

Appendix E

Preliminary Geotechnical Report



7400 CATHEDRAL OAKS ROAD
GOLETA, CALIFORNIA

PRELIMINARY GEOTECHNICAL REPORT

SUBMITTED TO
Mr. Glynne Couvillion
Shelby Partnership LP
690 Lilac Drive
Santa Barbara, California 93108

PREPARED BY
ENGEO Incorporated

July 14, 2025
Revised July 31, 2025

PROJECT NO.
8724.001.000

July 14, 2025
Revised July 31, 2025

Project No.
8724.001.000

Mr. Glynne Couvillion
Shelby Partnership LP
690 Lilac Drive
Santa Barbara, California 93108

Subject: 7400 Cathedral Oaks
Goleta, California

PRELIMINARY GEOTECHNICAL REPORT

Dear Mr. Couvillion:

ENGEO prepared this preliminary geotechnical report for Shelby Partnership LP as outlined in our proposal dated June 25, 2025. We characterized the subsurface conditions at the project site to develop our preliminary geotechnical conclusions and recommendations for project planning. The accompanying report contains the findings of our recent study.

The findings of our preliminary geotechnical study indicate that the site is geotechnically feasible for the proposed project, provided that the recommendations contained in this report are incorporated into planning. The main geotechnical considerations for the project include presence of expansive soil and bedrock, existing fill, agriculturally disturbed surficial soil, strong ground shaking, variable depth to bedrock, slope stability, and corrosion potential. Design-level exploration(s) should be conducted prior to site development once additional site access is established.

We are pleased to have been of service on this project and are prepared to consult further with you and your design team as the project progresses. If you have any questions regarding the contents of this report, please do not hesitate to contact us.

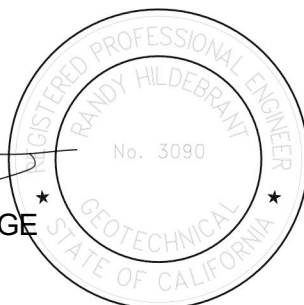
Sincerely,

ENGEO Incorporated



Randy Hildebrandt, PE, GE

rh/jjt/cb



Josef J. Tootle, PE, GE

TABLE OF CONTENTS

LETTER OF TRANSMITTAL

1.0	INTRODUCTION	1
1.1	PURPOSE AND SCOPE	1
1.2	PROJECT LOCATION AND DESCRIPTION	1
1.3	PREVIOUS EXPLORATION	2
2.0	FINDINGS	2
2.1	GEOLOGY AND SEISMICITY	2
2.1.1	Geology	2
2.1.2	Seismicity	2
2.1.3	Site History	3
2.2	FIELD EXPLORATION	4
2.3	SURFACE CONDITIONS	4
2.4	LABORATORY TESTING	5
2.5	SUBSURFACE CONDITIONS	6
2.6	GROUNDWATER CONDITIONS	6
3.0	PRELIMINARY CONCLUSIONS	6
3.1	EXISTING FILL	7
3.2	DISTURBED SURFICIAL SOIL	7
3.3	EXPANSIVE SOIL	7
3.4	SEISMIC HAZARDS	8
3.4.1	Ground Rupture	8
3.4.2	Ground Shaking	8
3.4.3	Liquefaction and Seismic Settlement	8
3.4.4	Lateral Spreading	9
3.5	LANDSLIDING	9
3.6	COMPRESSIBLE AND COLLAPSIBLE SOILS	9
3.7	FLOODING AND TSUNAMI	9
3.8	NATURALLY OCCURRING RADON GAS	9
3.9	DIFFERENTIAL FILL THICKNESS	10
3.10	EXCAVATABILITY	10
3.11	SOIL CREEP	10
3.12	KEYWAYS AND BENCHED FILL	10
3.13	SOIL CORROSION POTENTIAL	10
3.14	2025 CBC SEISMIC DESIGN PARAMETERS	11
4.0	PRELIMINARY EARTHWORK RECOMMENDATIONS	12
4.1	GENERAL SITE CLEARING	12
4.2	EXISTING FILL AND DISTURBED SOIL MITIGATION	13
4.3	KEYWAYS	13
4.4	CUT/FILL TRANSITION AND CUT BUILDING PAD PREPARATION	13
4.5	OVER-OPTIMUM SOIL MOISTURE CONDITIONS	13
4.6	ACCEPTABLE FILL	14
4.7	FILL COMPACTION	14
4.8	SLOPES	14
4.9	EROSION CONTROL	15
4.10	SITE DRAINAGE	15
4.10.1	Surface Drainage	15

TABLE OF CONTENTS (Continued)

4.10.2	Subsurface Drainage	15
4.11	CORRECTIVE GRADING PLAN.....	16
5.0	PRELIMINARY FOUNDATION RECOMMENDATIONS.....	16
5.1.1	Structural Mat Slabs.....	16
5.1.2	Drilled Piers	16
6.0	PRELIMINARY RETAINING WALL RECOMMENDATIONS.....	17
7.0	EXTERIOR FLATWORK.....	17
8.0	PRELIMINARY PAVEMENT DESIGN	17
9.0	STORMWATER INFILTRATION.....	17
10.0	STORMWATER BIORETENTION AREAS.....	18
11.0	LANDSCAPING CONSIDERATION	18
12.0	FUTURE STUDIES	19
13.0	LIMITATIONS AND UNIFORMITY OF CONDITIONS	19

SELECTED REFERENCES

FIGURES

APPENDIX A – Boring and Test Pit Logs (2009)

APPENDIX B – Laboratory Test Data (2009)

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

We prepared this preliminary geotechnical report for the planning of a new residential development located in Goleta, California. As outlined in our proposal dated June 25, 2024, you authorized us to prepare a preliminary geotechnical exploration report that included the following items.

- Review of publicly available geological maps, reports, and historical topographic maps and aerial photographs, in addition to the Safety Element Chapter 5.0 of the City of Goleta General Plan/Land Use Plan.
- Performing a site visit to observe the current surface conditions of the project site and if significant topographic changes have occurred.
- Review of the previous subsurface data and laboratory test results and preparation of a preliminary geotechnical report.

For our use, we received the following.

- L&P Consultants. 2016. Preliminary Grading, Drainage & Improvement Plan for Vesting Tentative Tract Map 32,045 and Final Development Plan. July 10, 2025. Sheet 2. Project No. 01-023.01

This report was prepared for the exclusive use of our client and their consultants for design of this project. In the event that any changes are made in the character, design, or layout of the development, we must be contacted to review the conclusions and recommendations contained in this report to evaluate whether modifications are recommended. This document may not be reproduced in whole or in part by any means whatsoever, nor may it be quoted or excerpted without our express written consent.

1.2 PROJECT LOCATION AND DESCRIPTION

The proposed project site is located at 7400 Cathedral Oaks Road in Goleta, California (Figures 1 and 2). The approximately 15-acre project area is currently occupied by two single-family dwellings and a storage structure on the western portion of the site. The Preliminary Grading, Drainage, & Improvement Plan also shows existing elevations ranging from approximately 250 feet (NAVD88) at the northeastern corner of the project site to approximately 150 feet along the Cathedral Oaks frontage. The site is accessible through a private driveway from Cathedral Oaks Road at the southwestern corner of the project site.

We understand that 56 single-family residential units with attached garages are proposed. The Preliminary Grading, Drainage, & Improvement Plan shows cuts on the order of 17 feet and fill on the order of approximately 12 feet for the creation of level building pads for the proposed residential structures. The Preliminary Grading, Drainage, & Improvement Plan also shows four units at the northern end of the site situated on split-level lots and the opposing lots located on or adjacent to a fill slope. The building loads are expected to be typical of residential structures up to three stories in height. The Glen Annie Golf Club Course borders the project site to the east, north, and northwest. El Encanto Creek borders the project site to the southwest.

Cut slopes with a gradient of 2½:1 (horizontal:vertical) up to 14 feet high and combined 2½:1 and 3:1 cut slopes up to 18 feet high are planned at the four northernmost lots. Rear yard slopes straddling a cut-fill transition at the north-central part of the site are shown with a gradient of 2:1 up to about 10 feet high and up to 6-feet-high retaining walls. Along Cathedral Oaks Road, an open-space area consisting of up to about 14 feet of fill over existing fill is planned with a gradient of 3:1. Various retaining walls up to 12 feet in height with level and sloping backfill conditions are also proposed at the project site.

Other site improvements include paved roadways and utilities. A bioretention basin is located along the western boundary of the project site and at the top the bank of El Encanto Creek.

1.3 PREVIOUS EXPLORATION

We previously performed a geotechnical exploration of the project site and published a report dated February 23, 2011. The proposed project was similar, but with 60 single-family residential units proposed. The field exploration consisted of four borings and five test pits performed in 2009. Our previous field exploration is further discussed in Section 2.2.

2.0 FINDINGS

2.1 GEOLOGY AND SEISMICITY

2.1.1 Geology

Our review of available geologic mapping indicates that the site is underlain by south-dipping Rincon shale (Tr) at the northern end of the project site and older silt, sand, and gravel (Qoa) deposits at the central and southern portions of the site (Dibblee, 1987) as shown in Figure 4. The Dibblee geologic shows an east-northeast strike and 23-degree dip. The Glen Annie Fault is shown north of the project site while the More Ranch Fault is shown south of the project site. The Rincon shale is an early Miocene shallow marine gray clay shale or claystone and was observed in TP-2 with an approximate east-northeast strike and 35-degree dip. The older alluvium is incised by a natural drainage along the western property boundary. A more recent geologic map by Conrad et. al. (2014), as shown in Figure 5, also maps the southern portion of the project site within late Pleistocene intermediate-age alluvial deposits (Qoa2) and the northern portion within early Miocene Rincon Shale. We have included site geology in the Site Plan, Figure 2.

2.1.2 Seismicity

The Goleta area contains numerous active earthquake faults. Nearby active faults include the San Luis Range and Oceanic faults. A Holocene-active fault is defined by the California Geologic Survey as one that has had surface displacement within Holocene time (about the last 11,700 years) (CGS, 2018). Faults near or within Goleta include the More Ranch Fault, the Glen Annie Fault, and the Carneros Fault (see Figures 6 and 7). The City of Goleta Safety Element notes that none of these faults are classified as active by the California Geological Survey (CGS) or subject to an Alquist-Priolo Special Studies Zone. However, according to the Santa Barbara County Seismic Safety and Safety Element (SSSE), the More Ranch Fault is considered active based on the existence of a geologically recent fault scarp (County of Santa Barbara 1991). The More Ranch Fault is located south of Highway 101 and not considered a fault rupture risk for the project area; therefore, fault rupture is not anticipated.

To determine nearby active faults that are capable of generating strong seismic ground shaking at the site, we utilized the USGS Unified Hazard Tool* and the peak ground acceleration (PGA) for a 2,475-year return period, with the resulting faults listed below in Table 2.1.2-1.

TABLE 2.1.2-1: Active Faults Capable of Producing Significant Ground Shaking at the Site (Latitude: 34.9695 Longitude: -120.4178)

SOURCE	R _{RUP} (km)	MOMENT MAGNITUDE M _w
San Luis Range (So Margin)[8]	2.4	7.0
San Luis Range [5]	2.5	7.0
San Luis Range [6]	6.3	6.8
San Luis Range - Oceano [0]	6.9	7.0
San Luis Range (So Margin)[7]	7.4	7.4
Oceanic - West Huasna [2]	7.4	6.7
Oceanic - West Huasna [3]	7.9	6.9
Casmalia [5]	13.7	7.5
Los Osos 2011 [6]	15.5	6.8
South Cuyama [0]	16.5	7.0
San Andreas (Cholame) rev [0]	63.0	8.1

*USGS Unified Hazard Tool – Edition: Dynamic Conterminous U.S. 2014 (update)

2.1.3 Site History

We reviewed historical aerial photographs and topographic maps containing the subject site, as summarized in Table 2.1.3-1.

TABLE 2.1.3-1: Historical Review Summary

HISTORICAL MAP/PHOTOGRAPH	YEARS
Topographic Maps	1943, 1951, 1952, 1957, 1965, 1975, 1982, 1987, 1989, 2000, 2012, 2015, 2018, 2022
Aerial Photographs	1947, 1953, 1961, 1967, 1984, 1994, 2002, 2005, 2009, 2010, 2012, 2014, 2016, 2018, 2020, 2022

The 1949 photograph shows the project site occupied by avocado orchards and continue through the 1994 photograph. The 2002 photograph shows the majority of the site cleared of orchards and a few structures along the southwestern boundary of the project site. An orchard is still present in the northern part of the project site and can also be seen in the 2005, 2009, and 2010 photographs. During our previous study, we were notified that the southern and southeastern portions of the site were reportedly regraded in the 1990s; however, supporting documentation was not available at the time of this report. At the time of our previous study, portions of the project site were being used for wood chopping operations. Remnants of the northern orchard can be seen through the 2022 photograph. Some trees have grown, mostly on the western side of the project, since the removal of the majority of the orchard. We did not observe significant deviations between the topographic maps.

2.2 FIELD EXPLORATION

The field exploration of our previous study was performed on June 4, 2009, and consisted of drilling four exploratory test borings (1-B1 through 1-B4) and excavating four test pits (TP-1 through TP-4) at the locations shown in the Site Plan, Figure 2. The borings were drilled at accessible areas to a maximum depth of approximately 51 feet. The exploratory test pits were excavated in accessible areas to a maximum depth of approximately 10 feet deep. Geographical coordinates of the exploration locations were collected using a recreational-grade global positioning unit and should be considered accurately located only to the degree implied by the method used.

The test borings were drilled using a truck-mounted CME-75 drill rig equipped with 6-inch-diameter hollow stem augers. Soil samples recovered during drilling were retrieved using a 3-inch outside-diameter (O.D.) California-type split-spoon sampler fitted with 6-inch-long brass liners or a 2-inch O. D. Standard Penetration Test sampler. The samplers were driven with a 140-pound safety hammer falling a distance of 30 inches. An automatic trip system was used to lift the safety hammer during our exploration. The penetration of the samplers into the native materials was field recorded as the number of blows needed to drive the sampler 18 inches in 6-inch increments. The boring logs show the number of blows required for the last 1 foot of penetration. The blow counts have not been converted using any correction factors.

Boreholes were logged in the field by an ENGEO Engineering Geologist. The field logs were then used to develop the report borelogs in Appendix A. The logs depict subsurface conditions within the borings on the date of drilling; however, subsurface conditions may vary with time.

The test pits were excavated using a backhoe to expose conditions in the subsurface from about 2 to 10 feet deep. Test pit locations were selected to expose firm native soil or bedrock. An ENGEO Engineering Geologist performed the field logging of the test pits. The field logs were used to develop the report test pit logs presented in Appendix A. The logs depict subsurface conditions within the test pits on the date of drilling; however, subsurface conditions may vary with time.

The test pits were backfilled with nominal compactive effort. Test pits within areas that are not completely removed by design cuts will require overexcavation and recompaction during site grading.

2.3 SURFACE CONDITIONS

We performed a site visit on July 1, 2025, to observe the current conditions of the project site. The vegetation in the southern three-quarters of the project site has been mowed and mature trees were observed along the project boundary. The northern slope was covered with overgrown grasses, scrubs, and trees. Any trees related to the previous orchard appeared to have been removed. A wood chopping operation is present in the southeastern corner of the project site. We were not able to observe the current creek banks due to fencing and dense vegetation. We observed large desiccation cracks throughout the area up to about 2 to 3 inches in width and about 1½ feet deep.

PHOTOGRAPH 2.3-1: Project Site Looking North



PHOTOGRAPH 2.3-2: Example Desiccation Cracks



Additional information for notable on-site features is included in the Site Plan, Figure 2.

2.4 LABORATORY TESTING

Selected samples recovered during our previous field exploration were tested to determine the following soil and rock characteristics.

TABLE 2.4-1: Laboratory Testing

CHARACTERISTIC	TEST METHOD
Plasticity Index	ASTM D4318
Hydrometer	ASTM D422
Unconfined Compression	ASTM D2166
Moisture Content and Unit Weight	ASTM D7263
Moisture Only	ASTM D2216
Expansion Index	ASTM D4829
Sulfate	CTM 417

Laboratory data is included in Appendix B.

2.5 SUBSURFACE CONDITIONS

The site soil is relatively uniform and consists predominantly of stiff to very hard clay and silt. Boring 1-B3 encountered existing fill in the upper approximately 7½ feet of the boring. The approximate extent of the fill is shown in the Site Plan, Figure 2; however, additional fill is likely near the existing structures. We observed older alluvium to the maximum depth explored of 51½ feet deep in Boring 1-B1 while in Boring 1-B4, performed at the northern end of the project site, we observed approximately 8 feet of clay over bedrock. The surface clay and bedrock deposits have a high to critical expansion potential with Plasticity Indexes of 50 to 53 and an Expansion Index of 90. Desiccation cracks were observed throughout the site at the surface in addition to alluvium-filled cracks as deep as 7 feet below ground surface observed within TP-1 and TP-2.

