Appendix D:
Geology and Soils Supporting Information

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June 25, 2019 Job No. 5008.02

Mangal Dhillion
3343 Industrial Drive, Suite 9
Santa Rosa, CA 95403
c/o: Archilogix
Attention: Kristin Kiefer
kk@archilogix.com

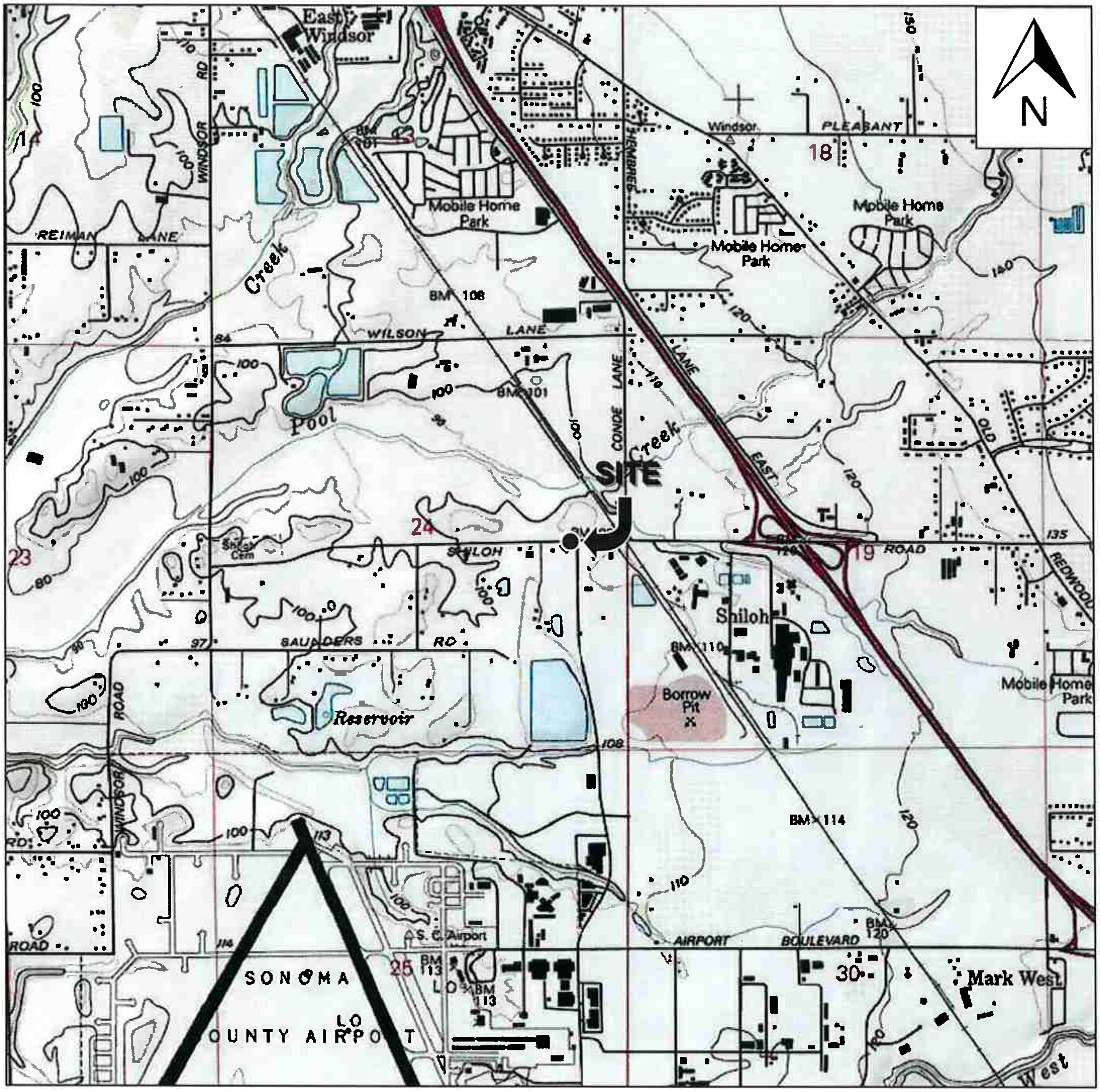
Subject: Geotechnical Investigation
Proposed Shiloh Mixed Use Development
1200 Shiloh Road & 5823 Skylane Boulevard
Windsor, California

Dear Mangal:

PJC and Associates, Inc. (PJC) is pleased to submit the results of our geotechnical investigation for the proposed Shiloh mixed use development project located at 1200 Shiloh Road & 5823 Skylane Boulevard in Windsor, California. The approximate location of the site is shown on the Site Location Map, Plate 1. The site corresponds to latitude and longitudinal coordinates of 38.5254° north and 122.8007° west, according to field GPS measurements performed at the site. Our services were completed in accordance with our proposal for geotechnical engineering services, dated February 6, 2019 and your authorization to proceed with the work dated February 19, 2019. This report presents our engineering opinions and recommendations regarding the geotechnical aspects of the design and construction of the proposed project. Based on the results of this study, it is our opinion that the project site can be developed from a geotechnical engineering standpoint provided the recommendations presented herein are incorporated in the design and carried out through construction.

1. PROJECT DESCRIPTION

Based on our review of the preliminary project plans provided by Archilogix, dated September 5, 2018, it is our understanding that the project will consist of the construction of three multi-family structures and a neighborhood market at the project site. The residential structures will be separated into 27 individual units. It is anticipated that the structures will be two to three-story buildings, of wood or metal frame construction, with concrete slab-on-grade floors. The project will be served by underground utilities and asphaltic concrete paved driveways and parking areas. In addition, we anticipate that exterior concrete flatwork and landscape features will be constructed. We anticipate that the project will be serviced by underground municipal utilities.



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REFERENCE: USGS HEALDSBURG, CALIFORNIA 7.5 MINUTE QUADRANGLE, DATED 1993.

PJC & Associates, Inc. Consulting Engineers & Geologists	SITE LOCATION MAP PROPOSED SHILOH MIXED USE DEVELOPMENT 1200 SHILOH ROAD & 5823 SKYLANE BOULEVARD WINDSOR, CALIFORNIA	PLATE
	Proj. No: 5008.02 Date: 4/19 App'd by: PJC	1

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

Grading and drainage plans, were unavailable at the time of this report. The project site is situated on nearly level terrain. Based on site topography, we assume that the structures and improvements will be constructed at or near the existing grades. Therefore, we anticipate that site grading will be minimal and will consist of cuts and fills of approximately two to three feet and less to upgrade the site soils, achieve the desired building pad grades, and provide adequate gradients for site drainage.

2. PREVIOUS GEOTECHNICAL INVESTIGATION PERFORMED

PJC previously performed a subsurface investigation at the property on July 3, 2011. The results of the soil investigation were never published in a geotechnical investigation report at that time. The previous soil investigation included the drilling of five exploratory boreholes (BH-1 through BH-5) to depths extending to depths between 13½ and 50½ feet below the existing ground surface. The borehole from our 2011 exploration is incorporated into this report. Also, additional exploratory boreholes were drilled on February 20, 2019 and May 24, 2019. The boreholes were advanced to observe the subsurface conditions underlying project site and to collect samples for visual classification and laboratory testing. Our project geologists logged the soils encountered during drilling of the borings.

3. SCOPE OF SERVICES

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

a. Drilling eight exploratory boreholes to depths between 3 and 50½ feet below the existing ground surface to observe the soil and groundwater conditions underlying the project site. Our staff geologists were onsite to log the materials encountered in the boreholes and to obtain representative samples for visual classification and laboratory testing.

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

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

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

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

4. SITE CONDITIONS

a. General. The site is located on the southwestern corner of Shiloh Road and Skylane Boulevard. The roughly rectangular-shaped side by side lots comprises approximately 75,000 square feet of generally level terrain. At the time of our subsurface explorations of February 20, 2019 and May 24, 2019, the eastern half of the site was covered in perennial grasses and the western half was occupied by earthen driveway and an existing residence. We anticipate that the existing residence will be demolished and removed from the site. The site is bounded by Shiloh Road to the north, Skylane Boulevard to the east, a commercial business development to the south, and a single family residence and adjoining grass field to the west.

b. Topography and Drainage. The site is located on level terrain at the northern margin of the Santa Rosa Plain. According to the USGS Healdsburg, California 7.5 minute Quadrangle, the site lies at an approximate elevation of 105 feet above mean sea level. Site drainage consists of sheet flow over the ground surface, by surface infiltration and a ditch along the central portion of the proposed development area. Regional drainage is provided by Pool Creek and Mark West Creek and their tributaries in the near vicinity.

