammer to remain above the auger. The boring diameter was approximately 6 inches (outer diameter). The samplers consisted of both a SPT split spoon sampler and a lined Modified California split spoon sampler (2.375 inch i.d.). The borings for this investigation used water and drilling mud to prohibit soil from sluicing up the auger.

The CPT rig used during the field investigation was a 23-ton truck-mounted rig provided by Holguin, Fahan & Associates, Inc. The cone tip has a cross-sectional area of 10 square centimeters. The CPT is capable of obtaining tip pressure and side friction data at 2 inch (0.05 meter) intervals.

Data Analyses

The data obtained from the CPT and SPT tests were processed using the procedures proposed from the 1996 NCEER (Youd, 1997) and 1998 NCEER/NSF Workshops (Youd, 2001), and the SCEC implementation document (Martin, 1999). The analyses were performed using procedures programmed in the computer using Microsoft Visual Basic in conjunction with a Microsoft Excel spreadsheet.

SPT Analysis

The data from the SPT tests were processed according to the procedures proposed by NCEER, 2001. The field blowcounts were corrected for overburden, hammer energy, rod length, percent fines, and sampler liner. Tests performed using the lined California sampler (with 3 inch outer diameter and 2.37 inch inner diameter) were converted to SPT blowcounts using the procedures proposed by Lowe and Zaccheo (Fang, 1991). The cyclic resistance of the soils is compared to the cyclic stress ratio. Ratios less than 1.3 are considered to have a potential for liquefaction. The following correlations were used in these analyses.

Cyclic Stress Ratio, CSR: $CSR = 0.65(a_{max}/g)(\sigma_{vo}/\sigma'_{vo})r_d$

Stress Reduction Coeff, r_d:

$r_d = 1.0 - 0.00765z$ for $z \le 9.15m$

$r_d = 1.174 - 0.0267z$ for $9.15m < z \le 23m$

Cyclic Resistance Ratio, $CRR_{7.5}$:

$$CRR_{7.5} = \frac{1}{34 - (N_1)_{60}} + \frac{(N_1)_{60}}{135} + \frac{50}{[10 \times (N_1)_{60} + 45]^2} - \frac{1}{200}$$

$for: (N_1)_{60} < 30$

Relative Density	$D_r = -98 + 66\log_{10}\frac{q_c}{[\sigma'_{vo}]^{0.5}}$	Jamiolkowski et al (1985), Units of 10kPa
	$D_r = \frac{1}{2.41} * \ln[q_c/(157 * \sigma'^{0.55}_{vo})]$	Baldi et al (1986), Units of kPa
Undrained Shear Strength:	$S_u = \frac{q_c - \sigma_v}{N_K}$	Robertson & Campanella (1989), N_k=15
Effective Internal Friction:	$\phi' = \tan^{-1}[0.1 + 0.38\log\frac{q_c}{\sigma'_{vo}}]$	Roberston & Campanella (1983)
	$\phi' = 53.881 - 27.6034e^{(-0.0147N)}$	Peck et al., (1974) after Coyle (1985)
Overconsolidation Ratio:	programmed from chart	Schmertmann (1978)

The results of our analyses are presented on the attached graphs. Boring B2 was located adjacent to CPT 2 for verification of the noted correlations. The comparison between these data sources indicates the correlations are effective. The successful correlation of the boring and CPT data allows us to utilize the CPT data for our analyses throughout the site. The CPT data was relied upon because it is superior at defining the stratigraphy of the materials throughout the soil profile. Layers of materials in which the CSR exceeds the $CRR_{7.5}$ are considered liquefiable.

Liquefaction Induced Settlement

The analyses of the potential liquefaction induced settlement are performed using the same electronic spreadsheet used to perform the liquefaction analyses. The spreadsheet is programmed to perform the analyses proposed by Tokimatsu and Seed (1987).

For the settlement analyses, the normalized, fines corrected SPT blowcounts are compared to digitized files of chart data (SPT blowcounts vs. Volumetric strain for clean sands) provided in Tokimatsu and Seed. The fines correction to the SPT blowcounts consider a liquefied soil. Therefore, this fines correction produces smaller corrected blowcounts than the corrected blowcounts used to estimate the potential for triggering of liquefaction. This fines correction is based on the recommended procedures for implementation of Publication 117 (Martin and Lew, 1999). The spreadsheet estimates the percent volumetric strain for each layer assuming the lateral strain is minor so the volumetric strain is equivalent to settlement. The estimated settlement for each soil layer and a summation of all the soil layers below the design groundwater level are then reported.

Seismic Settlement of Dry Sands

For coarse-grained materials above the design groundwater level the potential for settlement related to ground shaking is analyzed using the methods proposed by Tokimatsu and Seed (1987). Like in the liquefaction-induced-settlement analyses, the SPT blowcounts and/or CPT derived SPT blowcounts are corrected to an equivalent blowcount for clean sand. Clayey soils with 15 percent clay or more, and soils with an Ic of 2.6 or greater are discarded from the analyses. The following equations are used in the analysis to enter into charts provided with the methodology.

SPT Blowcounts: R.S. Olsen (1997) (see attached graph)

Soil Behavior Index, Ic:

$$I_c = [(3.47 - \log Q)^2 + (1.22 + \log F)^2]^n$$

Soil Type: Soil Behavior Chart, Robertson & Wride (1997)

Where: $Q = [(q_c - \sigma_{vo})/P_a][(P_a/\sigma'_{vo})^n]$

And $F = [f_s/(q_c - \sigma_{vo})] \times 100\%$

Percent Fines: Robertson & Wride (1997)

Where:	if	$Ic < 2.6$	$FC(\%) = 0$
	if	$1.26 \le Ic \le 3.5$	$FC(\%) = 1.75Ic^{3.25} - 3.7$
	if	$Ic > 3.5$	$FC(\%) = 100$

Grain characteristic corr. factor, K_c: $K_c = 1.0$ for $I_c \le 1.64$

$K_c = -0.403I_c^4 + 5.581I_c^3 - 21.63I_c^2 + 33.75I_c - 17.88$ for $I_c > 1.64$

Overburden corr. factor, K_σ: $K_\sigma = (\sigma_v')^{f-1}$ where: f ranges from 0.8 to 0.6 inversely to Dr

Equivalent Clean Sand Normalized Penetration Resistance:

$$(q_{c1N})_{cs} = K_c q_{c1N}$$

Cyclic Resistance Ratio, $CRR_{7.5}$:

$CRR_{7.5} = 0.833[(q_{c1N})_{cs}/1000] + 0.05$ for $(q_{c1N})_{cs} < 50$

$CRR_{7.5} = 93[(q_{c1N})_{cs}/1000]^3 + 0.08$ for $50 \le (q_{c1N})_{cs} < 160$

Cyclic Stress Ratio, CSR:

$$CSR = 0.65(a_{max}/g)(\sigma_{vo}/\sigma'_{vo})r_d$$

Magnitude Scaling Factor, MSF:

$MSF = 10^{2.24}/M_w^{2.56}$ Magnitude Scaling Factor (Revised Idriss)

Liquefaction Safety Factor: $FS = (CRR_{7.5}/CSR)MSF$

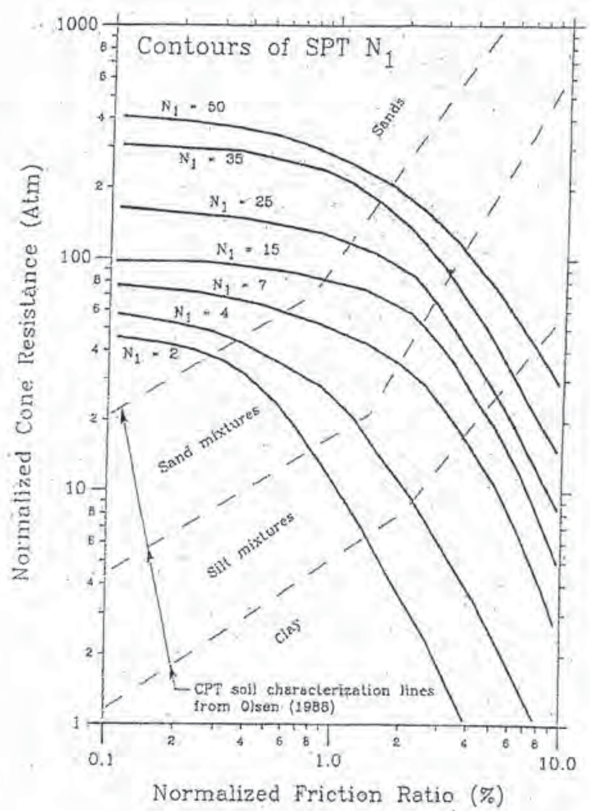

Figure 11 CPT estimation of SPT N_1 using both CPT measurements (Olsen 1994, 1988 1986, 1984).

