GEOTECHNICAL INVESTIGATION
DESIGN PHASE

FOR
PROPOSED RESIDENTIAL CONSTRUCTION
111 ERRETT CIRCLE
SANTA CRUZ, CALIFORNIA 95060
APN 004-151-01

PREPARED FOR
CIRCLE OF FRIENDS, LLC

PROJECT NO. 18-105-SC

PREPARED BY

BUTANO GEOTECHNICAL ENGINEERING, INC.
MARCH 2018

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The sandstone encountered was highly weathered and loose to very dense.

Groundwater was encountered at 8 1/3 feet, 4 feet, 8 ½ feet, and 7 feet in borings B1 through B4 respectively. Groundwater levels will vary seasonally.

Complete soil profiles are presented on the Boring Logs, Appendix B, Figures B-4 through B-11. The boring locations are shown on the Boring Site Plan, Appendix B, Figure B-2.

4.0 PROJECT DESCRIPTION

Based on our discussions with the client it is our understanding that the existing structures will be demolished and the site will be improved with multiple residential units.

Development of the lot may include subdividing the parcel.

5.0 GEOTECHNICAL HAZARDS

5.1 General

In our opinion the geotechnical hazards that could potentially affect the proposed project are:

- Intense seismic shaking
- Collateral seismic hazards

5.1.1 Intense Seismic Shaking

The hazard of intense seismic shaking is present throughout central California. Intense seismic shaking may occur at the site during the design lifetime of the proposed structure from an earthquake along one of the regions many faults. Generally, the intensity of shaking will increase the closer the site is to the epicenter of an earthquake, however, seismic shaking is a complex phenomenon and may be modified by local topography and soil conditions. The transmission of earthquake vibrations from the ground into the structure may cause structural damage.

The City of Santa Cruz has adopted the seismic provisions set forth in the 2016 California Building Code to address seismic shaking. The seismic provisions in the 2016 CBC are minimum load requirements for the

seismic design of the proposed structure(s). The provisions set forth in the 2016 CBC will not prevent structural and nonstructural damage from direct fault ground surface rupture, coseismic ground cracking, liquefaction and lateral spreading, seismically induced differential compaction, seismically induced landsliding, or seismically induced inundation.

Table 1 has been constructed based on the 2016 CBC requirements for the seismic design of the proposed structure. The Site Class has been determined based on our field investigation and laboratory testing.

Table 1. Seismic Design Parameters

S_S	S_1	Site Class	F_a	F_v	S_{DS}	S_{D1}	F_{PGA}	PGA_M	Occupancy Category	Seismic Design Category
1.500	0.600	C	1.0	1.3	1.000	0.520	1.000	0.534	II	D

Latitude: 36.959515 Longitude: -122.038419

5.1.2 Collateral Seismic Hazards

In addition to intense seismic shaking and fault surface rupture, other seismic hazards that may have an adverse effect to the site and/or the structure are: coseismic ground cracking, seismically induced liquefaction, (and associated hazards), seismically induced landsliding, and seismically induced inundation (tsunami and seiche). It is our opinion that the potential for collateral seismic hazards to affect the site and to damage the proposed structure is low.

6.0 DISCUSSIONS AND CONCLUSIONS

One expansion index test was conducted at the site and yielded an EI = 80 indicating a medium potential for expansion. One one-dimensional swell test was conducted and yielded a swell pressure of 510 psf. Based on the swell pressure there is low potential for heave.

Very loose and soft soil was encountered in the upper one to three feet.

Infiltration of collected drainage is not practical at this site because of the high groundwater table and low percolation rates.

7.0 RECOMMENDATIONS

7.1 General

Based on the results of our field investigation, laboratory testing, and engineering analysis it is our opinion that from the geotechnical standpoint, the subject site will be suitable for the proposed improvements.

7.2 Site Grading

7.2.1 Site Clearing

The site should be cleared of non-engineered fill, very soft and loose soil, organics and debris within the project limits. This should include the removal of any pre-existing foundation elements, previously poured concrete, and abandoned or unused utilities.

Any soil disturbed by site clearing and demolition of the existing church should be recompacted according to section 7.2.2. It is anticipated that this zone of disturbance will range from 12 to 24 inches below existing grade.

7.2.2 Preparation of On-Site Soils

Site Grading-General

Areas to receive fill should be scarified in the upper 8 inches, moisture conditioned and compacted to a minimum of 90 percent relative compaction. Scarification and compaction should extend a minimum of 2 feet laterally of any proposed improvements.

Engineered fill may then be placed in maximum eight-inch lifts with each lift being compacted to a minimum of 90 percent relative compaction.

The on-site soil may be re-used as engineered fill after any deleterious material is removed and it is moisture conditioned. The on-site soil may need to be moisture conditioned to achieve compaction.

Imported fill material should be approved by a representative of Butano Geotechnical Engineering, Inc. prior to importing. On-site and imported fill should be primarily granular with **no material greater than 2½ inches in diameter** and no more than 20 percent of the material passing the #200 sieve. The fines fraction of fill should not consist of expansive material.

The Geotechnical Engineer should be notified not less than 5 working days in advance of placing any fill or base course material proposed for import. Each proposed source of import material should be sampled, tested, and approved by the Geotechnical Engineer prior to delivery of any soils imported for use on the site.

Any surface or subsurface obstruction, or questionable material encountered during grading, should be brought immediately to the attention of the Geotechnical Engineer for proper processing as required.

Paved Areas

The upper 8 inches of subgrade and all aggregate baserock in paved areas should be compacted to a minimum of **95 percent** relative compaction. This should extend a minimum of 2 feet laterally of all paved areas.

7.2.3 Cut and Fill Slopes

No significant cuts or fills are anticipated for this project.

7.2.4 Excavating Conditions

The on-site soil may be excavated with standard earthwork equipment.

7.2.5 Surface Drainage

Positive drainage should be maintained away from the structures at a minimum gradient of 2 percent for 5 feet. If this is not possible due to property boundaries the surface drainage should be collected in a swale and routed away from foundation elements. Collected drainage should be released at approved locations.

7.2.6 Utility Trenches

Utility trenches should be backfilled based on the City of Santa Cruz standard details. At a minimum this should consist of 4 inches of bedding sand below the utility and 8 inches of bedding sand above the utility.

Backfill of all exterior and interior trenches should be placed in thin lifts not to exceed 8 inches and mechanically compacted to achieve a relative compaction of not less than 95 percent in paved areas and 90 percent in

other areas per ASTM D1557. Care should be taken not to damage utility lines.

The on-site native soils may be utilized for trench backfill above the bedding sand. If sand or granular material is used for trench backfill, a 3 foot concrete plug should be placed in each trench where it passes under the exterior footings.

Utility trenches that are parallel to the sides of a building should be placed so that they do not extend below a line sloping down and away at an inclination of 2:1 H:V from the bottom outside edge of all footings.

Trenches should be capped with 6 inches of relatively impermeable material. Import material must be approved by the Geotechnical Engineer prior to its use.

Trenches must be shored as required by the local regulatory agency, the State of California Division of Industrial Safety Construction Safety Orders, and Federal OSHA requirements.

7.3 Foundations

7.3.1 Conventional Shallow Foundations

General

Conventional shallow foundations may be used after the very loose and soft soil is over excavated and replaced as engineered fill per section 7.2.2. Two feet of over excavation should be anticipated.

As an alternative, foundations may be founded one-foot into firm or medium dense in-situ soil. This option will create footings approximately 3 feet deep.

New foundation elements and foundation pad excavations must be checked by the Geotechnical Engineer before steel is placed and concrete is poured.

Footing Dimensions

Footing widths should be based on the allowable bearing value. The minimum recommended depth of embedment is 12 inches for foundations founded on engineered fill, and 3 feet for foundations founded on in-situ

soil. Embedment depths should not be allowed to be affected adversely, such as through erosion, softening, digging, etc. Should local building codes require deeper embedment of the footings or wider footings, the local codes must apply.

Bearing Capacity

The allowable bearing capacity used should not exceed 2,000 psf for footings bearing on in-situ soil or engineered fill. The allowable bearing capacity may be increased by one-third in the case of short duration loads, such as those induced by wind or seismic forces. In the event that footings are founded in structural fill consisting of imported materials, the allowable bearing capacities will depend on the type of these materials and should be re-evaluated.

Lateral Resistance

Friction coefficient - 0.30, between the in-situ soil or engineered fill and rough concrete. A passive resistance of 200 and 350 pcf may be assumed below a depth of 12 inches for in-situ soil and engineered fill, respectively. Where both friction and the passive resistance are utilized for sliding resistance, either of the values indicated should be reduced by one-third.

7.3.2 Concrete Slabs-on-Grade

General

We recommend that interior concrete slab-on-grades be founded on 2 feet of engineered fill per section 7.2.2.

We recommend that exterior concrete slab-on-grades and flatwork be founded on 12 inches of engineered fill per per section 7.2.2.

The finished subgrade should be proof-rolled just prior to construction to provide a firm, relatively unyielding surface, especially if the surface has been loosened by the passage of construction traffic.

Capillary Break and Vapor Barrier

The following paragraph outlines the minimum capillary break and vapor barrier that shall be utilized for interior slab-on-grades, or slab-on-grades where moisture sensitive floor coverings are anticipated.

