PJC & Associates, Inc.
Consulting Engineers & Geologists

August 23, 2011 Job No. 5066.01

Gary Raugh
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7822 Silverado Trail
Napa, CA 94558

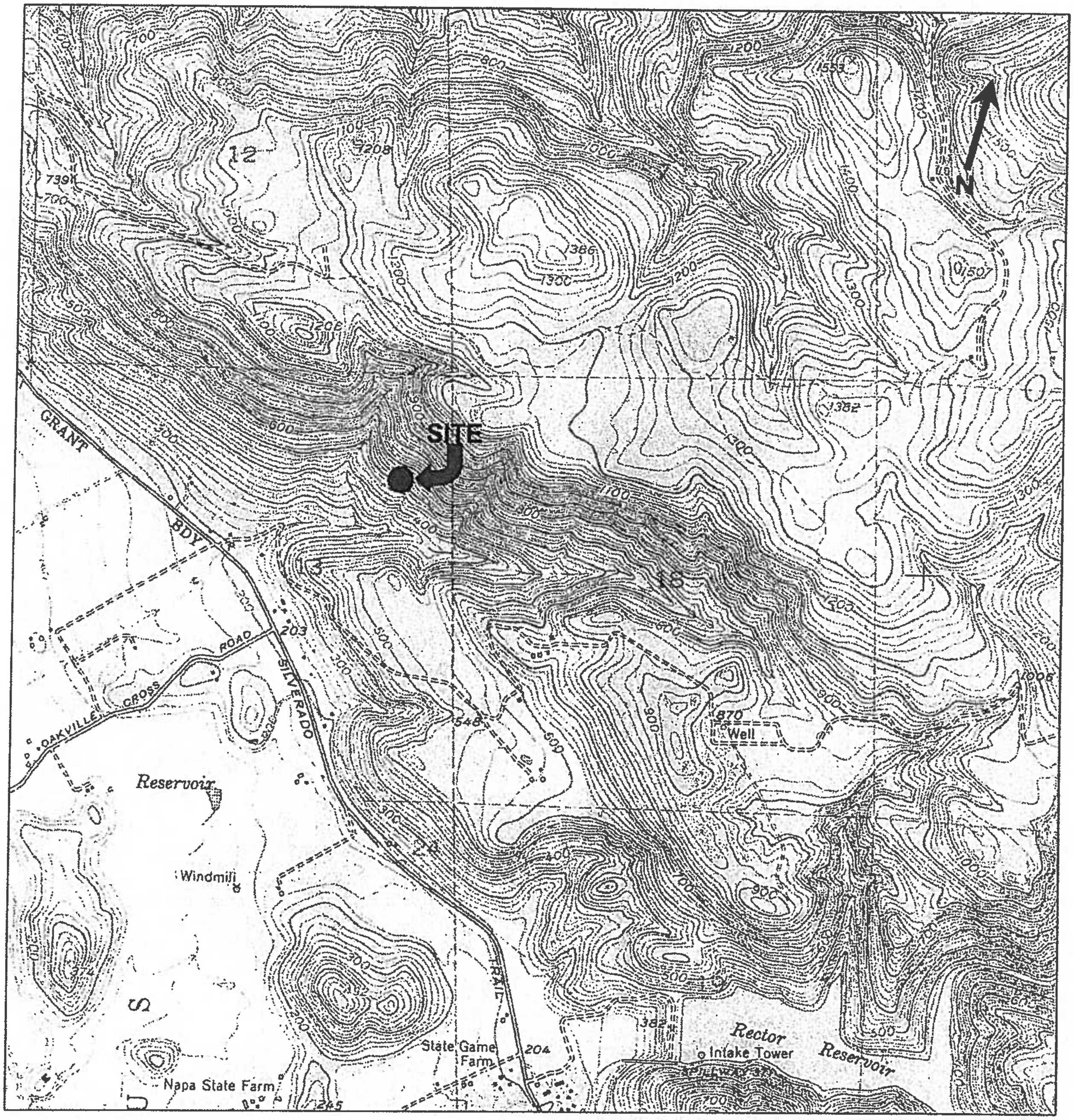
Subject: Design Level Geotechnical Investigation
Proposed Residence, Swimming Pool and Driveway
7830 Silverado Trail
Oakville, California

Dear Gary:

PJC and Associates, Inc. (PJC) is pleased to submit the results of our design level geotechnical investigation for the proposed residence, swimming pool and driveway located at 7830 Silverado Trail in Oakville, California. The approximate location of the project site is shown on the Site Location Map, Plate 1. The proposed residence site corresponds to the latitude and longitudinal coordinates of 38.4617° north and 122.3579° west, according to field GPS measurements recorded in the field. Our services were completed in accordance with our proposal for geotechnical engineering services, dated June 30, 2011. This report presents our engineering opinions and recommendations regarding the geotechnical aspects of the design and construction of the proposed project. Based on the results of this study, it is our opinion that the project site can be developed from a geotechnical engineering standpoint provided the recommendations presented herein are incorporated in the design and carried out through construction.

1. PROJECT DESCRIPTION

Project architectural plans were not available at the time of this report. Based on information provided by Mr. Andrew Simpson of Delta Consulting & Engineering (Delta), and our review of a preliminary grading plan, prepared by Delta, dated July 5, 2011, it is our understanding that the project will consist of constructing a 124 foot x 216 foot building pad on moderately to steeply sloping undeveloped terrain. According to preliminary earthwork and grading estimates, we anticipate that the project will include approximately 3,325 cubic yards of cut and 3,324 cubic yards of fill to construct the building pad.



SCALE: 1:24,000

REFERENCE: USGS YOUNTVILLE, CALIFORNIA. QUADRANGLE, INSPECTED 1978

PJC & Associates, Inc. *Consulting Engineers & Geologists*	SITE LOCATION MAP PROPOSED RESIDENCE, POOL AND DRIVEWAY 7830 SILVERADO TRAIL OAKVILLE, CALIFORNIA	PLATE 1
	Proj. No: 5066.01 Date: 8/11 App'd by: PJC	

Upon completion of the building pad, we anticipate the construction a single family residence with an attached garage, and swimming pool at the site. We anticipate that the residence will consist of a one or two story, wood-frame structure with joist-supported, raised wood or concrete slab-on-grade interior floors. We anticipate that concrete slab-on-grade floors will be used in the garage. We anticipate the swimming pool will be constructed below ground and will consist of gunite construction with a concrete slab-on-grade pool terrace. We anticipate that the residence and pool will be serviced by underground municipal utilities and a private on-site septic sewer system.

Structural loading information was not available at the time of this investigation. For our analysis, we anticipate that structural foundation loads will be light with dead plus live continuous wall loads less than two kips per lineal foot (plf) and dead plus live isolated column loads less than 50 kips. If these assumed loads vary significantly from the actual loads, we should be consulted to review the actual loading conditions and, if necessary, revise the recommendations of this report.

The project will also include the construction of a private driveway, which will provide access to the building site. According to the preliminarily plans, we anticipate that the proposed driveway alignment will be approximately 727 lineal feet in length and will traverse across moderately to steeply sloping undeveloped terrain. We anticipate that the finished driveway surface will be paved with asphaltic concrete. We anticipate that construction of the driveway will include drainage provisions, including but not limited to rock-lined drainage swales, concrete drop inlets and AC berms to direct and control surface drainage and runoff.

According to the preliminary plans, we anticipate cuts of approximately 25 feet and less and fills of approximately 16 feet and less to achieve the desired pad elevations, and provide adequate gradients for site drainage. Preliminary earthwork and grading estimates for construction of the driveway were not available at the time of this report. Based on the topography of the proposed driveway alignment, we anticipate that grading and earthwork for construction of the driveway will consist of cuts of approximately five to 15 feet and less and fills of approximately five to 15 feet and less to achieve the desired driveway alignment elevations, and provide adequate gradients for site drainage. According to information provided by Mr. Simpson, we anticipate that engineered retaining walls will not be required for the project.

