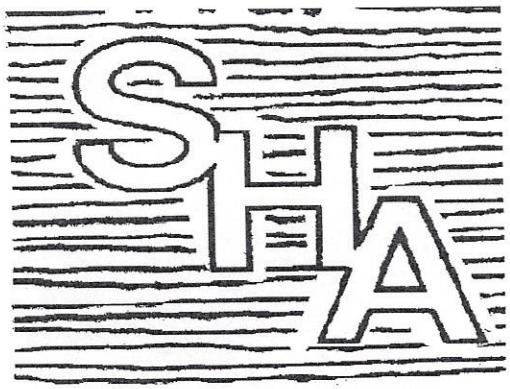

SALEM HOWES ASSOCIATES INC

GEOTECHNICAL CONSULTANTS

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REPORT
GEOTECHNICAL INVESTIGATION

R V PARKING AND STORAGE
1 MARSH DRIVE
NOVATO, CA

31 JANUARY 2024

SALEMHOWESASSOCIATES INC.
GEOTECHNICAL ENGINEERS AND GEOLOGISTS

Marsh 1 Rpt
2312043

31 January 2024

R.V Stich Construction Inc.
PO Box 1707
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Job :2312043

SUBJECT: Report
Geotechnical Investigation,
R V Parking and Storage
1 Marsh Drive, Novato

Contents

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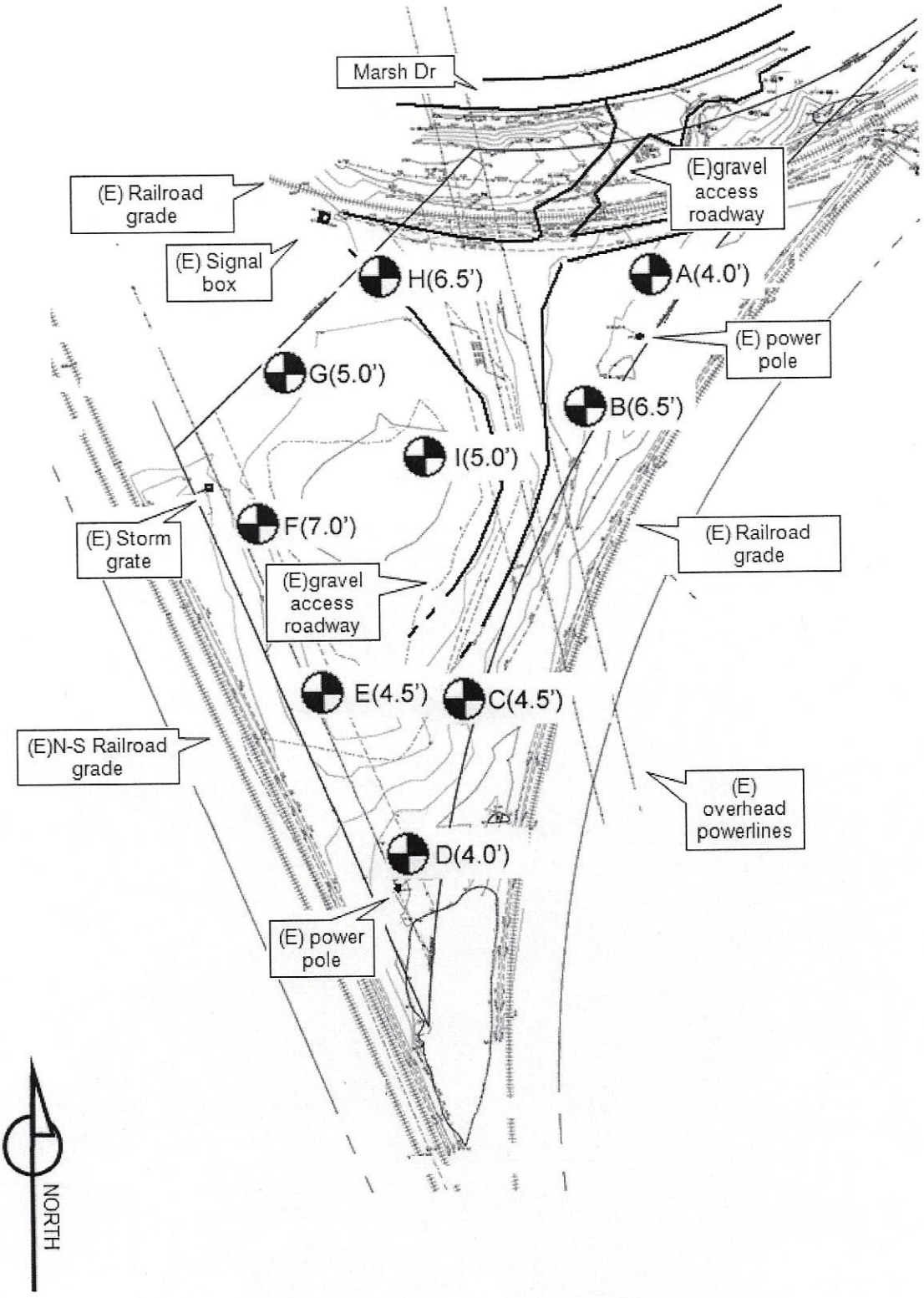


LEGEND

Location of test boring

(n) Depth of fill in feet

A

SITE PLAN AND LOCATION OF TEST BORINGS

REDUCED COPY == S.A.D.

Introduction

This report presents the results of our geotechnical investigation of the proposed 1 Marsh Drive prefab container storage units located at the above address. It conforms to the requirements of section 1803 in the 2022 California Building Code (CBC). The purpose of our investigation was to evaluate the geotechnical feasibility of the proposed development, assess the suitability of the building site, and provide detailed recommendations and conclusions for foundations as they relate to our specialty field of practice, geotechnical engineering and engineering geology. The scope of services specifically excluded any investigation needed to determine the presence or absence of issues of economic concern on the site, or of hazardous or toxic materials at the site in the soil, surface water, ground water, or air.

If this report is passed onto another engineer for review it must be accompanied by the approved architectural and structural drawings so that the reviewer can evaluate the exploration and data in the context of the complete project. Ground conditions and standards of practice change; therefore, we should be contacted to update this report if construction has not been started before the next winter or one-year from the report date.