5. GEOLOGIC SETTING

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

The structure of the northern Coast Ranges region is extremely complex due to continuous tectonic deformation imposed over a long period of time. The initial tectonic episode in the northern Coast Ranges was a result of plate convergence, which is believed to have begun during the late Jurassic period. This process involved eastward thrusting of oceanic crust beneath the continental crust (Klamath Mountains and Sierra Nevada) and the scraping off of materials that are now accreted to the continent (northern Coast Ranges). East-dipping thrust and reverse faults were believed to be the dominant structures formed.

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

b. Local Geology. According to the geologic map of the Healdsburg 7.5 Minute Quadrangle prepared by the California Geological Survey (CGS), the site is underlain by early to late Pleistocene Age, older and undivided alluvial deposits (Qoa). The unit is described to consist of uplifted, or deeply dissected older alluvium, fan, and terrace deposits. Our subsurface exploration confirmed that the project site is underlain by alluvial deposits. These deposits extend to great depths below the project site.

6. FAULTING

Geologic structures in the region are primarily controlled by northwest-trending dextral faults. The site is not located within the current Alquist-Priolo Earthquake Fault Zone boundaries. According the USGS National Seismic Hazard Map (2008), the closest known active faults to the site are the Rodgers Creek, the Maacama, and the San Andreas. The Rodgers Creek is located 2.2 miles to the west, the Maacama is located 6.6 miles to the north, and the San Andreas is located 18.6 miles west. Table 1 outlines the nearest known active faults and their associated maximum magnitudes.

TABLE 1
CLOSEST KNOWN ACTIVE FAULTS

Fault Name	Distance from Site (Miles)	Maximum Earthquakes (Moment Magnitude)
Rodgers Creek	2.2	7.33
Maacama	6.6	7.40
San Andreas	18.6	7.94

Reference – USGS 2008 National Seismic Hazard Maps.

7. SEISMICITY

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

8. SUBSURFACE CONDITIONS

a. Exploration and Soils. The subsurface conditions at the site were explored by drilling eight exploratory boreholes (BH-1 through BH-8) within the proposed building areas. The boreholes were drilled to depths between 3 and 50½ feet below the existing ground surface. The approximate borehole locations are shown on the Borehole Location Plan, Plate 2. The boreholes were drilled to collect soil samples of the underlying strata for visual examination and laboratory testing and to explore liquefaction potential at the site. The drilling and sampling procedures and descriptive borehole logs are included in Appendix A. The laboratory procedures are described in Appendix B.

Our boreholes and laboratory tests indicate that the site is covered by approximately two to three feet of artificial fill. In general, the artificial fill appeared moderately compacted, however, varied in density, strength, and compressibility. Also, the fill has unknown origin and placement history. The natural alluvial soils generally consist of sandy clays and silts that are medium stiff to very stiff and exhibit low plasticity characteristics. Below the near surface alluvium our boreholes identified discontinuous layers of silts and clays with varying amounts of sand and gravel. The underlying soils are stiff (dense) to very stiff (very dense). A detailed description of subsurface conditions found in our boreholes is given on Plates 3 through 10.

b. Groundwater. During our subsurface exploration on July 3, 2011, the groundwater table was first observed in BH-5 at an approximate depth of 16 feet below the ground surface. Prior to backfilling the borehole, the water level was measured to be approximately 10½ feet below the ground surface. Groundwater was not observed in BH-1 through BH-4 during our subsurface exploration. At the time of our subsurface exploration on February 20, 2019, the groundwater table was observed in BH-6 at an approximate depth of 14 feet below the ground surface during drilling. Groundwater was not encountered in our shallow boreholes (BH-7 & BH-8) on May 24, 2019. Groundwater levels typically rise and fall by several feet due to variations in seasonal rainfall intensity, duration and other factors. Provided the project does not include significantly deep excavations, we do not anticipate the presence of groundwater will significantly impact the project.

9. GEOLOGIC HAZARDS AND SEISMIC CONSIDERATIONS

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

a. Surface Fault Rupture. Rupture of the ground surface typically occurs along active fault traces. Evidence of existing faults or previous fault-related ground displacement is not indicated in the geologic literature reviewed or during our field exploration. Therefore, we judge that the risk of surface fault rupture at the site is low.

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

c. Liquefaction. According to the Association of Bay Area Governments (ABAG) the site is located in an area considered to have a low liquefaction potential. To evaluate the potential of liquefaction at the site, we drilled one borehole to a depth 51.5 feet below the existing ground surface. The borehole encountered hard alluvial sandy clays, clayey silts and medium dense clayey sands that extend to the maximum depth explored. These soils are not prone to liquefaction in their existing state. Therefore, we judge that the risk of soil liquefaction at the site is low.

d. Lateral Spreading and Lurching. Lateral spreading is normally induced by vibration of near-horizontal alluvial soil layers adjacent to an exposed slope face. Lurching is an action which produces cracks or fissures parallel to an unsupported slope face, such as streams or banks, when the earthquake motion is at right angles to them. No creeks banks or exposed faces are located on or adjacent to the site. Therefore, we judge that the potential for lateral spreading and lurching at the site is nonexistent.

e. Expansive Soils. Based on laboratory testing of the soils at the site (PI=4 and PI=7) the surface soils exhibit low plasticity characteristics and are judged to have a low expansion potential Additional laboratory testing could be required in the field during construction.

10. CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our investigation, it is our professional opinion that the project is feasible from a geotechnical engineering standpoint provided the recommendations contained in this report are incorporated into the design and carried out through construction. The primary geotechnical considerations in design and construction of the project are the presence of artificial fills and weak and compressible near surface alluvial soils.

As previously indicated, artificial fills were encountered in the boreholes during our exploration. The fills were of variable density and thickness. Such fills could undergo unacceptable total and/or differential settlements under loading of proposed structures. We conclude that, it will be necessary to excavate the existing artificial fills for their full depth and replace the subexcavation with properly compacted fills, as subsequently discussed.

Below the artificial fills, natural sandy silt alluvial soils were encountered. The upper portion of the alluvium appears weak and compressible under anticipated loading conditions. These soils can undergo considerable strength loss and increased compressibility, thus causing irregular and erratic ground settlement under loads. This ground movement results in the form of cracked foundations, slabs, and pavements and distress to architectural features of the structures. The detrimental effects of such movements can be significantly reduced by excavating the soils within the weak zone and replacing them as engineered fill. Therefore, in their current state, these soils are not suitable in their existing condition for the support of building foundations, concrete slabs-on-grade, or engineered fills.

We conclude that, where foundations, pavements, concrete slab-on-grade floors, and improvements are planned for the project, the existing artificial fills and weak soils should be subexcavated and be replaced with properly compacted fill. The site soils generally appear to be suitable for reuse as low to non-expansive material. Following grading, spread footing foundations, excavated into properly compacted engineered fill will be suitable to support the buildings. Furthermore, slabs and pavements can be supported by the engineered fill.

The sections below provide geotechnical recommendations and criteria for the design and construction of the proposed project.

11. EARTHWORK AND GRADING

We anticipate that site grading will be minimal and will consist of cuts and fills of approximately two to three feet and less to upgrade the site soils, achieve the desired building pad grades, and provide adequate gradients for site drainage.

a. Demolition and Stripping. Following demolition and removal of the existing residence, areas to be graded should be stripped of old foundations, debris, surface vegetation, underground utilities, etc. These materials should be moved to a suitable area. If underground utilities pass through the site, we recommend that these utilities be removed in their entirety or rerouted where they exist outside an imaginary plane sloped two horizontal to one vertical (2H:1V) from the outside bottom edge of the nearest foundation element. Voids left from the removal of utilities or other obstructions should be replaced with compacted engineered fill under the observation of the geotechnical engineer.

b. Subexcavation and Compaction. Where structures are planned, artificial fills and weak upper natural soils should be subexcavated and be replaced with approved onsite or imported fills. In addition, the artificial fills within planned concrete flatwork and asphalt paved driveways and parking areas should be removed. The excavations should extend at least five feet beyond the edges of the perimeter of the structures, and thee feet beyond the pavements and flatwork. For estimating purposes the depth of excavation should be assumed to be three to four feet. The exact depths of excavations should be determined by the geotechnical engineer in the field during construction. Deeper depths could be required where weak soils are identified.

The bottom of the subexcavations should be scarified to a depth of eight inches, moisture conditioned to within two percent of the optimum moisture content, and compacted to a minimum of 90 percent of the maximum dry density of the materials, as determined by the ASTM D1557-10 laboratory compaction test procedure. The excavated soils, free of excessive organics and rocks larger than four inches in size could be reused as engineered fill. Approved onsite or imported soils of low expansion potential should be used in the upper 30 inches of the building pads and upper 18 inches of concrete flatwork areas and pavements.

