PATEL & ASSOCIATES, INC.

P.O. Box 1121 • Victorville, CA 92393 • Phone (760) 243-1436 • Fax (760) 243-1471

REPORT

PRELIMINARY SOIL INVESTIGATION

APN 482-031-01,02,07,08

TRACT 17049

On a 10.0 acre site on the Northwest corner of
Tamarisk Road and Huerta Road,
in the City of Victorville,
County of San Bernardino, California

Prepared for

JBL INVESTMENTS, INC.
515 W. Mayfield Road, Suite 203
Arlington, TX. 76014

May 24, 2006 Project No. 11240306

Celebrating our 15th Anniversary

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Project No. 11240306

May 24, 2006

JBL INVESTMENTS, INC.
515 W. Mayfield Road, Suite 203
Arlington, TX., 76014

Attention: Mr. Allen D. Su,

Subject: **Preliminary Soils Investigation** for the **10.0** acre parcel, **Tract Map 17049**, located on the Northwest corner of Tamarisk Road and Huerta Road, in the City of Victorville, County of San Bernardino, California.

In accordance with your authorization, **Patel and Associates, Inc.** Performed a Preliminary Soils Investigation for the subject property. The enclosed report contains the results of our field investigation, laboratory testing and classification, geotechnical considerations, conclusions, and recommendations. Our efforts were directed towards providing recommendations for foundation design.

We sincerely appreciate the opportunity of being service to you on this aspect of the project. Please do not hesitate to call us should you have any questions regarding the content of the reports.

Respectfully submitted,
PATEL AND ASSOCIATES, INC.

Ramesh B. Patel, P.E.
Principal Engineer

John Longoria
Senior Associate Engineer

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1.0 INTRODUCTION AND SCOPE OF WORK

1.1 Introduction

This report presents the results of our **P**reliminary **S**oils **I**nvestigation for the 10.0 acre property for the proposed Tentative Tract 17049, a 45 lot subdivision located on the Northwest corner of Tamarisk Road and Huerta Road, in the City of Victorville, County of San Bernardino, California, location shown on **Figures 1** and **2**.

1.2 Scope of Work

Our scope of work included:

* Review of available soils data.
* Subsurface investigation by Drill Rig.
* Perform laboratory testing.
* Geotechnical Engineering considerations.
* Report preparation with conclusions and recommendations.

2.0 FIELD INVESTIGATION AND LABORATORY TESTING

2.1 Field Investigation

A field investigation using a CME Drill Rig equipped with 8" hollow stem auger, was performed on May 4, 2006. A total of eight **(8)** borings were excavated to an approximate depth of twenty **(20)** feet from the existing ground surface and located as shown on **Figure No. 3**.

The purpose of our investigation was to ascertain the geotechnical properties for the foundation of the buildings and the support for the driveways and was not intended to provide evidence of potential environmental conditions. **Appendix A** presents the boring logs. The boring logs and related data depict subsurface conditions only at the specific locations and time indicated.

2.2 Laboratory Testing

Laboratory testing on select representative samples included:

* Maximum Density Tests
* Inplace Dry Density Tests
* Gradation/Sieve Analysis
* Sand Equivalents

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Inplace dry density in conjunction with laboratory maximum dry density, provides an indication of relative density (or relative compaction). This inplace relative compaction is utilized in estimation of potential shrinkage factors during grading and recommendations for site preparations. Our test results indicated that relative compaction of the upper four (4) feet of earth material ranged from loose to medium dense. Two (2) Maximum Density tests were performed.

Gradation/Sieve Analysis is useful in classifying of soils in accordance with the Unified Soil Classification System, ASTM D2487. A total of four (4) Gradation/Sieve Analysis tests were performed. Gradation analysis can be utilized in qualitative determination of other engineering properties, such as compressibility, shear strength, and R-value.

Sand equivalent (SE) is an indicator for cleanliness of the coarse grained soils and is useful in qualitative estimation of the R-value. A total of one (1) sand equivalent test was performed.

Results of our laboratory testing are contained in **Appendix B**.

3.0 SITE AND SUBSURFACE CONDITIONS

3.1 Site Conditions

The subject site is currently vacant property. The proposed location of the Tentative Tract 17049 is shown on **Figure No. 1**. The property is located on the Northwest corner of Tamarisk Road and Huerta Road, in the City of Victorville. The property is in Section 35, T5N, R4W, APN 482-031-01,02,07,08.

The surface topography is relatively flat with a grade of approximately 2% and drains towards the Northeast.

3.2 Subsurface Conditions

Our field investigation and laboratory testing revealed that the near surface soils consist predominantly of silty **SANDS (SM),** sandy **SILT (SM-ML).** The soils in the upper 0-4 feet were of silty sand. The soils from the 4-15 feet depth were mostly SANDS with silts with loose to medium dense conditions.
Appendix A presents the detailed logs of soils encountered in our borings.

4.0 GEOTECHNICAL ENGINEERING CONSIDERATIONS

Our soil engineering evaluations are based on the limited field investigation and laboratory testing performed for the subject project.

4.1 Foundation System Considerations

Allowable bearing pressure for foundations depends upon the shear strength, settlement characteristics of the underlying soils, types of foundation system, acceptable differential movement, and depth of embedment. Based on the type of structures, our evaluations are directed towards the isolated footings as well as continuous footings.

4.2 Settlement and Heaving considerations:

Although no swell consolidation testing was performed, based on low field densities and our observations, the four feet of soils are likely to settle due to loading and introduction of water. In general, desert soils are cemented and undergo rapid consolidation due to saturation known as hydroconsolidation. Based on the loose to medium dense condition, the site is susceptible to low to moderate collapse potential according to criteria given below. This condition can be mitigated by overexcavation and recompaction.

Collapse Potential, %	Severity of Problem
0 - 1	No Problem
1 - 5	Moderate Trouble
5 - 10	Trouble
10 - 20	Severe Trouble
> 20	Very Severe Trouble

Clayey soils tend to swell upon saturation. Based on our observation the soils can be characterized as very low to low in expansion potential as per Uniform Building Code classifications as tabulated below.

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

4.3 Seismic Considerations

Review of available Alquist-Priolo Special Studies Maps indicate that the trench is not located within any known and published active fault zone. Detailed geologic study was not within the scope of this report. It is noted that there are several active faults situated in Southern California. Some of these major fault zones are located within thirty (30) miles of the project location.

According to the 1997 Unified Building Code (UBC) and 2001 California Building Code (CBC) the site soils can be classified as Type S_D, Table 16-J, P-2-30 of (UBC) . The site is considered to be located in Seismic Zone 4. The Table below provides the seismic parameters as contained in 1997 UBC and the 2001 California Building Code. Any changes in the present code should be considered during the design.

Table	16-I	16-J	16-K	16-Q	16-R	16-S	16-
Parameter	Z=0.4	S_u= 2000psf	1	C_a=0.44N_a	C_v=0.64N_v	N_a=1.0	N_v =

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According to the 1997 Unified Building Code (UBC) and 2001 California Building Code (CBC) the site soils can be classified as Type S_D, Table 16-J, P-2-30 of (UBC) . The site is considered to be located in Seismic Zone 4. The Table below provides the seismic parameters as contained in 1997 UBC and the 2001 California Building Code. Any changes in the present code should be considered during the design.

Table	16-I	16-J	16-K	16-Q	16-R	16-S	16-T
Parameter	Z=0.4	S_u = 2000psf	1	C_a=0.44N_a	C_v=0.64N_v	N_a=1.0	N_v = 1.0

4.4 Seismically Induced Settlement

Ground movement and settlement can occur when relatively low density soils are subject to ground vibrations. Potential for settlement of near surface soils due to earthquake cannot be precluded.

4.5 Liquefaction Potential

Although our field investigation did not extend to great depths, based on our general experience, the site is not subject to liquefaction.

4.6 Wind Consideration

The site is located in the high wind zone. Design provisions of the latest Uniform Building Code should be followed.

5.0 CONCLUSIONS

In our opinion the soils encountered on this project site are suitable for construction of the residential development and installation of asphalt for driveways.

5.1 Upper four (4) feet of the soils are loose to medium dense, and dry. These materials are subject to settlement due to consolidation and ground vibrations. Overexcavation and recompaction of near surface soils, and other mitigating measures are discussed in **Section 6.0** of this report.

5.2 Our investigation and testing indicate that the near surface soils are likely to exhibit very low to low expansion potential.

5.3 Moderate to severe ground shaking should be expected during large magnitude earthquakes.

5.4 Seismic considerations contained in **Section 4.3** should be considered during planning and design in conjunction with requirements of latest Uniform Building Code.

5.5 The site is situated in a high wind speed area. The design should consider wind forces meeting the current requirements of the latest Uniform Building Code.

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6.0 RECOMMENDATIONS

6.1 Site Preparation

To achieve uniform support for foundations and slab-on-grade, the site should be cleared of all vegetation, debris and any deleterious materials.

As described earlier herein, the upper four (4) feet of material is relatively loose to medium dense. To mitigate rapid settlement, and or expansion, we recommend that the building pad areas, extending five **(5)** feet beyond the outer most limits should be over-excavated to a depth of at least three **(3)** feet below the existing or lowest cut grade and further scarified to a depth of twelve **(12)** inches. The scarified surface should be inspected by an experienced soils engineer prior to recompaction. Upon approval of the soils engineer, the material should be uniformly moisture conditioned and recompacted to relative compaction of at least 90 percent. All grading operation, including excavation, removal and recompaction, shall be observed by experienced civil engineer (civil engineer experienced in soils engineering) or his/her representative.

6.2 Shrinkage and Subsidence Factors due to Grading

Our field investigation and field and laboratory testing determined that the near surface soils are loose to medium dense. Accordingly, we estimate the shrinkage factor to be approximately **15** to **20** percent during overexcavation and recompaction. Shrinkage is defined as the decrease in volume of soil due to artificial compaction, expressed as percentage of ratio of compacted dry density minus inplace density to compacted dry density. Shrinkage factors provided herein assumes an average relative compaction of 92 percent. Additionally, a subsidence factor of approximately **0.25** feet may be taken due to site preparation.

