PJC & Associates, Inc.

Const/finp *Engineers & Geologists*

February 3, 2021 Job No. 53046. 01

Nils Welin & Klas Berghede
300 Montgomery Street, Ste 813
San Francisco, CA 94104

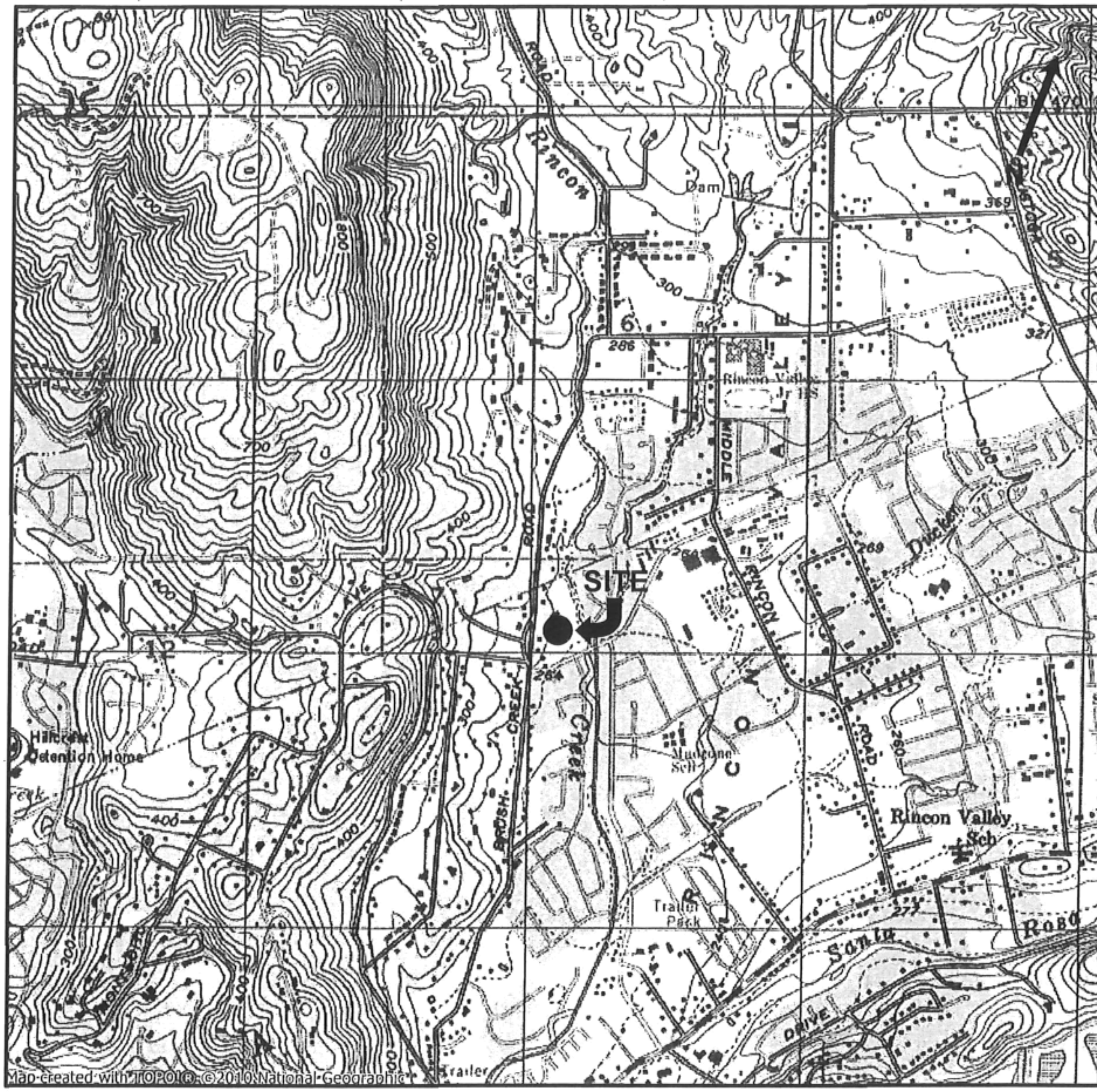
Subject: Geotechnical Investigation
Proposed Residential Development
2210 Brush Creek Road
Santa Rosa, California

PJC & Associates, Inc. (PJC) is pleased to submit this report which presents the results of our geotechnical investigation for the proposed residential development located at 2210 Brush Creek Road in Santa Rosa, California. The approximate location of the site is shown on the Site Location Map, Plate 1. Our services were completed in accordance with our proposal for geotechnical engineering services, dated October 15, 2020. 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 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

Based on the tentative subdivision map and information provided by Hogan Land Services, it is our understanding that the project will consist of subdividing the existing 1.52 acres parcel into five separate lots, resulting in parcel sizes between 0.20 and 0.44 acres in size. It is our understanding that it is desired to construct a new single-family residence on each of the newly created lots. At the time of this report, the project was in the preliminary design phase and building locations and design concepts have not yet been determined. Therefore, we assume that the structures will probably consist of one or two story, wood frame construction with raised wood or concrete slab-on-grade floors.

Structural foundation loading information for the project was not available at the time of this report. 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.



SCALE 1:24,000

REFERENCE: USGS SANTA ROSA CALIFORNIA QUADRANGLE, DATED 1998.

PJC & Associates, InC. Consulting Engineers & Geologists	SITE LOCATION MAP PROPOSED RESIDENTIAL DEVELOPMENT 2210 BRUSH CREEK ROAD SANTA ROSA, CALIFORNIA	PLATE 1
	Proj. No: S.3046.01 Date: 2/21 App'd by: AJD	

Grading plans were not available at the time of this report. However, we anticipate that the structures will likely be constructed at or near existing grade. Therefore, we assume site grading will probably consist of cuts and fills on the order of four feet and less to achieve the desired grades and to provide adequate site drainage.

2 SCOPE OF SERVICES

The purpose of this investigation was to evaluate the subsurface conditions at the site and to develop geotechnical criteria for design and construction of the project. Specifically, the scope of our services consisted of the following:

a Drill four exploratory boreholes to depths between ten and 50.5 feet below the existing ground surface to observe the soil and groundwater conditions. Our project geologist was on site to observe the drilling, log the materials encountered in the boreholes and to obtain representative samples for visual classification and laboratory testing.

b. Perform laboratory tests on selected samples to evaluate their index and engineering properties.

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, etc.).

d. Perform engineering analyses to develop geotechnical recommendations for site preparation and grading, foundation type(s) and design criteria, lateral earth pressures, slab-on-grade recommendations, site drainage, and construction considerations.

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

3. SITE CONDITIONS

a. General: The site is located in a rural residential area of Santa Rosa, approximately 350 feet north of the intersection of Fountain Grove Parkway and Brush Creek Road. The existing, 1.52 acres parcel is bordered by Lyric Lane and single-family residential parcels to the north, a large, semi-developed parcel to the south, Rincon Creek to the east, and Brush Creek Road to the west. At the time of our investigation, the western area of the site, within the proposed designated remainder, was occupied by an existing single-family residence, swimming pool and landscape areas. The remaining portions of the parcel were undeveloped and covered in perennial grasses and scattered native and non-native trees.

b. Topography and Drainage: The site is located on relatively level to gently sloping topography, with the exception of the steeply sloping banks of Rincon Creek, with maximum estimated natural gradients of one horizontal to one vertical (1H: 1V). According to the United States Geological Survey (USGS) Santa Rosa, California, 7.5 Minute Quadrangle Map (Topographic), the site is situated across elevations between 275 and 255 feet above mean sea level (MSL). No creeks or seasonal drainage swales pass through the site. However, the eastern boundary of the site consists of the western bank of Rincon Creek. The site drainage generally consists of sheet flow and surface infiltration, and is provided by Rincon Creek. Water flow was present during our subsurface exploration, with water depths up to approximately 12 to 18 inches deep in some areas.

