Earth Systems
Southern California

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February 6, 2009

VT-24086-01
09-2-6

Meiners Oaks County Water District
Attention: Mike Hollebrands
202 W. El Roblar Drive
Meiners Oaks, California 93023

Project: Two Proposed Water Tanks
Meiners Oaks County Water District
Meiners Oaks Area of Ventura County, California

As authorized, we have performed a geotechnical study for the two proposed water tanks to be located at the existing Meiners Oaks County Water District tank site located about 1/4-mile north of the intersection of Fairview Road and Highway 33 in the Meiners Oaks area of Ventura County, California. The accompanying Geotechnical Engineering Report presents the results of our subsurface exploration and laboratory testing programs, as well as our conclusions and recommendations pertaining to geotechnical aspects of project design.

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 SOUTHERN CALIFORNIA

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CERTIFIED
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STATE OF CALIFORNIA

Copies: 4 - Meiners Oaks County Water District
1 - Project File

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INTRODUCTION

A. Project Description

This report presents results of a Geotechnical Engineering study performed for two proposed water tanks to be located at the existing Meiners Oaks County Water District tank site about 1/4-mile north of the intersection of Fairview Road and Highway 33 in the Meiners Oaks area of Ventura County, California. One of the tanks will be a replacement of an existing tank that is distressed. The sizes of the tanks have not yet been provided to us, but are assumed to have a minimum capacity of 500,000 gallons.

It is our understanding that the two proposed tanks lie in a relatively flat pad area that consists of an abandoned, filled-in water reservoir. Based on undated topographic plans provided to this office by the Client, the depth of the previous reservoir was about 30 feet, and the approximate plan view dimensions of the reservoir were about 200 feet by 300 feet. It appears that the proposed tanks will lie along the buried sloped flanks of the reservoir.

B. Purpose and Scope of Work

The purpose of the geotechnical study that led to this report was to evaluate the soil/bedrock conditions of the site with respect to the proposed tank construction. These conditions include surface and subsurface soil/bedrock types, expansion potential, settlement potential, bearing capacity, and the presence or absence of subsurface water. The scope of our work included:

1. Reconnaissance of the site.
2. Excavating, sampling, and logging of 8 test pits to study bedrock, soil, and groundwater conditions.
3. Laboratory testing of soil samples obtained from the subsurface exploration to determine their physical and engineering properties.
4. Analyzing the geotechnical data obtained.
5. Preparing this report.

Contained in this report are:

1. Descriptions and results of field and laboratory tests that were performed.
2. Discussions pertaining to the local bedrock, soil, and groundwater conditions.
3. Conclusions and recommendations pertaining to site grading and structural design.

C. Site Setting

The site of the proposed water tanks is located about 1/4-mile north of the intersection of Fairview Road and Highway 33 in the Meiners Oaks area of Ventura County, California (see Vicinity Map in Appendix A). The tanks will be located on a relatively flat pad area that includes 4 existing tanks and one metal building. The tank pad is about 350 feet by 500 feet and lies partially across a southwest-northeast natural gully. Natural 5:1 (horizontal to vertical) or flatter gradient slopes are located on the northwest and southeast side of the tank pad. The proposed construction area is generally free of vegetation except for sparse areas of grasses and weeds.

GEOLOGIC HAZARDS

Some common geologic hazards which could impact a site in the Southern California region include ground shaking from regional earthquakes, faulting (or other ground deformation), tsunami, seiche, and landslides.

Ground Shaking

The site is located in Southern California which is within an active seismic area where large numbers of earthquakes are recorded each year. Historically, major earthquakes felt in the vicinity of the subject site have originated from faults outside the area. These include the 1812 Santa Barbara Channel Earthquake, 1857 Fort Tejon earthquake, the 1872 Owens Valley earthquake, and the 1952 Arvin-Tehachapi earthquake.

This site, like all other sites in the general area, can be affected by moderate to major earthquakes centered on faults in southern California. An estimate of the seismic shaking that the proposed tanks could experience was made by a calculation (dividing the S_{DS} seismic design value by 2.5) as recommended in the 2007 California Building Code. This calculation results in an estimated peak horizontal ground acceleration of about 0.62-g.

The 2007 CBC requires design by different seismic parameters than required by the previous building code. The site is located at about geographic coordinates 34.4627N and 119.27570W. These values were input into the USGS's web based Seismic Hazard Curves and Uniform Response Spectra calculator to determine the site's short term (0.2 sec.) and long term (1.0 sec.)

spectral accelerations. The results of the analysis are presented on a data sheet included in Appendix B.

Fault Rupture

The subject lot is not located within a State of California designated fault hazard zone. No faults are mapped crossing through the site on a regional geology map by Dibblee. Therefore, the potential for fault rupture below the building sites is considered low.

Tsunami and Seiche

Due to the subject site's higher elevation and location away from any large bodies of water (i.e. oceans, lakes or reseviors), the potential for a tsunami or seiche hazard is low at the subject site.

Landslides

The proposed tank sites are not plotted in an area of required investigation for earthquake-induced landslides on the Seismic Hazard Zones map of the Matilija Quadrangle (CGS, 2002b, see the attached Seismic Hazard Zones Map in Appendix A). There are no identified landslides or rockfalls either on or trending into tank sites. Therefore, the potential for landsliding hazards at the subject site is low.

Liquefaction

The site is not mapped in a zone of required investigation for liquefaction (CGS, 2002b, see the attached Seismic Hazard Zones Map in Appendix A). Although groundwater is estimated to be greater than 40 feet deep based on CGS, 2002b, perched groundwater was encountered in many of our test pits within the existing fill soils. Therefore, the potential for liquefaction at the subject site is considered low and no mitigative measures are thought necessary.

Flooding

The site is not located within a 100- or 500-year flood zone as recognized by Ventura County, (1994). If one of the on-site tanks ruptured, then localized flooding would occur.

SOIL CONDITIONS

1. Evaluation of the subsurface in the general areas of the proposed tanks indicates that soils are generally artificial fill overlying Sespe Formation bedrock (fill thickness varies from 0 to greater than 18 feet). The artificial fill consists of loose to medium dense clayey silty sand with gravel to silty clayey sand with some gravel, cobbles, and boulders. The fill contains

zones of debris including asphaltic concrete, concrete, metal, piping, glass, plastic, and other construction debris. Some of the boulders, asphaltic concrete, and concrete are up to 4 feet in size. The Sespe Formation bedrock consists of moderately dense to dense interebedded sandstones and siltstones. Testing indicates that anticipated bearing soils lie in the "very low" expansion range of Table 1805.4.2 of the 2007 Ventura County Building Code.

2. Groundwater was encountered within the existing fill soils in numerous test pits during the subsurface exploration.
3. It appears that soils can be cut by normal heavy grading equipment.
4. Samples for near-surface soils were tested for pH, resistivity, soluble sulfates, and soluble chlorides. Testing indicates that anticipated bearing soils lie within the "negligible" sulfate exposure range in Table 4.3.1 in ACI 318, Section 4.3. Hence, special concrete designs to combat sulfate attack do not appear necessary. A soil resistivity measurement indicates that the soil is "moderately corrosive" to ferrous metals. The test results provided in Appendix B should be provided to the project designers for their interpretations pertaining to the corrosivity or reactivity of various construction materials (such as concrete and piping) with the soils.