The vapor barrier shall consist of a waterproof membrane (Stegowrap 15 Mil or equivalent) placed directly below the floor slab and in direct contact with the concrete. Sheet overlap for the vapor barrier shall be a minimum of 6 inches. A 4-inch minimum layer of ¾ inch drainrock shall be placed below the waterproof membrane to act as a capillary break. Care must be taken to not rip the vapor barrier. A 6-inch layer of Class II Baserock compacted to 90 percent may be placed between the drainrock and the waterproof membrane to prevent rips or tears in the vapor barrier.

If the manufacturer's recommendations or the project requirements for the capillary break and vapor barrier are more stringent than the minimums outlined above, the designer should follow those recommendations and requirements. Recommendations by the manufacturer may include but is not limited to specifications for; concrete mix design, puncture resistance of vapor barrier, permeance of vapor barrier, soil flatness, capillary break section, structural section, and testing recommendations.

7.4 Settlements

Total and differential settlements beneath the new foundation elements are expected to be within tolerable limits under static conditions. Vertical movements are not expected to exceed 1 inch. Differential movements are expected to be within the normal range (½ inch) for the anticipated loads.

7.5 Plan Review

The recommendations presented in this report are based on preliminary design information for the proposed project and on the findings of our geotechnical investigation. When completed, the Grading Plans, Foundation Plans and design loads should be reviewed by Butano Geotechnical Engineering, Inc. prior to submitting the plans and contract bidding. Additional field exploration and laboratory testing may be required upon review of the final project design plans.

7.6 Observation and Testing

Field observation and testing should be provided by a representative of Butano Geotechnical Engineering, Inc. to enable them to form an opinion regarding the adequacy of the site preparation, the adequacy of fill materials, and the extent to which the earthwork is performed in accordance with the geotechnical conditions present, the requirements of the regulating agencies, the project specifications, and the recommendations presented in this report.

Butano Geotechnical Engineering, Inc. should be notified **at least 5 working days** prior to any site clearing or other earthwork operations on the subject project in order to observe the stripping and disposal of unsuitable materials and to ensure coordination with the grading contractor. During this period, a preconstruction meeting should be held on the site to discuss project specifications, observation and testing requirements and responsibilities, and scheduling.

8.0 LIMITATIONS

The recommendations contained in this report are based on our field explorations, laboratory testing, and our understanding of the proposed construction. The subsurface data used in the preparation of this report was obtained from the borings drilled during our field investigation. Variation in soil, geologic, and groundwater conditions can vary significantly between sample locations. As in most projects, conditions revealed during construction excavation may be at variance with the findings of this investigation. If this occurs, the changed conditions must be evaluated by the Project Geotechnical Engineer, and revised recommendations be provided as required. In addition, if the scope of the proposed construction changes from the described in this report, our firm should also be notified.

Our investigation was performed in accordance with the usual and current standards of the profession, as they relate to this and similar localities. No other warranty, expressed or implied, is provided as to the conclusions and professional advice presented in this report.

This report is issued with the understanding that it is the responsibility of the Owner, or of his Representative, to ensure that the information and recommendations contained herein are brought to the attention of the Engineer for the project and incorporated into the plans, and that it is ensured that the Contractor and Subcontractors implement such recommendations in the field. The use of information contained in this report for bidding purposes should be done at the Contractor's option and risk.

This firm does not practice or consult in the field of safety engineering. We do not direct the Contractor's operations, and we are not responsible for other than our own personnel on the site; therefore, the safety of others is the responsibility of the Contractor. The Contractor should notify the Owner if he considers any of the recommendations presented herein or the actions required to carry out these recommendations to be unsafe.

The findings of this report are considered valid as of the present date. However, changes in the conditions of a site can occur with the passage of time, whether they are due to natural events or to human activities on this or adjacent sites. In addition,

changes in applicable or appropriate codes and standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, this report may become invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and revision as changed conditions are identified.

The scope of our services mutually agreed upon did not include any environmental assessment or study for the presence of hazardous to toxic materials in the soil, surface water, or air, on or below or around the site. Butano Geotechnical Engineering, Inc. is not a mold prevention consultant; none of our services performed in connection with the proposed project are for the purpose of mold prevention. Proper implementation of the recommendations conveyed in our reports will not itself be sufficient to prevent mold from growing in or on the structures involved.

REFERENCES

ASTM International (2016).*Annual Book of ASTM Standards, Section Four, Construction.* Volume 4.08, Soil and Rock (I): D 430 - D 5611.

ASTM International (2016).*Annual Book of ASTM Standards, Section Four, Construction.* Volume 4.09, Soil and Rock (II): D 5714 - Latest.

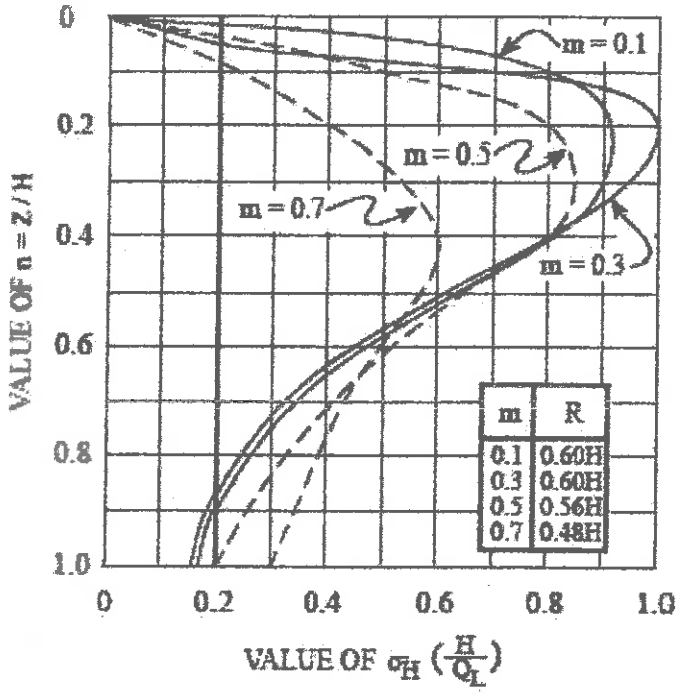
Brabb, E.E., 1997, Geologic map of Santa Cruz County, California: a digital database: U.S. Geological Survey, Open-File Report OF-97-489, scale 1:62,500

California Building Code (2016).

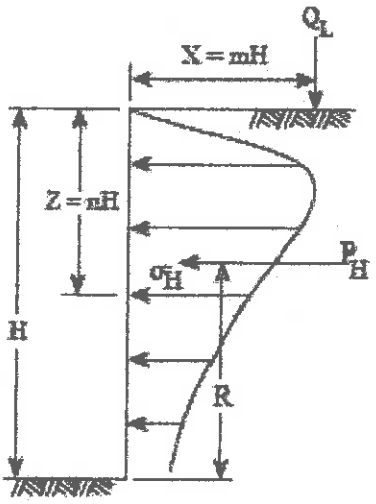
APPENDIX A

FIGURES AND STANDARD DETAILS

LINE LOAD



m	R
0.1	0.60H
0.3	0.60H
0.5	0.56H
0.7	0.48H



FOR $m \leq 0.4$:

$$\sigma_H \left(\frac{H}{Q_L}\right) = \frac{0.20\,n}{(0.16+n^2)^2}$$

$$P_H = 0.55\,Q_L$$

FOR $m > 0.4$:

$$\sigma_H \left(\frac{H}{Q_L}\right) = \frac{1.28\,m^2 n}{(m^2+n^2)^2}$$

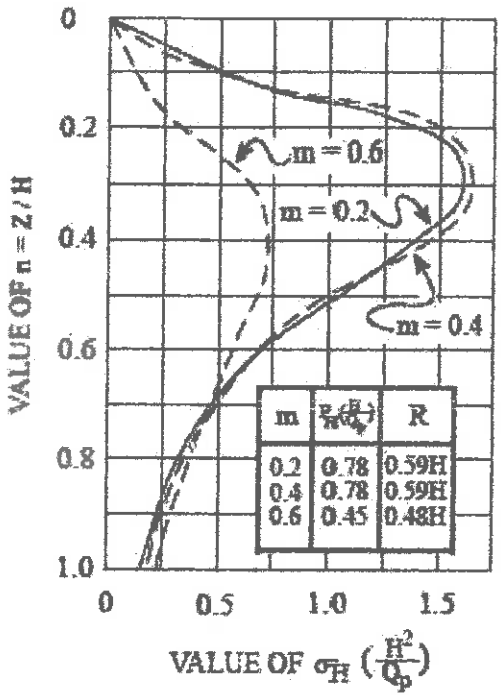
RESULTANT $P_H = \dfrac{0.64\,Q_L}{(m^2+1)}$

PRESSURES FROM LINE LOAD Q_L

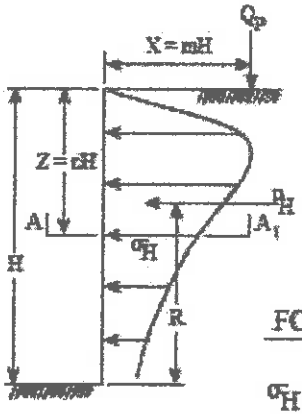
(BOISSINESQ EQUATION MODIFIED BY EXPERMENT)