6.3 Overexcavation and Recompaction

To provide uniform consistent soil support and drainage, we recommend that the upper three **(3)** feet below the existing grade or lowest cut grade be over excavated and recompacted. Once the pads have been excavated the bottom should be scarified an additional twelve **(12)** inches, the scarified surface should be observed by an experienced engineer and the bottom should be tested prior to the recompaction. Upon approval of the engineer, the material shall be uniformly moisture conditioned to near optimum moisture content and recompacted to a minimum relative compaction of 90%. The excavation then backfilled and compacted in loose lifts not exceeding eight (8) inches, after uniformly moisture conditioned as per compaction criteria provided herein this report.

6.4 Imported Fill

Imported fill should be free of all deleterious substances, and non expansive. The source of the imported fill should verified by the Engineer prior to being brought to the Site.

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6.5 Compaction Criteria

Following compaction criteria should be observed:

Structural Fill-Building areas extending at least 5' beyond the outermost building limit	90% or greater @ -2 to +2% of OMC
Backfill around retaining walls, Trench backfill from 1' to 4' below the subgrade	90% or greater @ -2 to +3% of OMC

All compaction and moisture content criteria are relative to ASTM D1557 Maximum Dry Density (MDD) and Optimum Moisture Content (OMC).

6.6 Foundation Design

The use of shallow, continuous and isolated footing foundation system is recommended provided other recommendations given in our report are followed. The max allowable bearing pressure and minimum footing foundation requirements are given below.

Maximum Allowable Bearing Pressure	# of Floors	Continuos Footings		Isolated Footings		Lateral Bearing Capacity	Sliding Coefficient
		Width	Depth	Width	Depth		
1800 psf	**Single Story**	**12"**	**12"**	**18"**	**12"**	**180 psf**	**0.25**
1800 psf	**Two Story**	**15"**	**18"**	**18"**	**24"**	**180 psf**	**0.25**

The bearing pressure can be increased by one-third for seismic or wind loading. As a minimum, all footings should be reinforced with one **(1)** No. 4 bar at the top and one **(1)** No. 4 bar at the bottom. Additional reinforcing should be determined by a structural engineer. A total settlement on the order of **0.75** inches should be anticipated, with differential settlement of about **0.40** inches.

6.7 Slab on Grade

We recommend a minimum thickness of four (4) inches. Two (2) inches of granular bedding (clean sand) underneath all slabs-on-grade underlain by a 6 mil thick Visqueen is recommended. All slabs should be reinforced with steel reinforcement of No. 3 bars twenty-four (24) inches on center both ways, placed at mid-height of the slab is recommended. An equivalent-welded wire mesh reinforcement, 6x6 - 10x10 may be used in lieu of No. 3 bars. We recommend construction joints at every approximately 200 square feet.

Concrete works exposed to an outside environment should be air contained with an air content of four (4) percent at the time of placement. All concrete should be placed at a slump not to exceeding four (4) inches at time of placement.

6.8 Retaining Structures

Retaining walls may be designed for a lateral earth pressure coefficient of **0.50** (i.e., equivalent fluid pressure of **45** lbs./sq.ft./ft.) for a level non-cohesive, non-expansive backfill. Passive earth resistance may be computed based on a coefficient of **2.0** or an equivalent fluid pressure of **260** psf/ft. For a retaining wall 12' or higher, seismic lateral earth pressure coefficient of **0.20** may be used when considering the seismic force on the retaining wall. This force of action should be taken at **0.60** H (H is the height of the retaining wall) from the base of the wall.

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6.9 Cement Type and Corrosion Potential

Based on our experience, we recommend Type II cement for all concrete works in contact with soils. Additionally we recommend 15 to 20 % Type F Fly Ash as substitute for cement by weight.

6.10 Trench Backfill

Utility trench backfill material should be non-expansive, free of debris and any deleterious substances. Local onsite material is suitable for trench backfill. Granular bedding of one (1) foot underneath the water and sewer line pipes and six (6) inches above the pipes should be considered. The backfill should be compacted in loose lifts not exceeding six (6) inches to achieve relative compaction as set in **Section 6.4 Compaction Criteria.**

6.11 Surface Drainage and Landscaping

All grading should be such to direct surface runoff away from the building foundations. Roof runoff should also be directed away from the foundations. To mitigate settlement and potential swelling/collapse of near surface soils which could lead to distress to a structure, we recommend desert landscaping.

6.12 Preliminary Pavement Structure

Based on the soil classifications and our experience with similar soils. The following preliminary pavement structure may be used for your planning purposes.

Tamarisk Road	4" of AC over 6" of CL II Base
Huerta Road	4" of AC over 6" of CL II Base
Pah-Ute Avenue	4" of AC over 6" of CL II Base
Interior Streets	4" of AC over 4" of CL II Base

Final pavement structure thickness should be based on the traffic index TI to be provided by the City of Victorville, soil classification and R-value testing on subgrade soils, once the **rough grading** is complete.

6.13 Field Observations and Testing

The recommendations contained in this report are based on the results of our limited preliminary investigation and our general experience with the similar soil conditions. It is critical that Patel and Associates, Inc. observe the earthworks operation at various stages of the related construction activities. These activities include but may not be limited to:

* Clearing and grubbing.
* Overexcavation and scarification.
* Fill placement and backfilling.
* Subgrade preparation
* Placement of Base Course
* Trench and Utility backfill
* When any unusual conditions are encountered.

Based on these observations and testing, it may be necessary to modify the recommendations contained herein.

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6.14 Final Report

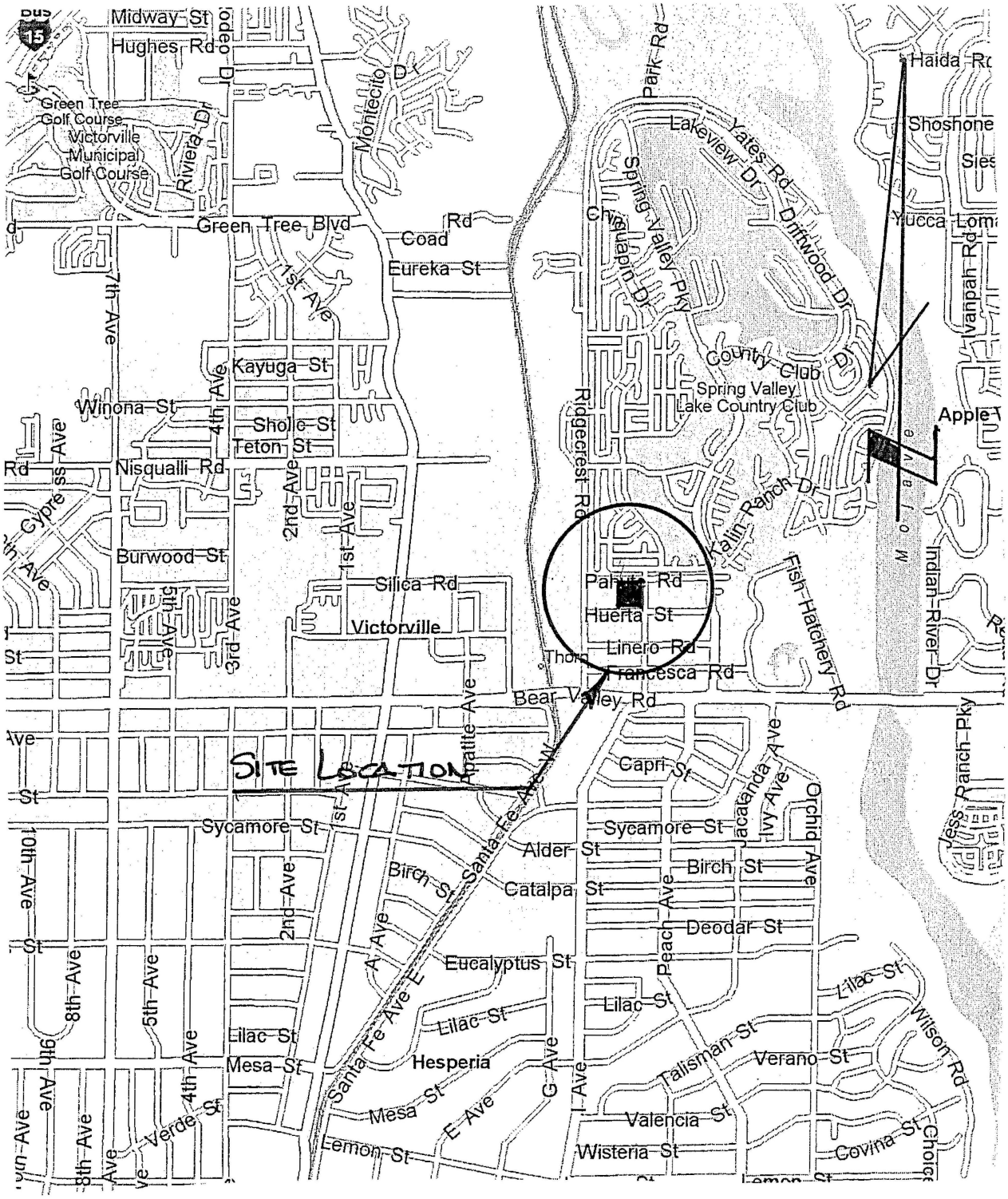
A final report should be prepared which will contain field observations, test results and additional recommendations, as warranted.

