Geotechnical Study

Farm work force housing site is in a narrow valley, not visible from Cloverdale Road

Sigma Prime Geosciences, Inc.
Effective Solutions

GEOTECHNICAL STUDY

FIFTH CROW FARM
DIAZ FLATS
4309 CLOVERDALE ROAD
PESCADERO, CALIFORNIA

PREPARED FOR:
TERESA KURTAK
FIFTH CROW FARM
P.O. BOX 527
PESCADERO, CA 94060

PREPARED BY:
SIGMA PRIME GEOSCIENCES, INC.
332 PRINCETON AVENUE
HALF MOON BAY, CALIFORNIA 94019

FEBRUARY 27, 2023

Sigma Prime Geosciences, Inc.
Effective Solutions

February 27, 2023

Teresa Kurtak
Fifth Crow Farm
P.O. Box 527
Pescadero, CA 94060

Subject: Geotechnical Report for proposed Farm Labor Housing:
4309 Cloverdale Road – Diaz Flats, Pescadero, California.
Sigma Prime Job No. 22-108

Dear Ms. Kurtak:

As per your request, we have performed a geotechnical study for the proposed Farm Labor Housing at 4309 Cloverdale Road in Pescadero, California. The accompanying report summarizes the results of our field study and engineering analyses, and presents geotechnical recommendations for the planned structures.

Thank you for the opportunity to work with you on this project. If you have any questions concerning our study, please call.

Yours,

Sigma Prime Geosciences, Inc.

Charles M. Kissick, P.E.

ATTACHMENT D

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TABLE OF CONTENTS

1. INTRODUCTION

We are pleased to present this geotechnical study report for the proposed Farm Labor Housing at 4309 Cloverdale Road in Pescadero, California at the location shown in Figure 1. The proposed development site is in an area of Fifth Crow Farm known as Diaz Flats. The purpose of this investigation was to evaluate the subsurface conditions at the site, and to provide geotechnical design recommendations for the proposed construction.

1.1 PROJECT DESCRIPTION

Two Farm Labor Housing duplexes are planned at the location shown in Figure 2. The units are expected to be prefabricated modular buildings. Structural loads are expected to be very light, as is typical for this type of construction.

1.2 SCOPE OF WORK

In order to complete this project we have performed the following tasks:

- Reviewed published information on the geologic and seismic conditions in the site vicinity;
- Geologic site reconnaissance;
- Subsurface study, including 3 soil borings at the site;
- Engineering analysis and evaluation of the subsurface data to develop geotechnical design criteria; and
- Preparation of this report presenting our recommendations for the proposed structure.

2. FINDINGS

2.1 GENERAL

The site reconnaissance and subsurface study were performed on February 7, 2022. The subsurface study consisted of drilling 3 soil borings with continuous sampling. The soil borings were advanced to depths of 12 and 18 feet. The approximate locations of the borings are shown in Figure 2, Site Plan. The soil boring logs are attached in Appendix A.

2.2 SITE CONDITIONS

At the time of our study, the site was undeveloped. The site is very level. The site is vegetated with grasses and weeds.

2.3 REGIONAL AND LOCAL GEOLOGY

Based on Brabb, et al (1998), the site vicinity is primarily underlain by Holocene younger (inner) alluvial fan deposits. The unit is described as unconsolidated fine to coarse grained sand, silt, and gravel.

2.4 SITE SUBSURFACE CONDITIONS

The subsurface conditions at the site, based on the soil borings, consist of 1.7 to 3 feet of moderately compacted gravelly clay fill material over stiff native clay. The clay becomes medium stiff below depths of 5 to 6.5 feet. Loose silty sand lenses, 0.5 to 2 feet thick, were encountered at depths between 13 to 17 feet. The upper clay has low plasticity, with a plasticity indices of 10 to 14.

2.5 GROUNDWATER

Groundwater was encountered in each boring at a depth of 8 to 9 feet. Groundwater is not expected to impact the construction.