For us to review the drawings for compliance with our recommendations the four following notes must be on the structural drawings:

- The geotechnical engineer shall accept the pier holes prior to placing any reinforcing steel in accordance with the CRC requirements. Notify geotechnical engineer before the start of drilling. (If that isn't stated they may require inspections in accordance with CBC Chapter 2-Definitions, "Special Inspections, Continuous". This would require a full time inspector during drilling.)
- Drainage details may be schematic, refer to the text and drawings in the geotechnical report for actual materials and installation.
- Refer to Geotechnical Report for geotechnical observation and acceptance requirements.

Along with the structural drawings, to complete the review, we need the pertinent calculations from the structural engineer or the geotechnical design assumptions should be included on the drawings notes per requirements of the 2022 CBC.

- ***It is the owner's responsibility*** that the contractor knows of and complies with the BMP's (Best Management Practices) of the Regional Water Quality Control Board, available at www.swrcb.ca.gov, ↵ water quality ↵ stormwater ↵ construction

The fieldwork consisted of reconnaissance mapping of exposed geologic features on the site and in the immediate surrounding area and the drilling of nine test borings in the area of the proposed development. The borings were advanced using a portable hydraulic drill rig with 3-inch flight augers and sampled by Standard Penetration Tests* (see "notes to borings logs"). Fieldwork was conducted in December of 2023. During this period we reviewed select geotechnical references pertinent to the area and examined stereo-paired aerial photographs of the site, which were available from Pacific Aerial Surveys in Oakland.

Discussion and Summary

This is a fill over bay mud site that will require surface preparation (grading) to accept the placement of two to three feet of imported engineered fill to obtain the desired finished surface grade elevation.

Existing site conditions consist of four to seven feet of compacted fill over an estimated 40-feet of bay mud.[(1) Rice].
There are several foundation alternatives which we should discuss with your project civil and structural engineers; e.g. helical piers, pipe piles, friction piles or spread footings. There are pro's and con's to each type of construction, including economic considerations.

During our investigation we did not observe any local geologic hazards that would adversely affect the site. We judge that following the recommendations in this report and standard Marin County fill over baymud construction practices structures can be safely constructed on this site without adversely impacting the ground stability or changing the drainage in any measurable manner. Detailed discussions and recommendations are covered in the following sections of this report.

Geology and Slope Stability

The site has been mapped by Rice and others [(1)] as Quaternary Mud [Qm] overlying bedrock of the Franciscan Geologic Assemblage. The mud is described in the literature as a grayish blue to blueish gray expansive and moist to wet silty clay [MH-CH] that can contain peaty horizons and marsh grass roots and stems near the top of the mud horizon. The mud is part of the tidal and intertidal sequence of silts and clays that have been laid down along the shoreline of San Francisco and San Pablo Bays over thousands of years. The tidal mud has formed meandering and twisting channels and flats that allow the tidal sea water to ingress and egress the area during tidal sequences, exposing and covering the banks of the channels in seawater and allowing grasses to propagate over time forming additional flats and grassland habitat. The tidal areas around the bay and in this particular area have become a farmed or grazed bay land that has been separated by seawaters via levees and drainage channels and has since subsided over time as the underlying mud has dried and vegetation decayed resulting in lowered elevations. Other areas have become developed neighborhoods such as Bel Marin Keys in Novato and Mariner Cove of Corte Madera. The site is located within a triangular area between three rail road grades that are part of the Sonoma Marin Transit Authority and consists of a mat of fill overlying the mud and tidal mud. The fill is stiff to hard, generally loose near the surface and can be somewhat competent in hand with depth. At boring "H" the fill is very hard, tight and highly competent while at boring "A" the fill is loose and full of debris near the surface. The fill at boring "D" was considerably softer and adjacent to a large power pole, the railroad grade and MMWD easement that likely contain a storm drain. The borings encountered stiff to hard fill from existing grade from four feet in borings "A" and "D" to seven feet in boring "F". The fill overlays the bay mud and estuary remnants that are documented in the literature to depths of forty feet as noted in the literature. Borings "C", "D", "F" and "G" encountered tidal mud overlying the bay mud with borings "C" and "D" encountering four feet of stiffer tidal silt and borings "F" and "G" encountering two feet of tidal silt. The literature does not note if those depths are bedrock or base of mud. The fill was laid upon the mud and grading the area somewhat smooth and was likely used by the railroad in the past as a staging area and in the recent past. A few dump piles are present and consist of bricks, concrete, some car tires and general loose material from years of public use. A large flattened mulch pile is present at the approximate center of the area and is estimated to be six to twelve inches thick. The area is gently sloping at the edges of the fill pad approaching the setback of the rail road grade so as not to affect the railroad grade from lateral spreading pushing the rail lines off of its alignment.

Fill soil in this area is typically stiff and roughly four feet thick in most areas. Settlement in the fill is expected over the life of most structures and should be anticipated over an extended period of time and more so as fill is thickened during construction. However, many areas may have reached near total settlement and any additional settlement may be attributed to the settlement of the underlying muds from dewatering and decaying of organics that may continue to settle over time as the weight of overlying fill and structures continue to compact the alluvial soils.

Ground Water

Ground water was observed in the test borings "A" at nine feet and two feet in boring "E" and much of the water seen in the borings has seeped into the fill soil and mud from rain and surface ponding and not considered groundwater. Much of the groundwater in this reclaimed watershed area potentially settles within the fill as there is not any natural sedimentary deposits that can relief subsurface water pressure as the mud is expansive and does not contain any sand lenses near the top of the horizon. There are not any clusters of Pampas Grass (Cortderia Jubata), Sedge (Cortaderia Selloana and Carex) or seeps which are indicators of high ground water. However, ground water conditions vary with the seasons and annual fluctuations in weather. A general rise in ground water can be expected after one or more rain events as the soil becomes saturated and unable to dissipate any runoff. Based on the limited time we have been able to collect ground water data on this site, it is not possible to accurately predict the range of ground water fluctuations in the future. Therefore, ground water sensitive structures should be designed to anticipate a rise in the water level that could potentially affect their function and stability.