2.6 GROUNDWATER CONDITIONS

We did not observe static or perched groundwater in any of our subsurface explorations. The boreholes and test pits were backfilled on the day of drilling. Fluctuations in the level of groundwater may occur due to variations in rainfall, irrigation practice, and other factors not evident at the time measurements were made.

3.0 PRELIMINARY CONCLUSIONS

Based upon this preliminary study, it is our opinion that the project site is feasible for the proposed residential development from a geotechnical standpoint, provided the preliminary recommendations contained in this report and future design-level geotechnical studies are incorporated into the development plans. A site-specific geotechnical exploration should be performed as part of the design process. The exploration would include additional borings, test pits, and laboratory soil testing to provide data for preparation of specific recommendations regarding grading, foundation design, drainage, and stormwater infiltration considerations for the proposed development. The exploration will also allow for more detailed evaluations of the geotechnical issues discussed below and afford the opportunity to provide recommendations regarding techniques and procedures to be implemented during construction to mitigate potential geotechnical/geological hazards.

Based upon our field exploration and review of readily available published maps and reports for the site, the main geotechnical concerns for the proposed site development include existing fill, agriculturally disturbed surficial soil, expansive soil, strong ground shaking, variable depth to

bedrock, slope stability, and corrosion potential. These items and other geotechnical issues are discussed in the following sections of this report.

3.1 EXISTING FILL

As previously mentioned, our borings and test pits indicate that portions of the project site are underlain by up to about 7½ feet of fill as shown in Figure 2. The lateral extent and depth of fill is expected to vary. We are not aware of any documentation of the existing fill; therefore, the acceptability of the existing fill for the current land plan cannot be determined.

If not engineered, existing fill can undergo excessive settlement, especially under new fill or building loads. Without proper documentation of existing fill placed on the site, we recommend complete removal and recompaction of the existing fill. We present fill removal recommendations in Section 4.2.

3.2 DISTURBED SURFICIAL SOIL

The historical photographs and topographic maps indicate the project site had been occupied by an orchard and then removed. It is our experience that the trees and associated root systems introduce significant organic content into the subgrade and the removal of the trees causes disturbance of the upper soil, typically in the upper 3 to 5 feet. Similar to non-engineered fill, agriculturally disturbed soil and soil with significant organic content can undergo excessive settlement. We present disturbed surficial soil removal recommendations in Section 4.2.

3.3 EXPANSIVE SOIL

We observed potentially expansive clay and bedrock near the surface of the site during our site visit and in our borings and test pits. Laboratory testing of representative near-surface soil and bedrock samples collected indicate the soil and bedrock have a Plasticity Index of 53 and 50, respectively. Laboratory testing of a near-surface soil sample collected from Test Pit TP-3 indicated the soil has an Expansion Index of 90. These laboratory test results indicate that the near-surface soil and bedrock have a high to critical expansion potential.

Expansive soil changes in volume with changes in moisture. It can shrink or swell and cause heaving and cracking of slabs-on-grade, pavements, and structures founded on shallow foundations.

Successful performance of structures on expansive soil requires special attention during construction. It is imperative that exposed soil be kept moist prior to placement of concrete for foundation construction. It can be difficult to remoisturize expansive clayey soil without excavation, moisture conditioning, and recompaction.

We have provided specific grading recommendations for compaction of clay soil at the site. The purpose of these recommendations is to minimize the potential detrimental swell potential of the clay by compacting the soil at an increased moisture content and controlling the amount of compaction. Our recommendations for the building foundation and site improvement also consider the differential shrink/swell potential of the site soil.

3.4 SEISMIC HAZARDS

Potential seismic hazards resulting from a nearby moderate to major earthquake can generally be classified as primary and secondary. The primary effect is ground rupture, also called surface faulting. The common secondary seismic hazards include ground shaking, soil liquefaction, lateral spreading, and landslides. The following sections present a discussion of these hazards as they apply to the site. Based on topographic and lithologic data, the risk of regional subsidence or uplift, tsunamis and seiches is considered low to negligible at the site.

3.4.1 Ground Rupture

Since there are no known active faults crossing the property and the site is not located within an Earthquake Fault Special Study Zone, it is our opinion that ground rupture is unlikely at the project site.

3.4.2 Ground Shaking

An earthquake of moderate to high magnitude generated within the Goleta region could cause considerable ground shaking at the site, similar to that which has occurred in the past. To mitigate the shaking effects, structures should be designed using sound engineering judgment and the 2025 California Building Code (CBC) requirements, as a minimum. Seismic design provisions of current building codes generally prescribe minimum lateral forces, applied statically to the structure, combined with the gravity forces of dead and live loads. The code-prescribed lateral forces are generally considered to be substantially smaller than the comparable forces that would be associated with a major earthquake. Therefore, structures should be able to: (1) resist minor earthquakes without damage, (2) resist moderate earthquakes without structural damage but with some non-structural damage, and (3) resist major earthquakes without collapse but with some structural as well as nonstructural damage. Conformance to the current building code recommendations does not constitute any kind of guarantee that significant structural damage would not occur in the event of a maximum magnitude earthquake; however, it is reasonable to expect that a well-designed and well-constructed structure will not collapse or cause loss of life in a major earthquake (SEAOC, 1996).

3.4.3 Liquefaction and Seismic Settlement

Soil liquefaction results from loss of strength during cyclic loading, such as imposed by earthquakes. Soil most susceptible to liquefaction is clean, loose, saturated, uniformly graded, fine-grained sand. Empirical evidence indicates that loose to medium dense gravel, silty sand, low plasticity silt, and some low plasticity clay are also potentially liquefiable. Groundwater was not encountered to the terminal depth of our borings as noted earlier, the soil consists stiff to very hard clay and silt, and the soil is considered older alluvium. For these reasons and based upon engineering judgment, it is our opinion that the potential for liquefaction at the site is low during seismic shaking.

Densification of loose granular soil above the water table can cause settlement of the ground surface due to earthquake-induced vibrations. We did not encounter granular soil in our explorations; therefore, dynamic densification should be negligible.

3.4.4 Lateral Spreading

Lateral spreading is a failure within weaker soil material, commonly resulting from liquefaction, which causes the soil to move toward a free face or down a slope. Due to the negligible risk of liquefaction, the potential risk of lateral spreading is also considered negligible.

3.5 LANDSLIDING

The City of Goleta Safety Element (Figure 7) has mapped the northern portion of the project within an area of high landslide potential and noted that the Rincon geologic formation is susceptible to landslides. In addition, the geologic map by Conrad et al. 2014 (Figure 5) and the CGS landslide database (Figure 8) includes several mapped landslides in the region. Due to the general adverse bedding orientation of the bedrock to the proposed cut slope located at the northern portion of the project site (See Figure 3), landslides are an increased risk to the project. We provide grading recommendations in Section 4.8 to reduce the risk of landsliding to the project.

The western roadway improvements appear to be off set from the creek bank a considerable distance from the creek bank and may be considered low landslide risk. However, Lot 1 is located relatively close to the creek bank and should be evaluated further during a design-level study for landslide risk.

3.6 COMPRESSIBLE AND COLLAPSIBLE SOILS

As noted previously, the subgrade soil was stiff to very hard and shallow bedrock was encountered in the northern portion of the project site. Therefore, we anticipate only minor settlement generally occurring during grading and building construction and negligible settlement occurring after the completion of construction.

We did not observe significant pore space in the soil at the project site. In addition, we observed the soil to contain natural moisture and to be relatively stiff. Furthermore, the project site is located in a generally moist climate with seasonal rainfall and not conducive to producing collapsible soil. For these reasons, the risk of hydrocollapse is considered low.

3.7 FLOODING AND TSUNAMI

The Federal Emergency Management Agency (FEMA) has not mapped the project area within an area of flood risk; however, the civil engineer should review pertinent information relating to possible flood levels for the subject site based on final pad elevations and provide appropriate design measures for development of the project, if recommended. The City of Goleta Safety Element also does not indicate flood or tsunami risk to the project.

3.8 NATURALLY OCCURRING RADON GAS

Radon is a radioactive gas formed by the decay of small amounts of naturally occurring uranium and thorium in rock and soil. Sometimes radon gas can move from underlying soil and rock into structures and become concentrated in indoor air. Noted in the City of Goleta Safety Element, Because of its radioactivity, radon levels in excess of 4.0 picocuries per liter are considered hazardous by the U.S. Environmental Protection Agency and require radon reduction measures. Radon gas is associated with the Rincon formation, and areas subject to moderate and high potential for radon gas levels exceeding 4.0 picocuries per liter occur where the Rincon Formation is at or close to the ground surface.

As shown in Figure 9, CGS has mapped in the project area within high risk for indoor Radon gas. Project planning should assume implementation of Radon collection systems and we recommend further consultation with an Environmental Engineer.

3.9 DIFFERENTIAL FILL THICKNESS

Building pads constructed in cuts may encounter variably expansive subsurface conditions in the near-surface soil and rock; these pads may therefore be subject to damaging differential soil movements. Building pads that transition from cut to fill within the building pad area also can experience differential soil movements.

Due to cutting into the hill, we estimate that the bottom of various building foundations may be near or within the Rincon formation while the remainder of the building will be founded in the overlying soil. The performance of the foundation may vary between soil and bedrock; therefore, we provide grading and foundation recommendations to provide a more uniform subgrade to support the building on a relatively rigid mat slab or the use of drilled pier foundations.

3.10 EXCAVATABILITY

Based upon our observation and experience, we anticipate that conventional grading and backhoe equipment will likely be able to excavate the soil deposits. The bedrock should be considered rippable using a CAT D9 or larger bulldozer, equipped with single or multi-shank rippers. To confirm rippability, consideration should be given to performing a seismic refraction survey.

3.11 SOIL CREEP

Soil creep is a natural process that involves slow downhill movement of soil mantle on a slope. Soil creep consists of lateral extension and vertical settlement. Soil creep results when surficial expansive soil is subjected to wetting and drying cycles caused by seasonal moisture changes, precipitation, and/or long-term landscape irrigation; by the growth of roots; and by burrowing animals. The surface manifestations of soil creep include tipping/tilting of fence posts, separations of exterior concrete slabs or other landscape elements from residential buildings, and cracks with vertical and/or horizontal offsets in surface and near-surface improvements. The amounts of vertical and horizontal movement are a function of the soil physical characteristics, such as plasticity, height and gradient of the downhill slope, and the depth of wetting and drying cycles. Improvements constructed on or near downhill slopes will be impacted by soil creep. Any improvements planned on or near the tops of downhill slopes should consider soil creep.

3.12 KEYWAYS AND BENCHED FILL

We anticipate that significant cut and fill slopes will include the construction of drained keyways and benched fill to provide proper stability of the compacted fill. We present typical recommendations for keyways, benching and subdrains in Section 4.3.

3.13 SOIL CORROSION POTENTIAL

One representative sample was taken from a near-surface soil sample obtained from Boring B-2 during our previous field exploration. The sample was tested in our laboratory for water-soluble sulfate (SO_4) in soil. The laboratory test results are included in Appendix B.

The concentration of water-soluble sulfate (SO_4) in soil was determined in accordance with Caltrans Test Method 417. As reported in the attached analytical results, the sample tested contained 0.324 percent by weight water soluble sulfate (SO_4) in soil. The 2025 CBC references the American Concrete Institute Manual ACI 318, which provides guidelines to characterize the potential exposure for sulfate attack and associated recommendations for concrete in contact with soil based upon the exposure risk. The sulfate exposure is considered severe by ACI 318 and Type V cement, 0.45 maximum water/cement ratio, and minimum strength of 4,500 psi are specified.

We recommend additional samples collected of the on-site soil and bedrock during the design-level study and additional corrosion potential testing performed. The analytical tests generally include redox, pH, resistivity, chloride, in addition to sulfate. The additional analytical tests will further indicate risk of corrosion to reinforced concrete and buried metallic improvements.

3.14 2025 CBC SEISMIC DESIGN PARAMETERS

The 2025 CBC utilizes seismic design criteria established in the ASCE/SEI Standard “Minimum Design Loads and Associated Criteria for Buildings and Other Structures,” (ASCE 7-22). According to ASCE 7-22, the site soil should be classified based on the time-averaged shear-wave velocity measured from the ground surface to a depth of 100 feet. We did not measure shear-wave velocity during the current exploration, and this should be evaluated during future design-level studies. Since we don’t have shear-wave velocity data for the site, a default site class was used for the seismic analysis. This default site class envelopes site classes C, CD, and D.

We provide the 2025 CBC multi-period MCE_R and DE response spectra based on the United States Geological Survey’s (USGS’s) Seismic Design Geodatabase in Table 3.14-1. We also provide the seismic design parameters based on the two-period spectrum in Table 3.14-2.

TABLE 3.14-1: 2025 CBC Multi-Period MCE_R and DE Response Spectra – Default Site Class (Latitude: 34.9695 Longitude: -120.4178)

PERIOD (seconds)	PSEUDO-SPECTRAL ACCELERATION (g)	
	MCE_R	DE
0	0.61	0.41
0.01	0.61	0.41
0.02	0.61	0.41
0.03	0.64	0.43
0.05	0.78	0.52
0.075	0.99	0.66
0.1	1.16	0.77
0.15	1.35	0.90
0.2	1.47	0.98
0.25	1.52	1.01
0.3	1.57	1.05
0.4	1.55	1.03
0.5	1.47	0.98
0.75	1.18	0.78

PERIOD (seconds)	PSEUDO-SPECTRAL ACCELERATION (g)	
	MCE _R	DE
1	0.96	0.64
1.5	0.68	0.45
2	0.50	0.34
3	0.32	0.22
4	0.23	0.15
5	0.18	0.12
7.5	0.11	0.074
10	0.077	0.052

TABLE 3.14-2: 2025 CBC Seismic Design Parameters
(Latitude: 34.9695 Longitude: -120.4178)

PARAMETER	VALUE
Site Class	Default
Mapped MCE _R Spectral Response Acceleration at Short Periods, S _S (g)	1.18
Mapped MCE _R Spectral Response Acceleration at 1-second Period, S ₁ (g)	0.38
MCE _R Spectral Response Acceleration at Short Periods, S _{MS} (g)	1.41
MCE _R Spectral Response Acceleration at 1-second Period, S _{M1} (g)	1.96
Design Spectral Response Acceleration at Short Periods, S _{DS} (g)	0.94
Design Spectral Response Acceleration at 1-second Period, S _{D1} (g)	0.64
MCE _G Peak Ground Acceleration adjusted for Site Class effects, PGAM (g)	0.55

4.0 PRELIMINARY EARTHWORK RECOMMENDATIONS

The following preliminary recommendations are for initial land planning and preliminary estimating purposes. Final recommendations regarding site grading will be provided after additional site-specific exploration has been undertaken.

4.1 GENERAL SITE CLEARING

Grading should begin with the removal of existing structures, including their foundations. Underground structures, such as buried pipes, septic tanks, and leach fields, if any, which will be abandoned or are expected to deteriorate, should be removed from the project site entirely.

All existing vegetation and soft or compressible soil should be removed, as necessary, within the project limits. The depth of removal of these materials should be determined by the geotechnical engineer's qualified representative in the field at the time of grading.

Areas to receive fill or structures and those areas that serve as borrow for fill should be stripped of existing vegetation. Tree roots should be removed to a depth of at least 3 feet below finished grade in cut areas and 3 feet below original grade in fill areas. Subject to approval by the landscape architect, strippings and organically contaminated soil that is not suitable for use as engineered fill may be used in landscape areas. Any topsoil that will be retained for future use in landscape areas should be stockpiled in areas where it will not interfere with the grading operations.

Within the development areas, excavations resulting from demolition and stripping which extend below final grades, should be cleaned to firm undisturbed soil, as determined by the geotechnical engineer's representative. Following clearing and grubbing, all depressions in areas to be filled should be scarified, moisture conditioned, and backfilled with compacted engineered fill.

4.2 EXISTING FILL AND DISTURBED SOIL MITIGATION

All existing fill and soft material should be excavated to firm native soil. Excavated material may be used as fill material if it meets the requirements of Section 4.6. To mitigate disturbed surficial soil, we generally recommend excavating a minimum of 3 to 5 feet from the existing ground surface in areas of fill or limited cut. The excavation should be backfilled with moisture conditioned and compacted engineered fill following scarifying a minimum of 1 foot, moisture conditioning, and compacting the exposed subgrade.

4.3 KEYWAYS

After stripping, grading should begin with constructing keyways. Keyways should be graded at the toe of fill slopes. Slope the key bottom at least 2 percent downward toward the heel of the key. All fill should be adequately keyed into firm natural materials unaffected by shrinkage cracks.

Typical keyway configurations and subdrain details are shown in Figure 10. Actual keyway dimensions will be determined during a design-level study. Subsurface slope keys or benched terraces should be constructed above the lower toe keyway. The actual size of the keyways will be determined by the Geotechnical Engineer following preparation of final 40-scale grading plans and/or in the field during grading.

All keyway excavations should be examined and approved by the engineering geologist during grading for extents of adverse bedding, seepage, or bedrock conditions that may affect slope stability. If adverse geologic conditions are detected during grading, additional recommendations may be necessary.