2.6 FAULTS AND SEISMICITY

The site is in an area of high seismicity, with active faults associated with the San Andreas fault system. The closest active fault to the site is the San Gregorio fault, located about 2200 feet to the east. Other faults most likely to produce significant seismic ground motions include the San Andreas, Hayward, Rodgers Creek, and Calaveras faults. Selected historical earthquakes in the area with an estimated magnitude greater than 6-1/4, are presented in Table 1 below.

TABLE 1
HISTORICAL EARTHQUAKES

Date	Magnitude	Fault	Locale
June 10, 1836	6.5[1]	San Andreas	San Juan Bautista
June 1838	7.0[2]	San Andreas	Peninsula
October 8, 1865	6.3[2]	San Andreas	Santa Cruz Mountains
October 21, 1868	7.0[2]	Hayward	Berkeley Hills, San Leandro
April 18, 1906	7.9[3]	San Andreas	Golden Gate
July 1, 1911	6.6[4]	Calaveras	Diablo Range, East of San Jose
October 17, 1989	7.1[5]	San Andreas	Loma Prieta, Santa Cruz Mountains

(1) Borchardt & Toppozada (1996)
(2) Toppozada et al (1981)
(3) Petersen (1996)
(4) Toppozada (1984)
(5) USGS (1989)

2.7 2022 CBC EARTHQUAKE DESIGN PARAMETERS

Based on the 2022 California Building Code (CBC) and our site evaluation, we recommend using Site Class Definition D (stiff soil) for the site. The other pertinent CBC seismic parameters are given in Table 2 below.

Table 2
CBC SEISMIC DESIGN PARAMETERS

S_S	S_1	S_{MS}	S_{M1}	S_{DS}	S_{D1}
1.904	0.761	1.904	null	1.269	null

Because the S_1 value is greater than 0.75, Seismic Design Category E is recommended, per CBC Section 1613.5.6. The values in the table above were obtained from a software program by the Structural Engineers Association of California which provides the values based on the latitude and longitude of the site and the Site Class Definition. The latitude and longitude were measured at 37.2342 and –122.3687, respectively, and were accurately obtained from Google Earth™.

3. CONCLUSIONS AND RECOMMENDATIONS

3.1 GENERAL

It is our opinion that, from a geotechnical standpoint, the site is suitable for the proposed construction, provided the recommendations presented in this report are followed during design and construction. Detailed recommendations are presented in the following sections of this report.

Because subsurface conditions may vary from those encountered at the location of our borings, and to observe that our recommendations are properly implemented, we recommend that we be retained to 1) Review the project plans for conformance with our report recommendations and 2) Observe and test the earthwork and foundation installation phases of construction.

3.2 GEOLOGIC HAZARDS

We reviewed the potential for geologic hazards to impact the site, considering the geologic setting, and the soils encountered during our investigation. The results of our review are presented below:

- Fault Rupture - The site is not located in an Alquist-Priolo special studies area or zone where fault rupture is considered likely (California Division of Mines and Geology, 1974). Therefore, active faults are not believed to exist beneath the site, and the potential for fault rupture to occur at the site is low, in our opinion.

- Ground Shaking - The site is located in an active seismic area. Moderate to large earthquakes are probable along several active faults in the greater Bay Area over a 30 to 50 year design life. Strong ground shaking should therefore be expected several times during the design life of the structure, as is typical for sites throughout the Bay Area. The improvements should be designed and constructed in accordance with current earthquake resistance standards.

- Differential Compaction - Differential compaction occurs during moderate and large earthquakes when soft or loose, natural or fill soils are densified and settle, often unevenly across a site. In our opinion, due to the medium stiff clay and minor amounts of loose sand, a small amount of differential compaction may occur, but the likelihood of significant damage to the structures from differential compaction is low.

- Liquefaction - Liquefaction occurs when loose, saturated sandy soils lose strength and flow like a liquid during earthquake shaking. Ground settlement often accompanies liquefaction. Soils most susceptible to liquefaction are saturated, loose, silty sands, and uniformly graded sands. Loose silty sands below a water table were encountered but are very limited. The likelihood of liquefaction occurring at the site is moderate.

- Static Settlement –Total settlement should be less than1-inch, and differential settlement should be less than 1/2-inch.

