PJC & Associates, Inc.
Consulting Engineers & Geologists

June 26, 2019 Job No. 9215.01

Two Rock Volunteer Fire Company
Attention: Ernie Nunes
7618 Valley Ford Road
Petaluma, CA 94952
jnunesfarm@gmail.com
c/o: Lee Erickson
lee.erickson@hotmail.com

Subject: Geotechnical Investigation Report
Proposed Truck Storage
7599 Valley Ford Road
Petaluma, California
APN: 022-140-017

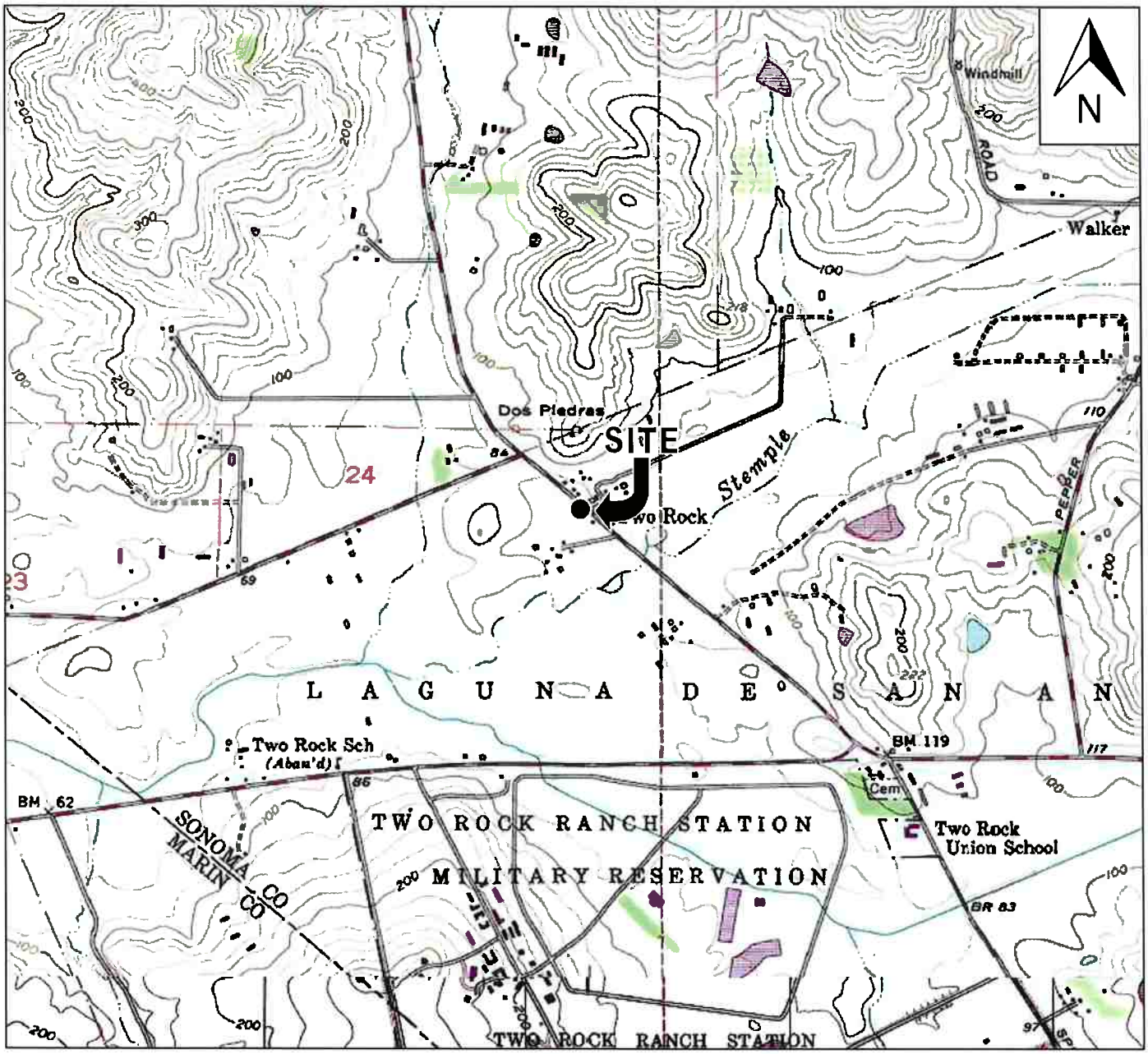
Reference: Civil Plans, titled "Two Rock Volunteer Fire Department" Sheets C2 through C5, prepared by Lee Erickson, dated April 26, 2019.