REFERENCE: Design Manual
NAVFAC DM-7.02
Figure 11
Page 7.2-74

POINT LOAD



m	$\frac{P_H}{n}\left(\frac{H^2}{Q_p}\right)$	R
0.2	0.78	0.59H
0.4	0.78	0.59H
0.6	0.45	0.48H



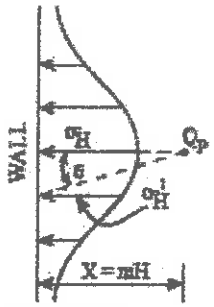
FOR $m \leq 0.4$:

$$\sigma_H \left(\frac{H^2}{Q_p}\right) = \frac{0.28\,n^2}{(0.16+n^2)^3}$$

FOR $m > 0.4$:

$$\sigma_H \left(\frac{H^2}{Q_p}\right) = \frac{1.77\,m^2 n^2}{(m^2+n^2)^3}$$

$$\sigma_H^1 = \sigma_H \cos^2(1.1\,\theta)$$



SECTION $A\text{-}A_1$

PRESSURES FROM POINT LOAD Q_P

(BOISSINESQ EQUATION MODIFIED BY EXPERMENT)

BUTANO GEOTECHNICAL ENGINEERING, INC.	SURCHARGE PRESSURE DIAGRAM	FIGURE A-1

APPENDIX B

FIELD EXPLORATION PROGRAM

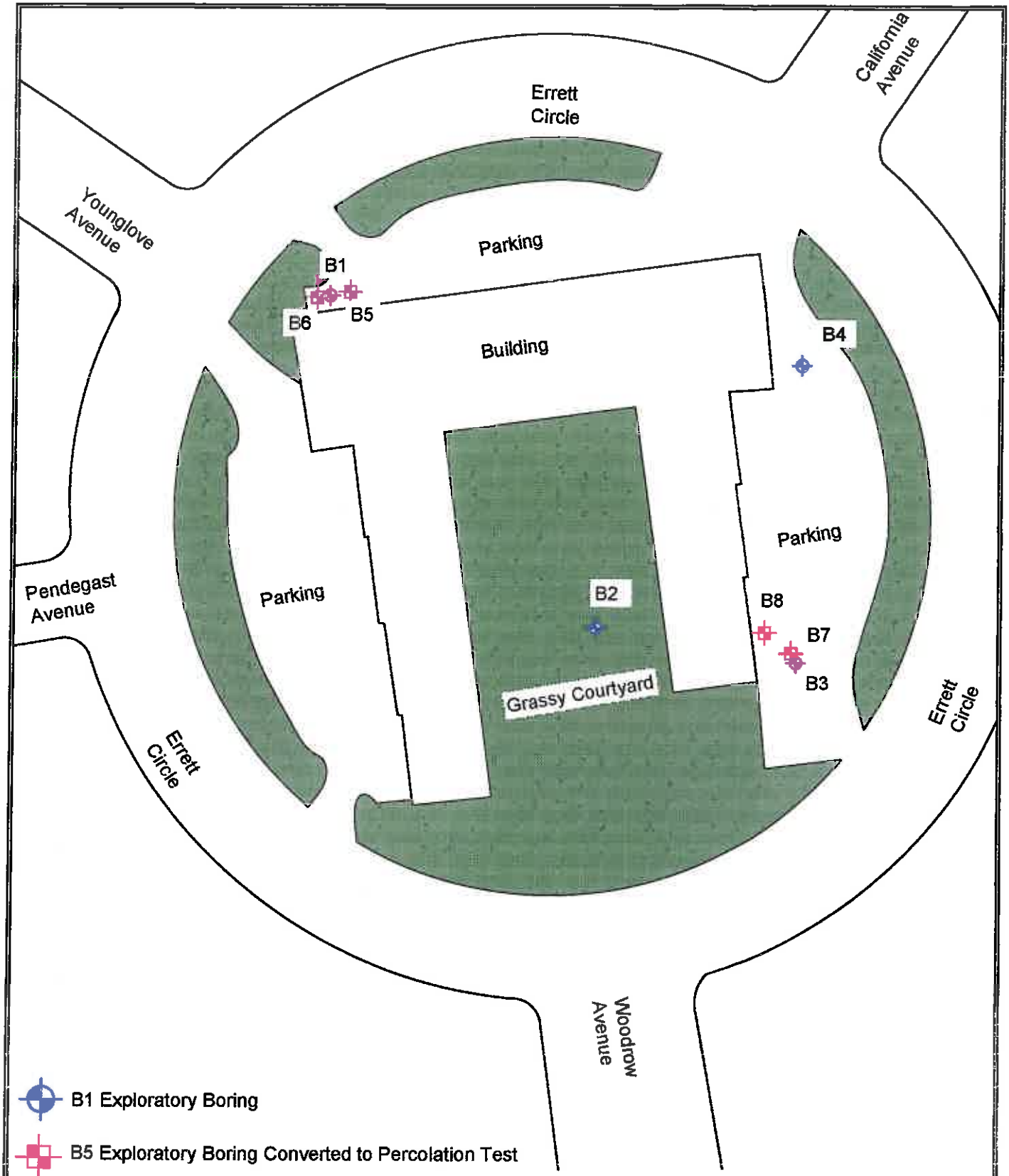
FIELD EXPLORATION PROCEDURES

Subsurface conditions were explored by advancing 8 borings below existing grade with a 6 inch solid stem auger on a truck mounted drill rig. Borings B5 through B8 were converted to percolation test holes. The Key to The Logs and the Logs of the Borings are included in Appendix B, Figures B-3 through B-11. The approximate locations of the borings are shown on the Boring Site Plan Figure B-2. The borings were located in the field by tape measurements from known landmarks. Their locations as shown are therefore within the accuracy of such measurement.

The soils encountered in the borings were continuously logged in the field by a representative of Butano Geotechnical Engineering, Inc. Bulk and relatively undisturbed soil samples for identification and laboratory testing were obtained in the field. These soils were classified based on field observations and laboratory tests. The classifications are accordance with the Unified Soil Classification System (USCS: Figure B-3).

N.T.S.

BUTANO	**SITE LOCATION PLAN**	FIGURE
GEOTECHNICAL ENGINEERING, INC.	111 Errett Circle	B-1



BUTANO GEOTECHNICAL ENGINEERING, INC.	**BORING SITE PLAN** 111 Errett Circle	FIGURE B-2

KEY TO LOGS

UNIFIED SOIL CLASSIFICATION SYSTEM

PRIMARY DIVISIONS			GROUP SYMBOL	SECONDARY DIVISIONS
COARSE GRAINED SOILS More than half of the material is larger than the No. 200 sieve	GRAVELS More than half of the coarse fraction is larger than the No. 4 sieve	CLEAN GRAVELS (Less than 5% fines)	GW	Well graded gravels, gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines
		GRAVEL WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines
			GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines
	SANDS More than half of the coarse fraction is smaller than the No. 4 sieve	CLEAN SANDS (Less than 5% fines)	SW	Well graded sands, gravelly sands, little or no fines
			SP	Poorly graded sands, gravelly sands, little or no fines
		SAND WITH FINES	SM	Silty sands, sand-silt mixtures, non-plastic fines
			SC	Clayey sands, sand-clay mixtures, plastic fines
FINE GRAINED SOILS More than half of the material is smaller than the No. 200 sieve	SILTS AND CLAYS Liquid limit less than 50		ML	Inorganic silts and very fine sands, silty or clayey fine sands or clayey silts with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts and organic silty clays of low plasticity
	SILTS AND CLAYS Liquid limit greater than 50		MH	Inorganic silts, micaceous or diatomacaceous fine sandy or silty soils, elastic silts
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS			Pt	Peat and other highly organic soils

GRAIN SIZE LIMITS

SILT AND CLAY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		
No. 200	No. 40	No. 10	No. 4	3/4 in.	3 in.	12 in.	

US STANDARD SIEVE SIZE

RELATIVE DENSITY	
SAND AND GRAVEL	BLOWS/FT*
VERY LOOSE	0 - 4
LOOSE	4 - 10
MEDIUM DENSE	10 - 30
DENSE	30 - 50
VERY DENSE	OVER 50

CONSISTENCY	
SILT AND CLAY	BLOWS/FT*
VERY SOFT	0 - 2
SOFT	2 - 4
FIRM	4 - 8
STIFF	8 - 16
VERY STIFF	16 - 32
HARD	OVER 32

MOISTURE CONDITION	
CLAY	DRY
	MOIST
	SATURATED
SAND	DRY
	DAMP
	WET
	SATURATED

* Number of blows of 140 pound hammer falling 30 inches to drive a 2 inch O.D. (1 3/8 inch I.D.) split spoon (ASTM D-1586).