4.4 CUT/FILL TRANSITION AND CUT BUILDING PAD PREPARATION

To create a more uniform subgrade to support the building foundations overlying cut/fill transitions, as shown in Figure 10, we recommend subexcavating the cut area of the building pad to provide a minimum of 3 feet of engineered fill underlying the building foundation. The fill portion of the building pad should be subexcavated 3 to 5 feet of engineered fill after removal of existing fill, if present, to mitigate disturbed surficial soil. Localized areas may require deeper subexcavation. The subexcavation should extend a minimum of 5 feet beyond building limits. Care should be taken to provide a similar soil type across the building pad. Cut pads should be subexcavated to provide a minimum of 3 feet of engineered fill underlying the building foundation. The fill should be compacted in accordance with Section 4.7.

4.5 OVER-OPTIMUM SOIL MOISTURE CONDITIONS

The contractor should anticipate encountering excessively over-optimum (wet) soil moisture conditions during winter or spring grading, or during or following periods of rain. Wet soil can make proper compaction difficult or impossible. Wet soil conditions can be mitigated by:

1. Frequent spreading and mixing during warm dry weather;
2. Mixing with drier materials;

3. Mixing with a lime, lime-flyash, or cement product; or
4. Stabilizing with aggregate or geotextile stabilization fabric, or both.

Options 3 and 4 should be evaluated by ENGEO prior to implementation.

4.6 ACCEPTABLE FILL

Except for the organically contaminated near-surface material, the site soil and bedrock containing less than 3 percent organics are suitable for use as engineered fill. No rock fragments larger than 6 inches in diameter shall be placed in the fill. ENGEO should be consulted on the use of rock greater than 6 inches in diameter.

Imported fill material should meet the above requirements and have a plasticity index similar to, or less than, the on-site soil material.

4.7 FILL COMPACTION

For land planning and cost estimating purposes, the following compaction control requirements should be anticipated for general fill areas.

- Test Procedures: ASTM D1557
- Required Moisture Content: Not less than 4 to 5 percentage points above optimum moisture content
- Minimum Relative Compaction: 88 to 90 percent for general fill

Relative compaction refers to the in-place dry density of soil expressed as a percentage of the maximum dry density of the same material.

4.8 SLOPES

We have provided specific slope recommendations due to the presence of potentially expansive soil and bedrock. Cut slopes in the Rincon formation should be rebuilt with engineered fill. Unreinforced slopes inclined as steep as 2:1 (horizontal: vertical) can be constructed up to 8 feet in height. Unreinforced slopes inclined at 2½:1 can be constructed up to 12 feet tall. Unreinforced slopes greater than 12 feet tall should be inclined at 3:1 or less. The contractor is responsible for constructing temporary construction slopes in accordance with Cal/OSHA requirements.

As previously discussed, cut slopes with a gradient of 2½:1 (horizontal:vertical) up to 14 feet high are planned at the four northernmost lots. Rear yard slopes straddling a cut-fill transition at the north-central part of the site are shown with a gradient of 2:1 up to about 10 feet high.

These slope inclinations and heights may be possible by excavating a keyway, rebuilding the outer portion of the slope with engineered fill, and placing geogrid reinforcement within the fill as shown in Figure 10. Laboratory fill strength testing and stability analysis should be performed during a design-level study to determine minimum geogrid reinforcement requirements and thickness of the cut slope rebuild.

Slope analysis should also be performed to evaluate the global stability of retaining walls located on or supporting slopes.

4.9 EROSION CONTROL

No water should be allowed to discharge in a concentrated manner over downslopes as this could cause erosion and could possibly destabilize slopes. Erosion of graded slopes can be mitigated by hydroseeding, landscaping or placement of topsoil materials prior to the winter rains following rough grading. All landscaped slopes should be maintained in a vegetated state after project completion with drought-tolerant vegetation requiring drip irrigation.

Due to the nature of the soil and bedrock, slopes may experience erosion when grading is halted by heavy rain. Therefore, before work is stopped, it is vital that no completed slope be left standing through a winter season without erosion control measures having been provided.

4.10 SITE DRAINAGE

4.10.1 Surface Drainage

The project civil engineer is responsible for designing surface drainage improvements. Regarding geotechnical engineering issues, we recommend that finish grades be sloped away from buildings and pavements to the maximum extent practical to reduce the potentially damaging effects of expansive soil. The latest California Building Code Section 1804.4 specifies minimum slopes of 5 percent away from foundations. Where surface improvements restrict meeting this slope requirement, we recommend that specific drainage requirements be developed. As a minimum, we recommend the following.

1. Discharge roof downspouts into closed conduits and direct away from foundations to appropriate drainage devices.
2. Consider the use of rear lot surface drainage collection systems to reduce overland surface drainage from back to front of lot.
3. Do not allow water to pond near foundations, pavements, or exterior flatwork.

4.10.2 Subsurface Drainage

Subsurface drainage systems should be installed in keyways and slope rebuild areas. Typical keyway subdrains are shown in Figures 10 and 11. Subdrains should also be added where wet conditions are encountered during grading.

Subdrain systems should consist of a minimum 6-inch-diameter perforated pipe encased in Caltrans Class 2 permeable material, or crushed rock wrapped in filter fabric. As an alternative, prefabricated geocomposite drainage material, such as SKAPS TNS 220-6, could be considered in lieu of the granular medium above the subdrain zone.

Discharge from the subdrains will generally be low but in some instances may be continuous. Subdrains should outlet into the storm drain system or other approved outlets, and their locations should be surveyed and documented by the project civil engineer for future maintenance and for documentation as they relate to the proposed buildings.

Not all sources of seepage are evident during the time of field work because of the intermittent nature of some of these conditions and their dependence on long-term climatic conditions. Furthermore, new sources of seepage may be created by a combination of changed topography, manmade irrigation patterns, and potential utility leakage. Since uncontrolled water movements

are one of the major causes of detrimental soil movements, it is of utmost importance that a geotechnical engineer be advised of any seepage conditions so that remedial action may be initiated, if necessary. Corrective grading plans will be provided to depict the extents of anticipated subdrain locations.

4.11 CORRECTIVE GRADING PLAN

A corrective grading plan showing recommended keyways, subdrains, slope rebuilds and geogrid reinforcement, subexcavations, and pad treatments should be prepared prior to grading. This allows graphic representations of our grading and subsurface drainage recommendations presented in this report. This can assist in obtaining more accurate earthwork bids as well as clarifying the geotechnical recommendations as they apply to the final grading plan.

5.0 PRELIMINARY FOUNDATION RECOMMENDATIONS

Based on our understanding of the soil/bedrock conditions and laboratory testing, we recommend supporting the proposed buildings on a rigid post-tension or conventionally reinforced structural mat slab designed for the anticipated vertical expansive soil conditions on flat pads and the additional lateral component of soil expansion and vertical soil creep on pads that are adjacent to slopes. Alternatively, drilled pier foundations could be considered for split-level lots and lots upslope of a slope.

5.1.1 Structural Mat Slabs

The use of structural mat slabs consisting of post-tensioned or conventional reinforcing is common for residential structures underlain by expansive soil and bedrock. For similar projects with similar soil conditions, we generally encounter structural mat slabs 11 to 14 inches in thickness.

5.1.2 Drilled Piers

Structures located on split-level lots near the top of slopes, including Lot 1, can be supported on drilled piers. The piers should be interconnected by grade beams. The construction of deeper piers with a wider spacing and stiffer grade beams is preferred. We also recommend extending the piers into bedrock. For planning purposes, the piers may be assumed to have a minimum depth of 12 feet and at least 5 feet into bedrock.

Due to the very high expansion potential of some of the site soil, the grade beams should be raised off the ground to protect the grade beams against subgrade swell pressures. A void or pad of compressible or degradable material at least 3 inches thick should be provided between the bottom of the grade beam and the ground.

If any portion of a structure utilizes a raised timber floor, we recommend that a subsurface drain be provided around the perimeter of the residential building to help protect against subsurface seepage under the foundation. In addition, crawl spaces should include subsurface drains, moisture reducing membranes, and waterproofing surface slabs.

6.0 PRELIMINARY RETAINING WALL RECOMMENDATIONS

Due to the very high expansion potential of some of the site soil, project planning should assume import granular material with low expansion potential for retaining wall backfill. The zone of backfill should be a minimum width of the height of the retaining wall. Retaining walls may be supported on spread footings or drilled piers. Spread footings with sloping foreground conditions should be deepened such that the horizontal distance to daylight to the top of the footing be a minimum of 10 feet.

7.0 EXTERIOR FLATWORK

Exterior flatwork includes items such as concrete sidewalks, steps, and outdoor courtyards exposed to foot traffic only. Provide a minimum section of 5 inches of concrete over 4 inches of aggregate base. Thicken flatwork edges to at least 9 inches to help control moisture variations in the subgrade and rebar within the middle third of the slab to help control the width and offset of cracks. Consideration should be given to placing rebar reinforcement in the middle third of the concrete flatwork to help control the width and offset of cracks. It is our experience that wire mesh is not sufficient to control cracking. As is common with concrete construction, minor cracking should be expected. Construct control and construction joints in accordance with current Portland Cement Association Guidelines.

8.0 PRELIMINARY PAVEMENT DESIGN

Based on index testing of the site soil and bedrock, an R-value of 5 would be appropriate for design. Using estimated traffic indexes for various pavement loading requirements, we developed the following recommended pavement sections using Chapter 630 of the Caltrans Highway Design Manual (including the asphalt factor of safety), presented in the table below.

TABLE 8.0-1: Recommended Hot Mix Asphalt Pavement Sections

TRAFFIC INDEX	HOT MIX ASPHALT (inches)	CLASS 2 AGGREGATE BASE (inches)
4	2.5	7.0
4.5	2.5	9.0
5	3.0	10.0
5.5	3.0	12.0
6	3.5	13.0

The civil engineer should determine the appropriate traffic indexes based on the estimated traffic loads and frequencies.

9.0 STORMWATER INFILTRATION

Due to the density of the site soil, high fines content (percentage passing the No. 200 sieve), and high plasticity index, the near-surface site soil is expected to have a low permeability value for stormwater infiltration in grassy swales or permeable pavers, unless subdrains are installed. Therefore, Best Management Practices should assume that limited stormwater infiltration will occur at the site.

10.0 STORMWATER BIORETENTION AREAS

Due to the proposed bioretention located at the top of the existing creek bank and potential instability from increased groundwater, we recommend installing an impermeable liner consisting of a minimum 30-mil geomembrane with all seams and penetrations sealed.

If smaller bioretention areas are implemented, we recommend that, when practical, they be planned a minimum of 5 feet away from structural site improvements, such as buildings, roads, retaining walls, and sidewalks/driveways. When this is not practical, bioretention areas located within 5 feet of structural site improvements can either:

1. Be constructed with structural side walls capable of withstanding the loads from the adjacent improvements, or
2. Incorporate filter material compacted to between 85 and 90 percent relative compaction (ASTM D1557, latest edition) and a waterproofing system designed to reduce the potential for moisture transmission into the subgrade soil beneath the adjacent improvement.

In addition, we recommend that bioretention design incorporate a waterproofing system consisting of a 20-mil vapor proof membrane or better lining the bioswale excavation and a subdrain, or other storm drain system, to collect and convey water to an approved outlet. The waterproofing system should cover the bioretention area excavation in such a manner as to reduce the potential for moisture transmission beneath the adjacent improvements.

Site improvements located adjacent to bioretention areas that are underlain by base rock, sand, or other imported granular materials, should be designed with a deepened edge that extends to the bottom of the imported material underlying the improvement.

11.0 LANDSCAPING CONSIDERATION

As the near-surface soil is moderately to very highly expansive, we recommend greatly restricting the amount of surface water infiltration near structures, pavements, and flatwork. This may be accomplished by:

- Selecting landscaping that requires little or no watering, especially within 5 feet of structures, slabs-on-grade, or pavements.
- Using low precipitation sprinkler heads.
- Regulating the amount of water distributed to lawn or planter areas by installing timers on the sprinkler system.
- Providing surface grades to drain rainfall or landscape watering to appropriate collection systems and away from structures, slabs-on-grade, or pavements.
- Preventing water from draining toward or ponding near building foundations, slabs-on-grade, or pavements.
- Avoiding open planting areas within 3 feet of the building perimeter.

We recommend that these items be incorporated into the landscaping plans.

12.0 FUTURE STUDIES

As previously discussed, a site-specific design-level geotechnical exploration should be performed as part of the design process. Preliminary conclusions and recommendations presented herein are based on limited site and laboratory data. The exploration would include test-pits, borings, and laboratory soil testing to provide data for preparation of specific recommendations regarding grading, seismic parameters, foundation design, corrosion potential, and drainage for the proposed development. The exploration will also allow for more detailed evaluations of the geotechnical issues discussed in this report and afford the opportunity to provide recommendations regarding techniques and procedures to be implemented during construction to mitigate potential geotechnical/geological hazards.

13.0 LIMITATIONS AND UNIFORMITY OF CONDITIONS

This report presents preliminary geotechnical recommendations for planning of the improvements discussed in Section 1.3 for the 7400 Cathedral Oaks Road project. If changes occur in the nature or design of the project, we should be allowed to review this report and provide additional recommendations, if any. It is the responsibility of the owner to transmit the information and recommendations of this report to the appropriate organizations or people involved in design of the project, including but not limited to developers, owners, buyers, architects, engineers, and designers. The conclusions and recommendations contained in this report are solely professional opinions and are valid for a period of no more than 2 years from the date of report issuance.

We strive to perform our professional services in accordance with generally accepted principles and practices currently employed in the area; there is no warranty, express or implied. There are risks of earth movement and property damages inherent in building on or with earth materials. We are unable to eliminate all risks; therefore, we are unable to guarantee or warrant the results of our services.

This report is based upon field and other conditions discovered at the time of report preparation. We developed this report with limited subsurface exploration data. We assumed that our subsurface exploration data are representative of the actual subsurface conditions across the site. Considering possible underground variability of soil and groundwater, additional costs may be required to complete the project. We recommend that the owner establish a contingency fund to cover such costs. If unexpected conditions are encountered, ENGEO must be notified immediately to review these conditions and provide additional and/or modified recommendations, as necessary.

Our services did not include excavation sloping or shoring, soil volume change factors, flood potential, or a geohazard exploration. In addition, our geotechnical exploration did not include work to determine the existence of possible hazardous materials. If any hazardous materials are encountered during construction, the proper regulatory officials must be notified immediately.

This document must not be subject to unauthorized reuse, that is, reusing without written authorization of ENGEO. Such authorization is essential because it requires ENGEO to evaluate the document's applicability given new circumstances, not the least of which is passage of time.

Actual field or other conditions will necessitate clarifications, adjustments, modifications, or other changes to ENGEO's documents. Therefore, ENGEO must be engaged to prepare the necessary clarifications, adjustments, modifications, or other changes before construction activities

commence or further activity proceeds. If ENGEO's scope of services does not include on-site construction observation, or if other persons or entities are retained to provide such services, ENGEO cannot be held responsible for any or all claims arising from or resulting from the performance of such services by other persons or entities, and from any or all claims arising from or resulting from clarifications, adjustments, modifications, discrepancies, or other changes necessary to reflect changed field or other conditions.

We determined the lines designating the interface between layers on the exploration logs using visual observations. The transition between the materials may be abrupt or gradual. The exploration logs contain information concerning samples recovered, indications of the presence of various materials such as clay, sand, silt, rock, existing fill, etc., and observations of groundwater encountered. The field logs also contain our interpretation of the subsurface conditions between sample locations. Therefore, the logs contain both factual and interpretative information. Our recommendations are based on the contents of the final logs, which represent our interpretation of the field logs.

SELECTED REFERENCES

- American Concrete Institute. 2019. Building Code Requirements for Structural Concrete (ACI 318-19) and Commentary (ACI 318R-19).
- American Society of Civil Engineers. 2022. Minimum Design Loads for Buildings and other Structures ASCE 7-16. Reston: American Society of Civil Engineers.
- Bryant, W. and Hart, E. 2007. Special Publication 42, "Fault-Rupture Hazard Zones in California," Interim Revision 2007, California Department of Conservation.
- California Building Standards Commission. 2025 California Building Code, Volumes 1 and 2, Sacramento, California.
- California Department of Transportation. 2017. Highway Design Manual.
- California Geologic Survey. 2008. Special Publication 117A, Guidelines for Evaluating and Mitigating Seismic Hazards in California.
- California Geological Survey. 2018. Earthquake Fault Zones – A Guide for Government Agencies, Property Owners / Developers, and Geoscience Practitioners for Assessing Fault Rupture Hazards in California: Special Publication 42 (SP42). Available at https://www.conservation.ca.gov/cgs/Documents/Publications/Special-Publications/SP_042.pdf.
- Churchill, R. 1995. Radon Zone Map for Santa Barbara County, California Geological Survey, Department of Conservation. December 31, 1995. Interagency Agreement Doc #1094-36.
- City of Goleta. 2006. Goleta General Plan/Coastal Land Use Plan. Adopted by Resolution No. CC-06-38. October 2, 2006. Amended by Voter Referenda: Measure G, November 6, 2012.
- Conrad, J.E., Ritchie, A.C., Johnson, S.Y., Greene, H.G., Dartnell, P., Seitz, G.G., and Gutierrez, C.I. 2014. Offshore and Onshore Geology and Geomorphology, Offshore of Coal Oil point Map Area, California.
- Dibblee, Jr., T.W. 1987. Geologic Map of the Dos Pueblos Quadrangle, Santa Barbara County, California, U.S. Geologic Survey, Open-file Report.
- Federal Emergency Management Agency. 2012. Flood Insurance Rate Map, Santa Barbara County, California and Incorporated Areas, Map Number 06083C1334G. Map Revised December 4, 2012.
- Field, E.H., Biasi, G.P., Bird, P., Dawson, T.E., Felzer, K.R., Jackson, D.D., Johnson, K.M., Jordan, T.H., Madden, C., Michael, A.J., Milner, K.R., Page, M.T., Parsons, T., Powers, P.M., Shaw, B.E., Thatcher, W.R., Weldon, R.J., II, and Zeng, Y. 2013. Uniform California earthquake rupture forecast, version 3 (UCERF3)—The time-independent model: U.S. Geological Survey Open-File Report 2013–1165, 97 p., California Geological Survey Special Report 228, and Southern California Earthquake Center Publication 1792, <http://pubs.usgs.gov/of/2013/1165/>.