Dear Ernie:

PJC and Associates, Inc. (PJC) is pleased to submit the results of our geotechnical investigation for the proposed truck storage building located at 7599 Valley Ford Road in Petaluma, California. The approximate location of the site is shown on the Site Location Map, Plate 1. The site corresponds to latitudinal and longitunal coordinates of 38.2661° north and 122.7931° west, according to GPS measurements performed at the site. Our services were completed in accordance with our authorization for geotechnical engineering services, dated May 3, 2019, and your authorization to proceed with the work dated May 21, 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 referenced project plans and information provided by Lee Erickson, it is our understanding that the project will consist of demolishing the existing building at the stie and constructing a truck garage on the property. We anticipate the structure will consist of a prefabricated, 60' x 90', metal



SCALE: 1:24,000

REFERENCE: USGS TWO ROCK, CALIFORNIA 7.5 MINUTE QUADRANGLE, DATED 1971.

PJC & Associates, Inc.
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SITE LOCATION MAP
PROPOSED TRUCK STORAGE
7599 VALLEY FORD ROAD
PETALUMA, CALIFORNIA

PLATE
1

Proj. No: 9215.01 Date: 6/19 App'd by: PJC

building with concrete slab-on-grade floors.

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

The project site is situated on terrain that gently slopes towards the south. Based on our review of building sections provided on the plans, we anticipate that site grading will consist of cuts and fills of approximately two to five feet to achieve the desired finish pad grades, and provide adequate gradients for site drainage.

2. SITE CONDITIONS

a. General. The property is situated in mixed-use rural, residential, and agricultural area in Two Rock. At the time of our subsurface investigation on May 30, 2019, the proposed building site was occupied by perennial grasses and fill debris left from the demolition of the structure which previously occupied the site.

b. Topography and Drainage. The property is situated on terrain that gently slopes toward the south. According to the United States Geological Survey (USGS) Two Rock, California, 7.5 Minute Quadrangle Map (Topographic), the site is situated near an elevation of 79 feet above mean sea level (MSL). Site drainage is provided by sheet flow and surface infiltration that drains to a natural swale on the neighboring property approximately 25 feet west of the proposed building envelope.

c. Geology. According to a geologic map of the Two Rock 7.5 Minute Quadrangle, prepared by the California Geologic Survey (CGS), the site has been mapped to be underlain by early to Latest Pleistocene to Holocene alluvial type soil deposits (Qa). Alluvial type soil deposits are generally characterized to consist of poorly sorted and unconsolidated soil stratums of sand, gravel, silt and clay. Our subsurface exploration confirmed that the site is underlain by alluvial soil deposits. Although the alluvium is mantled by a layer of fill containing large cobbles and small boulders.

d. Subsurface Conditions. On May 30, 2019, two exploratory test pits (TP-1 and TP-2) were excavated at the site to depths between two and four feet below the ground surface to investigate the soil and groundwater conditions underlying the site and to obtain representative samples for visual classification and laboratory testing. Our staff geologist was on site

to observe the excavation, log the materials encountered and to obtain representative samples for visual classification and laboratory testing.

The test pits were excavated outside the perimeter of the proposed building site and therefore outside the boundary of the existing undocumented fill material. The fill material at the site is estimated to vary in thickness by one to four feet and contains abundant large gravels, cobbles and small boulders. In general the test pits encountered topsoil overlying alluvial soils that extended to the furthest depths explored. The topsoil found at the site consisted of sandy silt and appeared moist, soft to stiff, and exhibited low to medium plasticity characteristics. Underlying the topsoil the test pits encountered sandy silt and sandy clay alluvial deposits that extended to the furthest depths explored. the sandy silt alluvial soil appeared very moist, medium stiff, and exhibited low plasticity characteristics. The sandy clay alluvial soil appeared very moist to saturated, medium stiff to very stiff, and exhibited low to medium plasticity characteristics.

Seepage was encountered in TP-1 and TP-2 during our field exploration on May 30, 2019 at an approximate depth of three feet. Subsurface seepage or perched groundwater zones could develop during and following prolonged rainfall. However, we judge that such conditions would likely dissipate following seasonal rainfall.

