134 LYSTRA COURT
TELEPHONE (707) 528-3078

REESE & ASSOCIATES CONSULTING GEOTECHNICAL ENGINEERS

SANTA ROSA, CA 95403
FACSIMILE (707) 528-2837

Report
Soil Investigation
DeCristo Family Trust Apartments
109 Ellis Street
Petaluma, California

Prepared for
The Don Joseph DeCristo Family Trust
7356 Country Club Drive
La Jolla, CA 92037

By

REESE & ASSOCIATES
Consulting Geotechnical Engineers

Brian F. Piazza
Project Geologist

Jeffrey K. Reese
Civil Engineer No. 47753

REGISTERED PROFESSIONAL ENGINEER
JEFFREY KENT REESE
No. C 47753
Exp. 12-31-19
STATE OF CALIFORNIA

Job No. 1592.1.1
October 3, 2018

INTRODUCTION

This report presents the results of our soil investigation for the proposed new apartment building project to be located at 109 Ellis Street in Petaluma, California. We understand that the proposed development will be a three-story, wood- and/or steel-frame structure with a concrete slab-on-grade floor utilized for parking. The apartment building will be served by a new asphalt- or concrete-paved driveway and underground utilities. Foundation and floor loads are not known at this time but are expected to be normal for the type of construction proposed.

The object of our investigation, as outlined in our proposal dated May 16, 2018, was to review selected, published, geologic information in our files, explore subsurface conditions, measure depth to groundwater, obtain samples for visual classification and laboratory testing and determine physical properties of the soils sampled. We then performed engineering analyses to develop conclusions and recommendations concerning:

1. Proximity of the site to active faults.
2. Site preparation and grading.
3. Foundation support and design criteria.
4. Support of concrete slab-on-grade floors.
5. Retaining wall design criteria.
6. Quality and compaction criteria for development of asphalt- or concrete-paved roadways.
7. Soil engineering drainage.
8. Supplemental soil engineering services.

WORK PERFORMED

We reviewed selected, published, geologic information in our files including:

1. The Cotati and Petaluma River Quadrangle Sheets of the Alquist-Priolo Earthquake Fault Zone maps, California Division of Mines and Geology, 1983.

2. "Geology for Planning in Sonoma County", Special Report 120, by M.E. Huffman and C.F. Armstrong, California Division of Mines and Geology, 1980.

3. "Historic Ground Failures in Northern California Associated with Earthquakes", Geological Survey Professional Paper 993, Plate 4, by T. L. Youd and S. N. Hoose, U.S. Department of the Interior, 1978.

4. Liquefaction Susceptibility Map, Association of Bay Area Governments website (www.abag.ca.gov), 2006.

5. "Simplified Procedure for Evaluating Soil Liquefaction Potential," by H.B. Seed & I. M. Idriss, Journal of the Soil Mechanics and Foundation Division, American Society of Civil Engineers, Vol. 97, No. 9, 1971.

6. "Soil Liquefaction During Earthquakes," by I. M. Idriss & R.W. Boulanger, Earthquake Engineering Research Institute, 2008.

On June 25, 2018, we were at the site to observe surface conditions and explore subsurface conditions to the extent of three test borings at the approximate locations indicated on Plate 1. The borings were drilled to depths of about 12 to 49½ feet with truck-mounted hollow-stem and flight auger equipment. Our engineer located the borings, observed the drilling, logged the conditions encountered and obtained samples for visual classification and laboratory testing. Soil samples were obtained with a 2.5-inch (inside-diameter), split-spoon sampler driven with a 140-pound drop hammer. A 2-inch (outside-diameter), Standard Penetration split-spoon sampler was used at selected depths where granular materials were encountered. The stroke during driving was about 30 inches. The blows required to drive the samplers were recorded and converted to equivalent Standard Penetration blow counts for correlation with empirical data. Logs of the borings showing soil classifications, sample depths and converted blow counts are presented on Plates 2 through 4. The soils are classified in accordance with the Unified Soil Classification System, explained on Plate 5.

Selected samples were tested in our laboratory to determine moisture content, dry density, strength characteristics and classification (percent passing No. 200 sieve, percent free swell and Atterberg Limits). The test results are shown on the logs, with the strength data shown in the manner described by the Key to Test Data on Plate 5. Detailed results of the Atterberg Limits tests are shown on Plate 6.

The boring locations indicated on Plate 1 are approximate and were established by estimating from existing surface features. The locations of the borings should be considered no more accurate than implied by the methods used to establish the data. At the completion of the exploration, the borings in excess of 15 feet were backfilled with cement and the shallower boring was backfilled with the soil cuttings.

SURFACE AND SUBSURFACE CONDITIONS

The project site consists of one parcel located north of downtown Petaluma, California. The total area of the project site is approximately 0.70 acres. The site is bordered on the northwest and southwest by residential properties, on the southwest by Ellis Street and on the north/northeast by the Washington Creek Channel. Three existing single-family residences and outbuildings are located on the property. We understand that the existing structures will be demolished as part of the proposed construction.

The project site slopes very gently downward to the southeast, toward Ellis Street. Contour lines on a topographic map prepared by Steven Lafranchi & Associates indicate a difference in elevation across the site of about 2 feet. In general, at the time of our exploration the ground surface was covered with grass and weeds, and shrinkage cracks were observed at the ground surface.

The borings and laboratory tests indicate that the site is underlain by discontinuous layers of fill materials and natural clayey, silty and sandy natural soils to the maximum depth explored. Fill materials consisting of sandy gravel were encountered in Test Boring 2, and extend to depths of about 2 feet below the existing ground surface. Boring 2 was drilled in a gravel driveway that provide access to a house on the property. Laboratory test results indicate that the existing sandy gravel fill materials generally exhibit a low expansion potential. That is, the soils would tend to undergo low strength and volume changes with seasonal variations in moisture content.