Effective Shear Strain: $\gamma_{eff} = \dfrac{\tau_{av}}{G_{max} \times \dfrac{G_{eff}}{G_{max}}}$

Average Cyclic Shear Stress: $\tau_{av} = 0.65 \bullet \dfrac{a_{max}}{g} \bullet \sigma_o \bullet r_d$

Shear Modulus at Low Strain:

$$G_{max} = 1000 \bullet (K_2)_{max} \bullet (\sigma'_N)^{1/2} \quad \text{in psf units}$$

$$(K_2)_{max} \cong 20(N_1)^{1/3} \qquad \text{(Ohta and Goto, 1976)}$$

Using the referenced methodology, the volumetric strain is estimated for each soil layer or layer portion above the design water level. This methodology is considered applicable to dry or moist sands (unsaturated). Again the lateral strains are considered insignificant so the volumetric strain is considered as settlement. The estimated settlement for each soil layer and a summation of all the soil layers above the groundwater level are then reported by incorporation into the attached settlement graphs.

Currently the practice of soils engineering lacks accurate means or knowledge to estimate the potential seismic settlement for fine-grained soils. The use of this methodology for soils with significant amounts of fine grain sizes is believed to be conservative. This methodology is used with the understanding of its limitations and for lack of better simplified means of estimating the potential for seismic settlement.

The estimate of potential differential settlement is typically taken to be half of the total seismic settlement (Martin and Lew, 1999).

Surface Manifestations

Consideration of the potential for surface manifestations used the procedure proposed by Ishihara, 1985. The potential is considered a function of the relative density (SPT blowcounts), depth and thickness of liquefiable material, and thickness of overlying non-liquefiable material. This analysis only considers liquefiable sands with SPT blowcounts of 10 or less. The likelihood of surface manifestations is considered low.

Liquefaction-Induced Lateral Spread

The potential for liquefaction-induced lateral spread was analyzed using the procedures proposed by Barlett and Youd (1995) as modified in 1999. The potential is considered a function of earthquake distance and magnitude, thickness and grain-size distribution in the liquefiable layers, and ground slope or nearness of an open face. It should be noted that this procedure was developed using a historical database of large displacement events. The database includes few points with movement magnitudes of small value, on the order that is of interest for engineering purposes. The procedure is also applicable only for earthquake sources greater than 10 kilometers from the subject site (though we have evaluated our data using smaller source distances). These two elements of the analyses are cause to suspect the output when faults are near source events and when the magnitude of movement is relatively small (a few meters). Therefore, for our purposes we have used this analyses as an indicator whether lateral-spread may be possible; however, the magnitudes of movement output from the analyses are considered suspect.

Considering the blow counts and estimated blow counts obtained during the investigation, the potential for lateral spreading during a design level earthquake are considered remote.

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Liquefaction Analysis Using CPT Data

CPT: 1
G.W. Depth: 7 ft.
Design G.W. Depth: 7 ft.
Removal: 0 ft.

W.O.: 8925
Elev.: 0
Ic: 2.6

Fill Height: 0.0 ft. 120 pcf
Max horizontal acc. @ surface: 0.48 g
Design earthquake magnitude: 7.50
Magnitude Scaling Factor: 1.00

Layer	Layer Bott. (ft)	Layer Thick. (ft)	Avg. Tip Resist qc (tsf)	Avg. Side Fric. fs	Avg. Tip Resist qc1N (tsf)	Norm. Frc. Rt. (%)	Eff. O.B. (tsf)	Soil Behavior Type	Avg. rd	Kc	Kσ	Avg. Fines Content (%)	Avg. Dr (%)	Avg. SPT N1(60)liq (bpf)	Min. CRR (M=7.5)	Avg. CSR	Min. Liq. FS	Avg. Strain (%)	Liq Settle. (in)
16	7.87	0.82	31.6	1.58	51.4	5.1	0.436	Silt mixtures - clayey silt to silty clay (4)	0.98	3.38	1	35.8	—	43.1	0.42	0.317	1.26	0.0	0
20	12.14	0.66	24.6	1.03	37.5	4.3	0.561	Silt mixtures - clayey silt to silty clay (4)	0.98	3.68	1	38.1	—	29.8	0.26	0.386	0.67	0.0	0
22	12.80	0.16	30.6	0.93	39.1	3.1	0.587	Silt mixtures - clayey silt to silty clay (4)	0.97	2.99	1	32.6	—	18.6	0.23	0.396	0.58	0.0	0
23	12.96	0.16	71.4	1.17	53.1	2.9	0.592	Sand mixtures - silty sand to sandy silt (5)	0.97	1.43	1	15.4	64	24.0	0.28	0.398	0.71	0.0	0
24	13.94	0.98	35.9	1.33	45.7	3.8	0.609	Silt mixtures - clayey silt to silty clay (4)	0.97	3.07	1	33.2	—	29.9	0.29	0.404	0.70	0.0	0
28	17.22	0.49	34.8	1.45	44.6	4.3	0.710	Silt mixtures - clayey silt to silty clay (4)	0.96	3.33	1	35.3	—	33.3	0.40	0.433	0.93	0.0	0
30	18.37	0.49	39.9	1.52	47.0	4.0	0.743	Silt mixtures - clayey silt to silty clay (4)	0.96	3.15	1	30.8	—	32.0	0.34	0.440	0.78	0.0	0
36	20.83	0.33	37.0	1.39	41.3	4.0	0.817	Silt mixtures - clayey silt to silty clay (4)	0.95	3.44	1	35.9	—	29.5	0.31	0.454	0.69	0.0	0
40	22.64	0.33	28.7	0.69	30.7	2.5	0.869	Silt mixtures - clayey silt to silty clay (4)	0.95	3.11	1	33.6	—	11.2	0.16	0.461	0.34	0.0	0
48	30.35	0.16	71.2	3.02	66.6	4.4	1.093	Silt mixtures - clayey silt to silty clay (4)	0.92	2.68	0.98	29.9	—	43.8	Infin	0.477	Infin	0.0	0
49	32.22	1.97	193.3	3.95	178.3	2.1	1.126	Sands - clean sand to silty sand (6)	0.91	1.25	0.96	11.9	91	50.5	Infin	0.477	Infin	0.0	0
50	32.48	0.16	164.2	4.29	149.2	2.6	1.159	Sand mixtures - silty sand to sandy silt (5)	0.91	1.44	0.94	15.6	84	51.3	Infin	0.477	Infin	0.0	0
51	32.64	0.16	108.5	4.50	98.4	4.2	1.164	Very stiff, fine grained* (9)	0.91	2.17	0.94	25.0	—	52.1	Infin	0.476	Infin	0.0	0
53	32.97	0.16	106.0	4.73	95.7	4.5	1.174	Very stiff, fine grained* (9)	0.90	2.30	0.97	26.3	—	52.2	Infin	0.476	Infin	0.0	0
54	33.14	0.16	195.5	5.62	176.2	2.9	1.179	Sand mixtures - silty sand to sandy silt (5)	0.90	1.42	0.97	15.3	91	51.3	Infin	0.476	Infin	0.0	0
55	33.63	0.49	243.5	6.63	218.6	2.7	1.189	Very stiff sand to clayey sand* (8)	0.90	1.31	0.93	13.2	99	51.1	Infin	0.476	Infin	0.0	0
56	38.88	5.25	276.0	5.40	238.6	1.9	1.279	Sands - clean sand to silty sand (6)	0.88	1.16	0.91	9.6	99	50.7	Infin	0.471	Infin	0.0	0
57	39.21	0.33	445.2	9.47	372.8	2.1	1.366	Very stiff sand to clayey sand* (8)	0.86	1.10	0.88	8.0	100	50.7	Infin	0.464	Infin	0.0	0
58	42.49	3.28	488.4	6.63	400.6	1.4	1.423	Sands - clean sand to silty sand (6)	0.84	1.01	0.87	4.5	100	50.4	Infin	0.458	Infin	0.0	0
59	42.65	0.16	534.7	3.34	430.6	0.6	1.477	Gravelly sand to dense sand (7)	0.83	1.08	0.86	0.6	100	50.1	Infin	0.452	Infin	0.0	0
60	44.95	2.30	465.9	4.29	370.8	0.9	1.515	Sands - clean sand to silty sand (6)	0.81	1.00	0.85	2.8	100	49.7	Infin	0.447	Infin	0.0	0
61	45.11	0.16	180.2	3.90	141.5	2.2	1.553	Sand mixtures - silty sand to sandy silt (5)	0.80	1.36	0.84	14.2	81	41.7	Infin	0.442	Infin	0.0	0
62	45.28	0.16	113.3	4.30	88.9	3.9	1.558	Silt mixtures - clayey silt to silty clay (4)	0.80	2.17	0.84	25.0	—	48.3	Infin	0.441	Infin	0.0	0
63	47.24	1.97	415.2	4.23	321.8	1.1	1.591	Sands - clean sand to silty sand (6)	0.79	1.01	0.84	4.0	99	49.8	Infin	0.436	Infin	0.0	0
64	47.41	0.16	526.0	3.16	411.6	0.6	1.625	Gravelly sand to dense sand (7)	0.78	1.00	0.82	0.5	100	50.1	Infin	0.432	Infin	0.0	0
65	49.05	1.64	359.8	2.51	274.2	0.7	1.653	Sands - clean sand to silty sand (6)	0.77	1.01	0.82	2.9	98	41.8	Infin	0.427	Infin	0.0	0

