GEOTECHNICAL ENGINEERING REPORT
AND
RESPONSE TO CGS REVIEW
FOR PROPOSED LIBRARY REMODEL,
NORDHOFF HIGH SCHOOL,
OJAI, CALIFORNIA

PROJECT NO.: 301909-001
JUNE 7, 2018

PREPARED FOR
OJAI UNIFIED SCHOOL DISTRICT

BY
EARTH SYSTEMS PACIFIC
1731-A WALTER STREET
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June 7, 2018

Project No.: 301909-001
Report No.: 18-6-17

Attention: Andrew Cantwell
Ojai Unified School District
414 East Ojai Avenue
Ojai, CA 93023

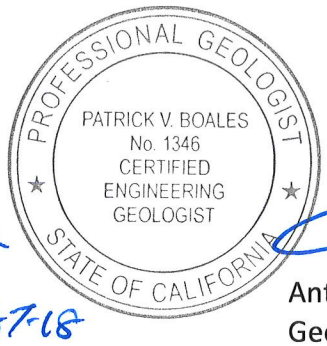
Project: Nordhoff High School Library Remodel
1401 Maricopa Highway
Ojai, California

As authorized, we have performed a geotechnical evaluation for the proposed remodel of the Library building on the campus of Nordhoff High School in the City of Ojai, California. The accompanying Geotechnical Engineering Report presents our conclusions and recommendations pertaining to geotechnical aspects of project design based on the results of previous subsurface exploration and laboratory testing programs performed on the campus by our firm. This report completes the scope of services described within our Proposal No. VEN-18-05-036 dated May 25, 2018.

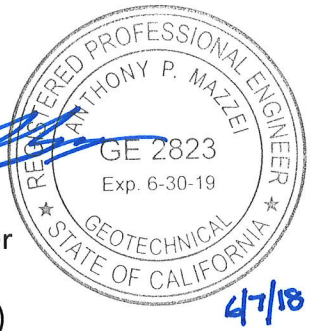
We have appreciated the opportunity to be of service to you on this project. Please call if you have any questions, or if we can be of further service.

Respectfully submitted,

EARTH SYSTEMS PACIFIC



Patrick V. Boales
Engineering Geologist 6-7-18



Anthony P. Mazzei
Geotechnical Engineer 6/7/18

Copies: 2 - Ojai Unified School District (1 via US mail, 1 via email)
1 - Catherine Young at RNT Architects (via email)
1 - Project File

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INTRODUCTION

This report presents results of a Geotechnical Engineering study performed for proposed remodeling of the library building at Nordhoff High School in the City of Ojai, California (see Vicinity Map in Appendix A). This report supplements a Geohazards Report by Earth Systems Pacific (Earth Systems) dated March 28, 2018 for this project, and also responds to concerns expressed in the referenced Engineering Geology and Seismology Review by California Geological Survey (03-CGS3395, May 24, 2018). (A copy of the review is included in Appendix D of this report.)

Current plans indicate that the proposed remodel will be include removal of one bearing wall, addition of some new framed walls, installation of plywood sheathing in several areas, depressing a slab edge near the bathroom, adding new slab-on-grade to existing, adding new anchors at existing shear walls, adding hold downs to existing footings, and enlarging some footings.

No grading is expected to be required to complete the project, although some compaction may be necessary under new slabs or widened footings.

PURPOSE AND SCOPE OF WORK

The purpose of the geotechnical study that led to this report was to analyze the soil conditions of the site with respect to the proposed improvements. These conditions include surface and subsurface soil types, expansion potential, settlement potential, bearing capacity, and the presence or absence of subsurface water. The geologic setting and detailed analyses of most geohazards were discussed in the referenced Geohazards Report prepared by Earth Systems in March 2018, and those discussions are not repeated herein. However, additional analyses to evaluate liquefaction potential and seismic-induced settlement of dry sands are included herein.

The scope of work included:

1. Reviewing data generated as part of a geotechnical study performed in 1999 for several additions to structures within the campus.
2. Consulting with owner representatives and design professionals.
3. Analyzing the geotechnical data.
4. Preparing this report.

Contained in this report are:

1. Descriptions and results of field and laboratory tests that were performed in 1999.
2. Conclusions and recommendations pertaining to earthwork and structural design.

SOIL CONDITIONS

During geotechnical studies performed by Earth Systems Consultants Southern California in 1999, 14 borings were advanced within the main campus where the administration and classroom buildings are currently located. Three of the borings (B-5, B-6, and B-7) were advanced to depths ranging from 6 to 16.5 feet, and were all located within about 70 feet of the library building. Boring B-8 was advanced to a depth of 51.5 feet at a distance of about 165 feet from the southwest corner of the library building, and Boring B-9 was also advanced to 51.5 feet at approximately 260 feet from the northwest corner of the library building. (Logs of Borings B-5 through B-9 are included in Appendix A.)

Based on the data obtained from the 1999 studies, near-surface soils in the bearing zone generally consist of lean clays. Some near-surface soils encountered in the borings were logged as Artificial Fill, whereas others were logged as Older Alluvium. Soils encountered at approximate bearing depths are characterized by variable blow counts and in-place densities. Testing of near-surface soils (i.e. anticipated bearing soils) encountered in Boring B-8 lay in the “low” expansion range because the expansion index equaled 34. [The locally adopted version of this classification of soil expansion, Table 1809.7, is included in Appendix B of this report.]

Groundwater was encountered at depths ranging from 18 to 25 feet in the borings, despite mapping by CGS that indicated depths to historical high groundwater have been greater than 40 feet.

Samples of near-surface soils were tested for pH, resistivity, soluble sulfates, and soluble chlorides. The test results provided in Appendix B should be distributed to the design team for their interpretations pertaining to the corrosivity or reactivity of various construction materials (such as concrete and piping) with the soils. It should be noted that sulfate contents (82 mg/Kg) are in the “S0” (“negligible”) exposure class of Table 19.3.1.1 of ACI 318-14; therefore, it appears that special concrete designs will not be necessary for the measured sulfate contents.

Based on criteria established by the County of Los Angeles (2013), measurements of resistivity of near-surface soils (1,790 ohms-cm) indicate that they are "corrosive" to ferrous metal (i.e. cast iron, etc.) pipes.

ANALYSIS OF SITE CLASS

Subsurface and laboratory test data presented for Boring B-8 in the referenced 1999 Geotechnical Engineering Report were analyzed to determine Site Class for soils underlying the area near the library building. The analysis, which is presented in Appendix C, indicates that the N-bar value is 19.9, and these soils are Site Class D. (Please note that Site Class D was used in the seismic analyses presented in the referenced Geohazards Report dated March 28, 2018.)

ANALYSIS OF LIQUEFACTION POTENTIAL

Although the campus is not located within any of the Liquefaction Hazard Zones delineated by the State of California (CGS, 2003b), a new analysis was performed because of the presence of groundwater encountered within the borings.

Earthquake-induced vibrations can be the cause of several significant phenomena, including liquefaction in fine sands and silty sands. Liquefaction results in a loss of strength and can cause structures to settle or even overturn if it occurs in the bearing zone. Liquefaction is typically limited to the upper 50 feet of soils underlying a site.

Fine sands and silty sands that are poorly graded and lie below the groundwater table are the soils most susceptible to liquefaction. Sufficiently dense soils, soils that have plasticity indices greater than 7, and/or soils located above the groundwater table are not generally susceptible to liquefaction.

An examination of the conditions existing at the site, in relation to the criteria listed above, indicates the following:

1. Groundwater was found under this site at depths ranging from 18 to 25 feet below the ground surface.

2. Hydrometer analyses for soil samples obtained from Boring B-8 at various depths indicate that most soils below about 10 feet are fine-grained (see Appendix B).
3. Standard penetration tests conducted in the borings indicate that most soils within the tested depth are in a relatively dense state.

Based on the above, cyclic mobility analyses were undertaken to analyze the liquefaction potentials of the various soil layers. The analyses were performed in general accordance with the methods proposed by NCEER (1997). In the analyses, the design earthquake was considered to be a 7.2 moment magnitude event, and a peak ground acceleration of 0.805 g was assumed, as per the discussion in the referenced Geohazards Report. It was also assumed that the upper 5 feet of soil had been compacted during grading for the structure. Two analyses were performed: one assuming groundwater at 18 feet, and the other assuming groundwater at 25 feet.

The analysis indicated that all soil layers below the groundwater table had factors of safety that exceeded 1.3 (see Appendix C for calculations), except for the zone encountered in Boring B-8 between 18 and 22 feet (when groundwater is assumed to be at 18 feet). Those zones with factors of safety less than 1.3 are considered potentially liquefiable (C.G.S., 2008, and SCEC, 1999).

The volumetric strain for the potentially liquefiable zones was estimated using a chart derived by Tokimatsu and Seed (1987) after reducing the $N_{1(60)}$ values by the calculated "FC Delta" value, then making adjustments for fines content as per Seed (1987) and SCEC (1999). Using this methodology, the volumetric strain was found to be approximately 0.9 inches when groundwater is at 18 feet.

According to data generated by Ishihara (National Academy Press, 1985), no "ground" damage would be expected related to the zones encountered in the borings because of the thickness of soils overlying the 3-foot thick potentially liquefiable layer. (Examples of ground damage are sand boils and ground cracks.)

Although the analysis predicts that there will be no ground damage, there is a potential for differential areal settlement suggested by the findings. As mentioned previously, the total liquefaction-related settlement could potentially range up to about 0.9 inches. According to SCEC

(1999), up to about half of the total settlement could be realized as differential settlement. As a result, differential settlement could range up to about 0.5 inches at the ground surface.

"Free face" lateral spreading does not appear to pose a potential hazard because there are no nearby sloped areas or canyons (Bartlett and Youd, 1995). However, "ground slope" lateral spreading, sometimes referred to as "ground oscillation", can occur when adjusted blow counts ($N_{1(60)}$) measured within potentially liquefiable zones are less than 15, which includes the potentially liquefiable zone between 19 and 22 feet.

The cumulative thickness of these layers is about one meter. The potential ground oscillation was analyzed in accordance with procedures developed by Youd, Hansen and Bartlett (2002). In the analyses, it was assumed that the surface slope was 1.4%, which is equivalent to about 20 feet of fall in 1,400 feet, as shown on the Matilija Quadrangle near the subject site. Fine contents were assumed to be 68% based on hydrometer testing performed on samples gathered from within the zone during subsurface studies. The cumulative displacement was calculated to be about one foot if the zone was to liquefy. (Calculations are included within Appendix C of this report.)

Based on descriptions and blow counts, clay layers at the site do not appear to be sensitive. Hence, strength loss and post-liquefaction consolidation are not thought to be significant concerns.

Based on the above, it is the opinion of this firm that a potential for liquefaction exists at this site, although potential settlements are relatively minor. Displacements of up to about one foot could be experienced as a result of lateral spreading if groundwater levels are near the highest measured in 1999.

SEISMICALLY-INDUCED SETTLEMENT OF DRY SANDS

Dry sands tend to settle and densify when subjected to earthquake shaking. The amount of settlement is a function of relative density, cyclic shear strain magnitude, and the number of strain cycles. Procedures to evaluate this type of settlement were developed by Seed and Silver (1972) and later modified by Pyke, et al. (1975). Tokimatsu and Seed (1987) presented a simplified procedure that has been reduced to a series of equations by Pradel (1998).

The Tokimatsu and Seed procedure, as implemented by Pradel, has been used to evaluate seismically-induced settlement at this site. The site acceleration (0.805 g), earthquake magnitude (7.2), and subsurface data (from Boring B-8) were the same as those used for the liquefaction analyses. Also, as per the liquefaction analyses, two conditions were considered: one with groundwater at a depth of 25 feet, and a second with groundwater at a depth of 18 feet. The calculations, which are combined with the liquefaction analyses, and presented in Appendix C, indicate that seismically-induced settlement could be about 0.3 inches when groundwater is at a depth of 25 feet, or 0.2 inches when groundwater is at 18 feet.

The effect of the estimated seismically-induced settlement at the ground surface should be minor aerial settlement. Hence, no special mitigation measures are considered necessary.

CONCLUSIONS AND RECOMMENDATIONS

The site is suitable for the proposed development from a Geotechnical Engineering standpoint provided that the recommendations contained in this report are successfully implemented into the project. As mentioned in the introduction to this report, no grading is expected to be necessary to remodel the library, as proposed.

Some existing footings will be enlarged, and some modifications to some slab elevations and layouts will be made as part of this project. Excavations should be observed by a representative of this firm to check for firmness. If soft spots are observed within excavations, some recompaction may be necessary.

Footings may be designed using presumptive load-bearing values (i.e., vertical foundation pressure, lateral bearing pressure, and lateral sliding resistance) provided in the 2016 California Building Code for “clay” soils.

ADDITIONAL SERVICES

This report is based on the assumption that an adequate program of monitoring and testing will be performed by Earth Systems during construction to check compliance with the recommendations given in this report. The recommended tests and observations include, but are not necessarily limited to the following:

1. Review of the building plans during the design phase of the project.
2. Observation and testing during site preparation and foundation construction.
3. Consultation as required during construction.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

The analysis and recommendations submitted in this report are based in part upon the data obtained from the borings drilled on the site. The nature and extent of variations between and beyond the borings may not become evident until construction. If variations then appear evident, it will be necessary to reevaluate the recommendations of this report.

The scope of services did not include any environmental assessment or investigation for the presence or absence of wetlands, hazardous or toxic materials in the soil, surface water, groundwater or air, on, below, or around this site. Any statements in this report or on the soil boring logs regarding odors noted, unusual or suspicious items or conditions observed, are strictly for the information of the client.