During backfilling of excavations, the fill material should be spread in eight-inch thick loose lifts, moisture conditioned to within two percent of the optimum moisture content and compacted to the recommendations given in Table 2. Imported fill, if needed, should be evaluated and approved by the geotechnical engineer before importation. It is recommended that any import fill to be used on site be of a low to non-expansive nature and should meet the following criteria:

Plasticity Index	less than 12
Liquid Limit	less than 35
Percent Soil Passing #200 Sieve	between 15% and 40%
Maximum Aggregate Size	4 inches

TABLE 2
SUMMARY OF COMPACTION RECOMMENDATIONS

Area	Compaction Recommendations*
General Engineered Fill	In lifts, a maximum of eight inches loose thickness, compact to at least 90 percent relative compaction at or within two percent of the optimum moisture content.
Asphalt driveways and parking areas	The upper eight inches (subgrade) compact to at least 95 percent relative compaction at or within two percent of the optimum moisture content.
Trenches**	Compact to at least 90 percent relative compaction at or within two percent of the optimum moisture content. Compact to 95 percent relative compaction under pavements or improvements.

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

Cut and fill slopes should be no steeper than two horizontal to one vertical (2H:1V). Steeper slopes should be retained.

A representative of PJC should observe all site preparation and fill placement. It is important that during the stripping, grading and scarification processes, a representative of our firm should be present to observe whether any undesirable material is encountered in the construction area.

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

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

12. FOUNDATIONS: SPREAD FOOTINGS

Where an engineered fill pad is graded beneath the proposed structures, a spread footing foundation could be used to support the structures.

a. Vertical Loads. The recommended soil bearing pressures, depths of embedment and minimum widths of spread footings are presented in Table 3. Allowable soil bearing pressures may be increased by one-third for transient applications such as wind and seismic loads. All footings should be reinforced, as determined by the project structural engineer.

TABLE 3
FOUNDATION DESIGN CRITERIA

Footing Type	Bearing Pressure (psf)*	Minimum Depth(in)	Minimum Width (in)
Continuous Wall	2,000	18*	12
Isolated Column	2,500	18*	18

* Dead plus live load.
**Min depth into engineered fill

b. Lateral Loads. Resistance to lateral forces may be computed by using friction or passive pressure. A friction factor of 0.30 is considered appropriate between the bottom of the concrete structures and the engineered fill. A passive pressure equivalent to that exerted by a fluid weighing 300 pounds per square foot per foot of depth (psf/ft) is recommended. Unless restrained at the surface, the top six inches should be neglected for passive resistance.

c. Settlement. Total settlement of shallow foundations designed and constructed in accordance with the recommendations is estimated to be less than one inch. Differential settlement is expected to be less than one half inch. The majority of the settlement is expected to occur during construction and placement of dead loads.

13. SEISMIC DESIGN

Based on criteria presented in the 2016 edition of the California Building Code (CBC) and ASCE (American Society of Civil Engineers) STANDARD ASCE/SEI 7-10, the following minimum criteria should be used in seismic design:

a. Site Class: D

b. Mapped Acceleration Parameters: S_S = 1.973 g

S_1 = 0.801 g

c. Site Adjusted Spectral Response Acceleration Parameters: S_{MS} = 1.973 g

S_{M1} = 1.201 g

d. Design Spectral Acceleration Parameters: S_{DS} = 1.315 g

S_{D1} = 0.801 g

14. NON-STRUCTURAL CONCRETE SLABS-ON-GRADE

Non-structural concrete slabs-on-grade may be used for interior slab on grade floors provided they are underlain by at least 30 inches of a low to non-expansive compacted fill. The low to non-expansive fill should extend at least five feet beyond interior slab edges. Any exterior flatwork may be underlain by at least 18 inches of a low to non-expansive engineered fill and should extend at least three feet beyond exterior slab edges

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

For slabs-on-grade with moisture sensitive surfacing, we recommend that an vapor retarder at least 15 mils thick be placed over the drain rock to prevent migration of moisture vapor through the concrete slabs. Control joints should be provided to induce and control cracking. The slabs should be cast and maintained separate of foundations.

Special precautions must be taken during the placement and curing of concrete slabs-on-grade. Excessive slump (high water-cement ratio) of the concrete and/or improper curing procedures and ad mixtures used during either hot or cold weather conditions will lead to excessive shrinkage, cracking or curling of the slabs. High water-cement ratios and/or improper curing also greatly increases water vapor transmission through the concrete. Concrete placement and curing operations should be performed in accordance with the American Concrete Institute (ACI) manual.

We anticipate that the slabs could potentially be subjected to equipment point loads and forklift traffic. Therefore, we recommend that the slabs be designed and reinforced as determined by the project structural engineer.

15. UTILITY TRENCH BACKFILLS

Shallow excavations for utility trenches can be readily made with either a backhoe or trencher. Larger earth moving equipment should be used for deeper excavations. Trench excavations should conform to the current CAL-OSHA requirements to provide stability and for worker safety. The contractor is solely responsible for shoring and safety of trench excavations.

The onsite trenches may be backfilled with clean, approved on-site soils or aggregate baserock. Trench backfills should be placed in horizontal lifts of about 8 inches in thickness or less before compaction, and be compacted to at least 90 percent of the maximum dry density in structural areas and 95 percent in structural areas. The moisture content of the compacted backfill soils should be at or within two percent of the optimum moisture content. Jetting should not be used to achieve trench backfill compaction.

Special care should be taken in the control of utility trench backfilling in slab-on-grade and pavement areas. Poor compaction will cause excessive settlements resulting in damage to the slabs and pavements.

16. ASPHALTIC CONCRETE PAVEMENTS

As previously indicated, the existing artificial fills beneath planned pavement areas should be removed for their full depth. The excavations should be replaced with properly compacted soils of low expansion potential. Following subgrade preparation and compaction, the soils will have relatively good supporting capacity. We obtained a bulk sample of the artificial fill and performed R-value testing. The results were an R-value of 40. Because the quality and constituents of artificial fill and natural surface soils can vary significantly across a site, we have selected an R-value of 25 for use in preliminary pavement design calculations. The preliminary pavement sections are presented in Table 4 below. During grading, PJC personnel should observe the materials to be used as pavement subgrade, and to perform R-Value testing to confirm or modify these pavement thicknesses.

TABLE 4
PAVEMENT DESIGN FOR PAVEMENT AREAS

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

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

Prior to placement of the aggregate base material, the top 8 inches of the pavement subgrade should be scarified to at least 8 inches deep, uniformly moisture conditioned within two percent of optimum and compacted to at least 95 percent relative compaction. Aggregate base material should be spread in thin layers and compacted to at least 95 percent relative compaction to form a firm and unyielding base. The subgrade and aggregate base sections should both visually pass a firm unyielding proof-roll inspection.

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

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

Where pavements will abut landscaped areas, water can seep below the concrete curb and into the base rock within the pavement section. Continued saturation of the base rock leads to permanent wetness towards the lower elevation of the pavement where water ponds. Soft subgrade conditions and pavement damage can occur as a result.

Several precautionary measures can be taken to minimize the intrusion of water into the base rock; however, the cost to install the protective measures should be balanced against the cost of repairing damaged pavement sections. An alternative, which can be taken to extend the life of the pavement, would be to construct a cutoff wall along the perimeter edges of the pavements. The trench should be 4 inches wide, extend at least 36 inches deep, and be filled with a lean concrete mix. We can provide further consultation during final design.

17. CONCRETE PAVEMENTS

We anticipate that concrete pavements maybe used for the project. As with the case for asphaltic pavements, concrete pavements constructed on the weak soils and highly expansive soils may be prone to differential movement, heave, and cracking. For optimum performance the recommendations provided in the earthwork section of this report should be followed.

Concrete pavements should be underlain by 18 inches of low to non-expansive imported fill or lime-treated sit soils. We recommend that Class II base rock be placed under concrete pavements. We recommend a section of at least six inches. The Class II base rock should be compacted to at least 95 percent at or within two percent of optimum moisture content. We recommend a minimum concrete pavement thickness of six inches for a TI of 4 and seven inches for a TI of 5 and 6.

Asphalt pavements near trash enclosures can be prone to depressions and rutting conditions. Therefore, we recommend that a reinforced concrete slab-on-grade pavement should be constructed within 10 feet of trash enclosures.

18. DRAINAGE

a. Surface Drainage. Drainage control design should include provisions for positive surface gradients, so that surface runoff is not permitted to pond adjacent to the building foundations or slabs. Surface runoff should be directed away from foundations. If the drainage facilities discharge onto the natural ground, adequate means should be provided to control erosion and to create sheet flow. Care must be taken so that discharges from the roof gutter and downspout systems are not allowed to infiltrate the subsurface near the structure.