Summary of Analysis of CPT Data

Evaluation of Soil Characteristics
Using CPT Data

CPT: 1
G.W. Depth: 7 ft.
Design G.W. Depth: 7 ft.
Elev.: 0

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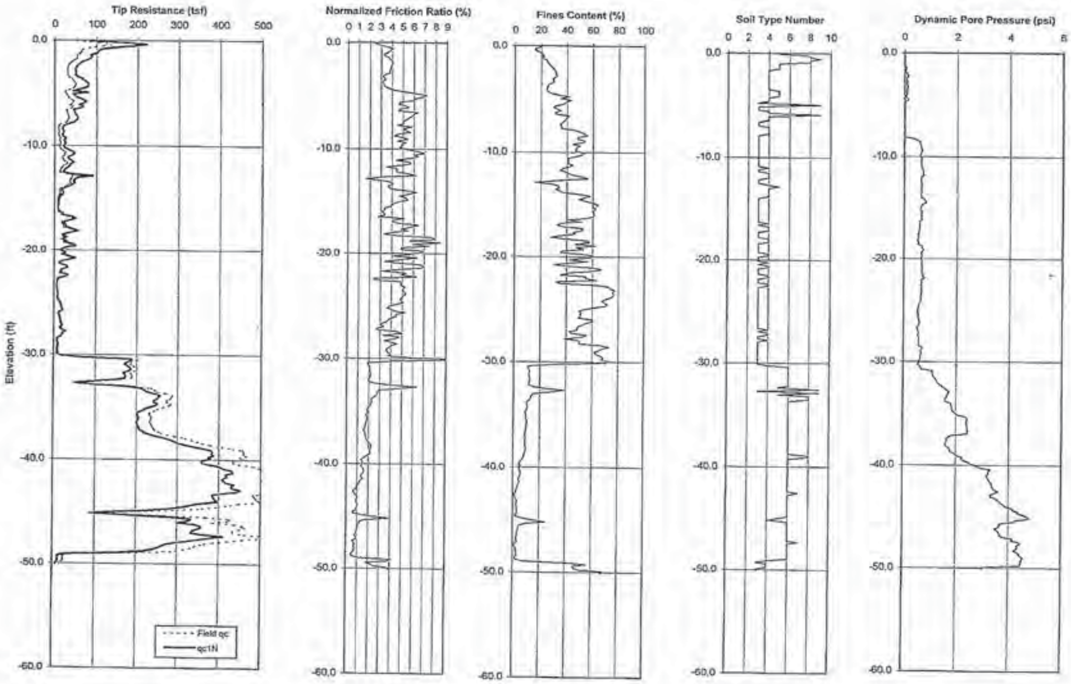

GEOLABS-WESTLAKE VILLAGE

"Dry" Sand Seismic Settlement Using CPT Data

CPT: 1
G.W. Depth: 7 ft.
Design G.W. Depth: 7 ft.
Removal: 0 ft.

W.O.: 8925
Elev.: 0
Ic: 2.6

Fill Height: 0.0 ft. 120 pcf
Max horizontal acc. @ surface: 0.48 g
Design earthquake magnitude: 7.50
Magnitude Scaling Factor: 1.00

0.005

Layer	Layer Bott. (ft)	Layer Thick. (ft)	Avg. Tip Resist qc (tsf)	Avg. Side Fric. fs	Avg. Tip Resist qc1N (tsf)	Norm. Frc. Rt. (%)	Eff. O.B. (tsf)	Soil Behavior Type	Avg. rd	Kc	Ko	Fines Content (%)	Avg. Dr (%)	Spt N160cs (bpf)	Cyclic Shear Stress Tav (psf)	Gmax (ksf)	γeff / (Geff/Gmax)	γeff	Vol. Strain (%)	"Dry" Settle. (in)
1	0.16	0.16	52.3	1.29	85.1	2.5	0.005	Sand mixtures - silty sand to sandy silt (5)	1.00	1.74	1	20.0	100	34.0	3.00	1.34E+02	2.30E-05	2.80E-05	2.63E-03	5.20E-05
2	0.49	0.33	121.6	4.03	199.0	3.3	0.020	Very stiff sand to clayey sand* (8)	1.00	1.45	1	15.7	100	55.3	13.00	3.18E+02	3.88E-05	5.22E-05	3.19E-03	1.25E-04
4	0.95	0.33	76.3	2.88	124.2	3.8	0.051	Very stiff sand to clayey sand* (8)	1.00	1.84	1	21.3	100	58.2	32.00	5.38E+02	5.91E-05	9.12E-05	5.56E-03	2.19E-04
5	1.64	0.66	58.3	2.06	94.9	3.5	0.081	Sand mixtures - silty sand to sandy silt (5)	1.00	2.00	1	23.1	98	52.8	50.00	6.67E+02	7.52E-05	1.32E-04	8.05E-03	6.34E-04
6	3.61	1.97	36.5	1.36	59.4	3.7	0.160	Silt mixtures - clayey silt to silty clay (4)	1.00	2.64	1	29.5	—	41.8	99.00	1.29E+03	7.62E-05	1.13E-04	5.49E-03	2.01E-03
7	4.27	0.66	44.9	1.44	73.1	3.2	0.238	Sand mixtures - silty sand to sandy silt (5)	0.99	2.16	1	24.8	66	40.1	149.00	1.09E+03	1.36E-04	3.37E-04	2.29E-02	1.81E-03
8	4.76	0.49	44.5	1.92	72.5	4.4	0.273	Silt mixtures - clayey silt to silty clay (4)	0.99	2.62	1	29.2	—	55.1	169.00	1.88E+03	9.99E-05	1.28E-04	7.79E-03	4.60E-04
12	5.91	0.33	43.2	2.01	70.3	4.7	0.347	Silt mixtures - clayey silt to silty clay (4)	0.99	2.73	1	30.4	—	58.2	214.00	2.16E+03	9.92E-05	1.38E-04	8.41E-03	3.31E-04
14	6.56	0.49	40.0	1.93	63.3	5.0	0.382	Silt mixtures - clayey silt to silty clay (4)	0.99	2.98	1	32.5	—	57.7	235.00	2.25E+03	1.04E-04	1.44E-04	8.78E-03	5.18E-04