Findings of this report are valid as of this date; however, changes in conditions of a property can occur with passage of time whether they are due to natural processes or works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur whether they result from legislation or broadening of knowledge. Accordingly, findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of 1 year.

In the event that any changes in the nature, design, or location of the structure and other improvements are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing.

This report is issued with the understanding that it is the responsibility of the Owner, or of his representative to ensure that the information and recommendations contained herein are called to the attention of the Architect and Engineers for the project and incorporated into the plan and that the necessary steps are taken to see that the Contractor and Subcontractors carry out such recommendations in the field.

As the Geotechnical Engineers for this project, Earth Systems has striven to provide services in accordance with generally accepted geotechnical engineering practices in this community at this time. No warranty or guarantee is expressed or implied. This report was prepared for the exclusive use of the Client for the purposes stated in this document for the referenced project only. No third party may use or rely on this report without express written authorization from Earth Systems for such use or reliance.

It is recommended that Earth Systems be provided the opportunity for a general review of final design and specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications. If Earth Systems is not accorded the privilege of making this recommended review, it can assume no responsibility for misinterpretation of the recommendations contained herein.

CAMPUS-SPECIFIC BIBLIOGRAPHY

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Tokimatsu, Kohji and H. Bolton Seed, 1987, Evaluation of Settlements in Sands Due to Earthquake Shaking, Journal of Geotechnical Engineering, ASCE, August 1987, New York, New York.

Youd, T.L., C.M. Hansen, and S.F. Bartlett, 2002, Revised Multilinear Regression Equations for Prediction of Lateral Spread Displacement, in Journal of Geotechnical and Geoenvironmental Engineering, December 2002.

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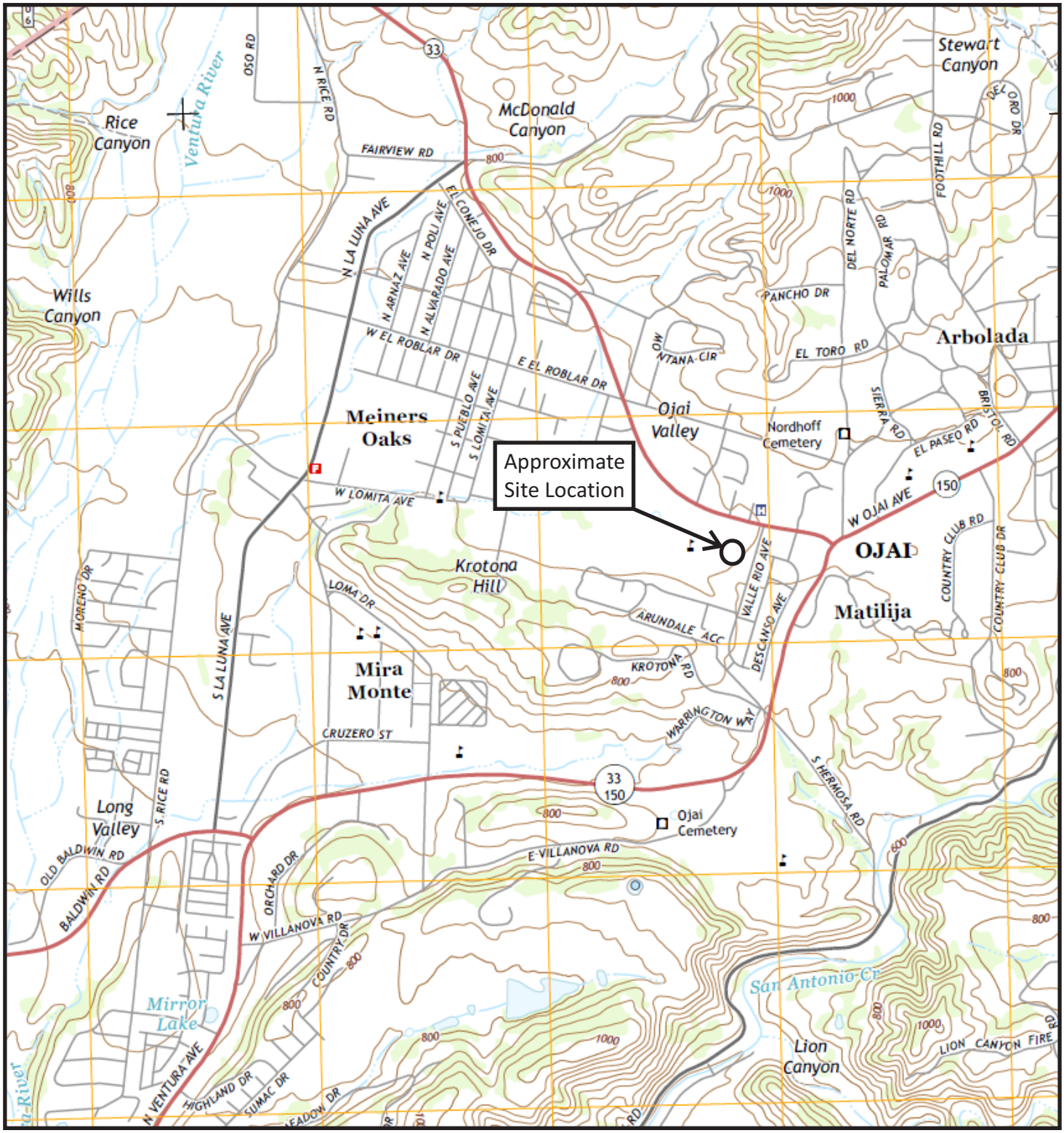
APPENDIX A

Vicinity Map
Seismic Hazard Zones Map
Geologic Map
Logs of Borings from 1999



*Taken from USGS Topo Map, Matilija Quadrangle, California, 2015.

Approximate Scale: 1" = 2,000'

0 2,000' 4,000'

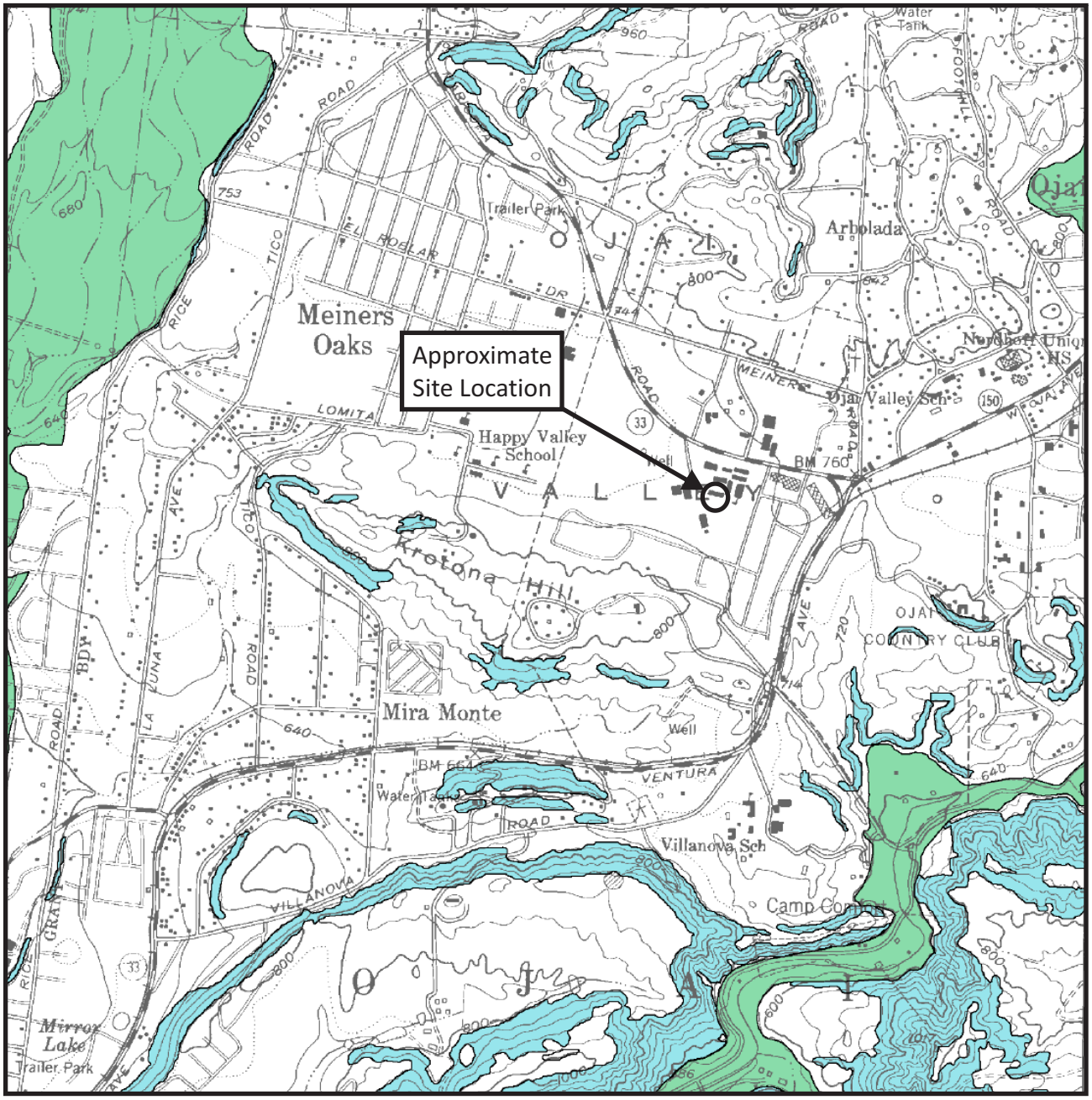
N

VICINITY MAP

1401 Maricopa Highway
Nordhoff High School Library Remodel
Ojai, California

Earth Systems

April 2018	301909-001



MAP EXPLANATION

Zones of Required Investigation:

Liquefaction

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

Earthquake-Induced Landslides

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

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STATE OF CALIFORNIA

SEISMIC HAZARD ZONES

Delineated in compliance with
Chapter 7.8, Division 2 of the California Public Resources Code
(Seismic Hazards Mapping Act)

MATILIJA QUADRANGLE

OFFICIAL MAP

Released: April 17, 2003

STATE GEOLOGIST

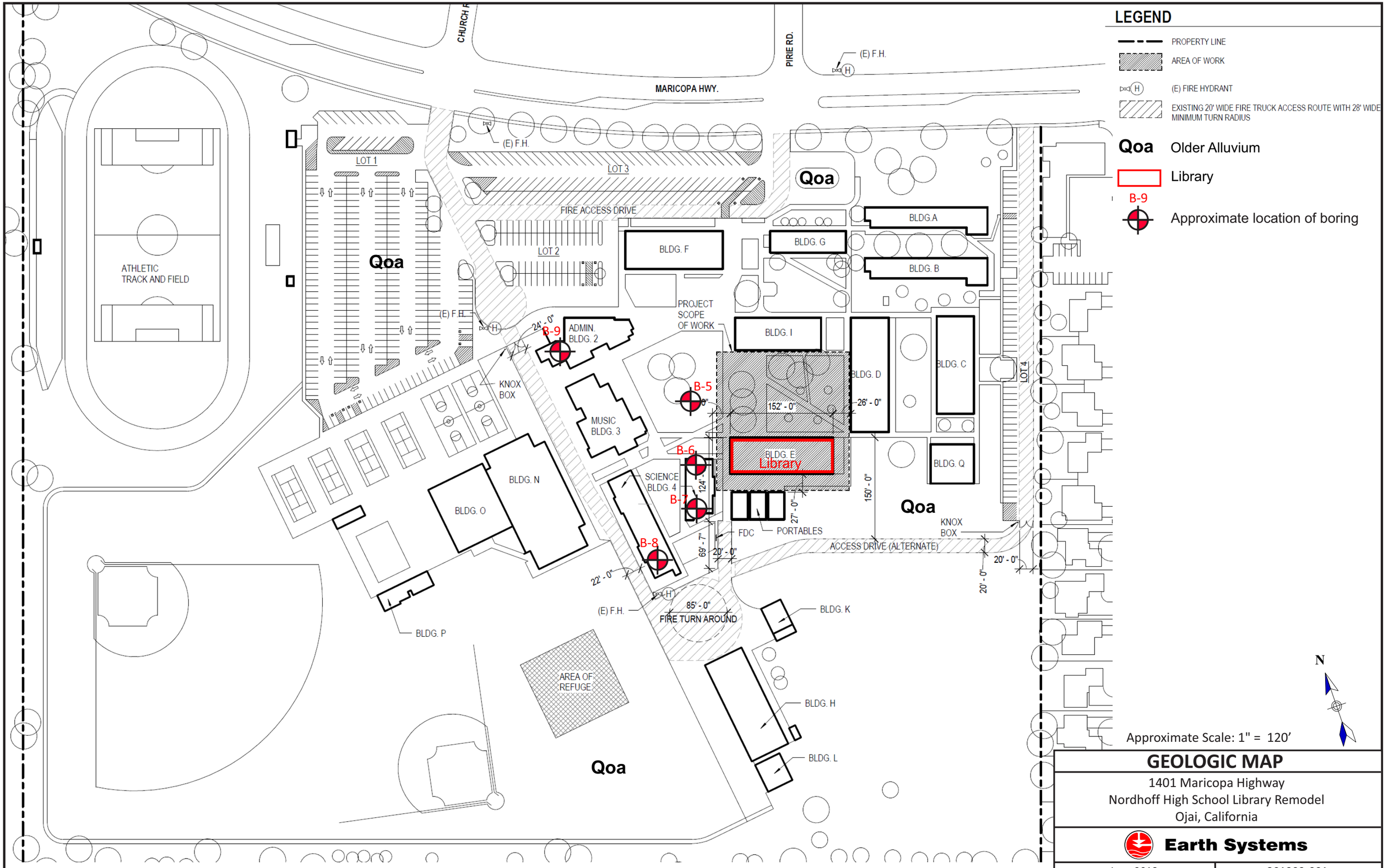
Approximate Scale: 1" = 2,000'

SEISMIC HAZARD ZONES MAP

1401 Maricopa Highway
Nordhoff High School Library Remodel
Ojai, California

Earth Systems

April 2018	301909-001



GEOLOGIC MAP

1401 Maricopa Highway
Nordhoff High School Library Remodel
Ojai, California

Earth Systems

June 2018	301909-001

Earth Systems Consultants • So. Calif.
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: 5
PROJECT NAME: Nordhoff High School Additions
PROJECT NUMBER: VT-22084-01
BORING LOCATION: Per Plan

DRILLING DATE: 11/26/99
DRILLING METHOD: 6" Hollow Stem Auger
DRILL: Mobile Drill B-80
LOGGED BY: NA

VERTICAL DEPTH (feet)	SAMPLE TYPE: Bulk	SAMPLE TYPE: SPT	SAMPLE TYPE: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0			■	20/30	▨	CL	110.3	6.7	FILL: Sandy lean clay, mottled pale and moderate yellowish brown.
			■	19/38	▨	CL	119.6	13.3	
			■	16/16	▨	CL	115.6	14.5	OLDER ALLUVIUM: Sandy lean clay, dark yellowish brown. Moist.
10									
20									
30									
40									

Total Depth = 6.0 feet
Groundwater Not Encountered

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradual.