CONCLUSIONS AND RECOMMENDATIONS

Based on the test pits excavated, the proposed tank site is underlain by undocumented artificial fill that includes miscellaneous debris. As observed, compaction of this fill is below the normally accepted minimum standard of 90% relative compaction. The thickness of the fill could not be determined in all areas because of limitations of the equipment. Near the north sides of the proposed tanks, the fill appears to be only about 4 feet thick. Near the south side of the westernmost tank the fill is about 13.5 feet thick, but near the south side of the easternmost tank the fill was not penetrated by test pits 10 feet and 18 feet deep.

Our understanding is that the tank to be replaced is distressed because of differential settlement. Our test pits indicate that the fill on the north side of that tank is thin (a few feet at most) but on the south side of that tank the fill is about 13.5 feet thick. It appears that the fill was compressed by the weight of the water filled tank (estimated to develop about 1,500 psf pressure on the ground). Because the depth of the fill is differential across the tank, the settlement occurred differentially. The differential settlement seems to attest to the compressibility of the undocumented fill.

It can be assumed that similar performance will occur if the new tanks are built in the locations explored because significant differential depths of fill were found from one side of the a tank to another.

There are a variety of options to mitigate the potential settlement. These methods include: removing the undocumented fill from the tank pads areas and replacing it as properly compacted and certified fill, surcharging the tank pad areas to pre-compress the undocumented fill, and placing the tanks on pile supported mat foundations. A fourth method is using rammed aggregate piers to support the tanks. A fifth method is to modify the fill in place by compaction grouting to improve its compression characteristics.

Removing the undocumented fill and replacing it with compacted and certified fill is most the common, and typically lowest cost way to remediate this type of problem soil. For the proposed tanks, the fill should be removed down to bedrock to a distance beyond a tank equal to the depth to bedrock. Because the backcut should be sloped at a minimum of 1 horizontal to 1 vertical, the top of the backcut will be a distance from the edge of a proposed tank equal to two times the depth of removal. In addition, the differential depth of uncertified fill should be reduced by undercutting the shallow bedrock side of the tank pad a minimum of 5 feet below finish pad grade. While simple in concept, it may be difficult to achieve this grading in the field because of the proximity of existing adjacent water tanks. The existing tanks appear likely to interfere with the lateral extent of the removals and deep removal close to the existing tanks could destabilize them. There is the added problem of groundwater within the undocumented fill so the site would need to be dewatered to allow grading. The water would need to be drained or pumped out of the soil and it can be anticipated that the removed soils will require drying before they can be placed and compacted.

Surcharging may be viable option. A surcharge is usually a pile of soil placed in a pad area, and whose weight is at least equal to, but typically larger than, the proposed construction weight. The larger the weight of the surcharge, the quicker the soil will compress and the more assurance there will be that settlement under the ultimate construction weight will be acceptable. To equal the weight of the proposed water tank, the soil would need to be piled about 14 feet high. A surcharge about 20 feet high would be more effective. The time to compress the soil is unknown, but could be several to six months. The lateral extent of the soil surcharge beyond the edges of the proposed tanks would be about a distance equal to the height of the surcharge. The settlement of the ground surface should be monitored to determine when an acceptable amount of compression of the undocumented fill has been achieved. A complication of this option is that the soil beyond the area being surcharged may also be compressed to some extent, so the existing tanks could be adversely affected and that would need to evaluated.

A pile supported mat foundation would be a structural option. Piles could be driven to bear on the bedrock. Assuming piles on 8-foot centers, there would need to be about 40 piles with each carrying about 100,000 pounds of load. If the piles were to be placed on about 10-foot centers, there would need to be about 25 piles with each carrying about 160,000 pounds. The length of the piles would vary across the tanks to conform to the depth to bedrock. The thickness of the structural mat foundation that would cap the piles would need to determined by a structural engineer, but an about 18-inch thick mat is probably required. With this option it would only be necessary to grade the upper few feet of a tank pad.

Rammed aggregate piers (RAP's) are another option. RAP's are used to improve the soil bearing capacity and to reduce settlement potential. They are constructed by drilling holes (in this case to bedrock) and incrementally filling the holes with aggregate base that is rammed into place. The result is dense columns of aggregate base that can support significant load. For a tank, RAP's would be constructed on equal spacing throughout and perhaps to some extend beyond the edges of the proposed tanks. RAP's are a specialty contractor item. The contractor would need to determine the feasibility RAP's in this application and provide a design. The design is related to the depth, spacing, and diameter of RAP's. Groundwater and large debris in the fill may be a complication in implementing this option.

Compaction grouting can improve the compression and strength characteristics of the soil. The grouting is done by driving grout tubes into or through the soft soils, and pumping a stiff grout out the bottom of the tubes. The tubes are retracted a few feet and the pumping is repeated. This process produces irregular columns of grout in the soil that displace and compress the surrounding soil. This method works best in soils that can drain freely, such as sands, and poorest in soils with restricted drainage, such as clays. For the compaction to occur, there needs to be enough soil overburden to confine the soils, otherwise the soils is lifted but not compressed. When the soil cover is reduced to less than about 10 feet, compaction grouting becomes progressively less effective. For the subject water tanks, compaction grouting may be of limited value because of a lack of overburden under much of the proposed tank pad areas.

Before any of these options can be thoroughly evaluated, the site should be drilled, relatively undisturbed samples gathered, and laboratory tests performed.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

The analysis and recommendations submitted in this report are based in part upon the data obtained from the pits excavated on the site. The nature and extent of variations between and beyond the pits 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 our 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 test pit logs regarding odors noted, unusual or suspicious items or conditions observed, are strictly for the information of our 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 be 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 proposed water tanks, 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 insure 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 Southern California strives to provide our services in accordance with the 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 homeowner and their authorized agents.

It is recommended that Earth Systems Southern California 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 Southern California is not accorded the privilege of making this recommended review, we can assume no responsibility for misinterpretation of our recommendations.

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APPENDIX A

Field Study
Vicinity Map
Regional Geology Map
Seismic Hazard Zone Map
Test Pit Location Map
Test Pit Logs
Symbols Commonly Used on Boring Logs
Unified Soil Classification

FIELD STUDY

A. On January 31, 2008, three test pits (TP-1, 2, and 3) were excavated with a backhoe in the general area of the proposed tanks to depths of 3.5, 4, and 4 feet below the existing ground surface to observe the soil/bedrock profile and to obtain samples for laboratory analysis. Groundwater was encountered in two of the test pits (TP-1 and TP-3) at depths of about 2 to 3.5 feet within existing artificial fill soils, therefore, additional test pits (as discussed below) were required to define the depth of the existing artificial fill.