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 late Jurassic time. This process involved eastward thrusting of oceanic crust beneath the continental crust (Klamath Mountains and Sierra Nevada) and the scraping off of materials that were 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 in 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 published geologic literature, the site is underlain by two separate Pleistocene to Holocene alluvial deposits. The western area of the site, underlying the designated remainder, consists of alluvial fan and terrace deposits (Qhpf) Consisting of gravel, sand and silt, that commonly includes cobbles and boulders reworked from Tertiary to Pleistocene non-marine gravel, from late Tertiary volcanic rocks and from Mesozoic bedrock. The eastern portions of the site, including the proposed lots 1 through 4, are underlain by undivided alluvial fan and fluvial terrace deposits consisting of gravel, sand and silt, derived primarily from Pleistocene and older sedimentary and igneous units, including older Tertiary to Pleistocene non-marine gravel, late Tertiary volcanic rocks, and Mesozoic bedrock units of the Franciscan Complex, Coast Range ophiolite and Great Valley sequence.

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. Based on our research, the three closest potentially active faults to the site are the Rodgers Creek, Maacama and West Napa faults. The Rodgers Creek fault is located two miles to the southwest, the Maacama fault is located seven miles north and the West Napa fault is located 17 miles southeast of the site. Table 1 outlines the closest known active faults and their associated maximum magnitude.

TABLE 1
CLOSEST KNOWN ACTIVE FAULTS

Fault Name	Distance from Site (Miles)	Maximum Earthquakes (Moment Magnitude)
Rodgers Creek	2	7.0
Maacama	7	6.9
West Napa	17	6.5

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 following subsections of this report.

7. SUBSURFACE CONDITIONS

a. Soils. The subsurface conditions of the site were investigated by drilling four exploratory boreholes (BH-1 through BH-4) near the center of each proposed parcel to depths between ten and 50.5 feet below the existing ground surface. The approximate borehole locations are shown on the Borehole Location Plan, Plate 3. The test pits were used to perform standard penetration tests (SPT), observe the soil and groundwater conditions, and obtain samples for visual examination and laboratory testing. The drilling and sampling procedures, and descriptive borehole logs are included in Appendix A of this report. The laboratory procedures are presented in Appendix B.

The exploratory boreholes generally encountered discontinuous alluvial type soil deposits that extended to the maximum depths explored. At the surface, our exploration encountered young alluvial deposits consisting of sandy clays that extended to depths between three and three and one-half feet below the existing ground surface. The young alluvial sandy clays appeared slightly moist, medium stiff to hard, porous and exhibited medium to high plasticity characteristics. Underlying the young alluvial sandy clays, our exploration encountered older alluvial deposits consisting of sandy clays, gravelly clays, silty clays and clayey sands that extended to the maximum explored depths explored. The older alluvial fine-grained deposits appeared moist to saturated, very stiff to hard and exhibited low to high plasticity characteristics. The older alluvial granular deposits appeared saturated, dense and fine to coarse grained.

b. Groundwater. Groundwater was encountered in BH-1 at a depth of 24.5 feet below the existing ground surface during our subsurface exploration on November 5, 2020. Groundwater was not encountered in the other boreholes. However, groundwater levels can fluctuate by several feet throughout the year due to seasonal rainfall and other factors. Evaluation of these factors is beyond the scope of this report.

8. GEOLOGIC HAZARDS & 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. During our field exploration, we drilled a borehole to a depth of 50.5 feet below the existing ground surface to assess the liquefaction potential at the site. Our field exploration revealed no loose, saturated, granular soil stratums within 50.5 feet of the ground surface at the site. The subsurface conditions consisted primarily of fine-grained soils. The granular deposit our exploration did encounter was dense and contained significant fines contents. Therefore, it is judged that the risk of soil liquefaction at the site is low.

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 eastern portion of the site, within proposed lot 4, is bordered to the east by the banks of Rincon Creek. Based our observations, the banks of Rincon Creek are on the order of ten feet tall, heavily vegetated, and appeared relatively stable, with no signs of major erosional sloughing or slumping. Additionally, the proposed riparian setback for structures adjacent to the creek banks is 80 feet. We judge this to be a sufficient setback distance to avoid significant distress due to potential seismically induced creek bank instability.

e. Expansive Soils. Based on Atterberg Limits testing (PI=20, 33 & 68) and our visual observations, the surface and near surface soils at the site are judged to have a moderate to very high expansion potential.

9. CONCLUSIONS

Based on our field and office studies, we judge that from a geotechnical engineering standpoint, the project is feasible provided the recommendations presented in this report are incorporated into the design and carried out through construction. The primary geotechnical concerns in design and construction of the project are the presence of weak, compressible and expansive surface and near surface soils.

The surface and near surface alluvial soils are weak and compressible, and are not suitable for support of fills, foundations, or slabs. These soils could experience significant differential settlement under loads generated by new construction. Furthermore, based on our visual observations and laboratory testing (PI=20, 33 & 68), the surface and near surface have a moderate to very high expansion potential. Shrinking and/or swelling of these materials due to loss or increase of moisture content can cause irregular and excessive ground movement and distress and damage to foundations. Therefore, if raised wood floors are desired in living areas, it will be necessary to extend the foundations through the zone of significant moisture variation, and into the underlying firm, native soils. This can be accomplished with a drilled pier and grade beam foundation system.

It is our understanding that slabs-on-grade may be utilized in living areas as well. Therefore, to mitigate the potential effects of the expansive soils, we recommend that all structures utilizing concrete slabs-on-grade be supported on a 30 inch thick blanket of imported, non-expansive compacted engineered fill. Provided all structures are supported on at least 30 inches of imported non-expansive engineered fill, shallow spread footings and conventional concrete slabs-on-grade may be used. Furthermore, the slabs-on-grade should be provided with underslab drains to prevent hydrostatic uplift and control seepage, as shown on Plate 2.

The project was in the preliminary design stages at the time of this report, when the proposed building envelopes and design concepts are determined, we should review the proposed design and if necessary, revise the recommendations of this report. Additional subsurface exploration and laboratory testing may be required.

Detailed geotechnical engineering recommendations for use in design and construction of the project are presented in the subsequent sections of this report.

10. EARTHWORK & GRADING-GENERAL

We anticipate site grading will probably consist of cuts and fills on the order of feet and less to achieve the desired pad grades and to provide adequate gradients for site drainage.

a. Stripping. Structural areas should be stripped of the surface vegetation, old fills, debris, underground utilities, etc. These materials should be moved off site; some of them, if suitable could be stockpiled for later use in landscape areas. If underground utilities pass through the site, we recommend that these utilities be removed in their entirety or rerouted where they exist outside an imaginary plane sloped one horizontal to one vertical (1H:1V) from the outside bottom edge of the nearest foundation element. Voids left from the removal of utilities or other obstructions should be replaced with compacted engineered fill under the observation of the project geotechnical engineer. All wells, septic systems and leach fields should be abandoned and plugged according to regulations set forth by the Sonoma County Health Department.

b. Excavation and Compaction. Following site stripping, areas to receive fill should be prepared by removing the unsuitable surface and near surface soils and exposing firm native soils, as determined by the geotechnical engineer in the field during construction. Areas that are scheduled to receive fill should be scarified to a minimum depth of eight inches, moisture conditioned to at least three percent over optimum moisture content, and recompacted to at least 90 percent of relative maximum dry density as determined by ASTM D-1557 test procedures

All fill material should be placed and compacted in accordance to the recommendations presented in Table 2. It is recommended that any import fill to be used on site be of a low to non-expansive nature and should meet the following criteria:

Plastic Index	less than 12
Liquid Limit	less than 35
Percent Soil Passing #200 Sieve	between 15% and 35%
Maximum Aggregate Size	4 inches

The existing on-site soils, free of organics and rocks larger than six inches in dimension, are suitable for use as compacted engineered fill. All fills should be placed in lifts no greater than eight inches in loose thickness and compacted to the general recommendations provided for engineered fill.

