GEOTEchnical Investigation
for Evaluation of
Existing Residence Foundation
at the
Overlook Drive Property
16075 Overlook Drive
Monte Sereno, California

Report Prepared for:
Midpeninsula Regional Open Space District

Report Prepared by:
GeoForensics, Inc.

February 2015
Midpeninsula Regional Open Space District
330 Distel Circle
Los Altos, CA 94022

Attention: Ms. Sue Voiss

Subject: Overlook Drive Property
16075 Overlook Drive
Monte Sereno, California
GEOTECHNICAL INVESTIGATION FOR
EVALUATION OF EXISTING RESIDENCE FOUNDATION

Dear Mr. and Mrs.:

In accordance with your authorization, we have performed a subsurface investigation into the geotechnical conditions present at the location of the proposed improvements. This report summarizes the conditions we measured and observed, and presents our evaluation of the existing foundation.

Site Description

The subject site is a gently to steeply sloping, irregularly-shaped parcel located on the south side of Overlook Drive (at the approximate location shown on Figure 1). For purposes of description in this report, it is assumed that the property faces east, with the front door on the west side of the house. The property is bounded by other developed single family residential lots to the north and west, a steep slope down to the east, and Overlook Drive to the north.

The site is currently occupied by a two-story tall, wood-framed residence situated near the center of the lot. The elevated wooden house floors are supported over an open area beneath the house. An asphalt driveway leads across the front of the house.

The ground surface in the site vicinity has an overall steep slope down towards the east (as shown on Figure 2). At the site, the ground slopes gently to steeply down towards the east. Surface gradients range from 20:1 to 2:1 (horizontal:vertical, H:V), with localized 1.5:1 slopes. During the original development of the property, it appears that up to at least 3 to 8 feet of cuts and fills were required to create the existing level driveway.

The grounds around the residence are vegetated with a variety of small to medium sized bushes and shrubs, numerous small to large trees, and various other native plants and grasses. There are wood decks to all sides of the house.
Proposed Construction

We understand that the current development for the site proposes the upgrading of the existing residence foundations. Excavation work at the site is expected to be limited to foundation excavations. No significant fill placement is anticipated as part of this work.

INVESTIGATION

Scope and Purpose

The purpose of our investigation was to determine the nature of the subsurface soil conditions so that we could provide geotechnical recommendations for the proposed foundation upgrades. In order to achieve this purpose, we have performed the following scope of work:

1 - visited the property to observe the geotechnical setting of the area to be developed;
2 - reviewed relevant published geotechnical maps;
3 - drilled two borings near the location of the proposed improvements;
4 - performed laboratory testing on collected soil samples;
5 - assessed the collected information and prepared this report.

The findings of these work items are discussed in the following sections of this report.

Site Observations

We visited the site on January 12, 2014 to observe the geotechnically relevant site conditions. During our visit, we noted the following conditions:

A - The existing house appears to be supported by wood posts over concrete piers or wood piles. The foundation system appeared to be fair condition. Many of the wood posts are cross braced. However, we observed several of the wood posts to be slightly leaning. Some of the wood posts were observed to be cracking/splitting.

B - The exterior house walls were covered with wood siding. The wood siding walls were generally in good condition.

C - We consider the drainage around the house to be fair to good. The ground surface near the house, and over much of the lot, has sufficient slope away from the house to adequately carry water away from the house. The roof downspouts discharge collected water into corrugated flexible pipe resting on grade, which extends to outfall downslope of the house.

D - The trees upslope of the house were observed to be generally straight and no hummocky terrain (to suggest any on-site landsliding or slope instabilities) around the house was observed. However, some trees downslope and to the sides of the house were observed to be slightly leaning (an indication of creep).
Geologic Map Review

We reviewed the Geologic Map of the Castle Rock Ridge Quadrangle, Santa Clara and Santa Cruz Counties, California, by T.W. Dibblee and J.A. Minch (2007), and the State of California Seismic Hazards Zone Map: Castle Rock Ridge Quadrangle Quadrangle (8/11/05). The relevant portions of the Dibblee and J.A. Minch map and State map have been reproduced in Figures 3 and 3a.