7.0 LIMITATIONS

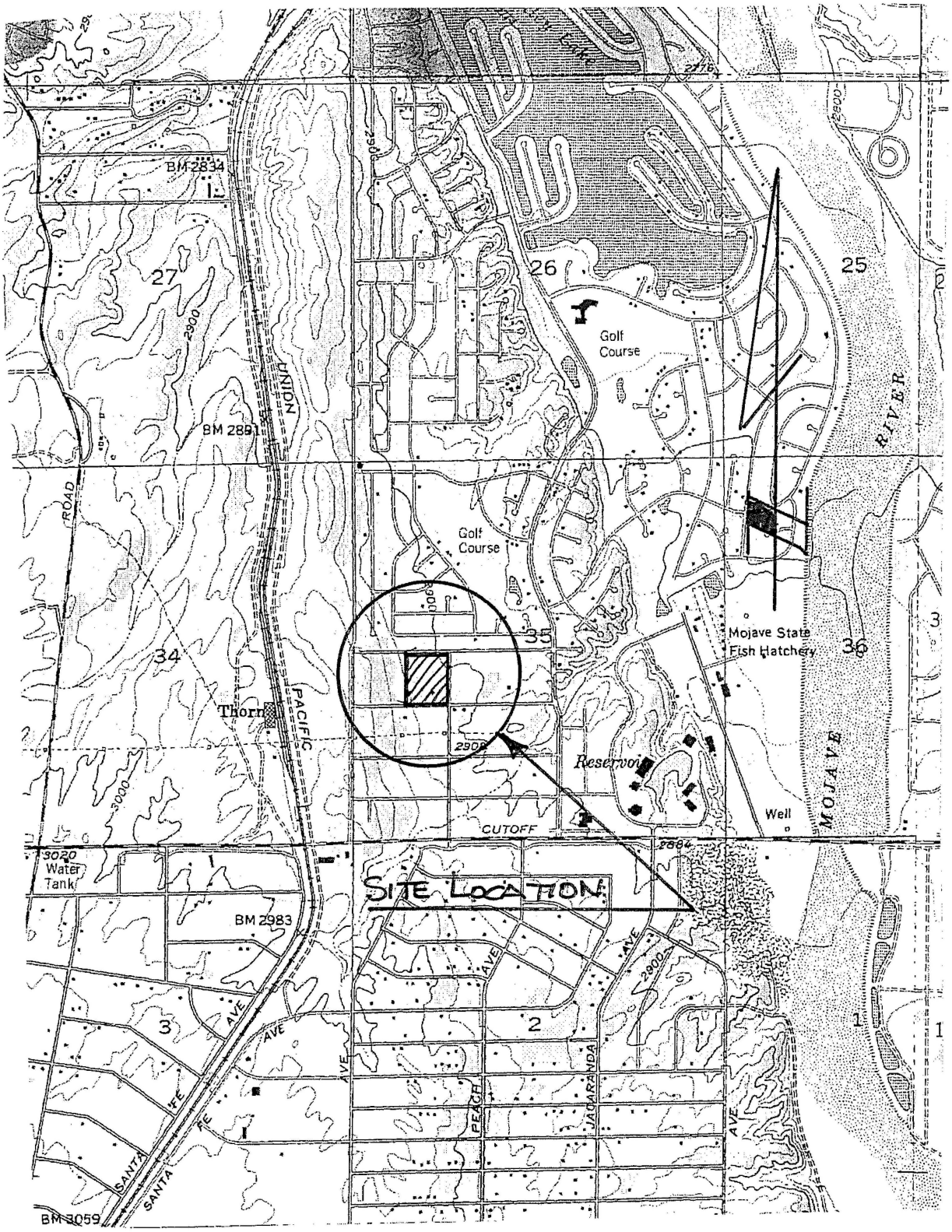
Conclusions, recommendations and professional opinions resulting from our site observations, field investigation and laboratory testing are intended solely for the proposed **Tentative Tract 17049**. Our conclusions and recommendations are based on our understanding of the project and consistent with the level of skill ordinarily exercised by other professional consultants under similar circumstances at the same time our services were provided.

This report is exclusively prepared to assist **JBL Investments, Inc** in the design of the footings and foundation support for the single family homes on site. Patel and Associates, Inc. should be consulted to provide written modifications to the recommendations contained in this report, depending upon the project requirements.

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	APN 482-031-01,02,07,08	
	TRACT 17049	
	Vicinity Map	Figure No. **1**



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	APN 482-031-01,02,07,08	
	TRACT 17049	
	USGS Topo	Figure No. **2**



PATEL AND ASSOCIATES, INC.

Geotechnical and Environmental Engineering

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Phone : 760-243-1436 Fax: 760-243-1471

ville	Project No. 11240306
	APN 482-031-01,02,07,08
	TRACT 17049
PLOT PLAN	Figure No. 3

APPENDIX A

TABLE 1 Soil Classification Chart

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification	
				Group Symbol	Group Name[B]
Coarse-Grained Soils More than 50 % retained on No. 200 sieve	Gravels More than 50 % of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5 % fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$[E]	GW	Well-graded gravel[F]
			$Cu < 4$ and/or $1 > Cc > 3$[E]	GP	Poorly graded gravel[F]
		Gravels with Fines More than 12 % fines[C]	Fines classify as ML or MH	GM	Silty gravel[F,G,H]
			Fines classify as CL or CH	GC	Clayey gravel[F,G,H]
	Sands 50 % or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5 % fines[D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$[E]	SW	Well-graded sand
			$Cu < 6$ and/or $1 > Cc > 3$[E]	SP	Poorly graded sand[I]
		Sands with Fines More than 12 % fines[D]	Fines classify as ML or MH	SM	Silty sand[G,H,I]
			Fines classify as CL or CH	SC	Clayey sand[G,H,I]
Fine-Grained Soils 50 % or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	Inorganic	PI > 7 and plots on or above "A" line[J]	CL	Lean clay[K,L,M]
			PI < 4 or plots below "A" line[J]	ML	Silt[K,L,M]
		organic	$\frac{\text{Liquid limit – oven dried}}{\text{Liquid limit – not dried}} < 0.75$	OL	Organic clay[K,L,M,N] / Organic silt[K,L,M,O]
	Silts and Clays Liquid limit 50 or more	inorganic	PI plots on or above "A" line	CH	Fat clay[K,L,M]
			PI plots below "A" line	MH	Elastic silt[K,L,M]
		organic	$\frac{\text{Liquid limit – oven dried}}{\text{Liquid limit – not dried}} < 0.75$	OH	Organic clay[K,L,M,P] / Organic silt[K,L,M,O]
Highly organic soils	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12 % fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay

[D] Sands with 5 to 12 % fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15 % sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15 % gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29 % plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30 % plus No. 200, predominantly sand, add "sandy" to group name.

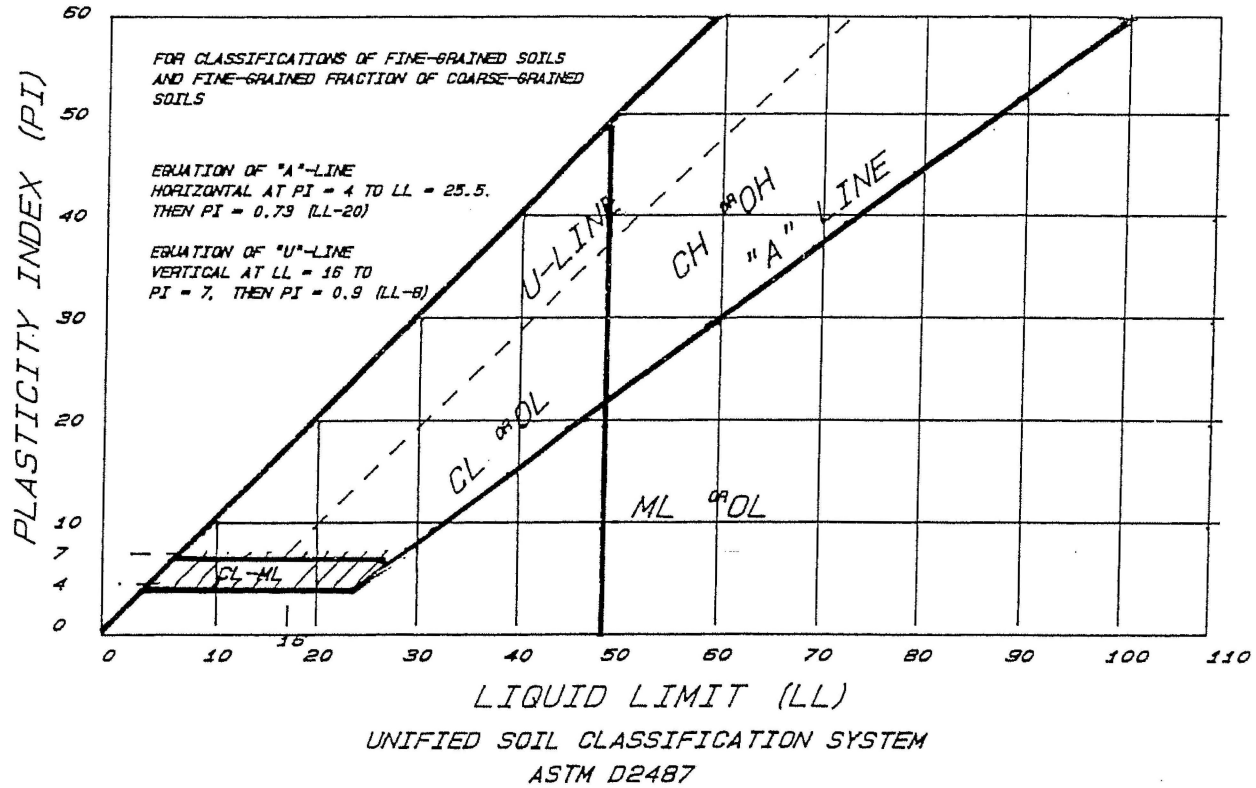
[M] If soil contains ≥ 30 % plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



UNIFIED SOIL CLASSIFICATION SYSTEM
ASTM D2487

BORING LOG B-1

Date: 5-4-06
Project Name: TRACT 17049
Drilling Co: WDC
Logged By: RBP

Sheet No: 1 of 1
Project No: 11240306
Type of Rig: CME 75
Sampled By: RBP

Hole Diameter 8" Drive Weight: 140 lbs. Drilled: 22.0' Final Depth:

Depth Feet	Sample Type	Blows Per Foot	Dry Density pcf.	Moisture Content %	Lab Test Type		Geotechnical Description
5	RING	27				SM-ML	Fine SAND with silts, Pale Yellow, Damp, Medium Dense
10	RING	35			DS	SM-ML	Medium to fine SAND with silts, Pale Yellow, Damp, Medium Dense
15	SPT	26				SM	Medium to fine silty SAND, Brown, Damp, Medium Dense
20	SPT	45					Bottom of Exploratory Boring No Groundwater
25							
30							
35							
40							
45							
50							