2. SCOPE OF SERVICES

The purpose of this study is to provide geotechnical criteria for the design and construction of the proposed project as described above. Specifically, the scope of our services included the following:

a. Drilling five exploratory boreholes to depths of one and one-half to three feet below the existing ground surface to observe the soil, bedrock and groundwater conditions along the driveway alignment and at the building site. Our professional geologist was on site to log the materials encountered in the boreholes and to obtain representative samples for visual classification and laboratory testing.

b. Laboratory observation and testing of representative samples obtained during the course of our field investigation to evaluate the engineering properties of the subsurface soils and bedrock along the driveway alignment and at the building at the site.

c. Review seismological and geologic literature on the site area, discuss site geology and seismicity, and evaluate potential geologic hazards and earthquake effects (i.e., liquefaction, ground rupture, settlement, lurching and lateral spreading, expansive soils, slope stability, etc.).

d. Perform engineering analyses to develop geotechnical recommendations for site preparation and earthwork, foundation type(s) and design criteria, lateral earth pressures, settlement, concrete slab-on-grade design, retaining wall design, swimming pool design, surface and subsurface drainage control and construction considerations.

e. Preparation of this report summarizing our work on this project

3. SITE CONDITIONS

a. General. The project site is situated approximately one-half mile northeast of the intersection of Silverado Trail and Oakville Cross Road. The property is comprised of 60.16 acres of land which is accessed via a private community driveway. The site is located on the lower flank of the mountains above the eastern margin of Napa Valley. Topography at the property is generally comprised of a broad generally southwest facing slope. Well defined intervening season drainage swales exist to the northwest and southeast.

The proposed driveway alignment initiates approximately 100 feet east of a large concrete culvert crossing along the existing driveway. The proposed driveway alignment immediately ascends a relatively steep cut slope and directly onto undeveloped terrain. The terrain along the alignment is predominately covered in perennial grasses, scrubby bushes, sparse stands of oak trees and resistant andesite boulders. According to the preliminary grading plans prepared by Delta, slope gradients vary from 33 percent to 65 percent along the proposed driveway alignment. The proposed driveway alignment continues to ascend upwards to the proposed building pad, which is located less than 100 feet upslope of the existing water tank at the property.

According to the USGS Yountville, California Quadrangle, the proposed building pad is located near an elevation of 600 feet above mean sea level (MSL). The building pad is undeveloped and covered in perennial grasses, bushes, oak trees and resistant andesite boulders. According to the preliminary grading plans by Delta, slope gradients at the proposed building pad vary from 31 percent to 40 percent.

b. Drainage. Drainage at the property generally sheets from the slopes at the property and is channeled into the bisecting seasonal drainage swales. Due to the steep slope inclinations and shallow bedrock conditions, soil development at the property is generally poor. Therefore, we anticipate that sheet flow and surface run-off prevails over subsurface infiltration during and following intense rainfalls. Average annual rainfalls in the area are on the order of 30 inches per year. The drainage swales are relatively steep and appear to be subject to seasonal flash flood conditions. At the time of field investigation on July 20, 2011, the drainage swales at and near the property appeared dry.

4. GEOLOGIC SETTING

The site is located in the Coast Ranges Geomorphic Province of California. This province is characterized by northwest trending topographic and geologic features, and includes many separate ranges, coalescing mountain masses and several major structural valleys. The province is bounded on the east by the Great Valley and on the west by the Pacific Ocean. It extends north into Oregon and south to the Transverse Ranges in Ventura County.

The structure of the northern Coast Ranges region is extremely complex due to continuous tectonic deformation imposed over a long period of time. The initial tectonic episode in the northern Coast Ranges was a result of plate convergence, which is believed to have begun during the late Jurassic period. This process involved eastward thrusting of oceanic crust beneath the continental crust (Klamath Mountains and Sierra

Nevada) and the scraping off of materials that are now accreted to the continent (northern Coast Ranges). East-dipping thrust and reverse faults were believed to be the dominant structures formed.

Right lateral, strike slip deformation was superimposed on the earlier structures beginning mid-Cenozoic time, and has progressed northward to the vicinity of Cape Mendocino in Southern Humboldt County (Hart, Bryant and Smith, 1983). Thus, the principal structures south of Cape Mendocino are northwest trending, nearly vertical faults of the San Andreas system.

According to preliminary geologic mapping of the Yountville Quadrangle performed by the California Geologic Survey (CGS-2004), the property is underlain by Tertiary andesitic lava flows of the Sonoma Volcanics Group (Tsvasl). Locally, this particular lava flow is known as the "Flows of Stags Leap". Lava and ash bedrock units of the Sonoma Volcanic Group are thought to have been emplaced between approximately three to eight million years ago. Shortly after deposition, compressive forces uplifted and folded the bedrock units. Bedrock units of the Sonoma Volcanic Group tend to be highly fractured and weathered to depths of 40 to 60 feet below the ground surface. Resistant andesite boulders and bedrock outcrops are scattered across the surface through most of the property. A detailed discussion of the subsurface conditions encountered in our exploratory boreholes is presented in Section 7 of this report.

5. FAULTING

Geologic structures in the region are primarily controlled by northwest trending faults. No known active fault passes through the site. The site is not located in the Alquist-Priolo Earthquake Fault Studies Zone. According to the CGS, an approximately located fault trace exists approximately 550 feet northeast of the project site. Additionally, CGS has mapped a second, approximately located fault approximately 1,000 feet southwest of the project site. However, the State of California has not classified these two particular fault traces as active fault sources during Holocene time (the last approximately 11,000 years). Based on our review of the computer software program *EQFAULT*, the three closest known active faults to the site are the West Napa, the Hunting Creek-Berryessa and the Concord-Green Valley. The West Napa fault is located 3.5 miles to the southwest, the Hunting Creek-Berryessa fault is located 7.5 miles to the northeast and the Concord-Green Valley fault is located 8.7 miles to the southeast. Table 1 outlines the nearest known active faults and their associated maximum credible magnitude and maximum acceleration, with respect to the site.

TABLE 1
CLOSEST KNOWN ACTIVE FAULTS

Fault Name	Distance from Site (Miles)	Maximum Credible Earthquakes (Moment Magnitude	Estimated Maximum Site Accelerations (g's)
West Napa	3.5	6.5	0.210
Hunting Creek-Berryessa	7.5	6.9	0.173
Concord-Green Valley	8.7	6.9	0.157

Reference- "EQFAULT" Ver 3.00, software program

6. SEISMICITY

The site is located within a zone of high seismic activity related to the active faults that transverse through the surrounding region. Future damaging earthquakes could occur on any of these fault systems during the lifetime of the proposed project. In general, the intensity of ground shaking at the site will depend upon the distance to the causative earthquake epicenter, the magnitude of the shock, the response characteristics of the underlying earth materials and the quality of construction. Seismic considerations and hazards are discussed in the Section 8 of this report.

7. SUBSURFACE CONDITIONS

a. <u>Soils and Bedrock</u>. The subsurface conditions at site were investigated by drilling five exploratory boreholes (BH-1 through BH-5) to depths between 1.5 to 3.0 feet below the existing ground surface. Difficult drilling conditions were encountered, due to the relatively hard and strong, shallow bedrock conditions. The approximate borehole locations are shown on the Borehole Location Plan, Plate 2. The boreholes were used to perform standard penetration testing and to collect soil samples of the underlying stratums for visual examination and laboratory testing. The drilling and sampling procedures and descriptive borehole logs are included in Appendix A. The laboratory procedures are included in Appendix B.

The exploratory boreholes generally encountered a surface colluvial soil underlain by relatively shallow andesite bedrock of the Sonoma Volcanic Group which extended to the maximum depths explored. The surface colluvial soil deposit consisted of a sandy silt soil deposit which extended from one to one and one-quarter feet below the ground surface. The colluvial soil deposit appeared dry to slightly moist, soft and exhibited low plasticity characteristics. Underlying the surface soils, exploratory boreholes encountered andesite bedrock of the Sonoma Volcanic Group which extended to the maximum depths explored. The andesite appeared moderately hard, moderately strong and moderately weathered.

b. Groundwater. No groundwater or subsurface seepage was encountered during the time of our field exploration on July 20, 2011. Furthermore, no springs or surface seeps were observed at or near the site during our investigation. Perched groundwater zones and seepage could develop at the site due to seasonal rainfall and would vary on the amount of rainfall received and time since it was received. However, based on site topography and surface and subsurface conditions, we judge that seepage at the site would likely dissipate within a few days to several weeks following seasonal rainfall.