SELECTED REFERENCES (Continued)

- Jennings, C.W., and Bryant, W.A. 2010. Fault activity map of California: California Geological Survey Geologic Data Map No. 6, map scale 1:750,000.
- Seed, H. B., Woodward, R. J., Jr and Lundgren, R. 1962. Prediction of swelling potential for compacted clays: J. ASCE, Soil Mechanics and Foundation Division, Vol. 88, No. SM-3, Part 1, pp 53-87.
- Southern California Earthquake Center. 1999. Recommended Procedures for Implementation of DMG Special Publication 117 Guidelines for Analyzing and Mitigating Liquefaction in California.



FIGURES

FIGURE 1: Vicinity Map

FIGURE 2: Site Plan

FIGURE 3: Cross Section A-A'

FIGURE 4: Regional Geologic Map

FIGURE 5: Regional Geologic Map

FIGURE 6: Regional Faulting and Seismicity Map

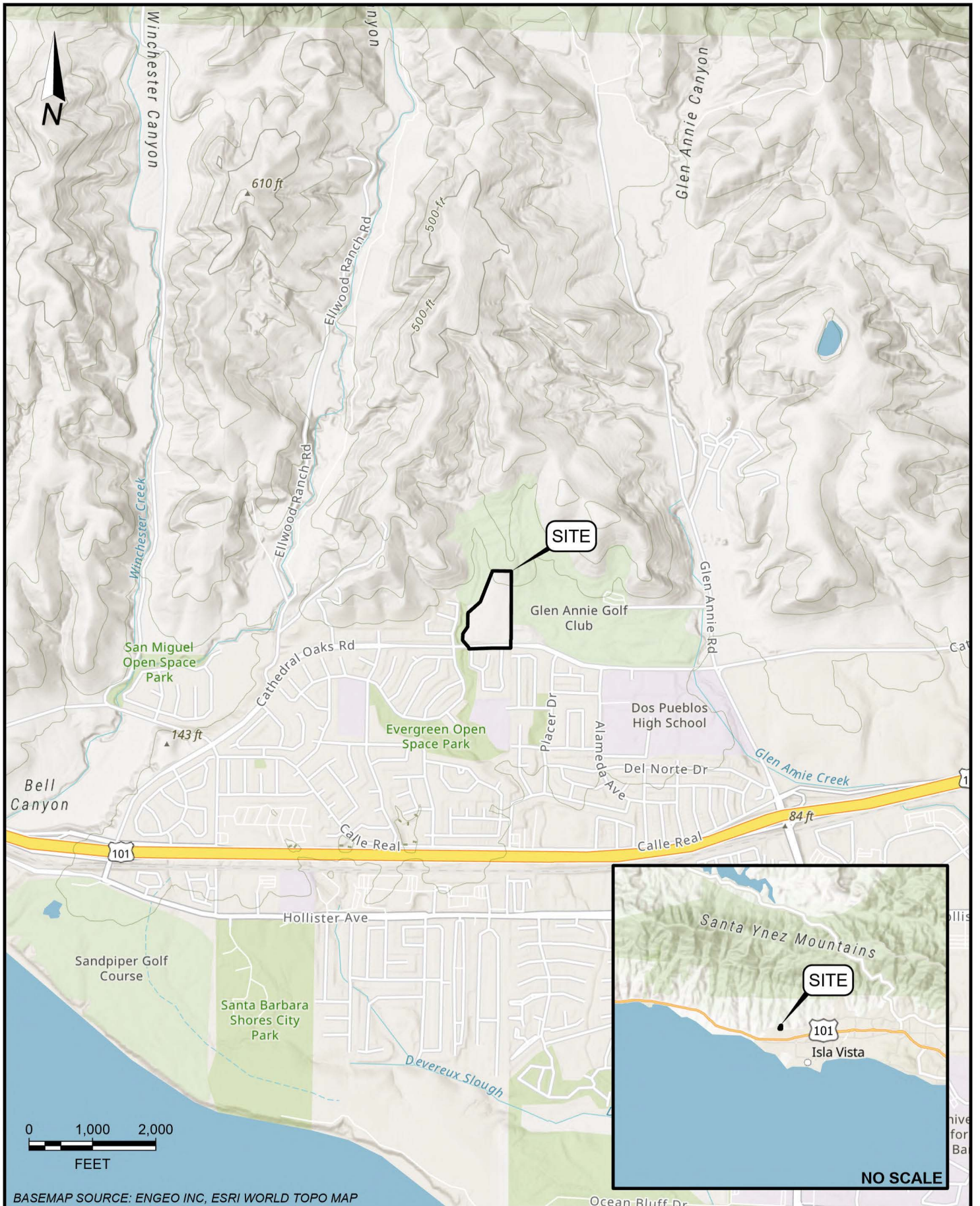
FIGURE 7: City of Goleta Geologic Hazards Map

**FIGURE 8: California Geological Survey Landslide
Inventory**

FIGURE 9: Indoor Radon Potential

FIGURE 10: Corrective Grading Details

FIGURE 11: Typical Subdrain Details



BASEMAP SOURCE: ENGEO INC, ESRI WORLD TOPO MAP



VICINITY MAP
7400 CATHEDRAL OAKS ROAD
GOLETA, CALIFORNIA

PROJECT NO.: 8724.001.000

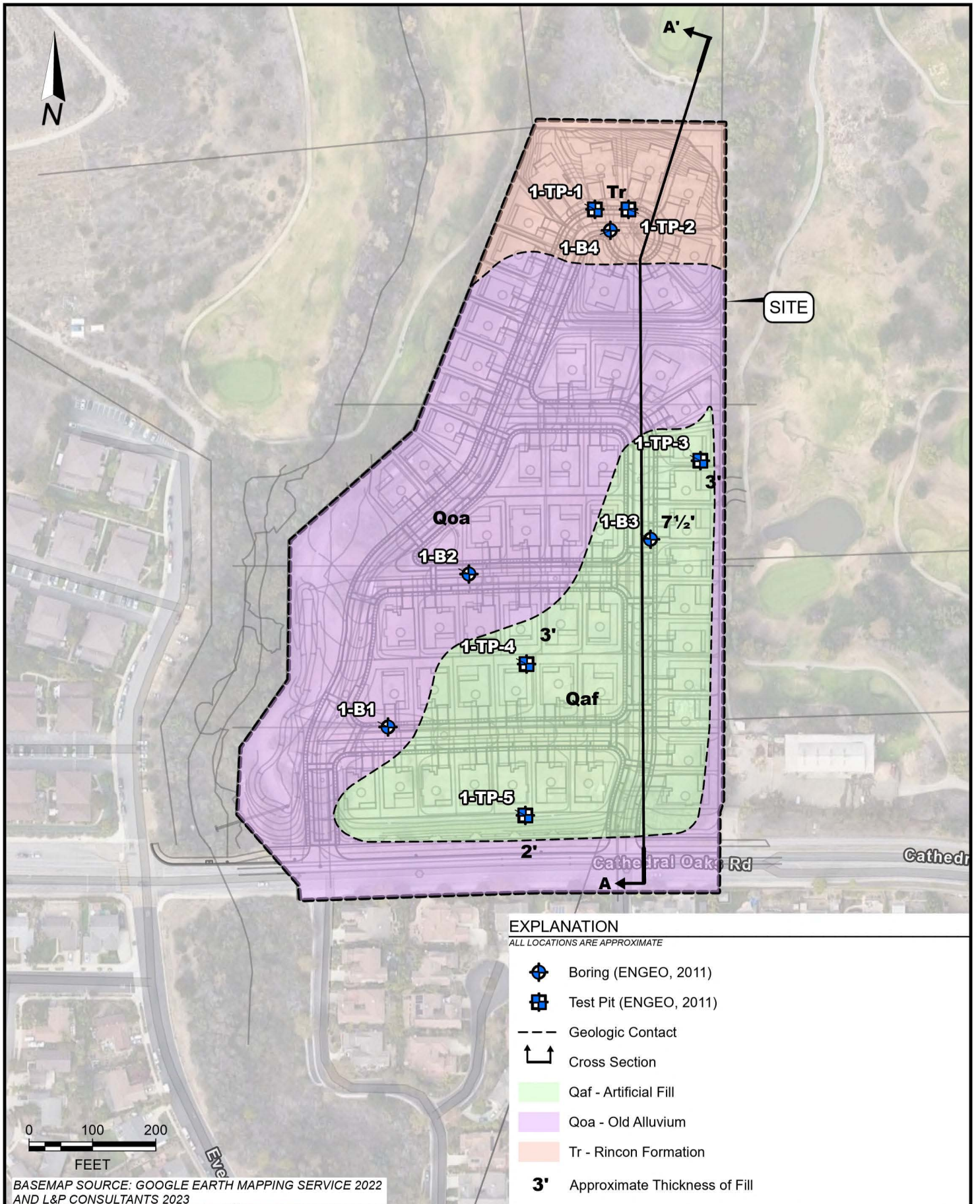
SCALE: AS SHOWN

DRAWN BY: MMH

CHECKED BY: JJT

FIGURE NO.

1



SITE PLAN
7400 CATHEDRAL OAKS ROAD
GOLETA, CALIFORNIA

PROJECT NO.: 8724.001.000

SCALE: AS SHOWN

DRAWN BY: MMH

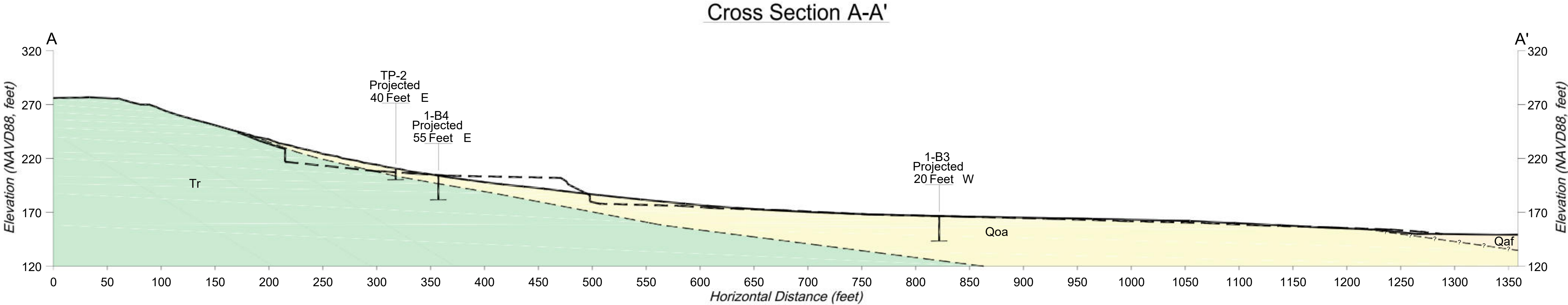
CHECKED BY: JJT

FIGURE NO.

2

ORIGINAL FIGURE PRINTED IN COLOR

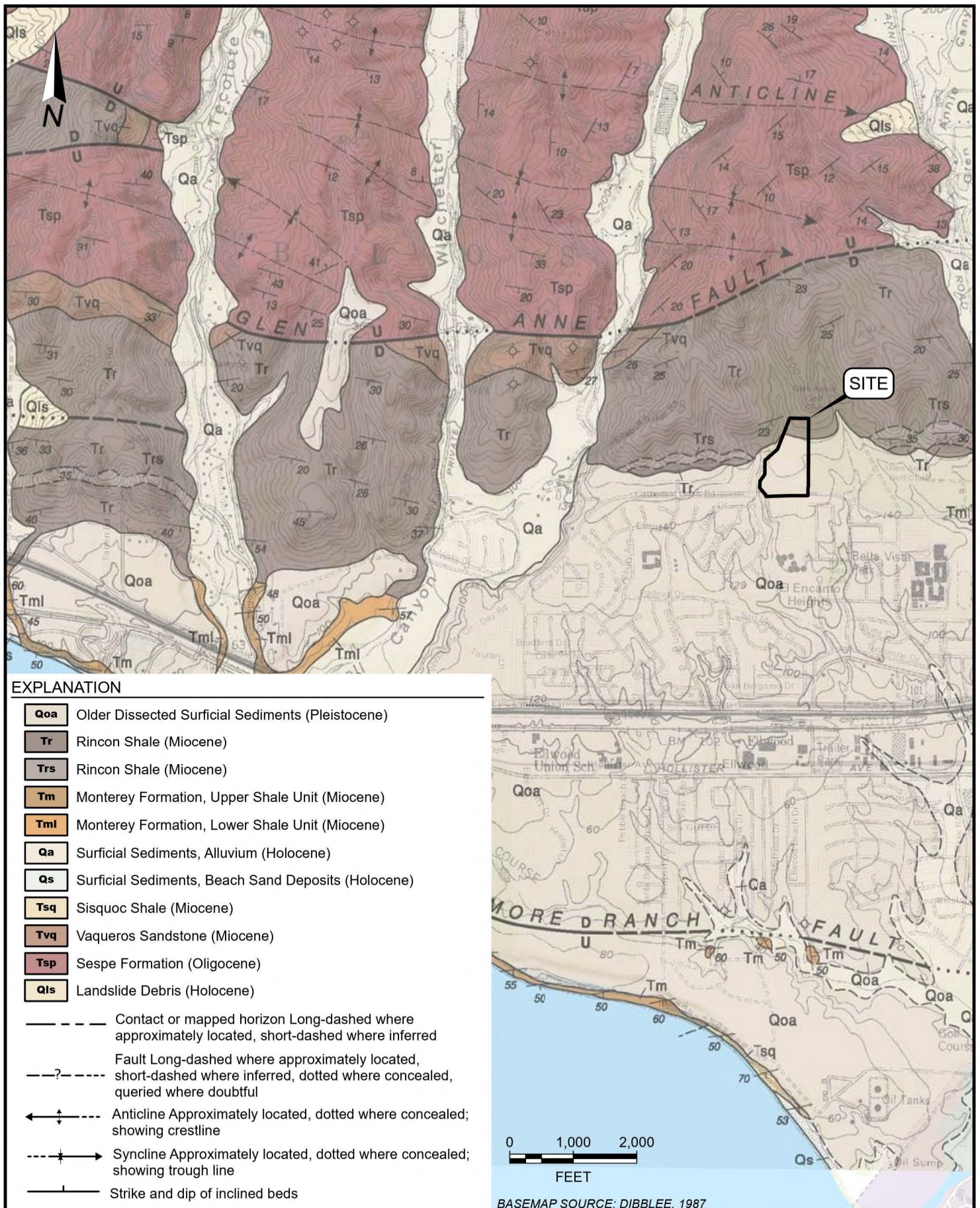
Copyright © 2015 by ENGEO Incorporated. This document and its contents are the property of ENGEO Incorporated. No part of this document may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or by any information storage and retrieval system, without the prior written permission of ENGEO Incorporated. All rights reserved. 10/15/15 10:15 AM 10/15/15 10:15 AM

