GEOTECHNICAL ENGINEERING INVESTIGATION

WILLOW ROAD EXTENSION – PHASE I
POMEROY ROAD TO HETRICK ROAD
SAN LUIS OBISPO COUNTY, CALIFORNIA

For

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December 22, 2008 Job No. 203125.PH1

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INTRODUCTION

This report presents the results of our geotechnical engineering investigation for the proposed Willow Road Extension – Phase I in Nipomo, an unincorporated area located in southwestern San Luis Obispo County, California. Our work was performed generally in accordance with the scope of work as per our agreement. The location of the site and its vicinity are shown on the Location Map, Plate 1.

The geotechnical recommendations presented in this report are intended for design input and are not intended to be used as specifications. These recommendations should not be used for bidding purposes or directly for construction cost estimates.

PROPOSED CONSTRUCTION

Based on the plans provided by Rajappan & Meyer Consulting Engineers Inc., the proposed Phase I project consists of extension of the existing Willow Road from Pomeroy Road to Hetrick Road in Nipomo, California. Willow Road currently terminates at Pomeroy Road.

The future Willow Road extension will continue with an interchange at Route 101, an undercrossing under the existing Route 101, a bridge crossing over Nipomo Creek, and ends by joining at grade with the existing North Thompson Avenue. A frontage road along the southwest corner of the future Willow Road/Route 101 interchange is also planned. This report covers the results of our geotechnical engineering investigation for the proposed Willow Road Extension – Phase I. Investigation results for the interchange, undercrossing, and bridge structures are covered under separate geotechnical reports.

The proposed roadway extension is generally in cut. A retention basin up to approx. 10 feet deep is proposed at the northwestern corner of the intersection of the existing Willow Road and Pomeroy Road.

Our recommendations presented in this report are based on the above information. Any major deviations should be reported to our office for further consideration.

PURPOSE AND SCOPE

The purpose of this investigation was to evaluate the general soil conditions at the project site, to evaluate their engineering properties, and to provide recommendations for structural pavements and a retention basin for the proposed Willow Road Extension – Phase I.

The scope of work performed for this investigation included a review of the readily available soils and geologic literature, obtain representative soil samples and log soil materials encountered in six drilled borings, laboratory testing of the collected samples, engineering analysis of the field and laboratory data, and preparation of this report.

Due to limitations inherent in geotechnical investigations, it is neither uncommon to encounter unforeseen variations in the soil conditions during construction nor is it practical to determine all such variations during an acceptable program of drilling and sampling for a project of this scope. Such variations, when encountered, generally require additional geotechnical engineering services to attain a properly constructed project. We, therefore, recommend that a contingency fund be provided to accommodate any additional charges resulting from technical services that may be required during construction.

SITE CONDITIONS

The project site is located in a mainly suburban and residential area of Nipomo. The area immediately west of Route 101 is moderately populated with residential dwellings, while the areas immediately east of Route 101 are open agricultural fields and a green house nursery is located to the southeast of the site. Based on the topographic plans provided to us, the site vicinity is generally undulating with elevations ranging from 350 to 420 feet. There are developments and residential units in the general vicinity of the proposed Phase I alignment.

FIELD EXPLORATION & LABORATORY TESTS

Based on the preliminary plans, discussions with the designers, and readily available geotechnical data in the area, six exploratory borings were drilled at selected locations to maximum depths of 20 feet below the existing ground surface. The approximate locations of the borings are shown on the Site Plan, Plate 2 and Log of Test Boring (LOTB) sheets.

The test borings were advanced with a truck-mounted drill rig using hollow stem auger drilling method. Selected samples were obtained from 2.5-inch I.D. & 3.0-inch O.D. (Modified California) sampler at various depths. The samplers were driven into subsurface soils under the impact of a 140-pound hammer having a free fall of 30 inches. (When correlating standard penetration data, the blow counts for the Modified California Sampler can be converted to equivalent SPT blow counts by multiplying a conversion factor of 0.65). The samples were sealed and transported to our laboratory for further evaluation and testing. The field investigation was conducted under the supervision of our field engineer who logged the test borings and prepared the samples for subsequent laboratory testing and evaluation.

The LOTB summarizes the findings from the exploration and is presented in Appendix A. The boring logs presented were prepared from the field logs which were edited after visual re-examination of the soil samples in the laboratory and results of classification tests on selected soil samples as indicated on the logs. The abrupt stratum changes shown on these logs may be gradational and relatively minor changes in soil types within a stratum may not be noted on the logs due to field limitations.

Laboratory tests were performed on selected samples obtained during field exploration to determine the physical and engineering properties of the subsoils. Laboratory data of moisture contents, dry density, and grain size distribution are presented on the LOTB. Detail results of laboratory tests are presented in Appendix B.

GEOLOGY

General geologic features pertaining to the site were evaluated by reference to the geology map titled "Generalized Geology of the Arroyo Grande-Nipomo Mesa Area" by the Department of Water

Resources, Southern District, 2002. The accompanied geologic section C-C' was also referenced in our evaluation. Based on the map and the geologic section, the site can be divided into two portions, namely west and east of Route 101. West of Route 101, the subject site is generally underlain by older dune sand (Qos); East of Route 101, the subject site is generally underlain by older alluvial deposits (Qoal). The geologic map and the geologic section C-C' are shown on Plates 3A and 3B, respectively.

SUBSURFACE CONDITIONS

Based on the investigation and readily available data, the subsoils at the Phase I extension are underlain by older dune sand deposits. The soils generally consist of loose silty sand at shallow depth and grade to medium dense silty sand and poorly graded sand with depth.

Groundwater was not encountered above Elev. 350 feet within Phase I alignment during field exploration in January 2007. However, groundwater level may vary with the passage of time due to seasonal rainfall, surface and subsurface flows, ground surface run-off and other factors that may not be present at the time of investigation.

Detailed descriptions of the materials encountered in each of the exploratory borings are presented on the LOTB, Appendix A. It should be noted that these descriptions and related information depict subsurface conditions only at the locations indicated on the LOTB and on particular date noted. Because of the variability from place to place within soils in general, subsurface conditions at other locations may differ from conditions occurring at the locations explored. Also, the passage of time may result in a change in soil conditions at these locations due to environmental changes.

EARTHQUAKE CONSIDERATIONS

Seismic Sources

The project site is located in a seismically active part of central coastal California. Many faults exist in the San Luis Obispo Area are capable of producing earthquakes that may cause strong ground shaking at the site. Maximum credible earthquake magnitudes for some of the major faults in the area as determined by Mualchin (1996) are summarized below. These maximum credible

earthquake magnitudes represent the largest earthquakes that could occur on the given fault based on the current understanding of the regional tectonic structure.

EARTHQUAKE DATA

Fault	Type	Estimated Distance From Project Site	Maximum Credible Earthquake	Anticipated Peak Bedrock Acceleration
SMF – Santa Maria River-Foxen Canyon	Reverse (including thrust)	0.8 mile	6.5	0.7 g
OCO – Oceano	Reverse (including thrust)	2.7 miles	6.0	0.4 g

Active faults in the vicinity include the Santa Maria River-Foxen Canyon Fault (reverse fault, Mw = 6.5) located at approximately 0.8 mile from the site, and the Oceano Fault (reverse fault, Mw = 6.0) located at approximately 2.7 miles from the site. Based on the seismic hazard map prepared by Mualchin (1996) and attenuation relationship proposed by Sadigh, et al (1997), a Peak Bedrock Acceleration of 0.7 g is anticipated at the site. The fault map for the project vicinity is shown on the Fault Map, Plate 4.

Seismic Hazards/Liquefaction Potential

Potential seismic hazards may arise from three sources: surface fault rupture, ground shaking, and liquefaction.

Surface Fault Rupture

According to the County of San Luis Obispo Local Hazard Mitigation Plan (LHMP), the Santa Maria River and Foxen Canyon faults are buried northwest-striking reverse faults. The fault trace is buried and is inferred to parallel the Santa Maria River and U.S. Highway 101. The fault zone is mapped as extending into the southern segment of the Wilmar Avenue fault zone and appears to coincide with Nipomo Creek, which is located at approx. 0.8 mile from the site. The geologic section (profile C-C' as shown on the geologic map) is attached (Plate 3B) to show the relative locations of Hetrick Road, Wilmar Avenue Fault/Nipomo Creek and Route 101. The potential for surface fault rupture is relatively low for the proposed Phase I project.

Ground Shaking

Based on available geological and seismic data, the possibility of the site to experience strong ground shaking may be considered moderate to high.

Liquefaction Potential

Liquefaction is a phenomenon in which saturated cohesionless soils are subject to a temporary but essentially total loss of shear strength under the reversing, cyclic shear stresses associated with earthquake shaking. Submerged cohesionless sands and silts of low relative density are the type of soils, which usually are susceptible to liquefaction. Clays are generally not susceptible to liquefaction.

Based on the current investigation, groundwater was encountered above Elev. 350 feet. The existing grade of Phase I extension generally varies form Elev. 370 feet to 419 feet. In our opinion, the liquefaction potential for the proposed Phase I extension may be considered relatively low.

FINDINGS AND RECOMMENDATIONS

General

Based on the findings of our investigation, it is our opinion that the site is feasible for the planned project provided the recommendations presented in this report are incorporated into the final design and construction.