Site Conditions

The building site is located within the reclaimed marshland area within the triangular zone adjacent to the railroad along the western terminus of SR 37 and Highway 101 and the area is mapped as Bay Mud [Qm]. Fill has been places over the extent of the lot within the setbacks of the site. The fill is soft in the upper six inches and stiffens below one foot and consists of rocky silty clayey [ML-CL] soil and is likely prone to settlement over time. The fill below two feet is stiff to hard, and can be excavated by common means. However, hard massive areas may require the use of an excavator mounted "hoe ram" if large clasts are encountered near the surface. It should be noted that the fill is not uniform in thickness or content and varies in tightness and overall uniformity. The underlying mud and tidal silts may provide additional settlement over time as the fill bench loads the site and dewaters the mud and silt.

Earthquake Hazards and Seismic Design

This site is not subject to any unusual earthquake hazards, located near an active fault, within a current Alquist-Priolo Special Studies Zone or Seismic Hazards Zone as shown on the most recently published maps form the California Geologic Society. There were no geomorphic features observed in the field or on air photos, or geologic features in the literature that would suggest the presence of an active fault or splay fault traces. However, historically the entire San Francisco Bay Area has the potential for strong earthquake shaking from several fault systems, primarily the San Andreas Fault which lies approximately 13 miles to the southwest and the Rodgers Creek Fault, nine miles to the northeast. The U.S. Geologic Survey estimates [(2)] (we realize these percentage estimates have been up dated ,slightly, practically every year; however, the basic message is that we live in earthquake country and one should be prepared) there is up to 21 percent chance of a major quake (Magnitude 8) from 2000 to 2030 on the San Francisco Bay region segment of the San Andreas Fault. The probability is lower north of San Francisco and increases to the south. However, in the

same period, there is a 32 percent chance of a major event (Magnitude 7) on the Hayward fault and Rodgers Creek Faults. The total 30-year probability of one or more large earthquakes occurring in the entire San Francisco region is 70 percent (see Plate 1). Based on the bedrock and soils observed at the site, we do not anticipate those seismically induced hazards, specifically: liquefaction, settlement and differential compaction, landsliding, and flooding are present.

For California Building Code design purposes on this site the top 100 feet of the ground has an average Soil Profile Site of Class E per Table 20.3-1 ASCE-7. Seismic design criteria in conformance with the latest edition of the CBC and ASCE-7 should be obtained from the USGS web site. In California, the standard of practice requires the use of a seismic coefficient of 0.15, and minimum computed Factor of Safety of 1.5 for static and 1.1 to 1.2 for pseudo-static analysis of natural, cut and fill slopes.

As a owner there are a number of measures one can take to limit structural damage, protect lives and valuable objects in the event of a major earthquake. To be prepared and understand the mechanics of earthquakes we strongly recommend that you purchase a very practical book entitled "Peace of Mind in Earthquake Country" by Peter Yanev. This book is written for the non professional and, while currently out of print, used copies are available in paperback (Chronicle Books/S.F.) from Amazon.com and other locations.

Foundation Conditions

This is a soil site and all excavations can be accomplished by common means. Ground water may be encountered below elevation zero (sea level).

Footings: Footings may be used on the fill if minor settlement is acceptable. We should discuss the potential loading with the civil structural engineer before a decision to use footing is made.

Structures with foundations on soil may undergo differential settlement of up to one-half inch across the length of the structure. The footing should be designed as a “grade beam” that can span ten-feet and cantilever five-feet at the corners. There are no conditions that require provisions to mitigate the effects of expansive soils, liquefaction, soil strength or adjacent loads. Footings on he engineered fill may be designed

Site Preparation: At the footing location remove loose deleterious substances such as expansive clay, rubbish, and organic, perishable or uncompactable material. Compact the footing bottom with a “jumping jack” hand compactor. This applies to larger areas such as the sub-base for slabs on grade. If soft areas of soil are encountered at foundation grade they should be overexcavated to firm material as directed by the engineer and backfilled to grade with Caltrans Specification Class 2 Material. All fill densities should be verified by testing procedures ASTM D-1556 and D-1557, or ASTM D-2292 and D-3017 (Nuclear Method).

As a minimum, spread footings should conform to the requirements of Sections 1808 and1809 of the CBC. The footings should be stepped as necessary to produce level bottoms. If areas of soft soil are encountered during footing excavation, they should be overexcavated and replaced with Caltrans Specification Class 2 Aggregate base or approved imported material compacted to 90-percent or backfilled with lean concrete. For geotechnical considerations, since soil is a discontinuous medium,

footings should be constructed in a grid like fashion by tie beams. Isolated interior and deck footings should be avoided.

Based on our site exploration footings bottomed on the stiff fill soil at should conform to the requirements in table 1806.2 and of the CBC for a type 3 "Class of Materials", including the "notes" in Sections 1806 and 1809; with a lateral bearing pressure increased to 250 lbs/ft^2/ft.

In addition we recommend that the footings be reinforced in accordance with the minimum requirements for a member in flexure (span 10 feet and cantilever 5 feet) to mitigate the effects of ground displacement during possible long term settlement.

Note: (The allowable bearing pressure and lateral bearing/sliding was based on visual soil mass classification and was calculated from SPT "N" values using $\varnothing$ = 14° and γ = 130 lbs/ft^3 and C=1ksf in Figure 1 page 7.2-131 of the NAVFAC manual)
Lateral bearing and lateral sliding may be combined and a one third increase is allowed for transitory loading.

Any structure constructed with footing on soil will undergo some settlement with time; however, because of the deep soil section the differential settlement of a structure on this site will most likely be negligible.

Notice: We will not accept the foundation for concrete placement if the foundation grades are over 24 hours old, dried out or saturated and we will require that they be overexcavated. The contractor may submit plans for remedial measures, such as spraying or covering the excavation, to extend this time period. However, acceptance is always subject to the condition of the foundation grade immediately prior to the pour.

