Appendix D:
Geology and Soils Supporting Information

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D.1 - Geotechnical Investigation

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GEOTECHNICAL INVESTIGATION

On

PROPOSED RESIDENTIAL DEVELOPMENT

At

215 Skelly
Hercules, California

For
D.R. Horton

By
Quantum Geotechnical, Inc.

Project No. G025.G
November 11, 2021

QUANTUM GEOTECHNICAL, INC.

Project No. G025.G
November 11, 2021

Mr. Adam Foster
Forward Planner
D.R. Horton
6683 Owens Drive
Pleasanton, CA 94588

Subject: Proposed Residential Development
215 Skelly
Hercules, California
GEOTECHNICAL INVESTIGATION

Dear Mr. Foster

In accordance with your authorization, ***Quantum Geotechnical, Inc.,*** has investigated the geotechnical conditions at the subject site located in Hercules, California

The accompanying report presents the results of our field investigation. Our findings indicate that development of the site for the proposed development is feasible provided the recommendations of this report are carefully followed and are incorporated into the project plans and specifications.

Should you have any questions relating to the contents of this report or should additional information be required, please contact our office at your convenience.

Sincerely,
Quantum Geotechnical, Inc.

Simon Makdessi, P.E., G.E.
President

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GEOTECHNICAL INVESTIGATION

PURPOSE AND SCOPE

The purpose of the investigation for the proposed new residential development located at 215 Skelly, Hercules in California was to determine the surface and subsurface soil conditions at the subject site. Based on the results of the investigation, criteria were established for the grading of the site, the design of foundations for the proposed development, and the construction of other related facilities on the property.

Our investigation included the following:

a. Field reconnaissance by the Soil Engineer;
b. Determine the general seismicity of the site in accordance with the 2019 CBC;
c. Excavation and logging of four exploratory soil borings;
c. Laboratory testing of soil samples;
d. Analysis of the data and formulation of conclusions and recommendations; and
e. Preparation of this written report.

PROPOSED DEVELOPMENT

It is our understanding that the proposed project consists of developing the site for the construction of a new residential subdivision consisting of 39 single family residence lots. Based on a review of a Conceptual Grading and Utility Plan by CBG dated June 2020, grading will consist of cuts up to 13 feet deep and fills up to 5 feet thick. Several retaining walls 2 to 3 feet high are planned between lots and site retaining walls up to 5 feet high are planned along the rear property line for the northern lots. The residence structures are planned to be supported on a post-tensioned slab foundation system.

SITE LOCATION AND DESCRIPTION

The site is located in the western part of Hercules, north of Highway 4 and east of Pinole Creek. The terrain surrounding the site is comprised of moderate rolling hills. The site is roughly rectangular shaped and measures approximately 7.3 acres in size. The lot currently hosts multiple building such as residences, shed structures, stables, and a large metal clad shed that appear to be abandoned relics of the site's previous use as a farm. Various pieces of mechanical equipment, a large tank, miscellaneous furniture, and piles of mulch, wood debris and construction debris are

strewn throughout the site The ground cover onsite consists of grass to waist high vegetation, various large and small trees and shrubs, and degraded asphaltic concrete and gravel driveways. There appears to be a couple of local graded areas where fills up to 5 feet high have been placed.

Along the majority of the eastern part of the site (lots 1-4), a cut slope exists down to the entrance driveway. The upper 4 to 5 feet of the cut slope is near vertical and exposes siltstone/sandstone bedrock from the near surface.

GENERAL GEOLOGIC CONDITIONS

The site is located within the Coast Ranges Geomorphic Province of California. Throughout the Cenozoic Era, the western part of California has been affected by tectonic forces associated with lateral or transform plate motion between the North American and Pacific crustal plates, which has produced a complex system of northwest-trending faults - the San Andreas, Hayward, and Calaveras Fault systems being the most prominent within the Bay Area. Uplift, erosion and subsequent re-deposition of sedimentary rocks within this province have been driven primarily by the northwest-southeast directed strike-slip movement of the tectonic plates and the associated northeast oriented compressional stress. The northwest-trending coastal mountain ranges are the result of an orogeny believed to have been occurring since the Pleistocene epoch (approximately 2-3 million years before present).

The site resides in the alluvial flatlands surrounding the Pinole Creek channel. According to the geologic map of Graymer et al. (1994), the site is underlain by undivided quaternary deposits, and may be partially underlain by bedrock of Hambre Sandstone on the eastern portion. Site and regional geology are displayed in the “Regional Geologic Map”, Figure 2, Appendix A. The bedrock exposures along the eastern part of the site confirms the geologic mapping.

The California Geologic Survey has published a seismic hazard map for the Mare Island 7.5-minute quadrangle which includes the site area. This map excludes the site from zones of required mitigation for land sliding, fault, and liquefaction hazards. There is no nearby data in the CA Water Resource Library to indicate near site groundwater level, but it is anticipated to be moderate, within the top 30 feet, due to the site proximity to the northern San Francisco Bay. The Association of Bay Area Governments has published an interactive map of liquefaction susceptibility within the bay area. This mapping indicates that the site has a low to moderate susceptibility to liquefaction.

The USGS Quaternary Fault database provides a record of quaternary active fault traces, defined as exhibiting seismicity within the last 1.6 million years based on historic mapping and observations. Faults can act as preliminary sources of seismically induced ground shaking, and can also act as co-seismic sources of shaking induced by nearby faults even after seismic activity has ceased. A list of Quaternary active fault traces within 10 miles of the site is provided in Table I below. Fault traces within the vicinity of the site are as indicated on Figure 1, "Site Vicinity and Fault Map", attached to Appendix A.

Table I
List of Holocene Faults

Fault ID	Distance from Site (mi)	USGS Activity Level (yrs)
Pinole	0.3	< 1.6 mya
Moraga	2.4	< 1.6 mya
Hayward	3.8	< 150 ya
Franklin	4.1	< 1.6 mya
Southampton	6.5	< 1.6 mya

INVESTIGATION

The field investigation was performed on August 03, 2020, and included a reconnaissance of the site and the drilling of four exploratory borings, at the locations shown on Figure 3, "Site Plan" attached to Appendix A.

The borings were drilled to depths ranging from 20 to 45 feet below the existing grade. The drilling was performed with a truck-mounted mobile B-40 drill rig utilizing 8 inch diameter hollow stem augers. Visual classifications were made from cuttings and the samples in the field. As the drilling proceeded, disturbed soil samples were obtained by means of a 2.0 inch O.D. split-spoon sampler. The sampler was driven into the in-situ soil under the impact of a 140-pound hammer undergoing a free fall of 30 inches. The number of blows required to advance the sampler 12 inches into the soil is reported on the boring logs. The samples were sealed and returned to the laboratory for testing. Classifications made in the field were verified in the laboratory after further examination

and testing. The stratification of the soils, descriptions, location of undisturbed soil samples and blow counts are shown on the respective "Logs of Test Borings" contained within Appendix A.

Laboratory testing was conducted for moisture content, Atterberg Limits, sieve analysis, and corrosion potential. The laboratory test results are presented on the boring logs, and summarized in Appendix B.

SUBSURFACE CONDITIONS

The subsurface conditions varied between the borings. Boring B-1 encountered 8 feet of very stiff to hard silt and underlain by stiff and very stiff silty clay to the maximum depth explored of 45 feet. In boring B-2, the surficial 8 foot silty clay layer is underlain medium dense and dense clayey to poorly-graded sand to 16 foot depth, where very stiff silty clay was encountered to the maximum depth explored of 20 feet. In borings B-3 and B-4 on the eastern portion of the site, a surface layer of stiff and hard, silty clay ranging in depth from 5 to 7 feet, and underlain by dense, well cemented residual soil, and weathered sandstone to siltstone bedrock to the maximum depth explored of 25 feet.

Groundwater was encountered in borings B-1 and B-2 at depths 11 and 13 feet, respectively, at the time of our investigation. Groundwater was not encountered in the borings on the eastern portion of the site property. Groundwater elevation may fluctuate based on seasonality, nearby development activities, and urbanization, among other factors.

A more thorough description and stratification of the soil conditions are presented on the respective, “Logs of Test Borings” in Appendix A. The approximate locations of the borings are shown on Figure 3, “Site Plan” Appendix A.

LIQUEFACTION POTENTIAL EVALUATION

Liquefaction occurs primarily in relatively loose, saturated, cohesionless soils. Under earthquake stresses, these soils become “quick”, lose their strength and become incapable of supporting the weight of the overlying soils or structures. The data used for evaluating liquefaction potential of the subsurface soils consisted of the penetration resistance, the soil gradation, the relative density of the materials, and the groundwater level. For the purpose of our evaluation, we have assumed a design groundwater table of 15 foot depth.

Loose to medium dense cohesionless soil such as sands and some silts and low plasticity clays are potentially liquefiable, while dense and very dense cohesionless sands and gravels are considered to have a very low potential for liquefaction. All materials encountered in the borings were at least very stiff and dense, and therefore the potential for liquefaction or dynamic compaction is considered nil.

2019 CBC Seismic Design Criteria

The potential damaging effects of regional earthquake activity should be considered in the design of structures. As a minimum, seismic design should be in accordance with Chapter 16 of the 2019 California Building Code (CBC). The 2019 CBC utilizes the design procedures outlined in the ASCE 7-16 Standard.

Using the criteria in Chapter 20 of ASCE 7-16, in its current condition, the site is classified as Site Class D. As a result, no site response analysis is required. The seismic design parameters have been developed using the online "Seismic Design Maps" tool (5) by the Structural Engineering Association (SEA) and Office of Statewide Health Planning and Development (OSHPD) and a site location based on longitude and latitude. The parameters generated for the subject site for a latitude of 38.00867° N, and longitude of 122.2891° W, are presented in the following Table II:

Table II
2019 CBC Seismic Design Criteria

Seismic Parameter	Coefficient	Value
Site Class – Stiff Soil		D
Peak Ground Acceleration (Site Modified)	PGA_M	0.872
Mapped MCE Spectral Acceleration at Short-Period 0.2 secs	S_s	1.891
Mapped MCE Spectral Acceleration at a Period of 1.0s	S_1	0.715
Adjusted MCE, 5% Damped Spectral Response Acceleration at Short Period of 0.2s	S_{MS}	1.891
Adjusted MCE, 5% Damped Spectral Response Acceleration at Period of 1.0s	S_{M1}	1.216
Design 5% Damped Spectral Response Acceleration at Short Period of 0.2s for Occupancy Category I/II/III	S_{DS}	1.260
Design 5% Damped Spectral Response Acceleration at Period of 1.0s for Occupancy Category I/II/III	S_{D1}	0.810

DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

GENERAL

1. From a geotechnical point of view, the site is suitable for the construction of the proposed residential development provided the recommendations presented in this report are incorporated into the project plans and specifications.