This report was prepared specifically for the proposed roadway extension – Phase I as presented in the general plans provided to us. Normal construction procedures were assumed throughout our analysis and represent one of the basis of recommendations presented herein. Our design criteria have been based upon the materials encountered on the site. Therefore, we should be notified in the event that these conditions are changed, so as to modify or amend our recommendations.

Structural Pavement Sections

Based on the layout plans provided by Rajappan & Meyer, six borings were drilled in the vicinity of the proposed Willow Road Extension – Phase I. R-value tests were performed on the soil samples

collected from the borings. The subgrade soils generally consist of silty sands and poorly-graded sand with silt. The subgrade material and R-value test results are summarized below:

SUMMARY OF SUBGRADE SOIL & R-VALUE RESULTS

Location	Depth	Description	R-Value
B-1	5’	Silty Sand (SM), reddish brown, moist	71
B-6	5’	Silty Sand (SM), reddish brown, moist	74

Based on the laboratory test results, the R-values are over 70 due to sandy nature of the subgrade material. However, for design purposes and in accordance with Caltrans standard practice, an R-value of 40 was adopted for our analysis. A design Traffic Index (T.I.) of 9.5 was provided by the County. The recommended pavement section options are presented in the following table.

STRUCTURAL PAVEMENT SECTIONS

Locations	R-value	Design Life (years)	TI	Structural Pavement Sections			
				Composite Sections			Full Depth HMA
				RHMA-G	HMA	AB	AC
Willow Road Ext.	40	20	9.5	0.10’	0.40’	0.85’	0.90’
Lateral Streets	40	20	9.5	--	0.50’	0.85’	0.90’

Hot Mix Asphalt (Asphalt Concrete) and Aggregate Bases (Class 2 or 3, AB) should conform to the Caltrans Standard Specifications in Section 39 and 26 respectively. RHMA-G is the gap-graded rubberized asphalt. It is our understanding that the County prefers to use rubberized asphalt on Willow Road extension for better noise control. Therefore, per Caltrans Highway Design Manual, the upper 0.10’ (minimum) of HMA is replaced with RHMA-G. Due to native sandy soil conditions, open-graded rubberized asphalt is not desirable. Pavement subgrade and structural sections should be prepared and compacted in accordance with the project specifications and Caltrans standard.

Grading

All grading operations should be performed in accordance with the project specifications and Caltrans Standard Specifications for Earthwork (Section 19). A representative from our office or

regulating agency should observe all excavated areas during grading and perform moisture and density tests on prepared subgrade and compacted fill material. Any fill material imported to the site should be non-expansive and granular material. It should also be non-corrosive, free of deleterious material and should be reviewed by the Geotechnical Engineer.

Due to sandy nature of the on-site soils, it is recommended that erosion control measures be implemented on the finish slopes of the project.

Should there be any alterations of the proposed construction that will affect the stated bases of our recommendations, we should be informed so that we can review such changes and amend our recommendations.

Engineered Fill. Engineered fill should be non-expansive and consist of relatively granular material having a P.I. of less than 15. In addition, we recommend that the material within three feet of the proposed pavement subgrade should be granular in nature, and have a minimum R-value of 40. The fill shall also be free of organic and inorganic debris, rubbles and any other deleterious material. The on-site soils may be used as engineered fill, provided they meet the above criteria.

Slope Ratio. For construction purposes, a temporary slope ratio up to 1.5H:1V may be used. Local irregularities, such as loose sand pockets/layers, may require flattening of the slope. For permanent slope ratio, a gradient no steeper than 2H:1V is recommended with proper erosion control measures for on-site sandy soils. Excavation, slope ratios and other safety-related issues should conform to OSHA guidelines.

Compaction of Fill and Subgrades. The project specific recommendations for required compaction as per Caltrans standards are as follows:

- 90% for subgrade preparation, general fill and backfilling after removing buried utilities, and depressions caused due to construction activities, etc.
- 95% for all engineered fill for structural backfill of footing subgrade, and for upper 6 inches of pavement subgrade and aggregate base of pavement sections.

Retention Basin

In order to determine the particle size distribution, two gradation analyses were conducted on the soil samples obtained from the vicinity of the proposed retention basin, namely B-1 at 5 feet and SW-2 at 9.5 feet. Based on the results from the gradation analysis, the soil is classified as silty sand and poorly-graded sand with silt respectively. Based on published values of permeability for typical soil types[1], the permeability of this soil is expected to be in the order of $k = 1 \times 10^{-2}$ cm/sec.

Per information provided, the basin is up to 10 feet deep. For temporary construction, the cut slope ratio should not be steeper than 1.5H:1V. Local irregularities may require the slope to be flatter. If there are right-of-way limits or other physical restrictions, the basin excavation may require temporary shoring for construction. It is also our understanding that crushed rock backfill is planned for the basin. It is recommended that a layer geotextile filter fabric be used between the crushed rock backfill and native sandy soils to prevent migration of fine soils into the voids of the crushed rock. The geotextile filter fabric should conform to Caltrans Standard Specifications (Section 88-1.03, Filter Fabric).

Corrosion

Per Caltrans guidelines and based on the corrosion test data, the subsurface soil at this site is considered non-corrosive. Corrosion data is presented in the table below.

CORROSION TEST RESULTS

Boring	Location		Depth (ft)	Minimum Resistivity (ohms-cm)	pH	Chloride (ppm)	Sulfate (ppm)
	Sta.	Offset					
SW-3	293+00	7 ft Rt.	4.5	9380	4.79	14.2	20.0

Based on the data, the site is considered non-corrosive per Caltrans latest corrosion design guidelines. Standard Type II modified or Type I-P (MS) modified cement may be used for the concrete substructures. The minimum cement factor should be per Caltrans Bridge Design Specifications (Section 8.22).

1 *Introductory Soil Mechanics And Foundations*, George B. Sowers & George F. Sowers, 1970

Plan Review

We recommend that final plans be reviewed by this office prior to construction so that the intent of our recommendations is included in the project plans and specifications and to further see that no misunderstandings or misinterpretations have occurred.

Construction Observation

To a degree, the performance of any structure is dependent upon construction procedures and quality. Hence, observation of foundation excavations should be carried out by the regulating agencies. If the subsurface conditions different from those forming the basis of our recommendations are encountered, this office should be informed in order to assess the need for design changes. Therefore, the recommendations presented in this report are contingent upon good quality control and these geotechnical observations during construction.

INVESTIGATION LIMITATIONS

Our services consist of professional opinions and recommendations made in accordance with generally accepted geotechnical engineering principles and practices and are based on our site reconnaissance and the assumption that the subsurface conditions do not deviate from observed conditions. All work done is in accordance with generally accepted geotechnical engineering principles and practices. No warranty, expressed or implied, of merchantability or fitness, is made or intended in connection with our work or by the furnishing of oral or written reports or findings. The scope of our services did not include any environmental assessment or investigation for the presence or absence of hazardous or toxic materials in structures, soil, surface water, groundwater or air, below or around this site. Unanticipated soil conditions are commonly encountered and cannot be fully determined by taking soil samples and excavating test borings; different soil conditions may require that additional expenditures be made during construction to attain a properly constructed project. Some contingency fund is thus recommended to accommodate these possible extra costs.

This report has been prepared for the proposed Phase I roadway extension as described earlier, to assist the engineer in the design of this project. In the event any changes in the design or location of the facilities are planned, or if any variations or undesirable conditions are encountered during

construction, our conclusions and recommendations shall not be considered valid unless the changes or variations are reviewed and our recommendations modified or approved by us in writing.

This report is issued with the understanding that it is the designer's responsibility to ensure that the information and recommendations contained herein are incorporated into the project and that necessary steps are also taken to see that the recommendations are carried out in the field.

The findings in this report are valid as of the present date. However, changes in the subsurface conditions can occur with the passage of time, whether they be due to natural processes or to the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards occur, whether they result from legislation or from the broadening of knowledge. Accordingly, the findings in this report might be invalidated, wholly or partially, by changes outside of our control.

Respectfully submitted,
PARIKH CONSULTANTS, INC.