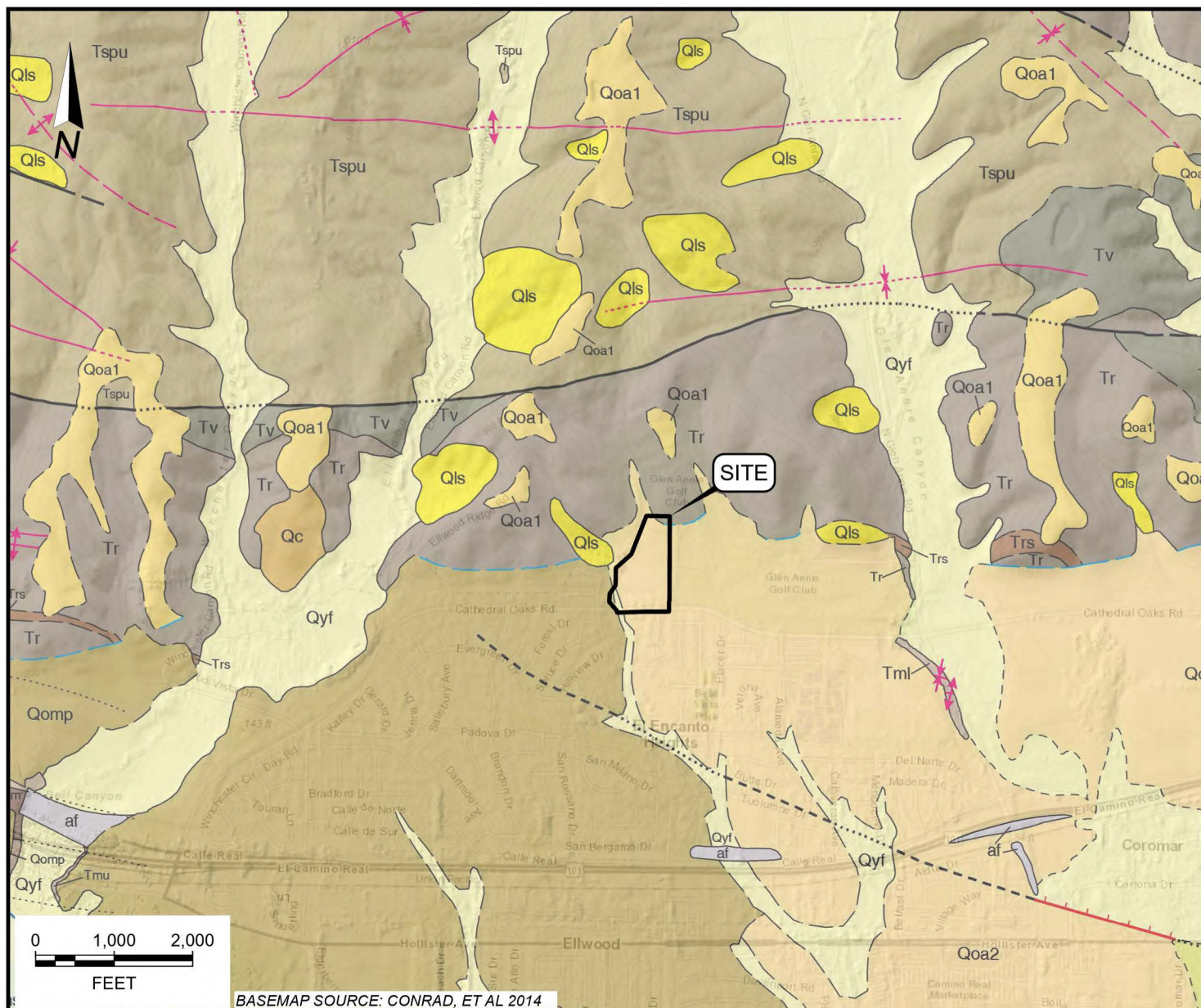


Legend

- | | | | |
|--|------------------------|--|---|
| Qaf | Artificial Fill | | Existing Ground Surface |
| Qoa | Old Alluvium | | Proposed Ground Surface |
| Tr | Rincon Formation | | Recommended Corrective Grading |
| 1-BX | Boring (ENGEO, 2011) | | Geologic Contact, dashed where approximate queried where inferred |
| TP-X | Test Pit (ENGEO, 2011) | | Apparent Dip of Bedding |

Disclaimer: Cross Section Is For Illustration
Purposes Only. The Transition Between
Materials May Be Abrupt Or Gradual. Variations
Should Be Expected.





EXPLANATION

af Artificial Fill (late Holocene)	Qes Coastal-Estuarine Deposits (Holocene)
Qyf Alluvium and Colluvium (Holocene and late Pleistocene)	Qds Dune Sand (Holocene)
Qoa2 Intermediate-Age Alluvial Deposits (late Pleistocene)	Qb Beach Deposits (late Holocene)
Qoa1 Older Alluvial Deposits (late and middle Pleistocene)	Tmu Upper Siliceous Unit (late Miocene)
Qomp Marine-Terrace Deposits (Late Pleistocene)	Tsq Sisquoc Formation (early Pliocene and late Miocene)
Qls Landslide Deposits (Holocene to middle Pleistocene)	--- Contact or mapped horizon Long-dashed where approximately located, short-dashed where inferred
Tr Rincon Shale (early Miocene)	---?--- Fault Long-dashed where approximately located, short-dashed where inferred, dotted where concealed, queried where doubtful
Tv Vaqueros Formation (late Oligocene)	--- Anticline Approximately located, dotted where concealed; showing crestline
Qc Colluvium (Holocene and late Pleistocene)	--- Syncline Approximately located, dotted where concealed; showing trough line
Trs Siliceous Shale Interval (early Miocene)	--- Strike and dip of inclined beds
Tspu Upper Sandstone and Mudstone Unit (late Oligocene)	
Tmm Middle Shale Unit (late and middle Miocene)	
Tml Lower Calcareous Unit (middle and early Miocene)	



EXPLANATION

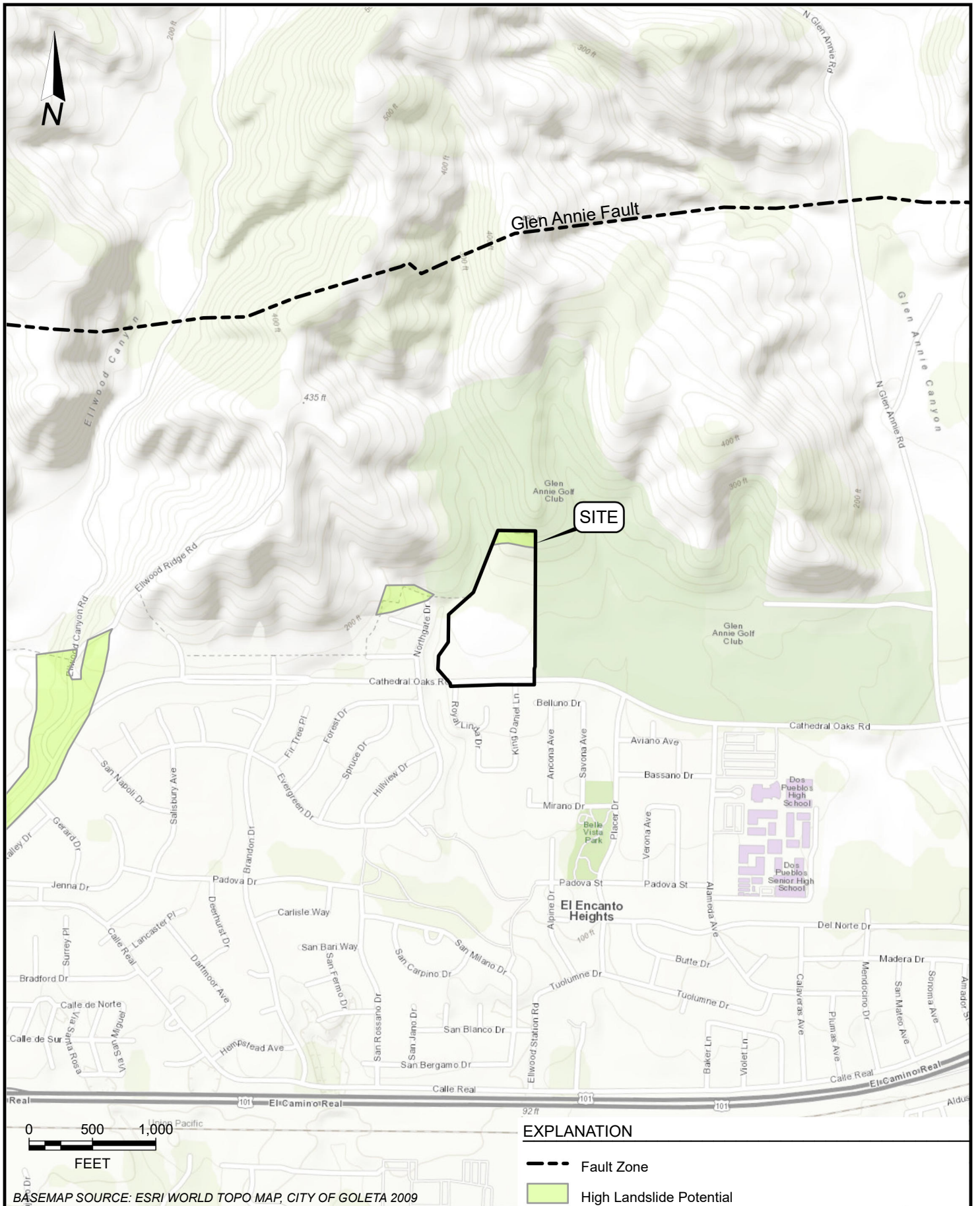
HISTORICAL EARTHQUAKE EPICENTERS

- Magnitude 5-6
- Magnitude 6-7
- Magnitude 7+
- Historical Blind Thrust Fault Zone

QUATERNARY FAULTS 2018-2020

Based on time of most recent surface deformation

- Historical (<150 Years), Well Constrained Location
- Historical (<150 Years), Moderately Constrained Location
- Historical (<150 Years), Inferred Location
- Latest Quaternary (<15,000 Years), Well Constrained Location
- Latest Quaternary (<15,000 Years), Moderately Constrained Location
- Latest Quaternary (<15,000 Years), Inferred Location
- Late Quaternary (<130,000 Years), Well Constrained Location
- Late Quaternary (<130,000 Years), Moderately Constrained Location
- Late Quaternary (<130,000 Years), Inferred Location
- Middle And Late Quaternary (<750,000 Years), Well Constrained Location
- Middle And Late Quaternary (<750,000 Years), Moderately Constrained Location
- Middle And Late Quaternary (<750,000 Years), Inferred Location
- Undifferentiated Quaternary(<1.6 Million Years), Well Constrained Location
- Undifferentiated Quaternary(<1.6 Million Years), Moderately Constrained Location
- Undifferentiated Quaternary(<1.6 Million Years), Inferred Location
- Class B (Various Age), Well Constrained Location
- Class B (Various Age), Moderately Constrained Location
- Class B (Various Age), Inferred Location



BASEMAP SOURCE: ESRI WORLD TOPO MAP, CITY OF GOLETA 2009



CITY OF GOLETA GEOLOGIC HAZARDS MAP
7400 CATHEDRAL OAKS ROAD
GOLETA, CALIFORNIA

PROJECT NO.: 8724.001.000

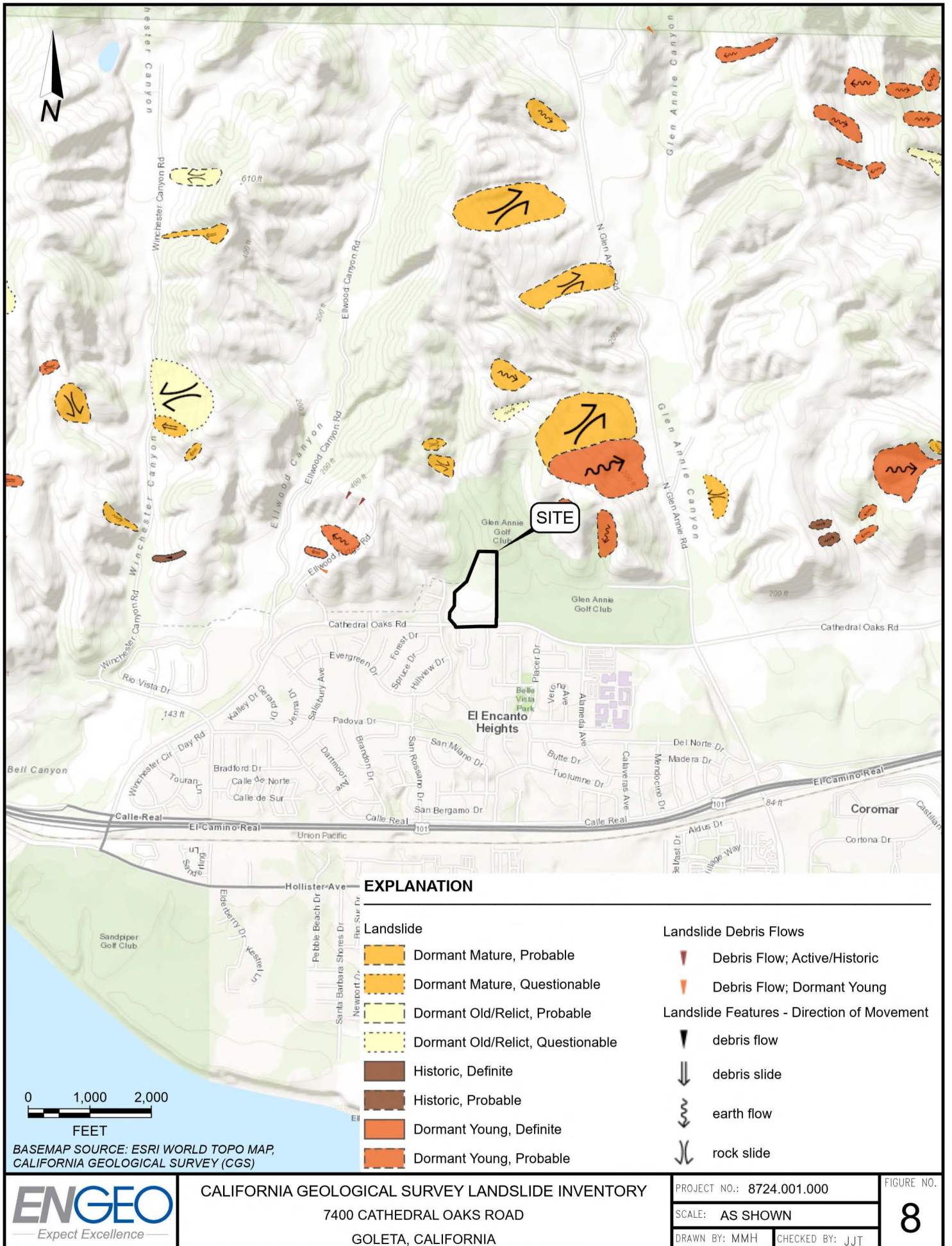
SCALE: AS SHOWN

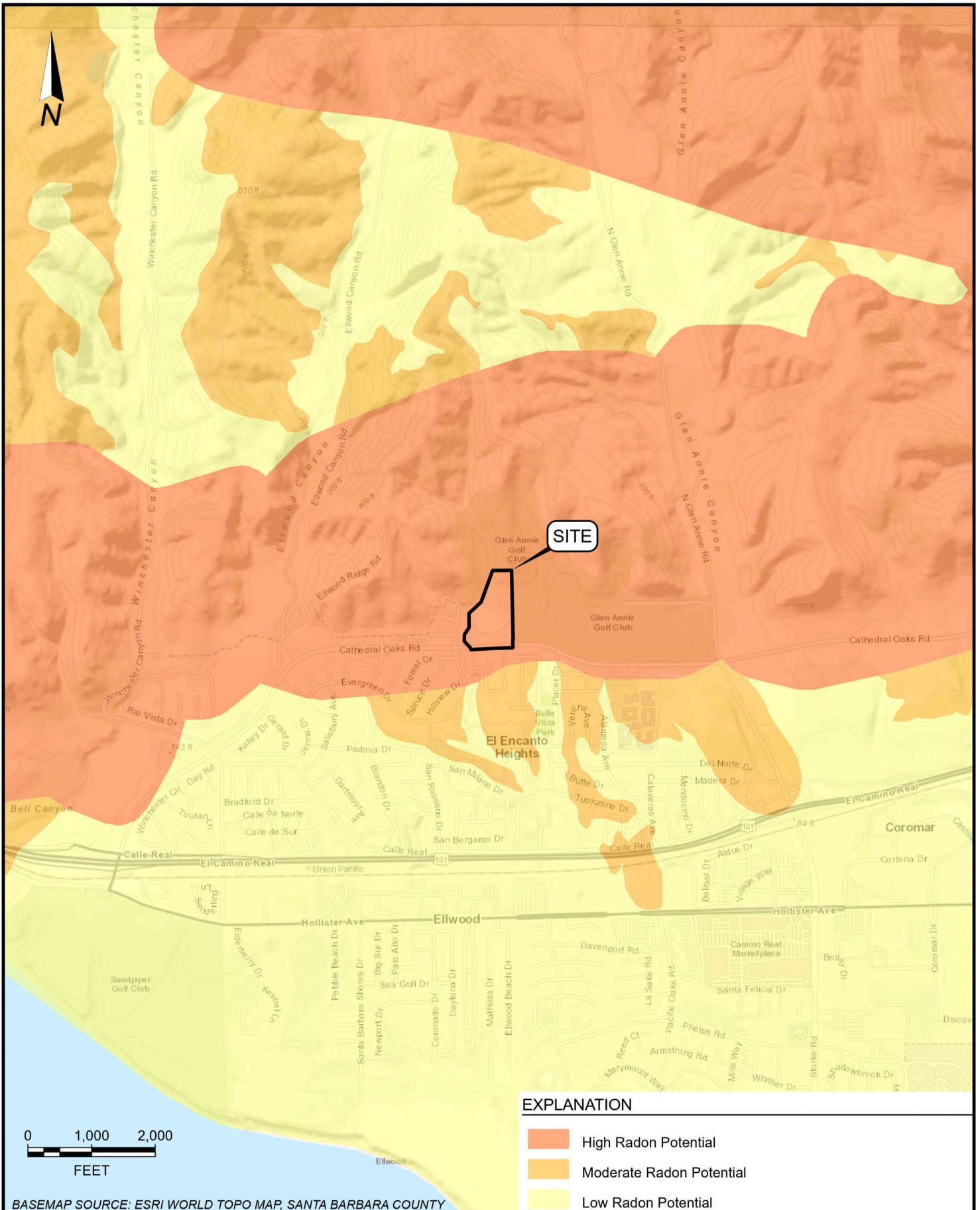
DRAWN BY: MMH

CHECKED BY: JJT

FIGURE NO.