BORING: B-1

PLATE A-1

BORING LOG B-2

Date:5-4-06
Project Name: TRACT 17049
Drilling Co: WDC
Logged By: RBP

Sheet No: 1 of 1
Project No: 11240306
Type of Rig: CME 75
Sampled By: RBP

Hole Diameter 8" Drive Weight: 140 lbs. Drilled: 20.0' Final Depth: 20.0'

Depth Feet	Sample Type	Blows Per Foot	Dry Density pcf.	Moisture Content %	Lab Test Type		Geotechnical Description
--						SC	Fine clayey SAND, Brown, Damp to Moist, Loose very cohesive
--							
--							
--					MAX M&D SIEVE		
5 --	SPT	30	112.18	3.08%			
--						SM-ML	Medium to Fine SAND with silts, Brown, Damp, Medium Dense
--							
--							
--							
10--	SPT	42					
--							
--							
--							
15 --	SPT	36					
--							
--							
--							
20--	SPT	33					Bottom of Exploratory Boring No groundwater
--							
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25--							
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30--							
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35--							
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40--							
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45'-							

BORING: B-2

PLATE A-2

BORING LOG B-3

Date: 5-4-06
Project Name: TRACT 17049
Drilling Co: WDC
Logged By: RBP

Sheet No: 1 of 1
Project No: 11240306
Type of Rig: CME 75
Sampled By: RBP

Hole Diameter 8" Drive Weight: 140 lbs. Drilled: 15.0' Final Depth:

Depth Feet	Sample Type	Blows Per Foot	Dry Density pcf.	Moisture Content %	Lab Test Type		Geotechnical Description
--						SM	Medium to fine silty SAND, Brown, Damp, Medium Dense
5 --	RING	37	102.2	14.97%	M&D SIEVE		
10--	SPT	25					
15 --	SPT	31					Bottom of Exploratory Boring No Groundwater
20--							
25--							
30--							
35--							
40--							
45'-							

BORING: B-3

PLATE A-3

BORING LOG B-4

Date:5-4-06
Project Name: TRACT 17049
Drilling Co: WDC
Logged By: RBP

Sheet No: 1 of 1
Project No: 11240306
Type of Rig: CME 75
Sampled By: RBP

Hole Diameter 8" Drive Weight: 140 lbs. Drilled: 15.0' Final Depth:

Depth Feet	Sample Type	Blows Per Foot	Dry Density pcf.	Moisture Content %	Lab Test Type		Geotechnical Description
--						SM	Medium to fine silty SAND, Brown, Damp, Loose to Medium Dense
--							
--							
--							
5 --	RING	72	126.98	2.83%	M&D SIEVE		
--							
--							
--							
--							
10--	SPT	80					
--							
--							
--							
--							
15 --	SPT	45					Bottom of Exploratory Boring No Groundwater
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20--							
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25--							
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35--							
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40--							
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45'-							

BORING: B-4

PLATE A-4

BORING LOG B-5

Date: 5-4-06
Project Name: TRACT 17049
Drilling Co: WDC
Logged By: RBP

Sheet No: 1 of 1
Project No: 11240306
Type of Rig: CME 75
Sampled By: RBP

Hole Diameter 8" Drive Weight: 140 lbs. Drilled: 15.0' Final Depth:

Depth Feet	Sample Type	Blows Per Foot	Dry Density pcf.	Moisture Content %	Lab Test Type		Geotechnical Description
--						SM	Medium to fine silty SAND, Brown, Damp, Loose
5 --	SPT	10					
10--	SPT	49				SC	Medium to fine clayey SAND, Brown, Moist, Medium Dense
--						SM	Medium to fine silty SAND, Brown, Damp, Medium Dense
15 --	SPT	22					**Bottom of Exploratory Boring** **No Groundwater**
20--							
25--							
30--							
35--							
40--							
45'-							

BORING: B-5

PLATE A-5

BORING LOG B-6

Date: 5-4-06
Project Name: TRACT 17049
Drilling Co: WDC
Logged By: RBP

Sheet No: 1 of 1
Project No: 11240306
Type of Rig: CME 75
Sampled By: RBP

Hole Diameter 8" Drive Weight: 140 lbs. Drilled: 20.0' Final Depth:

Depth Feet	Sample Type	Blows Per Foot	Dry Density pcf.	Moisture Content %	Lab Test Type		Geotechnical Description
--						SM	Medium to fine silty SAND, Brown, Damp, Medium Dense
--							
--							
--							
5 --	RING	82	115.75	4.97%	M&D SE		
--							
--							
--							
--							
10--	SPT	30					
--							
--							
--							
--							
15 --	SPT	33					
--							Bottom of Exploratory Boring No Groundwater
--							
--							
20--							
--							
--							
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25--							
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--							
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30--							
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35--							
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40--							
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45--							
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--							
--							
50--							

BORING: B-6

PLATE A-6

BORING LOG B-7

Date: 5-4-06
Project Name: TRACT 17049
Drilling Co: WDC
Logged By: RBP

Sheet No: 1 of 1
Project No: 11240306
Type of Rig: CME 75
Sampled By: RBP

Hole Diameter 8" Drive Weight: 140 lbs. Drilled: 17.0' Final Depth:

Depth Feet	Sample Type	Blows Per Foot	Dry Density pcf.	Moisture Content %	Lab Test Type		Geotechnical Description
--						SM	Medium to fine silty SAND, Brown, Damp, Medium Dense to Dense
--							
--							
--					MAX		
5 --	RING	50 for 5"	117.92	5.25%	M&D SIEVE		
--							
--							
--							
10--	SPT	18				SM	Medium to fine SAND with silts, Grayish Brown, Damp, Medium Dense
--							
--							
--							
15 --	SPT	25					
--							
--							Bottom of Exploratory Boring No Groundwater
--							
20--							
--							
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25--							
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30--							
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35--							
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40--							
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45--							
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--							
--							
50--							

BORING: B-7

PLATE A-7

BORING LOG B-8

Date: 5-4-06
Project Name: TRACT 17049
Drilling Co: WDC
Logged By: RBP

Sheet No: 1 of 1
Project No: 11240306
Type of Rig: CME 75
Sampled By: RBP

Hole Diameter 8" Drive Weight: 140 lbs. Drilled: 15.0' Final Depth:

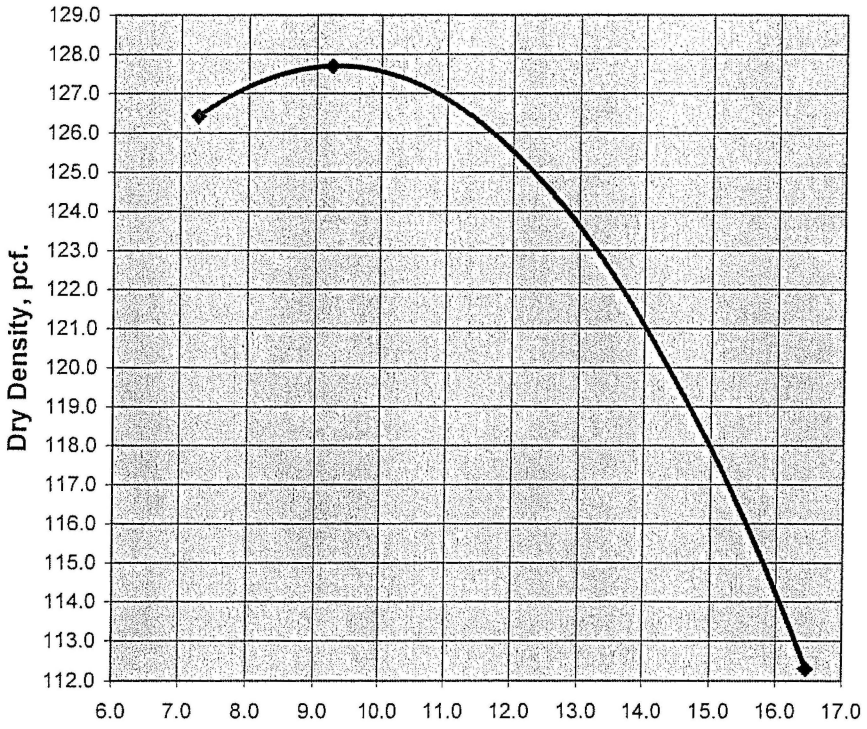
Depth Feet	Sample Type	Blows Per Foot	Dry Density pcf.	Moisture Content %	Lab Test Type		Geotechnical Description
--						SM	Medium to fine silty SAND, Brown, Damp, Medium Dense
5 --	SPT	44				SC	Fine clayey SAND, Brown, Damp, Medium Dense
10--	SPT	33				SM-ML	Medium to fine SAND-SILT, Brown, Damp, Medium Dense
15 --	SPT	27				ML	Medium to fine sandy SILT, Brown, Damp, Medium Dense
							Bottom of Exploratory Boring **No Groundwater**
20--							
25--							
30--							
35--							
40--							
45--							
50--							

BORING: B-8

PLATE A-8

APPENDIX B

Dry Density - Moisture Content Relationship



Date: 5/25/2006 Location : B-2

Field Density Test No. 1 Depth: 3.0'

