FINAL GEOTECHNICAL REPORT
CT DOT PROJECT NO. 171-305
AMTRAK ACCESS ROAD

BRIDGE 02
AMTRAK ACCESS ROAD OVER TROUT BROOK
NEWINGTON, WEST HARTFORD, AND HARTFORD, CONNECTICUT

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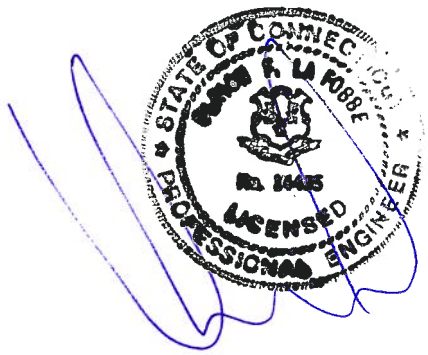

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1.0 INTRODUCTION

1.1 General

This report summarizes the final design subsurface exploration program, inferred subsurface conditions, and geotechnical analyses for Bridge 02, for the Amtrak Access Road (AAR) project; and provides geotechnical engineering recommendations for bridge foundation design. Bridge 02 will carry the AAR over Trout Brook in West Hartford, Connecticut. Other portions of the AAR project, including adjacent Retaining Walls 103 and 108, and the AAR roadway, are addressed under separate cover.

The AAR project involves the design and construction of an unpaved/gravel 4.45 mile roadway to be utilized as an access road for Amtrak maintenance vehicles. The AAR will be adjacent to the existing railroad tracks and is required since a new busway line will be replacing the existing access road. The AAR project begins in Newington, Connecticut, passes through West Hartford, and ends in Hartford, Connecticut. The site location, alignment, and other portions of the AAR project are indicated on Figures 1A, 1B, and 1C, Appendix 1.

Baker Engineering Corporation (Baker) is the Prime Designer for the AAR. Geo**Design**, Inc. (Geo**Design**) is the Geotechnical Subconsultant to Baker.

1.2 Datums

All elevations referenced in this report are in feet and are based on NGVD 1929. The coordinates are based on Connecticut Coordinate System, NAD 1983.

1.3 Design Criteria

The AAR is intended to carry Amtrak maintenance vehicle and equipment traffic. It is not intended to carry rail traffic or to be a public highway. Foundation recommendations for design in this report have been based on AASHTO Load and Resistance Factor Bridge Design Specifications, 3rd Edition, 2004 (AASHTO LRFD) with Interim Specifications through 2006, and Connecticut Department of Transportation Geotechnical Engineering Manual, 2005 Edition. Seismic design recommendations are based on AASHTO LRFD Specifications 4th Edition, 2007 with 2008 Interims. Recommendations are also based on State of Connecticut Department of Transportation (ConnDOT) Standard Specifications for Roads, Bridges, and Incidental Construction, Form 816 (2004).

1.4 Existing Structure

An existing arch bridge carries two Amtrak Railroad (RR) tracks over Trout Brook. At the crossing the RR tracks run south-southwest to north-northeast over the northwest-southeast

trending Trout Brook. In this report the railroad will be considered to run north-south, with the AAR base line stationing increases from south to north.

Trout Brook normal water surface is roughly at about Elevation 35 feet, with water depths of about 1 to 2 feet. The railbed crossing over New Britain Avenue on the existing bridge is at about Elevation 66 feet. Present access to the tracks for maintenance is provided by an existing access way along the west side of the rails. East of the existing bridge on either side of Trout Brook are steep embankments behind concrete wingwalls. The embankments are covered with a mix of grass, shrubs, and trees, and upright utility poles. The railroad embankment side slopes range from about 1V:1.7H to 2V:1H.

The original construction date of the arch bridge is unknown. The existing arch bridge is a single span stone and concrete, earth-filled arch with an internal slab span. The existing wingwalls are 30 to 40 feet long (running east and south, respectively). The method of foundation support (spread footings or piles) for the existing bridge and wingwalls are unknown. The existing structure does not display indications of excessive settlement or foundation distress.

1.5 Proposed Structure

The existing structure and wingwalls will remain in place and continue to carry the existing railroad tracks and proposed Busway over Trout Brook. The proposed AAR Bridge 02 will be a 135-foot single span structure constructed immediately east of the existing structure. The overall structure width will be 13’10” consisting of a 10’0” travel lane, and 1’11” concrete parapets on each shoulder. The travel surface of the proposed bridge will consist of a prestressed concrete deck, and 18-foot approach slabs are proposed on either side of the proposed bridge.

The proposed bridge will have full integral abutments to be located behind the existing wingwalls. The abutment on the south side of Trout Brook is designated as Abutment 1 and that on the north side of Trout Brook as Abutment 2. Each abutment will have a wing wall extending from its east end. Wingwall 1B will extend to the south approximately 10 feet, and will abut proposed Retaining Wall 103. Wingwall 2B will extend approximately 10 feet to the north, and will abut proposed Retaining Wall 108.

Figure 2 illustrates the project site and proposed structure.

2.0 PREVIOUS SUBSURFACE INFORMATION

2.1 Geologic Setting

Published geologic data indicates that the site is underlain by sedimentary bedrock of the Portland Arkose formation. Depth to bedrock in the vicinity of the proposed bridge is indicated

to vary between 50 and 100 feet, with the bedrock surface sloping downward to the east. The composition and texture of the Portland Arkose ranges from a coarse conglomerate to fine grained shale.

Natural overburden soils are indicated to consist primarily of ground moraine glacial till mantling the bedrock, which is overlain by glaciolacustrine deposits of clay, silt and sands, followed by an alluvial deposit. The existing railroad embankment is mapped as artificially placed fill material. Otherwise, the geologic maps would imply that surficial man-placed fill is relatively thin (less than 5 feet thick) at the project site.

The ground moraine glacial till is a dense heterogeneous mixture of rock and soil particles of all sizes, ranging from cobbles to silt and clay sized particles that were deposited below the advancing glacial ice. In this portion of Connecticut, the Glacial Till can vary greatly in composition, depending on the soils and bedrock present during the final glacial advance. Two types of till, termed “stony till” and “clayey till”, are typically identified as occurring in the site vicinity in the geological literature.

The glaciolacustrine deposits consist of sediments deposited in Glacial Lake Hitchcock approximately 15,000 years ago. These sediments predominantly occur in alternating clayey and silty layers called varves. During the warm summer seasons, a more turbulent flow entering the lake transported silt-sized (or even fine Sand) particles from outwash and settled on the lake bottom. During the cold winter months, a frozen lake surface created a calm lake which promoted settlement of clay particles in suspension. Each varve represents a silt and clay pair resulting from yearly seasonal changes and lake behavior. Varving may be indistinct or absent in portions of the deposit, depending on conditions in the glacial lake at the time the sediments were deposited. It is also typical to find coarser sediments at the bottom and top of this stratum. The former consisting of sediments deposited into the lake bottom early during lake formation when water was shallow, and the latter due to sediments washed onto the exposed lake bed after the lake had drained.

In numerous sources of reference literature, the glaciolacustrine deposit found in this region is referred to as Connecticut Valley Varved Clay (CVVC). We called this deposit layer Clay and Silt (varved) on our boring logs. However, in the rest of the report, we will use the term “Glaciolacustrine Silts and Clays” or “Silts and Clays” to refer to this strata.

The Alluvial Deposit consists of sediments deposited by Trout Brook. Given its origin, the deposit is not a continuous layer and the lateral extent and thickness of the layer varies. The Alluvial Deposit consists of fine to medium grained Sand/Silt, with some Clay and little Gravel.

2.2 Flood Levels

According to the Federal Emergency Management Agency's (FEMA) "Flood Insurance Rate Map", the base flood elevation where AAR crosses over Trout Brook is approximately El. 48 feet. The base flood elevation has a one-percent annual chance of occurring. This elevation is approximately 13 feet above the normal groundwater levels, and approximately 17 feet below the RR track elevation.

2.3 Existing Subsurface Data

Pilot borings for the proposed "New Britain – Hartford Busway" (Busway) project were conducted in 2003 by Baker Engineering. The Busway project's alignment in the vicinity of Bridge 02 is to the west side of the RR tracks. Borings SB-52 and SB-53 were performed approximately 65 feet west of proposed Bridge 02 (see Figure 2 for locations). Laboratory tests were performed on samples obtained from these borings. The boring logs and laboratory data from these boring are included in Appendix 4 and have been incorporated into the subsurface profile presented on Figure 3.

3.0 SUBSURFACE EXPLORATIONS

Pertinent test borings performed for this study include a total of eight borings. Two borings required offsets due to shallow refusals, and are designated with an "A" or "B" following the boring name. Six borings (designated AAB-02-21 through AAB-02-24, AARW-06-25 and AARW-06-26) were performed at the proposed locations of the Bridge 02 abutments and wingwalls. Two borings (designated AARW-05-18 through AARW-05-19) were performed south of Bridge 02 along the proposed alignment of the adjoining Retaining Wall 103. These borings provide soil type, relative density, consistency, and composition in the vicinity of the proposed structure foundations. Two of the borings extended to bedrock, five borings ended in the Silts and Clays, and one boring ended in the Glacial Till. Final design boring locations in the area of Bridge 02 are shown on Figure 2, Appendix 1, and boring logs are attached in Appendix 2.

These borings were performed by Warren George, Inc. of Jersey City, New Jersey, and were observed and logged by Geo**Design**, Inc. The borings were conducted between July 22, 2008 and September 14, 2008. Borings were performed using conventional rotary drilling equipment, and were advanced using a drive and wash method. When borings were advanced without casing, Revert II drillers mud was used to maintain an open hole. Samples were obtained with a two-inch O.D. split-barrel sampler in general compliance with ASTM 1586. Standard Penetration Test (SPT) sampling was typically semi-continuous through strata above the natural Silts and Clays deposits. The typical sampling interval changed to five feet in the Silts and Clays. In borings advanced to bedrock, 10 to 15-foot rock cores were obtained.

Two two-inch observation wells were installed into Borings AARW-05-19 and AARW-06-26. Several groundwater observations were obtained from the wells during the boring program.

3.1 Subsurface Profile

The test boring data has been plotted on subsurface profiles presented as Figures 3A and 3B. Figure 3A is a longitudinal profile along the bridge. Figure 3B is a transverse profile along the north abutment (a transverse profile was not performed for the south abutment since there was limited information). A legend for the subsurface profiles is provided on Figure 4. The recent and previous test boring data, interpreted in light of the site's geologic setting indicates the following generalized subsurface profile (from the ground surface downward) at the bridge site:

- **Organic Topsoil and Subsoil** – 0 to 3 feet thick;
- **Fill –** 0 to 20 feet thick;
- **Silt/Sand (Alluvium Deposit) –** 7 to 25 feet thick;
- **Silts and Clays (Glaciolacustrine Deposit)** – 37 to 44 feet thick;
- **Silt/Fine Sand (Glaciofluvial Deposit)** – 0 to 19 feet thick;
- **Glacial Till** – 0 to 15 feet thick;
- **Decomposed Bedrock** – 0 to 16 feet thick;
- **Bedrock.**

The groundwater table is indicated to be at about Elevations 37 to 43 feet.

These soil and rock strata are described in greater detail below.

3.1.1 Fill

The existing surficial **Fill** at the proposed bridge site consisted predominantly of a mixture of fine to medium or fine to coarse Sand, varying amounts of fine to coarse Gravel, less than 15 percent Silt, and trace amounts of Organic Fibers. The Fill was generally loose to dense with very loose and very dense pockets. SPT blow counts ranged from 3 to 78 blows per foot, but were mostly between 5 and 38.

The Fill was 8 to 10 feet thick at test boring locations for Bridge 02. The Fill would be thicker toward the RR tracks in the existing railroad embankment. The bottom of the Fill at the test borings varied from about Elevation 48 to 56 feet.

3.1.2 Silt/Sand (Alluvium Deposit)

The **Silt/Sand** layer was encountered in each of the eight borings. The layer generally consisted of loose to medium dense Silt and fine Sand. SPT blow counts ranged from 4 to 27, but were

mostly between 6 and 12. The Silt/Sand was 16 to 25 feet thick at test boring locations for Bridge 02, with the bottom of the layer at varying from about Elevation 29 to 38 feet.

3.1.3 Silts and Clays

The **Silts and Clays** layer occurred below the Silt/Sand layer throughout the site. At the proposed bridge site the upper surface of the Silts and Clays varied between El. 29 to 38 feet. Where fully penetrated at Borings AAB-02-22A, AAB-02-23B, and AARW-06-26, the Silts and Clays was 36 to 44 feet thick, with the bottom of the strata between about El. -6 to -10 feet. SPT blow counts in the Silts and Clays varied from 0 to 25 blows per foot, but were mostly in the range of 5 to 12 blows per foot, indicating a consistency varying from soft to stiff.

As described in Section 2.1, Silts and Clays is of glaciolacustrine origin, and consists generally of a mixture of silt and clay with minor content of fine sand. Distinct varving was not present in portions of the stratum in boring AAB-02-22A. Laboratory tests on the Silts and Clays are discussed in Section 4.0 below.

3.1.4 Silt/Sand (Glaciofluvial Deposit)

A layer of **Silt/Sand (Glaciofluvial Deposit)** was encountered in two borings on the north side of the proposed bridge. Boring AAB-02-23B encountered an eight foot layer of hard to very stiff clayey Silt, with little coarse Sand, trace fine Gravel. Boring AARW-06-26 encountered a 19-foot layer consisting of very dense fine to coarse Sand, with trace to little Silt. The SPT values of the Glaciofluvial Deposit in Boring AAB-02-23A was about 20, and in Boring AARW-06-26 ranged from 82 to over 100.

3.1.5 Glacial Till

Up to about 30 feet of ground moraine **Glacial Till** was encountered in Boring AAB-02-22A, and about two feet of Glacial Till was encountered underlying the Glaciofluvial deposit in Boring AAB-02-23A. The Glacial Till is very dense with SPT blow counts ranging from 34 to over 100 blows per foot. However, we note that Samples S-13 and S-14 in Boring AAB-02-22A, the last 12-inches of the 24-inch penetration had blow counts of less than 10. This indicates unpredictable variability of the Glacial Till consistency. The Till is a red-brown heterogeneous mixture of fine to coarse Sand with 20 to 30 percent Silt and a variable content of fine to coarse Gravel. The recovered Glacial Till samples were more representative of “Sandy Till” than “Clayey Till” (see section 2.10). In Boring AAB-02-23B, an inferred cobble/boulder was drilled through, indicating the likely presence of cobbles and boulders within this Glacial Till stratum.

3.1.6 Decomposed Bedrock

A 16-foot thick layer of **Decomposed Bedrock** was encountered in Boring AAB-02-23 below layers of Silt/Sand and Glacial Till. The layer was penetrated by roller bit, followed by a core which returned little sample recovery and indicated very poor rock quality. A split spoon sample followed, penetrating the decomposed rock 11 inches. The recovered soil sample consisted of completely decomposed shale bedrock, made up of fine to coarse Sand and Silt, with little fine Gravel.

3.1.7 Bedrock

Shale **Bedrock** was cored in Borings AAB-02-23A and AARW-06-26 about 91 and 99 feet deep, respectively, (El. -35 and -30 feet). The recovered Bedrock samples are described as hard, slightly to moderately weathered, red brown, fine grained SHALE, with fracturing near 30 degrees. The Rock Quality Designation (RQD) values for the core samples range from 17 to 91 percent, generally increasing with depth, indicating very poor to excellent quality.

3.2 Groundwater

Readings in observation wells installed in Borings AARW-05-19 and AARW-06-26 were taken up to 24 days following installation. The groundwater levels were observed between El. 43 feet (about 9 feet below existing ground surface at AARW-05-19) and El. 37 feet (about 23 feet below existing ground surface at AARW-06-26). See Table 1, Appendix 2 for observation well readings. We estimate the normal Trout Brook water surface level is at approximate Elevation 35 feet.

The groundwater generally decreases in elevation from south to north at a slope of approximately ¼-inch per linear foot.

Groundwater conditions vary over time depending on factors such as brook water levels, temperature, season, precipitation, construction activity and other conditions, and may differ from those currently observed in the borings and monitor wells.

4.0 LABORATORY TESTING

The laboratory testing program conducted for this study is summarized below. Test reports are attached in Appendix 3. As previously noted, laboratory reports for previous testing by others is attached in Appendix 4.

Laboratory testing was focused primarily on the strength and consolidation properties of the Silts and Clays, and on index tests to evaluate the potential variability of the Silts and Clays properties. Laboratory testing was performed (as indicated) by either the University of

Massachusetts (UMass) in Amherst, Massachusetts, or GeoTesting Express, Inc. (GeoTesting) in Boxborough, Massachusetts.

4.1 Consolidation Tests

Constant Rate of Strain (CRS) Consolidation Tests were performed on tube samples of the Silts and Clays by University of Massachusetts, Amherst (UMass), to determine the stress history and the compression/recompression index. CRS tests were performed on samples from Borings AAB-02-22A (43 to 45 feet) and AAB-02-23B (58 to 60 feet). See Appendix 3 for test results. Note that UMass indicated that testing on these samples were more difficult than others on the AAR project due to their high Silt content.

Consolidation test results indicate that the Silts and Clays are over consolidated, with approximate Over Consolidation Ratios (OCR) around 2.3, Coefficient of Consolidation (C_v) of 6.5 ft^2/day, Preconsolidation Stress (σ'_p) of about 7000 psf, and Modified Recompression Index (C_{rc}) ranging between 0.021 and 0.040.

4.2 Strength Tests

Several Direct Simple Shear (DSS) Tests were performed at UMass to estimate the shear strength of the Silts and Clays. DSS Tests simulate a shear force acting horizontally to soil. Because of the particular horizontal-layered structure of Silts and Clays, the shear strength along its varves is much lower than the shear strength cross the varves. Thus DSS Tests on Silts and Clays samples give a conservative shear strength value as compared to triaxial testing.

The DSS tests were performed on samples from Bridge 02, as well as several other locations on the AAR project. Horizontal shear strengths mostly ranged between 1000 psf and 1500 psf; and at Bridge 02, the shear strength result was about 1250 psf. See Appendix 3 for the test results.

Geo**Design** also used Stress History And Normalized Soil Engineering Properties (SHANSEP) Method recommended by Ladd & DeGroot in their 2003 article "*Recommended Practice for Soft Ground Site Characterization: Arthur Casagrande Lecture*". The SHANSEP method allows for the correlation of the undrained shear strength (S_u), insitu stress (σ'_{vc}), and OCR to provide a reliable way to predict shear strength in the Silts and Clays layer. This correlation was developed using the expression, $S_{u,DSS}/\sigma'_{vc} = 0.18(OCR)^{0.73}$.

4.3 Index Tests

Liquid Limits (LL), Plastic Limits (PL), and Plasticity Indexes (PI) were determined for five jar samples (tested by GeoTesting) and two tube samples (tested by UMass) of the Silts and Clays. Test samples were selected from 30 to 72 foot depths. Figure 5, Appendix 1 presents a graphic and distribution of natural water content, LL, and PI vs. depth.

LL results varied from 22 to 68 percent, with PL results ranging from 15 to 32 percent, and PI ranging from 7 to 36 percent. Throughout the depth of Silts and Clays, the results indicate the LL is mostly around 40 percent, indicating medium plasticity, and the average natural moisture content was about 37 percent.

4.4 Gradation Analyses

4.4.1 Hydrometer Analyses

Three hydrometer analyses were performed (by GeoTesting) on jar samples of the Silts and Clays from various depths in the area of Bridge 02. Samples were cut vertically across the varves for a representative gradation. The identity of test samples and test results are attached in Appendix 3.

Results indicated a generally consistent pattern in gradation of the Silts and Clays. Fine Sand and Silt content (0.002 to 0.075 mm) decreased with depth, and the Clay content (less than 0.002 mm) increased with depth. The Silt content varied from about 42 to 78 percent, and Clay varied from 18 to 56 percent.

4.5 Natural Moisture Content

Natural moisture contents were measured from twelve jar samples (tested by GeoTesting) and from three tube samples (tested at UMass) of the Silts and Clays. Samples were cut vertically across the varves for representative moisture content. Results are plotted vs. depth in Appendix 1, Figure 5.

The natural moisture content results for the Silts and Clays varied from 23 to 46 percent. In general, the results display a pattern with moisture contents between 40 and 50 percent in the upper and middle area of the Silts and Clays layer, with lower moisture contents (around 30 percent) at the bottom of the Silts and Clays layer. The average moisture content was approximately 37 percent.

5.0 GEOTECHNICAL ISSUES AND ANALYSES

5.1 Foundation Type

Up to 17 feet of Alluvium Silts/Sand was found below bottom of footing elevations, with up to 43 feet of Silts and Clays below the Silts/Sands. Preliminary drawings and the June 2006 Bridge Type Study, provided by Baker, indicate integral bridge abutments supported with deep foundations.

5.1.1 Bridge Loads and Elevations

Baker provided the following approximate superstructure service loads at each proposed bridge abutment:

- Dead (weight of super structure only): 380 Kips
- Live: 220 Kips

Based on the drawings provided by Baker, Geo**Design** estimates Abutment 1 and 2 footings to have dimensions of 3 by 14 feet. Geo**Design** estimates additional Dead Load from the weight of each abutment to be approximately 20 Kips. Therefore the total service load of 620 Kips is estimated at each abutment.

Geo**Design** estimates service loads for 12-foot high concrete wingwalls of 144 Kips for Wingwall 1B with approximate footing dimensions of 8 by 20 feet; of 194 Kips for Wingwall 2B with approximate footing dimensions of 8 by 27 feet; and a service load of 137 kips for Wingwall 2A with approximate footing dimension of 8 by 19 feet.

The proposed abutment and wingwall bottom of footing elevations (BFE) are as follows:

- Proposed south Abutment 1 and Wingwall 1A/B: El. 53.0 ft.
- Proposed north Abutment 2 and Wingwall 2A/B: El. 52.5 ft.

5.1.2 Foundation Type Selection

With an integral abutment design, pile foundations are required. The conditions at this site will result in friction or end bearing piles penetrating through the Silt/Sand and Silt and Clays layers, supporting the bridge on underlying soils suitable to carrying the anticipated bridge loads. We evaluated the existing soil conditions and profile with consideration to friction piles. We anticipate that Bedrock will be encountered before sufficient frictional resistance is gained within the Sand/Silt or Till stratums.

With consideration to an integral abutment design for a bridge span of this length (135 feet), literature recommends driving piles through shallow shell casings and filling with sand or crushed stone to allow for pile flexing as the super structure translates. The shell casings will also favor against vibrations from pile driving, settlement of the Alluvium Silt/Sand stratum during pile driving, and damage to the pile in the upper Fill and Silt/Sand layers.

In Section 6.0 of this report, we provide design deep (pile) foundation recommendations.

5.1.3 Settlement due to Abutment and Wingwall Backfill

5.1.3.1 Magnitude of Settlements

We estimate that the total consolidation settlement due to placement of up to 11 feet of new embankment fill behind Wingwalls 1B, and 2A/B, of approximately 0.3 to 0.5 inches. The maximum settlement is likely to occur along the centerline of the embankment fill. The settlement will gradually decrease to nominal value as the grade height of the new embankment decreases.

With Bridge 02 abutment and wingwalls being supported on deep pile foundations, the total backfill settlement will also equal the differential settlement with respect to the bridge structure. Consolidation of the Silts and Clays under the embankment loading will also induce down drag load on the deep pile foundations of the proposed bridge.

Consolidation of the Silts and Clays under the weight of the new embankment fill will also induce limited settlement in nearby areas. We estimate settlements of less than 0.1 inches below the nearest railroad track. Ten feet east from the toe of the widened embankment, we estimate settlements of less than 0.4 inches.

Potential instantaneous-type construction settlements within the Alluvium Silt/Sand layer of less than 0.75 inches could occur rapidly during construction. However, based on the close proximity of the work to the RR tracks, vibrations from the passing trains for nearly 100 years may have substantially consolidated the Alluvium Silt/Sand layer, thereby reducing the potential and magnitude for construction-related settlements.

5.1.3.2 Rate of Settlements

Because the proposed embankments will be relatively narrow (about 15 feet) as compared to the thickness of the Silts and Clays (40 feet), and because of the anisotropic properties of Varved Clay, horizontal drainage will greatly affect the rate of consolidation.

In estimating the rate of consolidation, we used *"Field Consolidation of Varved Clay"*, a report by Professor Richard P. Long, Professor Kent A. Healy and Mr. Peter J. Carey from University of Connecticut. Figure 13 of this report depicts the field-measured apparent coefficient of consolidation for different loading geometries quantified as the ratio of the Varved Clay Thickness (Silts and Clays) and to the Embankment Width (dimension ratio). For a dimension ratio of one, the field-measured apparent coefficient of consolidation is 4 ft^2/day. We conservatively chose this value because most embankment widths are narrower than the thickness of clay. As a result, the apparent coefficient of consolidation is no less than 4 ft^2/day. We estimate consolidation of the Silts and Clays will occur over about three months, with secondary (minor) settlement taking up to 50 years.

5.2.3.3 Silt and Clay Properties

The following Silt and Clay properties were also used in the design and estimating settlements:

- Void Ratio, e = 1.2
- Unit Weight, γ = 105 pounds per cubic foot (pcf)
- Saturated Unit Weight, γ_{sat} = 113 pcf
- Undrained Shear Strength = 850 pounds per square foot (psf)
- Young's Soil Modulus of Elasticity = 300 to 500 tons per square foot (tsf)
- Compression Index, $C_{c\varepsilon}$ = 0.11
- Re-Compression Ratio, $C_{r\varepsilon}$ = 0.02
- Secondary Compression Index, C_{α} = 0.0009
- Initial Effective Stress at top of Silt/Clay Layer = 1515 pcf
- Initial Effective Stress at Bottom of Silt/Clay Layer = 3580 pcf
- Maximum Past Effective Stress at Top of Silt/Clay Layer = 7400 pcf
- Maximum Past Effective Stress at Bottom of Silt/Clay Layer = 5560 pcf

5.1.4 Seismic Parameters and Liquefaction

Soils within and below the bearing zones of the substructures were analyzed with regard to their potential to liquefy during the AASHTO design seismic event for this locale. Based on their consistency, high Silt and Clay contents, and plasticity, these saturated soils are not considered susceptible to liquefaction in the event of an earthquake. The Glacial Till soils are sufficiently dense so as to not be susceptible to liquefaction.

Since the proposed bridge is in Seismic Zone 1, per Section 4.7.4.1 of AASHTO LRFD 2007 with 2008 interims, seismic loads do not need to be analyzed. Thus, seismic parameters have not been provided.

6.0 GEOTECHNICAL RECOMMENDATIONS FOR DESIGN

6.1 Pile Foundations

As discussed in Section 5.1.2 integral abutments require deep pile foundations. We recommend the piles bear below the Silts and Clays stratum. Given the overall subsurface profile, the depth to Bedrock and the thickness of the Glacial Till layer, steel piles driven to Bedrock are considered the most suitable pile type.

The Bedrock surface elevation varies from El. -35 feet on the south, to El. -30 feet on the north side of the bridge. We estimate piles lengths of 91 feet long at Abutment 1, 90 feet long at

Wingwall 1B, 90 feet long at Abutment 2, and 86 feet long at Wingwall 2A/B. These pile lengths allow for one foot embedment each into the pile cap and bedrock.

To accommodate integral abutments, we recommend a 24-inch open-ended steel shell be installed at each pile location to a minimum of 15 feet below bottom of abutment elevation, or to the top of the Silts and Clays, whichever is greater. Following pile installation, the shell casing should be filled with crushed stone (Form 816, Article M.01.01, No. 8), and removed.

6.1.1 Down Drag Load

As noted in Section 5.1.3, consolidation of the Silts and Clays under the embankment loading will induce a down drag load on the bridge foundations. The magnitude of down drag forces depends on the friction coefficient between soil and the pile, and the geometry of the pile cross section. For a fixed cross sectional area and friction coefficient, the larger the pile perimeter the higher the down drag force. In addition, the greater the Clay thickness, the greater is the down drag force. At Bridge 02, the Silts and Clays thickness is up to 44 feet, therefore, the down drag force on an HP10 pile is approximately 170 kips, and the down drag force on an HP12 pile is approximately 210 kips.

Bitumen coatings have been used to coat piles and reduce the friction between the soil and pile. One millimeter thick bitumen coating can significantly reduce the amount of down drag force on a pile. The bitumen coating only needs to be applied to the length of section to be in contact with the Silts and Clays layer (ranging from 37 to 44 linear feet per pile). We estimate that the down drag load of a bitumen coated pile is about 10 times less than that on a pile without the coating. This reduces the down drag force on an HP10 pile to 15 kips, and on an HP12 pile to 17 kips.

6.1.2 Pile Type/Size Selection

Although piles may be either end bearing or friction, or a combination of the two, (CTDOT Bridge Manual), as discussed in Section 5.1.2 of this report, there is variable and limited thickness of Till for development of pile capacity in friction. Further, steel H-piles are typically used for bearing on bedrock or dense hardpan.

ConnDOT has requested that pile tip stresses not exceed 24ksi. We therefore recommend vertical, end-bearing, bitumen coated, Grade 50 steel HP-Piles with a maximum tip stress of 24 ksi. We further recommend pile tip reinforcement with integrally cast cutting teeth (or similar) be used.

We recommend PDA testing of the piles (Section 6.1.5), and therefore recommend a dynamic resistance factor, ($Ø_{dyn}$), of 0.65 and Fy = 50ksi. We recommend the nominal compressive resistances and down-drag loads as presented in the following table. Note that the nominal

(ultimate) compressive resistance per pile should be factored and then reduced by the corresponding down drag load. See consideration to lateral loads below (Section 6.1.3).

Pile Section	Nominal (Ultimate) Compressive Resistance, P_n (kips/pile)	Factored Compressive Resistance, P_r (kips/pile)	Bitumen Coated Down Drag Load (kips/pile)
HP10x57	403	262	15

6.1.3 Lateral Loads

The allowable lateral load per pile is dependent on both the allowable deflection of the pile group, and the factored axial load per pile. At this phase of design, an allowable lateral load cannot be provided because these two parameters are unknown. However, an estimate of the allowable lateral load for a vertical pile can be determined with figures in Appendix 1.

Figures 7A and 7B, Appendix 1 give the deflection of a single HP10x57 pile under a given factored lateral load. These figures should be used to estimate allowable lateral load with respect to deflection.

The combined flexure and axial equations given in Section 6.9.2.2 of AASHTO LRFD should be used to check the structural adequacy of the proposed pile. The structural engineer can perform this check by inputting the following variables into these equations:

- P_u = factored axial load per pile
- P_r – downdrag = factored axial resistance per pile as given in the table above
- M_{ux}, M_{uy} = factored moment for a given factored lateral load (see Figures 8A and 8B, Appendix 1 of this report)
- M_{rx}, M_{ry} = factored flexural resistance (phi = 1.0) per AASHTO 6.12.2.2

This procedure should be used to determine pile layout. Allowable lateral loads may need to be refined based on pile spacing, axial load, pile head fixity, and group effects.

6.1.4 Pile Spacing

Pile spacing should be in accordance with AASHTO LRFD Section 10.7.1.2, such that center-to-center pile spacing should not be less than 30-inches or 2.5 pile diameters.

For piles in groups, the lateral resistance will be less than the sum of the single pile lateral resistance. If pile groups are considered with pile spacing less than five diameters, group reduction factors must be applied in accordance with AASHTO LRFD Section 10.7.2.4, Table 10.7.2.4-1, and Figure 10.7.2.4-1.

6.1.5 Pile Load Testing

Given the limited room at the project site and limited staging areas, we recommend Dynamic Pile Testing in lieu of a static load test. At least two indicator piles should be driven at each abutment and dynamically tested to establish driving criteria for production piles.

Preliminary installation criteria for the piles should be based on wave equation analysis employing the characteristics of the pile type, soil conditions, and pile driving hammer and cushions proposed by the Contractor. The Contractor should employ a Dynamic Testing Consultant that should perform a wave equation analyses, confirming that the pile driving system proposed by the Contractor can meet the capacity, driving resistance, and allowable stress limits.

6.2 Abutment and Wingwall Design Parameters

6.2.1 Static Design Parameters

For design of the abutments and wingwalls backfilled with Pervious Structural Backfill in accordance with ConnDOT standards, we recommend the following static design parameters:

- Unit weight of soil above the water table of 125 pcf
- Unit weight of soil below the water table of 62.6 pcf
- Soil Angle of Internal Friction, phi = 34°
- Coefficient of Friction for Soil against Wall, tan delta = 0.40
- Coefficient of Passive Earth Pressure, $K_P = 3.5$
- Coefficient of Active Earth Pressure, $K_a = 0.28$

Load Factors for soil loads should be selected based on Table 3.4.1-2 (AASHTO LRFD).

Earth pressure calculations should assume a minimum surface surcharge of 24 inches soil depth or 250 psf. Where applicable, Cooper E80 railroad loading shall be applied to abutments and wingwalls in accordance with Figure 9, Appendix 1.

Abutments and wingwalls should be designed to comply with ConnDOT Manual Standard, Plate Number 3.5.2 – U-Type wingwall for retaining wall drainage and backfill requirements.

7.0 CONSTRUCTION CONSIDERATIONS

7.1 Excavation Support and Protection

In accordance with American Railway Engineering and Maintenance-of-Way Association (AREMA) the contractor shall be solely responsible for the design, construction, and performance of temporary structures. Temporary structures are defined as those structures used to facilitate the construction of a permanent structure. Furthermore, the contractor shall have working drawings and design calculations for the temporary structures signed and sealed by a licensed CT professional engineer. These and other AREMA requirements should be referenced and noted in the contract documents.

The requirement for temporary sheeting is also set forth by Amtrak Specification 02261A - Rev. 1 dated June 6, 2001 (see Figure 6, Appendix 2).

Based on soil and groundwater conditions, steel sheeting or soldier piles and lagging are recommended for as temporary structures.

7.1.1 Existing Bridge Foundations

Excavations will occur immediately adjacent to the existing bridge carrying Amtrak over Trout Brook. The depth and type of foundation for the existing bridge is unknown. We recommend that no excavation occur within a line drawn downward and outward at a 1H:1V slope from the field exposed bottom edge of the existing bridge abutment.

7.1.2 Existing Railroad Tracks and Embankment

According to Figure 6, Amtrak requires protection of the existing RR tracks when construction occurs within two well-defined zones. Temporary sheeting is required if excavations extend into “zone 2” below the boundary defined as a 1V:1.5H slope beginning 10 feet outside the centerline of the nearest RR track. Temporary sheeting to be left-in-place is required if excavations extend into “zone 3” below the boundary defined as a 1V:1H slope beginning at the closest end of the RR tie.

Based on the Amtrak requirements, the western bottoms of Abutments 1 & 2 and Wingwall 2A are within “zone 3” which requires temporary lateral support to remain in-place. We estimate that bottoms of Wingwalls 1B and 2B are within “zone 2” which requires temporary sheeting that can be removed upon construction completion.
For the purpose of measurement and payment, we recommend Baker show on their drawings, the limits of temporary lateral support, and the Amtrak zones in which excavations will take place. Further, we recommend that a separate measurement and payment item be developed for temporary lateral support (e.g. railway sheeting).

7.1.3 Design Parameters

We recommend the following parameters for temporary lateral earth support:

Unit weight of existing embankment = 125 pounds per cubic foot (pcf)
Submerged unit weight of embankment = 63 pcf
Phi (embankment) = 34 degrees

Unit weight of Sandy Silt = 110 pcf
Submerged weight of Sandy Silt = 48 pcf
Phi (Sandy Silt) = 34 degrees

Unit weight of Silts and Clays = 105 pcf
Submerged weight of Silts and Clays = 43 pcf
Phi (Silts and Clays) = 38 degrees

7.1.4 Vibrations and Settlement

The present subsurface data indicate Alluvium Silts/Sands with medium dense consistency. It is possible that this layer will be susceptible to localized settlement from vibrations during pile driving and other construction activities. It is likely that driving the piles through shell casing will reduce the likelihood of this settlement. In any case, vibrations from such operations may still impact the railroad tracks and/or existing bridge. We recommend that a monitoring plan be required to be developed by the contractor (in accordance with Amtrak protocol), and that these structures be closely monitored for vibrations and settlement during construction.

7.1.5 Utilities

We understand utility poles in the existing embankment will be specified to be relocated (by Others) prior to construction.

7.2 Pile Installation

We expect excavation to proposed bottom of pile cap elevation will expose the Sands/Silts layer. Should a working mat be required to promote good working conditions and provide a stable surface for equipment operation, we recommend the mat consist of at least 18 inches of material below the proposed bottom of pile cap meeting gradation specifications for Compacted Granular Fill (Form 816, Article M.02.02) and/or Crushed Stone (Form 816, Article M.01.01).

If bitumen coating is employed to reduce down drag loads, care must be taken as to not damage the bitumen coating with extreme temperatures or driving through granular soils. Driving the piles through the shell casing will eliminate most of this risk.

We recommend that the piles be equipped with cast steel driving shoes.

7.3 Dewatering

Groundwater (about El. 35 feet) is expected to be below excavations to the proposed bottom of abutments and wingwalls (El. 52.5 to 53 feet). Footings are about 4 feet above at the level of the base flood elevation (El. 48 feet), which has a 1-percent annual chance of occurring (as indicated on the FEMA FIRM maps). Therefore, based on the subsurface data, we expect that dewatering of groundwater will not be needed; however, the contractor should be prepared to collect and remove water from the site caused by local, perched groundwater conditions, and water from precipitation and runoff.

7.4 Reuse of Excavated Material

Excavated inorganic site soils, other than the Silts and Clays, are expected suitable for re-use as embankment fill (ConnDOT Form 816 Section 2.02.03.5) where other materials are not required for structure backfill. Excavated Silts and Clays are not expected to be suitable for reuse on the project except as provided for placement of "unsuitable" materials in the outer slopes of an embankment as indicated on Standard Drawing No. 201.

Materials excavated from the Bridge 02 site are not expected to be suitable for re-use as Granular Fill or Pervious Structure Backfill.

7.5 Special Provisions

Special Provisions will need to be developed for the following:

- Bitumen Coated Piles (if adopted)
- Dynamic Pile Driving analysis (PDA) Test
- Vibration Monitoring During Sheeting and/or Pile Installation
- Settlement Monitoring
- Shell Casings for Piles at Integral Abutments

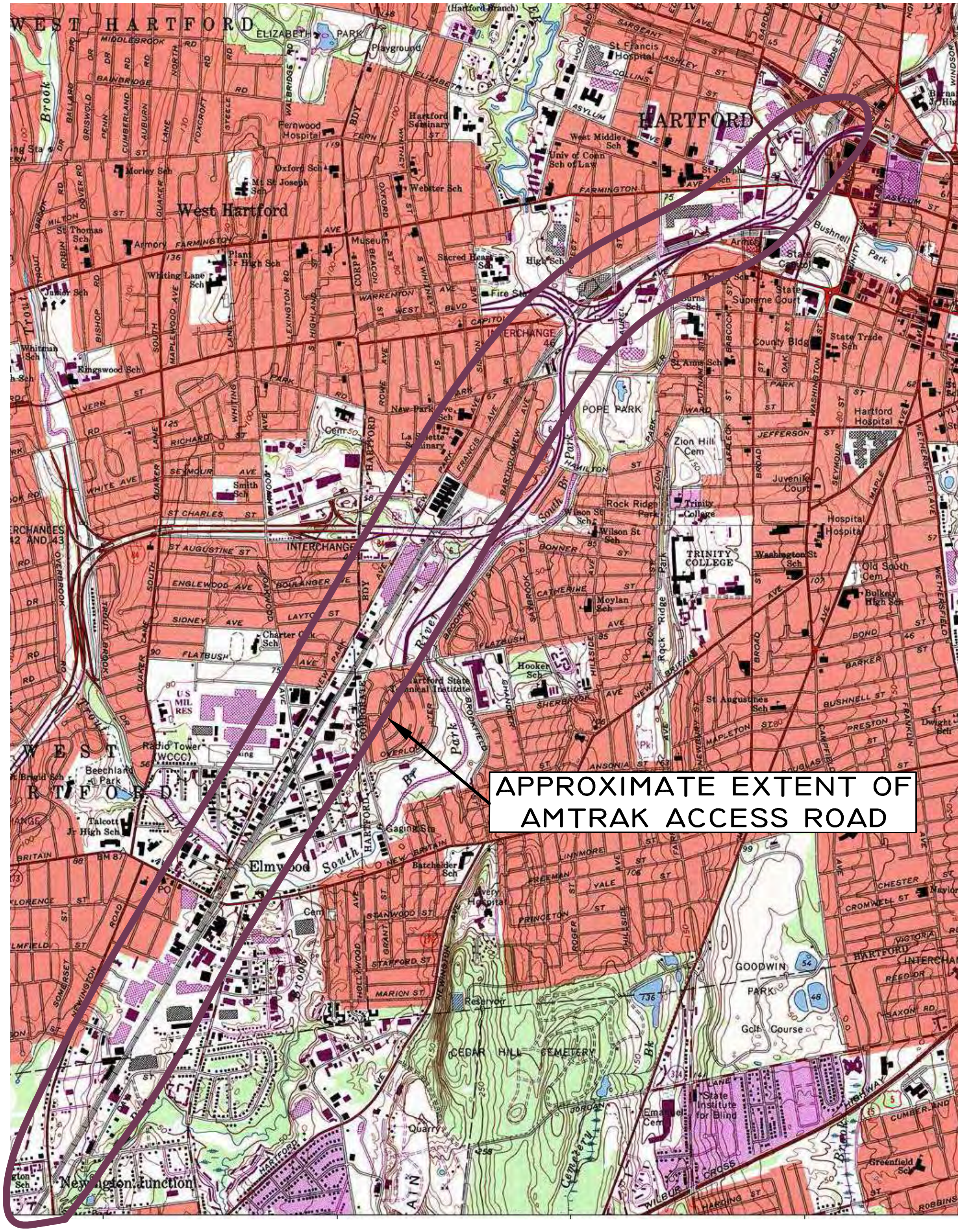
8.0 LIMITATIONS

This report is subject to the limitations attached in Appendix 5.

Appendix 1

Figures
&
Tables

Figures



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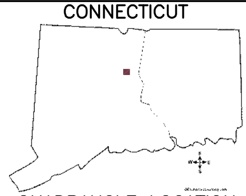
DRAWN BY: SMC | REVIEWED BY: MGB

CONNECTICUT



QUADRANGLE LOCATION

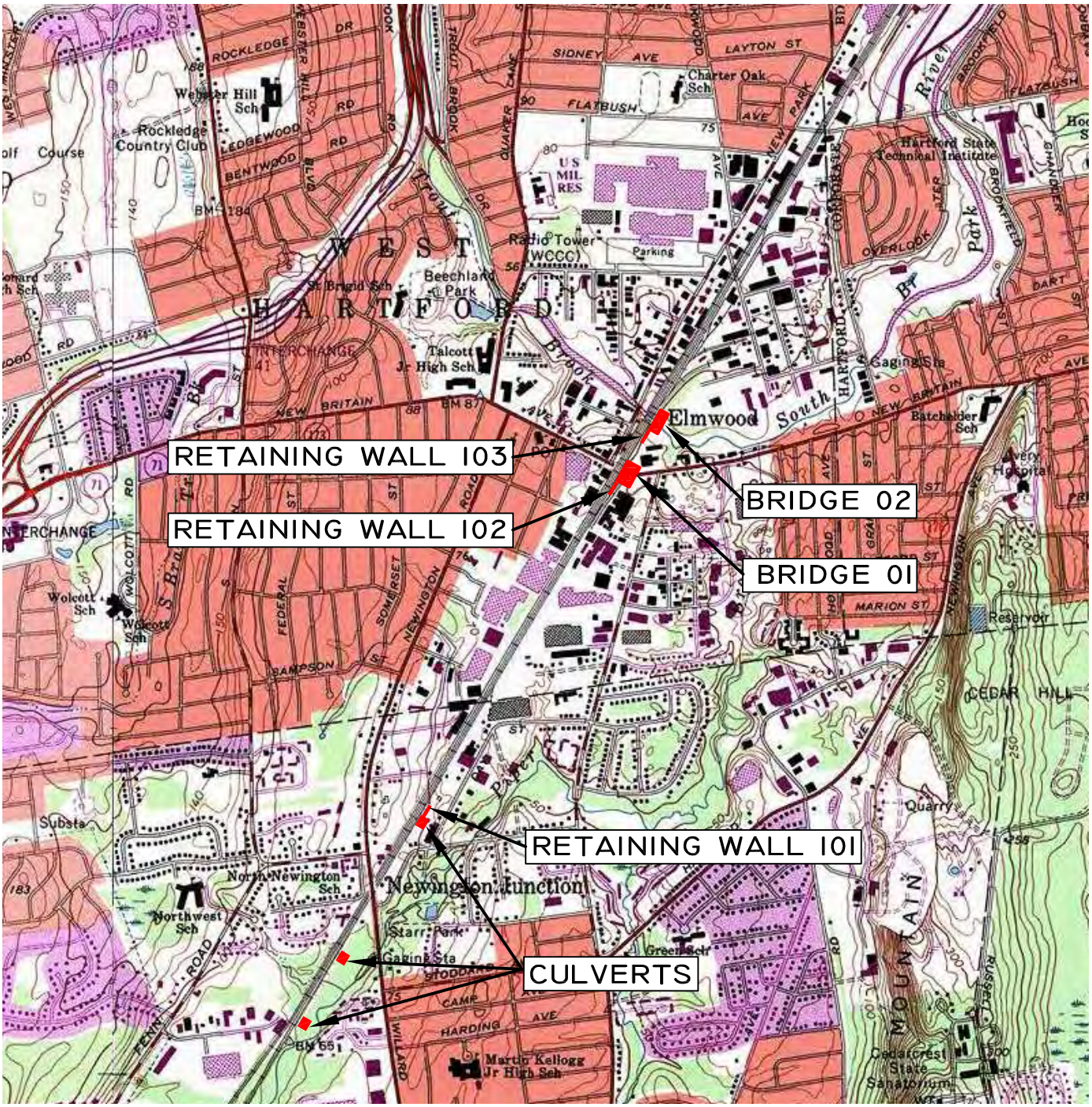
NOT TO SCALE

AREA PLAN – AMTRAK ACCESS ROAD NEWINGTON, WEST HARTFORD, HARTFORD, CONNECTICUT CONNDOT PROJECT # 171-305

REFERENCE:
U.S.G.S. 7.5 MINUTE QUADRANGLE: NEWINGTON, W.HARTFORD, HARTFORD, CT. Figure was created using TOPO! 2003 software

PROJECT NO. 183-010.0
DATE: 10-23-08
FIGURE NO. 1A

ACAD FILE No. M:\CL\183\10\CADD\HARTFORD AREA MAP.dwg



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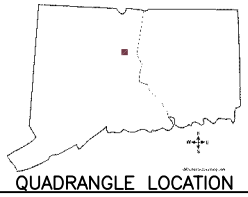
CONNECTICUT



QUADRANGLE LOCATION

AREA PLAN – AMTRAK ACCESS ROAD NEWINGTON, WEST HARTFORD, HARTFORD, CONNECTICUT CONNDOT PROJECT # 171-305

REFERENCE:
U.S.G.S. 7.5 MINUTE QUADRANGLE: NEWINGTON, W.HARTFORD, HARTFORD, CT. Figure was created using TOPO! 2003 software

SCALE IN FEET
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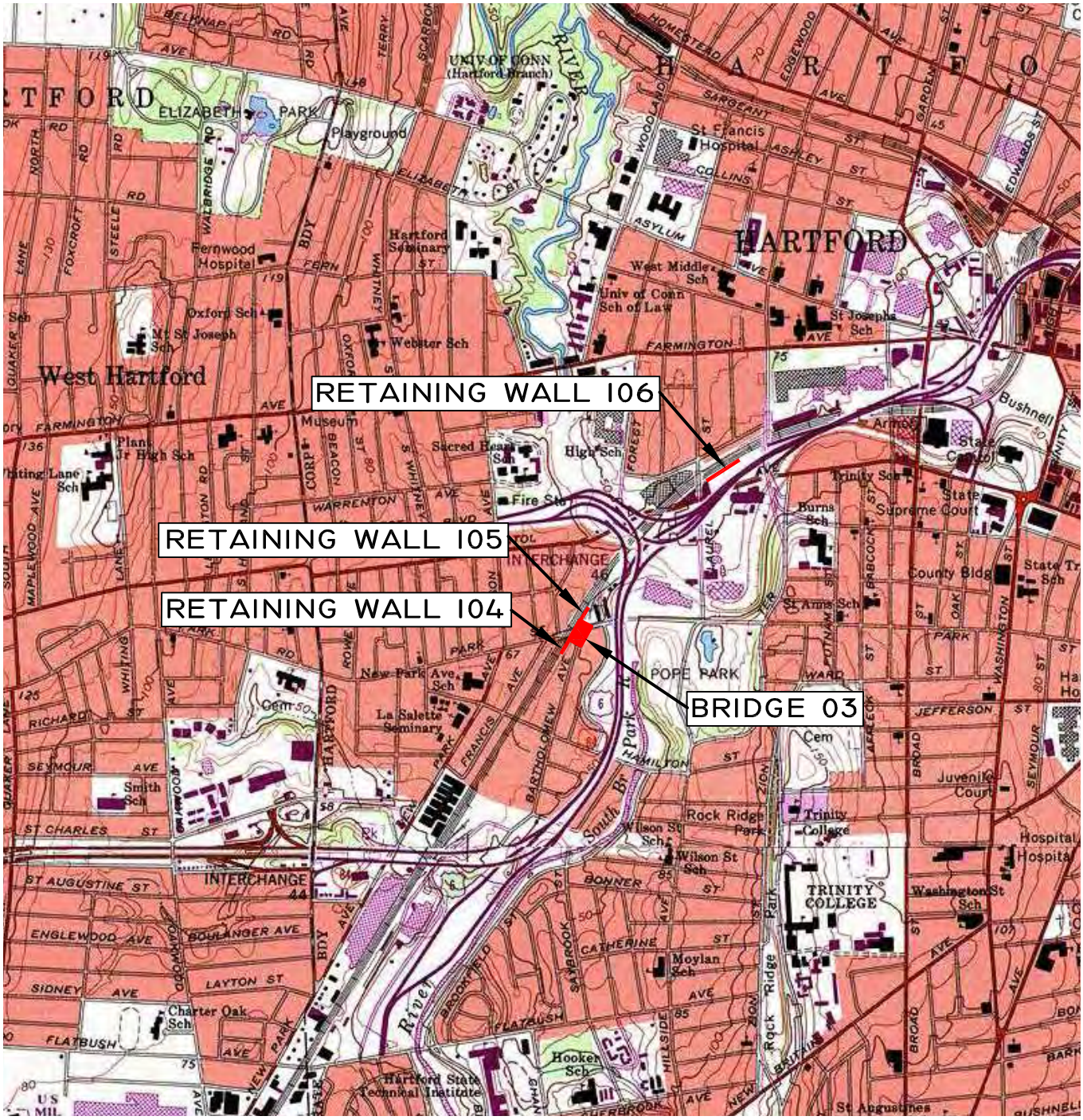
PROJECT NO. 183-010.0
DATE: 10-23-08
FIGURE NO. 1B



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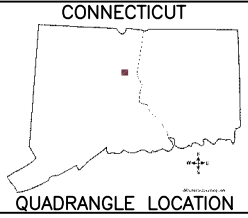
CONNECTICUT



QUADRANGLE LOCATION

AREA PLAN – AMTRAK ACCESS ROAD NEWINGTON, WEST HARTFORD, HARTFORD, CONNECTICUT CONNDOT PROJECT # 171-305

REFERENCE:
U.S.G.S. 7.5 MINUTE QUADRANGLE: NEWINGTON, W.HARTFORD, HARTFORD, CT. Figure was created using TOPO! 2003 software

SCALE IN FEET
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PROJECT NO. 183-010.0
DATE: 10-23-08
FIGURE NO. 1C

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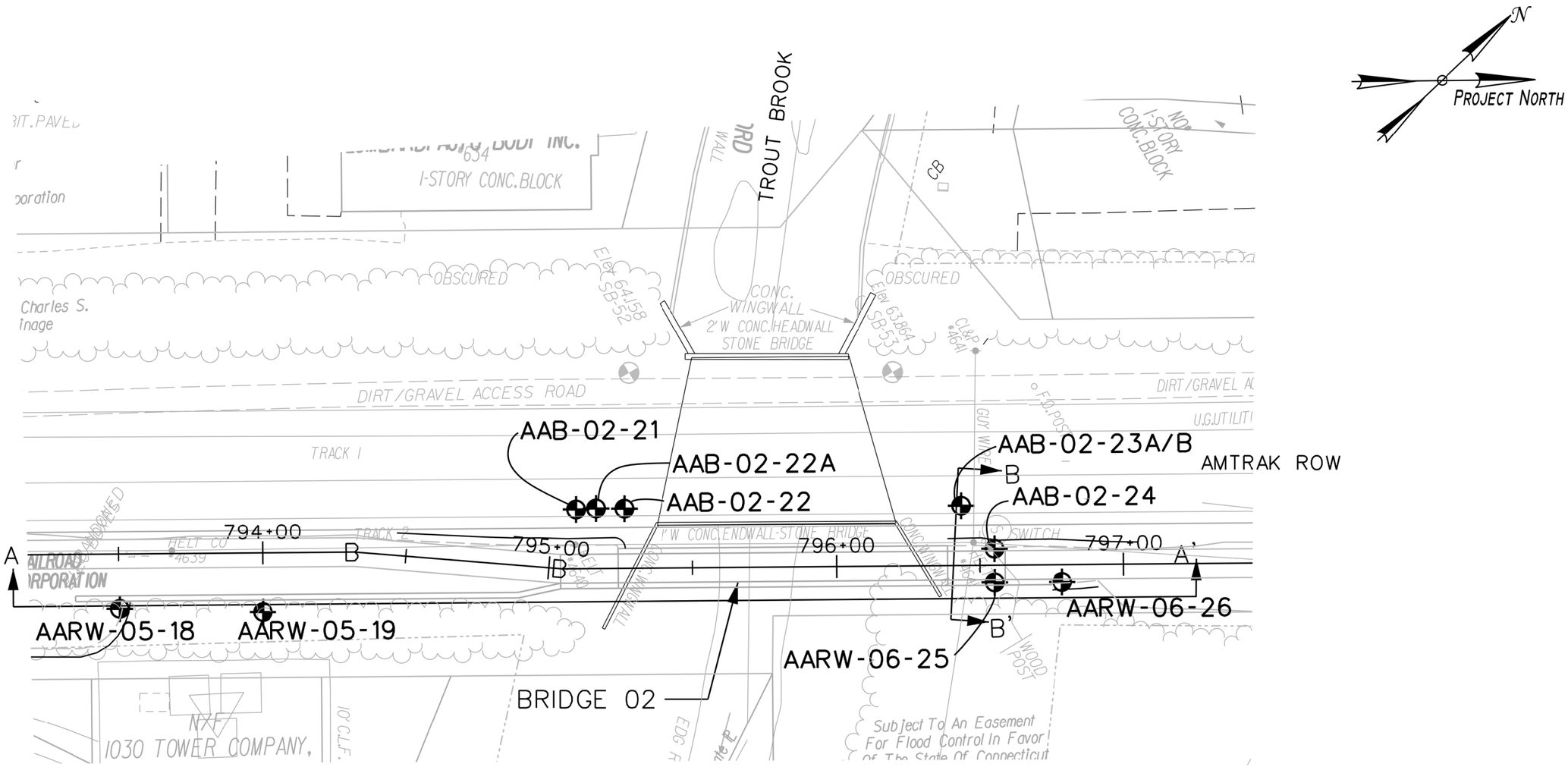

LEGEND

AARB- AAB- AARW-	GEODESIGN TEST BORING LOCATIONS
SB- RB-	PREVIOUS TEST BORINGS BY OTHERS

M:\CL\183\10\CADD\CURRENT CAD FILES\OVERALL PLAN w Sheets for Bridges & Structures (11-25-08)

DESIGNED BY	MGB
DRAWN BY	SMC
CHECKED BY	RTS
APPROVED BY	MPT

NO.	DATE		DRWN.	CHKD	APPVD

REVISIONS

PRIME DESIGNER:

Baker Engineering NY, Inc.