The Dibblee and Minch map indicates that the site is underlain by the Greenstone (map symbol “fg”). Dibblee and Minch describes these materials as consisting of “black, weathered dark brown, massive, amorphous, locally brecciated, interstratified or intertongued with graywacke sandstone.”

Dibblee and Minch maps Santa Clara Formation (map symbol “Qsc”) east of the site. Dibblee and Minch describe these materials as consisting of “gray to red-brown gravel/conglomerate, sandstone, and mudstone; gray to buff claystone and siltstone; cobble, pebble and boulder conglomerate of chert, greenstone, graywacke, schist, serpentinite, and limestone in a sandy matrix.”

Our subsurface exploration (see below) encountered clay and sand materials which we judged to be more consistent with the Santa Clara Formation mapping.

The Seismic Hazards Zone Map indicates the site is outside of the areas where there have been previous occurrences of landslide movement; however, the site is mapped within an area where there is a historic occurrence of earthquake induced landslides and where local topographic, local geological, geotechnical, and groundwater conditions would indicate a potential for permanent ground displacement such that mitigation, as defined in Public Resource Code Section 2693(c), would be required.

The active San Andreas Fault is mapped approximately 2 miles (3.3 km) southwest of the site, and the potentially active Monte Vista-Shannon Fault is mapped approximately 1.4 miles (2.2 km) to the northeast.

Subsurface Exploration

On January 12, 2014 we drilled two borings at the site at the locations shown on Figure 4. The borings were drilled using a Mobile B-24 truck-mounted drilling rig and a Minute Man portable drilling rig (as noted on logs) equipped with 4.0 and 3.25 inch diameter, helical flight augers, respectively. Logs of the soils encountered during drilling record our observations of the cuttings traveling up the augers and of relatively undisturbed samples collected from the base of the advancing holes. The final boring logs are based upon the field logs with occasional modifications made upon further laboratory examinations of the recovered samples and laboratory test results. The final logs are attached in Appendix A.

The relatively undisturbed samples were obtained by driving a 3.0 inch (outer diameter) Modified California Sampler and a Standard Penetration Sampler (as noted on logs) into the base of the advancing hole by repeated blows from a 140 pound (truck rig) and a 70 pound (portable rig)
hammer lifted 30 inches. On the logs, the number of blows required to drive the sampler the final 12 inches of the 18 inch drive, have been recorded as the Blow Counts. These blows have not been adjusted to reflect equivalent blows of any other type of sampler or hammer, or to account for the different hammers and samplers used.

**Subsurface Conditions**

Boring 1 first penetrated 8 feet of firm to stiff silty sandy clay. This was underlain by dense to very dense silty gravelly sand with sandstone fragments down to the terminated boring depth of 18.5 feet. We interpret the sand encountered at 8 feet, to be Santa Clara Formation bedrock.

Boring 2 first penetrated 3.5 feet of silty sandy clay. The clay was underlain by loose to very dense silty gravelly sand down to the terminated boring depth of 12.5 feet. The sands were loose to medium dense from 3.5 to 7 feet, and medium dense to very dense below 7 feet. We interpret the sand encountered at 7 feet, to be Santa Clara Formation bedrock.

Please refer to Appendix A for a more detailed description of each boring.

No free groundwater was encountered during the drilling of the hole. However, during periods of heavy rain or late in the winter, groundwater seepage may exist at shallower depths, most likely as perched water atop the bedrock.

**Laboratory Testing**

The relatively undisturbed samples collected during the drilling process were returned to the laboratory for testing of engineering properties. In the lab, selected soil samples were tested for moisture content, density, and plasticity. The results of the laboratory tests are attached to this report in Appendix B.

Plasticity Index (PI) testing performed on the site near surface materials produced a PI result of 27. This testing indicated that the near surface materials have moderate plasticity and are of moderate expansion potential.

**CONCLUSIONS AND RECOMMENDATIONS**

**General**

Based upon our investigation, we believe that the proposed improvements can be safely constructed. Geotechnical development of the site is controlled by the presence of moderately expansive near surface soils and steep slopes, however, is aided by the presence of dense, non-expansive bedrock.