GEOLABS-WESTLAKE VILLAGE

Evaluation of Liquefaction Resistance of Soils
Using CPT Data

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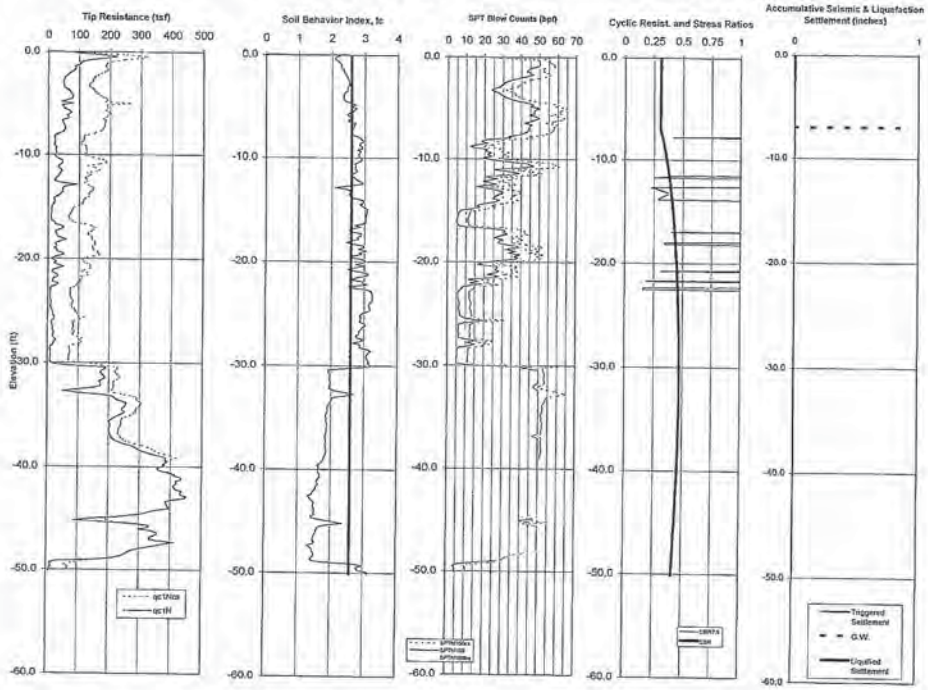
CPT:	1
G.W. Depth:	7 ft.
Design G.W. Depth:	7 ft.
Elev.:	0
Ic:	2.6 (Standard Value)
Fill Height:	0.0 ft. 120 pcf
Max horizontal acc. @ surface:	0.48 g
Design earthquake magnitude:	7.5
Removal:	0 ft



GEOLABS-WESTLAKE VILLAGE

*Exclude Settlement from layers thinner than 6 inches

CPT-Based Soil Behavior Type

CPT: 1
G.W. Depth: 7 ft
Ic: 2.6

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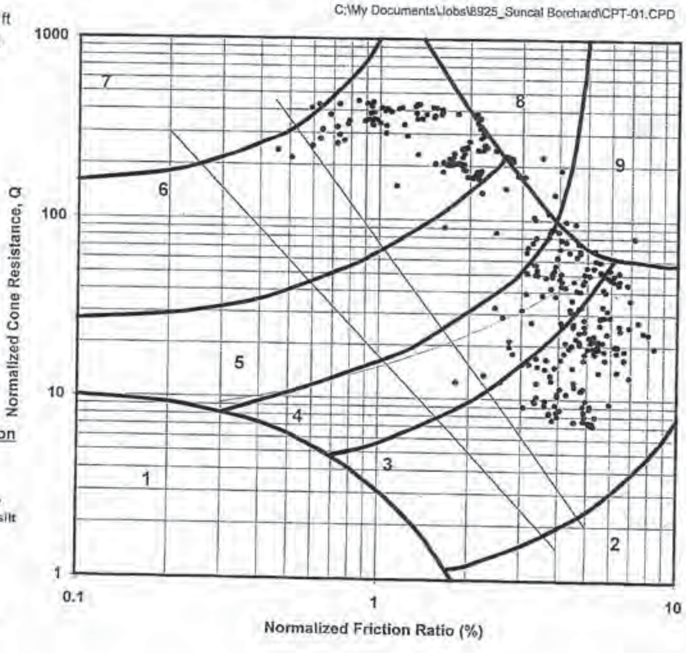
Soil Consistency Number
(Sand / Clay)
1 = very loose / very soft
2 = loose / soft
3 = medium dense / medium stiff
4 = dense / stiff
5 = very dense / very stiff
6 = — / hard

Soil Behavior Type Classification
1. Sensitive Fine Grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand*
9. Very stiff, fine grained*

*Heavily overconsolidated or cemented



GEOLABS-WESTLAKE VILLAGE

Summary of Analysis of CPT Data

CPT: 1
G.W. Depth: 7 ft.
Design G.W. Depth: 7 ft.
Removal: 0 ft.

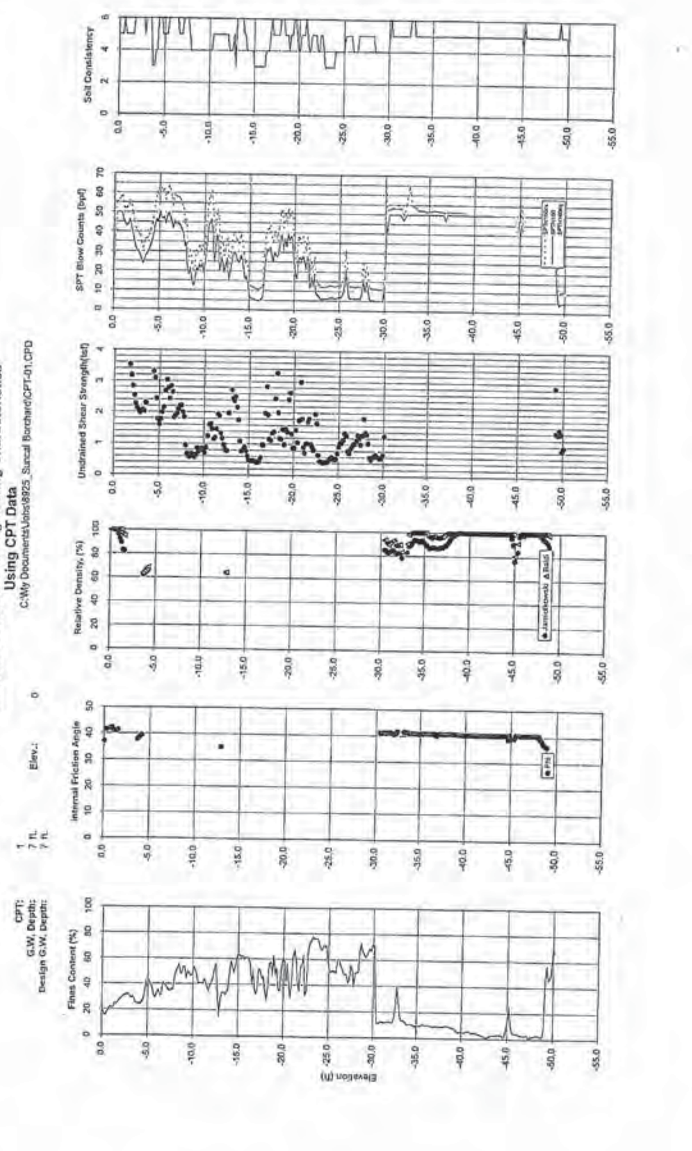
W.O.: 1725
Elev.: 0
Ic: 2.6

Fill height: 0.0 ft. 110 pcf
Max horizontal acc. at surface: 0.48 g
Design earthquake magnitude: 7.50