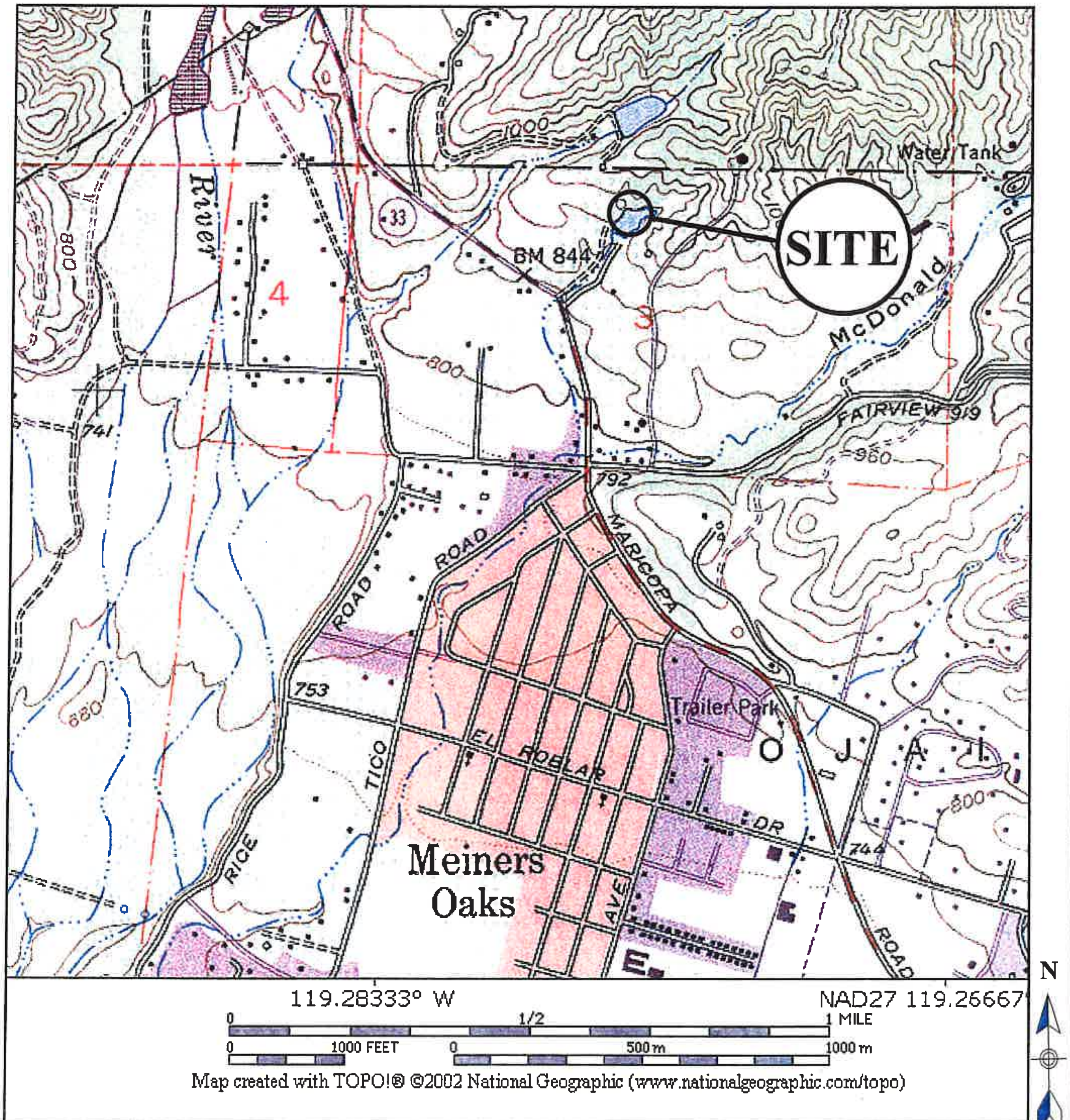
On March 11, 2008, three additional test pits (TP-4, 5, and 6) were excavated with a subcontracted backhoe in the general area of the proposed tanks to depths of 4, 7, and 10 feet below the existing ground surface to observe the soil/bedrock profile and to obtain samples for laboratory analysis. Groundwater was encountered in two of the test pits (TP-5 and TP-6) at depths of about 3 to 8 feet within existing artificial fill soils, therefore, additional test pits (as discussed below) were required to define the depth of the existing artificial fill.

On September 17, 2008, two additional test pits (TP-7 and 8) were excavated with a subcontracted backhoe in the general area of the proposed tanks to depths of 13 and 14 feet below the existing ground surface to observe the soil/bedrock profile and to obtain samples for laboratory analysis. Groundwater was encountered in one of the test pits (TP-8) at a depth of about 13 feet within existing artificial fill soils.

B. Samples were obtained within the test pits with a Modified California (M.C.) ring sampler (ASTM D 3550 with shoe similar to ASTM D 1586). The M.C. sampler has a 3-inch outside diameter and a 2.37-inch inside diameter. The samples were obtained by driving the sampler with a lightweight hand operated slide hammer and/or pushing the sampler with the backhoe bucket.

C. Bulk samples of the soils encountered were gathered from the excavation cuttings.

D. The final logs of the test pits represent our interpretations of the contents of the field logs and the results of laboratory testing performed on the samples obtained during the subsurface study. The final logs are included in this Appendix.