Foundation Design-Helical Piers

Based on the fill soil strength below the top five feet we recommend using drilled helical piers for foundation support below that depth (in the fill layer < ~ six feet). The design engineer should conduct a test installation at a depth of six ± feet to determine the capacity of an individual pier based on the manufacturers specifications. Bearing capacity is normally determined by torque measurement on the drilling machine then converter to bearing values by the manufacturers table. To reduce the number of piers they may be grouped together under a single 'footing'.

Piers in compression need not be proof loaded; piers in tension should have 25% of the piers tested to 125% of the design load and locked off at some nominal value.

Lateral resistance to transient loads may be taken by a moment connection in the grade beam, angled piers or soil passive pressure on the grade beam.

Pipe Piles

Pipe piles shall be 3.5" $\varnothing$ O.D. extra strong steel pipe F_y= 36 ksi with 0.30" wall thickness meeting ASTM A53AERW standards. Contact manufacturer for corrosion protection. Tieback to (E) foundation to resist lateral loading. It is estimated that pipe piles (or mini piers) will reach refusal at 60-feet depth.

Driven Pipe Piles:
The piles shall be driven with a minimum 150 lb. pneumatic hammer rated at 340 blows per minute or the approved equivalent. The piles shall be driven to practical refusal, defined by less than 6 inch penetration per minute, or as otherwise accepted by the Engineer. Piles designed for skin friction shall be driven to the minimum depth as specified by the Engineer or to practical refusal.

Grouted Pipe Piles:
This application normally consists of drilling an 8 to 12 inch diameter hole 12 inches into the bedrock, then seating a 3.5 inch pipe on the rock and grouting it from the inside with a sand-cement grout until the grout appears at the surface around the outside of the pipe.

Mini-piers
Are small diameter (≈ 4-inch) with sacrificial tips that are drilled into the ground then grouted.

All piers/piles should have a nominal penetration of 18-inches into the bedrock.

Piles constructed in this manner less than 15 feet long may use the following design values:
(we recommend that the manufacturer be contacted for the actual allowable load for a specific product)

Geotechnical Drainage Considerations
These recommendations apply to the geotechnical aspect of the drainage as they affect the stability of the construction and land. They do not include site grading and area drainage, which is within the design responsibility of civil engineers and landscape professionals. The civil and landscape professionals should make every effort to comply with the Marin County "Stormwater Quality Manual for Development Projects In Marin County" by the Marin County Stormwater Pollution Prevention Program (MCSTOPPP www.mcstoppp.org) and Bay area Stormwater Management Agencies Association (BASMAA www.basmaa.org) when possible.

The site should be graded to provide positive drainage away from the pool and foundations at a rate of 5 percent within the first ten feet (per requirements of the CBC section1804.3). All roofs should be equipped with gutters and downspouts that discharge into a solid drainage line. Gutters may be eliminated if roof runoff is collected by shallow surface ditches or other acceptable landscape grading. All driveways and flat areas should drain into controlled collection points and all foundation and retaining walls constructed with backdrainage systems. Surface drainage systems, e.g. roofs, ditches and drop inlets *must be maintained separately* from foundation and backdrainage systems. The two systems may be joined into one pipe at a drop-inlet that is a minimum of two feet in elevation below the invert of the lowest back or slab drainage system. A bentonite seal should be placed at the transition point between drainpipes and solid pipes.

One should observe the ponding of water during winter and consult with you landscape professional for the location of surface drains and with us if subdrains are required.

All drop inlets that collect water contaminated with hydrocarbons (e.g. driveways) should be filtered before discharged in to a natural drainage.

Fills

All fill should be placed on level benches cut into undisturbed rock as accepted by the Engineer in the field. The Engineer shall preapprove all fill materials. Backdrainage may be required at the discretion of the Engineer. The face of any unreinforced fill slope should not exceed an angle of 2:1 (vertical to horizontal). Reinforced fills (fills with layers of geofabrics) may be designed for steep angles on an individual basis. Unclassified fills should be compacted to 90 percent of the maximum dry density of the materials as determined by ASTM D-1557 test procedures. Soil and fill serving as pavement sub-bases should have the top twelve inches compacted to 95 percent maximum density. All fill densities should be verified by testing procedures ASTM D-1556 and D-1557, or ASTM D-2292 and D-3017 (Nuclear Method). Fill specifications will be provided if required. Fills and fill behind retaining walls can be expected to settle over time due to their own weight or the additional weight from structures. Any structures that cannot tolerate settlement should be founded on piers drilled through the fill into the bedrock.

Drainage Checklist

Before submitting the project drawings to us for review the architect and structural engineer should be sure the following applicable drainage items are shown on the drawings:

- Under-slab drains and outlets
- Crawl space drainage
- Cross-slope footing and grade beam weep holes
- Retaining wall backdrainage pipes with no gravel under the pipes
- Invert of foundation drains located 4-inches below interior grade
- No gravel under any drainpipe
- Upslope exterior foundation drains
- Drains installed in accordance with §1101.12 of the CPC
- Bentonite seals at drainpipe transition to solid pipe
- Outfall details and location

In lieu of the above details actually being shown on the drawings there may be a:

- ***Note on the structural drawings***: "Drainage details may be schematic and incomplete, refer to the text and drawings in the geotechnical report for actual materials and installation"

Construction Observations

In order to assure that the construction work is performed in accordance with the recommendations in this report, SalemHowes Associates Inc. must perform the following applicable inspections. We will provide a full time project engineer to supervise the foundation excavation, drainage, compaction and other geotechnical concerns during construction and accept the footing grade / pier holes prior to placing any reinforcing steel in accordance with the CRC or CBC Section 1702-Definitions and Table 1704.9 continuous inspections for drilled piers and earthwork, if required. Otherwise, if directed by the Owner, these inspections will be performed on an "periodic as requested basis" by the Owner or Owner's representative. We will not be responsible for construction we were not called to inspect. In this case it is the responsibility of the Owner to assure that we are notified in a timely manner to observe and accept each individual phase of the project.

Key Observation Points

- Map excavations in progress to identify and record soil conditions.
- Accept final footing grade prior to placement of reinforcing steel.
- Accept pier/pile drilling/construction
- Test compacted fills
- Accept subdrainage prior to backfilling with drainage rock.
- Accept drainage discharge location.