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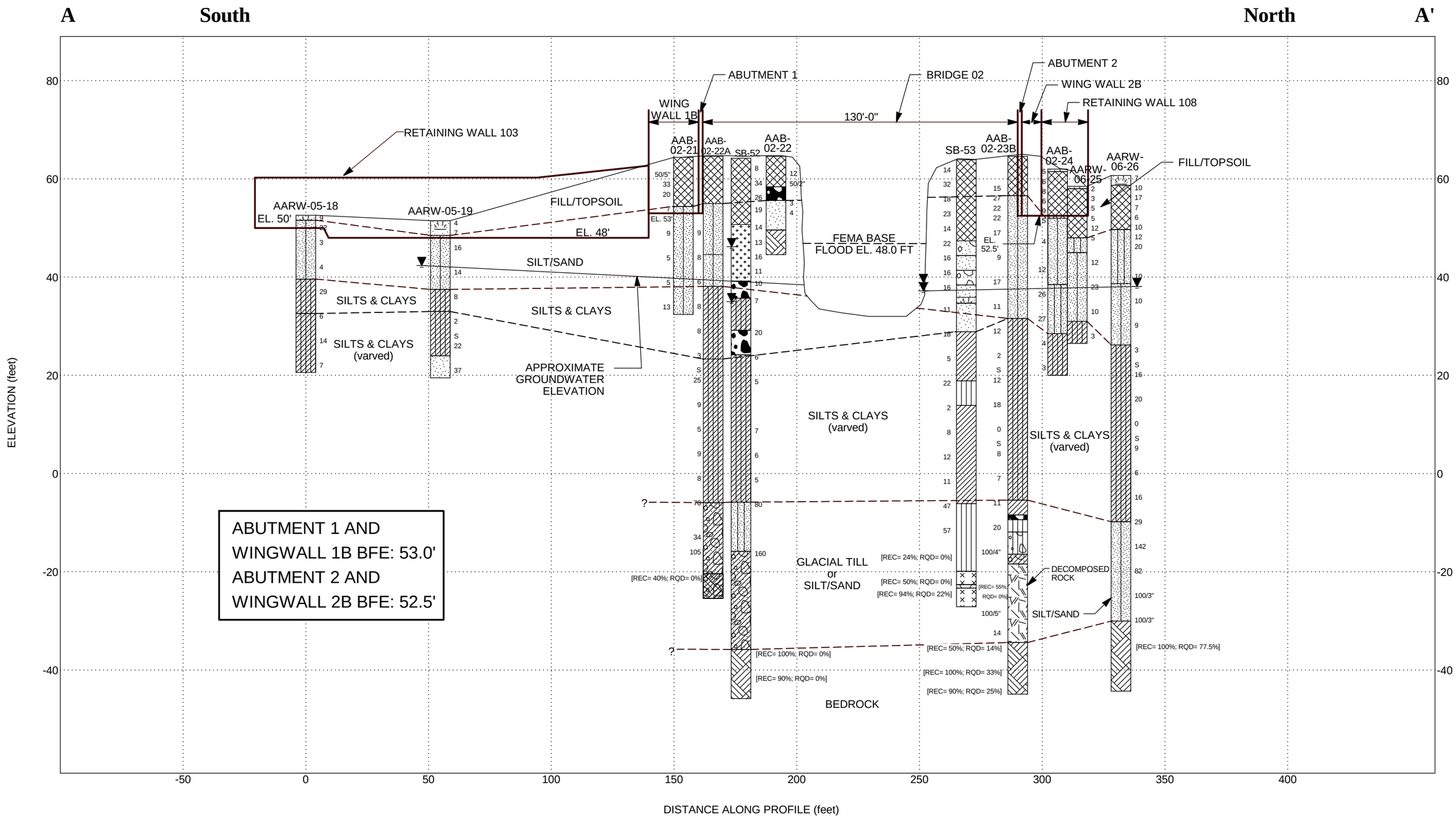
DWG. TITLE: BRIDGE 02

PROJECT: STATE PROJECT NO. 171-305
AMTRAK ACCESS ROAD
NEWINGTON, WEST HARTFORD AND HARTFORD, CT.

FILE NO. 183-10

SCALE 1" = 40' DATE 10-27-08

DRAWING NO. 2



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0 40
Horizontal Scale (feet)

Vertical Exaggeration: 2x

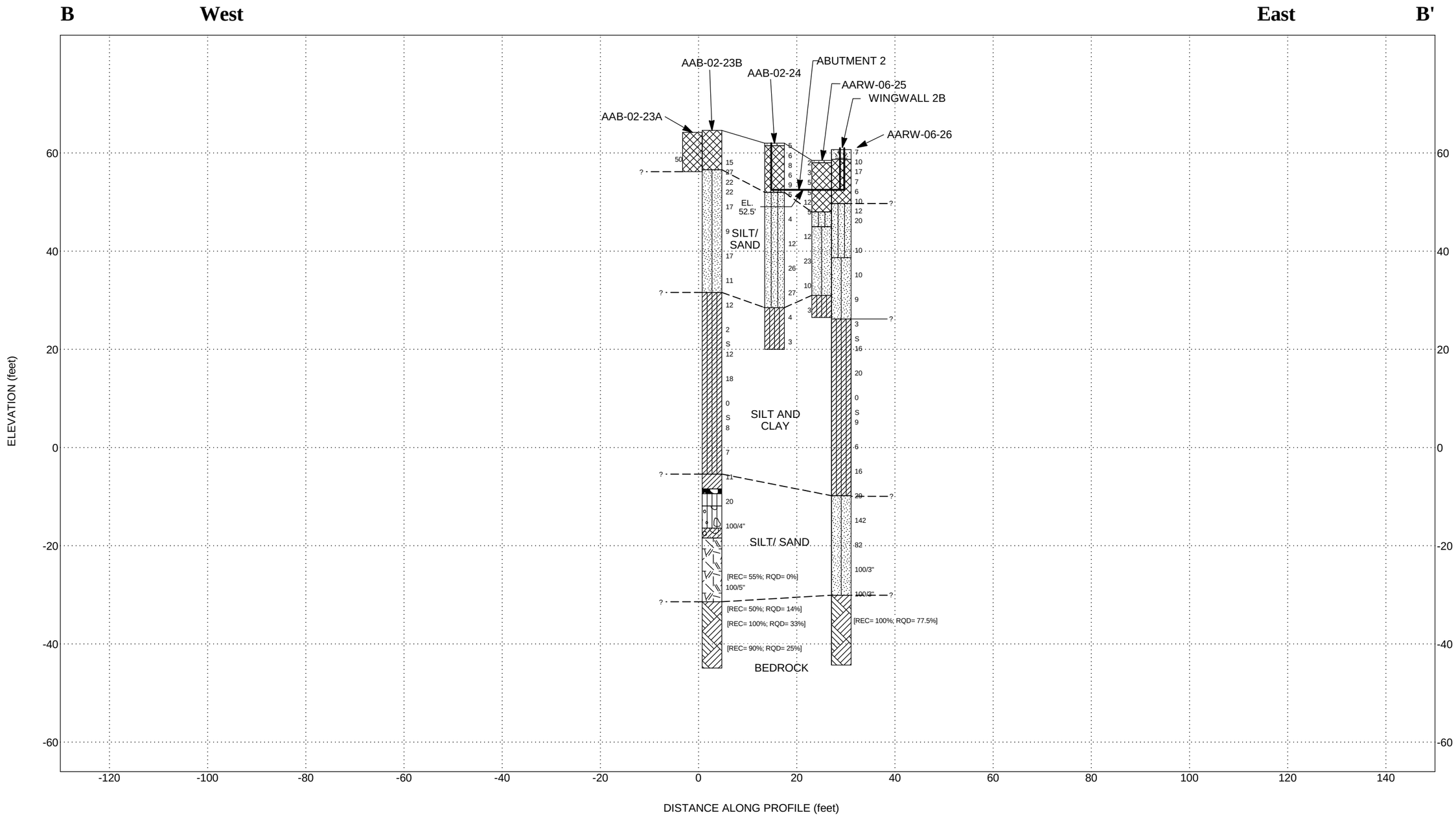
Notes:
1. Data concerning the various strata have been interpreted at boring locations only. The stratigraphy between borings may vary from that shown.
2. Refer to plan view for subsurface profile location. For strata details and symbol legend, see Subsurface Profile Legend and boring logs appended to this report.
3. Numbers displayed beside boring(s) represent SPT "N" values corresponding to their respective sampling interval. Where coring was performed, numbers represent Recovery and RQD values.

SUBSURFACE PROFILE A-A'

AMTRAK Access Road
RW 103, Bridge 02, RW 108

Date: 10/24/08	Drawn By: DSF/JPM	Reviewed By: MGB	File No.: 0183-010.0	Figure No.: 3A

GEO STANDARD 11 X 17 (2/19/04) COMBINATION BORING LOGS - IMPORT AMTRACK ACCESS BORINGS.GPJ FBNWNL01.GDT 10/24/08



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0 20
Horizontal Scale (feet)

Vertical Exaggeration: 1x

Notes:
1. Data concerning the various strata have been interpreted at boring locations only. The stratigraphy between borings may vary from that shown.
2. Refer to plan view for subsurface profile location. For strata details and symbol legend, see Subsurface Profile Legend and boring logs appended to this report.
3. Numbers displayed beside boring(s) represent SPT "N" values corresponding to their respective sampling interval. Where coring was performed, numbers represent Recovery and RQD values.

SUBSURFACE PROFILE B-B'

AMTRAK Access Road
New Britain - Hartford Busway

Date: 1/21/09	Drawn By: JPM	Reviewed By: MGB	File No.: 0183-010.0	Figure No.: 3B

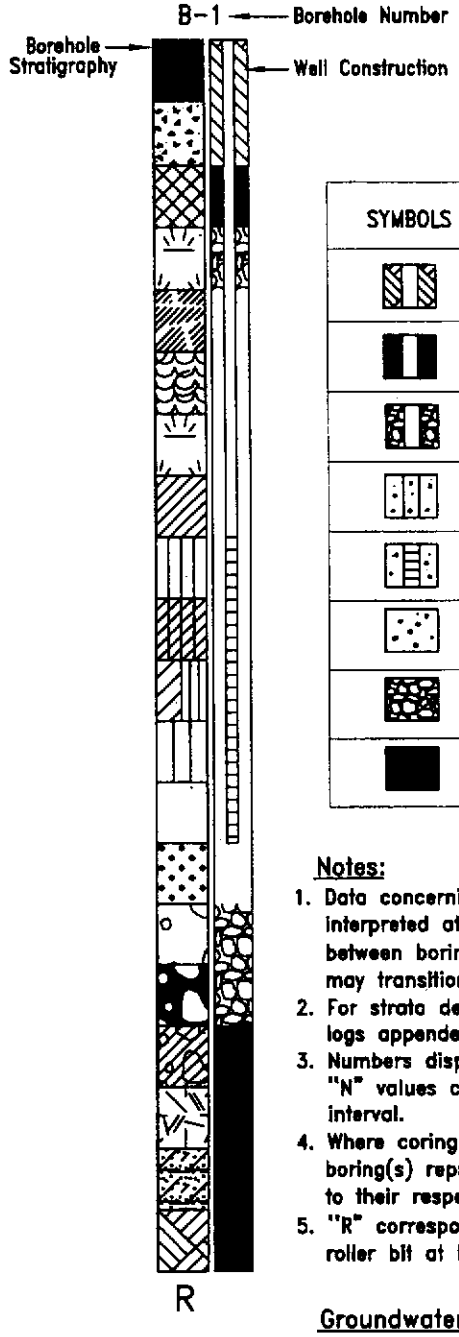
GEO STANDARD 11 X 17 (2/19/04) BUSWAY OVERALL 2009.GPJ FBNWNL01.GDT 1/21/09

\MISCELLANEOUS\LEGENDS\SUBSURFACE PROFILE LEGEND.dwg

STRATIGRAPHY SYMBOLS

SYMBOLS	TYPICAL DESCRIPTIONS OF PREDOMINENT MATERIAL TYPE
	ASPHALT
	CONCRETE
	FILL
	TOPSOIL
	SUBSOIL
	ORGANIC SILT OR CLAY WITH SHELLS
	PEAT
	CLAY
	SILT
	CLAY/SILT MIXTURE
	CLAY/SILT/SAND MIXTURE
	SILT/SAND MIXTURE
	SAND/SILT MIXTURE
	POORLY-GRADED SAND
	WELL-GRADED SAND
	SAND/GRAVEL MIXTURE
	SAND/GRAVEL/SILT MIXTURE
	BOULDERS AND/OR COBBLES
	GLACIAL TILL
	DECOMPOSED BEDROCK
	SANDSTONE
	BEDROCK

EXPLANATION OF BORING



WELL SYMBOLS

SYMBOLS	TYPICAL DESCRIPTIONS
	CEMENT SEAL: 1 PIPE
	BENTONITE SEAL: 1 PIPE
	SLOUGH BACKFILL: 1 PIPE
	FILTER PACK: 1 PIPE
	SLOTTED PIPE WITH FILTER PACK: 1 PIPE
	FILTER PACK AT BOTTOM OF HOLE
	SLOUGH AT BOTTOM OF HOLE
	BENTONITE AT BOTTOM OF HOLE

Notes:

1. Data concerning the various strata have been interpreted at boring locations only. The stratigraphy between borings may vary from that shown, and may transition more gradually within borings.
2. For strata details, see Report and boring logs appended to this report.
3. Numbers displayed beside boring(s) represent SPT "N" values corresponding to their respective sampling interval.
4. Where coring was performed, numbers displayed beside boring(s) represent Recovery and RQD values corresponding to their respective sampling interval.
5. "R" corresponds to refusal of sampler, casing and/or roller bit at bottom of boring.

Groundwater Observations (where applicable)

▽ Water Level Reading at time of drilling.

▼ Water Level Reading after completing drilling.

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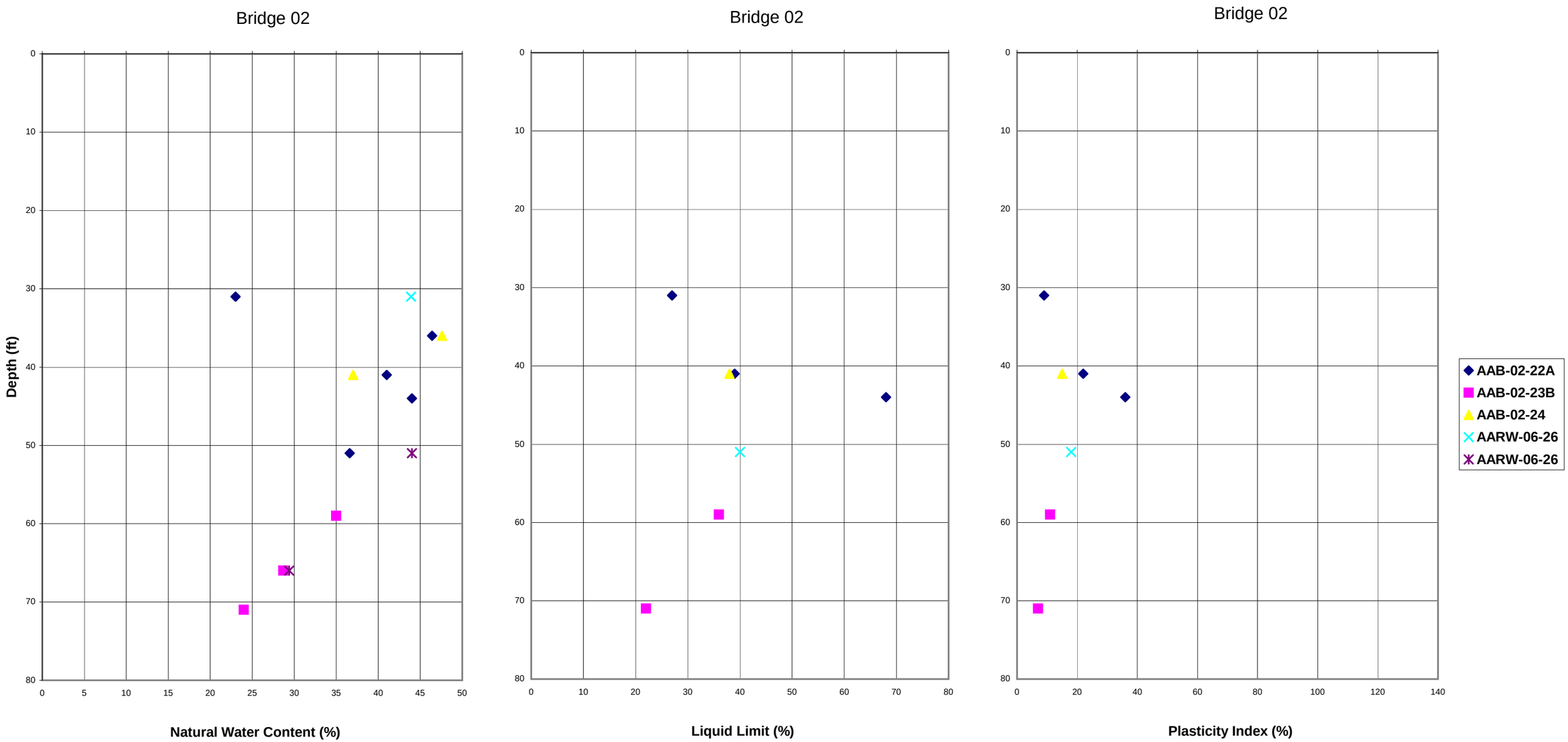
Figure 4

SUBSURFACE PROFILE LEGEND



Bridge 02 - AAR over Park Street

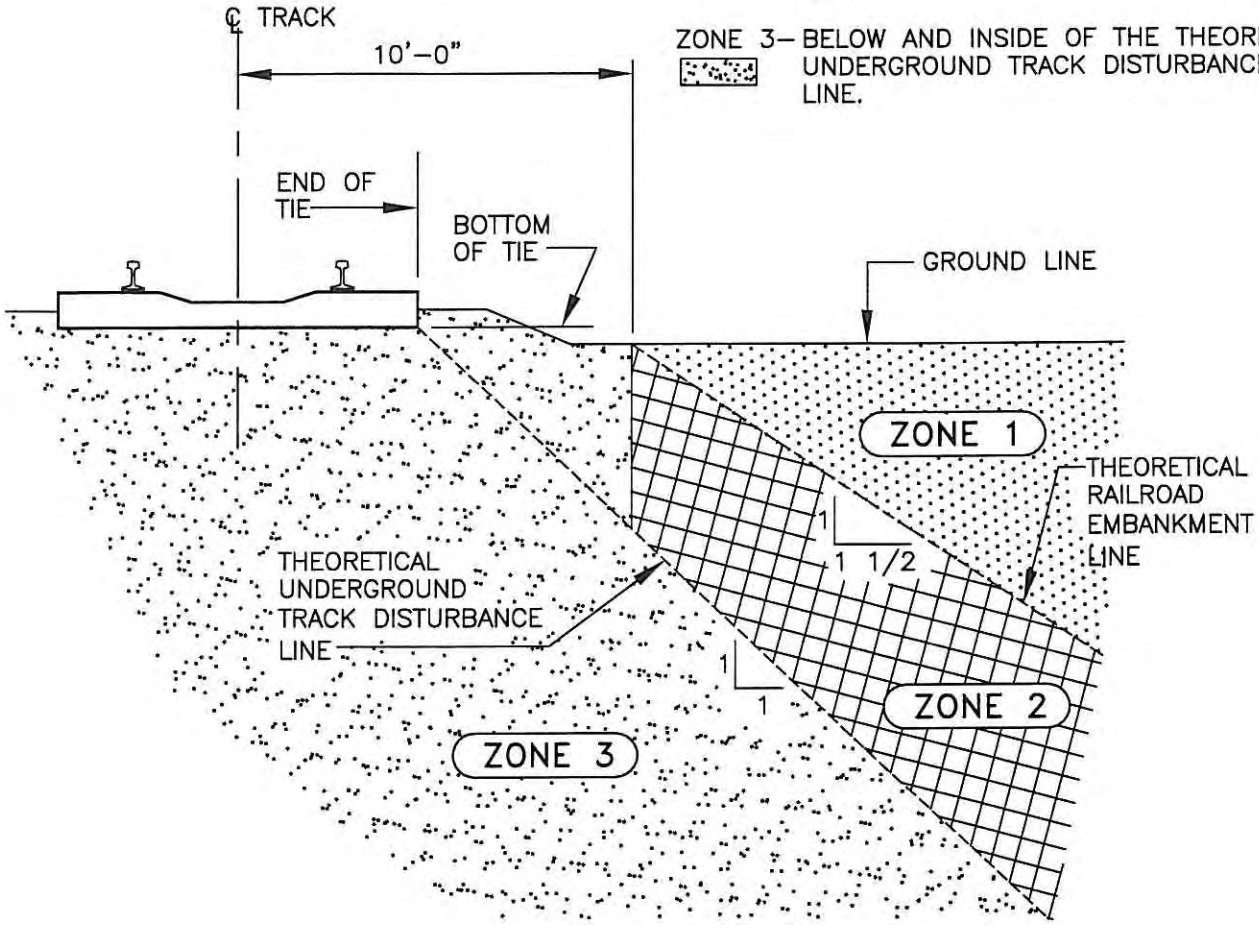
Figure 5
Atterberg Limits Vs. Depth

LEGEND

ZONE 1 – ABOVE AND OUTSIDE THE THEORETICAL RAILROAD EMBANKMENT LINE.

ZONE 2 – FARTHER THAN 10 FEET FROM THE CENTERLINE OF TRACK, BELOW THE THEORETICAL RAILROAD EMBANKMENT LINE AND ABOVE THE THEORETICAL UNDERGROUND TRACK DISTURBANCE LINE.

ZONE 3 – BELOW AND INSIDE OF THE THEORETICAL UNDERGROUND TRACK DISTURBANCE LINE.



NORMAL REQUIREMENTS FOR SHEET PILING ADJACENT TO TRACK

1. EXCAVATIONS WITHIN ZONE 1 – ABOVE AND OUTSIDE OF THE THEORETICAL RAILROAD EMBANKMENT LINE – DO NOT NORMALLY REQUIRE SHEETING TO PROTECT RAILROAD ROAD BED. SHEETING MAY BE REQUIRED FOR OTHER REASONS.

2. EXCAVATIONS WHOSE BOTTOMS EXTEND INTO ZONE 2 REQUIRE SHEETING, BUT THE SHEETING MAY NORMALLY BE PULLED AFTER THE EXCAVATION HAS BEEN BACKFILLED.

3. EXCAVATIONS WHOSE BOTTOMS EXTEND INTO ZONE 3 WILL NORMALLY REQUIRE THE SHEETING TO BE LEFT IN PLACE AND CUT–OFF PER REQUIREMENTS.

Figure 6

Amtrak®
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Office of Chief Engineer
STRUCTURES
National Railroad Passenger Corporation
30th Street Station, Philadelphia, Pennsylvania 19104

SKETCH 1
SPEC. 02261A – REV. 1

File No:	
Design No:	3501
Sheet No.	1 of 1
Drg. No.	SK–1

Designed CJR | Drawn JLM | Date 6/06/01

BY DCF 12-30-08
Chk MGB 1-19-09

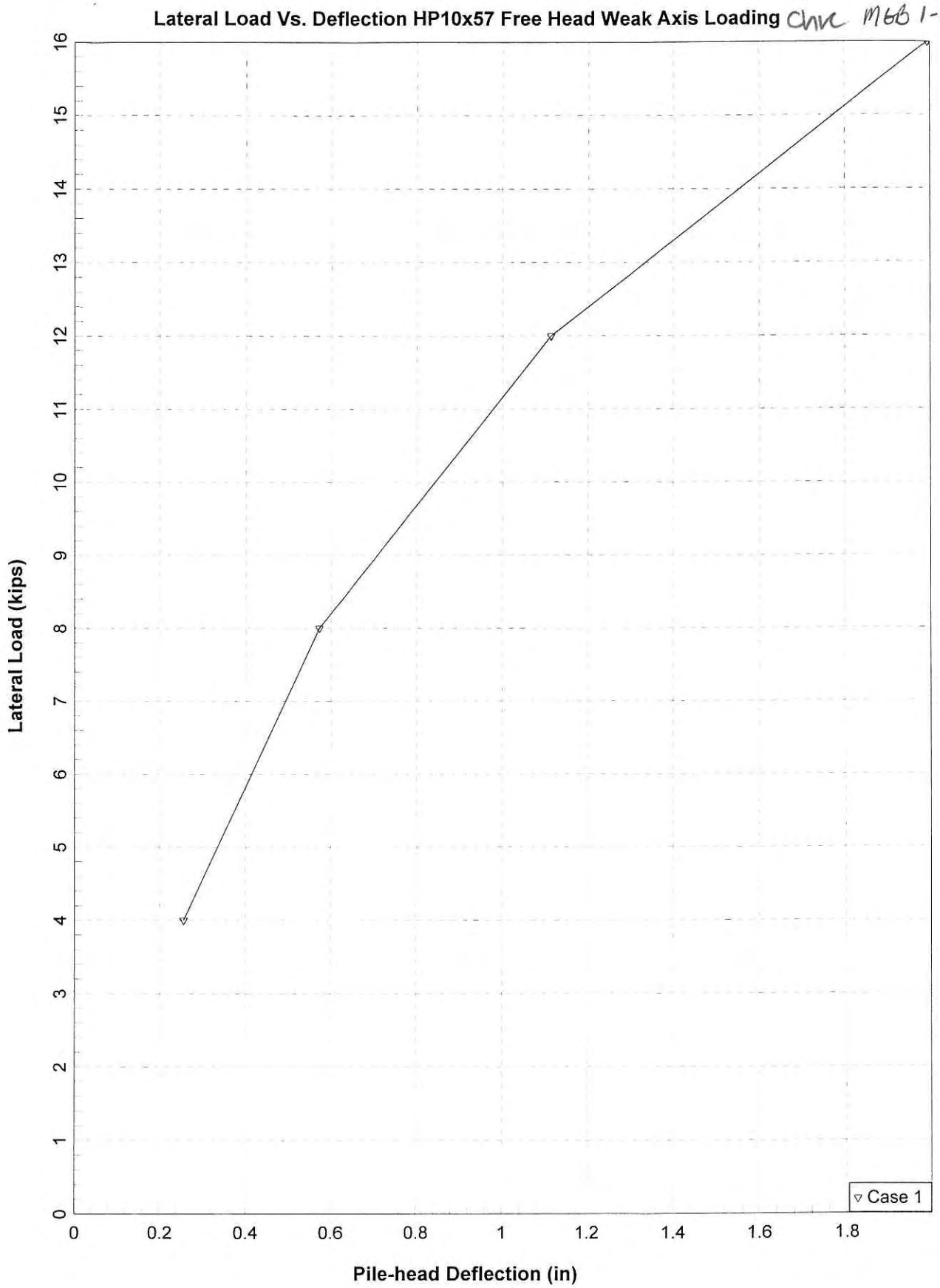


FIGURE 7A

BY DJ 12-30-08
Chk MGB 1-19-09

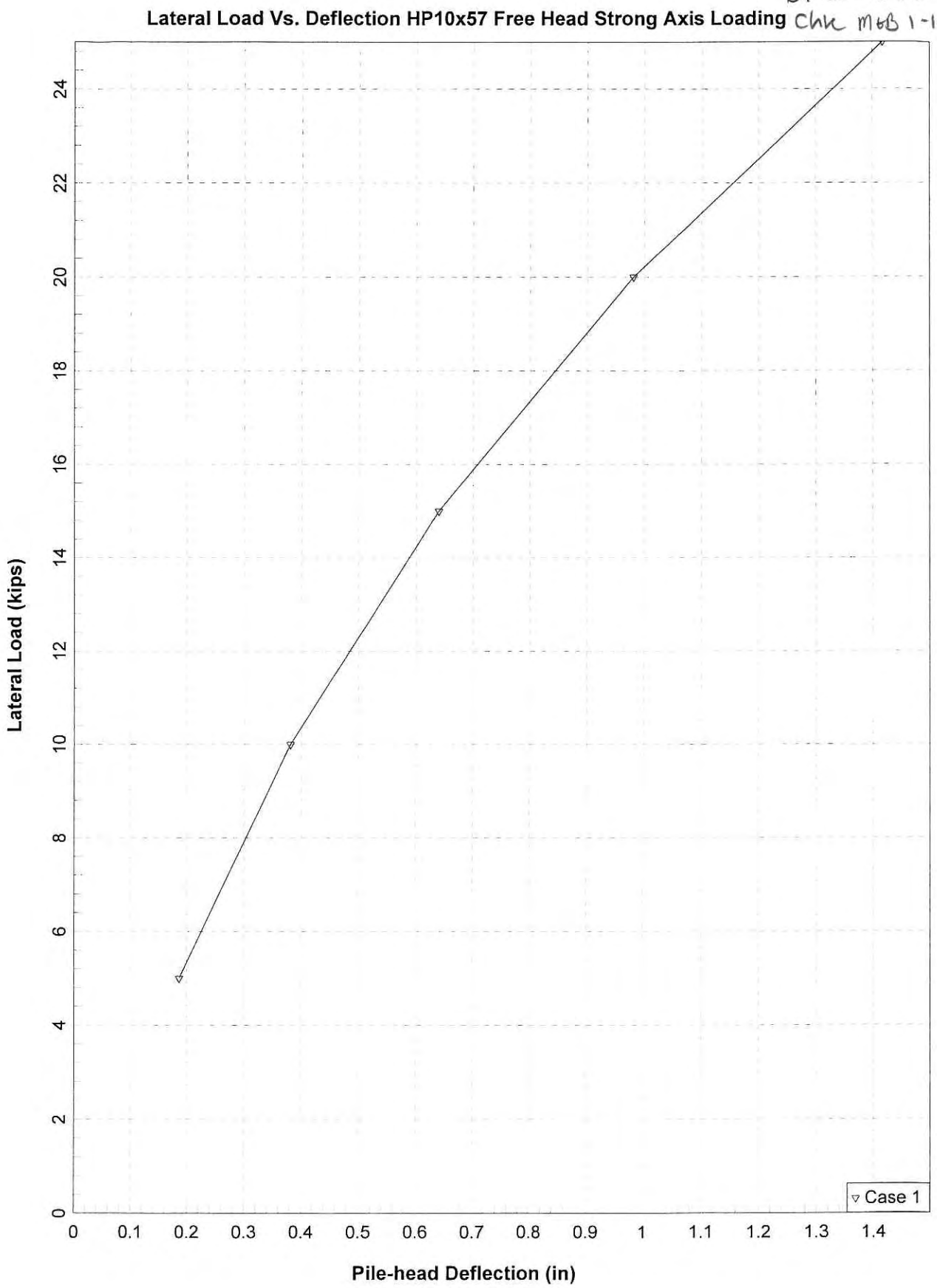


FIGURE 7B

BY DLF 12-30-08
Chk MGB 1-19-09

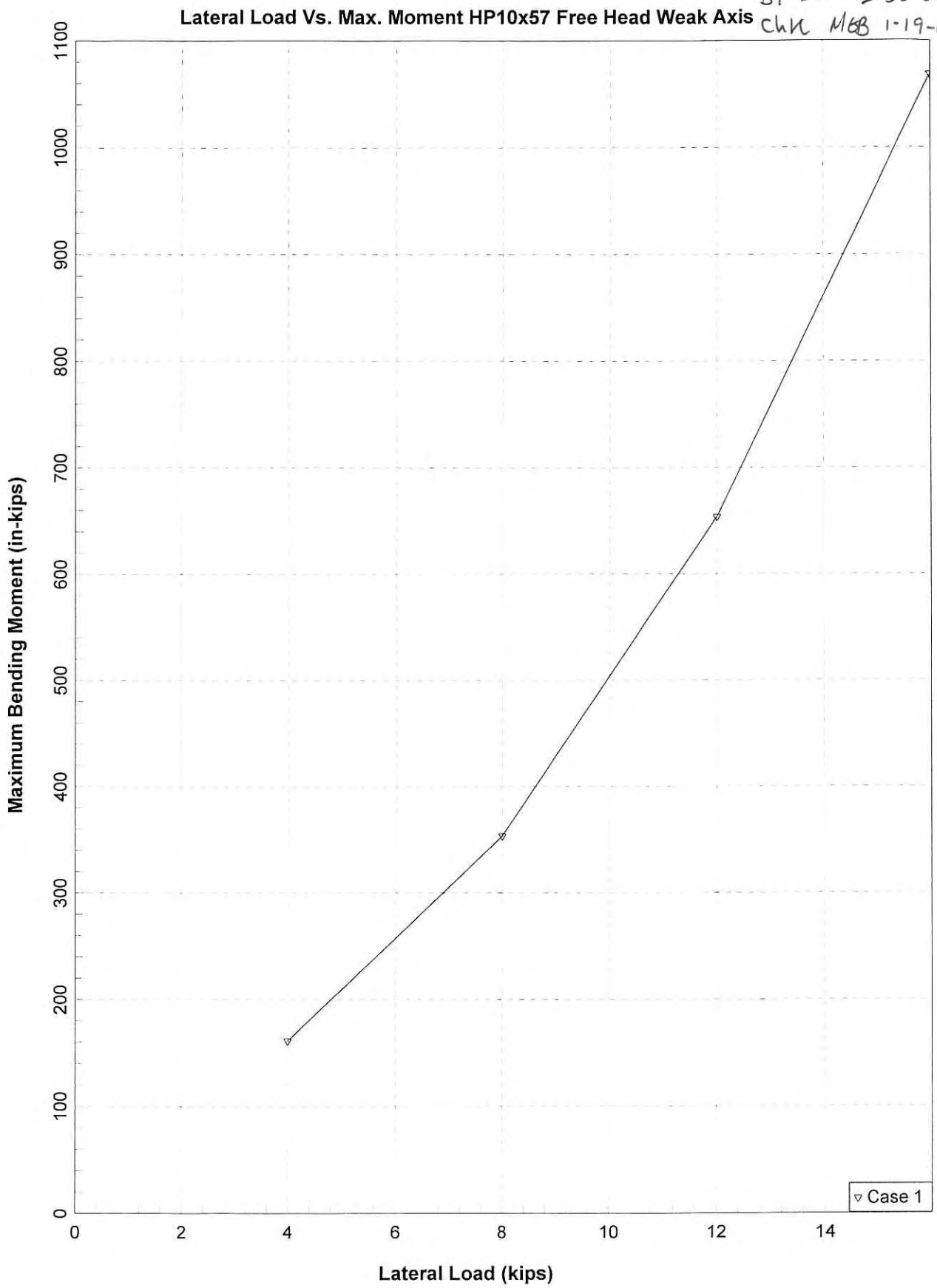


FIGURE 8A

By DJF 12-30-08

Lateral Load Vs. Max. Moment HP10x57 Free Head Strong Axis Chk MoB 1-19-09

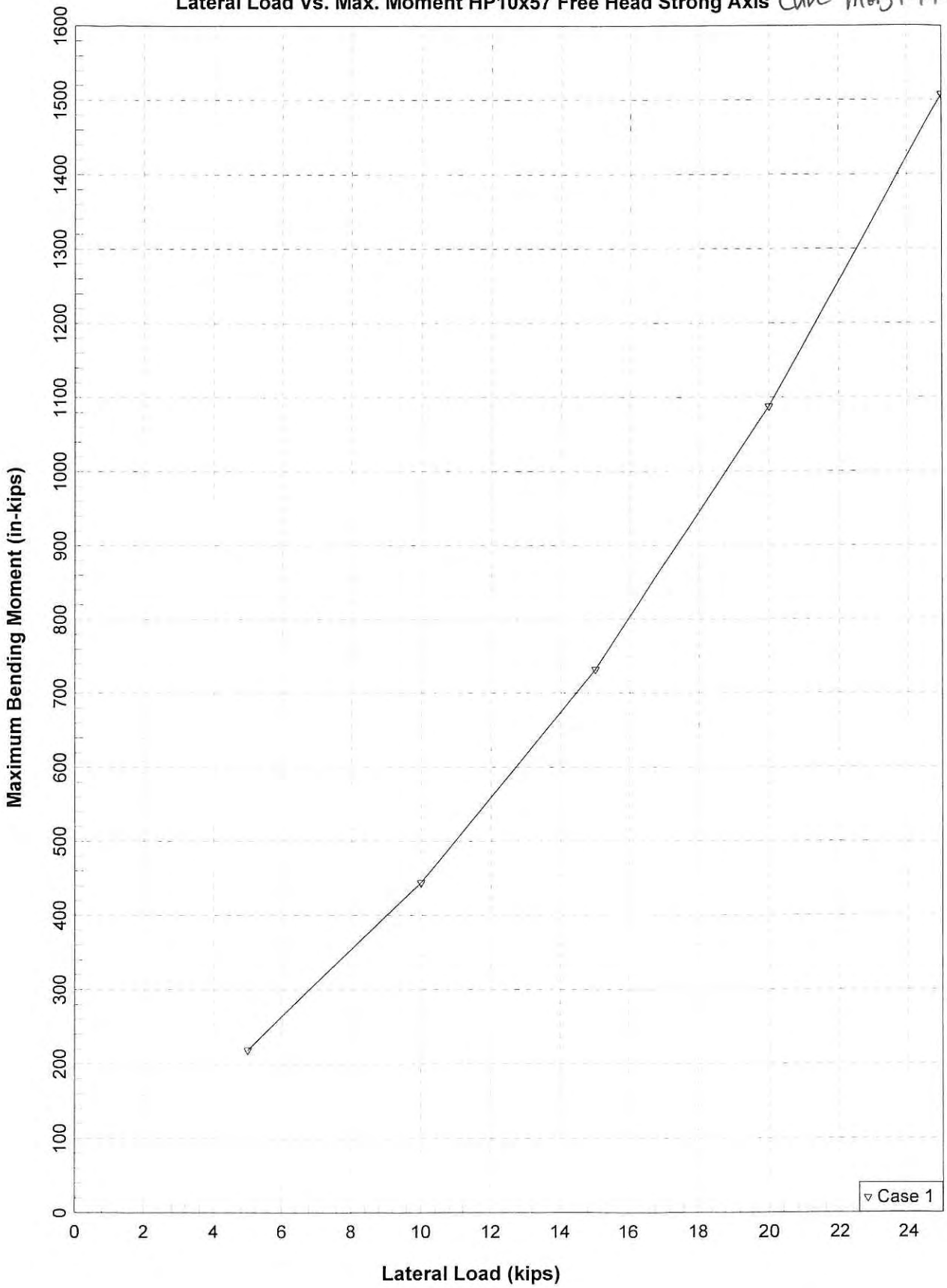
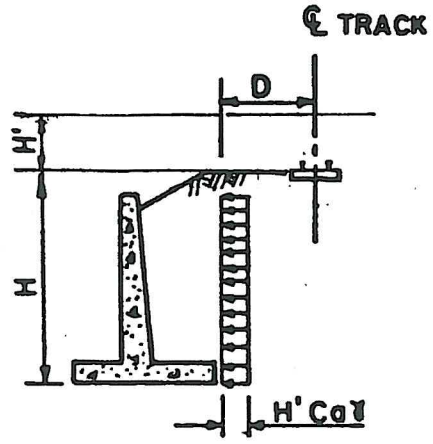
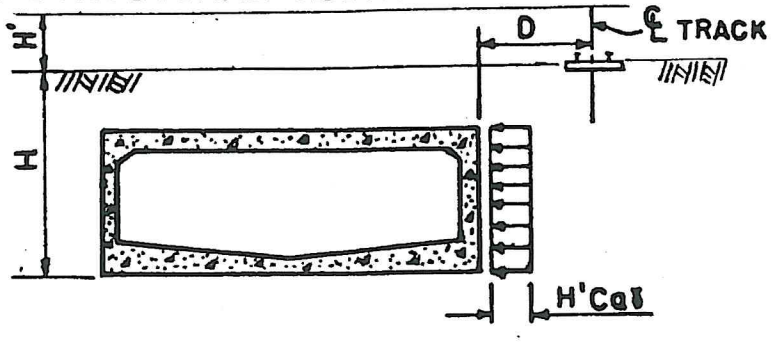


FIGURE 8B

COOPER E80 RAILROAD LIVE LOAD ON WALL

TRACKS PARALLEL TO STRUCTURAL SECTION





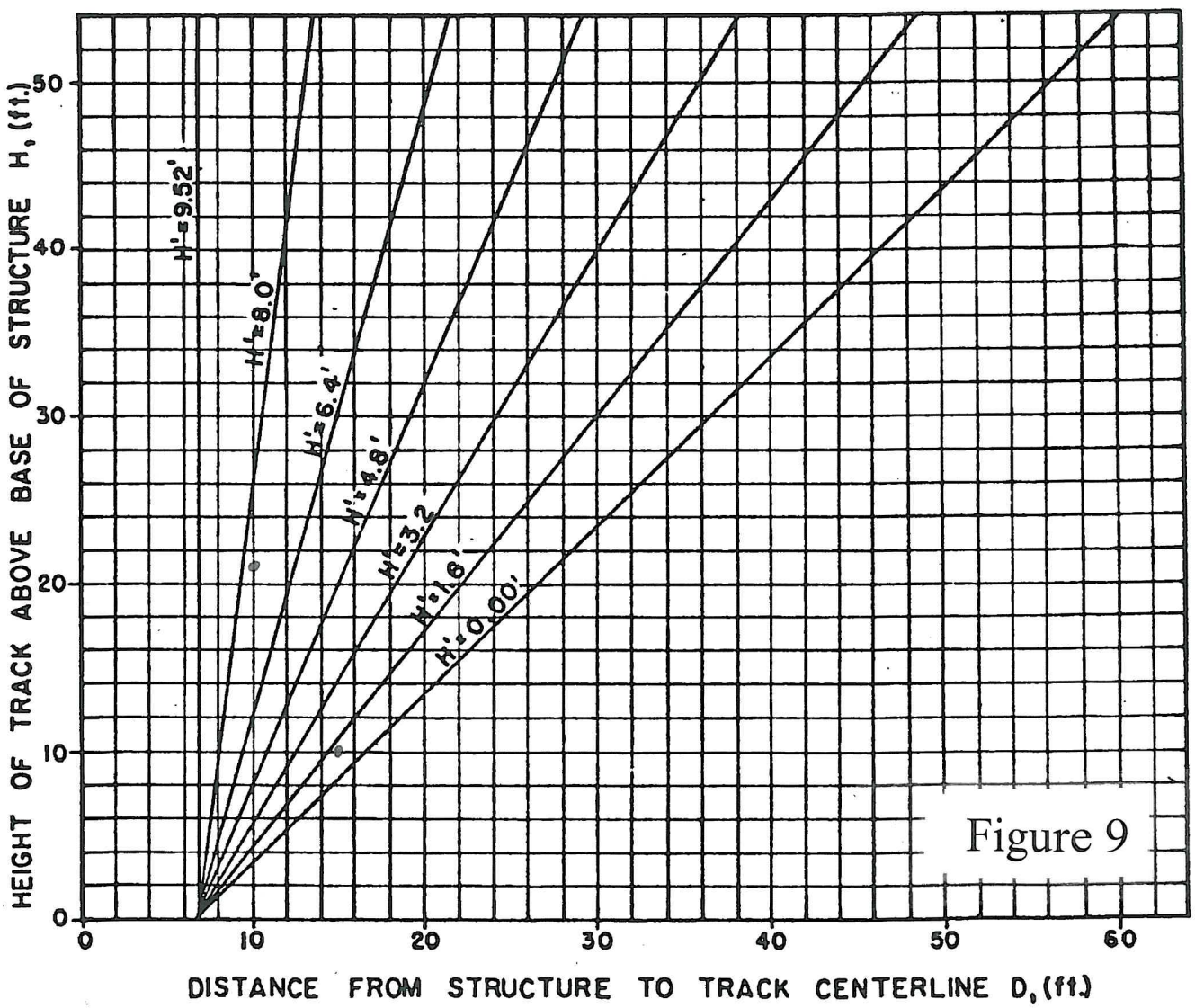


Figure H 374.2D

Calculation of L. L. SURCHARGE:

$$H' \text{ max.} = \frac{P}{s \times b \times \gamma} = \frac{80{,}000\#}{5' \times 14' \times 120\text{pcf}} = 9.52'$$

H' = live load surcharge
P = E80 axle load in lbs.
s = axle spacing in feet
γ = unit weight of backfill in lbs./ft.^{3}
b = transverse distribution of axle load in feet
C_a = active earth pressure coefficient

Ratio side loads when other than E80 Railroad loads are appropriate.

It is necessary to consider the effect of only one track in computing the LL surcharge. The exceptional case of tracks closer than 7' can be generally ignored since the increase in surcharge is minor.

Impact loads are not applied to side walls (AREA).

Refer also to Figure H374.2C

Tables

Amtrak Access Road Subsurface Explorations
Newington, West Hartford , and Hartford
State Project No. 171-305, Geo**Design** No. 0183-010.0

Table 1: 2008 Well Readings

Well #	Date Installed	Ground Surface Elevation (ft)	8/15	8/20	8/22	8/25	8/26	8/27	9/2[1]	9/8[1]	9/12	Average Depth	Average Elevation (ft)
AARW-05-19	08/21/08	51.5			9.1		8.4	8.9	8.6	8.2	8.2	8.6	42.9
AARW-06-26	08/19/08	60.7		23.0	23.0		22.8	22.8	22.8	20.8	22.8	22.6	38.1

Notes:
All well readings are depth (ft) to groundwater from ground surface.
Wells are listed in order from west to east.
[1] Approximately 5.5 inches of rainfall between 9/2 and 9/8

Appendix 2

Boring Logs

AAB-02-Series
AARW-05-Series
AARW-06-Series

AAB-02-Series

Connecticut DOT Boring Report

Inspector: RJM	Town: Newington/Hartford/ West Hartford	Hole No.: AAB-02-21	
Engineer: Geo**Design**, Inc.	Project No.: 0183-010.0 / 171-305	Stat./Offset:	
Start Date: 8-27-08	Route No.:	Northing: 827339.7	
Finish Date: 8-27-08	Bridge No.:	Easting: 1007152.66	
		Surface Elevation: 64.4	

Project Description: AMTRAK Access Road -

Casing Size/Type: HW 4" ID	Sampler Type/Size: SS/ 1-3/8" ID	Core Barrel Type: N/A
Hammer Wt.: 300 lb. Fall: Push	Hammer Wt.: 140 lb. Fall: 30"	

Groundwater Observations: @6.5' after 0.2 hours

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0						Fill		
	S-1	25 26 26	18	12			Very dense, gray black fine to coarse GRAVEL and fine to coarse SAND, trace Silt, trace Ash	
	S-2	37 28 50/5"	17	12			Very dense, brown to red brown fine to coarse SAND, little fine to coarse Gravel, little Silt	60
5	S-3	29 17 16 15	24	12			Dense, brown fine to medium SAND, trace fine to coarse Gravel, trace Silt	
	S-4	17 9 11 41	24	24			Medium dense, Top 12": gray fine to coarse SAND, little (-) fine to coarse Gravel, trace Silt Bottom 12": brown fine SAND, trace Silt, (with brown SILT partings to 1/8" thick)	55
10	S-5	3 3 4 3	24	12		Silty Sand	Loose, brown fine SAND, some Silt	
								50
15	S-6	3 4 5 5	24	20			Loose, brown fine SAND, some Silt	
								45
20	S-7	1 2 3 3	24	21			Loose, brown fine SAND, some Silt	
								40
25	S-8	1 2 3 3	24	21			Loose, brown to gray brown SILT, trace fine Sand	
								35
30	S-9	6 8 5 7	24	22			Medium dense, brown fine SAND, some Silt	
							END OF BORING 32ft	
35								30

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 32ft Rock: 0ft	NOTES: High rail rig with cathead driven donut hammer used. Pilot hole to 6 feet with 4" casing, then boring advance open hole with REVERT II drillers mud to maintain open hole. Boring tremmy backfilled with cement grout and topped off with 2 feet of rail road ballast.	Sheet 1 of 1
No. of Soil Samples: 9 No. of Core Runs: 0		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Inspector: RJM	Town: Newington/Hartford/ West Hartford	Hole No.: AAB-02-22	
Engineer: Geo**Design**, Inc.	Project No.: 0183-010.0 / 171-305	Stat./Offset:	
Start Date: 8-28-08	Route No.:	Northing: 827354.2	
Finish Date: 8-28-08	Bridge No.:	Easting: 1007161.1	
		Surface Elevation: 64.6	

Project Description: AMTRAK Access Road -

Casing Size/Type: HW 4" ID	Sampler Type/Size: SS/ 1-3/8" ID	Core Barrel Type: N/A
Hammer Wt.: 300 lb. Fall: Spin	Hammer Wt.: 140 lb. Fall: 30"	

Groundwater Observations: @None observed

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0						Fill		
	S-1	11 11 8	18	47			Medium dense, gray black fine to coarse GRAVEL, some fine to medium Sand, little Silt	
	S-2	6 6 6 12	24	12			Medium dense, brown fine to medium SAND, little Silt	
5	S-3	13 19 50/2"	14	3			Very dense, brown/gray fine to coarse GRAVEL, little fine to medium Sand, trace Silt	60
						Boulder		
10	S-4	1 1 2 1	24	12		Sand	Very loose, brown fine to medium SAND, trace fine Gravel, trace Silt	55
	S-5	2 2 2 3	24	12			Loose, brown fine to medium SAND, trace fine Gravel, trace Silt	
15						Boulder?		50
20							END OF BORING 20ft	45
25								40
30								35
35								30

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 20ft Rock: 0ft	NOTES: High rail rig with cathead driven donut hammer used. Lost drill water after roller bit advance through boulder to 9', and again on boulder at 15'. Roller bit advanced into rock / possible bridge structure from 15-20'. Borehole abandoned at 20'; tremmy backfilled with cement grout, with 2' of railroad ballast replaced at ground surface. Boring relocated 10' W and redrilled (AAB-02-22A)	Sheet 1 of 1
No. of Soil Samples: 4 No. of Core Runs: 0		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Inspector:		Town: Newington/Hartford/ West Hartford	Hole No.: AAB-02-22A
Engineer:	Geo**Design**, Inc.	Project No.: 0183-010.0 / 171-305	Stat./Offset:
Start Date:	8-29-08	Route No.:	Northing: 827345.8
Finish Date:	9-9-08	Bridge No.:	Easting: 1007155.94
			Surface Elevation: 64.6

Project Description: AMTRAK Access Road -

Casing Size/Type: HW 4" ID	Sampler Type/Size: SS/ 1-3/8" ID	Core Barrel Type: N/A
Hammer Wt.: 300 lb. Fall: Spin/Push	Hammer Wt.: 140 lb. Fall: 30"	

Groundwater Observations: @None observed

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0						Fill	See AAB-02-22 for descriptions from 0-20 feet.	
5								60
10						Sand & Silt		55
15	S-1	2 3 6 5	24	6			Loose, brown fine SAND, some Silt	50
20	S-2	2 3 5 7	24	5			Loose, brown to dark brown varved fine SAND and SILT	45
25	S-3	3 3 3 4	24	12		Clay & Silt	Loose, brown Top 2": SAND and SILT, Middle 8": SILT, bottom 2": Clayey Silt	40
30	S-4	2 3 5 7	24	20			Medium/ loose Top 4": gray, Clayey SILT, some medium to coarse Sand, Bottom 16": loose, brown SILT, some fine Sand	35
35								30

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 90ft Rock: 0ft	NOTES: Highrail rig with cathead driven donut hammer. Pilot hole to 15 feet, 4 inch casing then boring advanced open hole with use of revert drillers mud to maintain open hole. S-7 extended 4" casing to 30' due to water loss. After casing advanced to 40' S-9 due to continued loss of drill water. Boring abandoned at 90 feet due to drilling complications.	Sheet 1 of 3
No. of Soil Samples: 14 No. of Core Runs: 1		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Inspector:		Town: Newington/Hartford/ West Hartford	Hole No.: AAB-02-22A
Engineer:	Geo**Design**, Inc.	Project No.: 0183-010.0 / 171-305	Stat./Offset:
			Northing: 827345.8
Start Date:	8-29-08	Route No.:	Easting: 1007155.94
Finish Date:	9-9-08	Bridge No.:	Surface Elevation: 64.6

Project Description: AMTRAK Access Road -

Casing Size/Type: HW 4" ID	Sampler Type/Size: SS/ 1-3/8" ID	Core Barrel Type: N/A
Hammer Wt.: 300 lb. Fall: Spin/Push	Hammer Wt.: 140 lb. Fall: 30"	

Groundwater Observations: @None observed

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
35	S-5	4 4 4 5	24	24		Clay & Silt *(con't)*	Medium, brown gray SILT and CLAY, trace coarse Sand	
40	S-6	2 2 1 2	24	24			Soft, brown gray Clayey SILT	25
						Clay & Silt (varved)		
	UP-1	P U S H	24	24				
45	S-7	5 13 12 18	24	24			Very stiff, brown Clayey SILT, varved, (layers to "thick)	20
50	S-8	9 4 5 7	24	24			Stiff, loose Bottom 12": Brown Clayey SILT, Top 12" gray fine to coarse SAND, some Silt	15
55	S-9	4 1 4 5	24	24			Medium, brown clayey SILT, varved with medium coarse SAND, some Silt	10
60	S-10	5 4 5 5	24	12			Stiff, red brown clayey SILT, (layers to 2" thick) varved with Silty Clay (layers to 3/4" thick)	5
65	S-11	6 4 4 2	24	14			Stiff, red brown SILT and CLAY (one piece coarse gravel near sample bottom)	0
70								-5

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 90ft Rock: 0ft	NOTES: Highrail rig with cathead driven donut hammer. Pilot hole to 15 feet, 4 inch casing then boring advanced open hole with use of revert drillers mud to maintain open hole. S-7 extended 4" casing to 30' due to water loss. After casing advanced to 40' S-9 due to continued loss of drill water. Boring abandoned at 90 feet due to drilling complications.	Sheet 2 of 3
No. of Soil Samples: 14 No. of Core Runs: 1		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Inspector:		Town: Newington/Hartford/ West Hartford	Hole No.: AAB-02-22A
Engineer:	Geo**Design**, Inc.	Project No.: 0183-010.0 / 171-305	Stat./Offset:
Start Date:	8-29-08	Route No.:	Northing: 827345.8
Finish Date:	9-9-08	Bridge No.:	Easting: 1007155.94
Project Description:	AMTRAK Access Road -		Surface Elevation: 64.6
Casing Size/Type:	HW 4" ID	Sampler Type/Size: SS/ 1-3/8" ID	Core Barrel Type: N/A
Hammer Wt.:	300 lb. Fall: Spin/Push	Hammer Wt.: 140 lb. Fall: 30"	
Groundwater Observations:	@None observed		

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
70	S-12	19 20 50 50	21	21		Glacial Till	Hard, very dense Top 6": Red brown SILT and CLAY, Bottom 15": red brown fine to medium SAND, some Silt, trace fine Gravel	
75								-10
	S-13	10 26 8 2	18	12			Dense, red brown fine to coarse SAND, some Silt, little fine to coarse fractured Gravel	
80	S-14	28 100 5 2	18	6			Very dense, brown fine to coarse SAND, little Silt, trace fine Gravel	-15
85	C-1		60	24	0	Decomposed Bedrock	Cemented, red brown fine to coarse SAND, some Silt, little fine to coarse Gravel, Siltstone-cobble fragments embedded	-20
90							END OF BORING 90ft	-25
95								-30
100								-35
105								-40

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 90ft Rock: 0ft	NOTES: Highrail rig with cathead driven donut hammer. Pilot hole to 15 feet, 4 inch casing then boring advanced open hole with use of revert drillers mud to maintain open hole. S-7 extended 4" casing to 30' due to water loss. After casing advanced to 40' S-9 due to continued loss of drill water. Boring abandoned at 90 feet due to drilling complications.	Sheet 3 of 3
No. of Soil Samples: 14 No. of Core Runs: 1		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Inspector:		Town: Newington/Hartford/ West Hartford	Hole No.: AAB-02-23
Engineer:	Geo**Design**, Inc.	Project No.: 0183-010.0 / 171-305	Stat./Offset:
Start Date:	9-10-08	Route No.:	Northing: 827454.9
Finish Date:	9-10-08	Bridge No.:	Easting: 1007220.93
			Surface Elevation: 64.2

Project Description: AMTRAK Access Road -

Casing Size/Type: HW 4" ID	Sampler Type/Size: SS/ 1-3/8" ID	Core Barrel Type: N/A
Hammer Wt.: 300 lb. Fall: Spin	Hammer Wt.: 140 lb. Fall: 30"	

