June 5, 2017

Mr. Tim Morgan c/o
Vista Tassajara HOA
563 Leisure Street
Livermore, CA 94551

Re: Geotechnical Engineering Report for Hillview Drive Slope Repair
Vista Tassajara, Danville, California
*SFB Project No.: 768-1*

Mr. Morgan:

In accordance with the request of the Vista Tassajara Homeowners Association, Stevens, Ferrone & Bailey Engineering Company, Inc. (SFB) has performed a geotechnical investigation and prepared plans and specifications for the repair of a portion of the hillside located above the Hillview Drive cul-de-sac in Danville, California, as shown on the attached Site Plan and Engineering Geology Map, **Figure 1**. This report presents the results of our field investigation, laboratory tests, and slope stability analyses of the proposed slope repair plans. The purpose of this report is to support the Grading and Drainage Plans prepared by SFB for the repair of the hillslope.

It is our understanding that a landslide occurred on the hillside above the southern terminus (cul-de-sac) of Hillside Drive during the winter of 2016/2017. As shown on the attached **Figure 1**, the landslide exists within open space land managed by the Vista Tassajara HOA. The toe of the landslide is located at the base of the slope and has negatively impacted the private lot and residence at 95 Hillview Drive, and has the potential for negatively impacting the private lot and residence at 92 Hillview Drive and Hillview Drive itself. The landslide has detrimentally damaged surface drainage (and possibly subsurface drainage) facilities on the slope. The damaged hillside requires repair otherwise additional landslide movement will occur in the future that can affect private lots, Hillview Drive, and non-subdivision property located to the east.

## 1.0 Previous Grading During Original Subdivision Development

As part of our work, we reviewed the following available documents and plans related to the original Vista Tassajara Subdivision 6736 development:

- *Geotechnical Investigation Report*, prepared by Berlogar Geotechnical Consultants (BGC) and dated 2/8/88;
- *Grading Plans*, prepared by PRW and Associates and dated 2/17/88;
- *As-Built Subdrain Location Plan*, prepared by BGC and dated 10/12/88; and
- *Soil Engineering Services During Mass Grading*, a report prepared by BGC and dated 11/8/88.

It is our understanding the original mass grading of the subdivision was performed in June through September 1988. The landslide site and vicinity are located within a previously mapped landslide area (Slide 23) that, according to BGC, extended to depths of about 25 to 45 feet below original grades as shown on Plate 4 (Section A) of BGC's subdivision geotechnical investigation report. According to BGC, most of Slide 23 was removed during mass grading except for specific upslope portions that extended beyond the subdivision boundary that were left in place but buttressed with engineered fill. According to previous BGC field compaction test results at the Slide 23 area, fills (that were placed after the landslide was removed) were placed at optimum moisture content or higher and compacted to not less than 90 percent relative compaction per ASTM D1557. Subdrains were reportedly installed in the landslide repair area. The subdrain locations (but not elevations) are recorded on an as-built subdrain location plan prepared by BGC.

## 2.0 Existing Surface and Subsurface Conditions

SFB performed reconnaissance and geologic mapping of the site and surrounding area on February 22, April 5 and 19, and May 2, 2017. In addition, a topographic survey of the area was performed by Meridian Associates, Inc., in April 2017. At the time of our investigation, several landslides were observed at the site and encompassed an area of about 380 feet wide and 220 feet long in lateral extent (as shown on **Figure 1**). The deeper landslides generally exhibited rotational movement. Head scarps of about 5 to 15 feet high were located at the southeastern boundary of the landslides. Slide debris up to about 5 to 10 feet in thickness had accumulated at the base of the hillslope. The bottoms of the landslides were estimated to be at depths of about 15 to 25 feet below existing ground surface. Some of the soil debris had been removed and stockpiled in adjacent areas.

Subsurface exploration was performed by SFB using a track-mounted drill rig equipped with 6-inch diameter, continuous flight, solid stem auger. On April 19, 2017, three exploratory borings were drilled to depths of about 26-1/2 to 36 feet below existing ground surface. Soil samples were retrieved from the borings for geological and engineering evaluations and laboratory testing. Prior to the site development, four exploratory borings (B-8 through B-10) were previously performed by BGC in December 1987 to depths of about 27-1/2 feet to 57 feet at the landslide site and vicinity.

The approximate locations of SFB's borings and the previous borings by BGC are shown on **Figure 1**. The logs of SFB's borings and details regarding SFB's field investigation are included in **Appendix A.** The results of SFB's laboratory tests are discussed in **Appendix B**. Logs of the previous boring by BGC are provided in **Appendix C** for reference.

It should be noted that changes in the surface and subsurface conditions can occur over time as a result of either natural processes or human activity and may affect the validity of the conclusions and recommendations in this report. Our attached boring logs and related information depict location specific subsurface conditions encountered during our field investigation. The approximate locations of our borings were determined by using the results of the topographic survey and landmark references and should be considered accurate only to the degree implied by the method used.

Boring SFB-1, located in the central portion of the western slide, generally encountered stiff to very stiff clayey fill materials to a depth of about 35 feet where siltstone bedrock was encountered. It is estimated that the landslide extended to a depth of about 22 feet in this area (an elevation of about 767 feet). Groundwater was encountered on the surface of the bedrock. The boring extended to a depth of about 36 feet.

Boring SFB-2, located at the base of the western slide, encountered soft and saturated landslide debris to a depth of about 7 feet. Water was seeping in the boring at this depth. Below the landslide debris, stiff clayey fill materials were encountered to the maximum depth explored in this boring of 26-1/2 feet.

Boring SFB-3, located between the eastern and western slides, encountered firm and wet clayey fills within the upper 3 feet of the boring, and very stiff to hard clayey fills to the maximum depth explored in this boring of 26-1/2 feet. Water was seeping into the boring within the upper 6 feet.

Based on the results of our laboratory testing, the clayey fills have a high to very high plasticity and high to critical expansion potential. The laboratory testing on retrieved fill samples also indicate the in-situ fills not located within the landslide deposit area have moisture contents varying from 20 to 30 percent at the time of our sample retrieval. The dry densities of the retrieved in-situ fill soil samples generally ranged from 91 to 107 pounds per cubic foot (pcf), with an average of about 97 pcf. We performed two laboratory compaction curves on samples of the in-situ fill soils which resulted in a maximum dry density ranging from 113 to 114 pcf (per

ASTM D1557) at optimum moisture contents of 14 to 16 percent. Within the landslide deposit area (the area where the landslide debris extended up and over the previously existing ground surface) located in the lower reaches of the slope, our laboratory testing indicates that the weak landslide debris was saturated at the time of our investigation (water contents ranging from 39 to 40 percent) with dry densities ranging from 77 to 81 pcf.

The attached Cross-Sections A-A' and B-B' (attached as **Figures 2 and 3**) show our interpretations of the estimated possible landslide planes and associated subsurface conditions based on the results of our field explorations and mapping. The locations of the sections are shown on **Figure 1**.

## 3.0 Engineering Properties of Subsurface Materials

Engineering properties of the proposed engineered fills ("Rebuilt Fill"), existing clayey fills to remain beyond the upper and lower limits of the repair area ("Existing Fill"), and siltstone and claystone rock ("Bedrock") were derived from the field and laboratory testing results and typical engineering correlations.

To evaluate the long-term strength of the existing fill materials and the proposed engineered fill, onsite fill material samples were retrieved and remolded to an approximate dry density of about 98 pcf, similar to the average dry density properties of the existing fill materials within the hillslope, and approximately 5 percent above optimum moisture content as determined by ASTM Method D1557 for laboratory consolidated drained direct shear testing (ASTM D3080). The remolded direct shear test results indicate the "Existing Fill" has an effective cohesion of 250 psf (pounds per square foot) and an effective friction angle of 26 degrees. For comparison, drained fully softened peak (ASTM D7608) torsional shear testing was also performed on remolded fill material samples. The torsional shear test results indicate the onsite fill materials have fully softened peak internal friction angles ranging from about 21 to 25 degrees. According to Stark et al. (2005)[1], the drained fully softened shear strength condition corresponds to the condition where the clayey fill has absorbed as much water as possible, has reached equilibrium at the site, and has not undergone shearing (landsliding) in the past.

As part of our shear strength assessment, we performed a back-calculation along the failure surface to determine the internal angle of friction at the time of failure. Details regarding the back-calculation are provided in Section 4.0 below. Based on the results of the shear strength laboratory testing and the back-calculation results, it is our opinion that assigning a friction angle of 26 degrees to the "Existing Fill" materials is appropriate. It is also our opinion that assigning

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[1]Stark, Choi & McCone, *Drained Shear Strength Parameters for Analysis of Landslides*, Journal of Geotechnical and Geoenvironmental Engineering (ASCE), Vol. 131, No. 5, May 1, 2005.

a friction angle of 26 degrees to the "Rebuilt Fill" for long-term strength is appropriate and also conservative since the proposed hillside repair will include substantial surface and subsurface drainage.

The laboratory testing results are attached as **Appendix B** for reference. The table below summarizes the soil and rock engineering properties used in our analyses.

| Material | Unit Weight (pcf) | Static & Pseudo-Static (i.e., Earthquake) Conditions | |
|---|---|---|---|
| | | Cohesion (psf) | Friction Angle (deg) |
| Rebuilt Fill | 120 | 100 | 26 |
| Existing Fill | 120 | 100 | 26 |
| Bedrock | 125 | 100 | 30 |

## 4.0 Slope Stability Analyses of Existing Conditions and Proposed Slope Repair

SFB performed slope stability analyses using the two dimensional, limit equilibrium computer program, GSLOPE (Mitre Software, 1999). The procedures presented in the Southern California Earthquake Center (SCEC) publication, *Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California*, were followed during our analyses. For the major earthquake loading condition, a seismic coefficient (k) of 0.25 was applied in our pseudo-static analyses for the purpose of screening. This coefficient was determined based on a design-basis maximum ground acceleration of 0.69g (per the 2016 USGS Unified Hazard Tool[2] using a 10% probability of being exceeded in a 50-year period; a 475-year return period with a stiff soil site condition), a causative magnitude 6.9 earthquake located at 11.9 kilometers away, and a threshold displacement of 15 centimeters (approximately 6 inches). As stated in the SCEC publication, the threshold displacements provide an index of slope performance. The 15 centimeters (6 inches) value distinguishes conditions in which small to moderate displacements are likely from conditions in which large displacements are likely.

The representative Cross-Section A – A' (**Figure 2**) was used in our slope stability analyses to back-calculate the frictional resistance at the time of hillslope failure along the three possible

[2]Dynamic: Conterminous U.S. 2014 v4.1.0; https://earthquake.usgs.gov/hazards/interactive/

slide planes and to evaluate the possible repair schemes. An estimated groundwater level at 5 feet below existing ground surface was used for the existing fill layer. The hillside friction angle was back-calculated to achieve a factor of safety of 0.99 against sliding under static condition. Our back-calculations results indicate the existing hillslope fill materials along potential slide planes had a friction angle of about 25 to 26 degrees at the time of slope failure, which corresponds well with the remolded laboratory shear strength properties. This back-calculated frictional resistance also corresponds well with the upper bound, fully softened peak strength.

Our recommended slope repair which includes removal of the existing landslide debris, installation of subdrains, and keying and benching of proposed compacted, engineered fills is shown on the attached **Figures 4 and 5**. The representative Cross-Section a - a' (**Figure 5**) was used for our slope stability analyses of the proposed slope repair grading. The table below summarizes the most critical results of our slope stability analyses of the proposed slope repair grading along Section a - a' under both static and pseudo-static conditions. The cross-section profiles, soil and rock engineering properties used in the analyses, and the detailed results of the analyses are presented on the computer program printouts in the attached **Appendix D**.

| Cross-Section a-a' | Factor of Safety against Sliding | |
|---|---|---|
| | Static | Pseudo-Static (Earthquake Loading k = 0.25) |
| Proposed Slope Repair (No Groundwater) | 1.87 | 0.96 |
| Proposed Slope Repair (Groundwater within Existing Fill but not within Rebuilt Fill) | 1.75 | 0.86 |

The results of our slope stability analyses indicate that the factor of safety against sliding under static conditions after the proposed slope repair is completed is greater than the generally acceptable value of 1.5 for the most critical potential slide plane. For the major earthquake loading condition, a factor of safety against sliding of 0.96 was calculated, which is very close to 1.0 (in order to pass screen criteria outlined in the SCEC publication) when applying the seismic coefficient of 0.25. Therefore, it is our opinion the proposed slope repair shown on the proposed repair plans is appropriate for the site.

The results of our slope stability analyses also show that a properly functioning new and existing surface drainage and subdrain system is critical to the global stability of the rebuilt slope and the existing slope below and adjacent the repair area. A non-functioning subdrain system will allow the groundwater levels to rise within the hillslope and can lower the factor of safety below acceptable values, especially during seismic events. Also, during or immediately after heavy rainfall events, a non-functioning surface and/or subsurface drainage system at the site can cause hillslope failure.

## 5.0 Conclusions and Recommendations

It is our opinion that the Hillview Drive landslide was caused by a combination of weakened fill materials, added water weight within the slope due to the rainfall during the winter of 2016/2017, and the lack of proper surface drainage (mid-slope drainage benches and ditches) and subsurface drainage (subdrains) within the area.

We recommend the conditions and outlets of the existing surface drainage and subdrain system be checked in the field and both the proposed new and existing surface drainage and subdrain systems be regularly maintained by the HOA. As is common for all hillside residential subdivisions, we recommend routine maintenance of the hillslope be performed, including maintenance prior to rainstorms. Maintenance should include the re-compaction of loosened soils, collapsing and infilling holes with compacted soils or low strength sand/cement grout, removal and control of digging animals, modifying storm water drainage patterns to allow for sheet flow into drainage inlets or ditches rather than concentrated flow or ponding, removal of debris within drainage ditches and inlets, and immediately repairing any erosion or soil flow. The maintenance should also include checking drainage patterns, making sure both surface and subsurface drainage systems are functional and not clogged, and erosion control measures are adequate for anticipated storm events. Maintenance and repair should be performed if any of these measures appears to be inadequate. Temporary and permanent erosion and sediment control measures should be installed over any exposed soils after repairs are made.

Our landslide repair recommendations are shown on the Hillview Drive slope repair plans, including our recommended locations for keyways, subgrade benches, subdrains, surface drainage ditches and pipes, and finished grades. The repair plans also provide our specifications for fill materials, fill placement, moisture conditioning, compaction, and placement of erosion/sediment control measures. Please refer to the Hillview Drive slope repair plans for more details.

We recommend SFB be retained by the HOA to provide consulting services during the hillslope repair project and to perform construction observation and testing services during the construction phase of the hillslope repair project to observe, test, and document the implementation of our recommendations and the plans and specifications. Our onsite work will allow us to provide supplemental or revised recommendations in the event subsurface conditions different than those described in this report are encountered and/or if there is a need to modify plans, specifications, or details shown on the repair plans. We are not responsible for misinterpretation of our recommendations or misinterpretation of the repair plans, specifications, and details. The long-term stability of the repair area is highly dependant upon the proper implementation of the Hillview Drive slope repair plans.

## 6.0 Conditions and Limitations

It is not uncommon for slope movements to occur within the site's rebuilt and existing fills, soils, and bedrock and the hillside region; the magnitude of such movements depend upon numerous factors including degree of slope maintenance, drainage, rainfall, irrigation, earthquake shaking, and changes to the topography. Therefore, the stability of the site and vicinity can change over time. It is beyond the purpose of this report and the Hillview drive slope repair plans and specifications (and SFB's scope of work) to address the stability of areas beyond the Hillview drive slope repair limits.

SFB is not responsible for the validity or accuracy of information, analyses, test results, or designs provided to SFB by others. The analysis, designs, opinions, and recommendations submitted in this report and the associated plans and specifications are based in part upon the data obtained from field work and upon information provided by others. Site exploration and testing characterizes subsurface conditions only at the locations where the explorations or tests are performed; actual subsurface conditions between explorations or tests may be different than those described in this report and/or shown on the slope repair plans. Variations of subsurface conditions from those analyzed or characterized in this report and shown on the slope repair plans are not uncommon and may become evident during construction. In addition, changes in the condition of the site can occur over time as a result of either natural processes (such as earthquakes or changes in groundwater levels) or human activity (such as construction adjacent to the site, modifying topography, dumping of fill, or excavating). If changes to the site's surface or subsurface conditions occur, or if differing subsurface conditions are encountered, we should be contacted immediately to evaluate the differing conditions to assess if the opinions, conclusions, and recommendations provided in this report and shown on the slope repair plans are still applicable or should be amended.

This report is a design document that has been prepared in accordance with generally accepted geological and geotechnical engineering. It should be understood that advancements in the practice of geotechnical engineering and engineering geology, or discovery of differing surface or subsurface conditions, may affect the validity of this report and the slope repair plans and are not uncommon. SFB strives to perform its services in a proper and professional manner with reasonable care and competence. Geological engineering and geotechnical engineering are disciplines that are far less exact than other engineering disciplines; therefore we should be consulted if it is not completely understood what the limitations to using this report and the slope repair plans are.

In the event that there are any changes in the nature, design or location of the project, as described in this report, or if any future changes to the slope are planned, the conclusions and recommendations contained in this report shall not be considered valid unless we are contacted in writing, the project changes are reviewed by us, and the conclusions and recommendations presented in this report are modified or verified in writing.

If you have any questions or need additional information, please call our office.

Sincerely,

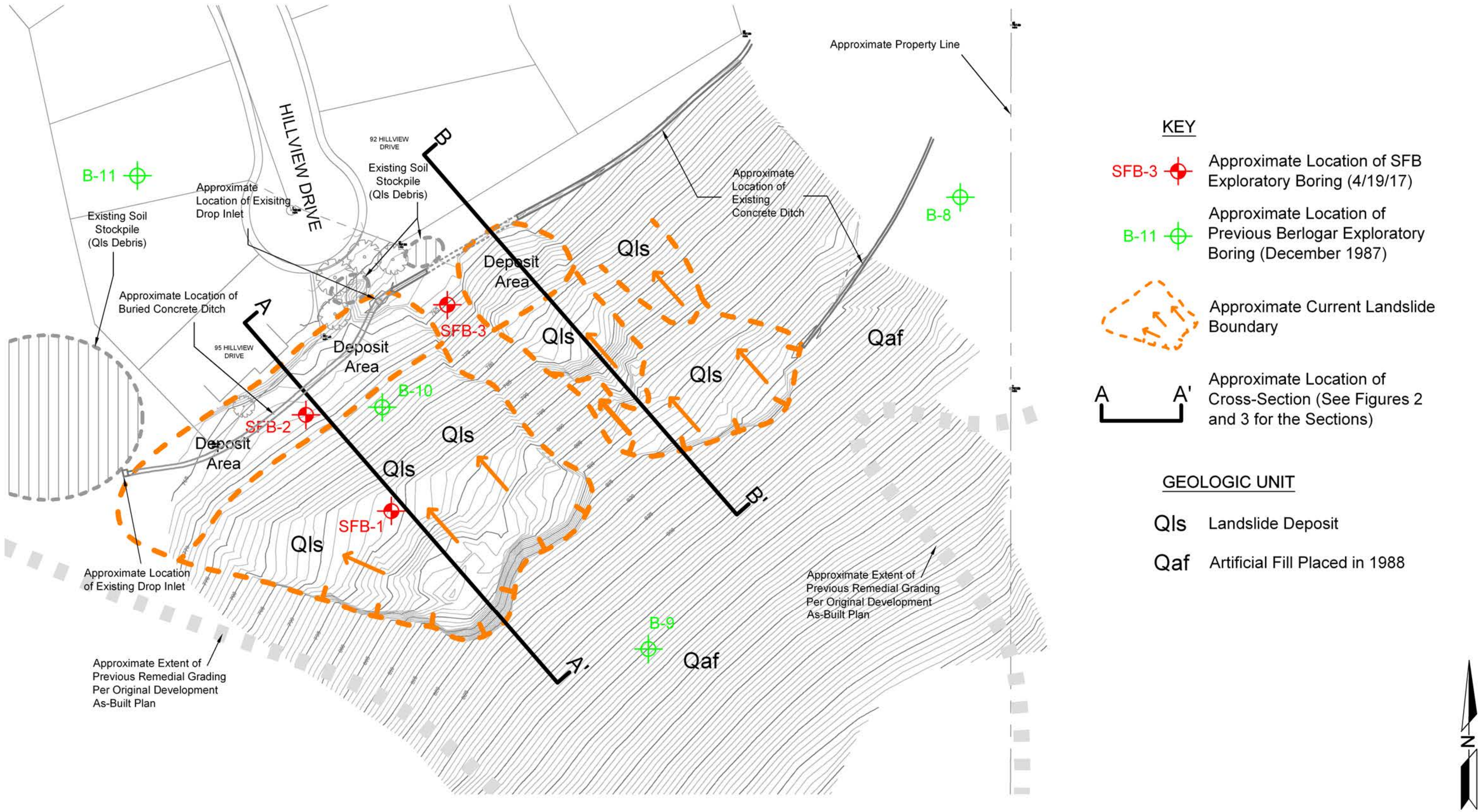
**Stevens, Ferrone & Bailey**
**Engineering Company, Inc.**

Taiming Chen, PE, GE
*Civil/Geotechnical Engineer*

Ken Ferrone, PE, GE, CEG
*Civil/Geotechnical Engineer*
*Certified Engineering Geologist*

TC/KCF
Copies: Addressee (1 by email)
Attachments: Figures 1 through 5
Appendices A, B, C & D

# FIGURES




NOTE: Topographic survey by Meridian Associates, Inc. and dated April 2017.

APPROXIMATE SCALE: 1" = 60'

0 60' 120'

DATE: June 2017

PROJECT NO.: 768-1

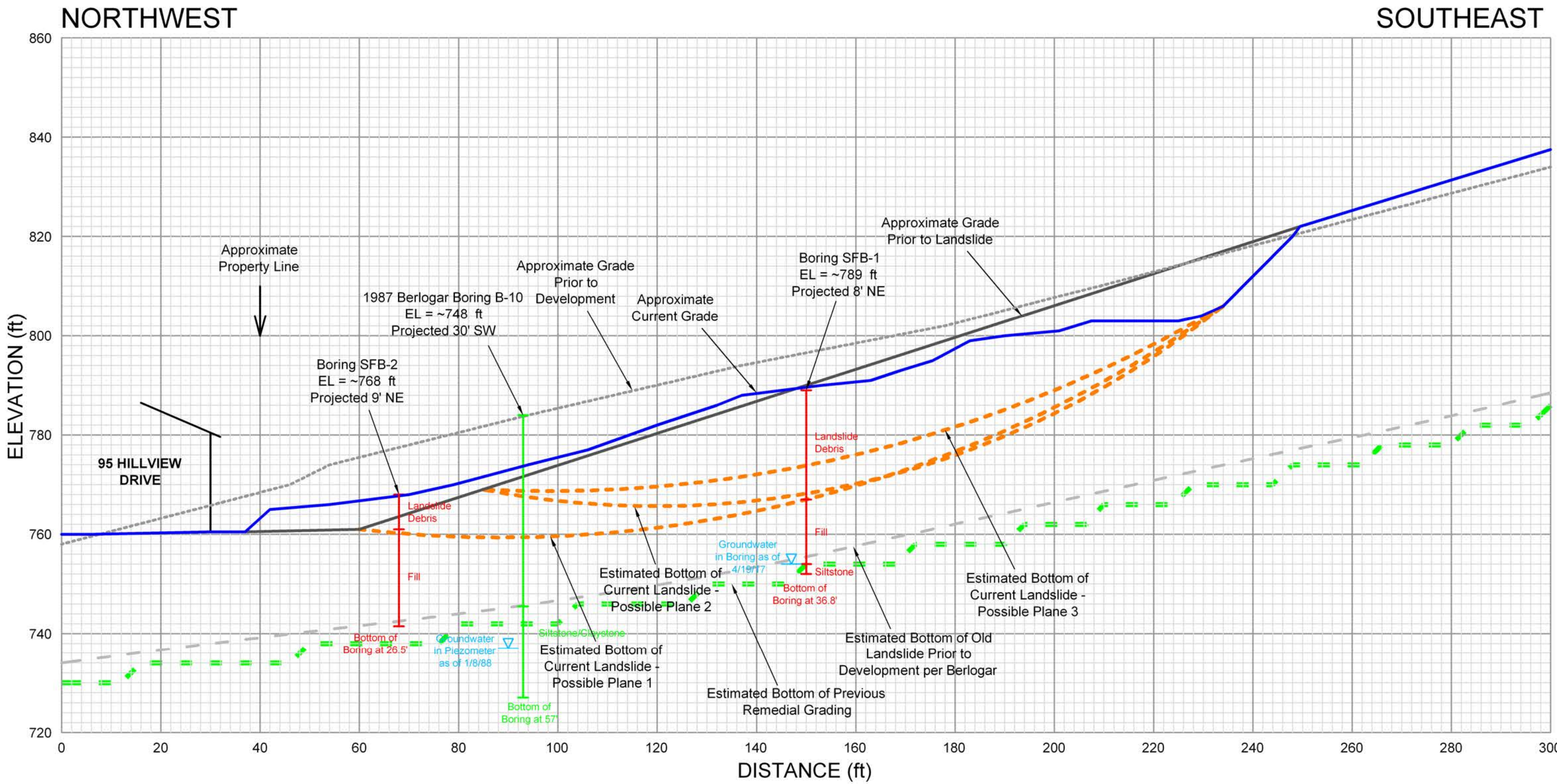
Stevens Ferrone & Bailey Engineering Company, Inc