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FIGURE B-3

LOG OF EXPLORATORY BORING

Project No.: 18-105-SC
Project: 111 Errett Circle
Date: January 24, 2018
Logged By: PE

Boring: B1
Location:
Elevation:
Method of Drilling: 6 inch diameter solid stem auger on a truck mounted drill rig

2" Ring Sample | 2.5" Ring Sample | Bulk Sample | Terzaghi Split Spoon Sample | Static Water Table

Depth (ft.)	Soil Type	Undisturbed	Bulk	Description	Blows / Foot	N_{60}	Dry Density (pcf)	Moisture Content (%)	Expansion Index	Particle Size (Fines %)	Unconfined - q_u (psf)	Other Tests: Swell (psf)	Other Tests: P.I.
	CL			1 1/2 inches Asphaltic Concrete over 5 1/2 inches Base Rock									
				Grey to tan Sandy Lean CLAY, stiff, moist,	24	13	112.5	18.5		56.8	2360	510	
				(Qcl - Terrace Deposit).									
				Stiff.	16	13		13.9					
5	SM			Tan Silty SAND, medium dense, damp,	27	10	99.8	23.1		48.6			
	BR												
10				Olive SANDSTONE, dense, damp,	53	48		40.9					
				(Tp - Purisima formation bedrock).									
				Boring terminated at a depth of 11 1/2 feet.									
15				Groundwater encountered at 8 feet 4 inches during drilling.									
20													
25													
30													

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FIGURE B-4

LOG OF EXPLORATORY BORING

Project No.: 18-105-SC
Project: 111 Errett Circle
Date: January 24, 2018
Logged By: PE

Boring: B2
Location:
Elevation:
Method of Drilling: 6 inch diameter solid stem auger on a truck mounted drill rig

2" Ring Sample | 2.5" Ring Sample | Bulk Sample | Terzaghi Split Spoon Sample | Static Water Table

Depth (ft.)	Soil Type	Undisturbed	Bulk	Description	Blows / Foot	N_{60}	Dry Density (pcf)	Moisture Content (%)	Expansion Index	Particle Size (Fines %)	Unconfined - q_u (psf)	Atterberg Limits L.L.	Atterberg Limits P.I.
	CL			Grey Lean CLAY with Sand, soft, moist, (Qcl - Terrace Deposit).	3	2	95.6	14.7					
				Very stiff.	20	16		18.1		76.3			
5				Very stiff, no sample recovered.	28	14							
				Very stiff.	20	16		15.2					
	BR			Olive SANDSTONE, medium dense, damp, highly weathered (Tp - Purisima formation bedrock).						49.4			
10				Medium Dense.	28	24		33.6		4.0			
15				Loose.	8	7		37.1					
20				Grey, very dense, competent.	50-6"			53.4					
				Boring terminated at a depth of 21 1/2 feet.									
25				Groundwater encountered at 4 feet during drilling.									
30													

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FIGURE B-5

LOG OF EXPLORATORY BORING

Project No.: 18-105-SC
Project: 111 Errett Circle
Date: January 24, 2018
Logged By: PE

Boring: B3
Location:
Elevation:
Method of Drilling: 6 inch diameter solid stem auger on a truck mounted drill rig

2" Ring Sample | 2.5" Ring Sample | Bulk Sample | Terzaghi Split Spoon Sample | Static Water Table

Depth (ft.)	Soil Type	Undisturbed	Bulk	Description	Blows / Foot	N_{60}	Dry Density (pcf)	Moisture Content (%)	Expansion Index	Particle Size (Fines %)	Unconfined - q_u (psf)	Atterberg Limits L.L.	Atterberg Limits P.I.
	SM			1 inch Asphaltic Concrete over 2 1/2 inches Base Rock									
				Brown Silty SAND, very loose, damp, no rings collected.	8	3		14.3					
	CL			Blue Lean CLAY with Sand, firm, moist.	9	7		35.4	80				
5	BR			Olive SANDSTONE, dense, damp, highly weathered, (Tp - Purisima formation bedrock).	39	35		19.3					
				(Qcl - Terrace deposit)									
10				Medium Dense.	24	20		32.7					
				Boring terminated at a depth of 11 1/2 feet.									
15				Groundwater encountered at 8 feet 6 inches during drilling.									
20													
25													
30													

BUTANO GEOTECHNICAL ENGINEERING, INC.

FIGURE B-6

LOG OF EXPLORATORY BORING

Project No.: 18-105-SC
Project: 111 Errett Circle
Date: January 24, 2018
Logged By: PE

Boring: B4
Location:
Elevation:
Method of Drilling: 6 inch diameter solid stem auger on a truck mounted drill rig

2" Ring Sample | 2.5" Ring Sample | Bulk Sample | Terzaghi Split Spoon Sample | Static Water Table

Depth (ft.)	Soil Type	Undisturbed	Bulk	Description	Blows / Foot	N_{60}	Dry Density (pcf)	Moisture Content (%)	Expansion Index	Particle Size (Fines %)	Unconfined - q_u (psf)	Atterberg Limits L.L.	Atterberg Limits P.I.
	SM			1 inch Asphaltic Concrete over 2 1/2 inches Base Rock Brown Clayey SAND, dense, damp, (Qcl - Terrace deposit).	43	39		15.2					
5	BR			Olive SANDSTONE, dense, damp, highly weathered, (Tp - Purisima formation bedrock).	33	30		21.8					
10				Medium Dense.	21	17		31.0					
				Boring terminated at a depth of 11 1/2 feet. Groundwater encountered at 7 feet during drilling.									

BUTANO GEOTECHNICAL ENGINEERING, INC.

FIGURE B-7

LOG OF EXPLORATORY BORING

Project No.: 18-105-SC
Project: 111 Errett Circle
Date: January 24, 2018
Logged By: PE

Boring: B5 - Percolation test hole
Location:
Elevation:
Method of Drilling: 6 inch diameter solid stem auger on a truck mounted drill rig

2" Ring Sample | 2.5" Ring Sample | Bulk Sample | Terzaghi Split Spoon Sample | Static Water Table

Depth (ft.)	Soil Type	Undisturbed	Bulk	Description	Blows / Foot	N_{60}	Dry Density (pcf)	Moisture Content (%)	Expansion Index	Particle Size (Fines %)	Percolation Rate (in/hr)	Atterberg Limits L.L.	Atterberg Limits P.I.
0	CL			Tan Sandy Lean CLAY, moist, (Qcl - Terrace deposit).									
5	SM			Tan silty SAND, damp. Percent fines from boring B1.						48.6	0		
6				Boring terminated at a depth of 5 feet 6 inches. Converted to percolation test hole. No groundwater encountered during drilling.									

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FIGURE B-8

LOG OF EXPLORATORY BORING

Project No.:	18-105-SC	Boring:	B6 - Percolation test hole
Project:	111 Errett Circle	Location:	
		Elevation:	
Date:	January 24, 2018	Method of Drilling:	6 inch diameter solid stem auger on a truck mounted drill rig
Logged By:	PE		

2" Ring Sample | 2.5" Ring Sample | Bulk Sample | Terzaghi Split Spoon Sample | Static Water Table

Depth (ft.)	Soil Type	Undisturbed	Bulk	Description	Blows / Foot	N_{60}	Dry Density (pcf)	Moisture Content (%)	Expansion Index	Particle Size (Fines %)	Percolation Rate (in/hr)	Atterberg Limits L.L.	Atterberg Limits P.I.
0	CL			Tan Sandy Lean CLAY, moist, (Qcl - Terrace deposit). Percent fines from boring B1.						56.8	1.5		
3				Boring terminated at a depth of 3 feet. Converted to percolation test hole. No groundwater encountered during drilling.									

BUTANO GEOTECHNICAL ENGINEERING, INC.

FIGURE B-9

LOG OF EXPLORATORY BORING

Project No.: 18-105-SC
Project: 111 Errett Circle
Date: January 24, 2018
Logged By: PE

Boring: B7 - Percolation test hole
Location:
Elevation:
Method of Drilling: 6 inch diameter solid stem auger on a truck mounted drill rig

2" Ring Sample | 2.5" Ring Sample | Bulk Sample | Terzaghi Split Spoon Sample | Static Water Table

Depth (ft.)	Soil Type	Undisturbed	Bulk	Description	Blows / Foot	N_{60}	Dry Density (pcf)	Moisture Content (%)	Expansion Index	Particle Size (Fines %)	Percolation Rate (in/hr)	Atterberg Limits L.L.	Atterberg Limits P.I.
0	CL												
1			X	Brown Silty SAND, damp.				15.9		40.5	0		
2													
3				Boring terminated at a depth of 2 feet. Converted to percolation test hole. No groundwater encountered during drilling.									
4													
5													
6													
7													

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FIGURE B-10

LOG OF EXPLORATORY BORING

Project No.:	18-105-SC	Boring:	B8 - Percolation test hole
Project:	111 Errett Circle	Location:	
		Elevation:	
Date:	January 24, 2018	Method of Drilling:	6 inch diameter solid stem auger on a truck mounted drill rig
Logged By:	PE		

2" Ring Sample | 2.5" Ring Sample | Bulk Sample | Terzaghi Split Spoon Sample | Static Water Table

Depth (ft.)	Soil Type	Undisturbed	Bulk	Description	Blows / Foot	N_{60}	Dry Density (pcf)	Moisture Content (%)	Expansion Index	Particle Size (Fines %)	Percolation Rate (in/hr)	Atterberg Limits L.L.	Atterberg Limits P.I.
1	SM			Brown Silty SAND, damp.									
2													
3	CL			Blue Lean CLAY with Sand, moist.									
4													
5	BR		X	Olive SANDSTONE, damp, highly weathered, (Tp - Purisima formation bedrock).						34.2	0		
6				Boring terminated at a depth of 5 feet 4 inches. Converted to percolation test hole. No groundwater encountered during drilling.									
7													

BUTANO GEOTECHNICAL ENGINEERING, INC.