3.3 EARTHWORK

3.3.1 Clearing & Subgrade Preparation

All deleterious materials, including topsoil, roots, vegetation, etc., should be cleared from the building area. The actual stripping depth required will depend on site usage prior to construction and should be established by the Contractor during construction.

3.3.2 Compaction

Scarified surface soils should be moisture conditioned to 3-5 percent above the optimum moisture content and compacted to at least 95 percent of the maximum dry density, as determined by ASTM D1157-78. All trench backfill should also be moisture conditioned to 3-5 percent above the optimum moisture content and compacted to at least 95 percent of the maximum dry density.

3.3.3 Surface Drainage

Impervious ground should slope away from the addition at 5 percent within 10 feet of the buildings. Pervious ground should slope away from the addition at 2 percent within 10 feet of the buildings. Ponding of water should not be allowed adjacent to the buildings.

3.4 FOUNDATIONS

The buildings will be prefabricated, designed to be founded on slab foundations. A reinforced slab or mat foundation may be designed for allowable bearing pressures of 2,000 pounds per square foot for dead plus live loads, with a one-third increase allowed for total loads including wind or seismic forces.

We recommend that the slabs be underlain by at least 6 inches of non-expansive granular fill. Where floor wetness would be detrimental, a vapor barrier, such Stego wrap, or equivalent may be used.

3.5.1 Lateral Loads

A passive pressure equivalent to that provided by a fluid weighing 300 pcf and a friction factor of 0.3 may be used to resist lateral forces and sliding against mat or spread footing foundations. These values include a safety factor of 1.5 and may be used in combination without reduction. Passive pressures should be disregarded for the uppermost 12 inches of foundation depth, measured below the lowest adjacent finished grade, unless confined by concrete slabs or pavements. However, the pressure distribution may be computed from the ground surface.

3.5 CONSTRUCTION OBSERVATION AND TESTING

The earthwork and foundation phases of construction should be observed and tested by us to 1) Establish that subsurface conditions are compatible with those used in the analysis and design; 2) Observe compliance with the design concepts, specifications and recommendations; and 3) Allow design changes in the event that subsurface conditions differ from those anticipated. The recommendations in this report are based on a limited number of borings. The nature and extent of variation across the site may not become evident until construction. If variations are then exposed, it will be necessary to reevaluate our recommendations.

4. LIMITATIONS

This report has been prepared for the exclusive use of the property owner for specific application in developing geotechnical design criteria, for the currently planned buildings at 4309 Cloverdale Road in Pescadero, California. We make no warranty, expressed or implied, except that our services were performed in accordance with geotechnical engineering principles generally accepted at this time and location. The report was prepared to provide engineering opinions and recommendations only. In the event that there are any changes in the nature, design or location of the project, or if any future improvements are planned, the conclusions and recommendations contained in this report should not be considered valid unless 1) The project changes are reviewed by us, and 2) The conclusions and recommendations presented in this report are modified or verified in writing.

The analyses, conclusions and recommendations contained in this report are based on site conditions as they existed at the time of our investigation; the currently planned improvements; review of previous reports relevant to the site conditions; and laboratory results. In addition, it should be recognized that certain limitations are inherent in the evaluation of subsurface conditions, and that certain conditions may not be detected during an investigation of this type. Changes in the information or data gained from any of these sources could result in changes in our conclusions or recommendations. If such changes do occur, we should be advised so that we can review our report in light of those changes.

5. REFERENCES

Borchardt, G. and Toppozada, T.R., 1996, Relocation of the "1836 Hayward Fault Earthquake" to the San Andreas Fault, Abstracts, American Geophysical Union Fall Meeting, December, San Francisco.

Brabb, Earl E., Graymer, R.W., and Jones, D.L.., 1998, Geology of the Onshore Part of San Mateo County, California, Derived from the Digital Database Open-File 98-137.