TABLE 2
SUMMARY OF COMPACTION RECOMMENDATIONS

Area	Com action Recommendations*
General Engineered Fill (Import)	In lifts, a maximum of eight inches loose thickness, compact to a minimum of 90 percent relative com action at or near o timum moisture content.
General Engineered Fill (Native)	In lifts, a maximum of eight inches loose thickness, compact to 90 percent relative compaction at least three percent over optimum moisture content.
Trenches" (!=p <)	Compact to at least 90 percent relative compaction at or near optimum moisture content.

*All compaction requirements stated in this report refer to dry density and moisture content relationships obtained through the laboratory standard described by ASTM D-1557-91
"Depths below finished subgrade elevations

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.

Generally, grading is most economically performed during the summer months when on-site soils are usually dry of optimum moisture content. Delays should be anticipated in site grading performed during the rainy season or early spring due to excessive moisture in the on-site soils. Special and relatively expensive construction procedures should be anticipated if grading must be completed during the winter and early spring.

Cut and fill slopes should be no greater the two horizontal to one vertical (2H:1V). Slopes steeper than 2H: 1V should be retained. Disturbed slopes should be planted with deep rooted groundcover to control erosion.

11. EARTHWORK AND GRADING-SELECT IMPORT BUILDING PADS

We anticipate that site grading for the select import building pads will probably consist of minor cuts and fills of four feet and less to achieve the desired pad elevations and to provide adequate gradients for site drainage.

a. Stripping. Structural areas should be stripped of the surface vegetation, old fills, debris, underground utilities, etc. These materials should be moved off site; some of them, if suitable could be stockpiled for later use in landscape areas. If underground utilities pass through the site, we recommend that these utilities be removed in their entirety or rerouted where they exist outside an imaginary plane sloped one horizontal to one vertical (1H: 1V) from the outside bottom edge of the nearest foundation element. Any existing wells, septic systems and leach fields should be abandoned and plugged according to regulations set forth by the Sonoma County Health Department. Voids left from the removal of utilities or other obstructions should be replaced with compacted engineered fill under the observation of the project geotechnical engineer.

b. Excavation and Compaction. The top 30 inches beneath the building pads should consist of a non-expansive material meeting the requirements for import fill given in the following sections of this report. The weak and unsuitable soils should be removed to their full depth, and firm exposed within the select import building pads. The select fill should be placed on firm native soils or subexcavated and recompacted native soils. The lateral extent of the subexcavation and non-expansive import should be a minimum of five feet beyond the foundations and three feet beyond exterior flatwork and pavements. The thickness of select import in flatwork and pavement areas may be reduced to 18 inches below the subgrade elevation.

All subgrades scheduled to receive fill should be scarified to minimum depth of eight inches, moisture conditioned to a moisture content at least three percent over optimum moisture content, and recompacted to at least 90 percent of the materials relative maximum dry density as determined by ASTM D-1557 test procedures. All fill material should be placed and compacted in accordance to the recommendations presented in Table 3. It is recommended that any import fill to be used on site be of a low to non-expansive nature and should meet the following criteria:

Plastic Index	less than 12
Liquid Limit	less than 35
Percent Soil Passing #200 Sieve	between 15% and 35%
Maximum Aggregate Size	4 inches

The existing site soils, free of organics and rocks larger than four inches in dimension, are suitable for use as compacted engineered fill. All fills should be placed in lifts no greater than eight inches in loose thickness and compacted to the general recommendations provided for engineered fill.

TABLE 3
SUMMARY OF COMPACTION RECOMMENDATIONS

Area	Compaction Recommendations*
General Engineered Fill (Import)	In lifts, a maximum of eight inches loose thickness, compact to a minimum of 90 percent relative compaction near optimum moisture content.
General Engineered Fill (Native)	In lifts, a maximum of eight inches loose thickness, compact to 90 percent relative compaction at least three percent over optimum moisture content.

*All compaction requirements stated in this report refer to dry density and moisture content relationships obtained through the laboratory standard described by ASTM D-1557

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.

Generally, grading is most economically performed during the summer months when on-site soils are usually dry of optimum moisture content. Delays should be anticipated in site grading performed during the rainy season or early spring due to excessive moisture in the on-site soils.

Special and relatively expensive construction procedures should be anticipated if grading must be completed during the winter and early spring.

Cut and fill slopes should be no steeper than two horizontal to one vertical (2H:1V). Steeper slopes should be retained. Disturbed slopes should be planted with deep rooted groundcover to reduce and control erosion.

12. FOUNDATIONS: DRILLED CAST-IN-PLACE PIERS

a. Vertical Loads. The structures may be supported by a drilled, concrete cast-in-place pier and grade beam foundation system extending through the weak and compressible soils, zone of significant moisture variation, and into the underlying firm native soils. The drilled piers should have a minimum diameter of 12 inches and be spaced at least three pier diameters center to center. The piers will derive their support through peripheral friction. Perimeter and interior piers should extend at least nine feet below the finish ground surface and at least six feet into firm native soils. The piers should be reinforced and designed by the project structural engineer. Perimeter and interior piers supporting continuous wall loads should be tied together with grade beams. The grade beams should be designed to span between the piers in accordance with structural requirements.

The portion of the piers extending at least three feet beneath the finished ground surface may be designed using an allowable dead plus live skin friction of 600 pounds per square foot (psf). This value may be increased by one-third for short duration wind and seismic loads. End bearing should be neglected because of difficulty in cleaning out small diameter pier holes and the uncertainty of mobilizing skin friction and end bearing simultaneously. A value equal to one-half the downward capacity of the pier may be used to resist uplift forces. An uplift swelling pressure of 1500 psf should be used for the design of the grade beam.

b. Lateral Loads. Lateral loads resulting from wind or earthquake can be resisted by the pier through a combination of cantilever action and passive resistance of the soils surrounding the pier. A passive equivalent fluid pressure of 250 psf/ft acting on two pier diameters should be used. The upper three feet of soil should be neglected for passive resistance.

c. Settlement. The maximum and differential settlements of the piers is estimated to be small and within tolerable limits.

If groundwater is encountered, it may be necessary to de-water the holes and/or place concrete by the tremie method. If caving soils are encountered, it may be necessary to case the holes.

13. FOUNDATIONS: CONVENTIONAL SPREAD FOOTINGS

a. Vertical Loads. Provided the earthwork and grading recommendations for the select import building pads are performed, the structures may be adequately supported by conventional spread footings extending at least 12 inches into imported, non-expansive compacted engineered fill. All footings should be reinforced. The recommended soil bearing pressures, depths of embedment and minimum width of spread footings are presented in Table 4. The bearing values provided have been calculated assuming that all footings bear on at least 12 inches of compacted engineered fill.

TABLE 4
FOUNDATION DESIGN CRITERIA

Footing Type	Bearing Pressure (psg*	Minimum Embedment (in)"	Minimum Width (in)
Continuous Wall	2000	12	12
Isolated Column	2500	12	18

*Dead plus live load
"* Depth into engineered fill.

The allowable soil bearing pressures are net values. The weight of the foundation and backfill over the foundation may be neglected when computing dead loads. Allowable soil bearing pressures may be increased by one-third for transient applications such as wind and seismic loads.

b. Lateral Loads. Resistance to lateral forces may be computed by using friction or passive pressure. A friction factor of 0.35 is considered appropriate between the bottom of the concrete structures and engineered fill. A passive pressure equivalent to that exerted by a fluid weighing 350 pounds per square foot per foot of depth (psf/ft) is recommended. Unless restrained at the surface, the upper six inches should be neglected for passive resistance.

Footing concrete should be placed neat against engineered fill. Footing excavations should not be allowed to dry before placing concrete. If shrinkage cracks appear in the footing excavations, the soil should be thoroughly moistened to close all cracks prior to concrete placement.

c. Settlement. Total settlement of individual foundations will vary depending on the width of the foundation and the actual load supported. Foundation settlements have been estimated based on the bearing values provided. Maximum settlements of shallow foundations designed and constructed in accordance with the preceding recommendations are estimated to be less than one inch. Differential settlement between similarly loaded, adjacent footings are expected to be less than one-half of one inch. The majority of the settlement is expected to occur during construction and placement of dead loads.