Groundwater Observations: @None observed

Depth (ft)	SAMPLES: Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0						Base Course Gravel		
	S-1	18 17 21 23	24	12			Dense, black fine to coarse GRAVEL, trace Silt and Cinders	
	S-2	24 23 40 44	24	12		Fill	Very dense, brown fine to medium SAND, trace coarse Sand, trace Silt	60
5								
							END OF BORING 6ft	55
10								
								50
15								
								45
20								
								40
25								
								35
30								
								30
35								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 6ft Rock: 0ft	NOTES: High rail rig with cathead driven donut hammer used. Pilot hole to 4 feet with 4 inch casing, advanced open hole with REVERT II/drillers mud to maintain open hole.	Sheet 1 of 1
No. of Soil Samples: 2 No. of Core Runs: 0		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Inspector:		Town: Newington/Hartford/ West Hartford	Hole No.: AAB-02-23A
Engineer:	Geo**Design**, Inc.	Project No.: 0183-010.0 / 171-305	Stat./Offset:
Start Date:	9-10-08	Route No.:	Northing: 827454.9
Finish Date:	9-10-08	Bridge No.:	Easting: 1007220.93
			Surface Elevation: 64.2

Project Description: AMTRAK Access Road -

Casing Size/Type: HW 4" ID	Sampler Type/Size: SS/ 1-3/8" ID	Core Barrel Type: N/A
Hammer Wt.: 140 lb. Fall: 4"	Hammer Wt.: 140 lb. Fall: 24"	

Groundwater Observations: @None observed

Depth (ft)	SAMPLES: Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0						Fill		
5	S-1	49 20 30 31	24	5			Very dense, light brown fine SAND, little medium Sand, trace Silt	60
							END OF BORING 8ft	55
10								
15								50
20								45
25								40
30								35
35								30

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 8ft Rock: 0ft	NOTES: High rail rig with cathead driven donut hammer used. Boring performed 5 feet west of AAB-02-23 for 0 to 5 ft; see AAB-02-23B	Sheet 1 of 1
No. of Soil Samples: 1 No. of Core Runs: 0		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Inspector:		Town: Newington/Hartford/ West Hartford	Hole No.: AAB-02-23B
Engineer:	Geo**Design**, Inc.	Project No.: 0183-010.0 / 171-305	Stat./Offset:
			Northing: 827454.9
Start Date:	9-11-08	Route No.:	Easting: 1007220.93
Finish Date:	9-14-08	Bridge No.:	Surface Elevation: 64.6

Project Description: AMTRAK Access Road -

Casing Size/Type: HW 4" ID	Sampler Type/Size: SS/ 1-3/8" ID	Core Barrel Type: N/A
Hammer Wt.: 300 lb. Fall: 24"	Hammer Wt.: 140 lb. Fall: 30"	

Groundwater Observations:

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0						Fill		
5								60
	S-1	10 7 8 9	24	1			Medium dense, brown fine to coarse SAND, trace Silt	
	S-2	13 13 14 14	24	15		Silty Sand	Medium dense, brown fine to coarse SAND, trace fine to coarse Gravel, trace Silt	
10								55
	S-3	8 6 16 14	24	14			Medium dense, brown fine SAND, some silt	
	S-4	8 6 16 14	24	12			Medium dense, brown fine SAND, some silt	
15								50
	S-5	2 8 9 10	24	20			Medium dense, brown fine SAND, some silt occasional gray brown CLAY and SILT, partings to 1/8"	
20								45
	S-6	4 4 5 7	24	12			Loose, brown fine SAND, some Silt	
25								40
	S-7	6 7 10 8	24	12			Medium dense, brown fine SAND, some Silt	
30								35
	S-8	5 4 7 6	24	22			Medium dense, red brown fine SAND, some Silt	
						Clay & Silt (varved)		
35								30

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 109.5ft Rock: ft	NOTES: Highrail truck rig with cathead driven donut hammer used. Boring performed 15 feet east of AAB-02-23A which was performed 5 feet west of AAB-02-23 following shallow refusals at initial locations Four inch casing advanced to 15 feet, boring then advanced open hole with REVERT II/drillers mud to maintain open hole.	Sheet 1 of 4
No. of Soil Samples: 17 No. of Core Runs: 4		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Inspector:		Town: Newington/Hartford/ West Hartford	Hole No.: AAB-02-23B
Engineer:	Geo**Design**, Inc.	Project No.: 0183-010.0 / 171-305	Stat./Offset:
			Northing: 827454.9
Start Date:	9-11-08	Route No.:	Easting: 1007220.93
Finish Date:	9-14-08	Bridge No.:	Surface Elevation: 64.6

Project Description: AMTRAK Access Road -

Casing Size/Type: HW 4" ID	Sampler Type/Size: SS/ 1-3/8" ID	Core Barrel Type: N/A
Hammer Wt.: 300 lb. Fall: 24"	Hammer Wt.: 140 lb. Fall: 30"	

Groundwater Observations:

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
35	S-9	6 6 6 7	24	15		Clay & Silt (varved) *(con't)*	Stiff, red brown Silty CLAY (layers to 3/4" thick) varved with gray clayey Silt, (layers to 1/4" thick)	
40	S-10	10 0 2 3	24	24			Soft, red brown Silty CLAY (layers to 3/4" thick) varved with gray clayey Silt, (layers to 1/4" thick)	25
	UP-1	P U S H	24	24			Stiff	
45	S-11	2 1 11 15	24	24			Top16': red brown Silty CLAY (layers to 1" thick) varved with gray brown SILT and CLAY (layers to 3/4" thick) Bottom 8" of sample red brown clayey Silt, trace fine Sand	20
50	S-12	1 3 15 9	24	24			Very stiff, medium dense Top 21": red brown Silty CLAY (layers to 3/4" thick) varved with red brown clayey SILT (layers to 3/4" thick) Bottom 3" of sample red brown SILT trace fine Sand.	15
55	S-13	0 0 0 0	24	24			Very soft, red brown Silty CLAY (layers to 2" thick), varved with red brown SILT and CLAY (layers to 1" thick)	10
	UP-2	P U S H	24	24				
60	S-14	4 4 4 5	24	24			Very soft, red brown Silty CLAY (layers to 2" thick), varved with red brown SILT and CLAY (layers to 1" thick)	5
65	S-15	5 4 3 5	24	20			Medium, red brown Clayey SILT, varved with Silty CLAY (layers to 2" thick) with occasional red fine Sand partings	0
70								-5

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 109.5ft Rock: ft	NOTES: Highrail truck rig with cathead driven donut hammer used. Boring performed 15 feet east of AAB-02-23A which was performed 5 feet west of AAB-02-23 following shallow refusals at initial locations Four inch casing advanced to 15 feet, boring then advanced open hole with REVERT II/drillers mud to maintain open hole.	Sheet 2 of 4
No. of Soil Samples: 17 No. of Core Runs: 4		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Inspector:		Town: Newington/Hartford/ West Hartford	Hole No.: AAB-02-23B
Engineer:	Geo**Design**, Inc.	Project No.: 0183-010.0 / 171-305	Stat./Offset:
Start Date:	9-11-08	Route No.:	Northing: 827454.9
Finish Date:	9-14-08	Bridge No.:	Easting: 1007220.93
			Surface Elevation: 64.6

Project Description: AMTRAK Access Road -

Casing Size/Type: HW 4" ID	Sampler Type/Size: SS/ 1-3/8" ID	Core Barrel Type: N/A
Hammer Wt.: 300 lb. Fall: 24"	Hammer Wt.: 140 lb. Fall: 30"	

Groundwater Observations:

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
70	S-16	6 5 6 6	24	12		Clay	Stiff, red brown Silty CLAY, little coarse Sand, trace fine Gravel	
						Boulder		
						Silt	Very stiff Top 10": Brown clayey SILT, varved with CLAY with occasional fine Sand partings Bottom 10": Hard Clayey SILT, little coarse Sand, trace fine Gravel	-10
75	S-17	7 8 12 23	24	20				
						Silt w/ Gravel	Hard/ Very Dense Top 8": Clayey SILT, trace coarse Sand, trace fine to coarse Gravel Bottom 8": Brown SILT, some fine to coarse Sand, little fine Gravel	-15
80	S-18	27 38 100/4"	16	16				
						Glacial Till		
						Decomposed Bedrock		-20
85								
								-25
90	C-1		42	23	0		Very Poor Quality, Soft, Extremely Weathered, red brown, SHALE (core times not recorded)	
	S-19	45 100/5"	11	10			Very dense, red brown fine to coarse SAND & SILT, little fine gravel, completely decomposed SHALE	-30
95								
						Bedrock		
	C-2		36	18	14		Very Poor Quality, Soft To Medium Hard, Slightly Weathered, red brown SHALE (core times not recorded)	-35
100	C-3		60	60	33		Poor Quality, Medium Hard, Slightly Weathered, red brown SHALE (core times not recorded)	
105								-40

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 109.5ft Rock: ft	NOTES: Highrail truck rig with cathead driven donut hammer used. Boring performed 15 feet east of AAB-02-23A which was performed 5 feet west of AAB-02-23 following shallow refusals at initial locations Four inch casing advanced to 15 feet, boring then advanced open hole with REVERT II/drillers mud to maintain open hole.	Sheet 3 of 4
No. of Soil Samples: 17 No. of Core Runs: 4		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Inspector:		Town: Newington/Hartford/ West Hartford	Hole No.: AAB-02-23B
Engineer:	Geo**Design**, Inc.	Project No.: 0183-010.0 / 171-305	Stat./Offset:
			Northing: 827454.9
Start Date: 9-11-08		Route No.:	Easting: 1007220.93
Finish Date: 9-14-08		Bridge No.:	Surface Elevation: 64.6
Project Description: AMTRAK Access Road -			
Casing Size/Type: HW 4" ID		Sampler Type/Size: SS/ 1-3/8" ID	Core Barrel Type: N/A
Hammer Wt.: 300 lb. Fall: 24"		Hammer Wt.: 140 lb. Fall: 30"	
Groundwater Observations:			

Depth (ft)	SAMPLES Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
105	C-4		60	54	25	Bedrock *(con't)*	Very Poor Quality, Soft, Extremely Weather, red brown SHALE with very poor quality (extremely weathered zone from approximately 106 to 107'), (Core times not recorded)	
110							END OF BORING 109.5ft	-45
115								-50
120								-55
125								-60
130								-65
135								-70
140								-75

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 109.5ft Rock: ft	NOTES: Highrail truck rig with cathead driven donut hammer used. Boring performed 15 feet east of AAB-02-23A which was performed 5 feet west of AAB-02-23 following shallow refusals at initial locations Four inch casing advanced to 15 feet, boring then advanced open hole with REVERT II/drillers mud to maintain open hole.	Sheet 4 of 4
No. of Soil Samples: 17 No. of Core Runs: 4		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Inspector:	BWE	Town:	Newington/Hartford/ West Hartford	Hole No.:	AAB-02-24
Engineer:	Geo**Design**, Inc.	Project No.:	0183-010.0 / 171-305	Stat./Offset:	5' East
Start Date:	7-29-08	Route No.:		Northing:	827457.4
Finish Date:	7-29-08	Bridge No.:		Easting:	1007239.88
				Surface Elevation:	62

Project Description: AMTRAK Access Road -

Casing Size/Type: HW 4" ID	Sampler Type/Size: SS/ 1-3/8" ID	Core Barrel Type: N/A
Hammer Wt.: 300 lb. Fall: N/A	Hammer Wt.: 140 lb. Fall: 30"	

Groundwater Observations: @8' wet sample; 10'

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	3 3 2 4	24	3		Topsoil FILL	Loose, dark brown to black fine to coarse GRAVEL, some fine to coarse Sand, trace Silt, trace Organics	60
	S-2	5 2 4 2	24	3			Loose, dark brown to black fine to coarse GRAVEL, some fine to coarse Sand, trace Silt, trace Organics	
5	S-3	4 4 4 3	24	0			Loose, no recovery	
	S-4	4 3 3 4	24	12			Loose, black fine to coarse SAND, little fine to coarse Gravel, trace Silt	55
	S-5	5 4 5 8	24	1			Loose, black coarse GRAVEL, some fine to coarse Sand, trace Silt	
10	S-6	1 2 3 2	24	5		Sandy Silt	Loose, light brown fine SAND and SILT	50
15	S-7	2 2 2 3	24	12			Loose, light brown fine to medium SAND	45
20	S-8	4 5 7 8	24	18			Medium dense, light brown fine SAND, some Silt	40
25	S-9	12 8 18 10	24	12			Medium dense, red brown SILT, some Sand	35
30	S-10	18 14 13 6	24	8			Medium dense, red brown SILT and fine to coarse SAND	30
35						Clay & Silt (varved)		

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 42ft Rock: 0ft	NOTES: Track rig with cathead driven hammer used. Pilot hole to 10 feet, then casing advanced. Open hole sustained using drillers mud.	Sheet 1 of 2
No. of Soil Samples: 5 No. of Core Runs: 0		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Inspector:	BWE	Town:	Newington/Hartford/ West Hartford	Hole No.:	AAB-02-24
Engineer:	Geo**Design**, Inc.	Project No.:	0183-010.0 / 171-305	Stat./Offset:	5' East
Start Date:	7-29-08	Route No.:		Northing:	827457.4
Finish Date:	7-29-08	Bridge No.:		Easting:	1007239.88
				Surface Elevation:	62

Project Description: AMTRAK Access Road -

Casing Size/Type: HW 4" ID	Sampler Type/Size: SS/ 1-3/8" ID	Core Barrel Type: N/A
Hammer Wt.: 300 lb. Fall: N/A	Hammer Wt.: 140 lb. Fall: 30"	

Groundwater Observations: @8' wet sample; 10'

Depth (ft)	SAMPLES: Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
35	S-11	1 2 2 1	24	24		Clay & Silt (varved) *(con't)*	Soft, gray brown Clayey SILT (layers to 1" thick) varved with SILT & CLAY (layers to 3/4" thick)	25
40	S-12	1 2 1 2	24	24			Soft, gray brown Clayey SILT (layers to 1" thick) varved with SILT & CLAY (layers to 1/2" thick)	20
							END OF BORING 42ft	
45								15
50								10
55								5
60								0
65								-5
70								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 42ft Rock: 0ft	NOTES: Track rig with cathead driven hammer used. Pilot hole to 10 feet, then casing advanced. Open hole sustained using drillers mud.	Sheet 2 of 2
No. of Soil Samples: 5 No. of Core Runs: 0		SM-001-M REV. 1/02

AARW-05-Series

Connecticut DOT Boring Report

Inspector:	BWE	Town:	Newington/Hartford/ West Hartford	Hole No.:	AARW-05-18
Engineer:	Geo**Design**, Inc.	Project No.:	0183-010.0 / 171-305	Stat./Offset:	
Start Date:	8-21-08	Route No.:		Northing:	827180.1
Finish Date:	8-22-08	Bridge No.:		Easting:	1007099.52
				Surface Elevation:	52.6

Project Description: AMTRAK Access Road -

Casing Size/Type: HW 4" ID	Sampler Type/Size: SS/ 1-3/8" ID	Core Barrel Type: N/A
Hammer Wt.: 140 lb. Fall: 30"	Hammer Wt.: 140 lb. Fall: 30"	

Groundwater Observations: @2' wet sample; 2.5' after 0.2 hours

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	3 4 5 4	24	4		Topsoil Silty Sand	Loose, dark brown fine GRAVEL, some fine to medium Sand, little Silt	
	S-2	5 9 13 23	24	8			Medium dense, red brown fine SAND, trace Silt, (wet)	50
5	S-3	1 2 1 2	24	10			Very loose, black fine to medium SAND, trace Silt, (oil odor)	45
10	S-4	1 2 2 4	24	20			Loose, black firm SAND and SILT, (petroleum odor)	40
						Silty Clay		
15	S-5	11 14 15 13	24	24			Very stiff, light brown Silty CLAY	35
20	S-6	2 3 3 3	24	24		Silt & Clay (varved)	Medium, red brown Silty CLAY (layers to 1" thick), varved with gray brown CLAY and SILT (layers to 1" thick)	30
25	S-7	3 5 9 7	24	18			Stiff, red brown Silty CLAY (layers to 1" thick), varved with gray brown CLAY and SILT (layers to 1" thick)	25
30	S-8	2 3 4 18	24	24			Medium, red brown Silty CLAY (layers to 3/4" thick), varved with gray brown CLAY and SILT (layers to 1/4" thick)	20
35							END OF BORING 32ft	

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 32ft Rock: 0ft	NOTES: Acker steel track rig with cathead driven donut hammer used. Pilot hole to 4 feet, 4 inch casing to 5 feet, open hole to 32 feet with REVERT II/drillers mud to maintain open hole.	Sheet 1 of 1
No. of Soil Samples: 5 No. of Core Runs: 0		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Inspector:	BWE	Town:	Newington/Hartford/ West Hartford	Hole No.:	AARW-05-19
Engineer:	Geo**Design**, Inc.	Project No.:	0183-010.0 / 171-305	Stat./Offset:	
Start Date:	8-21-08	Route No.:		Northing:	827227.8
Finish Date:	8-21-08	Bridge No.:		Easting:	1007126.83
				Surface Elevation:	51.5

Project Description: AMTRAK Access Road -

Casing Size/Type: HW 4" ID	Sampler Type/Size: SS/ 1-3/8" ID	Core Barrel Type: N/A
Hammer Wt.: 140 lb. Fall: 30"	Hammer Wt.: 140 lb. Fall: 30"	

Groundwater Observations: @2' wet sample; 9.1' after 1 hr.; 8.2' in well after 22 days

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches				Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	1	2	2	3	24	10		Topsoil	Loose, dark brown fine to medium SAND, some Silt, trace fine Gravel, trace Roots	50
	S-2	5	3	4	5	24	12		Sand	Loose, Top 6": dark brown fine to medium SAND, some Silt Bottom 6": light brown SAND, some Silt, (wet)	
5	S-3	4	6	10	9	24	15			Medium dense, light brown SAND, trace Silt	45
10	S-4	3	6	8	10	24	13			Medium dense, light brown SAND, trace Silt	40
15	S-5	6	5	3	4	24	11		Silty Clay	Medium, brown Silty CLAY	35
20	S-6	0	1	1	1	24	24		Silt & Clay (varved)	Soft, gray brown CLAY and SILT (layers to 1/5" thick), varved with Silty CLAY (layers to 1" thick)	30
	UP-1	P	U	S	H	24	18				
25	S-7	8	9	13	13	24	20			Very stiff, gray brown CLAY and SILT (layers to 1/5" thick), varved with Silty CLAY (layers to 1" thick)	25
30	S-8	20	23	14	10	24	18		Sand	Dense, red brown fine SAND, trace Silt	20
35										END OF BORING 32ft	

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 32ft Rock: 0ft	NOTES: Tripod, cathead driven donut hammer used. Pilot hole to 4 feet with 4 inch casing to 7 feet. Open hole beyond with REVERT II/drillers mud to maintain open hole. See Table 1 (App 2) for additional G.W. readings.	Sheet 1 of 1
No. of Soil Samples: 7 No. of Core Runs: 0		SM-001-M REV. 1/02

AARW-06-Series

Connecticut DOT Boring Report

Inspector:	BWE	Town:	Newington/Hartford/ West Hartford	Hole No.:	AARW-06-25
Engineer:	Geo**Design**, Inc.	Project No.:	0183-010.0 / 171-305	Stat./Offset:	5' East
Start Date:	7-30-08	Route No.:		Northing:	827451.1
Finish Date:	7-30-08	Bridge No.:		Easting:	1007249.94
				Surface Elevation:	58.5

Project Description: AMTRAK Access Road -

Casing Size/Type: HW 4" ID	Sampler Type/Size: SS/ 1-3/8" ID	Core Barrel Type: N/A
Hammer Wt.: N/A Fall: N/A	Hammer Wt.: 140 Fall: 30"	

Groundwater Observations: @6' wet sample; 19' after 0.2 hours

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	2 1 1 1	24	3		Topsoil / Fill	Very loose, dark brown coarse GRAVEL and fine SAND, trace Silt	
	S-2	1 1 2 1	24	7			very loose, dark brown fine SAND, some coarse Gravel, some Silt	55
5	S-3	4 2 3 2	24	3			Loose, black fine to medium SAND, some fine Gravel, trace Silt, (wet)	
	S-4	3 2 3 5	24	12			Loose, black fine to coarse SAND, some fine to coarse Gravel, trace Silt, (wet)	
	S-5	6 6 6 6	24	4			Medium dense, black fine to coarse GRAVEL and fine to coarse SAND, trace Silt, (wet)	50
10	S-6	3 2 3 3	24	12		Sandy Silt	Loose, Top 6": brown fine to coarse GRAVEL, some fine to coarse Sand, some Silt, (wet) Bottom 6": light brown SILT, trace fine Sand, (wet)	
						Silty Sand		45
15	S-7	8 8 4 3	24	12			Medium dense, brown fine SAND, some Silt, (wet)	
								40
20	S-8	11 12 11 5	24	12			Medium dense, light brown fine SAND, some Silt, (wet)	
								35
25	S-9	2 3 7 7	24	12			Medium dense, red brown fine to coarse SAND, some Silt, (wet)	
						Clay & Silt (varved)		30
30	S-10	1 1 2 1	24	24			Soft, gray brown CLAY and SILT (layers to 1-1/4" thick) varved with Silty CLAY (layers to 1/4" thick), (wet)	
							END OF BORING 32ft	25
35								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 32ft Rock: 0ft	NOTES: Acker steel track rig with cathead driven donut hammer used. Pilot hole to 10 feet, 4 inch casing to 10 feet, open hole to 32 feet using REVERT II/driller's mud to maintain open hole.	Sheet 1 of 1
No. of Soil Samples: 8 No. of Core Runs: 0		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Inspector:	BWE/BRB	Town:	Newington/Hartford/ West Hartford	Hole No.:	AARW-06-26
Engineer:	Geo**Design**, Inc.	Project No.:	0183-010.0 / 171-305	Stat./Offset:	None
Start Date:	7-22-08	Route No.:		Northing:	827471.3
Finish Date:	7-31-08	Bridge No.:		Easting:	1007262.01
				Surface Elevation:	60.7

Project Description: AMTRAK Access Road -

Casing Size/Type: HW 4" ID	Sampler Type/Size: SS/ 1-3/8" ID	Core Barrel Type: NX
Hammer Wt.: 300 lb. Fall: 24"	Hammer Wt.: 140 lb. Fall: 30"	

Groundwater Observations: @6' wet sample; 22' after 0.2 hours; 22.8' in the well after 43 days

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	5 4 3 6	24	3		Topsoil	Loose, black to brown fine to coarse GRAVEL, some fine to coarse Sand, little Silt, trace Organics	60
	S-2	10 6 4 4	24	5		FILL	Loose, brown to black fine to coarse GRAVEL, little fine to coarse Sand, trace Silt	
5	S-3	7 6 11 7	24	5			Medium dense, brown to black fine to coarse SAND and fine to coarse GRAVEL, trace Silt	55
	S-4	5 4 3 3	24	3			Loose, black fine to coarse SAND, little fine to coarse Gravel, trace Silt, (wet)	
	S-5	2 3 3 6	24	5			Loose, black to brown fine to coarse SAND, little fine to coarse Gravel, trace Silt	
10	S-6	3 4 6 3	24	0		Sandy Silt	Medium dense, no recovery	50
	S-7	4 4 8 10	24	24			Medium dense, light brown SILT, little fine Sand	
15	S-8	15 10 10 15	24	24			Medium dense, red brown SILT and fine SAND	45
20	S-9	4 4 6 5	24	24			Medium dense, red brown SILT and fine SAND	40
						Silty Sand		
25	S-10	2 5 5 4	24	20			Medium dense, red brown, fine SAND and SILT	35
30	S-11	4 4 5 9	24	14			Loose red brown, fine SAND and SILT	30
35								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 90ft Rock: 10ft	NOTES: Acker steel track rig with cathead driven donut hammer used. Pilot hole to 10 feet, 4 inch casing to 10 feet, open hole to 85 feet with drillers mud/REVERT II used to maintain open hole. Casing driven to bedrock before coring C-1 See Table 1 (App 2) for additional G.W. readings.	Sheet 1 of 3
No. of Soil Samples: 17 No. of Core Runs: 1		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Inspector:	BWE/BRB	Town:	Newington/Hartford/ West Hartford	Hole No.:	AARW-06-26
Engineer:	Geo**Design**, Inc.	Project No.:	0183-010.0 / 171-305	Stat./Offset:	None
Start Date:	7-22-08	Route No.:		Northing:	827471.3
Finish Date:	7-31-08	Bridge No.:		Easting:	1007262.01
				Surface Elevation:	60.7

Project Description: AMTRAK Access Road -

Casing Size/Type: HW 4" ID	Sampler Type/Size: SS/ 1-3/8" ID	Core Barrel Type: NX
Hammer Wt.: 300 lb. Fall: 24"	Hammer Wt.: 140 lb. Fall: 30"	

Groundwater Observations: @6' wet sample; 22' after 0.2 hours; 22.8' in the well after 43 days

Depth (ft)	SAMPLES Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
35	S-12	2 1 2 3	24	24		Clay & Silt (varved) *(con't)*	Soft, gray brown CLAY and SILT (layers to 1-1/2" thick) varved with red brown Silty CLAY (layers to 1-1/2" thick)	25
	UP-1	P U S H	24	24				
40	S-13	3 6 10 12	24	24			Very stiff, gray brown CLAY and SILT (layers to 1" thick) varved with red brown Silty CLAY (layers to 1-1/4" thick), occasional fine red SAND partings	20
45	S-14	5 13 7 6	24	24			Medium dense/ Stiff Top 10": Red brown SILT, some fine Sand, (wet) Bottom 14": Red brown Silty CLAY (layers to 1" thick) varved with gray brown SILT and CLAY (layers to 1" thick)	15
50	S-15	WOH 0 0 2	24	24			Very soft, red brown Silty CLAY (layers to 1-1/4" thick) varved with SILT and CLAY (layers to 1" thick)	10
	UP-2	P U S H	24	24				
55	S-16	5 4 5 4	24	18			Stiff, red brown SILT and CLAY (layers to 1-1/2" thick) varved with Silty CLAY (layers to 1" thick)	5
60	S-17	4 3 3 4	24	24			Medium, red brown SILT and CLAY (layers to 1" thick) varved with Silty CLAY (layers to 1" thick)	0
65	S-18	7 7 9 10	24	20			Very stiff, red brown SILT and CLAY (layers to 4" thick) varved with Silty CLAY (layers to 1/4" thick)	-5
70								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 90ft Rock: 10ft	NOTES: Acker steel track rig with cathead driven donut hammer used. Pilot hole to 10 feet, 4 inch casing to 10 feet, open hole to 85 feet with drillers mud/REVERT II used to maintain open hole. Casing driven to bedrock before coring C-1 See Table 1 (App 2) for additional G.W. readings.	Sheet 2 of 3
No. of Soil Samples: 17 No. of Core Runs: 1		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Inspector:	BWE/BRB	Town:	Newington/Hartford/ West Hartford	Hole No.:	AARW-06-26
Engineer:	Geo**Design**, Inc.	Project No.:	0183-010.0 / 171-305	Stat./Offset:	None
Start Date:	7-22-08	Route No.:		Northing:	827471.3
Finish Date:	7-31-08	Bridge No.:		Easting:	1007262.01
				Surface Elevation:	60.7

Project Description: AMTRAK Access Road -

Casing Size/Type: HW 4" ID	Sampler Type/Size: SS/ 1-3/8" ID	Core Barrel Type: NX
Hammer Wt.: 300 lb. Fall: 24"	Hammer Wt.: 140 lb. Fall: 30"	

Groundwater Observations: @6' wet sample; 22' after 0.2 hours; 22.8' in the well after 43 days

Depth (ft)	SAMPLES Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
70	S-19	12 14 15 13	24	12		Silty Sand	Very stiff, Top 4": red brown SILT and CLAY, (wet) Bottom 16": red brown fine SAND, some Silt and Clay	-10
75	S-20	29 52 90 87	24	14			Very dense, red brown fine SAND, trace Silt	-15
80	S-21	29 39 43 44	24	16			Very dense, red brown fine to coarse SAND, trace Silt	-20
85	S-22	139 107 100/3"	15	12			Very dense, red brown fine to coarse SAND, little Silt	-25
90	S-23	22 100/3"	9	8		Bedrock	Very dense, fine to coarse SAND and SILT, trace Gravel	-30
95								-35
100	C-1		120	120	77.5		Good Quality, Moderately Hard, Slightly Weathered, red brown, fine grained close to wide jointing, SHALE, fracturing 30º (Core times not recorded)	-40
105							END OF BORING 105ft	

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 90ft Rock: 10ft	NOTES: Acker steel track rig with cathead driven donut hammer used. Pilot hole to 10 feet, 4 inch casing to 10 feet, open hole to 85 feet with drillers mud/REVERT II used to maintain open hole. Casing driven to bedrock before coring C-1 See Table 1 (App 2) for additional G.W. readings.	Sheet 3 of 3
No. of Soil Samples: 17 No. of Core Runs: 1		SM-001-M REV. 1/02

Appendix 3

Laboratory Test Results

Consolidation (CRS) and
Direct Simple Shear (DSS) Tests
Index Tests
Gradation (Hydrometer)
Moisture Content

Consolidation (CRS)
&
Direct Simple Shear (DSS)

Results of Laboratory Tests Conducted for the Amtrak Access Road Project

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Review Draft – subject to change

17 November 2008

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1. INTRODUCTION

This report contains results of laboratory tests, including Atterberg Limits, constant rate of strain (CRS) consolidation and direct simple shear (DSS), conducted for GeoDesign, Inc., Middlebury, Connecticut. Eleven 3" tube samples were provided by GeoDesign for testing. All tests described herein were conducted at the University of Massachusetts Amherst Geotechnical Engineering Laboratory during September and October 2008 under the supervision of Dr. Don J. DeGroot. The report includes information on the scope of services, methods of investigation, and presentation of test results.

2. TEST SAMPLES

The test samples consisted of eleven 3" tubes labeled:

AAB-01-14 UP-1 18-20 ft.
AAB-01-14 UP-2 28-30 ft.
AAB-01-16 UP-1 13-15 ft.
AAB-02-22A UP-1 43-45 ft.
AAB-02-23B UP-2 58-60 ft.
AAB-03-36 UP-2 38-40 ft.
AARW-01-04 UP-2 43-45 ft.
AARW-04-11 UP-2 28-30 ft.
AARW-10-40 UP-1 63-65 ft.
AARW-10-40 UP-2 98-100 ft.
AARW-11-43 UP-2 23-25 ft.

The samples were collected by GeoDesign and provided to the University of Massachusetts Amherst Geotechnical Engineering Laboratory on September 16, 2008.

3. SCOPE OF SERVICES

The scope of services was discussed by telephone, electronic correspondence and in person between Dr. DeGroot and Marie Bartels, P.E. of GeoDesign, Inc. The final test program called for conducting Atterberg Limits, CRS and DSS tests on specimens taken from the sample tubes.

4. METHODS OF INVESTIGATION

4.1 Sample Extraction

CRS and DSS test specimens were extracted from the sample tube using the extrusion procedure shown in Figure 4.1.1. The selected section of a sample tube was cut using a horizontal band saw.

4.2 Water Content

Water contents were determined in general accordance with American Society for Testing and Materials (ASTM) Standard D2216 *Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock.*

4.3 Total and Dry Unit Weight

The total and dry unit weights of the soil were determined by using the trimmed CRS and DSS specimens. The volume of the CRS or DSS specimen/trimming ring was first measured and after trimming the wet mass of the specimen was weighed for calculation of the total unit weight. The dry unit weight was determined using the oven dry weight of the test specimen.

4.4 Atterberg Limits

Atterberg Limits were determined in general accordance with ASTM Standard D4318 *Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils*. Soil was prepared using the wet method. The as received soil was mixed with distilled water to a 15 blow count consistency using a Casagrande Cup and allowed to temper in a humid room for approximately 24 hours prior to testing. Liquid and Plastic Limit data points were determined by allowing the soil to dry at room temperature from the initial wet state to lower water contents.

4.5 Constant Rate of Strain (CRS) Consolidation

The constant rate of strain (CRS) consolidation tests were performed in general accordance with ASTM D4186 *Standard Test Method for One-Dimensional Consolidation Properties of Soils Using Controlled-Strain Loading* and Sandbeakken et al. (1986). The test was conducted using a GeoTac personal computer based test control and data acquisition system, which includes a load frame, flow pump, CRS consolidometer cell and Sigma-1 CRS consolidation software.

The general CRS test sequence consisted of the following stages:

1. Preparation of the specimen for testing first consisted of removing a test sample from the sample tube using the hand extrusion procedure described in Section 4.1 (Figure 4.1.1). The test specimen was hand trimmed in a humid room using a soil lathe together with a sharp trimming ring and sharp trimming tools. The top and bottom surfaces of the specimen were trimmed flat with a wire saw and a long sharp edged knife with the final trimmed dimensions equaling a diameter of 2.5 in and a height of 0.75 in.
2. The specimen was placed in the CRS cell with saturated moist top and bottom porous stones. After application of the seating load, one to three incremental loads were applied. Thereafter the cell chamber was filled with deaired water and the specimen was back pressure saturated to a final target back pressure equal to 6265 psf and left to sit overnight.
3. Constant rate of strain loading was conducted using a nominal strain rate of 1.5 %/hr (4.2×10^{-6} s^{-1}). An unload-reload loop was conducted during the test and included a constant stress period prior to starting the unload phase and again prior to starting the reload phase. The target unload stress was set equal to approximately 20% of the vertical stress acting on the specimen prior to start of the unload-reload loop.
4. After the unload-reload loop was completed, CRS loading continued until a maximum stress of approximately 58,000 psf or 30% strain at which point the test was either stopped or a final unload sequence was conducted.

All measurements during testing were made using load, displacement and pressure transducers. The measured data were reduced using the methods of Wissa et al. (1971; and also described in ASTM D4186 and Sandbeakken et al. 1986). All vertical strains were computed taking into

account the apparatus compliance that was determined using a steel disk. The preconsolidation stress was estimated using the Casagrande and strain energy methods (Becker et al. 1987).

4.6 Direct Simple Shear (DSS) Test

The Direct Simple Shear (DSS) tests were conducted using a Geonor DSS device in general accordance to the procedures described by Bjerrum and Landva (1966), DeGroot et al. (1992) and ASTM D6528 *Standard Test Method for Consolidated Undrained Direct Simple Shear Testing of Cohesive Soils.* The Geonor DSS device (Figure 4.6.1) consists of a specimen chamber, lever arm for application of consolidation weights and a gear driven thrust shaft for applying the horizontal shear stress to the specimen. Load cells and linear variable differential transformers, all connected to a dedicated data acquisition system, are used for measurement of load and displacement. Specimens are prepared for testing by trimming the soil into a 5.43 in^2 (35 cm^2) wire-reinforced rubber membrane or a set of thin stainless steel stacked rings with an internal membrane. Carborundum porous stones are placed on the top and bottom of the specimen. The membrane allows for one-dimensional consolidation during the consolidation phase of a test and direct simple shear strain mode of deformation during the shear phase of a test.

The general test sequence consisted of the following stages:

1. Preparation of the specimen for testing first consisted of extracting a test sample from the sample tube using a hand extrusion procedure (Figure 4.1.1) followed by use of Geonor trimming equipment that allows for setting up a nominal 2.6" diameter by 0.8" height specimen inside a wire reinforced membrane or stacked ring membrane assembly.
2. Incremental, one-dimensional consolidation to the preshear vertical effective stress using a lever arm and dead weight. Consolidation of the DSS specimens was conducted using the SHANSEP (Ladd 1991, Ladd and DeGroot 2003) method with the final preshear laboratory vertical effective stress (σ'_{vc}) creating either a normally consolidated (OCR = 1) or overconsolidated (OCR > 1) test specimen.
3. Maintaining the maximum consolidation stress (OCR = 1 tests) and the final preshear vertical effective stress (OCR > 1 tests) acting on the specimen for a period of approximately 24 hours.
4. Undrained shearing using the constant volume procedure at a nominal shear strain rate of 5%/hour during application of the horizontal shear stress.
5. Undrained shear is continued to an approximate maximum shear strain of 20%.

All vertical consolidation strains are computed taking into account the apparatus compliance which was determined using a steel disk. The measured horizontal force during undrained shear is corrected for the calibrated resistance of the wire reinforced membrane or stacked ring membrane assembly. Reduced data from the undrained shear phase of the test consists of shear strain (γ), horizontal shear stress (τ_h), equivalent change in pore water pressure (Δu), vertical effective stress (σ'_v), shear modulus ($G = \tau_h/\gamma$), and undrained shear strength (s_u) which is typically assumed to be equal to the maximum measured horizontal shear stress $(\tau_h)_{max}$ (Ladd 1991, DeGroot et al. 1992).

5. RESULTS

5.1 Tests Conducted and Specimen Locations

Table 1 presents a summary of the tests conducted on the sample tubes.

Figures 5.1.1 to 5.1.10 show the location of the CRS and DSS test specimens for each of the sample tubes.

5.2 Atterberg Limits and Torvane

Table 2 presents a summary of the Atterberg Limits results and Figure 5.2.1 plots them in a Casagrande Plasticity Chart.

5.3 Constant Rate of Strain and Incremental Load Consolidation Tests

Table 3 presents a summary of the CRS test specimen properties and results. Figures 5.3.1 to 5.3.40 present plots of the CRS test results including the compression curve (ε_v versus σ'_v), coefficient of consolidation versus vertical effective stress, void ratio versus hydraulic conductivity and constrained modulus versus vertical effective stress.

5.4 Direct Simple Shear Tests

Table 4 presents a summary of the DSS test specimen properties and results. Figures 5.4.1 to 5.4.45 present plots of the DSS tests results including the compression curve from the consolidation phase of the test and plots from the undrained shear phase including shear stress versus shear strain, shear induced pore pressure versus shear strain, shear stress versus vertical effective stress, and shear modulus versus shear strain.

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7. NOTATION AND UNITS

Notation

c_v = vertical coefficient of consolidation (ft^2/day)
e = void ratio
e_0 = initial void ratio
k_v = vertical hydraulic conductivity (ft/day)
LL = liquid limit (%)
PI = plasticity index (%)
PL = plastic limit (%)
s_u = undrained shear strength (psf)
t = time
w = water content (%)

% = percentage
Δu = equivalent DSS shear induced pore pressure (psf)
ε_v = vertical strain (%)
ε_{vc} = vertical consolidation strain (%)
ε_{vf} = final vertical consolidation strain (%)
ε_{vmax} = maximum vertical strain during consolidation phase of DSS test (%)
γ = shear strain for DSS test (%)
γ_t = total unit weight (pcf)
γ_d = dry unit weight (pcf)
σ'_p = preconsolidation stress (psf)
σ'_v = vertical effective stress (psf)
σ'_{vc} = vertical consolidation effective stress (psf)
σ'_{vmax} = maximum vertical stress during consolidation phase of DSS test (psf)
τ_h = horizontal shear stress (psf)

Units

cm = centimeter
ft = feet
in = inches
min = minute
pcf = pounds per cubic foot
psf = pounds per square foot
s = seconds

Table 1 Summary of Tests Performed

Test	**AAB-01-14 UP-1 18-20 ft.**	**AAB-01-14 UP-2 28-30 ft.**	**AAB-01-16 UP-1 13-15 ft.**	**AAB-02-22A UP-1 43-45 ft.**	**AAB-02-23B UP-2 58-60 ft.**	**AAB-03-36 UP-2 38-40 ft.**
Water Content	-	multiple	multiple	multiple	multiple	multiple
Total and Dry Unit Weight	-	1	1	multiple	1	multiple
Atterberg Limits	-	1	1	1	1	1
Torvane	-		multiple	multiple		multiple
Constant Rate of Strain Consolidation	-	CRS146	CRS153	CRS147	CRS155	CRS148
Incremental Load Consolidation	-					
Direct Simple Shear	-		G346	G348		G340 G341 G343

Table 1 (continued) Summary of Tests Performed

Test	**AARW-01-04 UP-2 43-45 ft.**	**AARW-04-11 UP-2 28-30 ft.**	**AARW-10-40 UP-1 63-65 ft.**	**AARW-10-40 UP-2 98-100 ft.**	**AARW-11-43 UP-2 23-25 ft.**
Water Content	multiple	multiple	multiple	multiple	multiple
Total and Dry Unit Weight	multiple	1	multiple	1	multiple
Atterberg Limits	1	1	1	1	1
Torvane	multiple				multiple
Constant Rate of Strain Consolidation	CRS152	CRS151	CRS150	CRS149	CRS154
Incremental Load Consolidation					
Direct Simple Shear	G347		G342		G344 G345

Table 2 Summary of Classification test results

Sample	CRS Test	LL	PL	PI	w	LI
-	-	(%)	(%)	(%)	(%)	(-)
1	2	3	4	5	6	7
AAB-01-14 UP-1 18-20 ft.	-	-	-	-	-	-
AAB-01-14 UP-2 28-30 ft.	CRS146	65	35	30	45	0.33
AAB-01-16 UP-1 13-15 ft.	CRS153	42	27	15	39	0.80
AAB-02-22A UP-1 43-45 ft.	CRS147	68	32	36	44	0.33
AAB-02-23B UP-2 58-60 ft.	CRS155	36	25	11	35	0.91
AAB-03-36 UP-2 38-40 ft.	CRS148	64	28	36	69	1.14
AARW-01-04 UP-2 43-45 ft.	CRS152	33	20	13	38	1.38
AARW-04-11 UP-2 28-30 ft.	CRS151	41	29	12	48	1.58
AARW-10-40 UP-1 63-65 ft.	CRS150	60	32	28	65	1.18
AARW-10-40 UP-2 98-100 ft.	CRS149	47	34	13	41	0.54
AARW-11-43 UP-2 23-25 ft.	CRS154	64	32	32	60	0.88

Note: water content values from adjacent CRS test specimen (see Table 4)

Table 3 Summary of Constant Rate of Strain (CRS) and Incremental Load (IL) specimen properties and test results

Test #	Boring Sample	Depth	w	e_0	γ_t	γ_d	σ'_{v0}	Sample Quality (at σ'_{v0})		σ'_p		OCR		Figure Numbers
								$\Delta e/e_0$	ε_v	Casa.	S.E.	Casa.	S.E.	
-	-	ft	%	-	pcf	pcf	psf	-	%	psf	psf	-	-	-
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CRS146	AAB-01-14 UP-2	28-30	45	1.278	111	77	1730	0.023 (1)	1.3 (B)	5618	5221	3.25	3.02	5.3.1 to 5.3.4
CRS147	AAB-02-22A UP-1	43-45	44	1.252	112	77	3650	0.068 (2)	3.8 (C)	7414†	6683†	1.83	2.03	5.3.5 to 5.3.8
CRS148	AAB-03-36 UP-2	38-40	69	1.945	100	59	2980	0.035 (1)	2.3 (C)	5430	5221	1.82	1.75	5.3.9 to 5.3.12
CRS149	AARW-10-40 UP-2	98-100	41	1.199	112	79	5200	0.072 (3)	3.9 (C)	6877†	7602†	1.31	1.46	5.3.13 to 5.3.16
CRS150	AARW-10-40 UP-1	63-65	65	1.863	100	61	3710	0.046 (2)	3.0 (C)	7519	7289	2.03	1.96	5.3.17 to 5.3.20
CRS151	AARW-04-11 UP-2	28-30	48	1.364	109	74	1455	0.027 (1)	1.6 (B)	7101	6662	4.88	4.58	5.3.21 to 5.3.24
CRS152	AARW-01-04 UP-2	43-45	38	1.088	115	83	2660	0.031 (2)	1.6 (B)	5952	5848	2.24	2.20	5.3.25 to 5.3.28
CRS153	AAB-01-16 UP-1	13-15	39	1.110	115	83	1030	0.020 (1)	1.0 (A/B)	5284	4657	5.13	4.52	5.3.29 to 5.3.32
CRS154	AARW-11-43 UP-2	23-25	60	1.710	103	64	1325	0.032 (2)	2.0 (B/C)	4365	4031	3.29	3.04	5.3.33 to 5.3.36
CRS155	AAB-02-23B UP-2	58-60 ft.	35	1.006	117	87	4575	0.058 (2)	2.9 (C)	-†	5556	-	1.21	5.3.37 to 5.3.40

Notes: †no distinct break evident in compression curve

1. Notation given in Section 7. 2. e_0 based on assumed specific gravity = 2.80 3. σ'_{v0} values provided by GeoDesign Inc

4. For estimates of σ'_p: Casa. = Casagrande construction; S.E. = strain energy method of Becker et al. (1987)

5. Sample quality evaluation methods:

Lunne et al. (2006) quality ratings 1 = very good to excellent, 2 = fair to good, 3 = poor, 4 = very poor					Terzaghi et al. (1996) Specimen Quality Designation (SQD) A (best) to E (worst)					
OCR	$\Delta e/e_0$ at σ'_{v0}									
1 to 2	< 0.04	0.04 – 0.07	0.07 – 0.14	> 0.14	ε_v at σ'_{v0}	< 1	1 - 2	2 - 4	4 - 8	> 8
2 to 4	< 0.03	0.03 – 0.05	0.05 – 0.10	> 0.10	SQD	A	B	C	D	E
Quality	1	2	3	4						

Table 4 Summary of Direct Simple Shear (DSS) specimen properties and test results

Test No.	Sample Tube	Depth	w_n	γ_t	γ_d	σ'_{vo}	Laboratory Consolidation					Shear Data at Peak $(\tau_h)_{max} = s_u$				Figure Numbers
							σ'_{vc}	σ'_{vmax}	OCR	ε_{vmax}	ε_{vf}	γ	τ_h	τ_h/σ'_{vc}	σ'_v/σ'_{vc}	
-	-	ft	%	pcf	pcf	psf	psf	psf	-	%	%	%	psf	-	-	-
1	2	3	4	5	5	6	7	8	9	10	11	12	13	14	15	16
G340	AAB-03-36 UP-2	38-40	63	104	63	2980	8332	8332	1.0	14.9	14.9	8.5	1557	0.187	0.611	5.4.1 to 5.4.5
G341	AAB-03-36 UP-2	38-40	65	103	62	2980	4189	8361	2.0	14.8	13.7	9.1	1229	0.294	0.887	5.4.6 to 5.4.10
G343	AAB-03-36 UP-2	38-40	62	104	64	2980	2111	8356	4.0	13.8	11.5	7.5	982	0.465	1.166	5.4.11 to 5.4.15
G342	AARW-10-40 UP-1	63-65	61	103	64	3710	10424	10424	1.0	15.2	15.2	9.6	1564	0.150	0.623	5.4.16 to 5.4.20
G344	AARW-11-43 UP-2	23-25	57	103	65	1325	8355	8355	1.0	14.4	14.4	8.8	1544	0.185	0.593	5.4.21 to 5.4.25
G345	AARW-11-43 UP-2	23-25	62	104	64	1325	2085	8353	4.0	16.0	13.5	18.4	1027	0.496	1.092	5.4.26 to 5.4.30
G346	AAB-01-16 UP-1	13-15	-	112	70	1030	12551	12551	1.0	16.1	16.1	8.3	2048	0.163	0.621	5.4.31 to 5.4.35
G347	AARW-01-04 UP-2	43-45	30	124	95	2660	12526	12526	1.0†	5.4†	5.4	10.0	3009	0.240	0.491	5.4.36 to 5.4.40
G348	AAB-02-22A UP-1	43-45	65	102	63	3650	8359	8359	1.0	16.4	16.4	10.2	1258	0.151	0.651	5.4.41 to 5.4.45

Notes:

†vertical strain likely too low for specimen to be truly normally consolidated

1. Notation given in Section 7
2. σ'_{v0} values provided by GeoDesign Inc
3. Undrained shear strength $s_u(DSS) = (\tau_h)_{max}$

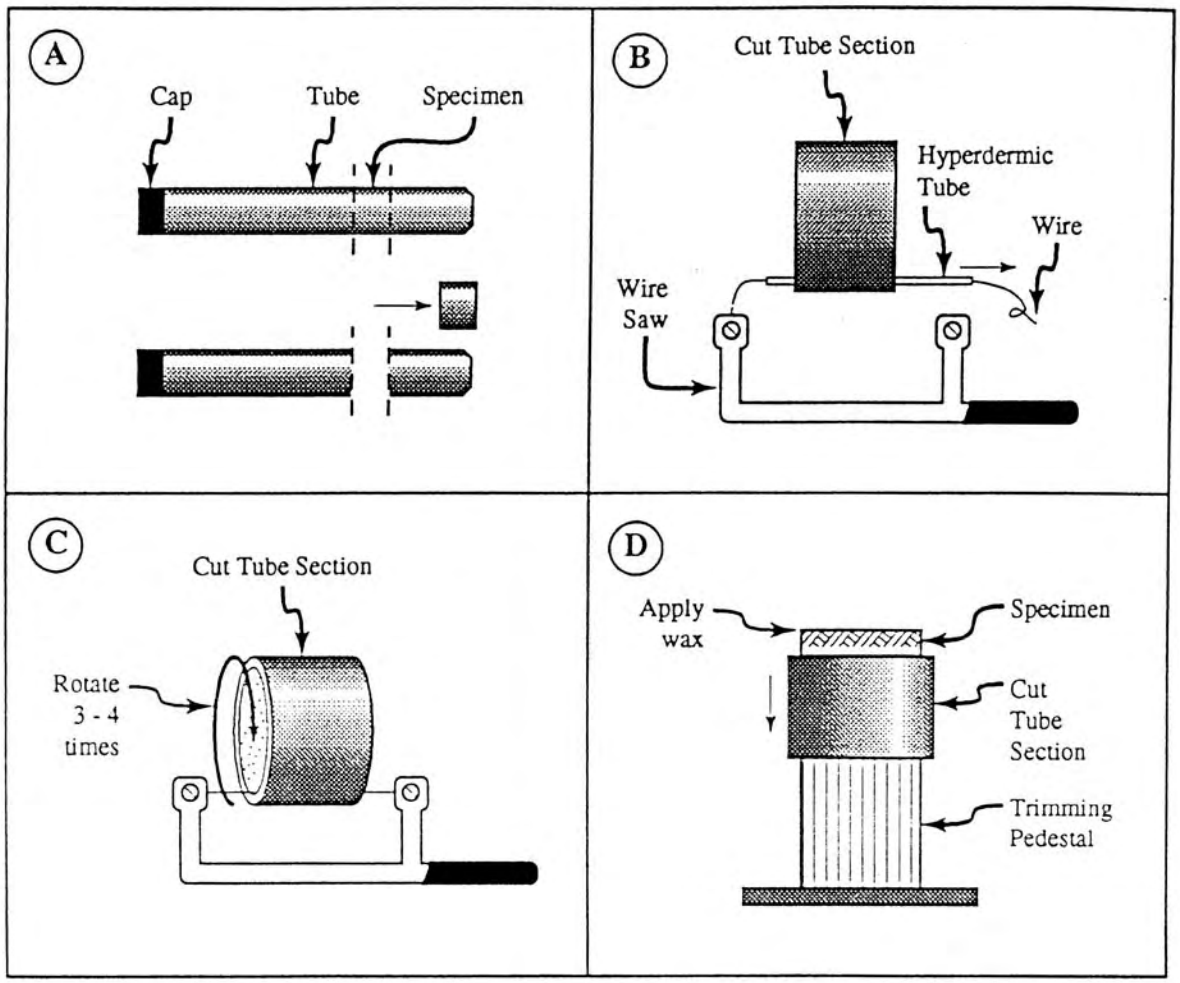

Figure 4.1.1 Procedure for sample extrusion for CRS, IL and DSS specimens (after Ladd and DeGroot 2003)

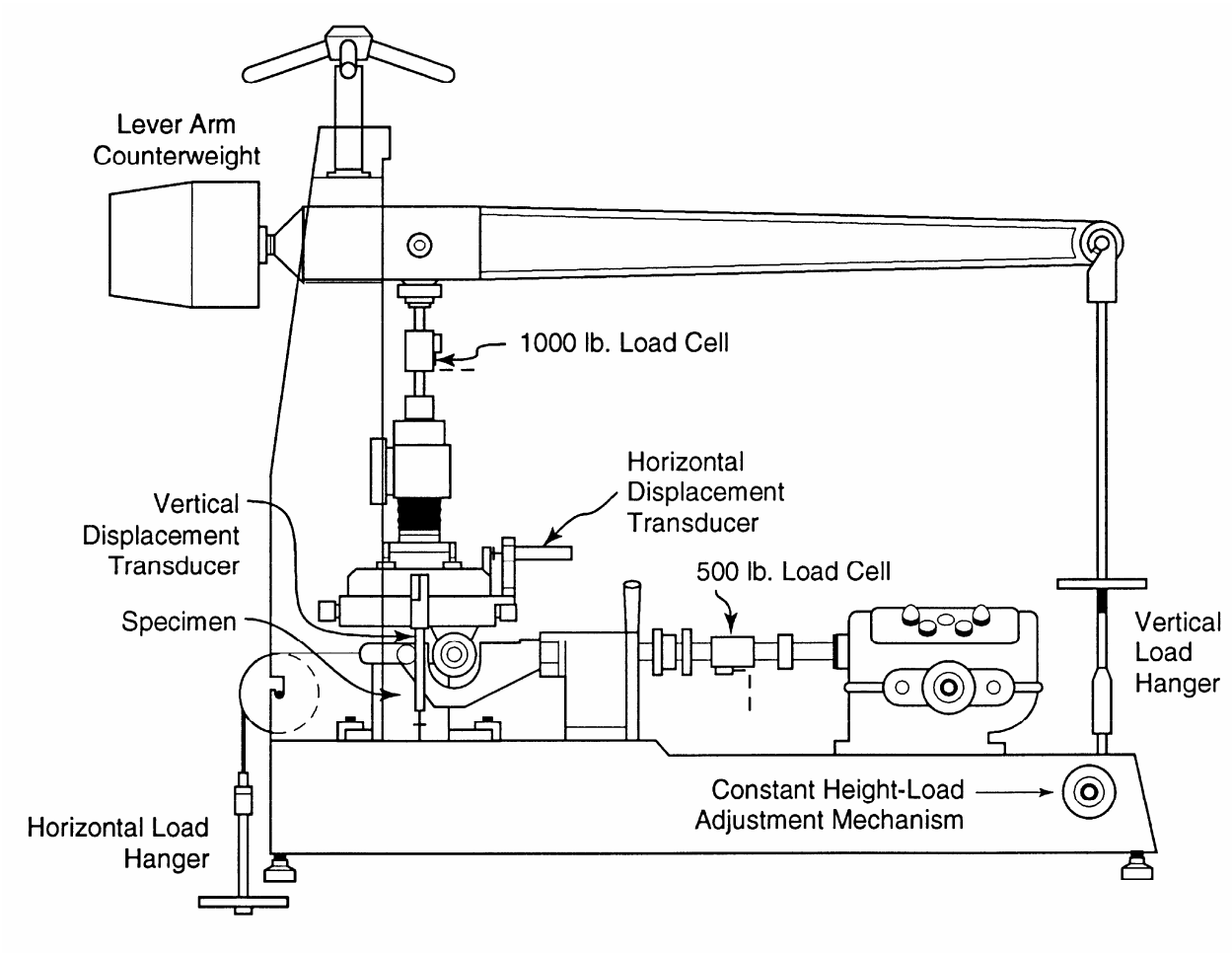

Figure 4.6.1 Geonor Direct Simple Shear (DSS) apparatus

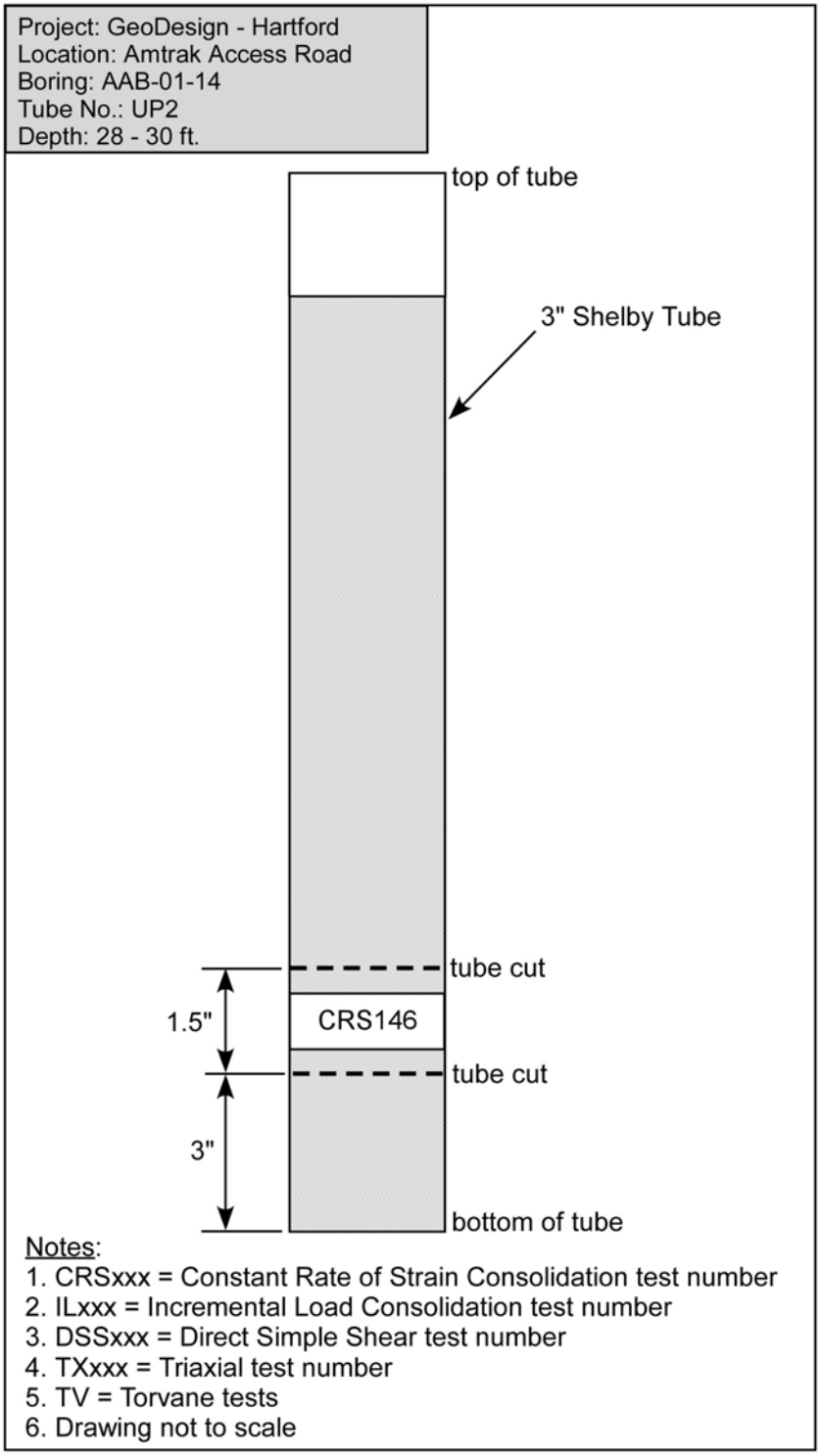

Figure 5.1.1 Test locations for Amtrak Access Road Sample AAB-01-14 UP-2 28-30 ft.