2. The most prominent geotechnical features of this site are;
   a) The possible presence of old fill, septic tanks and leach fields and irrigation line(s)
   b) the presence of moderately expansive near surface clay soil
   c) and presence of shallow bedrock along the eastern side of the site.

3. Based on our site reconnaissance, the site will contain localized areas of old fill as evidenced from surface topographic features. It is also likely that some localized areas of old fill may be present within the improved areas and possibly in the open areas from unknown past site activities. In addition, the old residence structures may have been served by septic systems and leach fields. We recommend that during the final stages of demolition, a number of test holes be excavated throughout the site to evaluate the presence and extent of any non-engineered fill, and to chase sewer pipes from the existing residences to evaluate if a septic tank is present. If encountered, it is recommended the old fill be removed and replaced as engineered fill. The sub-excavated material is may be suitable for reuse as fill as approved by the soil engineer.

4. Atterberg Limits testing on the surficial clay registered Plasticity Index (PI) values of 13, 20 and 29 indicating the material to be moderately and highly expansive. The moderately and highly expansive soil is prone to heave and shrink movements with changes in moisture content and must be carefully considered in the design and construction of foundations, drainage, hardscape and pavements. A post-tensioned slab foundation is the most appropriate foundation system for the proposed structures.

5. Based on a review of the conceptual grading plan, cuts ranging from 1 to 13 feet are anticipated in the south eastern area of the site where bedrock is present near surface. Based on the exposed cuts along the east side and the ease of drilling, the bedrock is assessed to be rippable with

standard earthwork equipment for mass grading activities, and excavator equipment for trenching activities.

DEMOLITION

6. Prior to any grading, demolition of the existing structures on the site should be completed. Demolition should include the complete removal of all surface and subsurface structures. In addition, all known underground structures must be located on the grading plans so that proper removal may be carried out, and all excavations are left open for proper backfilling. It is vital that Quantum Geotechnical Inc., intermittently observe the removal of subsurface structures and excavations, and be notified in ample time to ensure that no subsurface structures or excavations are covered. If Quantum Geotechnical Inc., is not contacted to observe the demolition and removal of subsurface structures, further backhoe exploratory investigation will need to be performed prior to the commencement of grading.

7. Excavations made by the removal of the structures may create disturbed/loose areas, and where this occurs the loose material should be excavated and replaced as engineered fill, or if it is less than 1 foot in thickness, can be compacted in place, prior to placing fill. We recommend that excavations greater than 1 foot deep be left open by the demolition contractor for backfill in accordance with the requirements for engineered fill. The removal of underground structures should be done under the observation of the Soil Engineer to verify adequacy of the removal and that subsoils are left in proper condition for placement as engineered fills. Any soil exposed by the removal operations which are deemed soft or unsuitable by the Soil Engineer, shall be excavated as uncompacted fill and be removed as required by the Soil Engineer during grading. Any resulting excavations should be properly backfilled with engineered fill under the observation of the Soil Engineer. It is important that Quantum Geotechnical Inc., be present during removal activities to verify that all excavations created by removal of subsurface structures are left open and located on a grading plan. If any excavations are loosely backfilled without our knowledge and these excavations are not located and backfilled during grading, future settlement of these loosely filled excavations could occur and may cause damage to structures and improvements.

GRADING

8. The grading requirements presented herein are an integral part of the grading specifications presented in Appendix C of this report and should be considered as such.

9. Grading activities during the rainy season on cohesive soils will be hampered by excessive moisture. Grading activities may be performed during the rainy season, however, achieving proper compaction may be difficult due to excessive moisture; and delays may occur. In addition, measures to control potential erosion may need to be provided. Grading performed during the dry months will minimize the occurrence of the above problems.

10. The site contains much vegetation cover and stripping of vegetation and topsoil will be required. Vegetation conditions may be different at the time of grading, and the extent of any stripping will be revaluated at that time. Organically contaminated soil material or strippings may be utilized in landscape areas located outside the building footprint.

11. Demolition of the existing structures and grubbing of trees may create disturbed/loose areas, and where this occurs the loose material should be excavated and replaced as engineered fill or if it is less than 1 foot in thickness, compacted in place, prior to placing fill. In addition, removal of portions of the existing pavements will be performed. The removed concrete, asphaltic concrete and aggregate base can be reused as fill provided the concrete and AC is broken down to pieces less than 6 inches in size and thoroughly mixed with soil material, however, we recommend that AC not be used in the upper 2 feet of soil in landscape areas as the AC may affect plant growth.

12. Following the removal of any strippings, old fill or loose fill, the top 8 inches of exposed native ground should be scarified and compacted to a minimum degree of relative compaction of 90% at 2 to 3 percent above optimum moisture content as determined by ASTM D1557-12 Laboratory Test Procedure. After recompacting the subgrade, the site may be brought to the desired finished grades by placing engineered fill in lifts of 8 inches in uncompacted thickness and compacting to a relative compaction of at least 90%, at 2 to 3 percent above optimum moisture content.

13. Based on a review of the preliminary grading plan, differential fill thickness across a building pad are generally of the order of 1 to 4 feet. Differential fill thicknesses less than 7 feet do not require mitigation by sub-excavation.

14. Based on a review of the conceptual grading plan, several lots will be graded such that the building pad will be created by cut and fill. The depth of cut ranges from 0 to 13 feet and the depth of fill within these pads is generally up to 4 feet. For these lots, we recommend that the cut portion of the pad be sub-excavated to a depth of 2 feet, and the excavation be backfilled with the sub-excavated material as engineered fill. If the base of the sub-excavation is found to be dry, we recommend that the base be ripped moisture conditioned and recompacted in place to the requirements of engineered fill.

15. The finish grade cut portion of lots at the eastern side and some on the south eastern corner may possibly comprise sandstone/siltstone bedrock. It may be difficult to promote landscape growth on bedrock material and make trenching for irrigation lines difficult. For such situations, we recommend that the entire pad be sub-excavated a depth of 2 feet and backfilled as engineered fill

16. All soils encountered during our investigation are suitable for use as engineered fill when placed and compacted at the recommended moisture content and provided it does not contain any debris.

SURFACE AND SUBSURFACE DRAINAGE

17. All finish grades should be provided with a positive gradient to an adequate discharge point in order to provide rapid removal of surface water runoff away from all foundations. No ponding of water should be allowed on the pad or adjacent to the foundations. Surface drainage must be designed by the project Civil Engineer and maintained by the property owners at all times. The pad should be graded in a manner that surface flow is to a controlled discharge system.

18. Lot slopes and drainage must be provided by the project Civil Engineer to remove all storm water from the pad and to minimize storm and/or irrigation water from seeping beneath the structures. Should surface water be allowed to seep under the structure, foundation movement resulting in structural cracking and damage will occur. Finished grades around the perimeter of the structure should be compacted and should be sloped at a minimum 2% gradient away from the exterior foundation. Surface drainage requirements constructed by the builder should be maintained during landscaping. In particular, the creation of planter areas confined on all sides by concrete walkways or decks and the residence foundation is not desirable since any surface water due to rain or irrigation becomes trapped in the planter area with no outlet. If such a landscape feature is necessary, surface area drains in the planter area or a subdrain along the foundation perimeter must be installed.

BIO-FILTRATION FACILITIES

19. According to local government requirements, roof downspout and drain flows should be directed to at grade bio-filtration areas, or raised planter boxes next to the building perimeter, where possible. From a geotechnical and maintenance point of view it is undesirable to discharge water into at grade bio-filtration areas near foundations, because of the possibility of water ponding for sustained periods of time, potentially creating excessive moisture related issues. However, certain design features could be made to minimize such potential effects. In addition, the property owners must always maintain the bio-filtration area to ensure that they are performing as designed and that water does not pond in the area for longer than 48 hours.

20. Typically, the bio-filtration areas consist of an 18 inch layer of sandy loam over 18 inches of permeable gravel material. The top of the bio-filtration area is typically approximately 1 foot below pad grade, therefore, the base of the bio-filtration area will be approximately 4 feet below pad grade. The base of the bio-filtration area will typically contain a perforated pipe to drain any water that may collect within 24 hours. In some situations, the bio-filtration areas may be located immediately adjacent the building structure.

21. Where bio-filtration areas are located closer than 5 feet of the building, the section of loose loam and gravel will provide reduced lateral support, and we recommend a deepened footing be constructed along the perimeter the building adjacent to the bio-filtration area and extending 3 feet

beyond in plan length. The depth of the deepened footing will depend on how close the bio-filtration area is located to the building perimeter. As a guide, the footing is to be deepened such that when an imaginary line inclined at 45 degrees from the outside edge base of the footings, it extends below the base of the bio-filtration area excavation. Where bio-filtration areas are located further than 5 feet, no special design is required. Provided the bio-filtration facility is lined with an impermeable liner, no waterproofing of the deepened footing is required.

22. Where bio-filtration areas are located closer than 3 feet of street pavements, a deepened curb footing is required. Where bio-filtration areas are located closer than 1 foot of street pavements, because pavements do not have a positive connection to a deepened curb/footing, the deepened curb/footing may need to be designed as a retaining wall rigid enough to create minimal lateral deflections.

23. Where bio-filtration areas are located closer than 2 feet of hardscape areas, a deepened edge footing is required. The deepened edge should extend at least 1 foot below the subgrade. Where the bio-filtration area is immediately adjacent the hardscape, the deepened edge is to extend at least 3 inches below the base of the bio-filtration system.

FOUNDATIONS

24. Provided the site is prepared as recommended in the "Grading" section, a post-tensioned slab foundation may be satisfactorily used. The slab must be designed to tolerate the expansive clay criteria presented in this section.