Additional Engineering Services

We should work closely with your project engineer and architect to interactively review the site grading plan and foundation design for conformance with the intent of these recommendations. We should provide periodic engineering inspections and testing, as outlined in this report, during the construction and upon completion to assure contractor compliance and provide a final report summarizing the work and design changes, if any.

Any engineering or inspection work beyond the scope of this report would be performed at your request and at our standard fee schedule.

Limitations on the Use of This Report

This report is prepared for the exclusive use of R.V.Stich Inc and their design professionals for construction of the proposed RV Parking and Storage . This is a copyrighted document and the unauthorized copying and distribution is expressively prohibited. Our services consist of professional opinions, conclusions and recommendations developed by a Geotechnical Engineer and Engineering Geologist in accordance with generally accepted principles and practices established in this area at this time. This warranty is in lieu of all other warranties, either expressed or implied.

All conclusions and recommendations in this report are contingent upon SalemHowes Associates being retained to review the geotechnical portion of the final grading and foundation plans prior to construction. The analysis and recommendations contained in this report are preliminary and based on the data obtained from the referenced subsurface explorations. The borings and exposures indicate subsurface conditions only at the specific locations and times, and only to the depths penetrated. They do not necessarily reflect strata variations that may exist between such locations. The validity of the recommendations is based on part on assumptions about the stratigraphy made by the geotechnical engineer or geologist. Such assumptions may be confirmed only during earth work and foundation construction for deep foundations. If subsurface conditions are different from those described in this report are noted during construction, recommendations in this report must be re-evaluated. It is advised that SalemHowes Associates Inc. be retained to observe and accept earthwork construction in order to help confirm that our assumptions and preliminary recommendations are valid or to modify them accordingly. SalemHowes Associates Inc. cannot assume responsibility or liability for the adequacy of recommendations if we do not observe construction.

In preparation of this report it is assumed that the client will utilize the services of other licensed design professionals such as surveyors, architects and civil engineers, and will hire licensed contractors with the appropriate experience and license for the site grading and construction.

We judge that construction in accordance with the recommendations in this report will be stable and that the risk of future instability is within the range generally accepted for construction on hillsides in the Marin County area. However, one must realize there is an inherent risk of instability associated with all fill over baymud construction and, therefore, we are unable to guarantee the stability of any such construction during a major event.

In the event that any changes in the nature, design, or location of the facilities are made, the conclusions and recommendations contained in this report should not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing by SalemHowes Associates Inc. We are not responsible for any claims, damages, or liability associated with interpretations of subsurface data or reuse of the subsurface data or engineering analysis without expressed written authorization of SalemHowes Associates Inc. Ground conditions and standards of practice change; therefore, we should be contacted to update this report if construction has not been started before the next winter.

We trust this provides you with the information required for your evaluation of geotechnical properties of this site. If you have any questions or wish to discuss this further please give us a call.

Prepared by:

SalemHowes Associates, Inc.
A California Corporation

Reviewed by:

E Vincent Howes
Geotechnical Engineer
GE #965 exp. 31 Mar 24

Attachments: Drawing A, Site Plan and Location of Test Borings
Typical Drain Detail
Typical Dispersion Field Details
Logs of Test Borings
Plate 1, San Francisco Bay Region Earthquake Probabilities

References:

General: 2019 California Building Code and Residential Building Code

[1] Rice, Salem J., Geology and Planning Novato Area, Marin County, California, California Division of Mines and Geology, 1975

[2]) USDA, Soil Conservation Service, Soil Survey of Marin County California, March 1985

[2] U.S. Geological Survey, Probabilities of Large Earthquakes in the San Francisco Bay Region, 2000 to 2030, Open-File Report 99-517, 1999

[3] California Department of Conservation, Division of Mines and Geology, Maps of Known Active Fault Near-Source Zones in California and Adjacent Portions of Nevada, February 1988, International conference of Building Officials

[4] Department of the Navy, Naval Facilities Engineering Command, Soil Mechanics, Design Manual 7.1, 7.2, (NAVFAC DM-7) May 1982,

[5] Uniform Construction Standards, most recent edition, Marin County Building Department

[6] Leps, Thomas M.,Review of Shearing Strength of Rockfill, Journal of the Soil Mechanics and Foundation Division, Proc. ASCE, Vol.96 No.SM4. July 1970, pp1159

[7] Bowles, Joseph, E., Foundation Analysis and Design, fourth edition, McGraw-Hill, 1988 pg. 614

[6] Seed, H.B. and Whitman, R.V. (1970) Design of Earth Structures for Dynamic Loads. Lateral Stresses in the Ground and Design of Earth Retaining Structures, ASCE, Cornell University

[9] Association of Bay Area Governments (ABAG), Manual of Standards for Erosion & Sediment Control Measures. Most recent edition.
Storm Water Quality Task Force, California Storm Water Best Management Practice Handbooks, Construction Activity, March 1993.

[10] USGS web site at http://earthquake.usgs.gov/research/hazmaps/design

[11]Schnabel, Harry, Tiebacks in Foundation Engineering and Construction, McGraw-Hill,1982

[11] Seed H.B. and Whitman, R.V. (1970) Design of Earth Structtures for Dynamic Loads

Terzaghi and Peck 1967 *Soil Mechanics in Engineeering Practice* 2nd ed, Wile and Sons, NY

Teng, W.C. 1962 *Foundation Design*, Prentice-Hall, Englewood Clifs, N.J.