1600 Willow Pass Court
Concord, CA 94520
Tel 925.688.1001
Fax 925.688.1005
www.SFandB.com

SITE PLAN AND ENGINEERING GEOLOGY MAP

HILLVIEW DRIVE SLOPE REPAIR
Danville, California

FIGURE 1

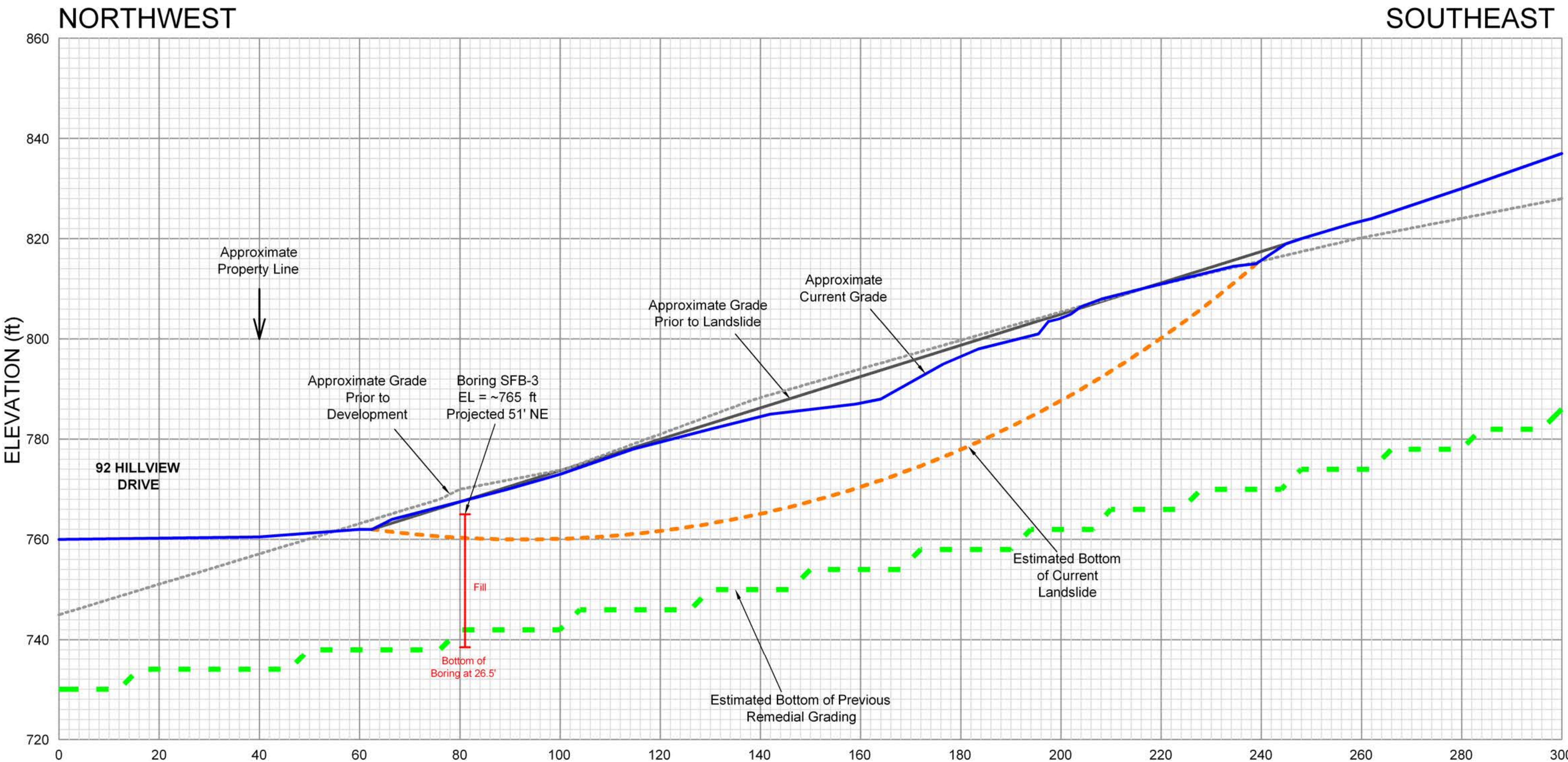



# CROSS-SECTION A - A'

*NOTE:*

1. *See Figure 1 for location of section.*
2. *Improvements, elevations, and locations of explorations are approximate.*
3. *Refer to exploration logs for more details. Boring logs projected onto cross-section.*
4. *See report for additional conditions and limitations.*

| | | | | | |
|---|---|---|---|---|---|
| HORIZONTAL & VERTICAL SCALE: 1" = 20'<br>0 20' 40' | DATE<br>June 2017<br>PROJECT NO.<br>768-1 | Stevens Ferrone & Bailey Engineering Company, Inc | *1600 Willow Pass Court<br>Concord, CA 94520<br>Tel 925.688.1001<br>Fax 925.688.1005<br>www.SFandB.com* | CROSS-SECTION A - A'<br>HILLVIEW DRIVE SLOPE REPAIR<br>Danville, California | FIGURE<br>2 |

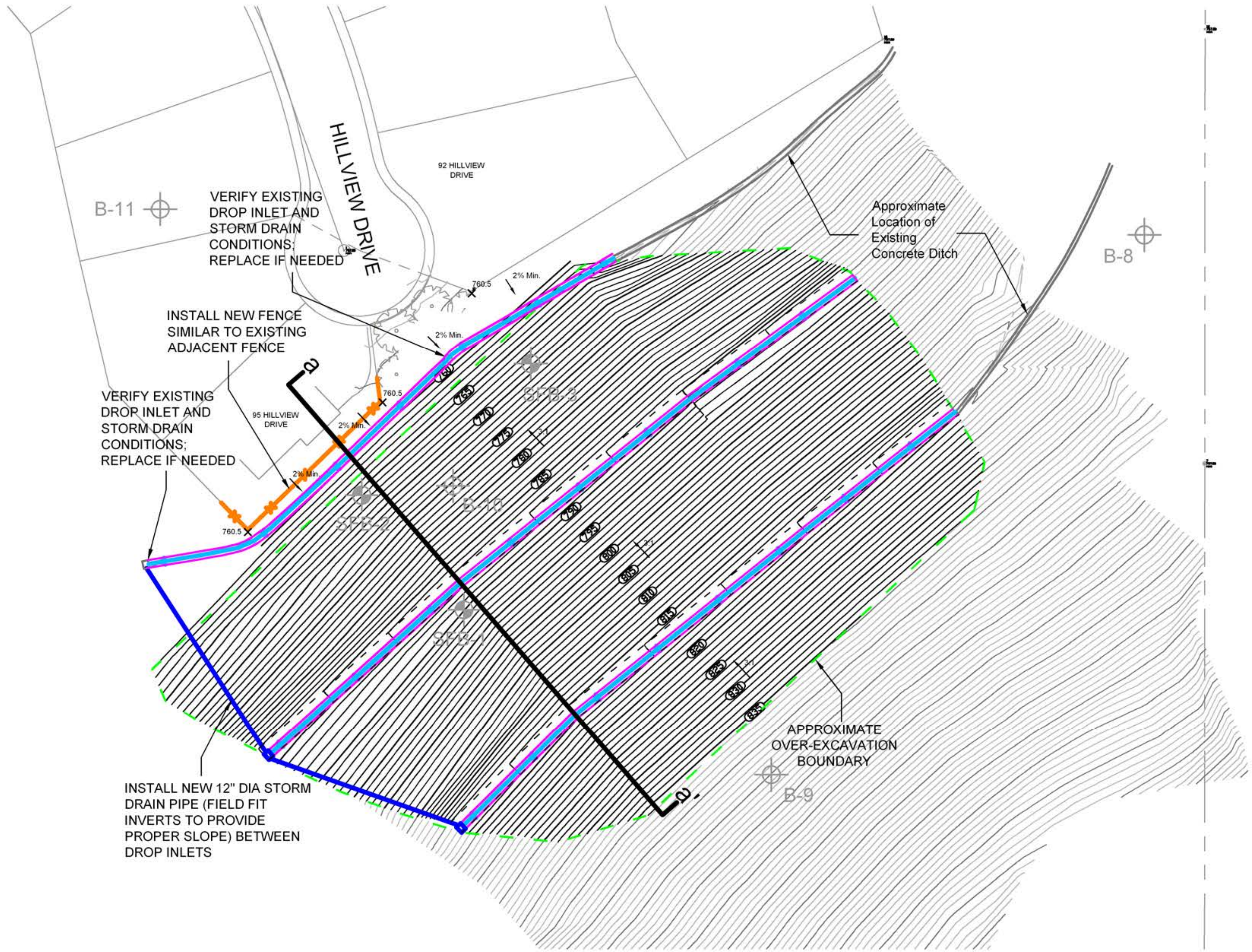



# CROSS-SECTION B - B'

*NOTE:*

1. *See Figure 1 for location of section.*
2. *Improvements, elevations, and locations of explorations are approximate.*
3. *Refer to exploration logs for more details. Boring logs projected onto cross-section.*
4. *See report for additional conditions and limitations.*

| HORIZONTAL & VERTICAL SCALE: 1" = 20' (0, 20', 40') | DATE: June 2017 | Stevens Ferrone & Bailey Engineering Company, Inc | *1600 Willow Pass Court, Concord, CA 94520, Tel 925.688.1001, Fax 925.688.1005, www.SFandB.com* | CROSS-SECTION B - B' | FIGURE |
|---|---|---|---|---|---|
| | PROJECT NO.: 768-1 | | | HILLVIEW DRIVE SLOPE REPAIR<br>Danville, California | 3 |




## KEY

- New Concrete J-Ditch with Subdrain (Arrow Showing Flow Direction)
- New Drop Inlet (Contra Costa County Type J Inlet with Frame & Grate)
- New 12 inch Dia. Storm Drain Pipe
- New Fence
- Approximate Final Grade Contour (800)
- 760.5 × Approximate Final Grade Elevation
- Approximate Over-excavation Boundary
- a a' Approximate Location of Cross-Section (See Figure 5 for the Sections)

NOTES: All elevations and locations shown are approximate; actual elevations and locations to be determined by the Engineer during construction.

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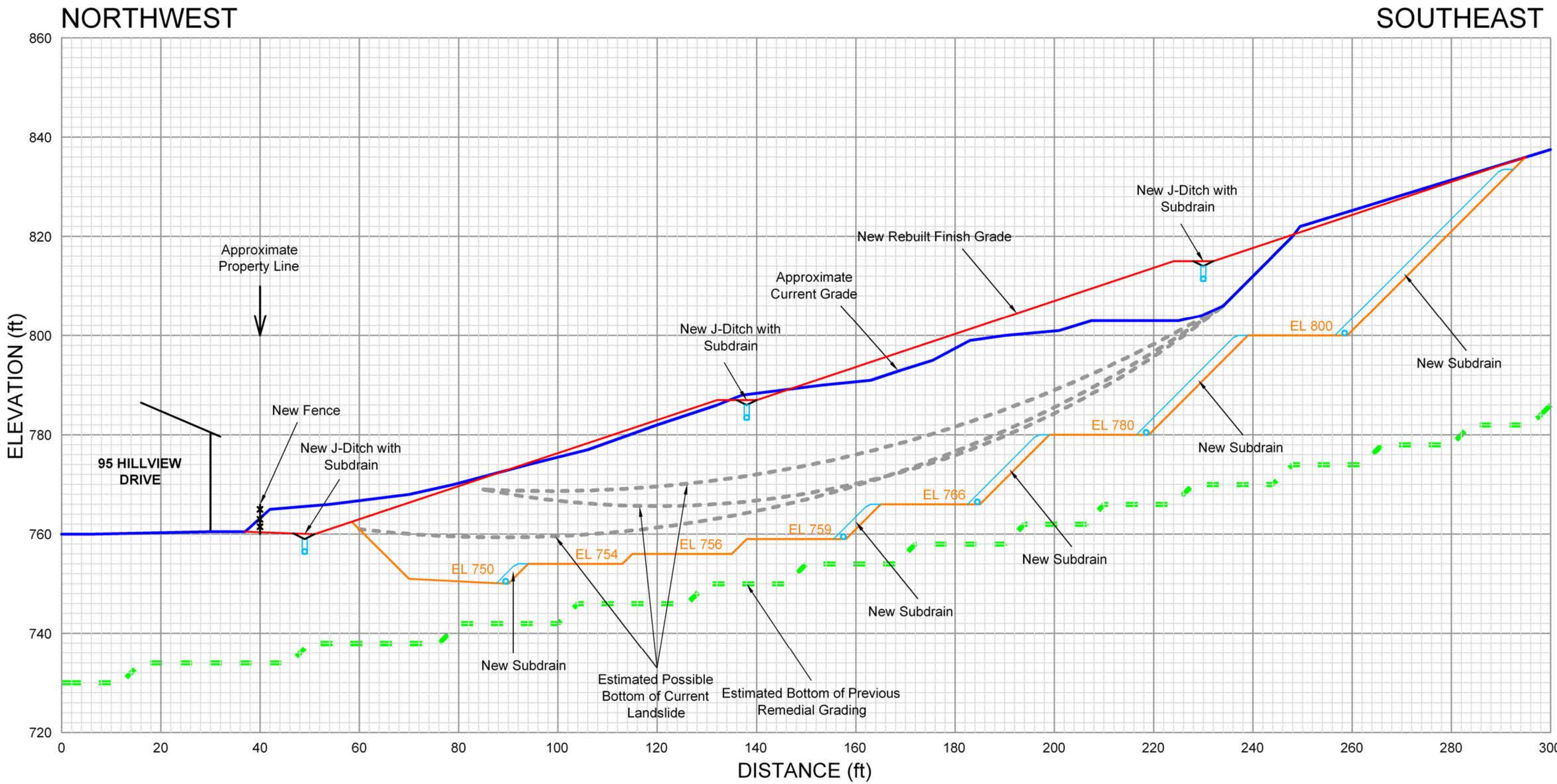
NOTE: Topographic survey by Meridian Associates, Inc. and dated April 2017.

| APPROXIMATE SCALE: 1" = 60'<br>0 60' 120' | DATE<br>June 2017<br>PROJECT NO.<br>768-1 | Stevens Ferrone & Bailey Engineering Company, Inc | 1600 Willow Pass Court<br>Concord, CA 94520<br>Tel 925.688.1001<br>Fax 925.688.1005<br>www.SFandB.com | RECOMMENDED SLOPE REPAIR<br>HILLVIEW DRIVE SLOPE REPAIR<br>Danville, California | FIGURE<br>4 |
|---|---|---|---|---|---|




## CROSS-SECTION a - a'

*NOTE:*
*All elevations and locations shown are approximate; actual elevations and locations to be determined by SFB during construction.*

| HORIZONTAL & VERTICAL SCALE: 1" = 20' (0, 20', 40') | DATE: June 2017 / PROJECT NO.: 768-1 | Stevens Ferrone & Bailey Engineering Company, Inc | 1600 Willow Pass Court, Concord, CA 94520, Tel 925.688.1001, Fax 925.688.1005, www.SFandB.com | CROSS-SECTION a - a' — HILLVIEW DRIVE REPAIR, Danville, California | FIGURE 5 |
|---|---|---|---|---|---|

**APPENDIX A**

Field Investigation

**APPENDIX A**
Field Investigation

Our field investigation for the proposed Hillview Drive slope repair project in Danville, California, consisted of surface reconnaissance and a subsurface exploration program. Geotechnical reconnaissance and geologic mapping of the site and surrounding area on February 22, April 5 and 19, and May 2, 2017. Subsurface exploration was performed using a track-mounted drill rig equipped with 6-inch diameter, continuous flight, solid stem auger. On April 19, 2017, three exploratory borings were drilled to depths of about 26-1/2 to 36 feet below existing ground surface. The soils are described in general accordance with the Unified Soil Classification System (ASTM D2487). The logs of the borings as well as a key for the classification of the soil (Figure A-1) are included as part of this appendix.

Representative samples were obtained from our exploratory boring at selected depths appropriate to the investigation. Relatively undisturbed samples were obtained using a 3-inch O.D. split barrel sampler with liners, and disturbed samples were obtained using the 2-inch O.D. split spoon sampler. All samples were transmitted to our offices for evaluation and appropriate testing. Both sampler types are indicated in the "Sampler" column of the boring log as designated in Figure A-1. The elevations discussed in this report and shown on the boring logs in this appendix were obtained from the base map shown on Figure 1; datum unknown.

Resistance blow counts were obtained in our boring with the samplers by dropping a 140-pound safety hammer through a 30-inch free fall. The sampler was driven 18 inches and the number of blows were recorded for each 6 inches of penetration. The blows per foot recorded on the boring log represent the accumulated number of converted blows that were required to drive the last 12 inches, or the number of inches indicated where hard resistance was encountered. The blow counts recorded on the boring log have been converted to equivalent SPT field blowcounts, but have not been corrected for overburden, silt content, or other factors.

The attached boring log and related information show our interpretation of the subsurface conditions at the dates and locations indicated, and it is not warranted that they are representative of subsurface conditions at other locations and times.

## UNIFIED SOIL CLASSIFICATION SYSTEM

| Major Divisions | | grf | ltr | Description |
|---|---|---|---|---|
| Coarse Grained Soils | Gravel<br>Gravelly Soils | | GW | Well-graded gravels or gravel sand mixtures, little or no fines |
| | | | GP | Poorly-graded gravels or gravel sand mixture, little or no fines |
| | | | GM | Silty gravels, gravel-sand-silt mixtures |
| | | | GC | Clayey gravels, gravel-sand-clay mixtures |
| | Sand And Sandy Soils | | 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, and-clay mixtures |

| Major Divisions | | grf | ltr | Description |
|---|---|---|---|---|
| Soils | Silts And Clays LL < 50 | | ML | Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity |
| | | | CL | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays |
| | | | OL | Organic silts and organic silt-clays of low plasticity |
| | Silts And Clays LL > 50 | | MH | Inorganic silts, micaceous or diatomaceous fine or silty soils, elastic silts |
| | | | CH | Inorganic clays of high plasticity, fat clays |
| | | | OH | Organic clays of medium to high plasticity |
| Highly Organic Soils | | | PT | Peat and other highly organic soils |

## GRAIN SIZES

U.S. STANDARD SERIES SIEVE: 200, 40, 10, 4

CLEAR SQUARE SIEVE OPENINGS: 3/4", 3", 12"

| Silts and Clays | Sand | | | Gravel | | Cobbles | Boulders |
|---|---|---|---|---|---|---|---|
| | Fine | Medium | Coarse | Fine | Coarse | | |

## RELATIVE DENSITY

| Sands and Gravels | Blows/Foot* |
|---|---|
| Very Loose | 0 - 4 |
| Loose | 4 - 10 |
| Medium Dense | 10 - 30 |
| Dense | 30 - 50 |
| Very Dense | Over 50 |

## CONSISTENCY

| Silts and Clays | Blows/Foot* | Strength (tsf)** |
|---|---|---|
| Very Soft | 0 - 2 | 0 - 1/4 |
| Soft | 2 - 4 | 1/4 - 1/2 |
| Firm | 4 - 8 | 1/2 - 1 |
| Stiff | 8 - 16 | 1 - 2 |
| Very Stiff | 16 - 32 | 2 - 4 |
| Hard | Over 32 | Over 4 |

*Number of Blows for a 140-pound hammer falling 30 inches, driving a 2-inch O.D. (1-3/8" I.D.) split spoon sampler.
**Unconfined compressive strength.

## SYMBOLS & NOTES

- Standard Penetration sampler (2" OD Split Barrel)
- Modified California sampler (3" OD Split Barrel)
- California Sampler (2.5" OD Split Barrel)
- Shelby Tube
- Pitcher Barrel
- HQ Core
- Ground Water level initially encountered
- Ground Water level at end of drilling

PI = Plasticity Index
LL = Liquid Limit
R = R-Value

### Increasing Visual Moisture Content

Saturated
Wet
Moist
Damp
Dry

### Constituent Percentage

| | |
|---|---|
| trace | <5% |
| some | 5-15% |
| with | 16-30% |
| -y | 31-49% |

Stevens, Ferrone & Bailey Engineering Company, Inc.
1600 Willow Pass Court
Concord, CA 94520
Tel: 925-688-1001
Fax: 925-688-1005

**KEY TO EXPLORATORY BORING LOGS**

**HILLVIEW DRIVE LANDSLIDE**
**Danville, CA**

| PROJECT NO. | DATE | FIGURE NO. |
|---|---|---|
| **768-1** | **June 2017** | **A-1** |

KEY 768-1.GPJ STEVENS FERRONE BAILEY.GDT 6/2/17

# ROCK MASS CHARACTERISTICS

**WEATHERING**

FRESH - Rock fresh, crystals bright, few joints may show slight staining. Rock rings under hammer blows if crystalline.
VERY SLIGHT - Rock generally fresh, joints stained, some joints may show thin clay coatings, crystals in broken face show bright. Rings under hammer blows if crystalline.
SLIGHT - Rock generally fresh, joints stained, and discoloration extends into rock up to 1 inch. Joints may contain clay. In granitiod rocks, some occasional feldspar crystals are dull and discolored. Crystalline rock rings under hammer blows.
MODERATE - Significant portions of rock show discoloration and weathering effects. In granitiod rocks, most feldspars are dull and discolored; some show clayey. Rock has dull sound under hammer and shows significant loss of strength as compared with fresh rock.
MODERATELY SEVERE - All rock except quartz discolored or stained. In granitiod rocks, all feldspars dull and discolored and majority show kaolinization. Rock shows severe loss of strength and can be excavated with geologist's pick. Rock goes "clunk" when struck.
SEVERE - All rock except quartz discolored or stained. Rock "fabric" clear and evident, but reduced in strength to strong soil. In some granitiod rocks, all feldspars kaolinized to some extent. Some fragments of strong rock usually remain.
VERY SEVERE - All rock except quartz discolored or stained. Rock "fabric" discernible, but rock mass effectively reduced to "soil" with only fragments of strong rock remaining.
COMPLETE - Rock reduced to "soil." Rock "fabric" not discernible or discernible only in small scattered locations. Quartz may be present as dikes or stringers.

**STRENGTH**

VERY STRONG - Resists breakage from hammer blows; but will yield dust and small chips.
STRONG - Withstands a few hammer blows; but will yield large fragments.
MODERATELY STRONG - Withstands a few firm hammer blows.
WEAK - Crumbles with light hammer blows.
FRIABLE - Can be broken down with hand and finger pressure.
LOW - Soil-like strength

**DISCONTINUITY SPACING**

| JOINTS | BEDDING, CLEAVAGE, FOLIATION | | |
|---|---|---|---|
| CRUSHED | Very Laminated | Less than 1/2 inch | Less than 1.3 cm |
| INTENSELY | Laminated | 1/2 to 1 inch | 1.3 cm to 2.5 cm |
| VERY CLOSE | Very Thin | 1 to 2 inches | 2.5 cm to 5 cm |
| CLOSE | Thin | 2 inches to 1 foot | 5 cm to 30 cm |
| MODERATELY CLOSE | Medium | 1 foot to 3 feet | 30 cm to 1 m |
| WIDE | Thick | 3 feet to 10 feet | 1 m to 3 m |
| VERY WIDE | Very Thick | Greater than 10 feet | Greater than 3 m |

**HARDNESS**

VERY HARD - Cannot be scratched with a knife; metal powder left on sample.
HARD - Scratched with knife with difficulty; trace of metal powder left on samples; scratch faintly visible.
MODERATELY HARD - Readily scratched with knife, scratch leaves heavy trace of dust and is readily visible.
LOW HARDNESS - Gouged or grooved to 1/16 inch by firm pressure on knife; scratches with penny.
SOFT - Gouged or grooved readily with a knife; small thin pieces can be grooved by finger pressure.
VERY SOFT - Carves with knife; scratched by fingernail.

**ROUGHNESS OF DISCONTINUITY SURFACES**

SMOOTH - Appears smooth and is essentially smooth to the touch. May be slickensided.
SLIGHTLY ROUGH - Asperities on the fracture are clearly visible.
MEDIUM ROUGH - Asperities are clearly visible and fracture surface feels abrasive.
ROUGH - Large angular asperities can be seen. Some ridge and high side angle steps are evident.
VERY ROUGH - Near vertical steps and ridges occur on the fracture surface.

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**KEY TO ROCK CHARACTERISTICS**

**HILLVIEW DRIVE LANDSLIDE**
**Danville, CA**

| PROJECT NO. | DATE | FIGURE NO. |
|---|---|---|
| **768-1** | **June 2017** | **A-2** |

ROCK CLASSIFICATION 768-1.GPJ STEVENS FERRONE BAILEY.GDT 6/2/17

| | | |
|---|---|---|
| DRILL RIG TK80A CFA | SURFACE ELEVATION 789 feet | LOGGED BY KF |
| DEPTH TO GROUND WATER 35 feet | BORING DIAMETER 6-inch | DATE DRILLED 04/19/17 |

| DESCRIPTION AND REMARKS | CONSIST | SOIL TYPE | DEPTH (FEET) | ELEVATION | SAMPLER | SPT N-VALUE | WATER CONTENT (%) | DRY DENSITY (PCF) | UNC. COMP. (KSF) | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|---|
| Landslide Debris: CLAY (CH), grayish brown, silty, some sand(fine- to coarse-grained), with occasional claystone pieces. | stiff | | 0 | | | | | | | |
| | | | | 785 | | | | | | |
| | | | 5 | | | 12 | 29 | 95 | | At 6':<br>Liquid Limit = 53<br>Plasticity Index = 36<br>Medium Sand = 1%<br>Fine Sand = 10%<br>Silt = 28%<br>Clay = 61% |
| | stiff - very stiff | | | 780 | | | | | | |
| | | | 10 | | | 17 | | | | |
| | | | | 775 | | | | | | |
| | | | 15 | | | 17 | 25 | 96 | | At 16':<br>Liquid Limit = 65<br>Plasticity Index = 44<br>Fine Sand = 3%<br>Silt = 14%<br>Clay = 83% |
| | | | | 770 | | | | | | |
| | stiff | | 20 | | | 11 | | | | |
| FILL: CLAY (CH), grayish brown, silty, some sand(fine- to coarse-grained), with occasional claystone pieces. | stiff | | | | | | | | | |
| | | | | 765 | | | | | | |
| | stiff - very stiff | | 25 | | | 16 | 30 | 91 | 2.7 | |
| | | | | 760 | | | | | | |
| | stiff | | 30 | | | 13 | 29 | | | |
| | | | | 755 | | | | | | |



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**EXPLORATORY BORING LOG**

**HILLVIEW DRIVE LANDSLIDE**
**Danville, CA**

| PROJECT NO. | DATE | BORING NO. |
|---|---|---|
| **768-1** | **June 2017** | **SFB-1** |

| DRILL RIG TK80A CFA | SURFACE ELEVATION 789 feet | LOGGED BY KF |
|---|---|---|
| DEPTH TO GROUND WATER 35 feet | BORING DIAMETER 6-inch | DATE DRILLED 04/19/17 |

| DESCRIPTION AND REMARKS | CONSIST | SOIL TYPE | DEPTH (FEET) | ELEVATION | SAMPLER | SPT N-VALUE | WATER CONTENT (%) | DRY DENSITY (PCF) | UNC. COMP. (KSF) | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|---|
| SILTSTONE grayish brown, moderately weathered. | friable | | 35 | | | 50/3" 50/6" | 17 | 107 | | |
| Bottom of Boring = 35.8 feet<br>Notes: Stratification is approximate, variations must be expected. Blowcounts converted to SPT N-values. See Report for additional details. | | | | | | | | | | |
| | | | | 750 | | | | | | |
| | | | 40 | | | | | | | |
| | | | | 745 | | | | | | |
| | | | 45 | | | | | | | |
| | | | | 740 | | | | | | |
| | | | 50 | | | | | | | |
| | | | | 735 | | | | | | |
| | | | 55 | | | | | | | |
| | | | | 730 | | | | | | |
| | | | 60 | | | | | | | |
| | | | | 725 | | | | | | |
| | | | 65 | | | | | | | |
| | | | | 720 | | | | | | |

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# EXPLORATORY BORING LOG

## HILLVIEW DRIVE LANDSLIDE
## Danville, CA

| PROJECT NO. | DATE | BORING NO. |
|---|---|---|
| **768-1** | **June 2017** | **SFB-1** |

| | | |
|---|---|---|
| DRILL RIG TK80A CFA | SURFACE ELEVATION 768 feet | LOGGED BY KF |
| DEPTH TO GROUND WATER Not Established | BORING DIAMETER 6-inch | DATE DRILLED 04/19/17 |

| DESCRIPTION AND REMARKS | CONSIST | SOIL TYPE | DEPTH (FEET) | ELEVATION | SAMPLER | SPT N-VALUE | WATER CONTENT (%) | DRY DENSITY (PCF) | UNC. COMP. (KSF) | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|---|
| LANDSLIDE DEBRIS:CLAY (CH), grayish brown, silty, some sand(fine- to coarse-grained), with occasional claystone pieces. | soft | | 0 | | X | 3 | | | | |
| | | | | 765 | | | | | | |
| Water seepage at 6'. | | | 5 | | X | 3 | 39 | 81 | | |
| FILL: CLAY (CH), grayish brown, silty, some sand(fine- to coarse-grained), with occasional claystone pieces. | stiff | | | 760 | | | | | | |
| | | | 10 | | X | 13 | 28 | 94 | 2.7 | At 11':<br>Liquid Limit = 59<br>Plasticity Index = 42<br>Fine Sand = 6%<br>Silt = 24%<br>Clay = 70% |
| | | | | 755 | | | | | | |
| | | | 15 | | X | 14 | 26 | 96 | 2.3 | |
| | | | | 750 | | | | | | |
| | | | 20 | | X | 10 | 28 | 94 | 2.9 | At 21':<br>Liquid Limit = 55<br>Plasticity Index = 37<br>Fine Sand = 7%<br>Silt = 23%<br>Clay = 70% |
| | | | | 745 | | | | | | |
| | | | 25 | | X | 10 | 30 | 92 | 2.5 | |
| Bottom of Boring = 26.5 feet<br>Notes: Stratification is approximate, variations must be expected. Blowcounts converted to SPT N-values. See Report for additional details. | | | | 740 | | | | | | |
| | | | 30 | | | | | | | |
| | | | | 735 | | | | | | |



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# EXPLORATORY BORING LOG

## HILLVIEW DRIVE LANDSLIDE
## Danville, CA

| PROJECT NO. | DATE | BORING NO. |
|---|---|---|
| **768-1** | **June 2017** | **SFB-2** |

| DRILL RIG TK80A CFA | SURFACE ELEVATION 765 feet | LOGGED BY KF |
|---|---|---|
| DEPTH TO GROUND WATER Not Established | BORING DIAMETER 6-inch | DATE DRILLED 04/19/17 |

| DESCRIPTION AND REMARKS | CONSIST | SOIL TYPE | DEPTH (FEET) | ELEVATION | SAMPLER | SPT N-VALUE | WATER CONTENT (%) | DRY DENSITY (PCF) | UNC. COMP. (KSF) | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|---|
| FILL: CLAY (CH), grayish brown, silty, some sand(fine- to coarse-grained), with occasional claystone pieces. | firm | CH | 0 | 765 | X | 4 | 40 | 77 | | |
| | very stiff | | | | | | | | | |
| Water seepage at 6'. | | | 5 | 760 | X | 26 | 23 | 103 | 3.5 | At 6': Liquid Limit = 58<br>Plasticity Index = 33<br>Fine Sand = 2%<br>Silt = 16%<br>Clay = 82% |
| | | | 10 | 755 | X | 26 | 24 | 102 | 4.0 | |
| | hard | | | | | | | | | |
| | | | 15 | 750 | X | 50/5" | 21 | 107 | 4.2 | At 16': Liquid Limit = 53<br>Plasticity Index = 27<br>Silt = 21%<br>Clay = 79% |
| | | | 20 | 745 | I | 39 | 20 | | | |
| | | | 25 | 740 | I | 39 | 22 | | | |
| Bottom of Boring = 26.5 feet<br>Notes: Stratification is approximate, variations must be expected. Blowcounts converted to SPT N-values. See Report for additional details. | | | | | | | | | | |
| | | | 30 | 735 | | | | | | |

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# EXPLORATORY BORING LOG

**HILLVIEW DRIVE LANDSLIDE**
**Danville, CA**

| PROJECT NO. | DATE | BORING NO. |
|---|---|---|
| **768-1** | **June 2017** | **SFB-3** |

**APPENDIX B**

Laboratory Investigation

# APPENDIX B
Laboratory Investigation

Our laboratory testing program for the proposed Hillview Drive slope repair project in Danville, California was directed toward a quantitative and qualitative evaluation of the physical and mechanical properties of the soils underlying the site.