Y. David Wang, Ph.D., P.E. C52911
Senior Engineer

REGISTERED PROFESSIONAL ENGINEER
GAURANG R. PARIKH
No. 666
EXP. 12-31-09
GEOTECHNICAL
STATE OF CALIFORNIA

Gary Parikh, P.E., G.E. 666
Project Manager

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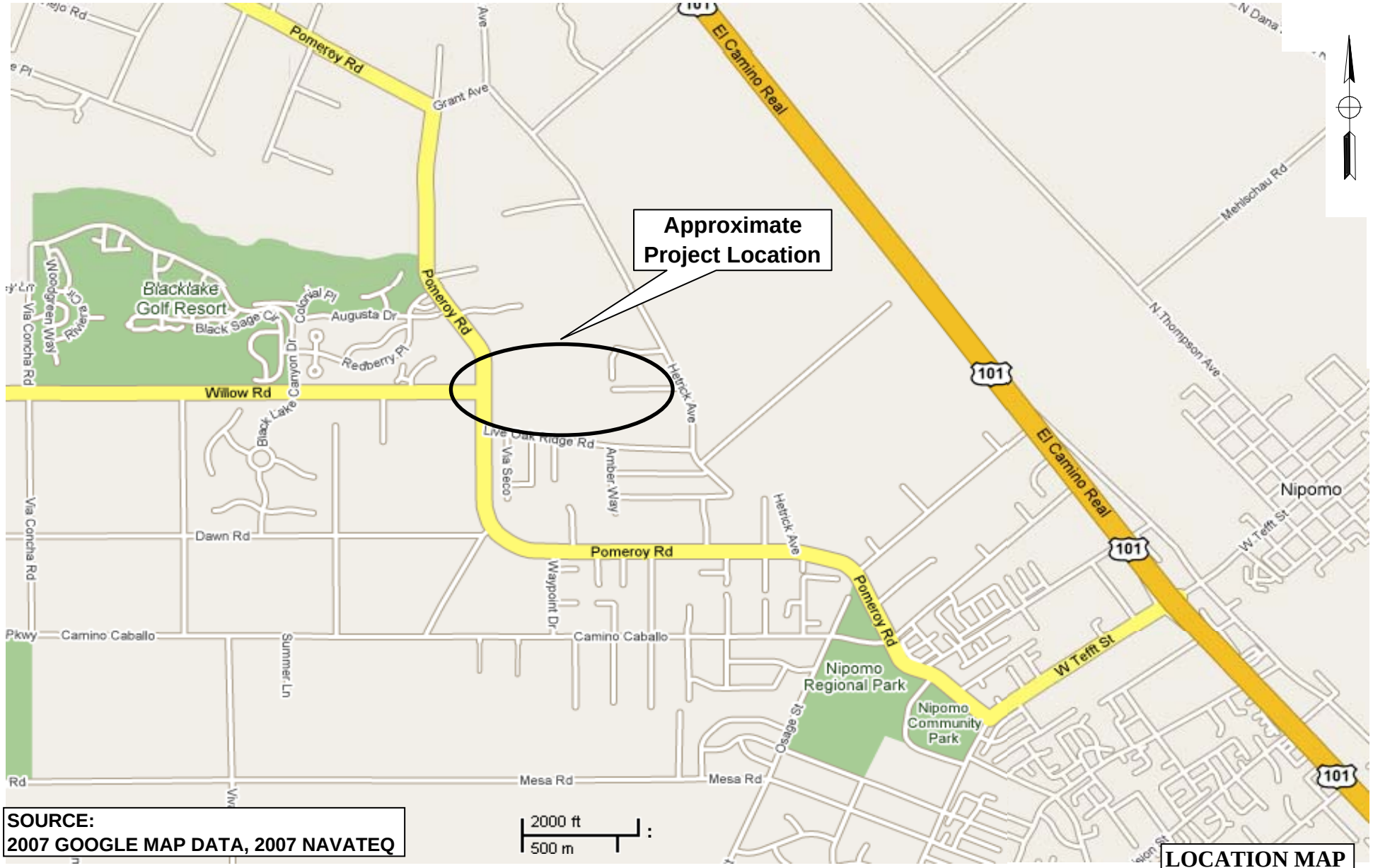
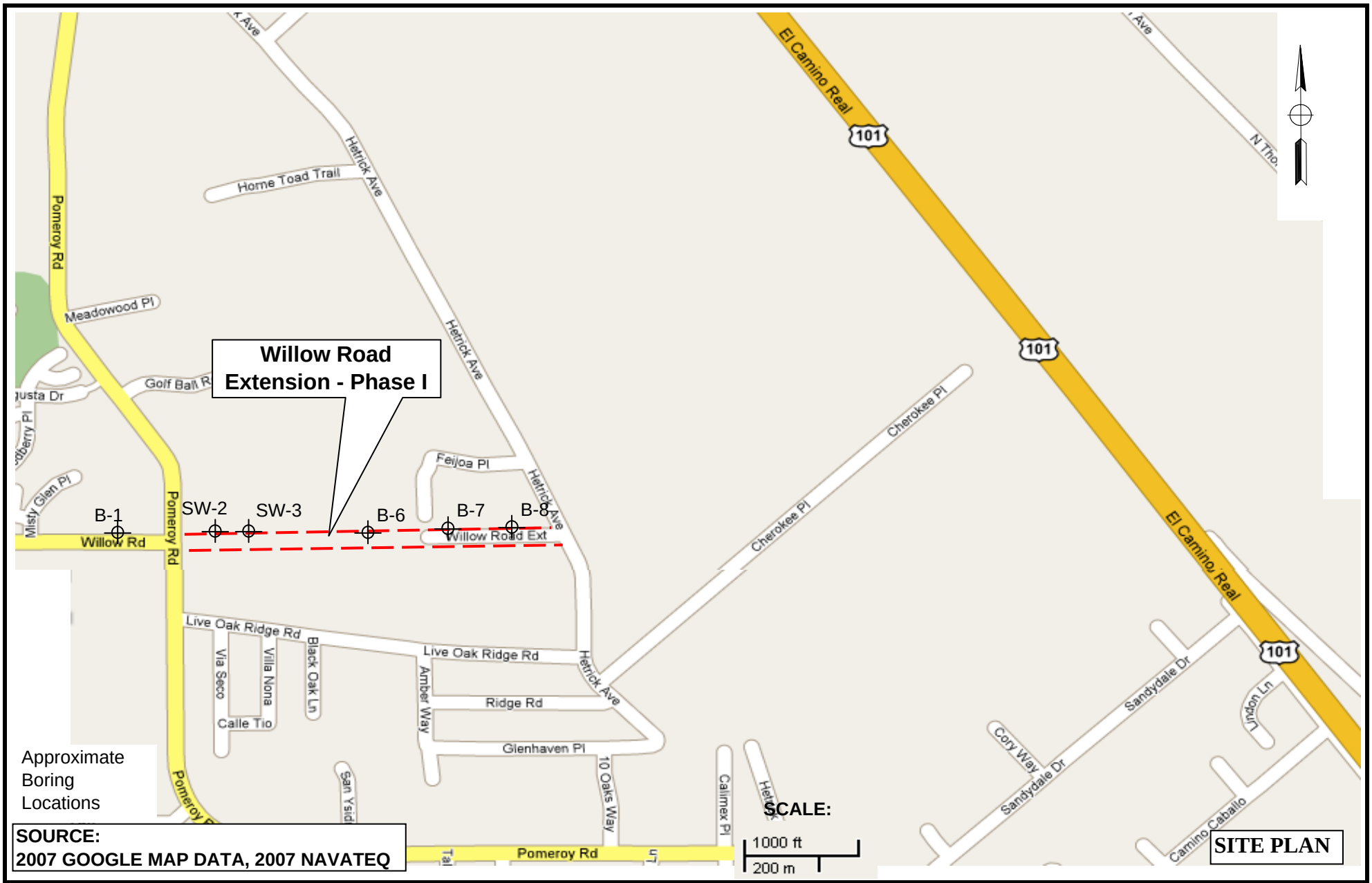


SOURCE:
2007 GOOGLE MAP DATA, 2007 NAVATEQ

LOCATION MAP

PARIKH CONSULTANTS, INC. GEOTECHNICAL CONSULTANTS MATERIALS TESTING	WILLOW ROAD EXTENSION - PHASE 1 POMEROY ROAD TO HETRICK AVENUE SAN LUIS OBISPO COUNTY, CALIFORNIA	
	JOB NO.: 203125.10	PLATE NO.: 1