Roof downspouts and surface drains must be maintained entirely separate from the foundation subdrains and slab subdrains. The outlets should discharge onto erosion resistant areas.

19. LIMITATIONS

The data, information, interpretations and recommendations contained in this report are presented solely as bases and guides to the geotechnical design of the proposed mixed use project located at 1200 Shiloh Road & 5823 Skylane Boulevard in Windsor, California. The conclusions and professional opinions presented herein were developed by PJC in accordance with generally accepted geotechnical engineering principles and practices. No warranty, either expressed or implied, is intended.

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

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

20. ADDITIONAL SERVICES

Upon completion of the project plans, they should be reviewed by our firm to verify that the design is consistent with the recommendations of this report. During the course of this investigation, several assumptions were made regarding development concepts. Should our assumptions differ significantly from the final intent of the project designers, our office should be notified of the changes to assess any potential need for revised recommendations. Observation and testing services should also be provided by PJC to verify that the intent of the plans and specifications are carried out during construction; these services should include observation and field density testing of engineered fill and pavement construction, observation of the foundation excavations and installation of drainage facilities. These services will be performed only if PJC is provided with sufficient notice to perform the work. PJC does not accept responsibility for items we are not notified to observe.

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

Sincerely,
PJC & ASSOCIATES, INC.

Patrick J. Conway
Geotechnical Engineer
GE 2303, California

REGISTERED PROFESSIONAL ENGINEER
PATRICK J. CONWAY
No. 2303
Exp. 3/31/20
GEOTECHNICAL
STATE OF CALIFORNIA

PJC:hca:sms

APPENDIX A
FIELD INVESTIGATION

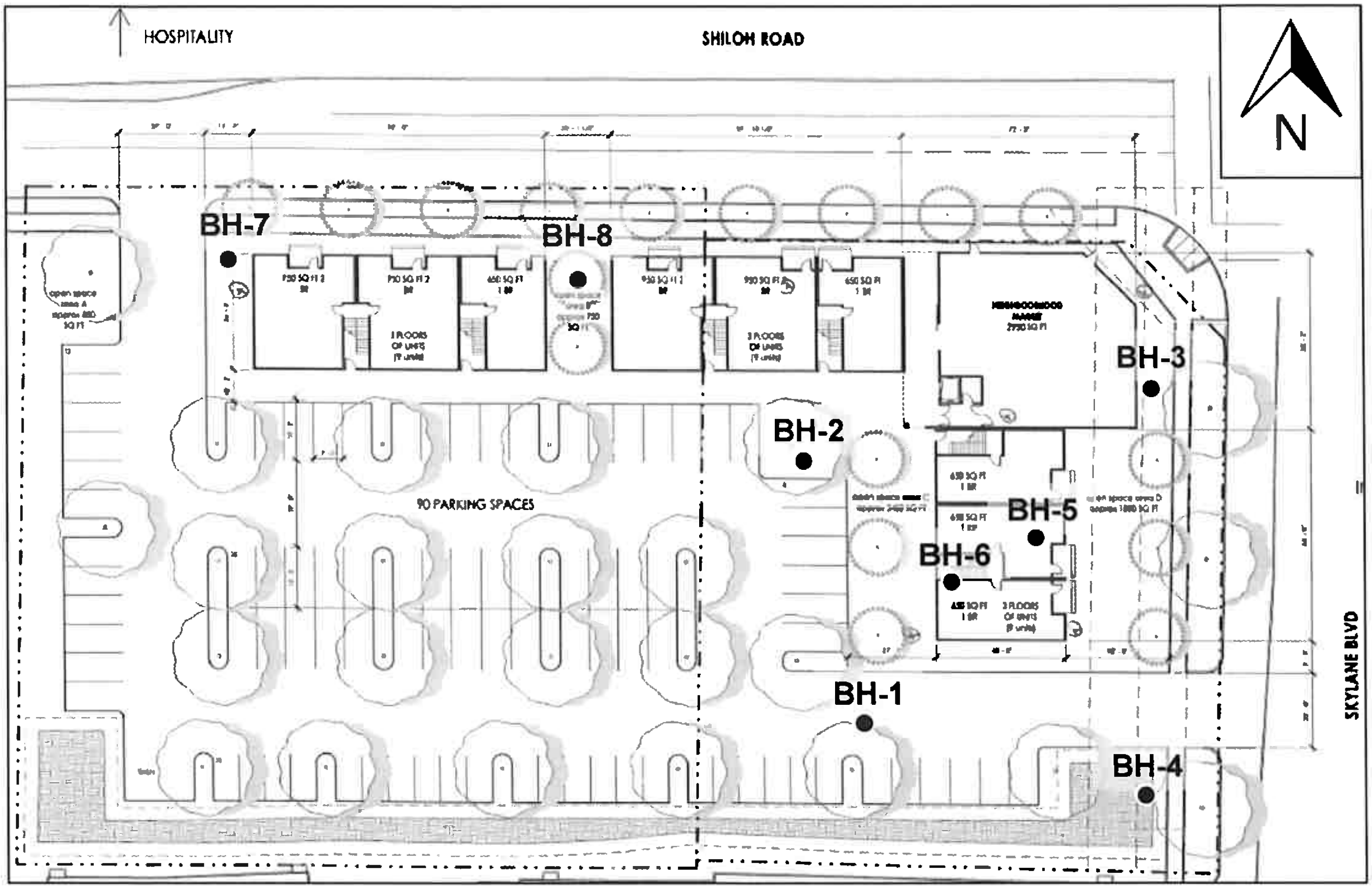
1. INTRODUCTION

The field program performed for this study consisted of drilling eight exploratory boreholes (BH-1 through BH-8) within the proposed building envelopes. The exploration was completed on June 3, 2011, February 20, 2019, and May 24, 2019. The approximate borehole locations are shown on the Borehole Location Plan, Plate 2. The descriptive logs of the boreholes are presented in this appendix as Plates 3 through 10.

2. BOREHOLES

Boreholes 1 through 5 were advanced using a truck-mounted B-53 drill rig equipped with 6-inch diameter solid or hollow stem flight augers. Borehole 6 was advanced using a portable drill equipped with solid stem flight augers. Boreholes 7 and 8 were drilled with a hand auger. The drilling was performed under the observation of our project geologist who maintained a continuous log of the soil conditions and obtained samples suitable for laboratory testing. The soils were classified in accordance with the Unified Soil Classification System, as explained in Plate 11.

Relatively undisturbed and disturbed samples were obtained from the exploratory boreholes. A 2.43 in I.D. California Modified Sampler containing liners was driven into the underlying soil using a 70 or 140 pound hammer falling 30 inches. A 1.375-inch inside diameter Standard Penetration Test (SPT), without liners, was also driven into the soils. The samplers were driven to obtain an indication of the consistency and relative density of the soil and to allow visual examination of at least a portion of the soil column. Soil samples obtained with the split-spoon samplers were retained for further observation and testing. The number of blows required to drive the samplers at 6-inch increments was recorded on each borehole log, and converted to equivalent SPT blow counts for correlation with empirical data. All samples collected were labeled and transported to PJC's office for laboratory examination and testing.



APPROXIMATE SCALE: 1" = 60'

EXPLANATION

● BOREHOLE LOCATION AND DESIGNATION

REFERENCE: SITE PLAN TITLED "SHILOH ROAD MIXED USE DEVELOPMENT," PREPARED BY ARCHILOGIX, LATEST REVISION DATED SEPTEMBER 05, 2018.

PJC & Associates, Inc.
Consulting Engineers & Geologists

BOREHOLE LOCATION PLAN
PROPOSED SHILOH MIXED USE DEVELOPMENT
1200 SHILOH ROAD & 5823 SKYLANE BOULEVARD
WINDSOR, CALIFORNIA

PLATE 2

Proj. No: 5008.02 Date: 4/19 App'd by: PJC

PJC & Associates, Inc.

