24 June 2013
Project 770608301

Ms. Ruchira Nageswaran
Knapp Architects
235 Montgomery Street
San Francisco, California 94104

Subject: Geotechnical Summary
Hawthorns Historic Structures Assessment
Midpeninsula Regional Open Space District Hawthorns Property
Portola Valley, California

Dear Ms. Nageswaran,

This letter presents our geotechnical site assessment for the historic Mansion, Cook House, and Carriage house structures on the Midpeninsula Regional Open Space District Hawthorns property in Portola Valley, California. We performed our assessment in accordance with the scope presented in the consultant services agreement executed on 4 March 2013. We understand that this letter will be appended as a technical document to your site assessment report; we are not re-iterating discussions such as history of the property or site and building descriptions that will be included within your report.

GEOTECHNCIAL ASSESSEMENT SCOPE

The objective of the geotechnical assessment was to provide geotechnical and geologic support to the team for the structural assessment. To that end, our scope of services included:

- Reviewing geologic and geologic hazard maps of the area,
- Performing a site geologic reconnaissance to characterize site surficial soil conditions (i.e. presence of fill or alluvial materials) in the areas of the structures
- Excavating and logging five hand-dug test pits to depths up to about feet below ground surface to evaluate the depths and supportive materials beneath the foundations of the Homestead House, Mansion, and Carriage House.
- Performing observations of distress within interior and crawlspace areas of the subject structures,
- Providing site seismic design criteria for the buildings,
- Developing recommendations for evaluating existing foundation and retaining wall elements and for new foundation and retaining walls.

Test pits

Two test pits were excavated adjacent to the exterior of the Mansion, two were excavated adjacent to the exterior of the Carriage House, and one was excavated adjacent to the Cook House. The approximate locations of the test pits are provided on the attached site plans, Figures 1a through 1c). The pits were excavated by Soil Engineering Construction of San Jose, California, and shored with wooden cribbing in accordance with OSHA guidelines. The test pits provided information regarding soil conditions and depth of footings; logs of the test pits are presented in Appendix A on Figures A-1 through

A-5. The pits were logged by our Senior Geologist in accordance with the soil classification chart shown on Figure A-6, and sample were collected and retained for laboratory classification. Following excavation, the pits were backfilled with spoils generated during their excavation.

GEOLOGY AND SEISMICITY

Regional and site geology and regional seismicity and faulting are discussed in this section.

Regional Geology

The site is in the Town of Portola Valley, within the Coast Ranges geomorphic province, characterized by northwest-southeast trending valleys and ridges (see Figure 2). These topographic features are controlled by folds and faults that resulted from the collision of the Farallon and North American plates and subsequent strike-slip faulting along the San Andreas fault system.

According to the "*Geologic Map, Town of Portola Valley, San Mateo County, California*" by Cotton, Shires, and Associates (2010), the majority of the site is underlain by Late Jurassic- to Late Cretaceous-age (165 to 70 million years) Franciscan Assemblage greenstone bedrock. The greenstone bedrock is mantled by an increasing thickness of Holocene and Pleistocene age (1.6 million years old to present day) alluvial deposits in the eastern portion of the property, associated with Los Trancos Creek. The Mansion and Carriage House are mapped in the area underlain by alluvium; the Cook House is mapped in the area underlain by bedrock. The map also indicates that a small area of Whiskey Hill claystone and sandstone bedrock sits atop the Franciscan greenstone on an isolated ridge in the northeastern portion of the property, and thick sequences of slope wash (colluvial soil) mantle the greenstone bedrock in the southwestern portion of the property (see Figure 3, Local Geologic Map).

According to the "Ground Movement Potential Map, Town of Portola Valley, San Mateo County, California" by Cotton, Shires, and Associates (2010), the areas corresponding to shallow bedrock on the geologic map are considered to be "Stable bedrock" areas. The area of alluvium is considered to be "Stable unconsolidated granular material", which though not likely to experience landsliding, may experience settlement and liquefaction during strong earthquakes. The area of thick slope wash is identified as an area of unstable, unconsolidated materials commonly less than 10 feet thick, subject to shallow landsliding, soil creep, slumping, or settlement. The Cook House is mapped within the stable bedrock area, the Mansion and Carriage House are mapped within the stable unconsolidated granular materials area (see Figure 4, Local Geologic Hazards Map).

Site Geology

Two test pits designated TP-1 and TP-2 were excavated adjacent to the exterior footings of the Mansion, at the approximate locations shown on Figure 1a. The pits indicate that the footings extend about 3 feet 8 inches to 4 feet 6 inches below grade. The upper 1 foot 4 inches to 2 feet 8 inches appeared to be a formed footing, with firm, friable sandy silt with gravel backfill adjacent to the exterior face of the footing. The bottom of formed footings rest on cemented irregular cobbles that appear to have been placed in a trench into stiff sandy clay and very dense silty sand colluvium

Test pits TP-3 and TP-4 were excavated adjacent to the exterior footings of the Carriage House, at the approximate locations shown on Figure 1b. Test pit TP-3 on the southeast side of the structure within the area of the covered exterior lean-to, appeared to reveal the footing is an inverted "T" shaped concrete footing, embedded 8 inches below the exterior grade. The footing extends through 6 to 7 inches of firm to stiff sandy silt fill, gaining bearing support in stiff sandy silt colluvium. Test pit TP-4 excavated on the southwest side of the structure revealed the footing is about 16 inches below the exterior grade, bottomed on the underlying colluvium. About 16 inches of firm to stiff sandy silt with gravel fill is against the exterior side of the footing.

Test pit TP-5, excavated near the left front (southwestern) corner of the Cook House revealed the foundation for this structure consists of a 1-foot wide column of cemented cobbles, extending about 16 inches below grade, and about 7 inches into the underlying colluvium.

Regional Seismicity and Faulting

The site coordinates are 37.371 (latitude) and -122.202 (longitude). The major active faults in the area are the San Andreas, San Gregorio, Hayward, and Calaveras Faults. These and other faults of the region are shown on Figure 5. For each of the active faults within about 100 kilometers (km) of the site, the distance from the site and estimated mean characteristic Moment magnitude[1] [2007 Working Group on California Earthquake Probabilities (WGCEP) (2008) and Cao et al. (2003)] are summarized in Table 1.

TABLE 1
Regional Faults and Seismicity

Fault Segment	Approx. Distance from fault (km)	Direction from Site	Mean Characteristic Moment Magnitude
N. San Andreas – Peninsula	1	Southwest	7.23
N. San Andreas (1906 event)	1	Southwest	8.05
Monte Vista-Shannon	3	Northeast	6.50
San Gregorio Connected	19	West	7.50
N. San Andreas - Santa Cruz	28	Southeast	7.12
Total Hayward	30	Northeast	7.00
Total Hayward-Rodgers Creek	30	Northeast	7.33
Total Calaveras	36	East	7.03
Zayante-Vergeles	37	Southeast	7.00
Monterey Bay-Tularcitos	51	South	7.30
Mount Diablo Thrust	52	Northeast	6.70
N. San Andreas – North Coast	57	Northwest	7.51

1 Moment magnitude is an energy-based scale and provides a physically meaningful measure of the size of a faulting event. Moment magnitude is directly related to average slip and fault rupture area.

Fault Segment	Approx. Distance from fault (km)	Direction from Site	Mean Characteristic Moment Magnitude
Greenville Connected	58	East	7.00
Green Valley Connected	62	Northeast	6.80
Great Valley 7	72	Northeast	6.90
Great Valley 5, Pittsburg Kirby Hills	78	Northeast	6.70
Ortigalita	82	East	7.10
Rodgers Creek	82	North	7.07
Point Reyes	85	Northwest	6.90
Rinconada	87	Southeast	7.50
West Napa	88	North	6.70
Quien Sabe	89	East	6.60
SAF – creeping segment (jl0.sa-creep, modified)	90	Southeast	6.70
Great Valley 8	93	East	6.80

Figure 5 also shows the earthquake epicenters for events with magnitude greater than 5.0 from January 1800 through December 2000. Since 1800, four major earthquakes have been recorded on the San Andreas Fault. In 1836 an earthquake with an estimated maximum intensity of VII on the Modified Mercalli (MM) scale (Figure 6) occurred east of Monterey Bay on the San Andreas Fault (Toppozada and Borchardt 1998). The estimated Moment magnitude, $M_{w,}$ for this earthquake is about 6.25. In 1838, an earthquake occurred with an estimated intensity of about VIII-IX (MM), corresponding to a M_w of about 7.5. The San Francisco Earthquake of 1906 caused the most significant damage in the history of the Bay Area in terms of loss of lives and property damage. This earthquake created a surface rupture along the San Andreas Fault from Shelter Cove to San Juan Bautista approximately 470 kilometers in length. It had a maximum intensity of XI (MM), a M_w of about 7.9, and was felt 560 kilometers away in Oregon, Nevada, and Los Angeles. The most recent earthquake to affect the Bay Area was the Loma Prieta Earthquake of 17 October 1989, in the Santa Cruz Mountains with a M_w of 6.9, approximately 47 km from the site.

In 1868 an earthquake with an estimated maximum intensity of X on the MM scale occurred on the southern segment (between San Leandro and Fremont) of the Hayward Fault. The estimated M_w for the earthquake is 7.0. In 1861, an earthquake of unknown magnitude (probably a M_w of about 6.5) was reported on the Calaveras Fault. The most recent significant earthquake on this fault was the 1984 Morgan Hill earthquake (M_w = 6.2).

The 2008 WGCEP at the U.S. Geologic Survey (USGS) predicted a 63 percent chance of a magnitude 6.7 or greater earthquake occurring in the San Francisco Bay Area in 30 years. More specific estimates of the probabilities for different faults in the Bay Area are presented in Table 2.

TABLE 2

WGCEP (2008) Estimates of 30-Year Probability of a Magnitude 6.7 or Greater Earthquake

Fault	Probability (percent)
Hayward-Rodgers Creek	31
N. San Andreas	21
Calaveras	7
San Gregorio	6
Concord-Green Valley	3
Greenville	3
Mount Diablo Thrust	1

GEOLOGIC HAZARDS

On the basis of the results of our geotechnical and geologic hazard evaluation and geotechnical investigation we conclude the primary geologic and geotechnical issue impacting the site is the potential strong to very strong ground shaking due to a seismic event on one of the nearby faults. This and other geologic and geotechnical issues as they pertain to the proposed development are discussed in following sections.

Strong Ground Shaking

During a major earthquake on one of the active faults in the general region, the site is anticipated to experience strong to very strong ground shaking. The intensity of the earthquake ground motion at the site will depend upon the characteristics of the generating fault, distance to the earthquake epicenter, magnitude and duration of the earthquake, and specific site geologic conditions. During its history, the site has been subjected to strong to very strong ground shaking from moderate to large earthquakes on the San Andreas, Hayward, and San Gregorio faults, and future strong ground shaking should be expected.

Fault Rupture

Historically, ground surface ruptures closely follow the trace of geologically young faults. The site is not within an Earthquake Fault Zone, as defined by the Alquist-Priolo Earthquake Fault Zoning Act and based on our review, no known active or potentially active faults exist on the site. Therefore, we conclude the risk of fault offset at the site from a known active fault is very low. In a seismically active area, the remote possibility exists for future faulting in areas where no faults previously existed; however, we conclude the risk of surface faulting and consequent secondary ground failure is very low.

Earthquake-Induced Landsliding

The area of the three subject buildings is relatively flat to gently sloping. Based on our review of seismic hazard maps, the site is not mapped as being within a zone subject to seismically-induced slope instability. However, some slopes on the property west of the subject buildings are mapped as having the potential for seismically induced landsliding (see Figure 7). Considering the site's topography and distance from any of the steep slopes, we conclude the potential for seismically-induced slope instability impacting the three subject buildings is negligible.