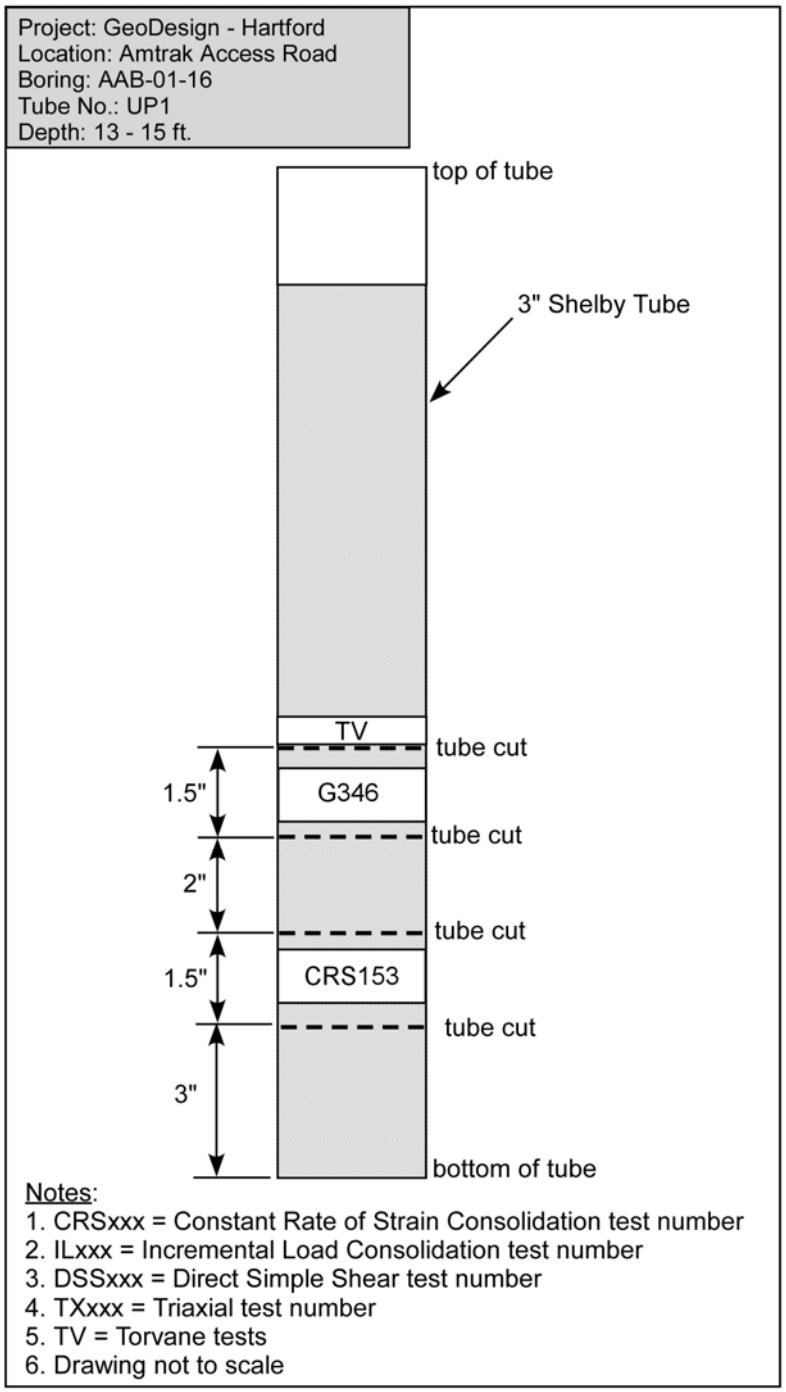

Figure 5.1.2 Test locations for Amtrak Access Road Sample AAB-01-16 UP-1 13-15 ft.

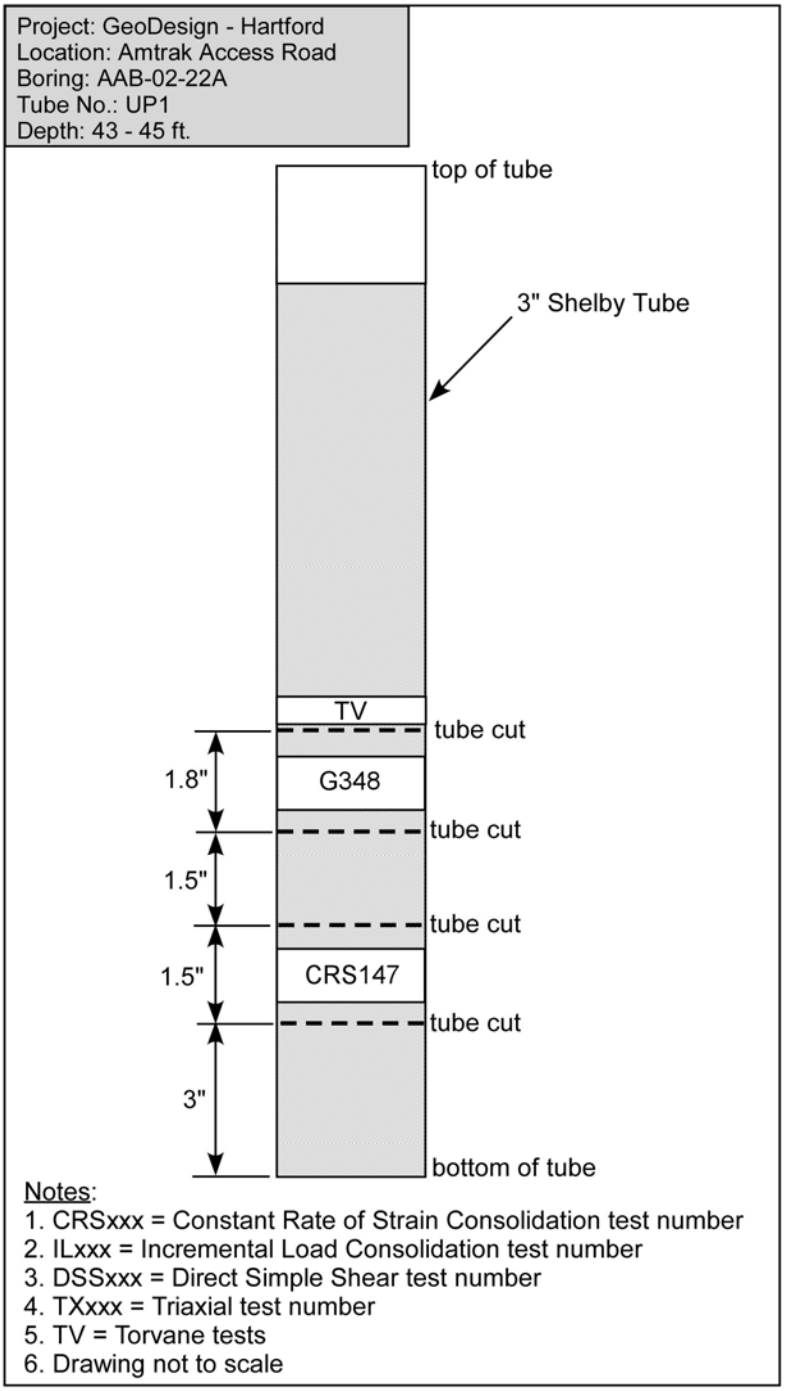

Figure 5.1.3 Test locations for Amtrak Access Road Sample AAB-02-22A UP-1 43-45 ft.

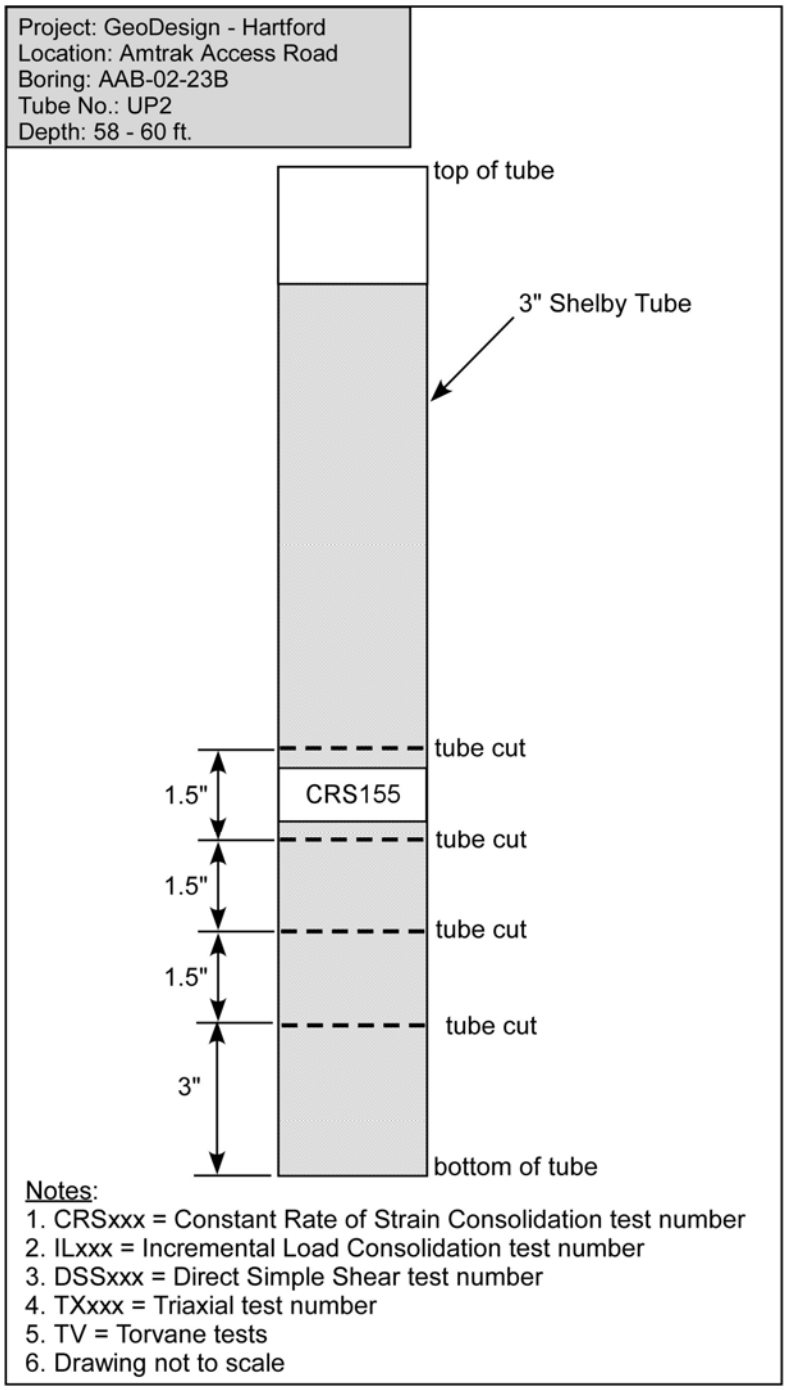

Figure 5.1.4 Test locations for Amtrak Access Road Sample AAB-02-23B UP-2 58-60 ft.

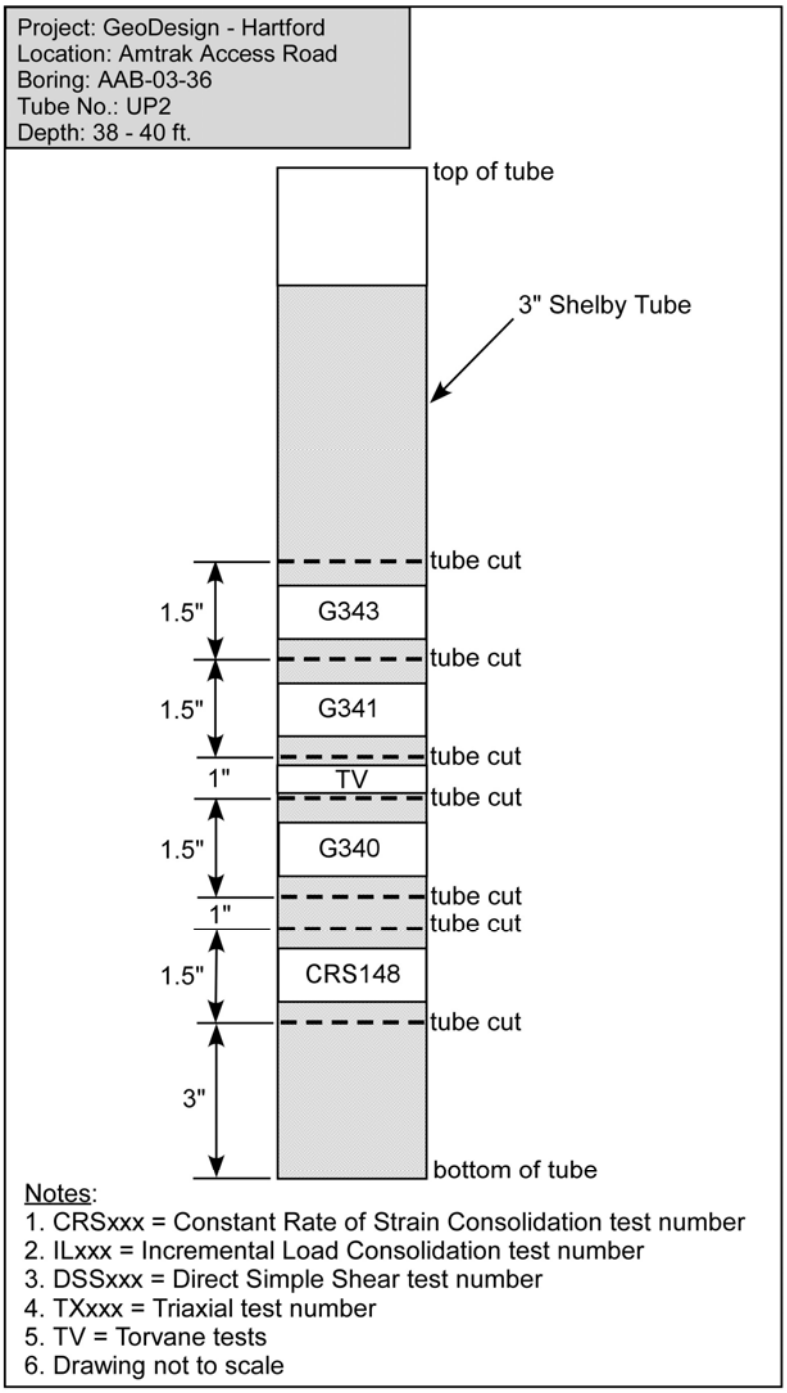

Figure 5.1.5 Test locations for Amtrak Access Road Sample AAB-03-36 UP-2 38-40 ft.

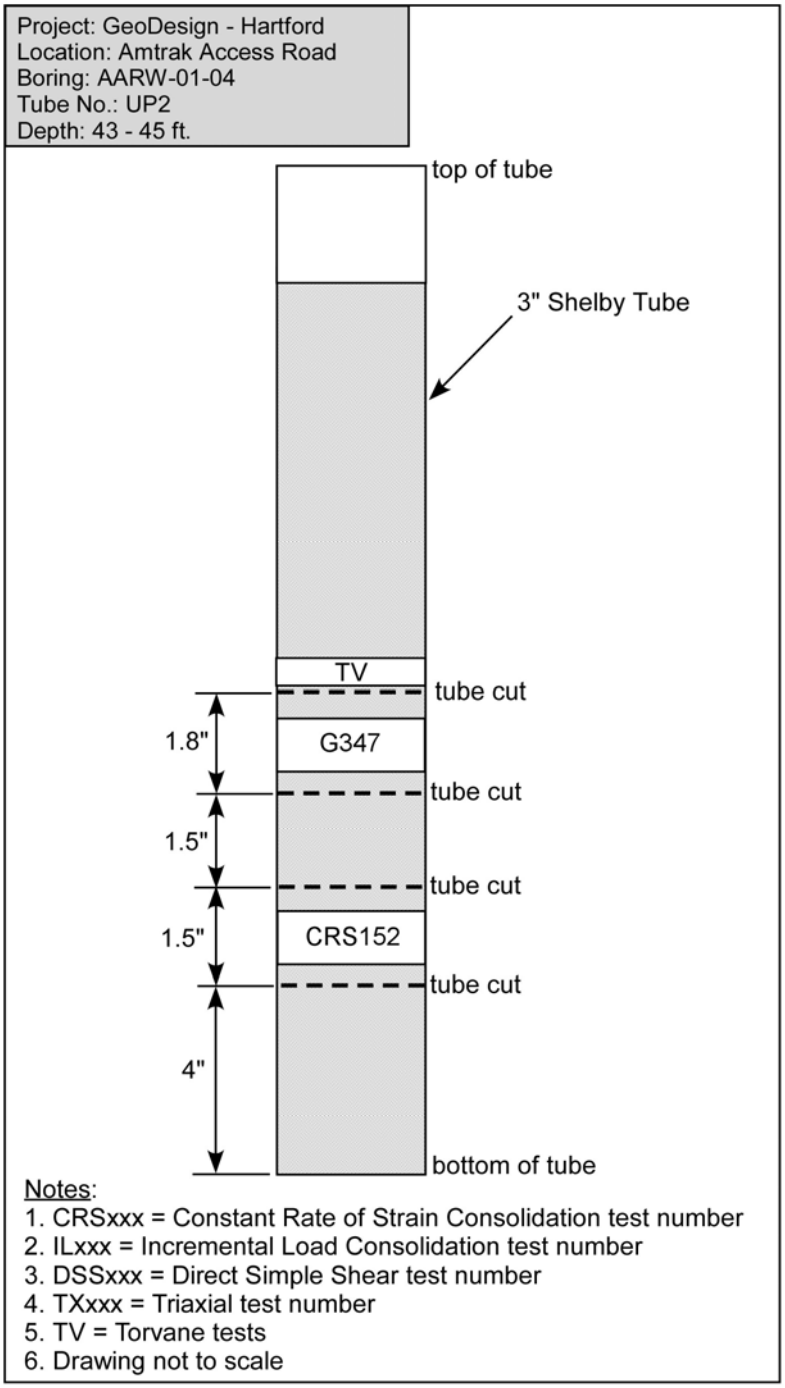

Figure 5.1.6 Test locations for Amtrak Access Road Sample AARW-01-04 UP-2 43-45 ft.

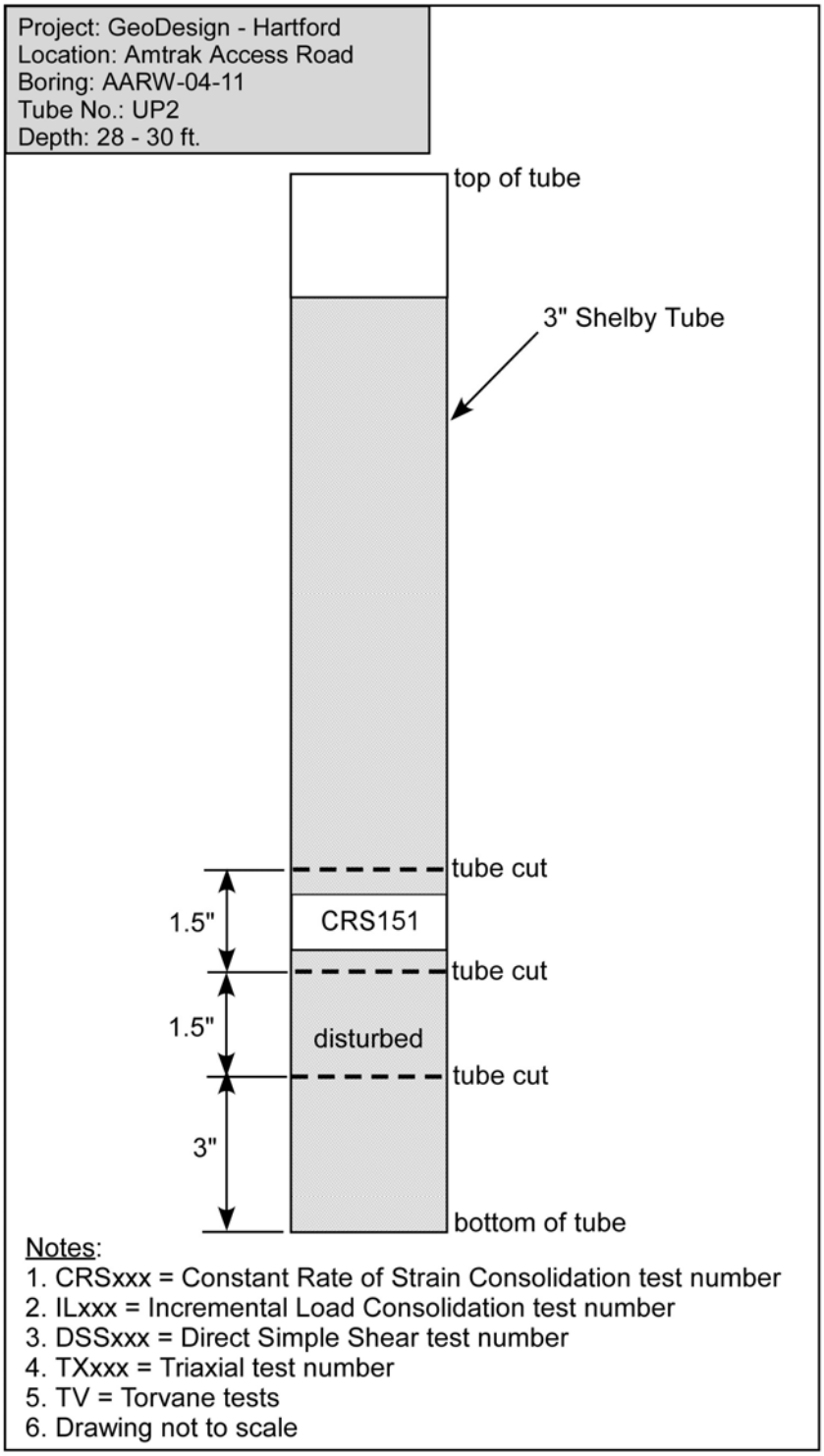

Figure 5.1.7 Test locations for Amtrak Access Road Sample AARW-04-11 UP-2 28-30 ft.

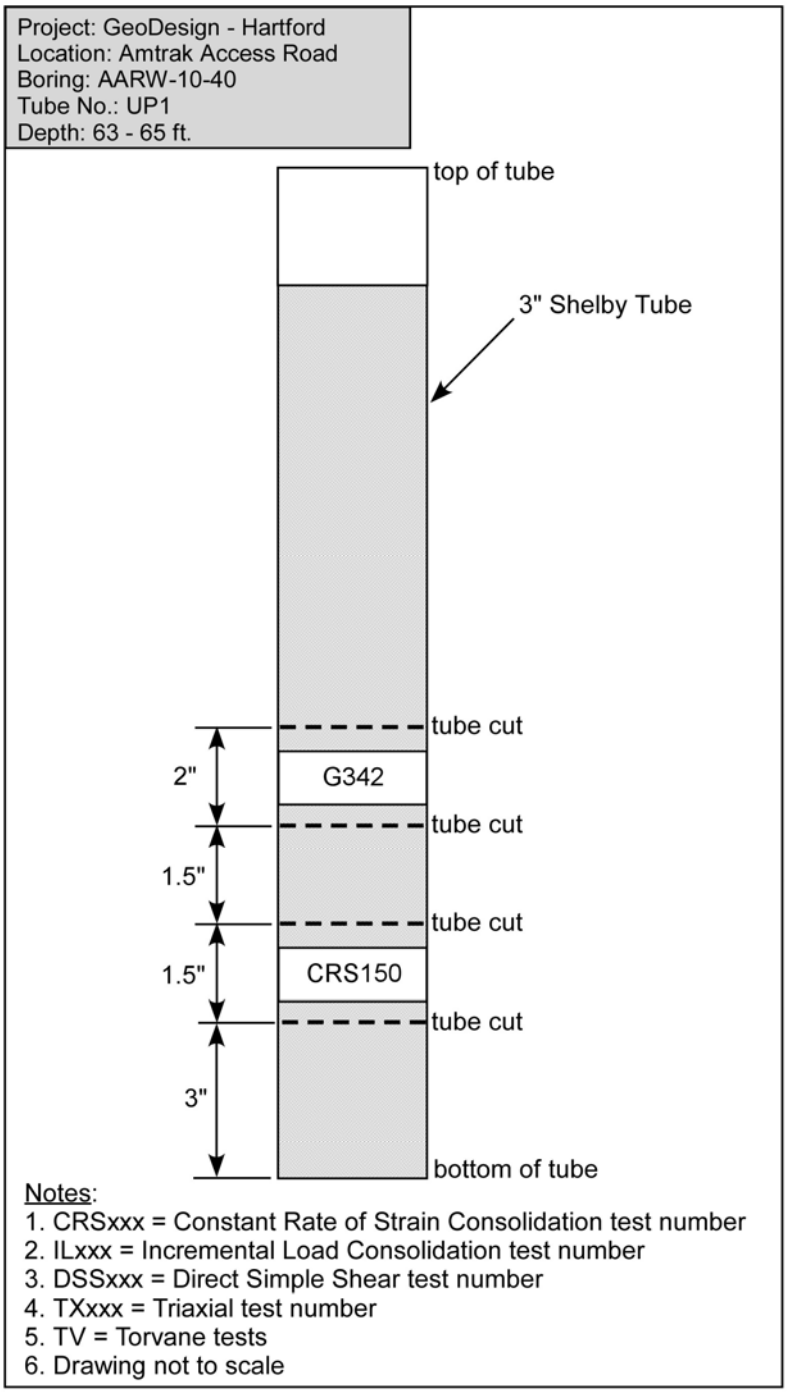

Figure 5.1.8 Test locations for Amtrak Access Road Sample AARW-10-40 UP-1 63-65 ft.

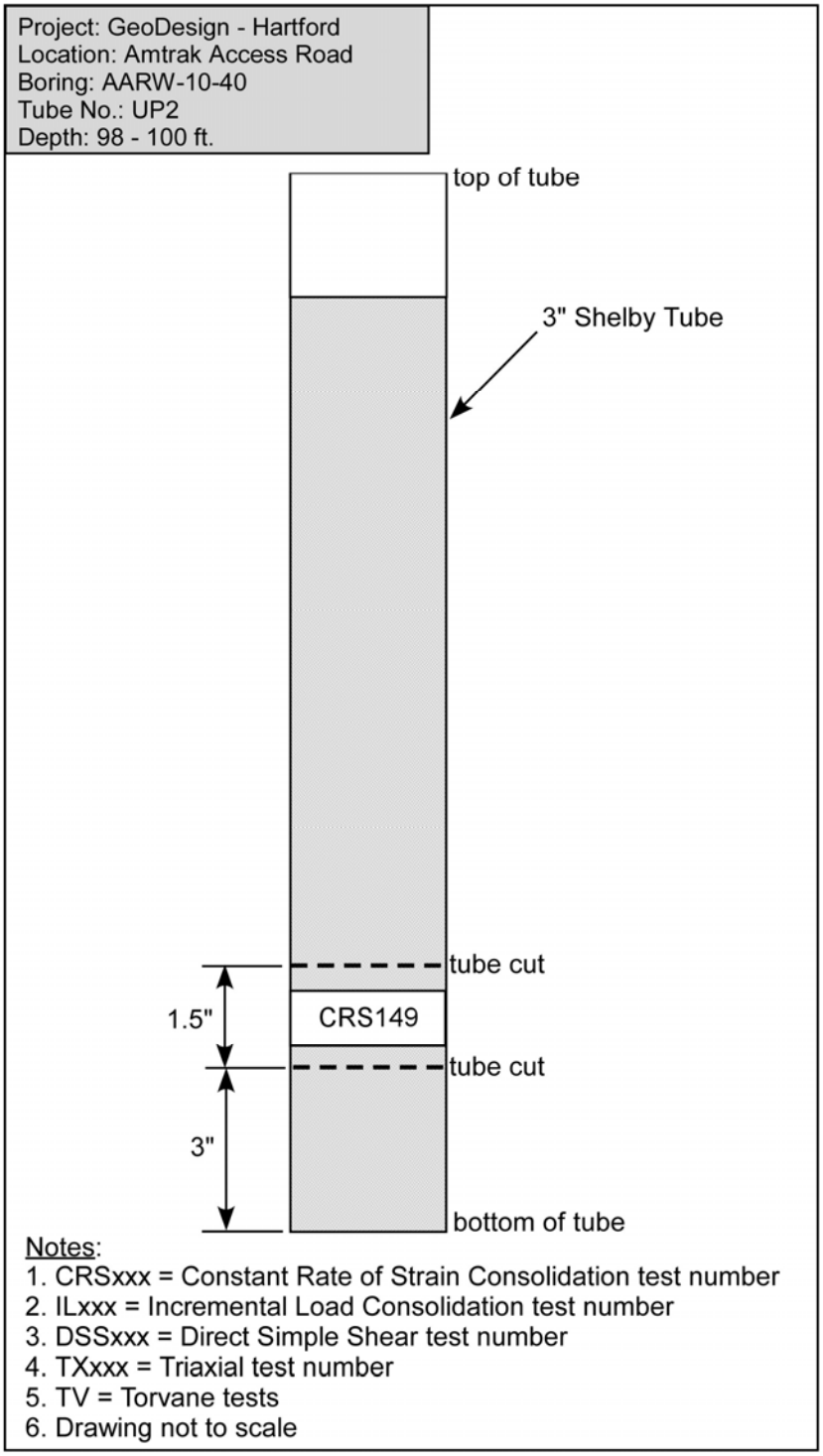

Figure 5.1.9 Test locations for Amtrak Access Road Sample AARW-10-40 UP-2 98-100 ft.

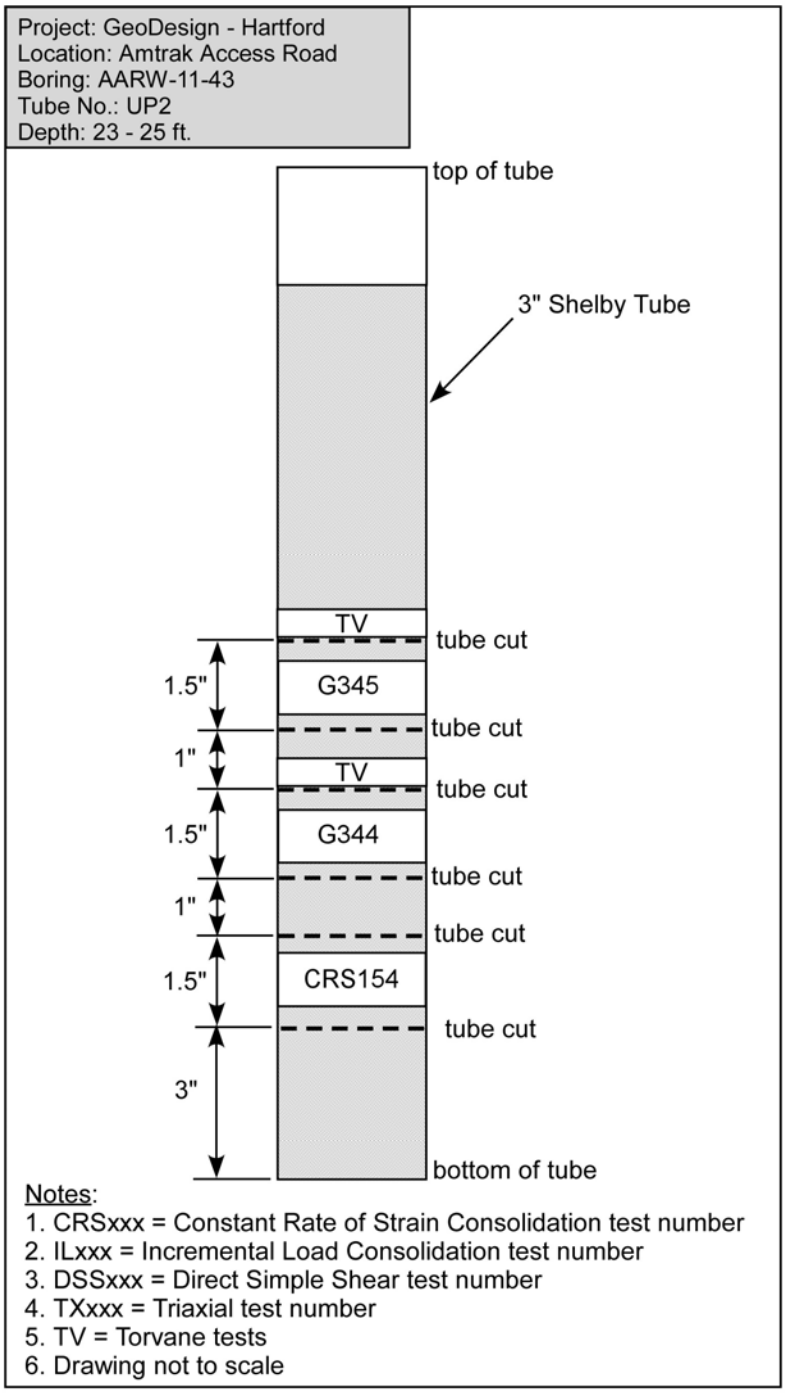

Figure 5.1.10 Test locations for Amtrak Access Road Sample AARW-11-43 UP-2 23-25 ft.

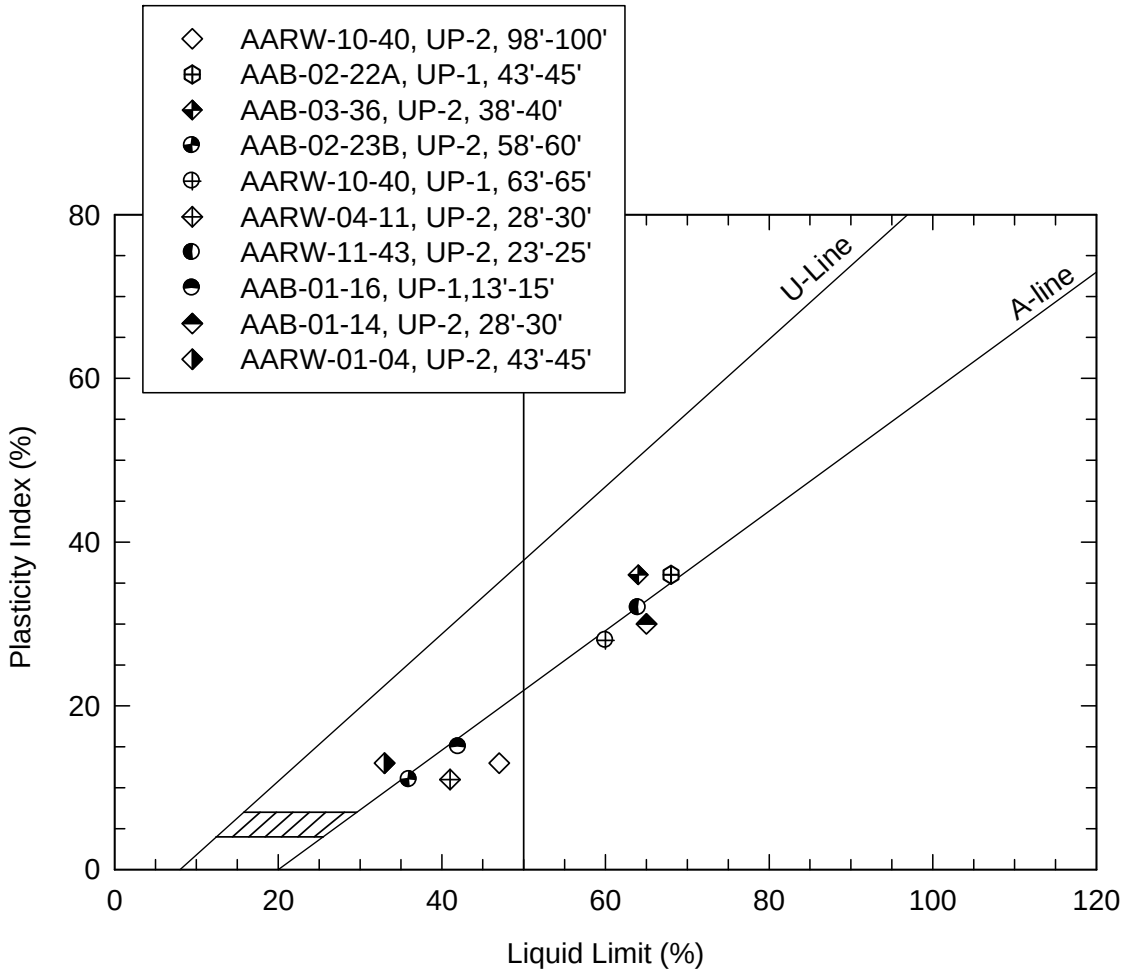

Figure 5.2.1 Plasticity Chart with Atterberg Limits results for selected samples

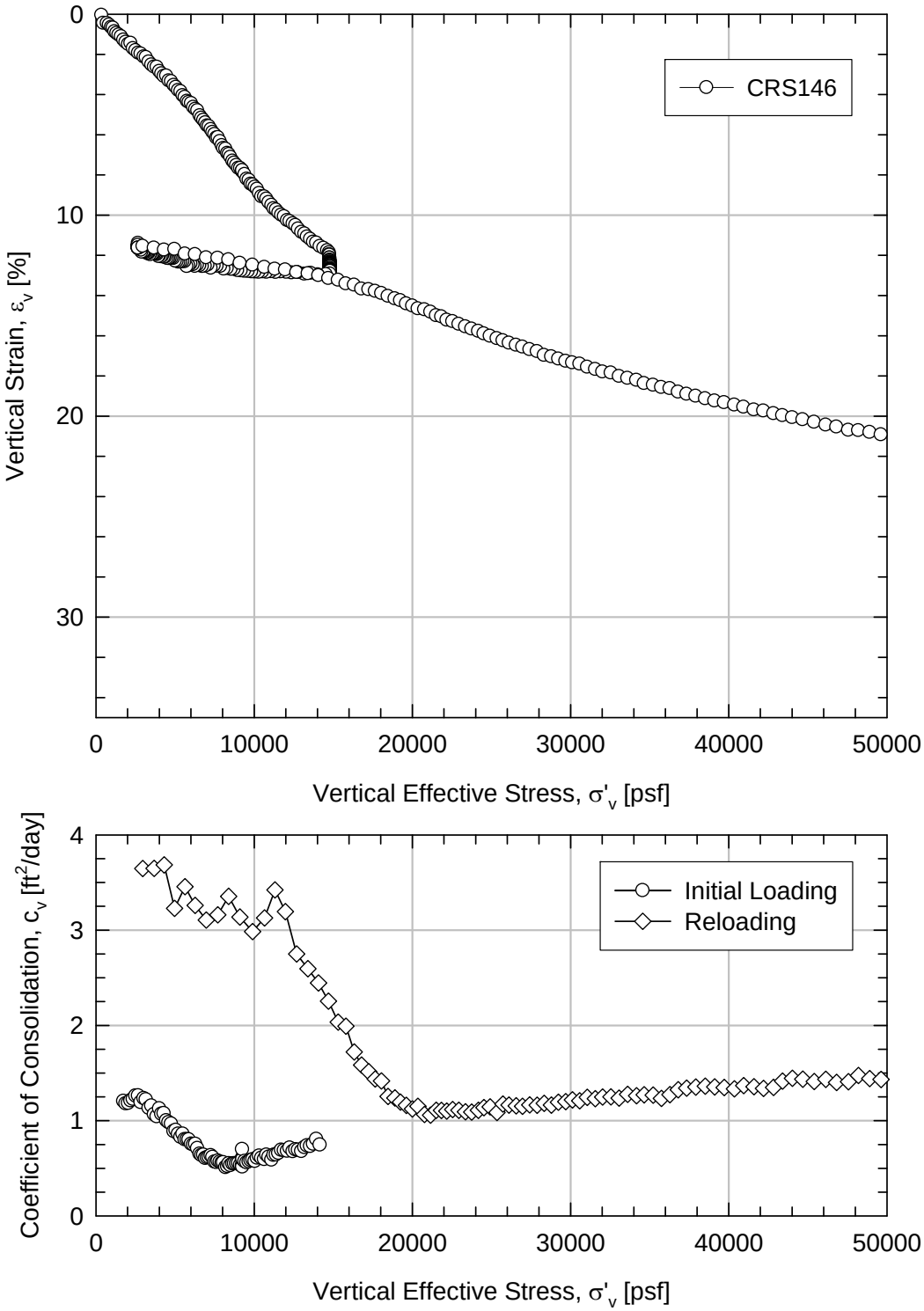

Figure 5.3.1 Vertical strain and coefficient of consolidation versus vertical effective stress for test CRS146 on sample AAB-01-14 UP-2 28-30 ft.

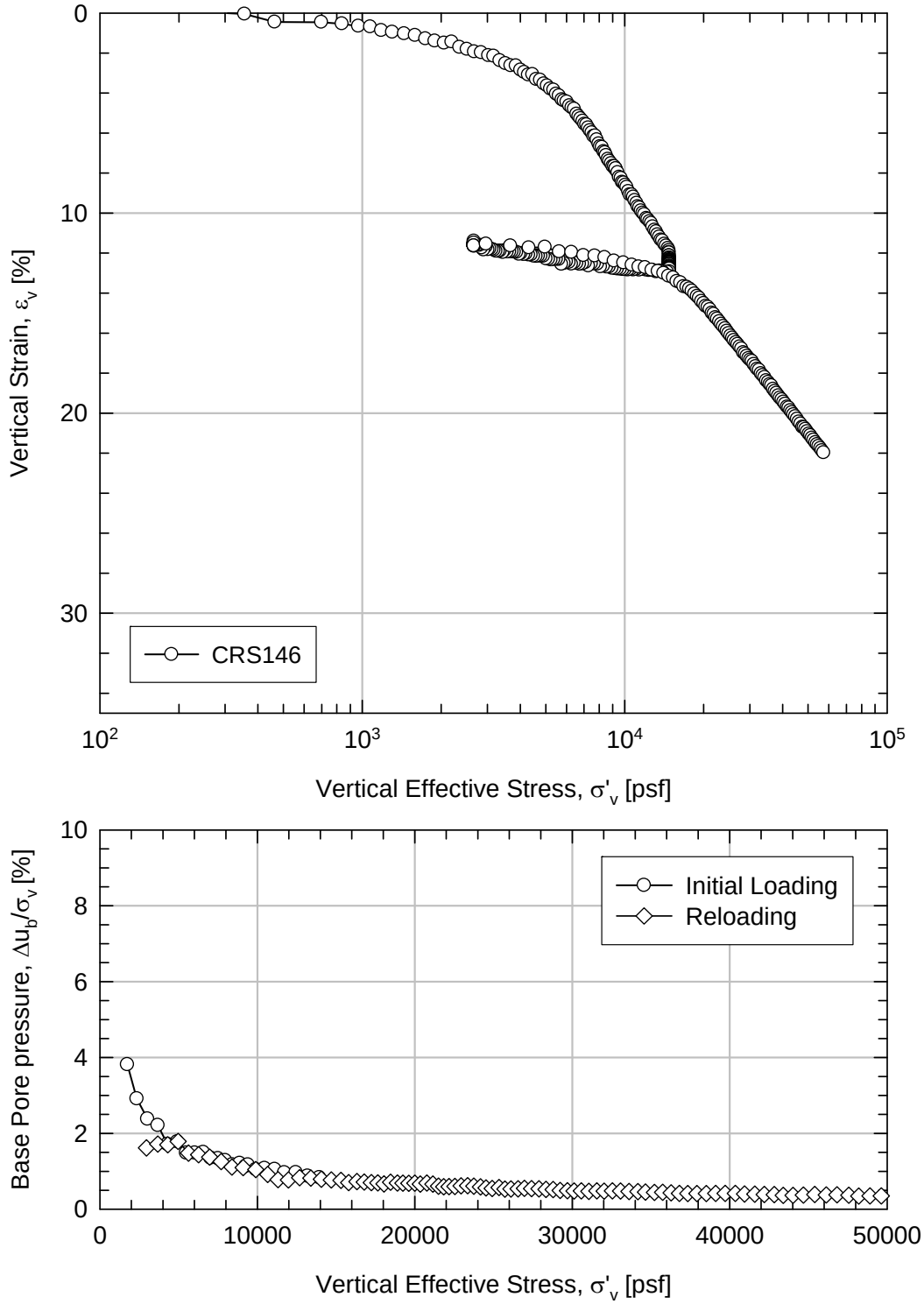

Figure 5.3.2 Vertical strain and normalized base pore pressure versus vertical effective stress for test CRS146 on sample AAB-01-14 UP-2 28-30 ft.

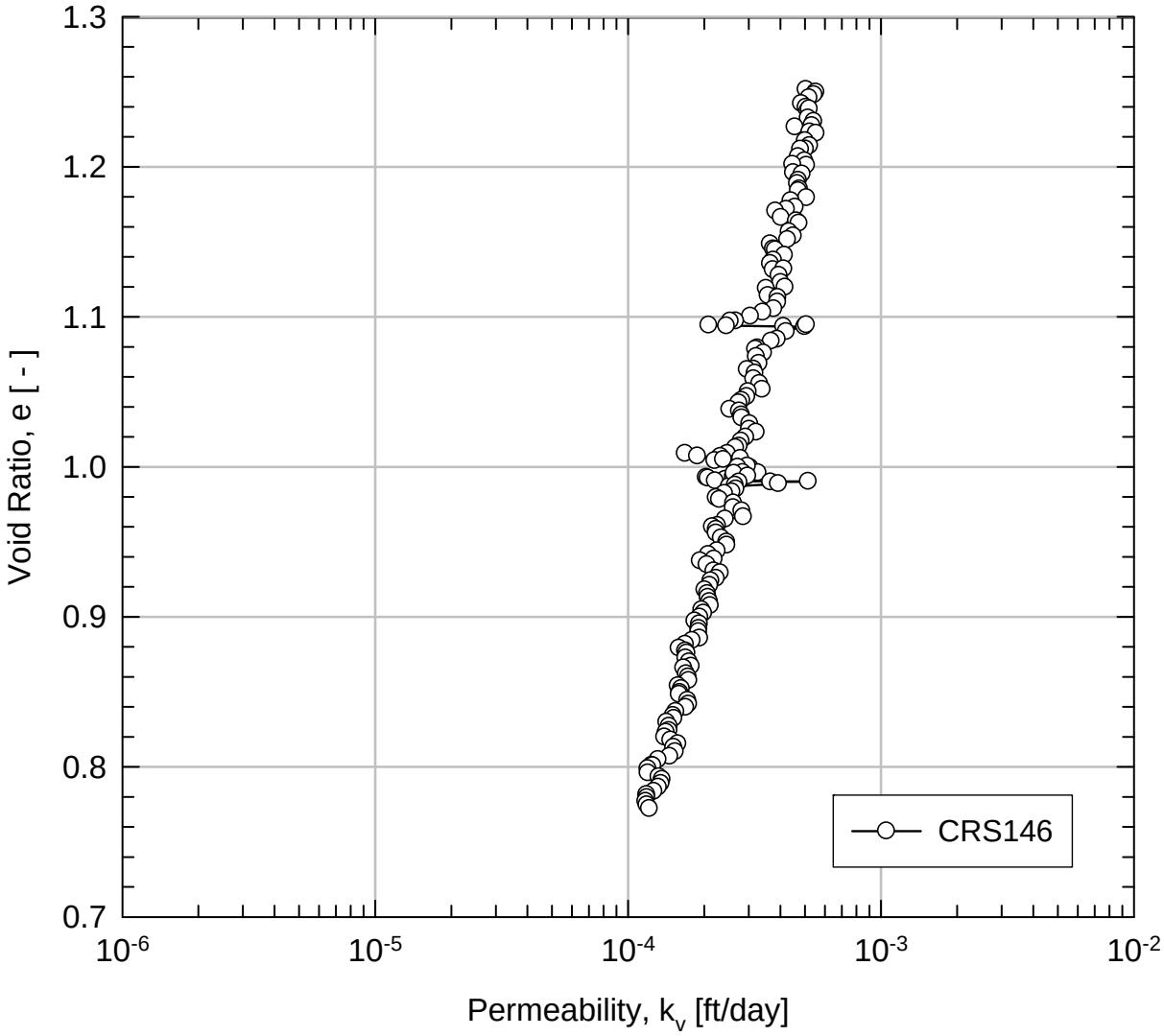

Figure 5.3.3 Void ratio versus permeability for CRS146 on sample AAB-01-14 UP-2 28-30 ft.

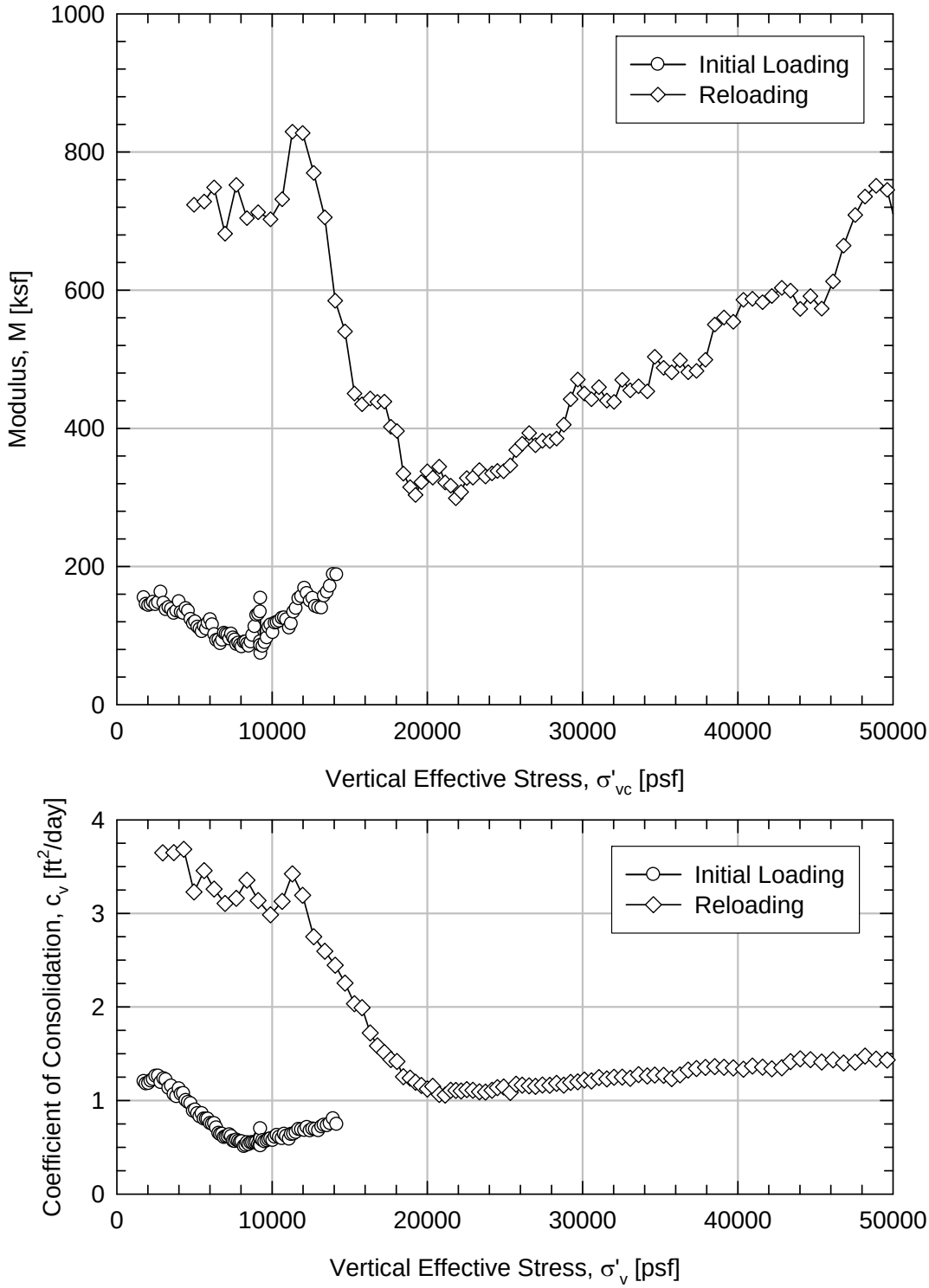

Figure 5.3.4 Modulus and coefficient of consolidation versus vertical effective stress for test CRS146 on sample AAB-01-14 UP-2 28-30 ft.