Post Tensioned Slab-on-Grade

25. Post-tensioned slabs should be designed using the following criteria which is based on the design method presented in the Post-Tensioning Institute, Standard Requirements for Design and Analysis of Shallow Post-Tensioned Concrete Foundations on Expansive Soils (PTI DC10.5-12), 2012. Using the relevant site soil and climatic parameters, the recommended geotechnical criteria for use in the design of the post-tensioned slabs is as follows;

	Swelling Mode	
	Center Lift	Edge Lift
Edge Moisture Variation Distance (e_m)	8.9 feet	4.6
Differential Soil Movement (y_m)	0.70 inches	1.19 inches

26. The maximum allowable bearing pressure at the base of the slab and for localized thickened footings should not exceed 2,000 p.s.f. for dead plus sustained live loads.

27. As indicated earlier, bio-filtration areas may be designed close to the foundation. Where bio-filtration areas are located closer than 5 feet of the building, the section of loose loam and gravel, will provide reduced lateral support, and we recommend a deepened footing be constructed along the perimeter the building adjacent to the bio-filtration area and extending 3 feet beyond in plan length. The depth of the deepened footing will depend on how close the bio-filtration area to the building perimeter. As a guide, the footing is to be deepened such that when an imaginary line inclined at 45 degrees from the outside edge base of the footings, it extends below the base of the bio-filtration area excavation.

General Construction Requirements for Post Tensioned Slab-on-Grade

28. Prior to construction of the slab, the slab subgrade should be observed by the Soil Engineer to verify that all under-slab utility trenches greater than 18 inches in width have been properly backfilled and compacted, and that no loose or soft soils are present on the slab subgrade.

29. Where the building pad consist of clayey soil, the slab subgrade should be soaked to saturation (minimum 5% above optimum) to a depth of 12 to 18 inches prior to placement of the capillary break or vapor retarder/barrier. This should be verified and approved by the Soil Engineer. The penetration of a thin metal probe to a depth of 10-12 inches generally indicates sufficient saturation.

30. The four (4) inch (minimum thickness) layer of gravel typically placed to provide a capillary break beneath concrete slab-on-grade floors may be omitted beneath the monolithically poured mat slab foundations provided that the slabs are at least 10 inches thick as recommended above. If it is desired to use a 4 inch layer or thinner of gravel section, the gravel should consist of broken stone, crushed or uncrushed gravel, quarry waste, or a combination thereof. The aggregate shall be free from deleterious substances. It shall be of such quality that the absorption of water in a saturated

dry condition does not exceed 3% of the oven dry weight of the sample. The material shall be ¾" minus material with no more than 3% passing the #200 sieve, as specified in Appendix C.

31. A moisture vapor retarder/barrier is recommended beneath all slabs-on-grade that will be covered by moisture-sensitive flooring materials such as vinyl, linoleum, wood, carpet, rubber, rubber-backed carpet, tile, impermeable floor coatings, adhesives, or where moisture-sensitive equipment, products, or environments will exist. We recommend that design and construction of the moisture vapor retarder/barrier conform to Section 1805 of the 2013 CBC and relevant sections of American Concrete Institute (ACI) guidance documents 302.1R-04, 302.2R-06 and 360R-10.

32. The moisture vapor retarder/barrier can be placed above the 4 inches of gravel or directly on the soil subgrade and should consist of a minimum 10 mils thick polyethylene with a maximum perm rating of 0.1 in accordance with ASTM E 1745. Seams in the moisture vapor retarder/barrier should be overlapped no less than 6 inches or in accordance with the manufacturer's recommendations. Joints and penetrations should be sealed with the manufacturer's recommended adhesives, pressure-sensitive tape, or both. The contractor must avoid damaging or puncturing the moisture vapor retarder/barrier and repair any punctures with additional polyethylene properly lapped and sealed. The installation of the vapor retarder membrane must be in conformance with ASTM E1643.

33. A minimum of two inches of wetted sand should be placed over the vapor retarder membrane to facilitate curing of the concrete and to act as a cushion to protect the membrane. The perimeter of the mat should be thickened to bear on the prepared building pad and to confine the sand. During winter construction, sand may become saturated due to rainy weather prior to pouring. Saturated sand is not desirable because the sand cushion may become over saturated, and boil into the concrete causing undesirable structural monopolies of sand pockets within the slab. As an alternate, a sand-fine gravel mixture that is stable under saturated conditions may be used. However, the material must be approved by the Soil Engineer prior to use.

34. Alternatively, the sand layer may be eliminated provided the concrete has a maximum water/cement ratio of 0.45 and a 10 mil Class A vapor retarder membrane, such as Stego® Wrap. In any case, the vapor retarder/barrier should have a maximum perm rating of 0.3 in accordance with ASTM E 1745. Seams in the moisture vapor retarder/barrier should be overlapped no less

than 6 inches or in accordance with the manufacturer's recommendations. Joints and penetrations should be sealed with the manufacturer's recommended adhesives, pressure-sensitive tape, or both. The contractor must avoid damaging or puncturing the vapor retarder/barrier and repair any punctures with additional polyethylene properly lapped and sealed.

35. It is our understanding that the preferred post-tensioned slab section is to consist of a slab with concrete having a water/cement ratio of no greater than 0.45, over a vapor retarder membrane underlain by soil subgrade. The sand and gravel sections that are sometimes typically used will not be utilized for this project. This is acceptable from a geotechnical point of view.

MISCELLANEOUS CONCRETE FLATWORK

36. Miscellaneous flatwork, driveways, and walkways may be designed with a minimum thickness of 4.0 inches. Any exterior concrete flatwork such as driveways, steps, patios, or walkways should be designed independently of the slab, and expansion joints should be provided between the flatwork and the structural unit. Control joints should be constructed to create squares or rectangles with a maximum spacing of 15 feet on large slab areas. Control joints for walkways should be constructed at a maximum of 5 feet spacing.

RETAINING WALLS

37. Retaining walls should be designed to resist lateral pressures exerted from a media having an equivalent fluid weight as follows:

Active Condition	=	45 p.c.f. for horizontal backslope
At-rest Condition	=	65 p.c.f.
Passive Condition	=	250 p.c.f.
Coefficient of Friction	=	0.30

38. For a non-horizontal backslope, the active condition equivalent fluid weight can be increased by 1.5 p.c.f. for each 2 degree rise in slope from the horizontal.

39. Active conditions occur when the top of the wall is free to move outward. At-rest conditions apply when the top of wall is restrained from any movement.

40. It should be noted that the effects of any surcharge, traffic or compaction loads behind the walls must be accounted for in the design of the walls.

41. The above criteria are based on fully drained conditions. If drained conditions are not possible, then the hydrostatic pressure must be included in the design of the wall. An additional linear distribution of hydrostatic pressure of 63 p.c.f. should be adopted, in this case.

42. In order to achieve fully-drained conditions, a drainage filter blanket should be placed behind the wall. The blanket should be a minimum of 12 inches thick and should extend the full height of the wall to within 12 inches of the surface. If the excavated area behind the wall exceeds 12 inches, the entire excavated space behind the 12-inch blanket should consist of compacted engineered fill or blanket material. The drainage blanket material may consist of either granular crushed rock and drain pipe fully encapsulated in geotextile filter fabric or Class II permeable material that meets CalTrans Specification, Section 68, with drainage pipe but without fabric. A 4-inch perforated drain pipe should be installed in the bottom of the drainage blanket and should be underlain by at least 4 inches of filter type material. A 12-inch cap of clayey soil material should be placed over the drainage blanket. All back drains should be outlet to suitable drainage devices. Retaining wall less than 3 feet in height may be provided with backdrains or weep holes.

43. As an alternate to the 12-inch drainage blanket, a pre-fabricated strip drain (such as Miradrain) may be used between the wall and retained soil. In this case, the wall must be designed to resist an additional lateral hydrostatic pressure of 30 p.c.f.

44. Piping with adequate gradient shall be provided to discharge water that collects behind the walls to an adequately controlled discharge system away from the structure foundation.

45. The retaining walls may be founded on a friction pier foundation or on spread footing foundations. Spread footing and pier design criteria are given below.

RETAINING WALL/SOUNDWALL FOUNDATION - SPREAD FOOTINGS

46. Spread footings should have a minimum depth of eighteen (18) inches below lowest adjacent pad grade (i.e., trenching depth) for soil subgrade. At this depth, the recommended design

bearing pressure for continuous footings should not exceed 2,500 p.s.f. due to dead plus sustained live loads and 3,300 p.s.f. due to all loads which include wind and seismic.

47. To accommodate lateral loads, the passive resistance of the foundation soil can be utilized. The passive soil pressures can be assumed to act against the front face of the footing below a depth of one foot below the ground surface. It is recommended that a passive pressure equivalent to that of a fluid weighing 250 p.c.f. be used. The weight of the soil above the footing can be used in the frictional calculations. For design purposes, an allowable friction coefficient of 0.30 can be assumed at the base of the spread footing.

RETAINING WALL/SOUNDWALL FOUNDATION - PIER FOOTINGS

48. The piers should be designed on the basis of skin friction acting between the soil and the pier. For the soils at the site, an allowable skin friction value of 500 p.s.f. can be used for combined dead and live loads, below a depth of 2 feet. This value can be increased by one-third for total loads which include wind or seismic forces. Given the moderately expansive nature of the soil, we recommend that any grade beams footings or bottom of soundwall panels that are buried into the ground, should be designed for an uplift pressure of 1,500 p.s.f. acting against the bottom of the grade beam/soundwall panel and an uplift adhesion of 300 p.s.f. acting along the upper 2 feet of the pier. Resistance to uplift is to be provided by the pier foundations, and an allowable skin friction value of 500 p.s.f can be used below 2 feet. The size, depth and spacing of the piers is to be determined by the structural engineer.

49. To resist lateral loads, the passive resistance of the soil can be used. The soil passive pressures can be assumed to act against the lateral projected area twice the pier diameter. It is recommended that a passive pressure equivalent to that of a fluid weighing 250 p.c.f be used below 2 feet of final pad grade.

PAVEMENT AREAS

50. R-value tests were not performed as part of this investigation, as the soil expected at subgrade level is not known and depends on the planned grading. Assuming the subgrade material will consist of the moderately expansive clay material, we will assume an R-value of 5 for preliminary design.