Seismically-Induced Ground Deformations

As discussed above, strong to very strong shaking is expected to occur at the project site during a major earthquake on a segment of one of the nearby faults. Strong shaking during an earthquake can result in ground failure such as that associated with soil liquefaction[2] and lateral spreading[3], and differential compaction[4]. We used the subsurface data obtained from our test pits and our review of published maps to evaluate the potential for seismically-induced ground deformations at the site.

Liquefaction and Lateral Spreading

The State of California Seismic Hazard Zones for the Mindego Hill Quadrangle (2005) indicates the area of the three buildings is not within a an area "where historic occurrence of liquefaction, or local geological, geotechnical and groundwater conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693 (c) would be required" (Figure 7).

When a soil liquefies during an earthquake, it experiences a significant temporary loss of strength. Flow failure, lateral spreading, differential settlement, loss of bearing, ground fissures, and sand boils are evidence of excess pore pressure generation and liquefaction. Lateral spreading refers to the finite, lateral displacement of gently sloping ground as a result of pore pressure build-up or liquefaction during an earthquake. Considering the site topography, density, and amount of fine grained material (silts and clays) found beneath the footings within the test pits, we conclude the potential for liquefaction and lateral spreading at the site is very low.

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2 Liquefaction is a transformation of soil from a solid to a liquefied state during which saturated soil temporally loses strength resulting from the buildup of excess pore water pressure, especially during earthquake-induced cyclic loading. Soil susceptible to liquefaction includes loose to medium dense sand and gravel, low-plasticity silt, and some low-plasticity clay deposits.

3 Lateral spreading is a phenomenon in which surficial soil displaces along a shear zone that has formed within an underlying liquefied layer. Upon reaching mobilization, the surficial blocks are transported downslope or in the direction of a free face by earthquake and gravitational forces.

4 Differential compaction, also known as cyclic densification, is a phenomenon in which non-saturated, cohesionless soil is compacted by earthquake vibrations, causing differential settlement.

Differential Compaction

Differential compaction, also known as cyclic densification, refers to seismically-induced differential compaction of non-saturated granular material (sand and gravel above the groundwater table) caused by earthquake vibrations. Our subsurface exploration and review of geologic maps indicate the area is underlain by dense silty sand and stiff sandy silt and sandy clay colluvium, mantled by thin layers of undocumented fill and topsoil. We did not encounter loose sands without fines. Considering the subsurface materials underlying the site, we conclude the potential for settlement from differential compaction is low.

Non-Seismic Ground Failure

Potential geologic hazards associated with ground failure not caused by earthquakes include expansive and collapsible soil.

Expansive Soil

Expansive soil shrinks or swells significantly with changes in moisture content. The clay content and porosity of the soil also influence the change in volume. The shrinking and swelling caused by expansive clay-rich soil often results in damage to overlying structures. On the basis of the sand and silt content of the materials encountered beneath the footings in the test pits, we judge the colluvium to have a low potential for expansion.

Collapsible Soil

Soil collapse is the densification of sediments resulting from significant increases in their moisture content. This process typically results from moisture infiltration into the subsurface caused by poor surface drainage, irrigation water or leaking pipes. This phenomenon is more prevalent in low-density, silty to sandy soil deposited in semi-arid and arid climates where the soil has not been subjected to saturation. Based on the relative density and type and amount of fines of the colluvium encountered in the test pits supporting the foundations of the subject buildings, we judge the potential for soil collapse at the site is low.

Flooding

We reviewed the Federal Emergency Management Agency (FEMA) website to evaluate the potential for flooding and earthquake-related flood inundations. Based on map 06081C0402E, the site is not within a 100-year flood hazard zone, and is in an area designated Zone X. A Zone X area includes areas outside the 500-year flood hazard zone.

CONCLUSIONS AND RECOMMENDATIONS

On the basis of the results of the available subsurface information we conclude the dense silty sand and medium stiff to stiff sandy silt and sandy clay colluvium can provide adequate support for the existing structures. However, some distress to the existing structures was observed. Distress to the foundations appears to be the result of:

- footings that were under-designed to resist loads, such as beneath the apparent foundation settlement in the area of the main stairway within the Mansion;
- footings that were not extended deep enough into support to resist lateral loads, such as Carriage House southeast footing which has rotated, resulting in large cracks in the slab-on-grade floor near this footing;
- vertical cracks at points of stress concentration where footings step down site grades;
- poor construction or materials resulting in concrete spauling and erosion;
- and lack of reinforcing steel in footings or basement retaining walls for the Mansion or Cook House;

To mitigate the distress, we understand that improvements to the structures consisting of repairs to existing footings and basement retaining walls, or new footing elements, retaining walls, or concrete slabs-on-grade may be constructed. The following sections provide geotechnical recommendations for evaluating the existing structures and for new improvements.

Seismic Design Criteria

For seismic design in accordance with the provisions of 2010 California Building Code (CBC) we recommend the following values:

- Site Class $S_{D.}$
- Maximum Considered Earthquake (MCE) S_s and S_1 of 2.991g and 1.222g, respectively.
- Site Coefficients F_A and F_V of 1.0 and 1.5, respectively.
- Maximum Considered Earthquake (MCE) spectral response acceleration parameters at short periods, S_{MS}, and at one-second period, S_{M1}, of 2.991g and 1.833g, respectively.
- Design Earthquake (DE) spectral response acceleration parameters at short period, S_{DS}, and at one-second period, S_{D1}, of 1.994g and 1.222g, respectively.

Existing Shallow Foundations

Our exploration revealed the three subject buildings are supported by concrete isolated spread footings and a concrete perimeter footings bearing in native stiff/dense colluvium. Existing shallow isolated and/or continuous spread footings may be evaluated using an allowable bearing capacity of 2,000 psf.

The passive resistance to evaluate existing foundations should be calculated using an equivalent fluid pressure of 250 pounds per cubic foot (pcf). The upper foot of passive resistance should be neglected unless confined by a slab or pavement. Frictional resistance should be computed using a base friction coefficient of 0.30. The passive resistance and base friction values include a factor of safety of 1.5 and may be used in combination without reduction.

New Foundations

New shallow, spread footings should bear in the underlying stiff/dense colluvium. The bottom of the footings should be embedded at least 18 inches below the lowest adjacent soil subgrade and should be at least 18 inches wide for continuous footings and 24 inches for isolated spread footings. Footings adjacent to utility trenches (or other footings) should bear below an imaginary 1.5:1 (horizontal to vertical) plane projected upward from the bottom edge of the utility trench (or adjacent footings).

For the recommended minimum embedment or for existing footings bearing in colluvium, the footings may be designed for an allowable bearing pressure of 2,000 pounds per square foot (psf) for dead plus live loads, with a one-third increase for total loads, including wind and/or seismic loads.

Lateral loads on footings can be resisted by a combination of passive resistance acting against the vertical faces of the footings and friction along the bases of the footings. Passive resistance may be calculated using lateral pressures corresponding to an equivalent fluid weight of 250 pounds per cubic foot (pcf); the upper foot of soil should be ignored unless confined by a concrete slab or pavement. Frictional resistance should be computed using a base friction coefficient of 0.30. The passive resistance and base friction values include a factor of safety of about 1.5 and may be used in combination without reduction.

Uplift loads may be resisted by the weight of the footing and any overlying soil. If footings are inadequate to provide the necessary uplift resistance, drilled piers or anchors may be used. If drilled piers or anchors are required, we should present design recommendations.

Weak soil or non-engineered fill encountered in the bottom of footing excavations should be excavated and replaced with engineered fill or lean concrete. The bottoms and sides of the footing excavations should be wetted following excavation and maintained in a moist condition until concrete is placed.

We should check footing excavations prior to placement of reinforcing steel. Footing excavations should be free of standing water, debris, and disturbed materials prior to placing concrete.

Existing Basement and Site Retaining Walls

For evaluation of the existing basements and site retaining walls, we recommend using the lateral pressures imposed by the soil and any adjacent surcharge loads. Because the site is in a seismically active area, the retaining wall should be checked for the seismic condition. Under seismic loading conditions, there will be a seismic increment that should be added to active earth pressures (Sitar, et. al., 2012). We used the procedures outlined in (Sitar, et. al., 2012) to compute the seismic active pressure. The more critical condition of either at-rest pressure or active pressure plus a seismic increment should be checked. At-rest and total pressures (active plus seismic pressure increment) for the Design Earthquake (DE) and Maximum Considered Earthquake (MCE) levels of shaking for the site, for level backfill, are presented in Table 3 for an undrained condition, since no backdrains were encountered in the test pits.

TABLE 3
Basement Wall Lateral Earth Pressures above the Groundwater Level

Drainage Condition	At-Rest Pressure (Equivalent Fluid Weight, pcf)	Total Pressure Active plus Seismic Pressure Increment (Equivalent Fluid Weight, pcf)	
		DE	MCE
Undrained	91	102	113

If surcharge loads occur above an imaginary 45-degree line (from the horizontal) projected up from the bottom of a retaining wall, a surcharge pressure should be included in the wall design. If this condition exists, we should be consulted to estimate the added pressure on a case-by-case basis. Where vehicle traffic will pass within 10 feet of retaining walls, temporary traffic loads should be considered in the design of the walls. Traffic loads may be modeled by a uniform pressure of 100 pounds per square foot applied in the upper 10 feet of walls.

New Basement and Site Retaining Walls

New building, site, or basement retaining walls should be supported on foundations designed in accordance with the recommendations given above for spread footings. Assuming a flat backfill adjacent to the walls, the walls should be designed for the lateral earth pressures summarized in Table 4. If retaining walls other than those addressed herein are planned, we should be consulted to determine appropriate earth pressures.

TABLE 4
Lateral Earth Pressures for New Retaining Walls

Drainage Condition	At-Rest Pressure (Equivalent Fluid Weight, pcf)	Total Pressure Active plus Seismic Pressure Increment (Equivalent Fluid Weight, pcf)	
		DE	MCE
Drained	60	81	104

The preceding pressures assume that sufficient drainage is provided behind the walls to prevent the buildup of hydrostatic pressures from surface or subsurface water infiltration. Adequate drainage may be provided by means of a backdrain system consisting of an approximately 1-foot thick curtain of drainrock (crushed rock or gravel) placed behind the wall. The drainrock should be separated from the backfill by a geotextile filter fabric, such as Mirafi 140 or an alternate, approved by the soil engineer. A 4-inch diameter heavy-duty rigid perforated subdrain pipe (Schedule 40, SDR 21 or equivalent), should be placed with the perforations down on a 2- to 3-inch layer of drainrock at the base of the drain. Where subdrain pipes will be buried at depth greater than 10 feet, Schedule 80 or equivalent pipe should be used. Flexible corrugated pipe should not be used.

As an alternative, back drainage may consist of an approved drainage mat placed directly against the wall. The bottom of the drainage mat should be in contact with the rigid 4-inch perforated drainpipe embedded in gravel. The mat's filter fabric should be placed around the drainpipe and between the pipe and the soil.

Perforated retaining wall subdrain pipes should be dedicated pipes and not connect to the surface drain system. The subdrain pipes should be installed with a positive gradient of at least 2 percent and should be provided with clean-out risers at their up-gradient ends and at all sharp changes in direction. Changes in pipe direction should be made with "sweep" elbows to facilitate future inspection and cleanout. The perforated pipes should be connected to buried solid pipes to discharge onto an energy dissipater at an appropriate downhill location or other suitable location, approved by the geotechnical engineer.

Backfill placed behind the walls should be compacted to at least 90 percent relative compaction, using light compaction equipment. Fill should be moisture conditioned to above optimum, and placed in loose lifts not exceeding 8 inches. If heavy compaction equipment is used, the walls should be appropriately temporarily braced, as the situation requires. If backfill consists entirely of drainrock, it should be placed in approximately 2-foot lifts and should be compacted with several passes of a vibratory plate compactor.