Expansive soils derive their name from their propensity to change volume in response to changes in moisture content. When they are dry, they shrink; when they become wet, they swell. The pressures these soils can exert as they expand can be sufficiently high to move conventional
residential foundations. The foundation movement induced by the soil shifting can cause wall coverings to crack, doors and windows to stick, and floors to slope. Seasonal movements of expansive soils have caused such distress to countless houses in the Bay Area. When located on slopes, these soils will also tend to slowly creep downhill.

To combat seasonal expansive soil movements, it is necessary to utilize a foundation system which derives its support from the deeper, more stable soils. Typically, a drilled, cast-in-place pier foundation system is used to reach the more stable materials. Therefore, we have recommended that such foundation system be utilized at this site. You have expresses a desire to use Helix Piers as part of the foundation upgrades. Therefore we have included a section of Helix Piers.

The recommendations in this report should be incorporated into the design and construction of the proposed new foundation upgrades.

**Seismicity**

The greater San Francisco Bay Area is recognized by Geologists and Seismologists as one of the most active seismic regions in the United States. Several major fault zones pass through the Bay Area in a northwest direction which have produced approximately 12 earthquakes per century strong enough to cause structural damage. The faults causing such earthquakes are part of the San Andreas Fault System, a major rift in the earth's crust that extends for at least 700 miles along western California. The San Andreas Fault System includes the San Andreas, San Gregorio, Hayward, Calaveras Fault Zones, and other faults.

During 1990, the U.S. Geological Survey cited a 67 percent probability that an earthquake of Richter magnitude 7, similar to the 1989 Loma Prieta Earthquake, would occur on one of the active faults in the San Francisco Bay Region in the following 30 years. Recently, this probability was increased to 70 percent, as a result of studies in the vicinity of the Hayward Fault. A 23 percent probability is still attributed specifically to the potential for a magnitude 7 earthquake to occur along the San Andreas Fault by the year 2020.

**Ground Rupture** - The lack of mapped active fault traces through the site, suggests that the potential for primary rupture due to fault offset on the property is low.

**Ground Shaking** - The subject site is likely to be subject to very strong to violent ground shaking during its life span due to a major earthquake in one of the above-listed fault zones. Current (2013) building code design may be followed by the structural engineer to minimize damages due to seismic shaking, using the following input parameters from the USGS Java Ground Motion Parameter Calculator based upon ASCE 7-10 design parameters:

| Site Class - C | $SM_S = 2.849$ | $SM_1 = 1.339$ | $SD_S = 1.889$ | $SD_1 = 0.893$ |
Landsliding - The state of California Seismic Hazards Zones map indicates that the site is in an area potentially subject to landsliding. The subject site and the surrounding area are gently to steeply sloping. Fortunately, the site is underlain by competent bedrock material at relatively shallow depths. However, as with any slope, minor sloughing of the steeper site slopes could occur during earthquake shaking. Although landsliding is unlikely to have a significant effect on the subject property, the proposed foundation upgrades should help to minimize any movements even further. Therefore, it is our opinion that the potential for any severe damages or collapse due to landsliding at the site are very low.

Liquefaction - The state of California Seismic Hazards Zones map indicates that the site is not in an area potentially subject to liquefaction. Liquefaction most commonly occurs during earthquake shaking in loose fine sands and silty sands associated with a high ground water table. These conditions were demonstrated to be absent down to the site bedrock, confirming the State’s mapping. Therefore, it is also our opinion that liquefaction is unlikely to occur on the subject property. Although there are some loose to medium dense sand deposits at the site, they are not saturated, and hence are unlikely to be subject to liquefaction. Therefore, it is our opinion that liquefaction is unlikely to affect the subject property.

Ground Subsidence - Ground subsidence may occur when poorly consolidated soils densify as a result of earthquake shaking. Some of the near surface soils are sandy and loose, which may have leave them susceptible to seismic densification. However, these settlements are projected to be less than 1 inch, which would not cause structural distress to a well designed building.