7



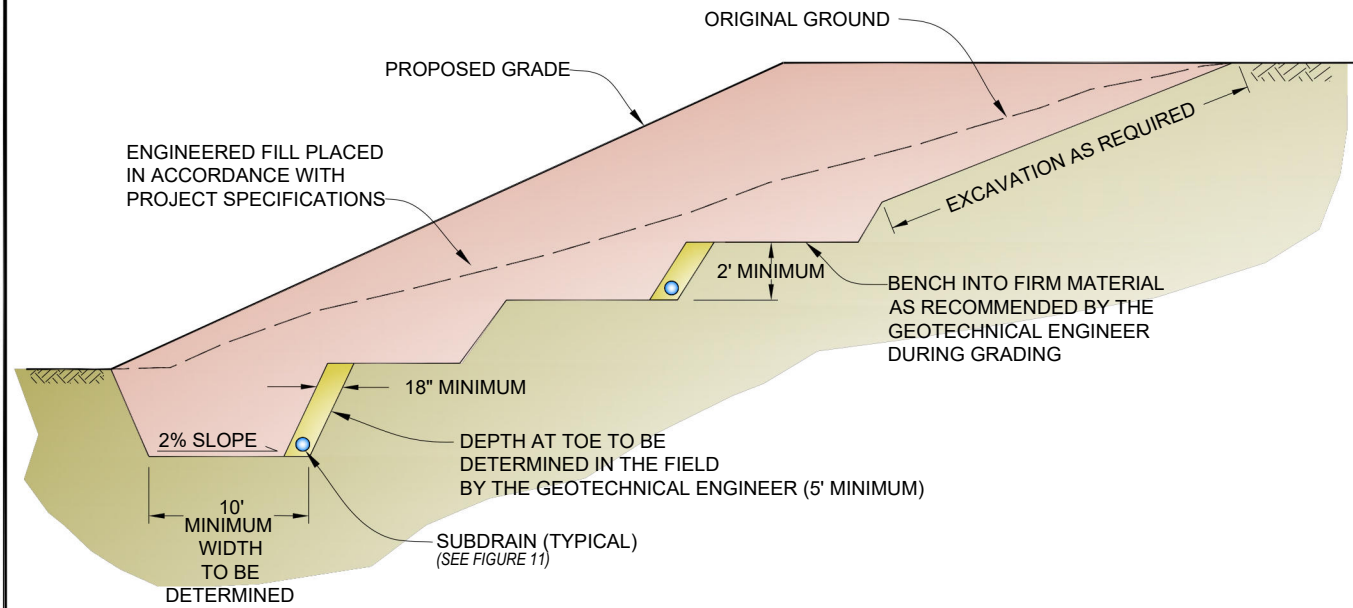


INDOOR RADON POTENTIAL
7400 CATHEDRAL OAKS ROAD
GOLETA, CALIFORNIA

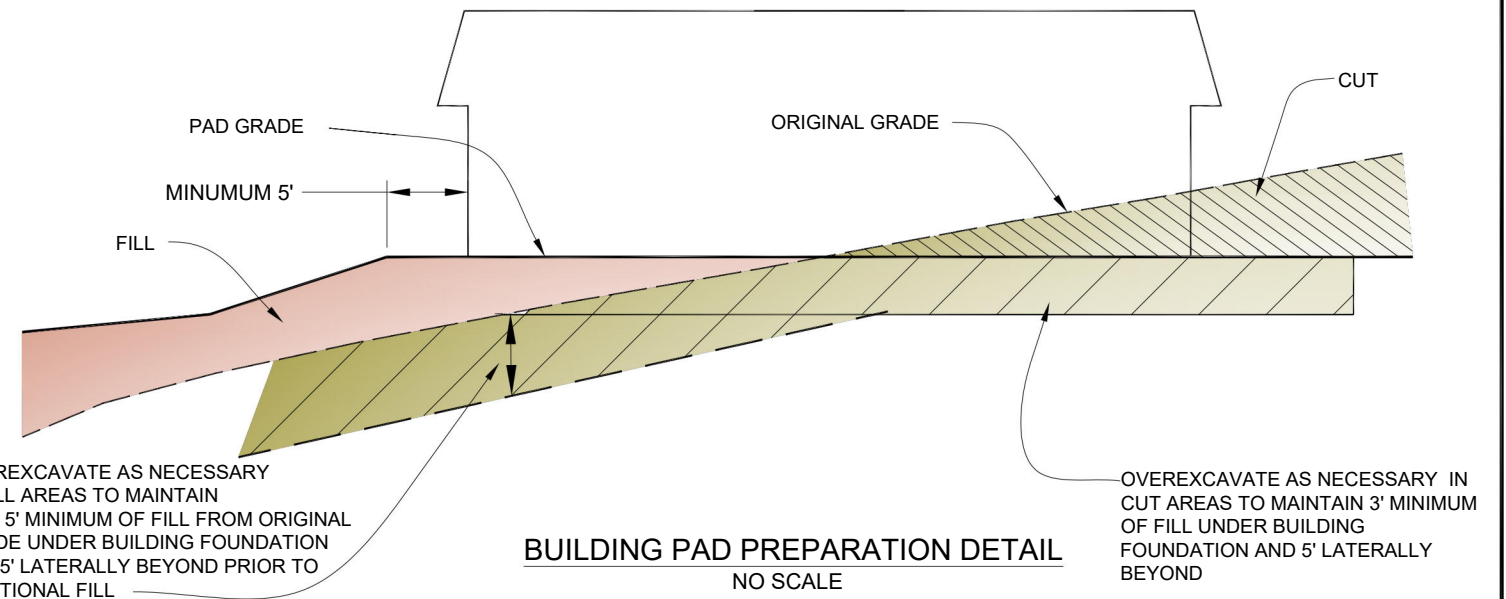
PROJECT NO.: 8724.001.000
SCALE: AS SHOWN
DRAWN BY: MMH CHECKED BY: JJT

FIGURE NO.
9

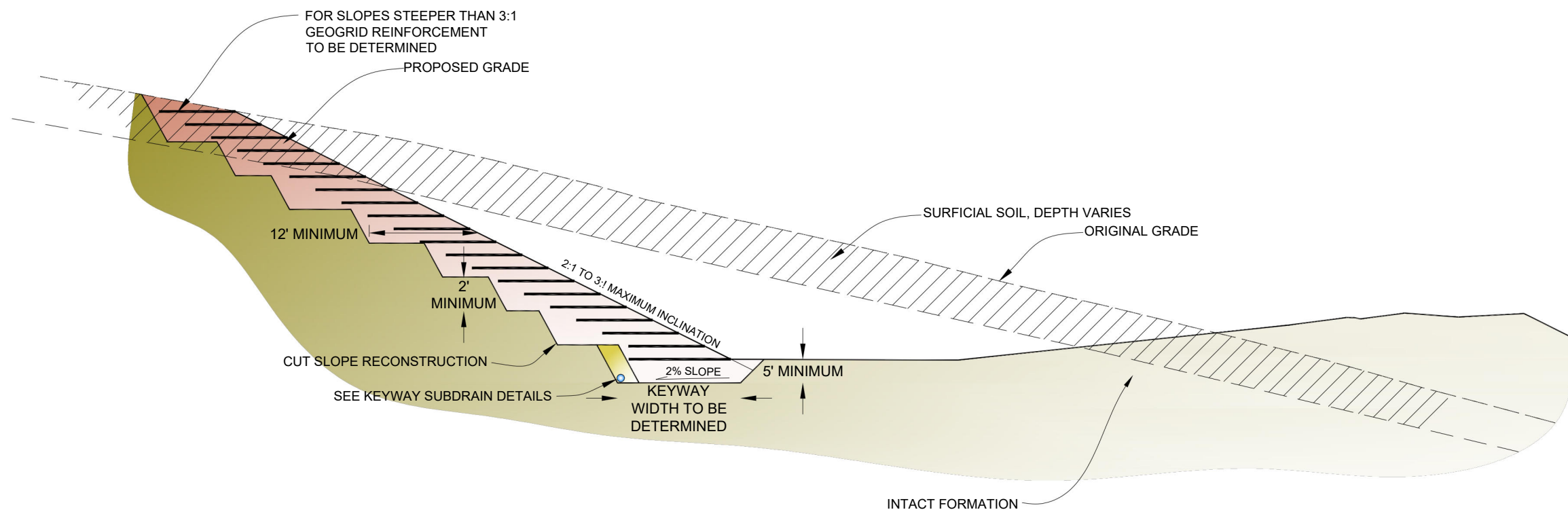
COPYRIGHT © 2025 BY ENGEO INCORPORATED. THIS DOCUMENT MAY NOT BE REPRODUCED IN WHOLE OR IN PART BY ANY MEANS WHATSOEVER, NOR MAY IT BE QUOTED OR EXCERPTED WITHOUT THE EXPRESS WRITTEN CONSENT OF ENGEO INCORPORATED.



TYPICAL KEYWAY DETAIL
NO SCALE



BUILDING PAD PREPARATION DETAIL
NO SCALE



CUT SLOPE REBUILD DETAIL
NO SCALE



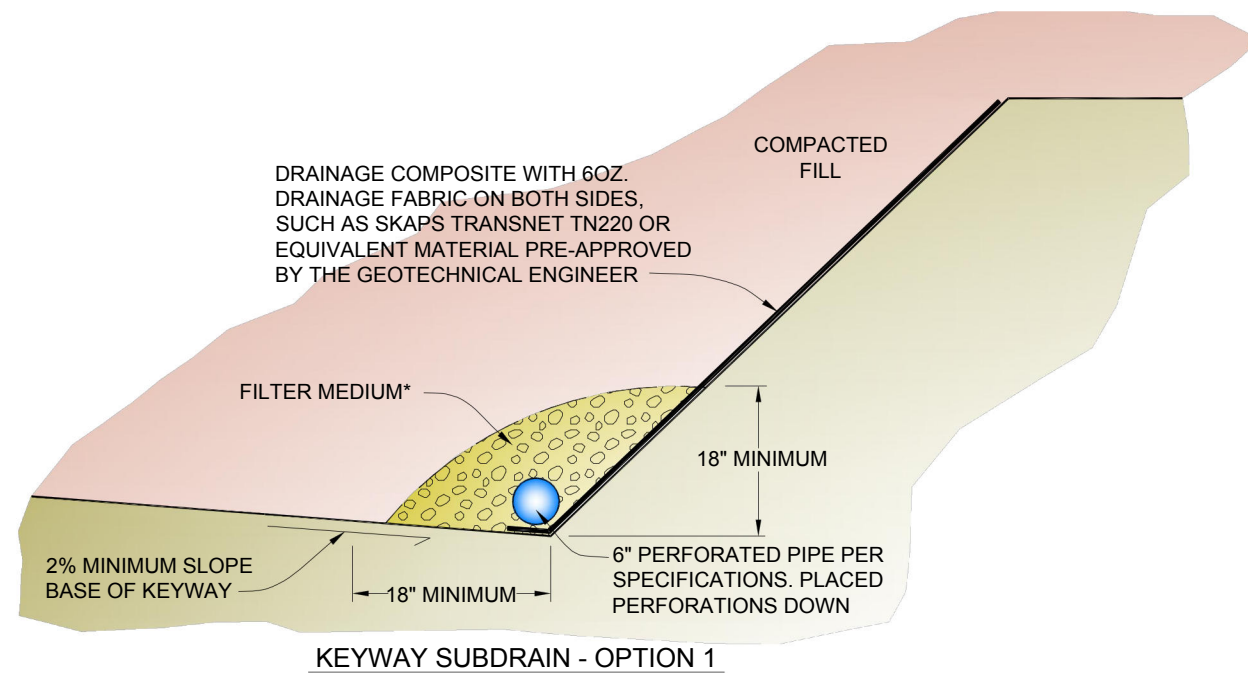
CORRECTIVE GRADING DETAILS
7400 CATHEDRAL OAKS ROAD
GOLETA, CALIFORNIA

PROJECT NO.: 8724.001.000
SCALE: AS SHOWN
DRAWN BY: NWC CHECKED BY: RH

FIGURE NO.
10

ORIGINAL FIGURE PRINTED IN COLOR

COPYRIGHT © 2025 BY ENGEO INCORPORATED. THIS DOCUMENT MAY NOT BE REPRODUCED IN WHOLE OR IN PART BY ANY MEANS WHATSOEVER, NOR MAY IT BE QUOTED OR EXCERPTED WITHOUT THE EXPRESS WRITTEN CONSENT OF ENGEO INCORPORATED.



*FILTER MEDIUM

ALTERNATIVE A

CLASS 2 PERMEABLE MATERIAL

MATERIAL SHALL CONSIST OF CLEAN, COARSE SAND AND GRAVEL OR CRUSHED STONE, CONFORMING TO THE FOLLOWING GRADING REQUIREMENTS:

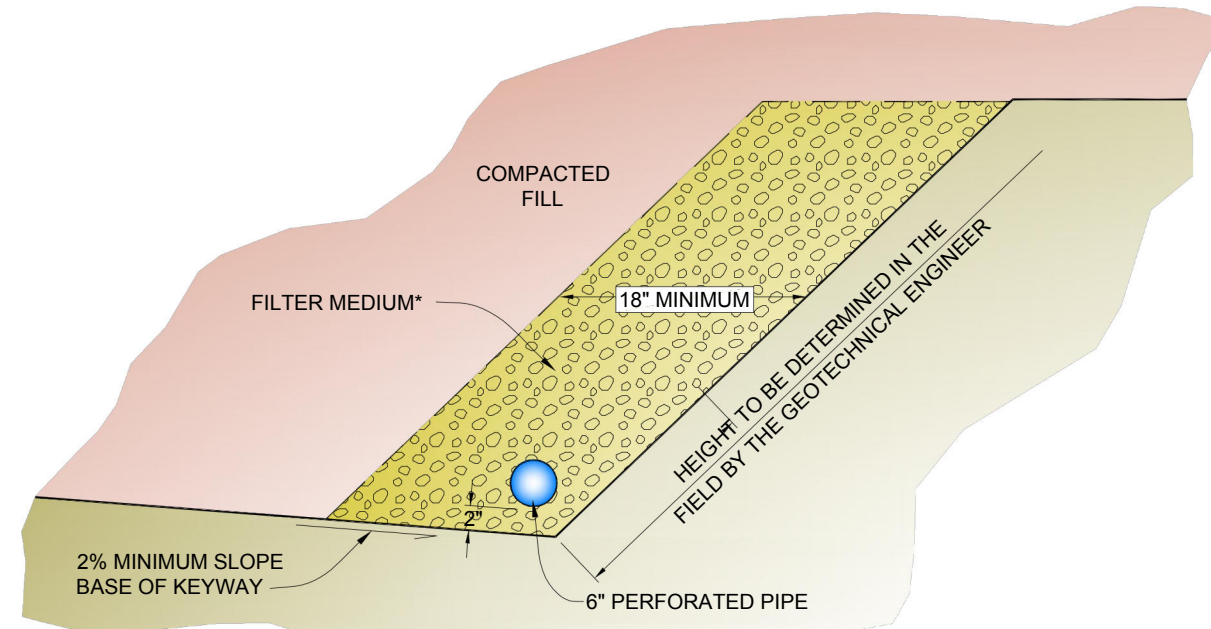
SIEVE SIZE	% PASSING SIEVE
1"	100
3/4"	90-100
3/8"	40-100
#4	25-40
#8	18-33
#30	5-15
#50	0-7
#200	0-3

ALTERNATIVE B

CLEAN CRUSHED ROCK OR GRAVEL WRAPPED IN FILTER FABRIC

ALL FILTER FABRIC SHALL MEET THE FOLLOWING MINIMUM AVERAGE ROLL VALUES UNLESS OTHERWISE SPECIFIED BY ENGEO:

GRAB STRENGTH (ASTM D-4632)	180 lbs
MASS PER UNIT AREA (ASTM D-4751)	6 oz/yd ²
APPARENT OPENING SIZE (ASTM D-4751)	70-100 U.S. STD. SIEVE
FLOW RATE (ASTM D-4491)	80 gal/min/ft
PUNCTURE STRENGTH (ASTM D-4833)	80 lbs



KEYWAY SUBDRAIN - OPTION 2

NOTES:

1. ALL PIPE JOINTS SHALL BE GLUED
2. ALL PERFORATED PIPE PLACED PERFORATIONS DOWN
3. 1% FALL (MINIMUM) ON ALL TRENCHES AND DRAIN LINES
4. PERFORATED PIPE REQUIREMENTS:

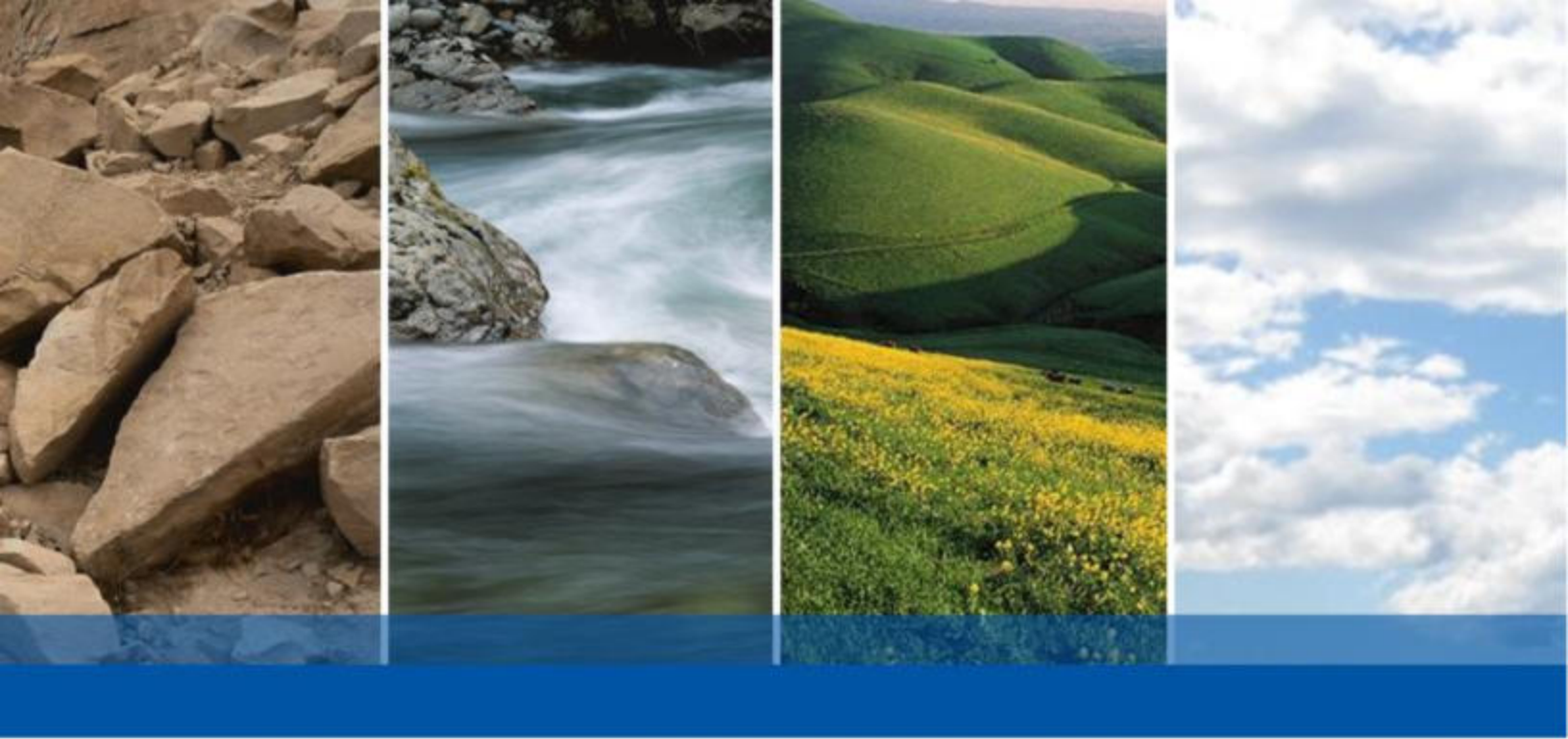
PIPE TYPE	STANDARD	TYPICAL SIZE (INCHES)	PIPE STIFFNESS (PSI)
BETWEEN 15 AND 50 FEET OF FINISHED GRADE			
PVC SDR 23.5	ASTM D3034	6	153
PVC SCHEDULE 40	ASTM D1785	6	135
BETWEEN 0 TO 15 FEET OF FINISHED GRADE			
PVC SDR 35	ASTM D3034	6	46



TYPICAL SUBDRAIN DETAILS
7400 CATHEDRAL OAKS ROAD
GOLETA, CALIFORNIA

PROJECT NO.: 8724.001.000
SCALE: AS SHOWN
DRAWN BY: NWC CHECKED BY: RH

FIGURE NO.
11



APPENDIX A

BORING AND TEST PIT LOGS (2009)

KEY TO BORING LOGS

MAJOR TYPES			DESCRIPTION
COARSE-GRAINED SOILS MORE THAN HALF OF MAT'L LARGER THAN #200 SIEVE	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE	CLEAN GRAVELS WITH LESS THAN 5% FINES	GW - Well graded gravels or gravel-sand mixtures GP - Poorly graded gravels or gravel-sand mixtures
		GRAVELS WITH OVER 12 % FINES	GM - Silty gravels, gravel-sand and silt mixtures GC - Clayey gravels, gravel-sand and clay mixtures
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDS WITH LESS THAN 5% FINES	SW - Well graded sands, or gravelly sand mixtures SP - Poorly graded sands or gravelly sand mixtures
		SANDS WITH OVER 12 % FINES	SM - Silty sand, sand-silt mixtures SC - Clayey sand, sand-clay mixtures
FINE-GRAINED SOILS MORE THAN HALF OF MAT'L SMALLER THAN #200 SIEVE	SILTS AND CLAYS LIQUID LIMIT 50 % OR LESS		ML - Inorganic silt with low to medium plasticity CL - Inorganic clay with low to medium plasticity OL - Low plasticity organic silts and clays
			MH - Elastic silt with high plasticity CH - Fat clay with high plasticity OH - Highly plastic organic silts and clays
			PT - Peat and other highly organic soils
	HIGHLY ORGANIC SOILS		

For fine-grained soils with 15 to 29% retained on the #200 sieve, the words "with sand" or "with gravel" (whichever is predominant) are added to the group name.

For fine-grained soil with >30% retained on the #200 sieve, the words "sandy" or "gravelly" (whichever is predominant) are added to the group name.

GRAIN SIZES

U.S. STANDARD SERIES SIEVE SIZE				CLEAR SQUARE SIEVE OPENINGS			
200	40	10	4	3/4 "	3"	12"	
SILTS AND CLAYS	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

RELATIVE DENSITY

SANDS AND GRAVELS

VERY LOOSE
LOOSE
MEDIUM DENSE
DENSE
VERY DENSE

BLOWS/FOOT (S.P.T.)

0-4
4-10
10-30
30-50
OVER 50

CONSISTENCY

SILTS AND CLAYS

VERY SOFT
SOFT
MEDIUM STIFF
STIFF
VERY STIFF
HARD

STRENGTH*

0-1/4
1/4-1/2
1/2-1
1-2
2-4
OVER 4

MOISTURE CONDITION

DRY
MOIST
WET

Dusty, dry to touch
Damp but no visible water
Visible freewater

LINE TYPES

————— Solid - Layer Break
----- Dashed - Gradational or approximate layer break

GROUND-WATER SYMBOLS



Groundwater level during drilling



Stabilized groundwater level

SAMPLER SYMBOLS



Modified California (3" O.D.) sampler



California (2.5" O.D.) sampler



S.P.T. - Split spoon sampler



Shelby Tube



Continuous Core



Bag Samples



Grab Samples

NR No Recovery

(S.P.T.) Number of blows of 140 lb. hammer falling 30" to drive a 2-inch O.D. (1-3/8 inch I.D.) sampler

* Unconfined compressive strength in tons/sq. ft., asterisk on log means determined by pocket penetrometer

ENGEO
INCORPORATED

LOG OF BORING 1-B1

Geotechnical Exploration
7400 Cathedral Oaks Road
Goleta, California
08724.000.000

DATE DRILLED: 6/4/2009
HOLE DEPTH: Approx. 51 ft.
HOLE DIAMETER: 6.0 in.
SURF ELEV (MSL): Approx. 175 ft.

LOGGED / REVIEWED BY: P. Lam / PJS
DRILLING CONTRACTOR: Martini Drilling
DRILLING METHOD: Hollow Stem Auger
HAMMER TYPE: 140 lb. Auto Trip

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits			Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
							Liquid Limit	Plastic Limit	Plasticity Index				
			Bare soil, woodchips, and dessication cracks at surface										
1			SILTY CLAY (CL), very dark brown / dusky yellowish brown (10YR 2/2), medium stiff, moist, trace rootlets, (Qoa)			24					12.4		>4.5*
5			Stiff, moist			14							>4.5*
2													
10			Reddish brown (5YR 4/3), stiff, moist, trace sand, trace charcoal, trace deeply weathered rock fragments (Qoa)			27					14.4	117.7	4.5*
4													
15			SANDY CLAY (CL), yellowish brown (10YR 5/8), very stiff, moist, fine- to medium-grained sand, with rock fragments, trace charcoal (Qoa)			24							>4.5*
5													
			Increased drilling resistance										
20			SILTY CLAY (CL), dark yellowish brown (10YR 4/6), stiff, moist, trace manganese staining on partings (Qoa)			24							
7													
25			Reddish brown / moderate brown (5YR 4/4), very stiff, moist, trace rock fragments, trace caliche, trace manganese staining on partings, slight increase in relative moisture (Qoa)			45							4.0*
8													



LOG OF BORING 1-B1

Geotechnical Exploration
7400 Cathedral Oaks Road
Goleta, California
08724.000.000

DATE DRILLED: 6/4/2009
HOLE DEPTH: Approx. 51 ft.
HOLE DIAMETER: 6.0 in.
SURF ELEV (MSL): Approx. 175 ft.

LOGGED / REVIEWED BY: P. Lam / PJS
DRILLING CONTRACTOR: Martini Drilling
DRILLING METHOD: Hollow Stem Auger
HAMMER TYPE: 140 lb. Auto Trip

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits			Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
							Liquid Limit	Plastic Limit	Plasticity Index				
30	9		Dark yellowish brown (10YR 3/6), stiff, moist, trace fine-grained sand, trace rock fragments, trace charcoal up to 1/2-inch diameter, silty sand at shoe (Qoa)			26							3.5*
35	10												
35	11		Very stiff, moist, trace fine-grained sand, trace charcoal, with carbonate filaments (Qoa)			41							3.5*
40	12		Very stiff, moist, trace sand, trace charcoal, trace carbonate filaments, carbonate-filled void at shoe (Qoa)			43							4.5*
45	13												
45	14		Dark yellowish brown (10YR 4/6), stiff, moist, trace sand, trace manganese staining, trace carbonate filaments (Qoa)			24							3.5*
50	15		Stiff, moist, trace sand, trace carbonate filaments (Qoa)			21					23.3	101.1	3.5*
			Bottom of boring at approximately 51 feet below ground surface. Groundwater not encountered.										

LOG OF BORING 1-B2

Geotechnical Exploration
7400 Cathedral Oaks Road
Goleta, California
08724.000.000

DATE DRILLED: 6/4/2009
HOLE DEPTH: Approx. 22½ ft.
HOLE DIAMETER: 6.0 in.
SURF ELEV (MSL): Approx. 180 ft.

LOGGED / REVIEWED BY: P. Lam / PJS
DRILLING CONTRACTOR: Martini Drilling
DRILLING METHOD: Hollow Stem Auger
HAMMER TYPE: 140 lb. Auto Trip

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits			Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
							Liquid Limit	Plastic Limit	Plasticity Index				
			Bare soil, woodchips, and dessication cracks at surface										
1			SILTY CLAY (CL), very dark brown / dusky yellowish brown (10YR 2/2), medium stiff, moist, trace sand, trace gravel, trace rootlets, (A)			17					13.6		>4.5*
5			Medium stiff, moist, trace sand, slight increase in moisture from previous (A)			16							3-3.5*
2													
10			Dark yellowish brown (10YR 3/6), stiff, moist, trace sand, slight increase in sand at shoe (Qoa)			21							4.5*
4													
15			Brown (10YR 4/3), very stiff, moist, trace sand, trace manganese staining on partings (Qoa)			39					18	111.9	>4.5*
5													
20			CLAYEY SILT (ML), dark yellowish brown (10YR 3/6), medium stiff, moist, with fine-grained sand, trace charcoal (Qoa)			16							4*
			SILTY CLAY (CL), dark yellowish brown (10YR 4/6), stiff to very stiff, moist, trace sand, (Qoa)			15					20.3		
			Bottom of boring at 22.5 feet below ground surface. No groundwater encountered.										

LOG OF BORING 1-B3

Geotechnical Exploration
7400 Cathedral Oaks Road
Goleta, California
08724.000.000

DATE DRILLED: 6/4/2009
HOLE DEPTH: Approx. 21 ft.
HOLE DIAMETER: 6.0 in.
SURF ELEV (MSL): Approx. 180 ft.

LOGGED / REVIEWED BY: P. Lam / PJS
DRILLING CONTRACTOR: Martini Drilling
DRILLING METHOD: Hollow Stem Auger
HAMMER TYPE: 140 lb. Auto Trip

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits			Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
							Liquid Limit	Plastic Limit	Plasticity Index				
			Bare soil, woodchips, and dessication cracks at surface										
1			SILTY CLAY (CL), dark brown (10YR 3/3), medium stiff, moist, trace sand, (Qaf)			17					17.8		2-2.5*
5			SILTY CLAY / CLAYEY SILT (CL-ML), yellowish red (5YR 4/6), medium stiff, moist, fine- to medium-grained sand, trace rock fragments, (Qaf)			11							
2													
10			SILTY CLAY (CL), yellowish brown / moderate yellowish (10YR 5/4), medium stiff to stiff, moist, with angular rock fragments, rock fragments predominantly 1/4-inch diameter and up to 1-inch diameter, trace iron oxide staining (Qaf/Qoa)			18					19.3	102.7	3*
4						16							
15			SILTY CLAY (CL), dark yellowish brown (10YR 4/6), medium stiff to stiff, moist, some fine-grained sand, trace charcoal (Qoa)			18							3*
5													
20			Mottled with very dark brown / dusky yellowish brown (10YR 2/2), medium stiff, moist, trace sand, trace charcoal (Qoa)			16					22.2	102	3.5-4*
			Bottom of boring at 22.5 feet below ground surface. No groundwater encountered.										

LOG OF BORING 1-B4

Geotechnical Exploration
7400 Cathedral Oaks Road
Goleta, California
08724.000.000

DATE DRILLED: 6/4/2009
HOLE DEPTH: Approx. 21 ft.
HOLE DIAMETER: 6.0 in.
SURF ELEV (MSL): Approx. 195 ft.

LOGGED / REVIEWED BY: P. Lam / PJS
DRILLING CONTRACTOR: Martini Drilling
DRILLING METHOD: Hollow Stem Auger
HAMMER TYPE: 140 lb. Auto Trip

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits			Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
							Liquid Limit	Plastic Limit	Plasticity Index				
			Bare soil and dessication cracks at surface.										
1			SILTY CLAY (CH), black (10YR 2/1), stiff, moist, trace sand, (A)			9	74	21	53	99			2.5*
5			Brownish yellow / dark yellowish orange (10YR 6/6), stiff, moist, trace rock fragments, trace carbonate filaments, rock fragments consist of Rincon Formation (A)			22							3.5*
2			Color change in cuttings.										
10			SHALE, weak (R2), very closely fractured, very thin bedding, completely weathered (WC) to highly weathered (WH), yellowish brown (10YR 5/8) and grayish brown (10YR 5/2), crystalline gypsum veinlet in sample (Tr)			33					27.7	96.3	>4.5* 3.8
4													
15			Massive, with gypsum (Tr)			21							>4.5*
5													
20			Very closely fractured to crushed, with gypsum (Tr)			18					30.5	101.6	>4.5*
			Bottom of boring at 22.5 feet below ground surface. No groundwater encountered.										



TEST PIT LOGS

7400 Cathedral Oaks Rd.
Goleta, CA
8724.000.000

Logged By: P. Lam
Logged Date: June 4, 2009

Test Pit Number	Depth (Feet)	Description
1-TP-1	0-5	Silty CLAY (CL), very dark brown, moist, trace gravel, trace sand, with organics, gradational contact with below (A).
	5-7	Silty CLAY (CL), light yellowish brown mottled with caliche, moist, trace gravel, illuviated soil fills partings down to 7 feet (Qoa). Bottom at approximately 7 feet. No groundwater encountered.
1-TP-2	0-5	Silty CLAY (CL), very dark brown, moist, trace gravel, trace sand, trace pale yellow sandstone pebbles, gradational contact with below, shrink-swell shears at 3 feet (A).
	5-7	Silty CLAY (CL), light yellowish brown, moist, trace carbonate veinlets, illuviated soil fills partings up to ½-inch wide (Qoa).
	7-10	SHALE, grayish brown, moist, friable to weak, very closely to closely fractured, laminated to very thin bedding, highly weathered, anastomosing weathering rinds (Rincon, Tr). Bedding 80, 35S. Bottom at approximately 10 feet. No groundwater encountered.
1-TP-3	0-3	Silty CLAY (CL), dark yellowish brown, moist, trace wood, sharp contact with below (Fill).
	3-8	Silty CLAY (CL), very dark brown, moist, gradational contact with below (A).
	8-9	Silty CLAY (CL), dark yellowish brown, logged from above (Qoa). Bottom at approximately 9 feet. No groundwater encountered.