51. Based on an R-Value of 5, the following flexible pavement sections are recommended.

Traffic Index	AC (inches)	Class II[1] AB (inches)
4.5	3.0	10.0
5.0	3.0	12.0
5.5	3.0	14.0
6.0	4.0	13.5
7.0	4.0	17.0

Notes: [1]Minimum R-Value = 78
R-Value = Resistance Value
All Layers in compacted thickness to Cal-Trans Standard Specifications

52. After underground facilities have been placed in the areas to receive pavement and removal of excess material has been completed, the upper 6 inches of the sub-grade soil shall be scarified, moisture conditioned, and compacted to a minimum relative compaction of 95% in accordance with the grading recommendations specified in this report.

53. All aggregate base material placed subsequently should be compacted to a minimum relative compaction of 95% based on the ASTM Test Procedure of D1557-12 (latest edition). The construction of the pavement areas should conform to the requirements set forth by the latest Standard Specifications of the Department of Transportations of the State of California and/or City of Hercules, Department of Public Works.

54. If planter areas are provided within or immediately adjacent to the pavement areas, provisions should be made to control irrigation water from entering the pavement subgrade. Water entering the pavement section at subgrade level, which does not have a means for discharge, could cause softening of this zone.

UTILITY TRENCHES

55. Applicable safety standards require that trenches in excess of 5 feet must be properly shored or that the walls of the trench slope back to provide safety for installation of lines. If trench wall sloping is performed, the inclination should vary with the soil type. The underground contractor should request an opinion from the Soil Engineer as to the type of soil and the resulting inclination.

56. With respect to state-of-the-art construction or local requirements, utility lines are generally bedded with granular materials. These materials can convey surface or subsurface water beneath the structures. It is, therefore, recommended that all utility trenches which possess the potential to transport water be sealed with a compacted impervious cohesive soil material or lean concrete where the trench enters/exits the building perimeter.

57. Utility trenches extending underneath all traffic areas must be backfilled with native or approved import material and compacted to a relative compaction of 90% to within 6 inches of the subgrade. The upper 6 inches should be compacted to 95% relative compaction in accordance with Laboratory Test Procedure ASTM D1557 (latest edition). Backfilling and compaction of these trenches must meet the requirements set forth by the City of Hercules, Department of Public Works. Utility trenches within landscape areas may be compacted to a relative compaction of 85%.

PROJECT REVIEW AND CONSTRUCTION MONITORING

58. All grading and foundation plans for the development must be reviewed by the Soil Engineer prior to contract bidding or submitted to governmental agencies so that plans are reconciled with soil conditions and sufficient time is allowed for suitable mitigative measures to be incorporated into the final grading specifications.

59. ***Quantum Geotechnical, Inc.*** should be notified at least two working days prior to site clearing, grading, and/or foundation operations on the property. This will give the Soil Engineer ample time to discuss the problems that may be encountered in the field and coordinate the work with the contractor.

60. Field observation and testing during the demolition and/or foundation operations must be provided by representatives of ***Quantum Geotechnical, Inc.*** to enable them to form an opinion regarding the adequacy of the site preparation, the acceptability of fill materials, and the extent to which the earthwork construction and the degree of compaction comply with the specification requirements. Any work related to the grading and/or foundation operations performed without the full knowledge and under the direct observation of the Soil Engineer will render the recommendations of this report invalid. This does not imply full-time observation. The degree of observation and frequency of testing services would depend on the construction methods and schedule, and the item of work.

REFERENCES

1. California Geological Survey. 1982. “State of California, Special Studies Zones, Mare Island”. 7.5 Minute Series (Topographic). Scale 1:24,000.

2. California Geological Survey. 2008. Guidelines for Evaluating and Mitigating Seismic Hazards in California. Special Publication 117A.

3. Graymer, R.W., Jones, D.L., and Brabb, E.E. 1994. Preliminary Geologic Map Emphasizing Bedrock Formations in Contra Costa County, California. U.S. Geological Survey. Open-File Report 94-622. Scale 1:75,000.

4. Nationwide Environmental Title Research, LLC. 2019. Historic Aerials. Accessed on July 30, 2020 from website: https://www.historicaerials.com/viewer.

5. Structural Engineers Association and Office of Statewide Health Planning and Development. 2018. “Seismic Design Maps”. Accessed August 14, 2020 from web site: https://seismicmaps.org/.

6. U.S. Geological Survey and California Geological Survey. 2020. "Quaternary fault and fold database for the United States". Accessed August 14, 2020 from USGS web site: http//earthquakes.usgs.gov/regional/qfaults/.

7. U.S. Geological Survey. 2020. “The National Map - Elevation”. Accessed August 14, 2020, from USGS website: https://viewer.nationalmap.gov/theme/elevation/##bottom

LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. It should be noted that it is the responsibility of the owner or his representative to notify ***Quantum Geotechnical, Inc.,*** in writing, a minimum of two working days before any clearing, grading, or foundation excavations can commence at the site.

2. The recommendations of this report are based upon the assumption that the soil conditions do not deviate from those disclosed in the borings and from a reconnaissance of the site. Should any variations or undesirable conditions be encountered during the development of the site, ***Quantum Geotechnical,*** will provide supplemental recommendations as dictated by the field conditions.

3. This report is issued with the understanding that it is the responsibility of the owner, or his representative, to ensure that the information and recommendations contained herein are brought to the attention of the Architect and Engineer for the project and incorporated into the plans and the necessary steps are taken to see that the Contractor and Subcontractors carry out such recommendations in the field.

4. At the present date, the findings of this report are valid for the property investigated. With the passage of time, significant changes in the conditions of a property can occur due to natural processes or works of man on this or adjacent properties. In addition, legislation or the broadening of knowledge may result in changes in applicable standards. Changes outside of our control may render this report invalid, wholly or partially. Therefore, this report should not be considered valid after a period of two (2) years without our review, nor should it be used, or is it applicable, for any properties other than those investigated.

5. Not withstanding all the foregoing, applicable codes must be adhered to at all times.

APPENDIX A

Figure 1 - Site Vicinity and Fault Map

Figure 2 - Regional Geologic Map

Figure 3 - Site Plan

Logs of Test Borings

Key to Boring Log

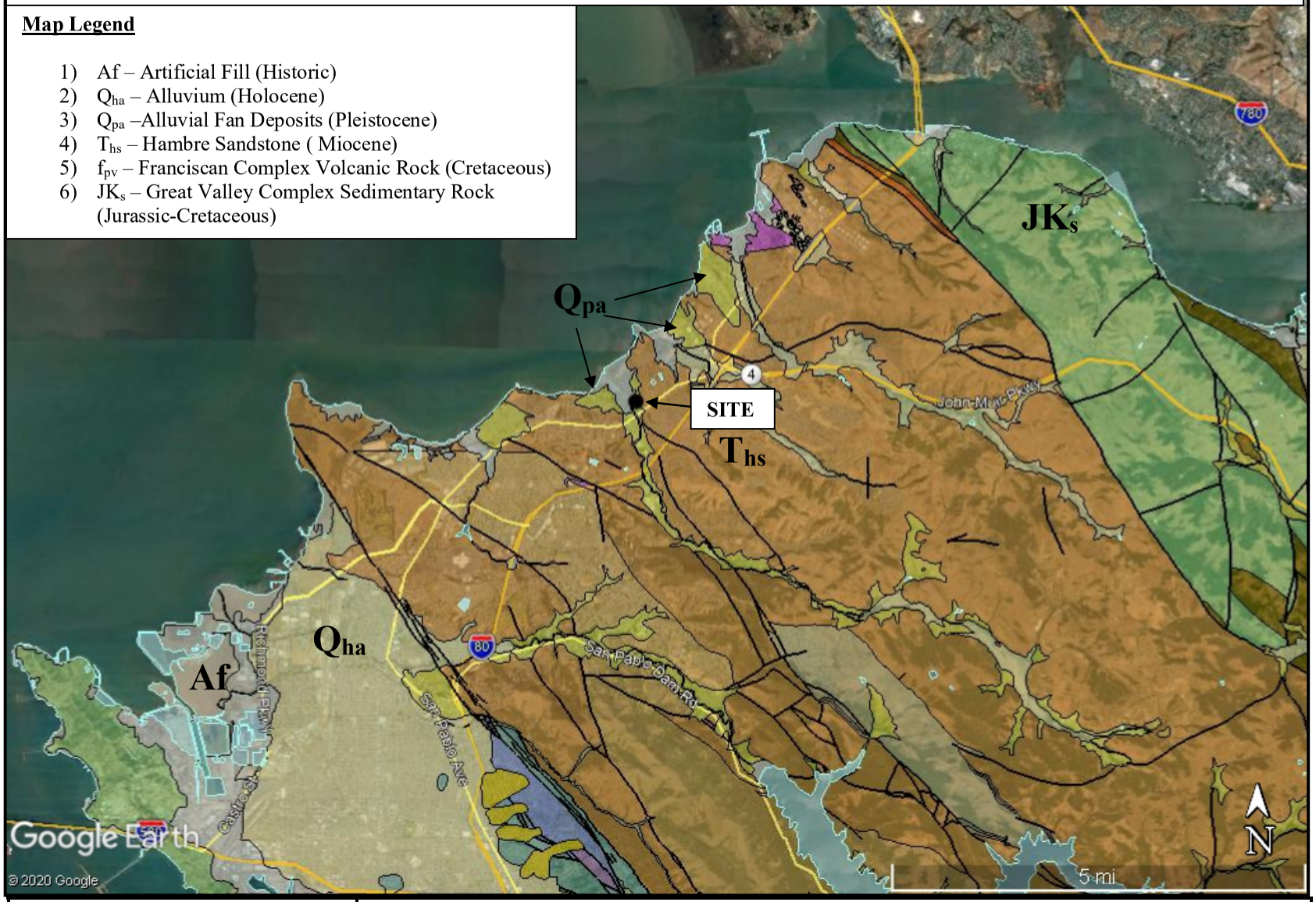
1. Base Map: Google Earth, 2020
2. Fault Map Overlay: U.S. Geological Survey and California Geological Survey. 2020. Quaternary fault and fold database for the United States. Accessed August 14, 2020 from USGS web site: https://earthquake.usgs.gov/hazards/qfaults/.