Soil Type: SM

Method of Compaction: ASTM D 1557A Maximum Dry Density: 128.0 pcf

Optimum Moisture Content: 9.50%

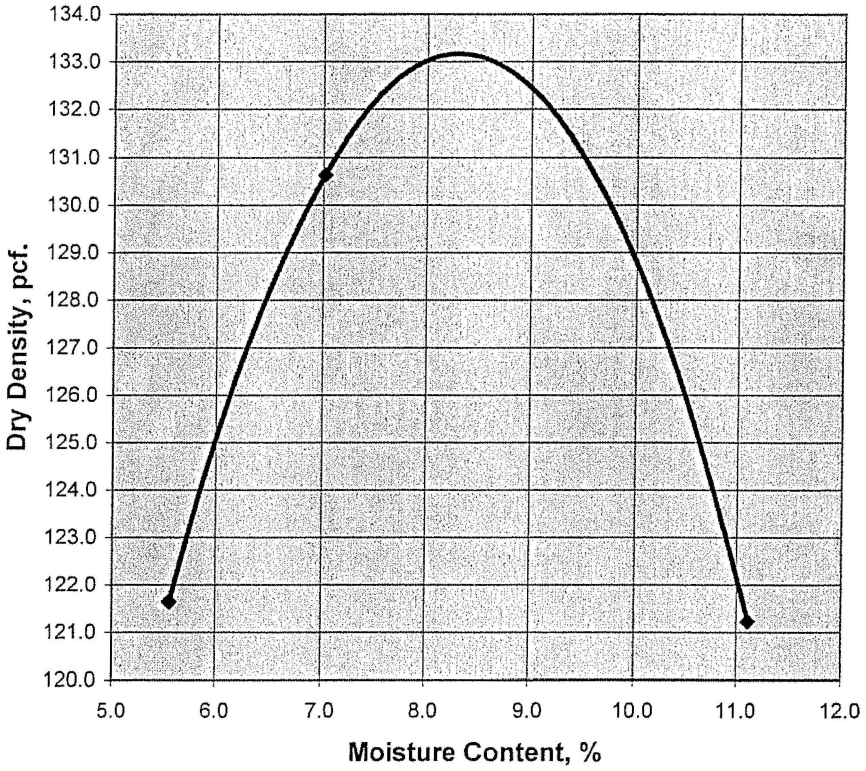
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Victorville | Proj No 11240306

TRACT 17049

PLATE B - 1

Dry Density - Moisture Content Relationship



Date: 5/25/2006 Location : B-7

Field Density Test No. 2 Depth: 4'

Soil Type: SM

Method of Compaction: ASTM D 1557A Maximum Dry Density: 133.0 pcf

Optimum Moisture Content: 8.5%

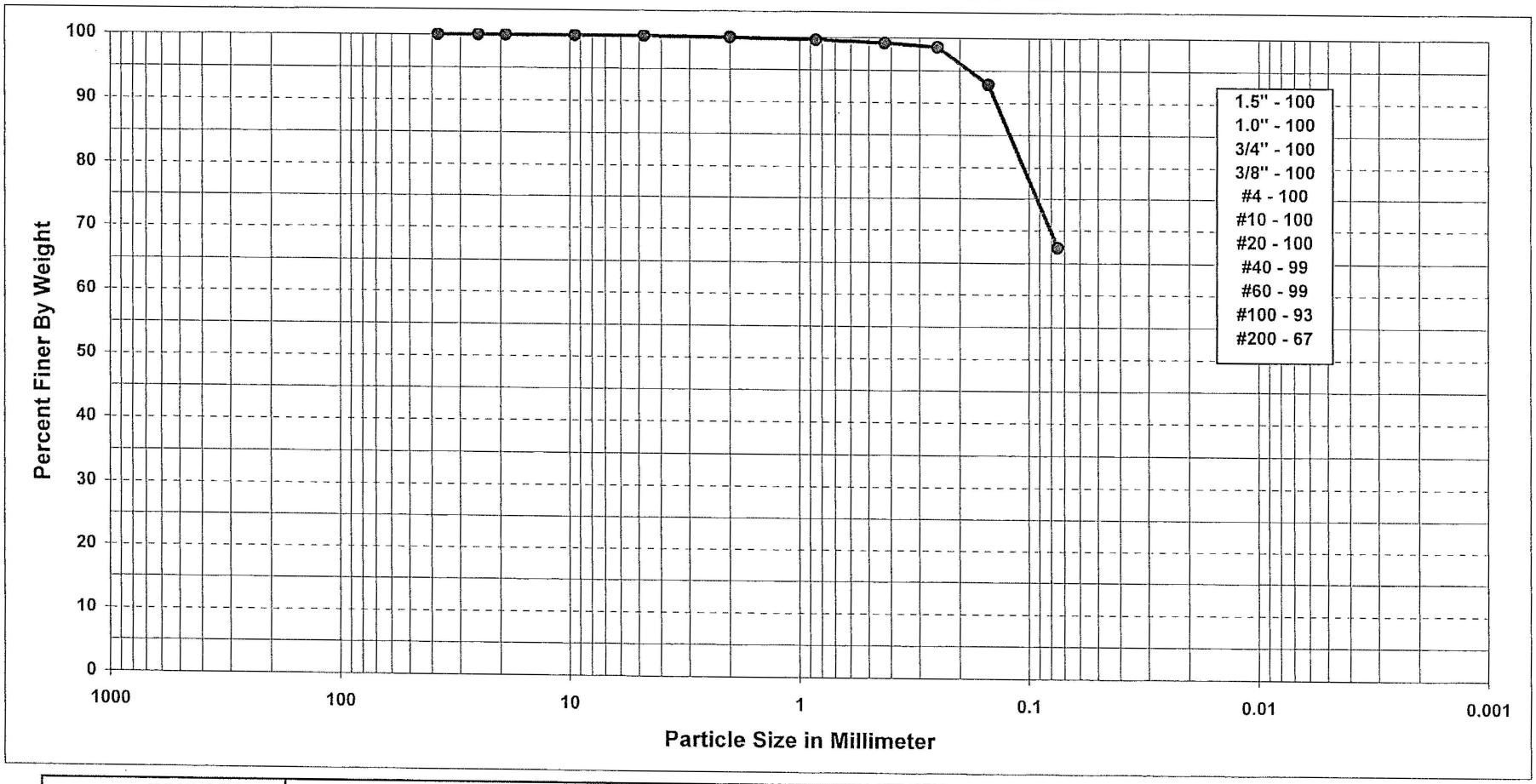
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Victorville	Proj No 11240306
TRACT 17049	
PLATE B - 2	

U.S. STANDARD SIEVE SIZE

HYDROMETER ANALYSIS

1.5" 1" 3/4" 3/8" #4 #10 #20 #40 #60 #100 #200



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Location	Type	Depth, ft.	Soil Classification
B-2	RING	3.0' - 4.5'	Silt (ML)

PARTICLE SIZE ANALYSIS

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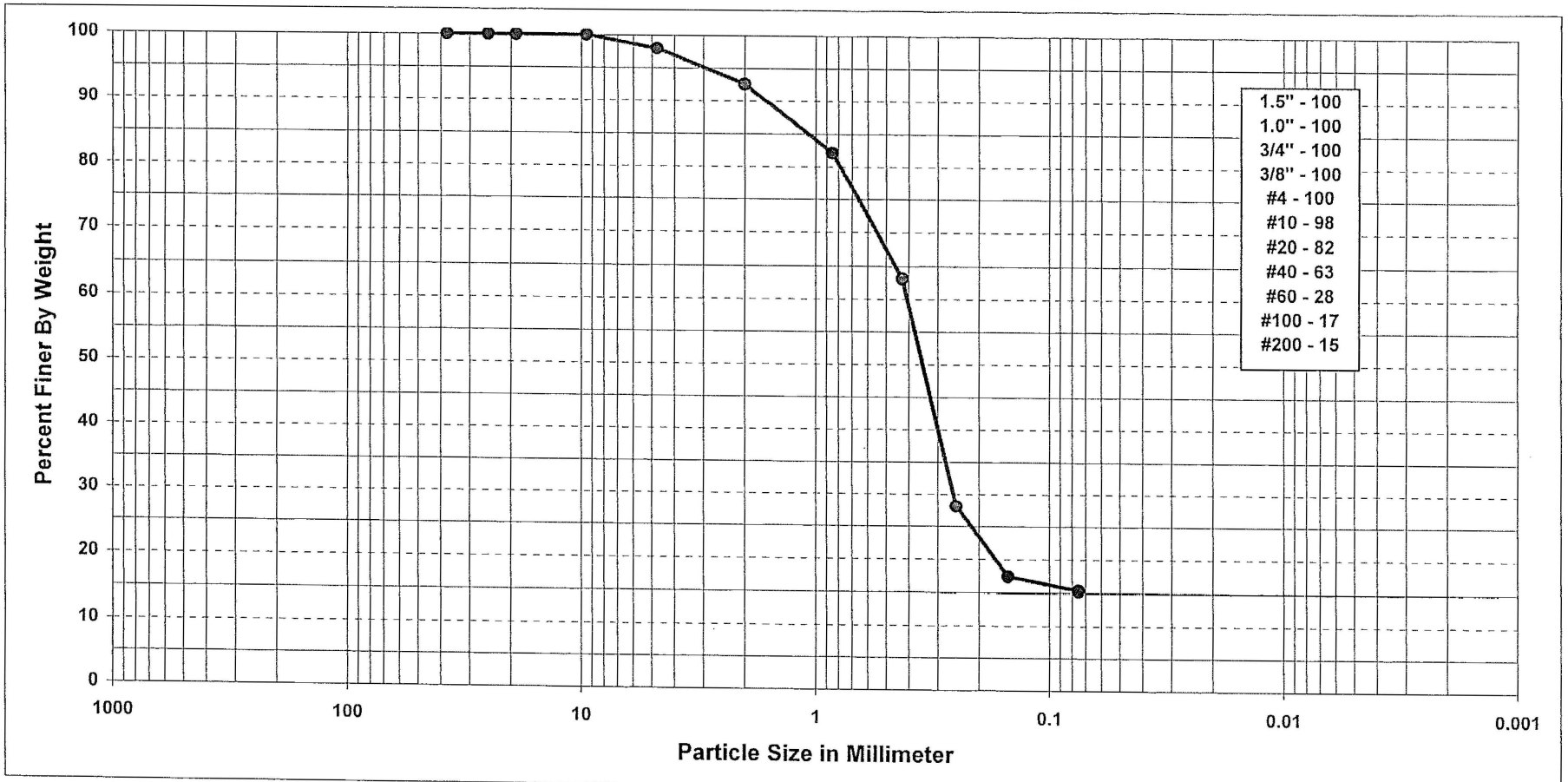
VICTORVILLE, CA 92393

Phone: 760-243-1436

Victorville	Project No. 11240306
APN 482-031-01,02,07,08	
TRACT 17049	
PLATE B-3	

U.S. STANDARD SIEVE SIZE

HYDROMETER ANALYSIS



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Location	Type	Depth, ft.					Soil Classification
B-3	RING	5.0'					Silty SAND (SM)

PARTICLE SIZE ANALYSIS

PATEL AND ASSOCIATES, INC.