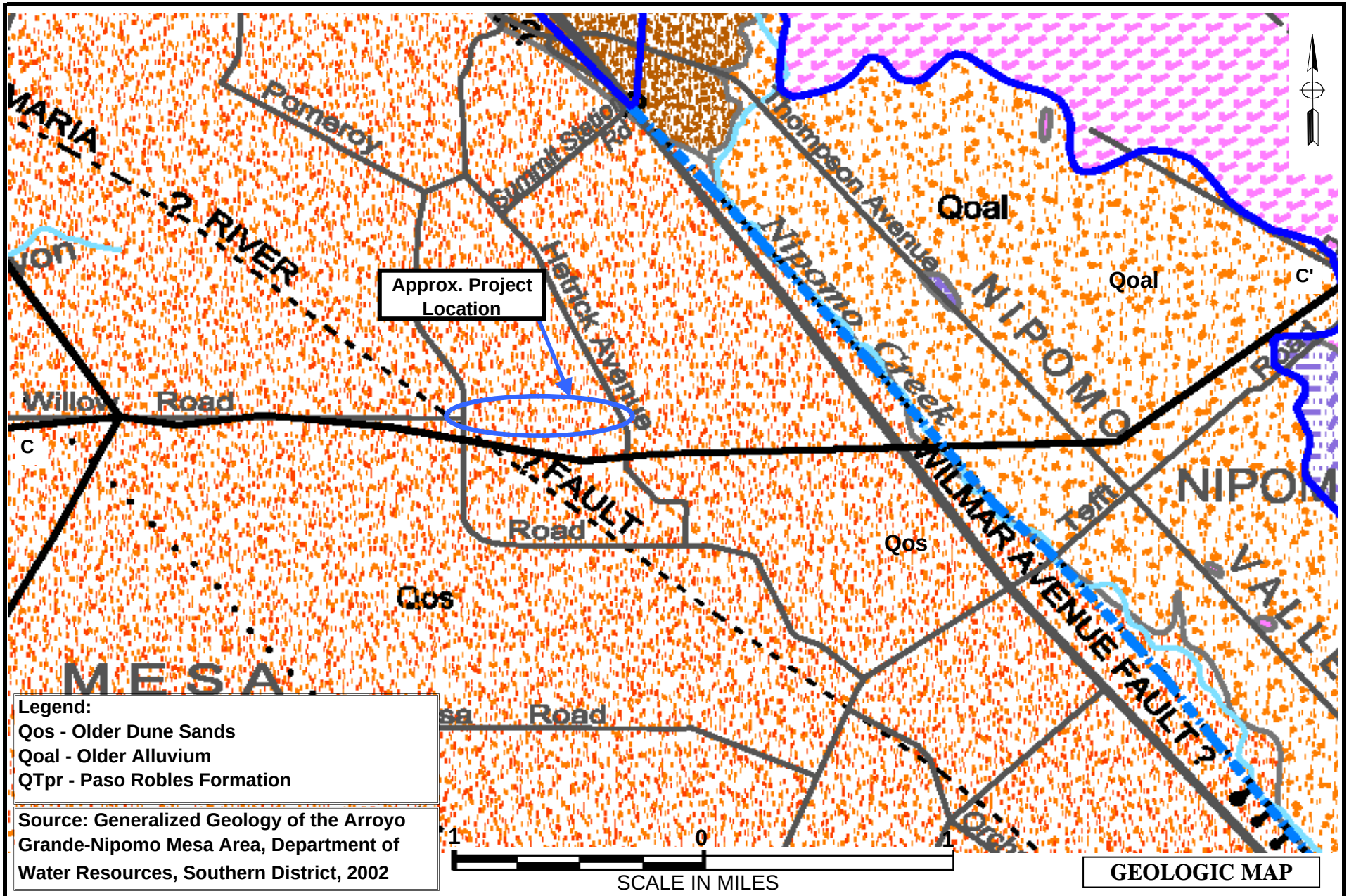


SOURCE:
2007 GOOGLE MAP DATA, 2007 NAVATEQ

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS TESTING

WILLOW ROAD EXTENSION - PHASE 1
POMEROY ROAD TO HETRICK AVENUE
SAN LUIS OBISPO COUNTY, CALIFORNIA

JOB NO.: 203125.10	PLATE NO.: 2



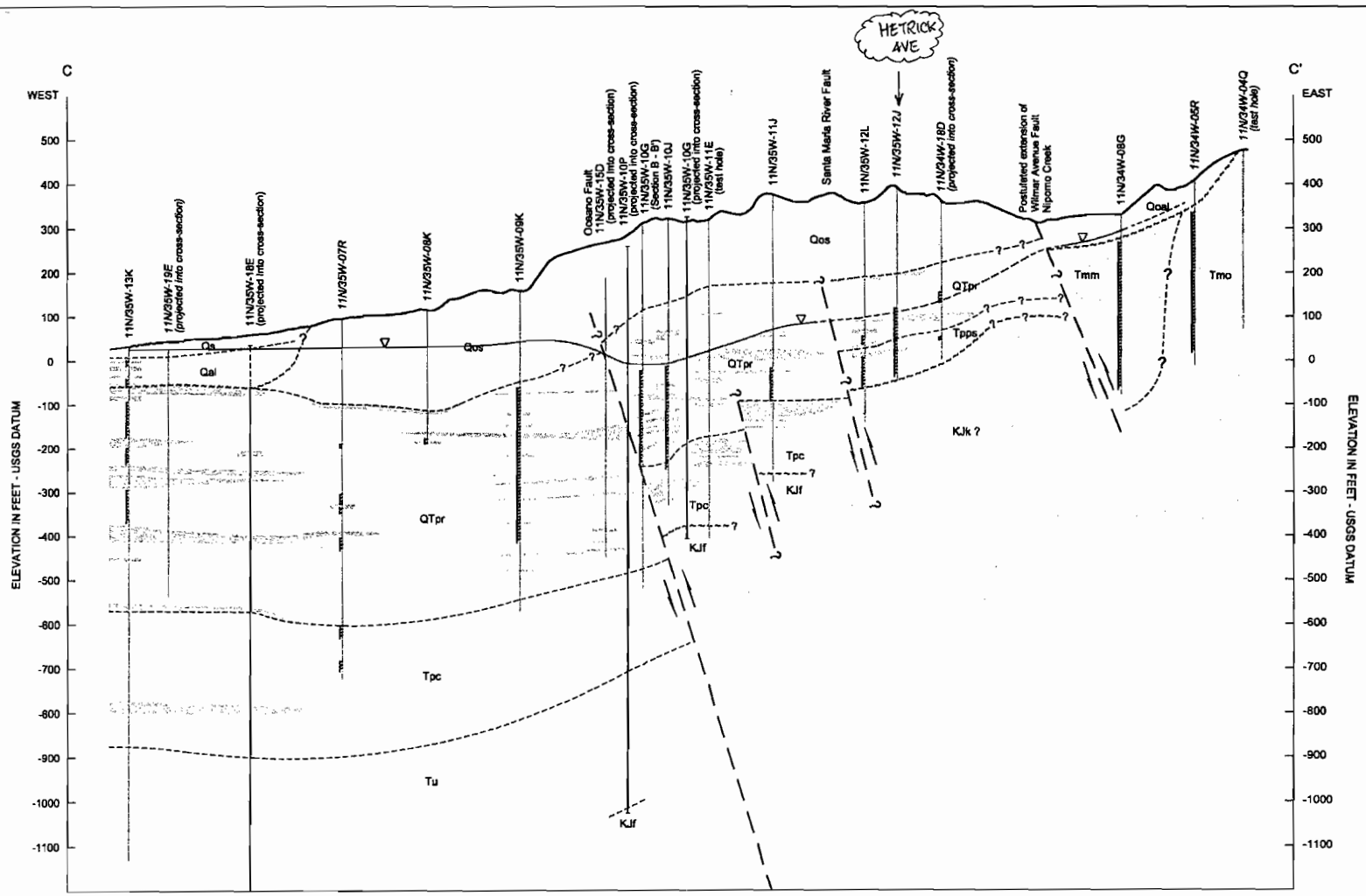
GEOLOGIC MAP

PARIKH CONSULTANTS, INC.

GEOTECHNICAL CONSULTANTS
MATERIALS TESTING

WILLOW ROAD EXTENSION - PHASE 1
POMEROY ROAD TO HETRICK AVENUE
SAN LUIS OBISPO COUNTY, CALIFORNIA

JOB NO.: 203125.10	PLATE NO.: 3A



EXPLANATION

Formation and Symbol	
Qs	Dune Sand
Qal	Alluvial Deposits
Qos	Older Dune Sand
Qoal	Older Alluvial Deposits
QTpr	Paso Robles Formation
Tpc	Careaga Formation
Tpps	Squire Member, Pismo Formation
Tmm	Monterey Formation
Tmo	Obispo Formation
Tu	Undifferentiated Tertiary Deposits
KJk	Knoxville Formation
KJf	Franciscan Complex

12N/36W-36L Water well with electric and geologic log

32S/12E-13L Water well with geologic log

10N/36W-02G Oil well with electric log, dashed above record

11N/35W-10P Oil well with geologic log, dashed above record

Hydrogeologic Unit

Unconsolidated to weakly cemented clayey silt to silty clay with minor sand and gravel

Unconsolidated to weakly cemented sand, gravel, silt, sandstone with minor clay and silty clay

Bedrock

F Perforated interval

Fault, arrows indicate relative vertical movement

Unconformity

Contact

1995 Groundwater Elevation

Note: References include: Department of Water Resources, 1970; Buchanan-Banks et al., 1978; Hall, 1981; Nitchman, 1988; Hanson et al., 1994; Lettis et al., 1994.