3. 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 followed. The primary geotechnical concerns in the design and construction of the project are the presence of weak and compressible surface soils and undocumented artificial fills.

The test pits encountered weak and compressible surface soils extending to depths up to approximately four feet below the existing ground surface. Weak and compressible soils may appear hard and strong when dry. However, they could potentially collapse under the load of foundations, engineered fill, and/or concrete slabs when their moisture content increases and approaches saturation. These soils can undergo considerable strength loss and increased compressibility, thus causing irregular and erratic ground settlement under loads.

As previously stated, our exploratory investigation encountered artificial fill that was left on site from the demolition of the previous structure. The undocumented fill extended to field estimated depths of approximately one to four feet below the existing ground surface. These soils can undergo considerable strength loss and increased compressibility, thus causing irregular and erratic ground settlement under loads. This ground movement manifests in the form of cracked foundations and slabs and distress to architectural features of structures.

Based on the geotechnical concerns listed above, the detrimental effects of such movements can be significantly reduced by subexcavating the weak and compressible site soils and fill and recompacting them to create an engineered fill pad. The engineered fill pad should be uniformly thick. PJC should approve the bottom of the subexcavation and test compaction of the engineered fill. For budgeting purposes, we estimate that the depth of subexcavation will be approximately four feet. The pad should be underlain by a minimum of 30 inches of compacted engineered fill. The actual subexcavation depths should be determined by an engineer of PJC in the field during construction. PJC should approve the bottom of the subexcavation prior to placement of engineered fill. The subexcavation should extend at least five feet beyond the individual footings in all directions. Provided the subexcavations are preformed according to our recommendations of this report, the proposed truck storage building may be supported on spread footings extending into the engineered fill.

Non-structural concrete slabs-on-grade may be used for the structure and exterior flatwork provided that they are supported on 18 inches of properly compacted low to non-expansive engineered fill. The engineered fill should extend at least five feet beyond the buildings footprint and three feet beyond the exterior flatwork edges.

The following section provides geotechnical recommendations and criteria for design and construction of the proposed project.

4. SITE GRADING AND EARTHWORK

Based on site topography, we anticipate that grading will likely consist of cuts and fills of approximately two to five feet and less to create level building pad, upgrade the site soils, and provide adequate gradients for site drainage.

a. Stripping. We recommend that structural areas be stripped of artificial fill, surface vegetation, roots and the upper few inches of soil containing organic matter. These materials should be moved off site; some of them, if suitable, could be stockpiled for later use in landscape areas. If underground utilities or any other obstructions pass through the site, we recommend that these utilities or obstructions 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. Any existing wells or septic systems not included in the project should be abandoned in accordance with the requirements of the County of Sonoma Health Department. 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. Excavation and Compaction. Where fill is required, the existing weak soils should be subexcavated and firm native soils exposed as determined by the geotechnical engineer on site during construction. The exposed surface 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 materials maximum dry density, as determined by the ASTM D-1557-12 laboratory compaction test procedures. Highly expansive soils, if encountered, should not be placed within 30 inches of any concrete slabs-on-grade. Most of the on-site soils free of excessive organics will be suitable for use as general engineered fill material. Cobbles and boulders should be removed. The engineered fill pad should be uniformly thick and vary no more then two feet across the pad.

Due to the sloping terrain at the property, importation of low to non-expansive engineered fill will likely be necessary. The imported 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 at least 90 percent of the materials maximum dry density. Imported fill should be evaluated and approved by the geotechnical engineer before importation. It is recommended that any import fill should 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

All fills should be placed in lifts no greater than eight inches in loose thickness and compacted to the general recommendations provided below.

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

Generally, grading is most economically performed during the summer months when on-site soils are usually dry of optimum moisture content. Delays should

be anticipated in site grading performed during the rainy season or early spring due to excessive moisture in the on-site soils. Special and relatively expensive construction procedures should be anticipated if grading must be completed during the winter and early spring.