The natural water content was determined on sixteen samples of the subsurface soils. The water contents are recorded on the boring logs at the appropriate sample depths.

Dry density determination was performed on thirteen samples of the subsurface soils to evaluate their physical properties. The results of the tests are shown on the boring logs at the appropriate sample depths.

Unconfined compression test was performed on eight relatively undisturbed samples of the subsurface soils to evaluate the undrained shear strengths of these materials. Failure was taken as the peak normal stress. The results of the tests are presented on the boring logs at the appropriate sample depths and are also attached to this appendix.

Gradation and hydrometer tests were performed on six samples of the subsurface soils. These tests were performed to assist in the classification of the soils and to determine their grain size distribution. The results of the tests are presented on the boring logs at the appropriate sample depths and are also attached to this appendix.

Laboratory compaction tests were performed on two representative samples of the onsite soils to determine the maximum dry density and optimum moisture content of these materials. The compaction tests were performed in accordance with ASTM D1557, latest edition. The results of the tests are attached to this appendix.

Consolidated drained direct shear tests (ASTM D3080) were performed on a set of remolded samples of the onsite fill materials. The results of the tests are attached to this appendix.

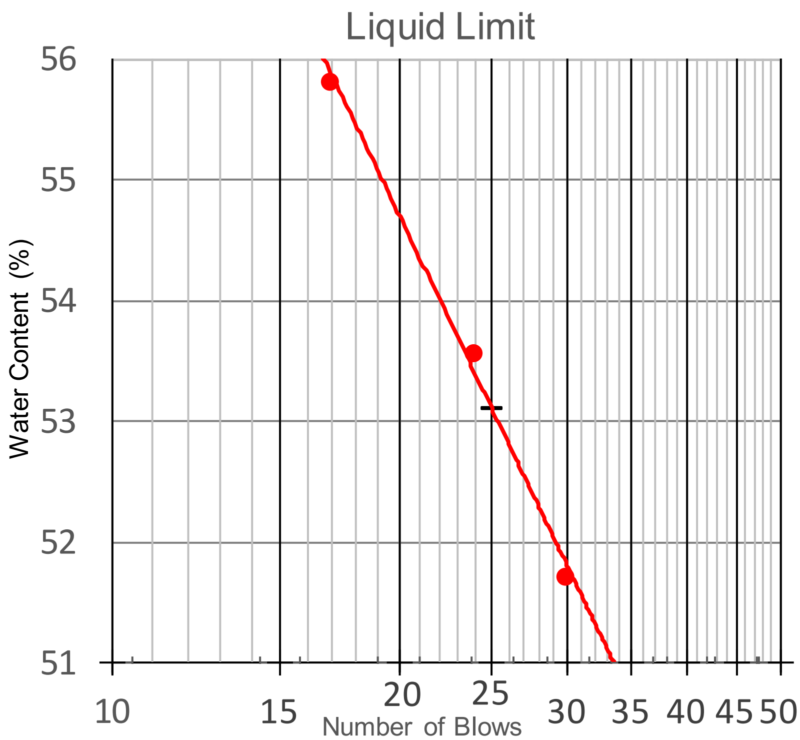
Drained fully softened peak (ASTM D7608) and residual (ASTM D6467) torsional shear tests were performed on a set of remolded samples of the onsite fill materials. The results of the tests are attached to this appendix.

## Atterberg Limits Test – ASTM D4318

**Project Number:** 768-1 **Project Name:** Hillview Drive Landslide

**Boring/Sample No:** SFB-1 **Depth** 6 ft **Date:** 05-04-17

**Description of Sample:** Gray brown silty CLAY some sand (CH) **Tested By** R

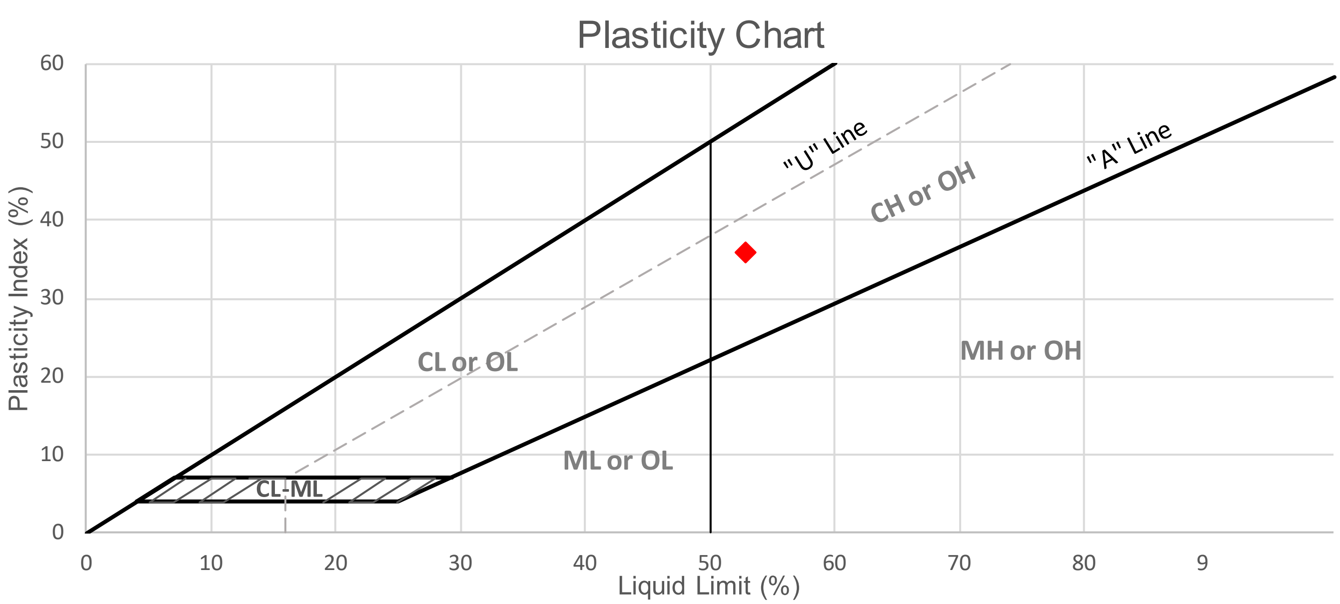



Plastic Limit Data

| Trial | 1 | 2 | Ave |
|---|---|---|---|
| Water Content (%) | 17.2 | 17.6 | 17 |

Data Summary

| | |
|---|---|
| Liquid Limit | **53** |
| Plastic Limit | **17** |
| Plasticity Index | **36** |
| Natural Water Content | **28.6** |
| Liquidity Index | **0.322** |
| % Passing #200 | **88.9** |



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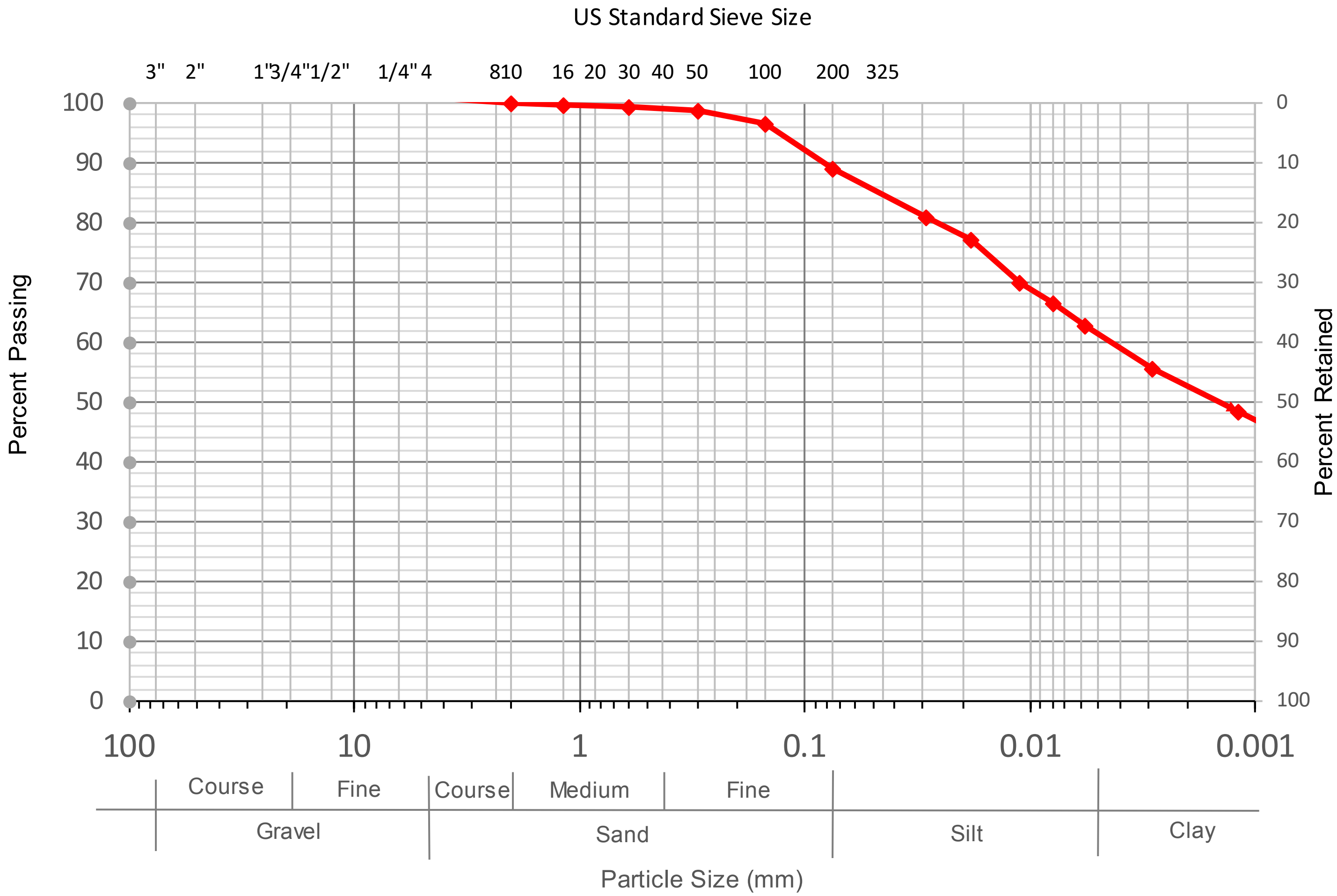
# Hydrometer Analysis – ASTM D422

**Project Number:** 768-1 **Project Name:** Hillview Drive Landslide

**Sample Number:** SFB-1 **Description:** Gray brown silty CLAY some sand (CH)

**Depth:** 6 ft **Test Date:** 05-01-17 **Tested By:** R




Composite Sieve Data

| Standard Sieve Size | Percent Passing |
|---|---|
| 3” | |
| 1.5” | |
| 3/4” | |
| 3/8” | |
| #4 | |
| #10 | 100 |
| #16 | 99.8 |
| #30 | 99.5 |
| #50 | 99.8 |
| #100 | 96.6 |
| #200 | 88.9 |

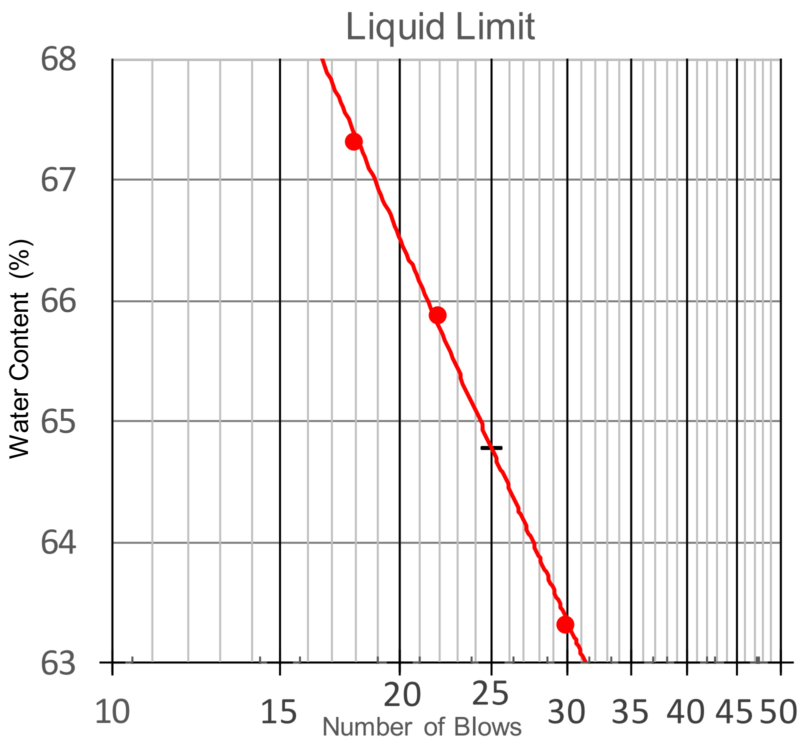
| Particle Diameter (mm) | Percent Soil in Suspension |
|---|---|
| 0.0288 | 80.8 |
| 0.0185 | 77.2 |
| 0.0111 | 70.0 |
| 0.0080 | 66.4 |
| 0.0057 | 62.8 |
| 0.0029 | 55.7 |
| 0.0012 | 48.5 |

# Atterberg Limits Test – ASTM D4318

**Project Number:** 768-1 **Project Name:** Hillview Drive Landslide

**Boring/Sample No:** SFB-1 **Depth:** 16 ft **Date:** 05-04-17

**Description of Sample:** Gray brown silty CLAY trace sand (CH) **Tested By** R

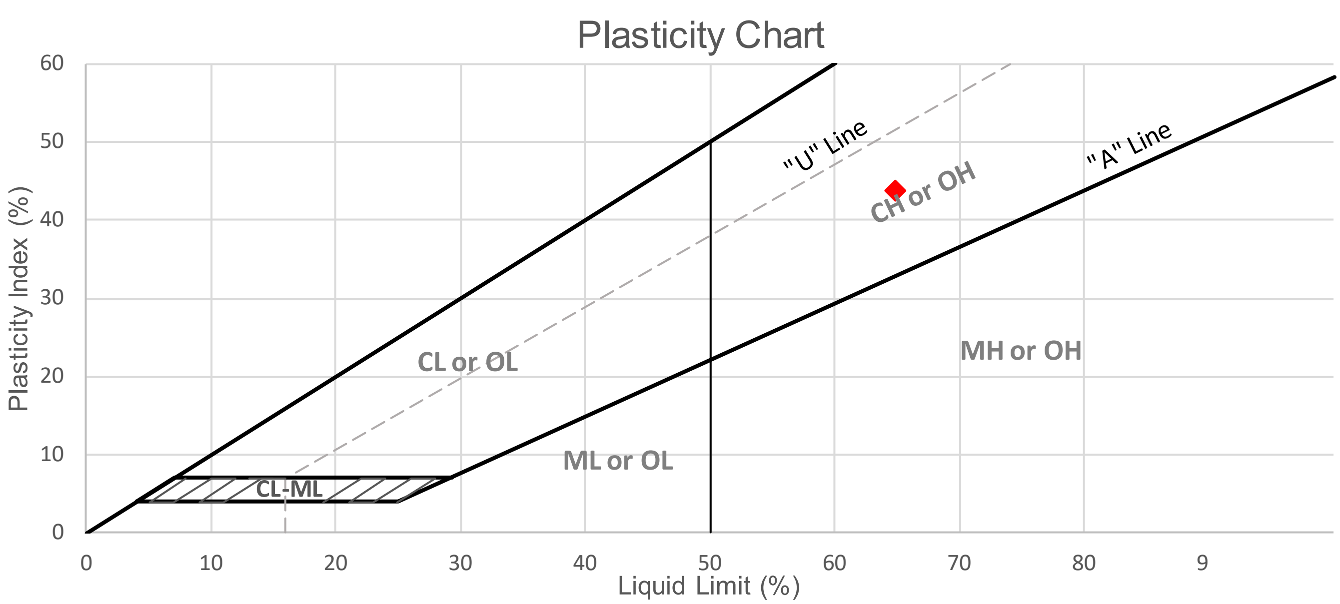



Plastic Limit Data

| Trial | 1 | 2 | Ave |
|---|---|---|---|
| Water Content (%) | 21.1 | 20.8 | 21 |

Data Summary

| | |
|---|---|
| Liquid Limit | **65** |
| Plastic Limit | **21** |
| Plasticity Index | **44** |
| Natural Water Content | **24.5** |
| Liquidity Index | **0.080** |
| % Passing #200 | **96.6** |

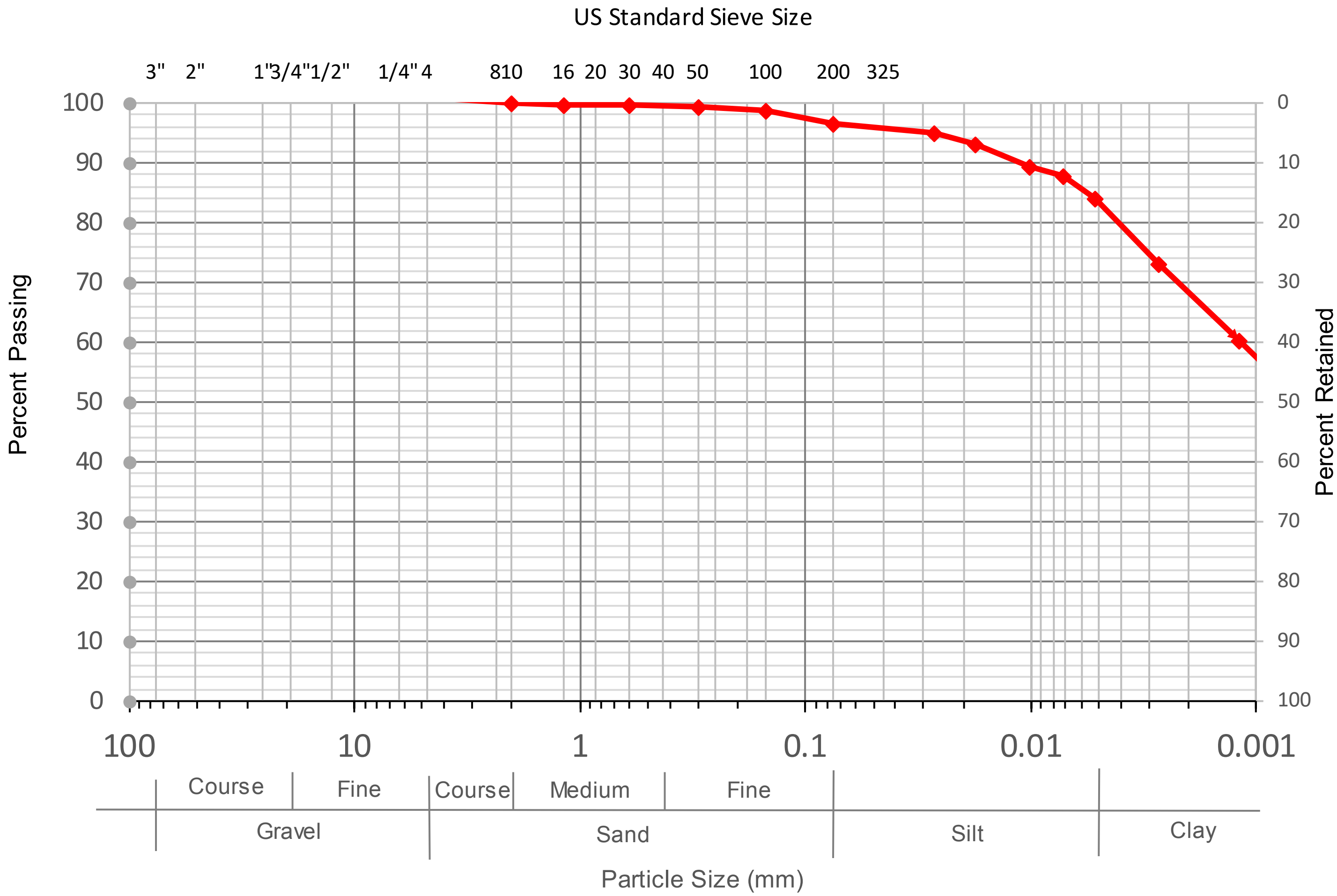


# Hydrometer Analysis – ASTM D422

**Project Number:** 768-1 **Project Name:** Hillview Drive Landslide

**Sample Number:** SFB-1 **Description:** Gray brown silty CLAY trace sand (CH)

**Depth:** 16 ft **Test Date:** 05-01-17 **Tested By:** R




Composite Sieve Data

| Standard Sieve Size | Percent Passing |
|---|---|
| 3” | |
| 1.5” | |
| 3/4” | |
| 3/8” | |
| #4 | |
| #10 | 100 |
| #16 | 99.8 |
| #30 | 99.6 |
| #50 | 99.4 |
| #100 | 98.7 |
| #200 | 96.6 |

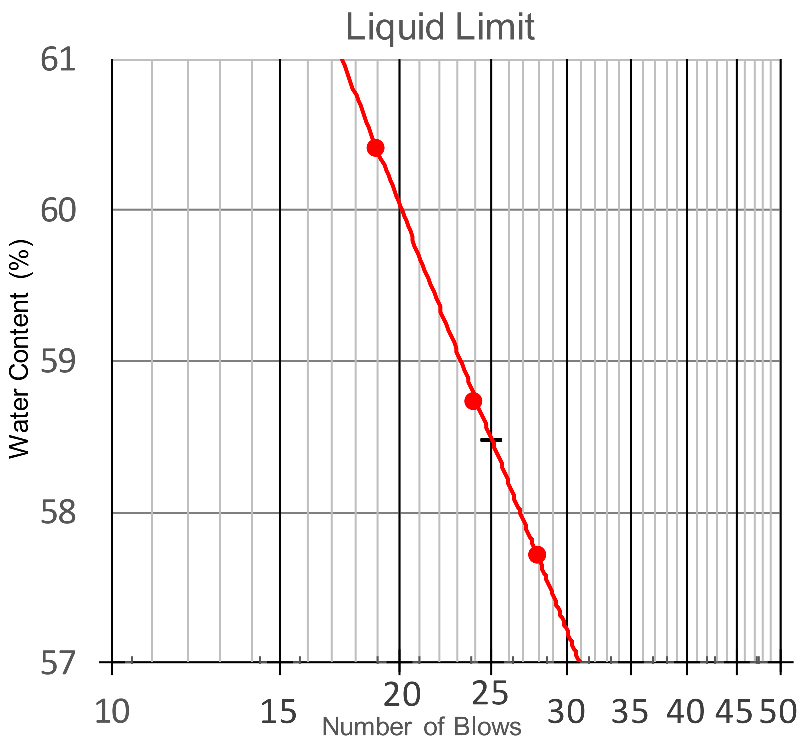
| Particle Diameter (mm) | Percent Soil in Suspension |
|---|---|
| 0.0270 | 95.0 |
| 0.0178 | 93.2 |
| 0.0102 | 89.5 |
| 0.0072 | 87.7 |
| 0.0052 | 84.1 |
| 0.0027 | 73.1 |
| 0.0012 | 60.3 |

# Atterberg Limits Test – ASTM D4318

**Project Number:** 768-1 **Project Name:** Hillview Drive Landslide

**Boring/Sample No:** SFB-2 **Depth:** 11 ft **Date:** 05-04-17

**Description of Sample:** Olive gray brown silty CLAY some sand (CH) **Tested By** R

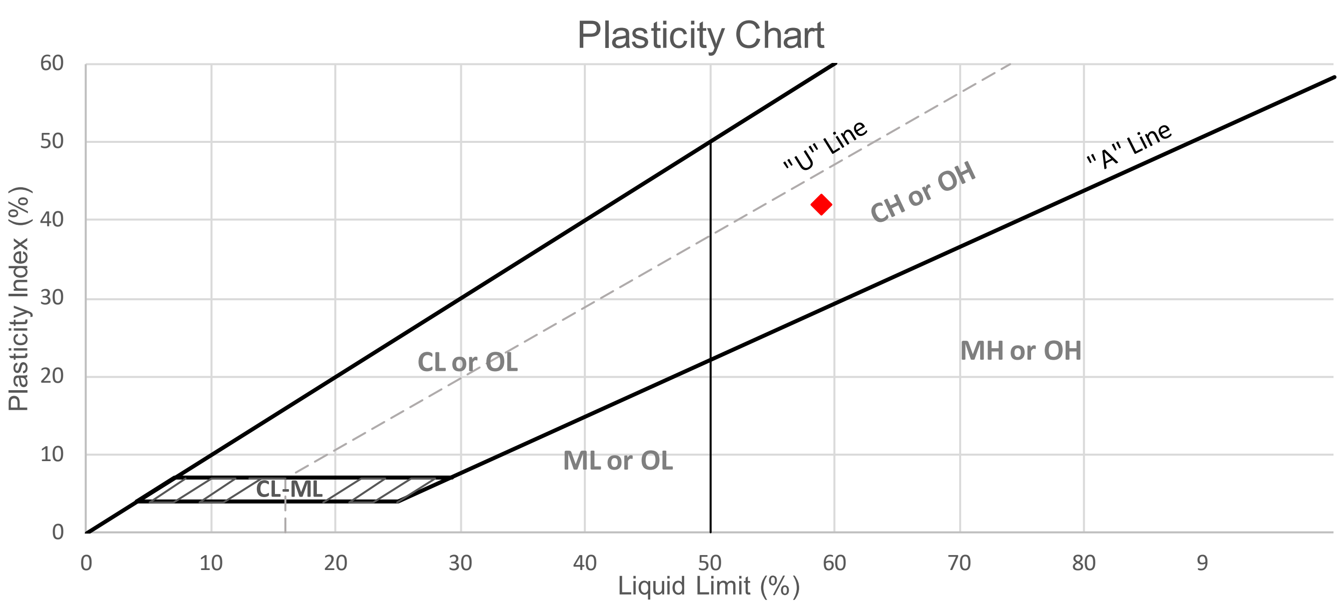



Plastic Limit Data

| Trial | 1 | 2 | Ave |
|---|---|---|---|
| Water Content (%) | 17.5 | 17.2 | 17 |