Location of geologic section shown on Plate 2

Vertical scale 20 times horizontal scale

Horizontal scale in feet

4000 0 4000

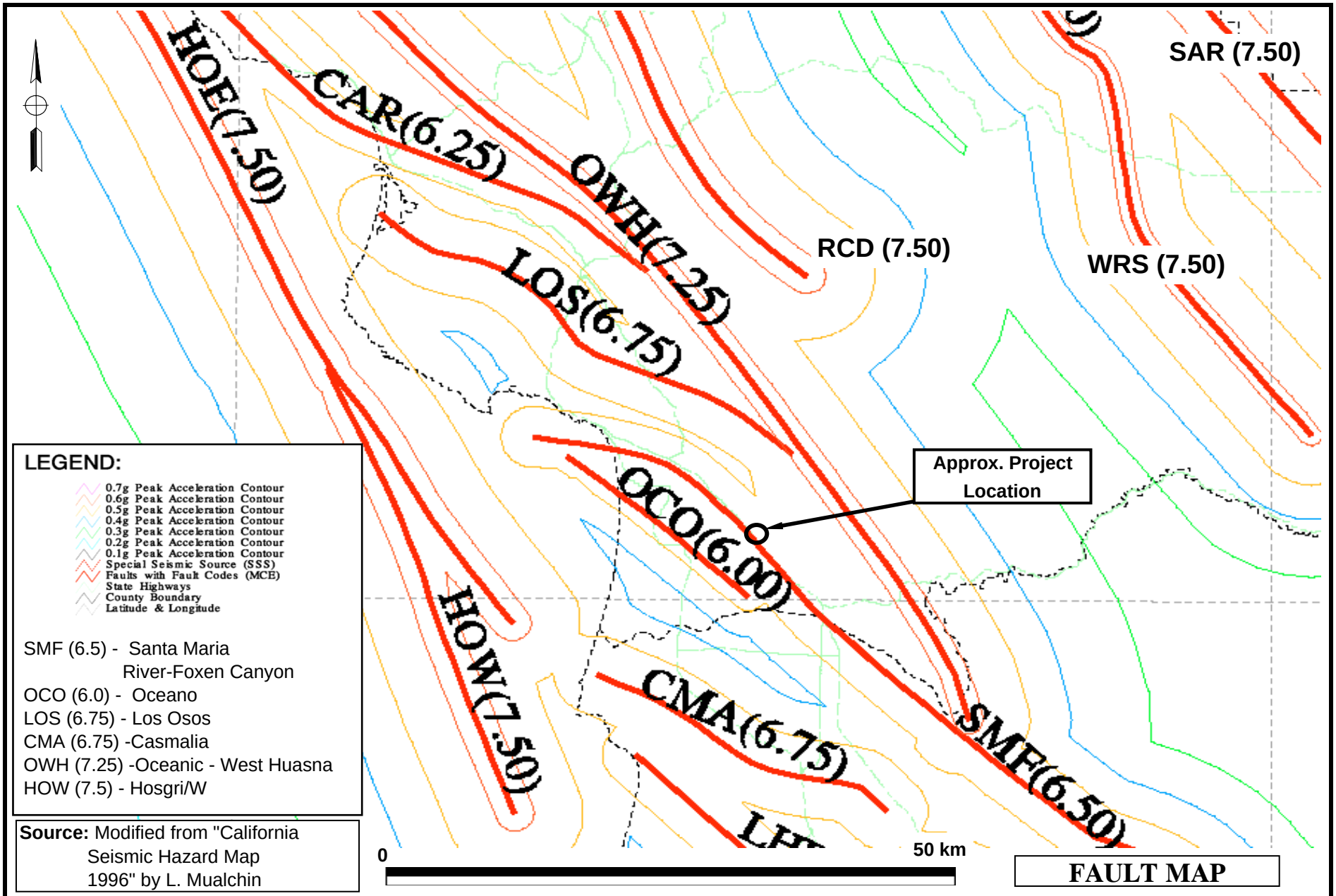
WATER RESOURCES OF THE ARROYO GRANDE - NIPOMO MESA AREA

◇◇◇

PLATE NO.: 3-B

GEOLOGIC SECTION C - C'

Department of Water Resources, Southern District, 2002



FAULT MAP

PARIKH CONSULTANTS, INC.
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MATERIALS TESTING

WILLOW ROAD EXTENSION - PHASE I
POMEROY ROAD TO HETRICK AVENUE
SAN LUIS OBISPO COUNTY, CALIFORNIA

JOB NO.: 203125.10 | PLATE NO.: 4

APPENDIX A

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
05	SLO	RTE 101	–		

GEOTECHNICAL PROFESSIONAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 866 — Exp. 12/31/09 — GEOTECHNICAL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

The County of San Luis Obispo or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

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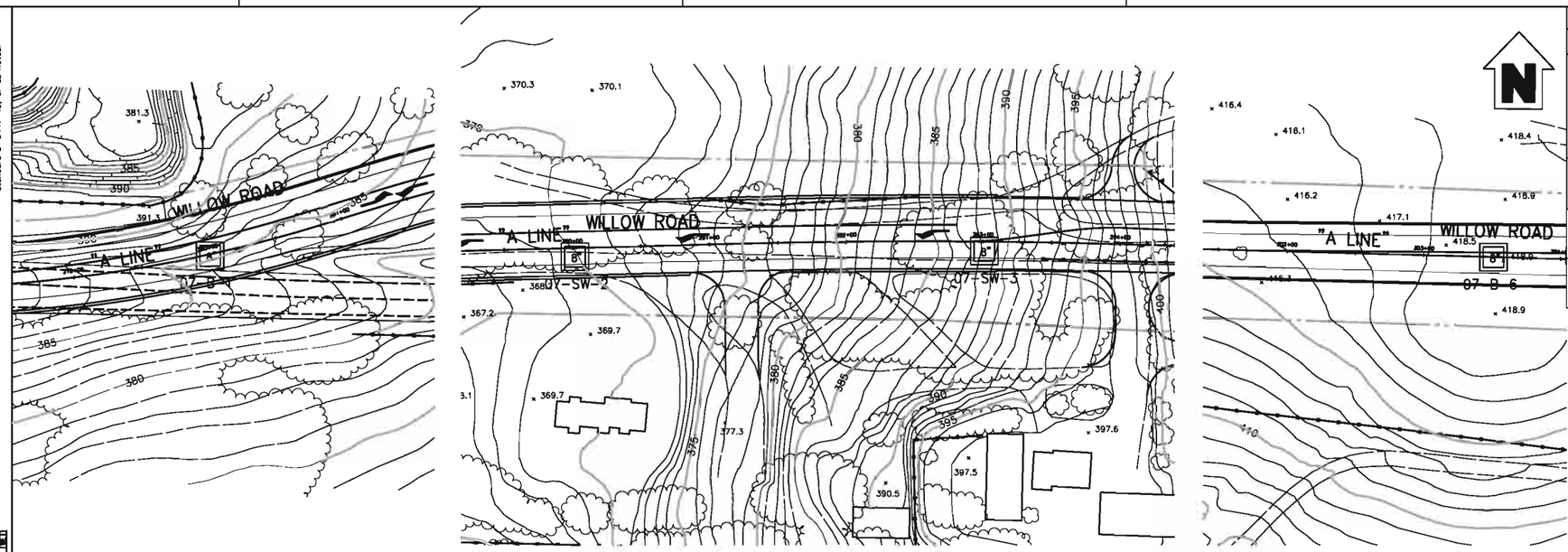
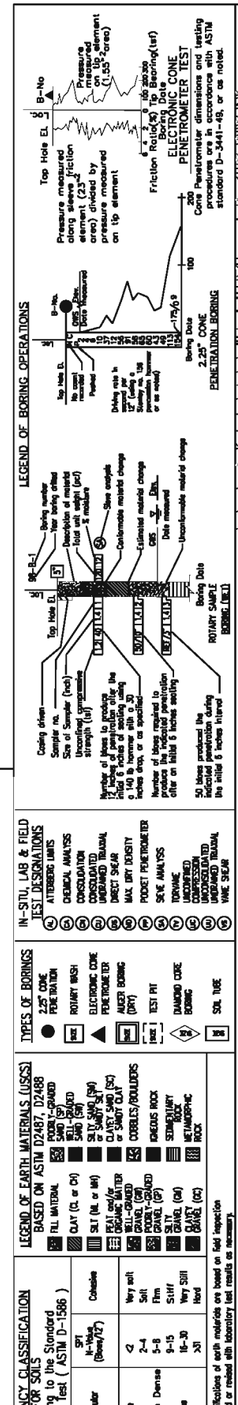
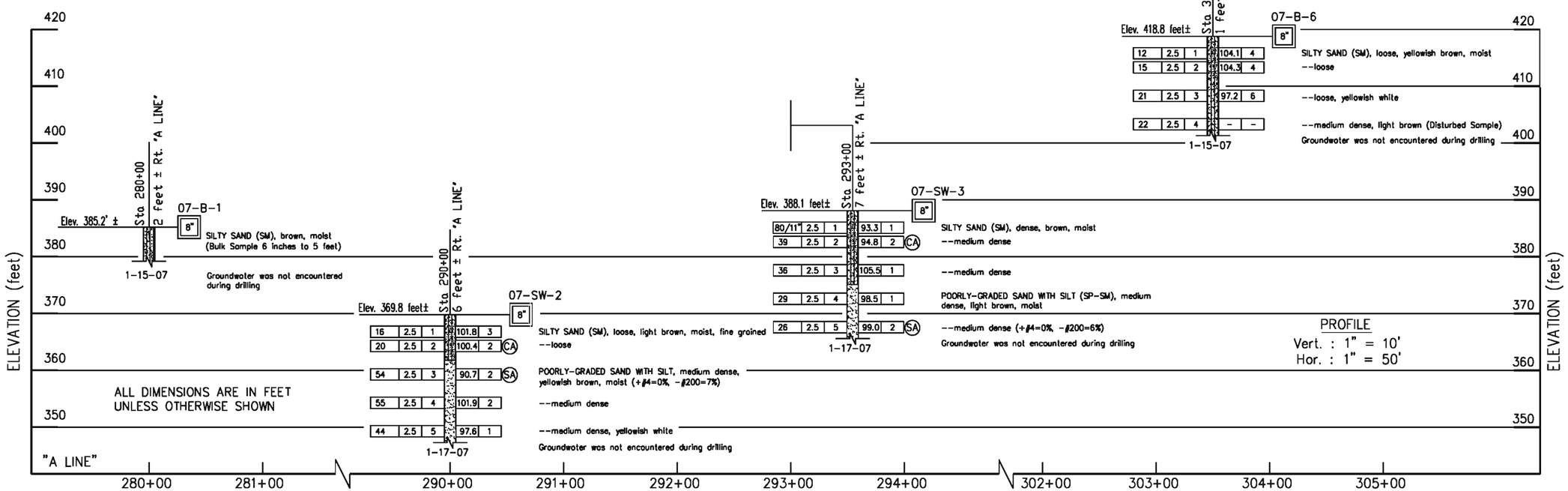
2360 QUME DRIVE, STE. A
SAN JOSE, CA 95131