Layer	Layer Bott. (ft)	Layer Thick. (ft)	Avg. Tip Resist. qc (tsf)	Avg. Side Fric. fs	Avg. Tip Resist qc1N (tsf)	Norm. Fric. Rt. (%)	Est. Wet Den. (pcf)	Soil Behavior Type	O.B. (tsf)	Eff. O.B. (tsf)	Norm. Exp. n	Ic Range	Ic	Fines Content (%)	Phi (deg)	Dr (%)	Su (tsf)	SPT N1(60) (bpf)	SPT N1(60)cs (bpf)
1	0.16	0.16	72.5	2.44	38.8	2.9	120	Sand mixtures - silty sand to sandy silt	0.005	0.005	0.5	2.43	2.45	27.6	38	100.0	—	8.7	13.7
2	0.33	0.16	80.1	1.62	146.1	2.0	120	Sands - clean sand to silty sand	0.010	0.010	0.5	2.01	1.51	13.1	47	100.0	—	38.5	41.9
3	0.49	0.16	111.7	3.00	151.6	2.6	120	Sand mixtures - silty sand to sandy silt	0.025	0.025	0.5	2.01	1.52	15.5	46	100.0	—	50.0	52.8
4	0.82	0.33	118.6	3.46	160.3	3.1	120	Very stiff sand to clayey sand*	0.040	0.040	0.8	2.07 to 2.14	1.47	15.9	[illegible]	100.0	—	50.0	55.4
5	1.64	0.82	44.7	1.31	72.8	2.7	120	Sand mixtures - silty sand to sandy silt	0.075	0.075	0.5	2.27 to 2.44	2.07	23.8	43	84.0	—	27.7	37.8
6	1.97	0.33	22.6	0.94	36.7	3.5	120	Silt mixtures - clayey silt to silty clay	0.109	0.109	0.7	2.6 to 2.67	3.44	38.2	—	—	1.5	21.8	30.9
7	2.62	0.66	19.8	1.03	32.8	5.2	120	Clays - silty clay to clay	0.138	0.138	0.7	2.72 to 2.75	4.44	45.0	—	—	1.3	30.8	41.7
8	3.28	0.66	34.9	1.61	56.8	4.7	120	Silt mixtures - clayey silt to silty clay	0.178	0.178	0.5 to 0.7	2.49 to 2.67	3.07	33.2	—	—	2.3	39.4	51.3
9	3.44	0.16	26.5	1.57	46.4	5.5	120	Clays - silty clay to clay	0.229	0.229	0.7	2.67	3.76	38.7	—	—	1.9	40.9	54.1
10	3.77	0.33	31.4	1.48	53.1	4.8	120	Silt mixtures - clayey silt to silty clay	0.219	0.219	0.3	2.58 to 2.6	3.25	34.9	—	—	2.1	37.8	49.9
11	3.94	0.16	20.6	1.01	33.4	5.0	120	Clays - silty clay to clay	0.233	0.235	0.7	2.75	4.03	42.1	—	—	1.4	29.4	40.2
12	4.10	0.16	17.4	0.85	60.0	5.4	120	Silt mixtures - clayey silt to silty clay	0.247	0.247	1	2.67	3.54	37.1	—	—	0.9	41.8	54.9
13	4.59	0.49	9.5	0.50	31.6	6.0	120	Clays - silty clay to clay	0.262	0.262	1	2.75 to 2.84	4.88	48.5	—	—	0.6	35.2	47.3
14	4.92	0.33	12.1	0.55	41.1	4.7	120	Silt mixtures - clayey silt to silty clay	0.287	0.287	1	2.64 to 2.69	3.66	37.8	—	—	0.8	31.5	43.1
15	5.25	0.33	14.4	0.61	23.6	4.3	120	Clays - silty clay to clay	0.306	0.306	0.7	2.78 to 2.81	4.77	48.1	—	—	0.8	18.2	23.3
16	5.91	0.66	13.5	0.83	23.8	4.1	120	Silt mixtures - clayey silt to silty clay	0.336	0.336	0.7	2.74 to 2.77	4.42	43.9	—	—	1.5	15.4	28.4
17	6.07	0.16	13.2	0.60	32.6	3.0	120	Clays - silty clay to clay	0.380	0.365	1	2.74	4.29	47.8	—	—	0.9	32.5	40.4
18	7.55	1.48	15.6	0.64	37.2	4.2	120	Silt mixtures - clayey silt to silty clay	0.410	0.407	1	2.8 to 2.71	3.66	37.8	—	—	1.5	26.2	36.4
19	9.35	1.80	11.6	0.64	22.6	5.9	120	Clays - silty clay to clay	0.508	0.483	1	2.59 to 3.06	5.83	52.8	—	—	0.7	27.3	37.8
20	10.17	0.82	29.7	1.06	41.8	4.2	120	Silt mixtures - clayey silt to silty clay	0.587	0.531	0.5 to 1	2.58 to 2.65	3.43	36.7	—	—	1.7	28.1	39.8
21	11.33	1.16	7.3	0.22	12.4	3.2	120	Clays - silty clay to clay	0.646	0.520	1	2.87 to 3.02	6.32	60.2	—	—	0.4	5.9	13.1
22	11.48	0.16	5.1	0.07	8.6	1.6	120	Silt mixtures - clayey silt to silty clay	0.675	0.546	1	2.93	6.08	54.0	—	—	0.3	2.8	8.1
23	11.81	0.33	3.6	0.14	9.2	2.8	120	Clays - silty clay to clay	0.707	0.562	1	3 to 3.01	6.80	66.8	—	—	0.3	4.5	10.3
24	12.14	0.33	8.2	0.19	16.0	2.2	120	Silt mixtures - clayey silt to silty clay	0.770	0.565	1	2.74 to 2.81	4.50	44.2	—	—	0.6	4.8	10.8
25	12.47	0.33	13.7	0.59	27.8	4.6	120	Clays - silty clay to clay	0.729	0.574	1	2.78 to 2.8	5.14	48.2	—	—	0.9	17.1	25.5
26	12.80	0.33	15.7	0.64	27.3	4.0	120	Silt mixtures - clayey silt to silty clay	0.753	0.583	1	2.68 to 2.78	4.28	42.5	—	—	1.1	16.7	25.1
27	15.09	2.30	6.3	0.33	11.8	4.4	120	Clays - silty clay to clay	0.818	0.621	1	3.07 to 3.14	7.30	61.8	—	—	0.5	7.2	13.7
28	15.26	0.16	20.4	0.60	39.7	2.3	120	Silt mixtures - clayey silt to silty clay	0.912	0.657	0.5	2.48	2.87	33.6	—	—	2.0	9.6	15.8
29	15.42	0.16	35.6	0.47	47.9	1.3	120	Sand mixtures - silty sand to sandy silt	0.922	0.661	0.5	2.17	1.71	19.5	28	38.0	—	8.1	12.3
30	15.59	0.16	22.0	0.70	33.7	3.4	120	Silt mixtures - clayey silt to silty clay	0.931	0.666	1	2.52	3.45	38.3	—	—	1.6	14.6	22.6
31	15.75	0.16	30.6	1.10	29.3	5.6	120	Clays - silty clay to clay	0.941	0.671	1	2.81	4.93	49.3	—	—	1.3	26.9	47
32	15.91	0.16	93.3	1.00	73.6	1.7	120	Sand mixtures - silty sand to sandy silt	0.951	0.676	0.6	2.15	1.58	17.7	40	57.0	—	19.6	33
33	16.08	0.16	32.0	1.00	39.0	3.5	120	Silt mixtures - clayey silt to silty clay	0.961	0.680	0.5	2.19	3.23	34.6	—	—	2.1	19.3	28
34	17.55	1.48	3.6	0.30	10.9	3.7	120	Clays - silty clay to clay	1.015	0.704	1	2.84 to 3.18	7.45	62.5	—	—	0.5	7.1	13.1
35	17.88	0.33	10.2	0.17	12.8	1.8	120	Silt mixtures - clayey silt to silty clay	1.064	0.720	1	2.8 to 2.8	4.80	49.1	—	—	0.5	4.1	10
36	18.04	0.16	10.6	0.29	12.8	3.1	120	Clays - silty clay to clay	1.079	0.737	1	2.97	5.85	53.1	—	—	0.6	5.4	11.4
37	18.54	0.49	14.0	0.31	17.3	2.4	120	Silt mixtures - clayey silt to silty clay	1.090	0.746	1	2.67 to 2.8	4.38	42.2	—	—	0.9	5.4	11.5
38	18.70	0.16	14.0	0.50	17.7	4.6	120	Clays - silty clay to clay	1.118	0.756	1	2.72	5.94	53.5	—	—	0.9	11.7	19.4
39	18.86	0.16	23.8	0.83	29.5	3.7	120	Silt mixtures - clayey silt to silty clay	1.138	0.761	1	2.66	3.63	38.2	—	—	1.6	14.8	22.8
40	19.52	0.66	65.7	1.16	73.1	1.8	120	Sand mixtures - silty sand to sandy silt	1.165	0.777	0.5	2.07 to 2.34	1.86	19.0	40	53.0	—	17.9	32.4
41	20.18	0.66	168.3	2.89	174.0	1.9	125	Sands - clean sand to silty sand	1.193	0.792	0.5	1.81 to 1.98	1.73	11.4	44	90.0	—	43.9	45.4
42	21.00	0.82	144.1	3.22	155.2	2.2	120	Sand mixtures - silty sand to sandy silt	1.238	0.814	0.5	2 to 2.04	1.33	15.8	44	80.0	—	46.2	50.2
43	22.80	1.80	184.3	4.52	205.8	2.2	125	Sands - clean sand to silty sand	1.375	0.864	0.5	1.80 to 1.99	1.74	11.8	45	87.0	—	48.8	50.7
44	25.10	2.30	183.7	4.88	186.0	2.6	125	Sand mixtures - silty sand to sandy silt	1.444	0.918	0.5	1.98 to 2.07	1.37	13.8	44	94.0	—	50.0	54.1
45	25.75	0.66	181.6	5.57	192.5	2.9	125	Very stiff sand to clayey sand*	1.534	0.958	0.5	2.03 to 2.08	1.30	14.8	44	95.0	—	50.0	54.7
46	25.92	0.16	224.9	5.97	222.4	2.7	125	Sand mixtures - silty sand to sandy silt	1.559	0.972	0.5	1.98	1.29	12.7	45	100.0	—	50.0	53.6
47	27.72	1.80	274.4	7.97	268.7	2.9	125	Very stiff sand to clayey sand*	1.621	1.000	0.5	1.89 to 1.99	1.72	11.4	46	100.0	—	50.0	57.8
48	34.45	6.73	310.6	6.18	285.9	1.7	125	Sands - clean sand to silty sand	1.897	1.130	0.5	1.82 to 1.95	1.09	7.5	46	100.0	—	50.0	50.8
49	34.78	0.33	233.0	5.09	206.5	1.6	125	Sand mixtures - silty sand to sandy silt	2.107	1.240	0.5	2 to 2.01	1.30	13.0	44	97.0	—	50.0	53.7
50	39.88	5.00	353.1	4.69	307.8	1.4	125	Sands - clean sand to silty sand	2.276	1.329	0.5	1.35 to 1.87	1.07	5.6	46	100.0	—	50.0	50.3
51	40.35	0.46	443.8	2.19	364.9	0.6	125	Gravelly sand to dense sand	2.450	1.417	0.5	1.26 to 1.3	1.00	0.3	46	100.0	—	50.0	50
52	40.52	0.16	444.2	2.69	363.6	0.6	125	Sands - clean sand to silty sand	2.471	1.427	0.5	1.36	1.00	1.0	46	100.0	—	50.0	50
53	40.84	0.33	381.5	1.29	319.8	0.4	125	Gravelly sand to dense sand	2.488	1.435	0.5	1.33 to 1.34	1.00	0.0	46	100.0	—	43.7	43.7
54	41.01	0.16	300.1	1.84	244.5	0.6	125	Sands - clean sand to silty sand	2.501	1.442	0.5	1.48	1.00	2.8	44	100.0	—	34.7	34.7
55	41.17	0.16	155.3	3.31	126.5	2.2	120	Sand mixtures - silty sand to sandy silt	2.511	1.448	0.5	2.07	1.40	15.0	41	78.0	—	34.4	38.8
56	41.50	0.33	71.0	2.95	57.6	4.7	120	Silt mixtures - clayey silt to silty clay	2.526	1.455	0.5 to 1	2.5 to 2.61	3.07	30.2	—	—	4.8	34.3	43.3
57	41.67	0.16	87.4	2.50	70.9	2.7	120	Sand mixtures - silty sand to sandy silt	2.541	1.462	0.5	2.26	1.80	21.8	39	57.0	—	28.8	38.3
58	41.83	0.16	69.8	2.23	56.5	3.3	120	Silt mixtures - clayey silt to silty clay	2.551	1.467	0.5	2.45	2.51	29.3	—	—	4.6	27.8	36
59	42.81	0.98	45.4	2.54	28.0	6.0	120	Clays - silty clay to clay	2.595	1.483	1	2.74 to 2.89	3.19	48.3	—	—	2.9	32.0	44.1
60	42.98	0.16	51.8	2.02	30.4	4.9	120	Silt mixtures - clayey silt to silty clay	2.620	1.500	1	2.66	3.83	39.7	—	—	3.3	37.0	44.1
61	43.14	0.16	77.7	1.70	67.0	2.3	120	Sand mixtures - silty sand to sandy silt	2.630	1.504	0.5	2.30	1.90	22.9	37	47.0	—	16.1	23.9
62	43.31	0.16	53.4	1.84	34.6	3.5	120	Silt mixtures - clayey silt to silty clay	2.639	1.509	1	2.61	3.30	35.0	—	—	3.6	16.5	25.3
63	43.47	0.16	41.6	1.90	25.8	5.3	120	Clays - silty clay to clay	2.649	1.514	1	2.69	5.04	53.0	—	—	2.6	34.2	46.1
64	43.80	0.33	54.0	2.11	33.6	4.1	120	Silt mixtures - clayey silt to silty clay	2.664	1.521	1	2.64 to 2.69	3.77	38.8	—	—	3.4	23.5	31.7
65	43.96	0.16	36.3	2.13	23.0	6.0	120	Clays - silty clay to clay	2.679	1.528	1	2.80	5.20	57.0	—	—	2.4	26.5	37.3
66	44.12	0.16	159.0	3.23	125.7	2.1	120	Sand mixtures - silty sand to sandy silt	2.689	1.533	0.5	2.06	1.38	34.8	41	79.0	—	33.1	37
67	47.90	3.77	311.0	5.88	251.8	1.8	125	Sands - clean sand to silty sand	2.811	1.594	0.5	1.82 to 1.87	1.12	8.4	44	100.0	—	50.0	51.3
68	48.06	0.16	290.4	4.47	231.2	2.0	125	Very stiff sand to clayey sand*	2.893	1.632	0.5	1.95	1.24	11.7	44	100.0	—	50.0	52.0