QUANTUM GEOTECHNICAL, INC.	SITE VICINITY AND FAULT MAP			
	Proposed Residential Development 215 Skelly, Hercules	Project No. G025.G	Drawn by: D.T.	Figure No. 1

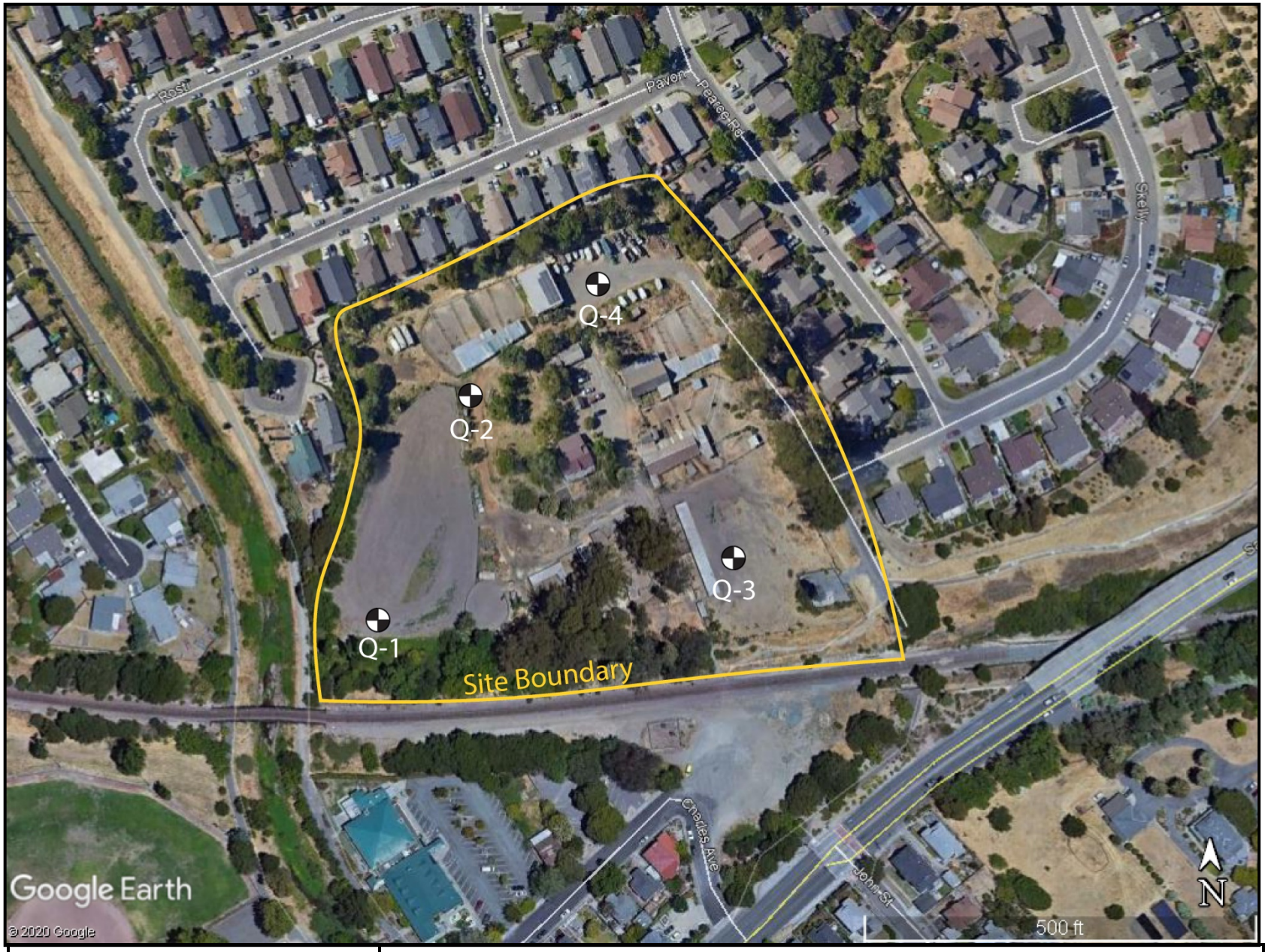
1. Base Map: Google Earth, 2020
2. Geologic Map Overlay: Graymer, R.W., Moring, B.C., Saucedo, G.J., Wentworth, C.M., Brabb, E.E., and Knudsen, K.L. 2006. "Geologic Map of the San Francisco Bay Region". USGS. Scientific Investigations Map 2918.

Map Legend

1) Af – Artificial Fill (Historic)
2) Q_{ha} – Alluvium (Holocene)
3) Q_{pa} –Alluvial Fan Deposits (Pleistocene)
4) T_{hs} – Hambre Sandstone (Miocene)
5) f_{pv} – Franciscan Complex Volcanic Rock (Cretaceous)
6) JK_s – Great Valley Complex Sedimentary Rock (Jurassic-Cretaceous)



QUANTUM GEOTECHNICAL, INC.	REGIONAL GEOLOGIC MAP			
	Proposed Residential Development 215 Skelly, Hercules	Project No. G025.G	Drawn by: D.T.	Figure No. 2



QUANTUM GEOTECHNICAL, INC.	SITE PLAN			
	Proposed Residential Subdivision 215 Skelly, Hercules	Project No. PENDING	Drawn by: D.T.	Figure No. 3

Project: **Proposed Residential Development** Project Location: **215 Skelly, Hercules** Project Number: **G025.G**	Log of Boring B-1 **Sheet 1 of 2**	**Quantum Geotechnical, Inc.** **1110 Burnett Ave., Ste B** **Concord, CA 94520**

Date(s) Drilled **08-03-20**	Logged By **DT**	Checked By **SM**
Drilling Method **Hollow Stem**	Drill Bit Size/Type **8 in.**	Total Depth of Borehole **45 ft.**
Drill Rig Type **Mobile B-40**	Drilling Contractor **Exploration Geoservices**	Approximate Surface Elevation **21 ft. amsl.**
Groundwater Level and Date Measured **11 ft.**	Sampling Method(s) **Modified California, SPT**	Hammer Data **Auto.**
Borehole Backfill **Grout**	Location **See Site Plan**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Percent Fines (-#200)	LL, %	PI, %
21	0				ML		Sandy SILT: Light greyish brown; dry; very fine sand; stiff; trace fine, subangular gravel.					
			1-1	53				16.0	107.1			
			1-2	22				26.5	91.4			
16	5				ML		At 5 ft.: Increase in fine sand; moist to very moist; medium stiff.					
					CL		CLAY with Sand: Dark bluish grey; very moist; medium stiff; very fine sand.					
			1-3	12				28.3	91.0			
11	10											
			1-4	9				42.6	75.2			
6	15											
					CL		Lean CLAY: Dark bluish grey; moist; stiff.					
			1-5	21				29.2	94.0			
1	20											
-4	25											
			1-6	20	CL		Silty CLAY: Dark olive brown; slightly moist; stiff; trace fine sand.					
			1-7	29				24.8	97.4			
-9	30											

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Project: **Proposed Residential Development** Project Location: **215 Skelly, Hercules** Project Number: **G025.G**	Log of Boring B-1 **Sheet 2 of 2**	**Quantum Geotechnical, Inc.** **1110 Burnett Ave., Ste B** **Concord, CA 94520**

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Percent Fines (-#200)	LL, %	PI, %
-9	30				CL		Silty CLAY: Dark olive brown; slightly moist; stiff; trace fine sand.					
-14	35		1-8	34								
					SC-CL		Sandy CLAY: Dark yellow brown; moist; medium to fine sand; minor gravel; stiff; dense.					
-19	40		1-9	55				17.1	103.3			
					CL		Silty CLAY: Dark olive brown with mottled orange brown; slightly moist; hard; well cemented. [Residual Soil?]					
-24	45		1-10	68			Bottom of Boring at 45 ft. Groundwater was first encountered at 11 ft.					
-29	50											
-34	55											
-39	60											
-44	65											

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Project: **Proposed Residential Development** Project Location: **215 Skelly, Hercules** Project Number: **G025.G**	Log of Boring B-2 **Sheet 1 of 1**	**Quantum Geotechnical, Inc.** **1110 Burnett Ave., Ste B** **Concord, CA 94520**

Date(s) Drilled **08-03-20**	Logged By **DT**	Checked By **SM**
Drilling Method **Hollow Stem**	Drill Bit Size/Type **8 in.**	Total Depth of Borehole **20 ft.**
Drill Rig Type **Mobile B-40**	Drilling Contractor **Exploration Geoservices**	Approximate Surface Elevation **21 ft. amsl.**
Groundwater Level and Date Measured **13 ft.**	Sampling Method(s) **Modified California**	Hammer Data **Auto.**
Borehole Backfill **Grout**	Location **See Site Plan**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Percent Fines (-#200)	LL, %	PI, %
21	0				ML-CL		Silty CLAY with Sand: Light olive brown; slightly moist; medium stiff; very fien sand.					
16	5		2-1	13				30.5	88.9		45	20
					SC		Clayey SAND: Dark olive brown; moist; fine to very fine sand; trace fine gravel; medium dense.					
11	10		2-2	24								
					SP		Poorly-Graded SAND: Dark reddish brown; moist to very moist; medium to fine sand; minor coarse to fine, subrounded gravel; medium dense. ▽					
6	15		2-3	41				25.0	93.8	28		
					CL		Silty CLAY: Dark olive brown; moist; very stiff.					
1	20		2-4	34			Bottom of Boring at 20 ft. Groundwater was first encountered at 13 ft.					
-4	25											
-9	30											