Data Summary

| | |
|---|---|
| Liquid Limit | **59** |
| Plastic Limit | **17** |
| Plasticity Index | **42** |
| Natural Water Content | **28.2** |
| Liquidity Index | **0.267** |
| % Passing #200 | **93.5** |



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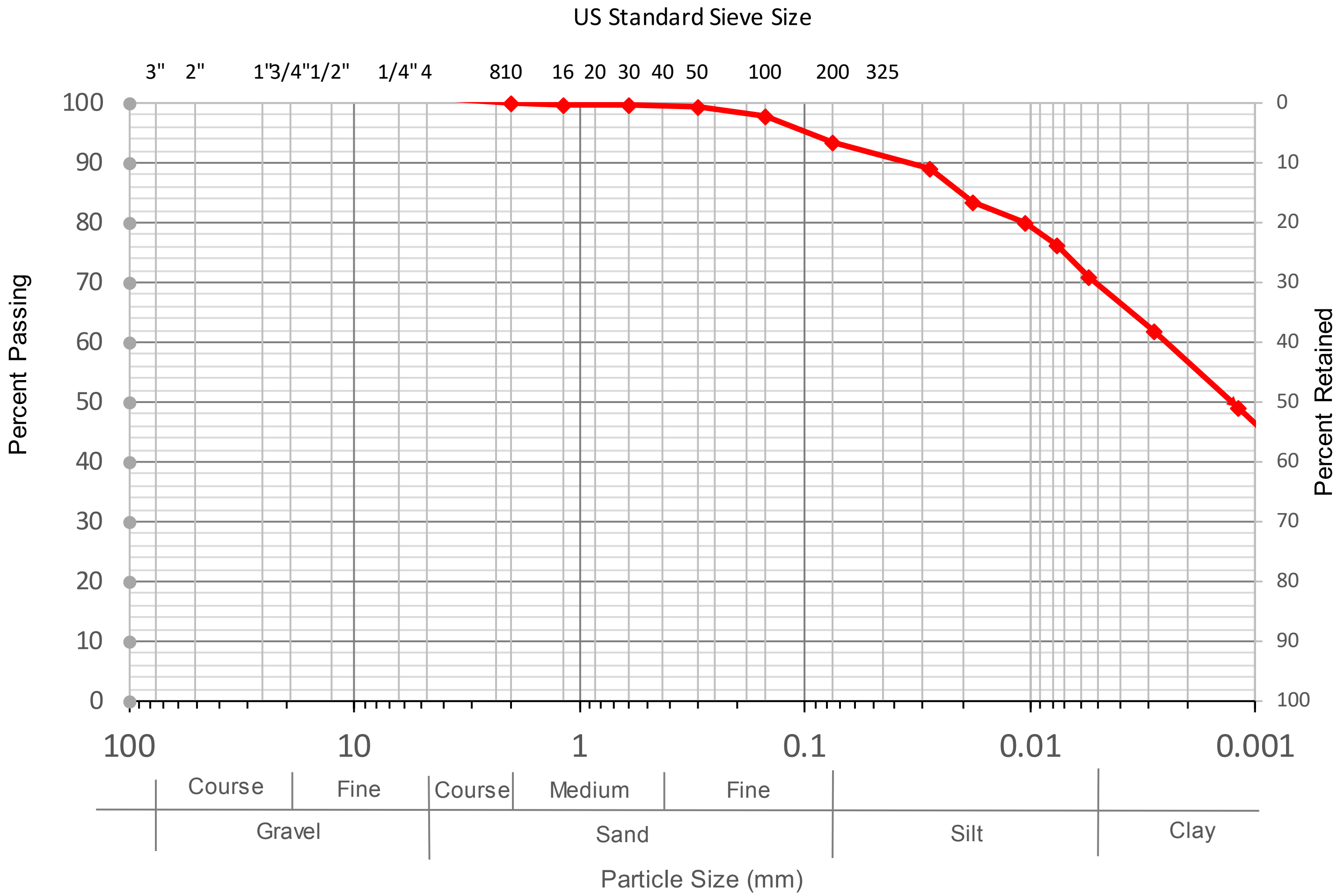
# Hydrometer Analysis – ASTM D422

**Project Number:** 768-1 **Project Name:** Hillview Drive Landslide

**Sample Number:** SFB-2 **Description:** Olive gray brown silty CLAY some sand (CH)

**Depth:** 11 ft **Test Date:** 05-01-17 **Tested By:** R




Composite Sieve Data

| Standard Sieve Size | Percent Passing |
|---|---|
| 3” | |
| 1.5” | |
| 3/4” | |
| 3/8” | |
| #4 | |
| #10 | 100 |
| #16 | 99.8 |
| #30 | 99.7 |
| #50 | 99.3 |
| #100 | 97.8 |
| #200 | 93.5 |

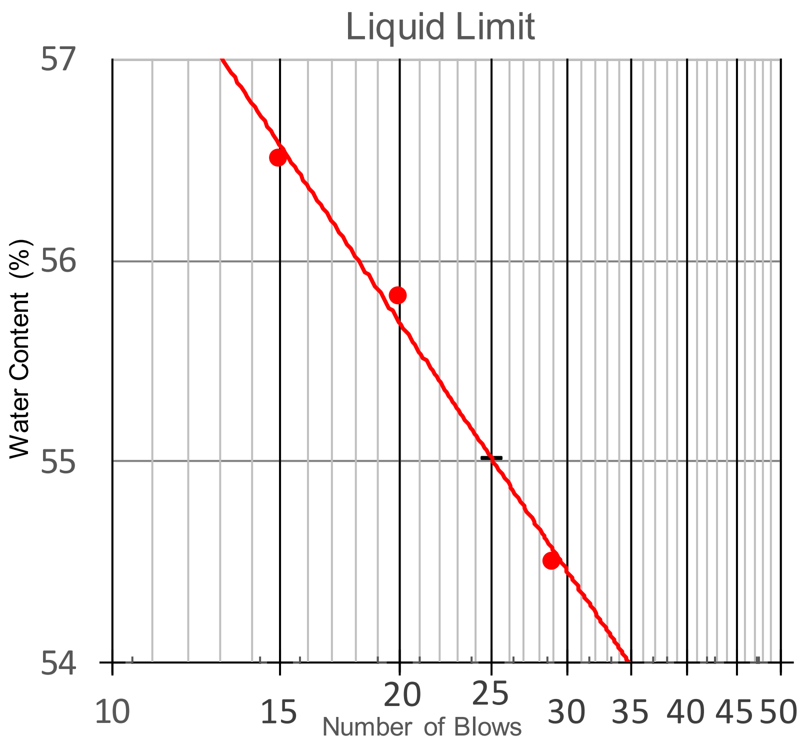
| Particle Diameter (mm) | Percent Soil in Suspension |
|---|---|
| 0.0278 | 88.9 |
| 0.0181 | 83.5 |
| 0.0106 | 79.9 |
| 0.0076 | 76.2 |
| 0.0055 | 70.8 |
| 0.0028 | 61.7 |
| 0.0012 | 49.0 |

## Atterberg Limits Test – ASTM D4318

**Project Number:** 768-1 **Project Name:** Hillview Drive Landslide

**Boring/Sample No:** SFB-2 **Depth:** 21 ft **Date:** 05-04-17

**Description of Sample:** Gray brown silty CLAY some sand (CH) **Tested By** R

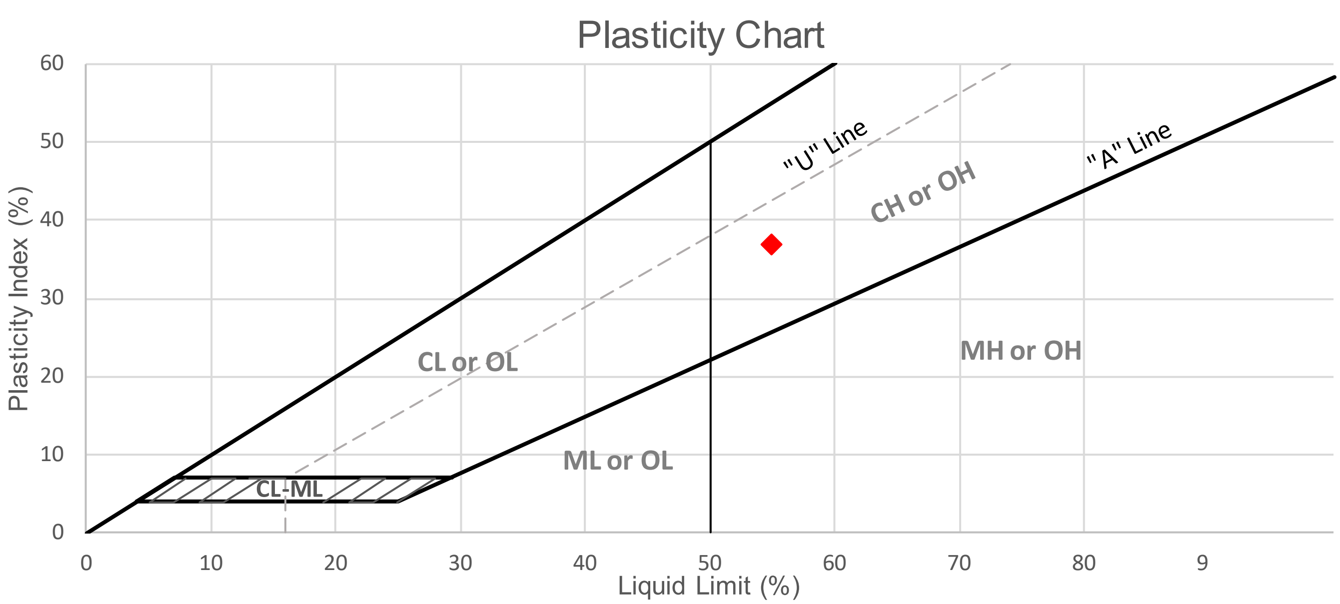



Plastic Limit Data

| Trial | 1 | 2 | Ave |
|---|---|---|---|
| Water Content (%) | 17.2 | 17.8 | 18 |

Data Summary

| | |
|---|---|
| Liquid Limit | **55** |
| Plastic Limit | **18** |
| Plasticity Index | **37** |
| Natural Water Content | **27.5** |
| Liquidity Index | **0.257** |
| % Passing #200 | **92.7** |

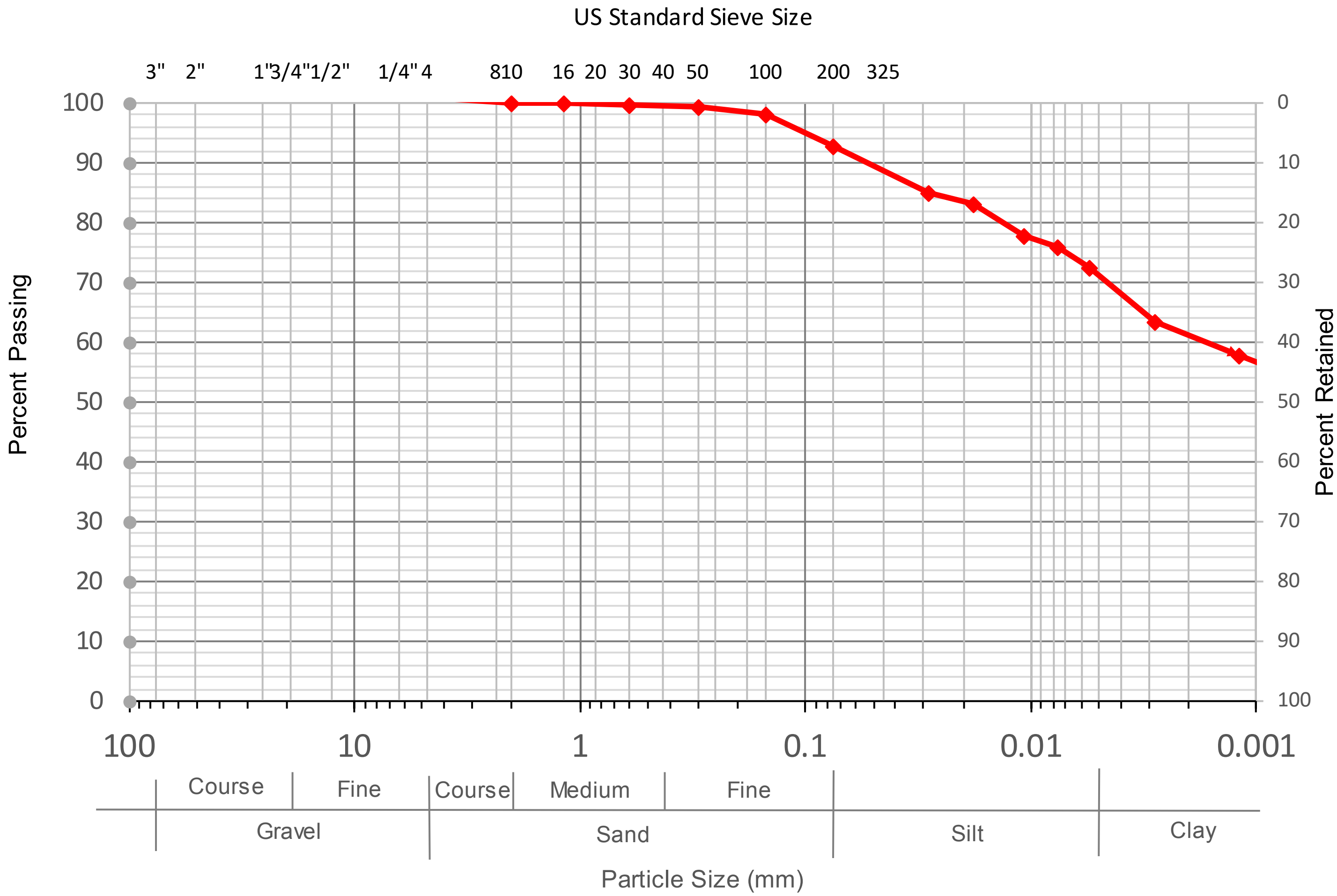


# Hydrometer Analysis – ASTM D422

**Project Number:** 768-1 **Project Name:** Hillview Drive Landslide

**Sample Number:** SFB-2 **Description:** Gray brown silty CLAY some sand (CH)

**Depth:** 21 ft **Test Date:** 05-01-17 **Tested By:** R




Composite Sieve Data

| Standard Sieve Size | Percent Passing |
|---|---|
| 3” | |
| 1.5” | |
| 3/4” | |
| 3/8” | |
| #4 | |
| #10 | 100 |
| #16 | 100 |
| #30 | 99.8 |
| #50 | 99.2 |
| #100 | 98.0 |
| #200 | 92.7 |

| Particle Diameter (mm) | Percent Soil in Suspension |
|---|---|
| 0.0283 | 85.0 |
| 0.0181 | 83.2 |
| 0.0107 | 77.8 |
| 0.0076 | 76.0 |
| 0.0055 | 72.4 |
| 0.0028 | 63.3 |
| 0.0012 | 57.9 |

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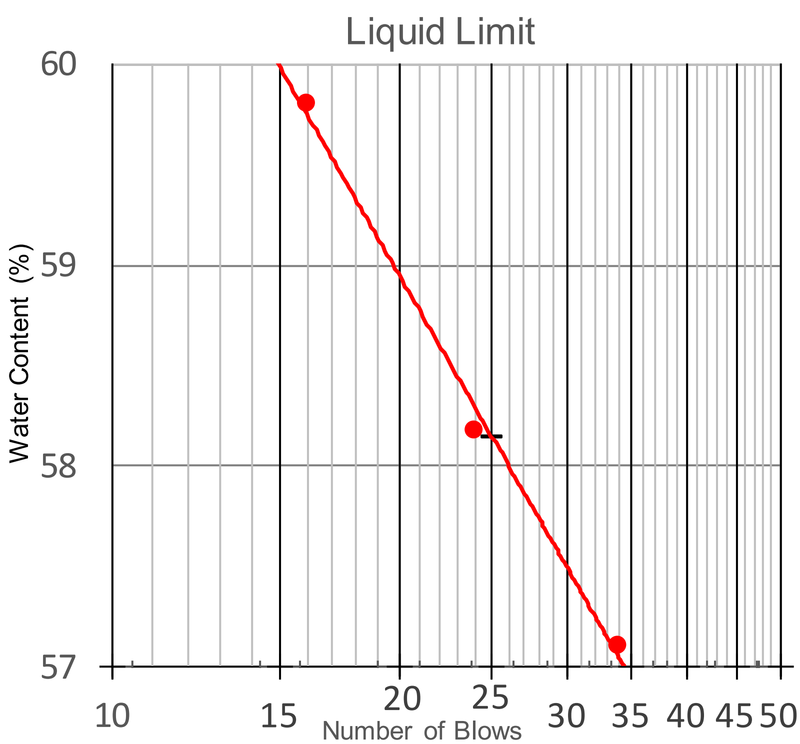
# Atterberg Limits Test – ASTM D4318

**Project Number:** 768-1 **Project Name:** Hillview Drive Landslide

**Boring/Sample No:** SFB-3 **Depth:** 6 ft **Date:** 05-04-17

**Description of Sample:** Gray brown silty CLAY trace sand (CH) **Tested By** R

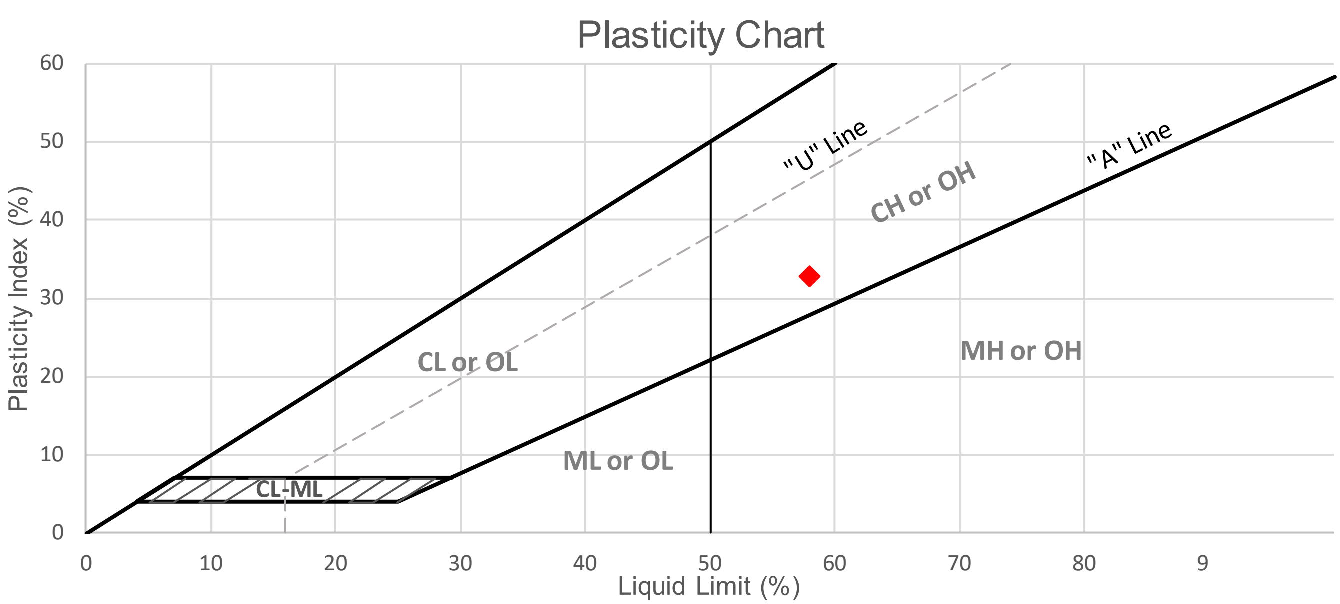



Plastic Limit Data

| Trial | 1 | 2 | Ave |
|---|---|---|---|
| Water Content (%) | 24.8 | 25.0 | 25 |

Data Summary

| | |
|---|---|
| Liquid Limit | **58** |
| Plastic Limit | **25** |
| Plasticity Index | **33** |
| Natural Water Content | **22.8** |
| Liquidity Index | **-0.067** |
| % Passing #200 | **98.3** |



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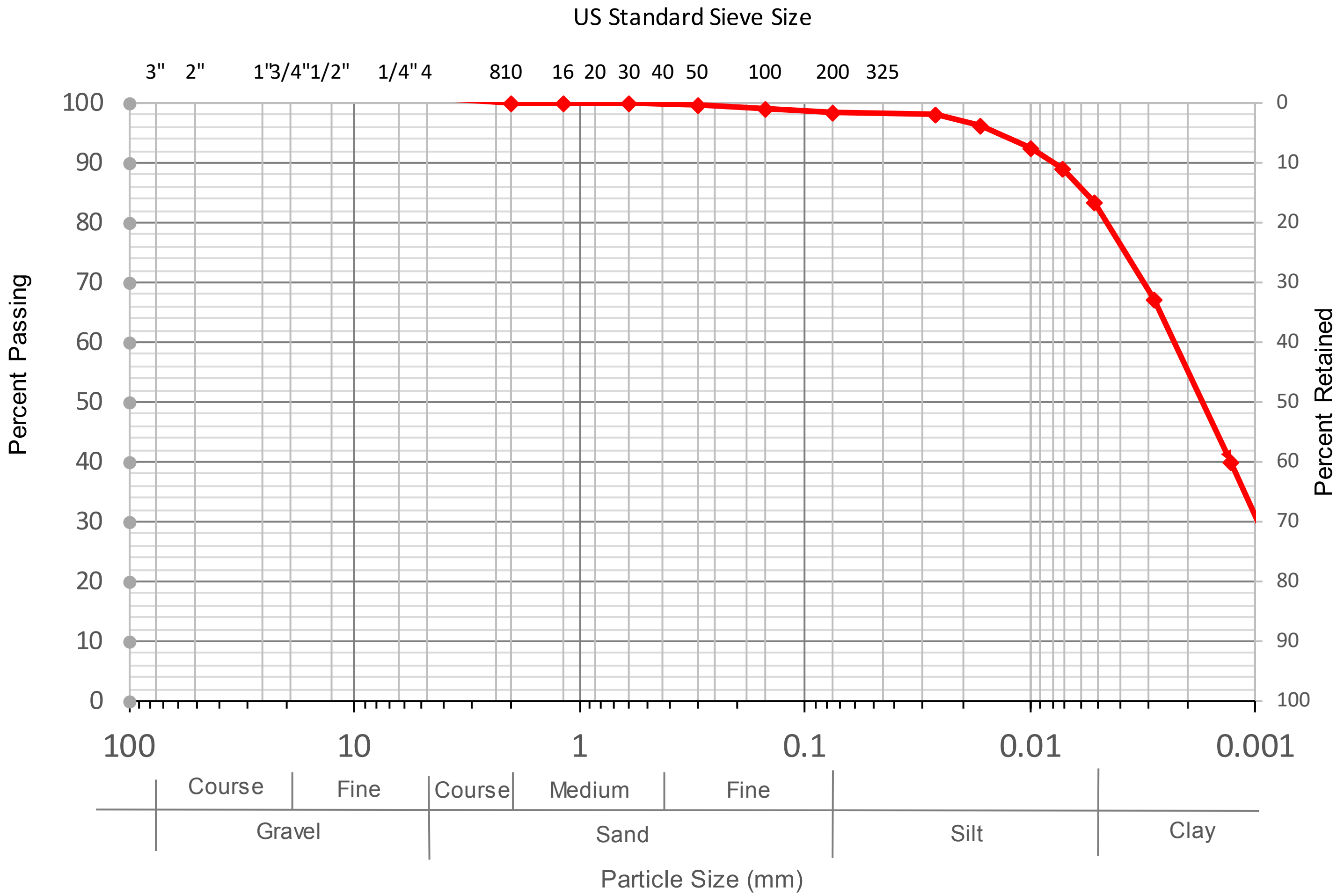
# Hydrometer Analysis – ASTM D422

**Project Number:** 768-1 **Project Name:** Hillview Drive Landslide

**Sample Number:** SFB-3 **Description:** Gray brown silty CLAY trace sand (CH)

**Depth:** 6 ft **Test Date:** 05-01-17 **Tested By:** R




Composite Sieve Data

| Standard Sieve Size | Percent Passing |
|---|---|
| 3" | |
| 1.5" | |
| 3/4" | |
| 3/8" | |
| #4 | |
| #10 | 100 |
| #16 | 100 |
| #30 | 100 |
| #50 | 99.6 |
| #100 | 99.1 |
| #200 | 98.3 |

| Particle Diameter (mm) | Percent Soil in Suspension |
|---|---|
| 0.0263 | 98.0 |
| 0.0168 | 96.2 |
| 0.0099 | 92.6 |
| 0.0072 | 88.9 |
| 0.0052 | 83.5 |
| 0.0028 | 67.2 |
| 0.0013 | 39.9 |

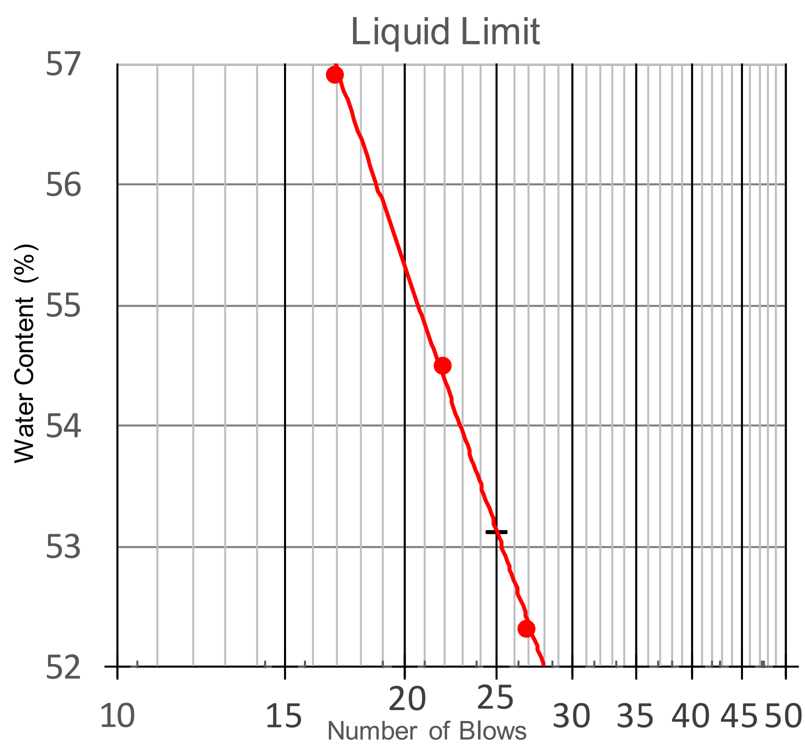
Stevens Ferrone & Bailey Engineering Company, Inc