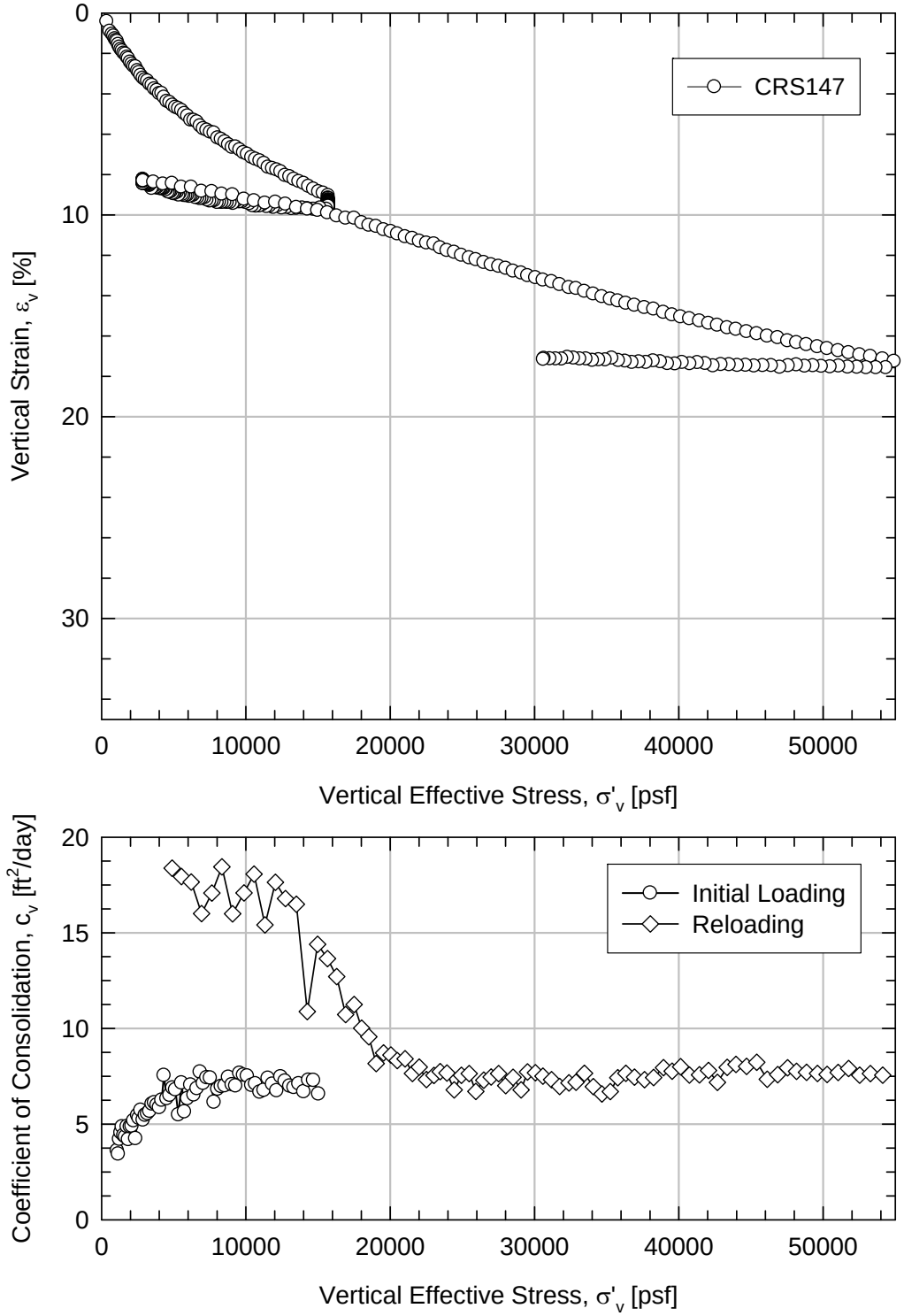

Figure 5.3.5 Vertical strain and coefficient of consolidation versus vertical effective stress for test CRS147 on sample AAB-02-22A UP-1 43-45 ft.

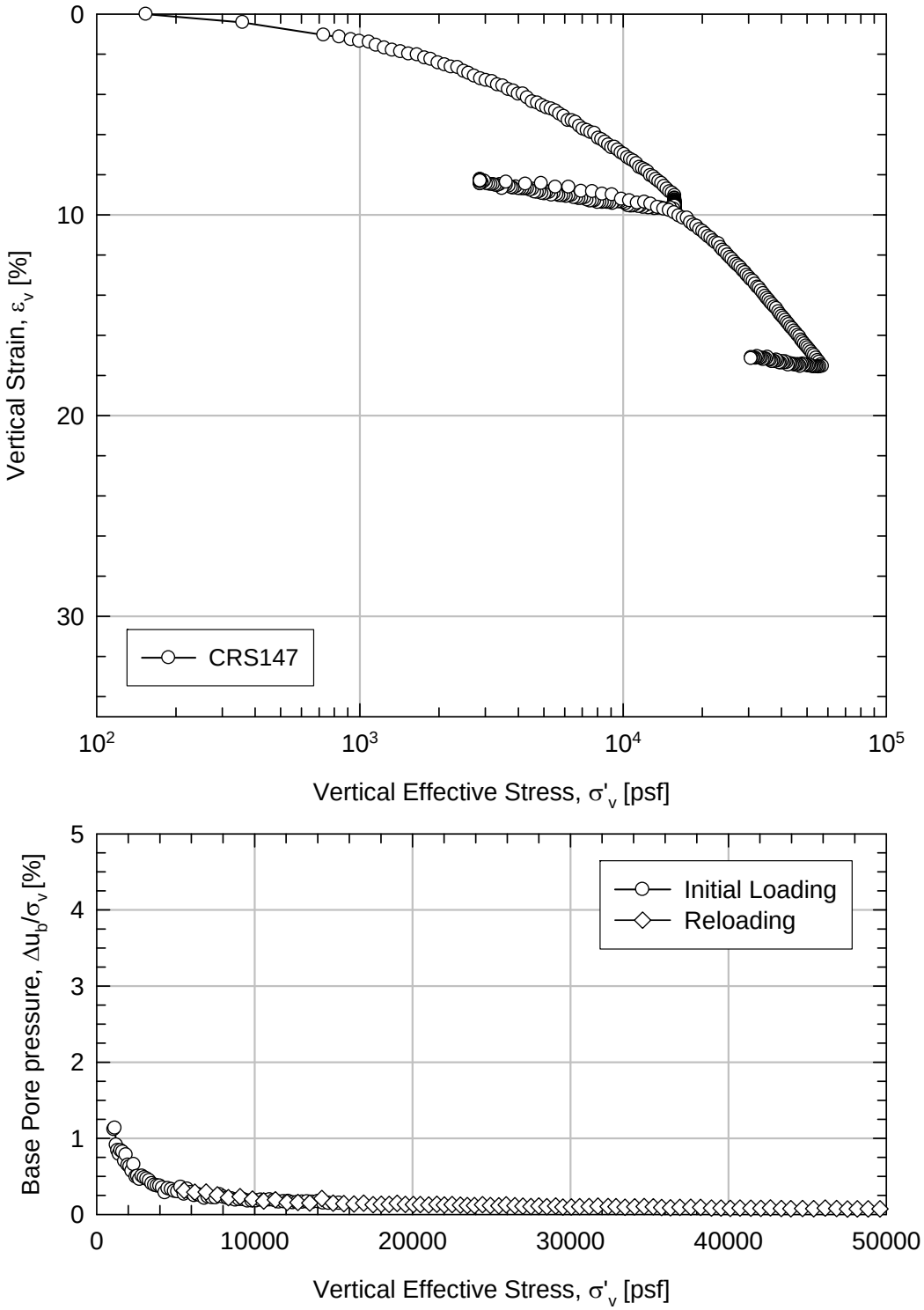

Figure 5.3.6 Vertical strain and normalized base pore pressure versus vertical effective stress for test CRS147 on sample AAB-02-22A UP-1 43-45 ft.

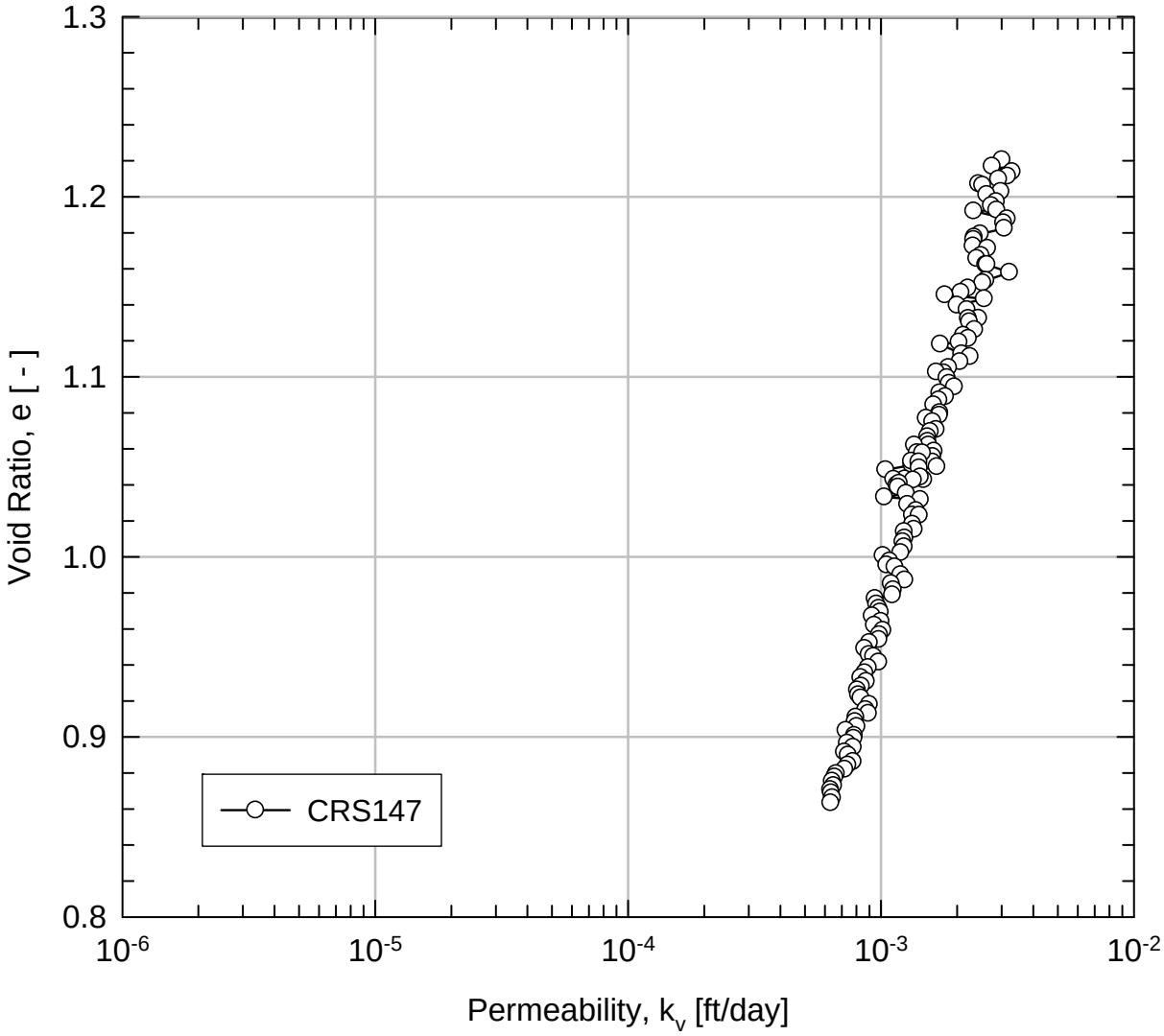

Figure 5.3.7 Void ratio versus permeability for CRS147 on sample AAB-02-22A UP-1 43-45 ft.

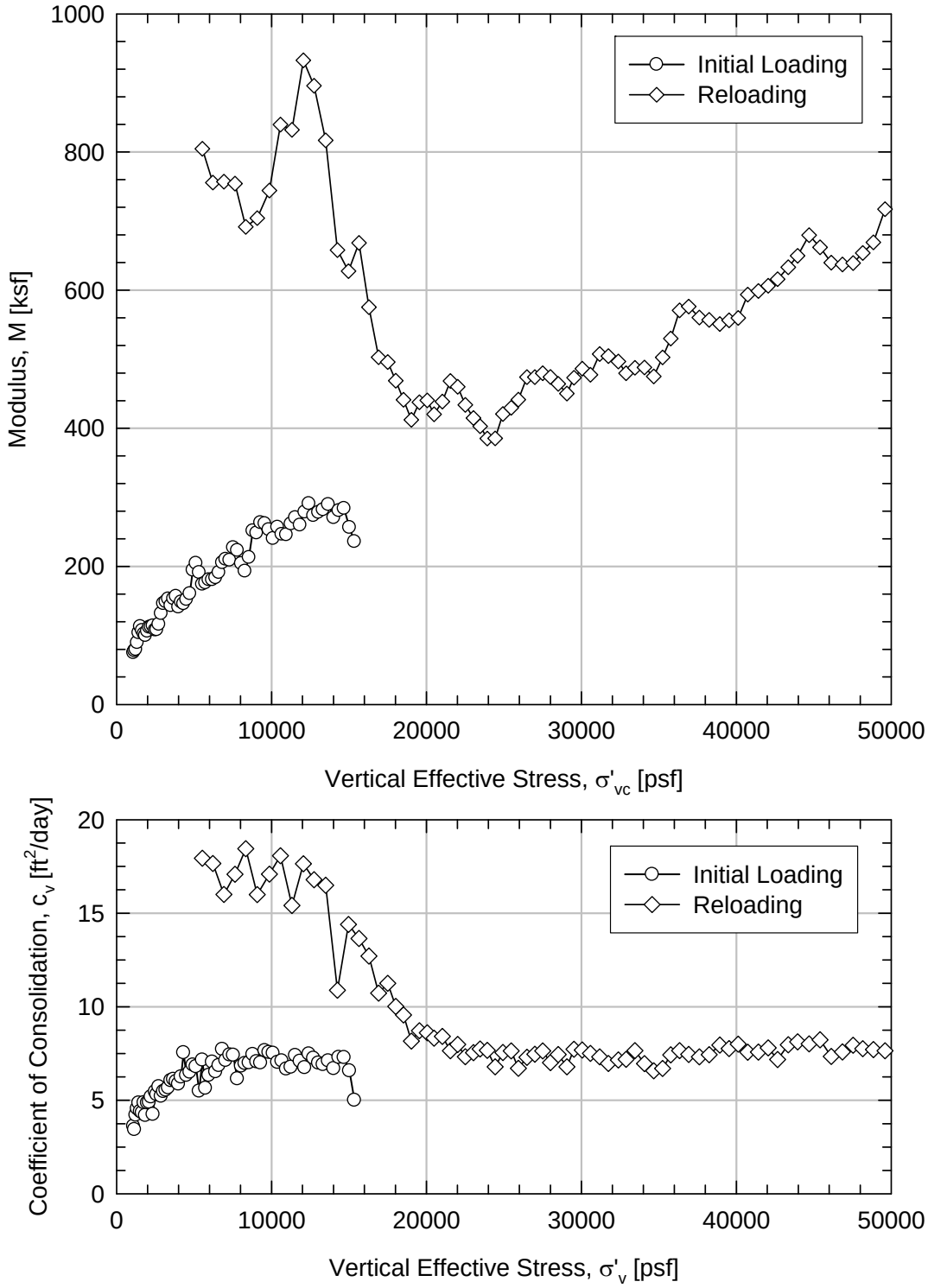

Figure 5.3.8 Modulus and coefficient of consolidation versus vertical effective stress for test CRS147 on sample AAB-02-22A UP-1 43-45 ft.

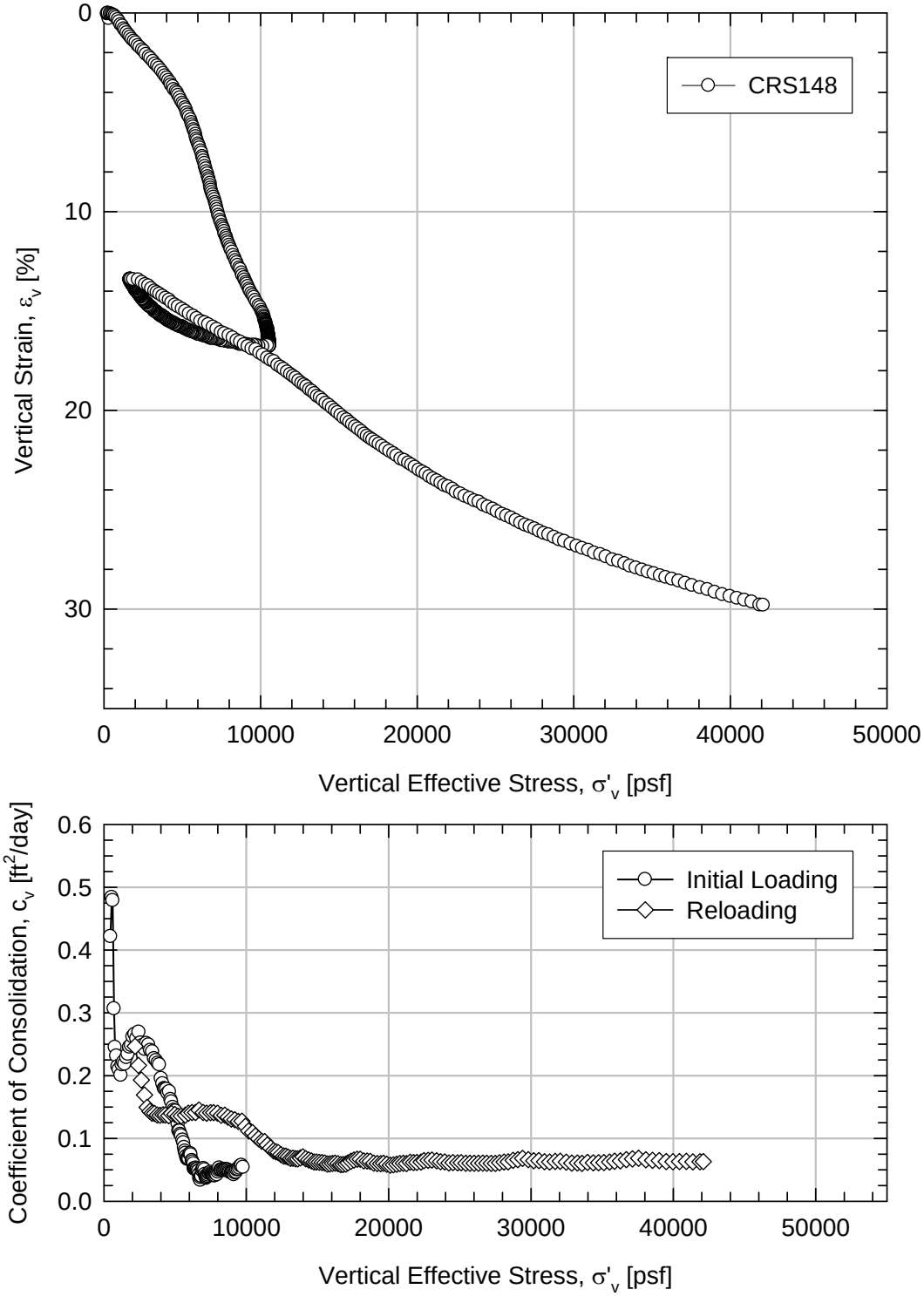

Figure 5.3.9 Vertical strain and coefficient of consolidation versus vertical effective stress for test CRS148 on sample AAB-03-36 UP-2 38-40 ft.

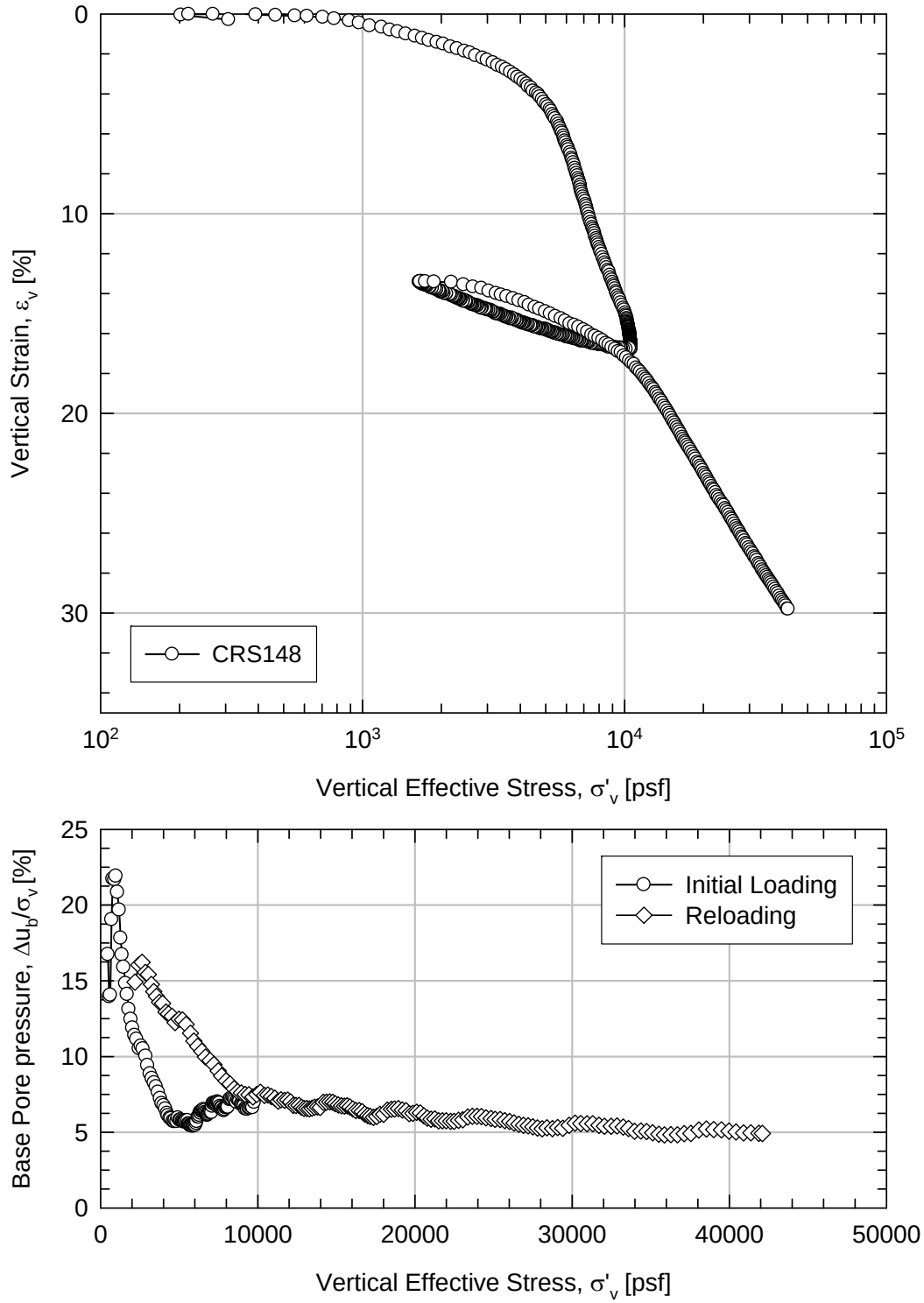

Figure 5.3.10 Vertical strain and normalized base pore pressure versus vertical effective stress for test CRS148 on sample AAB-03-36 UP-2 38-40 ft.

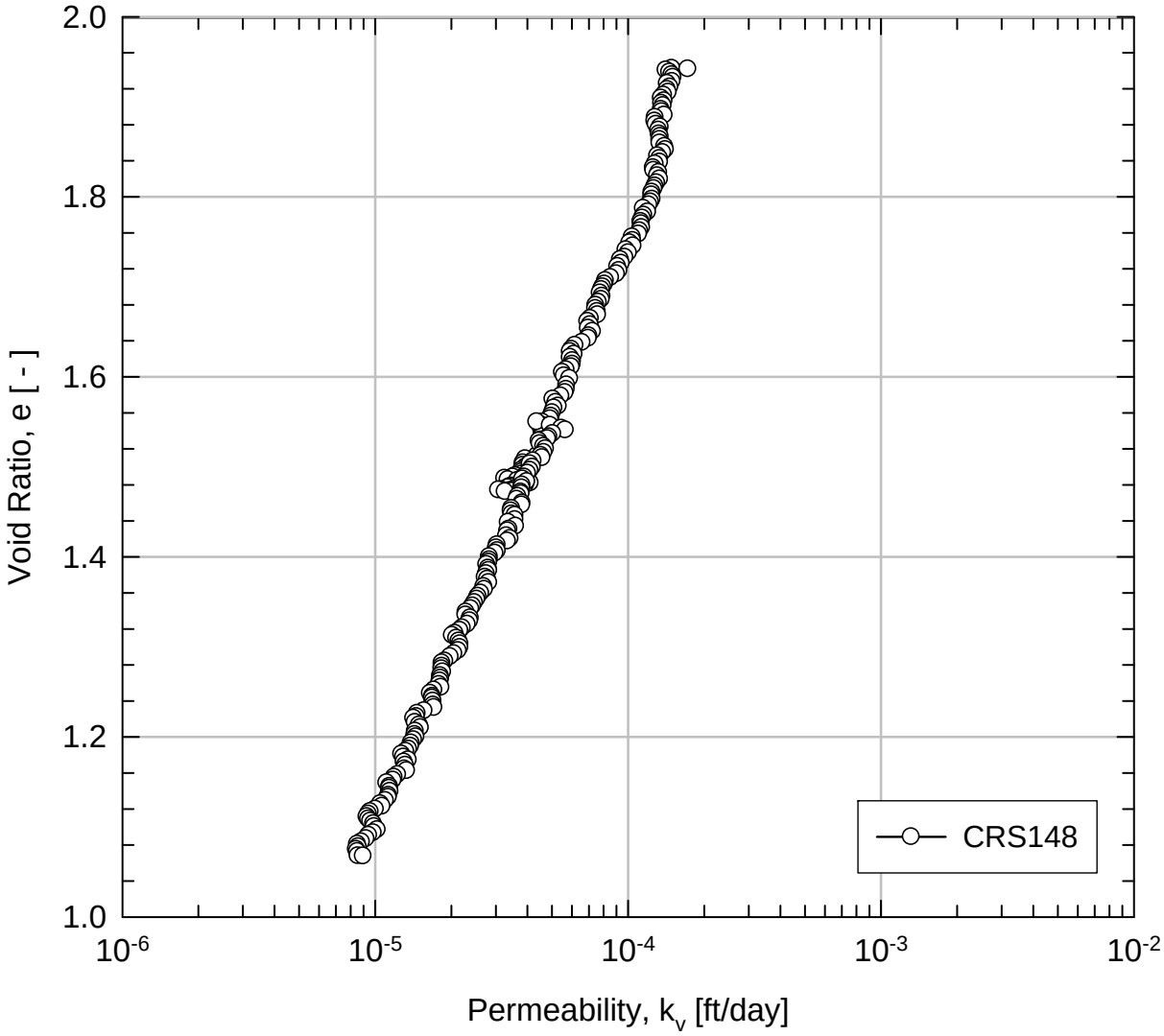

Figure 5.3.11 Void ratio versus permeability for CRS148 on sample AAB-03-36 UP-2 38-40 ft.

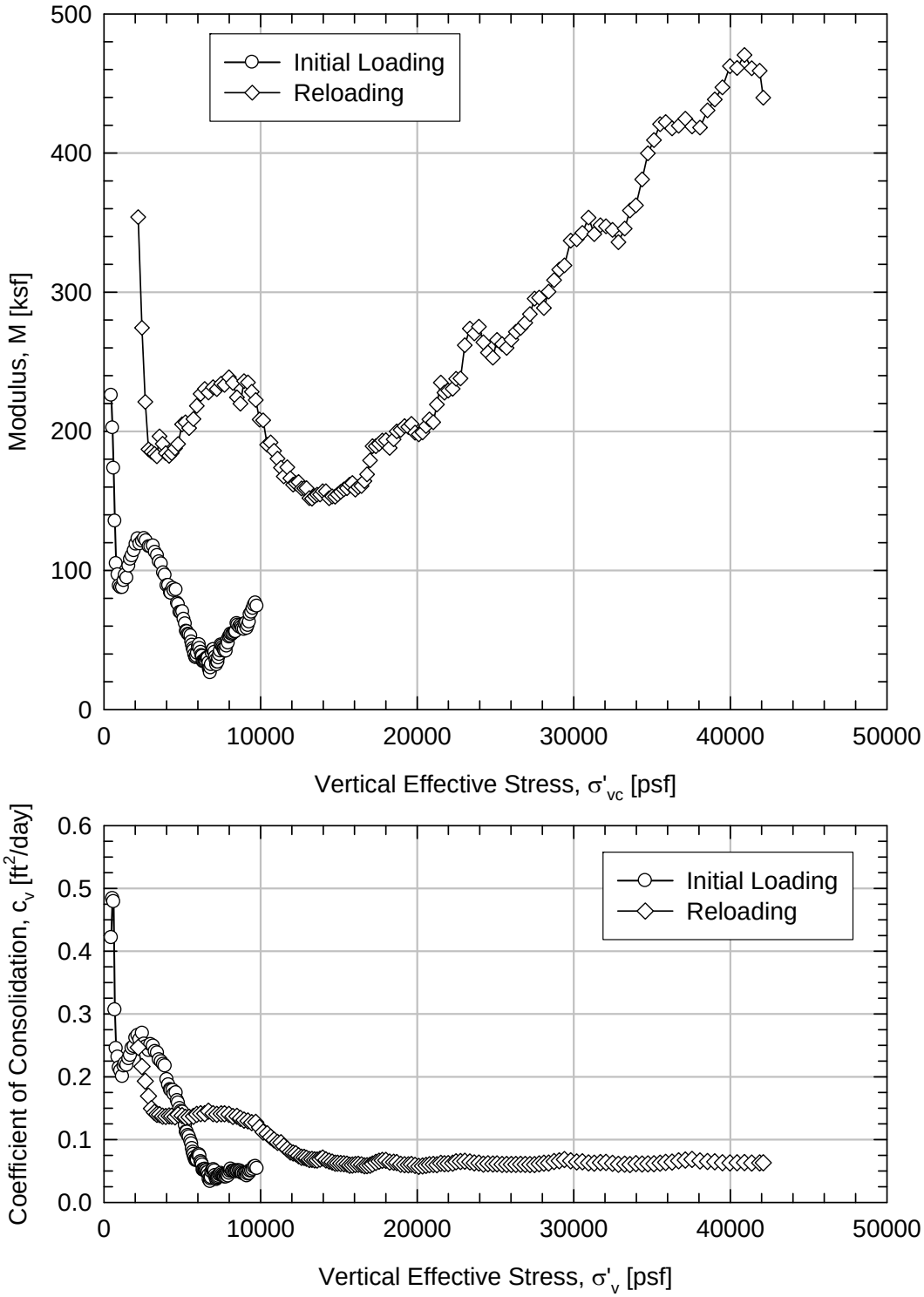

Figure 5.3.12 Modulus and coefficient of consolidation versus vertical effective stress for test CRS148 on sample AAB-03-36 UP-2 38-40 ft.

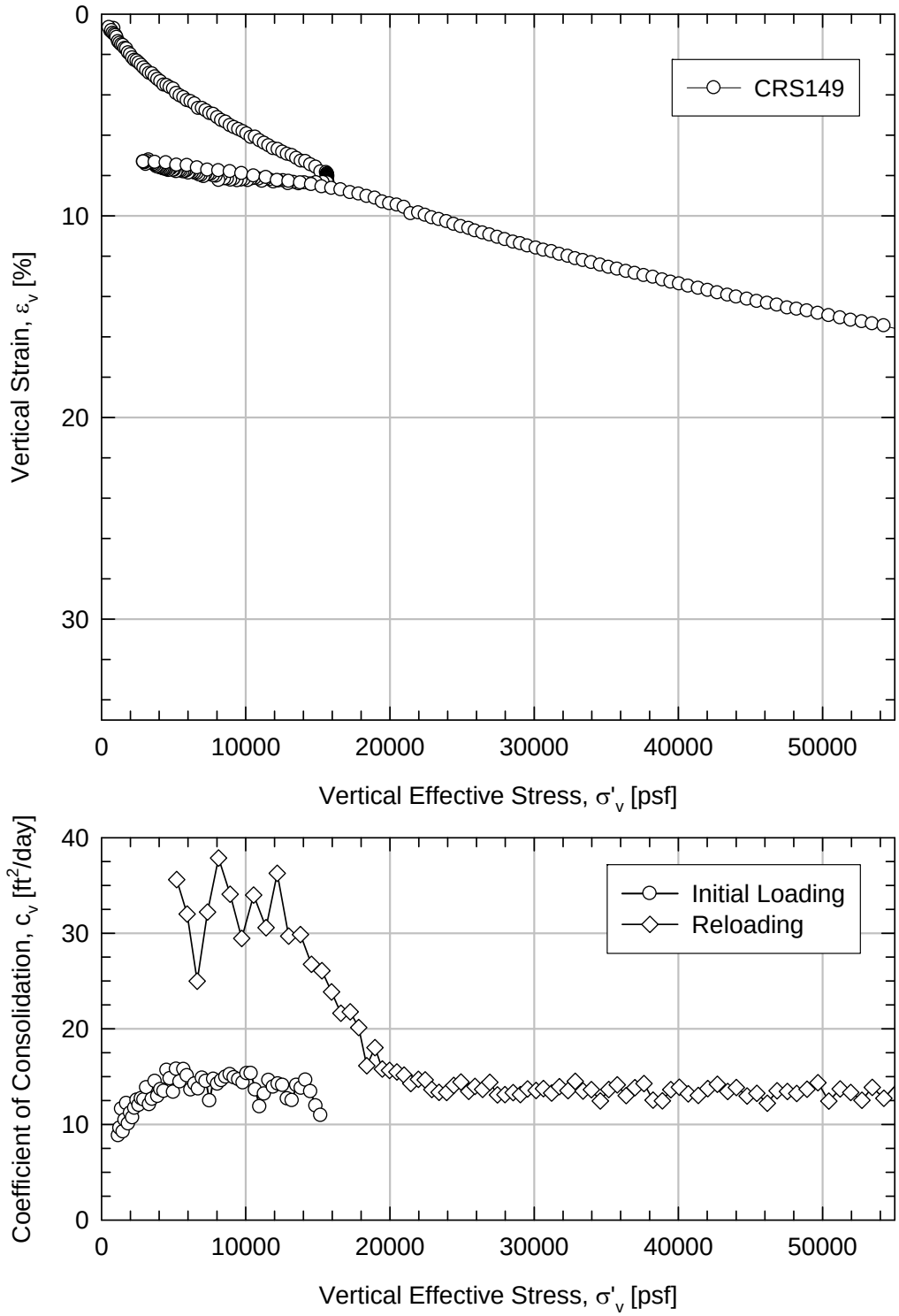

Figure 5.3.13 Vertical strain and coefficient of consolidation versus vertical effective stress for test CRS149 on sample AARW-10-40 UP-2 98-100 ft.

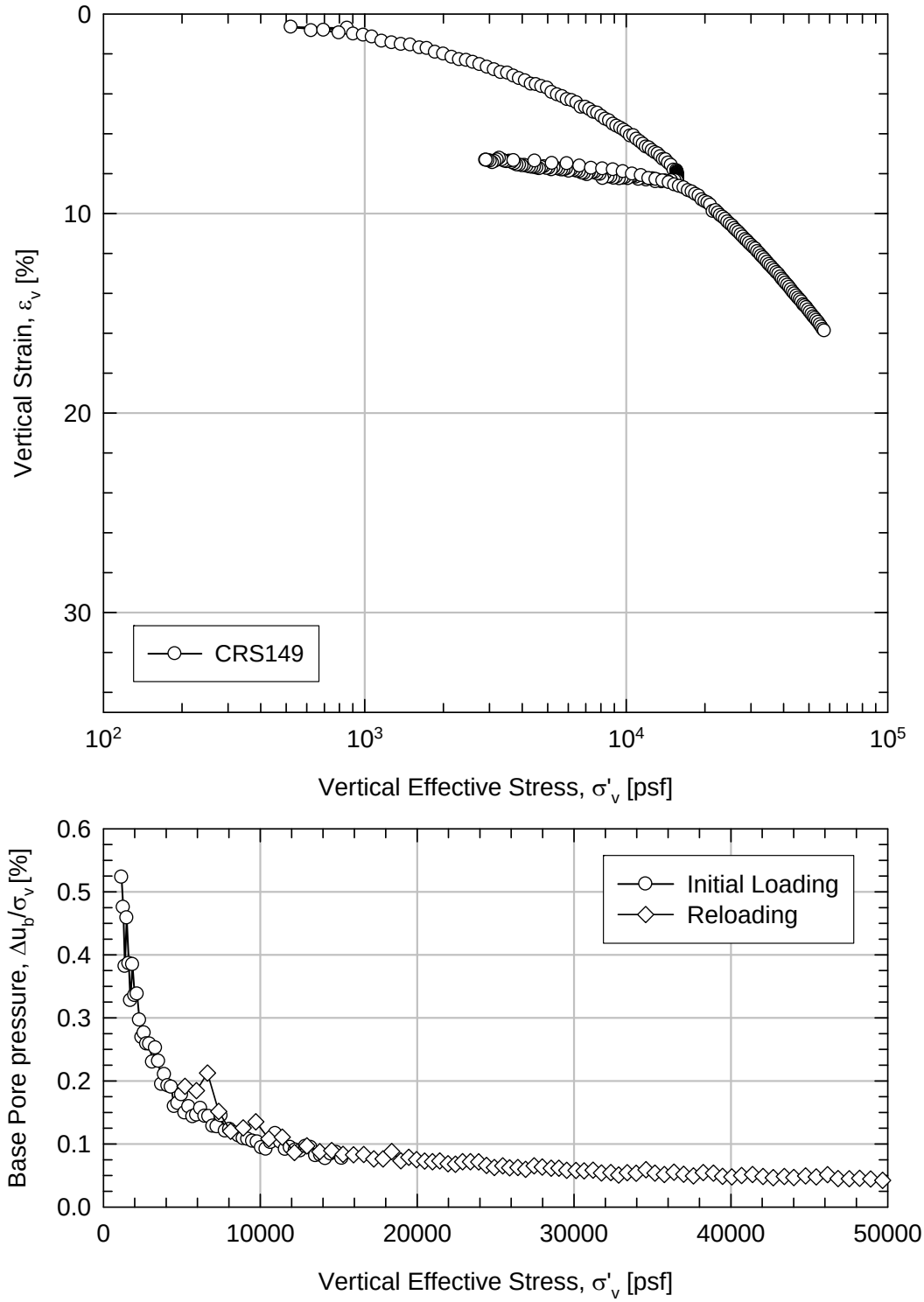

Figure 5.3.14 Vertical strain and normalized base pore pressure versus vertical effective stress for test CRS149 on sample AARW-10-40 UP-2 98-100 ft.

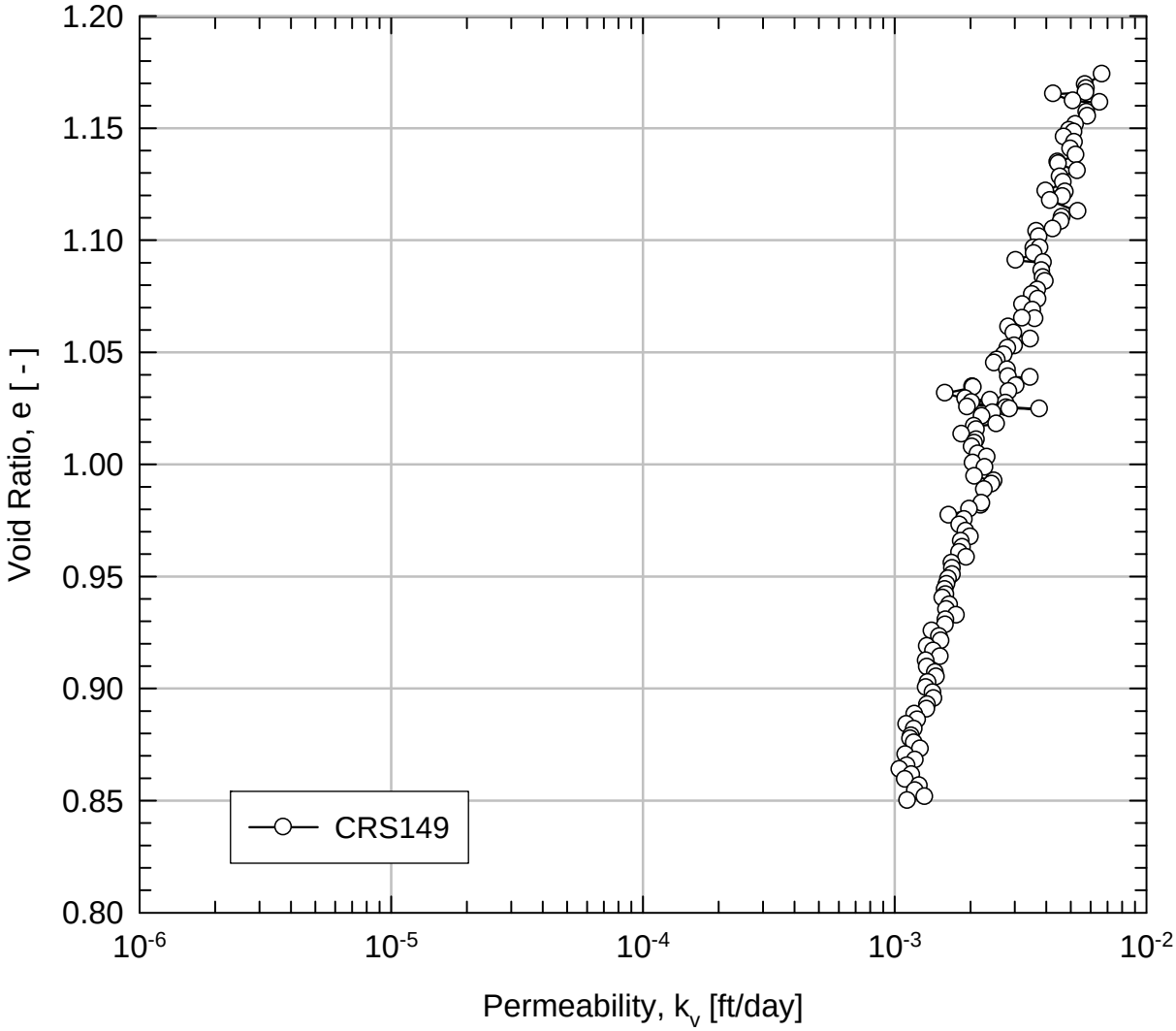

Figure 5.3.15 Void ratio versus permeability for CRS149 on sample AARW-10-40 UP-2 98-100 ft.

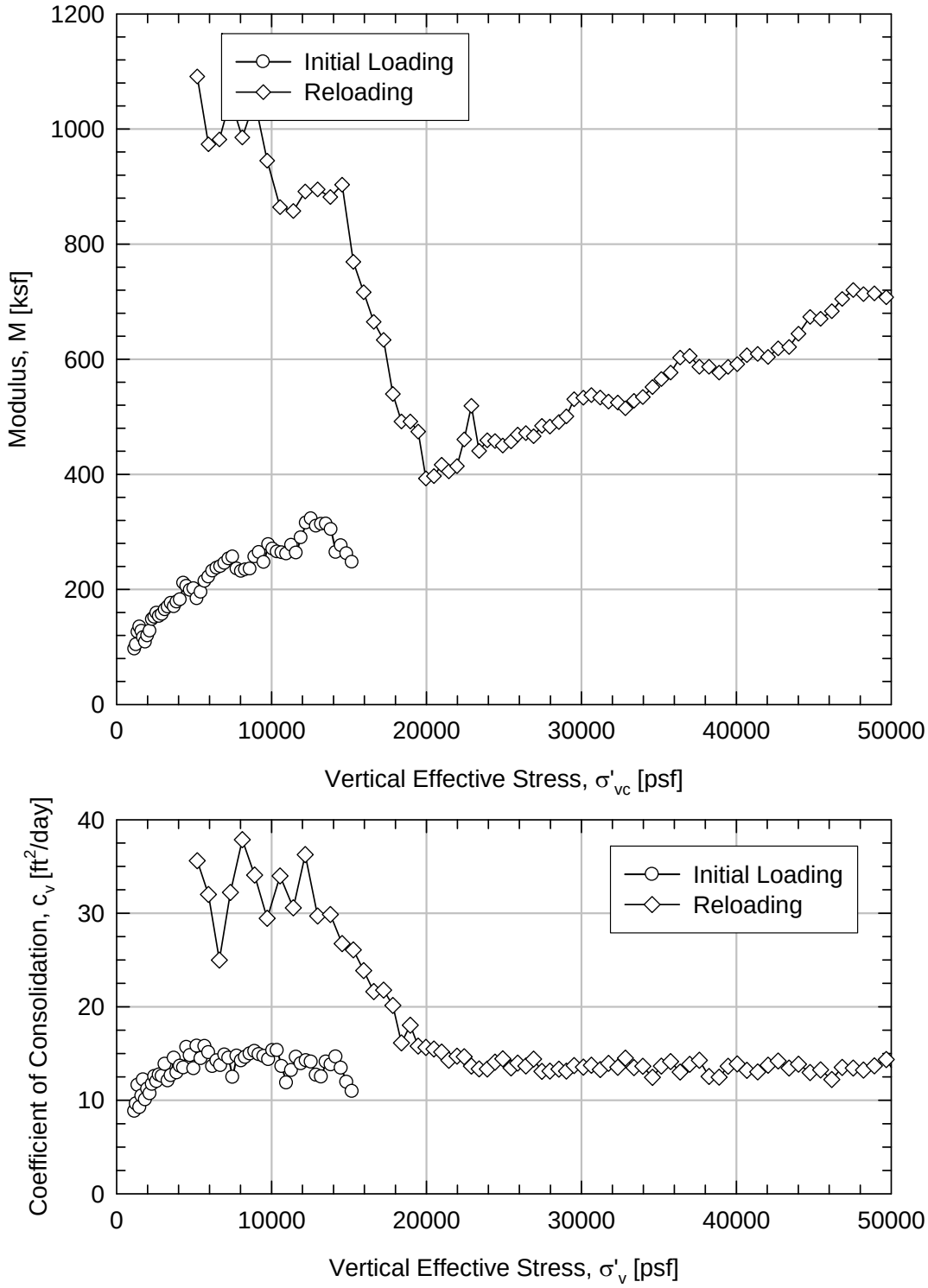

Figure 5.3.16 Modulus and coefficient of consolidation versus vertical effective stress for test CRS149 on sample AARW-10-40 UP-2 98-100 ft.

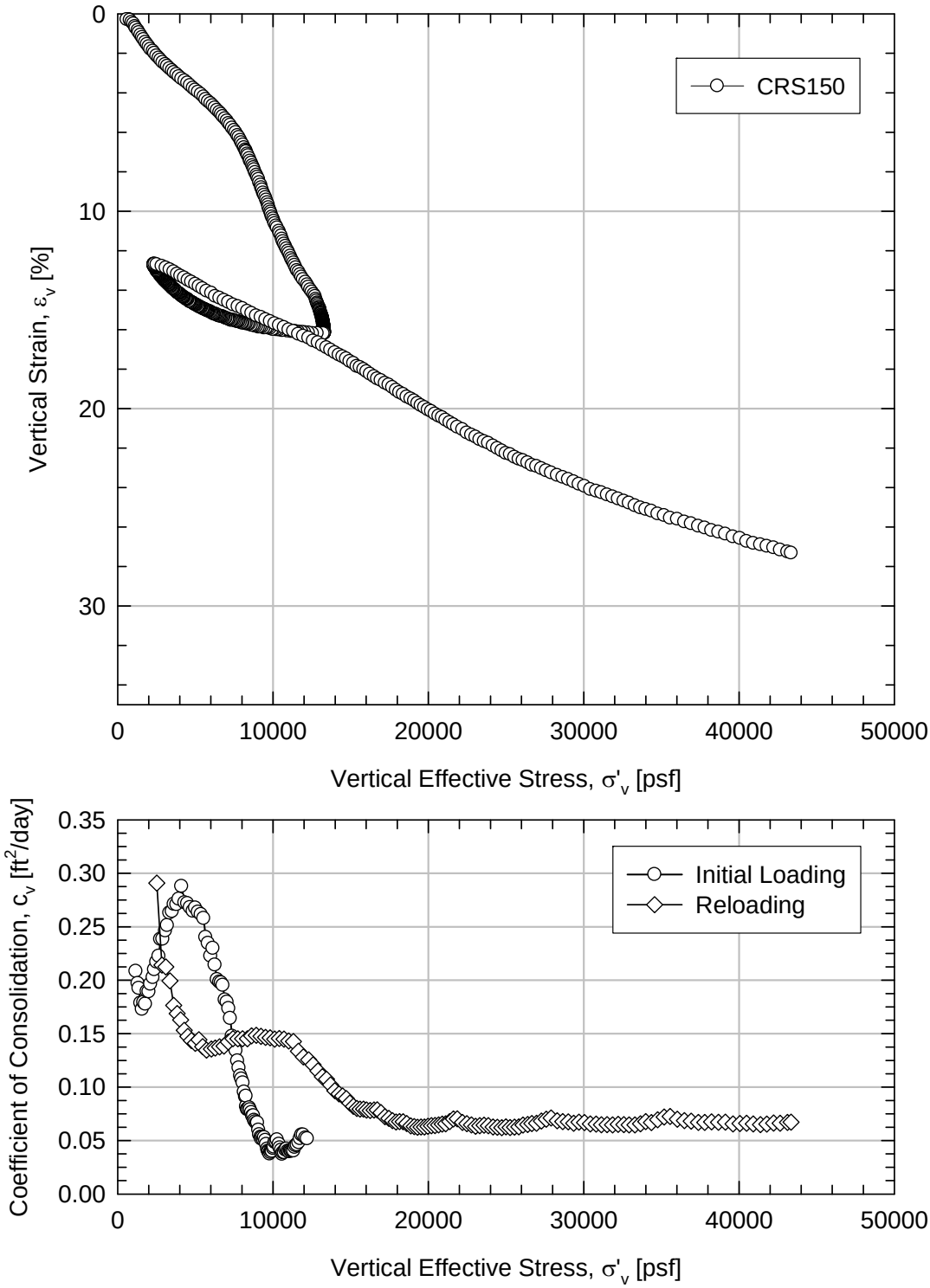

Figure 5.3.17 Vertical strain and coefficient of consolidation versus vertical effective stress for test CRS150 on sample AARW-10-40 UP-1 63-65 ft.

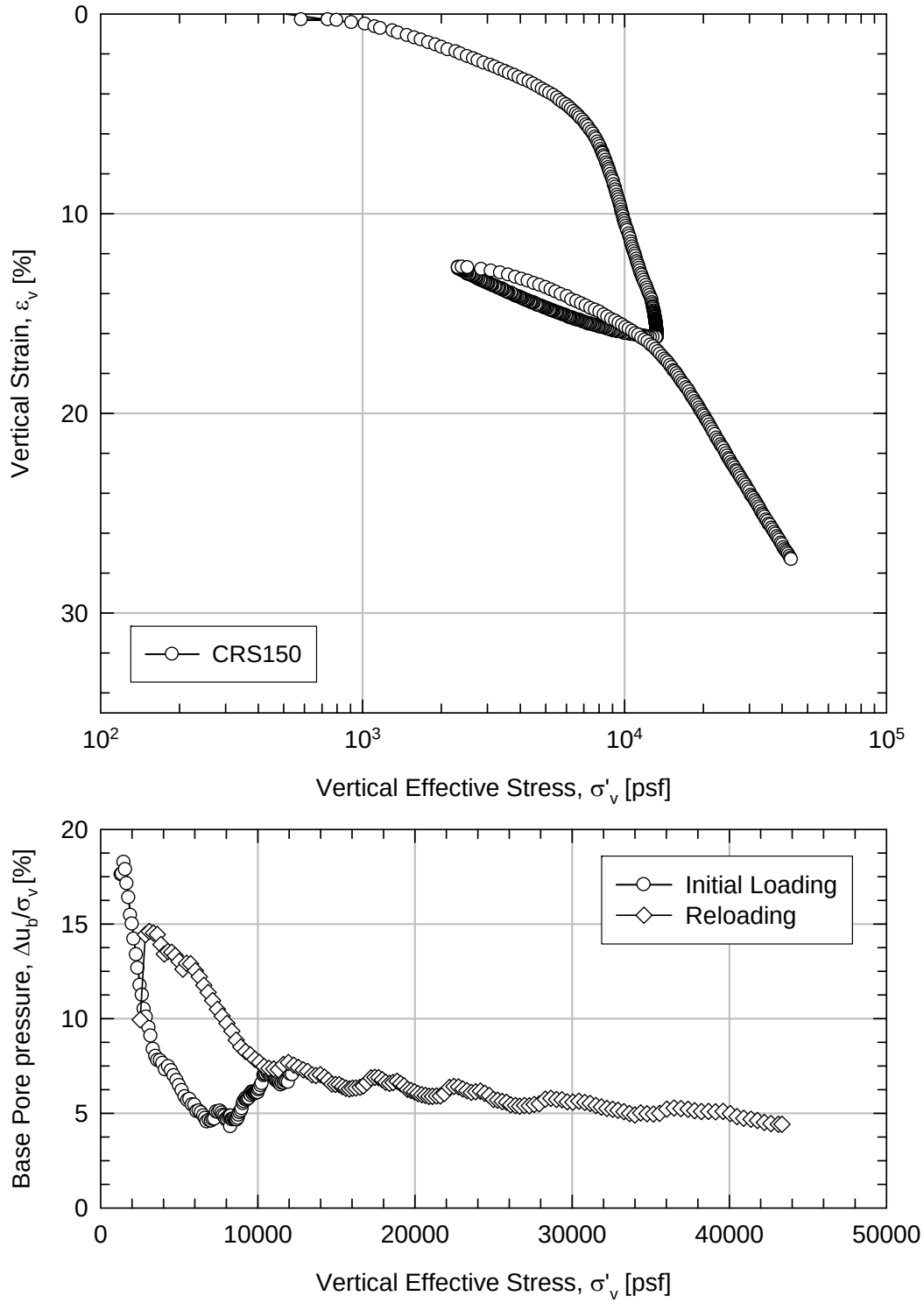

Figure 5.3.18 Vertical strain and normalized base pore pressure versus vertical effective stress for test CRS150 on sample AARW-10-40 UP-1 63-65 ft

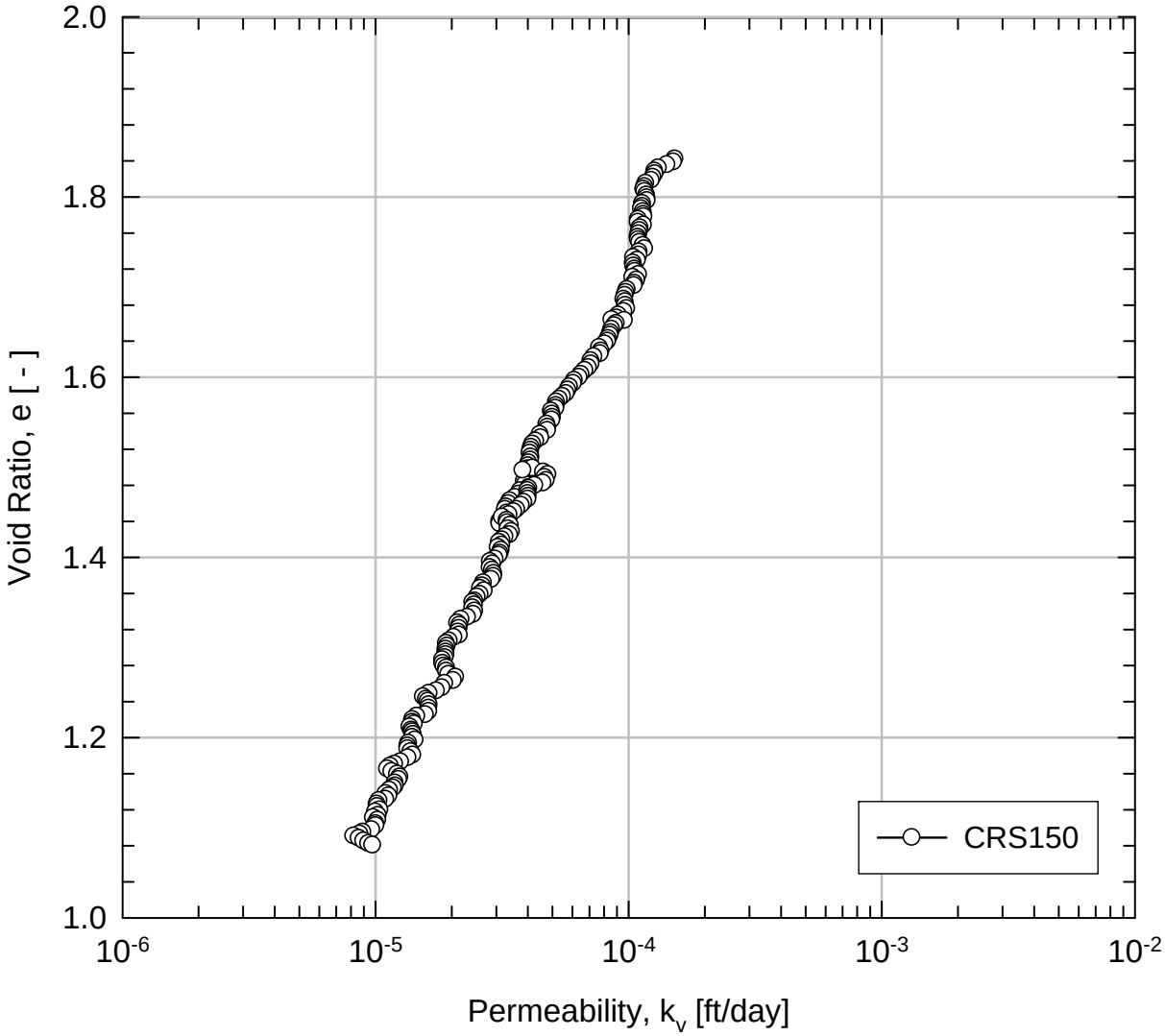

Figure 5.3.19 Void ratio versus permeability for CRS150 on sample AARW-10-40 UP-1 63-65 ft.