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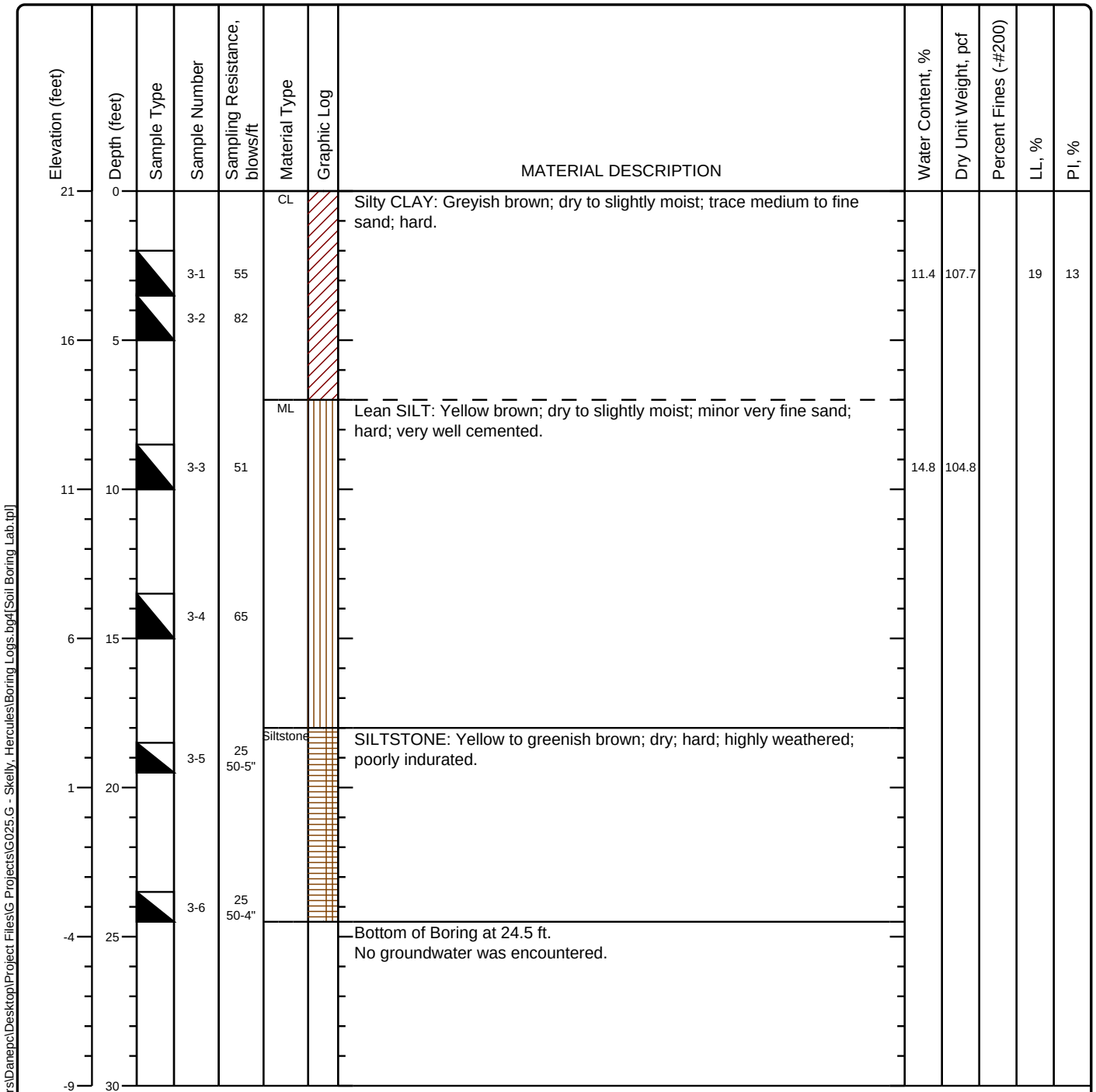
Project: **Proposed Residential Development** Project Location: **215 Skelly, Hercules** Project Number: **G025.G**	Log of Boring B-3 **Sheet 1 of 1**	**Quantum Geotechnical, Inc.** **1110 Burnett Ave., Ste B** **Concord, CA 94520**

Date(s) Drilled **08-03-20**	Logged By **DT**	Checked By **SM**
Drilling Method **Hollow Stem**	Drill Bit Size/Type **8 in.**	Total Depth of Borehole **24.5 ft.**
Drill Rig Type **Mobile B-40**	Drilling Contractor **Exploration Geoservices**	Approximate Surface Elevation **21 ft. amsl.**
Groundwater Level and Date Measured **None Encountered**	Sampling Method(s) **Modified California**	Hammer Data **Auto.**
Borehole Backfill **Grout**	Location **See Site Plan**	



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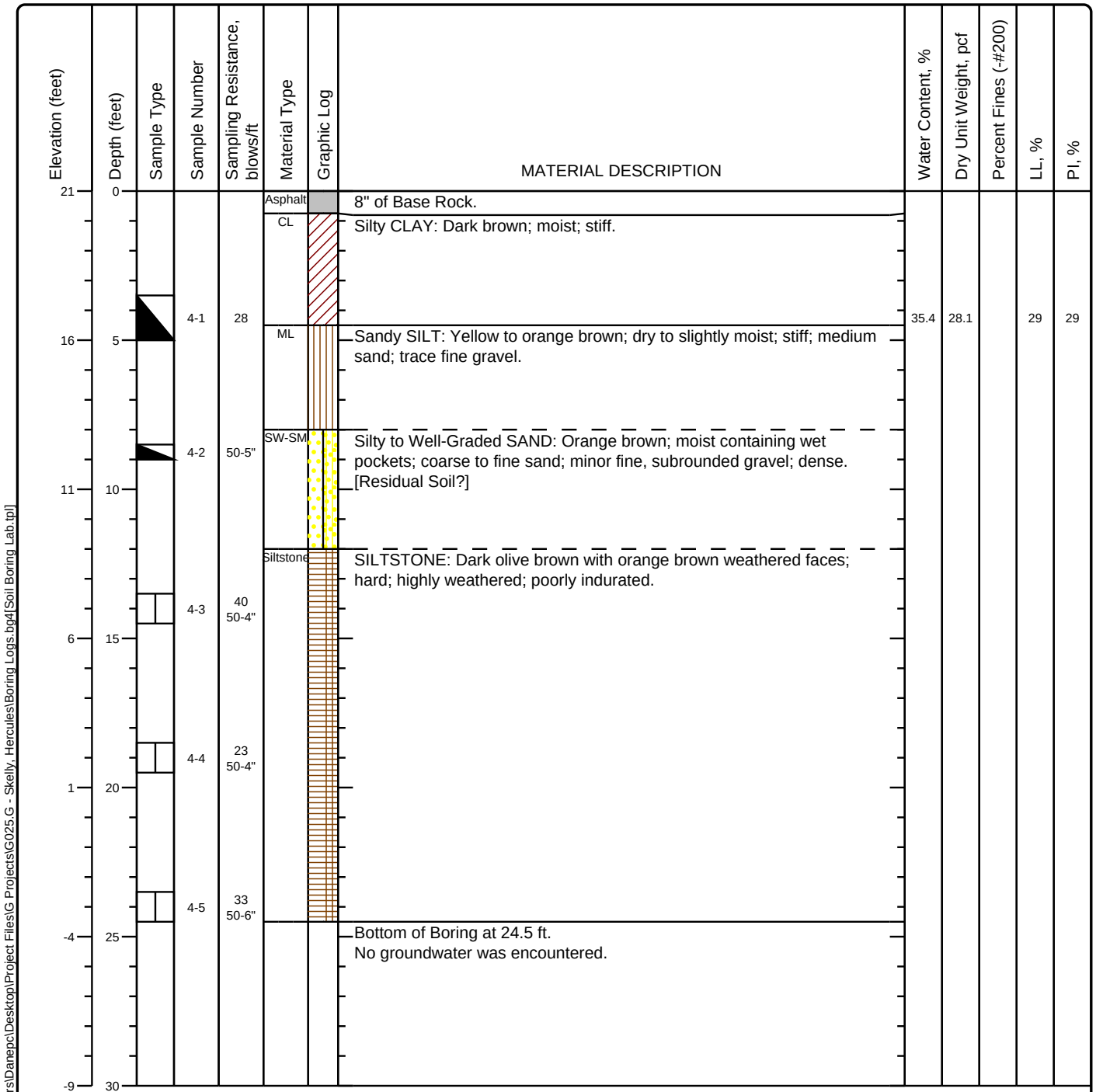
Project: **Proposed Residential Development** Project Location: **215 Skelly, Hercules** Project Number: **G025.G**	Log of Boring B-4 **Sheet 1 of 1**	**Quantum Geotechnical, Inc.** **1110 Burnett Ave., Ste B** **Concord, CA 94520**

Date(s) Drilled **08-03-20**	Logged By **DT**	Checked By **SM**
Drilling Method **Hollow Stem**	Drill Bit Size/Type **8 in.**	Total Depth of Borehole **24.5 ft.**
Drill Rig Type **Mobile B-40**	Drilling Contractor **Exploration Geoservices**	Approximate Surface Elevation **21 ft. amsl.**
Groundwater Level and Date Measured **None Encountered**	Sampling Method(s) **Modified California, SPT**	Hammer Data **Auto.**
Borehole Backfill **Grout**	Location **See Site Plan**	



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Project: **Proposed Residential Development** Project Location: **215 Skelly, Hercules** Project Number: **G025.G**	Key to Log of Boring **Sheet 1 of 1**	**Quantum Geotechnical, Inc.** **1110 Burnett Ave., Ste B** **Concord, CA 94520**

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Percent Fines (-#200)	LL, %	PI, %
1	2	3	4	5	6	7	8	9	10	11	12	13

COLUMN DESCRIPTIONS

1. Elevation (feet): Elevation (MSL, feet).
2. Depth (feet): Depth in feet below the ground surface.
3. Sample Type: Type of soil sample collected at the depth interval shown.
4. Sample Number: Sample identification number.
5. Sampling Resistance, blows/ft: Number of blows to advance driven sampler one foot (or distance shown) beyond seating interval using the hammer identified on the boring log.
6. Material Type: Type of material encountered.
7. Graphic Log: Graphic depiction of the subsurface material encountered.
8. MATERIAL DESCRIPTION: Description of material encountered. May include consistency, moisture, color, and other descriptive text.
9. Water Content, %: Water content of the soil sample, expressed as percentage of dry weight of sample.
10. Dry Unit Weight, pcf: Dry weight per unit volume of soil sample measured in laboratory, in pounds per cubic foot.
11. Percent Fines (-#200): The percent fines (soil passing the No. 200 Sieve) in the sample. WA indicates a Wash Sieve, SA indicates a Sieve Analysis.
12. LL, %: Liquid Limit, expressed as a water content.
13. PI, %: Plasticity Index, expressed as a water content.