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N

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Figure	1
Date:	3-21-22
Job No.:	22-108

Location Map

Fifth Crow Farm, Diaz Flats, 4309 Cloverdale Rd., Pescadero

EXPLANATION

B-1 Soil Boring, Drilled, 2/7/22

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Figure	2
Date:	3-21-22
Job No.:	22-108

Site Plan

Fifth Crow Farm, Diaz Flats, 4309 Cloverdale Rd., Pescadero

APPENDIX A

FIELD INVESTIGATION

The soils encountered during drilling were logged by our representative, and samples were obtained at depths appropriate to the investigation. The samples were taken to our laboratory where they were carefully observed and classified in accordance with the Unified Soil Classification System. The logs of our borings, as well as a summary of the soil classification system, are attached.

Several tests were performed in the field during drilling. The standard penetration resistance was determined by dropping a 140-pound hammer through a 30-inch free fall, and recording the blows required to drive the 2-inch (outside diameter) sampler 24 inches. The standard penetration resistance is the number of blows required to drive a standard split spoon sampler the last 12 inches of an 18-inch sample and is recorded on the boring logs at the appropriate depth. Use of the standard split spoon sampler defines a Standard Penetration Test (SPT), and yields an SPT-equivalent blow count. (Where we drove the sampler 24 inches in some cases, this is a modified SPT test.) A modified California (Mod-Cal) sampler was also used, which results in blow counts that are higher than an SPT-equivalent blow count, due to the Mod-Cal sampler's larger diameter. For analyses, it is normal practice to reduce the Mod-Cal blow counts to correspond to an SPT-equivalent blow count. The blow counts from the Mod-Cal sampler are uncorrected on the logs. The results of these field tests are presented on the boring logs.

The boring log and related information depict our interpretation of subsurface conditions only at the specific location and time indicated. Subsurface conditions and ground water levels at other locations may differ from conditions at the locations where sampling was conducted. The passage of time may also result in changes in the subsurface conditions.

ATTACHMENT D

Sigma Prime Geosciences, Inc.

Project Name	Project Number
Fifth Crow Farm - Diaz Flats	22-108

Location: See Figure 2

Drilling Method	Hole Size	Total Depth	Soil Footage	Rock Footage	Elevation	Datum
Continuous	4“	12’	12’	0’	68’	NAVD88

Boring No.	B-1
Page	1 of 1
Date(s)	2/7/22

Drilling Company: Access Soil Drilling

Logged By: CMK

Type of Drill Rig:

Type of Sampler(s): Mod Cal, 2½, SPT

Hammer Weight and Fall: 140 lb, 30“

Depth (feet)	Description	Graphic Log	Class	Blow Count	Sample No.	Sample Type	Comments
0	0’ - 1.7’: Gravelly Clay (FILL): dark brown; medium stiff; moist.		CL	13 13 9 14	1	MC	
	1.7’ - 5’: Clay (NATIVE): dark brown; stiff; moist.		CL	12 14 14 16	2	MC	Lab, Sample #2: Moisture%=20.4% Dry Density=100.9 pcf LL=33, PL=23, PI=10
5				4 6 5 5	3	2½“	
	5’ - 9.5’: Sandy Clay: yellowish brown; medium stiff; moist.		CL	4 4 4 5	4	2½“	
				2 2 3 3	5	SPT	▽ Groundwater @ 9’
10	9.5’ - 11’: Clay: dark brown; medium stiff; saturated.		CL	1 2	6	SPT	
	11’ - 12’: Sandy Clay: green-gray; stiff; sat..		CL	4 6			
	Bottom of Hole 12’ below ground surface. Groundwater @ 9’.						
15							
20							

Project Name	Project Number	ATTACHMENT D
Fifth Crow Farm - Diaz Flats	22-108	Sigma Prime Geosciences, Inc.

Location	
See Figure 2	

Drilling Method	Hole Size	Total Depth	Soil Footage	Rock Footage	Elevation	Datum	Boring No.	B-2
Continuous	4“	18’	18’	0’	67’	NAVD88	Page	1 of 1

Drilling Company	Logged By	Date(s)
Access Soil Drilling	CMK	2/7/22

Type of Drill Rig	Type of Sampler(s)	Hammer Weight and Fall
	Mod Cal, 2½, SPT	140 lb, 30“