# Atterberg Limits Test – ASTM D4318

**Project Number:** 768-1 **Project Name:** Hillview Drive Landslide

**Boring/Sample No:** SFB-3 **Depth:** 16 ft **Date:** 05-04-17

**Description of Sample:** Gray brown silty CLAY (CH/MH) **Tested By** R

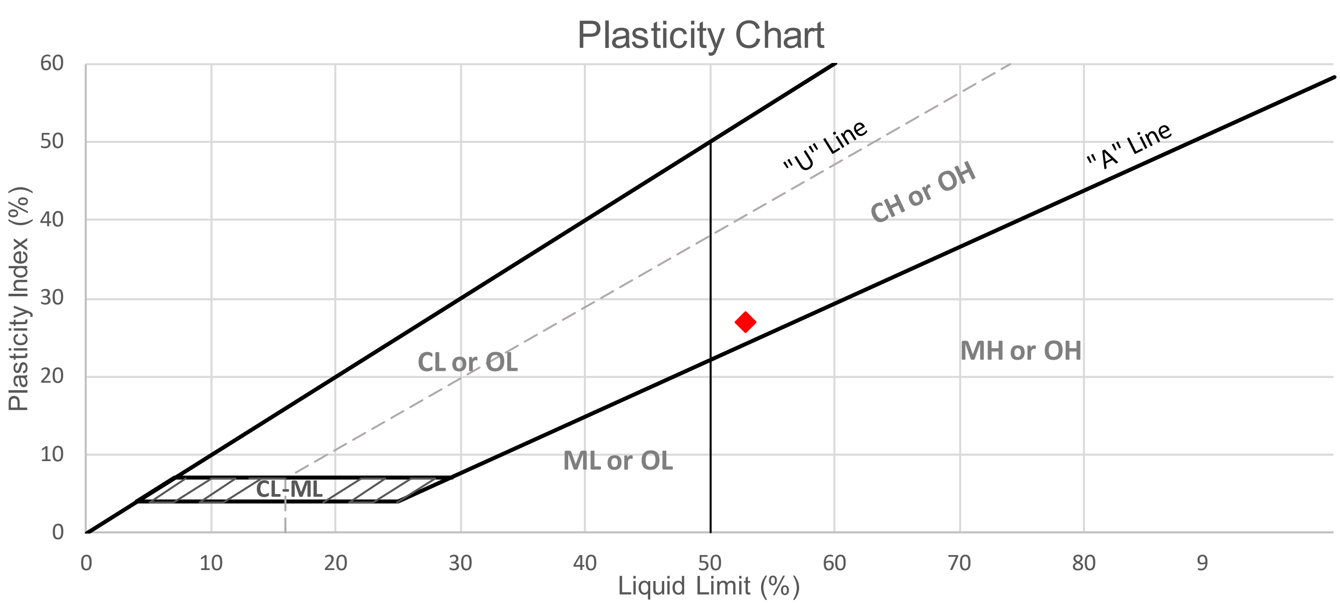



Plastic Limit Data

| Trial | 1 | 2 | Ave |
|---|---|---|---|
| Water Content (%) | 25.9 | 25.4 | 26 |

Data Summary

| | |
|---|---|
| Liquid Limit | **53** |
| Plastic Limit | **26** |
| Plasticity Index | **27** |
| Natural Water Content | **21.3** |
| Liquidity Index | **-0.174** |
| % Passing #200 | **99.7** |

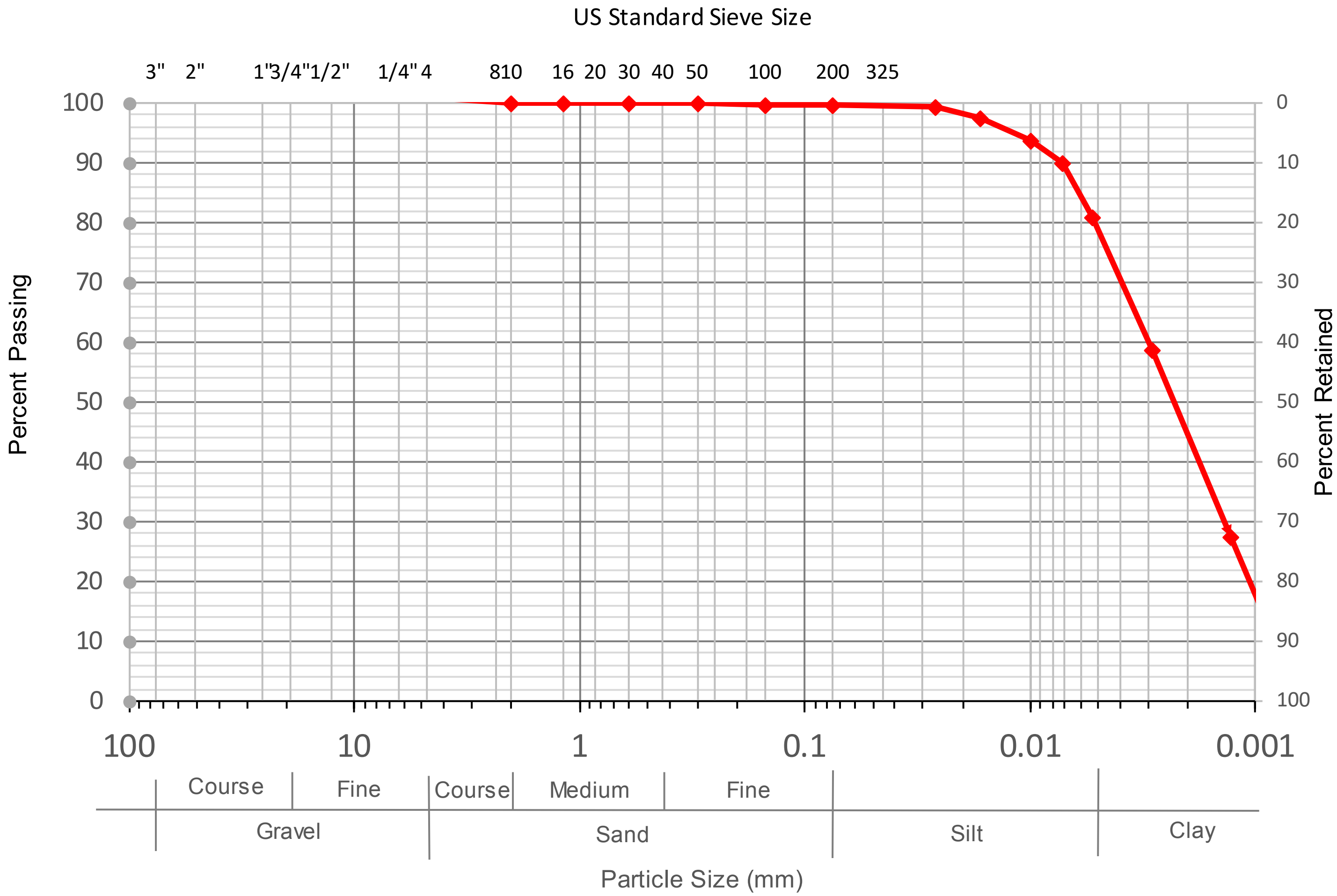


## Hydrometer Analysis – ASTM D422

**Project Number:** 768-1 **Project Name:** Hillview Drive Landslide

**Sample Number:** SFB-3 **Description:** Gray brown silty CLAY (CH)

**Depth:** 16 ft **Test Date:** 05-01-17 **Tested By:** R




Composite Sieve Data

| Standard Sieve Size | Percent Passing |
|---|---|
| 3” | |
| 1.5” | |
| 3/4” | |
| 3/8” | |
| #4 | |
| #10 | 100 |
| #16 | 100 |
| #30 | 100 |
| #50 | 100 |
| #100 | 99.8 |
| #200 | 99.7 |

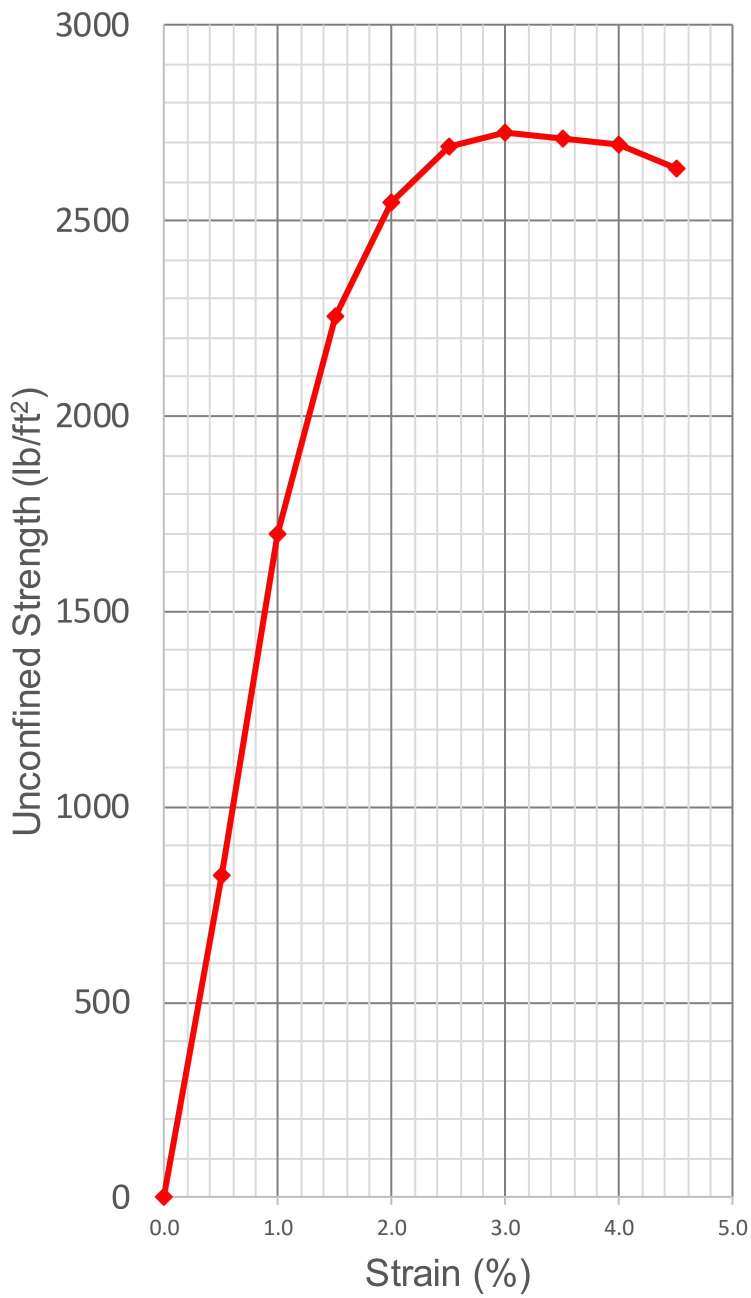
| Particle Diameter (mm) | Percent Soil in Suspension |
|---|---|
| 0.0263 | 99.3 |
| 0.0168 | 97.5 |
| 0.0099 | 93.8 |
| 0.0072 | 90.1 |
| 0.0053 | 80.9 |
| 0.0029 | 58.8 |
| 0.0013 | 27.6 |

## UNCONFINED COMPRESSIVE STRENGTH – D2166

**Project Number:** 768-1 **Boring #:** SFB-1 **Depth:** 26 ft

**Project Name:** Hillview Drive Landslide **Date:** 4/26/2017

**Description:** Gray brown silty CLAY some sand (CH) **Tested By:** R




| Soil Specimen Initial Measurements | |
|---|---|
| Diameter | 2.42 in |
| Initial Area | 4.60 $in^2$ |
| Initial Length | 5 in |
| Volume | 0.01331 $ft^3$ |
| Water Content | 29.6 |
| Wet Density | 118.4 pcf |
| Dry Density | 91.4 pcf |

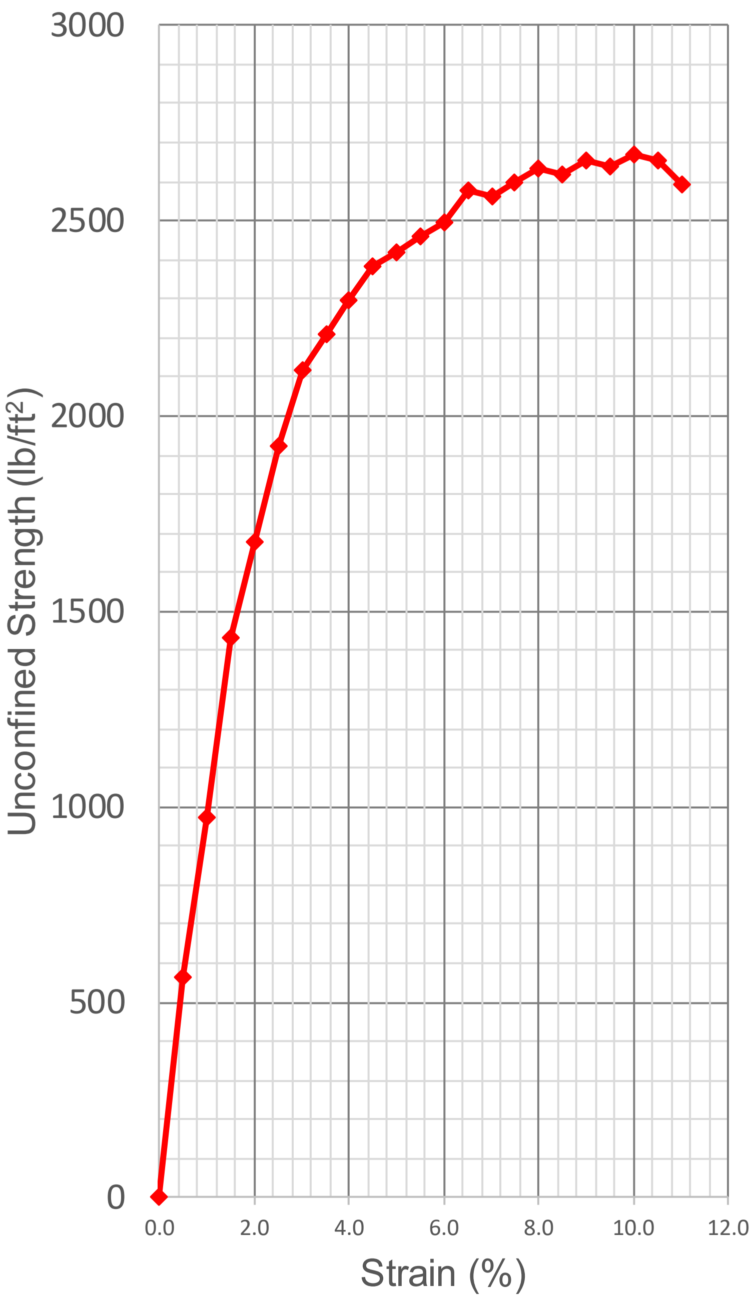
| Max Unconfined Compressive Strength | |
|---|---|
| Elapsed Time | 3 min |
| Vertical Dial | 0.15 in |
| Strain | 3.0 % |
| Area | 0.03293 $ft^2$ |
| Axial Load | 89.7 lbs |
| Compressive Strength | 2,724 psf |

# UNCONFINED COMPRESSIVE STRENGTH – D2166

**Project Number:** 768-1 **Boring #:** SFB-2 **Depth:** 11 ft

**Project Name:** Hillview Drive Landslide **Date:** 4/26/2017

**Description:** Olive gray brown silty CLAY some sand (CH) **Tested By:** R




| Soil Specimen Initial Measurements | |
|---|---|
| Diameter | 2.42 in |
| Initial Area | 4.60 $in^2$ |
| Initial Length | 5 in |
| Volume | 0.01331 $ft^3$ |
| Water Content | 28.2 |
| Wet Density | 120.8 pcf |
| Dry Density | 94.2 pcf |

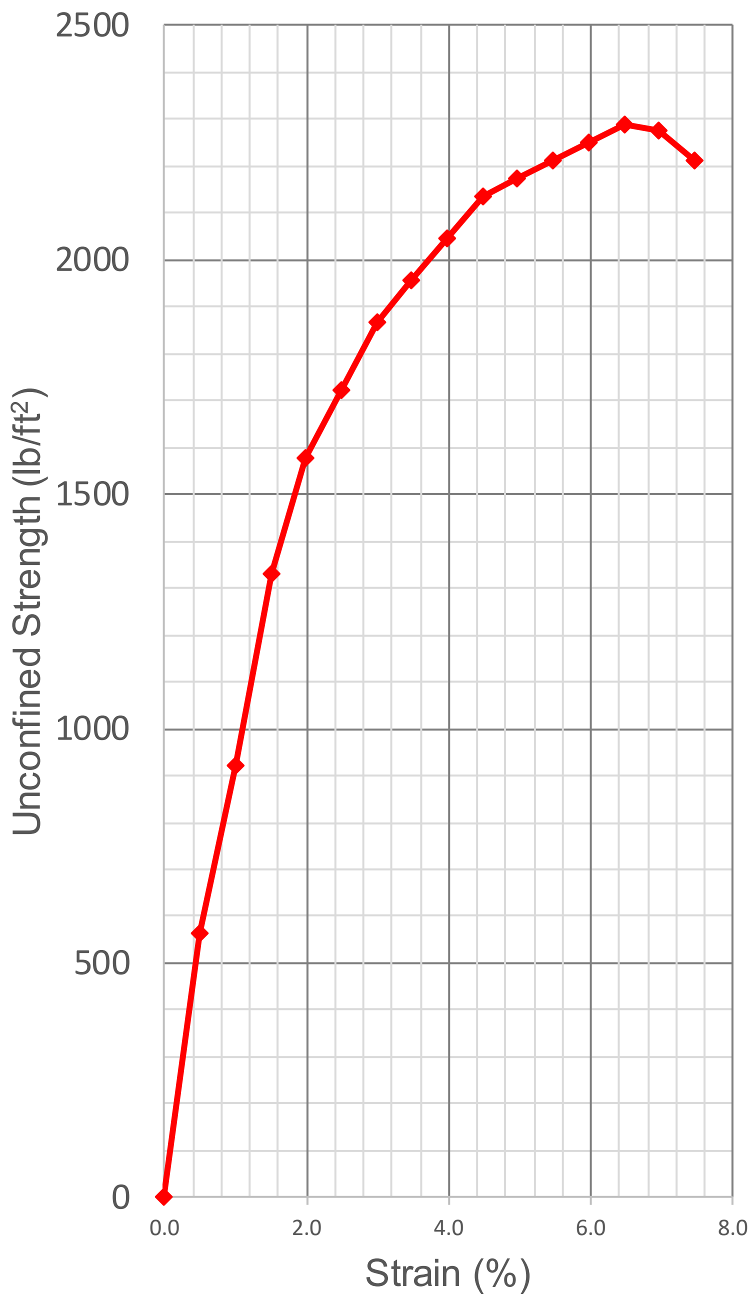
| Max Unconfined Compressive Strength | |
|---|---|
| Elapsed Time | 10 min |
| Vertical Dial | 0.5 in |
| Strain | 10.0 % |
| Area | 0.03549 $ft^2$ |
| Axial Load | 94.7 lbs |
| Compressive Strength | 2,668 psf |

## UNCONFINED COMPRESSIVE STRENGTH – D2166

**Project Number:** 768-1 **Boring #:** SFB-2 **Depth:** 16 ft

**Project Name:** Hillview Drive Landslide **Date:** 4/26/2017

**Description:** Gray brown silty CLAY some sand (CH) **Tested By:** R




| Soil Specimen Initial Measurements | |
|---|---|
| Diameter | 2.42 in |
| Initial Area | 4.60 $in^2$ |
| Initial Length | 5.03 in |
| Volume | 0.01339 $ft^3$ |
| Water Content | 25.5 |
| Wet Density | 120.9 pcf |
| Dry Density | 96.3 pcf |

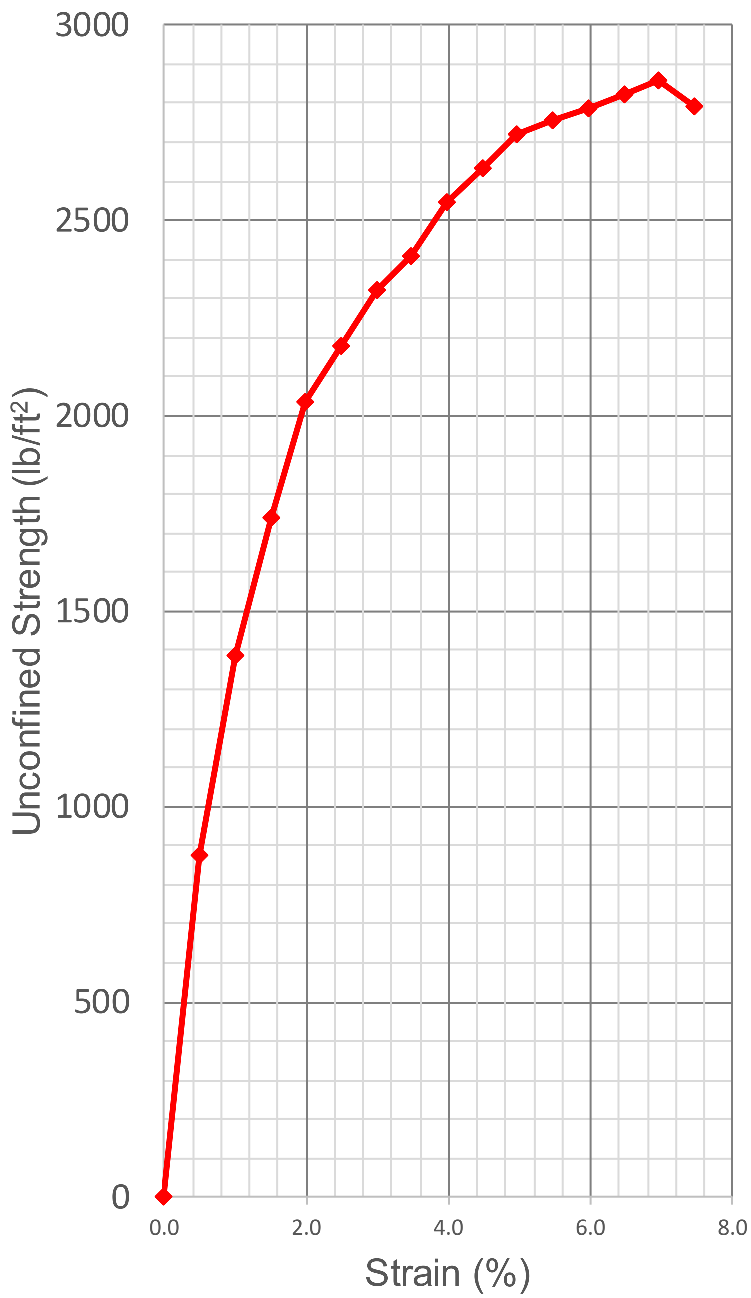
| Max Unconfined Compressive Strength | |
|---|---|
| Elapsed Time | 6.5 min |
| Vertical Dial | 0.325 in |
| Strain | 6.5 % |
| Area | 0.03415 $ft^2$ |
| Axial Load | 78.1 lbs |
| Compressive Strength | 2,287 psf |

# UNCONFINED COMPRESSIVE STRENGTH – D2166

**Project Number:** 768-1 **Boring #:** SFB-2 **Depth:** 21 ft

**Project Name:** Hillview Drive Landslide **Date:** 4/26/2017

**Description:** Gray brown silty CLAY some sand (CH) **Tested By:** R




| Soil Specimen Initial Measurements | |
|---|---|
| Diameter | 2.42 in |
| Initial Area | 4.60 $in^2$ |
| Initial Length | 5.03 in |
| Volume | 0.01339 $ft^3$ |
| Water Content | 27.5 |
| Wet Density | 120.4 pcf |
| Dry Density | 94.4 pcf |

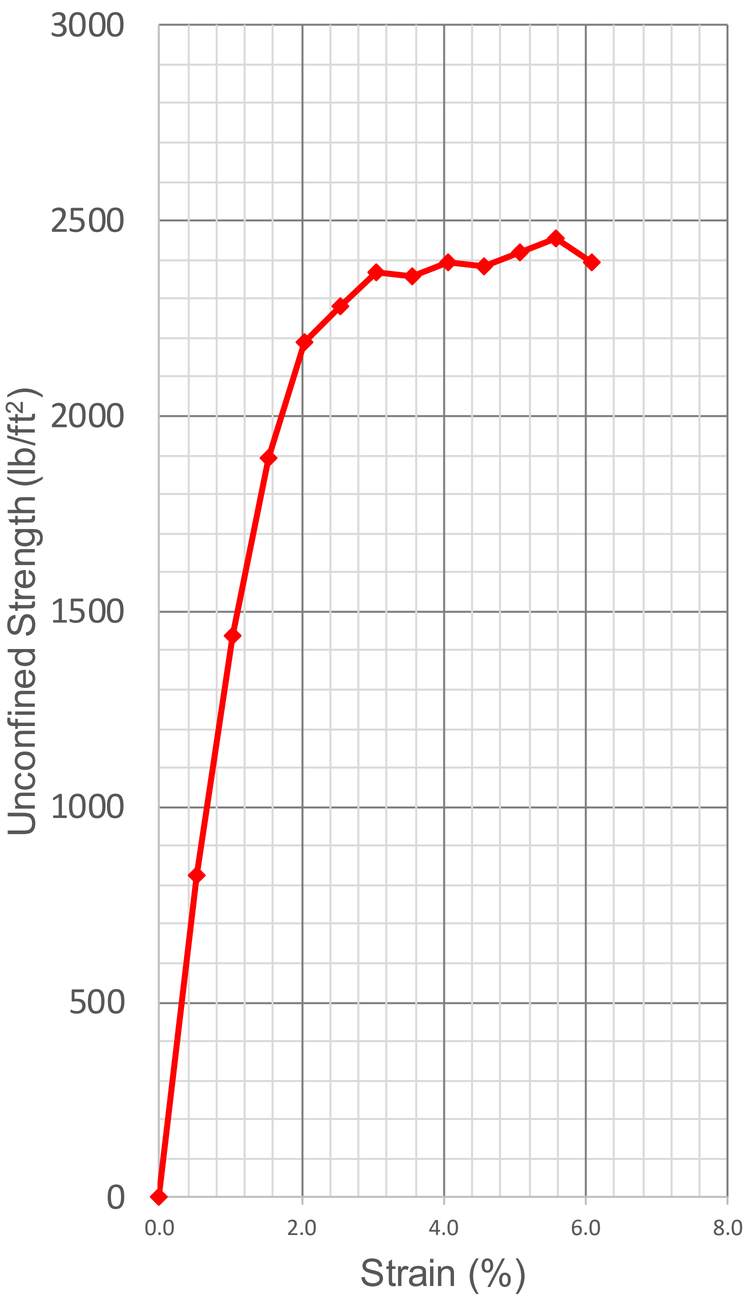
| Max Unconfined Compressive Strength | |
|---|---|
| Elapsed Time | 7 min |
| Vertical Dial | 0.35 in |
| Strain | 7.0 % |
| Area | 0.03433 $ft^2$ |
| Axial Load | 98.1 lbs |
| Compressive Strength | 2,857 psf |

UNCONFINED COMPRESSIVE STRENGTH – D2166

**Project Number:** 768-1 **Boring #:** SFB-2 **Depth:** 26 ft

**Project Name:** Hillview Drive Landslide **Date:** 4/27/2017

**Description:** Gray brown silty CLAY some sand (CH) **Tested By:** R




| Soil Specimen Initial Measurements | |
|---|---|
| Diameter | 2.42 in |
| Initial Area | 4.60 $in^2$ |
| Initial Length | 4.93 in |
| Volume | 0.01312 $ft^3$ |
| Water Content | 29.8 |
| Wet Density | 118.8 pcf |
| Dry Density | 91.6 pcf |