FIELD AND LABORATORY TEST ABBREVIATIONS

CHEM: Chemical tests to assess corrosivity
COMP: Compaction test
CONS: One-dimensional consolidation test
LL: Liquid Limit, percent
PI: Plasticity Index, percent
SA: Sieve analysis (percent passing No. 200 Sieve)
UC: Unconfined compressive strength test, Qu, in ksf
WA: Wash sieve (percent passing No. 200 Sieve)

MATERIAL GRAPHIC SYMBOLS

Lean CLAY, CLAY w/SAND, SANDY CLAY (CL)
SILT, SILT w/SAND, SANDY SILT (ML)
Clayey SAND (SC)
Clayey SAND to Sandy CLAY (SC-CL)
Siltstone
Poorly graded SAND (SP)
Well graded SAND with Silt (SW-SM)

TYPICAL SAMPLER GRAPHIC SYMBOLS

2.5-inch-OD Modified California w/ brass liners
2-inch-OD unlined split spoon (SPT)

OTHER GRAPHIC SYMBOLS

Water level (at time of drilling, ATD)
Water level (after waiting)
Minor change in material properties within a stratum
Inferred/gradational contact between strata
Queried contact between strata

GENERAL NOTES

1: Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
2: Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.

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Figure B-1

APPENDIX B

Laboratory Investigation

Summary of Laboratory Test Results

LABORATORY INVESTIGATION

The laboratory testing program was directed towards providing sufficient information for the determination of the engineering characteristics of the site soils so that the recommendations outlined in this report could be formulated.

The following tests were performed

- Moisture content;
- Sieve analysis
- Atterberg Limits tests;

A summary of all laboratory test results is presented on Table B-I of this appendix and on the respective "Logs of Test Borings", Appendix A.

SUMMARY OF LABORATORY TESTS

TABLE B-1

Sample Number	Depth (ft)	Moisture Content (% Dry Wt.)	Dry Density (pcf)	Sieve Analysis (% Passing No. 200 Sieve)	Atterberg Limits	
					Liquid Limit (%)	Plasticity Index (%)
1-1	2.0	16.0	107.1	--	--	--
1-2	3.5	26.5	91.4	--	--	--
1-3	8.5	28.3	91.0	--	--	--
1-4	13.5	42.6	75.2	--	--	--
1-5	18.5	29.2	94.0	--	--	--
1-7	28.5	24.8	97.4	--	--	--
1-9	38.5	17.1	103.3	--	--	--
2-1	3.5	30.5	88.9	--	45	20
2-3	13.5	25.0	93.8	28	--	--
3-1	2.0	11.4	107.7	--	19	13
3-3	8.5	14.8	104.8	--	--	--
4-1	3.5	35.4	28.1	--	29	29

Appendix C

The Grading Specification

Guide Specifications for Rock Under Floor Slabs

THE GRADING SPECIFICATIONS
on
Proposed Residential Development
215 Skelly
Hercules, California

1. General Description

1.1 These specifications have been prepared for the grading and site development of the subject residential development. ***Quantum Geotechnical Inc.***, hereinafter described as the Soil Engineer, should be consulted prior to any site work connected with site development to ensure compliance with these specifications.

1.2 The Soil Engineer should be notified at least two working days prior to any site clearing or grading operations on the property in order to observe the stripping of organically contaminated material and to coordinate the work with the grading contractor in the field.

1.3 This item shall consist of all clearing or grubbing, preparation of land to be filled, filling of the land, spreading, compaction and control of fill, and all subsidiary work necessary to complete the grading of the filled areas to conform with the lines, grades, and slopes as shown on the accepted plans. The Soil Engineer is not responsible for determining line, grade elevations, or slope gradients. The property owner, or his representative, shall designate the person or organizations who will be responsible for these items of work.

1.4 The contents of these specifications shall be integrated with the soil report of which they are a part; therefore, they shall not be used as a self-contained document.

2. Tests

The standard test used to define maximum densities of all compaction work shall be the ASTM D1557-12 Laboratory Test Procedure. All densities shall be expressed as a relative compaction in terms of the maximum dry density obtained in the laboratory by the foregoing standard procedure.

3. Clearing, Grubbing, and Preparing Areas To Be Filled

3.1 If encountered, all vegetable matter, trees, root systems, shrubs, debris, and organic topsoil shall be removed from all structural areas and areas to receive fill.

3.2 If encountered, any soil deemed soft or unsuitable by the Soil Engineer shall be removed. Any existing debris or excessively wet soils shall be excavated and removed as required by the Soil Engineer during grading.

3.3 All underground structures shall be removed from the site such as old foundations, abandoned pipe lines, septic tanks, and leach fields.

3.4 The final stripped excavation shall be approved by the Soil Engineer during construction and before further grading is started.

3.5 After the site has been cleared, stripped, excavated to the surface designated to receive fill, and scarified, it shall be disked or bladed until it is uniform and free from large clods. The native subgrade soils shall be moisture conditioned and compacted to the requirements as specified in the grading section of this report. Fill can then be placed to provide the desired finished grades. The contractor shall obtain the Soil Engineer's approval of subgrade compaction before any fill is placed.

4. Materials

4.1 All fill material shall be approved by the Soil Engineer. The material shall be a soil or soil-rock mixture which is free from organic matter or other deleterious substances. The fill material shall not contain rocks or lumps over 6 inches in greatest dimension and not more than 15% larger than 2-1/2 inches. Materials from the site below the stripping depth are suitable for use in fills provided the above requirements are met.

4.2 Materials existing on the site are suitable for use as compacted engineered fill after the removal of all debris and organic material. All fill soils shall be approved by the Soil Engineer in the field.

4.3 Should import material be required, it should be approved by the soil Engineer before it is brought to the site.

5. Placing, Spreading, and Compacting Fill Material

5.1 The fill materials shall be placed in uniform lifts of not more than 8 inches in uncompacted thickness. Each layer shall be spread evenly and shall be thoroughly blade mixed during the spreading to obtain uniformity of material in each layer. Before compaction begins, the fill shall be brought to a water content that will permit proper compaction by either (a) aerating the material if it is too wet, or (b) spraying the material with water if it is too dry.

5.2 After each layer has been placed, mixed, and spread evenly, either import material or native material shall be compacted to a relative compaction designated for engineered fill.

5.3 Compaction shall be by footed rollers or other types of acceptable compacting rollers. Rollers shall be of such design that they will be able to compact the fill to the specified density. Rolling shall be accomplished while the fill material is within the specified moisture content range. Rolling of each layer shall be continuous over its entire area and the roller shall make sufficient trips to ensure that the required density has been obtained. No ponding or jetting shall be permitted.

5.4 Field density tests shall be made in each compacted layer by the Soil Engineer in accordance with Laboratory Test Procedure ASTM D1556-15 or D6938-10. When footed rollers are used for compaction, the density tests shall be taken in the compacted material below the surface disturbed by the roller. When these tests indicate that the compaction requirements on any layer of fill, or portion thereof, has not been met, the particular layer, or portion thereof, shall be reworked until the compaction requirements have been met.

5.5 No soil shall be placed or compacted during periods of rain nor on ground which contains free water. Soil which has been soaked and wetted by rain or any other cause shall not be compacted until completely drained and until the moisture content is within the limits hereinbefore described or

approved by the Soil Engineer. Approval by the Soil Engineer shall be obtained prior to continuing the grading operations.

6. Pavement

6.1 The proposed subgrade under pavement sections, native soil, and/or fill shall be compacted to a minimum relative compaction of 95% at 2% above optimum moisture content for a depth of 12 inches.

6.2 All aggregate base material placed subsequently should also be compacted to a minimum relative compaction of 95% based on the ASTM Test Procedure D1557-12. The construction of the pavement in the parking and traffic areas should conform to the requirements set forth by the latest Standard Specifications of the Department of Transportation of the State of California and/or City of Hercules, Department of Public Works.

6.3 It is recommended that soils at the proposed subgrade level be tested for a pavement design after the preliminary grading is completed and the soils at the site design subgrade levels are known.

7. Utility Trench Backfill

7.1 The utility trenches extending under concrete slabs-on-grade shall be backfilled with native on-site soils or approved import materials and compacted to the requirements pertaining to the adjacent soil. No ponding or jetting will be permitted.

7.2 Utility trenches extending under all pavement areas shall be backfilled with native or approved import material and properly compacted to meet the requirements set forth by the City of Hercules, Department of Public Works.*

7.3 Where any opening is made under or through the perimeter foundations for such items as utility lines and trenches, the openings must be resealed so that they are watertight to prevent the possible entrance of outside irrigation or rain water into the underneath portion of the structures.

8. Subsurface Line Removal

8.1 The methods of removal will be designated by the Soil Engineer in the field depending on the depth and location of the line. One of the following methods will be used.

8.2 Remove the pipe and fill and compact the soil in the trench according to the applicable portions of sections pertaining to compaction and utility backfill.

8.3 The pipe shall be crushed in the trench. The trench shall then be filled and compacted according to the applicable portions of Section 5.

8.4 Cap the ends of the line with concrete to prevent entrance of water. The length of the cap shall not be less than 5 feet. The concrete mix shall have a minimum shrinkage.

9. Unusual Conditions

9.1 In the event that any unusual conditions not covered by the special provisions are encountered during the grading operations, the Soil Engineer shall be immediately notified for additional recommendations.

10. General Requirements

Dust Control

10.1 The contractor shall conduct all grading operations in such a manner as to preclude windblown dirt and dust and related damage to neighboring properties. The means of dust control shall be left to the discretion of the contractor and he shall assume liability for claims related to windblown material.

GUIDE SPECIFICATIONS FOR ROCK UNDER FLOOR SLABS

Definition

Graded gravel or crushed rock for use under slabs-on-grade shall consist of a minimum thickness of mineral aggregate placed in accordance with these specifications and in conformance with the dimensions shown on the plans. The minimum thickness is specified in the accompanying report.

Material

The mineral aggregate shall consist of broken stone, crushed or uncrushed gravel, quarry waste, or a combination thereof. The aggregate shall be free from deleterious substances. It shall be of such quality that the absorption of water in a saturated dry condition does not exceed 3% of the oven dry weight of the sample.

Gradation

The mineral aggregate shall be of such size that the percentage composition by dry weight, as determined by laboratory sieves (U.S. Sieves) will conform to the following gradation:

Sieve Size	Percentage Passing
¾''	90-100
No. 4	25-60
No. 8	18-45
No. 200	0-3

Placing

Subgrade, upon which gravel or crushed rock is to be placed, shall be prepared as outlined in the accompanying soil report.