We recommend that annual maintenance of retaining wall backdrain systems be performed. This maintenance should include: 1) inspection and flushing to make sure that subdrain pipes are free of debris and are in good working order; and 2) inspection of subdrain outfall locations to verify that introduced water flows freely through the discharge pipes and that no excessive erosion has occurred. If erosion is detected, we should be contacted to evaluate its extent and to provide mitigation recommendations, if needed.

Concrete Slabs-On-Grade

It is anticipated that concrete slabs-on-grade may be used for to replace the slab-on-grade floor portions of the Cook House, Carriage House, and basement of the Mansion. We recommend that slabs-on-grade be supported on a minimum of 6 inches of Class 2 aggregate baserock compacted to 95 percent relative compaction[5]. Building slabs-on-grade should be supported on a moisture barrier as described subsequently. Exterior slabs-on-grade should be underlain by 4 inches of Class 2 baserock.

Where water vapor transmission through the floor slab is undesirable, we recommend a capillary moisture break and a water vapor retarder be installed beneath the floor. A capillary moisture break and vapor retarder are generally not required below parking slabs-on-grade because there is sufficient air circulation to limit condensation of moisture on the slab surface; therefore a capillary moisture break and vapor retarder may be omitted for the Carriage House. A capillary moisture break consists of at least four inches of clean, free-draining gravel or crushed rock. The vapor retarder should meet the requirements for Class C vapor retarders stated in ASTM E1745-97. The vapor retarder should be placed in accordance with the requirements of ASTM E1643-98. These requirements include overlapping seams by six inches, taping seams, and sealing penetrations in the vapor retarder. The vapor retarder should be covered with two inches of sand to aid in curing the concrete and to protect the vapor retarder during slab construction. The particle size of the gravel/crushed rock and sand should meet the gradation requirements presented in Table 5.

5 Relative compaction refers to the in-place dry density of soil expressed as a percentage of the maximum dry density of the same material, as determined by the ASTM D1557-12 laboratory compaction procedure.

TABLE 5
Gradation Requirements for Capillary Moisture Break

Sieve Size	Percentage Passing Sieve
Gravel or Crushed Rock	
1 inch	90 – 100
3/4 inch	30 – 100
1/2 inch	5 – 25
3/8 inch	0 – 6
Sand	
No. 4	100
No. 200	0-5

The sand overlying the membrane should be dry at the time concrete is placed. Excess water trapped in the sand could eventually be transmitted as vapor through the slab. If the sand becomes wet, concrete should not be placed until the sand has been dried or replaced.

Concrete mixes with high water/cement (w/c) ratios result in excess water in the concrete, which increases the cure time and results in excessive vapor transmission through the slab. Therefore, concrete for the floor slab should have a w/c ratio less than 0.50. If approved by the project structural engineer, the sand can be eliminated and the concrete can be placed directly over the vapor retarder, provided the w/c ratio of the concrete does not exceed 0.45 and water is not added in the field. If necessary, workability should be increased by adding plasticizers. In addition, the slab should be properly cured.

Before any floor covering is placed, the contractor should check that the concrete surface and the moisture emission levels (if emission testing is required) meet the manufacturer's requirements.

Prior to placement of the aggregate base or the capillary break, the upper six inches of subgrade soil should be scarified, moisture-conditioned to above optimum moisture content, and compacted to at least 90 percent relative compaction. Subgrade areas disturbed by the proposed improvements should be re-rolled. Loose, disturbed materials should be excavated, removed, and replaced with engineered fill during final subgrade preparation. We understand that only portions of the slabs may be replaced, and hence the moisture and vapor barriers may not be as effective as a system that is placed under an entire slab.

FUTURE GEOTECHNICAL SERVICES

If remedial measures such as new foundation elements, retaining walls, or replacement concrete slabs-on-grade are planned, prior to construction, we should review the project plans and specifications to check their conformance with the intent of our recommendations. During construction, we should observe any excavation, grading, utility trench backfill, and foundation installation. These observations will allow us to compare the actual with the anticipated subsurface conditions and check that the contractor's work conforms to the geotechnical aspects of the plans and specifications.

LIMITATIONS

Our conclusions and recommendations result from limited engineering studies and are based on our interpretation of the geotechnical conditions existing at the site at the time of investigation. Actual subsurface conditions may vary. If any variations or undesirable conditions are encountered during construction, or if any remedial construction will use different foundation types or involve site grading, Treadwell & Rollo, A Langan Company should be notified to make supplemental recommendations, as necessary.

We appreciate the opportunity to work with you on this project. If you have any questions, please call.

Sincerely yours,
TREADWELL & ROLLO, A LANGAN COMPANY

Chris Hundemer
Certified Engineering Geologist #2314
Senior Project Manager

John Gouchon
Geotechnical Engineer #2282
Principal

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Attachments:
- Figures 1a through 1c – Site Plans for Mansion, Carriage House, and Cook House
- Figure 2 – Site Location Map
- Figure 3 – Local Geologic Map
- Figure 4 – Local Geologic Hazards Map
- Figure 5 – Bay Area Fault Map
- Figure 6 – Modified Mercalli Scale
- Figure 7 – Regional Seismic Hazards Map
- Figures A-1 through A-5 – Logs of Test Pits TP-1 through TP-5
- Figure A-6 – Soil Classification Chart

REFERENCES

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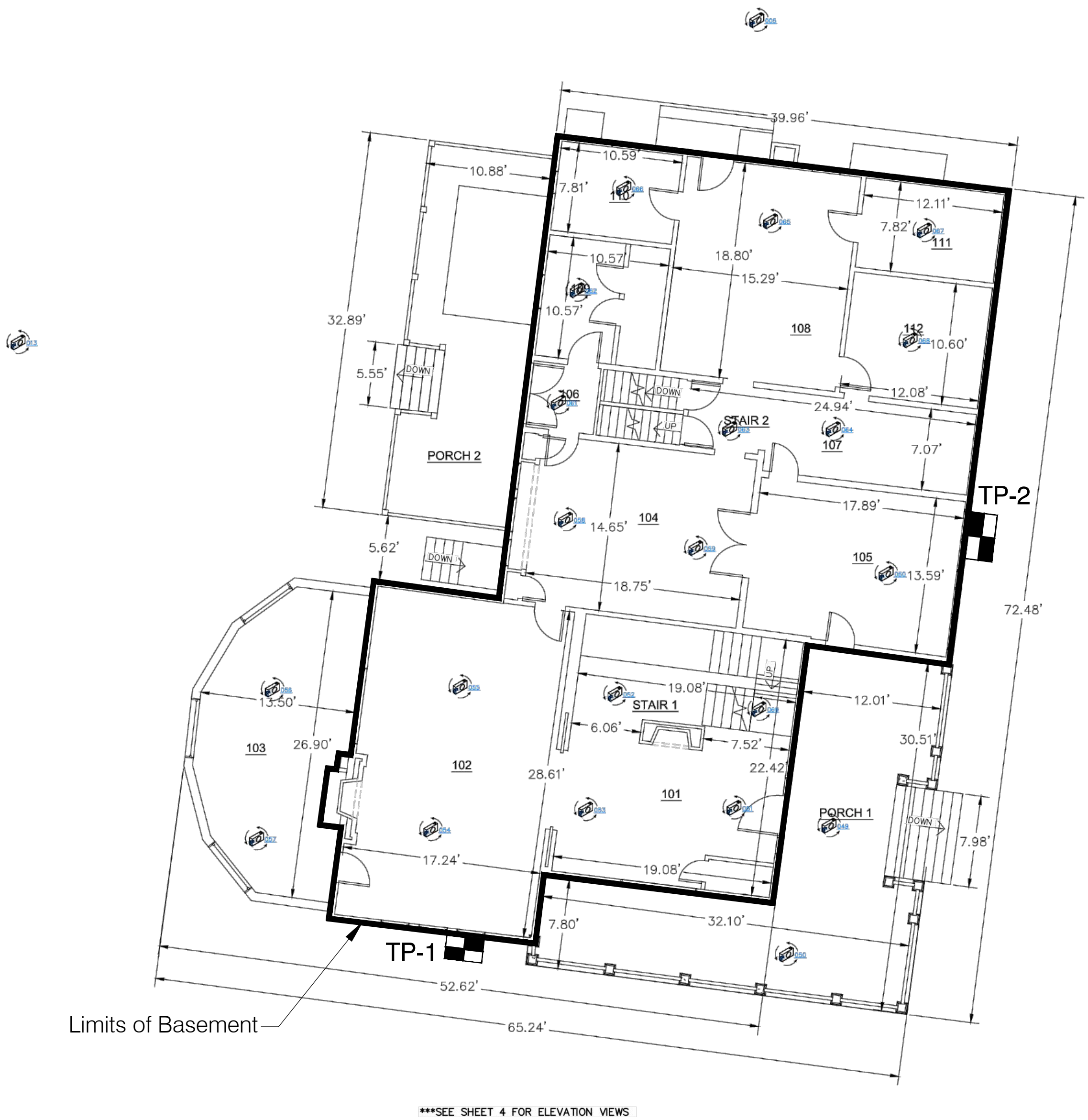
FIGURES



EXPLANATION

TP-1 Approximate location of Test Pit by Treadwell & Rollo, May 1 2013

0 16 Feet

Approximate scale

Reference: Base map from a drawing titled "Historic Mansion Floor 1, Plan View" Sheet 2 of 6, by NV5 Beyond Engineering, dated 04-18-2013.

HAWTHORNS HISTORIC STRUCTURES ASSESSMENT
Portola Valley, California

Treadwell&Rollo
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SITE PLAN FOR MANSION

Date 06/13/13	Project No. 770608301	Figure 1a

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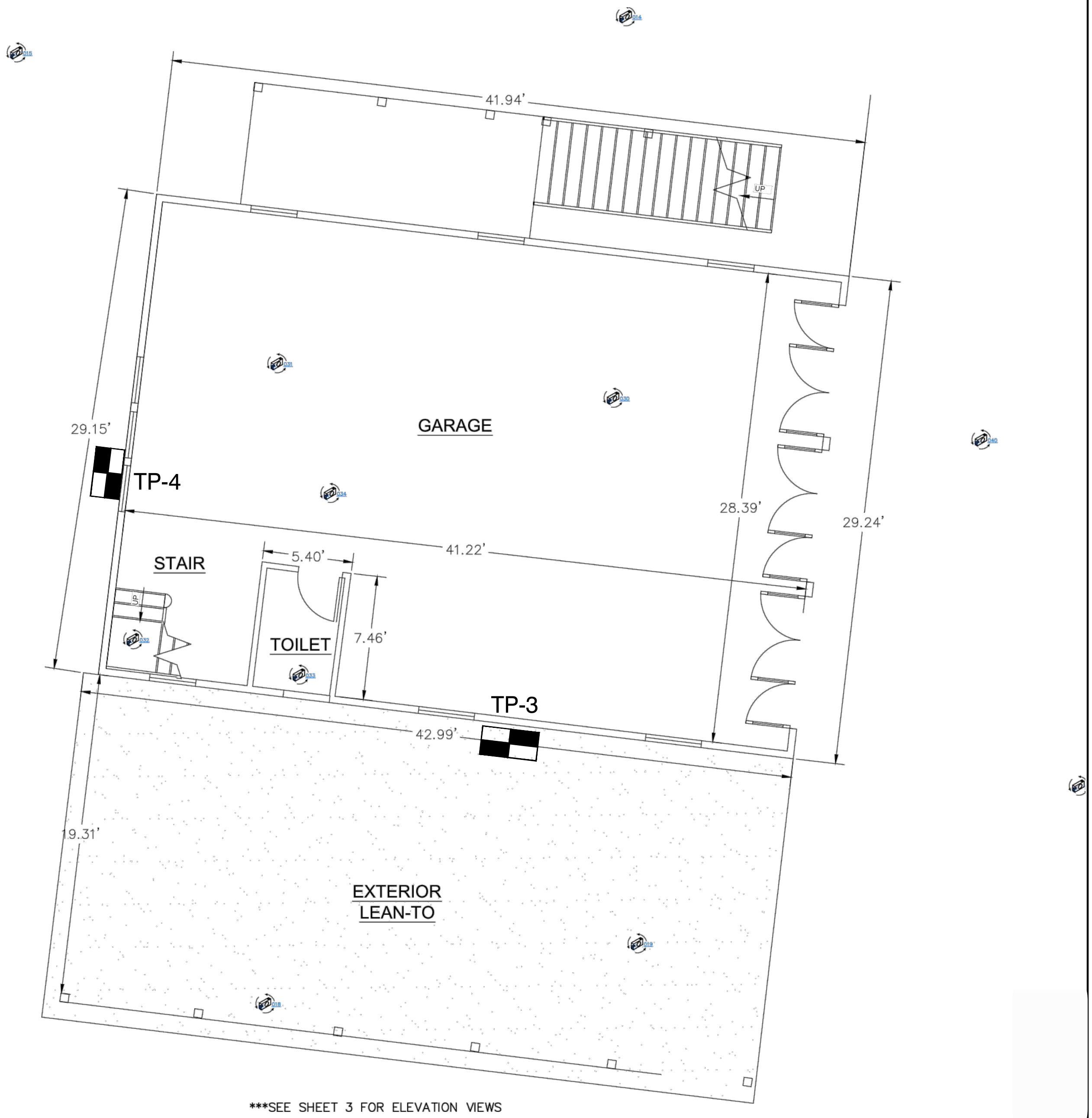