P. O. BOX 1121

VICTORVILLE, CA 92393

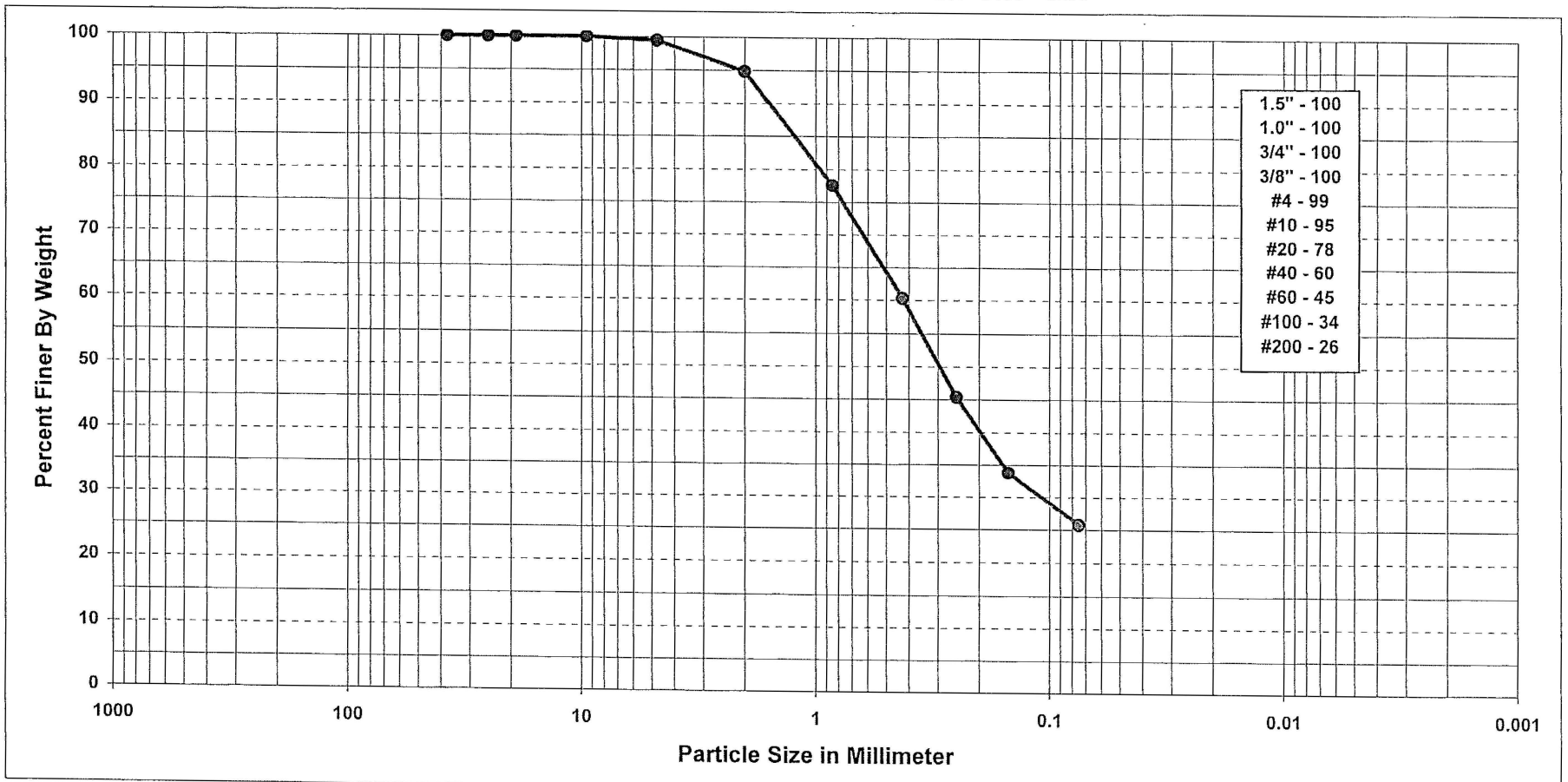
Phone: 760-243-1436

Victorville		Project No. 11240306
APN 482-031-01,02,07,08		
TRACT 17049		
PLATE B-4		

U.S. STANDARD SIEVE SIZE

HYDROMETER ANALYSIS

1.5" 1" 3/4" 3/8" #4 #10 #20 #40 #60 #100 #200



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Location	Type	Depth, ft.					Soil Classification
B-4	RING	5.0'					Silty SAND (SM)

PARTICLE SIZE ANALYSIS

PATEL AND ASSOCIATES, INC.

P. O. BOX 1121

VICTORVILLE, CA 92393

Phone: 760-243-1436

Victorville

Project No. 11240306

APN 482-031-01,02,07,08

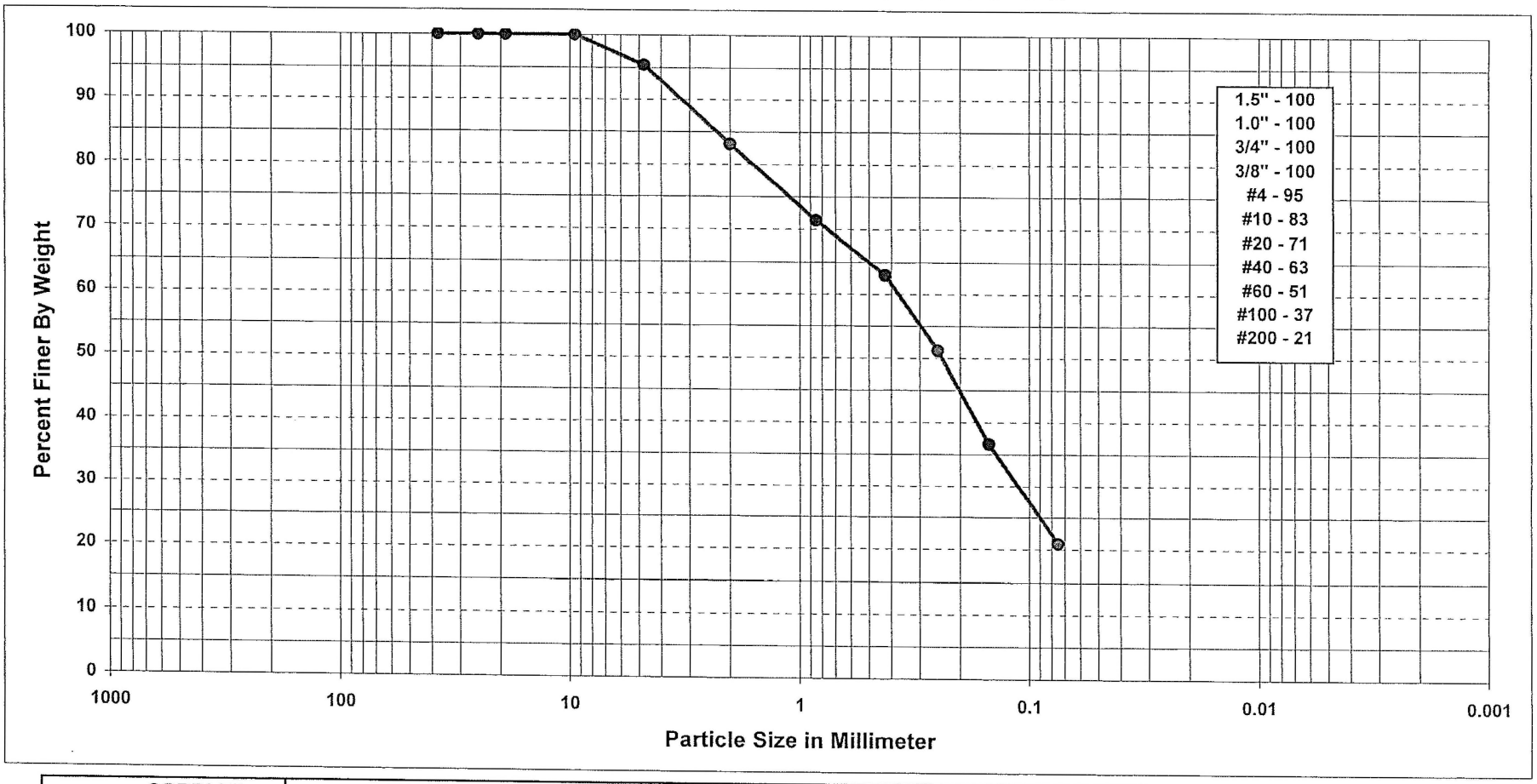
TRACT 17049

PLATE B-5

U.S. STANDARD SIEVE SIZE

HYDROMETER ANALYSIS

1.5" 1" 3/4" 3/8" #4 #10 #20 #40 #60 #100 #200



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Location	Type	Depth, ft.					Soil Classification
B-7	RING	5.0'					Silty SAND (SM)

PARTICLE SIZE ANALYSIS

PATEL AND ASSOCIATES, INC.

P. O. BOX 1121

VICTORVILLE, CA 92393

Phone: 760-243-1436

Victorville		Project No. 11240306
APN 482-031-01,02,07,08		
TRACT 17049		
PLATE B-6		

APPENDIX C

APPENDIX C

GUIDELINE TECHNICAL SPECIFICATIONS FOR EARTHWORKS

1.0 INTRODUCTION

The purpose of these guideline technical specifications is to supplement geotechnical report and the project requirements including the following pertinent code requirements. In case of conflict, recommendations provided in the report and interpretations of the engineer (civil engineer, geotechnical engineer or his/her representative) will govern. Additionally, the specifications are subject to modification if the site subsurface conditions change during the construction.

2.0 TERMS AND DEFINITIONS

2.1 **Earth Materials**: Natural soils encountered at the site or imported, free of organics, vegetation matter and deleterious materials.

2.2 **Suitable Materials**: Local excavated materials are suitable except organic materials, trash, debris, pit, highly-expansive clays. Suitable materials are generally classified as: Sand (SP, SW), silty, gravely or clayey sand (SM- SC), and silty and/or sandy clays (CL) with low plasticity. The classifications of soils are in accordance with United Soil Classification System, (USCS), ASTM D2487.