In Test Borings 1 and 3, the surface soils consist of sandy silt and clayey sands typical of topsoil. The upper 1½ to 2 feet of the surface soils are porous from prior cultivation and decomposition of organic material.

The soils underlying the fill and weak upper topsoils consist of stiff, highly expansive clayey soils, locally termed adobe. The adobe clay was observed to extend to a depth of about 5 to 8 feet below the existing ground surface. Below the adobe clays, the soils typically consist of medium dense to dense sandy gravels and clayey sands, and stiff to hard sandy clays to the maximum depth explored.

Groundwater was observed in all of the test borings during our exploration at depths of approximately 20½ and 18 feet, respectively. Boring 1 was left open for about 3 hours, at which time the depth of water was measured to be approximately 11½ feet below the adjacent grade. Test Boring 3 was left open for about 1 hour and water was measured about 10½ feet below the adjacent grade. We believe that groundwater conditions vary seasonally, and water levels could rise and fall several feet annually. Determination of precise depth to groundwater, extent of seasonal water level fluctuations or the existence of perched groundwater conditions is beyond the scope of this investigation.

CONCLUSIONS

Based on the results of our field exploration, laboratory testing and engineering analyses, we conclude that, from a soil engineering standpoint, the site can be used for the proposed development. The most significant soil engineering factors that must be considered in design and construction are the presence of existing fill materials, weak, compressible upper soils and near-surface, upper natural clayey soils that exhibit a high expansion potential.

We could not find evidence in our borings to indicate that the existing fills were properly placed and compacted under soil engineering observation and testing services. Such fills could undergo significant total and/or differential settlements under the anticipated loading conditions. Also, we believe that weak and compressible natural soils would similarly be subject to significant settlements when saturated under load. Therefore, we conclude that the existing fills and weak natural soils are not suitable for fill, foundation or slab support in their present condition. It will be necessary to remove (overexcavate) the existing fills and weak, natural soils for their full depth in planned building areas, as subsequently recommended.

Highly expansive soils can shrink and swell with seasonal changes in moisture content and can heave and/or distress lightly loaded footings or slabs. Our experience indicates that the depth of significant seasonal moisture change is typically in the range of about 2 to 3 feet. However, depending on factors such as seasonal rainfall totals, summer weather conditions and surface treatments, significant moisture variations in the near surface expansive soils can occur to substantially deeper depths. In areas where evaporation cannot occur such as under footings, slabs and pavements, the soils will eventually become saturated. The risk of future building damage caused by shrinking and swelling of the expansive upper soils can be significantly reduced by initially moisture conditioning the soils to cause preswelling, then covering the soils with a sufficient of a moisture confining and protecting blanket of approved on-site or imported fill of low expansion potential. The thickness of the nonexpansive fill blanket is dependent upon the degree of risk of floor slab heaving and cracking that is acceptable to the building user.

Most of the buildings with slab-on-grade floors in the site vicinity constructed within the past three decades have been underlain by about 24 to 30 inches of imported fill and are performing satisfactorily. Some structures have been built with imported fill thicknesses as little as 12 inches. However, our experience indicates that with this lesser amount of imported fill, the risk of future heave and resultant slab cracking and displacement is significant. For imported fill thicknesses of 12 inches, 1 to 2 inches of future heave of floor slabs could occur. Therefore, we conclude that to adequately reduce the risk of future heaving and resultant cracking, a nonexpansive fill blanket at least 30 inches thick will be needed.

Satisfactory foundation support of the building can be obtained from spread footings bottomed at relatively shallow depths on properly compacted fill. Concrete floor slabs and exterior concrete slabs can be supported on the recommended nonexpansive fill pad.
For footings designed and installed in accordance with our subsequent recommendations, we judge that total settlements resulting from structural loads would be less than about 1-inch. Post-construction settlements will be about 1/2-inch or less.

In driveway and parking areas, we believe that pavements consisting of asphalt concrete, aggregate base and possibly subbase material can be placed directly on properly prepared expansive site soils. However, pavements will be damaged where the expansive soils experience volume changes with seasonal changes in moisture content. Periodic maintenance, including repair of edge cracking, will likely be required. Future maintenance of paved areas could be significantly reduced by underlying the aggregates with imported select fill and by providing a moisture cutoff at pavement edges.

Liquefaction, a loss in shear strength, and densification, a reduction in void ratio, are phenomena associated with loose, cohesionless sands and gravels subjected to ground shaking during earthquakes, and can result in unacceptable total and/or differential settlements. Whether such phenomena will actually occur depends on complicated factors such as duration and intensity of ground shaking, and the response characteristics of the materials underlying the site.

Because the sandy soils encountered in our borings are generally relatively dense and/or contain a significant fraction of clayey fines, we judge the risk of liquefaction can be considered low. In addition, because the medium dense sand layer encountered in Test Boring 3 from 18 to 22 feet is relatively thin and overlain by about 18 feet of nonliquefiable clayey soils, we judge that the risk of settlement at the ground surface and resultant distress to the structure would be low if liquefaction were to occur.

SEISMIC DESIGN PARAMETERS

The geologic maps reviewed did not indicate the presence of active faults at the project site and the properties are not located within a presently designated Alquist-Priolo Earthquake Fault Zone. Therefore, we judge that there is little risk of fault-related ground rupture during earthquakes. In a seismically active region such as Northern California, there is always some possibility for future faulting at any site. However, historical occurrences of surface faulting have generally closely followed the trace of the more recently active faults. The closest faults generally considered active are the Rodgers Creek fault zone located approximately 4½ miles to the northeast, the San Andreas fault zone located approximately 15 miles to the southwest and the West Napa fault zone located about 17 miles to the east.

Very strong ground shaking will occur during earthquakes. The intensity at the site will depend on the distance to the earthquake epicenter, depth and magnitude of the shock and the response characteristics of the materials beneath the site. Because of the proximity of active faults in the region and the potential for very strong ground shaking, it will be necessary to design and construct the project in strict accordance with current standards for earthquake-resistant construction.