EXPLANATION

TP-3 — Approximate location of Test Pit by Treadwell & Rollo, May 1 2013

0 — 10 Feet
Approximate scale

Reference: Base map from a drawing titled "Historic Garage Floor 1, Plan View" Sheet 1 of 3, by NV5 Beyond Engineering, dated 04-18-2013.

HAWTHORNS HISTORIC STRUCTURES ASSESSMENT
Portola Valley, California

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SITE PLAN CARRIAGE HOUSE

Date 06/13/13	Project No. 770608301	Figure 1b

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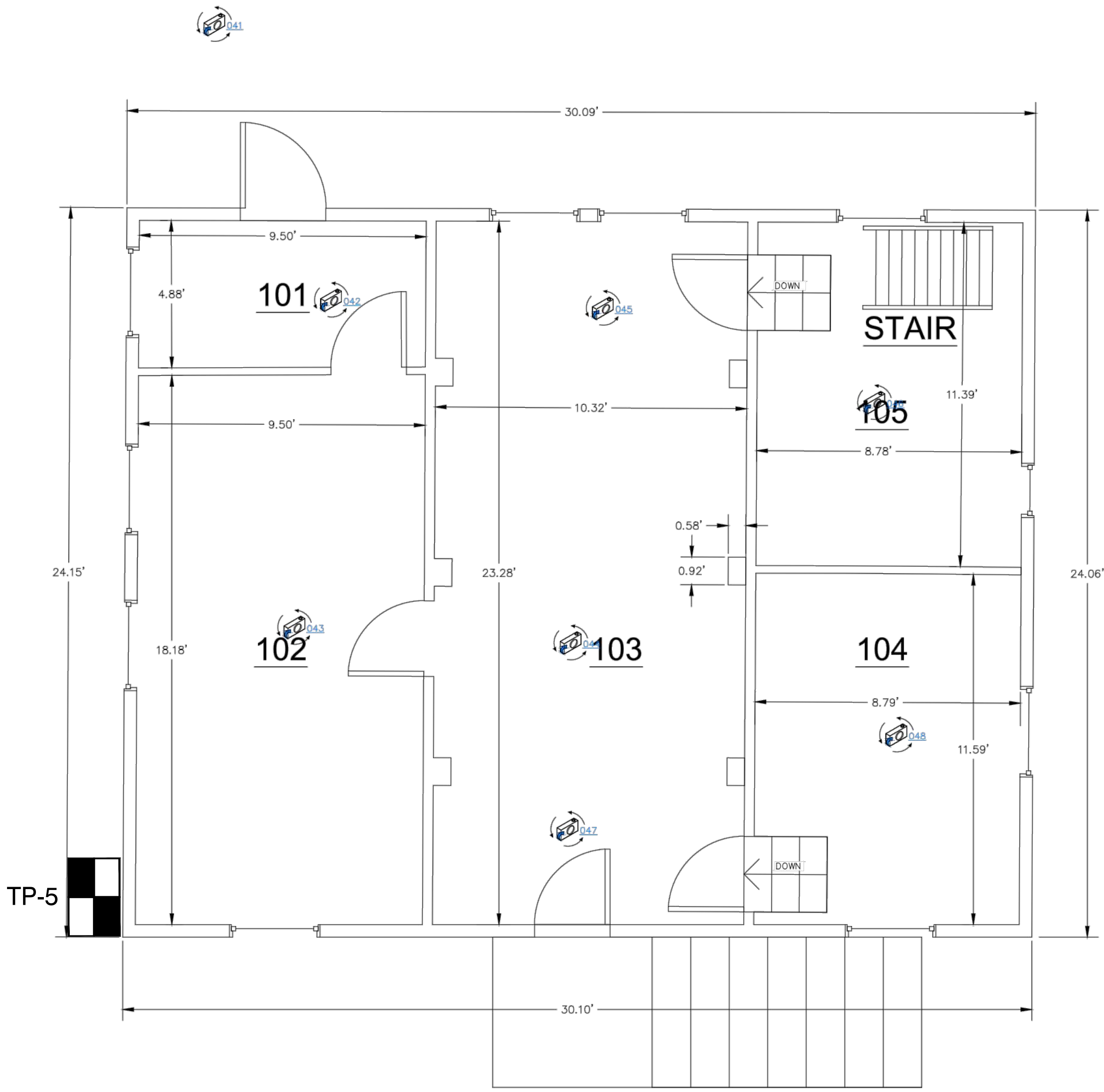

***SEE SHEET 2 FOR ELEVATION VIEWS

***ALL PANORAMIC CAMERA ICONS OUTSIDE OF THE BUILDING ARE NOT IN THEIR CORRECT LOCATIONS. THEY WERE PLACED CLOSER TO THE BUILDING TO

EXPLANATION

TP-5 Approximate location of Test Pit by Treadwell & Rollo, May 1 2013

0 6 Feet

Approximate scale

Reference: Base map from a drawing titled "Historic Cook Building Floor 1, Plan View" Sheet 1 of 3, by NV5 Beyond Engineering, dated 04-18-2013.

HAWTHORNS HISTORIC STRUCTURES ASSESSMENT
Portola Valley, California

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SITE PLAN FOR COOK BUILDING

Date 06/13/13	Project No. 770608301	Figure 1c

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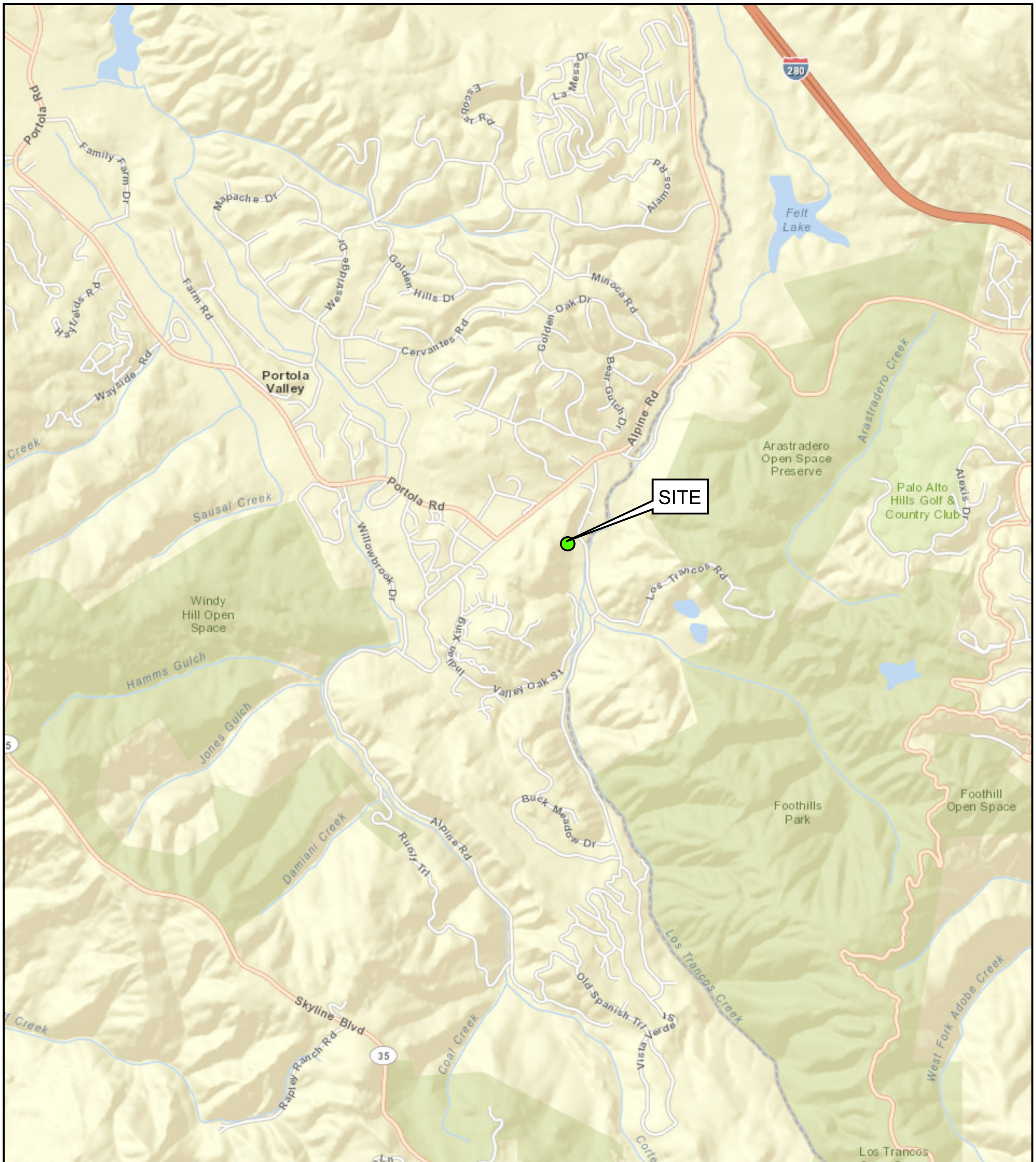

NOTES:

World street basemap is provided through Langan's Esri ArcGIS software licensing and ArcGIS online.
Credits: Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN.