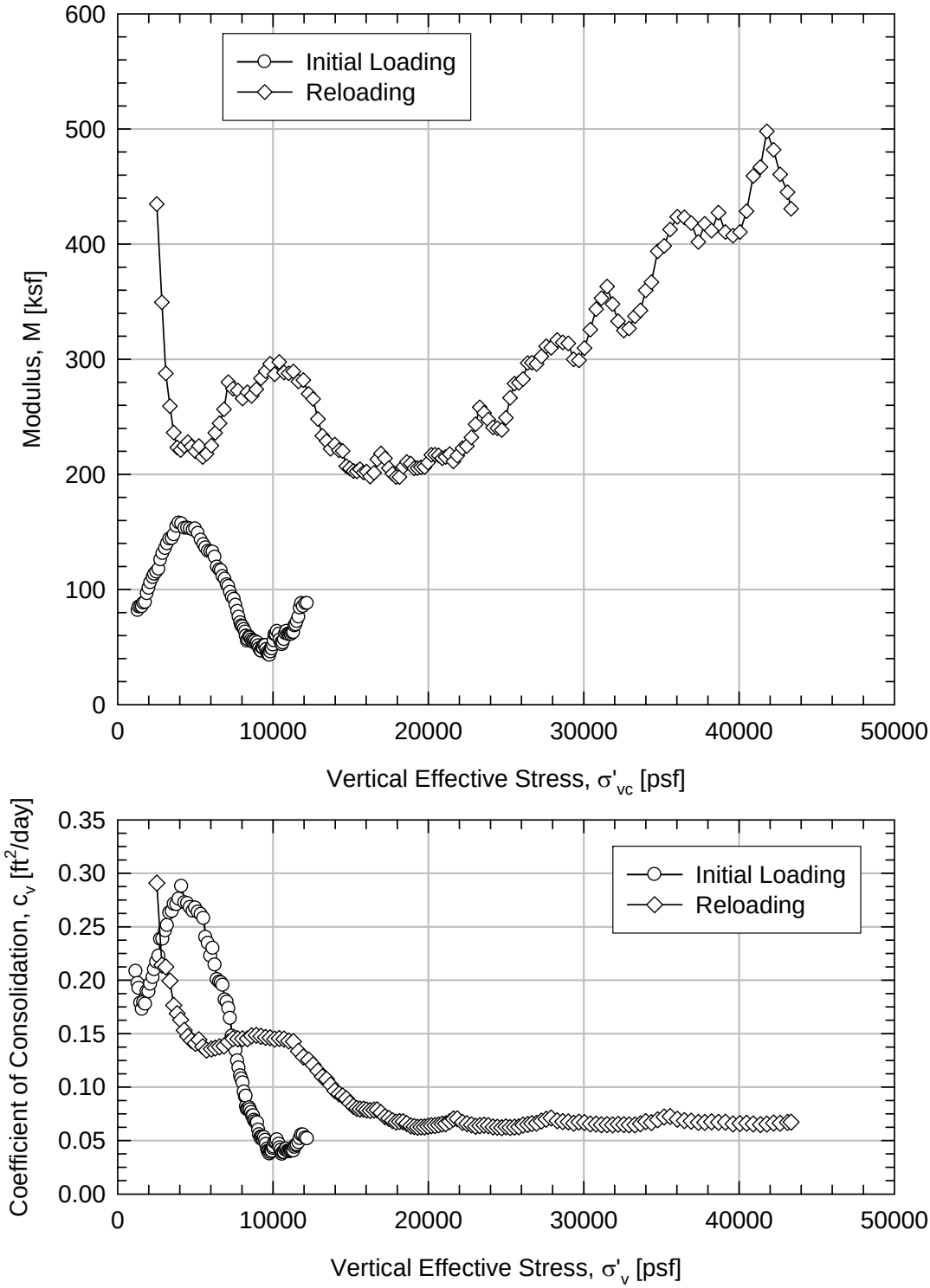

Figure 5.3.20 Modulus and coefficient of consolidation versus vertical effective stress for test CRS150 on sample AARW-10-40 UP-1 63-65 ft

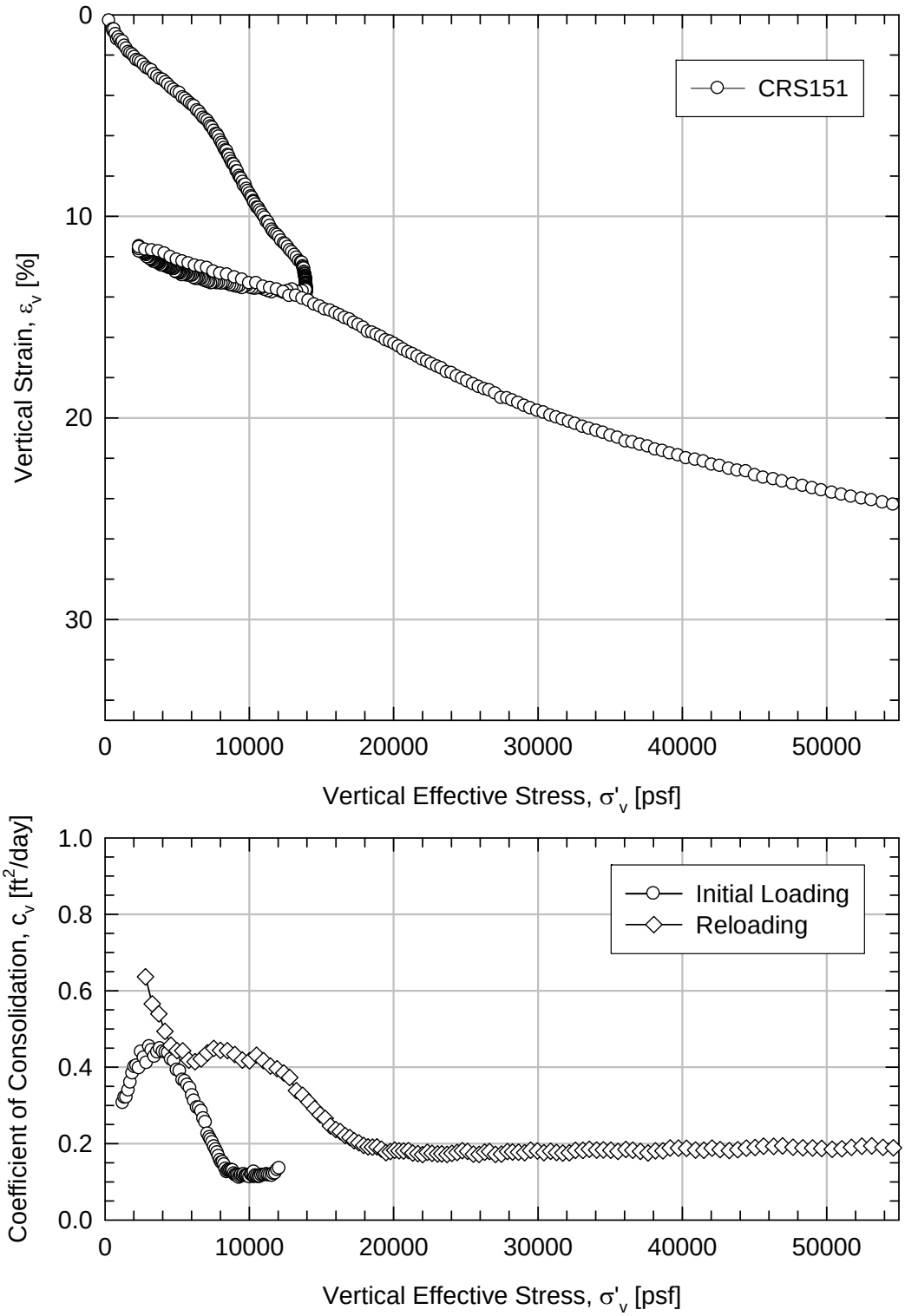

Figure 5.3.21 Vertical strain and coefficient of consolidation versus vertical effective stress for test CRS151 on sample AARW-04-11 UP-2 28-30 ft.

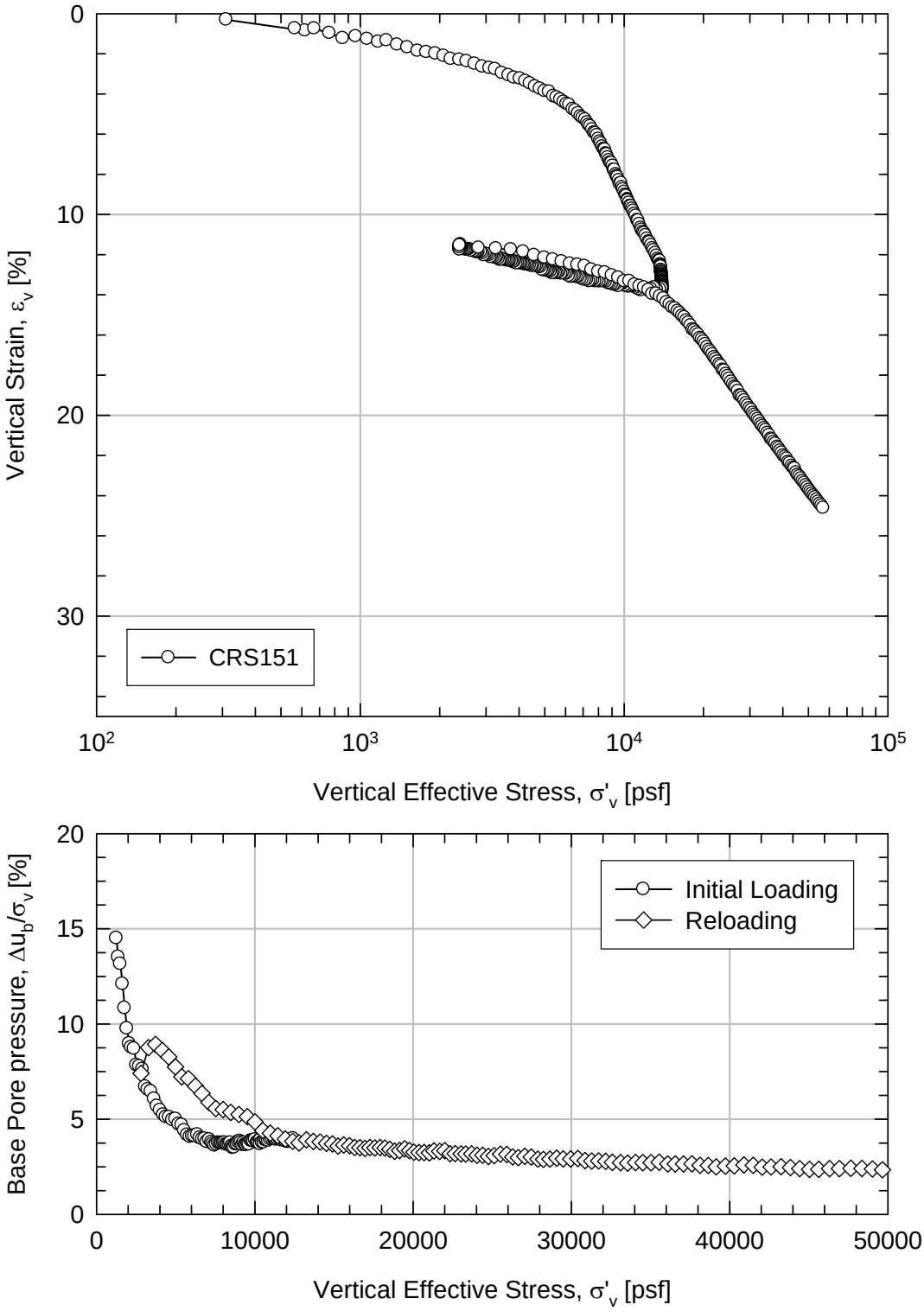

Figure 5.3.22 Vertical strain and normalized base pore pressure versus vertical effective stress for test CRS151 on sample AARW-04-11 UP-2 28-30 ft.

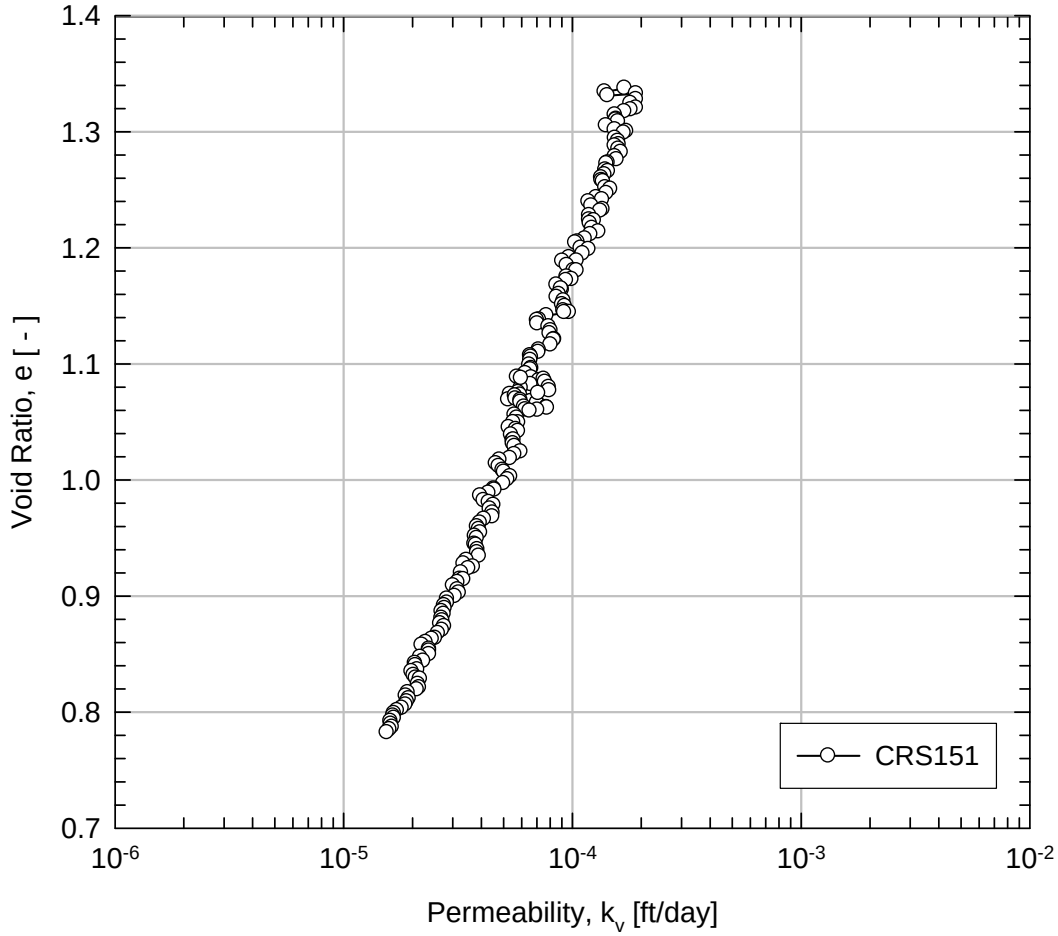

Figure 5.3.23 Void ratio versus permeability for CRS151 on sample AARW-04-11 UP-2 28-30 ft.

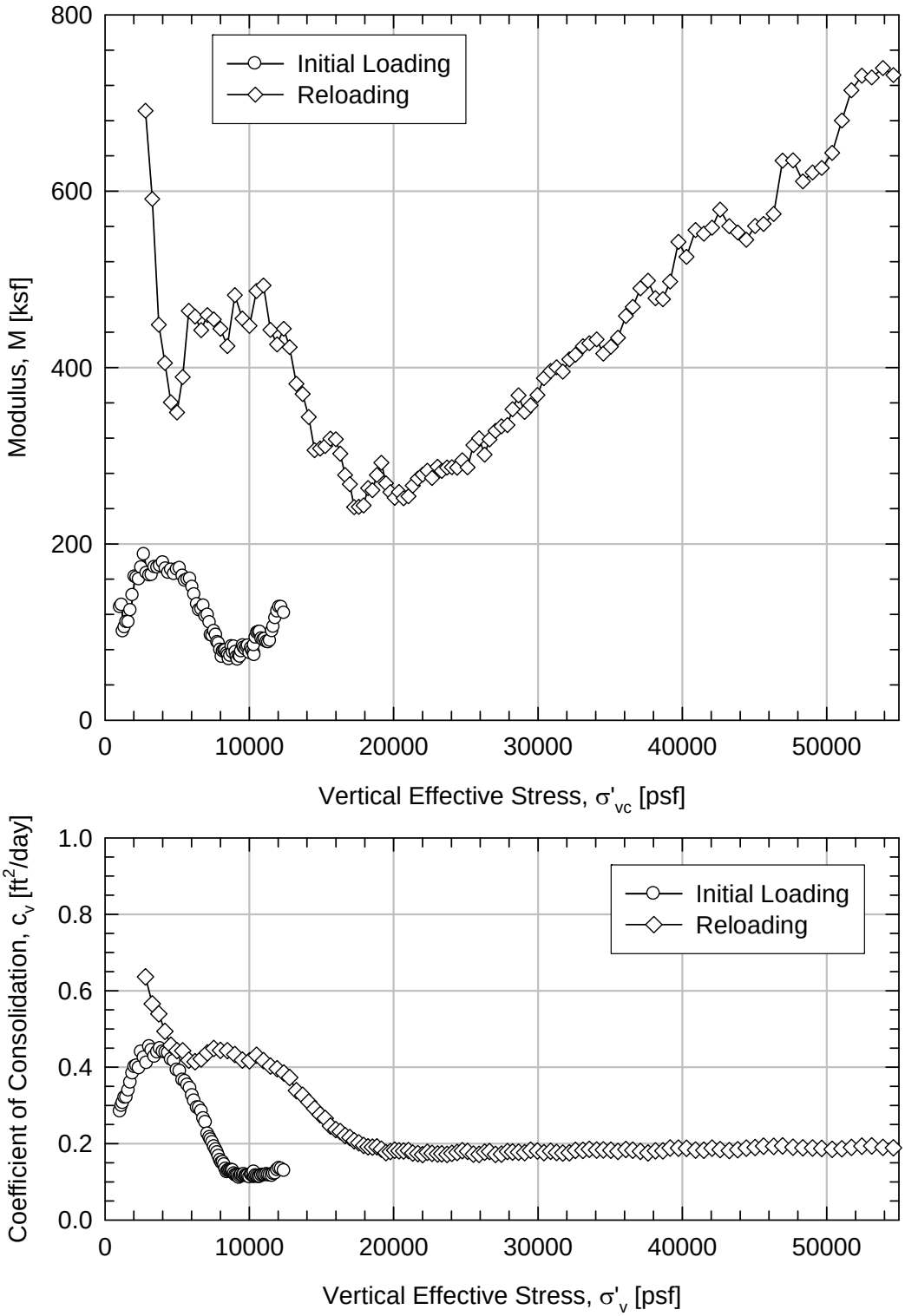

Figure 5.3.24 Modulus and coefficient of consolidation versus vertical effective stress for test CRS151 on sample AARW-04-11 UP-2 28-30 ft.

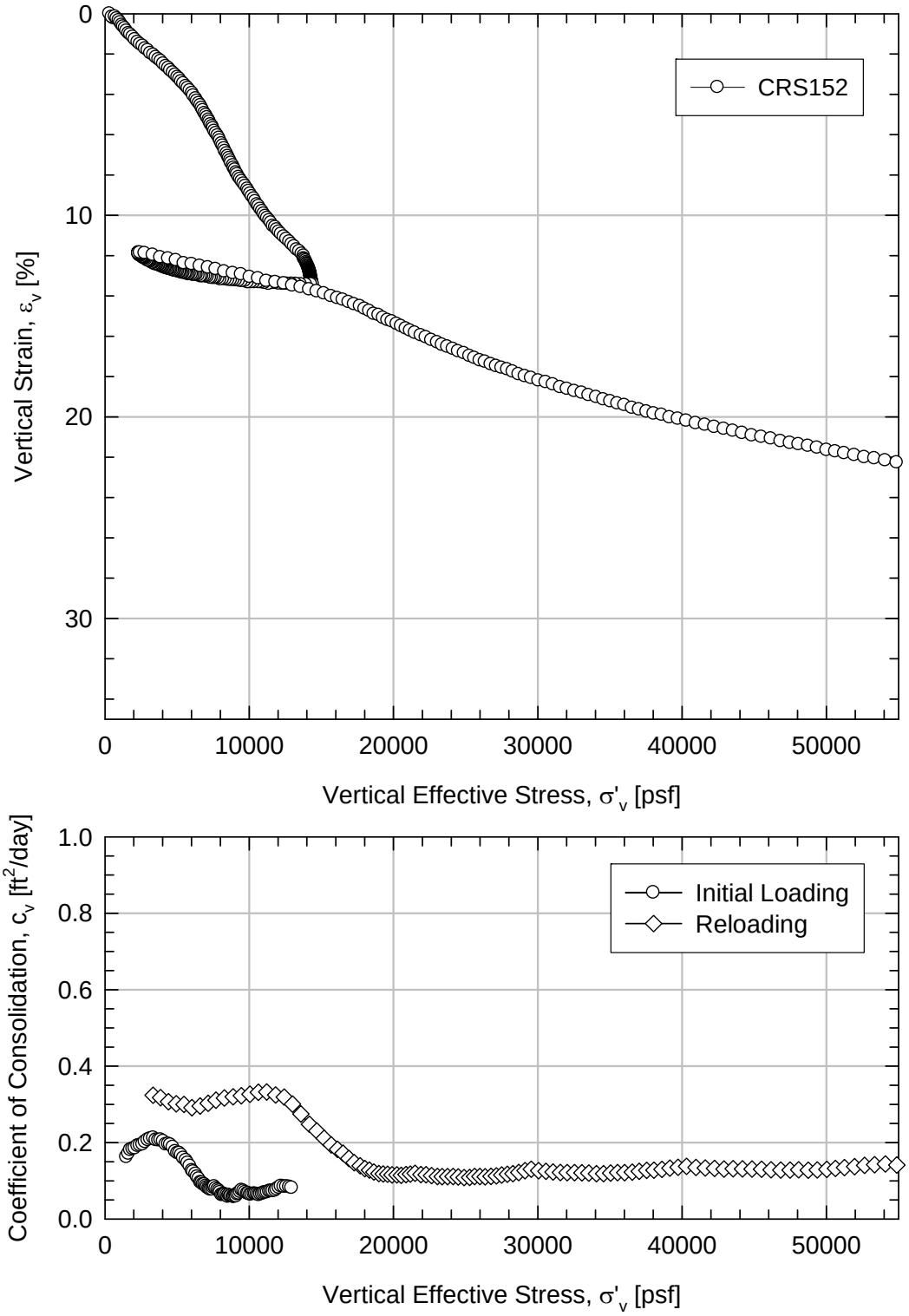

Figure 5.3.25 Vertical strain and coefficient of consolidation versus vertical effective stress for test CRS152 on sample AARW-01-04 UP-2 43-45 ft.

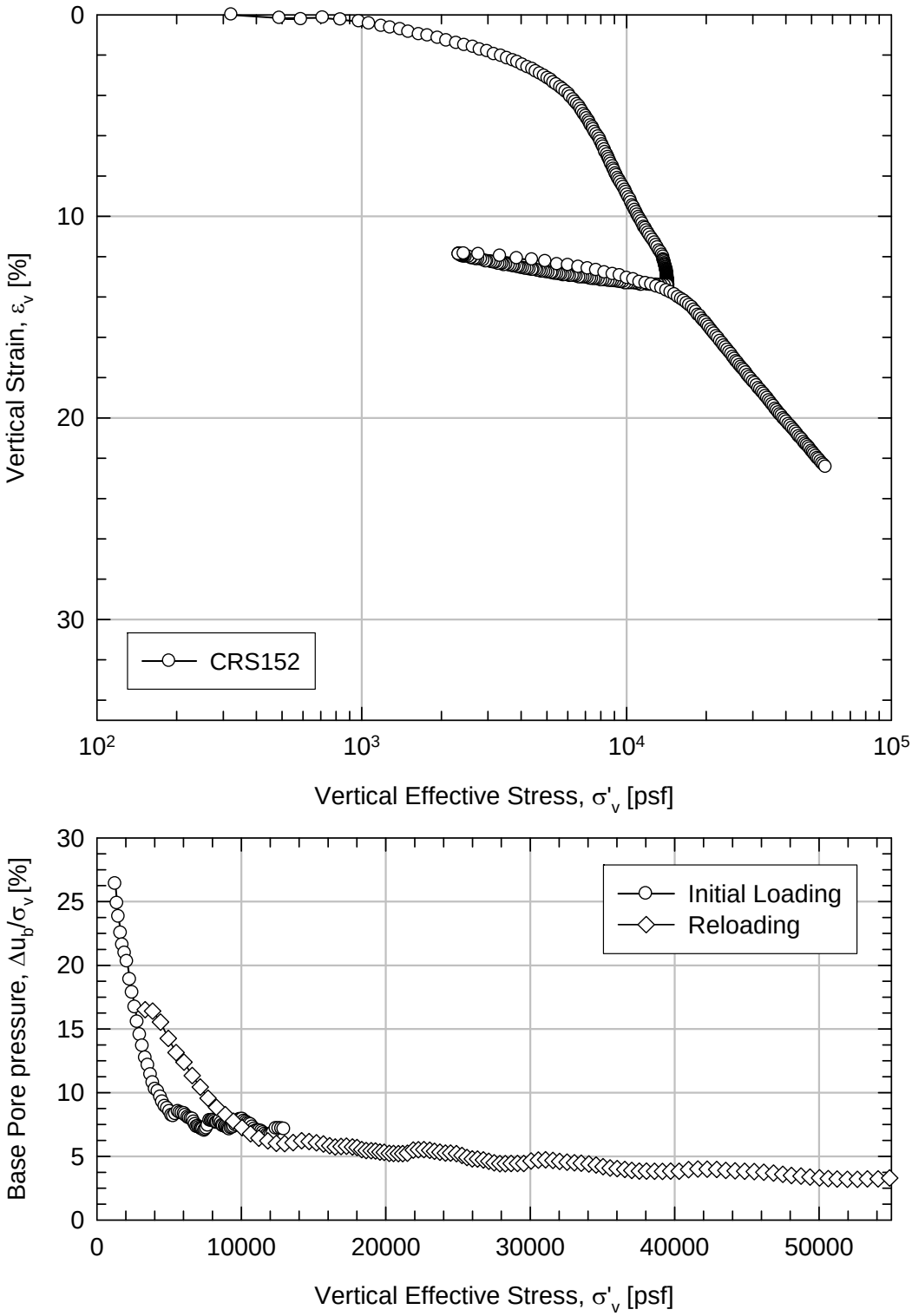

Figure 5.3.26 Vertical strain and normalized base pore pressure versus vertical effective stress for test CRS152 on sample AARW-01-04 UP-2 43-45 ft.

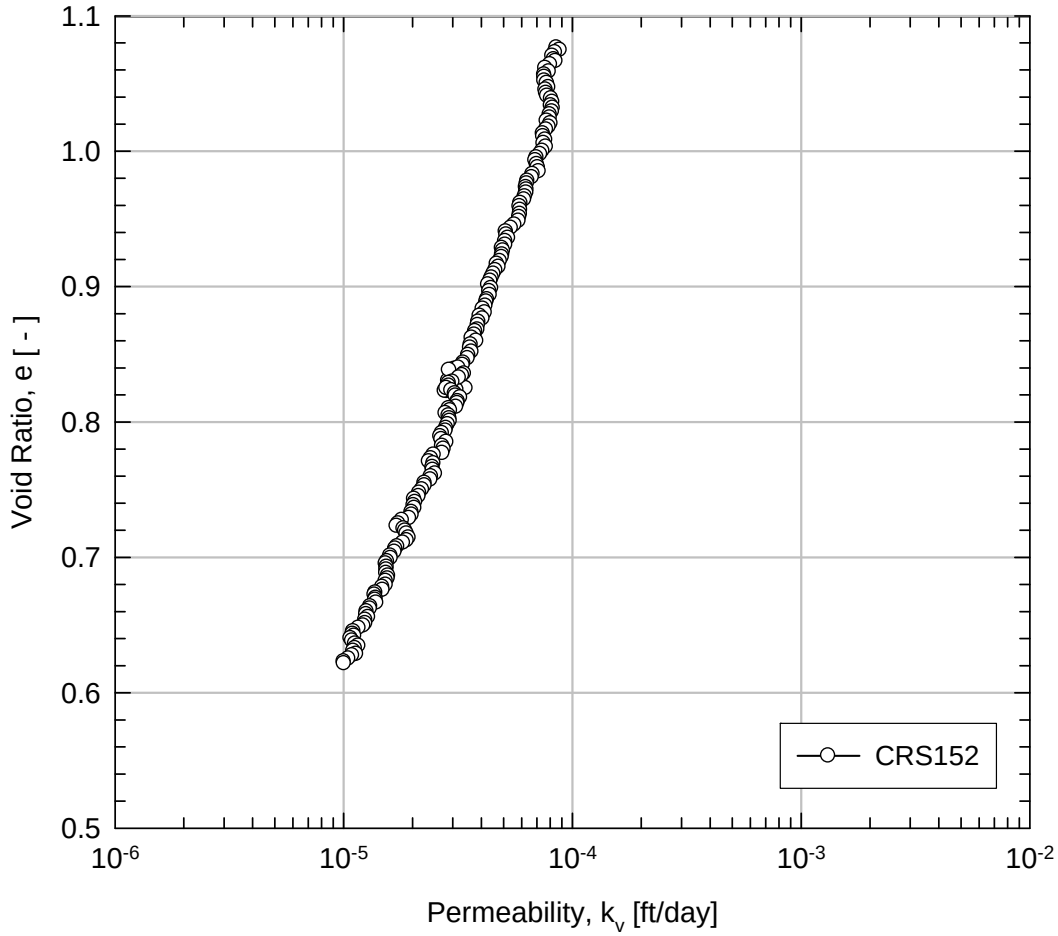

Figure 5.3.27 Void ratio versus permeability for CRS152 on sample AARW-01-04 UP-2 43-45 ft.

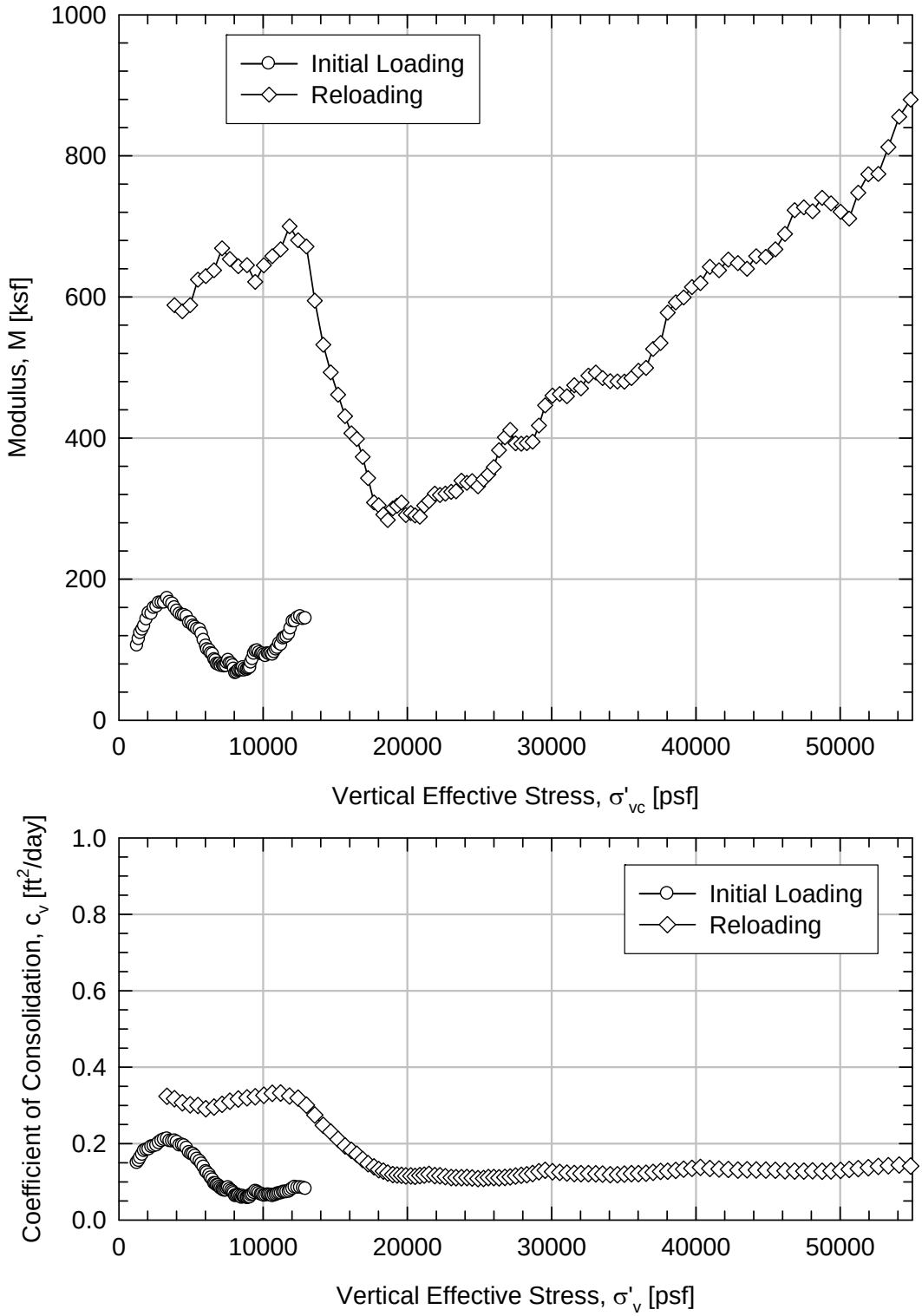

Figure 5.3.28 Modulus and coefficient of consolidation versus vertical effective stress for test CRS152 on sample AARW-01-04 UP-2 43-45 ft.

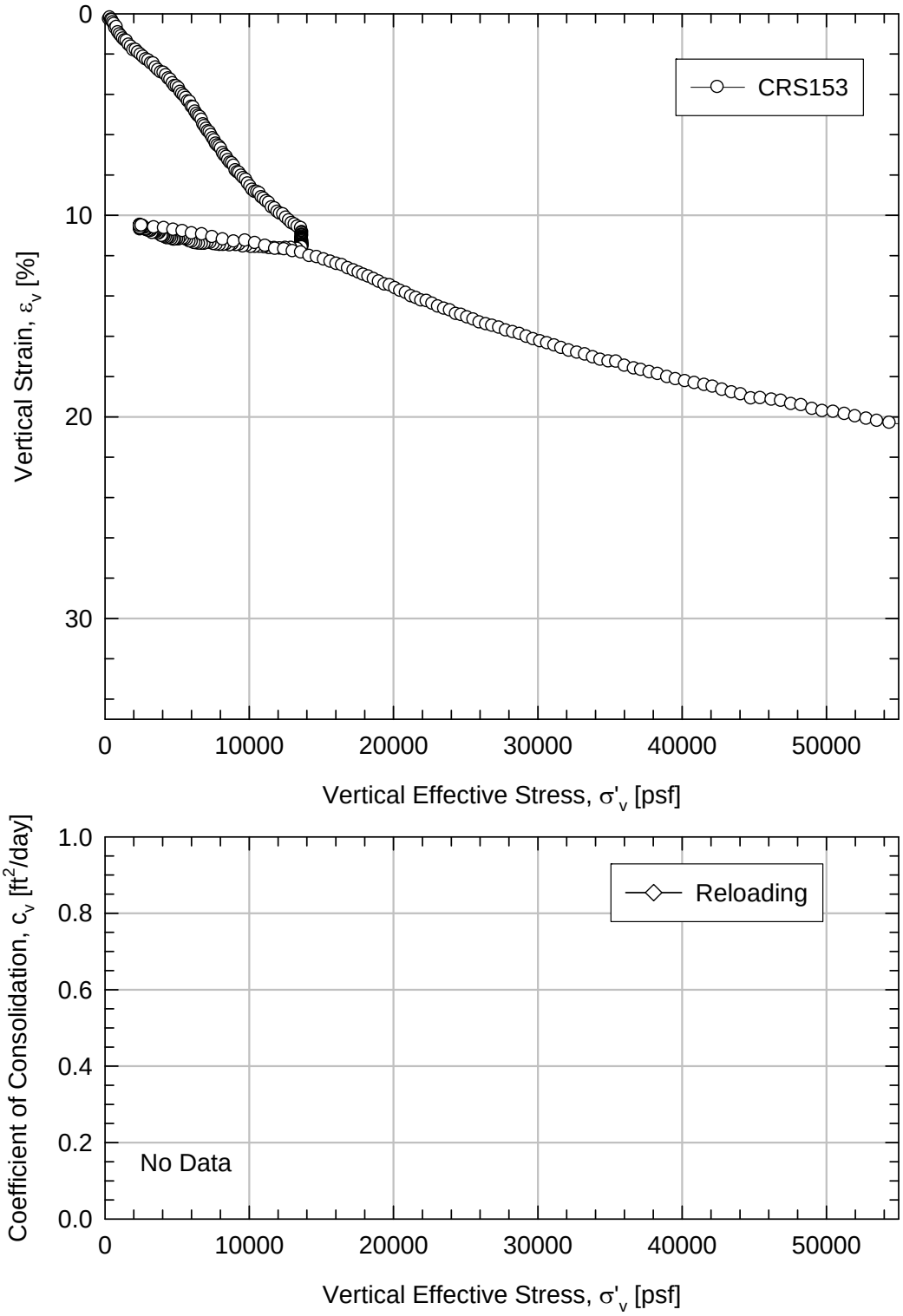

Figure 5.3.29 Vertical strain and coefficient of consolidation versus vertical effective stress for test CRS153 on sample AAB-01-16 UP-1 13-15 ft.

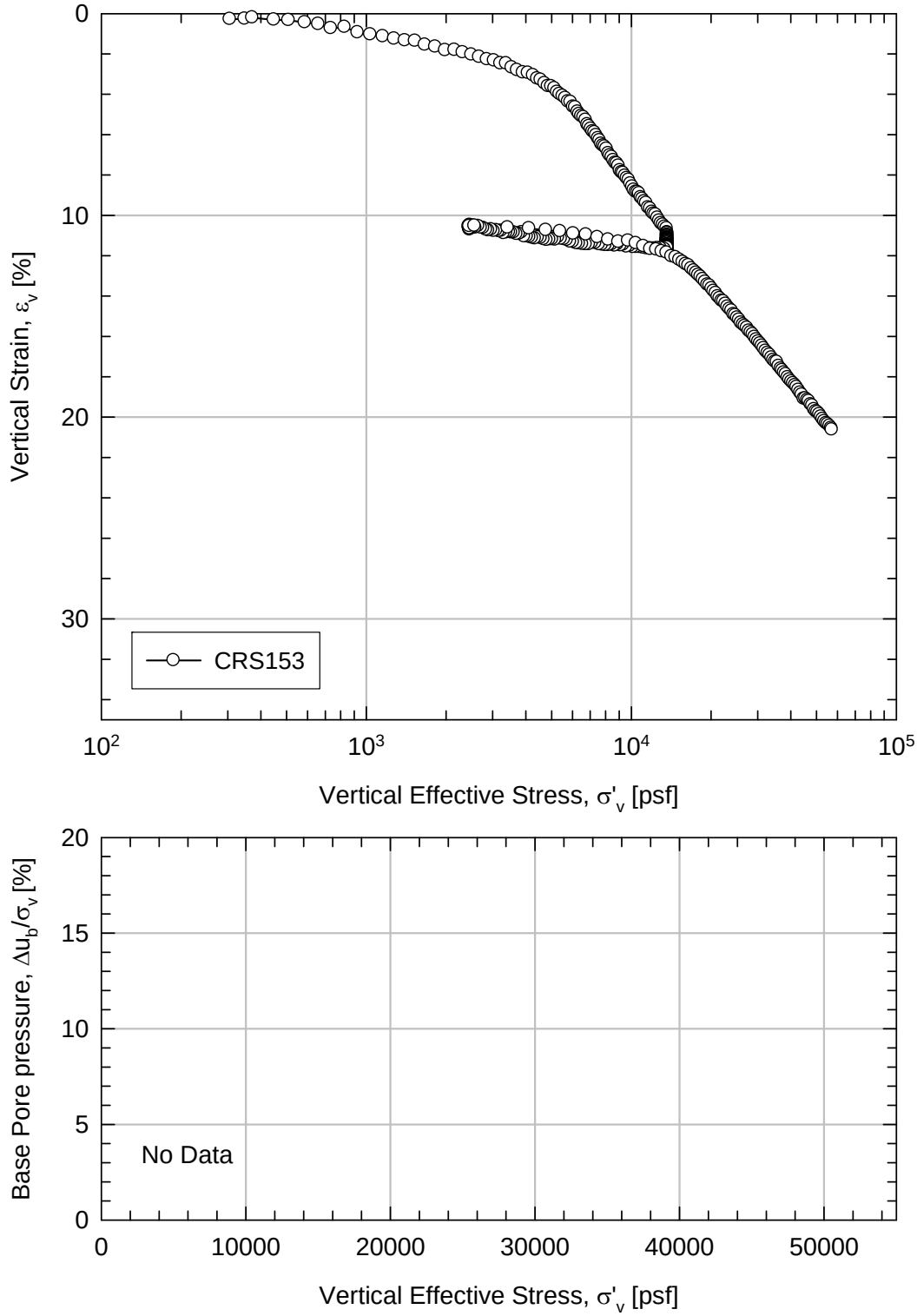

Figure 5.3.30 Vertical strain and normalized base pore pressure versus vertical effective stress for test CRS153 on sample AAB-01-16 UP-1 13-15 ft.

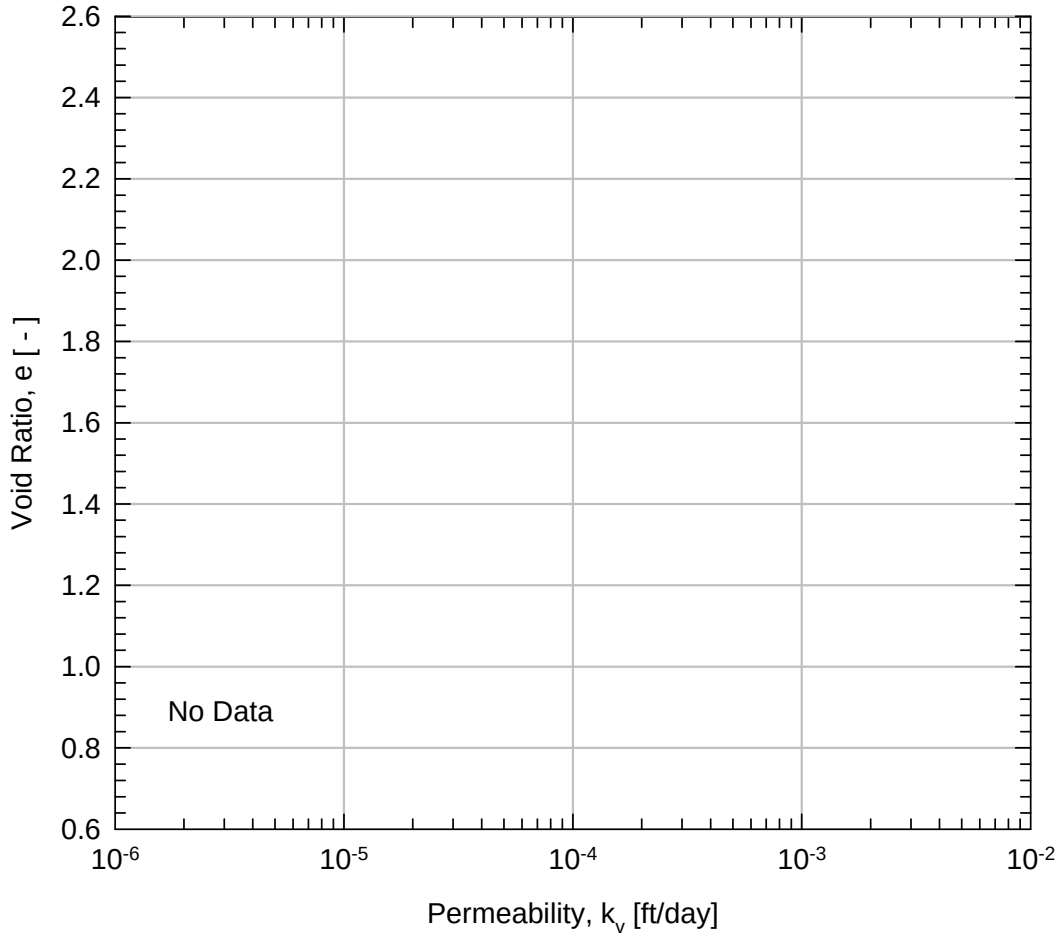

Figure 5.3.31 Void ratio versus permeability for CRS153 on sample AAB-01-16 UP-1 13-15 ft.

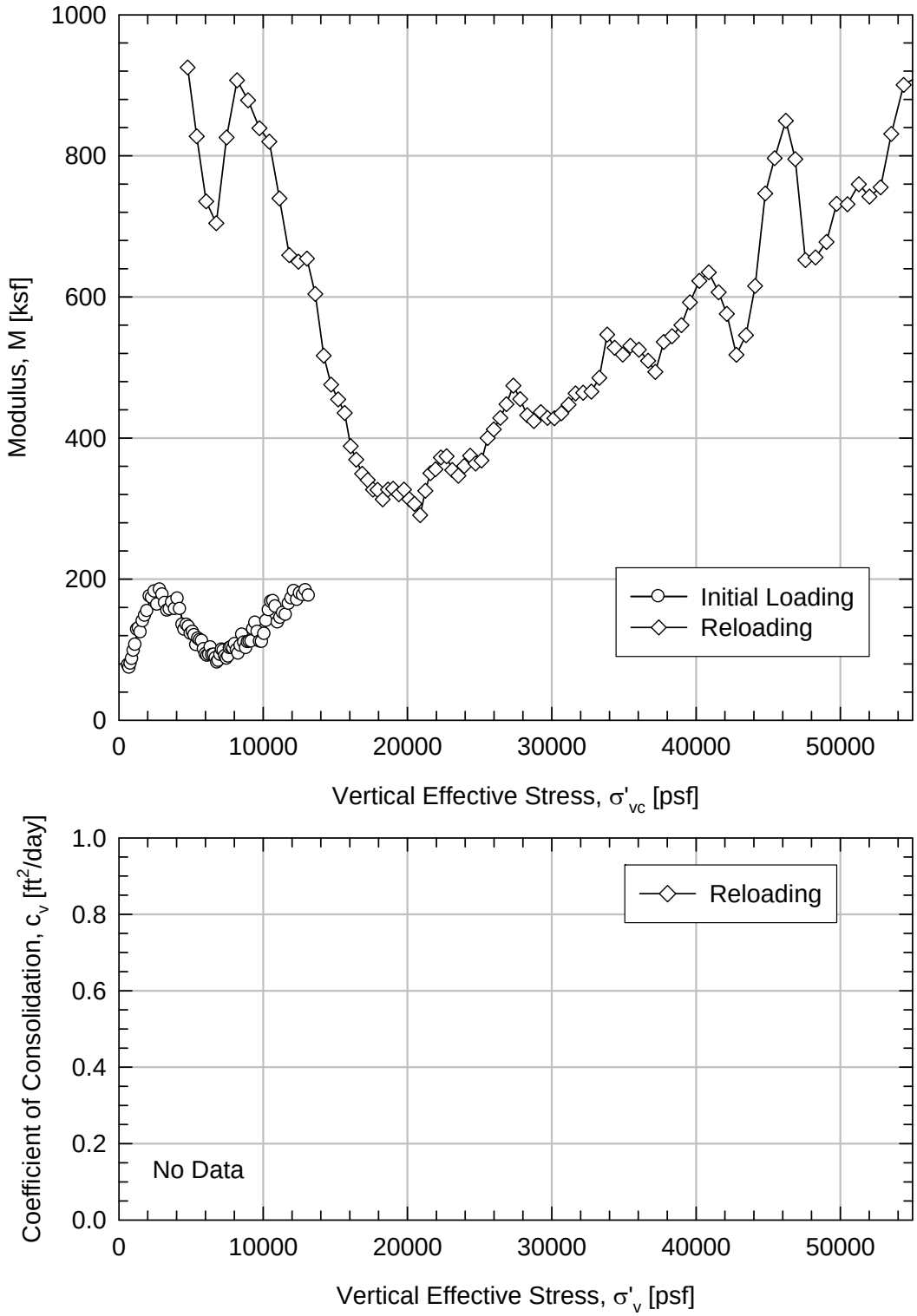

Figure 5.3.32 Modulus and coefficient of consolidation versus vertical effective stress for test CRS153 on sample AAB-01-16 UP-1 13-15 ft.

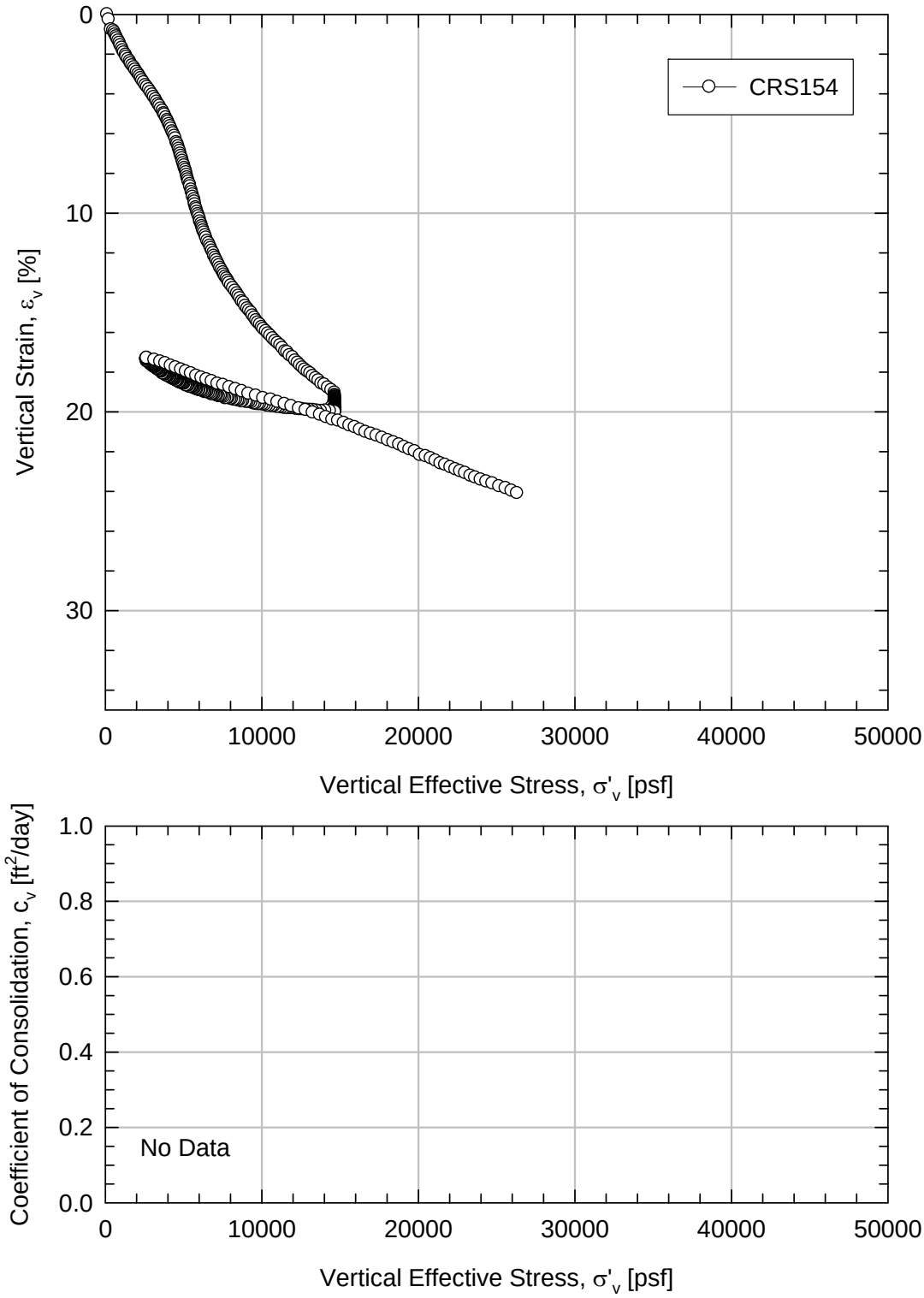

Figure 5.3.33 Vertical strain and coefficient of consolidation versus vertical effective stress for test CRS154 on sample AARW-11-43 UP-2 23-25 ft.

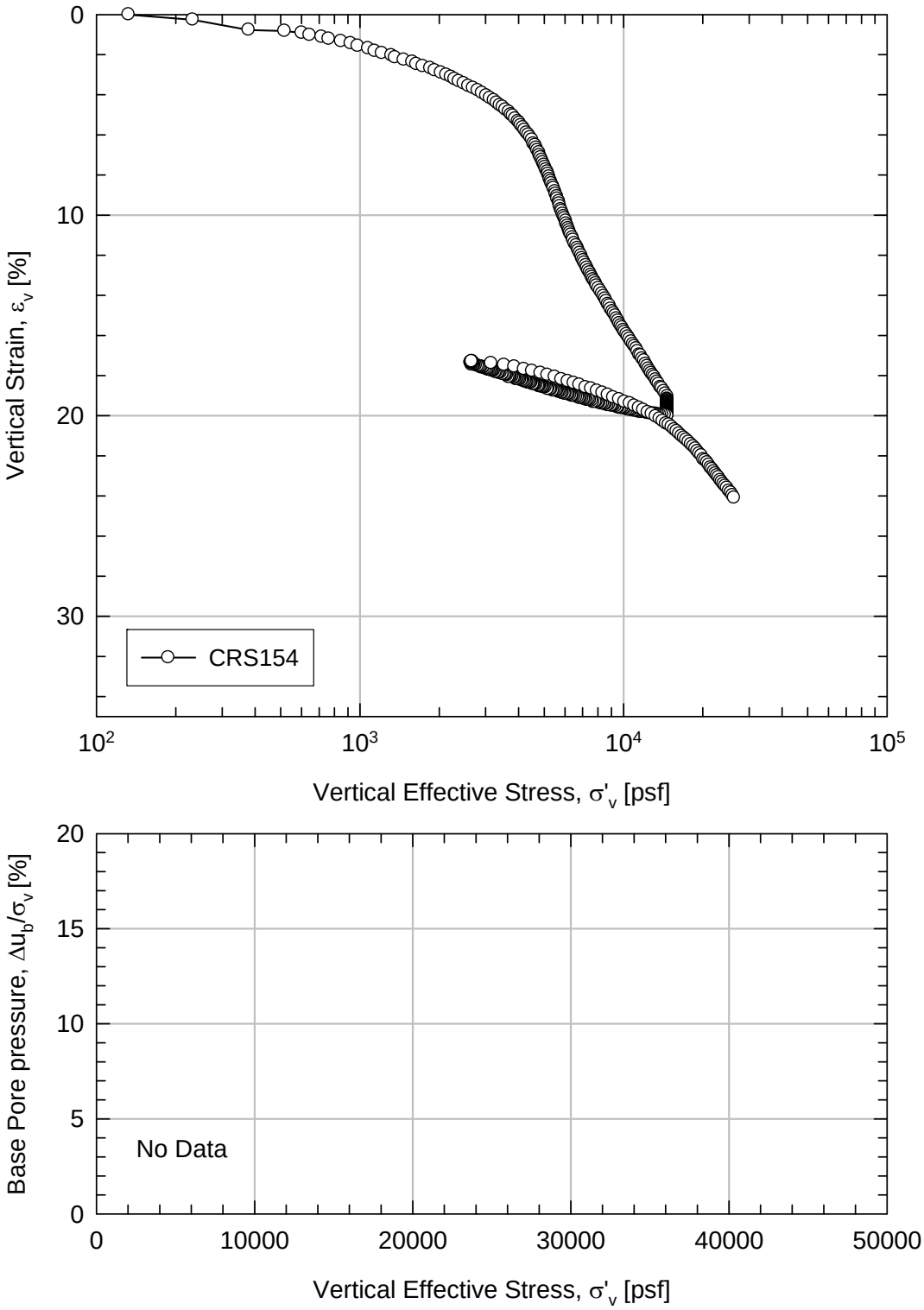

Figure 5.3.34 Vertical strain and normalized base pore pressure versus vertical effective stress for test CRS154 on sample AARW-11-43 UP-2 23-25 ft.