5. FOUNDATIONS: SPREAD FOOTINGS

a. Vertical Loads. We judge that the proposed structure may be adequately supported by spread footings extending a minimum of 12 inches into compacted engineered fill. Footing excavations should be observed and approved by the geotechnical engineer before reinforcing steel is placed and may need to be deepened depending on the conditions encountered at the specified depths. All footings should be reinforced. The recommended bearing pressures, depth of embedment and minimum widths of spread footings are presented in Table 1. The bearing values provided have been calculated assuming that all footings uniformly bear on properly compacted engineered fill and that footings have at least seven feet of horizontal confiment from the bottom of the footing to the face of the nearest slope.

TABLE 1
FOUNDATION DESIGN CRITERIA

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

* Dead plus live load.
** Into compacted engineered fill.

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

b. Lateral Loads. Resistance to lateral forces may be computed by using friction or passive pressure. A friction factor of 0.30 is considered appropriate between the bottom of the concrete structures and the bearing material. 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, only the bottom 12 inches should be used for passive resistance.

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

c. Settlement. Total settlement of individual foundations will vary depending on the width of the foundation and the actual load supported. Foundation settlements have been estimated based on the assumed foundation loads and bearing values provided. Maximum settlements of shallow foundations designed and constructed in accordance with the preceding recommendations are estimated to be less than one inch. Differential settlement between similarly loaded, adjacent footings 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, and occur within a few months upon application of the loads.

6. NON-STRUCTURAL SLABS-ON-GRADE

Non-structural concrete slabs-on-grade may be used for interior and exterior slab-on-grade areas, provided that they are supported on 18 inches of properly compacted low to non-expansive engineered fill. The engineered fill should extend at least five feet beyond interior slabs edges and three feet beyond the exterior flatwork.

Subgrade for all concrete slab-on-grade areas should be scarified to a depth of eight inches, moisture conditioned and compacted to produce a firm and unyielding surface. The slab subgrade should not be allowed to dry before placing concrete.

Slabs-on-grade should be at least five inches thick and should be supported on at least four inches of clean gravel or crushed rock to provide a capillary break and provide uniform support for the slab. The rock should be graded so that 100 percent passes the one inch sieve and no more than five percent passes the No. 4 sieve. We recommend that the gravel be placed as soon as possible after preparation of the subgrade to prevent drying of the subgrade soils. If the subgrade is allowed to dry out prior to slab-on-grade construction, the subgrade soil should be moisture conditioned, as recommended above, by sprinkling before slab-on-grade construction. To control cracking, the slabs should be reinforced as determined by the project structural engineer and provided with control joints.

For moisture sensitive slabs, we recommend that a vapor retarder membrane at least 15 mils thick be placed over the drain rock to prevent migration of moisture vapor through the concrete slab.

7. DRAINAGE

a. Surface drainage. All final grades should be provided with positive gradients away from foundations to provide rapid removal of surface water runoff to an adequate discharge point. No ponding of water should be

allowed adjacent to the foundations or on or above slopes. The use of continuous roof gutters with downspouts is recommended to reduce the possibility of soil saturation adjacent to the building. Downspouts from gutters should be discharged onto an impermeable surface such as pavement or into a closed conduit discharging a minimum of eight feet away from the structures. Outlets for foundation subdrains should be constructed and maintained entirely separate from roof downspouts.

b. Slab Subdrain. We recommend that subdrains be constructed below the slab-on-grade floors. Slab subdrain trenches should be constructed at a maximum of 20 foot intervals. The bottom of the trench should be sloped to drain by gravity. The bottom of the trench should be lined with a few inches of Class II permeable material. A 4-inch diameter, schedule 40 perforated pipe, with holes down and sloped to drain, should be placed on top of the thin layer of drain rock. The trench should then be backfilled with compacted Class II permeable drain rock. Surface drains must be maintained entirely separate from subdrains.

8. 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 = 1.50 g S_1 = 0.60 g
c.	Spectral Response Acceleration Parameters:	S_{Ms} = 1.50 g S_{M1} = 0.90 g
d.	Design Spectral Acceleration Parameters:	S_{Ds} = 1.00 g S_{D1} = 0.60 g

9. 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 truck storage building located at 7599 Valley Ford Road in Petaluma, 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 is based on the findings at the points of exploration and on interpretative data, including interpolation and extrapolation of information obtained at points of observation.