We have determined the seismic ground motion values in accordance with procedures outlined in Section 1613 of the 2016 California Building Code (CBC). Mapped acceleration parameters S_S and S_1 were obtained by inputting approximate site coordinates (latitude and longitude) into earthquake ground motion software developed by the United States Geological Survey. Based on our review of available geologic maps and our knowledge of the subsurface conditions, we judge that the site can be classified as Site Class D, as described in Table 20.3-1 of the American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI) Standard ASCE/SEI 7-10. Using corresponding values of site coefficients for Site Class D and procedures outlined in the CBC, the mapped acceleration parameters were adjusted to yield the design spectral response acceleration parameters S_{DS} and S_{D1}. The following earthquake design data summarize the results of the procedures outlined above.

2016 CBC Ground Motion Parameters

Site Class	D
Mapped Spectral Response Accelerations:	
S_S	1.626 g
S_1	0.639 g
Design Spectral Response Accelerations:	
S_{DS}	1.084 g
S_{D1}	0.639 g

RECOMMENDATIONS

Site Grading

The site should be cleared of debris, brush and dense growths of grass and vegetation, where encountered. Debris resulting from demolition of the existing structures, including foundations and associated subsurface utilities, should be removed from the site. Designated trees should be removed and the root systems excavated. Resultant voids should be backfilled with compacted soil, as subsequently described. The areas to be graded then should be stripped of the upper soils containing root growth and organic matter, where necessary. We anticipate that the depth of stripping will average about 3 inches. The strippings should be removed from the site or stockpiled for reuse as topsoil.

Wells, septic tanks or other voids encountered or created should be removed, filled with compacted soil or compacted granular material or capped with concrete, as determined by the appropriate governing agency or the soil engineer.

After stripping, excavations can be performed as necessary. We anticipate that, with the exception of organic matter, debris and rocks or hard fragments larger than 4 inches in diameter, the excavated material, including approved portions of the existing soil fills, will be suitable for reuse as fill outside of building and exterior slab areas or below the recommended imported fill pad.

Within building areas and extending at least 5 feet beyond the perimeter and to at least 3 feet beyond adjacent exterior concrete slab areas (building envelope), existing fills and weak natural soils should be removed for their full depth. Based on our test boring data, we anticipate overexcavation depths would vary from about 2 to 3 feet below the existing grade. Localized deeper overexcavation may be needed to remove deeper fills and/or weak soils, as determined in the field by the soil engineer. Because the actual depth of excavation to remove existing fill materials and/or weak natural soils could vary, we suggest contract documents contain provisions to account for such variations. The natural clayey soils then should be excavated sufficiently so as to provide space for the recommended 30 inches of imported, nonexpansive fill. In addition, the depth of the overexcavation should be adjusted, as needed, so as to provide space for at least 12 inches of approved, on-site or imported fill of low expansion below the bottom of footings. The excavation in areas should extend to at least 3 feet beyond the perimeter of the footings.

The surfaces exposed by stripping and/or excavation should be scarified at least 6 inches deep, moisture conditioned to at least 4 percentage points above optimum and so as to close any shrinkage cracks for their full depth and compacted to at least 87 percent relative compaction.[1] Such moisture conditioning should be performed in all planned improvement areas (building envelopes, asphalt and concrete paved areas, concrete walkway areas, etc.). Where expansive soils have dried and cracked after initial preparation, additional moisture conditioning would be needed to close shrinkage cracks before covering with aggregates and/or concrete.

---

1 Relative compaction refers to the in-place dry density of fill expressed as a percentage of maximum dry density of the same material determined in accordance with the American Society for Testing and Materials (ASTM) Standard ASTM D1557 laboratory compaction test procedure. Optimum moisture content refers to the moisture content at maximum dry density.

Approved, on-site and/or imported fill should be spread no greater than 8-inch-thick loose lifts, moisture conditioned to or near optimum (at least three percent above optimum for on-site clayey soils) and compacted to at least 90 percent relative compaction. Only imported nonexpansive fill should be used in the upper 30 inches of slab areas and under footings.

Imported fill should be of low expansion potential, free of organic matter, rocks or hard fragments larger than 4 inches in diameter, and have a Plasticity Index of 15 or less. The material proposed for use as imported fill should be tested and approved by the soil engineer prior to importation to the site or use within the building envelope.

Trench backfill materials within building envelopes and extending at least 5 feet beyond the perimeter should consist of similar imported fill. The backfill should be placed in layers and compacted to at least 87 percent relative compaction, except the upper 24 inches should be at least 90 percent. Granular imported backfill that could allow evaporation of moisture from the on-site soils below the building should not be used in building envelopes.

For grading performed in the driest time of the year, especially after winters of significantly less than normal total or springtime rainfall, shrinkage cracks in the expansive soils may be deep. Prolonged watering or controlled flooding with the possible use of wetting agents may be necessary to moisture condition the expansive soils to the high initial moisture content needed to close shrinkage cracks for their full depth. As a construction expediency, the grading contractor could elect to overexcavate a portion of the expansive soils to reduce the amount of moisture conditioning time needed. The overexcavated soils then could be moisture conditioned and replaced as properly compacted fill.

For grading performed in the rainy season (late fall, winter, early spring), the soils may become fully expanded naturally and not require increased moisture conditioning. However, with wintertime grading there are associated risks that include: 1) the site becoming too wet and soft to support construction equipment; 2) normally suitable imported fill becoming too wet to compact (requiring more expensive rocky fill); 3) excavation bottoms becoming unstable (requiring overexcavation and/or use of geotextile fabrics or placement of granular working pads); and, 4) procedures being required to eliminate the possibility of tracking mud onto adjacent public streets. Accordingly, we suggest that the contract documents contain provisions to account for such possible additional costs.