0 2,000 4,000
Feet

N
W E
S

HAWTHORNS HISTORIC STRUCTURES ASSESSMENT Portola Valley, California	**SITE LOCATION MAP**
Treadwell&Rollo *A LANGAN COMPANY*	Date 6/17/2013 | Project No. 770608301 | Figure 2

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EXPLANATION

EARTH MATERIALS

Surficial Deposits

Pleistocene and Holocene

- Qal — alluvium
- Qsw — slope wash

Landslide Deposits

- Als — active landslide
- Dls — dormant landslide
- Rls — recent landslide
- Ols — old landslide
- Qls — Quaternary landslide

Bedrock Units

Pliocene

- Qsc — Santa Clara Formation
- Tp — Purissima Formation

Miocene

- Tm — Monterey Formation
- Tls — Ladera sandstone
- Tb — basalt and diabase

Oligocene

- Tl — Lambert shale
- Tv — Vaqueros sandstone
- Tsl — San Lorenzo Formation

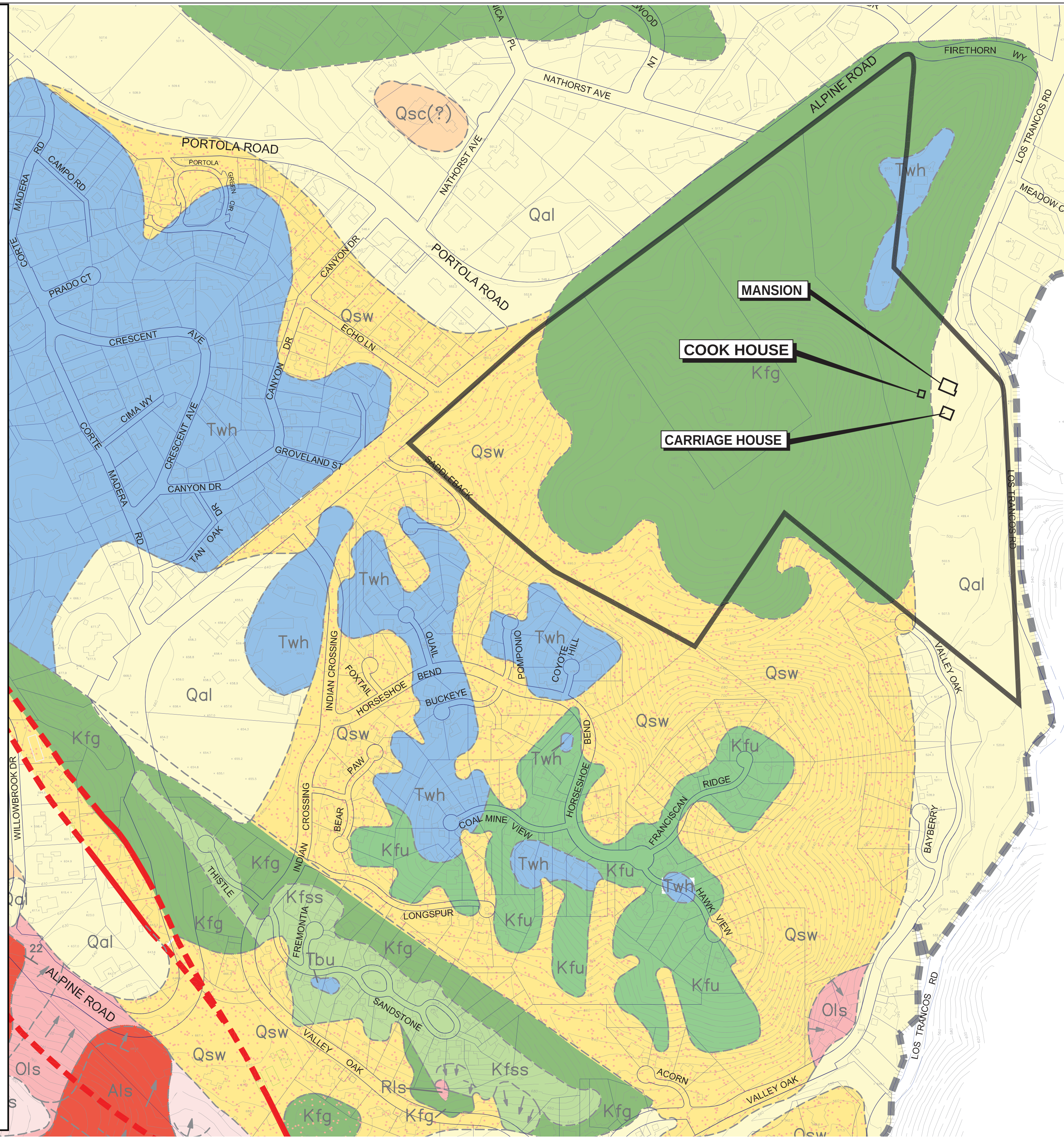
Eocene

- Twh — Whiskey Hill Formation
- Tbu — Butano Formation sandstone
- Tbs — Butano Formation shale

Franciscan Complex

Jurassic/Cretaceous

- Kfss — graywacke sandstone
- Kfg — greenstone
- Kfc — chert
- Ksp — serpentinite
- Kfu — Franciscan Complex undifferentiated



MAP SYMBOLS

- Geologic contact between earth materials (bedrock and surficial deposits, dashed where approximate, dotted where concealed)
- Traces of the San Andreas fault, dashed where approximate. En-echelon rupture behavior depicted by series of diagonal slashes.
- Fault (other than San Andreas) of undetermined activity, dashed where approximate, barbs are located on upthrown side of fault.
- Inactive Fault
- Strike and dip of fault plane
- Strike and dip of stratification
- Strike of vertical stratification
- Horizontal stratification
- Strike and dip of overturned stratification
- Strike and dip direction of fracture surface
- Strike of vertical fracture
- Boundary of landslide deposit, arrows show direction of movement
- Trace of axial plane of syncline
- Trace of axial plane of anticline

HAWTHORNS HISTORIC STRUCTURES ASSESSMENT
Portola Valley, California

LOCAL GEOLOGIC MAP

Date 06/13/13	Project No. 770608301	Figure 3

Treadwell&Rollo
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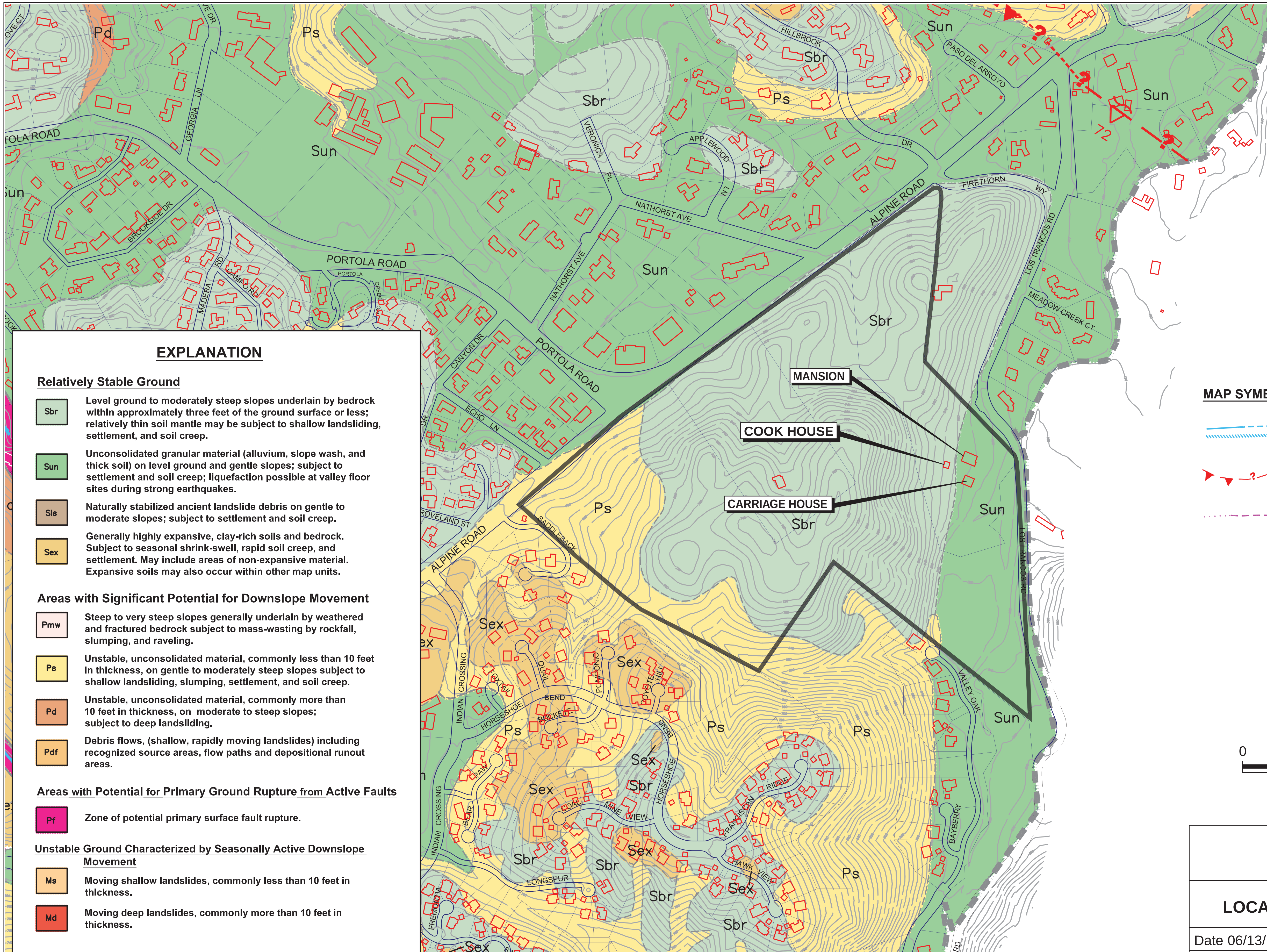
Reference: Base map from a drawing titled "Geologic Map, Town of Portola Valley, San Mateo County, California" by Cotton, Shires and Associates, Inc., dated September 2010.



EXPLANATION

Relatively Stable Ground

Sbr	Level ground to moderately steep slopes underlain by bedrock within approximately three feet of the ground surface or less; relatively thin soil mantle may be subject to shallow landsliding, settlement, and soil creep.
Sun	Unconsolidated granular material (alluvium, slope wash, and thick soil) on level ground and gentle slopes; subject to settlement and soil creep; liquefaction possible at valley floor sites during strong earthquakes.
Sls	Naturally stabilized ancient landslide debris on gentle to moderate slopes; subject to settlement and soil creep.
Sex	Generally highly expansive, clay-rich soils and bedrock. Subject to seasonal shrink-swell, rapid soil creep, and settlement. May include areas of non-expansive material. Expansive soils may also occur within other map units.

Areas with Significant Potential for Downslope Movement

Pmw	Steep to very steep slopes generally underlain by weathered and fractured bedrock subject to mass-wasting by rockfall, slumping, and raveling.
Ps	Unstable, unconsolidated material, commonly less than 10 feet in thickness, on gentle to moderately steep slopes subject to shallow landsliding, slumping, settlement, and soil creep.
Pd	Unstable, unconsolidated material, commonly more than 10 feet in thickness, on moderate to steep slopes; subject to deep landsliding.
Pdf	Debris flows, (shallow, rapidly moving landslides) including recognized source areas, flow paths and depositional runout areas.

Areas with Potential for Primary Ground Rupture from Active Faults

Pf	Zone of potential primary surface fault rupture.

Unstable Ground Characterized by Seasonally Active Downslope Movement

Ms	Moving shallow landslides, commonly less than 10 feet in thickness.
Md	Moving deep landslides, commonly more than 10 feet in thickness.

MAP SYMBOLS

Traces of the San Andreas fault, dashed where approximate. En-echelon rupture behavior depicted by series of diagonal slashes.

Fault (other than San Andreas) of undetermined activity, dashed where approximate, barbs are located on upthrown side of fault

Inactive Fault

0 500 1000 Feet

Approximate scale

Reference: Base map from a drawing titled "Ground Movement Potential Map, Town of Portola Valley, San Mateo County, California" by Cotton, Shires and Associates, Inc., dated September 2010.