10. ADDITIONAL SERVICES

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

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

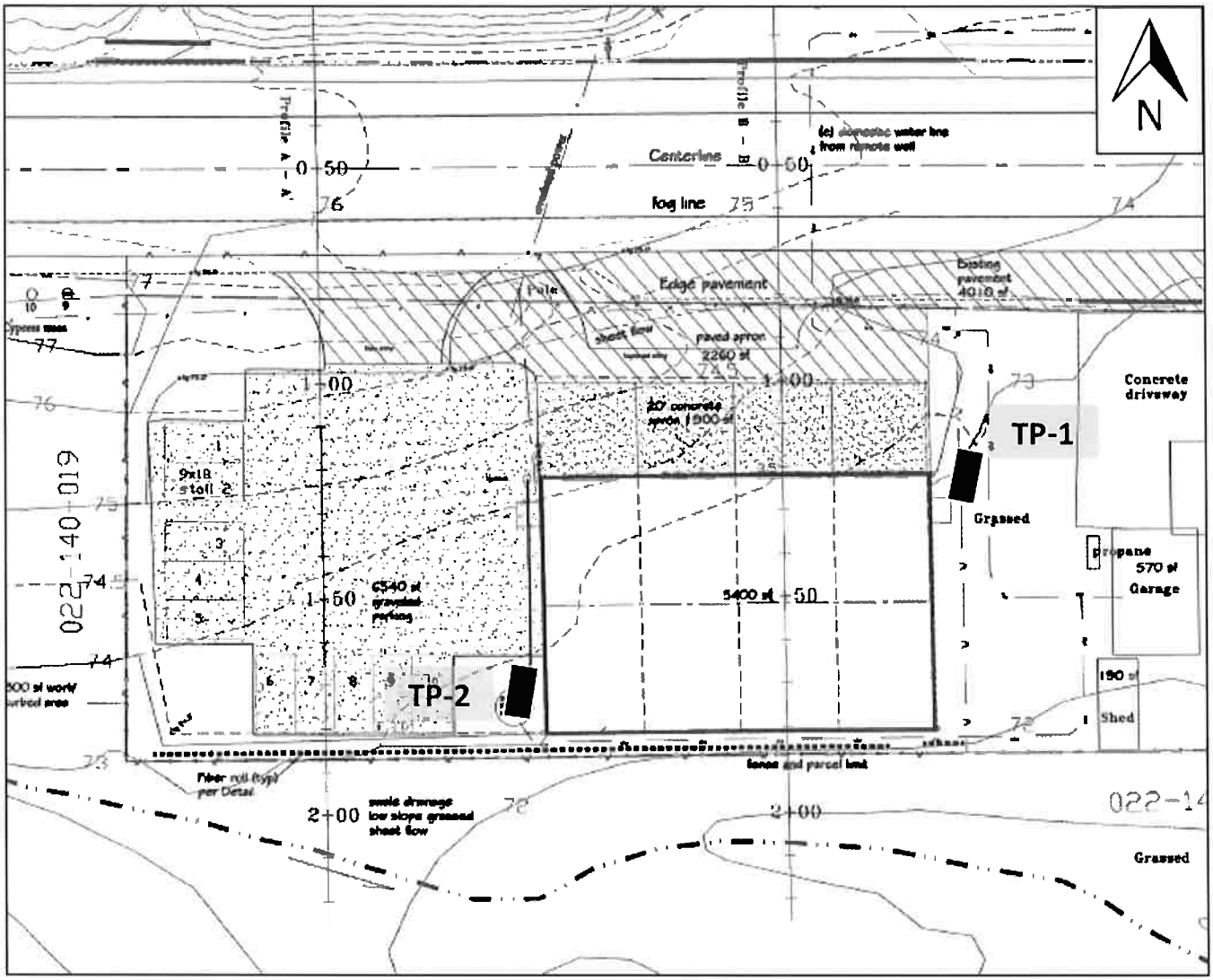
It has been a pleasure working with you on this project. Please call if you have any questions regarding this report or if we can be of further assistance.

Sincerely,

PJC & ASSOCIATES, INC.