14. SLAB-ON-GRADE

All interior slabs-on-grade should be constructed entirely on 30-inch thick blanket of imported, non-expansive compacted, engineered fill prepared in accordance with the earthwork and grading recommendation for select import building pads contained in this report. All slabs should be supported on at least six inches of clean gravel or crushed rock to provide a capillary moisture break and provide uniform support for the slab. 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.

We recommend that the gravel be placed as soon as possible after compaction of the subgrade to prevent drying of the subgrade soils. If the subgrade is allowed to dry out prior to slab-on-grade construction, the subgrade soils should be moisture conditioned by sprinkling prior to concrete placement.

We recommend that slabs be at least five inches thick and designed and reinforced as determined by the project structural engineer. Special care should be taken to insure that reinforcement is placed at the slab mid-height.

For slabs-on-grade with moisture sensitive surfacing, we recommend that an impermeable membrane be placed over the rock to prevent migration of moisture vapor through the concrete slab. Furthermore, the slabs-on-grade should be provided with underslab drains to prevent hydrostatic uplift and control seepage, as shown on Plate 2.

15. SEISMIC DESIGN

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. Based on the data reviewed, it is concluded that the project site could be subjected to seismic shaking resulting from earthquakes on the active faults primarily in the Coast Ranges. For design, a site class type D, spectral accelerations of Ss of 2.524 g and S1 Of 0.964 g are recommended. A ground motion hazard analysis was not performed as it is assumed that the structural seismic design will be performed in accordance with Exception 2 of Section 11.4.8 of ASCE 7-16.

16. UTILITY TRENCHES

Shallow excavations for footings and utility trenches can be readily made with either a backhoe or trencher; larger earth moving equipment should be used for deeper excavations. We expect the walls of trenches less than five feet deep, excavated into engineered fill or native soils, to remain in a near vertical configuration during construction provided no equipment or excavated soil surcharges are located near the top of the excavation. Where trenches extend deeper than five feet, the excavation may become unstable. All trenches regardless of depth, should be evaluated to monitor stability prior to personnel entering the trenches. Shoring or sloping of any deep trench wall may be necessary to protect personnel and to provide stability. All trenches should conform to the current CAL-OSHA requirements for worker safety.

We recommend trenches be backfilled with granular import fill and compacted to at least 90 percent of maximum dry density. The moisture content of compacted backfill soils should be within two percent of optimum moisture content. Jetting should not be used.

Special care should be taken in the control of utility trench backfilling in pavement areas. Poor compaction may cause excessive settlements resulting in damage to the pavements. In pavement areas, the top eight inches of trench backfill should be compacted to at least 95 percent relative compaction.

17. DRAINAGE

All final grades should be provided with positive gradients away from foundations to provide rapid removal of surface water runoff to an adequate discharge point. No ponding of water should be allowed on the building pads or adjacent to foundations.

The use of continuous roof gutters is recommended to reduce the possibility of soil saturation adjacent to the buildings. Downspouts from gutters should be discharged onto an impermeable surface such as pavement or into a closed conduit discharging a minimum of eight feet away from the structures.

We recommend that foundation subdrains be placed adjacent to all foundations, except the downhill foundation. The foundation subdrains should extend at least 12 inches below the interior subgrade. The subdrain should consist of a heavy walled four-inch diameter perforated pipe. The bottom of the trench should be sloped to drain by gravity and lined with a few inches of three quarter to one and a half inch-drain rock. The trench should then be backfilled to within six inches of finished surface with drain rock. The upper few inches should consist of compacted soil to reduce surface water inclusion. We recommend that a drainage filter cloth be placed between the soil and the drain rock or Class II permeable material be used in lieu of the filter fabric and drain rock. Furthermore, slabs-on-grade should be provided with underslab drains to prevent hydrostatic uplift and control seepage, as shown on Plate 2. Roof downspouts and surface drains must be maintained entirely separate from subdrains.

18. LIMITATIONS

The data, information, interpretations and recommendations in this report are presented solely as bases and guides for the geotechnical design of the proposed residential development located at 2210 Brush Creek Road in Santa Rosa, California. The conclusions and professional opinions presented herein were developed in accordance with generally accepted geotechnical engineering principles and practices. As with all geotechnical reports, the opinions expressed here are subject to revisions in light of new information, which may be developed in the future, and no warranties are either expressed or implied.

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 purpose 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 and approved in writing. This report and the drawings contained herein are intended only for the design of the proposed project. They are not intended to act by themselves as construction drawings or specifications.

Soil deposits may vary in type, strength, and many other important properties between the 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 PJC does not and cannot have complete knowledge of the subsurface conditions underlying the subject site. The criteria presented are based upon the findings at the points of exploration and upon 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 verify that the design is consistent with the recommendations of this report. During the course of this investigation, several assumptions were made regarding building loads and 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 be provided by PJC to verify that the intent of the plans and specifications is carried out during construction; these services should include observing the foundation excavations, field density testing of fill, and installation of the subsurface drainage facilities.

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

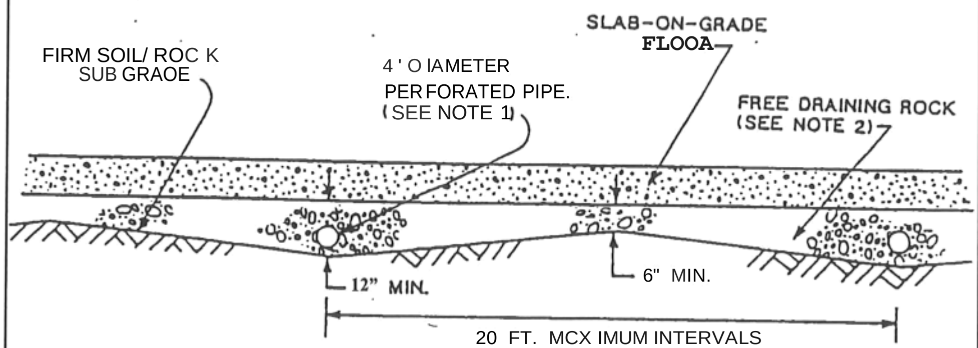
It has been a pleasure working with you on this project. Please call us if you have any questions regarding the results of this investigation, or if we can be of further assistance.

Sincerely,

PJC & Associates, Inc.

Donald A. Whyte
Project Geologist
PG 9109, California

Anthony J. DeMartini
Geotechnical Engineer
GE 2750, California



Notes:

1. PERFORATED PIPE (PVC OR EQUIVALENT) SHOULD BE PLACED WITH PERFORATIONS DOWN. THE PIPE SHOULD BE SLOPED FOR GRAVITY FLOW AND OUTLET THROUGH SOLID PIPE TO DAYLIGHT.

2. DRAIN ROCK SHOULD BE AT LEAST 6" THICK AND A MINIMUM OF 12" WHERE PIPES ARE LOCATED. THE DRAIN ROCK SHOULD BE / OR '‹ INCH DRAIN ROCK ON FILTER FABRIC OR CONSIST OF CLASS II PERMEABLE MATERIAL.