PLAN
1" : 50'

Note:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop





DESIGN OVERSIGHT	DRAWN BY	LAM TRAN	PREPARED FOR THE COUNTY OF SAN LUIS OBISPO DEPARTMENT OF PUBLIC WORKS	PERRY CHAN PROJECT ENGINEER	BRIDGE NO. –	WILLOW ROAD EXTENSION - PHASE 1
SIGN OFF DATE	CHECKED BY	PERRY CHAN	FIELD INVESTIGATION BY: L. Bhongoo DATE: Jan 2007		POST MILE –	LOG OF TEST BORINGS

OSF GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU
EA

FILE => $REQUEST

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) SHEET OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

PLATE A-1

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
05	SLO	RTE 101	–		

GEOTECHNICAL PROFESSIONAL DATE

PLANS APPROVAL DATE

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REGISTERED PROFESSIONAL ENGINEER GARY PARIKH No. G.E. 866 Exp. 12/31/09 GEOTECHNICAL STATE OF CALIFORNIA

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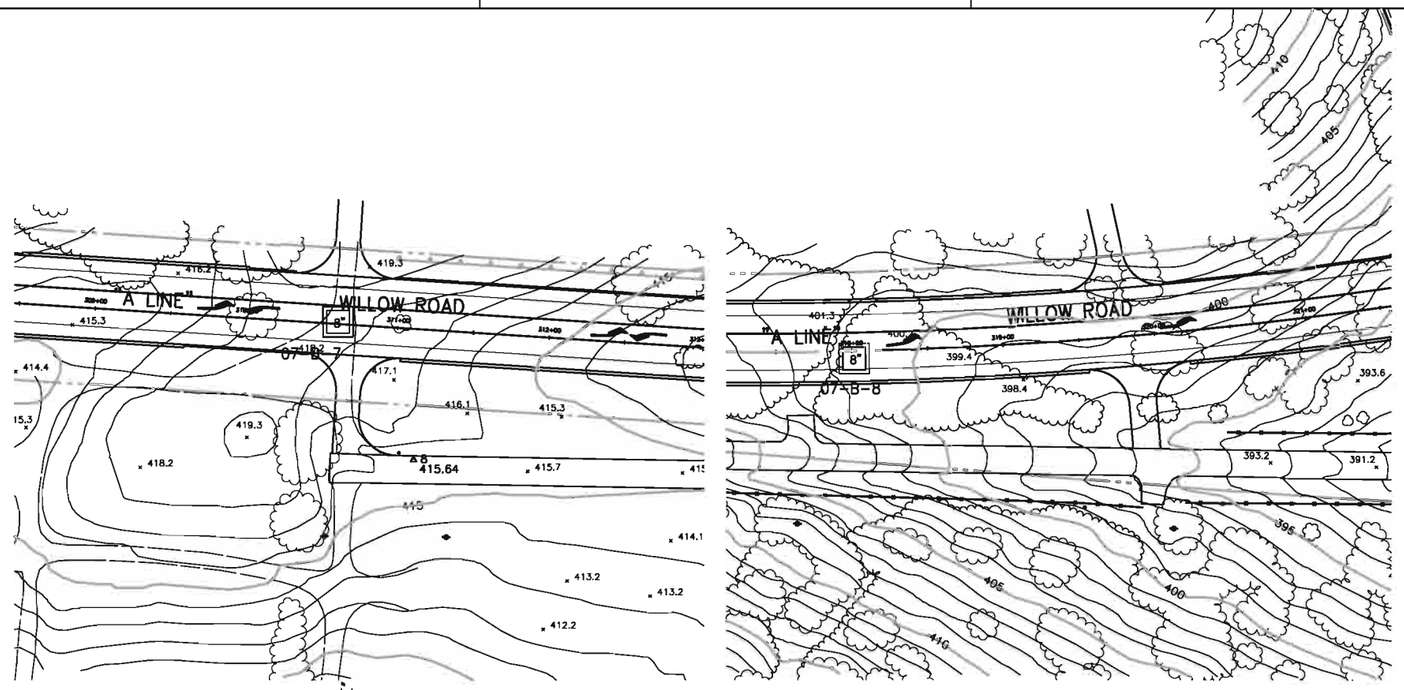
2360 QUME DRIVE, STE. A
SAN JOSE, CA 95131



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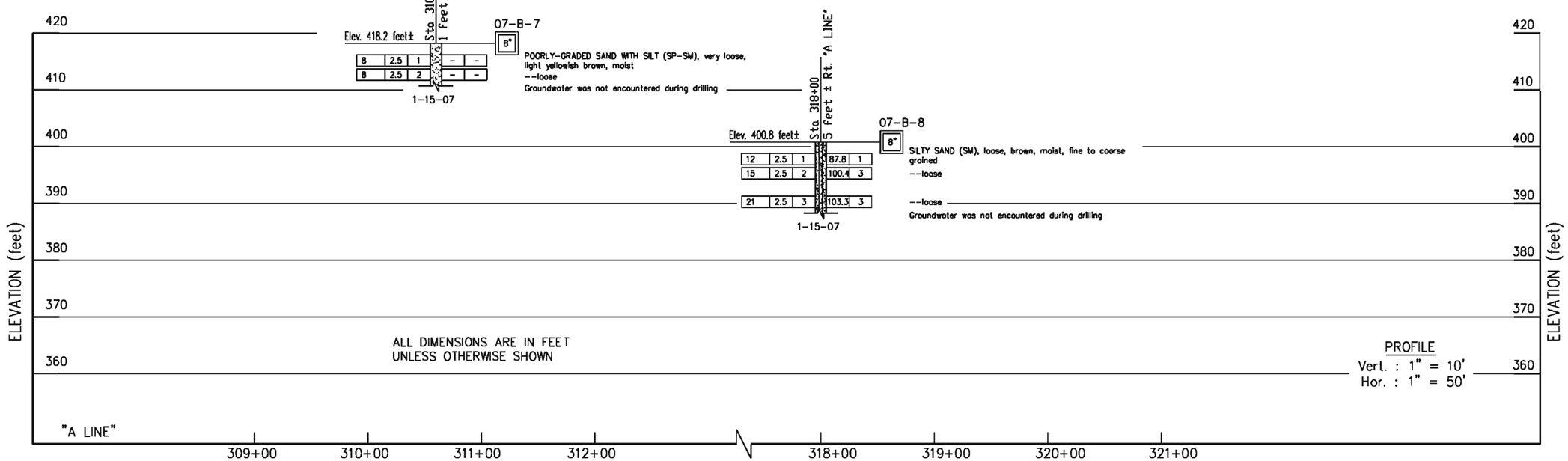
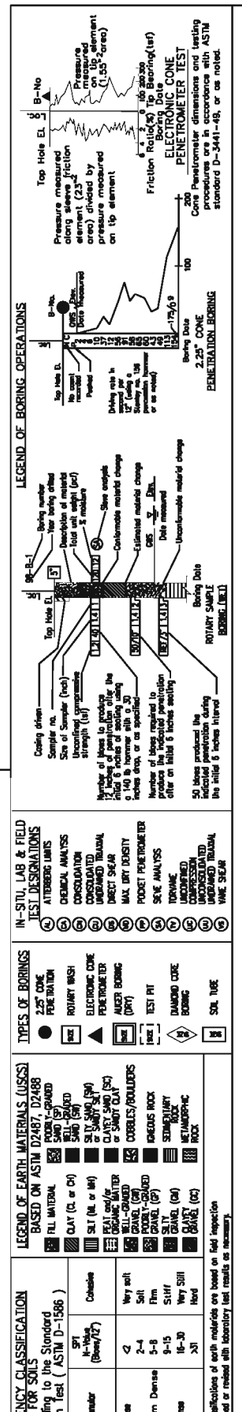
Hammer Assembly: A 140 lb hammer with a 30" drop





X DESIGN OVERSIGHT	DRAWN BY	LAM TRAN	L. Bhongoo FIELD INVESTIGATION BY:
X SIGN OFF DATE	CHECKED BY	PERRY CHAN	DATE: Jan 2007

PREPARED FOR THE
COUNTY OF SAN LUIS OBISPO
DEPARTMENT OF PUBLIC WORKS

PERRY CHAN
PROJECT ENGINEER

BRIDGE NO. –
POST MILE –

WILLOW ROAD EXTENSION - PHASE 1
LOG OF TEST BORINGS

CU
EA

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) SHEET OF

FILE => $REQUEST

OSF GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 2/25/05)

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

APPENDIX B

APPENDIX B

LABORATORY TESTS

Classification Tests
The field classification of the samples was visually verified in the laboratory according to the Unified Soil Classification System. The results are presented in “Log of Test Borings”, Appendix A.