8. SEISMIC CONSIDERATIONS

The site is located within a region subject to a high level of seismic activity. Therefore, the site could experience strong seismic ground shaking during the lifetime of the project. The following discussion reflects the possible earthquake effects which could result in damage to the proposed project.

a. Fault Rupture. Rupture of the ground surface is expected to occur along known active fault traces. No evidence of existing faults or previous ground displacement on the site due to fault movement is indicated in the geologic literature or field exploration. Therefore, the likelihood of ground rupture at the site due to faulting is considered to be low.

b. Ground Shaking. The site has been subjected in the past to ground shaking by earthquakes on the active fault systems that traverse the region. It is believed that earthquakes with significant ground shaking will occur in the region within the next several decades. Therefore, it must be assumed that the site will be subjected to strong ground shaking during the design life of the project.

c. Liquefaction. Our field exploration revealed no loose, saturated, granular soil stratums at the project site. The site is underlain by relatively shallow bedrock. The bedrock is not prone to the phenomenon of liquefaction and likely extends to a great depth beneath the site. Therefore, it is judged that liquefaction is not likely to occur at project site.

d. Lateral Spreading and Lurching. Lateral spreading is normally induced by vibration of near-horizontal alluvial soil layers adjacent to an exposed face. Lurching is an action, which produces cracks or fissures parallel to streams or banks when the earthquake motion is at right angles to them. The project site does not have alluvial layers adjacent to an exposed face. Therefore, we judge that the potential for lateral spreading and lurching at the site is low.

e. Expansive Soils. Based on our field observations and our experience, the colluvial soils exhibit low plasticity characteristics and are not considered expansive. However, it has been our experience with similar projects that pockets of expansive soils may potentially be encountered during construction. The bedrock is not considered expansive.

f. Slope Stability. Based on our site reconnaissance and subsurface exploration, the project site appears relatively stable. No obvious indications of active slope instability such as landsliding, debris flows or extensive soil creep was observed along the proposed driveway alignment or at the proposed building pad. Furthermore, the available geologic literature, does not indicate active global slope instability at or near the project site. However, the project is located on moderately steep to steeply sloping terrain. We judge that there is a potential hazard for rock falls during earthquakes and potentially during construction. Precautionary steps must be made to protect the on-site personnel during construction. We recommend the use of a temporary catchment structures to reduce the possibility of rocks and debris to topple downslope during construction. After construction has been completed, the project engineering geologist should determine if a permanent catchment wall would be necessary. If required, we can assist in the design of the catchment wall.

9. CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our investigation, it is our professional opinion that the project is feasible from a geotechnical engineering standpoint provided the recommendations contained in this report are incorporated into the design and carried out through construction. The primary geotechnical considerations in design and construction of the proposed residence and swimming pool are as follows:

a. The presence of weak and compressible surface soils.

b. Differential settlement of the structures due to cut/fill transitions.

c. Difficulties in hard rock excavations.

d. Moderately steep to relatively steep slopes at and adjacent to the building pad.

Based on the results of our work, the surface of the site is blanketed with a thin layer of colluvial soils that are weak and compressible and unsuitable for support of structural fills, foundations, concrete slabs-on-grade and asphalt pavements. Based on the preliminary grading scheme, it appears that grading will likely remove these soils and expose bedrock. The andesite bedrock at the site has good strength and is incompressible for the anticipated loads of construction. Therefore, the andesite is suitable for support of engineered fills, foundations, concrete slabs-on-grade and asphalt pavements.

Based on the building pad grading scheme, it appears that the building pad will be graded by cutting on the uphill side and placing fill on the downhill side to create a relatively level building pad. Cuts and fills up to 25 feet are possible.

Grading of a cut and fill pad will create a pad with earth materials that have highly variable compressibility properties. We anticipate that incompressible bedrock will be exposed on the uphill side of the pad. The downhill side will consist of engineered fill. Even though the fill will be properly placed and compacted, the mass could be prone to settlement. The entire pad will be prone to differential settlement, which would be detrimental to structures constructed at the surface. Due to the potential of differential settlement, the foundation must be designed to resist the differential movement. This could be accomplished with a stiffen spread footing foundation if raised wood floors are used. If concrete slabs-on-grade are desired, then the foundation should consist of a reinforced mat foundation.

Slope gradients at the proposed building site are considered moderately steep to relatively steep. No geomorphic evidence of global slope instability was observed during our site investigation at or near the building site or along the driveway alignment. Where fills are planned to be placed on slopes, the fill slopes should be properly keyed and benched. A fill slope detail is provided on Plate 1a. Furthermore, specific grading recommendations are provided in the following section of this report.

Swimming pool plans were not available at the time of this report. Therefore, the pool recommendations and geotechnical criteria in this report are subject to revisions when plans become available. The swimming pool should be supported on bedrock. Weak soils maybe encountered during excavation; therefore the swimming pool excavation should be approved by the geotechnical engineer in the field during construction.

Hard bedrock conditions are present at the site. Therefore, hard bedrock excavation techniques such as jackhammering will be necessary for excavation depths extending deeper than three feet. This should be accounted for in the overall project budget.

Based on the results of our work, we judge that construction of the driveway is feasible from a geotechnical engineering standpoint provided the geotechnical recommendations of this report are followed. The primary geotechnical considerations in design and construction of the driveway are as follows:

a. Steep natural slopes which could be prone to erosion, sloughing, raveling and shallow slope failures.

b. Differential settlement of the driveway due to cut/fill transitions.

Steep natural slopes exist along the driveway alignment. Due to the near surface bedrock condition and to minimize hillside disturbance, we judge that it is acceptable to grade 1H:1V cut slopes along the driveway alignment and at the building pad. However, we judge that the 1H:1V cut slopes could be more prone to raveling, slumping and rock falls. The engineering geologist should review conditions encountered during construction to observe if adverse geologic conditions are encountered. If adverse conditions are encountered, the slopes may need to be flattened or other treatment. The long-term success of overly steep graded cut slopes will largely depend on periodic maintenance. The owner should perform seasonal upkeep to the cut slopes.

We anticipate that grading of driveway will also consist of a cut and fill surface with materials of highly variable compressibility properties. The driveway could experience differential settlement which could cause cosmetic cracking to pavements. Therefore, the owner should anticipate periodic maintenance, such as slurry sealing.

The following sections present geotechnical recommendations and criteria for design and construction of the project.

10. EARTHWORK AND GRADING

a. <u>General</u>. According to preliminary earthwork and grading estimates, we anticipate that the project will include approximately 3,325 cubic yards of cut and 3,324 cubic yards of fill to construct the building pad. According to the preliminary plans, we anticipate cuts of approximately 15 feet and less and fills of approximately 25 feet and less to achieve the desired pad elevations, and provide adequate gradients for site drainage. Preliminary earthwork and grading estimates for construction of the driveway were not available at the time of the report. Based on the topography of the proposed driveway alignment, we anticipate that site grading for construction of the driveway will consist of cuts and fills of approximately five to 15 feet and less to achieve the desired driveway elevations, and provide adequate gradients for site drainage.

b. Stripping. Areas for grading should be stripped of surface vegetation, tree stumps, organics and soils containing organic matter. The lateral extent of the stripping should extend at least five feet beyond the building pad and at least three feet beyond the outside edge of the driveway alignment, toes of fills and crowns of slopes. The stripped materials should be removed from new construction areas. We anticipate that the depth of stripping will be on the order of about two to four inches. Deeper stripping depths may be required where weak and organic soils are encountered.

c. Removal of Weak Soils. The weak and compressible surface soils should be removed and bedrock exposed at the building pad and along the driveway alignment and where engineered fills are to be constructed. The depth of the weak soils is approximately one foot in thickness. However, deeper sections of weak organic soils maybe encountered during construction. The actual depth of subexcavation should be determined by the geotechnical engineer in the field during grading. The lateral extent of weak soil removal should extend at least five feet beyond the building pad perimeter and at least three feet beyond the edge of the driveway shoulder or toes of fill slopes. The stripped material could be stockpiled for later use in landscape areas or used as topsoil. The exposed surface should be prepared and compacted according to the following sections of this report.

d. Fill Material. Excavated material to be used for the construction of site fills should not contain organic material, should have no rock or similar irreducible material with a maximum dimension greater than 12 inches, and should be approved by the geotechnical engineer before use. Due to presence of boulders and the necessity of jackhammering, we anticipate screening will be required for the project. This will reduce the amount of soil available for fill. If expansive clays are encountered, they should not be placed within 18 inches of finish subgrade. Imported material, if required, should be low to non-expansive (plasticity index less than 15) and should be approved by the geotechnical engineer before use. Rocks greater than 12 inches can be placed in deeper sections of fill, if approved by the geotechnical engineer during grading.