Soil Characteristics and Engineering Characteristics
Using CPT Data
C:\My Documents\Jobs\8925_Suncal Borchard\CPT-01.CPD

CPT: 1
G.W. Depth: 7 ft.
Design G.W. Depth: 7 ft.
Elev.: 0



"Dry" Sand Seismic Settlement Using CPT Data

0.005

CPT: 2
G.W. Depth: 7 ft.
Design G.W. Depth: 7 ft.
Removal: 0 ft.

W.O.: 8025
Elev.: 0
Ic: 2.6

Fill Height: 0.0 ft. 120 pcf
Max horizontal acc. @ surface: 0.48 g
Design earthquake magnitude: 7.50
Magnitude Scaling Factor: 1.00

Layer	Layer Bott. (ft)	Layer Thick. (ft)	Avg. Tip Resist qc (tsf)	Avg. Side Fric. fs	Avg. Tip Resist qc1N (tsf)	Norm. Frc. Rt. (%)	Eff. O.B. (tsf)	Soil Behavior Type	Avg. rd	Kc	Kσ	Fines Content (%)	Avg. Dr (%)	Spt N160cs (bpf)	Cyclic Shear Stress τav (psf)	Gmax (ksf)	γeff / (Geff/Gmax)	γeff	Vol. Strain (%)	"Dry" Settle. (in)
1	0.16	0.16	22.5	0.44	38.8	2.0	0.005	Sand mixtures - silty sand to sandy silt (5)	1.00	2.45	1	27.8	100	13.7	3.00	1.00E+02	3.06E-05	3.91E-05	1.45E-02	2.85E-04
2	0.33	0.16	90.1	1.82	146.8	2.0	0.015	Sands - clean sand to silty sand (6)	1.00	1.31	1	13.1	100	41.9	9.00	2.52E+02	3.70E-05	4.91E-05	2.99E-03	5.90E-05
3	0.49	0.16	117.7	3.00	191.6	2.6	0.025	Sand mixtures - silty sand to sandy silt (5)	1.00	1.32	1	13.3	100	53.9	15.00	3.57E+02	4.38E-05	6.07E-05	3.70E-03	7.30E-05
4	0.82	0.33	110.8	3.46	180.3	3.1	0.040	Very stiff sand to clayey sand* (8)	1.00	1.47	1	15.9	100	55.4	25.00	4.61E+02	5.42E-05	8.08E-05	4.92E-03	1.94E-04
5	1.64	0.82	44.7	1.31	72.8	2.7	0.075	Sand mixtures - silty sand to sandy silt (5)	1.00	2.07	1	23.8	84	33.9	47.00	5.32E+02	8.95E-05	1.94E-04	4.08E-02	4.02E-03
8	3.28	0.66	34.9	1.61	56.6	4.7	0.178	Silt mixtures - clayey silt to silty clay (4)	0.99	3.07	1	33.2	—	51.3	85.00	1.14E+03	5.60E-05	8.01E-05	4.88E-03	3.85E-04
10	3.77	0.33	31.4	1.48	51.1	4.8	0.218	Silt mixtures - clayey silt to silty clay (4)	0.99	3.26	1	34.8	—	49.9	135.00	1.52E+03	8.33E-05	1.20E-04	7.33E-03	2.89E-04

GEOLABS-WESTLAKE VILLAGE

Liquefaction Analysis Using CPT Data

0

CPT: 2
G.W. Depth: 7 ft.
Design G.W. Depth: 7 ft.
Removal: 0 ft.