Foundation Support

Provided the pad is graded in conformance with our recommendations, minimum depth spread footings can be used for foundation support. Spread footings should be at least 12 inches wide and should be underlain by at least 12 inches of properly compacted fill of low expansion potential. Footings should be bottomed at least 12 inches below the lowest adjacent compacted pad grade. Spread footings can be designed to impose dead plus code live load and total design load (including wind or seismic forces) bearing pressures of 2,000 and 3,000 pounds per square foot (psf), respectively.

Resistance to lateral loads can be obtained from a combination of passive earth pressures and soil friction. We recommend the following criteria for design:

Passive Earth Pressure	=	300 pounds per cubic foot (pcf) equivalent fluid, neglect the upper 1-foot unless confined by pavement or slab
Soil Friction Factor	=	0.30

Slab-on-Grade

Provided the site is prepared as recommended above, floor slabs should be underlain by at least 30 inches of properly compacted approved on-site or imported fill of low expansion potential. Slab-on-grade subgrade should not be allowed to dry prior to concrete placement. In addition, slabs should be underlain by a capillary moisture break and cushion layer consisting of at least 4 inches of free-draining, crushed rock or gravel at least 1/4-inch and no larger than 3/4-inch in size. Crushed rock should be used where the slabs would be subjected to heavy vehicular traffic such as fork lifts or delivery trucks. Moisture vapor will condense on the underside of slabs. Where passage of moisture vapor through slabs would be detrimental, an impermeable moisture vapor barrier should be provided between the drainrock and the slabs. Where migration of moisture vapor through slabs is detrimental, a 10-mil minimum vapor retarder should be provided between the supporting base material and the slabs. Two inches of moist, clean sand could be placed on top of the membrane to aid in curing and to provide puncture protection. However, the actual use of sand should be determined by the architect or design engineer. The use of a less permeable and stronger membrane should be considered if sand is not to be placed for puncture protection, or where the flooring manufacturer requires a vapor barrier. Concrete design and curing specifications should recognize the potential adverse effects associated with placement of concrete directly on the membrane.

The slabs should be at least 5 inches thick and be reinforced to reduce cracking and help keep closed those cracks that do appear. The actual slab thickness and amount of reinforcing used should be determined by the structural design engineer based on anticipated use and performance.

Where at least 30 inches of compacted fill of low expansion potential is provided, slabs could be tied to perimeter foundations. Where less than 30 inches of imported fill is used, slabs should be carefully separated from foundations. Positive, low friction separations, such as felt paper or expansion joint material, should be provided between the slab and foundations. Frequent joints should be provided in the slabs to permit movements to occur and reduce the potential for slab distress.

Retaining Walls

Retaining walls may be needed as part of site development. Prior to construction of the walls, the wall footings area and the area behind the wall that will have a concrete slab-on-grade should be prepared as recommended above for those areas.

Where the walls can tilt slightly, active pressures can be developed and the walls should be designed for an equivalent fluid pressure of 45 pcf. If the tops of the walls are constrained from tilting, the pressures are higher and 60 pcf should be used.

Wall footings can be designed in accordance with the criteria above for building foundations. Where the wall back-fills are subjected to heavy storage and/or vehicular loads, the walls should be designed for a surcharge pressure equal to 2½ feet of additional backfill.

The walls should be fully backdrained with free-draining granular material and perforated plastic pipe. Discharge of the collected waters should be into the site drainage facilities.

Pavement Thicknesses

For planning purposes, based on our experience with similar projects and soils, we recommend the following minimum pavement sections for driveways and parking areas:

Material	Parking Areas	Driveway Areas
Class II Aggregate Base	6"	8"
Asphalt Concrete	2½"	2½"

Such pavements should be suitable for auto and light pickup truck traffic. Where heavier truck loadings are anticipated, the pavement thickness should be increased to at least 3 inches of asphalt and about 10 to 14 inches of aggregate base. Because of concentrated heavy wheel loads at dumpster lift points, reinforced concrete slabs should be used at those locations.

Future wetting and drying of the on-site expansive soils along pavement edges can occur. Pavement maintenance, especially repair of edge cracking, should be anticipated. Increased pavement performance and reduced future maintenance can be accomplished by underlying the paved areas with at least 12 inches of imported fill of low expansion potential. The fill, if used, should extend at least 3 feet beyond pavement edges, where attainable. Conventional curb and sidewalk and/or landscaping with an automatic sprinkler system can also provide some benefit in reducing future maintenance. Periodic patching or sealing of the asphalt-concrete pavement should be performed to reduce shrink/swell movements of the underlying expansive clays, should cracks occur. Future edge cracking could also be reduced by installation of a perimeter moisture vapor cutoff. We can provide specific recommendations, if desired.

Prior to subgrade preparation, underground utilities in the paved areas should be installed and properly backfilled. Subgrade soils in highly expansive material areas should be prepared by scarifying to a depth of at least 6 inches, uniformly moisture conditioning to at least 4 percent above optimum and compacting to at least 93 percent relative compaction. The moisture conditioning should be sufficient so as to close all shrinkage cracks for their full depth. This may require scarifying and recompacting, and/or overexcavation and replacement to achieve uniformity and proper moisture conditioning. Subgrade soils in other areas should be moisture conditioned to near or slightly above optimum and compacted to at least 95 percent. Finished subgrade should be smooth, firm, uniform and nonyielding. Approved aggregate base materials should be spread in layers, moisture conditioned and compacted to at least 95 percent relative compaction. The aggregate base surface should also be firm and nonyielding.

The materials and methods used should conform to the requirements of the State of California Caltrans Standard Specifications, current edition, and the requirements of the City of Petaluma.

Pavements on expansive soils can heave and settle. Gently sloping surfaces could allow water to stand with only minor displacements and should be avoided. Also, valley gutters in paved areas could need subgrade subdrains as determined during final design.