PROJECT: 1 Marsh Dr	BORING: A
ENGINEER: E. V. Howes	LOGGED BY: J. Gillis
JOB # : 2312043	DATE: 19 December 2023

PLASTICITY INDEX (PI)	LIQUID LIMIT	SAMPLE TYPE	(N) Blows Per foot	DEPTH (feet)	WATER LEVEL	DESCRIPTIVE LOG	GRAPHIC LOG	REMARKS
				1–3		FILL [Qaf] 0.0'-4.0' debris pile with concrete, brick and other material. brown, silty clayey [ML-CL] fill, mottled in texture and color, rocky at 4.0', grades to [Qm] below 4.0'		
		SPT	24	4				
		SPT	4	5–8		MUD [Qm] 4.0'-10.0' soft, grayish blue to blueish gray silts and muds [ML-OH] with blackend organics of grasses and rooting. trace odor from decaying marsh grasses. moist througout. no clasts, no rooting from current plants. no organics past 8.0'. wet and somewhat unconsolidated light gray silt to 10.0'		SPT sank from 7.5'-8.5'
		SPT	5	9	▼			Groundwater was encountered at 9.0'
				10		End of Log		End of boring at 10.0', SPT sinking under weight
				11–21				

DRILLED BY: TransBay	EQUIPMENT: Portable Hydraulic
BORING SIZE: 3"	SHEET: 1 of 1

PROJECT: 1 Marsh Dr	**BORING: B**
ENGINEER: E. V. Howes	**LOGGED BY: J. Gillis**
JOB # : 2312043	**DATE: 19 December 2023**

PLASTICITY INDEX (PI)	LIQUID LIMIT	SAMPLE TYPE	(N) Blows Per foot	DEPTH (feet)	WATER LEVEL	DESCRIPTIVE LOG	GRAPHIC LOG	REMARKS
		SPT	12	1		FILL [Qaf] 0.0'-6.5' stiff, orangish brown silty clayey [ML-CL] fill, mottled in texture and color, somewhat loose in hand at top 2.0'. sandstone and greenstone clasts rich at 3.0', no apparent stratification. medium stiffness at 4.5'-6.0', increase in clast frequency, loose in hand. wet silt in shoe		
		SPT	13	2				
		SPT	12	3				
		SPT	8	4				
		SPT	4	5				
		SPT	4	6				
				7		MUD [Qm] 6.5'-9.0' soft, grayish blue to blueish gray silts and muds [ML-OH] with blackend organics of grasses and rooting. trace odor from decaying marsh grasses. moist througout. no clasts, no rooting from current plants.		
				8				
				9		End of Log		
				10				
				11				
				12				Groundwater was not Encountered in boring
				13				
				14				
				15				
				16				
				17				
				18				
				19				
				20				
				21				

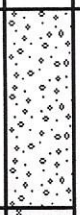
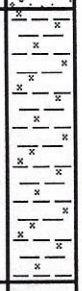
DRILLED BY: TransBay	**EQUIPMENT: Portable Hydraulic**
BORING SIZE: 3"	**SHEET: 1 of 1**

PROJECT: 1 Marsh Dr	BORING: C
ENGINEER: E. V. Howes	LOGGED BY: J. Gillis
JOB # : 2312043	DATE: 19 December 2023

PLASTICITY INDEX (PI)	LIQUID LIMIT	SAMPLE TYPE	(N) Blows Per foot	DEPTH (feet)	WATER LEVEL	DESCRIPTIVE LOG	GRAPHIC LOG	REMARKS
		SPT	8	1		FILL [Qaf] 0.0'-4.5' stiff, orangish brown silty clayey [ML-CL] fill, asphalt clasts at 2.0'. mottled in texture and color, somewhat loose in hand at top 2.0'. no apparent stratification throughout.		
		SPT	12	2				
		SPT	11	3				
		SPT	8	4				
		SPT	5	5		MUD [Qm] 4.5'-12.0' medium at 4.5', soft at 6.0'+, light gray silts and muds [ML-OH] with rusty organics of grasses and rooting where oxidized, slightly moist. trace odor from decaying marsh grasses. at 8.0' grades to grayish blue to blueish gray silts and muds with trace organics. moist througout. no clasts, no rooting from current plants.		Groundwater was not Encountered in boring
		SPT	4	6				
				7				SPT sank under weight organic rich, stinky
		SPT	2	8				
				9				
				10				
				11				
				12		End of Log		
				13				
				14				
				15				
				16				
				17				
				18				
				19				
				20				
				21				

DRILLED BY: TransBay	EQUIPMENT: Portable Hydraulic
BORING SIZE: 3"	SHEET: 1 of 1

PROJECT: 1 Marsh Dr	**BORING: D**
ENGINEER: E. V. Howes	**LOGGED BY: J. Gillis**
JOB # : 2312043	**DATE: 19 December 2023**

PLASTICITY INDEX (PI)	LIQUID LIMIT	SAMPLE TYPE	(N) Blows Per foot	DEPTH (feet)	WATER LEVEL	DESCRIPTIVE LOG	GRAPHIC LOG	REMARKS
		SPT	6	1		FILL [Qaf] 0.0'-4.0' stiff, orangish brown silty clayey [ML-CL] fill, asphalt clasts at 2.0'. mottled in texture and color, somewhat loose in hand at top 2.0'. no apparent stratification throughout.		
		SPT	5	2				
		SPT	4	3				
		SPT	5	4				
		SPT	3	5				
				6		MUD [Qm] 4.0'-9.5' soft, light gray silts and muds [ML-OH] with organics of grasses and rooting where oxidized, slightly moist. trace odor from decaying marsh grasses. somewhat cracked texture where dried. very soft at 8.0' grades to grayish blue to blueish gray silts and muds with trace organics. moist througout. no clasts, no rooting from current plants.		Groundwater was not Encountered in boring
		SPT	1	7				SPT sank under weight organic rich, stinky
				8				
				9				
				10		End of Log		
				11				
				12				
				13				
				14				
				15				
				16				
				17				
				18				
				19				
				20				
				21				

DRILLED BY: TransBay	**EQUIPMENT: Portable Hydraulic**
BORING SIZE: 3"	**SHEET: 1 of 1**

PROJECT: 1 Marsh Dr	BORING: E
ENGINEER: E. V. Howes	LOGGED BY: J. Gillis
JOB # : 2312043	DATE: 19 December 2023

PLASTICITY INDEX (PI)	LIQUID LIMIT	SAMPLE TYPE	(N) Blows Per foot	DEPTH (feet)	WATER LEVEL	DESCRIPTIVE LOG	GRAPHIC LOG	REMARKS
		SPT	24	1	▼	FILL [Qaf] 0.0'-4.5' stiff, orangish brown silty clayey [ML-CL] fill, gravel cover. mottled in texture and color, somewhat competent in hand. sandstone and greenstone clast throughout. wet at 2.0', no apparent stratification		Groundwater was encountered at 2.0'
		SPT	21	2				
		SPT	16	3				
		SPT	5	4				
		SPT	4	5		MUD [Qm] 4.5'-9.5' soft grayish blue to blueish gray silts and muds with trace organics. moist througout. no clasts, no rooting from current plants. no recovery at 4.5'		
				6				
				7				
				8		End of Log		
				9				
				10				
				11				
				12				
				13				
				14				
				15				
				16				
				17				
				18				
				19				
				20				
				21				