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BORING NO: 6
PROJECT NAME: Nordhoff High School Additions
PROJECT NUMBER: VT-22084-01
BORING LOCATION: Per Plan

DRILLING DATE: 11/26/99
DRILLING METHOD: 6" Hollow Stem Auger
DRILL: Mobile Drill B-80
LOGGED BY: NA

VERTICAL DEPTH (feet)	SAMPLE TYPE: Bulk	SAMPLE TYPE: SPT	SAMPLE TYPE: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0			■	6/11		CL	108.8	14.8	FILL: Sandy lean clay, mottled dark and moderate yellowish brown.
			■	19/24		CL	120.3	13.6	
			■	11/16		CL	115.8	16.3	OLDER ALLUVIUM: Sandy lean clay, dark yellowish brown. Saturated.
									OLDER ALLUVIUM: Sandy lean clay with some gravel to cobble , dark yellowish brown. Saturated.
10			■	11/17		CL	112.7	19.5	OLDER ALLUVIUM: Sandy lean clay, dark yellowish brown. Saturated.
		■		11/13/16		CL	--	16.1	OLDER ALLUVIUM: Sandy lean clay with some gravel to cobble , dark yellowish brown. Saturated.
20									
30									
40									

Total Depth = 16.5 feet
Groundwater Not Encountered
Note: Soils saturated from about 5 feet on down.

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradual.

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BORING NO: 7
PROJECT NAME: Nordhoff High School Additions
PROJECT NUMBER: VT-22084-01
BORING LOCATION: Per Plan

DRILLING DATE: 11/26/99
DRILLING METHOD: 6" Hollow Stem Auger
DRILL: Mobile Drill B-80
LOGGED BY: NA

VERTICAL DEPTH (feet)	SAMPLE TYPE: Bulk	SAMPLE TYPE: SPT	SAMPLE TYPE: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0			■	+100 (on rock)		CL	--	15.2	FILL: Sandy lean clay with some cobbles, mottled pale and moderate yellowish brown.
			■	18/31		CL	117.1	13.5	OLDER ALLUVIUM: Sandy lean clay, dark yellowish brown. Moist.
10			■	22/18		CL	113.4	19.8	OLDER ALLUVIUM: Sandy lean clay, dark yellowish brown. Saturated.
		■	■	10/12/13		CL	--	16.7	
20									
30									
40									

Total Depth = 16.5 feet
Groundwater Not Encountered
Note: Soils saturated from about 7 feet on down.

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradual.

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BORING NO: 8
PROJECT NAME: Nordhoff High School Additions
PROJECT NUMBER: VT-22084-01
BORING LOCATION: Per Plan

DRILLING DATE: 12/6/99
DRILLING METHOD: 6" Hollow Stem Auger
DRILL: Mobile Drill B-80
LOGGED BY: NA

VERTICAL DEPTH (feet)	SAMPLE TYPE: Bulk	SAMPLE TYPE: SPT	SAMPLE TYPE: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0			■	15/25		MH	99.5	11.6	OLDER ALLUVIUM: Elastic silt, pale yellowish brown.
			■	27/43		CL	113.8	12.5	OLDER ALLUVIUM: Lean clay, dark yellowish brown.
			■	43/50		SC	121.1	9.4	OLDER ALLUVIUM: Clayey sand, dark yellowish brown.
10			■	6/9		CL	105.2	22.9	OLDER ALLUVIUM: Sandy lean clay, dark yellowish brown. Saturated.
			■	6/12		CL	111.7	19.6	
20			■	5/10		CL	111.2	19.9	OLDER ALLUVIUM: Sandy lean clay with some gravel, dark yellowish brown. Saturated.
		■		6/9/16					OLDER ALLUVIUM: Sandy lean clay, dark yellowish brown. Saturated. ▽
30		■		8/11/14		CL	--	22.4	
		■		8/13/20		CL	--	17.4	
40									Continued

Total Depth = 51.5 feet
Groundwater Encountered @ 25 Feet
Note: Soils saturated from about 7 feet on down.

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradual.

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BORING NO: 8 (Continued)
PROJECT NAME: Nordhoff High School Additions
PROJECT NUMBER: VT-22084-01
BORING LOCATION: Per Plan

DRILLING DATE: 12/6/99
DRILLING METHOD: 6" Hollow Stem Auger
DRILL: Mobile Drill B-80
LOGGED BY: NA

VERTICAL DEPTH (feet)	SAMPLE TYPE: Bulk	SAMPLE TYPE: SPT	SAMPLE TYPE: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
40			■	8/12/19		CL	--	17.2	OLDER ALLUVIUM: Sandy lean clay, dark yellowish brown, saturated.
				10/21/26		CL	--	16.0	
50			■	11/18/26		CL	--	16.8	
60									
70									
80									

Total Depth = 51.5 feet
Groundwater Encountered @ 25 Feet
Note: Soils saturated from about 7 feet on down.

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradual.

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BORING NO: 9
PROJECT NAME: Nordhoff High School Additions
PROJECT NUMBER: VT-22084-01
BORING LOCATION: Per Plan

DRILLING DATE: 12/6/99
DRILLING METHOD: 6" Hollow Stem Auger
DRILL: Mobile Drill B-80
LOGGED BY: NA

VERTICAL DEPTH (feet)	SAMPLE TYPE: Bulk	SAMPLE TYPE: SPT	SAMPLE TYPE: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0			■	8/12		CL	110.8	16.8	OLDER ALLUVIUM: Lean clay, dark yellowish brown.
			■	11/16		CL	112.1	17.0	OLDER ALLUVIUM: Sandy lean clay, dark yellowish brown.
			■	11/17		CL	115.3	16.4	
10			■	7/10		CL	110.3	20.0	OLDER ALLUVIUM: Sandy lean clay, dark yellowish brown. Saturated.
			■	4/6		CL	114.3	17.2	OLDER ALLUVIUM: Sandy lean clay with some gravel, dark yellowish brown. Saturated. ▽
20		■		8/7/10		CL	--	22.2	OLDER ALLUVIUM: Sandy lean clay, dark yellowish brown. Saturated.
		■		4/6/13		CL	--	19.8	
30		■		10/13/14		CL	--	18.6	
		■		5/6/10		CL	--	23.2	
40									Continued

Total Depth = 51.5 feet
Groundwater Encountered @ 18 Feet
Note: Soils saturated from about 7 feet on down.

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradual.

Earth Systems Consultants • So. Calif.
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: 9 (Continued)
PROJECT NAME: Nordhoff High School Additions
PROJECT NUMBER: VT-22084-01
BORING LOCATION: Per Plan

DRILLING DATE: 12/6/99
DRILLING METHOD: 6" Hollow Stem Auger
DRILL: Mobile Drill B-80
LOGGED BY: NA

VERTICAL DEPTH (feet)	SAMPLE TYPE: Bulk	SAMPLE TYPE: SPT	SAMPLE TYPE: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
40		■		11/12/18		CL	--	17.8	OLDER ALLUVIUM: Sandy lean clay, dark yellowish brown, saturated.
				11/15/22		CL	--	14.8	
50		■		11/20/25		CL	--	17.6	
60									
70									
80									

Total Depth = 51.5 feet
Groundwater Encountered @ 25 Feet
Note: Soils saturated from about 7 feet on down.

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradual.

#

APPENDIX B

Tabulated Laboratory Test Results from 1999
Individual Laboratory Test Results from 1999
Table 1809.7 with Footnotes

TABULATED TEST RESULTS

BORING AND DEPTH	2@0-5'	8@0-2'	8@5-10'
USCS		MH	CH
MAXIMUM DENSITY (pcf)	--	119.0	126.5
OPTIMUM MOISTURE (%)	--	11.5	10.5
COHESION (psf)	--	0	700
ANGLE OF INTERNAL FRICTION	--	37	28
EXPANSION INDEX	65	22	34
Ph	--		--
RESISTIVITY (OHMs/cm)	--		--
SOLUBLE SULFATE (mg/kg)	--		--
SOLUBLE CHLORIDE (mg/kg)	--		--

GRAIN SIZE DISTRIBUTION (%)

BORING AND DEPTH	8@0-2'	8@5-10'	8@15'	8@20
GRAVEL	1.3	28.5	0	0.1
SAND	33.0	33.5	37.3	31.6
SILT	52.6	16.9	33.1	35.9
CLAY	13.1	21.1	29.6	32.4

BORING AND DEPTH	8@30'	9@15'	9@35'
GRAVEL	0	0	0
SAND	41.6	54.7	39.1
SILT	36.2	24.4	37.2
CLAY	22.5	20.9	23.7

VT-22084-01 Dec. 15, 1999

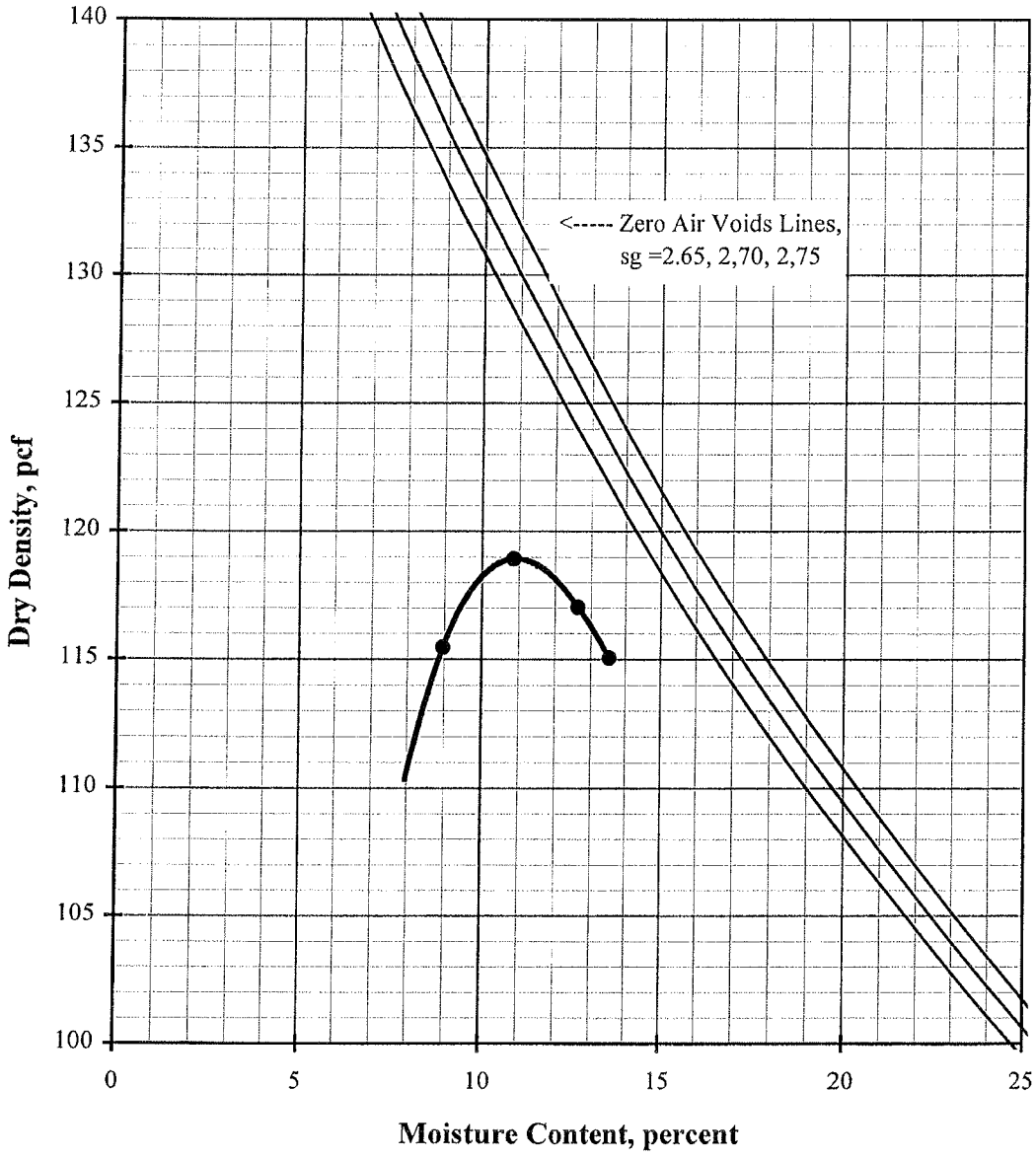
MAXIMUM DENSITY / OPTIMUM MOISTURE ASTM D 1557-91 (Modified)