Lateral Spreading - Lateral spreading may occur when a weak layer of material, such as a sensitive silt or clay, loses its shear strength as a result of earthquake shaking. Overlying blocks of competent material may be translated laterally towards a free face. Such conditions were not encountered on the proposed building site, therefore, the hazard due to lateral spreading is, in our opinion, considered very low.

Site Preparation and Grading

All debris resulting from the demolition of existing improvements should be removed from the site and may not be used as fill. Any existing underground utility lines to be abandoned should be removed from within the proposed building envelope and their ends capped outside of the building envelope.

Any vegetation and organically contaminated soils should be cleared from the building area. All holes resulting from removal of tree stumps and roots, or other buried objects, should be overexcavated into firm materials and then backfilled and compacted with native materials.

No fill placement is anticipated. Should plans change to include fills, contact our office for recommendations.
Temporary, dry-weather, vertical excavations should remain stable for short periods of time to heights of 5 feet. All excavations should be shored or sloped in accordance with OSHA standards.

Permanent cut and/or fill slopes should be no steeper than 2:1 (H:V). However, even at this gradient, minor sloughing of slopes may still occur in the future. Positive drainage improvements (e.g. drainage swales, catch basins, etc.) should be provided to prevent water from flowing over the tops of cut and/or fill slopes.

Foundations – Drilled Piers

Due to the presence of steep slopes and moderately expansive site soils, the foundations will need to penetrate into the deeper, more stable soils. We recommend a pier and grade beam foundation system be used.

Drilled piers should penetrate a minimum of 15 feet below lowest adjacent grade, and 8 feet into competent bedrock materials, whichever is deeper. It should be assumed that up to 8 feet of overburden will exist at the site, so nominal pier depths may range from 15 to 16 feet below lowest adjacent grade.

The piers should have a minimum diameter of 18 inches and be nominally reinforced with a minimum of four #4 bars vertically. Piers should be spaced a maximum of 10 feet center to center, and be spaced no closer than 4 diameters, center to center.

Actual pier depth, diameter, reinforcement, and spacing should be determined by the structural engineer based upon the following design criteria:

A friction value of 600 psf may be assumed to act on that portion of the pier within bedrock. A lateral creep force of 35 pcf Equivalent Fluid Weight (EFW) should be applied to all piers on any portion of the site where grading operations do not flatten slopes to less than 4:1 (H:V). This creep force should be applied over 3 projected pier diameters to a depth of 3 feet. Lateral support may be assumed to be developed along the length of the pier within bedrock, using a passive pressure of 400 pcf Equivalent Fluid Weight (EFW). Passive resistance may be assumed to act over 1.5 projected pier diameters. Above the bedrock, no frictional or lateral support may be assumed. These design values may be increased 1/3 for transient loads (i.e. seismic and wind).

Even though piers are designed to derive their vertical resistance through skin friction, the bases of the piers holes should be clean and firm prior to setting steel and pouring concrete. If more than 6 inches of slough exists in the base of the pier holes after drilling, then the slough should be removed. If less than 6 inches of slough exists, the slough may be tamped to a stiff condition. Piers should not remain open for more than a few days prior to casting concrete. In the event of rain, shallow groundwater, or caving conditions it may be necessary to pour piers immediately. All perimeter piers, and piers under load-bearing walls, should be connected by concrete grade beams.
All improvements connected directly to any pier supported structure, also need to be supported by piers. This includes, but is not limited to: porches, decks, entry stoops and columns, etc. If the designer does not wish to pier support these items, then care must be taken to structurally isolate them (with expansion joints, etc.) from the pier supported structure.

If the above recommendations are followed, total foundation settlements should be less than 1 inch, while differential settlements should be less than ½ inches.

**Foundation Alternative – Helix Piers**

Helical piers (Chance Augers) consist of a solid metal shaft fitted with a metal plate (or series of plates) warped into a screw thread on the tip of the lead shaft. The auger is screwed down into the ground until the required torque is achieved, indicating that adequate bearing pressures are also available. The helix then will accept vertical loads from the foundations and transmit them to bearing pressures on the plates at the tip of the augers. The design process of these augers is based upon proprietary information developed by the Chance Company, and the calculations and designs can be prepared based upon the information contained in other sections and figures in this report. We do recommend that the helix piers be embedded a minimum of 4 feet into the sandy Santa Clara Formation bedrock materials at the site to ensure adequate penetration of the lead plate into competent materials. Angled helix installation will be necessary to address lateral loading.