DRILLED BY: TransBay	EQUIPMENT: Portable Hydraulic
BORING SIZE: 3"	SHEET: 1 of 1

PROJECT: 1 Marsh Dr	BORING: F
ENGINEER: E. V. Howes	LOGGED BY: J. Gillis
JOB # : 2312043	DATE: 19 December 2023

PLASTICITY INDEX (PI)	LIQUID LIMIT	SAMPLE TYPE	(N) Blows Per foot	DEPTH (feet)	WATER LEVEL	DESCRIPTIVE LOG	GRAPHIC LOG	REMARKS
		SPT	16	1		FILL [Qaf] 0.0'-7.0' stiff, orangish brown silty clayey [ML-CL] fill, gravel cover. mottled in texture and color, somewhat competent in hand. sandstone and greenstone clast throughout. less competent at 5.0', greenstone clast rich. angular clasts at base of fill		Groundwater was not Encountered in boring
		SPT	28	2				
		SPT	16	3				
		SPT	10	4				
		SPT	14	5				
		SPT	10	6				
		SPT	5	7				
				8		MUD [Qm] 7.0'-10.5' soft light gray silts and intertidal muds with trace oxidized organics. moist throughout. wet and sticky muds at 9.0', no clasts, no rooting from current plants.		
				9				
				10				
				11		End of Log		
				12				
				13				
				14				
				15				
				16				
				17				
				18				
				19				
				20				
				21				

DRILLED BY: TransBay	EQUIPMENT: Portable Hydraulic
BORING SIZE: 3"	SHEET: 1 of 1

PROJECT: 1 Marsh Dr	**BORING: G**
ENGINEER: E. V. Howes	**LOGGED BY: J. Gillis**
JOB # : 2312043	**DATE: 19 December 2023**

PLASTICITY INDEX (PI)	LIQUID LIMIT	SAMPLE TYPE	(N) Blows Per foot	DEPTH (feet)	WATER LEVEL	DESCRIPTIVE LOG	GRAPHIC LOG	REMARKS
		SPT	14	1		FILL [Qaf] 0.0'-5.0' stiff, orangish brown silty clayey [ML-CL] fill, gravel cover. mottled in texture and color, somewhat competent in hand. sandstone and greenstone clast throughout. angular clasts at base of fill		Groundwater was not Encountered in boring
		SPT	15	2				
		SPT	10	3				
		SPT	7	4				
		SPT	8	5		MUD [Qm] 5.0'-9.0' medium stiffness grayish blue to blueish gray silts and intertidal muds with trace organics. moist throughout. wet and sticky muds at 7.5', no clasts, no rooting from current plants.		
		SPT	7	6				
				7				
				8				
				9		End of Log		
				10				
				11				
				12				
				13				
				14				
				15				
				16				
				17				
				18				
				19				
				20				
				21				

DRILLED BY: TransBay	**EQUIPMENT: Portable Hydraulic**
BORING SIZE: 3"	**SHEET: 1 of 1**

PROJECT: 1 Marsh Dr	BORING: H
ENGINEER: E. V. Howes	LOGGED BY: J. Gillis
JOB # : 2312043	DATE: 19 December 2023

PLASTICITY INDEX (PI)	LIQUID LIMIT	SAMPLE TYPE	(N) Blows Per foot	DEPTH (feet)	WATER LEVEL	DESCRIPTIVE LOG	GRAPHIC LOG	REMARKS
		SPT	23	1		FILL [Qaf] 0.0'-6.5' hard to very hard, orangish brown silty clayey [ML-CL] fill, gravel cover. mottled in texture and color, very tight in hand, resembles colluvium. sandstone and greenstone clast throughout. drilled past fill gravels.		Groundwater was not Encountered in boring
		SPT	50	2				
		SPT	71	3				
				4				
				5				
				6				
				7		MUD [Qm] 6.5'-9.0' soft grayish blue to blueish gray silts and muds, organic rich. moist throughout, no clasts, no rooting from current plants.		
		SPT	4	8				
				9		End of Log		
				10				
				11				
				12				
				13				
				14				
				15				
				16				
				17				
				18				
				19				
				20				
				21				

DRILLED BY: TransBay	EQUIPMENT: Portable Hydraulic
BORING SIZE: 3"	SHEET: 1 of 1

PROJECT: 1 Marsh Dr	BORING: I
ENGINEER: E. V. Howes	LOGGED BY: J. Gillis
JOB # : 2312043	DATE: 19 December 2023

PLASTICITY INDEX (PI)	LIQUID LIMIT	SAMPLE TYPE	(N) Blows Per foot	DEPTH (feet)	WATER LEVEL	DESCRIPTIVE LOG	GRAPHIC LOG	REMARKS
		SPT	22	1		FILL [Qaf] 0.0'-5.0' hard, orangish brown silty clayey [ML-CL] fill, gravel cover. mottled in texture and color, tight in hand. sandstone and greenstone clast throughout.		Groundwater was not Encountered in boring
		SPT	25	2				
		SPT	24	3				
		SPT	19	4				
		SPT	9	5				
				6		MUD [Qm] 5.0'-7.5' medium stiffness to stiff, grayish blue to blueish gray silts and muds, organic rich. moist throughout, no clasts, no rooting from current plants.		
				7				
				8		End of Log		
				9				
				10				
				11				
				12				
				13				
				14				
				15				
				16				
				17				
				18				
				19				
				20				
				21				

DRILLED BY: TransBay	EQUIPMENT: Portable Hydraulic
BORING SIZE: 3"	SHEET: 1 of 1

Notes to Boring Logs

1) Soil designations in this report conform to the Unified Soil Classifications per ASTM D22487, Classification of Soil for Engineering Purposes. Rock classifications conform to NAVFAC DM-7.