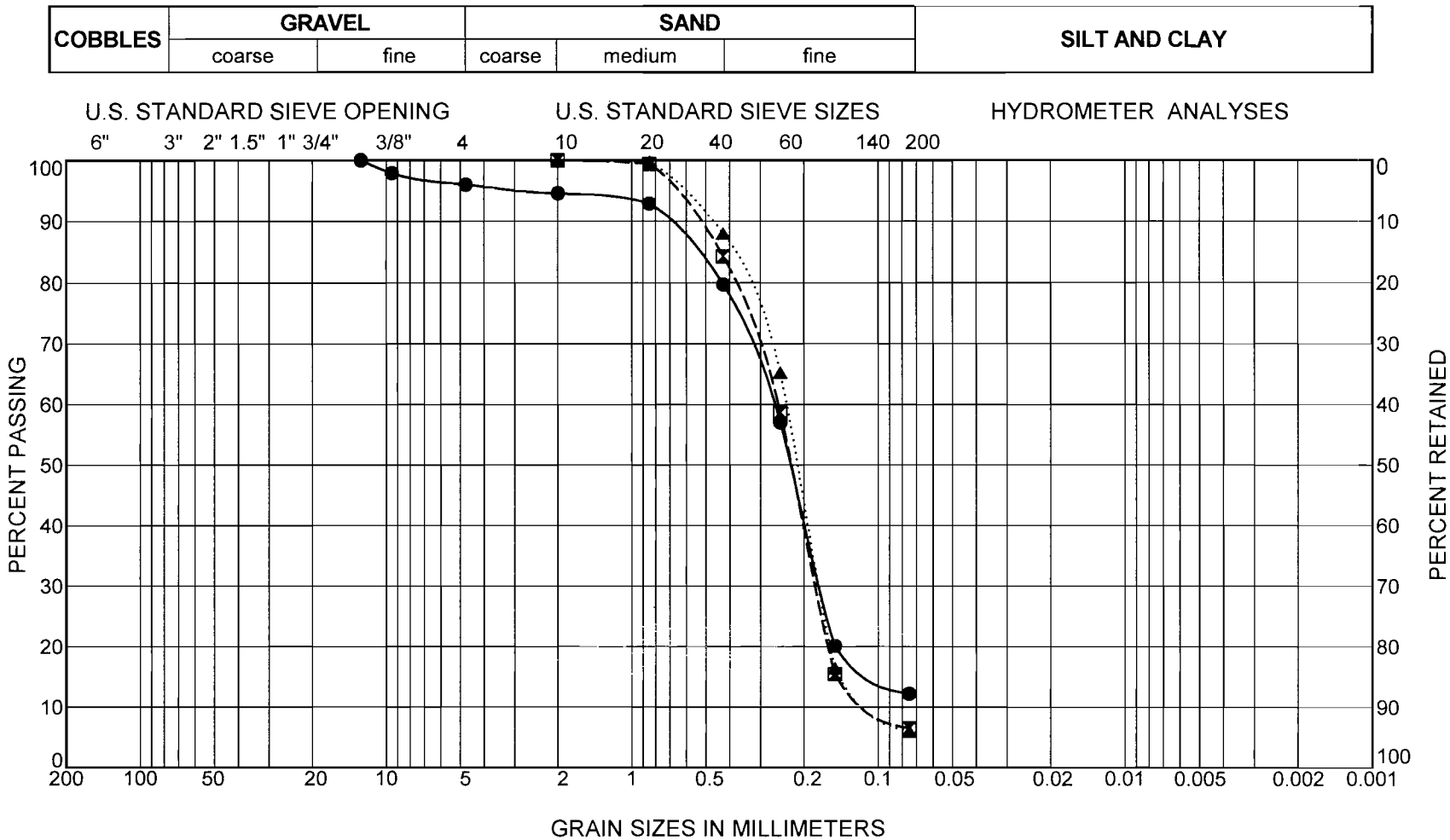
Moisture-Density
The natural moisture contents and dry unit weights were determined for selected undisturbed samples of the soils in general accordance with ASTM Test Method D 2216-92. This information was used to classify and correlate the soils. The results are presented at the appropriate depths on the "Log of Test Borings", Appendix A.

Grain Size Classification
Grain size classification tests (ASTM Test Method D422-63) were performed on selected samples of granular soil to aid in the classification. The results are presented on Plate B-2, “Grain Size Distribution Curves”.

Corrosion Tests
Corrosion tests were performed on selected samples to determine the corrosion potential of the soils. The pH and minimum resistively tests were performed according to California Test Method 643. The tests were performed by Sunland Analytical. The test results are presented on Plate B-3.

R-value Tests
R-value tests were performed on representative bulk samples for pavement design. The tests were performed according to California Test Method 301. The test results are presented on Plates B-4A and B-4B.

GRAIN SIZE DISTRIBUTION CURVES



Boring Number	Sample Number	Depth (feet)	Symbol	LL	PI	Description
B-1 (BULK)	1	5.0	●			SILTY SAND (SM)
SW-2	3	9.5	⊠			POORLY-GRADED SAND WITH SILT (SP-SM)
SW-3	5	19.5	▲			POORLY-GRADED SAND WITH SILT (SP-SM)

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS ENGINEERING

WILLOW ROAD EXTENSION - PHASE 1
COUNTY OF SAN LUIS OBISPO, CALIFORNIA

JOB NO: 203125.EXT

PLATE NO: B-2

Sunland Analytical
11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 03/15/2007
Date Submitted 03/13/2007

To: Prav Dayah
Parikh Consultants, Inc.
356 S. Milpitas Blvd.
Milpitas, Ca 95035

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

The reported analysis was requested for the following location:
Location : 203125.EXT/WILLOW RD Site ID : SW3 #2 @ 4.5'.
Thank you for your business.

* For future reference to this analysis please use SUN # 50036-99700.

EVALUATION FOR SOIL CORROSION

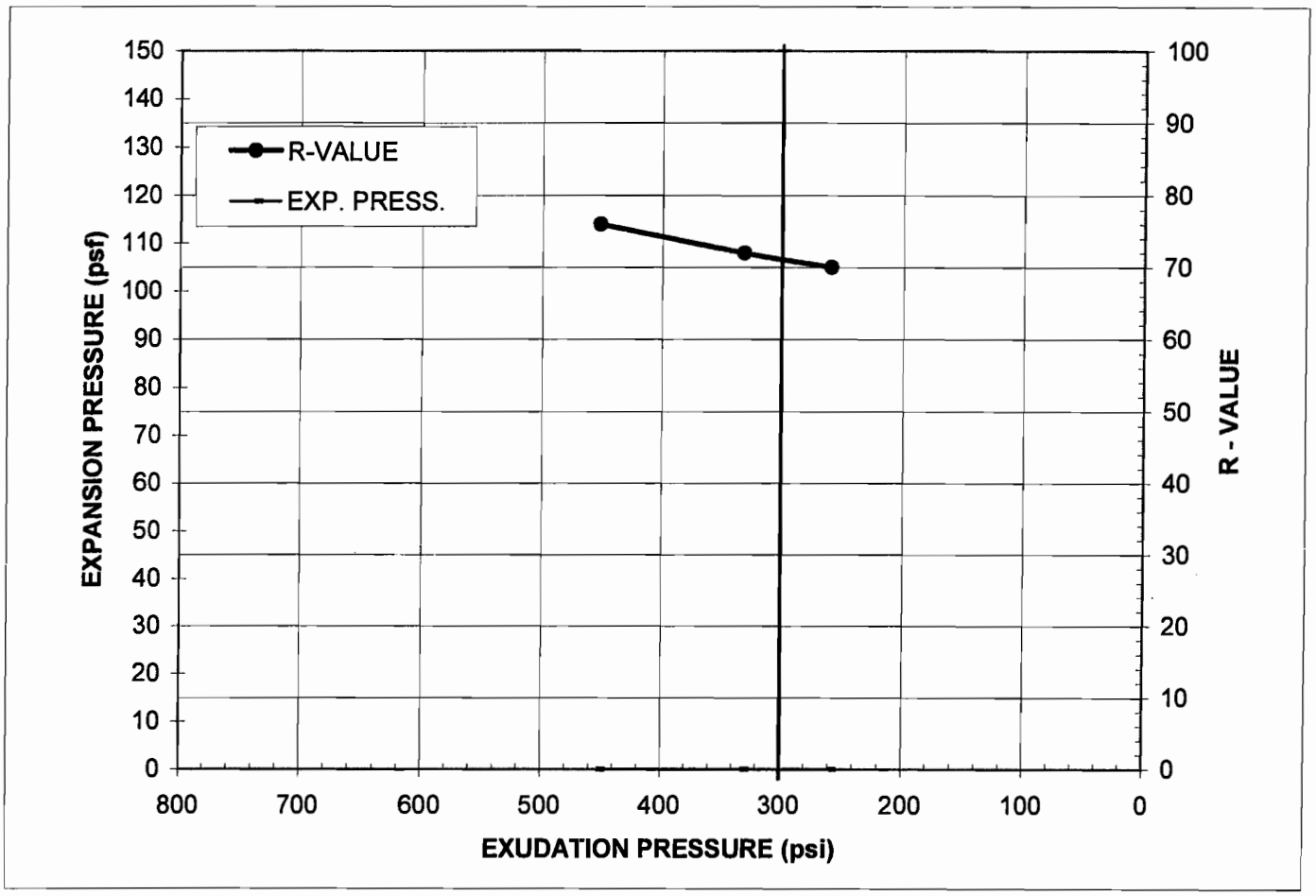
Soil pH	4.79		
Minimum Resistivity	9.38 ohm-cm (x1000)		
Chloride	14.2 ppm	00.00142	%
Sulfate	20.0 ppm	00.00200	%