Job Name Nordhoff High School
Sample ID: 8 @ 0-2'
Location: 8 @ 0-2'
Description: Sandy Silt w/ Clay

Procedure Used: A
Prep. Method: Moist
Rammer Type: Manual

Maximum Density: **119 pcf**
Optimum Moisture: **11.5%**

Sieve Size	% Retained
3/4"	0.0
3/8"	0.0
#4	0.0



VT-22084-01 Dec. 15, 1999

MAXIMUM DENSITY / OPTIMUM MOISTURE

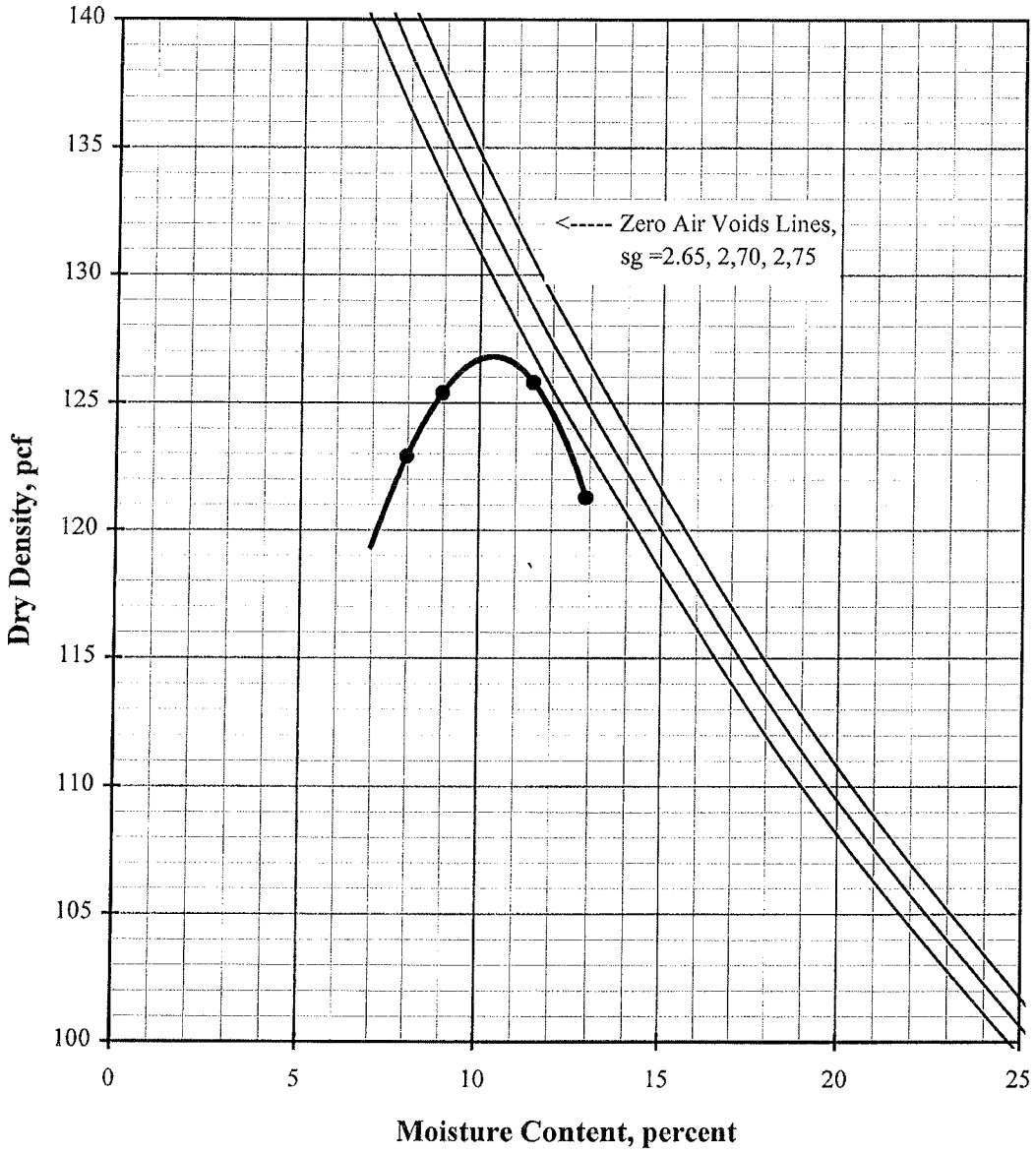
ASTM D 1557-91 (Modified)

Job Name Nordhoff High School
Sample ID: 8 @ 5-10
Location: 8 @ 5-10'
Description: Sandy Clay w/ Silt & Some Gravel

Procedure Used: A
Prep. Method: Moist
Rammer Type: Manual

Maximum Density: **126.5 pcf**
Optimum Moisture: **10.5%**

Sieve Size	% Retained
3/4"	0.0
3/8"	11.0
#4	0.0



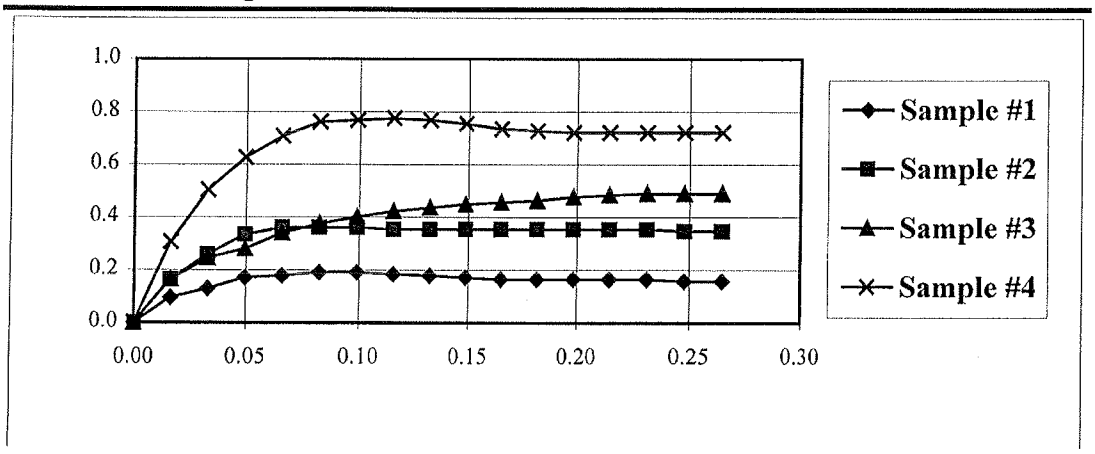
DIRECT SHEAR

080-90 (modified for unconsolidated, undrained conditions)

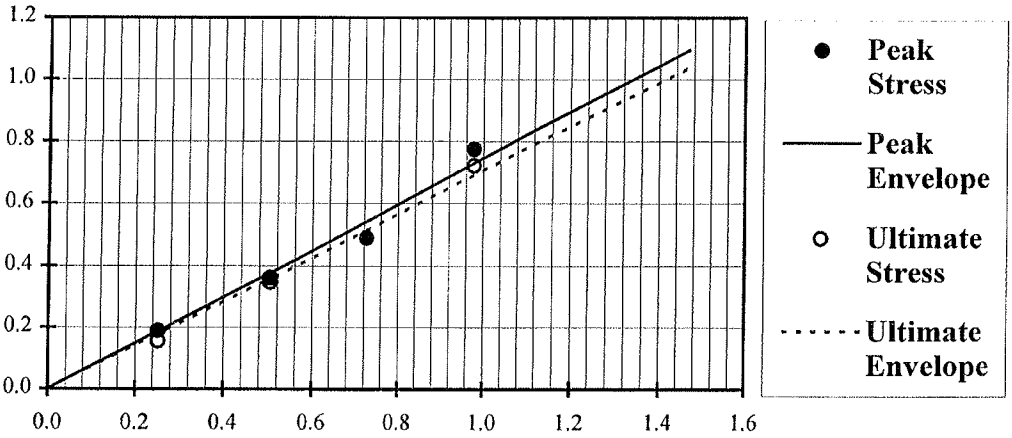
Nordhoff High School
8 @ 0-2'
Sandy Silt & w/ Clay & Some Gravel
Remolded

Initial Dry Density: 107.0 pcf
Initial Mosture Content: 11.5 %
Peak Friction Angle (Ø): 37°
Cohesion (c): 0.000 kg/cm^2 (0 psf)

Sample No.	1	2	3	4	Average
Initial					
Dry Density, pcf	107.0	107.0	107.0	107.0	107.0
Moisture Content, %	11.5	11.5	11.5	11.5	11.5
Saturation, %	55	55	55	55	55
At Test					
Moisture Content, %	18.9	19.0	19.0	19.3	19.1
Saturation, %	91	91	91	92	91
Normal Stress, kg/cm^2	0.25	0.51	0.73	0.98	
Peak Stress, kg/cm^2	0.19	0.36	0.49	0.78	
Ultimate Stress, kg/cm^2	0.16	0.35	0.49	0.72	



SHEAR vs. NORMAL STRESS DIAGRAM

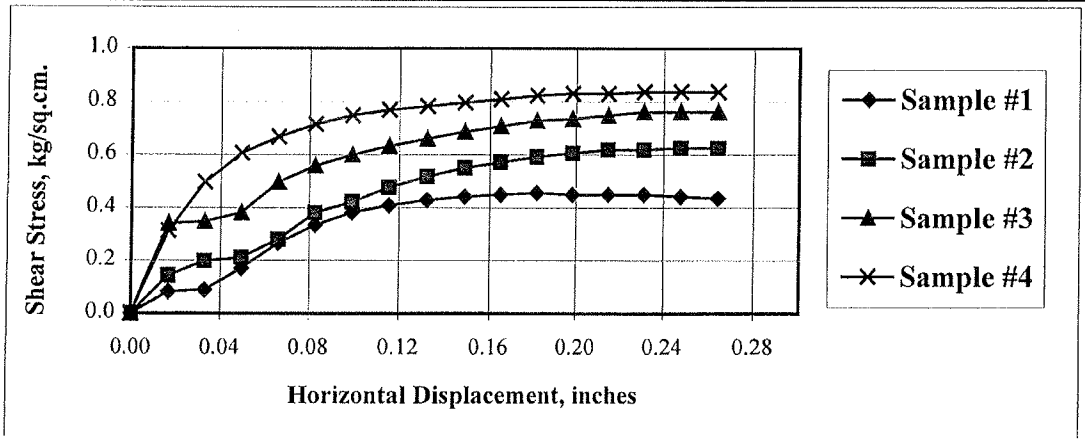


DIRECT SHEAR 080-90 (modified for unconsolidated, undrained conditions)

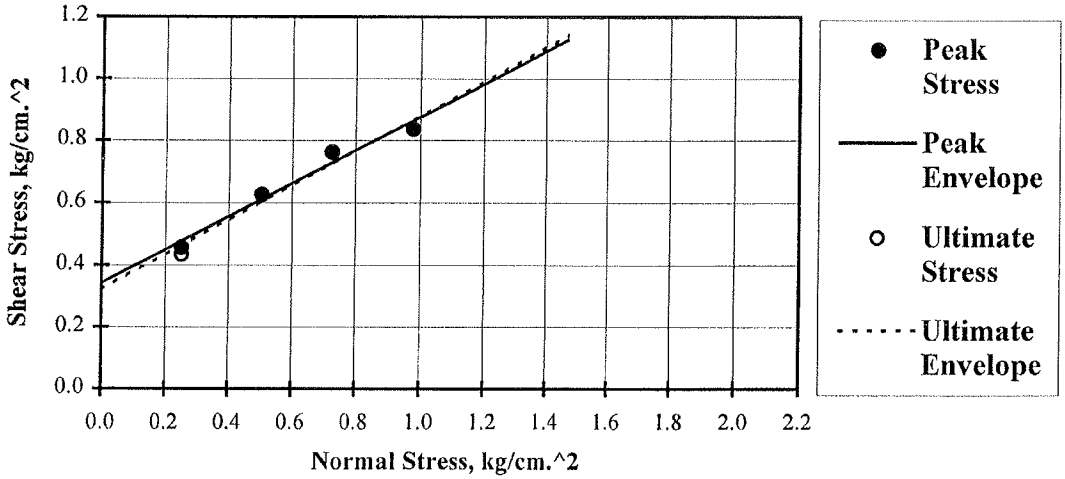
Nordhoff High School
8 @ 5-10'
Sandy Clay w/ Silt & Some Gravel
Remolded

Initial Dry Density: 114.3 pcf
Initial Mosture Content: 10.5 %
Peak Friction Angle (Ø): 28°
Cohesion (c): 0.343 kg/cm^2 (700 psf)