Imported fill, if necessary, should have a liquid limit of 40 or less and a plasticity index of 15 or less. The imported fill material should be no more than six inches in size and free of vegetation.

e. Compaction. All fill material should be placed in uniform lifts not exceeding eight inches in their loose state. All fills should be compacted, by mechanical means only, with acceptable compaction equipment, to a minimum of 90 percent relative compaction, as determined by ASTM D1557 test method. Driveway subgrade and base rock should be compacted to 95 percent relative compaction. Depressions or ruts created in the process of the grading operation should be properly backfilled with suitable fill and compacted to not less than 90 percent relative compaction. Following the site stripping and removal of weak soils, the upper eight inches of the exposed surface should be scarified, moisture conditioned, and properly compacted to at least 90 percent relative compaction to form a firm surface prior to fill placement. Cobble or boulder size rock fragments should not be nested together.

Depending on the time of year that grading is performed, the on-site material to be used for fill may have a moisture content significantly higher than the optimum moisture content. If so, it will be difficult to achieve the specified compaction. These materials will require greater than normal spreading, mixing, and aerating to achieve a moisture content where compaction can be achieved. Constructing fills during the rainy season will be very difficult and we recommend that it be avoided.

The fill materials should be moisture conditioned to at least two percent over the optimum moisture content as determined in the laboratory and compacted to at least 90 percent relative compaction.

f. <u>Benching and Keying</u>. Where fill is required on surface gradients steeper than 5:1 (horizontal to vertical), the soil mantle and any weak materials should be removed and benches cut horizontally into competent bedrock in conjunction with fill placement. The maximum height of benches should be reviewed in the field by the geotechnical engineer. A key will be required at the toe of all fill embankments, and consultation should be provided by the geotechnical engineer to determine where these keys should be constructed. All keys should be a minimum of eight feet in width and extend at least three feet into bedrock, as measured on the downhill side. A fill slope detail is presented on Plate 1a. The keys should be excavated into competent materials as determined by the geotechnical engineer. The materials excavated during benching may be used as structural fill if they conform to the requirements indicated under "Fill Material." Subdrains should be installed in all the keys.

g. <u>Cut and Fill Slopes</u>. Generally, it is recommended that cut slopes be constructed at an inclination no steeper than 1H:1V. However, this should be evaluated by the geotechnical engineer in the field during construction. Potentially unstable subsurface conditions, such as adverse bedding, joint planes, zones of weakness, clay zones, or exposed seepage, may require either flatter slopes than specified above or other treatment. It is recommended that a geotechnical engineer observe the cut slopes and provide final recommendations for the control of adverse conditions during grading operations, if encountered. During the rainy season, the cut slopes should be checked for springs or seepage areas. The surfaces of the cut slopes should be treated as needed in order to minimize the probability of slumping and erosion.

It is recommended that fill slopes be constructed at an inclination no steeper than 2H:1V. To minimize the probability of slumping and/or erosion of fill slopes, the face of the slopes should be properly treated to control erosion.

h. Cut and Fill Transitions. Based on the project plans, it appears that the driveway will be constructed on both cut and fill. Even though engineered fill and weak soils will be benched and mechanically compacted, they could still be prone to minor vertical and lateral deformation and differential settlement that could cause minor cracking to asphalt. We would expect the cracking to be minimal and the driveway to be fully serviceable. However, the owner must understand this potential. If the owner desires optimum performance, we could provide specific recommendations and criteria for design and construction. However, the recommendations and criteria would significantly increase the cost of construction of the project.

All site preparation and fill placement should be observed by a representative of PJC. It is important that during the stripping, subexcavation and grading/scarifying processes, a representative of our firm be present to observe whether any undesirable material is encountered in the construction area.

11. FOUNDATIONS: GRIDED SPREAD FOOTINGS

a. Vertical Loads. Due to the anticipated cut and fill pad, the proposed structure should be supported on stiffened, grid-type spread footing foundations bearing on an engineered fill or bedrock at least 18 inches below grade. The actual depth should be determined by the geotechnical engineer in the field during construction. The footings, perimeter and interior, should be tied together with grade or tie beams in both directions.

We recommend that the foundation system be reinforced and tied together to distribute the loads, help minimize potential differential settlement, and resist seismic effects. The intent is to provide a foundation strong enough to span a portion of non-support that may be caused by differential settlement of the varying fill thickness.

Spread footings should be laid out in a grid-like pattern, which ties all foundation elements in two directions in order to help resist deflection resulting from potential settlement and seismic forces. Offsets in foundation beams should be avoided wherever possible. The foundations should be tied together with grade or tie beams at intervals of 15 feet or less in both directions.

The tie and grade beams should be reinforced to resist bending in either an upward or downward direction. The strengthening will permit some redistribution of loads and tend to equalize settlements.

The foundation system should be designed strong enough to cantilever at least eight feet or one-quarter the width of the structure, whichever is greater, carrying the superimposed loads, but neglecting the weight of foundation below grade.

Footings should be at least 18 inches deep and 12 inches wide, and should be designed for a dead plus live load bearing pressure of 2,000 pounds per square foot (psf). This pressure may be increased by one-third for total design loads, including seismic forces.

b. Lateral Loads. For lateral resistance, we recommend a design friction coefficient of 0.3 times the net vertical load between the bottom of footings and the bearing material. For passive resistance, an equivalent fluid pressure of 300 pounds per cubic foot (pcf) should be used for design. The upper foot of soils should be neglected in computing the passive resistance.

c. Settlement. Total and differential settlement should be negligible to one and one-half inches, depending on the thickness of the fill.

All foundation excavations should be observed and approved by PJC prior to placement of the reinforcing steel. All loose soil should be completely removed before pouring the concrete. The foundations should be provided with re-leveling provisions such as extra long anchor bolts.

12. FOUNDATION OPTION: REINFORCED MAT SLAB

a. Vertical Loads. The structure may be supported on reinforced mat slab foundation. The mat should consist of a "waffle type" with rigid interior grade beams, and should be designed to impose a uniform load on the supporting soil. Due to the potential differential settlement, the beams should be designed as stiff grade beams capable of resisting both positive and negative moments.

For design purposes, we recommend that the grade beams be designed to span at least eight feet with full structural loading in both directions.

b. Settlement. We have assumed that the mat will impose a uniform load on the supporting soil and bedrock. Total and differential settlement should be negligible to one and one-half inches, depending on the thickness of the fill.

c. Modulus of Subgrade Reaction. Based on the properties of the supporting soils, a maximum subgrade reaction value of 50 pounds per cubic inch is recommended for use in the mat foundation design. An allowable bearing pressure of 1500 psf may be used.

d. Lateral Loads. Lateral loads resulting from wind or earthquake may be resisted in the form of friction or base adhesion between the base of the mat and the soil on which it is supported. A coefficient of sliding friction of 0.30 may be used for neat concrete placed against the native expansive fill.

13. CONVENTIONAL CONCRETE SLABS-ON-GRADE

Conventional concrete slabs-on-grade may be used for the garage floors and exterior flatwork provided the owner understands and accepts the potential for differential movement and cracking. If the risk is considered unacceptable, the garage floors and exterior flatwork should be structurally designed.

All slab subgrades should be moisture conditioned and rolled to produce a firm and unyielding subgrade. The slab subgrade should not be allowed to dry. Conventional slabs should be at least four inches thick and underlain with a capillary moisture break consisting of at least four inches of clean, free-draining crushed rock or gravel. The rock should be graded so that 100 percent passes the one-inch sieve and no more than five percent passes the No. 4 sieve.