METHODS
pH and Min.Resistivity CA DOT Test #643 Mod.(Sm.Cell)
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

R-VALUE REPORT

Parikh Consultants, Inc. ASTM D2844 or CTM 301 (408) 945-1011

Project Name:	Willow Road Extension	Date:	3/01/07
Client:	San Luis Obispo County	Project #:	203125.EXT
Sample #: B1	Depth: 5'	Lab #:	M608
Location / Source:	Nipomo	Sample Date:	
Material :	Silty sand, dark brown	Sampled By:	



Specimen No.	A	B	C
Exudation Pressure, psi	259	331	452
Expansion Pressure, psf	0	0	0
R-Value	70	72	76
Moisture Content at Test, %	11.3	10.8	10.7
Dry Density at Test, pcf	110.4	111.2	111.3

R-Value @ 300 psi Exudation Pressure = 71

Expansion Pressure @300 psi Exudation, psf = **0**

Minimum R-Value Requirement:

Comments:

Report By: Prav Dayah

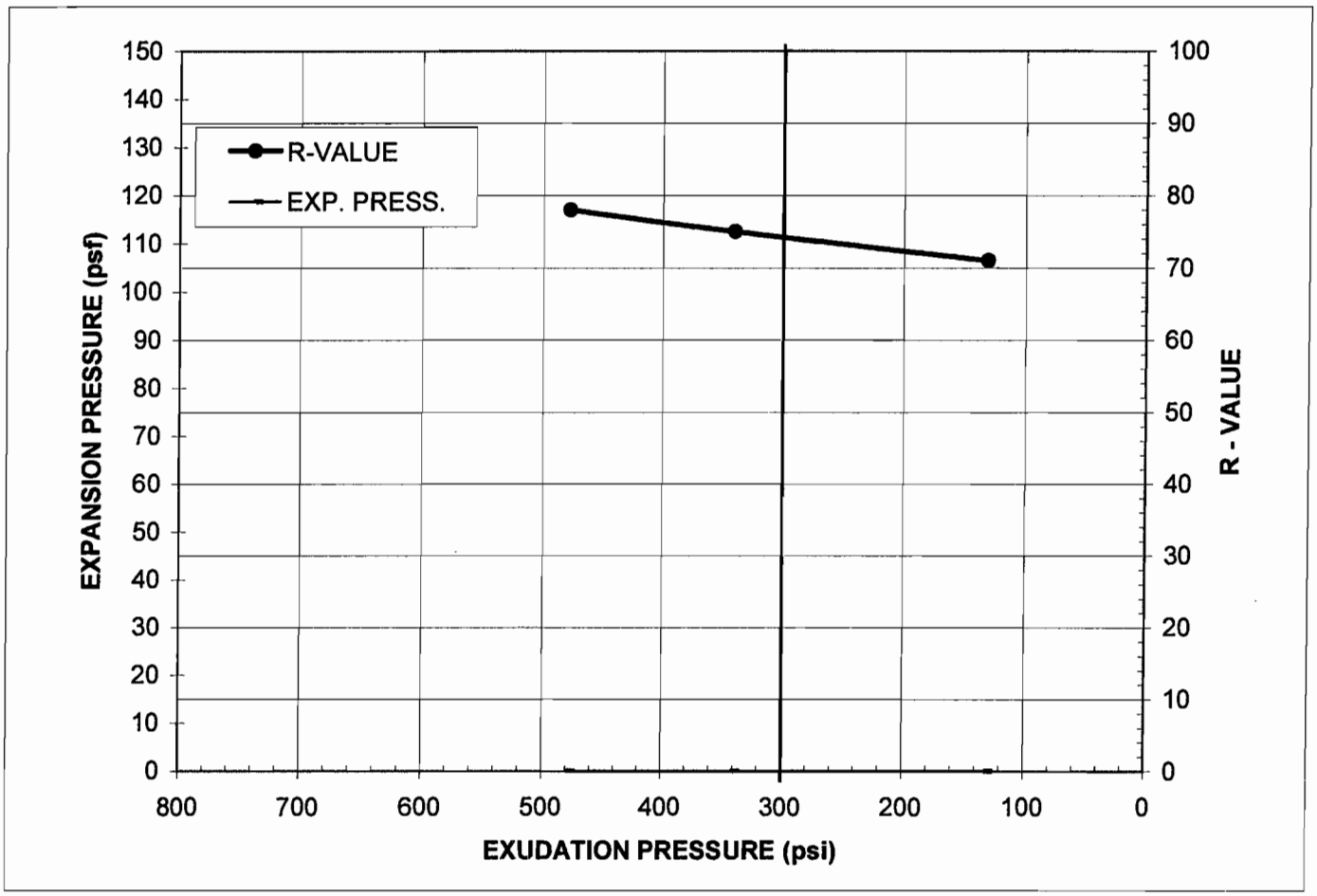
RVALUE with calcs pdp

PLATE NO.: B-4A

R-VALUE REPORT

Parikh Consultants, Inc. | ASTM D2844 or CTM 301 | (408) 945-1011

Project Name:	Willow Road Extension	Date:	3/01/07
Client:	San Luis Obispo County	Project #:	203125.EXT
Sample #:	B6 Depth: 5'	Lab #:	M608
Location / Source:	Nipomo	Sample Date:	
Material :	Silty sand, reddish brown	Sampled By:	



Specimen No.	A	B	C
Exudation Pressure, psi	131	340	478
Expansion Pressure, psf	0	0	0
R-Value	71	75	78
Moisture Content at Test, %	13.0	12.6	12.4
Dry Density at Test, pcf	109.4	110.1	111.3

R-Value @ 300 psi Exudation Pressure = 74

Expansion Pressure @300 psi Exudation, psf = **0**

Minimum R-Value Requirement:

Comments:

Report By: Prav Dayah

RVALUE with calcs pdp

PLATE NO.: B-4B

APPENDIX C

Structural Pavement Design / Calculation

I. West of Route 101 : TI = 9.5 $R_{AB} = 78$
$R_{Base} = 40$

$GE_{TOT} = 0.0032\,(TI)(100 - R_B)$
$= 0.0032\,(9.5)(100 - 40)$
$= 1.824$

$GE_{AC} = 0.0032\,(TI)(100 - R_{AB})$
$= 0.0032\,(9.5)(100 - 78)$
$= 0.67$

* HOT MIX ASPHALT (AC) :

$G_f = 5.67/(TI)^{\frac{1}{2}} = 5.67/(9.5)^{\frac{1}{2}} = 1.84$ (for $t < 0.5$ ft).

⇒ Apply a factor of 0.2 ft
$= GE_{AC} + 0.2\text{ft} = 0.67 + 0.2 = 0.87\text{ ft}$

Thickness of AC layer $= GE_{AC}/G_f = \dfrac{0.87\text{ft}}{1.84} = 0.47\text{ ft}$
$= 5.67$ in

AC : <u>use 6 inches</u> (⇒ GE_{AC} of 6 inches = 0.92)

* AB (Aggregate Base) :

$GE_{AB} = 0.0032\,(TI)(100 - R) = 0.0032(9.5)(100 - 40) = 1.824$

subtract GE_{AC} from GE_{AB} : $1.824 - 0.92 = 0.904\ (GE_{AB})$

Thickness of AB $= GE_{AB}/1.1 = \dfrac{0.904}{1.1} = 0.82\text{ ft} = 9.9$ inch

GE_{AB} for 10" AB ⇒ $GE_{AB} = 0.92$. use 10 inch

AC : 6 inches
AB : 10 inches

$GE_{TOT} = GE_{AB} + GE_{AC}$
$= 0.92 + 0.92 = 1.84 > 1.824$
OK

* Full Depth Calculation

$$GE = 0.0032\,(TI)(100 - R)$$
$$= 0.0032\,(9.5)\,(100 - 40)$$
$$= 1.824$$

$\Rightarrow$ Add factor of 0.1 ft $\Rightarrow$ 1.824 + 0.1 = 1.924 ft = GE

for $t > 0.5$ ft $\quad G_f = (7.00)\dfrac{(t)^{1/3}}{(TI)^{1/2}}$

$$t = \frac{GE}{G_f} = \frac{GE}{7\,(t)^{1/3}/(TI)^{1/2}}$$

$$t^{\frac{4}{3}} = \frac{GE\,(TI)^{\frac{1}{2}}}{7}$$

$$t = \left[\frac{GE\,(TI)^{\frac{1}{2}}}{7}\right]^{3/4}$$

$$= \left[\frac{1.924\,(9.5)^{\frac{1}{2}}}{7}\right]^{3/4}$$

$$= 0.88\text{ ft}$$

FULL DEPTH - USE 10.5" (AC only)