2.3 **Unsuitable Materials**: Organic soils, debris, trash, pit and highly expansive clays (fat clays) are not suitable. Expansive soils shall require special treatment to be used as foundation support.

2.4 **Unstable Materials**: Unstable materials are generally termed as collapsing and expansive soils. These soils require special treatment including removal and recompaction, also the material cannot be properly compacted or will not support construction equipment due to high moisture content or very loose is considered to be unstable.

2.5 **Backfill**: Earth material meeting requirements of Section 2.2 "Suitable Materials".

2.6 **ASTM**: American Society for Testing and Materials, latest edition.

2.7 **Standard Specifications**: State of California, Department of Transportation, Standard Specifications, latest edition.

2.8 **U.B.C.**: Uniform Building Code, latest edition.

2.9 **Maximum Dry Density (MDD):** is the laboratory maximum dry density determined in a soil sample in conformance with testing procedures of ASTM D1557 unless otherwise specified in the geotechnical report.

2.10 **Optimum Moisture Content (OMC):** is the moisture content corresponding maximum dry density as determined by test procedures conforming to ASTM D1557.

2.11 **Moisture Content (MC):** is the ratio of the weight of water to the weight of the dry solid material expressed as a percentage and determined by ASTM D2216, D3017 or the method approved by the engineer.

2.12 **Field Dry Density (FDD):** is the dry density of natural or compacted material as determined by ASTM D1556 - Sand Cone Method or ASTM D2922 - Nuclear Methods or ASTM D2937 - Drive-Cylinder Method.

2.13 **Relative Compaction**: is the ratio of the field dry density to the maximum dry density, expressed as a percentage.

3.0 GENERAL NOTES

3.1 The Owner shall retain the Soil Engineer for quality assurance and testing services.

3.2 The Contractor shall be responsible for quality control through out the prosecution of the work.

3.3 Contractor shall visit the project site and become familiar with the site conditions prior to the bidding.

3.4 Contractor shall verify the site and subsurface conditions at no cost to the owner. The preliminary soil engineering report does not constitute the actual subsurface conditions at the time of constructions or at the locations different from the excavated test pits/borings.

3.5 All excavations and foundations for the structures shall be inspected and approved by the soil engineer, prior to the preparations of subgrade, and backfill.

3.6 All foundation soils underneath the retaining wall footings shall be scarified to a depth of at least one (1') foot, brought to uniform moisture content near optimum moisture content and recompacted to a minimum relative compaction of 95% and as specified in the report.

4.0 FIELD OBSERVATIONS AND TESTING

Field observations and testing shall be performed by an experienced and qualified engineer (civil engineer, geotechnical engineer and their representatives). The engineer will observe and perform adequate amount of testing to meet the project and regulatory requirements. It will be the contractor's responsibility to assist the engineer, allow sufficient time and provide adequate notice to carry out the testing and schedule the personnel.

5.0 PREPARATION OF FILL AREAS

5.1 **Clearing, Overexcavation and Recompaction**: All areas receiving fill and used as foundation support shall be cleared of topsoil, vegetation, trash, debris and other deleterious materials. After clearing and grubbing, the over excavating, as stated in the preliminary geotechnical report, the area should be scarified as recommended in the report or to a minimum depth of 12 inches.

The overexcavation should extend to a depth recommended in the report or until stable ground is reached. The material scarified will be uniformly moisture conditioned to near optimum moisture content and recompacted to a relative compaction of 90 percent or greater. The placement of fill will commence upon completion of preparation and approved by the engineer.

5.2 **Benching**: Prior to the construction of fill slopes (embankments) and placement of fill on ground surface sloping steeper than 5 horizontal: 1 vertical, the ground shall be cut in benches. The lowest bench should be at least 12 feet wide to facilitate the fill placement in horizontal lifts. Under certain circumstances and if approved by the engineer, the width may be reduced to the size of the widest equipment (i.e., scraper, compactor or tractor) to be used. The lowest bench shall be at least two (2) feet deep. Other benches will be excavated to a firm material for a minimum width of four (4) feet.

6.0 EXCAVATION AND FILL MATERIAL

6.1 **Excavation**: All excavations should be carried out as per project documents. In general, all channel excavations can be accomplished by conventional heavy earth-moving equipment.

6.2 **Fill Materials**:

6.2.1 **Structural Fill**: The fill material shall be suitable material as defined in Section 2.2 and shall be approved by the engineer. Cobbles (rocks) six (6) inches or greater in size should not be used as structural fill. In general, the fill for structural fill shall be no-to-low in expansion potential meeting the following criteria:

a)	**Liquid Limit**	**<35**
b)	**Plasticity Index**	**<15**
c)	**Expansion Index Under 200 psf Surcharge Load**	**<20**

This material should extend to a minimum depth of five (5) feet below the foundation footing.

6.2.2 **Bedding Material Underneath Pipes and Culverts**: A one (1') foot thick class 2 aggregate base course shall be constructed underneath all culvert slabs and footing foundations for the retaining walls. The base course shall be placed over the prepared subgrade and shall meet the requirements of "Class 2 Aggregate Base (3/4" max.)" , Section 26 of Standard Specifications. The base course shall meet the placement and compaction requirements of sections 26-1.035, 26-1.04, and 26-1.05 of the Standard Specifications.

6.2.3 **Backfill Behind Retaining Structures**: All backfill material behind the retaining structures and box culverts shall be classified as sands (SP, SW) to silty Sand (SM), and meet the requirements of Section 2.2 "Suitable Materials" and shall be approved by the Civil Engineer. Excavated materials from the site meeting the requirements of Section 2.2 shall be used as backfill.

6.2.4 The pervious material (SP, SW) behind the retaining structures shall be hard, durable and free of any organics, vegetation, clay, and other deleterious materials. Contractor shall identify the source of material and furnish 30 days in advanced at least 50 pounds of material for testing and approval. The pervious granular material shall meet the following gradation criteria.

SIEVE SIZE	PERCENT PASSING
3/4 inch	100
3/8 inch	85-100
#4	60-80
#10	30-70
#40	0-30
#100	0-5

6.2.5 **Aggregate Base Course**: Aggregate base shall be Class 2 conforming to Section 26 "Standard Specifications:, California Department of Transportation, and shall be approved by the Engineer.

6.2.6 **Imported Material**: Import material to be used as structural fill shall meet the criteria as per Section 6.2.1.

7.0 FILL PLACEMENT

7.1 **General**: Suitable material to be used as fill shall be uniformly moisture conditioned either in stockpile or in-place. Prior to the placement, the area to receive fill shall be prepared as described in Section 4.0 and scarified to provide bond between existing compacted surface and new lift.

7.2 **Fill Placement**: Fill material shall be placed in uniform horizontal lifts not exceeding eight (8) inches, measured loose. The material shall be uniformly spread and should not contain any large rock particles, clods of clay lumps. Clods and clay lumps shall be broken down and thoroughly mixed. Large rock particles greater than six (6) inches shall be removed from the fill area. Fill material shall have uniform moisture content, near optimum as specified under Compaction Criteria, Section 7.4.

7.3 **Compaction**: Each loose lift shall be compacted using proper compaction equipment well suited to the type of material being compacted to produce uniform compaction. After the layer has been compacted, the compacted surface shall be scarified prior to the placement of another lift. Fill slopes should be compacted by back rolling. It may be necessary to overbuild the slopes and trimmed to achieve final finished slope.

7.4 **Compaction Criteria**: In general the compaction criteria given below should be followed. All compaction is relative to ASTM D1557 unless otherwise specifically stated.

Area	Relative Moisture Content Compaction at the time of (Relative Compaction to MDD) (Relative to OMC)
a) Structural fill	90% or greater-2 to +2% of OMC
b) Backfill around retaining walls	90% or greater-2 to +2% of OMC
c) Embankment Fill (levees)	90% or greater-2 to +2% of OMC
d) Trench backfill from 1' below the subgrade to 4' below the subgrade	90% or greater-2 to +2% of OMC
e) Trench backfill upper 1'	95% or greater-2 to +2% of OMC
f) Paved areas, both concrete & asphaltic aggregate base & upper 1' of subgrade	95% or greater-2 to +2% of OMC
g) Subgrade below concrete slabs at wet crossing, upper 1'	95% or greater-2 to +2% of OMC
h) General nonstructural backfill, (i.e., landscape area)	85% or greater-1 to +3% of OMC

7.5 **Quality Assurance and Testing**: As quality assurance, Engineer will observe overexcavation and placement of fill and conduct field density tests. Field density testing will be performed in conformance with ASTM D1556 - Sand Cone Method and ASTM D2922 - Nuclear Methods. Test location and frequency of testing will be at the discretion of the engineer. However, in general, field density tests will be performed at every two-foot compacted lift and/or every 1,000 cubic yards of fill placed. Additional testing will be performed at the discretion of the engineer. When test results and/or observations indicate, as determined by the engineer, that compaction is not as specified, the material shall be removed, replaced and recompacted to meet the specifications. It is the contractor's responsibility that both moisture content and relative compaction are met in a consistent manner.

8.0 TRENCH EXCAVATION AND BACKFILLS

8.1 **General**: Excavations for utility trenches greater than five (5) feet deep may require shoring. All excavations should be carried out in accordance with applicable standard specifications, Cal-OSHA requirements and local government agency requirements. Backfill shall be observed and tested by the engineer.

8.2 **Bedding Material**: Bedding material shall conform to applicable requirements of standard specifications and local government agency requirements. In general, granular bedding comprising of coarse sand and gravel is ideally suitable as bedding material. Local sandy soils may be used if acceptable to the governing agency.

8.3 **Backfill Material**: Granular backfill one (1) foot above the pipe is ideally suitable. Local sandy soil may be used if acceptable to the governing agency. Remainder of the trench shall be backfilled with local suitable material.