W.O.: 8025
Elev.: 0
Ic: 2.6

Fill Height: 0.0 ft. 120 pcf
Max horizontal acc. @ surface: 0.48 g
Design earthquake magnitude: 7.50
Magnitude Scaling Factor: 1.00

Layer	Layer Bott. (ft)	Layer Thick. (ft)	Avg. Tip Resist qc (tsf)	Avg. Side Fric. fs	Avg. Tip Resist qc1N (tsf)	Norm. Frc. Rt. (%)	Eff. O.B. (tsf)	Soil Behavior Type	Avg. rd	Kc	Kσ	Avg. Fines Content (%)	Avg. Dr (%)	Avg. SPT N1(60)liq (bpf)	Min. CRR (M=7.5)	Avg. CSR	Min. Liq. FS	Avg. Strain (%)	Liq Settle. (in)
20	10.17	0.82	26.2	1.09	41.8	4.3	0.601	Silt mixtures - clayey silt to silty clay (4)	0.98	3.43	1	36.2	—	32.1	0.34	0.358	0.95	0.0	0
28	15.26	0.16	30.4	0.69	36.7	2.3	0.657	Silt mixtures - clayey silt to silty clay (4)	0.97	2.67	1	29.8	—	12.1	0.17	0.419	0.40	0.0	0
29	15.42	0.16	38.8	0.47	47.9	1.2	0.661	Sand mixtures - silty sand to sandy silt (5)	0.97	1.71	1	19.5	38	9.8	0.13	0.421	0.31	0.0	0
32	15.91	0.16	63.5	1.09	75.6	1.7	0.676	Sand mixtures - silty sand to sandy silt (5)	0.97	1.68	1	17.7	57	20.1	0.24	0.425	0.56	0.0	0
33	16.08	0.16	32.0	1.08	38.0	3.5	0.680	Silt mixtures - clayey silt to silty clay (4)	0.97	3.23	1	34.6	—	22.2	0.25	0.426	0.59	0.0	0
40	19.52	0.66	65.7	1.15	73.1	1.8	0.772	Sand mixtures - silty sand to sandy silt (5)	0.96	1.69	1	19.0	53	19.5	0.17	0.447	0.39	0.0	0
41	20.18	0.66	158.3	2.99	174.0	1.9	0.792	Sands - clean sand to silty sand (6)	0.96	1.23	1	11.4	90	44.8	Infin	0.450	Infin	0.0	0
42	21.00	0.82	144.1	3.22	156.3	2.2	0.814	Sand mixtures - silty sand to sandy silt (5)	0.96	1.33	1	13.6	86	47.4	Infin	0.453	Infin	0.0	0
43	22.80	1.80	194.3	4.32	205.6	2.2	0.854	Sands - clean sand to silty sand (6)	0.95	1.24	1	11.6	97	50.8	Infin	0.459	Infin	0.0	0
44	25.10	2.30	183.7	4.68	188.0	2.6	0.916	Sand mixtures - silty sand to sandy silt (5)	0.95	1.33	1	13.6	94	51.1	Infin	0.465	Infin	0.0	0
45	25.75	0.66	192.8	5.57	192.6	2.9	0.959	Very stiff sand to clayey sand* (8)	0.94	1.39	1	14.6	95	51.2	Infin	0.469	Infin	0.0	0
46	25.92	0.16	224.9	5.97	223.4	2.7	0.972	Sand mixtures - silty sand to sandy silt (5)	0.94	1.29	1	12.7	100	51.1	Infin	0.470	Infin	0.0	0
47	27.72	1.80	274.4	7.07	268.2	2.6	1.002	Very stiff sand to clayey sand* (8)	0.93	1.23	1	11.4	100	51.0	Infin	0.472	Infin	0.0	0
48	34.45	6.73	310.5	5.18	285.9	1.7	1.136	Sands - clean sand to silty sand (6)	0.91	1.09	0.95	7.5	100	50.7	Infin	0.474	Infin	0.0	0
49	34.78	0.33	235.6	6.09	206.8	2.6	1.246	Sand mixtures - silty sand to sandy silt (5)	0.89	1.30	0.92	13.0	97	51.1	Infin	0.471	Infin	0.0	0
50	39.86	5.09	363.1	4.69	307.5	1.4	1.330	Sands - clean sand to silty sand (6)	0.87	1.07	0.89	5.8	100	50.5	Infin	0.466	Infin	0.0	0
51	40.35	0.49	443.8	2.19	384.9	0.5	1.417	Gravelly sand to dense sand (7)	0.85	1.00	0.87	0.3	100	50.1	Infin	0.458	Infin	0.0	0
52	40.52	0.16	444.2	2.68	383.9	0.6	1.427	Sands - clean sand to silty sand (6)	0.85	1.00	0.87	1.0	100	50.1	Infin	0.457	Infin	0.0	0
53	40.85	0.33	391.5	1.39	319.8	0.4	1.435	Gravelly sand to dense sand (7)	0.84	1.00	0.87	0.0	100	43.7	Infin	0.456	Infin	0.0	0
54	41.01	0.16	300.1	1.84	244.5	0.6	1.443	Sands - clean sand to silty sand (6)	0.84	1.00	0.86	2.6	100	35.0	Infin	0.456	Infin	0.0	0
55	41.17	0.16	155.5	3.31	125.5	2.2	1.448	Sand mixtures - silty sand to sandy silt (5)	0.84	1.40	0.86	15.0	76	35.7	Infin	0.455	Infin	0.0	0
56	41.50	0.33	71.0	2.95	52.6	4.3	1.455	Silt mixtures - clayey silt to silty clay (4)	0.84	3.07	0.9	33.2	—	37.1	Infin	0.454	Infin	0.0	0
57	41.67	0.16	97.4	2.56	78.8	2.7	1.462	Sand mixtures - silty sand to sandy silt (5)	0.84	1.89	0.93	21.8	57	30.6	0.36	0.453	0.79	0.0	0
58	41.83	0.16	69.9	2.23	56.5	3.3	1.467	Silt mixtures - clayey silt to silty clay (4)	0.83	2.51	0.89	28.3	—	29.9	0.31	0.453	0.69	0.0	0
61	43.14	0.16	77.7	1.70	62.0	2.3	1.504	Sand mixtures - silty sand to sandy silt (5)	0.82	1.56	0.92	22.6	47	20.0	0.23	0.448	0.50	0.0	0
66	44.13	0.16	159.0	3.23	125.7	2.1	1.533	Sand mixtures - silty sand to sandy silt (5)	0.81	1.38	0.92	14.6	76	34.4	Infin	0.445	Infin	0.0	0
67	47.90	3.77	325.0	5.68	251.8	1.8	1.594	Sands - clean sand to silty sand (6)	0.79	1.12	0.85	8.4	100	50.7	Infin	0.436	Infin	0.0	0
68	48.05	0.16	330.4	8.47	251.3	2.6	1.656	Very stiff sand to clayey sand* (8)	0.77	1.24	0.82	11.7	100	51.0	Infin	0.427	Infin	0.0	0

GEOLABS-WESTLAKE VILLAGE

CPT-Based Soil Behavior Type

CPT: 2
G.W. Depth: 7 ft
Ic: 2.6

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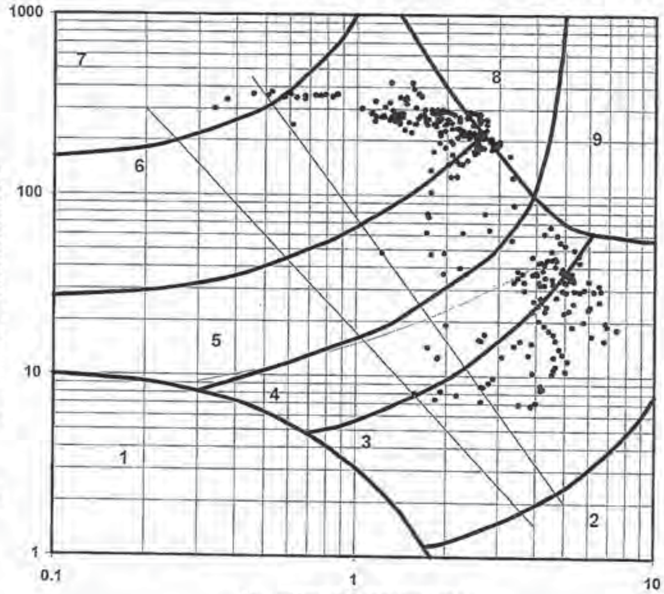
Soil Consistency Number
(Sand / Clay)
1 = very loose / very soft
2 = loose / soft
3 = medium dense / medium stiff
4 = dense / stiff
5 = very dense / very stiff
6 = — / hard