FIGURE B-11

APPENDIX C

LABORATORY TESTING PROGRAM

LABORATORY TESTING PROCEDURES

Classification

Soils were classified according to the Unified Soil Classification System in accordance with ASTM D 2487 and D 2488. Moisture content and density determinations were made for representative samples in accordance with ASTM D 2216. Results of moisture density determinations, together with classifications, are shown on the Boring Logs, Figures B-4 through B-11.

Unconfined Compression

One unconfined compression test was performed in accordance with ASTM D 2166. The result is shown on the boring logs.

Expansion Index

One expansion index test was performed on a representative bulk sample of the foundation zone soil in accordance with ASTM D 4829-03. The result is shown on the Boring Logs.

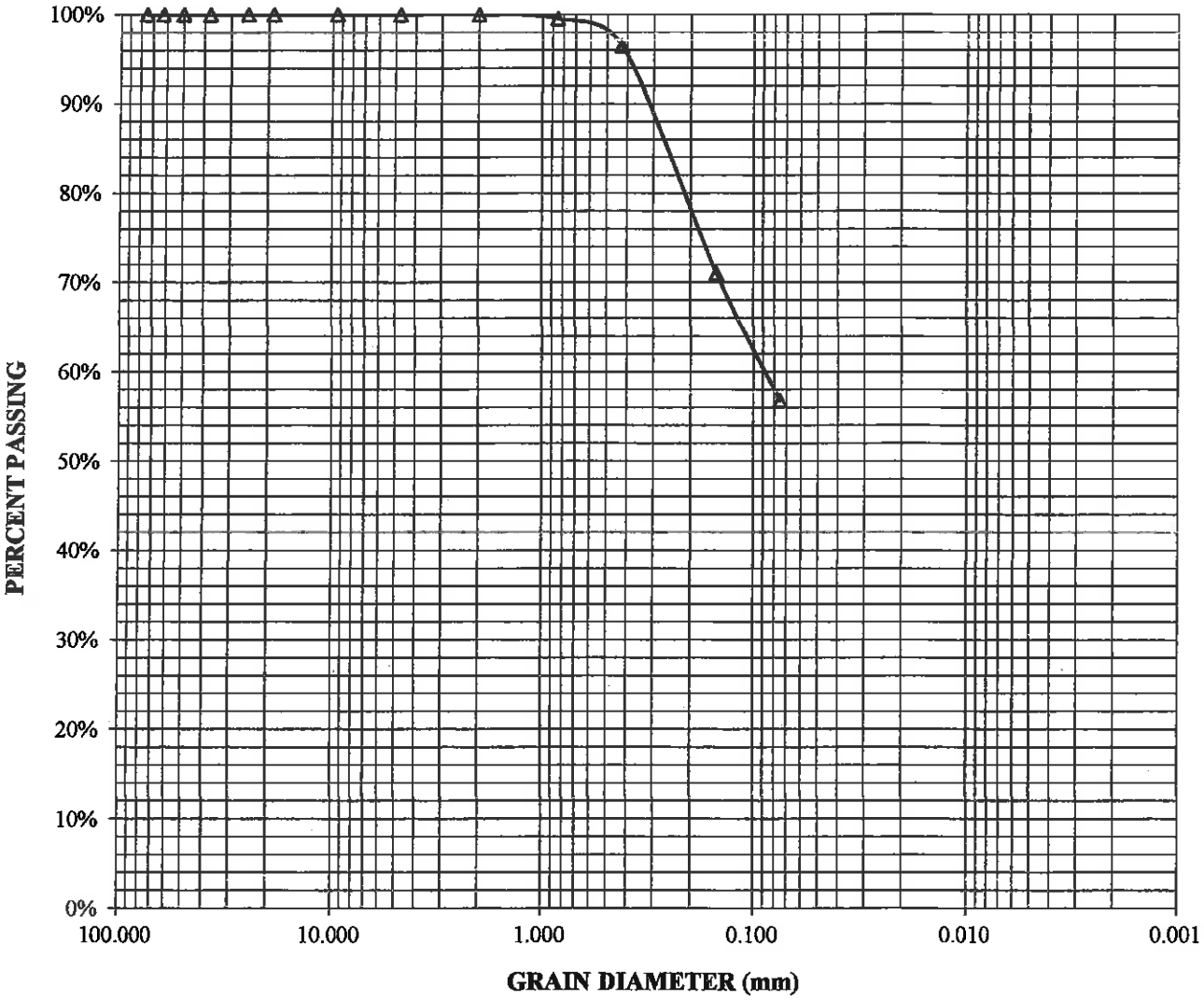
Particle Size Analysis

Seven sieves were performed on representative samples in accordance with ASTM D 422. The grain size distributions from the results of the particle size analysis are shown in Figures C-1 through C-7.

Swell Test

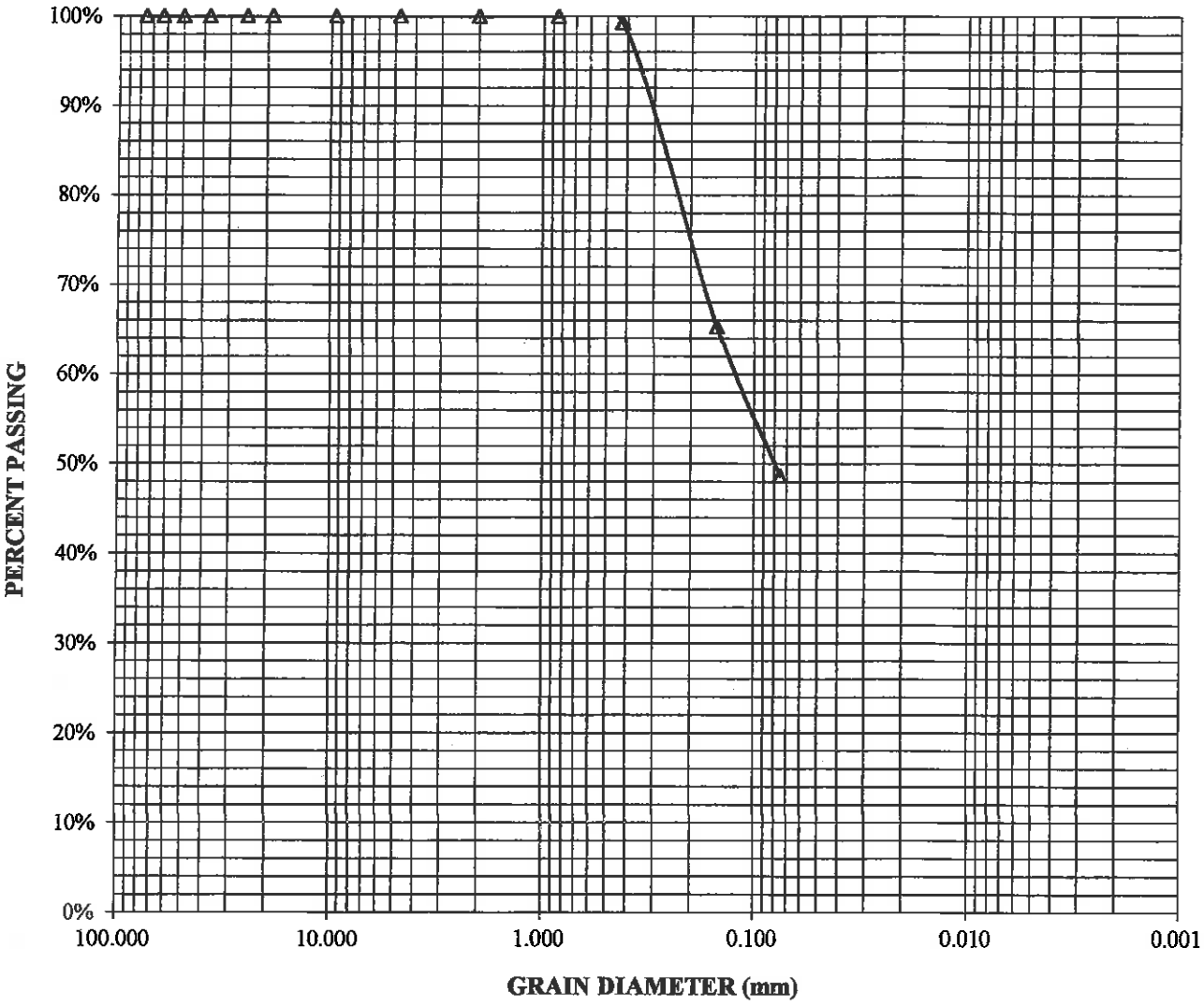
One one-dimensional swell test was performed on a representative relatively undisturbed sample in accordance with ASTM D-4546. The result is presented in Figures C-8 and shown on the boring logs.