Consulting Engineers & Geologists

BORING NUMBER BH-1

CLIENT Mangal Dhillion
PROJECT NAME Proposed Shiloh Mixed Use Development
JOB NUMBER 5008.02
LOCATION 1200 Shiloh Road & 5823 Skylane Boulevard, Windsor
DATE STARTED 6/3/11 **COMPLETED** 6/3/11 **GROUND ELEVATION** **HOLE SIZE** 6"
DRILLING CONTRACTOR Pearson Drilling
GROUND WATER LEVELS:
DRILLING METHOD B-53 Hollow Stem Auger with 140lb hammer
∇ **AT TIME OF DRILLING** 14.00 ft
LOGGED BY J.K. **CHECKED BY** SS
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0.0' - 1.0'; CLAYEY SAND (SC); gray-brown, moist, moderately compacted, fine grained (FILL).										
		1.0' - 4.25'; SANDY SILT (ML); gray-brown, moist, very stiff to hard, low plasticity (ALLUVIUM).	MC		37	4.5+	118	10				
			MC		65	4.5+	107	15				
5		4.25' - 8.5'; SANDY CLAY (CL); yellow-brown, moist, hard, medium plasticity (ALLUVIUM).										
			MC		81	4.45	110	18				
		8.5' - 11.0'; CLAYEY GRAVEL (GC); yellow and dark brown, moist, medium dense, fine to coarse grained (ALLUVIUM).										
10			MC		41		105	16				
		11.0' - 15.5'; SANDY CLAY (CL); olive brown, very moist to saturated, hard, medium plasticity (ALLUVIUM).										
	∇											
15			MC		39	4.5+	86	31				

Bottom of borehole at 15.5 feet.

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PJC & Associates, Inc.

Consulting Engineers & Geologists

BORING NUMBER BH-2

CLIENT Mangal Dhillion

PROJECT NAME Proposed Shiloh Mixed Use Development

JOB NUMBER 5008.02

LOCATION 1200 Shiloh Road & 5823 Skylane Boulevard, Windsor

DATE STARTED 6/3/11 COMPLETED 6/3/11

GROUND ELEVATION

HOLE SIZE 6"

DRILLING CONTRACTOR Pearson Drilling

GROUND WATER LEVELS:

DRILLING METHOD B-53 Hollow Stem Auger with 140lb hammer

AT TIME OF DRILLING --- Not Encountered

LOGGED BY J.K. CHECKED BY SS

AT END OF DRILLING ---

NOTES

AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0		0.0' - 1.0'; SANDY SILT (ML); gray-brown, moist, moderately compacted, low plasticity (FILL).										
		1.0' - 2.5'; SANDY SILT (ML); gray-brown, moist, hard, low plasticity (ALLUVIUM).	MC		42	4.5+	119	10	22	18	4	
		2.5' - 7.25'; CLAYEY SAND (SC); yellowish brown, moist, very dense, fine grained (ALLUVIUM).	MC		78		102	19				
5			MC		81		106	19				
		7.25' - 11.0'; CLAYEY SILT (ML); yellow-brown, moist, hard, low plasticity (ALLUVIUM).										
10		11.0' - 13.5'; SANDY CLAY (CL); yellow-brown, very moist, hard, low plasticity (ALLUVIUM).	MC		34	4.5+	94	29				

Bottom of borehole at 13.5 feet.

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PJC & Associates, Inc.

Consulting Engineers & Geologists

BORING NUMBER BH-3

CLIENT Mangal Dhillion **PROJECT NAME** Proposed Shiloh Mixed Use Development

JOB NUMBER 5008.02 **LOCATION** 1200 Shiloh Road & 5823 Skylane Boulevard, Windsor

DATE STARTED 6/3/11 **COMPLETED** 6/3/11 **GROUND ELEVATION** **HOLE SIZE** 6"

DRILLING CONTRACTOR Pearson Drilling **GROUND WATER LEVELS:**

DRILLING METHOD B-53 Hollow Stem Auger with 140lb hammer **AT TIME OF DRILLING** --- Not Encountered

LOGGED BY J.K. **CHECKED BY** SS **AT END OF DRILLING** ---

NOTES **AFTER DRILLING** ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0.0' - 1.5'; CLAYEY SAND (SC); mottled gray-brown, moist, moderately compacted, fine grained (FILL).										
		1.5' - 3.75'; SANDY SILT (ML); yellow-brown, moist, hard, low plasticity, with occasional gravels (ALLUVIUM).										
			MC		59	4.5+	114	14				60
		3.75' - 10.0'; CLAYEY SAND (SC); olive brown and yellow brown, very moist, dense, fine grained (ALLUVIUM).										
5												
			MC		62		103	22				
10												
		11.0' - 13.5'; SANDY CLAY (CL); dark olive brown, very moist, hard to very stiff, low to medium plasticity (ALLUVIUM).										
			MC		53	4.5+	100	24				
			MC		22	3.0	93	28				

Bottom of borehole at 13.5 feet.

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PJC & Associates, Inc.

Consulting Engineers & Geologists

BORING NUMBER BH-4

CLIENT Mangal Dhillion
PROJECT NAME Proposed Shiloh Mixed Use Development
JOB NUMBER 5008.02
LOCATION 1200 Shiloh Road & 5823 Skylane Boulevard, Windsor
DATE STARTED 6/3/11
COMPLETED 6/3/11
GROUND ELEVATION
HOLE SIZE 6"
DRILLING CONTRACTOR Pearson Drilling
GROUND WATER LEVELS:
DRILLING METHOD B-53 Hollow Stem Auger with 140lb hammer
∇ AT TIME OF DRILLING 11.50 ft
LOGGED BY J.K.
CHECKED BY SS
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0		0.0' - 1.0'; CLAYEY SAND (SC); gray-brown, moist, moderately compacted, fine grained (FILL).										
		1.0' - 7.0'; SANDY SILT (ML); yellow-brown, moist, hard, low plasticity (ALLUVIUM).										
			MC		51	4.5+	123	11				
5			MC		75		104	18				
		7.0' - 8.5'; CLAYEY GRAVEL (GC); dark yellow brown, moist, dense, fine to coarse grained (ALLUVIUM).										
		8.5' - 13.5'; SANDY CLAY (CL); olive brown, moist to saturated, hard, medium plasticity (ALLUVIUM).	MC		73	4.5+	108	15				
10	∇											
			MC		23	4.5+	93	27				

Bottom of borehole at 13.5 feet.

PLATE 6

PJC & Associates, Inc.

Consulting Engineers & Geologists

BORING NUMBER BH-5

CLIENT Mangal Dhillion
PROJECT NAME Proposed Shiloh Mixed Use Development
JOB NUMBER 5008.02
LOCATION 1200 Shiloh Road & 5823 Skylane Boulevard, Windsor
DATE STARTED 6/3/11
COMPLETED 6/3/11
GROUND ELEVATION
HOLE SIZE 6"
DRILLING CONTRACTOR Pearson Drilling
GROUND WATER LEVELS:
DRILLING METHOD B-53 Solid Stem Auger with 140lb Hammer
∇ **AT TIME OF DRILLING** 16.00 ft
LOGGED BY J.K.
CHECKED BY SS
▼ **AT END OF DRILLING** 10.50 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0.0' - 1.5'; CLAYEY SAND (SC); mottled gray-brown, moist, moderately compacted, fine grained (FILL).										
		1.5' - 4.0'; CLAYEY SAND (SC); yellow brown, moist, dense, fine grained, with occasional gravels (ALLUVIUM).	MC		37		117	12				
			MC		71		106	16				
5		4.0' - 19.0'; SANDY CLAY (CL); yellow-brown to gray-brown, moist to very moist, hard, low plasticity, with occasional gravels (ALLUVIUM).										
			MC		76	4.5+	105	20				
10		▼										
			MC		24	4.5+	81	36				
15		∇										
			MC		23	4.0	80	38				
20		19.0' - 33.0'; SANDY CLAY (CL); olive brown, saturated, stiff, low plasticity (ALLUVIUM).										

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BORING NUMBER BH-5

CLIENT Mangal Dhillion **PROJECT NAME** Proposed Shiloh Mixed Use Development

JOB NUMBER 5008.02 **LOCATION** 1200 Shiloh Road & 5823 Skylane Boulevard, Windsor

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
20		19.0' - 33.0'; SANDY CLAY (CL); olive brown, saturated, stiff, low plasticity (ALLUVIUM). *(continued)*										
			MC		22		96	28				
25			MC		30		94	28				79
30			SPT		11			39				
		33.0' - 39.0'; CLAYEY SAND (SC); dark olive brown, saturated, dense, fine grained (ALLUVIUM).										
35			SPT		26			22				23
		39.0' - 44.0'; CLAYEY SILT (ML); dark yellow-brown, saturated, very stiff, low plasticity (ALLUVIUM).										
40			SPT		19			40				

(Continued Next Page)

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Consulting Engineers & Geologists

BORING NUMBER BH-5

CLIENT Mangal Dhillion **PROJECT NAME** Proposed Shiloh Mixed Use Development

JOB NUMBER 5008.02 **LOCATION** 1200 Shiloh Road & 5823 Skylane Boulevard, Windsor

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
		39.0' - 44.0'; CLAYEY SILT (ML); dark yellow-brown, saturated, very stiff, low plasticity (ALLUVIUM). *(continued)*										
45		44.0' - 48.0'; SANDY CLAY (CL); dark olive brown, saturated, stiff, low plasticity (ALLUVIUM).										
			SPT		26			35				51
		48.0' - 51.5 '; CLAYEY SILT (ML); dark olive brown, saturated, very stiff, low plasticity (ALLUVIUM).										
50												
			SPT		29			35				

Bottom of borehole at 51.5 feet.