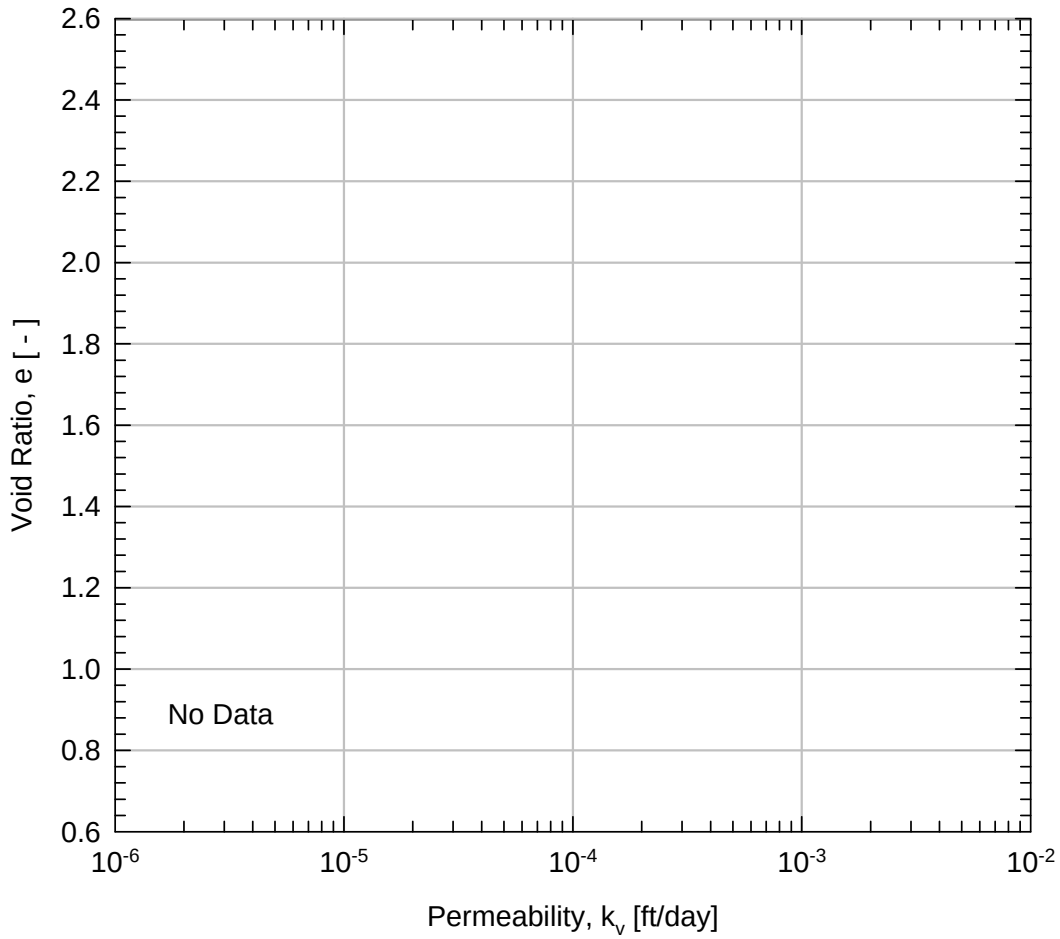

Figure 5.3.35 Void ratio versus permeability for CRS154 on sample AARW-11-43 UP-2 23-25 ft.

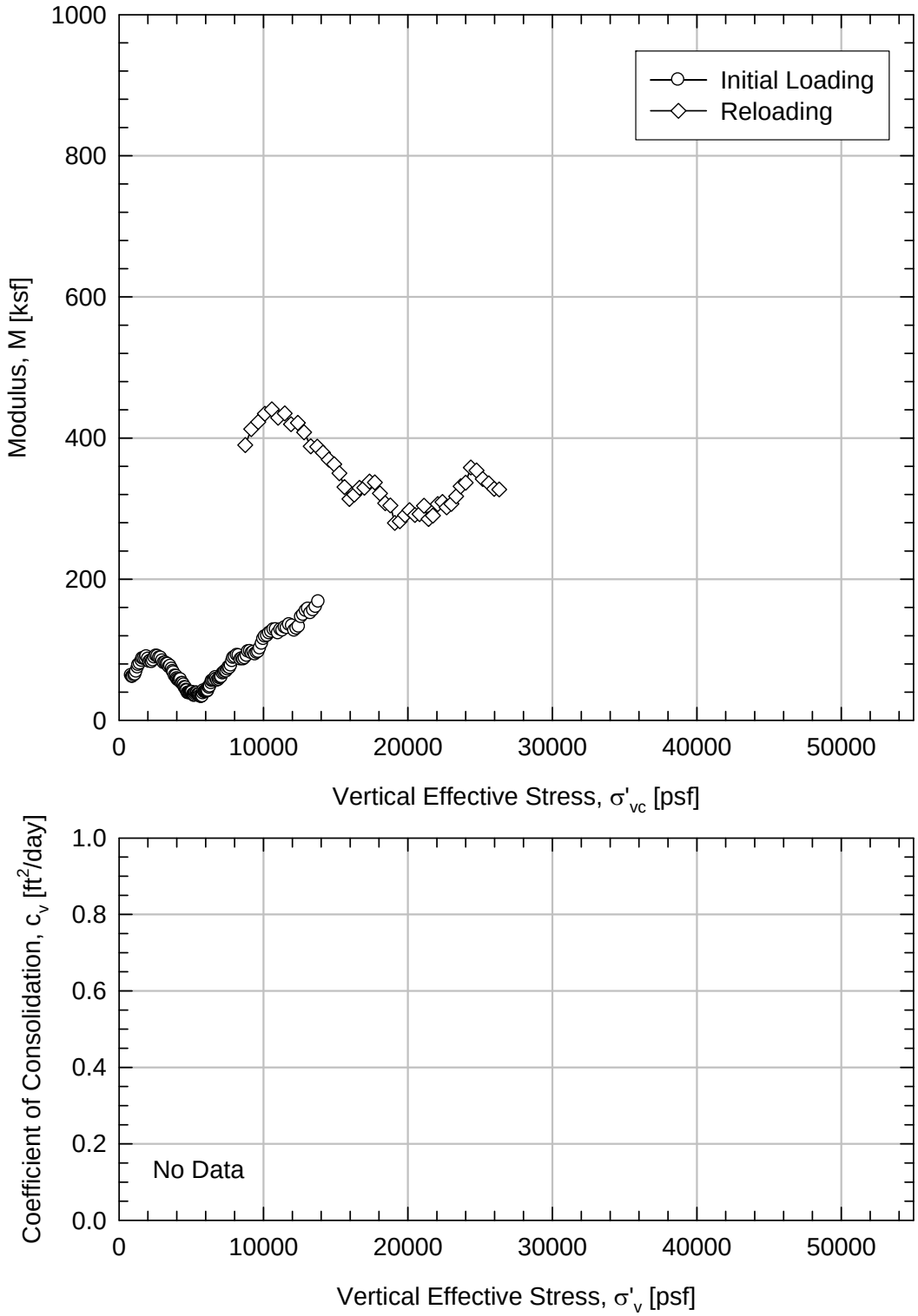

Figure 5.3.36 Modulus and coefficient of consolidation versus vertical effective stress for test CRS154 on sample AARW-11-43 UP-2 23-25 ft.

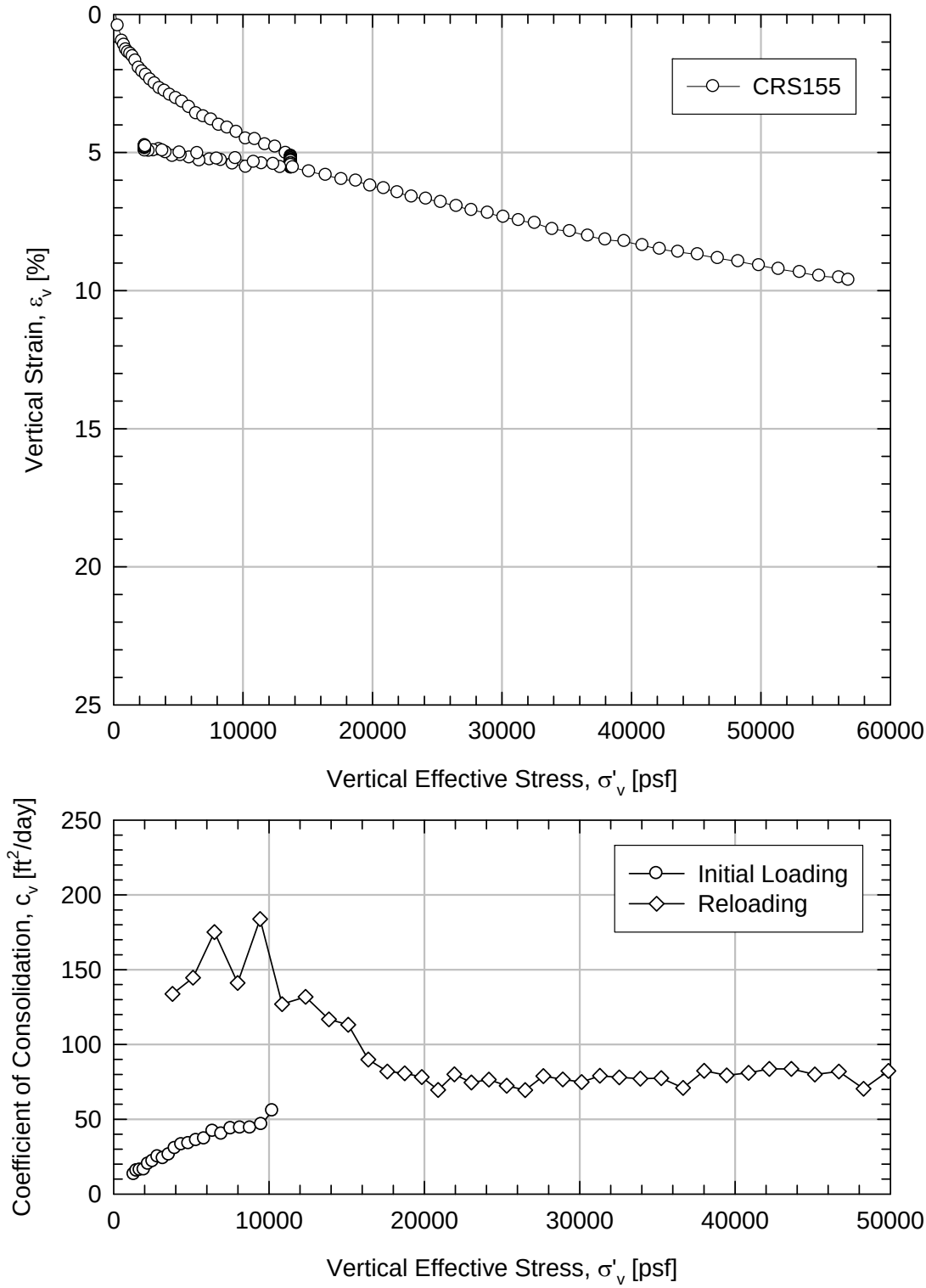

Figure 5.3.37 Vertical strain and coefficient of consolidation versus vertical effective stress for test CRS155 on sample AAB-02-23B UP-2 58-60 ft.

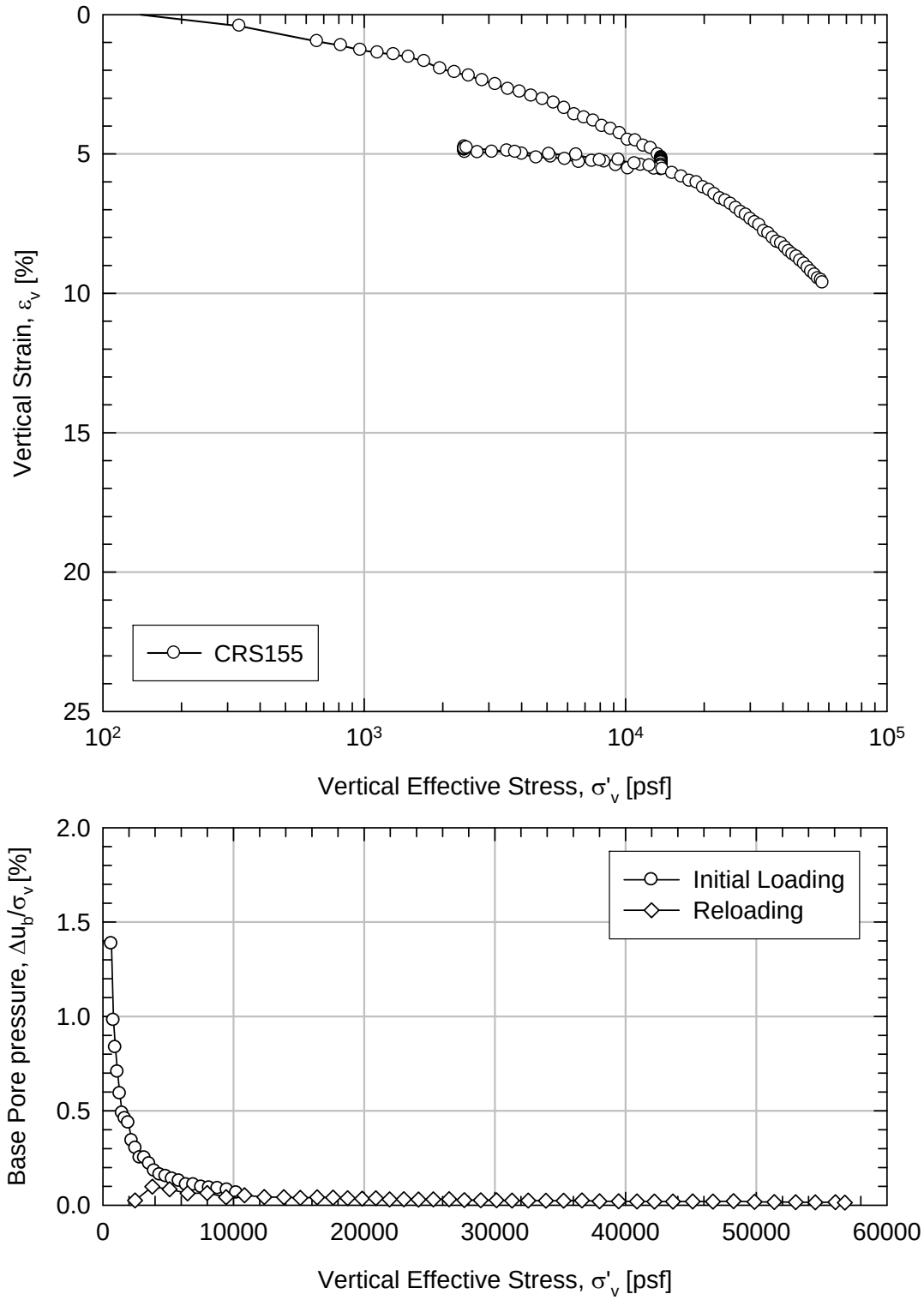

Figure 5.3.38 Vertical strain and normalized base pore pressure versus vertical effective stress for test CRS155 on sample AAB-02-23B UP-2 58-60 ft.

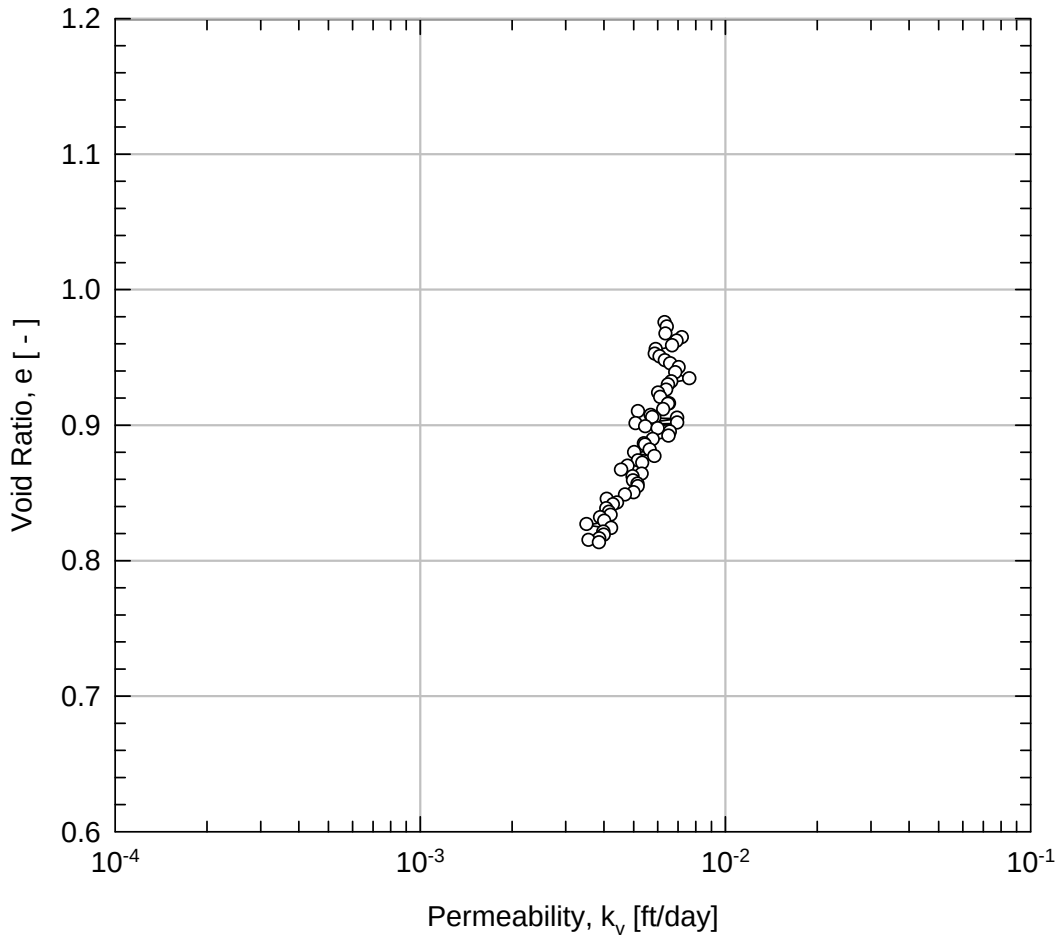

Figure 5.3.39 Void ratio versus permeability for CRS155 on sample AAB-02-23B UP-2 58-60 ft.

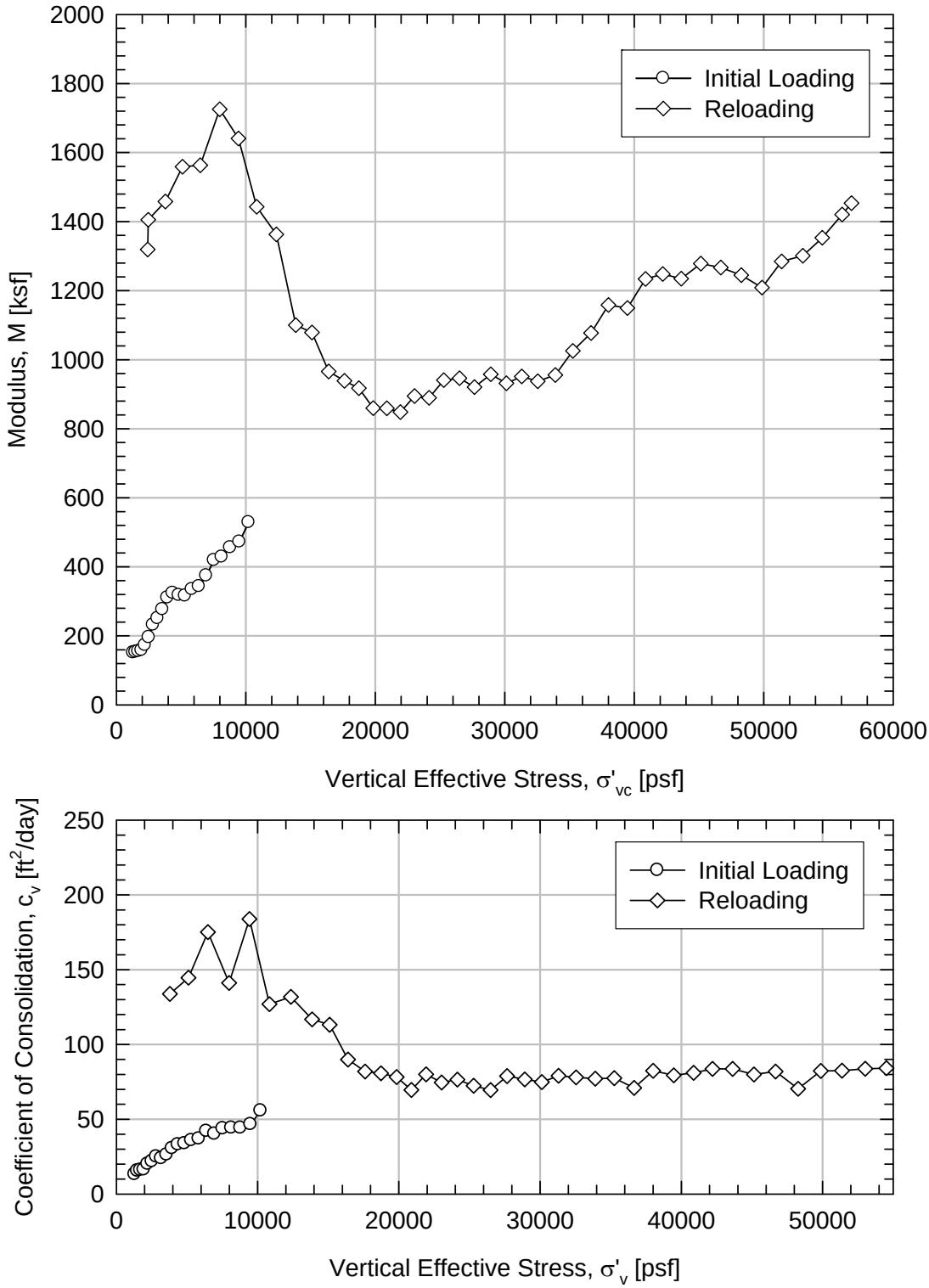

Figure 5.3.40 Modulus and coefficient of consolidation versus vertical effective stress for test CRS155 on sample AAB-02-23B UP-2 58-60 ft.

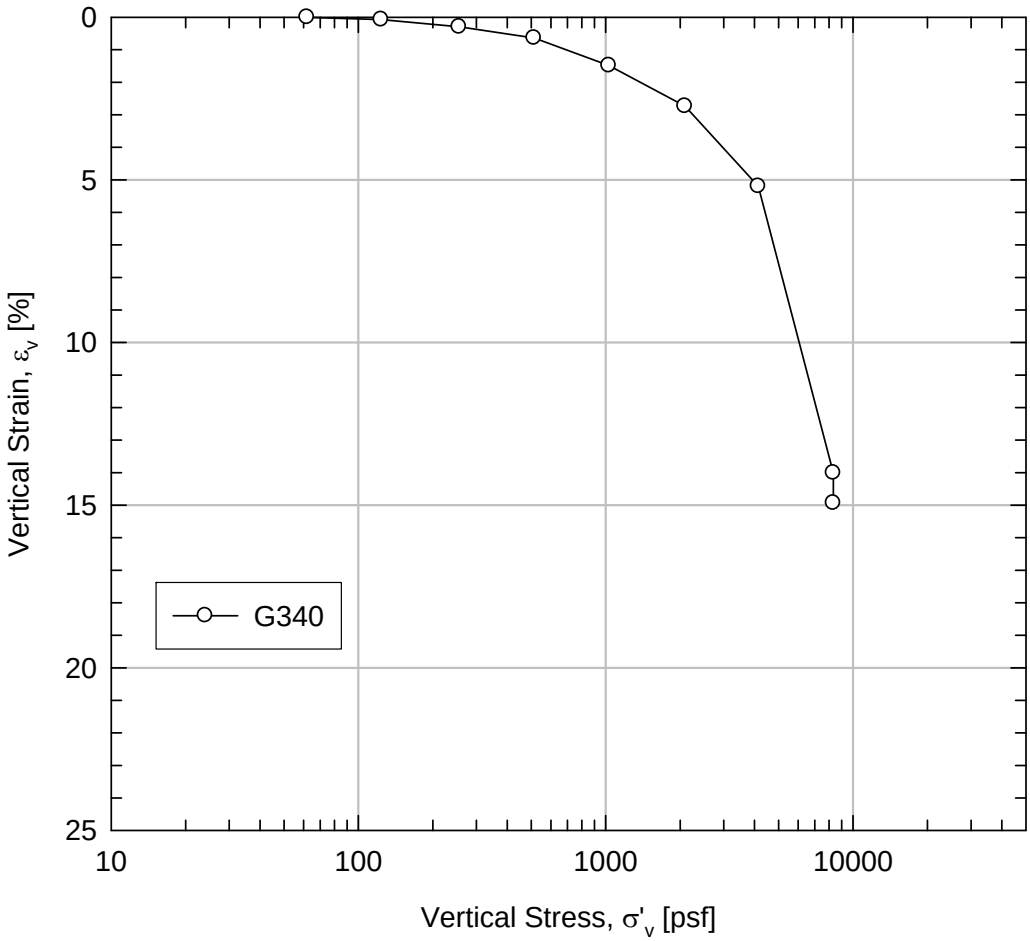

Figure 5.4.1 Vertical strain versus vertical effective stress for test DSS G340 on sample AAB-03-36 UP-2 38-40 ft.

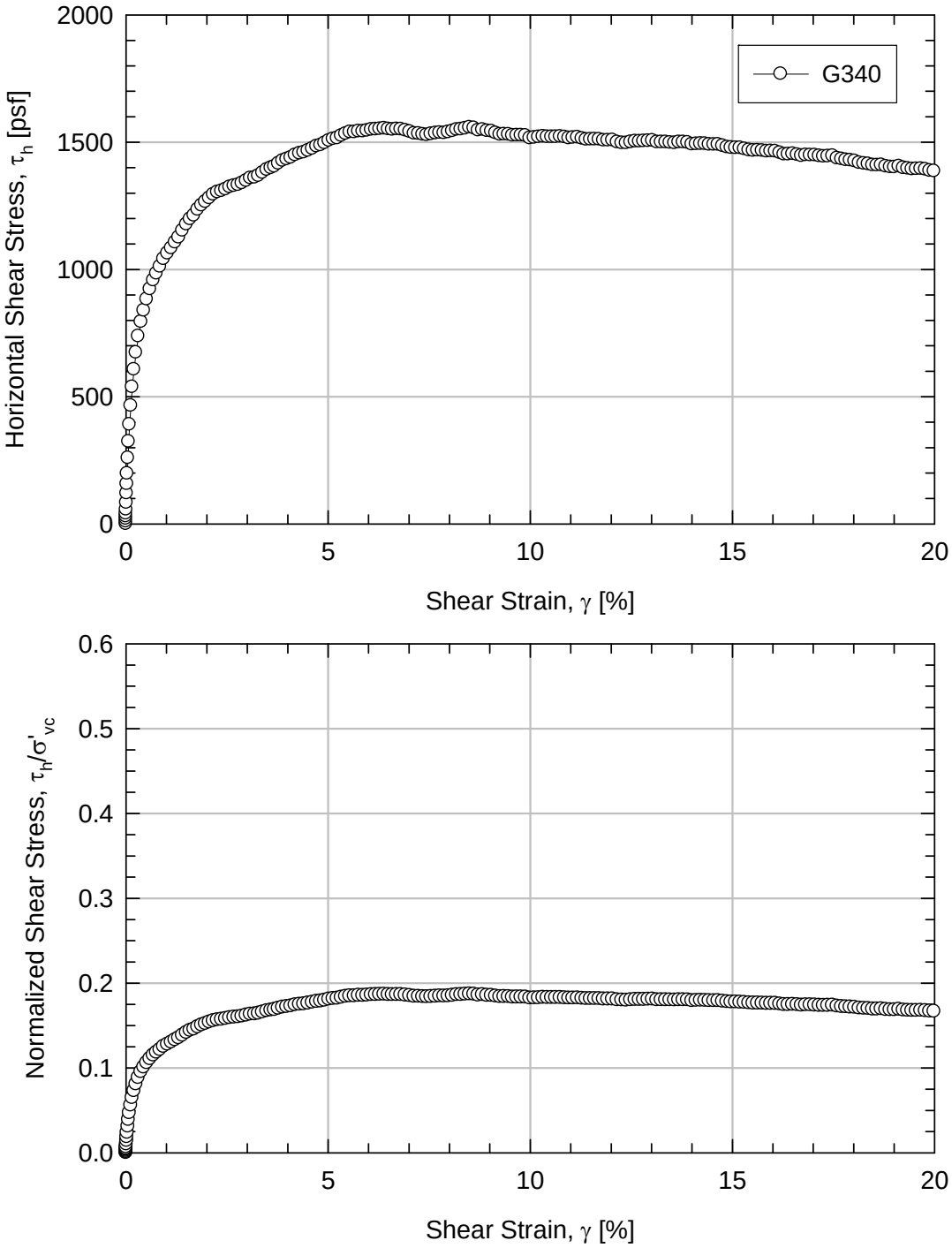

Figure 5.4.2 Horizontal shear stress and normalized shear stress versus shear strain for test DSS G340 on sample AAB-03-36 UP-2 38-40 ft.

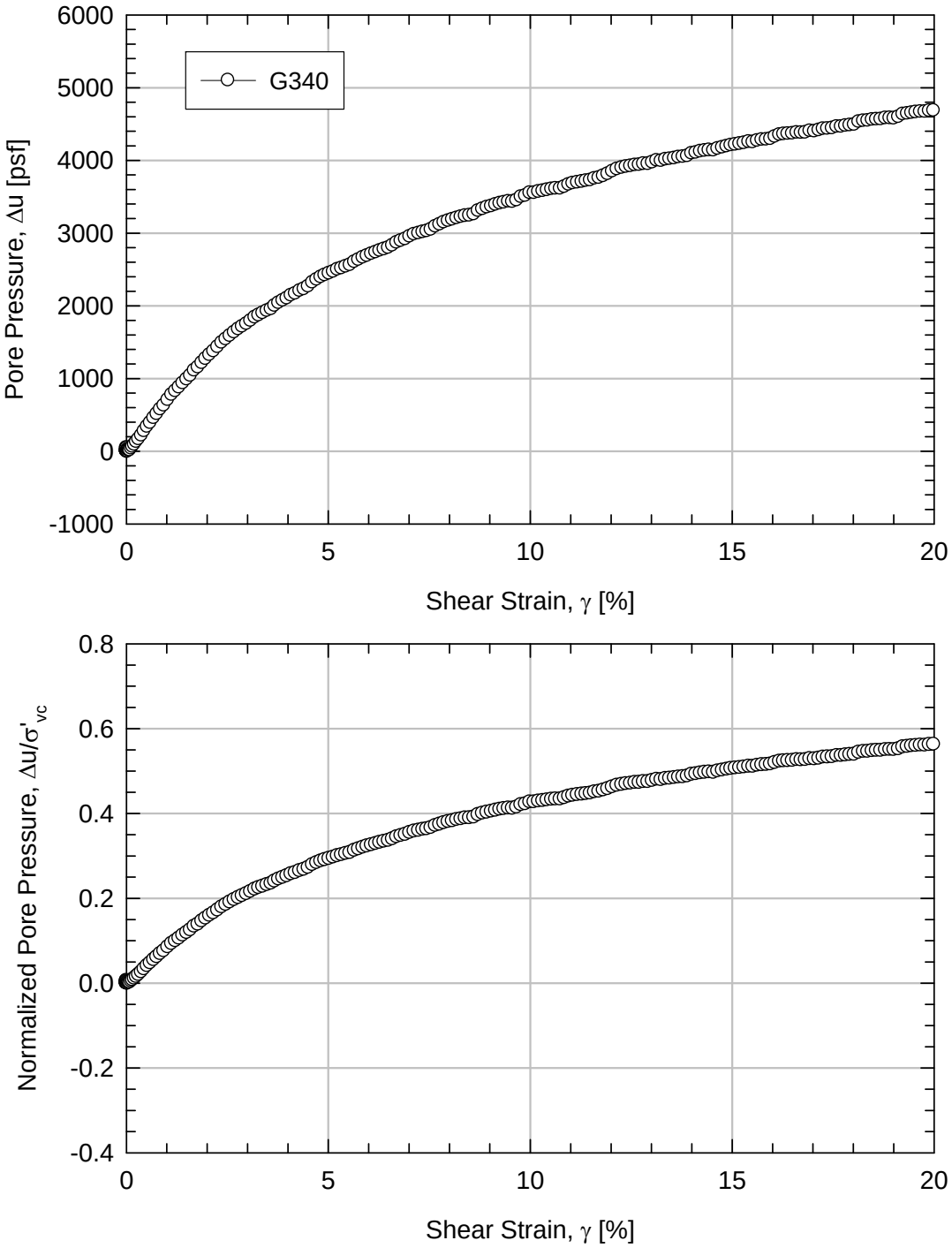

Figure 5.4.3 Pore pressure and normalized pore pressure versus shear strain for test DSS G340 on sample AAB-03-36 UP-2 38-40 ft.

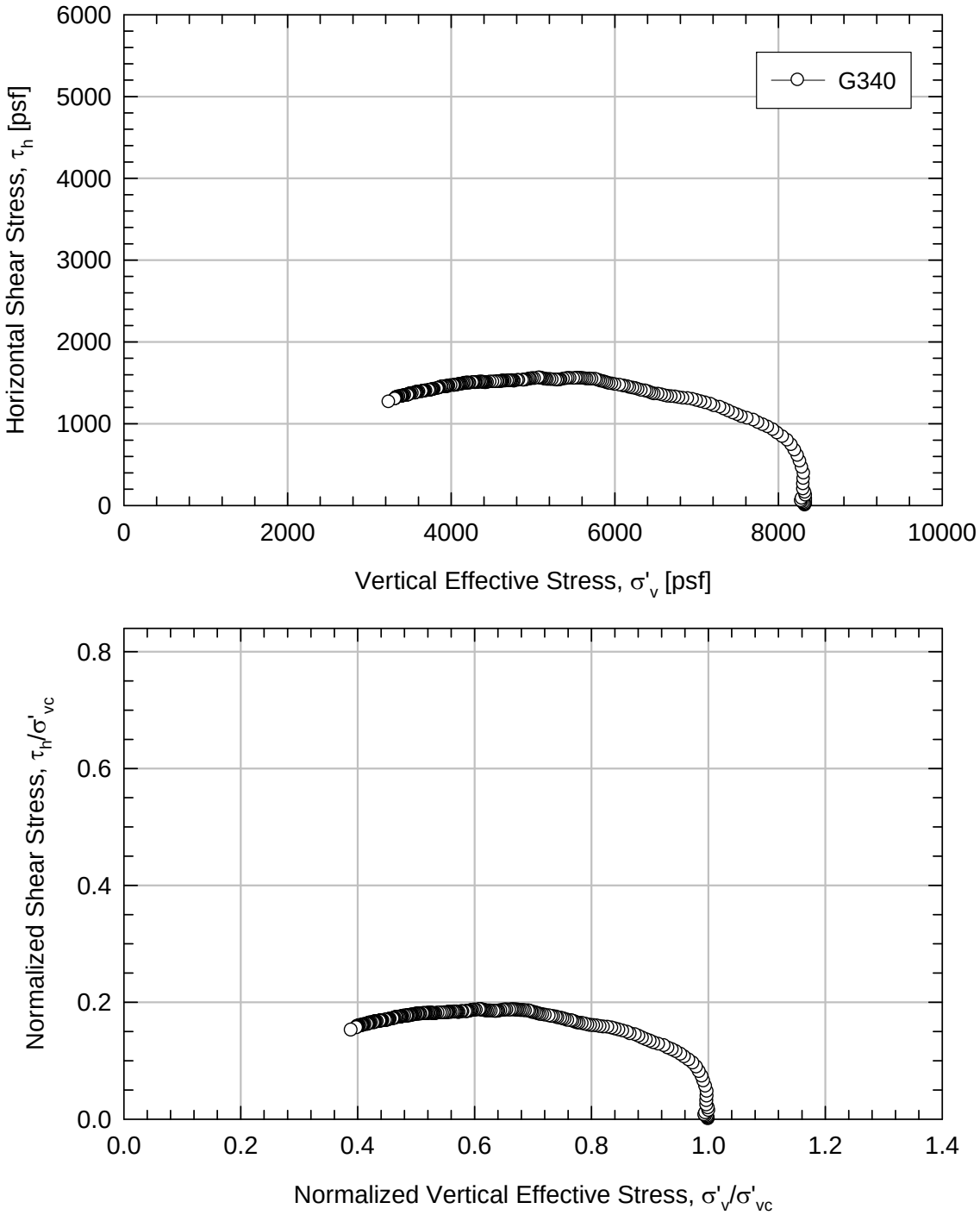

Figure 5.4.4 Horizontal shear stress versus vertical effective stress and normalized shear stress versus normalized vertical effective stress for test DSS G340 on sample AAB-03-36 UP-2 38-40 ft.

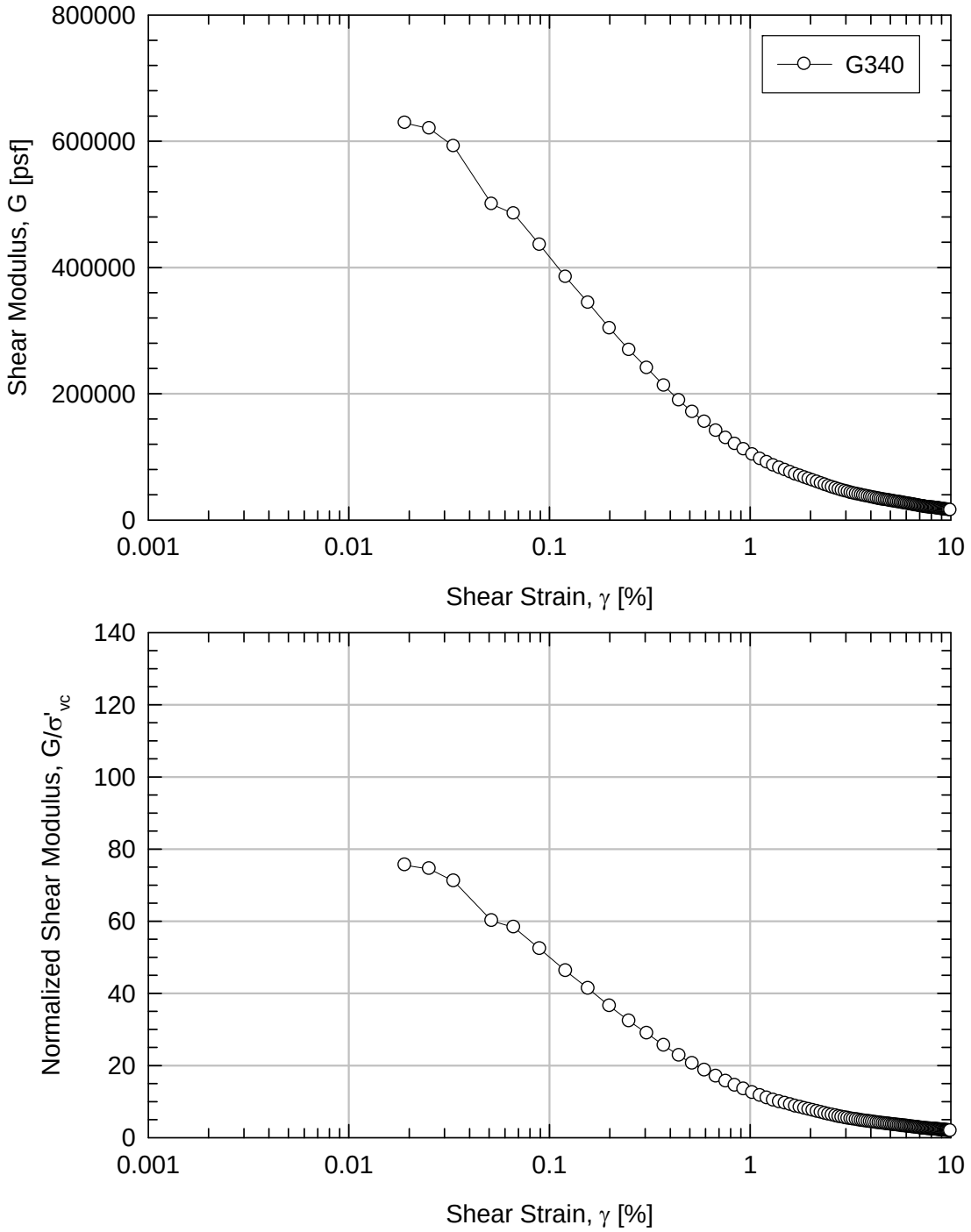

Figure 5.4.5 Shear modulus and normalized shear modulus versus shear strain for test DSS G340 on sample AAB-03-36 UP-2 38-40 ft.

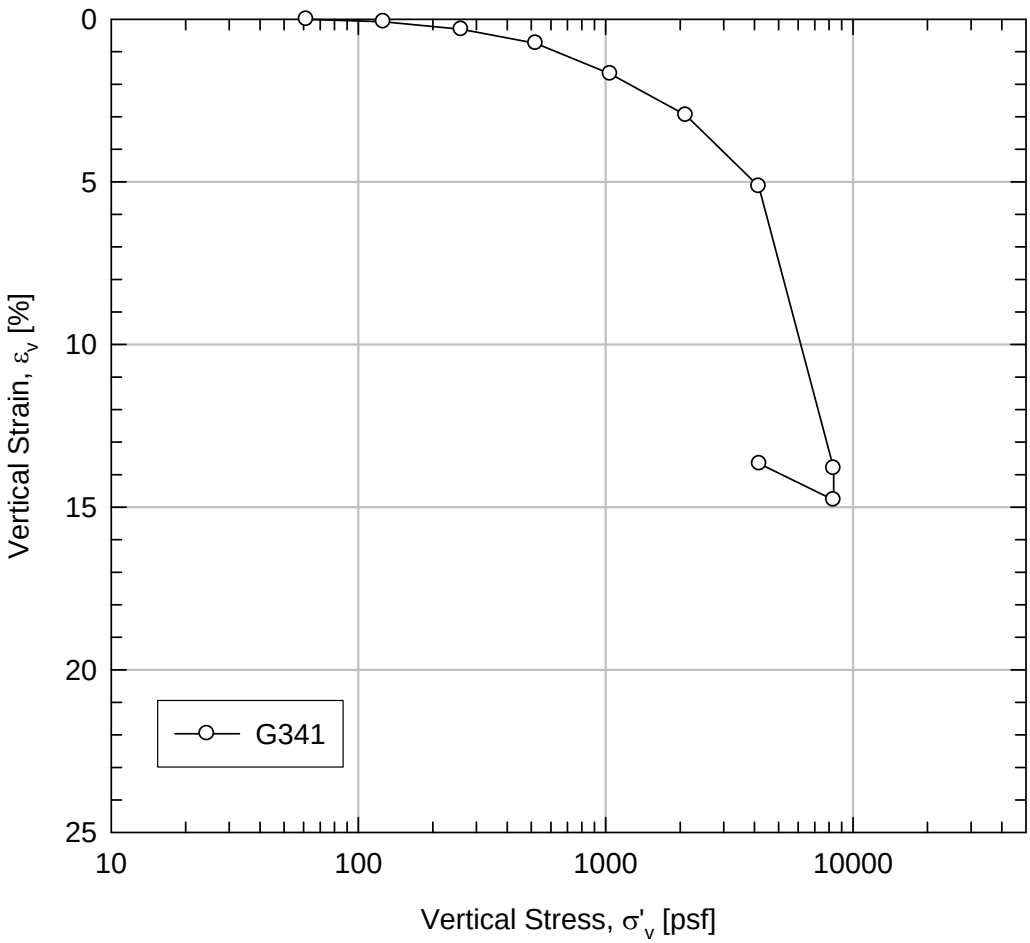

Figure 5.4.6 Vertical strain versus vertical effective stress for test DSS G341 on sample AAB-03-36 UP-2 38-40 ft.

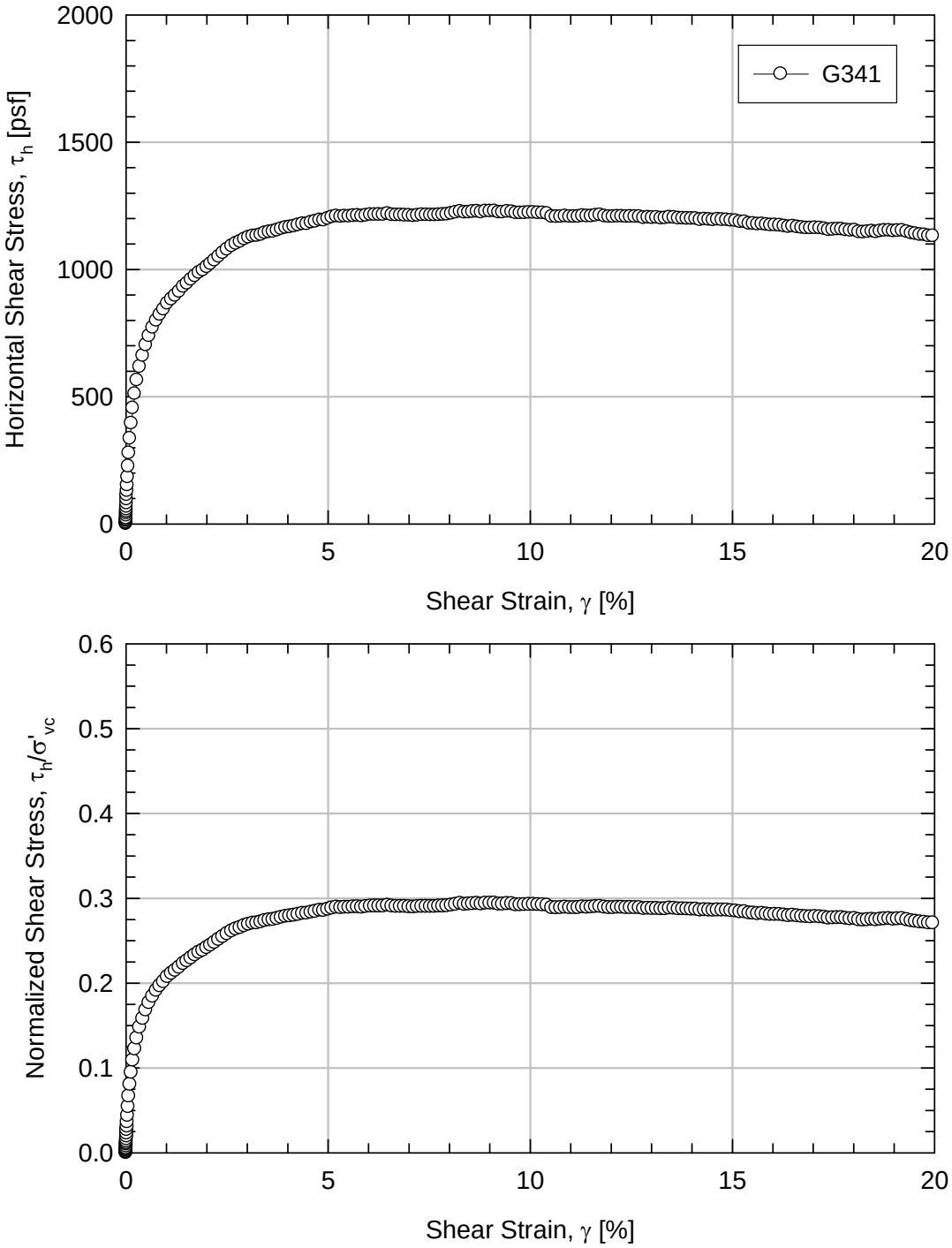

Figure 5.4.7 Horizontal shear stress and normalized shear stress versus shear strain for test DSS G341 on sample AAB-03-36 UP-2 38-40 ft.

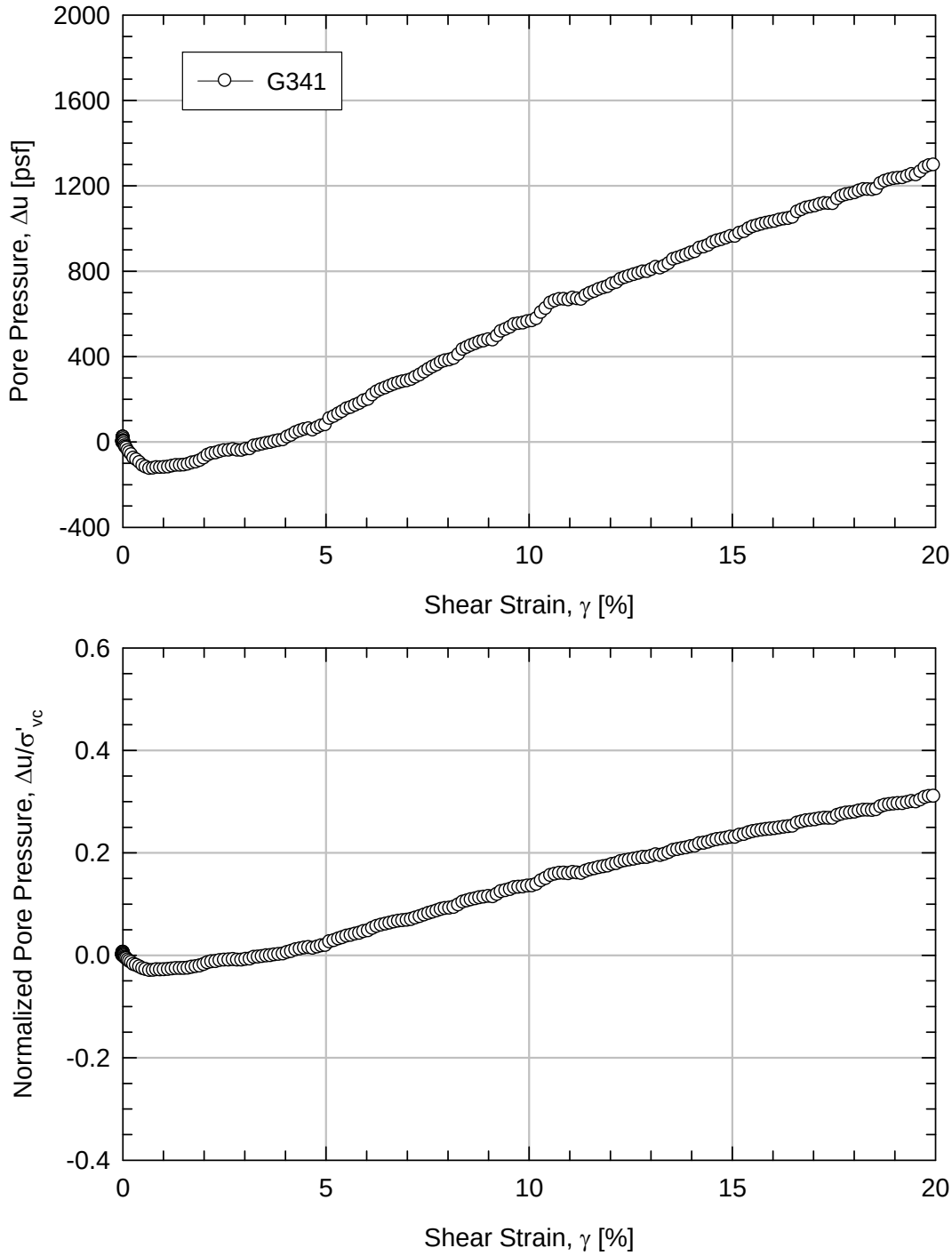

Figure 5.4.8 Pore pressure and normalized pore pressure versus shear strain for test DSS G341 on sample AAB-03-36 UP-2 38-40 ft.

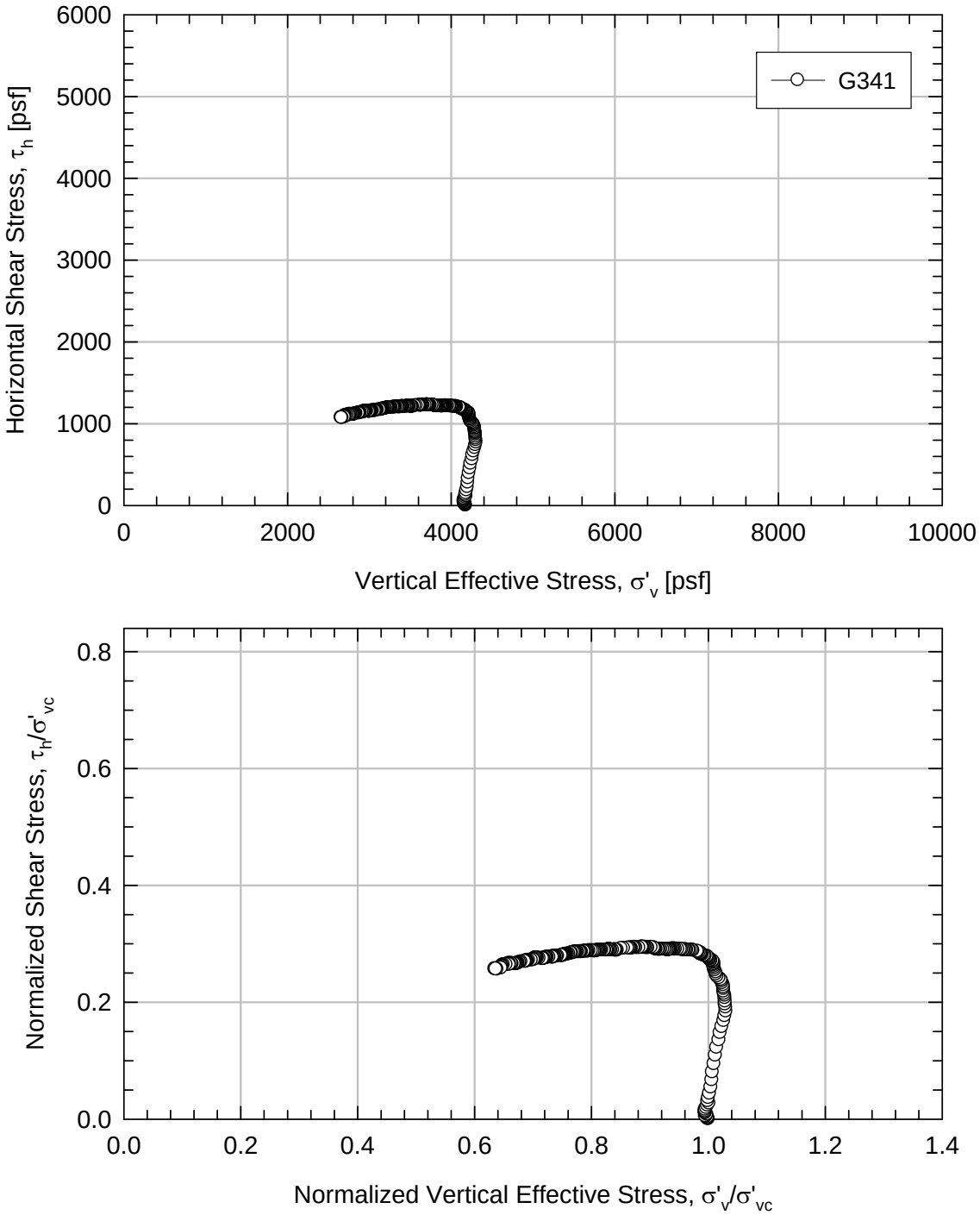

Figure 5.4.9 Horizontal shear stress versus vertical effective stress and normalized shear stress versus normalized vertical effective stress for test DSS G341 on sample AAB-03-36 UP-2 38-40 ft.