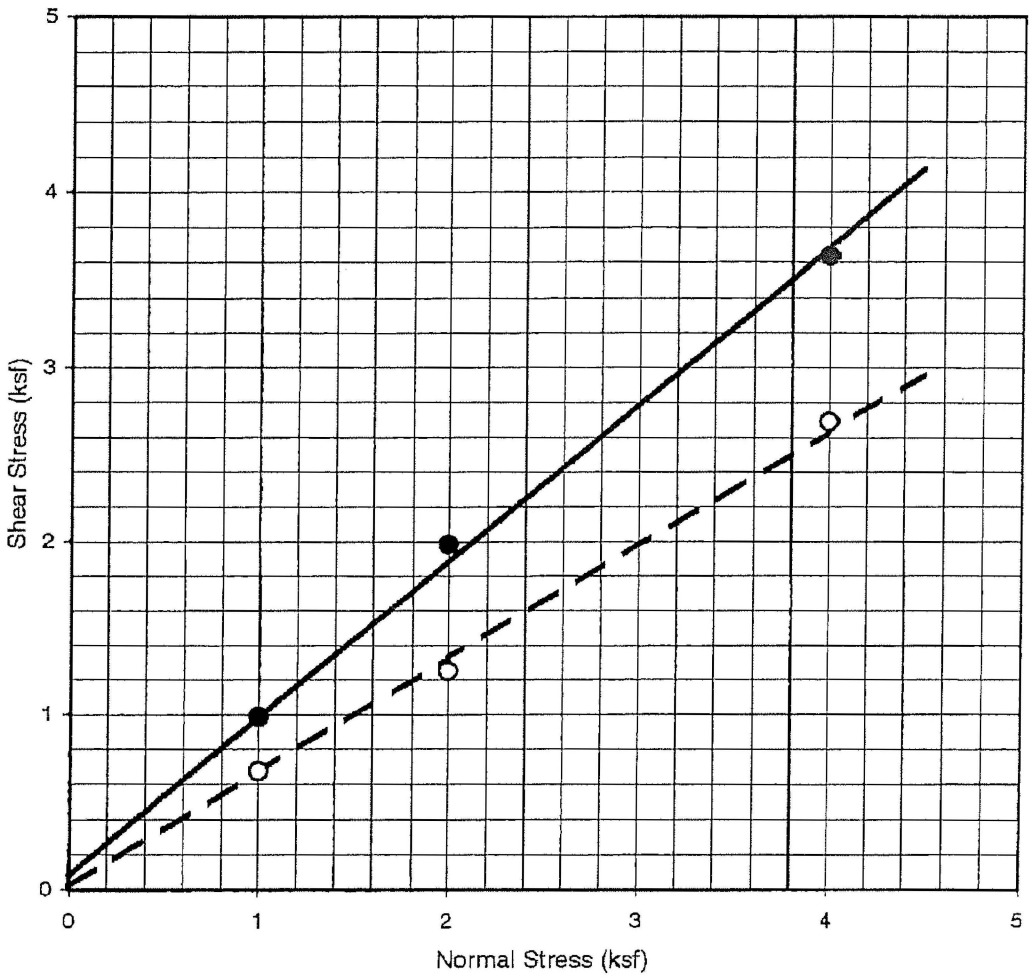
8.4 **Placement, Moisture Conditioning and Compaction**: Backfill shall be uniformly moisture conditioned and compacted. Compaction criteria provided in Section 6.4 should be followed. Upper one (1) foot of backfill should be compacted to 95 percent relative compaction.

9.0 EXCAVATIONS

Excavations and over-excavations shall be performed in accordance with plans and recommendations contained in the preliminary geotechnical investigation report. All excavations will be observed by the engineer. If unsuitable soils are discovered, the engineer will determine the extent of over-excavation. No fill placement over cut area will commence prior to approval by the engineer. Prior to placement of fill, cut surface shall be scarified and uniformly moisture conditioned and recompacted.

10.0 UNDER DRAINS

Under drains, if required, shall be constructed in accordance with plans and project requirements. Location of under drains will be surveyed to provide as-built location. Engineer may modify the location and requirement of the under drain depending upon the field condition.



Project Name:	:	Tract 17049	
Project No.	:	11240306	
Boring No.	:	B-1	
Sample No.	:	-	
Depth (ft)	:	10	
Sample Type	:	Undisturbed	
Soil Type	:	Yellowish Brown Fine Sandy Silt	
Test Condition	:	Saturated	
Initial Dry Density	:	104.4	pcf
Moisture Content (before)	:	14.0	%
Moisture Content (after)	:	23.8	%

INTERPRETED STRENGTH DATA

	Peak	Ultimate
COHESION (PSF) :	100	0
FRICTION ANGLE :	42 °	33 °

AP ENGINEERING AND TESTING

DIRECT SHEAR
TEST RESULTS
(ASTM D 3080)

May-06 Figure No.

MINIMUM FOUNDATION AND SLAB RECOMMENDATIONS FOR EXPANSIVE SOILS

(ONE AND TWO-STORY RESIDENTIAL BUILDINGS)

U.B.C.	Expansion Index 0-20 Very Low Expansion	Expansion Index 21-50 Low Expansion	Expansion Index 51-90 Medium Expansion	Expansion Index 91-130 High Expansion
1-Story Footings (See Note 1)	All footings 12" deep. Reinforcement for continuous footings: one No. 4 bar top & bottom.	All footings 12" deep. Reinforcement for continuous footings: one No. 4 bar top & bottom.	Exterior footings 18" deep. Interior footings 12" deep. Reinforcement for continuous footings: one No. 4 bar top & bottom.	Exterior footings 24" deep. Interior footings 18" deep. Reinforcement for continuous footings: one No. 5 bar top & bottom; or two No. 4 top & bottom.
2-Story Footings (See Note 1)	Exterior footings 18" deep. Interior footings 12" deep. Reinforcement for continuous footings: one No. 4 bar top & bottom.	Exterior footings 18" deep. Interior footings 12" deep. Reinforcement for continuous footing: one No. 4 bar top & bottom.	Exterior footings 18" deep. Interior footings 12" deep. Reinforcement for continuous footings: one No. 4 bar top and bottom.	Exterior footings 24" deep. Interior footings 18" deep. Reinforcement for continuous footings: one No. 5 bar top & bottom; or two No. 4 top & bottom.
Minimum Footing Width	Continuous: 12" for 1-story Continuous: 15" for 2-story Isolated column: 24"	Continuous: 12" for 1-story Continuous: 15" for 2-story Isolated column: 24"	Continuous: 12" for 1-story Continuous: 15" for 2-story Isolated column: 24"	Continuous: 12" for 1-story Continuous: 15" for 2-story Isolated column: 24"
Garage Door Grade Beam (See Note 2)	A grade beam 12" wide x 12" deep (18" deep for 2-story) should be provided across the garage entrance.	A grade beam 12" wide x 12" deep (18" deep for 2-story) should be provided across the garage entrance.	A grade beam 12" wide x 18" deep should be provided across the garage entrance.	A grade beam 12" wide x 24" deep should be provided across the garage entrance.
Living Area Floor Slabs (See Notes 3, 4, 5)	Nominal 4" thick slab. 6x6 - 10/10 WWF reinforcement at mid-height. 6-mil Visqueen moisture barrier on pad grade with 1" sand above Visqueen.	Nominal 4" thick slab. 6x6 - 10/10 WWF reinforcement at mid-height. 6-mil Visqueen moisture barrier above 2" sand base with 1" sand above Visqueen.	Nominal 4" thick slab. 6x6 - 6/6 WWF reinforcement at mid-height. 6-mil Visqueen moisture barrier above 3" sand base with 1" sand above Viqueen.	Nominal 4" thick slab. 6x6 - 6/6 WWF reinforcement at mid-height. 6-mil Visqueen moisture barrier above 4" sand base with 1" sand above Viqueen.
Garage Floor Slabs (See Notes 4 & 6)	Nominal 4" thick slab on pad grade. Garage slabs should be quarter-sawn.	Nominal 4" thick slab on 2" sand base. Garage slabs should be quarter-sawn.	Nominal 4" thick slab on 3" sand base. Garage should be quarter-sawn or reinforced with 6x6-10/10 WWF at mid-height.	Nominal 4" thick slab on 4" sand base. Garage slabs should be quarter-sawn and reinforced with 6x6-6/6 WWF at mid-height.
Presoaking of Living Area and Garage Slabs	Near-optimum to a depth of 6".	(1.2) x optimum to a depth of 12".	(1.3) x optimum to a depth of 18".	(1.4) x optimum to a depth of 24".

NOTES:

1) Depth of interior or exterior footings to be measured from lowest adjacent finish grade.
2) The base of the grade beam should be at the same elevation as that of the adjoining footings.
3) Living area slabs may be tied to the footings as directed by the structural engineer. For HIGH EXPANSION: Dowels consisting of No. 3 bars should be placed at 36 inches on centers in the footings and bent 3 feet into the slab.
4) It has been observed that welded wire fabric reinforcement seldom stays at the design height within concrete slabs. We recommend the use of No. 3 bars at 24 inches O.C. instead of 6x6-10/10 WWF and No. 3 bars at 18 inches O.C. instead of 6x6-6/6 WWF.
5) 6-mil Visqueen sheeting has proved successful. Equivalents are acceptable.
6) Garage slabs should be isolated from stem wall footings with a minimum 3/8" felt expansion joint.
7) Sand base should have a Sand Equivalent of 30 or greater (e.g., washed concrete sand).

Post-Tensioned Slabs

As an alternative to conventional foundations, buildings may be supported on post-tensioned slabs, to be designed by a structural engineer in consultation with the geotechnical consultant. In addition, a post-tensioned slab is also recommended for VERY HIGH expansion potential (Expansion Index greater than 130), if encountered. Post-tensioned slabs should have perimeter footings embedded a minimum of 12 inches below the adjacent grade. The slabs should be designed such that they can be deformed approximately 1 inch vertically over a width of 30 feet without distress in the event of shrinkage or swelling of the supporting soils. Living area slabs should be underlain by a 6 mil Visqueen moisture barrier covered by a 1-inch layer of sand. Presoaking is recommended for post-tensioned slabs: (1.2) x optimum to a depth of 12 inches, (1.3) x optimum to a depth of 18 inches, and (1.4) x optimum to a depth of 24 inches for MEDIUM, HIGH, and VERY HIGH expansion potential soils, respectively. Placement of sand base below Visqueen is also suggested for post-tensioned slabs: 2, 3, and 4 inches thick for MEDIUM, HIGH, and VERY HIGH expansion potential soils, respectively.