Soil Behavior Type Classification
1. Sensitive Fine Grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand*
9. Very stiff, fine grained*

*Heavily overconsolidated or cemented



GEOLABS-WESTLAKE VILLAGE

Evaluation of Soil Characteristics Using CPT Data

CPT: 2
G.W. Depth: 7 ft.
Design G.W. Depth: 7 ft.
Elev.: 0

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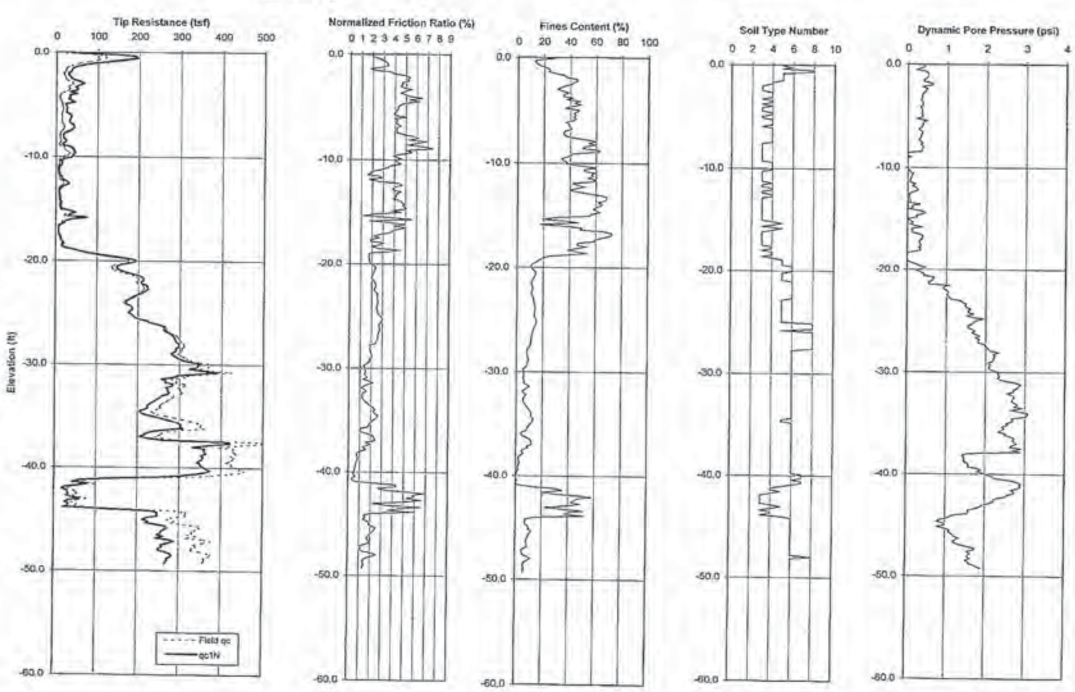

GEOLABS-WESTLAKE VILLAGE

Soil Characteristics and Engineering Characteristics
Using CPT Data

CPT: 2
G.W. Depth: 7 ft.
Design G.W. Depth: 7 ft.
Elev.: 0

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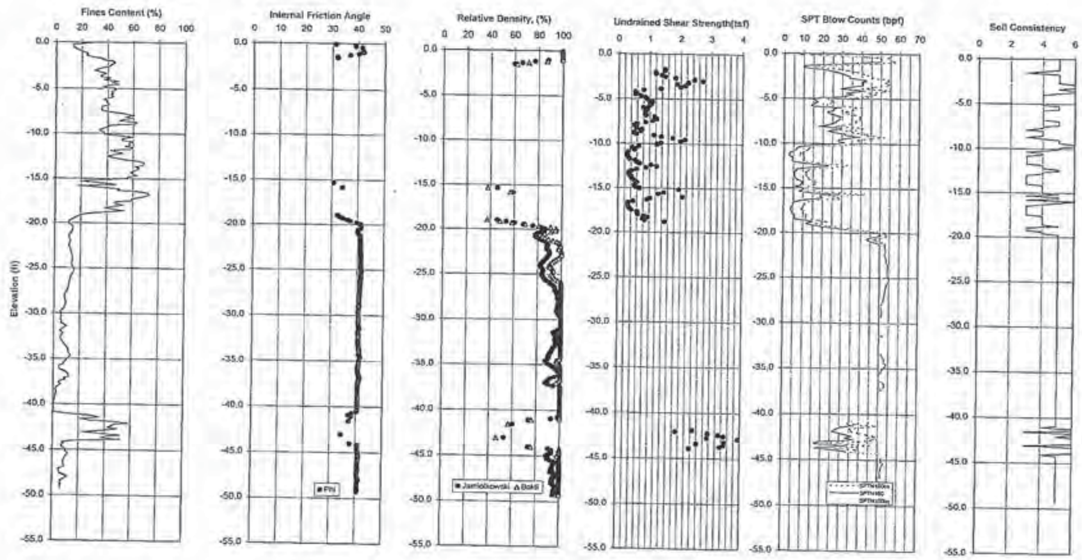

GEOLABS-WESTLAKE VILLAGE

Evaluation of Liquefaction Resistance of Soils
Using CPT Data

CPT: 2
G.W. Depth: 7 ft.
Design G.W. Depth: 7 ft.
Elev.: 0
Ic: 2.6 (Standard Value)

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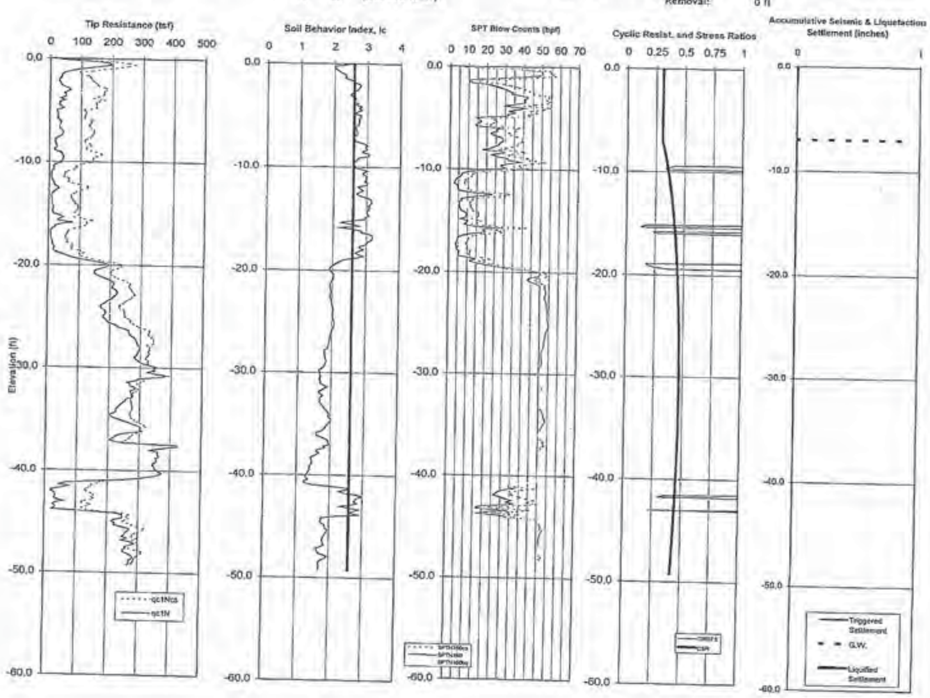
Fill Height: 0.0 ft. 120 pcf
Max horizontal acc. @ surface: 0.48 g
Design earthquake magnitude: 7.5
Removal: 0 ft



GEOLABS-WESTLAKE VILLAGE

*Exclude Settlement from layers thinner than 6 inches