Sample No.	1	2	3	4	Average
Initial					
Dry Density, pcf	114.3	114.3	114.3	114.3	114.3
Moisture Content, %	10.5	10.5	10.5	10.5	10.5
Saturation, %	61	61	61	61	61
At Test					
Moisture Content, %	16.0	15.7	16.1	15.9	15.9
Saturation, %	93	91	94	92	93
Normal Stress, kg/cm^2	0.25	0.51	0.73	0.98	
Peak Stress, kg/cm^2	0.46	0.63	0.76	0.84	
Ultimate Stress, kg/cm^2	0.44	0.63	0.76	0.84	



SHEAR vs. NORMAL STRESS DIAGRAM

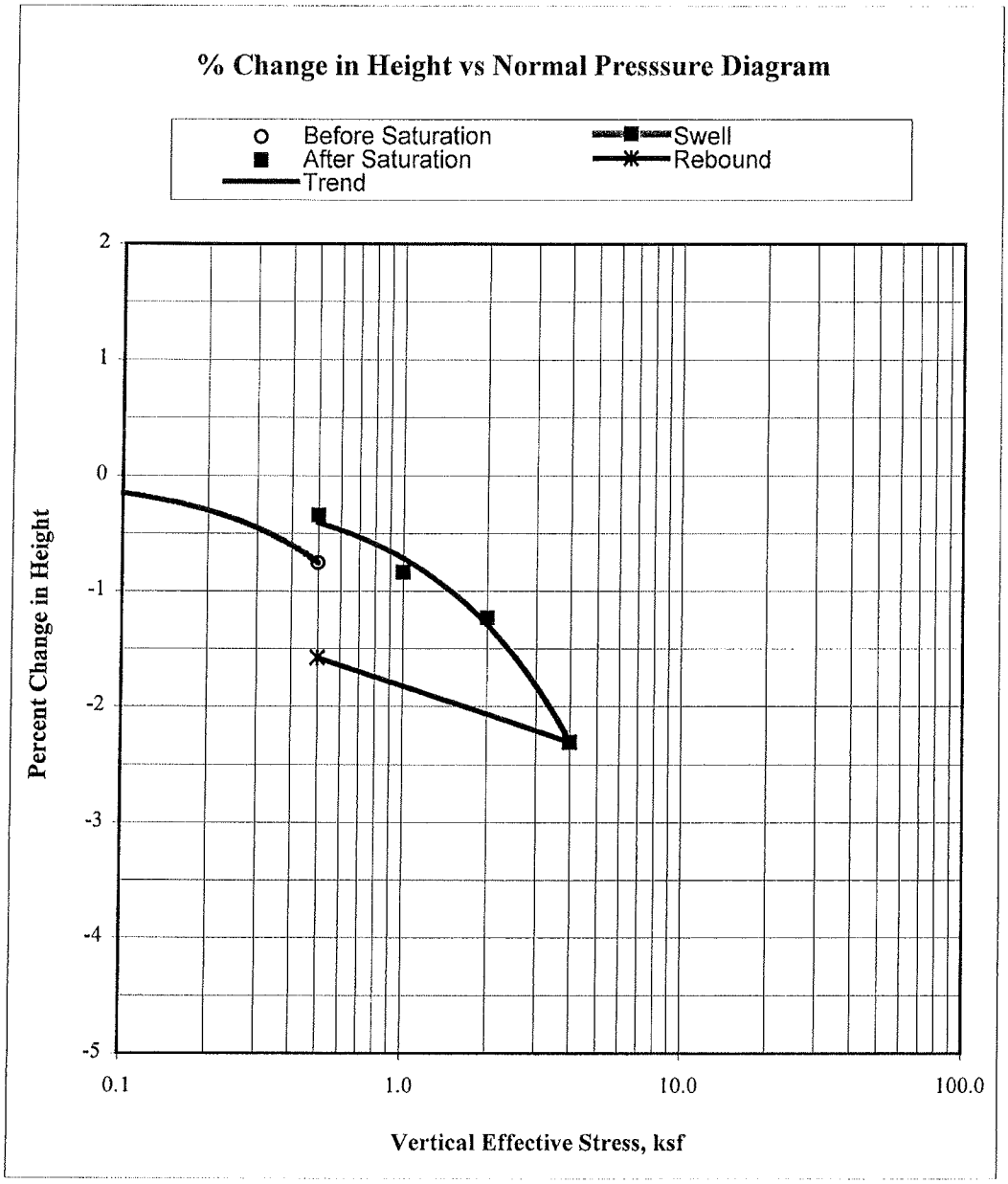


CONSOLIDATION TEST

ASTM D 2435-90

Nordhoff High School
3 @ 3'
Sandy Clay w/ Silt
Ring Sample

Initial Dry Density: 111.4 pcf
Initial Moisture, %: 16.8%
Specific Gravity: 2.67 (assumed
Initial Void Ratio: 0.496

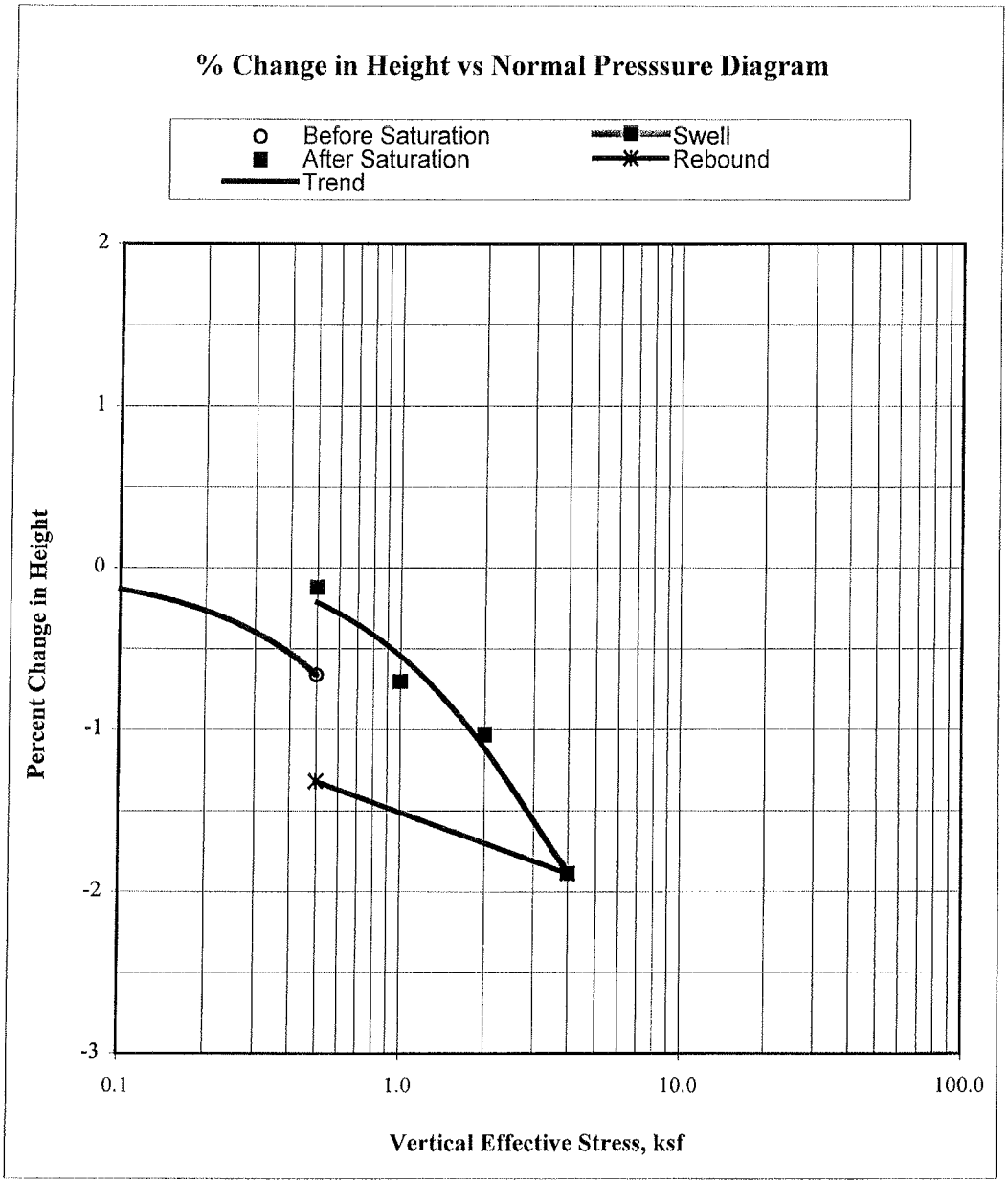


CONSOLIDATION TEST

ASTM D 2435-90

Nordhoff High School
6 @ 5'
Sandy Clay w/ Silt
Ring Sample

Initial Dry Density: 115.9 pcf
Initial Moisture, %: 16.3%
Specific Gravity: 2.67 (assumed
Initial Void Ratio: 0.439



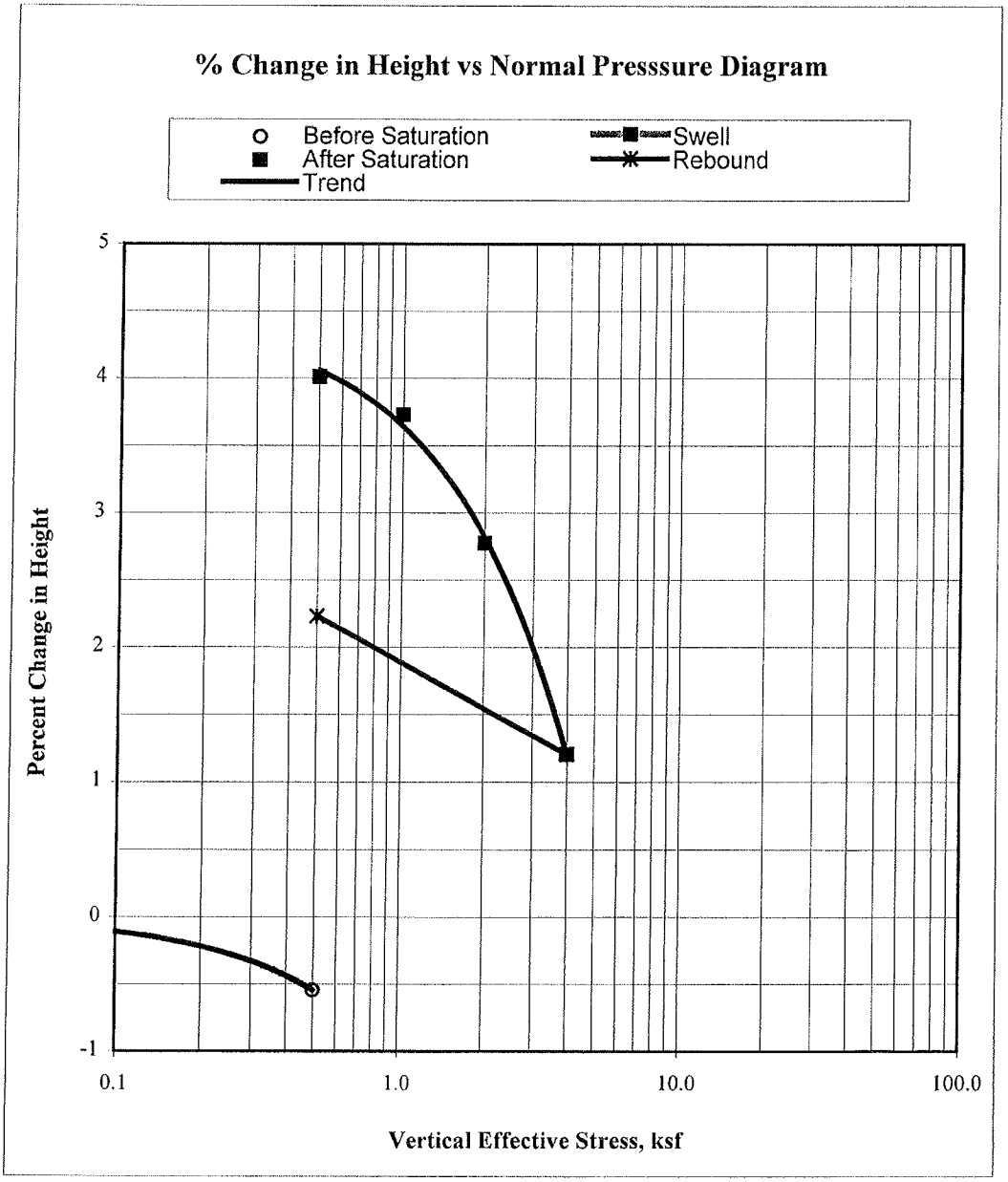
VT-22084-01 Dec 17, 1999

CONSOLIDATION TEST

ASTM D 2435-90

Nordhoff High School
8 @ 3'
Sandy Clay w/ Silt
Ring Sample

Initial Dry Density: 117.1 pcf
Initial Moisture, %: 12.5%
Specific Gravity: 2.67 (assumed
Initial Void Ratio: 0.424