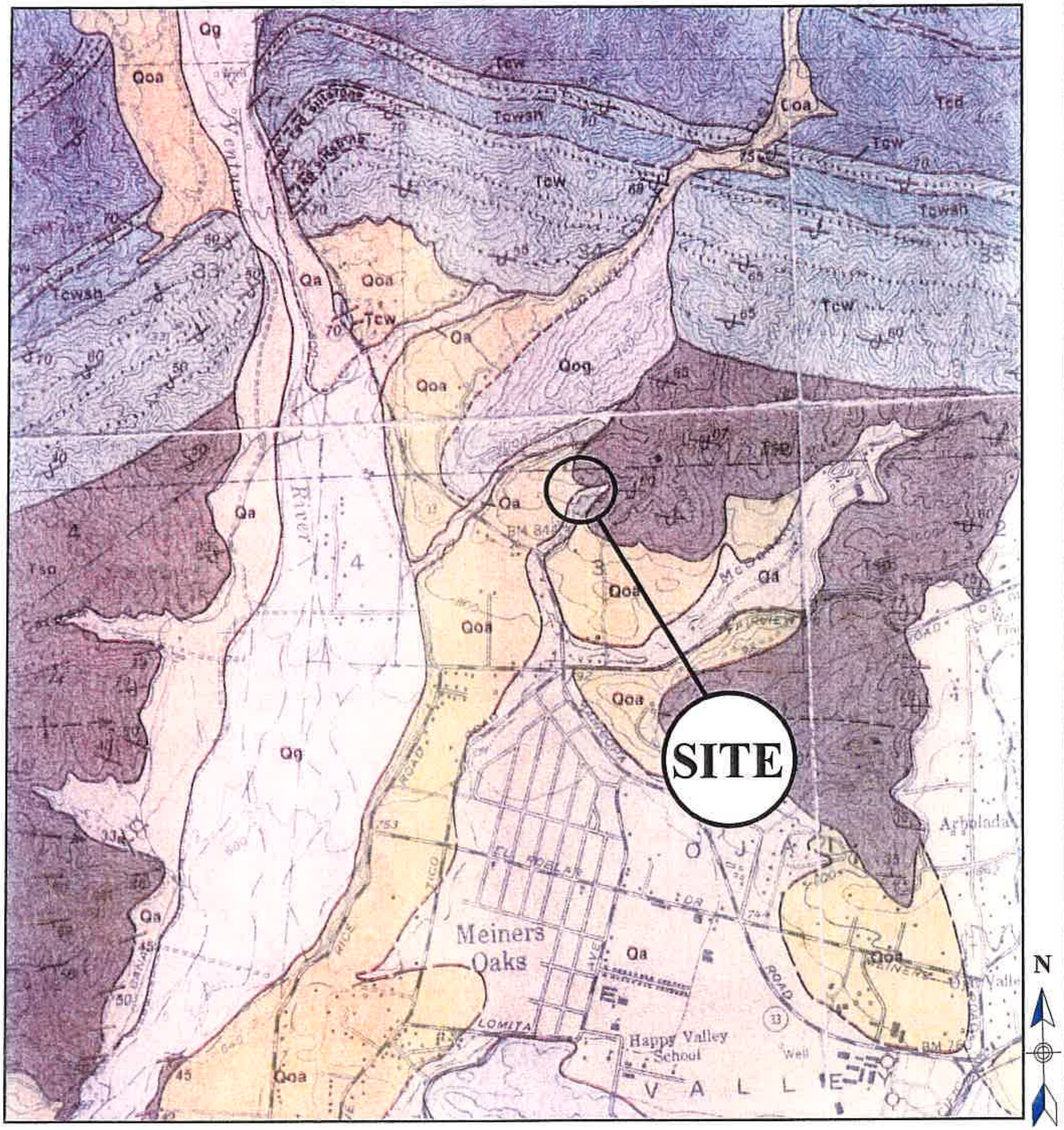


VICINITY MAP

MEINERS OAKS
COUNTY WATER DISTRICT
VENTURA COUNTY, CALIFORNIA

Earth Systems
Southern California

FEBRUARY 2009	VT-24086-01



*Taken from T.W. Dibblee, Jr., Geologic Map of the Matilija Quadrangle, 1987

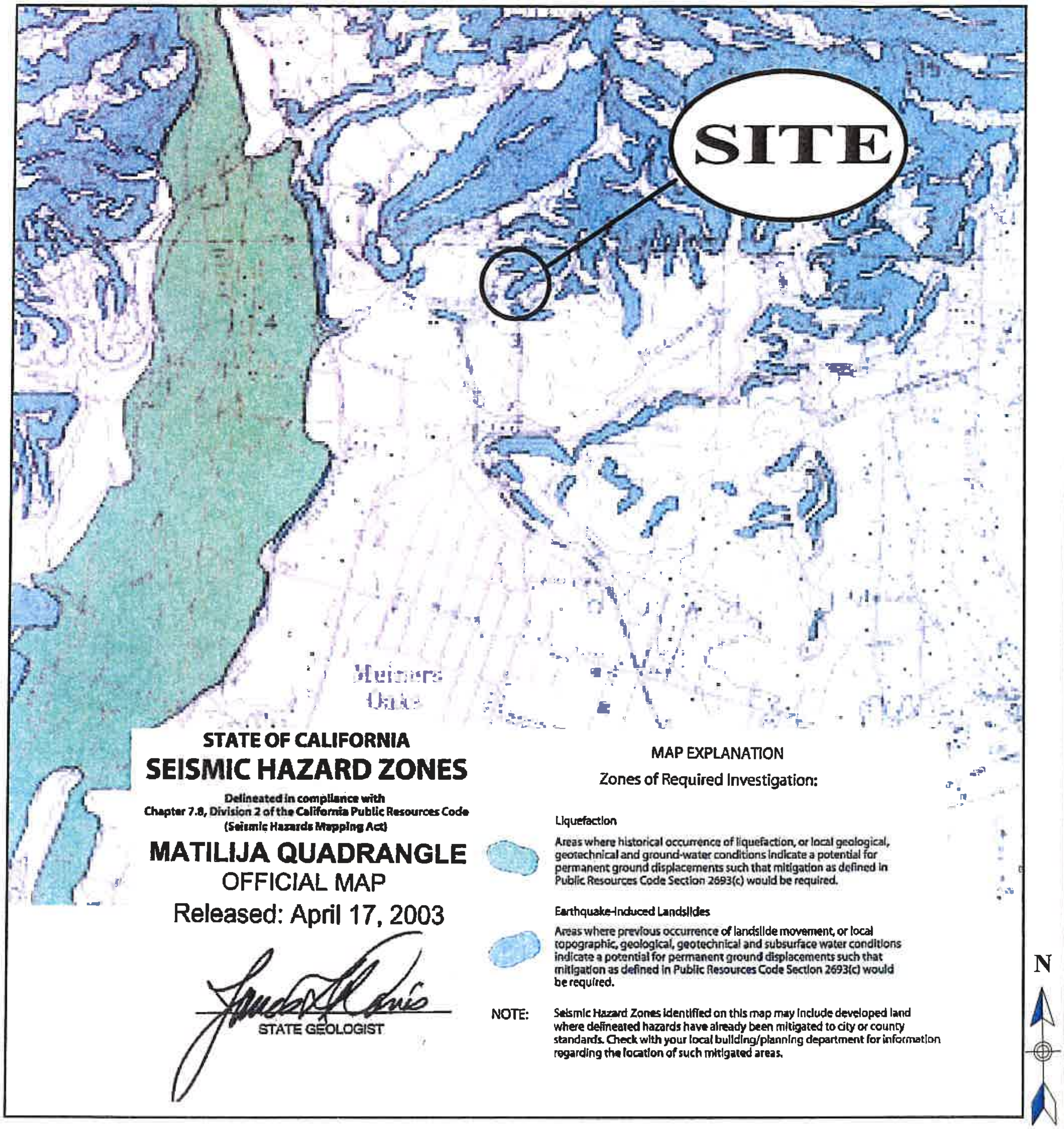
SCALE: 1:24,000

REGIONAL GEOLOGY MAP

MEINERS OAKS
COUNTY WATER DISTRICT
VENTURA COUNTY, CALIFORNIA

Earth Systems
Southern California

FEBRUARY 2009	VT-24086-01

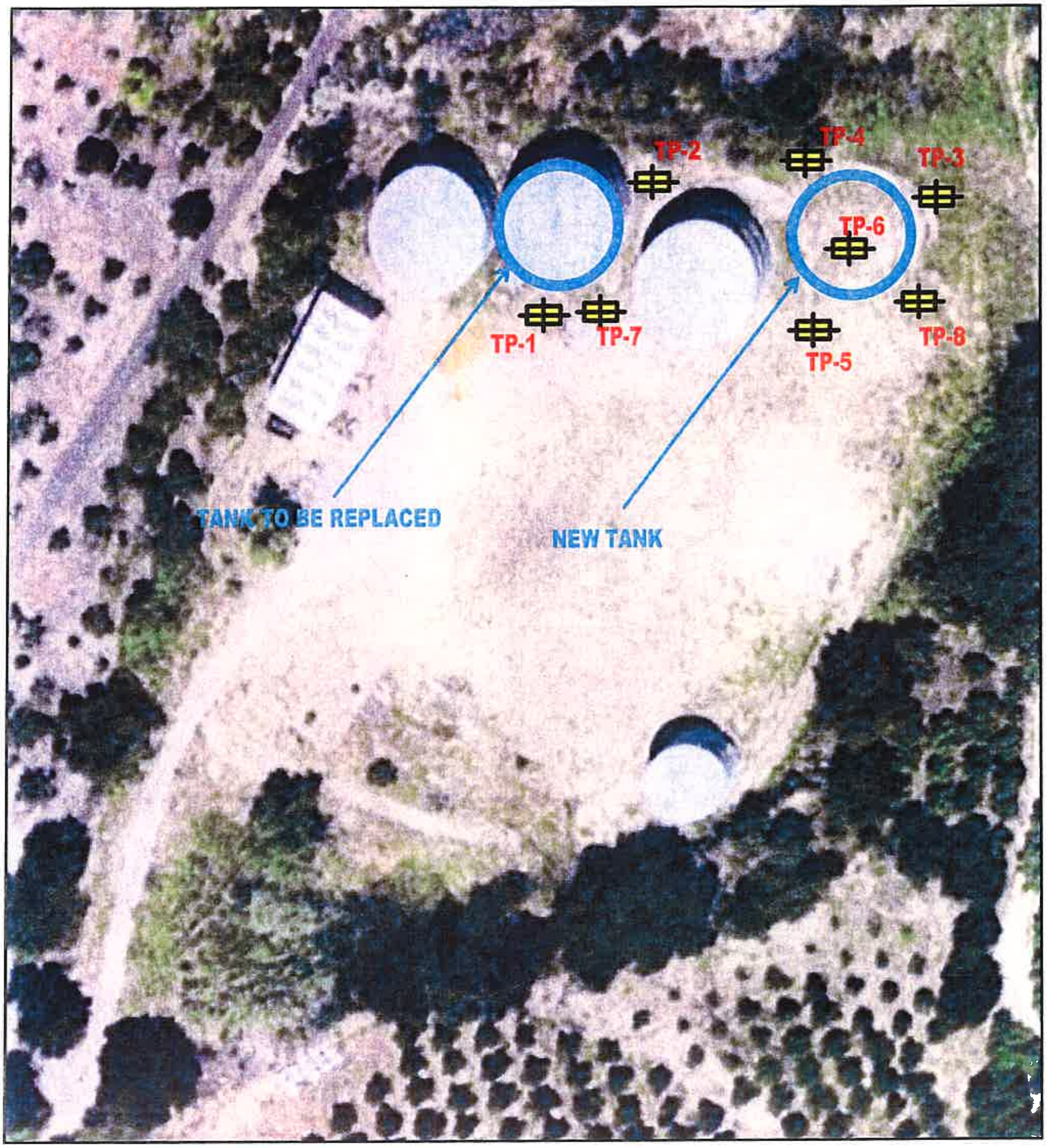


SEISMIC HAZARD ZONES MAP

MEINERS OAKS
COUNTY WATER DISTRICT
VENTURA COUNTY, CALIFORNIA

Earth Systems
Southern California

FEBRUARY 2009 | VT-24086-01



TP-1 TEST PITS LOCATION

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TEST PITS LOCATION MAP

MEINERS OAKS
COUNTY WATER DISTRICT
VENTURA COUNTY, CALIFORNIA

Earth Systems
Southern California

FEBRUARY 2009 | VT-24086-01

Earth Systems Southern California
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

TEST PIT NO: 1	EXCAVATION DATE: January 31, 2008
PROJECT NAME: Meiners Oaks County Water District	EXCAVATION COMPANY: R. Davis Construction
PROJECT NUMBER: VT-24086-01	EXCAVATION METHOD: Backhoe with 24" Bucket
TEST PIT LOCATION: Per Plan	LOGGED BY: Wesley Smith

Vertical Depth	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			■			SM			**FILL:** Clayey silty sand with gravel, asphalt, concrete, medium dense, very moist, dark reddish brown
			■			SC			**FILL:** Silty clayey sand with gravel, asphalt, boulder-sized concrete, metal, loose to stiff, wet, dark reddish brown
5									
10									Final Depth = 4 Feet (Refusal by groundwater) Groundwater first encountered 4 feet and stabilized at 3.5 feet
15									