TEST PIT LOGS

7400 Cathedral Oaks Rd.
Goleta, CA
8724.000.000

Logged By: P. Lam
Logged Date: June 4, 2009

Test Pit Number	Depth (Feet)	Description
1-TP-4	0-3	Silty CLAY (CL), dark yellowish brown mottled with very dark brown, moist, trace wood, sharp contact with below, contact increases in depth to approximately 5 feet at south end of excavation (Fill)
	3-7	Silty CLAY (CL), very dark brown, moist (A). Bottom at approximately 7 feet. No groundwater encountered.
1-TP-5	0-2	Sand (SP), dark yellowish brown, excavation terminated due to potential proximity to gas line, excavation is approximately 15 feet from gas line markings (Fill). Bottom at approximately 2 feet. No groundwater encountered.



APPENDIX B

LABORATORY TEST DATA (2009)

**EXPANSION INDEX TEST REPORT
ASTM D 4829**PROJECT NAME: **Cathedral Oaks Goleta**

REPORT DATE: 6/16/09

CLIENT:

PROJECT NO.: 8724.000.000

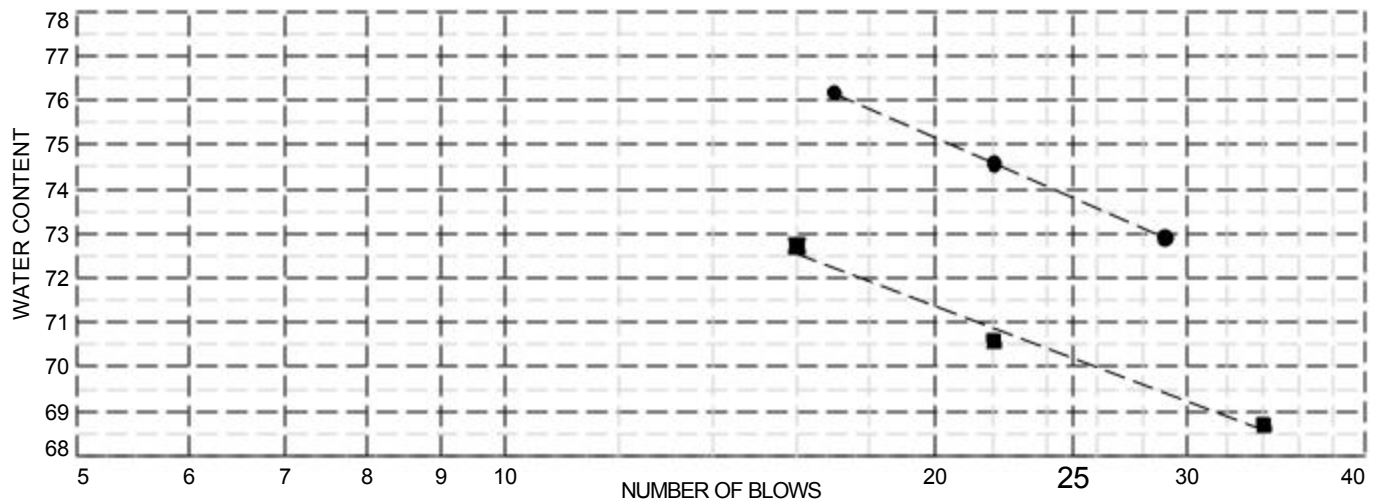
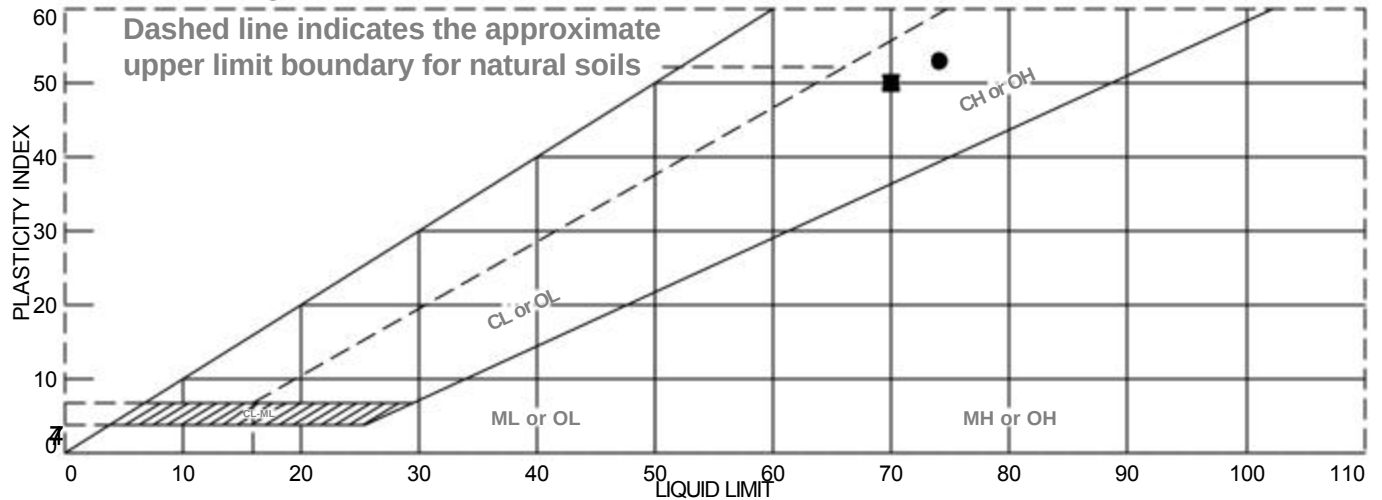
TESTED BY: SN

Sample ID	Soil Description	Initial Dry Density (pcf)	Initial Moisture Content (%)	Final Moisture Content (%)	Expansion Index
TP-3 @ 3.0 ft	Dark Gray Clay	97.9 pcf	11.90%	25.40%	90

CLASSIFICATION OF EXPANSIVE SOIL

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

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Very dark gray CLAY	74	21	53		99.1	CH
■	Olive brown CLAYSTONE	70	20	50		98.7	CH

Project No. 8724.000.000 Client:
Project: 7400 Cathedral Oaks Road. Goleta, CA

● Sample Number: B4 @ 2.5
■ Sample Number: TP2 @ 10

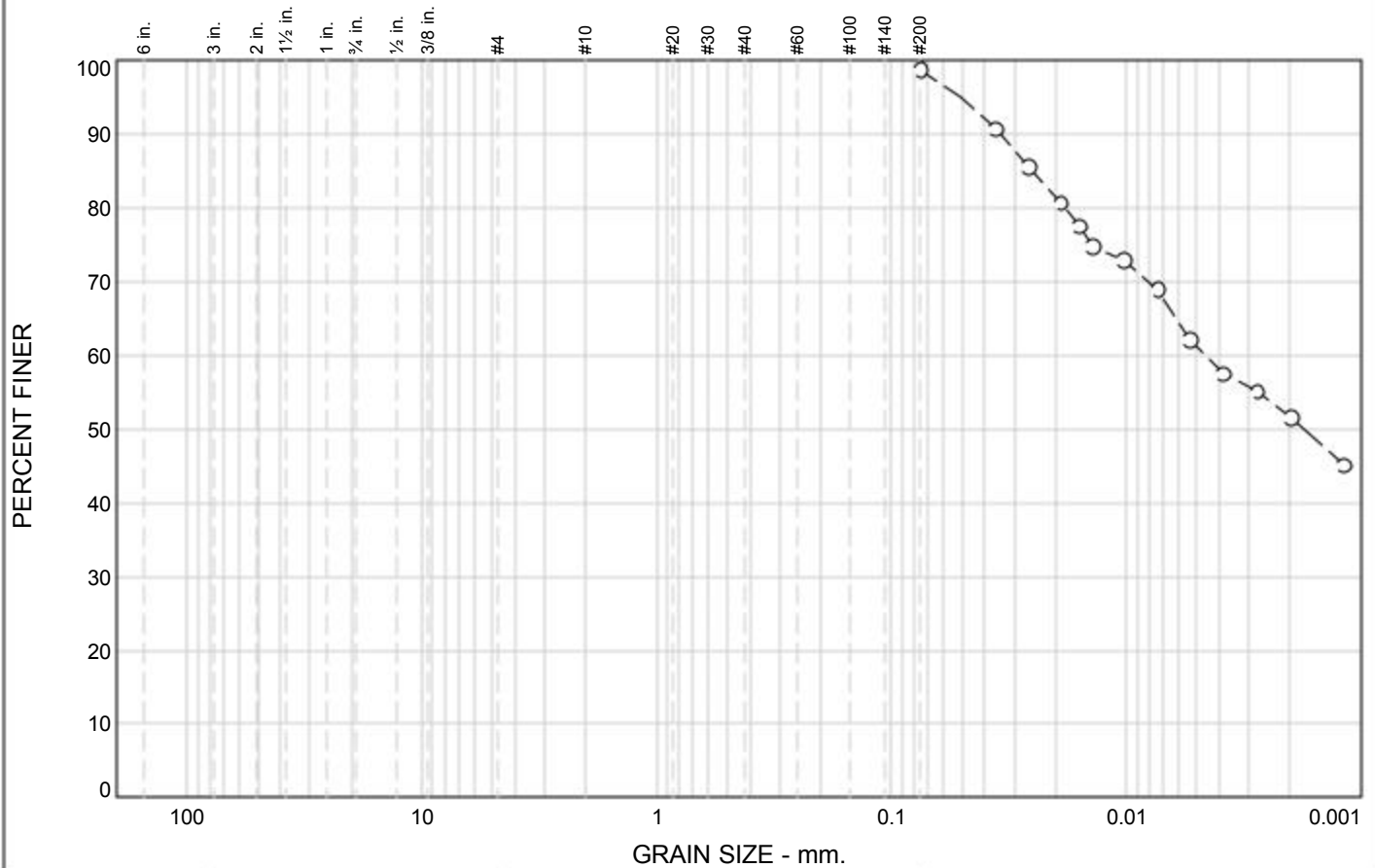
ENGEO INCORPORATED
GEOTECHNICAL AND
ENVIRONMENTAL CONSULTANTS
MATERIALS TESTING

Remarks:

Plate

Tested By: GC Checked By: RC

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						47.1	51.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	98.7		
0.0359 mm.	90.6		
0.0262 mm.	85.4		
0.0190 mm.	80.6		
0.0157 mm.	77.5		
0.0138 mm.	74.8		
0.0102 mm.	72.8		
0.0073 mm.	69.0		
0.0054 mm.	62.0		
0.0039 mm.	57.4		
0.0028 mm.	55.1		
0.0020 mm.	51.4		
0.0012 mm.	45.1		

* (no specification provided)

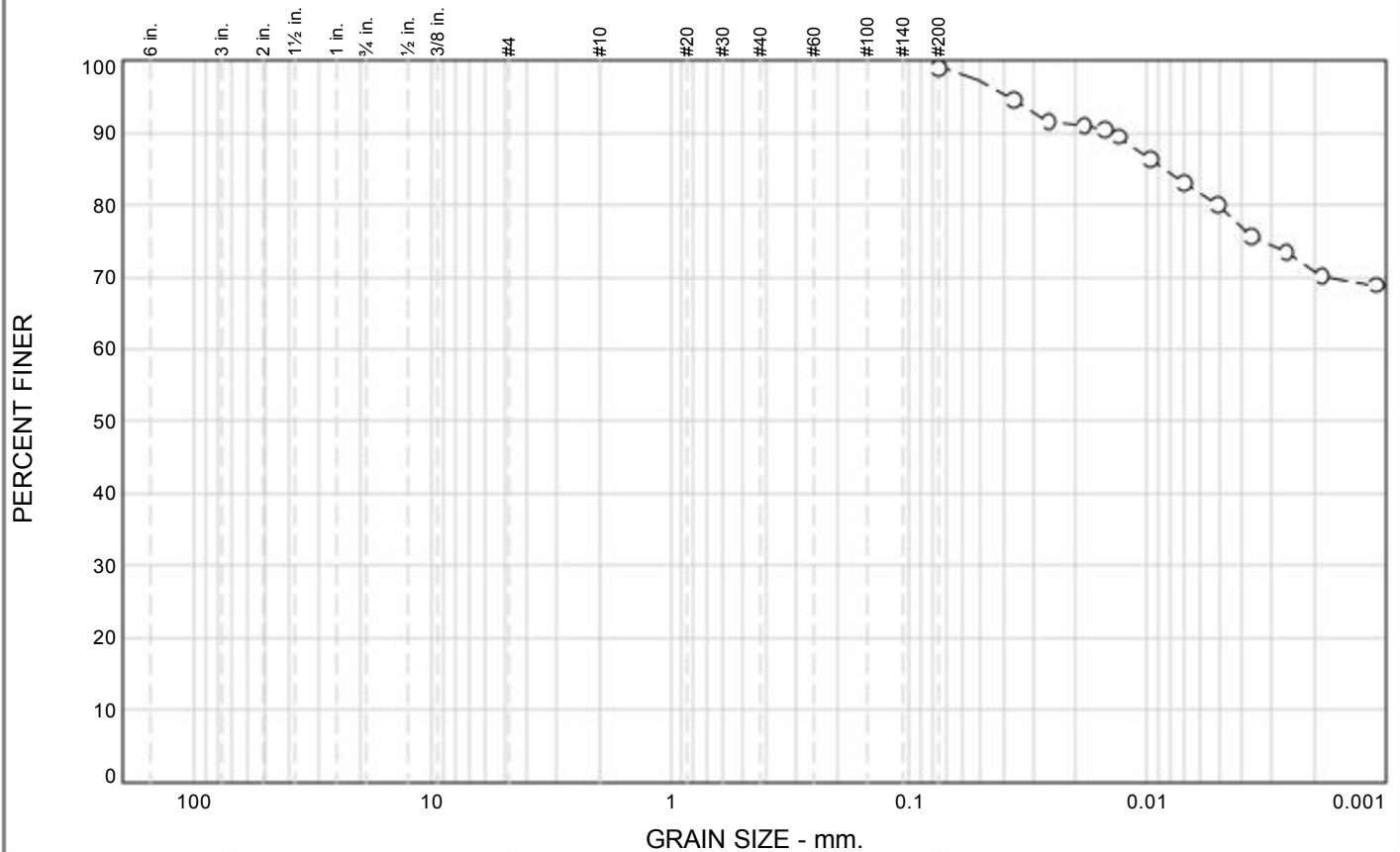
<u>Soil Description</u>		
Olive brown CLAY		
<u>Atterberg Limits</u>		
PL= 20	LL= 70	PI= 50
<u>Coefficients</u>		
D ₈₅ = 0.0255	D ₆₀ = 0.0048	D ₅₀ = 0.0018
D ₃₀ =	D ₁₅ =	D ₁₀ =
C _u =	C _c =	
<u>Classification</u>		
USCS= CH	AASHTO=	
<u>Remarks</u>		

Sample No.: TP2 @ 10
Location:

Source of Sample:

Date: 6-12-09
Elev./Depth:

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						28.4	70.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	99.1		
0.0362 mm.	94.6		
0.0260 mm.	91.5		
0.0185 mm.	90.9		
0.0151 mm.	90.5		
0.0132 mm.	89.5		
0.0098 mm.	86.4		
0.0070 mm.	83.1		
0.0050 mm.	80.0		
0.0037 mm.	75.6		
0.0026 mm.	73.4		
0.0019 mm.	70.1		
0.0011 mm.	68.9		

* (no specification provided)

Soil Description

Very dark gray CLAY

Atterberg Limits

PL= 21 LL= 74 PI= 53

Coefficients

D₈₅= 0.0086 D₆₀= D₅₀=
D₃₀= D₁₅=
C_u= C_c= D₁₀=

Classification

USCS= CH AASHTO=

Remarks

Sample No.: B4 @ 2.5
Location:

Source of Sample:

Date: 6-12-09
Elev./Depth:

ENGEO
INCORPORATED

GEOTECHNICAL AND
ENVIRONMENTAL CONSULTANTS
MATERIALS TESTING

Client:

Project: 7400 Cathedral Oaks Road. Goleta, CA

Project No: 8724.000.000

Plate

Tested By: RC

Checked By: GC

ENGEO Incorporated

SULFATE TEST RESULTS

CALTRANS Test Method 417

Project Name: 7400 Cathedral Oaks Road

Project Number: 8724.000.000

Tested By: GC

Date: June 12, 2009

Measurements less than 15 mg/kg are reported as Not Detectable (ND)

Sample Number	Sample Location	Matrix	Water Soluble Sulfate (SO ₄) in Soil	
			mg/kg	% by Weight
1	B2 @ 3.5	soil	3235	0.324