PJC & Associates, Inc.

Consulting Engineers & Geologists

BORING NUMBER BH-6

CLIENT Mangal Dhillion
PROJECT NAME Proposed Shiloh Mixed Use Development
JOB NUMBER 5008.02
LOCATION 1200 Shiloh Road & 5823 Skylane Boulevard, Windsor
DATE STARTED 3/13/19
COMPLETED 3/13/19
GROUND ELEVATION
HOLE SIZE 4"
DRILLING CONTRACTOR PJC
GROUND WATER LEVELS:
DRILLING METHOD Portable Drill with 70lb. Hammer
∇ AT TIME OF DRILLING 14.00 ft
LOGGED BY HA
CHECKED BY SS
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0.0' - 2.0'; SANDY CLAY (CL); moderate brown, moist, moderately compacted, low plasticity, porous with rootlets in upper 1' (FILL).	MC		70	2.0	109	14	26	19	7	
		2.0' - 4.5'; SANDY SILT (ML); dark bluish gray, moist, very stiff, low plasticity (ALLUVIUM).	MC		50			20				
5		4.5' - 6.5'; SANDY SILT (ML); tan, slightly moist, stiff, low plasticity, partially cemented, with trace gravels (ALLUVIUM).	MC		50			13				58
		6.5' - 9.5'; CLAYEY SAND (SC); yellowish tan, moist, dense, fine to medium grained, with gravels (ALLUVIUM).	SPT		50			15				
			SPT		50			14				42
10		9.5' - 15.0'; SILTY CLAY (CL); orangish tan, very moist to saturated, very stiff, medium plasticity (ALLUVIUM).	SPT		65			29				
	∇		MC		100	3.5	85	42				
15												

Bottom of borehole at 15.0 feet.

PJC & Associates, Inc.

Consulting Engineers & Geologists

BORING NUMBER BH-7

CLIENT Mangal Dhillion **PROJECT NAME** Proposed Shiloh Mixed Use Development

JOB NUMBER 5008.02 **LOCATION** 1200 Shiloh Road & 5823 Skylane Boulevard, Windsor

DATE STARTED 5/24/19 **COMPLETED** 5/24/19 **GROUND ELEVATION** **HOLE SIZE** 4"

DRILLING CONTRACTOR PJC **GROUND WATER LEVELS:**

DRILLING METHOD Portable Drill with 70lb. Hammer **AT TIME OF DRILLING** --- Not Encountered

LOGGED BY HA **CHECKED BY** SS **AT END OF DRILLING** ---

NOTES **AFTER DRILLING** ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		0.0' - 1.0'; GRAVELLY CLAY (CL); moderate brown, slightly moist, moderately compacted, low plasticity (FILL).	GB					6				
		1.0' - 2.0'; SILTY CLAY (CL); gray, moist, loosely compacted, low plasticity (FILL).	GB					23				
								31				
		2.0' - 3.0'; SANDY CLAY (CL); olive yellow, very moist, stiff, medium plasticity (ALLUVIUM).	GB					24				

Bottom of borehole at 3.0 feet.

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PJC & Associates, Inc.

Consulting Engineers & Geologists

BORING NUMBER BH-8

CLIENT Mangal Dhillion

PROJECT NAME Proposed Shiloh Mixed Use Development

JOB NUMBER 5008.02

LOCATION 1200 Shiloh Road & 5823 Skylane Boulevard, Windsor

DATE STARTED 5/24/19 COMPLETED 5/24/19 GROUND ELEVATION HOLE SIZE 4"

DRILLING CONTRACTOR PJC

GROUND WATER LEVELS:

DRILLING METHOD Portable Drill with 70lb. Hammer

AT TIME OF DRILLING --- Not Encountered

LOGGED BY HA CHECKED BY SS

AT END OF DRILLING ---

NOTES

AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
									LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0		0.0' - 2.0'; SANDY CLAY (CL); moderate brown, slightly moist, loosely compacted, low plasticity, with gravels (FILL).	GB					6				
		2.0' - 3.0'; SILTY CLAY (CL); olive yellow, moist, stiff, medium plasticity (ALLUVIUM).										

Bottom of borehole at 3.0 feet.

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MAJOR DIVISIONS				TYPICAL NAMES
COARSE GRAINED SOILS (More than half is larger than #200 sieve)	GRAVELS more than half coarse fraction is larger than no. 4 sieve size	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES
			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, POORLY GRADED GRAVEL-SAND MIXTURES
			GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND MIXTURES
	SANDS more than half coarse fraction is smaller than no. 4 sieve size	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL GRADED SANDS, GRAVELLY SANDS
			SP	POORLY GRADED SANDS, GRAVEL-SAND MIXTURES
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, POORLY GRADED SAND-SILT MIXTURES
			SC	CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES
FINE GRAINED SOILS (More than half is smaller than #200 sieve)	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS, SILTY OR CLAYEY FINE SANDS, VERY FINE SANDS, ROCK FLOUR, CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS OR LEAN CLAYS
			OL	ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS

KEY TO TEST DATA

LL — Liquid Limit (in %)
PL — Plastic Limit (in %)
G — Specific Gravity
SA — Sieve Analysis
Consol — Consolidation
■ "Undisturbed" Sample
☒ Bulk or Disturbed Sample
☐ No Sample Recovery

	Shear Strength, psf	Confining Pressure, psf	
*Tx	320	(2600)	Unconsolidated Undrained Triaxial
Tx CU	320	(2600)	Consolidated Undrained Triaxial
DS	2750	(2000)	Consolidated Drained Direct Shear
FVS	470		Field Vane Shear
*UC	2000		Unconfined Compression
LVS	700		Laboratory Vane Shear

Notes: (1) All strength tests on 2.8" or 2.4" diameter sample unless otherwise indicated
(2) * Indicates 1.4" diameter sample

APPENDIX B
LABORATORY INVESTIGATION

1. INTRODUCTION

This appendix includes a discussion of test procedures of the laboratory tests performed by PJC for use in the geotechnical study. The testing program was carried out by employing, whenever practical, currently accepted test procedures of the American Society of Testing and Materials (ASTM).

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

2. INDEX PROPERTY TESTING

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

a. Natural Water Content and Dry Density. The natural water content and dry density of selected samples was determined. The samples were extruded, visually classified and accurately measured to obtain volume and wet weight. The samples were then dried, in accordance with ASTM D-2216-80, for a period of 24 hours in an oven maintained at a temperature of 100° C. After drying, the weight of the sample was determined and the moisture content and dry density calculated.

b. Sieve Analysis. The gradation characteristics of selected samples were determined in accordance with ASTM D422. The samples were soaked in water until individual soil particles were separated and then washed on the No. 200 mesh sieve. That portion of the material retained on the No. 200 mesh sieve was oven-dried and then mechanically sieved. The grain-size distribution tests are presented on the borehole logs.

c. Atterberg Limits Determination. Liquid and plastic limits were determined on selected samples in accordance with ASTM D 4318-83. The results of the limits are shown on the borehole logs.