20									
25									
30									
35									

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

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TEST PIT NO: 2	EXCAVATION DATE: January 31, 2008
PROJECT NAME: Meiners Oaks County Water District	EXCAVATION COMPANY: R. Davis Construction
PROJECT NUMBER: VT-24086-01	EXCAVATION METHOD: Backhoe with 24" Bucket
TEST PIT LOCATION: Per Plan	LOGGED BY: Wesley Smith

Vertical Depth	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	X					CL			**FILL:** Sandy silty clay with gravel, soft, very moist, dark reddish brown
	X		■			N/A	116.7	10.2	**SESPE FORMATION BEDROCK:** Interbedded siltstones to sandstones, weathered, dense to hard, very moist, reddish brown
5									
10									Final Depth = 3.5 Feet No groundwater encountered
15									
20									
25									
30									
35									

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

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1731-A Walter Street, Ventura, California 93003
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TEST PIT NO: 3	EXCAVATION DATE: January 31, 2008
PROJECT NAME: Meiners Oaks County Water District	EXCAVATION COMPANY: R. Davis Construction
PROJECT NUMBER: VT-24086-01	EXCAVATION METHOD: Backhoe with 24" Bucket
TEST PIT LOCATION: Per Plan	LOGGED BY: Wesley Smith

Vertical Depth	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			■			SC			**FILL:** Clayey silty sand with gravel, asphalt, concrete, medium dense, very moist, dark reddish brown
5									
10									Final Depth = 4 Feet (Refusal by groundwater) Groundwater first encountered 2 feet and stabilized at 1.5 feet
15									
20									
25									
30									
35									