Soil Engineering Drainage

Ponding water will cause swelling of the expansive soils and would be detrimental to foundations. It is important that the area adjacent to the building be sloped to drain away from foundations. Good, positive surface drainage away from the building consisting of at least 1/2-inch per foot extending at least 4 feet out should be provided. The roofs should be provided with gutters or roof drain inlets with downspouts. The downspouts should either discharge onto paved areas or splash blocks draining at least 30 inches away from foundations, or be connected to rigid-wall nonperforated plastic pipelines that outlet into planned or existing storm drain facilities.

Where irrigated landscape areas abut the building, excess water can be introduced into soil layers along the edge of the building, tending to soften soils in the footing areas and increase the risk of potential migration of moisture beneath floor slabs. We believe that the installation of the recommended compacted fill pad that extends to at least 5 feet beyond the building perimeter should provide an effective barrier to the infiltration of excess water from landscape areas. However, we recommend that hot-mopping or other methods of waterproofing the exterior sides of below-grade cold joints in perimeter foundations be performed. Also, as an added precaution, landscape planters that abut the building could be lined with a plastic membrane (6-mil visqueen or equivalent) and be provided with a subdrain that outlets into planned site drainage systems (gutters, storm drains, etc.).

Supplemental Geotechnical Services

We should review grading and foundation plans for conformance with the intent of our recommendations. During site grading and foundation excavation operations, the soil engineer should provide intermittent observation and testing. The soil engineer should observe the conditions encountered, confirm needed overexcavation depths and modify our recommendations, if warranted. Field and laboratory tests should be performed to ascertain that the recommended moisture contents and degrees of compaction are being attained. Concrete placement and reinforcing should be checked as stipulated on the project plans or as required by the Building Department. It is our understanding that approval from the Building Department must be obtained prior to the placement of concrete in foundation elements.

LIMITATIONS

We have performed the investigation and prepared this report in accordance with generally accepted standards of the soil engineering profession. No warranty, either express or implied, is given.

It should be understood that our services were limited to the scope of work outlined above and specifically excluded other services including, but not limited to, an evaluation or analysis of soil chemistry, corrosion potential, mold and soil/groundwater contamination.

Subsurface conditions are complex and may differ from those indicated by surface features or encountered at test boring locations. Therefore, variations in subsurface conditions not indicated on the logs could be encountered. If the project is revised, or if conditions different from those described in this report are encountered during construction, we should be notified immediately so that we can take timely action to modify our recommendations, if warranted.

Supplemental services as recommended herein are performed on an as-requested basis. These services are in addition to this investigation, and are charged for on an hourly basis in accordance with our Standard Schedule of Charges. We can accept no responsibility for items we are not notified to check, nor for use or interpretation by others of the information contained herein.

Site conditions and standards of practice change. Therefore, we should be notified to update this report if construction is not performed within 24 months.

LIST OF PLATES

DISTRIBUTION

Copies submitted:	1	The Don Joseph DeCristo Family Trust 7356 Country Club Drive La Jolla, CA 92037 Diamondeagle4@gmail.com
	1	Jerry Kler Associates, Architects 475 Gate Road, Suite 222 Sausalito, CA 94965 Attention: Jerry Kler jerry@jerryklerarchitects.com

JM/JKR:nay/ra/Job No. 1592.1.1

▽ groundwater first encountered at time of drilling

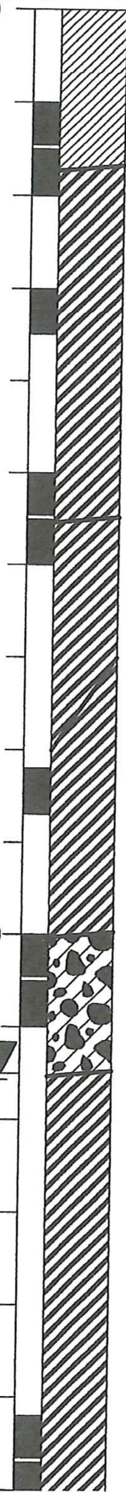
▼ groundwater at time of backfilling

LOG OF BORING 1

Equipment: 6" FLIGHT AUGER

Elevation: ______ Date: 6-25-18

Laboratory Test Results or Remarks	Blows/foot *	Moisture Content (%)	Dry Density(pcf)	Depth (ft)	Description
				0	LIGHT BROWN SANDY CLAY (CL), medium stiff, dry, porous with rootlets
LL = 44, PL = 22, PI = 22 Percent Free Swell = 65		12.7			
Percent Free Swell = 80	6	21.7	80		
				2	BLACK CLAY (CH), medium stiff, dry, with dessication cracks (adobe)
LL = 70, PL = 32, PI = 38 Percent Free Swell = 100	8	31.6	88		becomes wet
				4	
Percent Free Swell = 80	15	24.7	100		
				6	LIGHT BROWN-LIGHT GRAY CLAY (CH), very stiff, wet
				8	LIGHT BROWN VERY SANDY CLAY (CH), very stiff, wet, with occasional fine gravels
TxUU = 2020 (1500)	18	17.7	111		
					becomes gravelly per driller
				10	LIGHT BROWN SANDY GRAVEL (GC), medium dense, wet, with lenses of coarse sand
Percent Passing No. 200 Sieve = 19.8		10.4			
	15	14.7			
				▼	
				12	MOTTLED LIGHT GRAY, LIGHT BROWN SANDY CLAY (CH), stiff, moist
				14	
UC(P) = 2750					
	12	30.4	92	16	