D.2 - Paleontological Records Search

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Kenneth L. Finger, Ph.D.
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December 27, 2021

Dana DePietro
FirstCarbon Solutions
1350 Treat Boulevard, Suite 380
Walnut Creek, CA 94597

Re: Paleontological Records Search: Skelly Residential Project (2118.0006), City of Hercules, Contra Costa County, California

Dear Dr. DePietro:

As per your request, I have performed a records search on the University of California Museum of Paleontology (UCMP) database for the Skelly Residential Project in Hercules. The 7.3-acre project site is on the north side of the Atchison, Topeka and Santa Fe Railroad and east side of Pinole Creek (the border between Hercules and Pinole). Its PLS location is NW¼, NE¼, Sec. 22, T2N, R4W, Mare Island Quadrangle (1985 USGS 7.5-series topographic map). Google Earth imagery shows this flat terrain is partially covered with trees and has an indeterminate degree of disturbance (its prior usage is uncertain).

Geologic Units

According to the part of the geologic map by Dibblee and Minch (2005) shown here, the Skelly Residential Project site (yellow outline at center) is located on Holocene alluvium (Qa) and late Miocene siliceous rocks of the Monterey Formation (Tmc). The surrounding half-mile search are (dashed outline) also includes the older clastic (nonsiliceous) rocks of the Monterey Formation (Tm) and the Pliocene Orinda Formation (Tor), both of which could be present in the subsurface of the project site.

Key to mapped units

Qa	Surficial alluvium (Holocene)
Tor	Orinda Formation (Pliocene)
Tmc	Monterey Fm siliceous shale, mudstone, & diatomite, bedded to massive (late Miocene)
Tm	Monterey Fm clay shale & siltstone, massive to vaguely bedded (middle to late Miocene)

Records Search

Holocene deposits are too young to be fossiiferous. The records search on the UCMP database therefore focused on the Orinda and Monterey formations.

The Orinda Formation is represented by 26 vertebrate localities: 23 in Contra Costa County and three in Alameda County. None are within 15 miles of the project site; hence, the local paleontological potential of the Orinda Formation appears to be low. The composite assemblage in the UCMP collection comprises 140 specimens (see Appendix 1 taxonomic list). There are 198 plant localities recorded from the Orinda Formation, all from the Caldecott Tunnel II Project in Alameda County. The flora includes *Betula* (birch), *Magnolia* (magnolia), *Persea* (laurel), *Platanus* (plane tree), *Populus* (poplar), *Quercus* (oak), *Salix* (willow), *Ulma* (elm), and *Umbellaria* (bay laurel).

The record search for the Skelly Residential project performed on the UCMP database focused on the vertebrate and plant localities in the Orinda and Monterey Formations, both of which are ranked as highly sensitive for significant paleontological resources. The database lists four vertebrate localities in the Monterey Formation in Contra Costa County. Nearest to the project site is V4646 (Tormey B), about three miles to the northeast, which yielded a whale vertebra; hence, the Monterey Formation is ranked locally with a moderate to high paleontological sensitivity. The other three localities are more than eight miles to the southeast but none of their vertebrates are listed in the database. There UCMP database lists 27 vertebrate localities in the Monterey Formation elsewhere in California: one in San Benito County, one in Monterey County, two in Kern County, 11 in Los Angeles County, and 12 in San Bernardino County. Appendix 2 is a taxonomic list for the composite assemblage of 443 specimens. There are many more vertebrates from the widespread Monterey Formation housed in the museums of Southern California, particularly the Natural History Museum of Los Angeles County. The UCMP database lists no plant localities in this unit.

Remarks and Recommendations

I do not recommend a paleontological walkover survey of the Skelly Residential Project site because its surface is disturbed. The project will impact Miocene deposits of the Monterey Formation Formation and possibly impact the Pliocene Orinda Formation below the surficial Holocene alluvium. Although the widespread Monterey Formation has produced many vertebrate specimens, its yield in Contra Costa County is limited a single whale vertebra. The Orinda Formation has been more productive in the County, but at considerable distance from the project site, and its depth below the surficial layer on the site is unknown. It therefore appears that if the unit is disturbed by construction activities, is unlikely to yield any significant paleontological resources. Thus, I do not recommend paleontological monitoring of construction activities. Instead, a professional paleontologist should provide the construction crew with an orientation prior to the commencement of earth-disturbing activities so they are aware of the significant fossils that could be encountered and the appropriate procedures to follow.

If any vertebrate remains (i.e., bones, teeth, or unusually abundant and well-preserved invertebrates or plants) be unearthed, the crew should not attempt to remove them**,** as they could be extremely fragile and therefore prone to crumbling, and to ensure their occurrence is properly recorded; instead, all work in the immediate vicinity of the discovery should be diverted at least 15 feet until a professional paleontologist assesses the find and, if deemed appropriate, salvages it in a timely manner. All recovered fossils should be deposited in an appropriate repository, such as the UCMP, where they will be properly curated and made accessible for future study.

Sincerely,

Reference Cited

Dibblee, T.W., Jr., and Minch, J.A., 2005. Geologic map of the Mare Island quadrangle, Contra Costa, Solano, Marin, & Sonoma counties, California. Dibblee Foundation Map DF-145, scale 1:24,000.

APPENDIX 1
UCMP Vertebrates from the Pliocene Orinda Formation

Class Osteichthyes (bony fish)
- Order Lepisosteiformes
  - Family Lepisosteidae
    - *Lepisosteus* (gar)
- Order Perciformes
  - Family cf. Lutjanidae (snappers)
  - Family Cyprinidae (carps & minnows)

Class Reptilia (reptiles)
- Order Testudines
  - Family Testudinidae
    - *Hesperotestudo* (tortoise)

Class Aves (birds)

Class Mammalia (mammals)
- Order Artiodactyla (even-toed ungulates)
  - Family Camelidae (camels)
    - *Procamelus*
  - Family Dromomerycidae
    - *Cranioceras*
  - Family Merycoidodontidae (oreodonts)
    - *Ticholeptus*
- Order Carnivora
  - Family Felidae
    - *Barbourofelis* (false sabre-tooth cat)
  - Family Mustelidae (weasels, badgers, etc.)
- Order Cetacea
  - Family Cetotheriidae (baleen whales)
- Order Desmostylia
  - Family Desmostylidae
    - *Desmostylus* (extinct hippo-like marine mammal)
- Order Lagomorpha
  - Family Leporidae (rabbits & hares)
    - *Hypolagus*
- Order Lipotyphla
  - Family Soricidae
    - *Sorex* (shrew)
- Order Perissodactyla (odd-toed ungulates)
  - Family Equidae (horses)
    - *Hipparion* cf. *H. mohavense*
    - *Nannippus tehonensis*
    - *Pliohippus* cf. *P. leardi*
  - Family Rhinocerotidae (rhinoceroses)
    - *Aphelops*?
- Order Proboscidea
  - Family Gomphotheriidae
    - *Gomphotherium simpsoni*
  - Family Mammutidae (mastodons)
- Order Rodentia
  - Family Cricetidae (mice)
    - *Copemy*s
  - Family Geomyidae (gopher)
    - cf. *Pliosaccomys*

APPENDIX 2
UCMP Vertebrates from the Miocene Monterey Formation

- Class Chondrichthyes (cartilaginous fish)
  - Order Batoidea
    - Myliobatidae
      - *Myliobatis* (eagle ray)
  - Order Carcharhiniformes
    - Family Carcharhinidae
      - *Galeocerdo aduncus* (tiger shark)
      - *Galeocerdo cuvieri* (tiger shark)
      - *Carcharhinus brachyurus* (copper shark)
      - *Carcharhinus priscu*s (gray shark)
      - *Carcharhinus reticulata* (bull shark)
      - *Negaprion eurybathrodon*
      - *Physogaleus contortus*
    - Family Hemigaleidae
      - *Hemipristis serra* (snaggletooth shark)
  - Order Lamniformes
    - Family Lamnidae
      - *Cosmopolitodus hasta*lis (broad-toothed white shark)
      - *Isurus oxyrinchus* (shortfin mako shark)
      - *Isurus paucus* (longfin mako shark)
      - *Isurus planus* (hooked-tooth mako)
    - Family Odontaspididae
      - *Carcharias taurus* (sand tiger shark)
  - Order Squatiniformes
    - Family Squatinidae
      - *Squatina californica* (Pacific angelshark)
- Class Reptilia (reptiles)
  - Order Testudines (turtles)
    - Family Cheloniidae (green turtle, etc.)
    - Family Dermochelyidae (leatherback turtle, etc.)
      - *Psephophorus*
- Class Osteichthyes (bony fish)
  - Order Clupeiformes
    - Family Clupeidae
      - *Ganolytes cameo* (sardine)
  - Order Gadiformes (cod)
  - Order Perciformes (perch-like fish)
    - Family Carangidae
    - Family Echeneidae
  - Order Pleuronectiformes (flatfish)
    - Family Bothidae (lefteye flounders)
      - *Paralichthys*
- Class Aves (birds)
  - Order Pelecaniformes
    - Family Pseudodontornithidae
      - *Osteodontornis orri* (bony-toothed bird)
    - Family Sulidae
      - *Palaeosula stocktoni* (booby)
- Class Mammalia (mammals)
  - Order Carnivora
    - Family Otariidae
      - *Allodesmus* cf. *A. kernensis* (sea lion)
  - Order Cetacea
    - Family Balaenopteridae
      - *Plesiocetus occidentalis* (baleen whale)
    - Family Cetotheriidae
      - cf. *Nannocetus* (baleen whale)
    - Family Iniidae
      - *Kampholophos serrulus* (dolphin)
    - Family Kentriodontidae
      - *Loxolithax stocktoni* (porpoise)
    - Family Physeteridae (toothed whales)
  - Order Desmostylia
    - Family Desmostylidae
      - *Desmostylus hesperus* (extinct hippo-like marine mammal)
  - Order Proboscidea
    - Family Mammutidae
      - *Mammut americanum* (American mastodon)
  - Order Sirenia
    - Family Dugongidae
      - *Dusisiren jordani* (dugong)