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

Earth Systems Southern California
1731-A Walter Street, Ventura, California 93003
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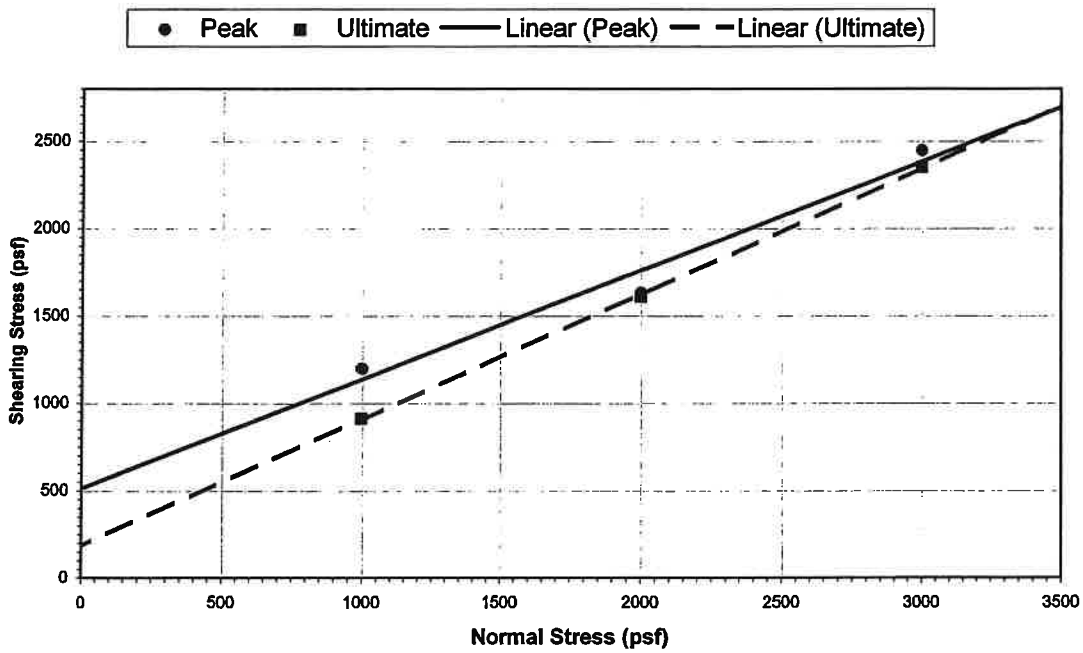
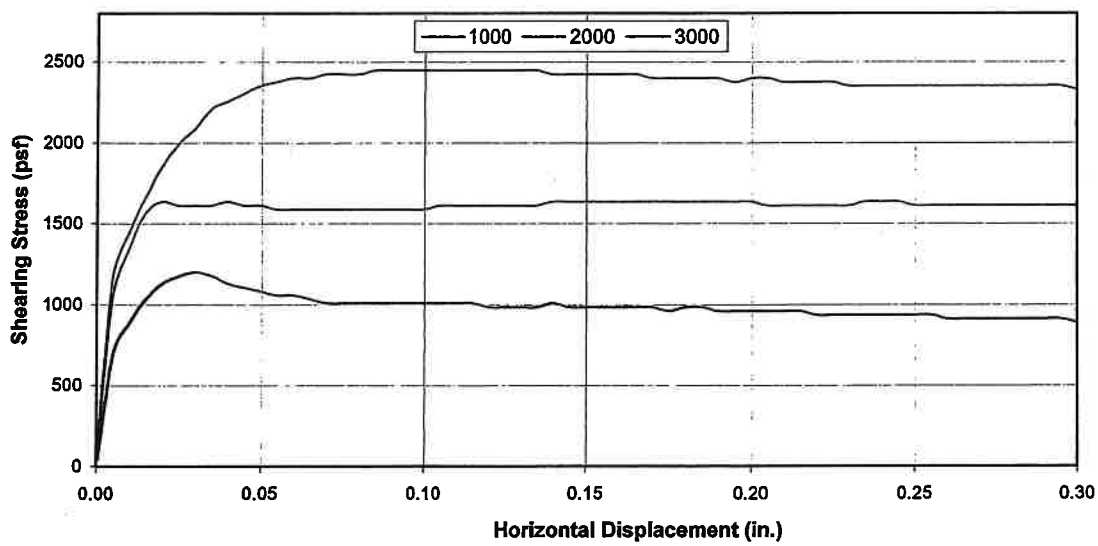
TEST PIT NO: 4	EXCAVATION DATE: March 11, 2008
PROJECT NAME: Meiners Oaks County Water District	EXCAVATION COMPANY: R. Davis Construction
PROJECT NUMBER: VT-24086-01	EXCAVATION METHOD: Backhoe with 24" Bucket
TEST PIT LOCATION: Per Plan	LOGGED BY: Wesley Smith

Vertical Depth	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	X		■			N/A	N/A	N/A	**FILL:** Sandy silty clay with gravel, cobbles, and asphalt, soft, very moist, dark reddish brown
5			■			N/A	113.8	8.9	**SESPE FORMATION BEDROCK:** Interbedded siltstones to sandstones, weathered, dense to hard, very moist, reddish brown
10									Final Depth = 7 Feet Groundwater encountered at 7 feet
15									
20									
25									
30									
35									

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





DIRECT SHEAR DATA*

Sample Location: T P 8 @ 0-5
Sample Description: Gravelly Silty Sand
Dry Density (pcf): 113.9
Intial % Moisture: 9
Average Degree of Saturation: 95.5
Shear Rate (in/min): 0.0257 in/min

Normal stress (psf)	1000	2000	3000
Peak stress (psf)	1200	1632	2448
Ultimate stress (psf)	912	1608	2352

	Peak	Ultimate
ϕ Angle of Friction (degrees):	32	36
c Cohesive Strength (psf):	510	180