HAWTHORNS HISTORIC STRUCTURES ASSESSMENT
Portola Valley, California

LOCAL GEOLOGIC HAZARDS MAP

Date 06/13/13	Project No. 770608301	Figure 4

Treadwell&Rollo
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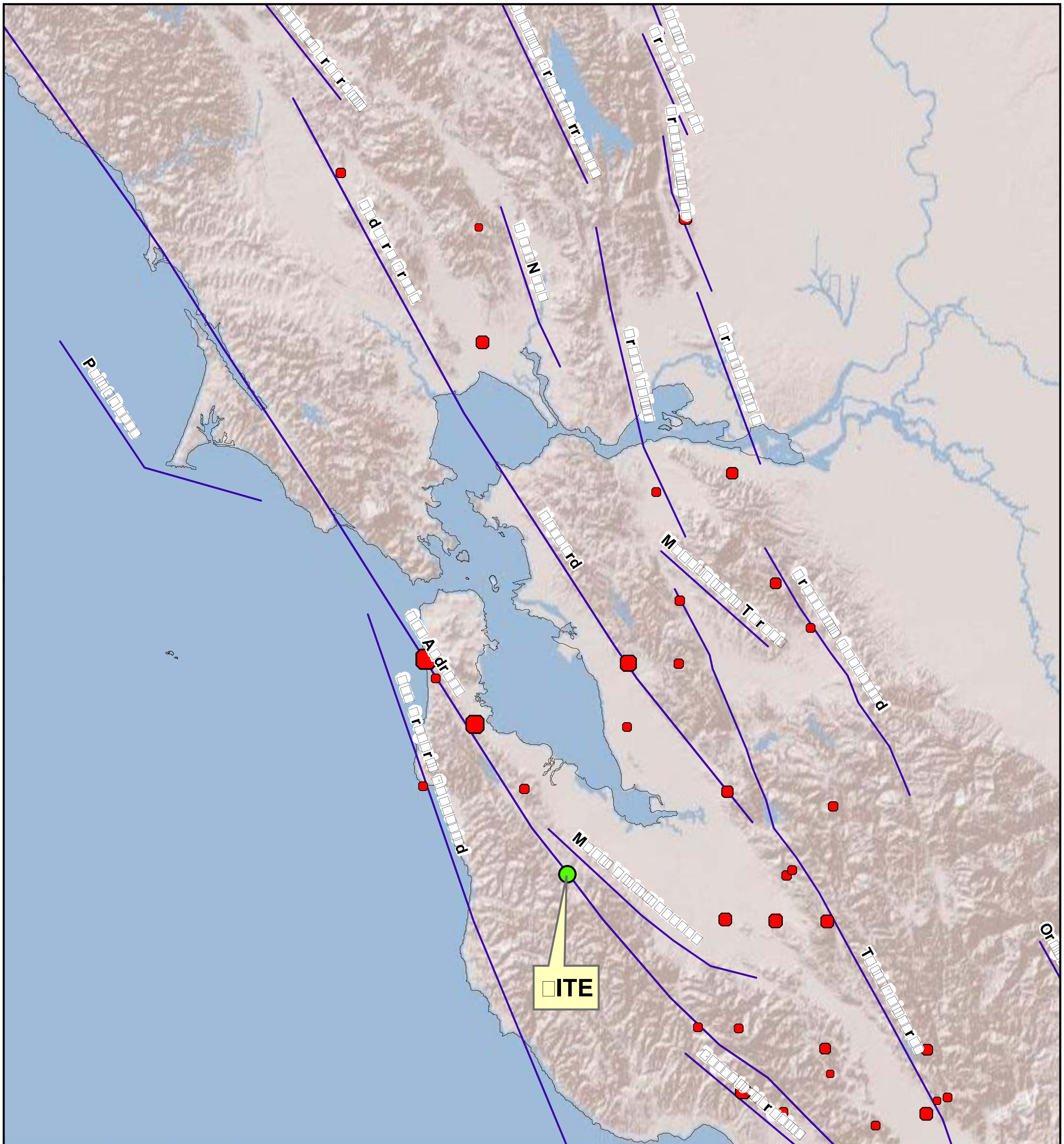

Legend

- Earthquake Epicenter - Magnitude 5
- Earthquake Epicenter - Magnitude 6
- Earthquake Epicenter - Magnitude 7
- Earthquake Epicenter - Magnitude 8

NOTES:

1. Digitized data for fault coordinates and earthquake catalog was developed by the California Geological Survey. The historic earthquake catalog includes events from January 1800 to December 2000.

0 10 20
Miles

N W E S

HAWTHORNS HISTORIC STRUCTURES ASSESSMENT Portola Valley, California	**MAP OF MAJOR FAULTS AND EARTHQUAKE EPICENTERS IN THE SAN FRANCISCO BAY AREA**
Treadwell&Rollo A LANGAN COMPANY	Date 06/17/13 | Project No. 770608301 | Figure 5

I	**Not felt by people, except under especially favorable circumstances. However, dizziness or nausea may be experienced.** Sometimes birds and animals are uneasy or disturbed. Trees, structures, liquids, bodies of water may sway gently, and doors may swing very slowly.
II	**Felt indoors by a few people, especially on upper floors of multi-story buildings, and by sensitive or nervous persons.** As in Grade I, birds and animals are disturbed, and trees, structures, liquids and bodies of water may sway. Hanging objects swing, especially if they are delicately suspended.
III	**Felt indoors by several people, usually as a rapid vibration that may not be recognized as an earthquake at first. Vibration is similar to that of a light, or lightly loaded trucks, or heavy trucks some distance away. Duration may be estimated in some cases.** Movements may be appreciable on upper levels of tall structures. Standing motor cars may rock slightly.
IV	**Felt indoors by many, outdoors by a few. Awakens a few individuals, particularly light sleepers, but frightens no one except those apprehensive from previous experience. Vibration like that due to passing of heavy, or heavily loaded trucks. Sensation like a heavy body striking building, or the falling of heavy objects inside.** Dishes, windows and doors rattle; glassware and crockery clink and clash. Walls and house frames creak, especially if intensity is in the upper range of this grade. Hanging objects often swing. Liquids in open vessels are disturbed slightly. Stationary automobiles rock noticeably.
V	**Felt indoors by practically everyone, outdoors by most people. Direction can often be estimated by those outdoors. Awakens many, or most sleepers. Frightens a few people, with slight excitement; some persons run outdoors.** Buildings tremble throughout. Dishes and glassware break to some extent. Windows crack in some cases, but not generally. Vases and small or unstable objects overturn in many instances, and a few fall. Hanging objects and doors swing generally or considerably. Pictures knock against walls, or swing out of place. Doors and shutters open or close abruptly. Pendulum clocks stop, or run fast or slow. Small objects move, and furnishings may shift to a slight extent. Small amounts of liquids spill from well-filled open containers. Trees and bushes shake slightly.
VI	**Felt by everyone, indoors and outdoors. Awakens all sleepers. Frightens many people; general excitement, and some persons run outdoors.** Persons move unsteadily. Trees and bushes shake slightly to moderately. Liquids are set in strong motion. Small bells in churches and schools ring. Poorly built buildings may be damaged. Plaster falls in small amounts. Other plaster cracks somewhat. Many dishes and glasses, and a few windows break. Knickknacks, books and pictures fall. Furniture overturns in many instances. Heavy furnishings move.
VII	**Frightens everyone. General alarm, and everyone runs outdoors.** People find it difficult to stand. Persons driving cars notice shaking. Trees and bushes shake moderately to strongly. Waves form on ponds, lakes and streams. Water is muddied. Gravel or sand stream banks cave in. Large church bells ring. Suspended objects quiver. Damage is negligible in buildings of good design and construction; slight to moderate in well-built ordinary buildings; considerable in poorly built or badly designed buildings, adobe houses, old walls (especially where laid up without mortar), spires, etc. Plaster and some stucco fall. Many windows and some furniture break. Loosened brickwork and tiles shake down. Weak chimneys break at the roofline. Cornices fall from towers and high buildings. Bricks and stones are dislodged. Heavy furniture overturns. Concrete irrigation ditches are considerably damaged.
VIII	**General fright, and alarm approaches panic.** Persons driving cars are disturbed. Trees shake strongly, and branches and trunks break off (especially palm trees). Sand and mud erupts in small amounts. Flow of springs and wells is temporarily and sometimes permanently changed. Dry wells renew flow. Temperatures of spring and well waters varies. Damage slight in brick structures built especially to withstand earthquakes; considerable in ordinary substantial buildings, with some partial collapse; heavy in some wooden houses, with some tumbling down. Panel walls break away in frame structures. Decayed pilings break off. Walls fall. Solid stone walls crack and break seriously. Wet grounds and steep slopes crack to some extent. Chimneys, columns, monuments and factory stacks and towers twist and fall. Very heavy furniture moves conspicuously or overturns.
IX	**Panic is general.** Ground cracks conspicuously. Damage is considerable in masonry structures built especially to withstand earthquakes; great in other masonry buildings - some collapse in large part. Some wood frame houses built especially to withstand earthquakes are thrown out of plumb, others are shifted wholly off foundations. Reservoirs are seriously damaged and underground pipes sometimes break.
X	**Panic is general.** Ground, especially when loose and wet, cracks up to widths of several inches; fissures up to a yard in width run parallel to canal and stream banks. Landsliding is considerable from river banks and steep coasts. Sand and mud shifts horizontally on beaches and flat land. Water level changes in wells. Water is thrown on banks of canals, lakes, rivers, etc. Dams, dikes, embankments are seriously damaged. Well-built wooden structures and bridges are severely damaged, and some collapse. Dangerous cracks develop in excellent brick walls. Most masonry and frame structures, and their foundations are destroyed. Railroad rails bend slightly. Pipe lines buried in earth tear apart or are crushed endwise. Open cracks and broad wavy folds open in cement pavements and asphalt road surfaces.
XI	**Panic is general.** Disturbances in ground are many and widespread, varying with the ground material. Broad fissures, earth slumps, and land slips develop in soft, wet ground. Water charged with sand and mud is ejected in large amounts. Sea waves of significant magnitude may develop. Damage is severe to wood frame structures, especially near shock centers, great to dams, dikes and embankments, even at long distances. Few if any masonry structures remain standing. Supporting piers or pillars of large, well-built bridges are wrecked. Wooden bridges that "give" are less affected. Railroad rails bend greatly and some thrust endwise. Pipe lines buried in earth are put completely out of service.
XII	**Panic is general.** Damage is total, and practically all works of construction are damaged greatly or destroyed. Disturbances in the ground are great and varied, and numerous shearing cracks develop. Landslides, rock falls, and slumps in river banks are numerous and extensive. Large rock masses are wrenched loose and torn off. Fault slips develop in firm rock, and horizontal and vertical offset displacements are notable. Water channels, both surface and underground, are disturbed and modified greatly. Lakes are dammed, new waterfalls are produced, rivers are deflected, etc. Surface waves are seen on ground surfaces. Lines of sight and level are distorted. Objects are thrown upward into the air.