REESE & ASSOCIATES
CONSULTING GEOTECHNICAL ENGINEERS

Job No: 1592.1.1

Date: 9-10-18

Appr: BFP

LOG OF BORING 1

DECRISTO FAMILY TRUST APARTMENTS
PETALUMA, CALIFORNIA

PLATE **2a**

*Converted to Standard Penetration Blow Counts

▽ groundwater first encountered at time of drilling

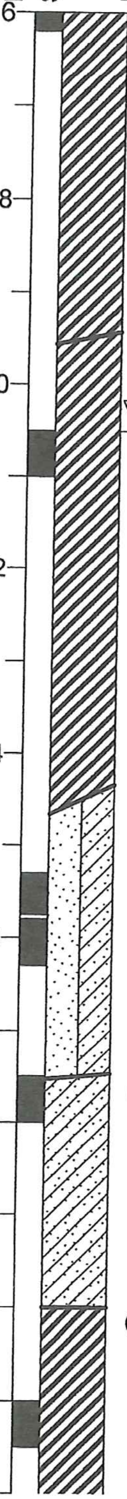
▼ groundwater at time of backfilling

LOG OF BORING 1

Equipment: 6" FLIGHT AUGER

Elevation: ______ Date: 6-25-18

Laboratory Test Results or Remarks	Blows/foot *	Moisture Content (%)	Dry Density(pcf)	Depth (ft)	Description
				16	
				18	
				20	YELLOW-BROWN VERY SANDY CLAY (CH), medium stiff, wet, slightly plastic ▽
Percent Free Swell = 80	8	33.9			
				22	
				24	LIGHT GRAY-BROWN CLAYEY SAND (SC-SP), medium dense, saturated
Percent Passing No. 200 Sieve = 6.6		24.1			
	16	23.3	101	26	
Percent Passing No. 200 Sieve = 14.2	36			28	LIGHT BROWN CLAYEY SAND (SC), dense, saturated
				30	GRAY-BROWN VERY SANDY CLAY (CH), medium stiff, wet, plastic
	7	37.0			
				32	



REESE & ASSOCIATES
CONSULTING GEOTECHNICAL ENGINEERS

Job No: 1592.1.1

Date: 9-10-18

Appr: BP

LOG OF BORING 1

DECRISTO FAMILY TRUST APARTMENTS
PETALUMA, CALIFORNIA

PLATE **2b**

*Converted to Standard Penetration Blow Counts

▽ groundwater first encountered at time of drilling

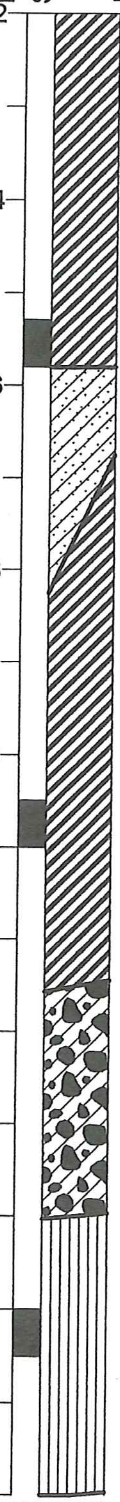
▼ groundwater at time of backfilling

LOG OF BORING 1

Equipment 6" FLIGHT AUGER

Elevation ____________ Date 6-25-18

Laboratory Test Results or Remarks	Blows/foot *	Moisture Content (%)	Dry Density(pcf)	Depth (ft)	Description
				32	
				34	
Percent Passing No. 200 Sieve = 50.4	20				
				36	MOTTLED GRAY AND LIGHT BROWN VERY CLAYEY SAND (SC), medium dense, wet, plastic
				38	LIGHT GRAY-BROWN FINE SANDY CLAY (CH), stiff, wet, plastic
				40	
	11	24.5			
				42	MOTTLED ORANGE AND BROWN CLAYEY GRAVEL (GC), medium dense, moist,
				44	
					BLUE-GRAY SANDY SILT (ML), very stiff, moist, with occasional fine gravel
	24	25.4		46	
				48	



REESE & ASSOCIATES
CONSULTING GEOTECHNICAL ENGINEERS

Job No: 1592.1.1

Date: 9-10-18

Appr: BFP

LOG OF BORING 1

DECRISTO FAMILY TRUST APARTMENTS
PETALUMA, CALIFORNIA

PLATE **2c**

*Converted to Standard Penetration Blow Counts

▽ groundwater first encountered at time of drilling

▼ groundwater at time of backfilling

LOG OF BORING 1

Equipment: 6" FLIGHT AUGER

Elevation: ______ Date: 6-25-18

Laboratory Test Results or Remarks	Blows/foot *	Moisture Content (%)	Dry Density(pcf)	Depth (ft)	Sample	Description
				48		BROWN SANDY GRAVEL (GP), very dense, saturated
	50+	14.1				

REESE & ASSOCIATES
CONSULTING GEOTECHNICAL ENGINEERS

Job No: 1592.1.1

Date: 9-10-18

Appr: BFP

LOG OF BORING 1

DECRISTO FAMILY TRUST APARTMENTS
PETALUMA, CALIFORNIA

PLATE 2d

*Converted to Standard Penetration Blow Counts

▽ groundwater first encountered at time of drilling

▼ groundwater at time of backfilling

LOG OF BORING 2

Equipment: 6" FLIGHT AUGER

Elevation: ______ Date: 6-25-18

Laboratory Test Results or Remarks	Blows/foot *	Moisture Content (%)	Dry Density(pcf)	Depth (ft)	Description
				0	GRAY SANDY GRAVEL (GP-GM), medium dense, dry (roadbase fill)
				2	DARK GRAY SANDY CLAY (CH), stiff, moist, plastic (adobe)
UC(P) = 3750 Percent Free Swell = 90	13	24.4	97		
				4	
TxUU = 1500 Percent Free Swell = 120	11	29.3	91		
					LIGHT GRAY SANDY CLAY (CL), stiff, wet, slightly plastic, with fine gravel
				6	
TxUU = 3050 (500)	21	19.2	108		
				8	
					BROWN CLAYEY GRAVEL (GC), medium dense, moist, with abundant sand
Percent Passing No. 200 Sieve = 22.8	21	15.0	111	10	
					BROWN CLAYEY SAND (SC), medium dense, moist
					GRAY-BROWN SANDY CLAY (CL), very stiff, moist
Percent Free Swell = 70	15				
				12	