Patrick J. Conway
Geotechnical Engineer
GE 2303, California

PJC:ljc:sms



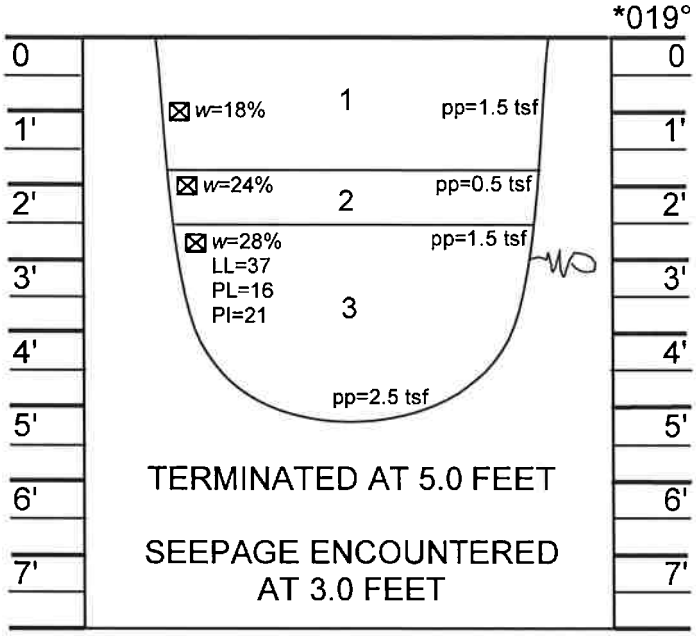
APPROXIMATE SCALE: 1"=40'

EXPLANATION

TEST PIT LOCATION AND DESIGNATION

REFERENCE: SITE MAP TITLED "TWO ROCK VOLUNTEER FIRE DEPARTMENT," SHEET C3, PREPARED BY ERICKSON ENGINEERING INC., DATED APRIL 26, 2019.

PJC & Associates, Inc. Consulting Engineers & Geologists	TEST PIT LOCATION MAP PROPOSED TRUCK STORAGE 7599 VALLEY FORD ROAD PETALUMA, CALIFORNIA	PLATE 2
	Proj. No: 9215.01 Date: 6/19 App'd by: PJC	



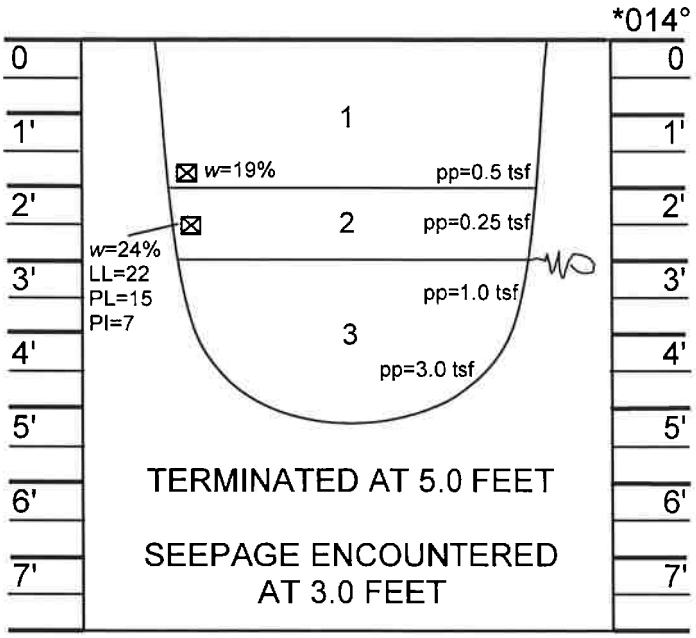
* Orientation of Test Pit

LITHOLOGY

1) 0.0'-1.75'; SANDY SILT (ML); grayish dark brown, moist, stiff, low plasticity, abundant roots, porous (TOPSOIL).

2) 1.75'-2.5'; SANDY SILT (ML); gray, very moist, medium stiff, low plasticity, porous (ALLUVIUM).

3) 2.5'-5.0'; SANDY CLAY (CL); mottled orange and brown, very moist to saturated, stiff to very stiff, medium plasticity (ALLUVIUM).



* Orientation of Test Pit

LITHOLOGY

1) 0.0'-2.0'; SANDY SILT (ML); dark gray, moist, soft to medium stiff, medium plasticity, abundant rootlets, porous, trace subrounded gravels (TOPSOIL).

2) 2.0'-3.0'; SANDY CLAY (CL-ML); gray brown, very moist, medium stiff to stiff, low plasticity, porous (ALLUVIUM).

3) 3.0'-5.0'; SANDY CLAY (CL); mottled orange and brown, saturated, stiff to very stiff, medium plasticity (ALLUVIUM).

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