PJC & Associates, Inc.
Consulting Engineers & Geologists

SLAB UNDERDRAIN SYSTEM
PROPOSED RESIDENTIAL DEVELOPMENT
2210 BRUSH CREEK ROAD
SANTA ROSA, CALIFORNIA

PLATE
2

Proj. No: 53046.01 | Date: 2/21 | App'd by: AJD

APPENDIX A
FIELD INVESTIGATION

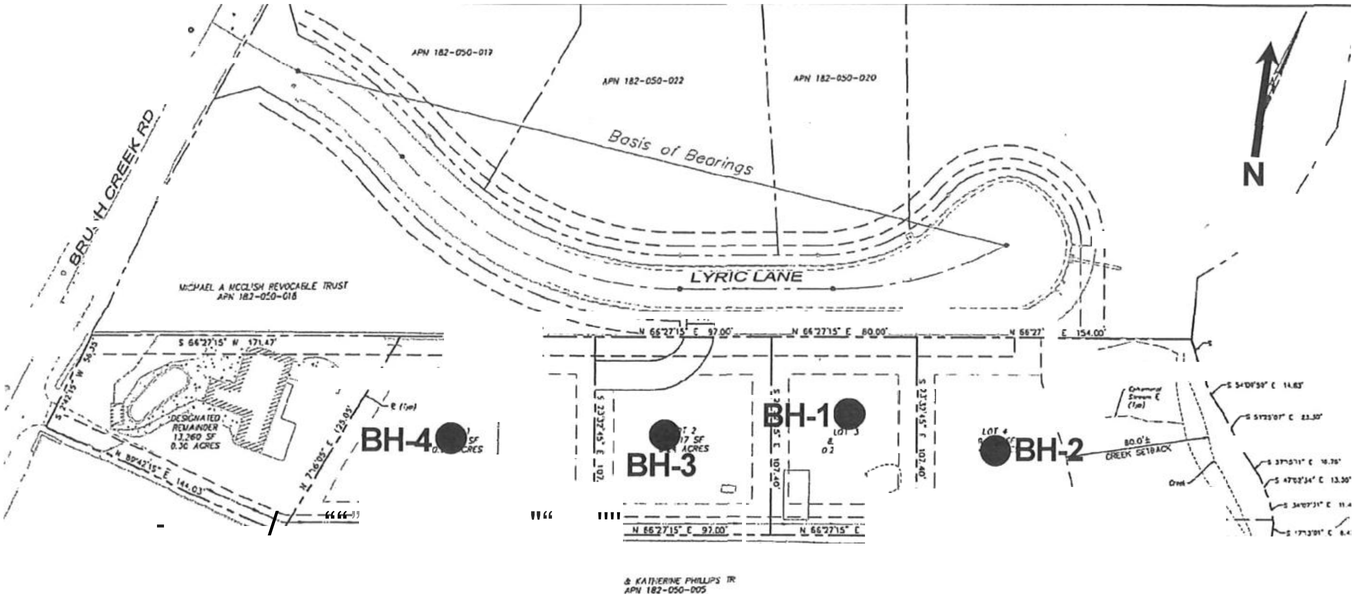
1. INTRODUCTION

The field program performed for this study consisted of drilling four exploratory boreholes (BH-1 through BH-4) in the vicinity of the proposed structures. The exploration was completed on November 5, 2020. The approximate borehole locations are shown on the Borehole Location Plan, Plate 3. Descriptive logs of the boreholes are presented in this appendix as Plates 4 through 7.

2 BOREHOLES

The boreholes were advanced using a truck mounted Mobile B-53 drill with hollow stem augers. The drilling was performed under the observation of a project geologist of PJC who maintained a continuous log of soil 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.

Relatively undisturbed and disturbed samples were obtained from the exploratory boreholes. A 2.43 in I.D. California Modified Sampler, or a 1.5 in 1. D. Standard Sampler, was driven into the underlying soil using an automatic trip hammer with a 140 pound hammer falling 30 inches to obtain an indication of the density of the materials and to allow visual examination of at least a portion of the soil column. Samples obtained with the split-spoon sampler were retained for further observation and testing. The number of blows required to drive the sampler at six-inch increments was recorded on each borehole log. All samples collected were labeled and transported to PJC's office for examination and laboratory testing.



EXPLANATION

@ BOREHOLE LOCATION AND DESIGNATION

NO SCALE

REFERENCE: SITE PLAN PREPARED BY ADOBE ASSOCIATES INC., SHEET C1.0, DATED MAY 20, 2020.

PJC & Associates, Inc.
Consulting Engineers & Geologists

BOREHOLE LOCATION PLAN
PROPOSED RESIDENTIAL DEVELOPMENT
2210 BRUSH CREEK ROAD
SANTA ROSA, CALIFORNIA

PLATE

3

Pro”. No:53046.01 Date:2/21 A 'd b :AJD

PJC & ASSOCIATES, INC.
P.O. BOX 469
SONOMA, CA 95476
Telephone: (707) 935-3747
Fax: (707) 935-3587

BORING NUMBER BH-1; PLATE 4

CLIENT NILS WELIN & KLAS BERGHEDE
PROJECT NAME PROPOSED RESIDENTIAL DEVELOPMENT
PROJECT NUMBER 53046.01
PROJECT LOCATION 2210 BRUSH CREEK ROAD; SANTA ROSA, CA
DATE STARTED 11/5/20 COMPLETED 11/5/20
GROUND ELEVATION ______ HOLE SIZE 6"
DRILLING CONTRACTOR Pearson Drilling
GROUND WATER LEVELS:
DRILLING METHOD *MOBILE B-53 W/ HOLLOW STEM AUGER
AT TIME OF DRILLING 24.50 ft
LOGGED BY D.W. CHECKED BY AJ
AT END OF DRILLING
NOTES
AFTER DRILLING ---

DEPTH	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (P_0	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT
0		0.0'-3.5'; SANDY CLAY (CL); brown, moist, medium stiff to stiff, medium plasticity. (YOUNG ALLUVIUM)	MC		10-13 (23)	1.0	88	15				
		3.5'-5.5'; SANDY CLAY (CL); moderate brown, moist, hard, low plasticity, with gravel. (OLDER ALLUVIUM)	M		17-19 (36)	4.5+	109	12				
		5.5'-8.0'; GRAVELLY CLAY (CH); orange-brown, moist, hard, high plasticity. (OLDER ALLUVIUM)	M		**17-30 (47)**	**4.5+**	**109**	**13**				
		8.0'-13.0'; SILTY CLAY (CH); fig ht yellowish gray, very moist, very stiff, high plasticity. (OLDER ALLUVIUM)	MC		8-12 (20)	3.25	83	36				
		13.0'-18.0", SANDY CLAY (CL); moderate brown,very moist, very stiff, medium plasticity, with coarse sands and few gravels. (OLDER ALLUVIUM)	MC		12-15 (27)	3.75	90	29				
		18.0'-20.5'; SANDY CLAY (CL); olive brown,very moist, very stiff, low plasticity, with fine to medium grained sands. (OLDER ALLUVIUM)	MC		8-11 (19)	2.0 3.5	96 96	25 28				52
		20.5'-28.0", SANDY CLAY (CL); g ray, very moist to saturated, very stiff to hard, medium plasticity. (OLDER ALLUVIUM)										

(Continued Next Page)

PJC & ASSOCIATES, INC.
P.O. BOX 469
SONOMA, CA 95476
Telephone: (707) 935-3747
Fax: (707) 935-3587

BORING NUMBER BH-1; PLATE 4

CLIENT NILS WELIN & KLAS BERGHEDE

PROJECT NAME PROPOSED RESIDENTIAL DEVELOPMENT

PROJECT NUMBER 53046.01

PROJECT LOCATION 2210 BRUSH CREEK ROAD; SANTA ROSA, CA

DEPTH	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT.	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT
25		20.5'-28.0'; SANDY CLAY (CL); gray, very moist to saturated, very stiff to hard, medium plasticity. (OLDER ALLUVIUM) *(continued)*	MC		17-21 (38)	4.0	96	28				
30		28.0'-32.0'; SANDY CLAY (CL); dark bluish gray, saturated, very stiff, low plasticity, with coarse sand. (OLDER ALLUVIUM)	SPT		6-9 (15)			28	32	18	14	65
35		32.0'-38.0'; SILTY CLAY (CH); gray, saturated, hard , high plasticity. (OLDER ALLUVIUM)	SPT		8-13 (21)			26				
40		38.0'-41.5'; SANDY CLAY (CL); brown, saturated, very stiff to hard, medium to high plasticity. (OLDER ALLUVIUM)	MC		15-21 (36)	4.5+		24				
45		41.5'-50.5'; CLAYEY SAND (SC); mottled gray and orange-brown, saturated, dense, fine to coarse grained. (OLDER ALLUVIUM) (N,)„ =36 @ 45.0'	S		13-16 (29)			25				
50		(N,)„ =30 @ 50. 0'	S		10-15 (25)			22				49

BOREHOLE TERMINATED AT 50.5 FEET.

Bottom of borehole at 50.5 feet.