BORING:	B1-1	PERCENT	PERCENT
DEPTH (ft):	1-2 1/2	PASSING No. 4	PASSING No. 200
SOIL TYPE (USCS):	CL-Sandy Lean CLAY	100.0%	56.8%



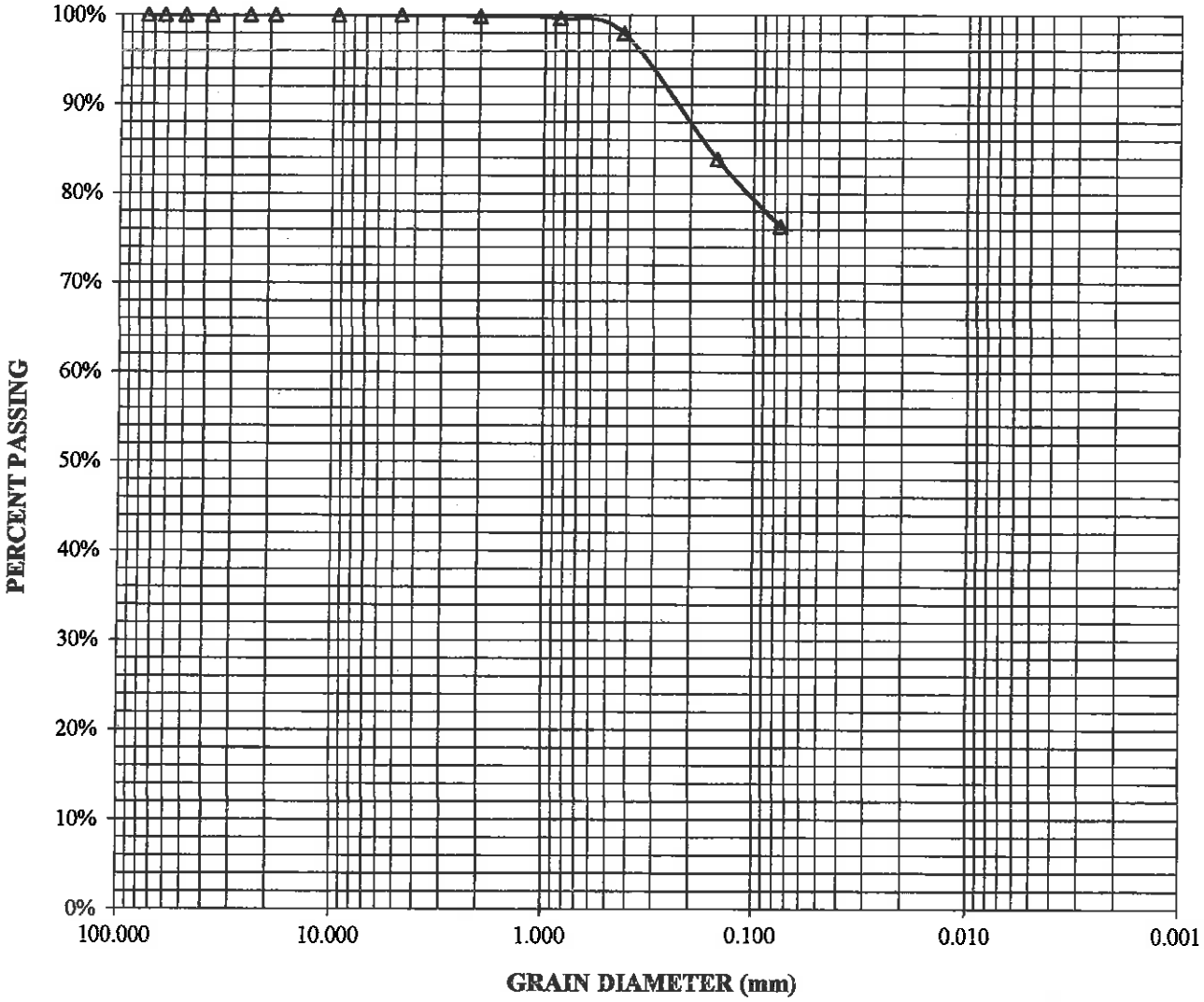
BUTANO	GRAIN SIZE DISTRIBUTION	FIGURE
GEOTECHNICAL ENGINEERING, INC.	111 Errett Circle	C-1

BORING:	B1-3	PERCENT	PERCENT
DEPTH (ft):	5-6 1/2	PASSING No. 4	PASSING No. 200
SOIL TYPE (USCS):	SM - Silty SAND	100.0%	48.6%



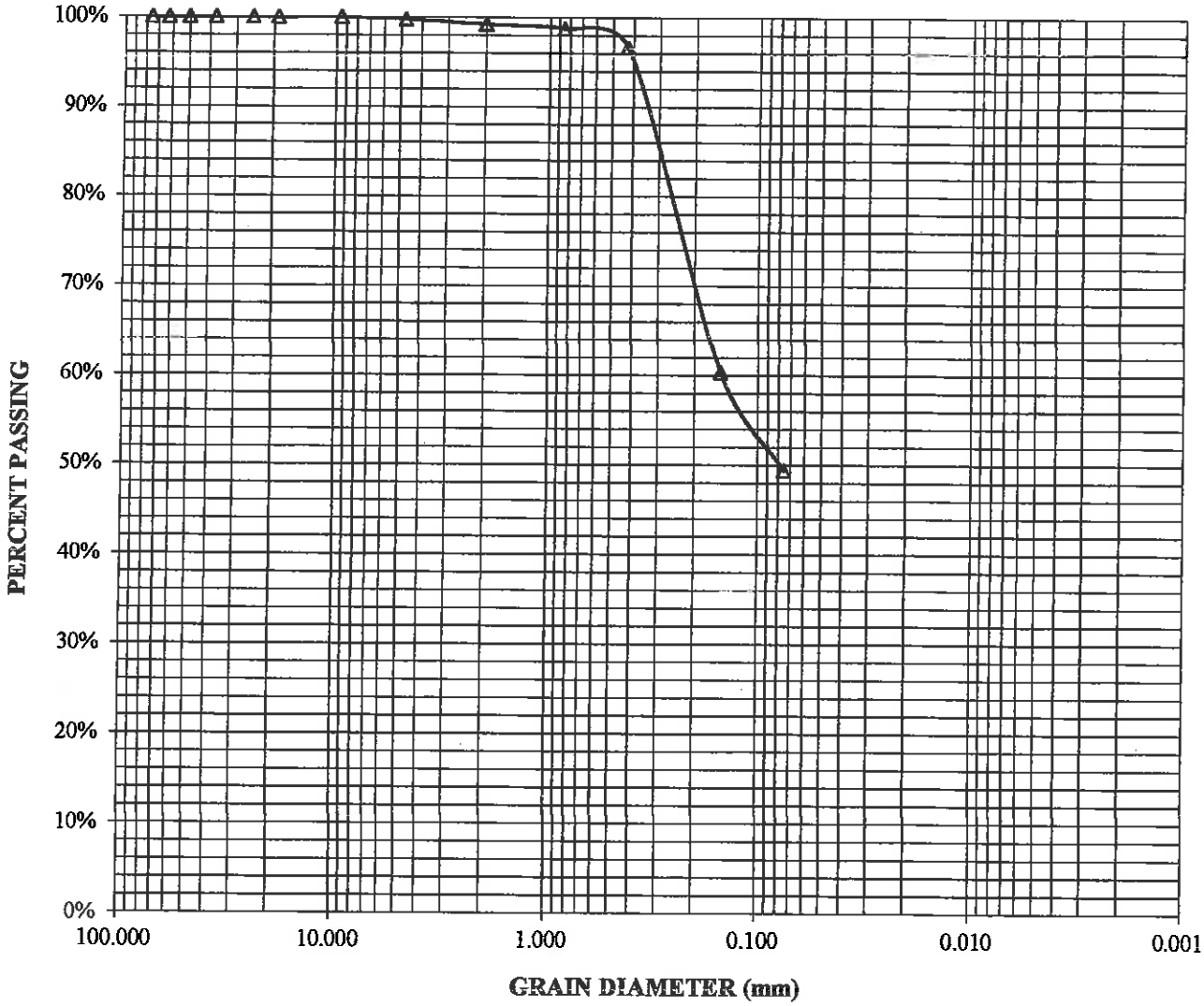
BUTANO	GRAIN SIZE DISTRIBUTION	FIGURE
GEOTECHNICAL ENGINEERING, INC.	111 Errett Circle	C-2

BORING:	B2-2	PERCENT	PERCENT
DEPTH (ft):	2 1/2-4	PASSING No. 4	PASSING No. 200
SOIL TYPE (USCS):	CL-Lean CLAY with Sand	100.0%	76.3%