(No free water encountered)

REESE & ASSOCIATES
CONSULTING GEOTECHNICAL ENGINEERS

Job No: 1592.1.1

Date: 9-10-18

Appr: BFP

LOG OF BORING 2

DECRISTO FAMILY TRUST APARTMENTS
PETALUMA, CALIFORNIA

PLATE 3

*Converted to Standard Penetration Blow Counts

▽ groundwater first encountered at time of drilling

▼ groundwater at time of backfilling

LOG OF BORING 3

Equipment: 6" FLIGHT AUGER

Elevation: ______ Date: 6-25-18

Laboratory Test Results or Remarks	Blows/foot *	Moisture Content (%)	Dry Density(pcf)	Depth (ft)	Description
				0	GRAY SANDY SILT (ML), soft, dry, porous, with root fibers (topsoil)
UC(P) = 1250					
UC(P) = 4500 Percent Free Swell = 70	8	24.4	96		
					DARK GRAY CLAY (CH), stiff, moist, plastic (adobe)
				2	
UC(P) = 3250 Percent Free Swell = 95	13	24.9	96		
				4	
					LIGHT GRAY CLAY (CH), stiff, moist
Percent Free Swell = 50	19	18.7	105		LIGHT GRAY-BROWN VERY SANDY CLAY (CH), stiff, moist
				6	
				8	
				10	MOTTLED ORANGE AND GRAY CLAYEY FINE SAND (SC), loose, moist, with pockets of clay (CH)
Percent Passing No. 200 Sieve = 56.7	9	24.5	101	▽	
					GRAY-BROWN SANDY CLAY (CH), stiff, wet, slightly plastic
				12	
	13				
				14	
LL = 42, PL = 19, PI = 23 Percent Passing No. 200 Sieve = 65.9	7				LIGHT GRAY VERY SANDY CLAY (CL), medium stiff, wet, plastic
				16	

REESE & ASSOCIATES
CONSULTING GEOTECHNICAL ENGINEERS

Job No: 1592.1.1

Date: 9-10-18

Appr: BFP

LOG OF BORING 3

DECRISTO FAMILY TRUST APARTMENTS
PETALUMA, CALIFORNIA

PLATE **4a**

*Converted to Standard Penetration Blow Counts

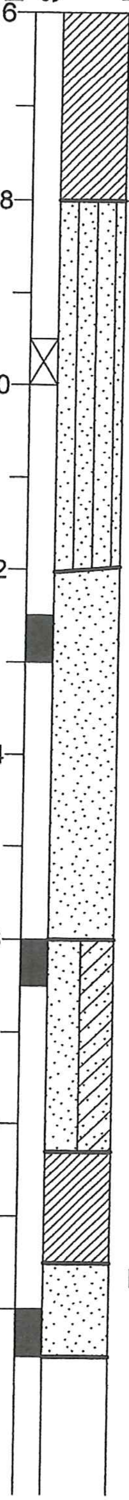
▽ groundwater first encountered at time of drilling

▼ groundwater at time of backfilling

LOG OF BORING 3

Equipment: 6" FLIGHT AUGER

Elevation: ______ Date: 6-25-18



Laboratory Test Results or Remarks	Blows/foot *	Moisture Content (%)	Dry Density (pcf)	Depth (ft)	Description
				16	
				18	▽ LIGHT GRAY SILTY SAND (SM), medium dense, wet
Percent Passing No. 200 Sieve = 13.0	23			20	
Percent Passing No. 200 Sieve = 16.5	20			22	LIGHT GRAY COARSE SAND (SP), medium dense, saturated, with very occasional rounded fine gravel
				24	
Percent Passing No. 200 Sieve = 9.8	28			26	LIGHT GRAY CLAYEY SAND (SC-SP), medium dense, wet
				28	LIGHT GRAY-BROWN SANDY CLAY (CL), very stiff, wet, slightly plastic
	39	15.0		30	BROWN COARSE SAND (SP), very dense, saturated

REESE & ASSOCIATES
CONSULTING GEOTECHNICAL ENGINEERS

Job No: 1592.1.1

Date: 9-10-18

Appr: BP

LOG OF BORING 3

DECRISTO FAMILY TRUST APARTMENTS
PETALUMA, CALIFORNIA

PLATE **4b**

*Converted to Standard Penetration Blow Counts

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS				TYPICAL NAMES
COARSE GRAINED SOILS MORE THAN HALF IS LARGER THAN No. 200 SIEVE	GRAVEL MORE THAN HALF OF COARSE FRACTION IS LARGER THAN No. 4 SIEVE SIZE	CLEAN GRAVEL WITH LESS THAN 5% FINES	GW	WELL GRADED GRAVEL, GRAVEL-SAND MIXTURE
			GP	POORLY GRADED GRAVEL, GRAVEL-SAND MIXTURE
		GRAVEL WITH OVER 12% FINES	GM	SILTY GRAVEL, GRAVEL-SAND-SILT MIXTURE
			GC	CLAYEY GRAVEL, GRAVEL-SAND-CLAY MIXTURE
	SAND MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN No. 4 SIEVE SIZE	CLEAN SAND WITH LESS THAN 5% FINES	SW	WELL GRADED SAND, GRAVELLY SAND
			SP	POORLY GRADED SAND, GRAVELLY SAND
		SAND WITH OVER 12% FINES	SM	SILTY SAND, GRAVEL-SAND-SILT MIXTURE
			SC	CLAYEY SAND, GRAVEL-SAND-CLAY MIXTURE
FINE GRAINED SOILS MORE THAN HALF IS SMALLER THAN No. 200 SIEVE	SILT AND CLAY LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILT, ROCK FLOUR, SANDY OR CLAYEY SILT WITH LOW PLASTICITY
			CL	INORGANIC CLAY OF LOW TO MEDIUM PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAY (LEAN)
			OL	ORGANIC CLAY AND ORGANIC SILTY CLAY OF LOW PLASTICITY
	SILT AND CLAY LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILT, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOIL, ELASTIC SILT
			CH	INORGANIC CLAY OF HIGH PLASTICITY, GRAVELLY, SANDY OR SILTY CLAY (FAT)
			OH	ORGANIC CLAY OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILT
HIGHLY ORGANIC SOILS			PT	PEAT AND OTHER HIGHLY ORGANIC SOILS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