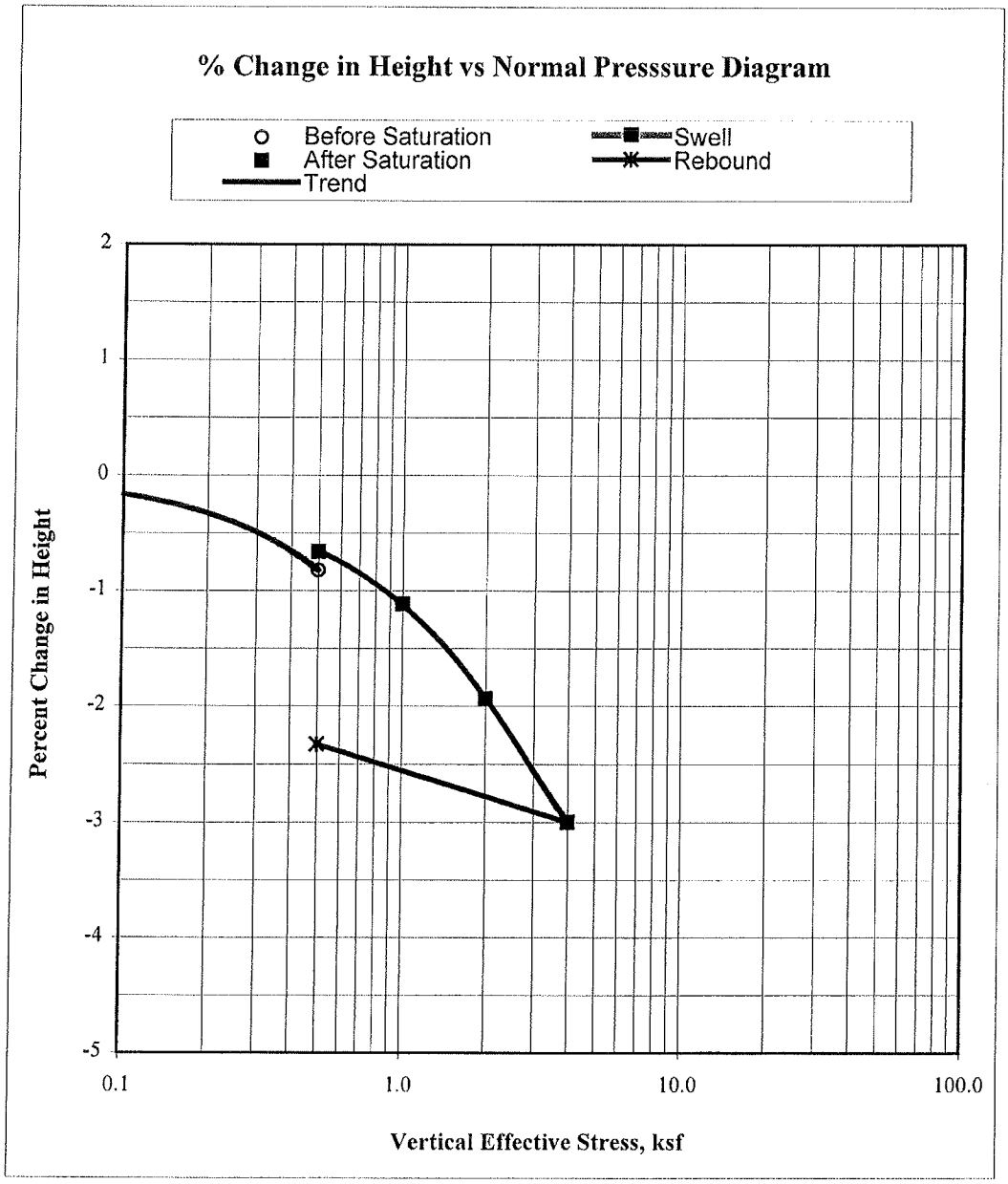
VT-22084-01 Dec 17, 1999

CONSOLIDATION TEST

ASTM D 2435-90

Nordhoff High School
9 @ 3'
Sandy Clay w/ Silt
Ring Sample

Initial Dry Density: 112.1 pcf
Initial Moisture, %: 17.0%
Specific Gravity: 2.67 (assumed
Initial Void Ratio: 0.487



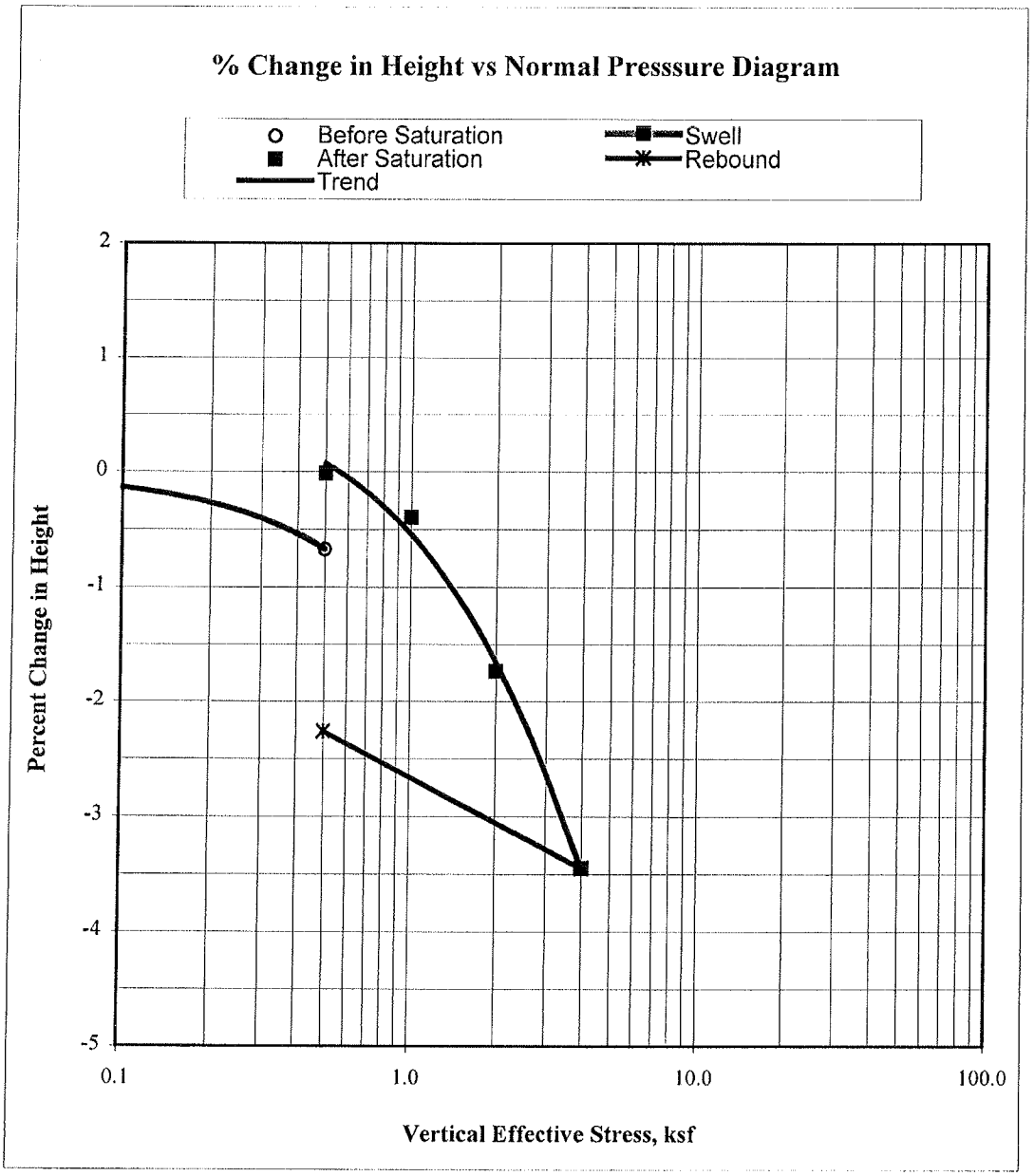
VT-22084-01 Dec 17, 1999

CONSOLIDATION TEST

ASTM D 2435-90

Nordhoff High School
13 @ 3'
Sandy Clay w/ Silt
Ring Sample

Initial Dry Density: 108.5 pcf
Initial Moisture, %: 19.2%
Specific Gravity: 2.67 (assumed)
Initial Void Ratio: 0.536

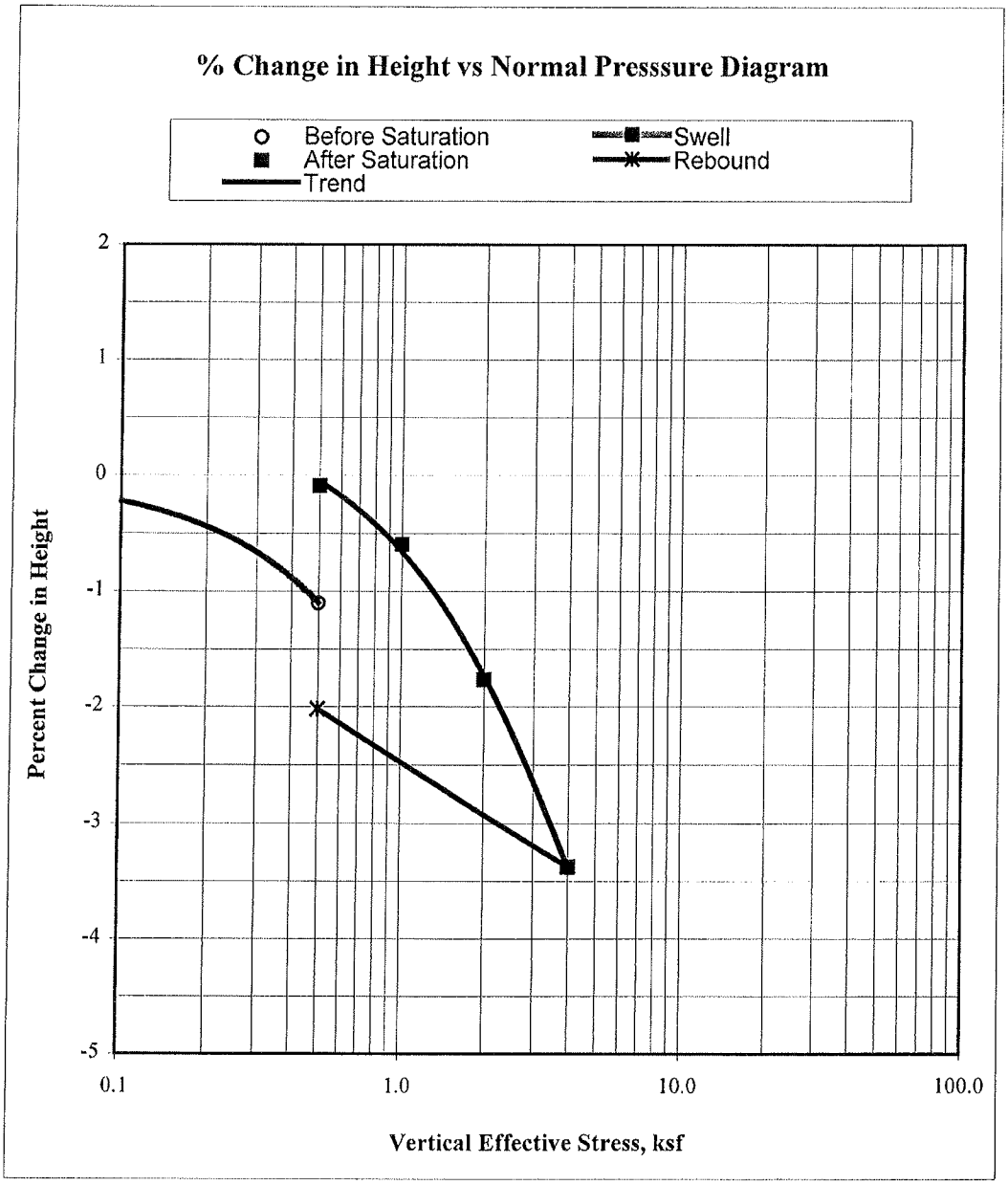


CONSOLIDATION TEST

ASTM D 2435-90

Nordhoff High School
14 @ 3'
Sandy Clay w/ Silt
Ring Sample

Initial Dry Density: 110.2 pcf
Initial Moisture, %: 18.6%
Specific Gravity: 2.67 (assumed
Initial Void Ratio: 0.513



Capco Analytical Services INC. (CAS)
1536 Eastman Avenue, Suite B
Ventura CA 93003
(805) 644-1095

Client: Earth Systems
Sample ID: 8 @ 0-2'
Date Received: 12/29/99
Date Sampled: N/A

Sample Matrix: Soil
CAS LAB NO: 99228601

WET CHEMISTRY ANALYSIS SUMMARY

COMPOUND	RESULT	UNITS	DF	PQL	METHOD	ANALYZED
*Chloride	35	mg/Kg	1	10	300.0M	12/29/99
pH	7.0	S.U.	1	---	9045	12/29/99
*Resistivity	1790	ohms-cm	1	3	9050	12/29/99
*Sulfate	82	mg/Kg	1	10	300.0M	12/29/99

*Sample was analyzed on a 1:10 soil/water extract. Results were reported based on the original soil sample weight.
PQL: Practical Quantitation Limit
BQL: Below Practical Quantitation Limit

Principal Analyst

CAPCO Analytical Services, Inc.