Depth (feet)	Description	Graphic Log	Class	Blow Count	Sample No.	Sample Type	Comments
0	0’ - 3: Gravelly Clay (FILL): dark brown; medium stiff; moist.		CL	10 12 12 15		MC	
					1		Lab, Sample #1: Moisture%=25.6% Dry Density=90.9 pcf LL=42, PL=28, PI=14
	3’ - 6.5’: Clay (NATIVE): dark brown; stiff; moist.			21 20 19 18		MC	
					2		
5			CL	18 17 12 9		MC	
					3		
	6.5.’ - 13’: Sandy Clay: yellowish brown; medium stiff; moist.			6 4 3 3	4	2½“	▽ Groundwater @ 8’
				2 3 4 3	5	2½“	
10	Stiff.		CL	6 8 6 4	6	2½“	
	13’ - 15’: Silty Sand: gray; loose; saturated		SM	2 2 3 4	7	SPT	
15	15’ - 16.5’: Clay: dark brown; very stiff; saturated.		CL	4 6 8 8	8	SPT	
	16.5’ - 17’: Silty Sand: gray; med. dense; sat.		SM	6 7 8 8	9	SPT	
	17’ - 18’: Clay: dark brown; very stiff; saturated.		CL				
	Bottom of Hole 18’ below ground surface. Groundwater @ 8’.						
20							

ATTACHMENT D

Sigma Prime Geosciences, Inc.

Project Name	Project Number
Fifth Crow Farm - Diaz Flats	22-108

Location: See Figure 2

Drilling Method	Hole Size	Total Depth	Soil Footage	Rock Footage	Elevation	Datum
Continuous	4“	12’	12’	0’	68’	NAVD88

Boring No.	**B-3**
Page	1 of 1
Date(s)	2/7/22

Drilling Company: Access Soil Drilling

Logged By: CMK

Type of Drill Rig:

Type of Sampler(s): Mod Cal, 2½, SPT

Hammer Weight and Fall: 140 lb, 30“

Depth (feet)	Description	Graphic Log	Class	Blow Count	Sample No.	Sample Type	Comments
0	0’ - 1.8’: Gravelly Clay (FILL): dark brown; medium stiff; moist.		CL	18 12 16 17	1	MC	
	1.8’ - 5’: Clay (NATIVE): dark brown; stiff; moist.		CL	20 17 19 14	2	MC	
5				5 3 4 5	3	2½“	
	5’ - 8.5’: Sandy Clay: yellowish brown; medium stiff; moist.		CL	2 3 3 4	4	2½“	
	8.5’ - 11’: Clay: dark brown; medium stiff; saturated.		CL	1 2 2 2	5	SPT	▽ Groundwater @ 9’
10				2 3 3 5	6	SPT	
	Bottom of Hole 12’ below ground surface. Groundwater @ 9’.						
15							
20							

UNIFIED SOIL CLASSIFICATION (ASTM D-2487-85)