HAWTHORNS HISTORIC STRUCTURES ASSESSMENT
Portola Valley, California

Treadwell&Rollo
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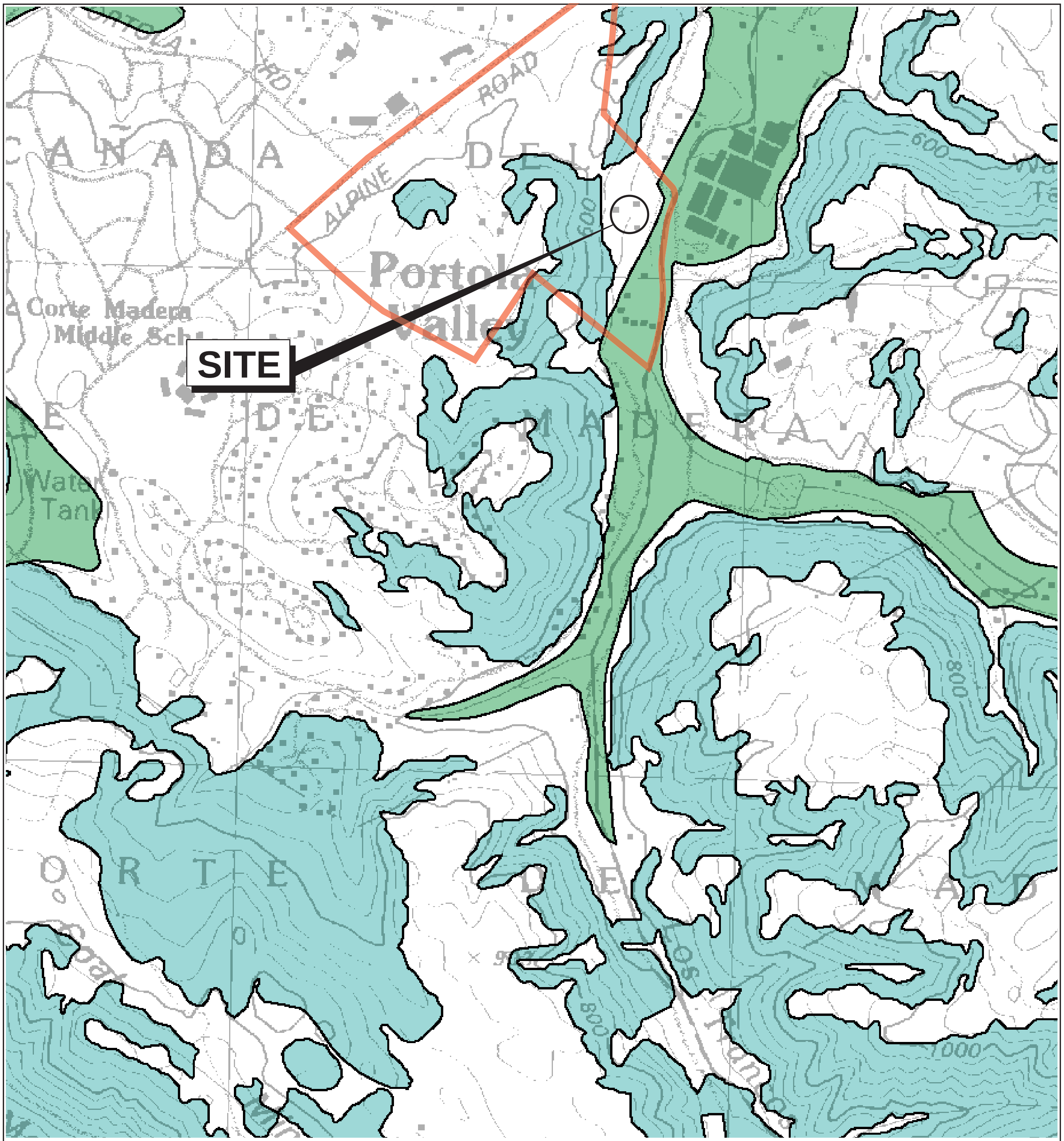
MODIFIED MERCALLI INTENSITY SCALE

Date 06/17/13	Project No. 770608301	Figure 6



EXPLANATION

Liquefaction; Areas where historic occurence of liquefaction, or local topographic, geological, geotechnical, and groundwater conditions indicate a potential for permanent ground displacement such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

Earthquake-Induced Landslides; Areas where previous occurence of landslide movement, or local topographic, geological, geotechnical, and subsurface water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

0 1,000 2,000 Feet

Approximate scale

Reference:
State of California "Seismic Hazard Zones"
Mindego Hill Quadrangle
Released on August 11, 2005

HAWTHORNS HISTORIC STRUCTURES ASSESSMENT
Portola Valley, California

Treadwell&Rollo
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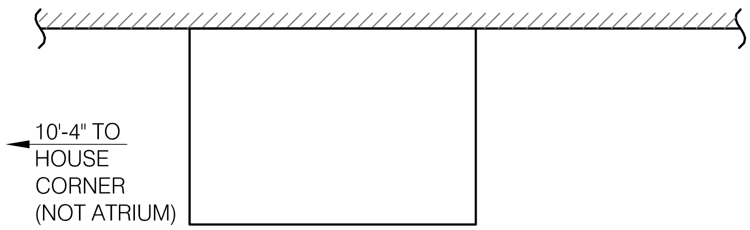
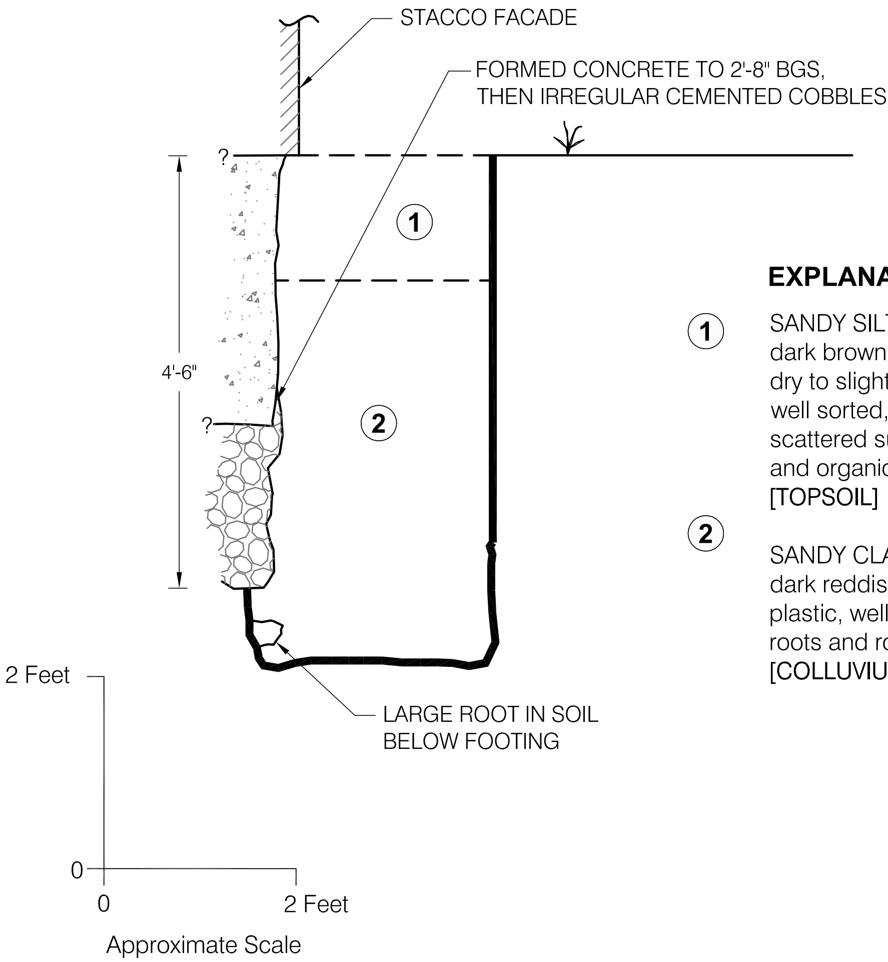
REGIONAL SEISMIC HAZARDS MAP

Date 06/17/13	Project No. 770608301	Figure 7

PLAN VIEW



SECTION VIEW



EXPLANATION

1 SANDY SILT (ML)
dark brown to dark grayish brown, homogeneous, dry to slightly moist, medium stiff, non-plastic, well sorted, fine to very fine grained, sand with scattered subrounded gravels, abundant of roots and organics
[TOPSOIL]

2 SANDY CLAY (CL)
dark reddish brown, slighlty moist, stiff, slightly plastic, well sorted, fine to medium grained, trace roots and rootlets
[COLLUVIUM]

HAWTHORNS HISTORIC STRUCTURES ASSESSMENT
Portola Valley, California

Treadwell&Rollo
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LOG OF TEST PIT TP-1

Date 06/13/13	Project No. 770608301	Figure A-1

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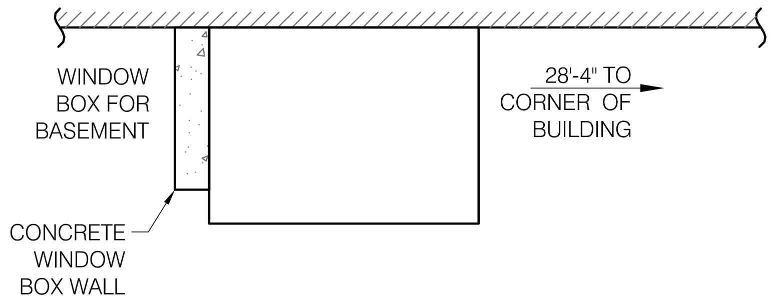
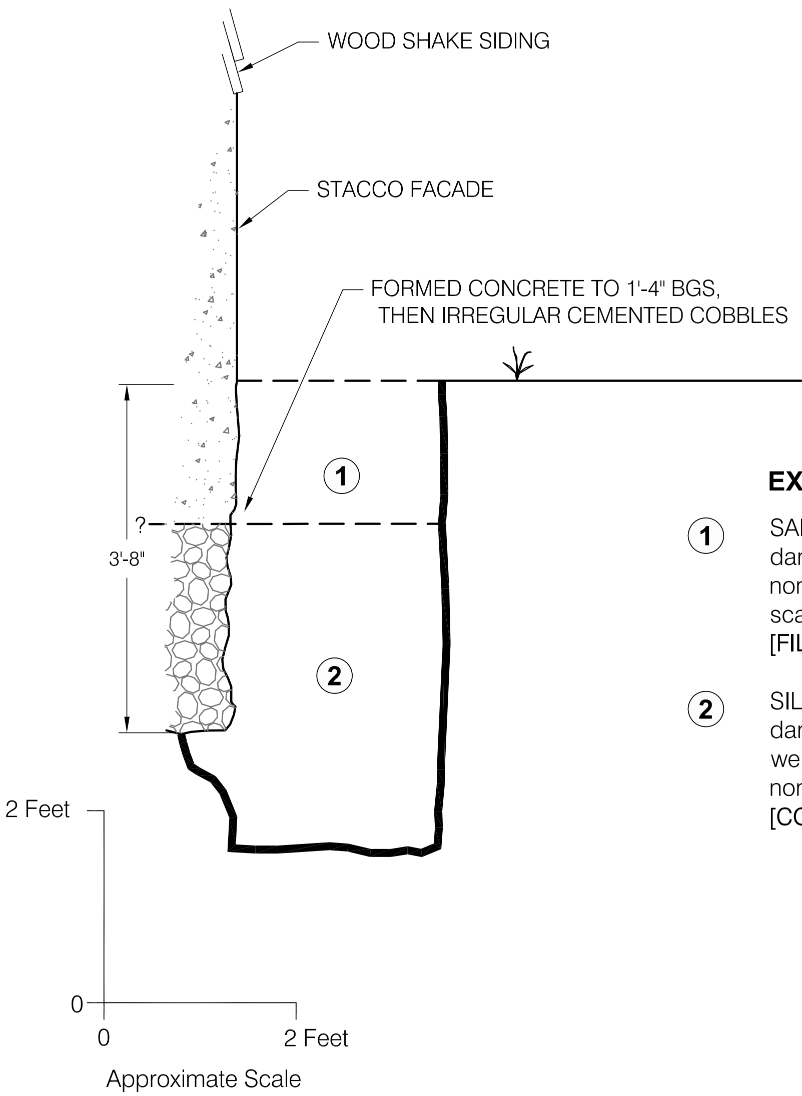
PLAN VIEW



SECTION VIEW



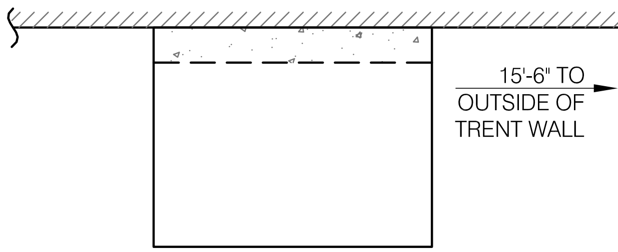
EXPLANATION

1 SANDY SILT with GRAVEL (ML)
dark brown, slightly moist, medium stiff, non-plastic, abundant roots and rootlets, scattered gravel and debris
[FILL]