Test Type: Peak,Ultimate

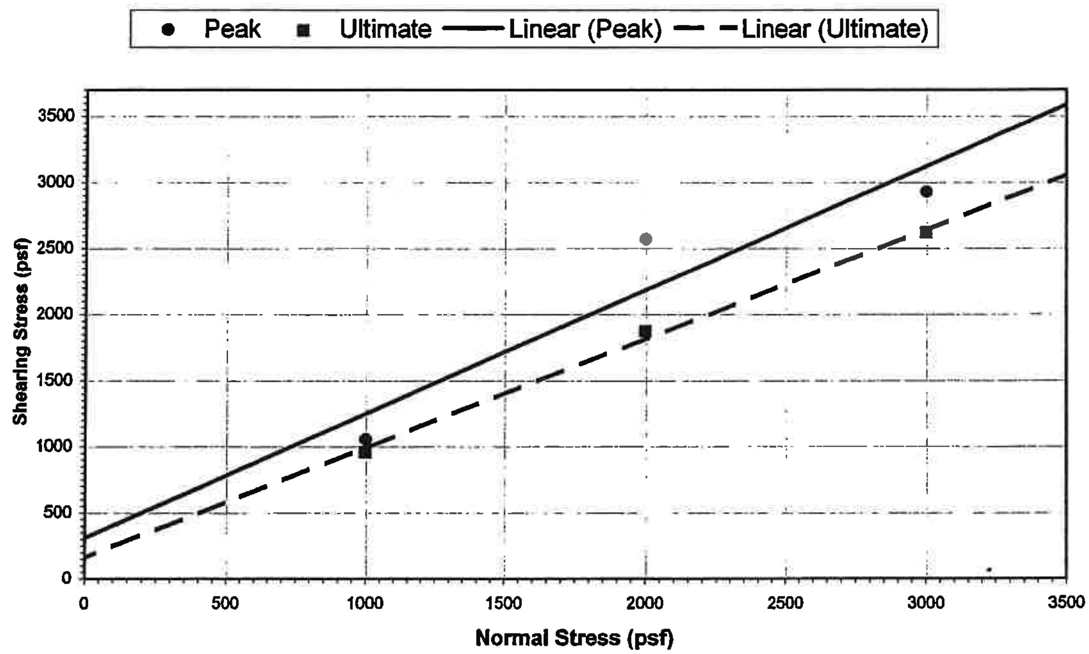
* Test Method: ASTM D-3080

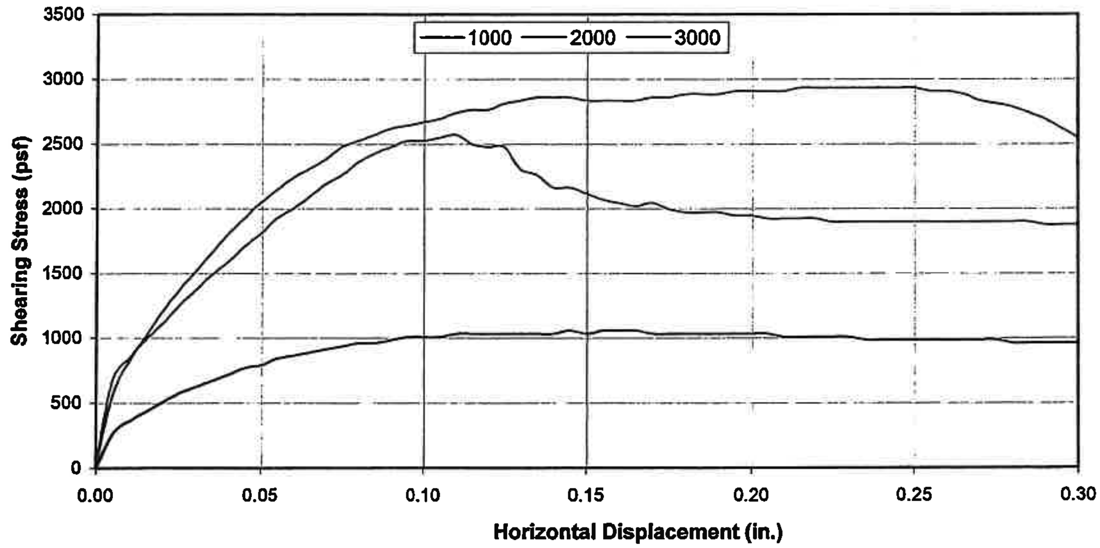
DIRECT SHEAR TEST

Meiners Oaks H2O Tanks

Earth Systems
Southern California

1/5/2009 VT-24086-01





DIRECT SHEAR DATA*

Sample Location: T P 2 @ 2.5
Sample Description: Siltstone Sandtone
Dry Density (pcf): 116.7
Intial % Moisture: 10.2
Average Degree of Saturation: 100.0
Shear Rate (in/min): 0.024 in/min

Normal stress (psf)	1000	2000	3000
Peak stress (psf)	1056	2568	2928
Ultimate stress (psf)	960	1872	2616

	Peak	Ultimate
ϕ Angle of Friction (degrees):	43	40
c Cohesive Strength (psf):	310	160

Test Type: Peak,Ultimate

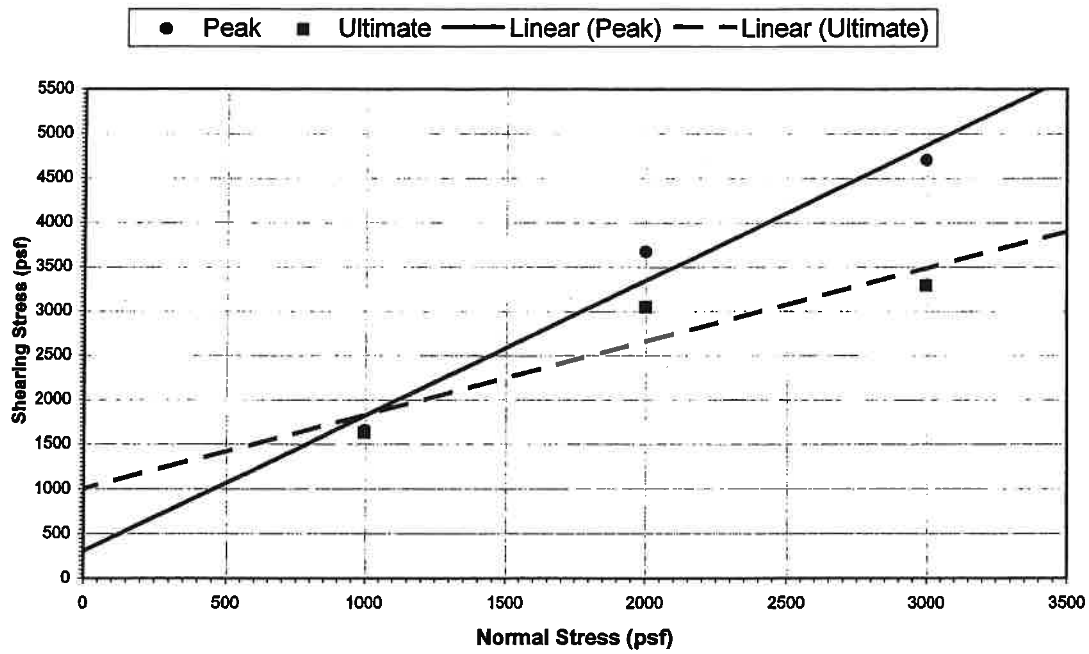
* Test Method: ASTM D-3080

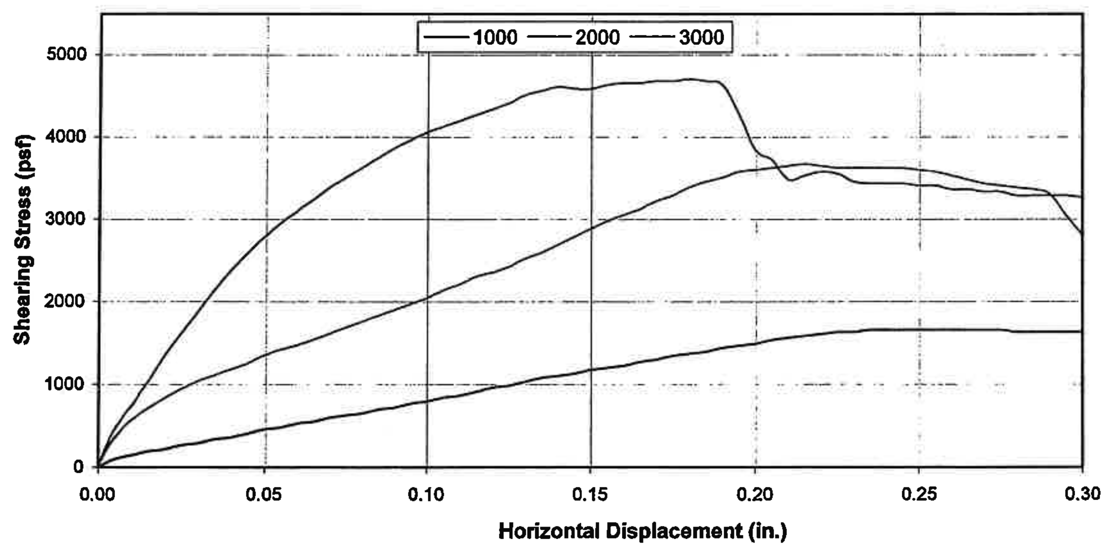
DIRECT SHEAR TEST

Meiners Oaks H2O Tanks

Earth Systems
Southern California

1/5/2009 | VT-24086-01





DIRECT SHEAR DATA*

Sample Location: T P 4 @ 4.5'
Sample Description: Siltstone Sandtone
Dry Density (pcf): 113.8
Intial % Moisture: 8.9
Average Degree of Saturation: 100.0
Shear Rate (in/min): 0.0116 in/min

Normal stress (psf)	1000	2000	3000
Peak stress (psf)	1656	3672	4704
Ultimate stress (psf)	1632	3048	3288

	Peak	Ultimate
ϕ Angle of Friction (degrees):	57	40
c Cohesive Strength (psf):	290	1000