ATTACHMENT D

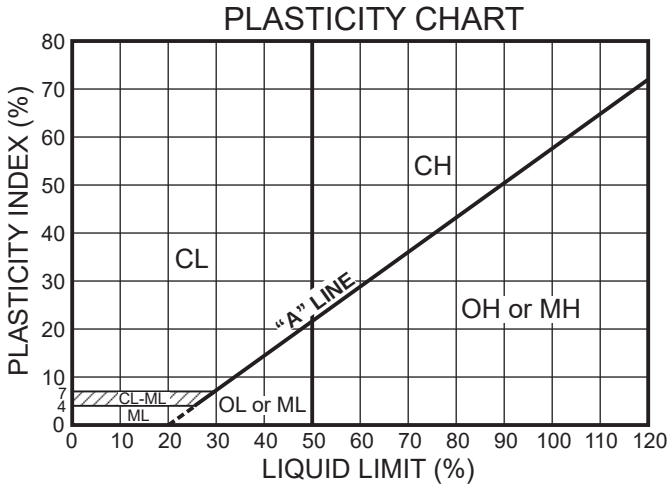
MATERIAL TYPES	CRITERIA FOR ASSIGNING SOIL GROUP NAMES			GROUP SYMBOL	SOIL GROUP NAMES & LEGEND	
COARSE-GRAINED SOILS > 50% RETAINED ON NO. 4 SIEVE	GRAVELS > 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS < 5% FINES	Cu > 4 AND 1 < Cc < 3	GW	WELL-GRADED GRAVEL	
			Cu < 4 AND/OR 1 > Cc > 3	GP	POORLY-GRADED GRAVEL	
		GRAVELS WITH FINES > 12% FINES	FINES CLASSIFY AS ML OR CL	GM	SILTY GRAVEL	
			FINES CLASSIFY AS CL OR CH	GC	CLAYEY GRAVEL	
	SANDS > 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN SANDS < 5% FINES	Cu > 6 AND 1 < Cc < 3	SW	WELL-GRADED SAND	
			Cu < 6 AND/OR 1 > Cc > 3	SP	POORLY-GRADED SAND	
		SANDS WITH FINES > 12% FINES	FINES CLASSIFY AS ML OR CL	SM	SILTY SAND	
			FINES CLASSIFY AS CL OR CH	SC	CLAYEY SAND	
FINE-GRAINED SOILS > 50% PASSING NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT < 50	INORGANIC	PI > 7 AND PLOTS > "A" LINE	CL	LOW-PLASTICITY CLAY	
			PI > 4 AND PLOTS < "A" LINE	ML	LOW-PLASTICITY SILT	
		ORGANIC	LL (oven dried)/LL (not dried)<0.75	OL	ORGANIC CLAY OR SILT	
	SILTS AND CLAYS LIQUID LIMIT > 50	INORGANIC	PI PLOTS > "A" LINE	CH	HIGH-PLASTICITY CLAY	
			PI PLOTS < "A" LINE	MH	HIGH-PLASTICITY SILT	
		ORGANIC	LL (oven dried)/LL (not dried)<0.75	OH	ORGANIC CLAY OR SILT	
HIGHLY ORGANIC SOILS		PRIMARILY ORGANIC MATTER, DARK COLOR, ORGANIC ODOR		PT	PEAT	

NOTE: $Cu=D_{60}/D_{10}$

$Cc=(D_{30})^2/(D_{10}+D_{60})$

BLOW COUNT

THE NUMBER OF BLOWS OF THE HAMMER REQUIRED TO DRIVE THE SAMPLER THE LAST 12 INCHES OF AN 18-INCH DRIVE. THE NOTATION 50/4 INDICATES 4 INCHES OF PENETRATION ACHIEVED IN 50 BLOWS.



SAMPLE TYPES

B	BULK SAMPLE
ST	PUSHED SHELBY TUBE
SPT	STANDARD PENETRATION
MC	MODIFIED CALIFORNIA
P	PITCHER SAMPLE
C	ROCK CORE

ADDITIONAL TESTS

CA - CHEMICAL ANALYSIS
CN - CONSOLIDATION
CP - COMPACTION
DS - DIRECT SHEAR
PM - PERMEABILITY
PP - POCKET PENETROMETER
Cor. - CORROSIVITY
SA - GRAIN SIZE ANALYSIS
(20%) - (PERCENT PASSING #200 SIEVE
SW - SWELL TEST
TC - CYCLIC TRIAXIAL
TU - CONSOLIDATED UNDRAINED TRIAXIAL
TV - TORVANE SHEAR
UC - UNCONFINED COMPRESSION
WA - WASH ANALYSIS
▽ - WATER LEVEL AT TIME OF DRILLING AND DATE MEASURED
▼ - LATER WATER LEVEL AND DATE MEASURED

LEGEND TO SOIL DESCRIPTIONS

Sigma Prime Geosciences, Inc.

FIGURE A-1

APPENDIX B

LABORATORY TESTS

Samples from the subsurface study were selected for tests to establish the physical and engineering properties of the soils. The tests performed are briefly described below.

The natural moisture content and dry density were determined in accordance with ASTM D 2216 on selected samples recovered from the borings. This test determines the moisture content and density, representative of field conditions, at the time the samples were collected. The results are presented on the boring logs, at the appropriate sample depth.

Two sample of clayey soil were tested for expansive potential, using the Atterberg limits test, as per ASTM D-4318. The results are presented on the boring logs, at the appropriate sample depths.