For slabs-on-grade with moisture sensitive surfacing, we recommend that an impermeable membrane at least 10 mils thick be placed over the drain rock to prevent migration of moisture vapor through the concrete slabs. In order to promote a more uniform curing of the slab and to provide protection of the vapor membrane, it is advisable to place two inches of fine gravel on top of the membrane prior to placing the slab concrete. If the sand is omitted, the thickness of the membrane should be increased to 15 mils. The gravel should be moistened slightly prior to placing concrete. Control joints should be provided to induce and control cracking. The slabs should be cast and maintained separate of existing foundations.

14. SWIMMING POOL SLAB AND WALLS

Pool plans were not available at the time of this report. Therefore, the following recommendations are subject to revisions when plans become available. The swimming pool should be supported on bedrock. Footings may be required where bedrock is not encountered. If the pool is placed in cut and fill, we should be consulted to provide specific recommendations for placement. Non to low expansive engineered fill may be necessary if expansive clays are encountered in the bottom of the pool. Seven feet of horizontal confinement should be provided from the bottom of the pool to the face of the nearest slope. This may also require footings. A relief valve should be installed at the bottom of the pool to reduce the risk of hydrostatic uplift of the pool when emptied. The pool slab should be at least five inches thick and should be reinforced as determined be the project structural engineer. The pool slab should be underlain by at least four inches of drain rock. A slab underdrain should be constructed under the pool slab to reduce the risk of hydrostatic uplift.

Cantilever retaining walls should be designed to resist an active lateral soil pressure of 40 pcf for level conditions. Restrained walls should be designed for an equivalent fluid pressure of 55 pcf. Pool walls extending above grade should be designed for an outward water pressure of 62 pcf.

15. SEISMIC DESIGN

Based on criteria presented in the 2007 edition of the California Building Code (CBC) and ASCE (American Society of Civil Engineers) STANDARD ASCE/SEI 7-05, the following minimum criteria should be used in seismic design:

a.	Site Class:	B
b.	Mapped Acceleration Parameters:	S_s=1.497 S_1=0.552
c.	Site Coefficients:	F_a=1.0 F_v=1.0

16. DRAINAGE AND EROSION CONTROL

a. General. Groundwater or seepage was not encountered in our exploratory boreholes. However, like all hillside sites, it is probable that seepage will develop in the porous soils and bedrock fractures during and following prolonged rainfall. Whenever water seepage is observed, the condition must be evaluated by the geotechnical engineer prior to covering with fill materials to assess whether a drainage blanket or subdrain is required.

b. Surface Drainage. Drainage control design should include provisions for positive surface gradients so that surface runoff is not permitted to pond, particularly above slopes, on the driveway, or adjacent to pavements. Surface runoff should be directed away from slopes and pavements and collected by asphalt dikes, lined ditches, drainage swales or catch basins. Water collected should be discharged to an existing watercourse. If the drainage facilities discharge onto the natural ground, adequate means should be provided to control erosion and to create sheet flow. Outboard driveway gradients on sloping topography will generally induce erosion and slope stability concerns by concentrated flows long the edges and we recommend that they be completely avoided.

c. Erosion Control. The discharge of channelized water flow will increase the potential for erosion and slope instability. Riprap or other means are recommended to dissipate energy and to create sheet flow. Slopes should be adequately planted or provided with erosion blankets or approved equivalent to retard erosion.

d. Subsurface Drainage. If raised wood floors are desired for living areas, we recommend that, except for the downhill foundation, foundation drains be placed around the perimeter of the foundation to reduce and control crawl space groundwater intrusion. Foundation drains should extend at least six inches below the bottom of the interior crawl space grade. The bottom of the trench should be sloped to drain by gravity. The bottom of the trench should be lined with a few inches of three-quarter to one and one-half inch drain rock. A four inch diameter, perforated pipe, with holes down and sloped to drain, should be placed on top of the thin layer of drain rock. The trench should then be backfilled to within 12 inches of the finished surface with drain rock. The upper 12 inches should consist of compacted soil to reduce surface water inclusion. We recommend that a drainage filter cloth such as Mirafi 140N be placed between the soil and the drain rock. The filter cloth may be omitted if Class II permeable material is used.

17. PRELIMINARY ASPHALTIC CONCRETE PAVEMENTS

It has been experience that the existing surface soils will have a moderate supporting capacity (after properly compacted) when used as a pavement subgrade. Based on our experience, an R-value of 25 was used in asphaltic concrete pavement design calculations. The actual R-Value should be determined from laboratory testing when the subgrade soils are exposed. This could alter the pavement design section.

Pavement thicknesses were computed from Chapter 600 of the Caltrans Highway Design Manual and are based on a pavement life of 20 years. The Traffic Indexes (TI) used are judged representative of the anticipated traffic but are not based on actual vehicle counts. The actual traffic indexes should be determined and provided by the project civil engineer. The recommended pavement sections are presented in Table 3.

Prior to placement of the aggregate base material, the top eight inches of the pavement subgrade should be scarified to at least eight inches deep, moisture conditioned to two percent over optimum moisture content, and compacted to a minimum of 95 percent relative compaction. Aggregate base material should be spread in thin layers and compacted to at least 95 percent relative compaction to form a firm and unyielding base.

The material and methods used should conform to the requirements of the County of Napa specifications or the current edition of the Caltrans Standard Specifications, except that compaction requirements for the soil subgrade and aggregate base rock should be based on ASTM D 1557. Aggregate used for the base coarse should comply with the minimum requirements specified in Caltrans Standard Specifications, Section 26, for Class 2 aggregate base.

In general, the pavements should be constructed during the dry season to avoid the saturation of the subgrade and base materials, which often occurs during the wet winter months. If pavements are constructed during the winter and early spring, a cost increase relative to drier weather construction should be anticipated. The soils engineer should be consulted for recommendations at the time of construction.

If expansive clays are encountered, they could potentially crack pavements due to the shrinking and swelling. The presence of expansive soils should be assessed by the geotechnical engineer prior to placement of base rock.

TABLE 3
PAVEMENT DESIGN FOR PAVEMENT AREAS
(Subgrade R-Value=25)

Traffic Index	Asphaltic Concrete (in)	Class II Aggregate Base (in)
4.0	2.0	6.0
5.0	2.5	7.5
6.0	3.0	9.5
7.0	3.5	11.5

18. LIMITATIONS

The data, information, interpretations and recommendations contained in this report are presented solely as bases and guides to the geotechnical design of the proposed residence, swimming pool and driveway located at 7830 Silverado Trail in Napa, California. The conclusions and professional opinions presented herein were developed by PJC in accordance with generally accepted geotechnical engineering principles and practices. No warranty, either expressed or implied, is intended.

This report has not been prepared for use by parties other than the designers of the project. It may not contain sufficient information for the purposes of other parties or other uses. If any changes are made in the project as described in this report, the conclusions and recommendations contained herein should not be considered valid, unless the changes are reviewed by PJC and the conclusions and recommendations are modified or approved in writing. This report and the figures contained herein are intended for design purposes only. They are not intended to act by themselves as construction drawings or specifications.

Soil and bedrock deposits may vary in type, strength, and many other important properties between points of observation and exploration. Additionally, changes can occur in groundwater and soil moisture conditions due to seasonal variations or for other reasons. Therefore, it must be recognized that we do not and cannot have complete knowledge of the subsurface conditions underlying the subject site. The criteria presented is based on the findings at the points of exploration and on interpretative data, including interpolation and extrapolation of information obtained at points of observation.

19. ADDITIONAL SERVICES

Upon completion of the project plans, they should be reviewed by our firm to determine that the design is consistent with the recommendations of this report. During the course of this investigation, several assumptions were made regarding development concepts. Should our assumptions differ significantly from the final intent of the project designers, our office should be notified of the changes to assess any potential need for revised recommendations. Observation and testing services should also be provided by PJC to verify that the intent of the plans and specifications are carried out during construction; these services should include observing grading and earthwork, foundation excavations and construction of drainage facilities.