PJC & ASSOCIATES, INC.
P.O. BOX 469
SONOMA, CA 95476
Telephone: (707) 935-3747
Fax: (707) 935-3587

BORING NUMBER BH-2; PLATE 5

CLIENT NILS WE LIN & KLAS BERGHEDE
PROJECT NAME PROPOSED RESIDENTIAL DEVELOPMENT
PROJECT NUMBER 53046.01
PROJECT LOCATION 2210 BRUSH CREEK ROAD; SANTA ROSA, CA
DATE STARTED 11/5/20 COMPLETED 11/5/20
GROUND ELEVATION HOLE SIZE 6"
DRILLING CONTRACTOR Pearson Drilling
GROUND WATER LEVELS:
DRILLING METHOD *MOBILE B-53 W/ FLIGHT AUGER
AT TIME OF DRILLING
LOGGED BY D.W. CHECKED BY AJ
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT.	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT
0.0	0.0'-3.0'; SANDY CLAY (CH); brown, moist, stiff to very stiff, porous, high plasticity. (YOUNG ALLUVIUM)										
		MC		14-19 (33)	4.5+	103	19 / 17	51	18	33	
	3.0'-4.5'; SANDY CLAY (CL); light brown, moist, hard, low plasticity, with gravel. (OLDER ALLUVIUM)										
	4.5'-9.0'; SANDY CLAY (CH); mottled orange, brown, and gray, moist to very moist, hard, high plasticity, with gravel. (OLDER ALLUVIUM)	MC		15-17 (32)		102	19				
		MC		12-20 (32)	4.5+	97	26				
	9.0'-13.5'; SANDY CLAY (CL); gray with minor orange mottling, very moist, hard, medium plasticity, with gravel. (OLDER ALLUVIUM)										
		MC		18-21 (39)	4.5	104	22				

BOREHOLE TERMINATED AT 13.5 FEET.

Bottom of borehole at 13.5 feet.

PJC & ASSOCIATES, INC.
P.O. BOX 469
SONOMA, CA 95476
Telephone: (707) 935-3747
Fax: (707) 935-3587

BORING NUMBER BH-3; PLATE 6

CLIENT NILS WE LIN & KLAS BERGHEDE
PROJECT NAME PROPOSED RESIDENTIAL DEVELOPMENT
PROJECT NUMBER 53046.01
PROJECT LOCATION 2210 BRUSH CREEK ROAD; SANTA ROSA, CA
DATE STARTED 11/5/20 COMPLETED 11/5/20
GROUND ELEVATION HOLE SIZE 6"
DRILLING CONTRACTOR Pearson Drilling
GROUND WATER LEVELS:
DRILLING METHOD *MOBILE B-53 W/ FLIGHT AUGER
AT TIME OF DRILLING ---
LOGGED BY D.W. CHECKED BY AJ
AT END OF DRILLING
NOTES
AFTER DRILLING -

DEPTH	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN.	DRY UNIT WT. fP fi	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT
0.0		0.0'-3. 0'; SANDY CLAY (CL); brown, moist, stiff to hard, porous, medium plasticity, with few gravels. (YOUNG ALLUVIUM)										
			MC		10-19 (29J	4.5+		13	37	17	20	
		3.0'-7.0'; SANDY CLAY (CH); olive brown, moist, very stiff, high plasticity. (OLDER ALLUVIUM)										
			SPT		6-11 (17)			19				
		7.0'-10.0'; SANDY CLAY (CH); pale yellow brown, very moist, stiff, high plasticity. (OLDER ALLUVIUM)										
			SPT		**5-7 (12)**			37				

BOREHOLE TERMINATED AT 10.0 FEET.
Bottom of borehole at 10.0 feet.

PJC & ASSOCIATES, INC.
P.O. BOX 469
SONOMA, CA 95476
Telephone: (707) 935-3747
Fax: (707) 935-3587

BORING NUMBER BH-4; PLATE 7

CLIENT NILS WELIN & KLAS BERGHEDE
PROJECT NAME PROPOSED RESIDENTIAL DEVELOPMENT
PROJECT NUMBER 53046.01
PROJECT LOCATION 2210 BRUSH CREEK ROAD; SANTA ROSA, CA
DATE STARTED 11/5/20 COMPLETED 11/5/20
GROUND ELEVATION HOLE SIZE 6"
DRILLING CONTRACTOR Pearson Drilling
GROUND WATER LEVELS:
DRILLING METHOD "MOBILE B-53 W/ FLIGHT AUGER
AT TIME OF DRILLING
LOGGED BY D.W. CHECKED BY AJ
AT END OF DRILLING
NOTES
AFTER DRILLING -

DEPTH	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT.	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT
0 0		0.0'-3.0'; SANDY SILT WITH CLAY (CL); moderate brown, moist, medium stiff, medium plasticity. (YOUNG ALLUVIUM)										
								18				
		3.0'-5.0'; SANDY CLAY (CH); olive brown, moist, very stiff, high plasticity. (OLDER ALLUVIUM)	MC		7-12 (19)	4.5+	89	26	92	24	68	
		5.0'-9.0'; SANDY CLAY (CL); mottled orange, brown and gray, very moist, hard, medium plasticity, with gravel. (OLDER ALLUVIUM)	MC		23-50 (73)	4.5+	90	27				
			SPT		33-50 (83)			25				
		9.0'-11.5'; SANDY CLAY (CL); dark reddish brown, very moist, very stiff to hard, medium plasticity. (OLDER ALLUVIUM)										
			SPT		14-24 (38)			36				

BOREHOLE TERMINATED AT 11.5 FEET.

Bottom of borehole at 11.5 feet.

MAJOR DIVISIONS				TYPICAL NAMES
COARSE GRAINED SOILS More than hall is larger than J/200 sieve	GRAVELS **more than half coarse fraction is larger 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 MIXTURES
			GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND MIXTURES
	SANDS **more than half** coarse fraction is smaller than no. 4 sieve size	CLEAN SANDS WITH LITTLE **QR NO FINES**	SW	WELL GRADED SANDS, GRAVELLY SANDS
			s	POORLY GRADED SANDS, GRAVEL-SAND MIXTURES
		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 #20£I sieve	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS, SILTY OR CLAYEY FINE SANDS, VERY F/NE SANOS, ROCK FLOUR, CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS OR 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 DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	iuoRGAxic cars *or* nice wmSTiGJTY, FAT CLAYS
			OH.	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS

KEY TO TEST DATA

Shear Strength, psf

Confining Pressure, psf

LL — Liquid Limit (in %)	”Tx	320	(2600)	Unconsolidated Undrained Triaxial
PL — Plastic Llmit (in %)	Tx CU	320	(2600)	Consolidated Undrained Triaxial
G — Specific Gravity	DS	2750	(2000)	Consolidated Drained Direct Shear
SA — Sieve Analysis	FVH	470		Field Vane Shear
Consol — Consolidation	“UC	look		Unconfined *Compression*
"Undisturbed" Sample	LVS	700		Laboratory Vane Shear

Bulk or Disturbed Sample

No Sample Recovery

Notes: (1) All strength tests on 2.8” or 2.4' diameter sample unless otherwise indicated

(2) ” I0diCates 1.4‘ diameter sample

%% PJC & Associates, Inc.

Consulting Engineers & Geologists

USCS SOIL CLASSIFICATION KEY
PROPOSED RESIDENTIAL DEVELOPMENT
2210 BRUSH CREEK ROAD
SANTA ROSA, CALIFORNIA

PLATE

8

Proj. No: 53046.01 Date: 2/21 **App’d by; AJD**

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 and "undisturbed" 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 borehole 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 a 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 and dry density, pocket penetrometer, Atterberg Limits testing and grain-size distribution.

a. Natural Water Content and Dry Density. Natural water content and dry density of the samples were determined on selected undisturbed samples. The samples were extruded, visually classified, trimmed to obtain a smooth flat face, and accurately measured to obtain volume and 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 and dry density calculated. The water content and dry density results are summarized on the borehole log, Plate 4 through 7.

b. Pocket Penetrometer. Pocket Penetrometer tests were performed on cohesive samples. The test estimates the unconfined compressive strength of a cohesive material by measuring the materials resistance to penetration by a calibrated, spring-loaded cylinder. The maximum capacity of the cylinder is 4.5 tons per square foot (tsf). The results of these test are indicated on the borehole logs.

c. Atterberg Limits. Liquid and plastic limits were determined on selected samples in accordance with ASTM D4318-83. The results of the limits are summarized on Plate 9.

d. Percent Passing #200 Sieve. The samples were soaked in water until individual soil particles were separated and then washed on the No. 200 mesh sieve. That portion of the material retained on the No. 200 mesh sieve was then oven-dried. The results are presented on Plate 10.