KEY TO TEST DATA

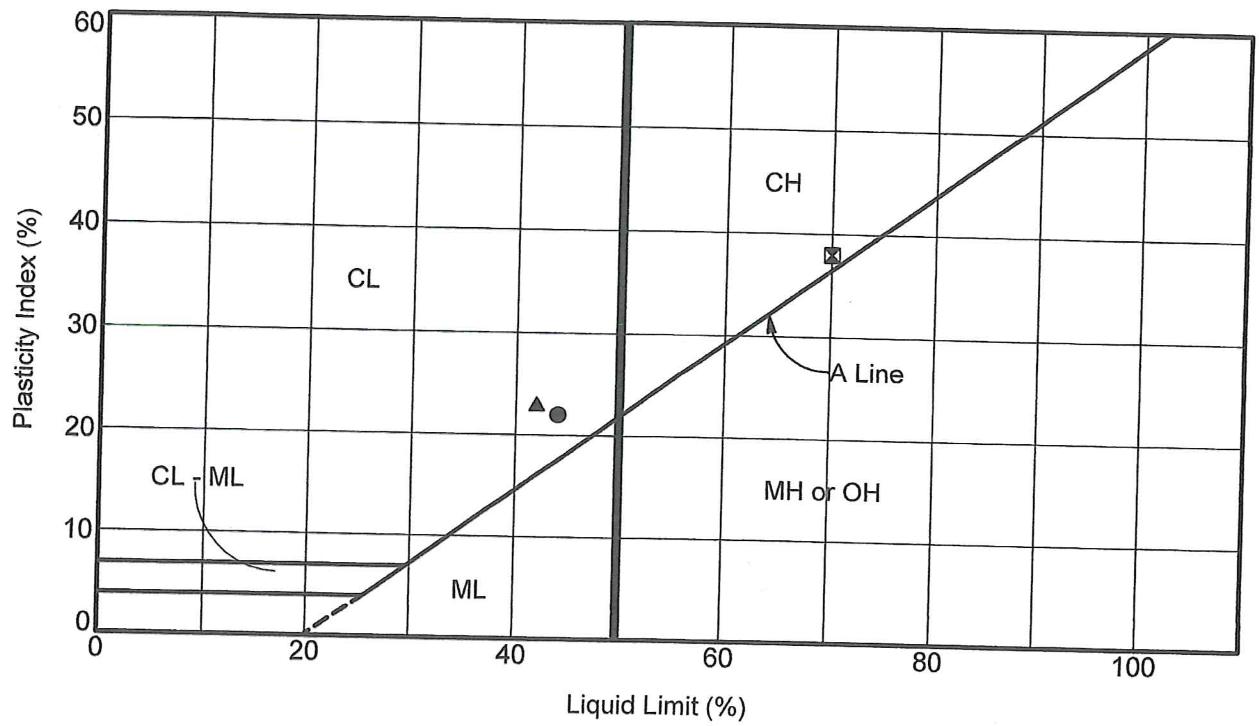
EI	–	Expansion Index
Consol	–	Consolidation
LL	–	Liquid Limit (in %)
PL	–	Plastic Limit (in %)
PI	–	Plasticity Index
SA	–	Sieve Analysis
G_s	–	Specific Gravity
■		"Undisturbed" Sample
□		Bulk Sample

			Shear Strength, psf	Confining Pressure, psf
TxUU	–	Unconsolidated Undrained Triaxial	320	(2600)
TxCU	–	Consolidated Undrained Triaxial	320	(2600)
DSCD	–	Consolidated Drained Direct Shear	2750	(2000)
FVS	–	Field Vane Shear	470	
LVS	–	Laboratory Vane Shear	700	
UC	–	Unconfined Compression	2000	*
UC(P)	–	Laboratory Penetrometer	700	*

Notes: (1) All strength tests on 2.8" or 2.4" diameter samples unless otherwise indicated.

* Compressive Strength

REESE & ASSOCIATES CONSULTING GEOTECHNICAL ENGINEERS	Job No: 1592.1.1 Date: 9-10-18 Appr: BFP	SOIL CLASSIFICATION CHART AND KEY TO TEST DATA DECRISTO FAMILY TRUST APARTMENTS PETALUMA, CALIFORNIA	PLATE 5



ASTM D 4318-98

Symbol	Classification and Source	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Free Swell (%)
●	**GRAY VERY SANDY CLAY (CL)** **Test Boring 1 at 1.0 feet**	**44**	**22**	**22**	**65**
⊠	**BLACK SANDY CLAY (CH)** **Test Boring 1 at 3.0 feet**	**70**	**32**	**38**	**100**
▲	**OLIVE-BROWN VERY SANDY CLAYEY (CL)** **Test Boring 3 at 15.0 feet**	**42**	**19**	**23**	**--**

REESE & ASSOCIATES
CONSULTING GEOTECHNICAL ENGINEERS

Job No: 1592.1.1
Date: 9-10-18
Appr: BFP

ATTERBERG LIMITS TEST RESULTS
DECRISTO FAMILY TRUST APARTMENTS
PETALUMA, CALIFORNIA

PLATE
6