**Drainage**

Due to the sloping nature of the site and the expansive nature of the site soils, it will be important to provide good drainage improvements at the property.

**Surface Drainage** - All roof eaves should be lined with gutters. The downspouts may be connected to solid drain lines, or may discharge onto paved surfaces which drain away from the structure. The downspouts may be connected to the same drain line as any catch basins, but must not connect to any perforated pipe drainage system.

**Drainage Discharge** - The surface drain lines should discharge at least 15 feet away from the house, preferably down the rear slope. The discharge location(s) should be protected by energy dissipaters to reduce the potential for erosion. Care should be taken not direct concentrated flows of water towards neighboring properties. This may require the use of multiple discharge points.

**Drainage Materials** - Drain lines should consist of hard-walled pipes (e.g. SDR 35 or Schedule 40 PVC). In areas where vehicle loading is not a possibility, SDR 38 or HDPE pipes may be used. Corrugated, flexible pipes may not be used in any drain system installed at the property.

Surface drain lines (e.g. downspouts, area drains, etc.) should be laid with a minimum 2 percent gradient (¼ inch of fall per foot of pipe).
Plan Review and Construction Observations

The use of the recommendations contained within this report is contingent upon our being contracted to review the plans, and to observe geotechnically relevant aspects of the construction.

We should be provided with a full set of plans to review at the same time the plans are submitted to the building/planning department for review. A minimum of one working week should be provided for review of the plans.

At a minimum, our observations should include: pier drilling or helix pier installation; installation of any drainage system (e.g. surface), and final grading. A minimum of 48 hours notice should be provided for all construction observations.

LIMITATIONS

This report has been prepared for the exclusive use of the addressee, and their architects and engineers for aiding in the design and construction of the proposed development. It is the addressee's responsibility to provide this report to the appropriate design professionals, building officials, and contractors to ensure correct implementation of the recommendations.

The opinions, comments and conclusions presented in this report were based upon information derived from our field investigation and laboratory testing. Conditions between or beyond our borings may vary from those encountered. Such variations may result in changes to our recommendations and possibly variations in project costs. Should any additional information become available, or should there be changes in the proposed scope of work as outlined above, then we should be supplied with that information so as to make any necessary changes to our opinions and recommendations. Such changes may require additional investigation or analyses, and hence additional costs may be incurred.

Our work has been conducted in general conformance with the standard of care in the field of geotechnical engineering currently in practice in the San Francisco Bay Area for projects of this nature and magnitude. We make no other warranty either expressed or implied. By utilizing the design recommendations within this report, the addressee acknowledges and accepts the risks and limitations of development at the site, as outlined within the report.

Respectfully Submitted;
GeoForensics, Inc.

Daniel F. Dyckman, PE, GE
Senior Geotechnical Engineer, GE 2145

cc: 5 to addressee
Qsc  Santa Clara Formation

gray to red-brown gravel/conglomerate, sandstone, and mudstone; gray to buff claystone and siltstone; cobble, pebble and boulder conglomerate of chert, greenstone, graywacke, schist, serpentine, and limestone in a sandy matrix

fg  Greenstone (metabasalt)

black, weathered dark brown, massive, amorphous, locally brecciated, interstratified or intertongued with graywacke sandstone

MAP EXPLANATION

Zones of Required Investigation

- Liquefaction

Areas where historical 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.

- Earthquake-Induced Landslides

Areas where historical occurrence of landslide movement, or local topographical, 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.