3. ENGINEERING PROPERTIES

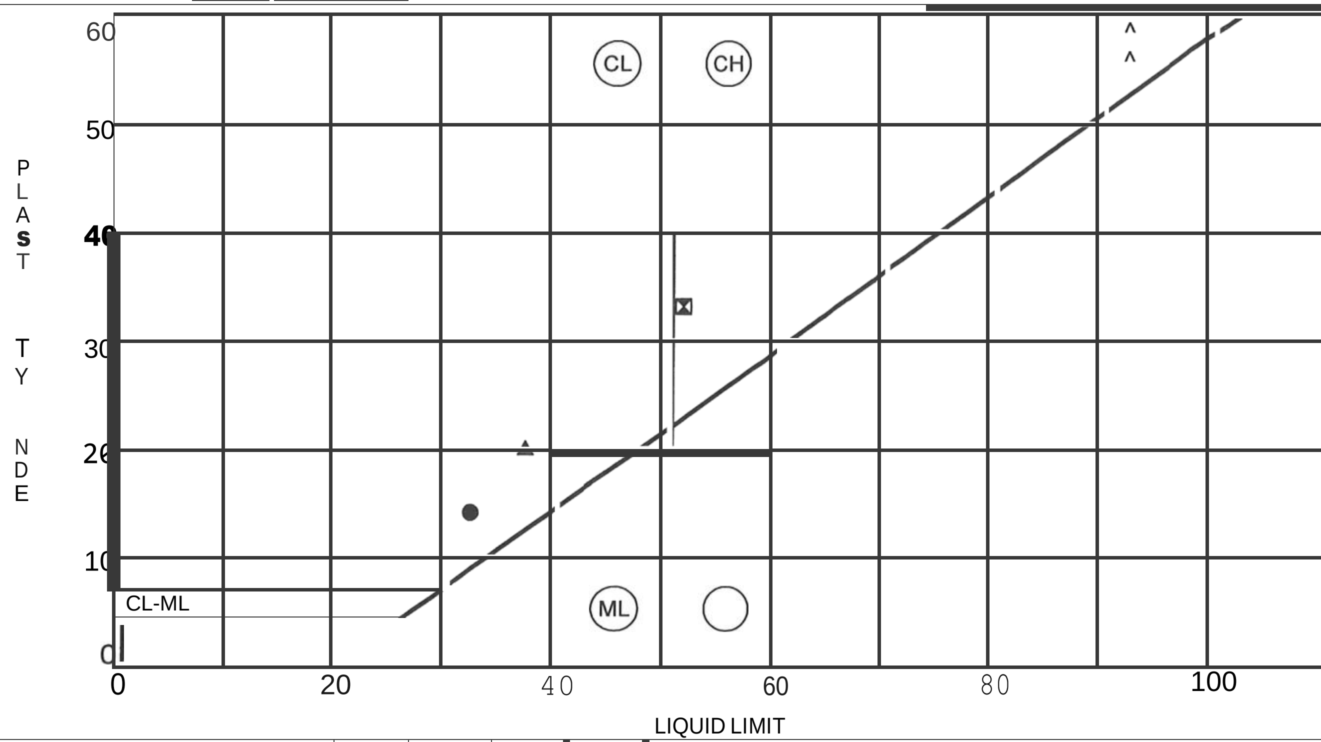
The engineering properties testing consisted of unconfined compression testing.

a. Unconfined Compression Test. Unconfined compression tests were performed on an intact sample obtained from the boreholes. In the unconfined compression test, the shear strength is determined by axial loading the sample under a slow constant strain rate until failure is obtained. Failure stress is defined as the maximum stress at ten percent strain. The results of these tests are presented on Plate 11.

PJC & ASSOCIATES, INC.
P.O. BOX 469
SONOMA, CA 95476
Telephone: (707) 935-3747
Fax: (707) 935-3587

ATTERBERG LIMITS' RESULTS
PLATE 9

CLIENT Nils Welin & Klas Berghede
PROJECT NAME Proposed Residential Development
PROJECT NUMBER S3046.01
PROJECT LOCATION 2210 Brush Creek Road, Santa Rosa



Specimen Identification		LL	PL	PI	Fines	Classification
BH-1	30.0	32	18	14	65	DARK BLUISH GRAY SANDY CLAY (CL)
BH-2	2.5	51	18	33		BROWN SANDY CLAY (CH)
BH-3	1.5	37	17	20		BROWN SANDY CLAY (CL)
BH-4	3.0	92	24	68		OLIVE BROWN SANDY CLAY (CH)

PJC & ASSOCIATES, INC.
P.O. BOX 469
SONOMA, CA 95476
Telephone: (707) 935-3747
Fax: (707) 935-3587