3. ENGINEERING PROPERTIES TESTING

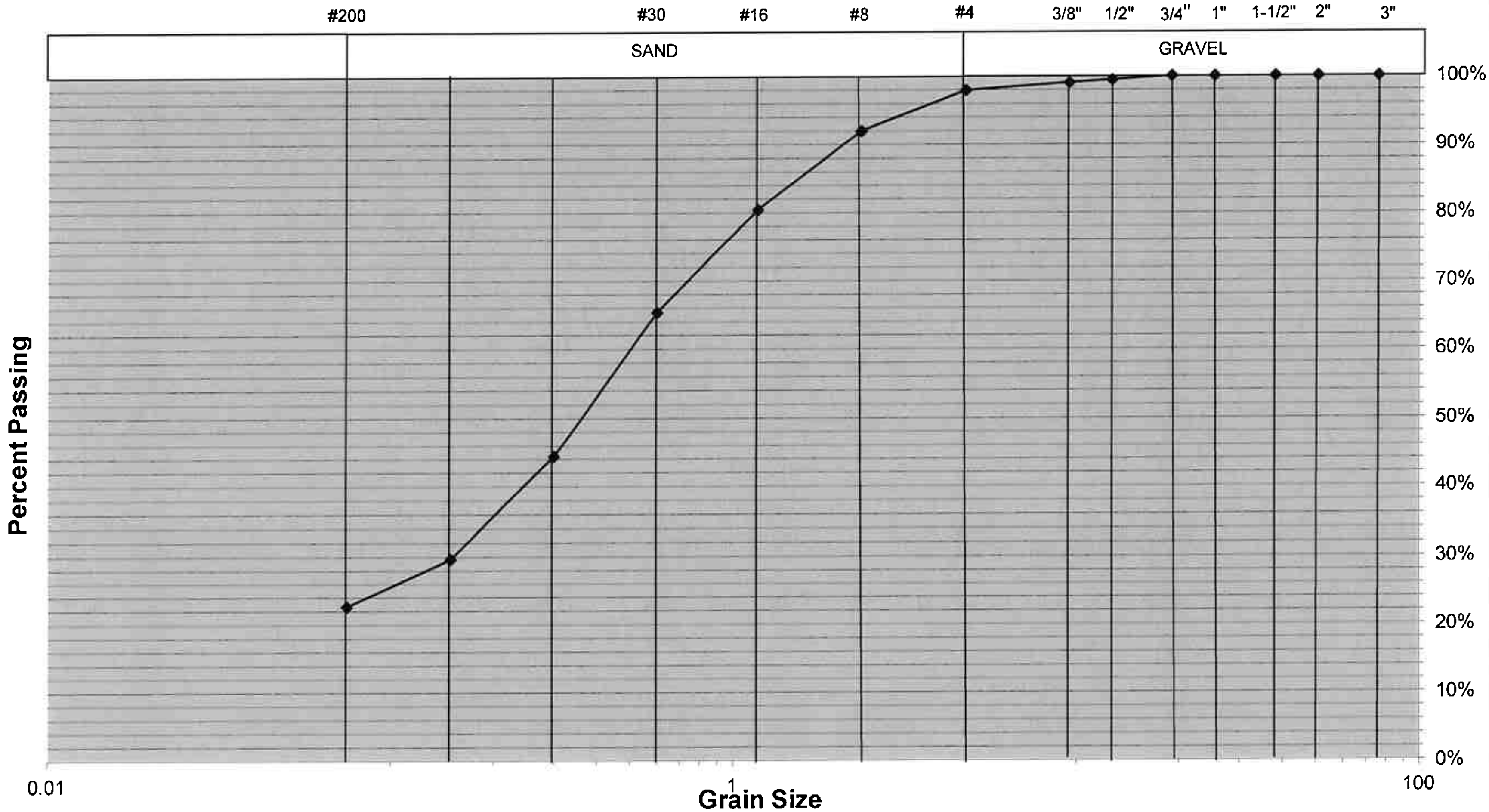
The engineering properties tests discussed in this report include unconfined compression testing, pocket penetrometer testing and R-value testing.

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

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

c. R-Value. An R-value test was performed on a representative sample of the surface soils to develop criteria for the design of pavement sections. The test was conducted in accordance with the California Division of Highways Test Method No. 310.

GRADATION CURVE



NOTES: BH-5 at 35.5 to 36.5 feet, dark olive brown clayey sand (SC).

SIEVE ANALYSIS
PROPOSED SHILOH MIXED USE DEVELOPMENT
1200 SHILOH ROAD & 5823 SKYLANE BOULEVARD
WINDSOR, CALIFORNIA

PLATE 12

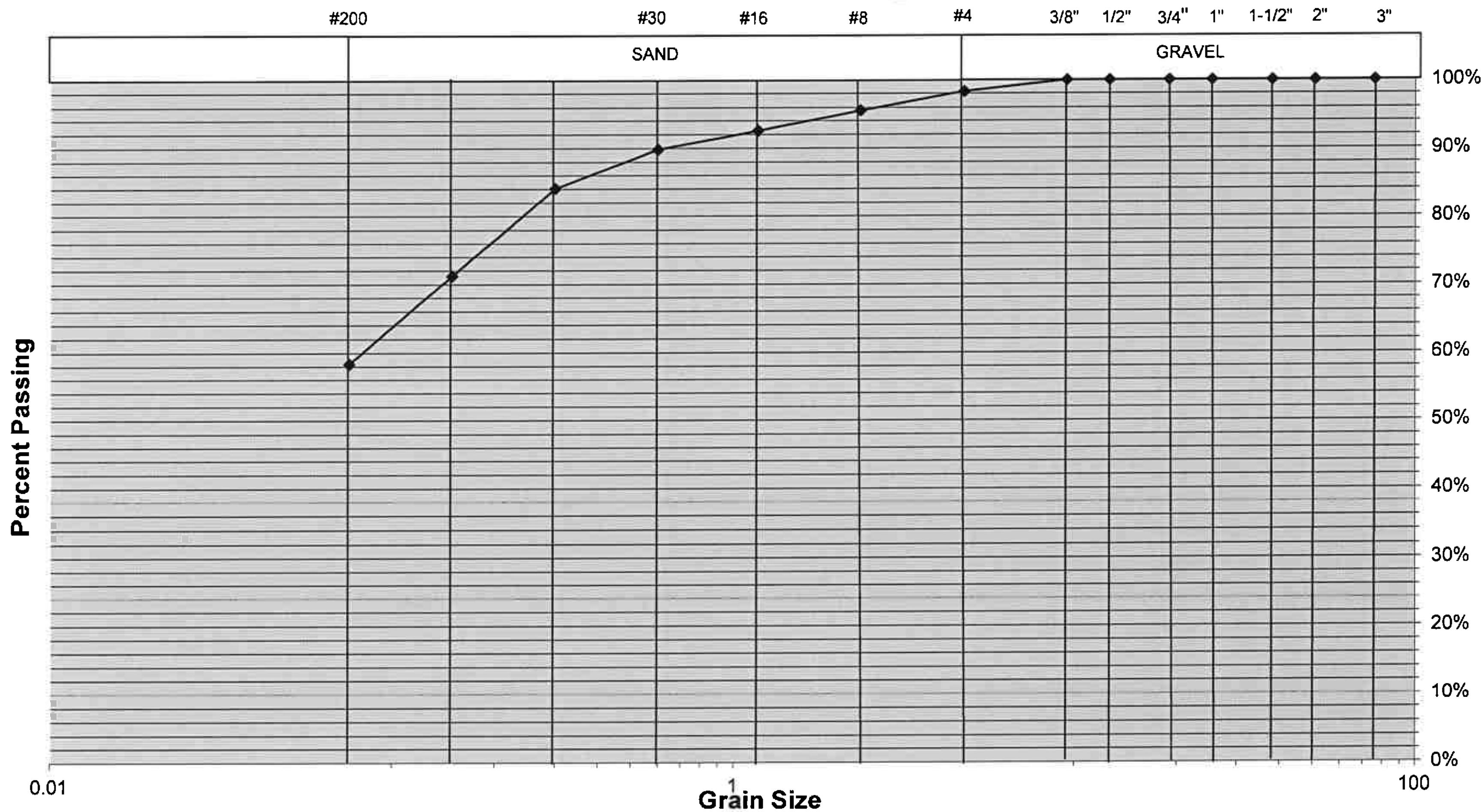
PJC

Proj. No: 5008.02

App'd by: PJC

Date: 4/19

GRADATION CURVE



NOTES: BH-6 at 4.5 to 5.0 feet, tan sandy silt (ML).