State of California Seismic Hazards Zones; Castle Rock ridge Quadrangle Official Map
Released: August 11, 2005

GEFORENSICS, INC.
561 Pilgrim Dr., Suite B, Foster City, CA 94404
Tel: (650) 349-3369 Fax: (650) 571-1878

Figure 3a - Seismic Hazards Map
Base drawing provided by Google Maps
No Scale on this drawing

Figure 4 - Site Photo with Approximate Boring Locations

GEOFORENSICS, INC.
561 Pilgrim Dr., Suite D, Foster City, CA 94404
Tel: (650) 349-3369 Fax: (650) 571-1878
APPENDIX A - BORING LOGS
<table>
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<th>DEPTH (ft)</th>
<th>SAMPLE NUMBER</th>
<th>SAMPLE LOC</th>
<th>BLOW COUNTS (12 inches)</th>
<th>MATERIAL DESCRIPTION</th>
<th>DRY DENSITY (pcf)</th>
<th>MOISTURE CONTENT (%)</th>
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<td>56</td>
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<td>11.1</td>
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<td>12.6</td>
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Bottom of Boring at 18.5 feet

No Groundwater

Logged by: BA
Job# 215005
Drilled on 1/12/15

Mobile B-24 Truck Mounted Drilling Rig
140 Pound Hammer
No Groundwater
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<th>SAMPLE LOC</th>
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<th>MATERIAL DESCRIPTION</th>
<th>DRY DENSITY (pcf)</th>
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<td>10</td>
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<td>50/6°</td>
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<td>Silty gravelly SAND; red brown and orange brown; slightly moist; dense to very dense (SM) (Santa Clara Formation)</td>
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</table>

Bottom of Boring at 12.5 feet

No Groundwater

Logged by: BA
Job# 215005
Drilled on 1/12/15

Minute Man Portable Drilling Rig
70 Pound Hammer
No Groundwater

Mod. Cal Sampler
SPT Sampler

Figure A2 - Log of Boring 2
APPENDIX B - LABORATORY TEST RESULTS
### Moisture-Density-Porosity Report

**Cooper Testing Labs, Inc. (ASTM D7263b)**

**CTL Job No.:** 060-2305  
**Client:** GeoForensics  
**Project No.:** 215005  
**By:** RU  
**Date:** 01/15/15

### Boring: Sample: Depth, ft:

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<td>18</td>
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### Visual Description:

- **Yellowish Brown Silty SAND, trace Gravel (loose)**
- **Yellowish Brown Silty SAND, trace Gravel (loose)**
- **Yellowish Brown Sandy CLAY (loose)**
- **Yellowish Brown Silty SAND, trace Gravel (loose)**
- **Yellowish Brown Silty SAND, trace Gravel (loose)**
- **Yellowish Brown Silty SAND, trace Gravel (loose)**

### Actual $G_s$

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<th>Assumed $G_s$</th>
<th>Moisture, %</th>
<th>Wet Unit wt, pcf</th>
<th>Dry Unit wt, pcf</th>
<th>Dry Bulk Dens,pb, (g/cc)</th>
<th>Saturation, %</th>
<th>Total Porosity, %</th>
<th>Volumetric Water Cont,θw,%</th>
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</table>

### Note:

All reported parameters are from the as-received sample condition unless otherwise noted. If an assumed specific gravity ($G_s$) was used then the saturation, porosities, and void ratio should be considered approximate.

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### Moisture-Density

**Zero Air-voids Curves, Specific Gravity**

- **The Zero Air-Voids curves represent the dry density at 100% saturation for each value of specific gravity**

- **Series 1**
- **Series 2**
- **Series 3**
- **Series 4**
- **Series 5**
- **Series 6**
- **Series 7**
- **Series 8**
LIQUID AND PLASTIC LIMITS TEST REPORT

Dashed line indicates the approximate upper limit boundary for natural soils

---

<table>
<thead>
<tr>
<th>MATERIAL DESCRIPTION</th>
<th>LL</th>
<th>PL</th>
<th>PI</th>
<th>%&lt;#40</th>
<th>%&lt;#200</th>
<th>USCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellowish Brown Sandy Elastic SILT</td>
<td>57</td>
<td>30</td>
<td>27</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Project No. 060-2305  Client: GeoForensics
Project: Overlook - 215005

- Source: I-I
  Elev./Depth: 4'

Remarks:

COOPER TESTING LABORATORY