TABLE 1809.7
PRESCRIPTIVE FOOTINGS FOR SUPPORTING WALLS OF LIGHT FRAME CONSTRUCTION*

WEIGHTED EXPANSION INDEX (13)	FOUNDATION FOR SLAB & RAISED FLOOR SYSTEM (4) (8)							CONCRETE SLABS (8) (12)		PREMOISTENING OF SOILS UNDER FOOTINGS, PIERS AND SLABS (4) (5)	RESTRICTION ON PIERS UNDER RAISED FLOORS
	NUMBER OF STORIES	STEM THICKNESS	FOOTING WIDTH	FOOTING THICKNESS	ALL PERIMETER FOOTINGS (5)	INTERIOR FOOTINGS FOR SLAB AND RAISED FLOORS (5)	REINFORCEMENT FOR CONTINUOUS FOUNDATIONS (2) (6)	3-1/2" MINIMUM THICKNESS			
					DEPTH BELOW NATURAL SURFACE OF GROUND AND FINISH GRADE			REINFORCEMENT (3)	TOTAL THICKNESS OF SAND (10)		
		(INCHES)									
0 - 20 Very Low (non-expansive)	1 2 3	6 8 10	12 15 18	6 6 8	12 18 24	12 18 24	1-#4 top and bottom	#4 @ 48" o.c. each way, or #3 @ 36" o.c. each way	2"	Moistening of ground recommended prior to placing concrete	Piers allowed for single floor loads only
21-50 Low	1 2 3	6 8 10	12 15 18	6 6 8	15 18 24	12 18 24	1-#4 top and bottom	#4 @ 48" o.c. each way, or #3 @ 36" o.c. each way	4"	120% of optimum moisture required to a depth of 21" below lowest adjacent grade. Testing required.	Piers allowed for single floor loads only
51-90 Medium	1 2	6 8	12 15	6 6	21 21	12 18	1-#4 top and bottom	#3 @ 24" o.c. each way	4"	130% of optimum moisture required to a depth of 27" below lowest adjacent grade. Testing required	Piers not allowed
	3	10	18	8	24	24	#3 bars @ 24" in ext. footing Bend 3' into slab (7)				
91-130 High	1 2	6 8	12 15	6 6	27 27	12 18	2-#4 Top and Bottom	#3 @ 24" o.c. each way	4"	140% of optimum moisture required to a depth of 33" below lowest adjacent grade. Testing required.	Piers not allowed
	3	10	18	8	27	24	#3 bars @ 24" in ext. footing Bend 3' into slab (7)				
Above 130 Very High	Special design by licensed engineer/architect										

*Refer to next page for footnotes (1) through (14).

#

APPENDIX C

Site Class Analysis
Liquefaction/Seismic-Induced Settlement Analysis Printouts and Graphs
Lateral Spreading Analysis Printout

EARTH SYSTEMS

Job Number:	301909-001
Job Name:	Nordhoff HS Library Remodel
Calc Date:	5/25/2018
CPT/Boring ID:	B-8

Use "SPT N_{60}" if correlated from CPT.
Use "Raw SPT blow/ft" if from SPT/ModCal.
Input Number Max Limit = 100.

Depth (ft)	SPT N	Sublayer Thick (ft)	Sublayer Thick/N
5.0	58.0	5.0	0.086
10.0	9.5	5.0	0.526
15.0	11.3	5.0	0.442
20.0	9.5	5.0	0.526
25.0	25.0	5.0	0.200
30.0	25.0	5.0	0.200
35.0	33.0	5.0	0.152
40.0	31.0	5.0	0.161
45.0	47.0	5.0	0.106
50.0	44.0	5.0	0.114

Total Thickness of Soil =	50.00	ft
N-bar Value =	19.9	*
Site Classification =	Class D	

*Equation 20.4-2 of ASCE 7-10

LIQUEFY-v 2.3.XLS - A SPREADSHEET FOR EMPIRICAL ANALYSIS OF LIQUEFACTION POTENTIAL AND INDUCED GROUND SUBSIDENCE

Developed 2006 by Shelton L. Stringer, PE, GE, PG - Earth Systems Southwest

Project: Nordhoff HS Library Remodel
Job No: 301909-001
Date: 6/7/2018
Boring: B-8 Data Set: 1

Methods: **Liquefaction Analysis using 1996 & 1998 NCEER workshop method (Youd & Idriss, editors)**
Journal of Geotechnical and Enviromental Engineering (JGEE), October 2001, Vol 127, No. 10, ASCE
Settlement Analysis from Tokimatsu and Seed (1987), JGEE,Vol 113, No.8, ASCE
Modified by Pradel, JGEE, Vol 124, No. 4, ASCE

EARTHQUAKE INFORMATION:

Magnitude: **7.2** 7.5
PGA, g: **0.81** 0.73
MSF: 1.11
GWT: **25.0** feet
Calc GWT: **18.0** feet
Remediate to: **5.0** **feet**

SPT N VALUE CORRECTIONS:

Energy Correction to N60 (C_E): 1.30 Automatic Hammer
Drive Rod Corr. (C_R): 1 Default
Rod Length above ground (feet): 3.0
Borehole Dia. Corr. (C_B): 1.00
Sampler Liner Correction for SPT?: 1 Yes
Cal Mod/ SPT Ratio: 0.63

Threshold Acceler., g: **0.31**

Total (ft) Liquefied Thickness	Total (in.) Induced Subsidence
4	1.1

Required SF: 1.30
Minimum Calculated SF: 0.39

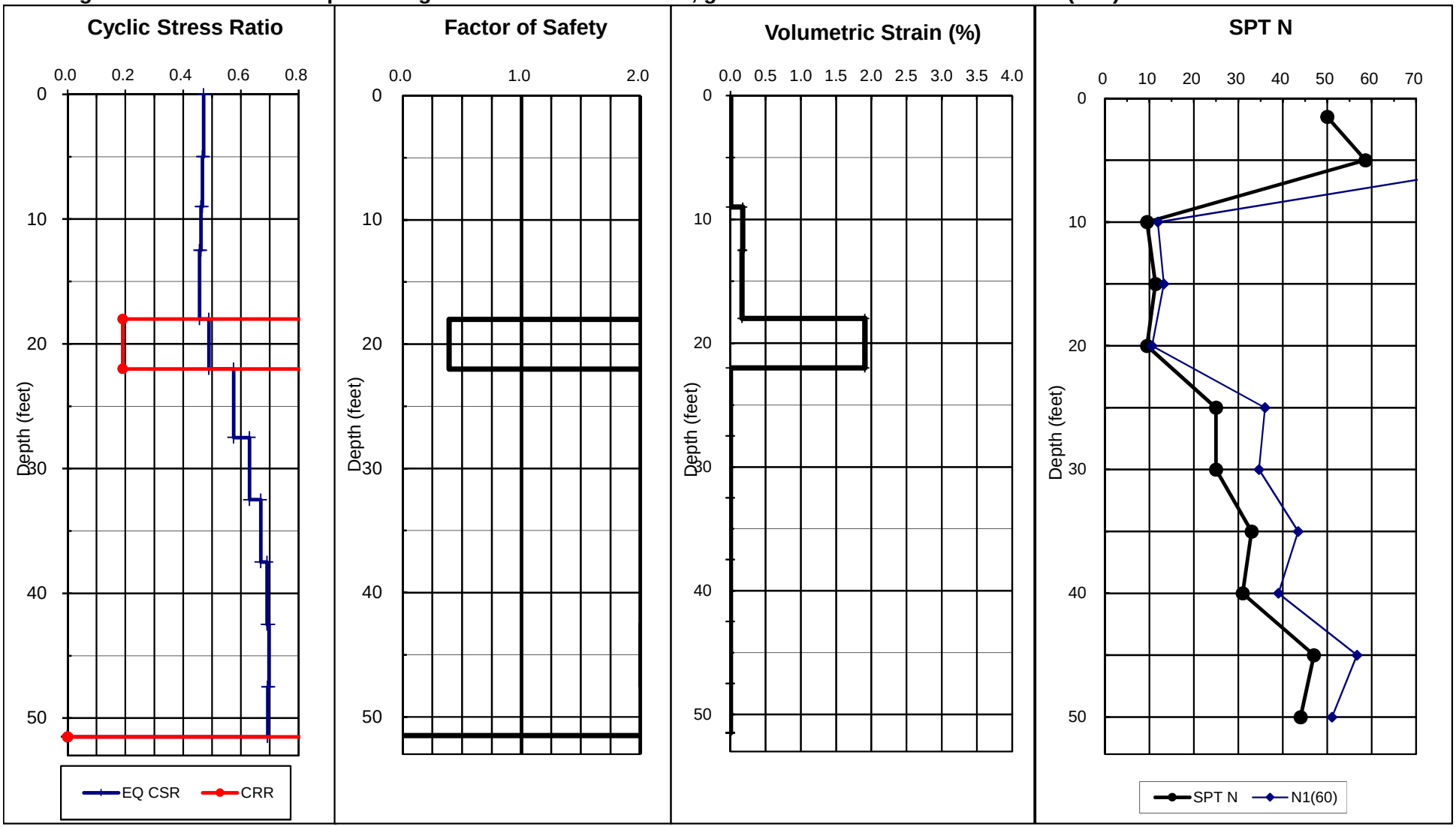
Base Depth (feet)	Cal Mod N	SPT N	Liquef. Suscept. (0 or 1)	Total Unit Wt. (pcf)	Fines Content (%)	Depth of SPT (feet)	Rod Length (feet)	Tot.Stress at SPT po (tsf)	Eff.Stress at SPT p'o (tsf)	rd	C_N	C_R	C_S	$N_{1(60)}$	Rel. Dens. Dr (%)	*Trigger FC Adj.* $\Delta N_{1(60)}$	*Equiv. Sand* $N_{1(60)CS}$	Kσ	M = 7.5 Available CRR	M =7.5 Induced CSR*	**Liquefac. Safety Factor**	*Post FC Adj.* $\Delta N_{1(60)}$	$N_{1(60)CS}$	Volumetric *Strain (%)*	**Induced Subsidence (in.)**
0.0				0				0.000																	
5.0	40	**50**	1	128	66	1.5	4.5	0.096	0.096	1.00	1.70	0.75	1.00	82.9	100	10.0	92.9	1.00	1.400	0.471	**Non-Liq.**	10.0	92.9	0.00	**0.00**
9.0	93	**59**	1	132	38	5.0	8.0	0.320	0.320	0.99	1.70	0.75	1.00	97.1	100	10.0	107.1	1.00	1.400	0.467	**Non-Liq.**	10.0	107.1	0.00	**0.00**
12.5	15	9	1	129	63	10.0	13.0	0.649	0.649	0.98	1.28	0.76	1.00	11.9	41	7.4	19.3	1.00	0.208	0.462	**Non-Liq.**	7.4	19.3	0.18	**0.07**
18.0	18	11	1	133	63	15.0	18.0	0.976	0.976	0.97	1.04	0.86	1.00	13.3	44	7.7	20.9	1.00	0.227	0.457	**Non-Liq.**	7.7	20.9	0.17	**0.11**
22.0	15	9	1	129	68	20.0	23.0	1.305	1.242	0.96	0.92	0.93	1.00	10.6	39	7.1	17.7	0.97	0.191	0.489	**0.39**	4.7	15.3	1.91	**0.92**
27.5	0	25	1	129	59	25.0	28.0	1.627	1.409	0.94	0.87	0.98	1.30	36.0	72	10.0	46.0	0.89	1.400	0.575	**2.43**	10.0	46.0	0.00	**0.00**
32.5	0	25	1	129	59	30.0	33.0	1.950	1.575	0.92	0.82	1.00	1.30	34.6	70	10.0	44.6	0.85	1.400	0.630	**2.22**	10.0	44.6	0.00	**0.00**
37.5	0	33	1	129	59	35.0	38.0	2.272	1.742	0.89	0.78	1.00	1.30	43.5	79	10.0	53.5	0.82	1.400	0.669	**2.09**	10.0	53.5	0.00	**0.00**
42.5	0	31	1	129	59	40.0	43.0	2.595	1.908	0.85	0.74	1.00	1.30	39.0	75	10.0	49.0	0.79	1.400	0.691	**2.03**	10.0	49.0	0.00	**0.00**
47.5	0	47	1	129	59	45.0	48.0	2.917	2.075	0.80	0.71	1.00	1.30	56.7	90	10.0	66.7	0.76	1.400	0.697	**2.01**	10.0	66.7	0.00	**0.00**
51.5	0	44	1	129	59	50.0	53.0	3.240	2.241	0.75	0.69	1.00	1.30	51.1	85	10.0	61.1	0.74	1.400	0.693	**2.02**	10.0	61.1	0.00	**0.00**

EARTH SYSTEMS - EVALUATION OF LIQUEFACTION POTENTIAL AND INDUCED SUBSIDENCE

Nordhoff HS Library Remodel **Project No: 301909-001** 1996/1998 NCEER Method

Ground Compaction Remediated to 5 foot depth

Boring: B-8 **Earthquake Magnitude: 7.2** **PGA, g: 0.81** **Calc GWT (feet): 18**



Total Thickness of Liquefiable Layers: 4.0 feet

Estimated Total Ground Subsidence: 1.1 inches

LIQUEFY-v 2.3.XLS - A SPREADSHEET FOR EMPIRICAL ANALYSIS OF LIQUEFACTION POTENTIAL AND INDUCED GROUND SUBSIDENCE

Developed 2006 by Shelton L. Stringer, PE, GE, PG - Earth Systems Southwest

Project: Nordhoff HS Library Remodel
Job No: 301909-001
Date: 6/7/2018
Boring: B-8 Data Set: 1

Methods: **Liquefaction Analysis using 1996 & 1998 NCEER workshop method (Youd & Idriss, editors)**
Journal of Geotechnical and Enviromental Engineering (JGEE), October 2001, Vol 127, No. 10, ASCE
Settlement Analysis from Tokimatsu and Seed (1987), JGEE,Vol 113, No.8, ASCE
Modified by Pradel, JGEE, Vol 124, No. 4, ASCE

EARTHQUAKE INFORMATION:

Magnitude: **7.2** 7.5
PGA, g: **0.81** 0.73
MSF: 1.11
GWT: **25.0** feet
Calc GWT: **25.0** feet
Remediate to: **5.0** **feet**

SPT N VALUE CORRECTIONS:

Energy Correction to N60 (C_E): 1.30 Automatic Hammer
Drive Rod Corr. (C_R): 1 Default
Rod Length above ground (feet): 3.0
Borehole Dia. Corr. (C_B): 1.00
Sampler Liner Correction for SPT?: 1 Yes
Cal Mod/ SPT Ratio: 0.63

Total (ft) Liquefied Thickness	Total (in.) Induced Subsidence
0	0.3

Threshold Acceler., g: **1.72**
Required SF: 1.30
Minimum Calculated SF: 2.13

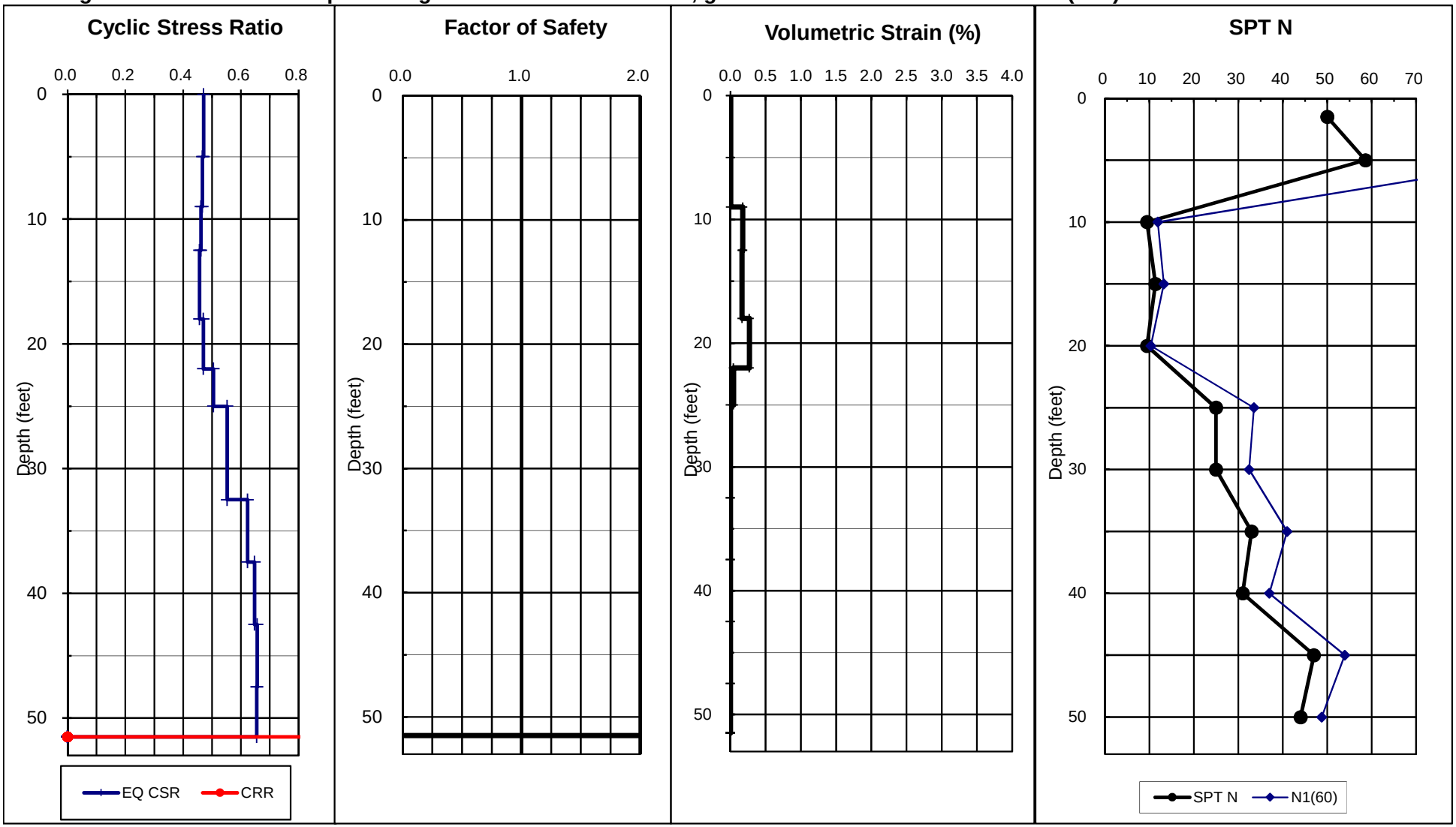
Base Depth (feet)	Cal Mod N	SPT N	Liquef. Suscept. (0 or 1)	Total Unit Wt. (pcf)	Fines Content (%)	Depth of SPT (feet)	Rod Length (feet)	Tot.Stress at SPT po (tsf)	Eff.Stress at SPT p'o (tsf)	rd	C_N	C_R	C_S	$N_{1(60)}$	Rel. Dens. Dr (%)	*Trigger FC Adj.* $\Delta N_{1(60)}$	*Equiv. Sand* $N_{1(60)CS}$	Kσ	M = 7.5 Available CRR	M =7.5 Induced CSR*	**Liquefac. Safety Factor**	*Post FC Adj.* $\Delta N_{1(60)}$	$N_{1(60)CS}$	Volumetric *Strain (%)*	**Induced Subsidence (in.)**
0.0				0				0.000																	
5.0	40	**50**	1	128	66	1.5	4.5	0.096	0.096	1.00	1.70	0.75	1.00	82.9	100	10.0	92.9	1.00	1.400	0.471	**Non-Liq.**	10.0	92.9	0.00	**0.00**
9.0	93	**59**	1	132	38	5.0	8.0	0.320	0.320	0.99	1.70	0.75	1.00	97.1	100	10.0	107.1	1.00	1.400	0.467	**Non-Liq.**	10.0	107.1	0.00	**0.00**
12.5	15	9	1	129	63	10.0	13.0	0.649	0.649	0.98	1.28	0.76	1.00	11.9	41	7.4	19.3	1.00	0.208	0.462	**Non-Liq.**	7.4	19.3	0.18	**0.07**
18.0	18	11	1	133	63	15.0	18.0	0.976	0.976	0.97	1.04	0.86	1.00	13.3	44	7.7	20.9	1.00	0.227	0.457	**Non-Liq.**	7.7	20.9	0.17	**0.11**
22.0	15	9	1	129	68	20.0	23.0	1.305	1.305	0.96	0.90	0.93	1.00	10.3	38	7.1	17.4	0.96	0.188	0.470	**Non-Liq.**	7.1	17.4	0.27	**0.13**
25.0	0	25	1	129	59	25.0	28.0	1.627	1.627	0.94	0.81	0.98	1.30	33.5	69	10.0	43.5	0.88	1.400	0.505	**Non-Liq.**	10.0	43.5	0.04	**0.02**
32.5	0	25	1	129	59	30.0	33.0	1.950	1.794	0.92	0.77	1.00	1.30	32.4	68	10.0	42.4	0.85	1.400	0.553	**2.53**	10.0	42.4	0.00	**0.00**
37.5	0	33	1	129	59	35.0	38.0	2.272	1.960	0.89	0.73	1.00	1.30	41.0	77	10.0	51.0	0.78	1.400	0.623	**2.25**	10.0	51.0	0.00	**0.00**
42.5	0	31	1	129	59	40.0	43.0	2.595	2.127	0.85	0.71	1.00	1.30	37.0	73	10.0	47.0	0.76	1.400	0.647	**2.16**	10.0	47.0	0.00	**0.00**
47.5	0	47	1	129	59	45.0	48.0	2.917	2.293	0.80	0.68	1.00	1.30	54.0	88	10.0	64.0	0.73	1.400	0.657	**2.13**	10.0	64.0	0.00	**0.00**
51.5	0	44	1	129	59	50.0	53.0	3.240	2.460	0.75	0.66	1.00	1.30	48.8	83	10.0	58.8	0.71	1.400	0.655	**2.14**	10.0	58.8	0.00	**0.00**

EARTH SYSTEMS - EVALUATION OF LIQUEFACTION POTENTIAL AND INDUCED SUBSIDENCE

Nordhoff HS Library Remodel **Project No: 301909-001** 1996/1998 NCEER Method

Ground Compaction Remediated to 5 foot depth

Boring: B-8 **Earthquake Magnitude: 7.2** **PGA, g: 0.81** **Calc GWT (feet): 25**



Total Thickness of Liquefiable Layers: 0.0 feet

Estimated Total Ground Subsidence: 0.3 inches

Job Number: 301909-001
Job Name: Nordhoff HS Library Remodel
Boring Number: B-8
Date: June 1, 2018
Calculated By: PVB

Prediction of Liquefaction Induced Lateral Spreading with Ground Slope Conditions

Based on Data Published in the ASCE Journal of Geotechnicial and Geoenvironmental Engineering December 2002
(Bartlett and Youd 2002)

Variables Used in Calculation Defined

Earthquake Magnitude (M)
Horizontal Distance to Nearest Seismic Energy Source, km (R)
Percent Slope (S)
Cumulative Thickness in Meters of Saturated Cohesionless Sediments with SPT $(N1)_{60}$ Values <= 15 (T_{15})
Average Fines Content in Percent (F_{15})
Mean Grain size in milimeters ($D50_{15}$)

$$\text{Log } D_H = -16.213 + 1.532M - 1.406\text{Log}(R + 10^{(0.89M - 5.64)}) - 0.012R + 0.338\text{Log}S + 0.540\text{Log}T_{15} + 3.413\text{Log}(100 - F_{15}) - 0.795\text{Log}(D50_{15} + 0.1\text{mm})$$

Requirements and Limitations Used to Develop this Model

Soils must be Liquefiable
Saturated Cohesionless Sediments with SPT $(N1)_{60}$ less than 15
Earthquake Magnitude (M) must be between 6 and 8
Percent Slope (S) must be between 0.1% and 6%
Cumulative Thickness (T15) must be between 1 and 15 meters
Depth to top of Liquefied layer must be between 1 and 10 meters
Distance to Fault Rupture (R_{eq}) must be determined using Figure 10 if soft soils are present.
F_{15} and $D50_{15}$ must be within bounds shown in Fig. 5.
If R or R_{eq} < 0.5 km use 0.5; otherwise use R or R_{eq}.

Input Values	
M = 7.2	
R = 0.7	km
S = 1.4	%
T_{15} = 1	m
F_{15} = 68	%
$D50_{15}$ = 0.05	mm

Horizontal Ground Displacement in meters (D_H) = 0.32
Horizontal Ground Displacement in feet (D_H) = 1.0

#

APPENDIX D

Engineering Geology and Seismology Review by CGS

State of California • Natural Resources Agency
Department of Conservation
California Geological Survey
801 K Street • MS 12-31
Sacramento, CA 95814
(916) 324-7324 • FAX (916) 445-3334

Edmund G. Brown Jr., *Governor*
John G. Parrish, Ph.D., *State Geologist*

Andrew Cantwell
District Superintendent
Ojai Unified School District
414 E Ojai Avenue
Ojai, CA 93023

May 24, 2018

Subject: **Engineering Geology and Seismology Review for Nordhoff High School – Remodel Library**
1401 Maricopa Highway, Ojai, CA
CGS Application No. 03-CGS3395 DSA #03-118819

Dear Mr. Cantwell:

In accordance with your request and transmittal of documents received on April 2, 2018, the California Geological Survey (CGS) has reviewed the engineering geology and seismology aspects of the consulting report prepared for Nordhoff High School in Ojai. It is our understanding that this project involves a remodel to the existing one-story library building; however, the detailed scope of work for the project is unclear. We note the requirements for the submission of a geologic hazard report to CGS for review are presented in California Division of the State Architect Interpretation of Regulations (DSA IR A-4.13). This review was performed in accordance with Title 24, California Code of Regulations, 2016 California building Code and followed CGS Note 48 guidelines. We reviewed the following report:

> **Geohazards Report for Proposed remodel of the Library Building at Nordhoff High School:** Earth Systems, 1731 Walter Street, Suite A, Ventura, CA 93003; company Project No. 301909-001, Report No. 18-3-60, report dated March 28, 2018, 14 pages, 2 appendices.

Based on our review of the data and report presented by Earth Systems, the consultants provide a generally qualitative Geohazard Report for the proposed improvement; however, the report does not adequately classify the site soils based on observation and testing from subsurface exploration. Additionally, a Geotechnical Report, signed by a registered Geotechnical Engineer, does not appear to have been submitted for our review, per CBC §1803.A. For the reasons stated above, we have not enclosed Note 48 Checklist Review Comments, and request appropriate qualitative subsurface exploration data and accompanying Geotechnical Report be submitted in order to complete our review of this project.

In conclusion, ***the engineering geology and seismology issues at this site are not adequately assessed in the referenced report***. The consultants are reminded that one copy of all supplemental documents should be submitted directly to CGS and should include the CGS application number. If you have any further questions about this review letter, please contact the reviewer at (650) 350-7309 or ante.mlinarevic@conservation.ca.gov.

Respectfully submitted,

Ante Mlinarevic
Engineering Geologist
PG 8352, CEG 2552

Concur:

Anne Rosinski
Senior Engineering Geologist
PG 7481, CEG 2353

Copies to:

Patrick V. Boales, *Certified Engineering Geologist*
Earth Systems, 1731 Walter Street, Suite A, Ventura, CA 93003

Tyson Cline, *Architect*
Tyson Cline, 285 N Ventura Ave #102, Ventura, CA 93001

Ted Beckwith, *Senior Structural Engineer*
Division of State Architect, 700 North Alameda Street, Suite 5-500, Los Angeles, CA 90012