SIEVE ANALYSIS
PROPOSED SHILOH MIXED USE DEVELOPMENT
1200 SHILOH ROAD & 5823 SKYLANE BOULEVARD
WINDSOR, CALIFORNIA

PLATE 13

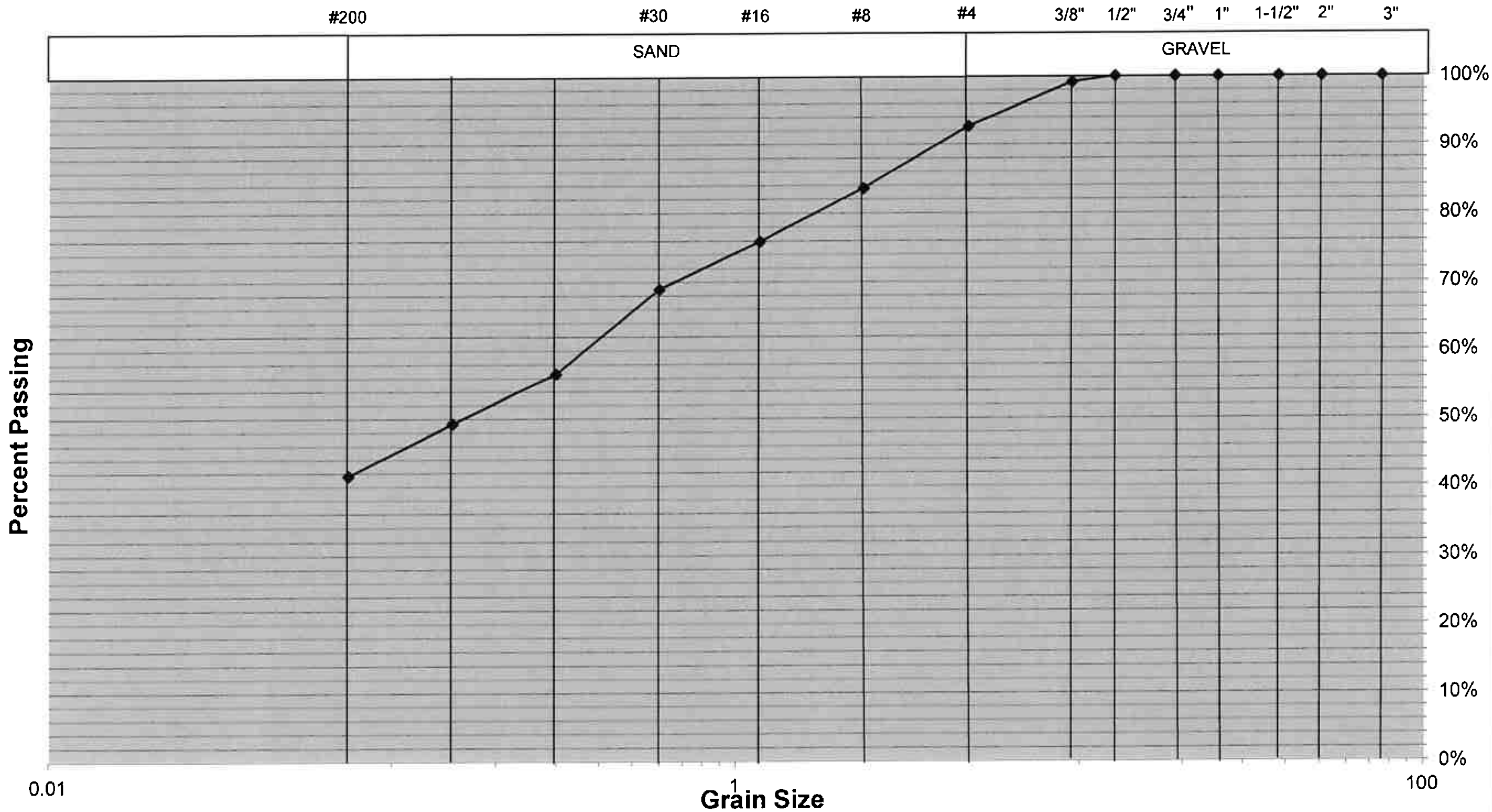
PJC

Proj. No: 5008.02

App'd by: PJC

Date: 4/19

GRADATION CURVE



NOTES: BH-6 at 8.5 to 9.0 feet; yellowish tan clayey sand (SC).

SIEVE ANALYSIS
PROPOSED SHILOH MIXED USE DEVELOPMENT
1200 SHILOH ROAD & 5823 SKYLANE BOULEVARD
WINDSOR, CALIFORNIA

PLATE 14

PJC

Proj. No: 5008.02

App'd by: PJC

Date: 4/19

APPENDIX C
REFERENCES

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

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

3. Preliminary Geologic Map of the Healdsburg 7.5 Minute, prepared by the California Geological Survey, dated 2011.

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

5. USGS Healdsburg California Quadrangle 7.5-Minute Topographic Map, photo revised 1980.

6. McCarthy, David. Essential of Soil Mechanics and Foundations. 5th Edition, 1998.

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

8. California Building Code (CBC), 2016 edition.

9. Preliminary Architectural Plans titled "Shiloh Road Mixed Use Development," prepared by Archilogix, latest revision dated September 05, 2018.

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D.2 - Paleontological Records Search

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Kenneth L. Finger, Ph.D.
Consulting Paleontologist

18208 Judy St., Castro Valley, CA 94546-2306 510.305.1080 klfpaleo@comcast.net

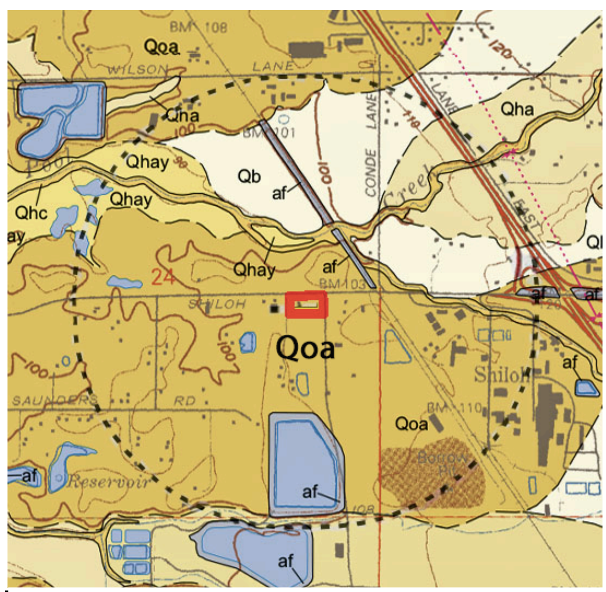
January 25, 2019

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

Re: Paleontological Records Search: Shiloh Mixed Use Project (3249.0012), Town of Windsor, Sonoma County

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 Shiloh Mixed Use project in Windsor. This site is in the south side of Shiloh Road westside of Skyline Boulevard. Its Public Land Survey (PLS) location is NW¼ NE¼, SE¼, Sec. 24, T8N, R9W, Healdsburg quadrangle (USGS 7.5-series topographic map). Google Earth imagery shows this flat terrain has been developed with a few structures on its western half and its eastern half is covered with low-lying vegetation suggestive of prior agricultural use.



Geologic Units

According to the part of the geologic map by Delattre and Gutierrez (2013) shown here, the entire project site (red outline at center) and much of the surrounding half-mile search area (dashed black outline) are located on Pleistocene alluvium, which has a high sensitivity but low potential of yielding significant paleontological resources. Being the oldest unit shown here, none of the others underlie it.

Key to mapped units

Af	Artificial fill (historical)
Qhay	Alluvial deposits, undivided (latest Holocene)
Qhc	Stream channel deposits (modern to latest Holocene)
Qb	Basin deposits (Holocene to latest Pleistocene)
Qoa	Older alluvium (early–late Pleistocene, undivided)

Paleontological Records Search

The paleontological record search for the Shiloh Mixed Use project was performed on the UCMP (University of California Museum of Paleontology) database and focused on the Pleistocene of Sonoma County. The results are 12 vertebrate specimens from 10 localities, all are ascribed to the Rancholabrean North Ameican Land Mammal Stage (NALMS), which is late Pleistocene; no plant localities are recorded. The paleofauna includes *Clemmys* (pond turtle), *Glossotherium harlandi* (Harlan's ground sloth), *G. robustus* (robust ground sloth), *Bison bison antiquus*, *Mammut americanum* (American mastodon). Nearest to the project site is V90056 (Rincon Valley West), 8 miles to the southeast, which yielded *Equus* (horse) teeth.

Remarks and Recommendations

The Shiloh Mixed Use project site is mapped solely as undifferentiated Pleistocene alluvium. A paleontological walkover survey of the site is not recommended due to its flat, heavily disturbed surface. Because few Pleistocene vertebrates have been recovered from Sonoma County and none were found within 8 miles of the site, I do not recommend paleontological monitoring. I recommend preconstruction training of the project crew so they are aware of what kinds of vertebrate fossils they should be on the lookout for and what they should do if any are uncovered during excavations. Should any significant fossils (i.e., bones, teeth, or unusually abundant and well-preserved invertebrates or plants) be unearthed, the construction crew should not attempt to remove them**,** as they could be extremely fragile and therefore prone to crumbling and to allow for recording the details of its occurrence; instead, all work in the immediate vicinity of the discovery should be diverted at least 15 feet from the find until a professional paleontologist has assessed the find and, if deemed significant, salvaged it in a timely manner. The paleontologist will then reassess whether a monitoring program is needed. 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.

If I can be of further assistance on this project, please do not hesitate to contact me.

Sincerely

Ken Finger

Reference Cited

Delattre, M.P, and Gutierrez, C.I., 2013. Preliminary geologic map of the Healdsburg 7.5' quadrangle, Sonoma Counties, California: a digital database version 1.0. ftp://ftp.consrv.ca.gov/pub/dmg/rgmp/Prelim_geo_pdf/Healdsburg24k_v1-0.pdf