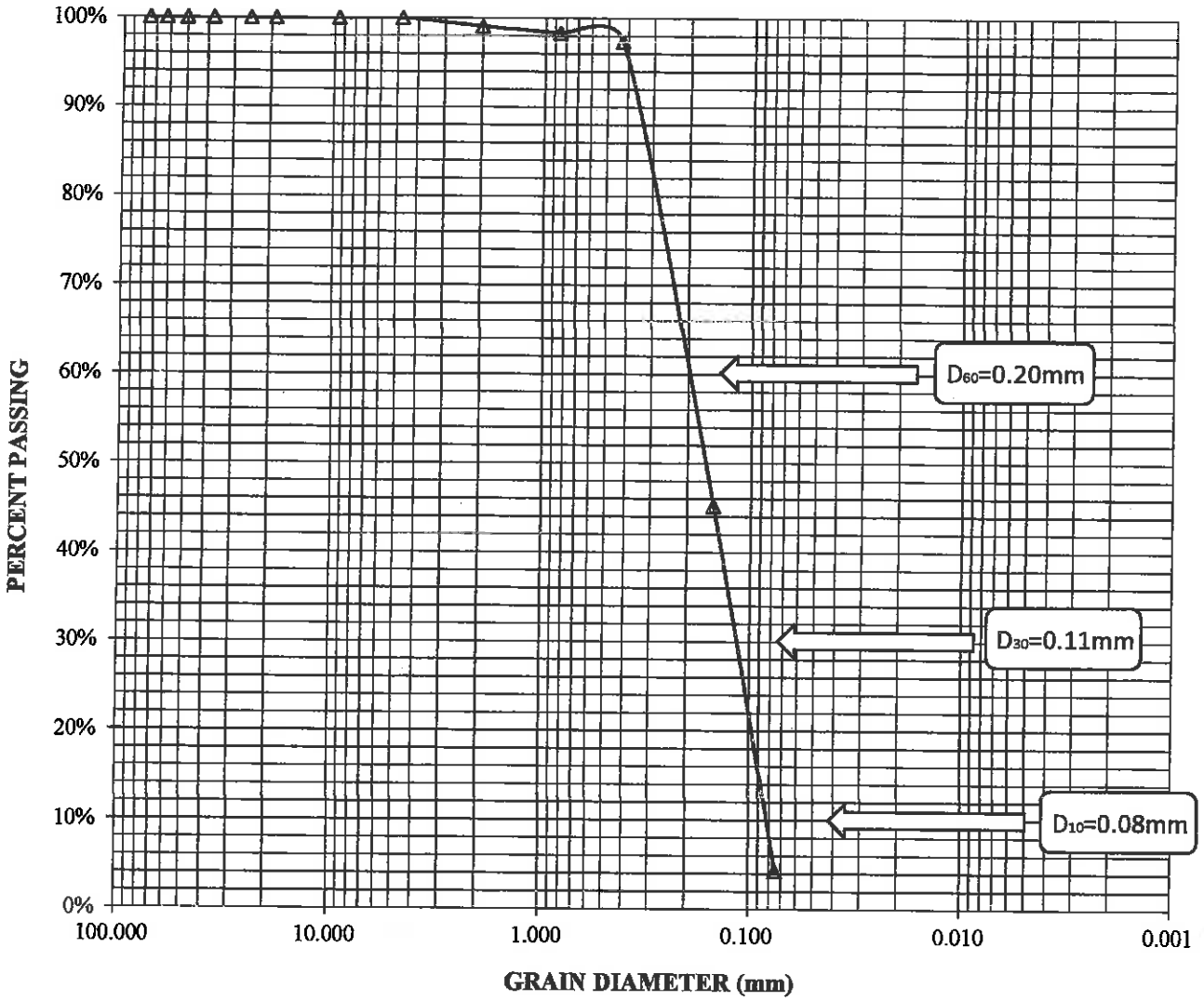
BUTANO	GRAIN SIZE DISTRIBUTION	FIGURE
GEOTECHNICAL ENGINEERING, INC.	111 Ernett Circle	C-3

BORING:	B2-4	PERCENT PASSING No. 4	PERCENT PASSING No. 200
DEPTH (ft):	6 1/2-8		
SOIL TYPE (USCS):	SM - Silty SAND	99.8%	49.4%



BUTANO	GRAIN SIZE DISTRIBUTION	FIGURE
GEOTECHNICAL ENGINEERING, INC.	111 Errett Circle	C-4

BORING:	B2-5	PERCENT	PERCENT
DEPTH (ft):	10-11 1/2	PASSING No. 4	PASSING No. 200
SOIL TYPE (USCS): SP-Poorly Graded SAND		100.0%	4.3%