These services will be performed only if PJC is provided with sufficient notice to perform the work. PJC does not accept responsibility for items we are not notified to observe.

It has been a pleasure working with you on this project. Please call if you have any questions regarding this report or if we can be of further assistance.

Sincerely,

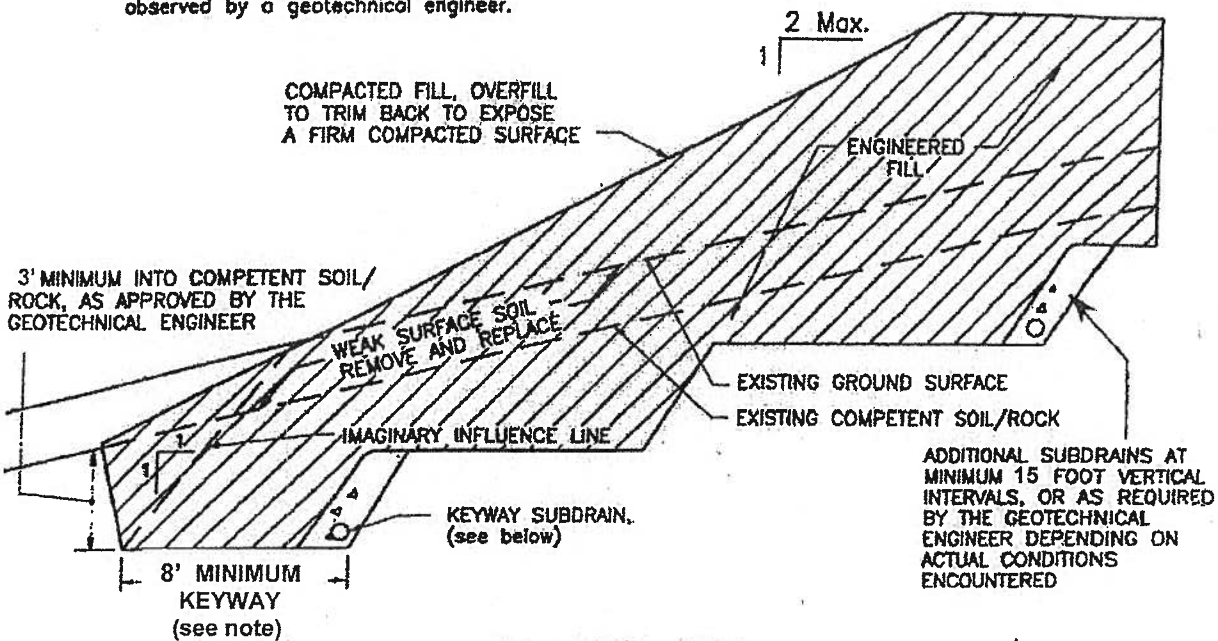
PJC & ASSOCIATES, INC.

Patrick J. Conway
Geotechnical Engineer
GE 2303, California

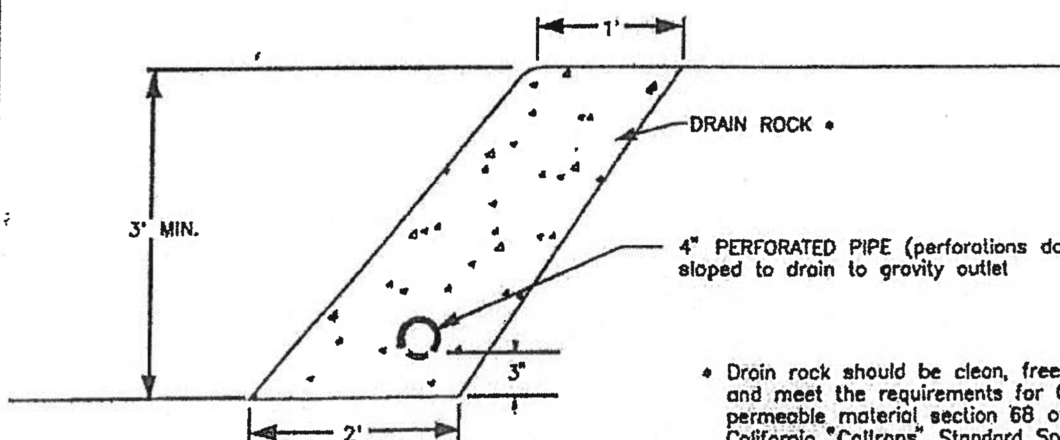
PJC/sms

cc: Delta Consulting Engineers (2)

Notes:
1. Keyway excavation and subdrain installation should be observed by the Geotechnical Engineer.
2. Where existing slope exceeds 5:1 excavate series of benches in competent soil/rock.
3. All subdrains should have cleanouts at a minimum of 400 foot intervals and at upslope end.
4. Installation of all subdrains should be observed by a geotechnical engineer.



FILL SLOPE DETAIL
not to scale



• Drain rock should be clean, free draining and meet the requirements for Class 2 permeable material section 68 of State of California "Caltrans" Standard Specifications. As an alternative, non-woven filter fabric (Mirafi 140N or equivalent) wrapped around 3/4" – 1-1/2" drain rock may be used, depending on actual conditions encountered.