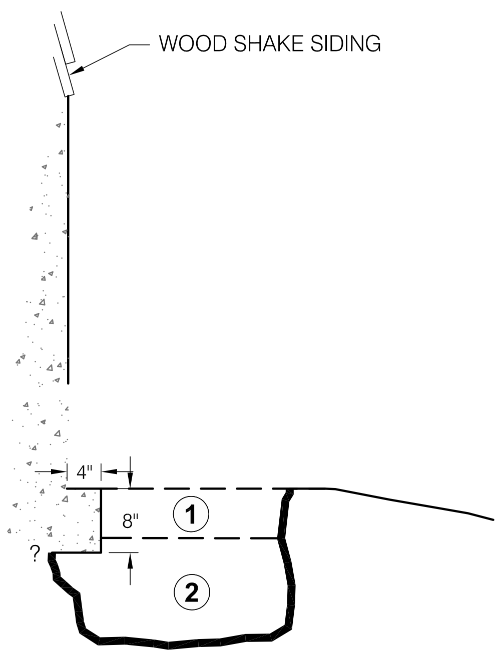
2 SILTY SAND (SM)
dark yellowish brown, slightly moist, very dense, well sorted, fine- to medium-grained, subrounded, non-plastic, scattered roots
[COLLUVIUM]

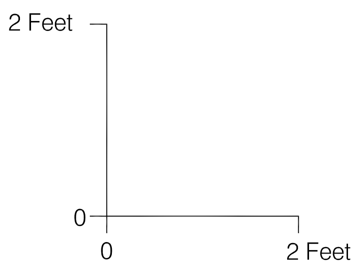
HAWTHORNS HISTORIC STRUCTURES ASSESSMENT Portola Valley, California	**LOG OF TEST PIT** **TP-2**
Treadwell&Rollo A LANGAN COMPANY	Date 06/13/13 · Project No. 770608301 · Figure A-2

PLAN VIEW



SECTION VIEW





Approximate Scale

EXPLANATION

1. SANDY SILT (ML)
grayish brown, dry to slightly moist, medium stiff to stiff, scattered roots and debris
[FILL]

2. SANDY SILT (ML)
brown to dark brown, moist, stiff, well sorted, very fine- to fine-grained, scattered rootlets
[COLLUVIUM]

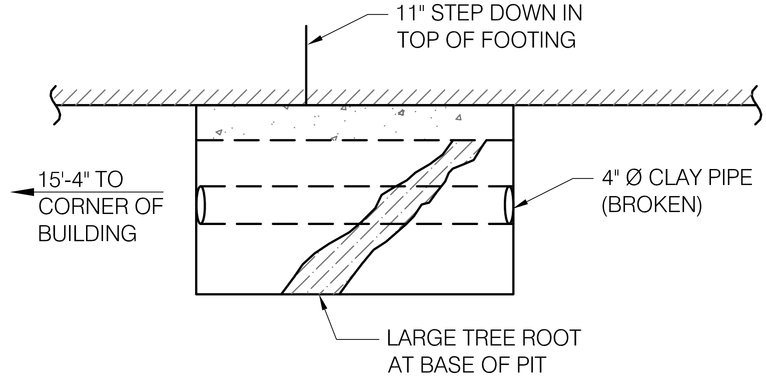
HAWTHORNS HISTORIC STRUCTURES ASSESSMENT
Portola Valley, California

Treadwell&Rollo
A LANGAN COMPANY

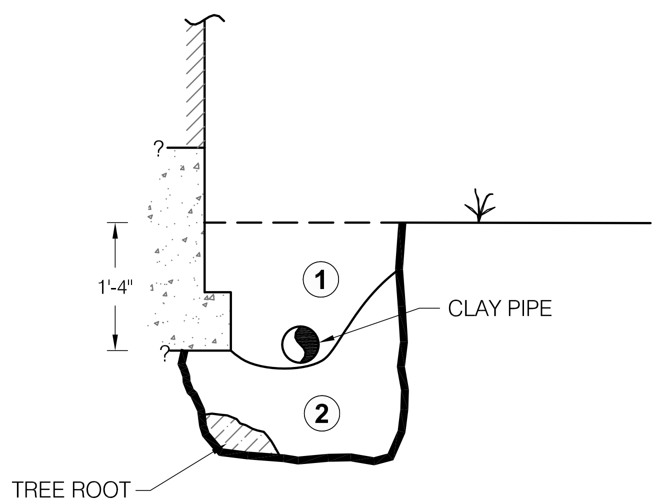
LOG OF TEST PIT
TP-3

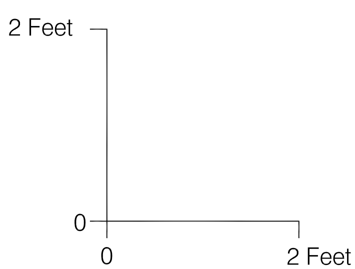
Date 06/13/13	Project No. 770608301	Figure A-3

PLAN VIEW



SECTION VIEW





Approximate Scale

EXPLANATION

1 SANDY SILT with GRAVEL (ML)
grayish brown, dry to slightly moist, medium stiff to stiff, scattered roots and debris, scattered gravel (drainage) at base of units
[FILL]

2 SANDY SILT (ML)
brown to dark brown, moist, stiff, well sorted, very fine- to fine-grained, scattered rootlets
[COLLUVIUM]

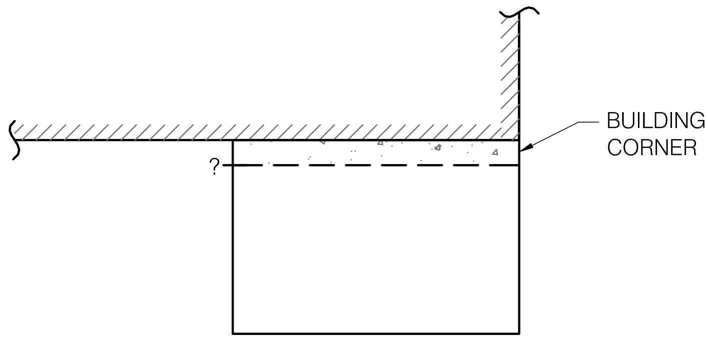
HAWTHORNS HISTORIC STRUCTURES ASSESSMENT
Portola Valley, California

Treadwell&Rollo
A LANGAN COMPANY

LOG OF TEST PIT
TP-4

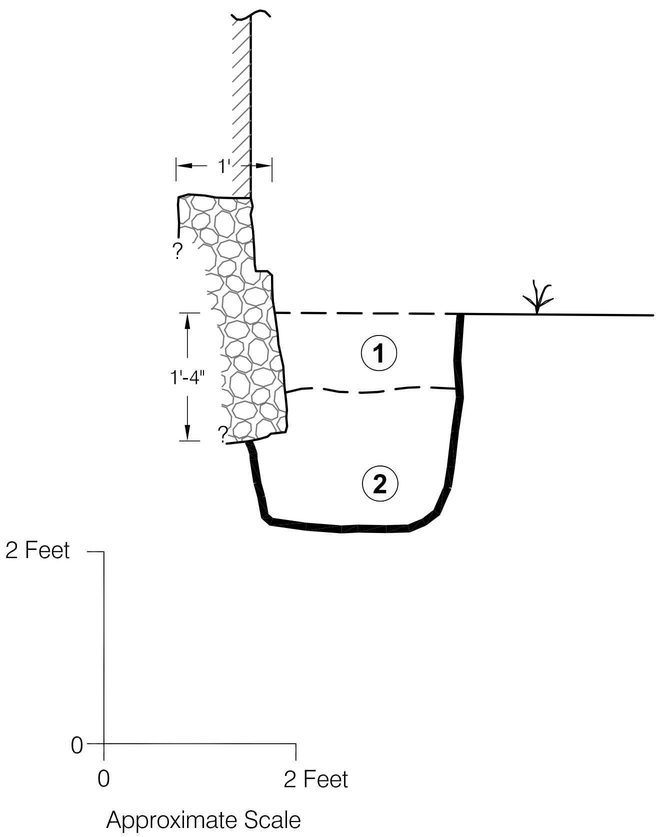
Date 06/13/13	Project No. 770608301	Figure A-4

PLAN VIEW



Footing = cement cobbles 3/8" to 4" diameter, locally cracked in many places, some roots growing into footing with/in soil in-filled clacks up to 1" wide

SECTION VIEW



EXPLANATION

1. SILTY SAND (SM)
   dark brown, slightly moist, loose, fine- to medium-grained sand, abundant roots and decaying organics
   [TOPSOIL]

2. SILTY SAND (SM)
   dark yellowish brown, slightly moist, very dense, well sorted, fine- to medium-grained, subrounded, non-plastic, homogeneous, scattered roots
   [COLLUVIUM]

HAWTHORNS HISTORIC STRUCTURES ASSESSMENT
Portola Valley, California

Treadwell&Rollo
A LANGAN COMPANY

LOG OF TEST PIT
TP-5

Date 06/13/13	Project No. 770608301	Figure A-5

UNIFIED SOIL CLASSIFICATION SYSTEM

Major Divisions		Symbols	Typical Names
Coarse-Grained Soils (more than half of soil > no. 200 sieve size	Gravels (More than half of coarse fraction > no. 4 sieve size)	GW	Well-graded gravels or gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
	Sands (More than half of coarse fraction < no. 4 sieve size)	SW	Well-graded sands or gravelly sands, little or no fines
		SP	Poorly-graded sands or gravelly sands, little or no fines
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
Fine -Grained Soils (more than half of soil < no. 200 sieve size)	Silts and Clays LL = < 50	ML	Inorganic silts and clayey silts of low plasticity, sandy silts, gravelly silts
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clays
		OL	Organic silts and organic silt-clays of low plasticity
	Silts and Clays LL = > 50	MH	Inorganic silts of high plasticity
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic silts and clays of high plasticity
Highly Organic Soils		PT	Peat and other highly organic soils

GRAIN SIZE CHART

Classification	Range of Grain Sizes	
	U.S. Standard Sieve Size	Grain Size in Millimeters
Boulders	Above 12"	Above 305
Cobbles	12" to 3"	305 to 76.2
Gravel	3" to No. 4	76.2 to 4.76
coarse	3" to 3/4"	76.2 to 19.1
fine	3/4" to No. 4	19.1 to 4.76
Sand	No. 4 to No. 200	4.76 to 0.075
coarse	No. 4 to No. 10	4.76 to 2.00
medium	No. 10 to No. 40	2.00 to 0.420
fine	No. 40 to No. 200	0.420 to 0.075
Silt and Clay	Below No. 200	Below 0.075

▽ Unstabilized groundwater level

▼ Stabilized groundwater level

SAMPLE DESIGNATIONS/SYMBOLS

- Sample taken with Sprague & Henwood split-barrel sampler with a 3.0-inch outside diameter and a 2.43-inch inside diameter. Darkened area indicates soil recovered
- Classification sample taken with Standard Penetration Test sampler
- Undisturbed sample taken with thin-walled tube
- Disturbed sample
- Sampling attempted with no recovery
- Core sample
- Analytical laboratory sample, grab groundwater
- Sample taken with Direct Push sampler
- Sonic

SAMPLER TYPE

C Core barrel

CA California split-barrel sampler with 2.5-inch outside diameter and a 1.93-inch inside diameter

D&M Dames & Moore piston sampler using 2.5-inch outside diameter, thin-walled tube

O Osterberg piston sampler using 3.0-inch outside diameter, thin-walled Shelby tube

PT Pitcher tube sampler using 3.0-inch outside diameter, thin-walled Shelby tube

S&H Sprague & Henwood split-barrel sampler with a 3.0-inch outside diameter and a 2.43-inch inside diameter

SPT Standard Penetration Test (SPT) split-barrel sampler with a 2.0-inch outside diameter and a 1.5-inch inside diameter

ST Shelby Tube (3.0-inch outside diameter, thin-walled tube) advanced with hydraulic pressure

HAWTHORNS HISTORIC STRUCTURES ASSESSMENT
Portola Valley, California

Treadwell&Rollo
A LANGAN COMPANY

CLASSIFICATION CHART

Date 06/17/13 | Project No. 770608301 | Figure A-6