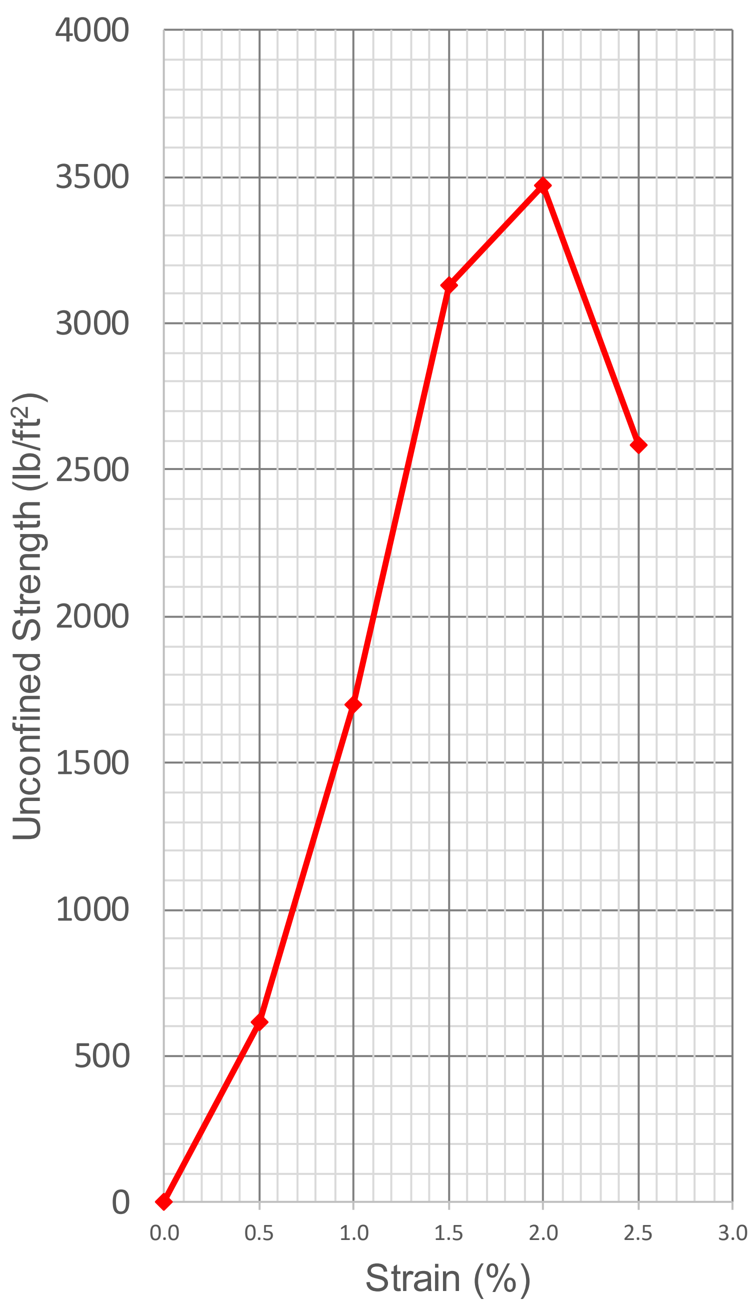
| Max Unconfined Compressive Strength | |
|---|---|
| Elapsed Time | 5.5 min |
| Vertical Dial | 0.275 in |
| Strain | 5.6 % |
| Area | 0.03383 $ft^2$ |
| Axial Load | 83.1 lbs |
| Compressive Strength | 2,456 psf |

## UNCONFINED COMPRESSIVE STRENGTH – D2166

**Project Number:** 768-1 **Boring #:** SFB-3 **Depth:** 6 ft

**Project Name:** Hillview Drive Landslide **Date:** 4/27/2017

**Description:** Gray brown silty CLAY trace sand (CH) **Tested By:** R




| Soil Specimen Initial Measurements | |
|---|---|
| Diameter | 2.42 in |
| Initial Area | 4.60 in$^2$ |
| Initial Length | 5 in |
| Volume | 0.01331 ft$^3$ |
| Water Content | 22.8 |
| Wet Density | 126.9 pcf |
| Dry Density | 103.3 pcf |

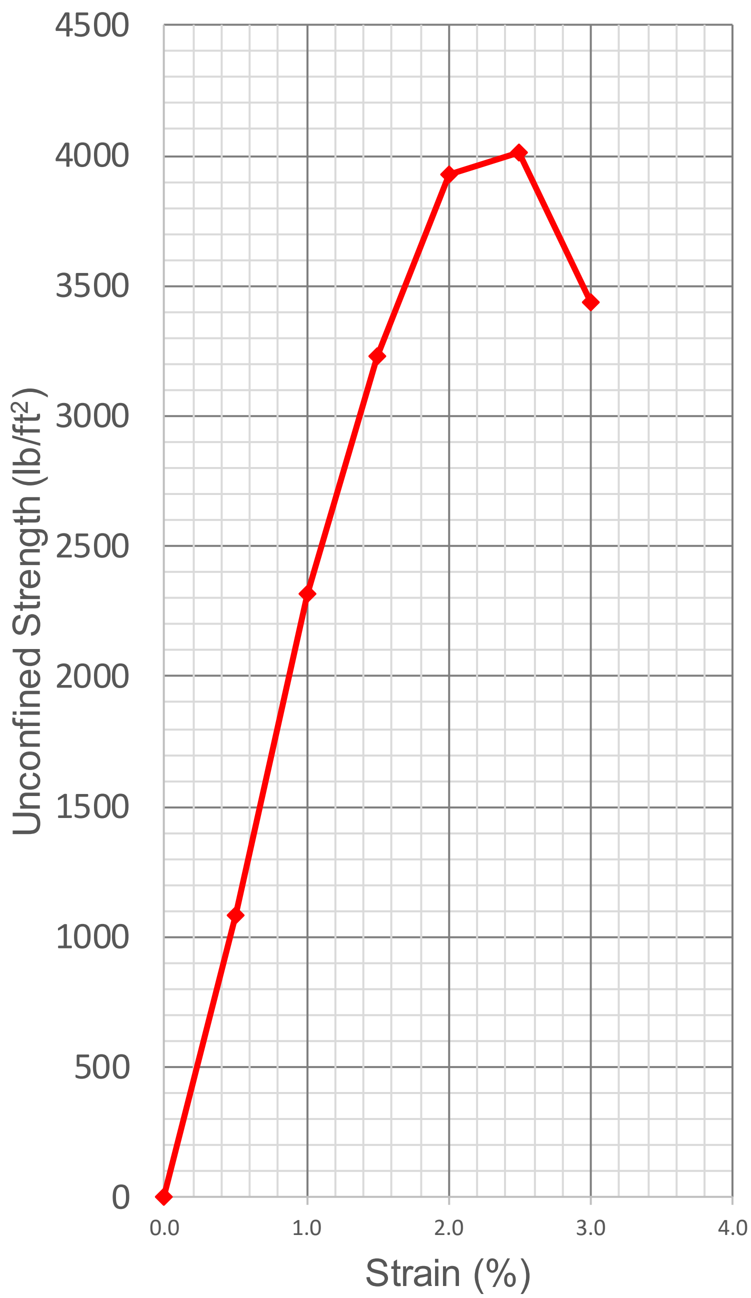
| Max Unconfined Compressive Strength | |
|---|---|
| Elapsed Time | 2 min |
| Vertical Dial | 0.1 in |
| Strain | 2.0 % |
| Area | 0.03260 ft$^2$ |
| Axial Load | 113.1 lbs |
| Compressive Strength | 3,470 psf |

UNCONFINED COMPRESSIVE STRENGTH – D2166

**Project Number:** 768-1 **Boring #:** SFB-3 **Depth:** 11 ft

**Project Name:** Hillview Drive Landslide **Date:** 4/27/2017

**Description:** Gray brown silty CLAY some sand (CH) **Tested By:** R




| Soil Specimen Initial Measurements | |
|---|---|
| Diameter | 2.42 in |
| Initial Area | 4.60 $in^2$ |
| Initial Length | 5 in |
| Volume | 0.01331 $ft^3$ |
| Water Content | 24.2 |
| Wet Density | 126.5 pcf |
| Dry Density | 101.9 pcf |

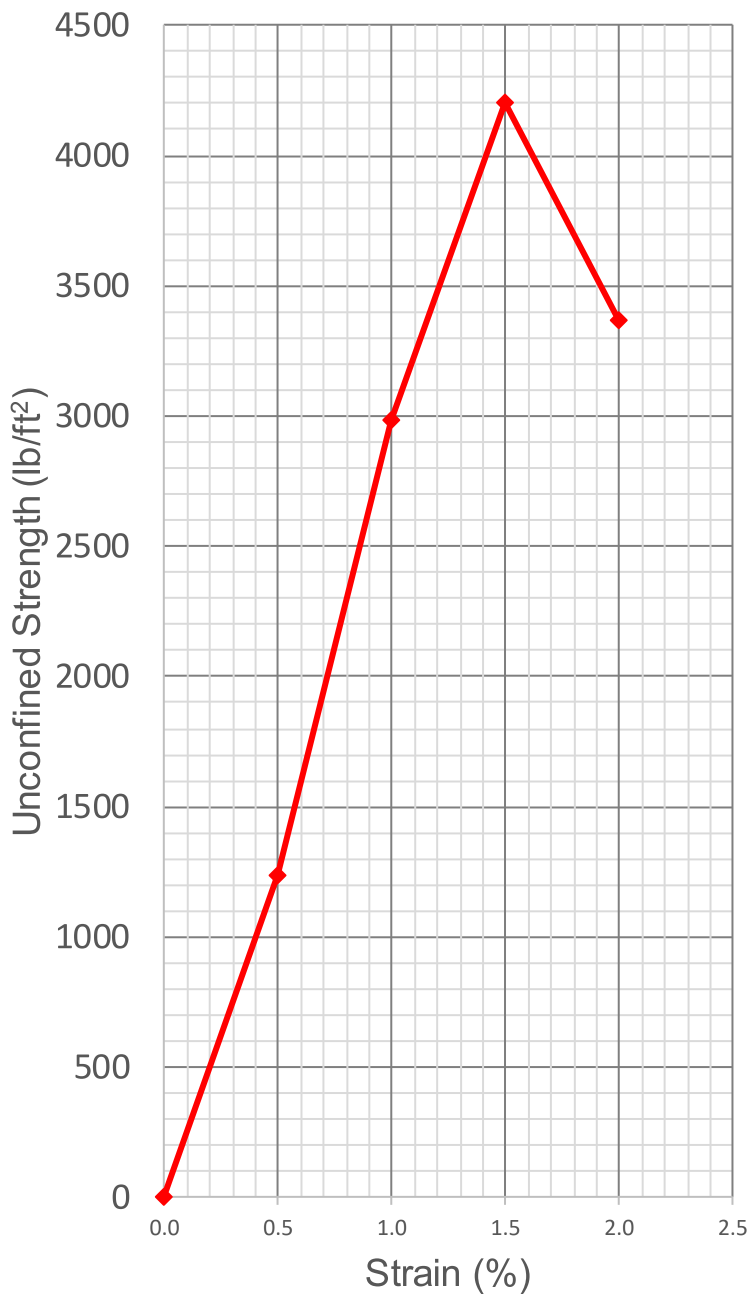
| Max Unconfined Compressive Strength | |
|---|---|
| Elapsed Time | 2.5 min |
| Vertical Dial | 0.125 in |
| Strain | 2.5 % |
| Area | 0.03276 $ft^2$ |
| Axial Load | 131.4 lbs |
| Compressive Strength | 4,011 psf |

UNCONFINED COMPRESSIVE STRENGTH – D2166

**Project Number:** 768-1 **Boring #:** SFB-3 **Depth:** 16 ft

**Project Name:** Hillview Drive Landslide **Date:** 4/27/2017

**Description:** Gray brown silty CLAY (CH/MH) **Tested By:** R




| Soil Specimen Initial Measurements | |
|---|---|
| Diameter | 2.42 in |
| Initial Area | 4.60 $in^2$ |
| Initial Length | 5 in |
| Volume | 0.01331 $ft^3$ |
| Water Content | 21.3 |
| Wet Density | 129.8 pcf |
| Dry Density | 107.0 pcf |

| Max Unconfined Compressive Strength | |
|---|---|
| Elapsed Time | 1.5 min |
| Vertical Dial | 0.075 in |
| Strain | 1.5 % |
| Area | 0.03243 $ft^2$ |
| Axial Load | 136.4 lbs |
| Compressive Strength | 4,206 psf |

Stevens Ferrone & Bailey Engineering Company, Inc

# Compaction Curve – ASTM D1557

**Project Number:** 768-1 **Project Name:** Hillview Drive Landslide **Sample #:** S-1

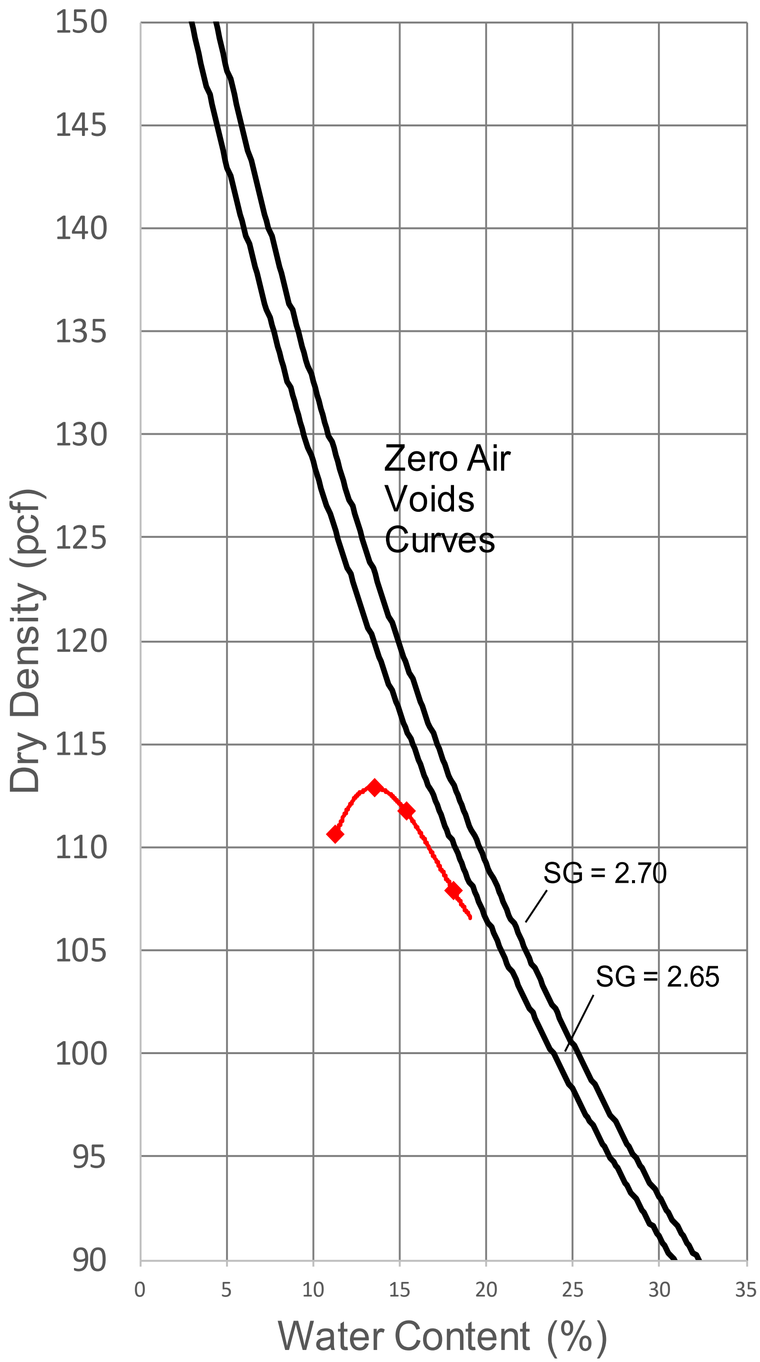
**Source of Material:** Onsite **Date:** 04-25-17

**Description:** Gray brown silty CLAY some sand (CL) **Tested By:** R

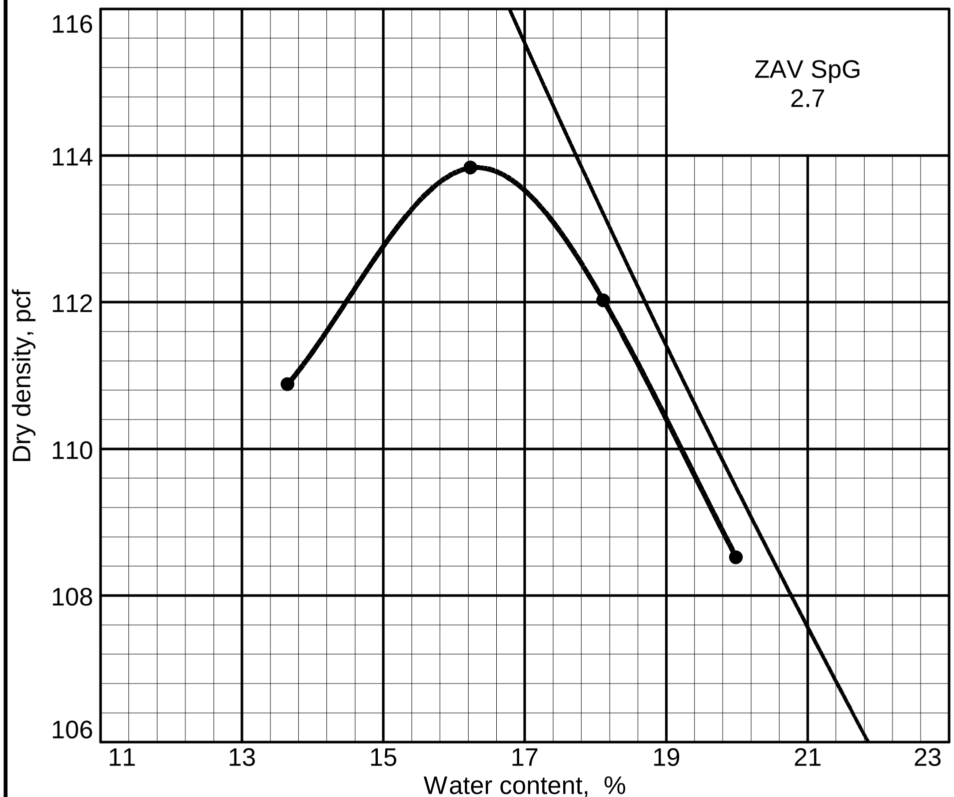
| | Test Method | |
|---|---|---|
| Method A | 4" Mold/ #4 Sieve < 25% retained | ☐ |
| Method B | 4" Mold/ 3/8" Sieve < 25% retained | ☑ |
| Method C | 6" Mold/ 3/8" Sieve > 20% retained | ☐ |
| Rock Correction 3/4" Sieve > 5% and < 30% retained | | ☐ |

| Trial Number | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Wet Density (pcf) | 123.1 | 128.1 | 128.9 | 127.4 |
| Moisture Content (%) | 11.3 | 13.5 | 15.4 | 18.1 |
| Dry Density (pcf) | 110.6 | 112.9 | 111.7 | 107.9 |

| | |
|---|---|
| Maximum Dry Density (pcf) | 113 |
| Optimum Moisture Content (%) | 14 |



# COMPACTION TEST REPORT




**Curve No.**

**Test Specification:**
ASTM D 1557-00 Method A Modified

**Hammer Wt.:** 10 lb.
**Hammer Drop:** 18 in.
**Number of Layers:** five
**Blows per Layer:** 25
**Mold Size:** .03333 cu.ft.

**Test Performed on Material Passing** No.4 **Sieve**

**Soil Data**

**NM** ____ **Sp.G.** 2.7
**LL** ____ **PI** ____
**%>No.4** ____ **%<#200** ____
**USCS** ____ **AASHTO** ____

**TESTING DATA**

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| **WM + WS** | 8.82 | 8.89 | 8.89 | 8.68 | | |
| **WM** | 4.48 | 4.48 | 4.48 | 4.48 | | |
| **WW + T #1** | 766.80 | 883.00 | 923.50 | 834.70 | | |
| **WD + T #1** | 688.30 | 797.60 | 835.70 | 773.10 | | |
| **TARE #1** | 295.60 | 326.10 | 294.90 | 321.70 | | |
| **WW + T #2** | | | | | | |
| **WD + T #2** | | | | | | |
| **TARE #2** | | | | | | |
| **MOISTURE** | 20.0 | 18.1 | 16.2 | 13.6 | | |
| **DRY DENSITY** | 108.5 | 112.0 | 113.8 | 110.9 | | |

**TEST RESULTS**

Maximum dry density = 113.8 pcf

Optimum moisture = 16.3 %

**Material Description**

Dark Olive CLAY

**Project No.** 646-017 **Client:** Stevens, Ferrone & Bailey

**Project:** Hillview Drive Landslide - 768-1

● **Source:** Bulk **Sample No.:** S-2

**Remarks:**

COMPACTION TEST REPORT

**COOPER TESTING LABORATORY**

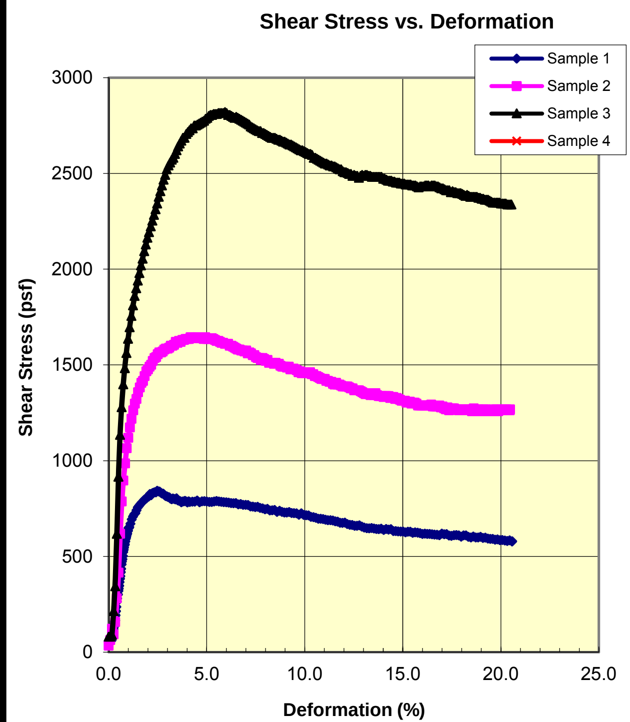
**Figure**

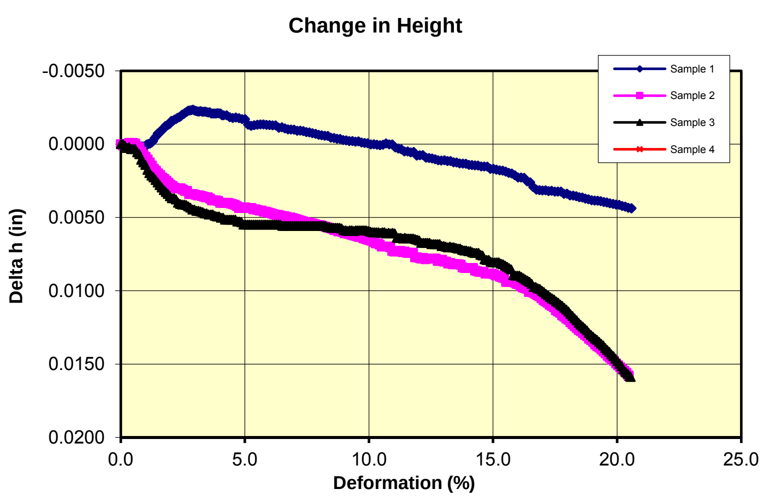
# Consolidated Drained Direct Shear
# (ASTM D3080)

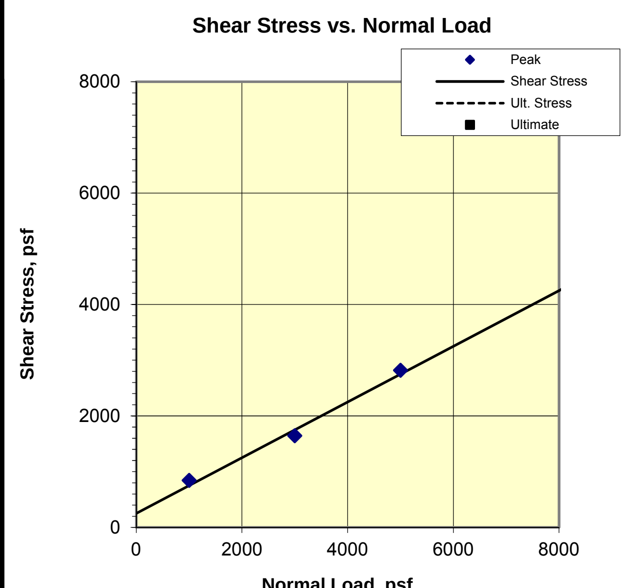
| | | | | | |
|---|---|---|---|---|---|
| CTL Job #: | 646-017 | Project #: | 768-1 | By: | MD |
| Client: | Stevens, Ferrone & Bailey | Date: | 5/5/2017 | Checked: | PJ |
| Project Name: | Hilllview Drive Landslide | Remolding Info: | 85% of 113.8 pcf @ 19.3(OPT+3%), | | |

| Specimen Data | | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| Boring: | Bulk | Bulk | Bulk | |
| Sample: | S-2 | S-2 | S-2 | |
| Depth (ft): | | | | |
| Visual Description: | Dark Olive CLAY | Dark Olive CLAY | Dark Olive CLAY | |
| Normal Load (psf) | 1000 | 3000 | 5000 | |
| Dry Mass of Specimen (g) | 120.0 | 120.0 | 121.4 | |
| Initial Height (in) | 1.00 | 1.02 | 1.01 | |
| Initial Diameter (in) | 2.43 | 2.43 | 2.43 | |
| Initial Void Ratio | 0.773 | 0.802 | 0.773 | |
| Initial Moisture (%) | 23.1 | 23.1 | 21.7 | |
| Initial Wet Density (pcf) | 121.4 | 119.5 | 120.0 | |
| Initial Dry Density (pcf) | 98.6 | 97.0 | 98.6 | |
| Initial Saturation (%) | 83.7 | 80.8 | 78.7 | |
| ΔHeight Consol (in) | -0.0313 | 0.0066 | 0.0157 | |
| At Test Void Ratio | 0.828 | 0.790 | 0.745 | |
| At Test Moisture (%) | 29.5 | 28.2 | 26.6 | |
| At Test Wet Density (pcf) | 124.0 | 125.3 | 126.9 | |
| At Test Dry Density (pcf) | 95.7 | 97.7 | 100.2 | |
| At Test Saturation (%) | 99.9 | 99.9 | 99.8 | |
| Strain Rate (%/min) | 0.01 | 0.01 | 0.01 | |
| Strengths Picked at | Peak | Peak | Peak | |
| Shear Stress (psf) | 843 | 1645 | 2820 | |
| ΔHeight (in) at Peak | -0.0020 | 0.0040 | 0.0055 | |
| Ultimate Stress (psf) | | | | |

| Phi (deg) | 26.6 | Ult. Phi (deg) | |
|---|---|---|---|
| Cohesion (psf) | 250 | Ult. Cohesion (psf) | |




Remarks:

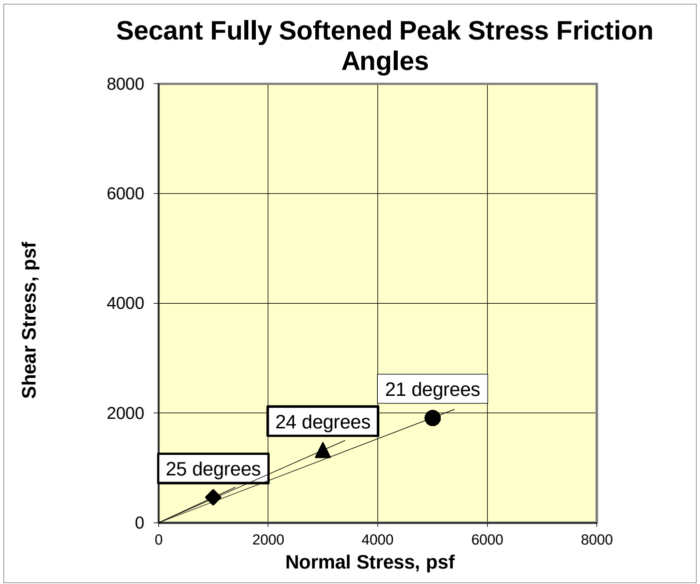
# Drained Fully Softened Peak Torsional Shear Strength (ASTM D7608)

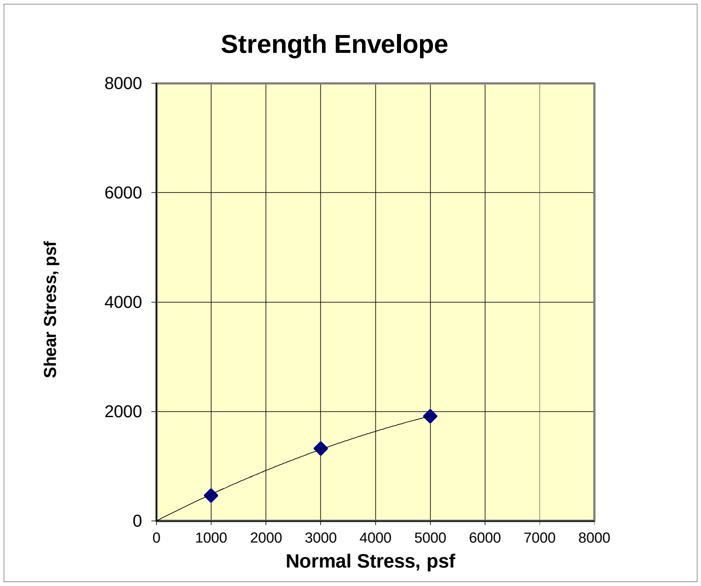
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **CTL Job No.:** | 646-017 | **Boring:** | Bulk | **Date:** | 5/16/2017 | **Clay, %:** | |
| **Client:** | Stevens, Ferrone & Bailey | **Sample:** | S-2 | **By:** | PJ | **LL:** | |
| **Project Name:** | Hillview Drive Landslide | **Depth (ft):** | | **Checked:** | DC | **PL:** | |
| **Project Number:** | 768-1 | **Test Type:** | Fully Softened Peak | | | | |

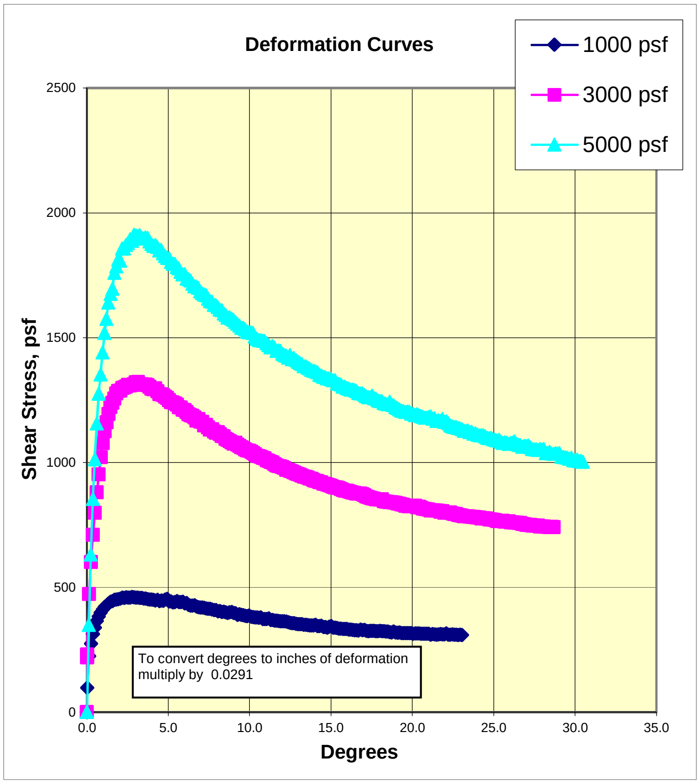
**Soil Type:** Dark Olive CLAY

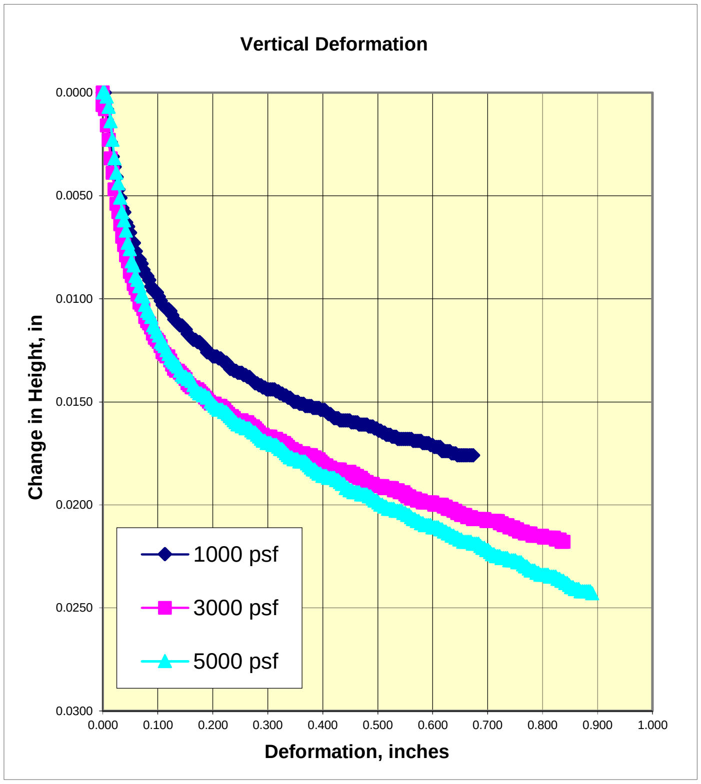
Remarks:

| | | | |
|---|---|---|---|
| **Normal Stress, psf:** | 1000 | 3000 | 5000 |
| **Secant Phi, deg.:** | 25 | 24 | 21 |



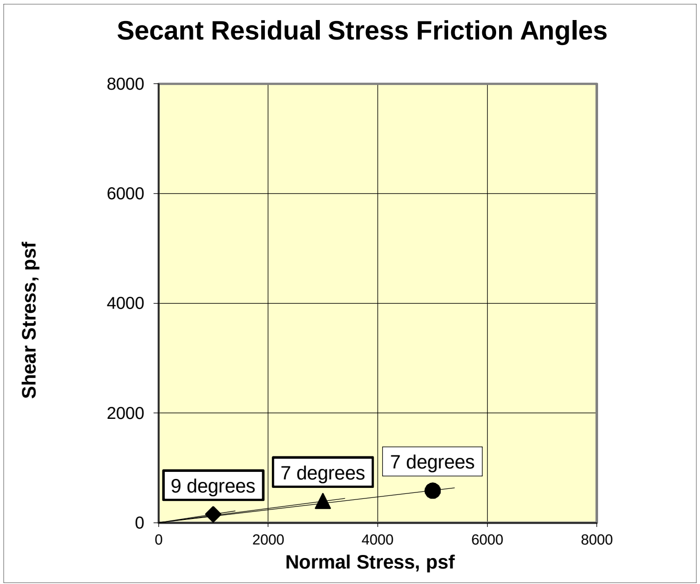
# Drained Residual Torsional Shear Strength (ASTM D6467)

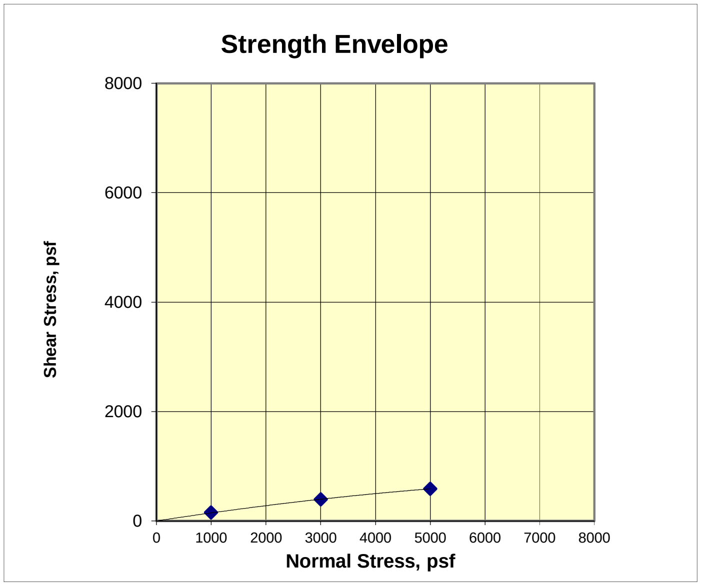
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **CTL Job No.:** | 646-017 | **Boring:** | Bulk | **Date:** | 5/12/2017 | **Clay, %:** | |
| **Client:** | Stevens, Ferrone & Bailey | **Sample:** | S-2 | **By:** | PJ | **LL:** | |
| **Project Name:** | Hillview Drive Landslide | **Depth (ft):** | | **Checked:** | DC | **PL:** | |
| **Project Number:** | 768-1 | **Test Type:** | Fully Softened Residual | | | | |

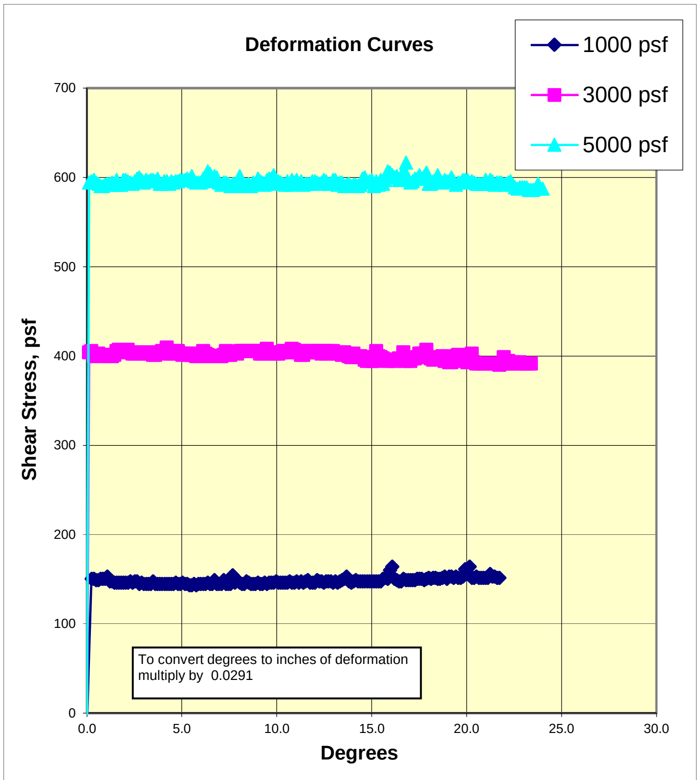
**Soil Type:** Dark Olive CLAY

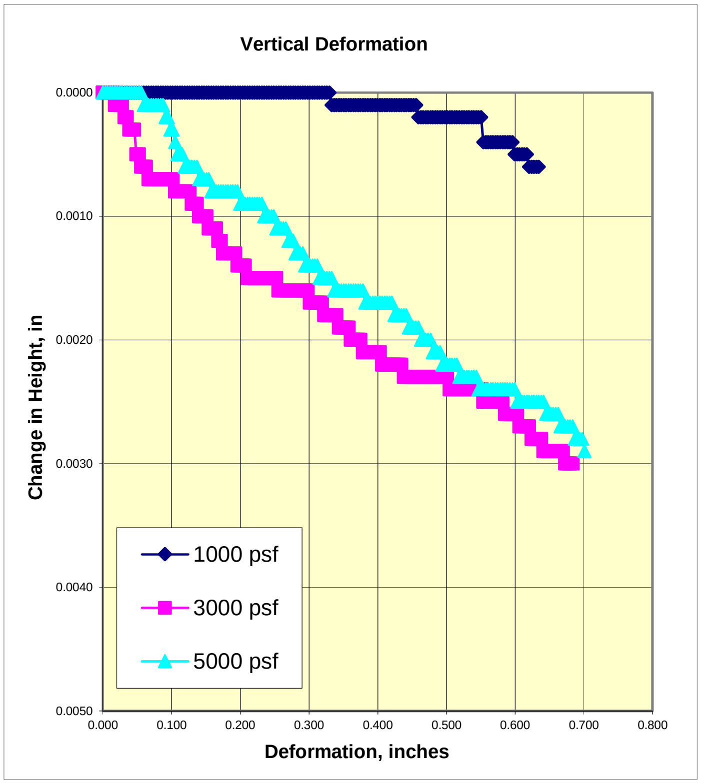
| **Normal Stress, psf:** | 1000 | 3000 | 5000 |
|---|---|---|---|
| **Secant Phi, deg.:** | 9 | 7 | 7 |

Remarks: A small friction correction was applied to each point.



# APPENDIX C

Logs of Previous Borings by Others

# BORING LOG B-8

JOB NUMBER: 1358.102 DATE DRILLED: 12/15/87

JOB NAME: Vista Tassajara SURFACE ELEVATION: +814 Feet

DRILL RIG: Method: Rotary Wash DATUM: Contra Costa County

| SAMPLER TYPE: | DRIVE WEIGHT – LB | HEIGHT OF FALL – IN |
|---|---|---|
| 2.5" I.D. Split Barrel | 140 | 30 |

| BLOWS PER FT. | MOISTURE CONTENT % | DRY UNIT WEIGHT p.c.f. | DEPTH IN FEET | USCS CLASSIFICATION | DESCRIPTION |
|---|---|---|---|---|---|
| | | | | CH | CLAY, dark gray, moist, soft |
| | | | | CL/ CH | SILTY CLAY, dark orange-brown, moist, very stiff, with calcareous deposits |
| 44 | 22.5 | 93 | 5 | | |
| 35 | -- | -- | 10 | | yellow-brown |
| | | | | CL/ ML | CLAYEY SILT, blue-green and orange-brown mottled, moist, very stiff |
| 64 | 26.8 | 97 | 15 | | |
| | | | | | CLAYSTONE, orange-brown, sheared, crushed, highly weathered, with randomly-oriented soft clay partings - landslide debris |
| 45 | -- | -- | 20 | | |

# BORING LOG B-8

JOB NUMBER: 1358.102 SHEET: 2 OF: 2

JOB NAME: Vista Tassajara DEPTH: 30' TO 33' 9"

NOTES:

| BLOWS PER FT. | MOISTURE CONTENT % | DRY UNIT WEIGHT p.c.f. | DEPTH IN FEET | USCS CLASSI-FICATION | DESCRIPTION |
|---|---|---|---|---|---|
| | | | | | Slide surface at 22 feet |
| | | | | | CLAYSTONE, gray-brown, hard, crushed, highly weathered |
| 50/ 3" | 33.7 | 88 | | | |
| | | | 25 | | |
| | | | | | dark gray, moderately weathered |
| 30/ 6" | 20.7 | 107 | | | |
| | | | 30 | | |
| | | | | | blue-gray |
| | | | | | Terminal depth of boring: 33 feet 9 inches<br>Piezometer installed to 33 feet |

# CORE LOG

PROJECT: Vista Tassajara
DRILLING COMPANY: Pitcher Drilling
DRILLING METHODS: Rotary Wash
ELEVATION (FEET): 832 ±

BORING NO.: B-9
JOB NO.: 1358.102.1
DATE BEGUN: 12/14/87
DATE COMPLETED: 12/14/87
DEPTH OF HOLE: 55½ feet
NUMBER OF CORE BOXES: -0-
LOGGED BY: R. Skinner

| RUN NO. | DRILL RATE (Min./Ft.) | CUT | RECOVERED | % REC. | DRILLING FLUID LOSS | RQD (%) | DEPTH | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 0 | CH | SILTY CLAY, dark brown, moist to wet, stiff, high plasticity<br>Augered from 0 to 4 feet<br>Set 5" diameter casting to 4 feet |
| | | | | | | | 2 | | |
| | | | | | | | 4 | CL | 2.5" I.D. drive sample at 4 feet, 16 blows/ft. |
| | | | | | 0% | | | | SILTY CLAY, brown, moist, stiff, low plasticity - landslide debris |
| | ½ | | | | | | | | |
| | ½ | | | | | | | | |
| | | | | | | | 6 | | Began rotary wash drilling at 4 feet with 4 7/8" diameter drill bit |
| | ½ | | | | | | | | |
| | ½ | | | | | | | | |
| | | | | | | | 8 | | |
| | ½ | | | | | | | | |
| | | | | | | | | | 2½" diameter drive sample at 9 feet, 45 blows/ft. |
| | ½ | | | | | | 10 | | |
| | 1 | | | | | | | | |
| | 1 | | | | | | | | |
| | 2 | | | | | | 12 | | Grading very stiff |
| | | | | | | | | | SILTSTONE, light brown, friable to weak, highly fractured, highly weathered (Qls) |
| | 1 | | | | | | 14 | | 2.5" diameter drive sample at 14 feet, 50 blows/3" |
| | 1 | | | | | | | | |
| | | | | | | | 16 | | |

# CORE LOG

BORING NO. B-9 JOB NO. 1358.102.1

| RUN NO. | DRILL RATE (Min./Ft) | CUT | RECOVERED | % REC. | DRILLING FLUID LOSS | RQD (%) | DEPTH | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|
| | 1½ | | | | 0% | | | | SILTSTONE, light brown, friable to weak, highly fractured, highly weathered - landslide debris |
| | 1½ | | | | | | | | |
| | 1½ | | | | | | 18 | | |
| | 1 | | | | | | | | Clay seam in sample<br>2.5" diameter drive sample at 19 feet, 50 blows/6" |
| | 1 | | | | | | 20 | | |
| | 1½ | | | | | | | | |
| | 1½ | | | | | | 22 | | |
| | 1½ | | | | | | | | |
| | 1½ | | | | | | 24 | CH | SILTY CLAY, brown, wet, stiff, high plasticity, possible slide plane |
| | 1½ | | | | | | | | 2.5" diameter drive sample at 24 feet, blows 50/4" |
| | 1½ | | | | | | 26 | | SANDSTONE, light brown, friable, highly fractured, highly weathered - landslide debris |
| | 1½ | | | | | | | | |
| | 1½ | | | | | | 28 | | CLAYSTONE, brown, friable, highly fractured, some clay seams, highly weathered - landslide debris |
| 1 | 2½ | 2.5 | 1.5 | 60 | 0% | 0 | | | Began pitcher barrel sampling at 29 feet |
| | 2½ | | | | | | 30 | | |
| 2 | 4 | 2.5 | 2.4 | 96 | 0% | 0 | 32 | | |

# CORE LOG

BORING NO. B-9 JOB NO. 1358.102

| RUN NO. | DRILL RATE (Min./Ft) | CUT | RECOVERED | % REC. | DRILLING FLUID LOSS | RQD (%) | DEPTH | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | 0% | | | | CLAYSTONE, mottled light gray and brown, friable, crushed, highly sheared, highly weathered, abundant clay seams - landslide debris |
| | 4 | | | | | | | | |
| | 4 | | | | | | | | |
| | | | | | | | 34 | | |
| 3 | 4 | 2.5 | 1.7 | 68 | 0% | 0 | | | |
| | 4 | | | | | | | | |
| | 4 | | | | | | 36 | | |
| 4 | 6 | 2.5 | 2.4 | 96 | 0% | 0 | | | Bedding dip 20" |
| | 9 | | | | | | 38 | | SILTSTONE, brown, weak, moderately fractured, moderately weathered, sandy |
| | 10 | | | | | | | | Slickensided surface, dip 17°<br>Interpreted slide plane at 38½ feet |
| 5 | 6 | 2.5 | 2.3 | 92 | 0% | 0 | | | |
| | | | | | | | 40 | | |
| | 4 | | | | | | | | |
| | 4 | | | | | | | | Rotary wash drilling 41½ to 46 feet |
| | | | | | | | 42 | | |
| | 1 | | | | 0% | | | | |
| | 1 | | | | | | | | |
| | 1 | | | | | | | | SILTSTONE, gray, weak, moderately fractured, unweathered, sandy |
| | | | | | | | 44 | | |
| | 1 | | | | | | | | |
| | 1½ | | | | | | | | |
| | | | | | | | 46 | | |
| 6 | 3 | 2.5 | 2.4 | 96 | 0 | 0 | | | |
| | 3 | | | | | | | | |
| | | | | | | | 48 | | |

# CORE LOG

BORING NO. B-9 JOB NO. 1358.102

| RUN NO. | DRILL RATE (Min./Ft) | CUT | RECOVERED | % REC. | DRILLING FLUID LOSS | RQD (%) | DEPTH | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | | | | 0% | | | | SILTSTONE, gray, weak, moderately fractured, unweathered, sandy |
| | | | | | 0% | | | | |
| | 1 | | | | | | | | Rotary wash drilling from 48½ to 53 feet |
| | | | | | | | 50 | | |
| | 1 | | | | | | | | |
| | 1 | | | | | | | | CLAYSTONE, dark gray, friable to weak crushed, moderately sheared, unweathered |
| | | | | | | | 52 | | |
| | 1 | | | | | | | | |
| 7 | 3 | 2.5 | 100 | 0% | 0 | 0 | | | |
| | | | | | | | 54 | | |
| | 3 | | | | | | | | |
| | 3 | | | | | | | | |

Total depth 55½ feet
Installed piezometer to 53 feet



BERLOGAR GEOTECHNICAL CONSULTANTS

# BORING LOG B-10

JOB NUMBER: 1358.102 | DATE DRILLED: 12/14/87

JOB NAME: Vista Tassajara | SURFACE ELEVATION: +786 Feet

DRILL RIG: Method: Rotary Wash | DATUM: Contra Costa County

| SAMPLER TYPE: | DRIVE WEIGHT – LB | HEIGHT OF FALL – IN |
|---|---|---|
| 2.5" I.D. Split Barrel | 140 | 30 |

| BLOWS PER FT. | MOISTURE CONTENT % | DRY UNIT WEIGHT p.c.f. | DEPTH IN FEET | USCS CLASSI-FICATION | DESCRIPTION |
|---|---|---|---|---|---|
| | | | | CL/ ML | CLAYEY SILT, yellow-brown, soft to stiff, moist |
| 22 | 24.7 | 97 | 5 | | |
| | | | | | SILTSTONE, orange-brown, argillaceous, crushed sheared, highly weathered - landslide debris |
| 60/ 6" | -- | -- | 10 | | |
| | | | | | CLAYSTONE, dark yellow-brown, crushed, sheared, highly weathered with randomly oriented thin bands of gray claystone - landslide debris |
| 95/ 10" | 24.5 | 94 | 15 | | |
| 60/ 6" | -- | -- | 20 | | |

# BORING LOG B-10

JOB NUMBER: 1358.102 SHEET: 2 OF: 3

JOB NAME: Vista Tassajara DEPTH: 20' TO 41'

NOTES:

| BLOWS PER FT. | MOISTURE CONTENT % | DRY UNIT WEIGHT p.c.f. | DEPTH IN FEET | USCS CLASSI-FICATION | DESCRIPTION |
|---|---|---|---|---|---|
| | | | | | SILTSTONE, continued |
| 100/9" | 24.5 | 97 | 25 | | brown to dark yellow-brown |
| 78/6" | -- | -- | | | randomly-oriented soft clay partings |
| | | | 30 | | |
| 90/6" | -- | -- | 35 | | |
| | | | | | Slide surface at 38½ feet |
| 90/6" | 21.8 | 104 | 40 | | SILTSTONE, dark gray, hard, crushed, moderately weathered, argillic |

# BORING LOG B-10

**JOB NUMBER:** 1358.102 **SHEET:** 3 **OF:** 3

**JOB NAME:** Vista Tassajara **DEPTH:** 40' **TO** 57'

**NOTES:**

| BLOWS PER FT. | MOISTURE CONTENT % | DRY UNIT WEIGHT p.c.f. | DEPTH IN FEET | USCS CLASSI-FICATION | DESCRIPTION |
|---|---|---|---|---|---|
| 96/6" | -- | -- | | | RHYOLITIC TUFF BED, 3/4 inch thick at 44½ feet |
| | | | 45 | | |
| | | | | | CLAYSTONE, light yellow-gray, hard, crushed moderately weathered, tuffaceous |
| 50/4" | -- | -- | 50 | | |
| | | | | | SILTSTONE, light gray, very hard, moderately weathered, tuffaceous |
| | | | 55 | | |
| 100/1" | -- | -- | | | |
| | | | | | Terminal depth of boring: 57 feet<br>Piezometer installed to 57 feet |

# BORING LOG B-11

JOB NUMBER: 1358.102

DATE DRILLED: 12/16/87

JOB NAME: Vista Tassajara

SURFACE ELEVATION: +728 Feet

DRILL RIG: Method: Rotary Wash

DATUM: Contra Costa County

SAMPLER TYPE: 2.5" I.D. Split Barrel

DRIVE WEIGHT – LB: 140

HEIGHT OF FALL – IN: 30

| BLOWS PER FT. | MOISTURE CONTENT % | DRY UNIT WEIGHT p.c.f. | DEPTH IN FEET | USCS CLASSI-FICATION | DESCRIPTION |
|---|---|---|---|---|---|
| | | | | CH | CLAY, dark gray-brown, moist, very stiff |
| 38 | 19.5 | 96 | | | |
| | | | 5 | | |
| | | | | CL/CH | SILTY CLAY, brown, moist, stiff |
| 55 | -- | -- | | | CLAYSTONE, tan, sheared, crushed, highly weathered, with randomly-oriented soft clay partings - landslide debris |
| | | | 10 | | |
| | | | | | Slide surface at 11½ feet |
| 82 | 24.1 | 100 | | | SILTSTONE, gray-brown, hard, crushed, highly weathered, argillic |
| | | | 15 | | |
| 90 | -- | -- | | | |
| | | | | | CLAYSTONE, brown, hard, crushed, highly weathered |
| | | | 20 | | |

# BORING LOG B-11

JOB NUMBER: 1358.102 SHEET: 2 OF: 2

JOB NAME: Vista Tassajara DEPTH: 20' TO 27' 6"

NOTES:

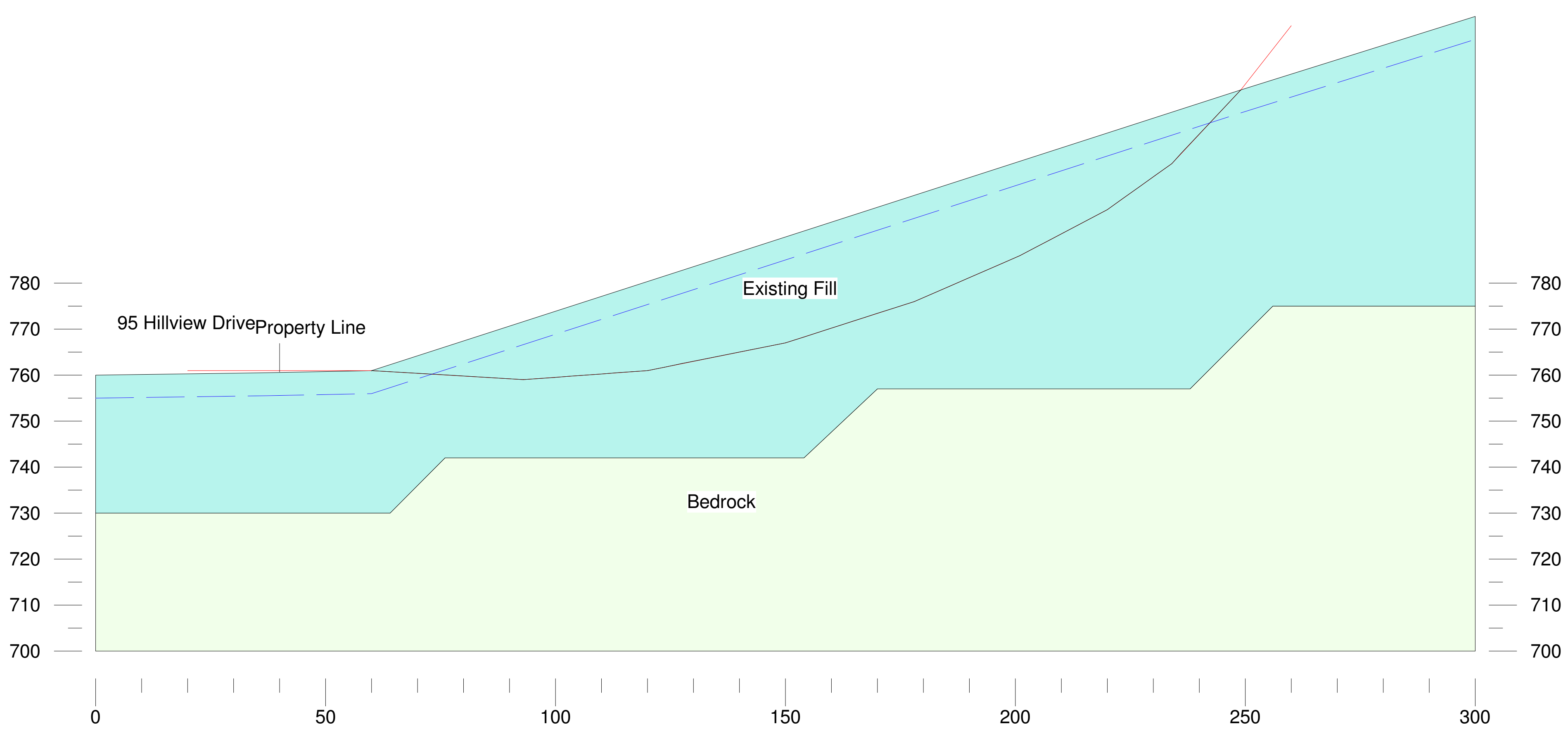
| BLOWS PER FT. | MOISTURE CONTENT % | DRY UNIT WEIGHT p.c.f. | DEPTH IN FEET | USCS CLASSIFICATION | DESCRIPTION |
|---|---|---|---|---|---|
| | | | | | CLAYSTONE, continued |
| 50/ 6" | 21.3 | 105 | | | |
| | | | 25 | | |
| 68/ 6" | -- | -- | | | |
| | | | | | Terminal depth of boring: 27 feet 6 inches<br>Piezometer installed to 27 feet |

**APPENDIX D**

Slope Stability Analysis Results

| | Gamma pcf | C psf | Phi deg | Piezo Surf. | Ru |
|---|---|---|---|---|---|
| Existing Fill | 120 | 0 | 25.9 | 1 | 0 |
| Bedrock | 125 | 100 | 30 | 0 | 0 |

Stevens Ferrone & Bailey Engineering Co. Inc.
SFB 768-1
Hillview Drive Landslide, Danville, CA
Section A
Back Calculation - Plane 1
With Groundwater at 5' Deep

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F = 0.992

| | Gamma pcf | C psf | Phi deg | Piezo Surf. | Ru |
|---|---|---|---|---|---|
| Existing Fill | 120 | 0 | 25.2 | 1 | 0 |
| Bedrock | 125 | 100 | 30 | 0 | 0 |

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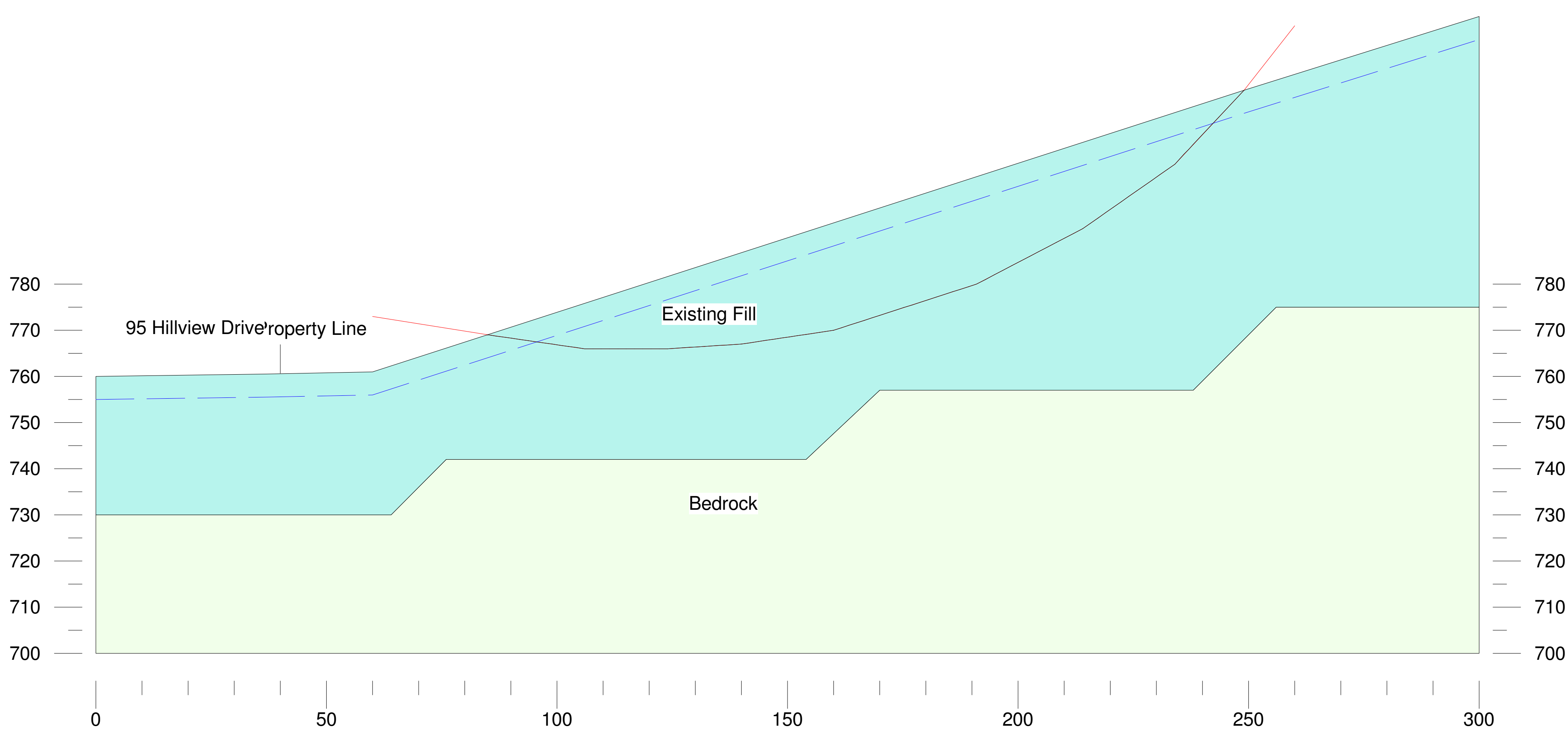
Hillview Drive Landslide, Danville, CA
Section A
Back Calculation - Plane 2
With Groundwater at 5' Deep

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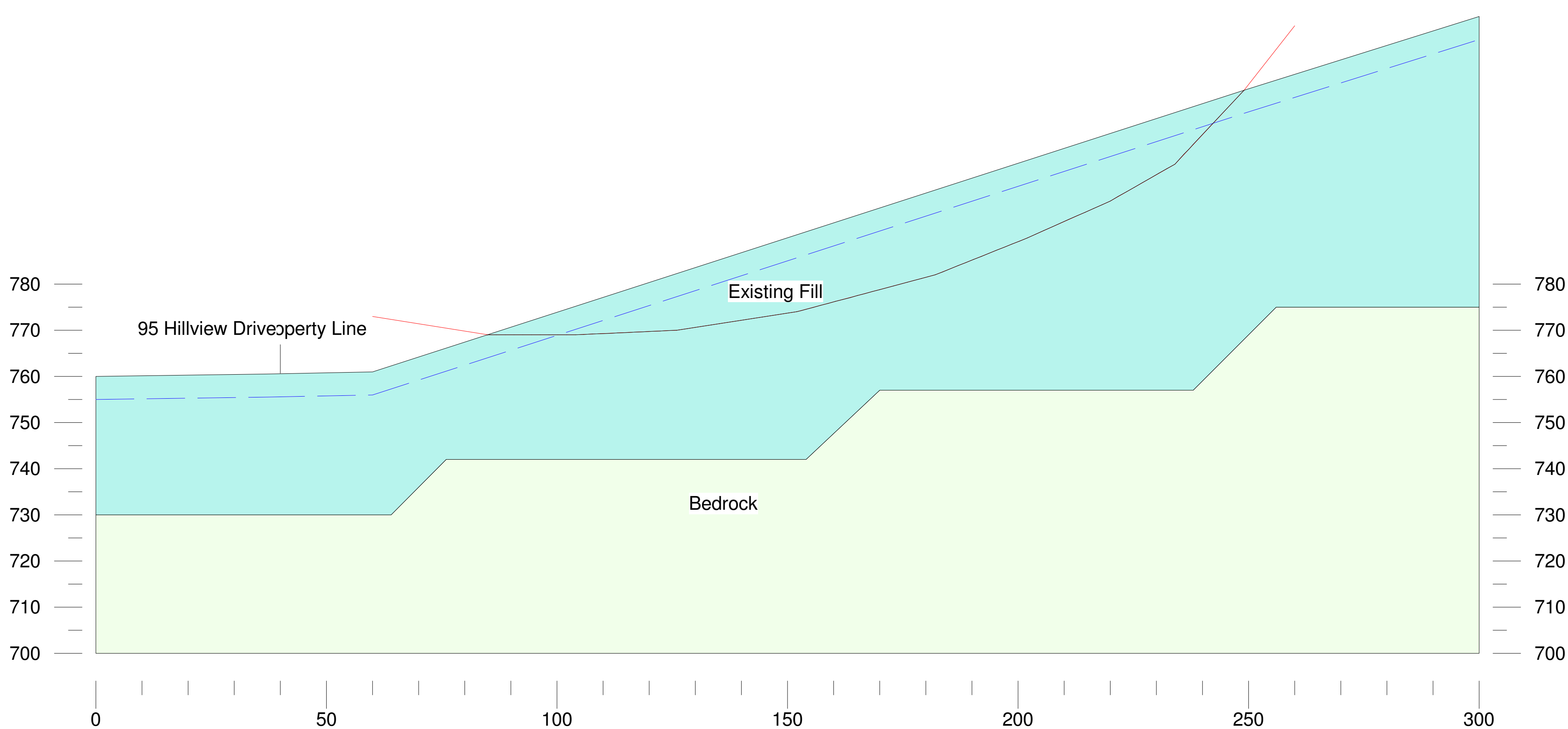
| | Gamma pcf | C psf | Phi deg | Piezo Surf. | Ru |
|---|---|---|---|---|---|
| Exisitng Fill | 120 | 0 | 24.7 | 1 | 0 |
| Bedrock | 125 | 100 | 30 | 0 | 0 |

Stevens Ferrone & Bailey Engineering Co. Inc.
SFB 768-1
Hillview Drive Landslide, Danville, CA
Section A
Back Calculation - Plane 3
With Groundwater at 5' Deep

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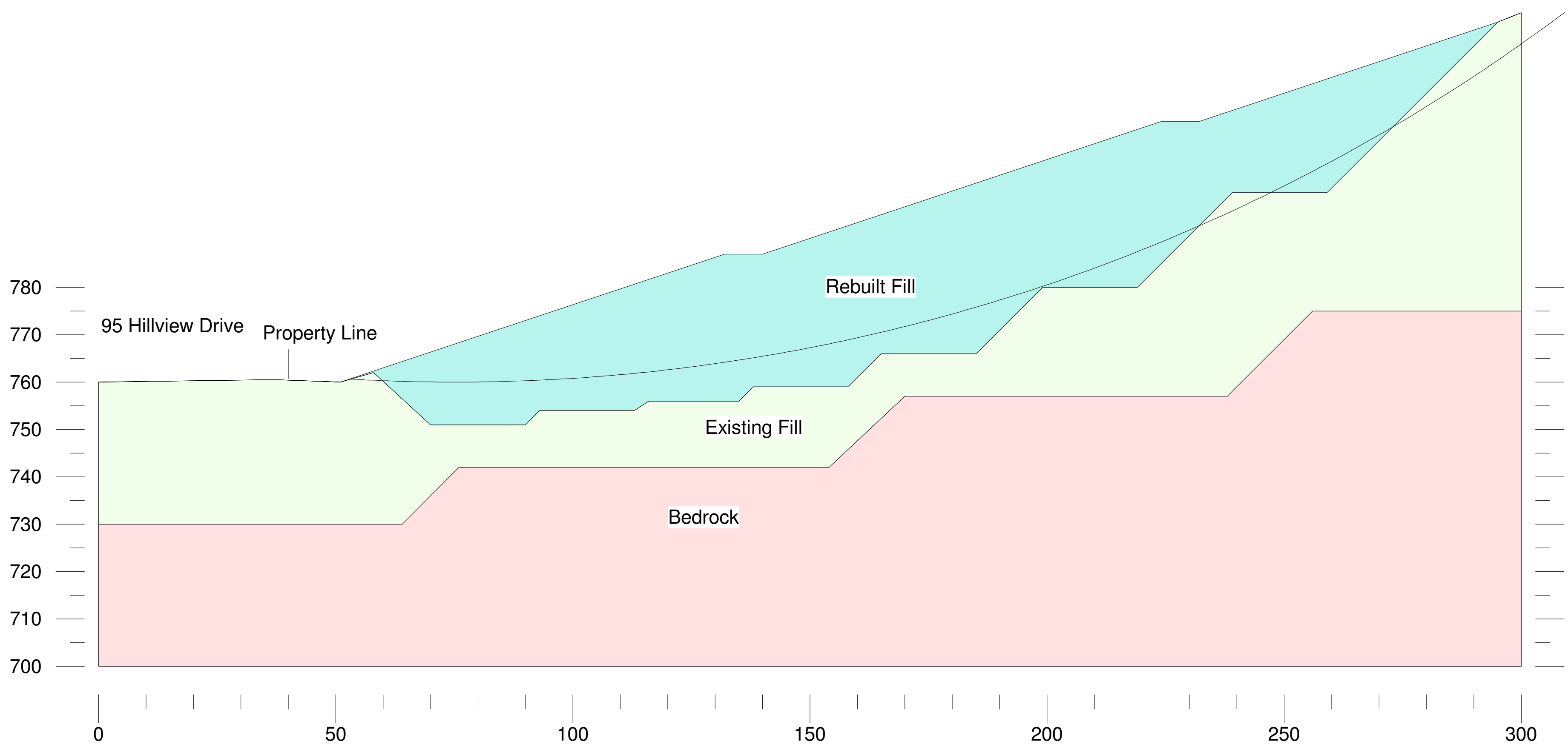
| | Gamma pcf | C psf | Phi deg | Piezo Surf. | Ru |
|---|---|---|---|---|---|
| Rebuilt Fill | 120 | 100 | 26 | 0 | 0 |
| Existing Fill | 120 | 100 | 26 | 0 | 0 |
| Bedrock | 125 | 100 | 30 | 0 | 0 |

Stevens Ferrone & Bailey Engineering Co. Inc.
SFB 768-1
Hillview Drive Landslide, Danville, CA
Section A
Slope Repair without Groundwater
Static

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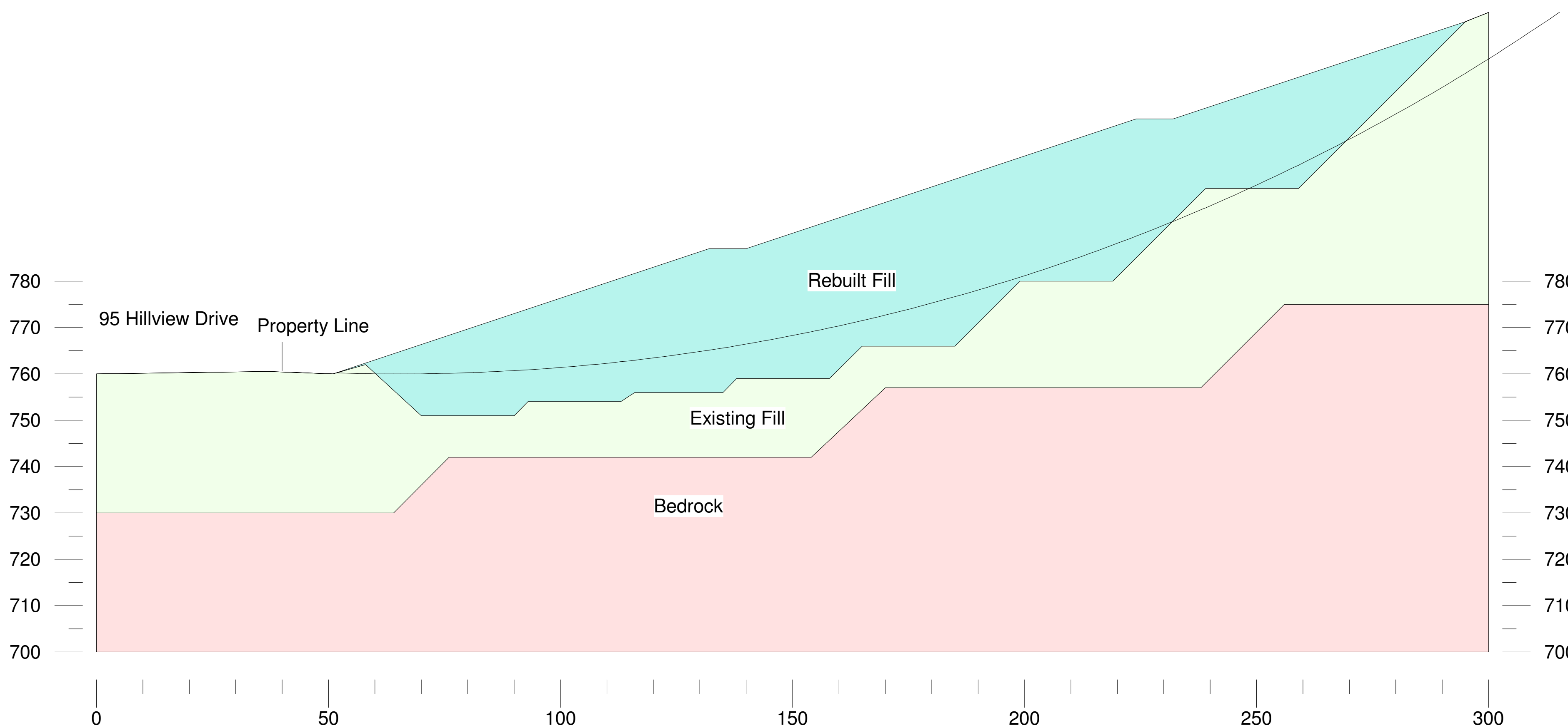
| | Gamma pcf | C psf | Phi deg | Piezo Surf. | Ru |
|---|---|---|---|---|---|
| Rebuilt Fill | 120 | 100 | 26 | 0 | 0 |
| Existing Fill | 120 | 100 | 26 | 0 | 0 |
| Bedrock | 125 | 100 | 30 | 0 | 0 |

Seismic coefficient = 0.25

Stevens Ferrone & Bailey Engineering Co. Inc.
SFB 768-1
Hillview Drive Landslide, Danville, CA
Section A
Slope Repair without Groundwater
Pseudo-Static

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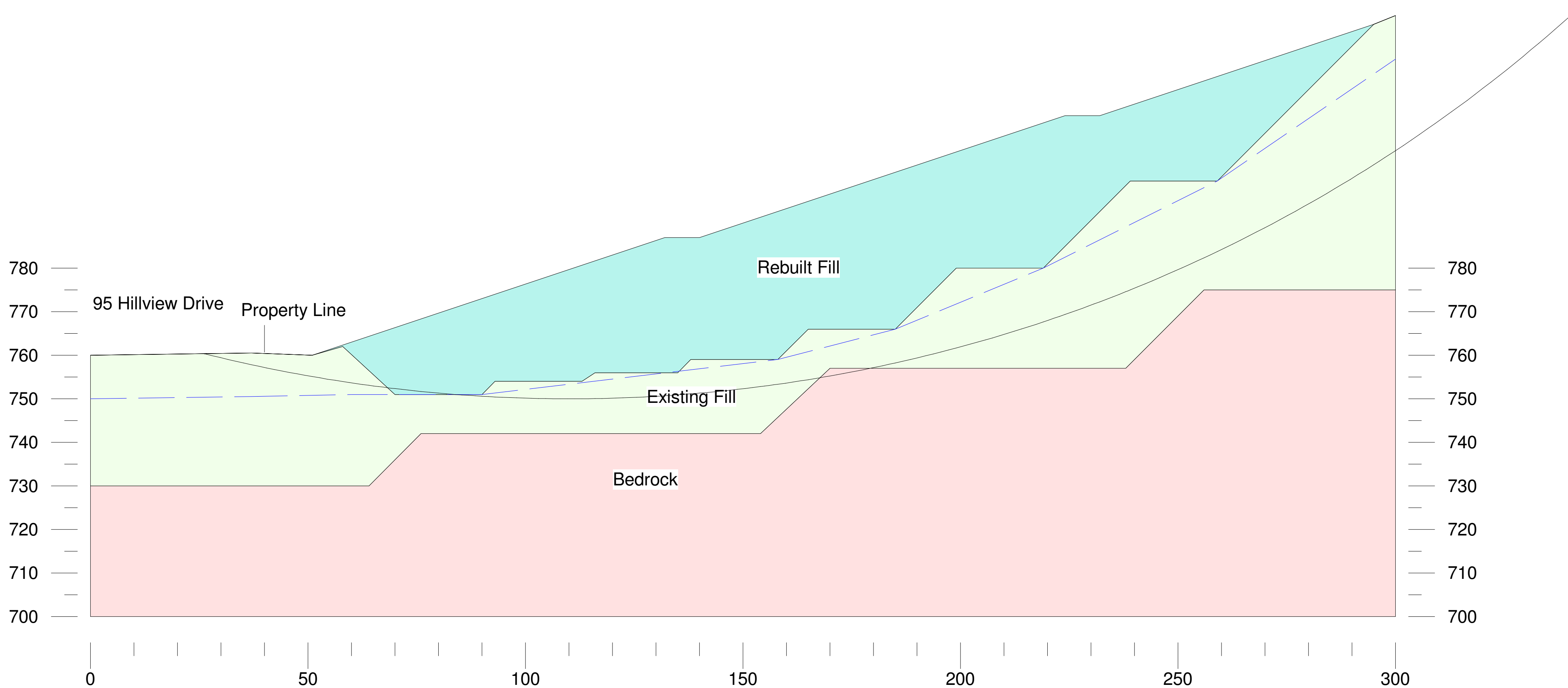
| | Gamma pcf | C psf | Phi deg | Piezo Surf. | Ru |
|---|---|---|---|---|---|
| Rebuilt Fill | 120 | 100 | 26 | 0 | 0 |
| Existing Fill | 120 | 100 | 26 | 1 | 0 |
| Bedrock | 125 | 100 | 30 | 0 | 0 |

Stevens Ferrone & Bailey Engineering Co. Inc.
SFB 768-1
Hillview Drive Landslide, Danville, CA
Section A
Slope Repair with Groundwater in Existing Fill
Static

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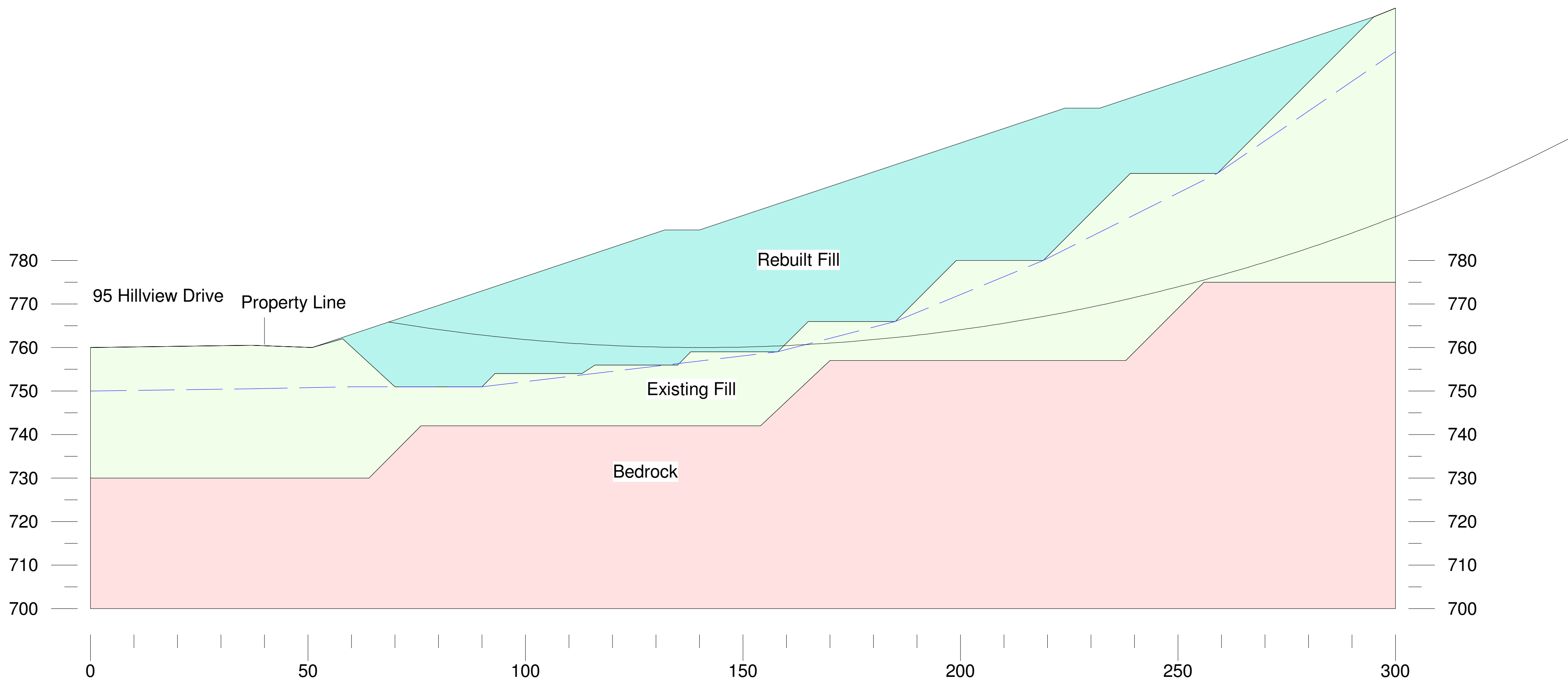
| | Gamma pcf | C psf | Phi deg | Piezo Surf. | Ru |
|---|---|---|---|---|---|
| Rebuilt Fill | 120 | 100 | 26 | 0 | 0 |
| Existing Fill | 120 | 100 | 26 | 1 | 0 |
| Bedrock | 125 | 100 | 30 | 0 | 0 |

Seismic coefficient = 0.25

Stevens Ferrone & Bailey Engineering Co. Inc.
SFB 768-1
Hillview Drive Landslide, Danville, CA
Section A
Slope Repair with Groundwater in Existing Fill
Pseudo-Static

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