SUBDRAIN DETAIL
not to scale

PJC & Associates, Inc.
Consulting Engineers & Geologists

FILL SLOPE DETAILS
PROPOSED RESIDENCE, POOL AND DRIVEWAY
7830 SILVERADO TRAIL
OAKVILLE, CALIFORNIA

Proj. No:	5066.01	Date:	8/11	App'd by:	PJC

PLATE
1a

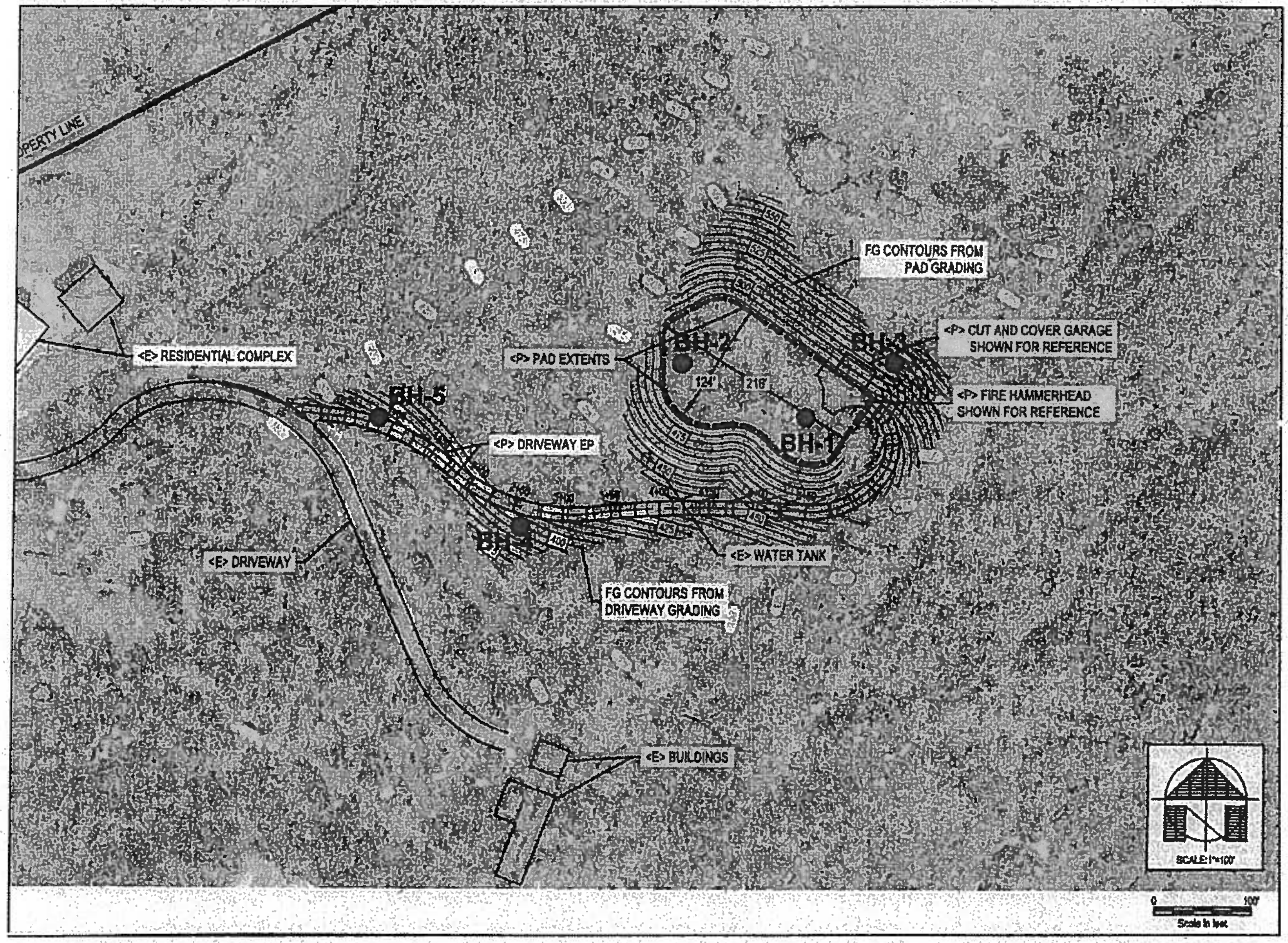
APPENDIX A
FIELD INVESTIGATION

1. INTRODUCTION

The field program performed for this study consisted of drilling five exploratory boreholes (BH-1 and BH-5) at the site. The exploration was completed on July 20, 2011. The borehole locations are shown on the Borehole Location Plan, Plate 2. Descriptive logs of the boreholes are presented in this appendix as Plates 3 through 7.

2. BOREHOLES

The boreholes were advanced using portable powered drilling equipment. The drilling was performed under the observation of a professional geologist of PJC who maintained a continuous log of the subsurface conditions and obtained samples suitable for laboratory testing. The soils were classified in accordance with the Unified Soil Classification System, as explained in Plate 8. The bedrock was classified according to Plate 9.



SCALE SHOWN ABOVE

EXPLANATION

● BOREHOLE LOCATION AND DESIGNATION

REFERENCE: PRELIMINARY GRADING PLAN, PREPARED BY DELTA, DATED JULY 5, 2011.

PJC & Associates, Inc. *Consulting Engineers & Geologists*	BOREHOLE LOCATION PLAN PROPOSED RESIDENCE, POOL AND DRIVEWAY 7830 SILVERADO TRAIL OAKVILLE, CALIFORNIA	PLATE **2**
	Proj. No: 5066.01 Date: 8/11 App'd by: PJC	

LOG OF BOREHOLE NO. BH-1

PROPOSED RESIDENCE, POOL AND DRIVEWAY
7830 SILVERADO TRAIL
OAKVILLE, CALIFORNIA

TYPE: **PORTABLE DRILL SOLID STEM** LOCATION: **SE END BLDG PAD**

DEPTH, FT	SYMBOL	SAMPLES	BLOWS PER FOOT OR RECOVERY, %	STRATUM DESCRIPTION SURF. EL **N/A**	LAYER ELEV./ DEPTH	WATER CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX (PI), %	PASSING NO. 200 SIEVE, %	UNIT DRY WEIGHT, PCF	COMPRESSIVE STRENGTH TSF
				0.0-1.25'; SANDY SILT (ML); reddish brown, slightly moist, soft, low plasticity, with gravels to boulder size rock fragments. (COLLUVIUM)	1.2	11						
				1.25-3.0'; ANDESITE (Tsvasl); grayish brown, moderately hard, moderately strong, moderately weathered. (BEDROCK)	3.0							
				REFUSAL 3.0 FEET								

COMPLETION DEPTH: **3.0'** DEPTH TO WATER: **NOT ENCOUNTERED**

DATE: **7-20-11**

U=Unconfined P=Pocket Penetrometer
Q=Unconsolidated-Undrained Triaxial T=Torvane

GEOT 5066 8-24-11

PLATE 3

LOG OF BOREHOLE NO. BH-2

PROPOSED RESIDENCE, POOL AND DRIVEWAY
7830 SILVERADO TRAIL
OAKVILLE, CALIFORNIA

TYPE: **PORTABLE DRILL SOLID STEM** LOCATION: **NW END BLDG PAD**

DEPTH, FT	SYMBOL	SAMPLES	BLOWS PER FOOT OR RECOVERY, %	STRATUM DESCRIPTION SURF. EL N/A	LAYER ELEV./ DEPTH	WATER CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX (PI), %	PASSING NO. 200 SIEVE, %	UNIT DRY WEIGHT, PCF	COMPRESSIVE STRENGTH TSF
				0.0-1.0'; SANDY SILT (ML); reddish brown, slightly moist, soft, low plasticity, with gravels to boulder size rock fragments. (COLLUVIUM)	1.0	9						
				1.0-3.0'; ANDESITE (Tsvasl); grayish brown, moderately hard, moderately strong, moderately weathered. (BEDROCK)	3.0							
				REFUSAL 3.0 FEET								

COMPLETION DEPTH: **3.0'** DEPTH TO WATER: **NOT ENCOUNTERED**

DATE: **7-20-11**

U=Unconfined P=Pocket Penetrometer
Q=Unconsolidated-Undrained Triaxial T=Torvane

GEOT 5066 8-24-11

PLATE 4

LOG OF BOREHOLE NO. BH-3

PROPOSED RESIDENCE, POOL AND DRIVEWAY
7830 SILVERADO TRAIL
OAKVILLE, CALIFORNIA

TYPE: **PORTABLE DRILL SOLID STEM** LOCATION: **ABOVE BLDG PAD**

DEPTH, FT	SYMBOL	SAMPLES	BLOWS PER FOOT OR RECOVERY, %	STRATUM DESCRIPTION SURF. EL **N/A**	LAYER ELEV./ DEPTH	WATER CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX (PI), %	PASSING NO. 200 SIEVE, %	UNIT DRY WEIGHT, PCF	COMPRESSIVE STRENGTH TSF
				0.0-1.25'; SANDY SILT (ML); reddish brown, dry, soft, low plasticity, with gravels to boulder size rock fragments. (COLLUVIUM)	1.2							
				1.25-3.0'; ANDESITE (Tsvasl); reddish brown to grayish brown, moderately hard, moderately strong, moderately weathered. (BEDROCK)	3.0							
				REFUSAL 3.0 FEET								

COMPLETION DEPTH: **3.0'** DEPTH TO WATER: **NOT ENCOUNTERED**

DATE: **7-20-11**

U=Unconfined P=Pocket Penetrometer
Q=Unconsolidated-Undrained Triaxial T=Torvane

GEOT 5066 8-24-11

LOG OF BOREHOLE NO. BH-4

PROPOSED RESIDENCE, POOL AND DRIVEWAY
7830 SILVERADO TRAIL
OAKVILLE, CALIFORNIA

TYPE: **PORTABLE DRILL SOLID STEM** LOCATION: **NEAR STA 2+65**

DEPTH, FT	SYMBOL	SAMPLES	BLOWS PER FOOT OR RECOVERY, %	STRATUM DESCRIPTION	LAYER ELEV./ DEPTH	WATER CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX (PI), %	PASSING NO. 200 SIEVE, %	UNIT DRY WEIGHT, PCF	COMPRESSIVE STRENGTH TSF
				SURF. EL **N/A**								
				0.0-1.0'; SANDY SILT (ML); reddish brown, dry, soft, low plasticity, with gravels to boulder size rock fragments. (COLLUVIUM)	1.0	4						
				1.0-1.5'; ANDESITE (Tsvasl); reddish brown to gray, moderately hard, moderately strong, moderately weathered. (BEDROCK)	1.5							
				REFUSAL 1.5 FEET								