Test Type: Peak,Ultimate

* Test Method: ASTM D-3080

DIRECT SHEAR TEST

Meiners Oaks H2O Tanks

Earth Systems
Southern California

1/5/2009 | VT-24086-01

File No.: VT-24086-01 January 5, 2009

EXPANSION INDEX

ASTM D-4829, UBC 18-2

Job Name: Meiner Oaks H2O Tanks
Sample ID: T P 8 @ 0-5
Soil Description: SM

Initial Moisture, %:	8.3
Initial Compacted Dry Density, pcf:	116.9
Initial Saturation, %:	51
Final Moisture, %:	15.8
Volumetric Swell, %:	0.8

Expansion Index: **8** **Very Low**

EI	UBC Classification
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
130+	Very High

SHORT HYDRO

Job Name:	Meiners Oaks Water Tanks
Job No.:	VT-24086-01
Sample ID:	**TP8 @ 0-5'**
Soil Description:	**SM/SW**

Hydroscopic Moisture

Air Dry Wt, g:	100.0
Oven Dry Wt, g	98.0
% Moisture:	2.0

Air Dry Sample Wt., g:	1051.1
Corrected Wt., g:	1030.5

Sieve Analysis for +#10 Material

Sieve Size	Wt Ret	% Ret	% Passing
1/2 inch		0.00	100.00
3/8 inch	116.7	11.10	88.90
#4	219.4	20.87	79.13
#8	319.5	30.40	69.60
#10	336.1	31.98	68.02

Air Dry Hydro Sample Wt., g:	89.3
Corrected Wt., g:	87.5
Calculation Factor	1.2864

Hydrometer Analysis for <#10 Material

Start time: 5:06:00 AM

Short Hydro	Time of Reading	Hydro Reading	Temp. at Reading, °C	Correction Factor	Corrected Hydro Reading
20 sec	5:06:20 AM	46	15	6.2	39.8
1 hour	6:06:00 AM	24	15	6.2	17.8
6 hour	11:06:00 AM	19	14	6.6	12.4

% Gravel:	20.9
% Sand(2mm - 74µm):	48.2
% Silt(74µm- 5µm):	17.1
% Clay(5µm - 2µm):	4.2
% Clay(≤2µm):	9.6

CAPCO
Analytical Services, Inc

Client: Earth Systems Southern California
CAS LAB NO: 08335401
Sample ID: TP8 @ 0-5'
Analyst: CR

Date Sampled: 12/03/08
Date Received: 12/09/08
Sample Matrix: Soil

WET CHEMISTRY ANALYSIS SUMMARY

COMPOUND	RESULTS	UNITS	DF	PQL	METHOD	ANALYZED
*Chloride	11	mg/Kg	1	0.3	300.0M	12/11/08
pH	7.6	S.U.	1	--	9045	12/09/08
*Resistivity	4400	ohms-cm	1	--	CA Test 424	12/10/08
*Sulfate	160	mg/Kg	1	1.5	300.0M	12/11/08

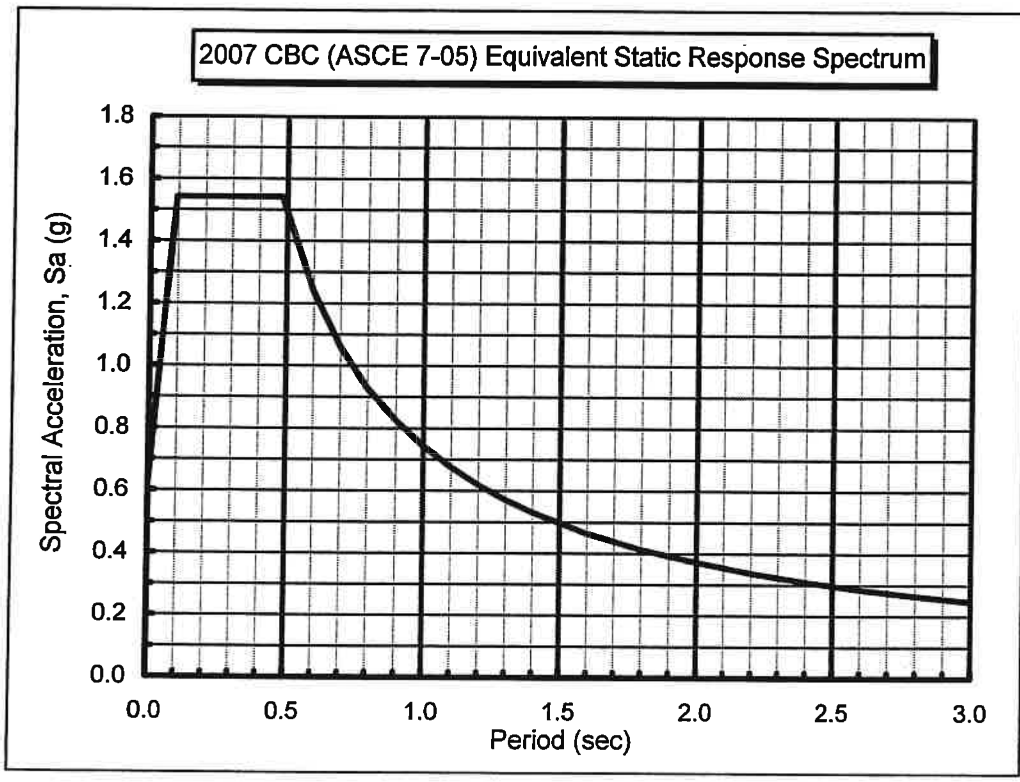
*Sample was extracted using a 1:3 ratio of soil and DI water.
Results were based on the original sample weight.
PQL: Practical Quantitation Limit
DF: Dilution Factor

AM Jay
Laboratory Supervisor

Anahit Aivazyan
Principal Analyst

2007 California Building Code (CBC) & ASCE 7-05 Seismic Parameters

				CBC Reference	ASCE 7-05 Reference
Seismic Design Category:		**E**		Table 1613.5.6	Table 11.6-2
Site Class:		**C**		Table 1613.5.2	Table 20.3-1
Latitude:		34.463	N		
Longitude:		-119.276	W		
Maximum Considered Earthquake (MCE) Ground Motion					
Short Period Spectral Response	S_S	**2.312**	**g**	Figure 1613.5	Figure 22-3
1 second Spectral Response	S_1	**0.857**	**g**	Figure 1613.5	Figure 22.4
Site Coefficient	F_a	1.00		Table 1613.5.3(1)	Table 11.4-1
Site Coefficient	F_v	1.30		Table 1613.5.3(2)	Table 11-4.2
	S_{MS}	2.312	g	$= F_a*S_S$	
	S_{M1}	1.114	g	$= F_v*S_1$	
Design Earthquake Ground Motion					
Short Period Spectral Reponse	S_{DS}	**1.541**	**g**	$= 2/3*S_{MS}$	
1 second Spectral Response	S_{D1}	**0.743**	**g**	$= 2/3*S_{M1}$	
	To	0.10	sec	$= 0.2*S_{D1}/S_{DS}$	
	Ts	0.48	sec	$= S_{D1}/S_{DS}$	



Period T (sec)	Sa (g)
0.00	0.617
0.05	1.096
0.10	1.541
0.20	1.541
0.30	1.541
0.48	1.541
0.60	1.238
0.70	1.061
0.80	0.928
0.90	0.825
1.00	0.743
1.10	0.675
1.20	0.619
1.30	0.571
1.40	0.531
1.60	0.464
1.80	0.413
2.00	0.371
2.20	0.338
2.40	0.309
2.60	0.286