GRAIN SIZE DISTRIBUTION

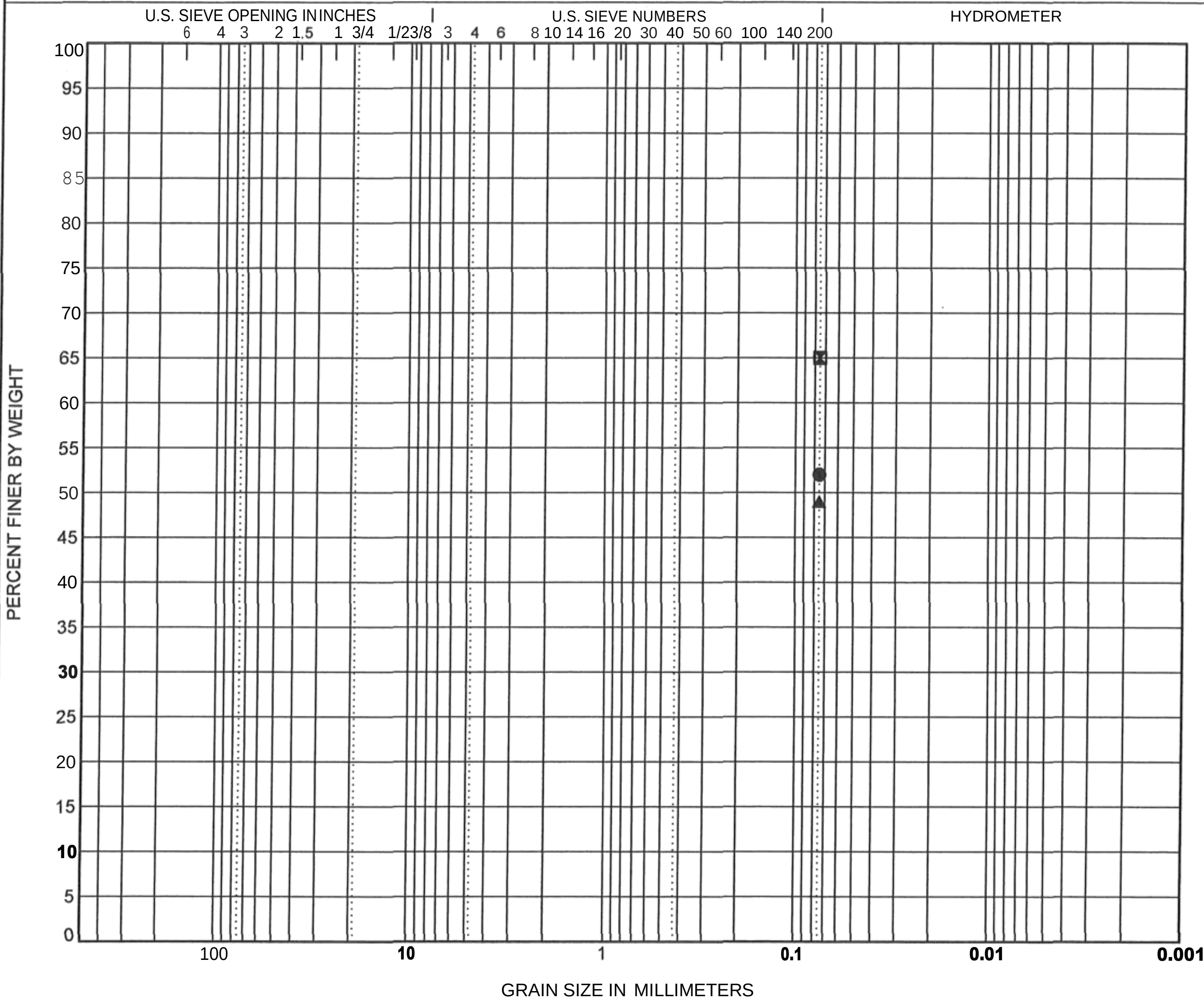
PLATE 10

CLIENT Nils Welin & Klas Berghede

PROJECT NAME Proposed Residential Development

PROJECT NUMBER 53046.01

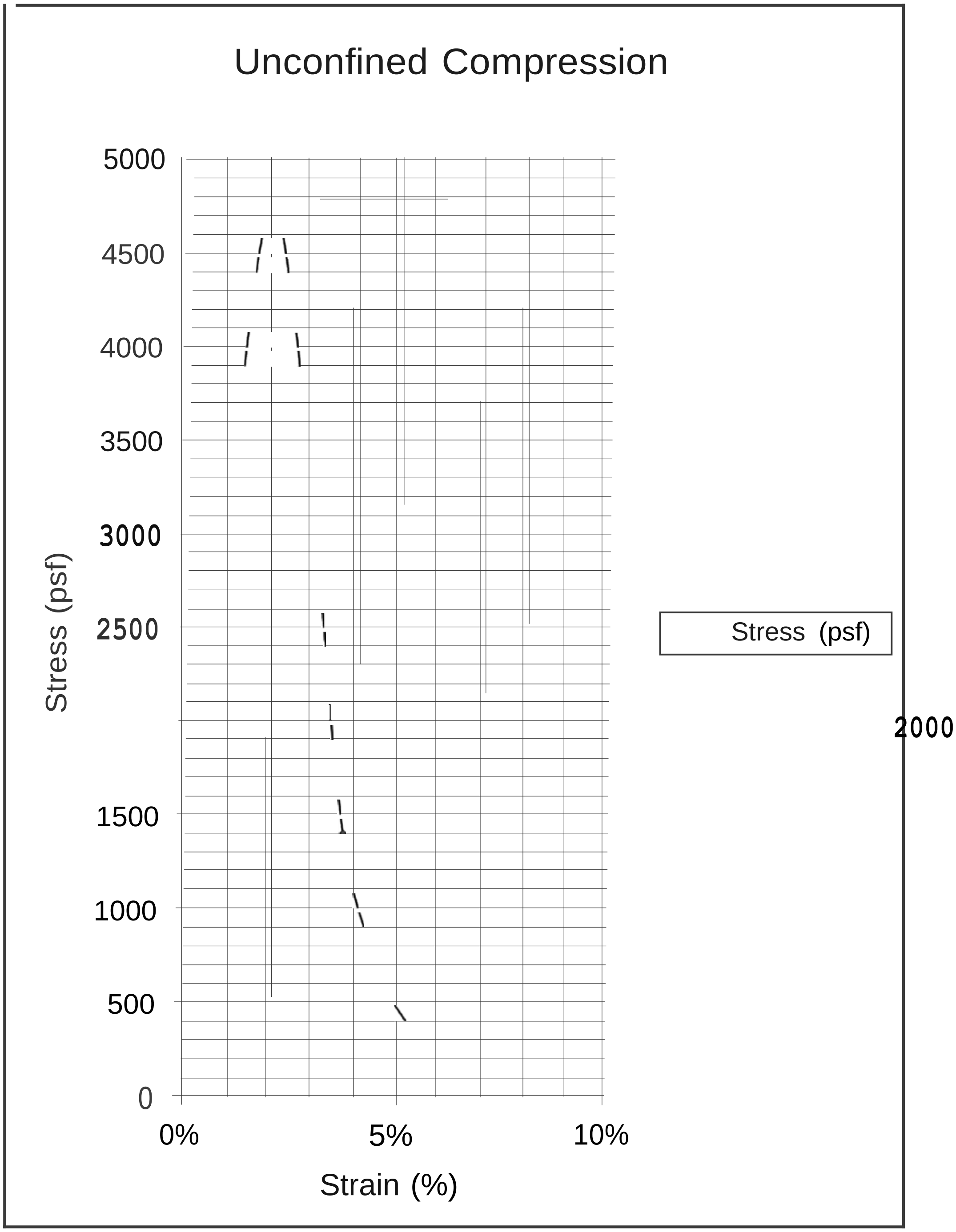
PROJECT LOCATION 2210 Brush Creek Road, Santa Rosa



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	BH-1	19.5	OLIVE BROWN SANDY CLAY (CL)					
⊠	BH-1	30.0	DARK BLUISH GRAY SANDY CLAY (CL)	32	18	14		
▲	BH-1	50.0	GRAY & ORANGE-BROWN CLAYEY SAND (SC)					

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BH-1	19.5	0.075						52.0	
⊠	BH-1	30.0	0.075						65.0	
▲	BH-1	50.0	0.075						49.0	



LOCATION: BH-1 AT 10.0 FEET
DESCRIPTION: LIGHT YELLOWI SH GRAY SILTY CLAY (CH)
MOISTURE CONTENT: 35.9%
DRY DENSITY: 82.9 pcf
*UNCONFINED COMPRESSIVE STRENGTH : 4749psf

*Failure stress is defined as the maxim um stress at ten percent strain.

PJC & Associates, Inc.
Consulting Engineers & Geologists

UNCONFINED COMPRESSION TEST
PROPOSED RESIDENTIAL DEVELOPMENT
2210 BRUSH CREEK ROAD
SANTA ROSA, CA

PLATE

11

Proj. No: S3046.01 **Date: 1/21** **App'd by: AJD**

APPENDIX C
REFERENCES

1. "Foundations and Earth Structures" Department of the Navy Design Manual 7.2 (NAVFAC DM-7.2), dated May 1982.

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. "Drilled Shafts: Construction Procedures and Design Methods" U.S. Department of Transportation Federal Highway Administration (FHWA-HI-88-042), dated July 1988.

4. Geology for Planning in Sonoma County, Special Report 120, California Division of Mines and Geology, 1980.

5. USGS Santa Rosa California Quadrangle 7.5-Minute Topographic Map, photorevised 1998.

6. Geologic & Geophysical Framework of the Santa Rosa 7.5-Minute Quadrangle, Sonoma County, California, by R.J. McLaughlin, A.M. Sama-Wojcicki, R.J. Fleck, V.E. Langenheim, C.A. McCabe and Elmira Wan, 2008.

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

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

9. McCarthy, David. Essential of Soil Mechanics and Foundations. h Edition, 1998.

10. Bowels, Joseph. Engineering Properties of Soils and Their Measurement. 4th Edition, 1992.

11. California Building Code (CBC), 2019 edition.

12. "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.

13. Blake, T.F. (2000), EQFAULT Version 3.0, software program.

14. U.S. Seismic Design Map, U.S. Geological Survey (USGS), http://earthquake.usgs.gov/designmaps/us/application. php?

15. Liquefaction Susceptibility Map, Association of Bay Area Governments, http://resilience.abaq.ca.gov/earthquakes/#LIQUEFACTlON

16. “Minimum Design Loads and Associated Criteria for Buildings and Other Structures" American Society of Civil Engineers (ASCE 7-16), dated 2017.

17. Preliminary Civil Plans, Sheets C1.0 and C2.0, prepared by Adobe Associates, Inc., dated December 1, 2020.