2) The SPT, Standard Penetration Test, is made using a standard 2" OD - 1.375" ID sampler driven by a 140# hammer falling 30" (per ASTM D-1586). A MPT, Modified penetration Test, is made using the same standard sampler driver by a 70# hammer falling 30". Other sampler and hammer size data for information only. TW indicates a Thin Wall sampler. The sample is driven 18" and the number of blows required to penetrate the last 12" is indicated on the log. "REF" (refusal) indicates the number of blows required to penetrate 6" exceeded 50.

3) Borehole and test pit data are considered representative of the subsurface condition only for the time and location at which the data were obtained. Interpretation or extrapolation of these data represent an exercise in judgment based on education and experience and is not warranted as precisely representing subsurface conditions at all locations. During construction variations will be observed in the field and field design changes should be expected.

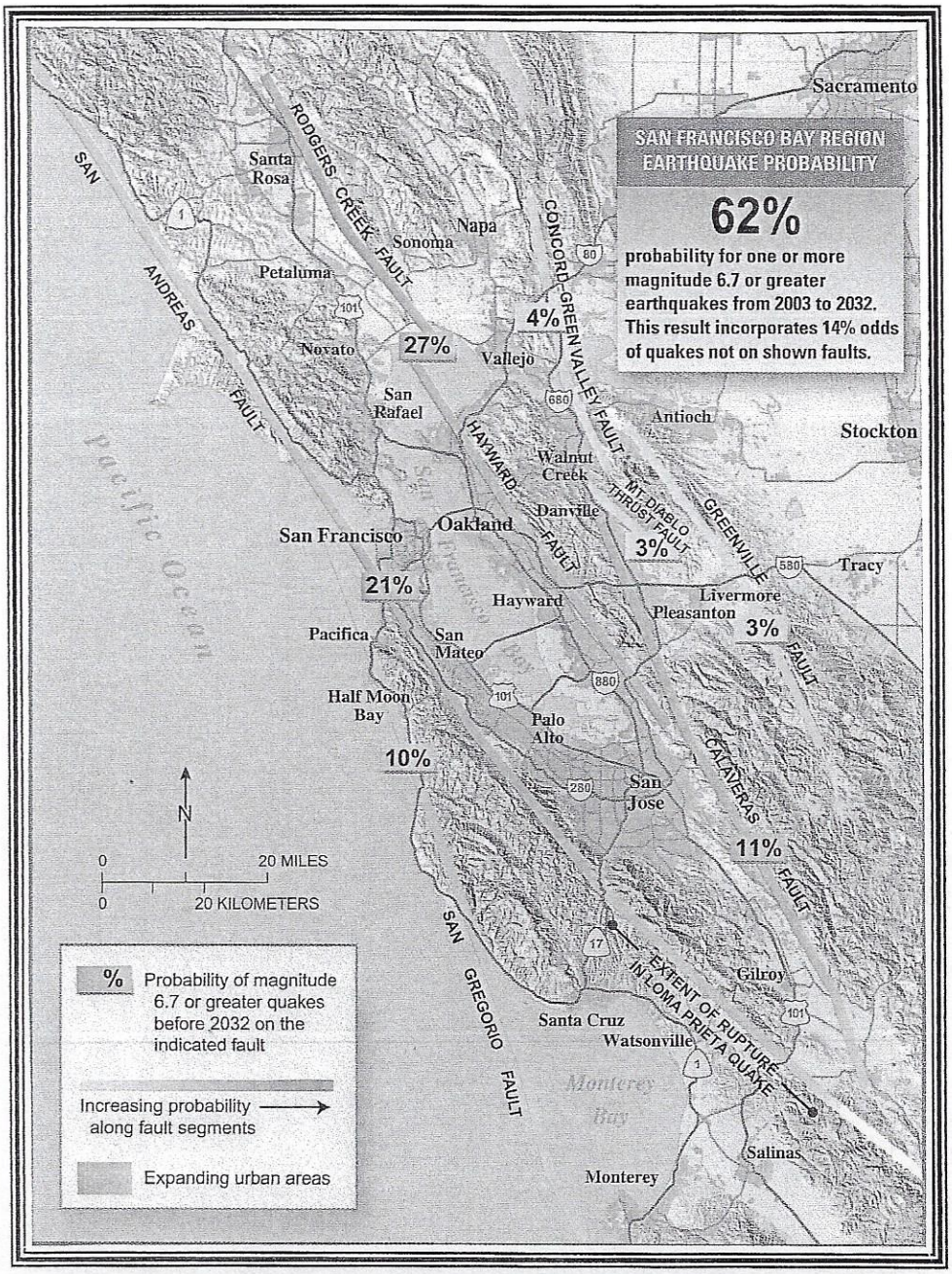
4) PP indicates in situ measurements made by a standard pocket penetrometer in tons per square foot unconfined compressive strength.

TV indicates in situ measurements made by a Torvane in kilograms per square centimeter.

5) LL indicates the Liquid Limit of soils and
PI indicates the Plasticity Index of soils per ASTM D-4318
Quc indicates the unconfined compressive strength per ASTM D-2166
TX/UU indicates an Unconsolidated Undrained Triaxial Test, Confinement pressure/Ultimate strength in psf.
DD indicates dry density in pcf.
mc indicates moisture content in percent.

Qaf := Fill, highly variable from place to place. Soil silt, clay, rock waste, garbage and dredged bay mud.

Qm = Bay Mud: Mainly silty carbonaeeous clay with minor amounts of sand. Contains shell feagmentsand lens of peat and sand. Very soft and plastic when saturated, shrinks and becomes hard when dry .



Using newly collected data and evolving theories of earthquake occurrence, U.S. Geological Survey (USGS) and other scientists have concluded that there is a 62% probability of at least one magnitude 6.7 or greater quake, capable of causing widespread damage, striking somewhere in the San Francisco Bay region before 2032. A major quake can occur in any part of this densely populated region. Therefore, there is an ongoing need for all communities in the Bay region to continue preparing for the quakes that will strike in the future.

Plate 1, San Francisco Bay Region Earthquake Probabilities

From: USGS Fact Sheet 039-03
Revised September 2004