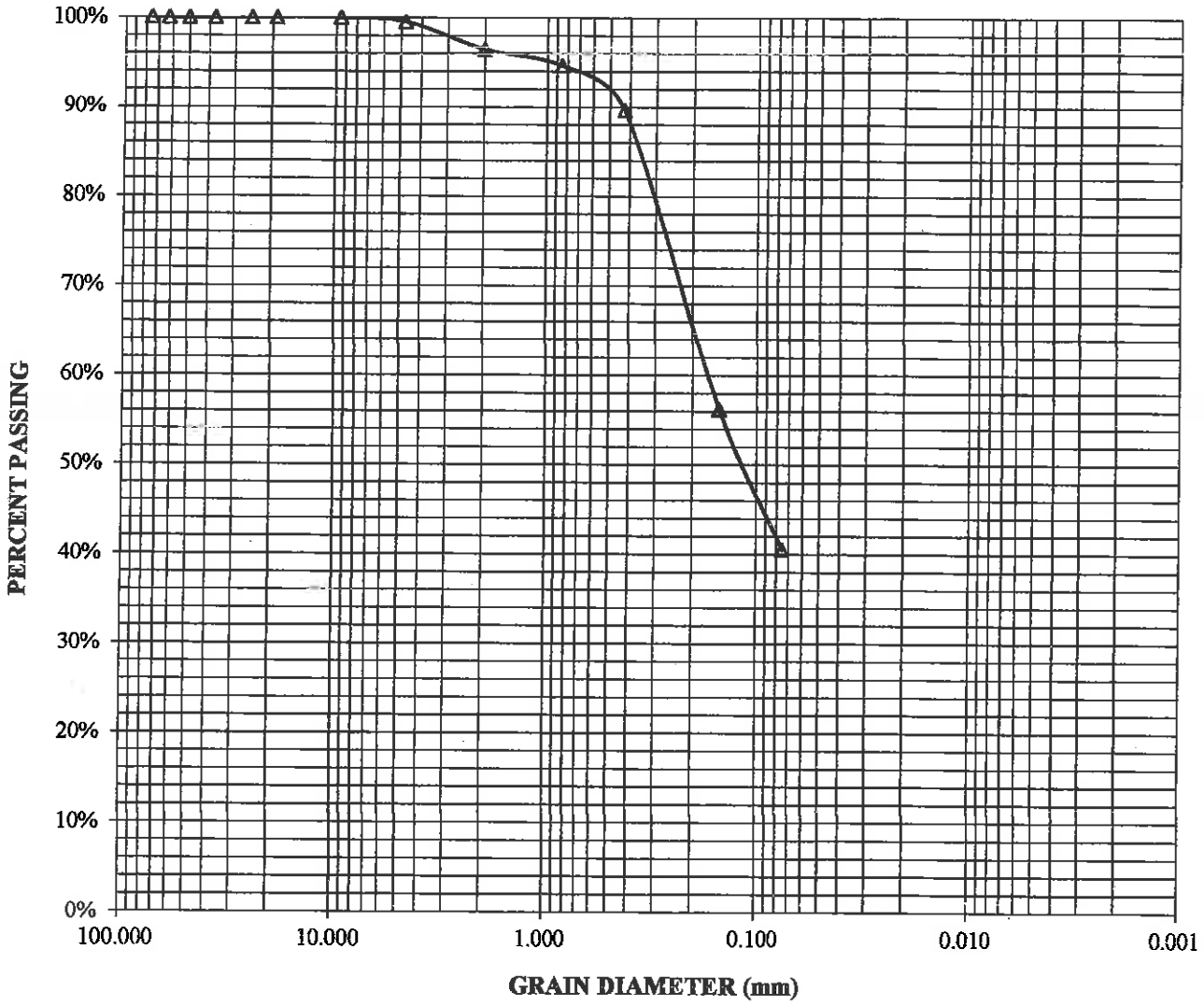


Cu= 2.5

Cc= 0.8

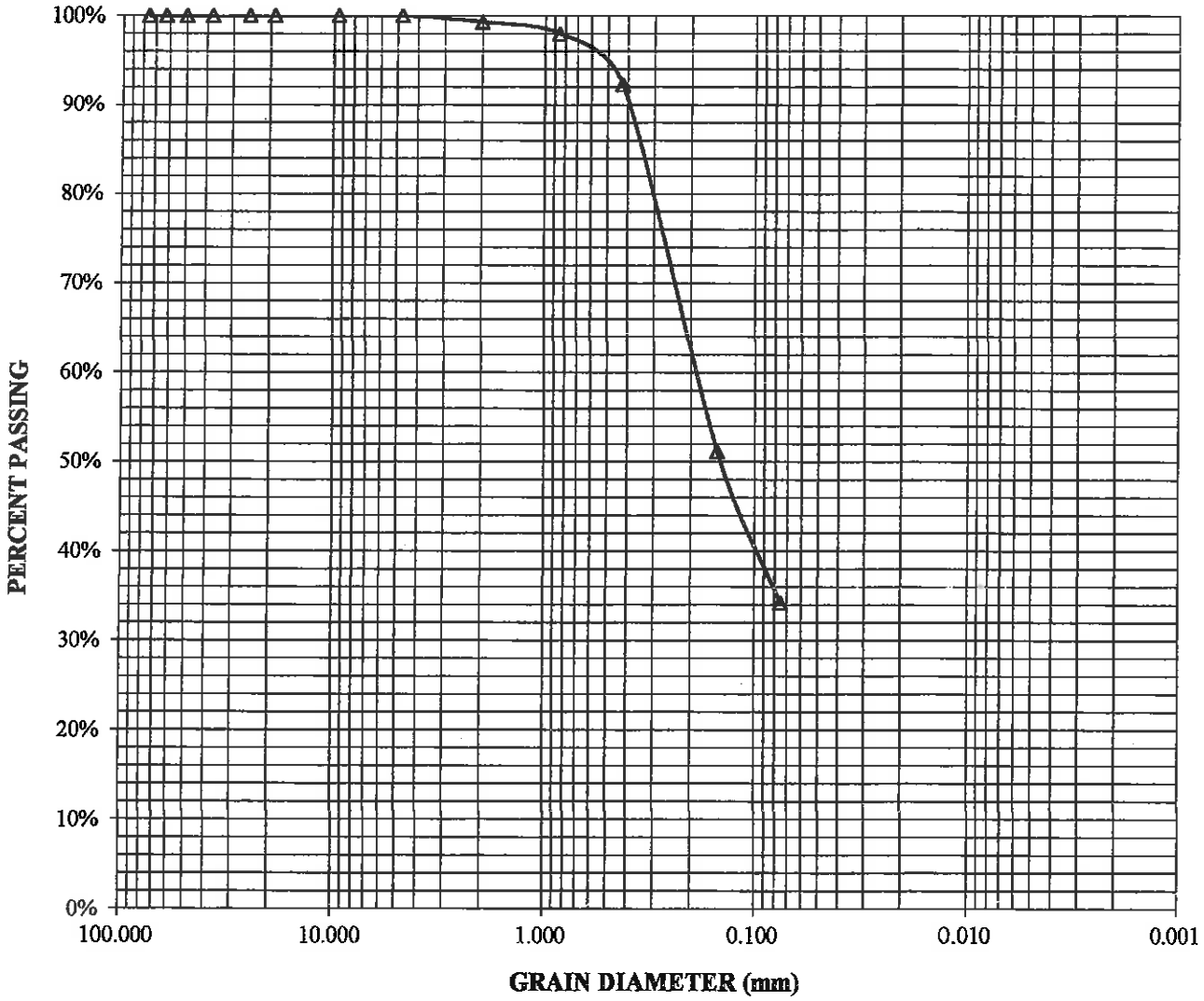
BUTANO	GRAIN SIZE DISTRIBUTION	FIGURE
GEOTECHNICAL ENGINEERING, INC.	111 Errett Circle	C-5

BORING:	P3-1	PERCENT	PERCENT
DEPTH (ft):	1 - 2	PASSING No. 4	PASSING No. 200
SOIL TYPE (USCS):	SM - Silty SAND	99.5%	40.5%



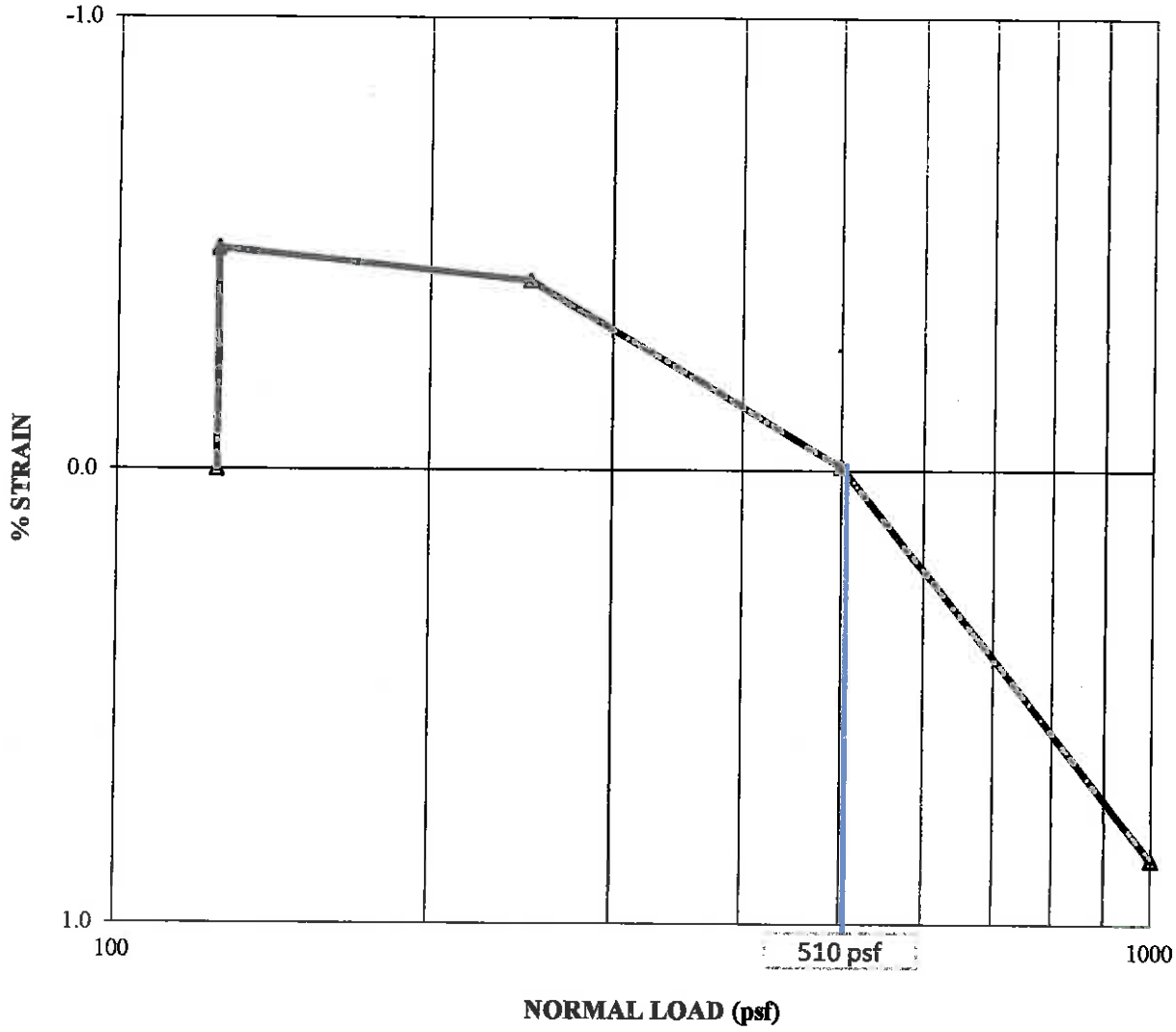
BUTANO	GRAIN SIZE DISTRIBUTION	FIGURE
GEOTECHNICAL ENGINEERING, INC.	111 Errett Circle	C-6

BORING:	P4-1	PERCENT	PERCENT
DEPTH (ft):	4 1/2-5	PASSING No. 4	PASSING No. 200
SOIL TYPE (USCS):	SC - Clayey SAND	100.0%	34.2%



BUTANO	GRAIN SIZE DISTRIBUTION	FIGURE
GEOTECHNICAL ENGINEERING, INC.	111 Errett Circle	C-7

BORING:	B1-1		
DEPTH (ft):	2.0		
SOIL TYPE (USCS):	CL	FIELD MOISTURE:	18.4%
		FINAL MOISTURE:	32.1%



BUTANO GEOTECHNICAL ENGINEERING, INC.	**SWELL TEST RESULTS** 111 Errett Circle	FIGURE C-8

APPENDIX D

PERCOLATION TESTING PROCEDURES

Constant head percolation tests were performed at three locations on the parcel in borings B5 through B8. The approximate locations of the test holes are shown on the boring site plan in Appendix B, Figure B-2.

The borings for the percolation holes were logged in the field during the drilling process.

The percolation test holes were drilled with a 6 inch diameter solid stem truck mounted auger. Perforated pipe was inserted to prevent potential collapse of the test holes and approximately 2 to 3 inches of clean, crushed ⅜ inch gravel was placed at the bottom of the holes as well as around the annulus of the pipe. The test holes were pre-soaked 24 hours prior to percolation testing.

Borings B5, B7, and B8 had standing water from pre-soaking. Most likely this was caused by the high groundwater table as boring B6 which has the highest fines content was also the only hole to percolate.

The percolation rates were measured and recorded every 30 minutes. The following rate reports the average of 3 consecutive measurements within 10 percent of each other.

Percolation Test Hole (6 inch diameter)	Depth (ft)	Soil Description	Percolation Rate (inches/hour)
B5	5 ½	Silty SAND (48.6% fines)	0.0
B6	3	Sandy Lean CLAY (56.8% fines)	1.5
B7	2	Silty SAND (40.5% fines)	0.0
B8	5 ½	Sandstone (34.2% fines)	0.0