COMPLETION DEPTH: **1.5'** DEPTH TO WATER: **NOT ENCOUNTERED**

DATE: **7-20-11**

U=Unconfined P=Pocket Penetrometer
Q=Unconsolidated-Undrained Triaxial T=Torvane

GEOT 5066 8-24-11

LOG OF BOREHOLE NO. BH-5

PROPOSED RESIDENCE, POOL AND DRIVEWAY
7830 SILVERADO TRAIL
OAKVILLE, CALIFORNIA

TYPE: **PORTABLE DRILL SOLID STEM** LOCATION: **NEAR STA. 0+80**

DEPTH, FT	SYMBOL	SAMPLES	BLOWS PER FOOT OR RECOVERY, %	STRATUM DESCRIPTION SURF. EL **N/A**	LAYER ELEV./ DEPTH	WATER CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX (PI), %	PASSING NO. 200 SIEVE, %	UNIT DRY WEIGHT, PCF	COMPRESSIVE STRENGTH TSF
				0.0-1.25'; SANDY SILT (ML); reddish brown, dry, soft, low plasticity, with gravels to boulder size rock fragments. (COLLUVIUM)	1.2	3						
				1.25-3.0'; ANDESITE (Tsvasl); reddish brown, moderately hard, moderately strong, moderately weathered. (BEDROCK)	3.0							
				REFUSAL 3.0 FEET								

COMPLETION DEPTH: **3.0'** DEPTH TO WATER: **NOT ENCOUNTERED**

DATE: **7-20-11**

U=Unconfined P=Pocket Penetrometer
Q=Unconsolidated-Undrained Triaxial T=Torvane

GEOT 5066 8-24-11

PLATE 7

MAJOR DIVISIONS				TYPICAL NAMES
COARSE GRAINED SOILS (MORE THAN HALF IS LARGER THAN #200 SIEVE)	GRAVELS (MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE)	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL GRADED GRAVELS, GRAVEL - SAND MIXTURES
			GP	POORLY GRADED GRAVELS, GRAVEL - SAND MIXTURES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, POORLY GRADED GRAVEL - SAND - SILT MIXTURES
			GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL - SAND - CLAY MIXTURES
	SANDS (MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE)	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL GRADED SANDS, GRAVELLY SANDS
			SP	POORLY GRADED SANDS, GRAVELLY SANDS
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, POORLY GRADED SAND - SILT MIXTURES
			SC	CLAYEY SANDS, POORLY GRADED SAND - CLAY MIXTURES
FINE GRAINED SOILS (MORE THAN HALF IS SMALLER THAN #200 SIEVE)	SILTS AND CLAYS (LIQUID LIMIT LESS THAN 50)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (LIQUID LIMIT GREATER THAN 50)		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACIOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS

UNIFIED SOIL CLASSIFICATION SYSTEM

		Shear Strength, psf	Confining Pressure, psf	
Consol - Consolidation	Tx	320	(2600)	Unconsolidated Undrained Triaxial
LL - Liquid Limit (in %)	Tx CU	320	(2600)	Consolidated Undrained Triaxial
PL - Plastic Limit (in %)	DS	2750	(2000)	Consolidated Drained Direct Shear
PI - Plasticity Index	FVS	470		Field Vane Shear
G_s - Specific Gravity	U	2000		Unconfined Compression
SA - Sieve Analysis	LVS	700		Laboratory Vane Shear
☒ "Undisturbed" Sample	SS - Shrink Swell			
☒ Bulk or Disturbed Sample	EXP - Expansion			
◪ Standard Penetration Test	P POCKET PENETROMETER			
☐ Sample Attempt with No Recovery				

Note: All strength tests on 2.8" or 2.4" diameter sample unless otherwise indicated.

KEY TO TEST DATA

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PROPOSED RESIDENCE, POOL AND DRIVEWAY
7830 SILVERADO TRAIL
OAKVILLE, CALIFORNIA

PLATE 8

Proj. No: 5066.01 Date: 8/11 App'd by: PJC

ROCK TYPES

CONGLOMERATE	SHALE
METAMORPHIC ROCKS HYDROTHERMALLY-ALTERED ROCKS	SANDSTONE
SHEARED SHALE MELANGE	IGNEOUS ROCKS
META-SANDSTONE	CHERT

BEDDING THICKNESS

MASSIVE	Greater than 6 feet
THICKLY BEDDED	2 to 6 feet
MEDIUM BEDDED	8 to 24 inches
THINLY BEDDED	2-1/2 to 8 inches
VERY THINLY BEDDED	3/4 to 2-1/2 inches
CLOSELY LAMINATED	1/4 to 3/4 inches
VERY CLOSELY LAMINATED	Less than 1/4 inch

JOINT, FRACTURE, OR SHEAR SPACING

VERY WIDELY SPACED	Greater than 6 feet
WIDELY SPACED	2 to 6 feet
MODERATELY WIDELY SPACED	8 to 24 inches
CLOSELY SPACED	2-1/2 to 8 inches
VERY CLOSELY SPACED	3/4 to 2-1/2 inches
EXTREMELY CLOSELY SPACED	Less than 3/4 inch

HARDNESS

Soft - pliable; can be dug by hand

Slightly Hard - can be gouged deeply or carved with a pocket knife

Moderately Hard - can be readily scratched by a knife blade; scratch leaves heavy trace of dust and is readily visible after the powder has been blown away

Hard - can be scratched with difficulty; scratch produces little powder and is often faintly visible

Very Hard - cannot be scratched with pocket knife, leaves a metallic streak

STRENGTH

Plastic - capable of being molded by hand

Friable - crumbles by rubbing with fingers

Weak - an unfractured specimen of such material will crumble under light hammer blows

Moderately Strong - specimen will withstand a few heavy hammer blows before breaking

Strong - specimen will withstand a few heavy ringing hammer blows and usually yields large fragments

Very Strong - rock will resist heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments.

DEGREE OF WEATHERING

Highly Weathered - abundant fractures coated with oxides, carbonates, sulphates, mud, etc., through discoloration, rock disintegration, mineral decomposition

Moderately Weathered - some fracture coating, moderate or localized discoloration, little to no effect on cementation, slight mineral decomposition

Slightly Weathered - a few strained fractures, slight discoloration, little or no effect on cementation, no mineral decomposition

Fresh - unaffected by weathering agents, no appreciable change with depth.

APPENDIX B
LABORATORY INVESTIGATION

1. INTRODUCTION

This appendix includes a discussion of test procedures and results of the laboratory investigation performed for the proposed project. The investigation program was carried out by employing currently accepted test procedures of the American Society of Testing and Materials (ASTM).

Disturbed samples used in the laboratory investigation were obtained during the course of the field investigation as described in Appendix A of this report. Identification of each sample is by test pit number and depth.

2. INDEX PROPERTY TESTING

In the field of soil mechanics and geotechnical engineering design, it is advantageous to have a standard method of identifying soils and classifying them into categories or groups that have similar distinct engineering properties. The most commonly used method of identifying and classifying soils according to their engineering properties is the Unified Soil Classification System described by ASTM D-2487-83. The USCS is based on recognition of the various types and significant distribution of soil characteristics and plasticity of materials.

The index properties tests discussed in this report include the determination of natural water content tests.

a. Natural Water Content. Natural water content was determined on selected disturbed samples. The samples were extruded, visually classified, and accurately weighed to obtain wet weight. The samples were then dried, in accordance with ASTM D-2216-80, for a period of 24 hours in an oven maintained at a temperature of 100 degrees C. After drying, the weight of each sample was determined and the moisture content calculated. The water content results are summarized on the borehole logs.

APPENDIX C
REFERENCES

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2. "Soil Dynamics, Deep Stabilization, and Special Geotechnical Construction" Department of the Navy Design Manual 7.3 (NAVFAC DM-7.3), dated April 1983.

3. Geologic Map of the Santa Rosa Quadrangle, Scale: 1:250,000, compiled by D.L Wagner and E.J. Bortugno, 1982.

4. California Geologic Survey, Geologic Map of the Yountville Quadrangle, 7.5 Minute, compiled by Stephen P. Bezore, Kevin B. Calhan, Janet M. Sowers, and Robert C. Witter, 2005.

5. "Soil Mechanics" Department of the Navy Design Manual 7.1 (NAVFAC DM-7.1), dated May 1982.

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11. "Maps of Known Active Fault Near-Source Zones in California and Adjacent Portions of Nevada," California Department of Conservation Division of Mines and Geology, Dated February 1998.

12. Blake, T.F. (2000b), FRISKSP version 4.0 software program.

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