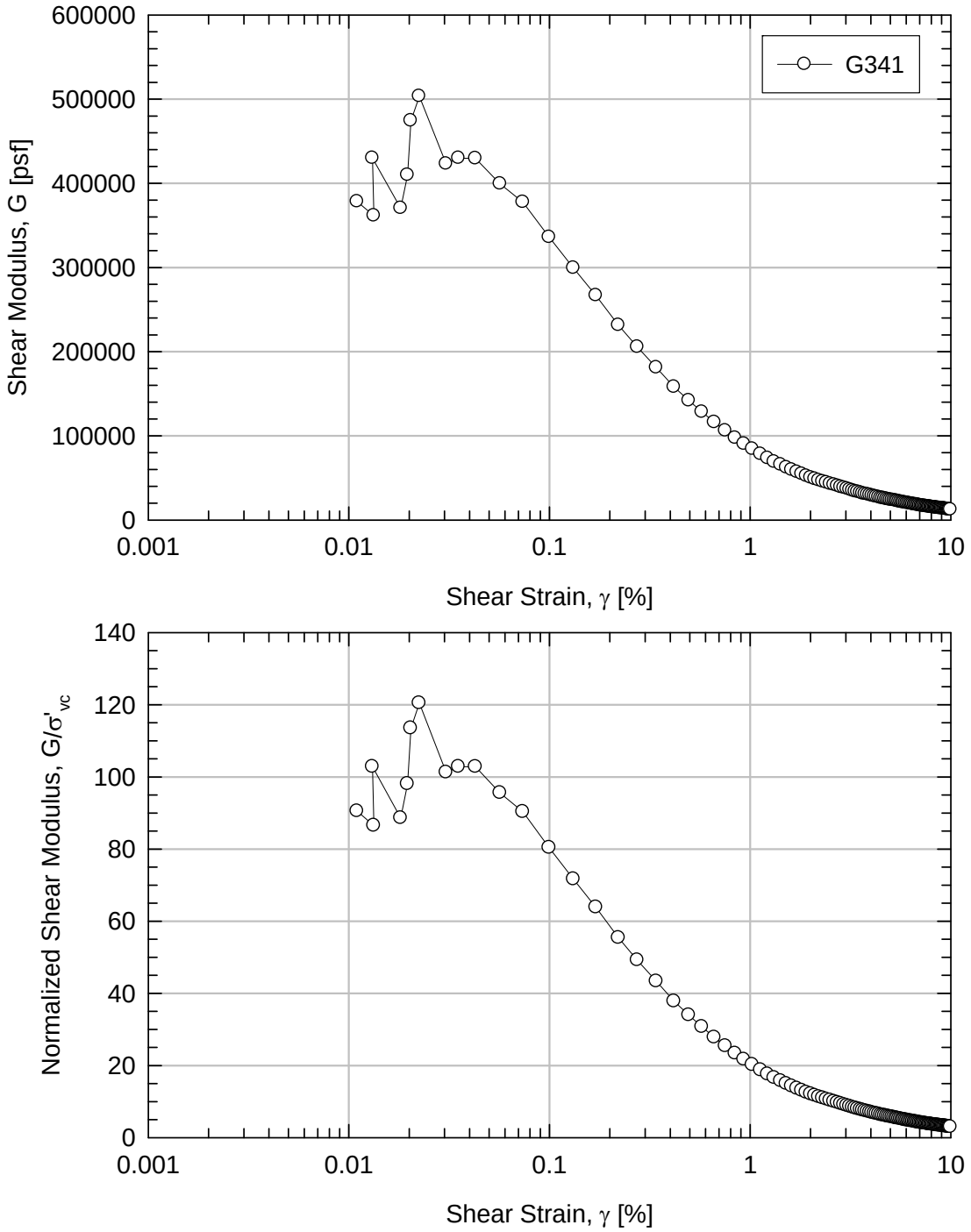

Figure 5.4.10 Shear modulus and normalized shear modulus versus shear strain for test DSS G341 on sample AAB-03-36 UP-2 38-40 ft.

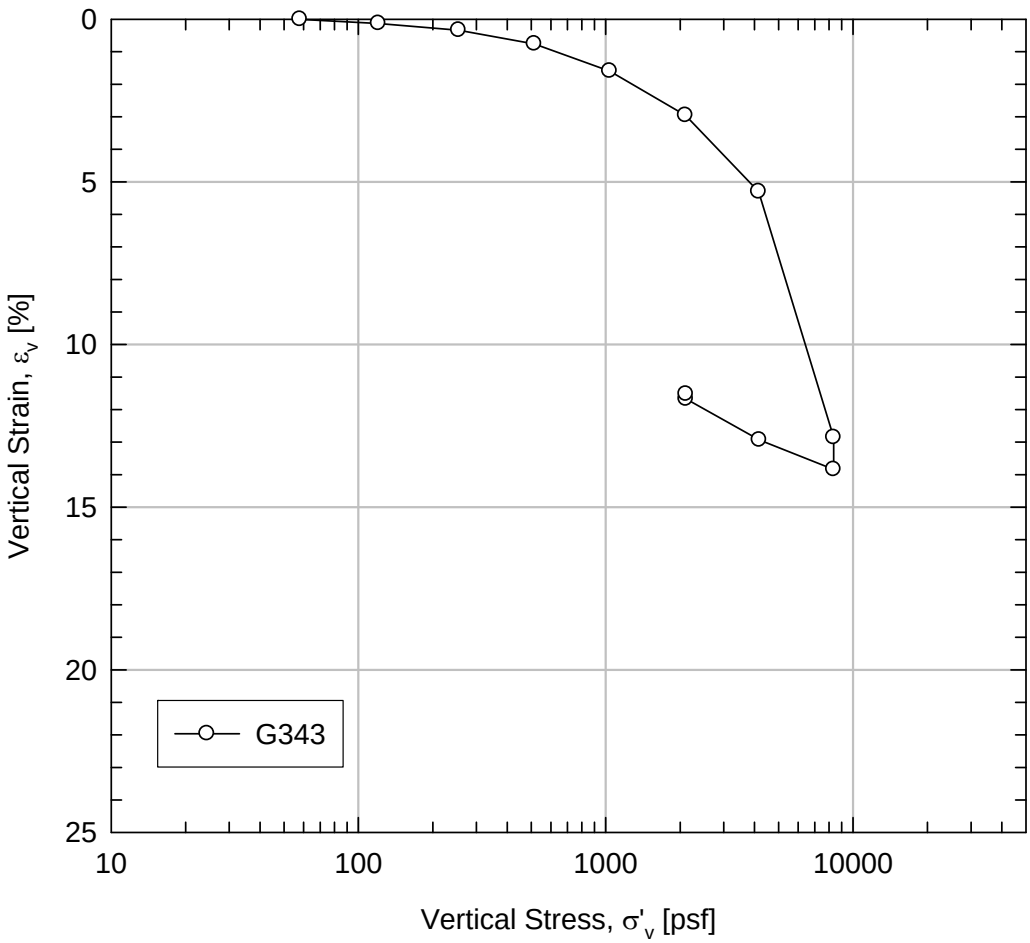

Figure 5.4.11 Vertical strain versus vertical effective stress for test DSS G343 on sample AAB-03-36 UP-2 38-40 ft.

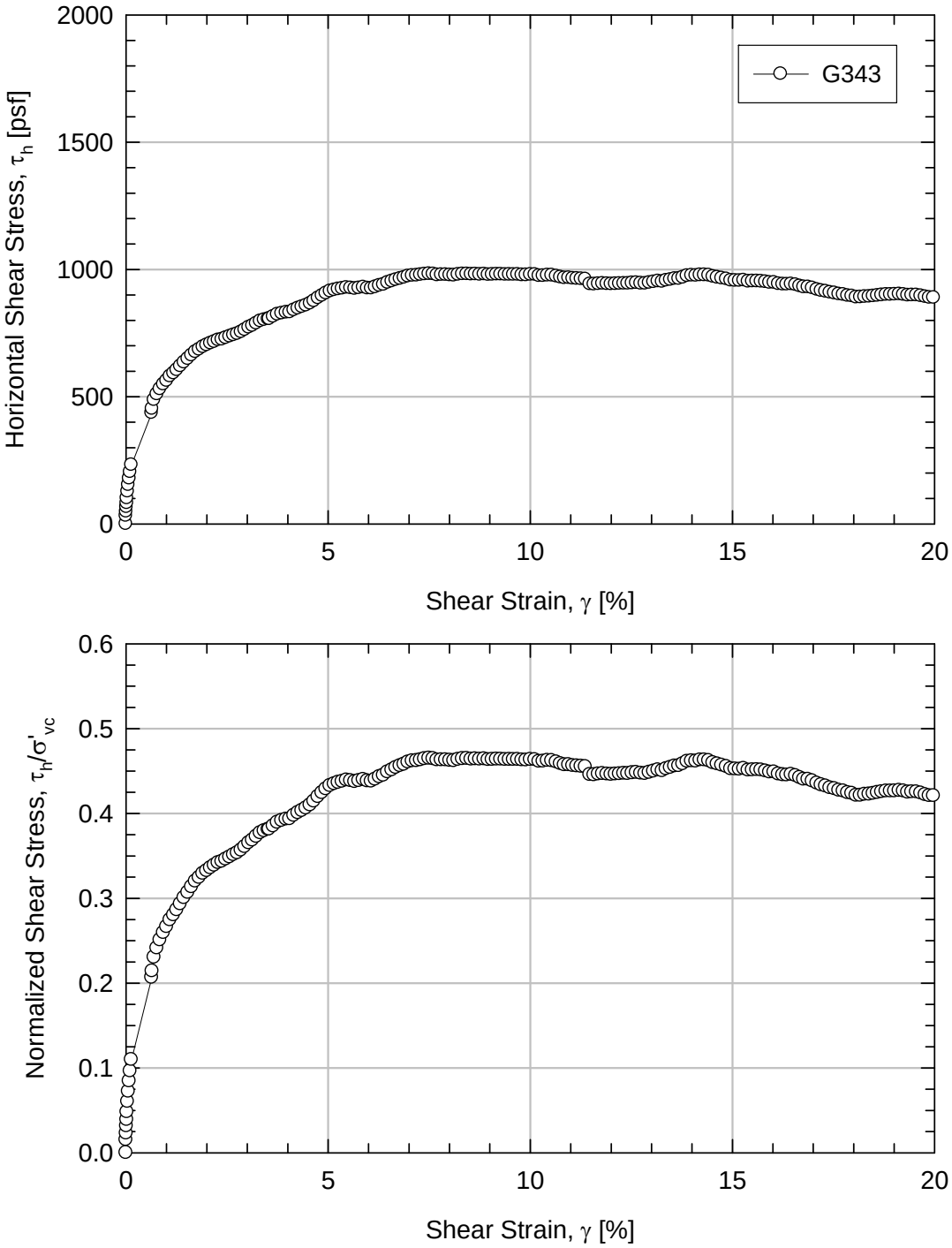

Figure 5.4.12 Horizontal shear stress and normalized shear stress versus shear strain for test DSS G343 on sample AAB-03-36 UP-2 38-40 ft.

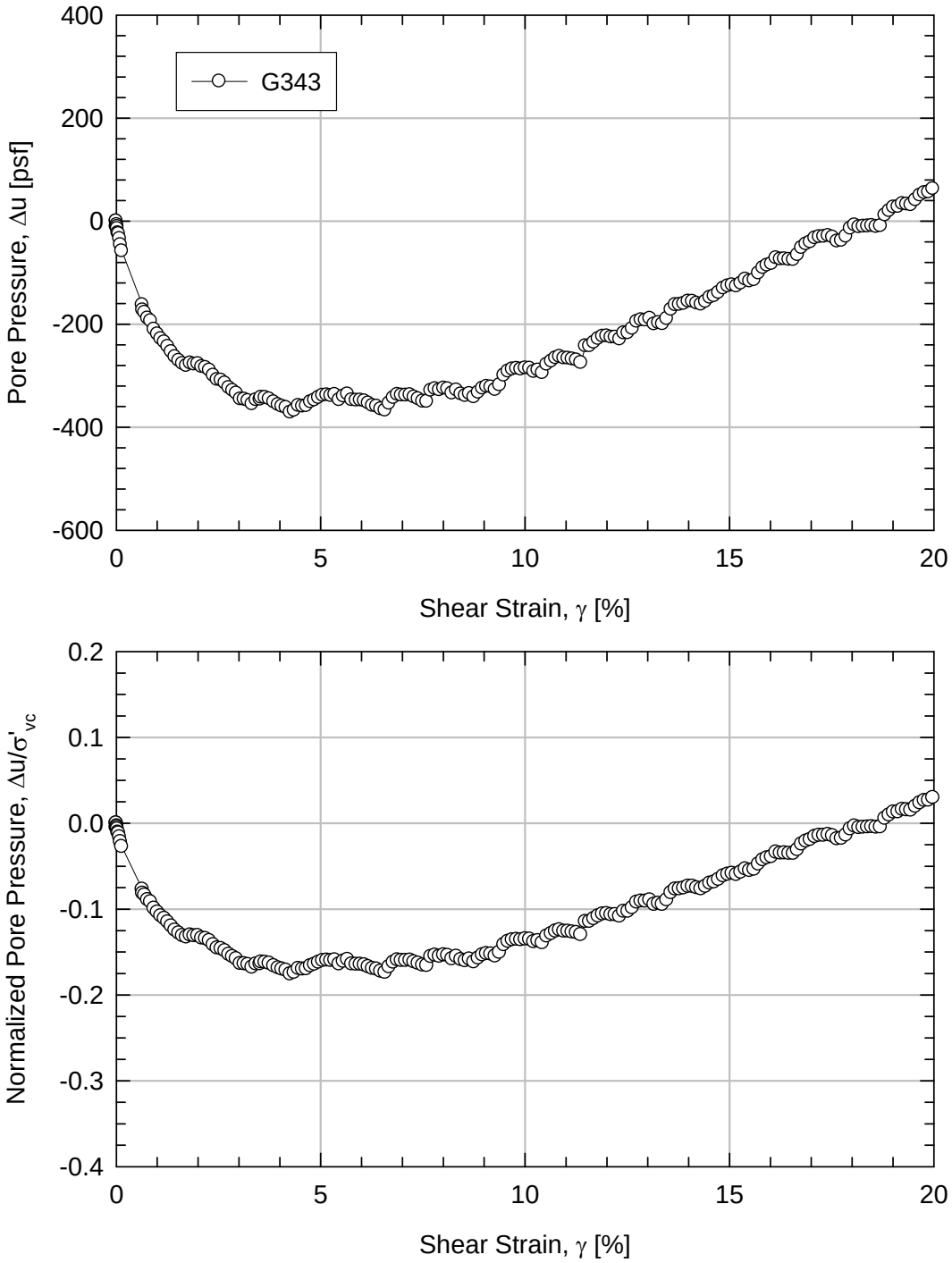

Figure 5.4.13 Pore pressure and normalized pore pressure versus shear strain for test DSS G343 on sample AAB-03-36 UP-2 38-40 ft.

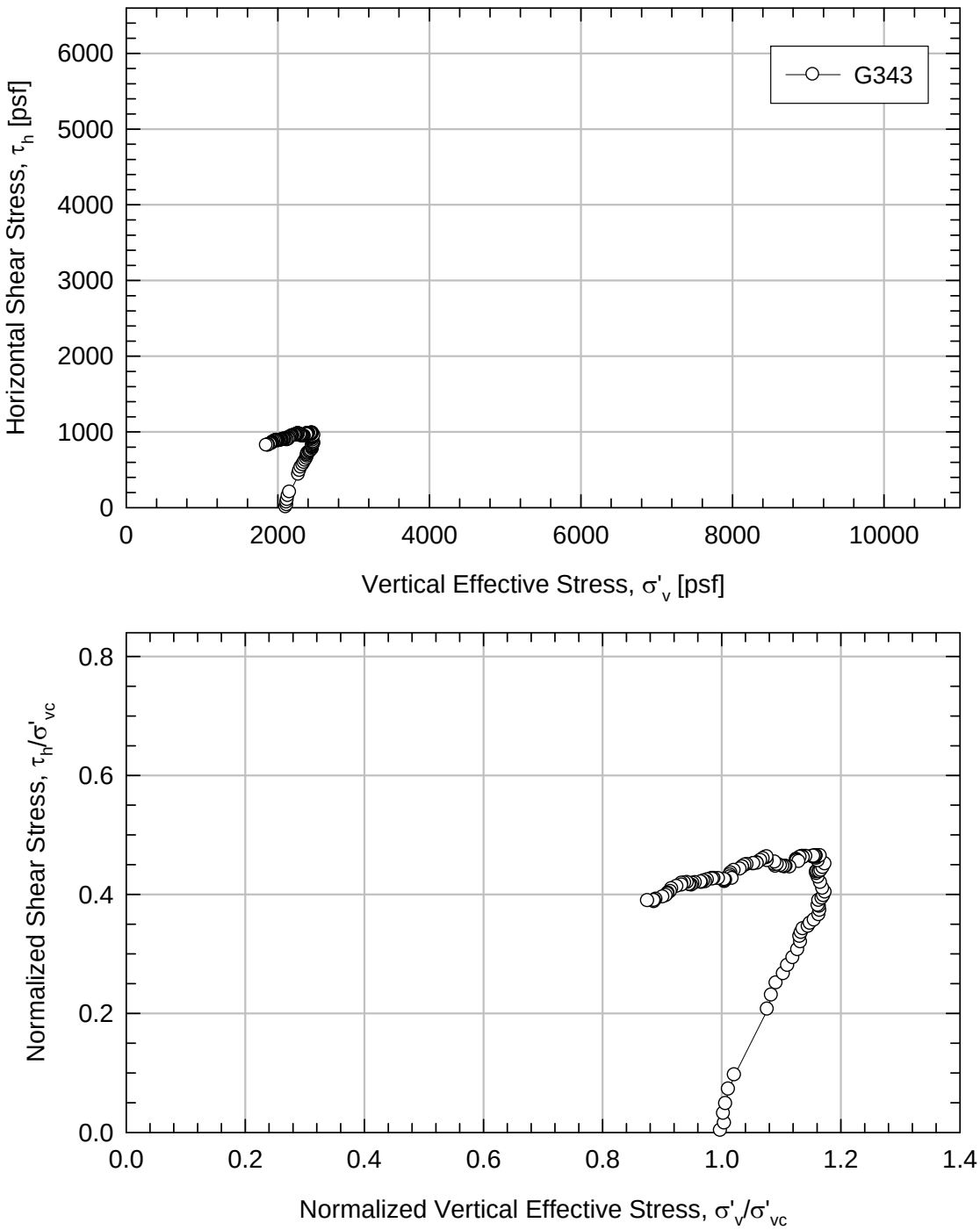

Figure 5.4.14 Horizontal shear stress versus vertical effective stress and normalized shear stress versus normalized vertical effective stress for test DSS G343 on sample AAB-03-36 UP-2 38-40 ft.

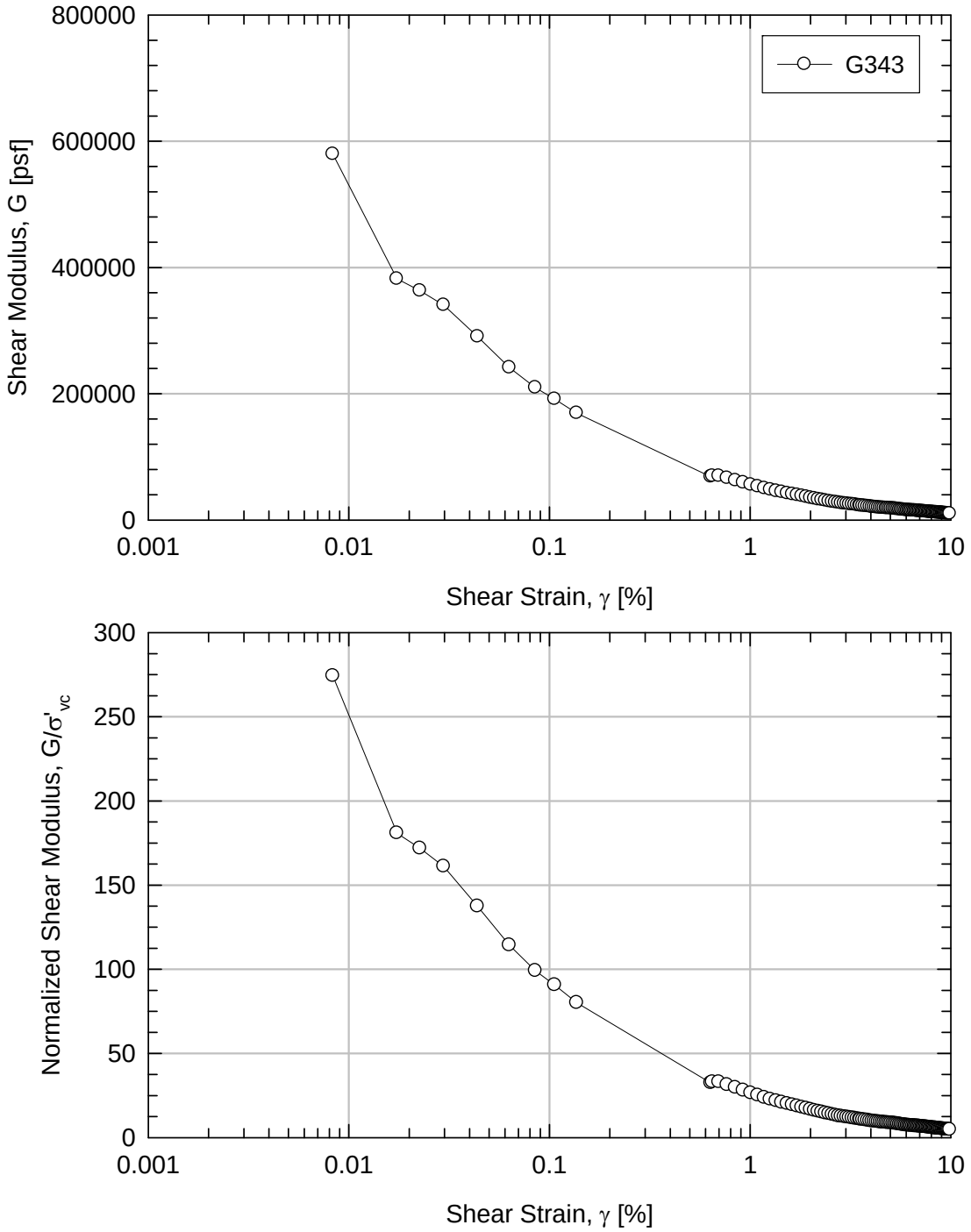

Figure 5.4.15 Shear modulus and normalized shear modulus versus shear strain for test DSS G343 on sample AAB-03-36 UP-2 38-40 ft.

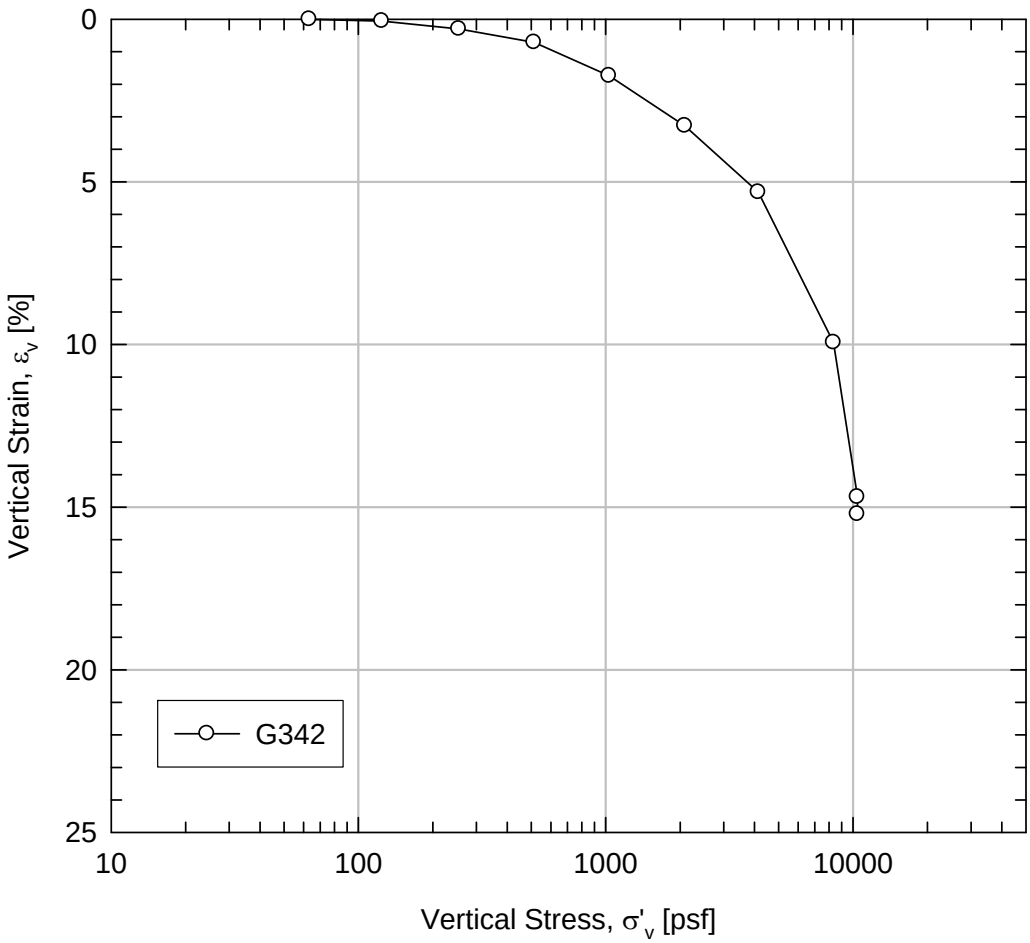

Figure 5.4.16 Vertical strain versus vertical effective stress for test DSS G342 on sample AARW-10-40 UP-1 63-65 ft.

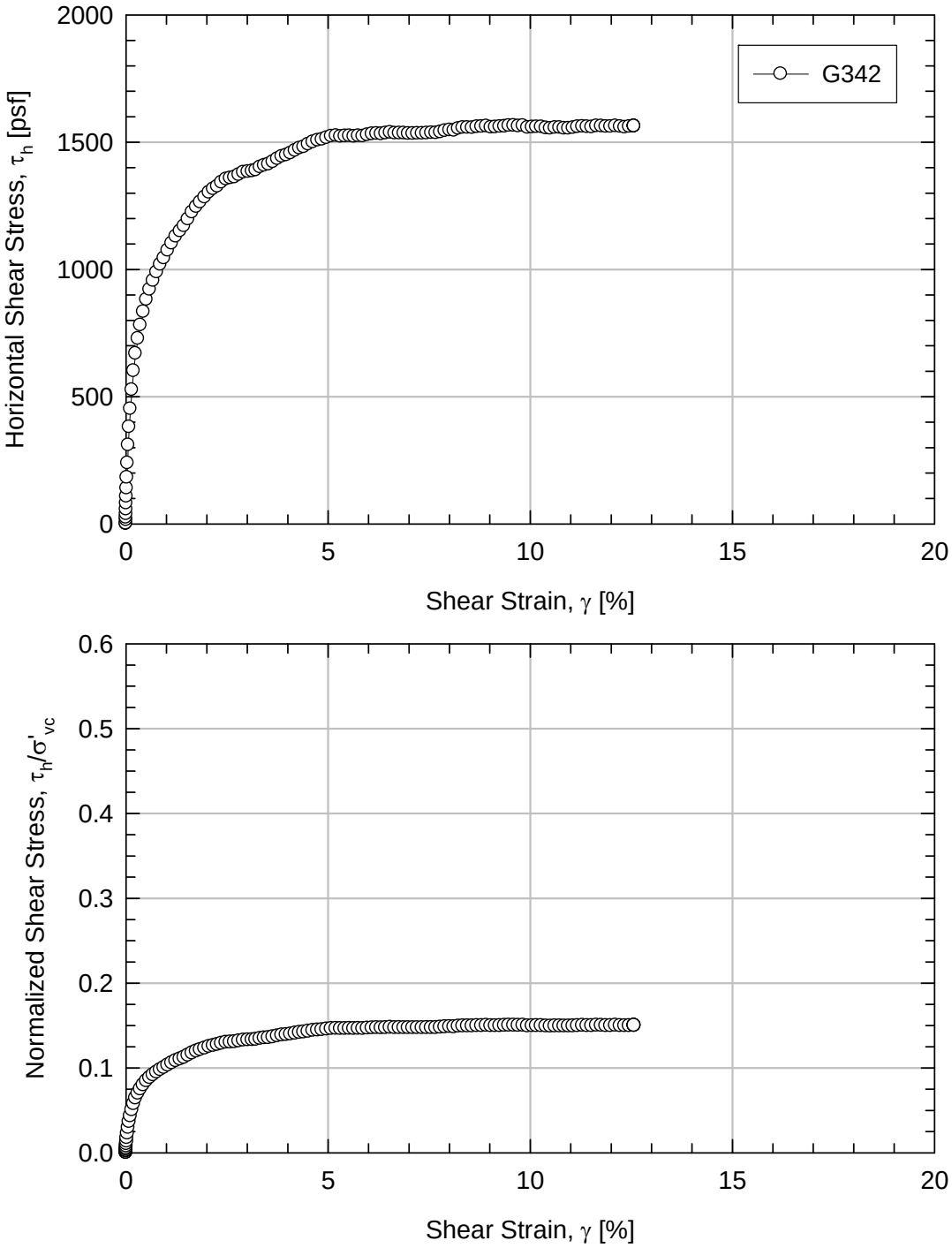

Figure 5.4.17 Horizontal shear stress and normalized shear stress versus shear strain for test DSS G342 on sample AARW-10-40 UP-1 63-65 ft.

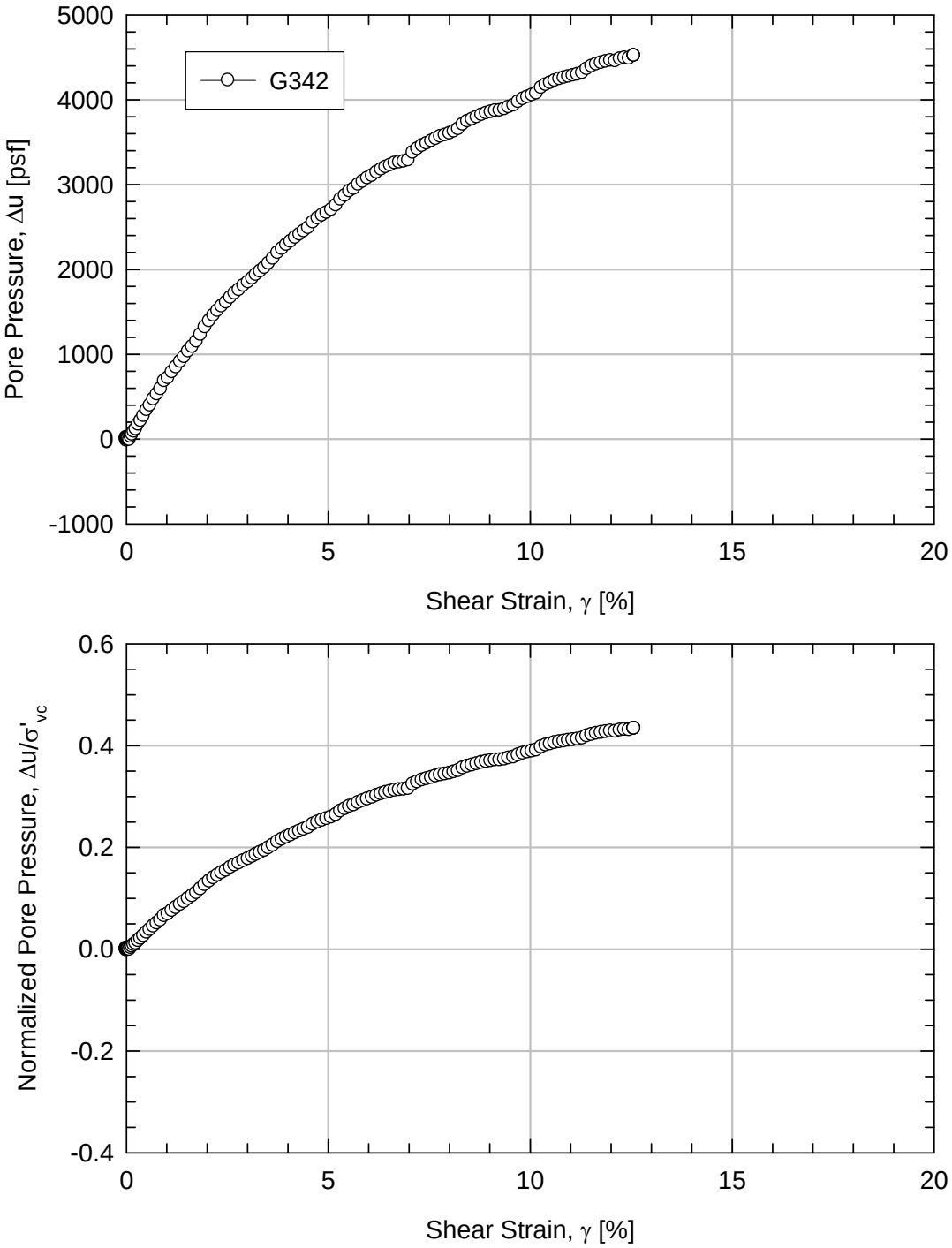

Figure 5.4.18 Pore pressure and normalized pore pressure versus shear strain for test DSS G342 on sample AARW-10-40 UP-1 63-65 ft.

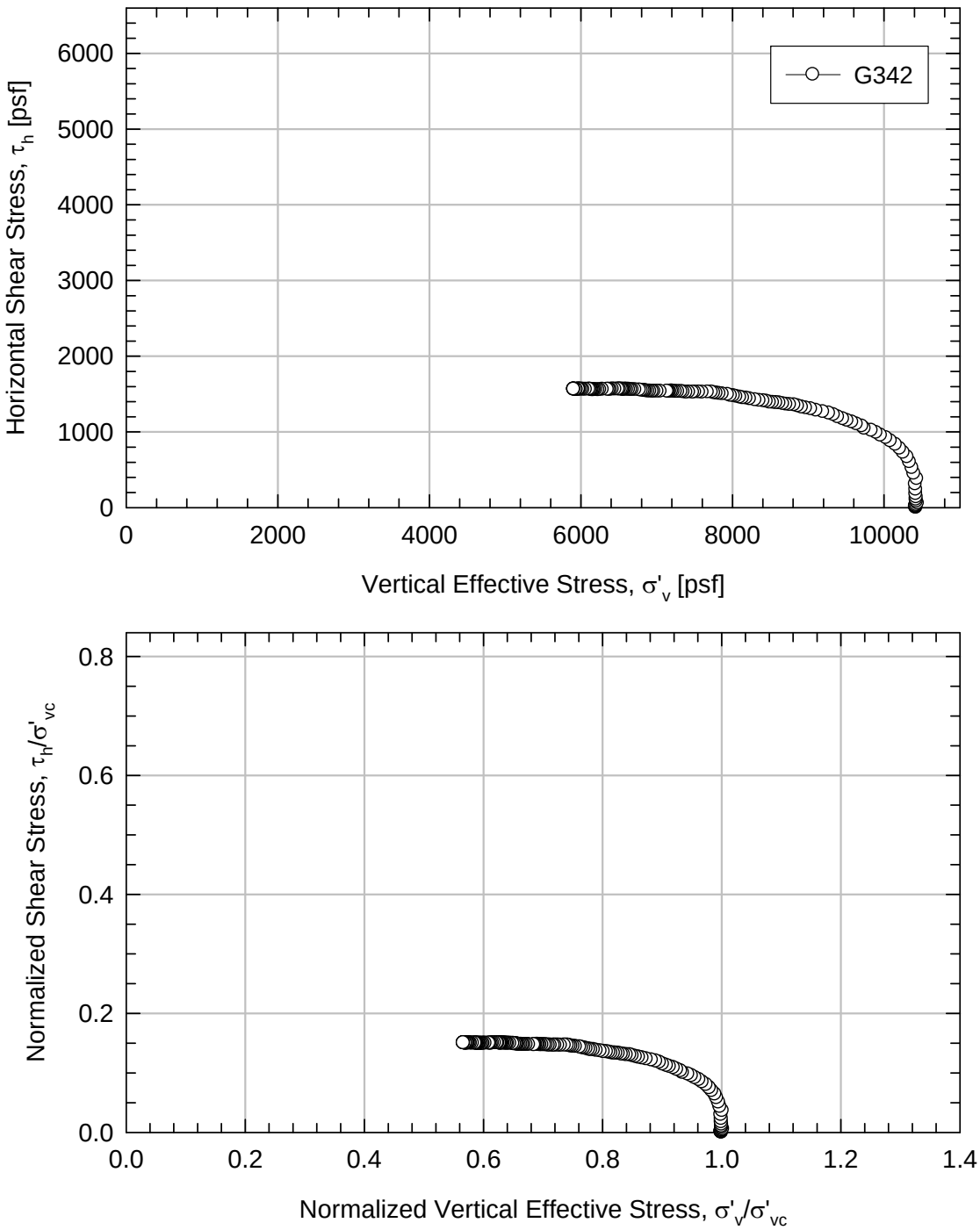

Figure 5.4.19 Horizontal shear stress versus vertical effective stress and normalized shear stress versus normalized vertical effective stress for test DSS G342 on sample AARW-10-40 UP-1 63-65 ft.

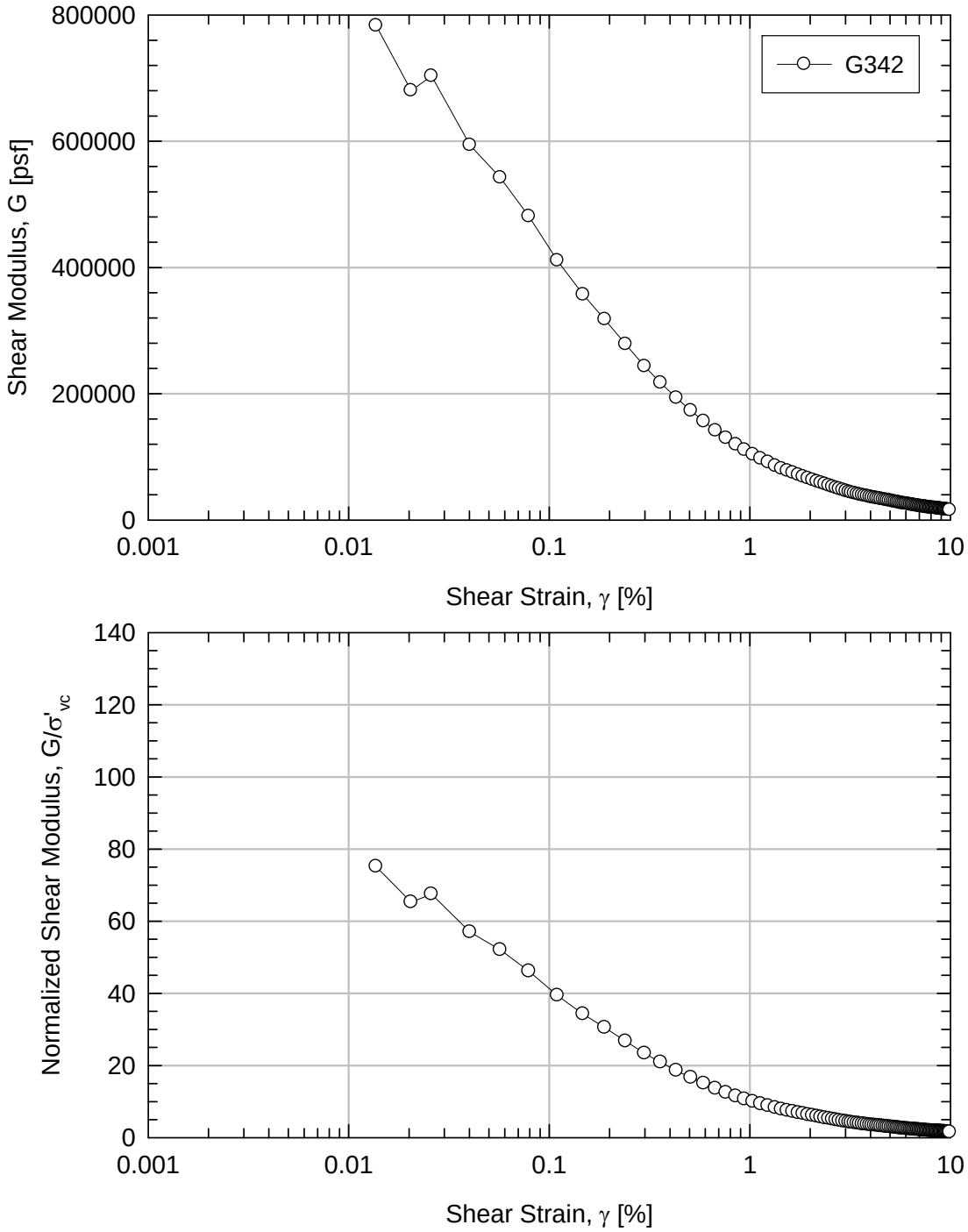

Figure 5.4.20 Shear modulus and normalized shear modulus versus shear strain for test DSS G342 on sample AARW-10-40 UP-1 63-65 ft.

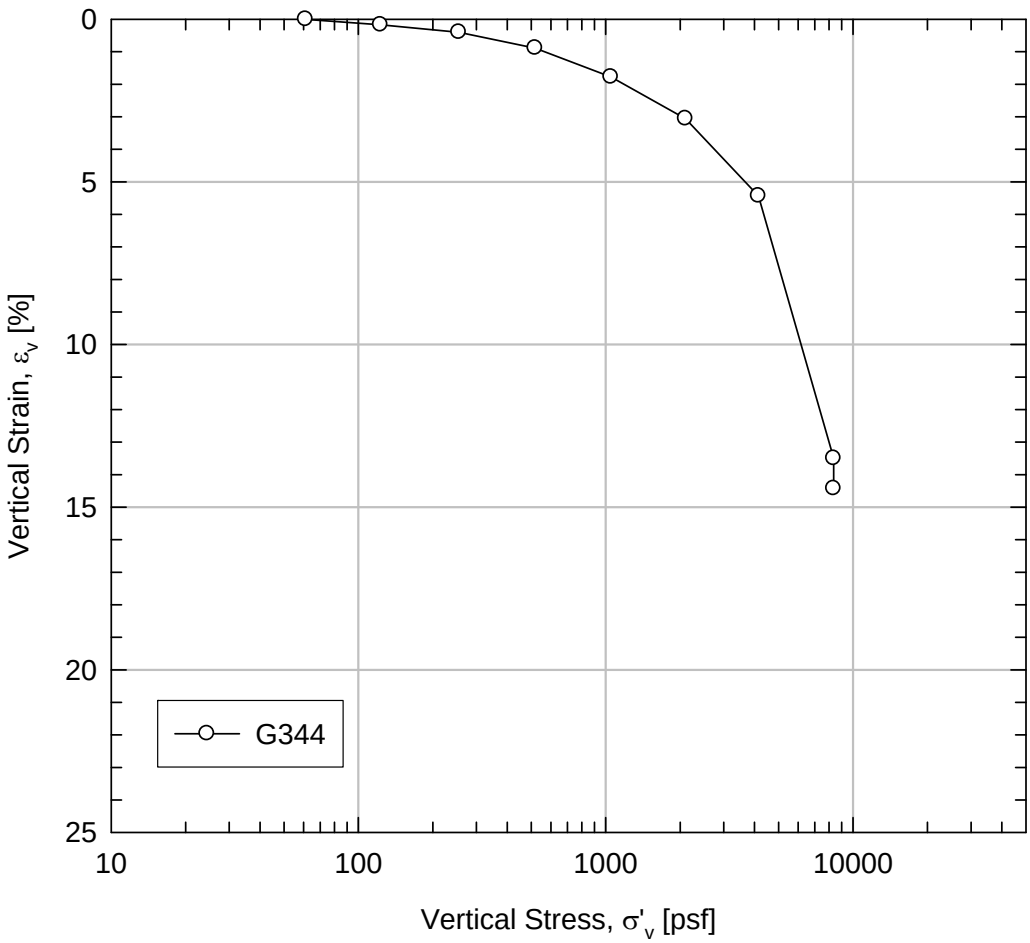

Figure 5.4.21 Vertical strain versus vertical effective stress for test DSS G344 on sample AARW-11-43 UP-2 23-25 ft.

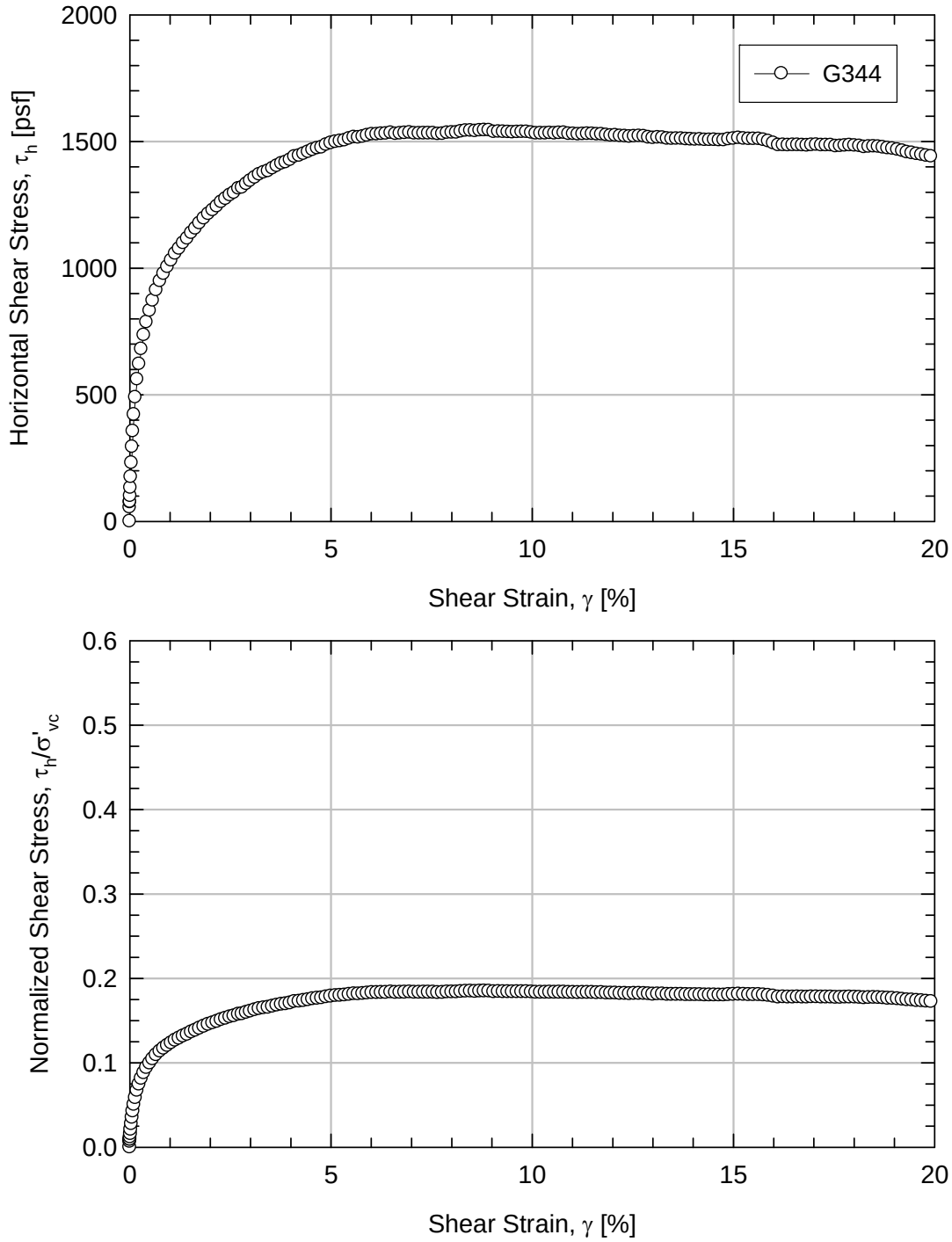

Figure 5.4.22 Horizontal shear stress and normalized shear stress versus shear strain for test DSS G344 on sample AARW-11-43 UP-2 23-25 ft.

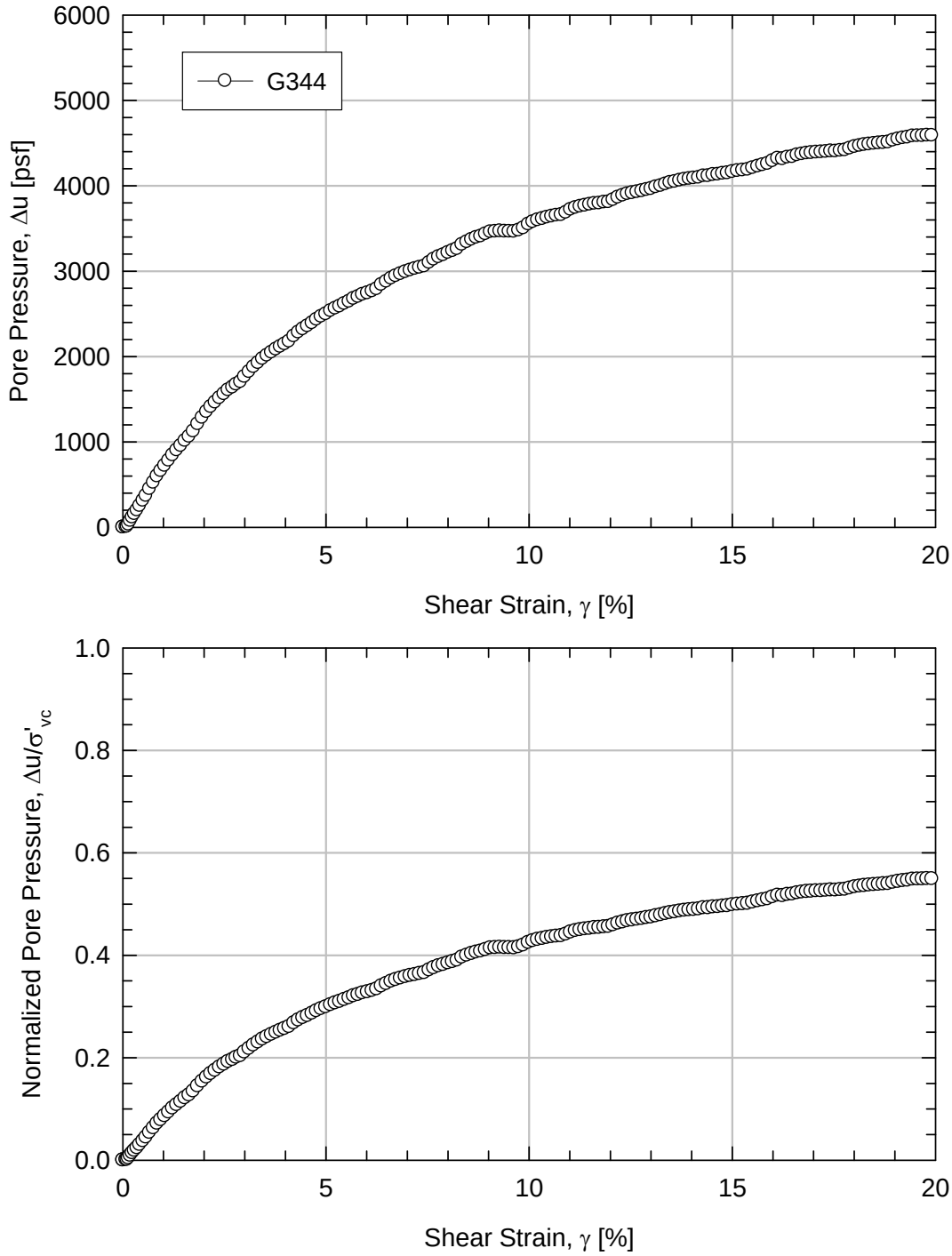

Figure 5.4.23 Pore pressure and normalized pore pressure versus shear strain for test DSS G344 on sample AARW-11-43 UP-2 23-25 ft.

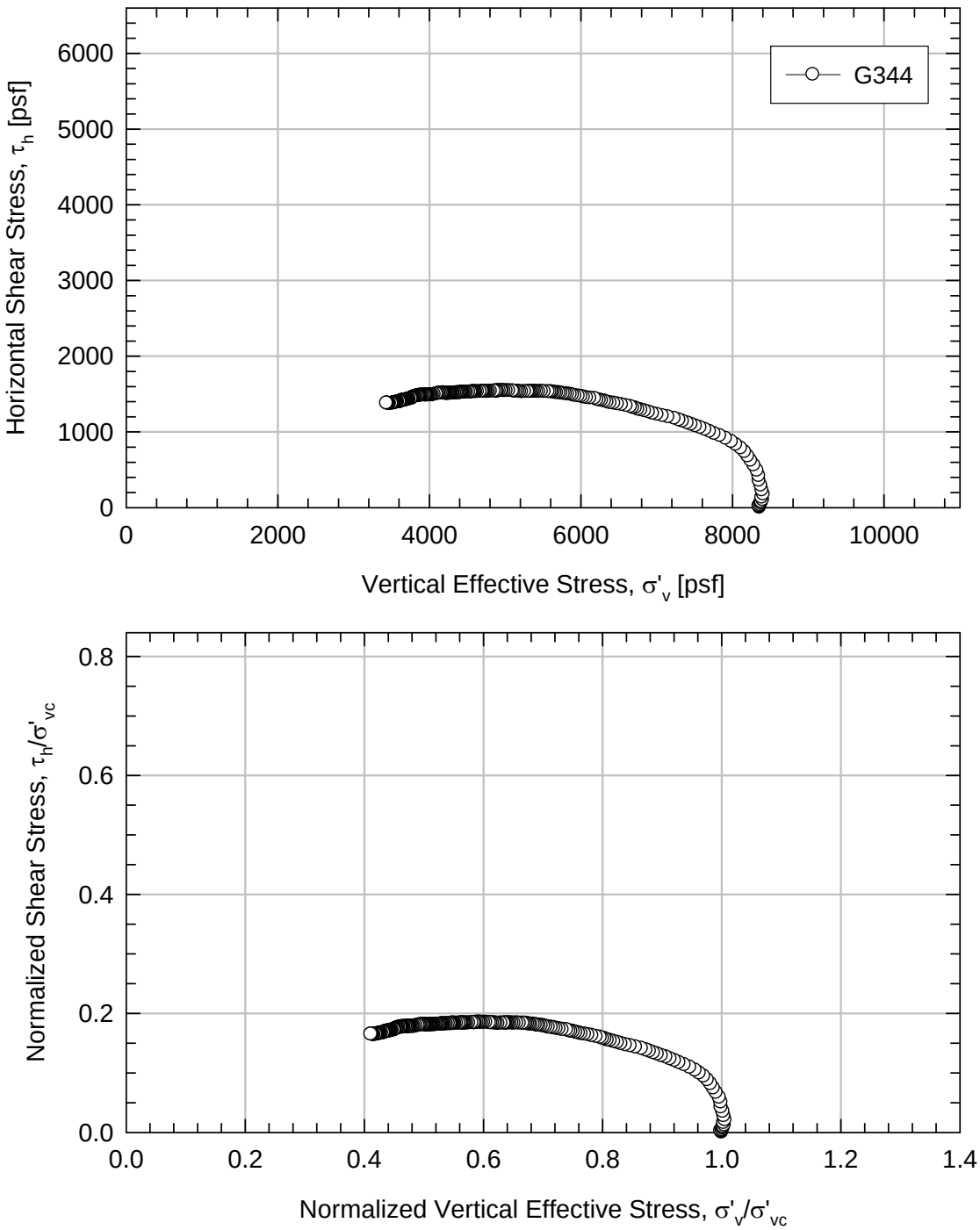

Figure 5.4.24 Horizontal shear stress versus vertical effective stress and normalized shear stress versus normalized vertical effective stress for test DSS G344 on sample AARW-11-43 UP-2 23-25 ft.

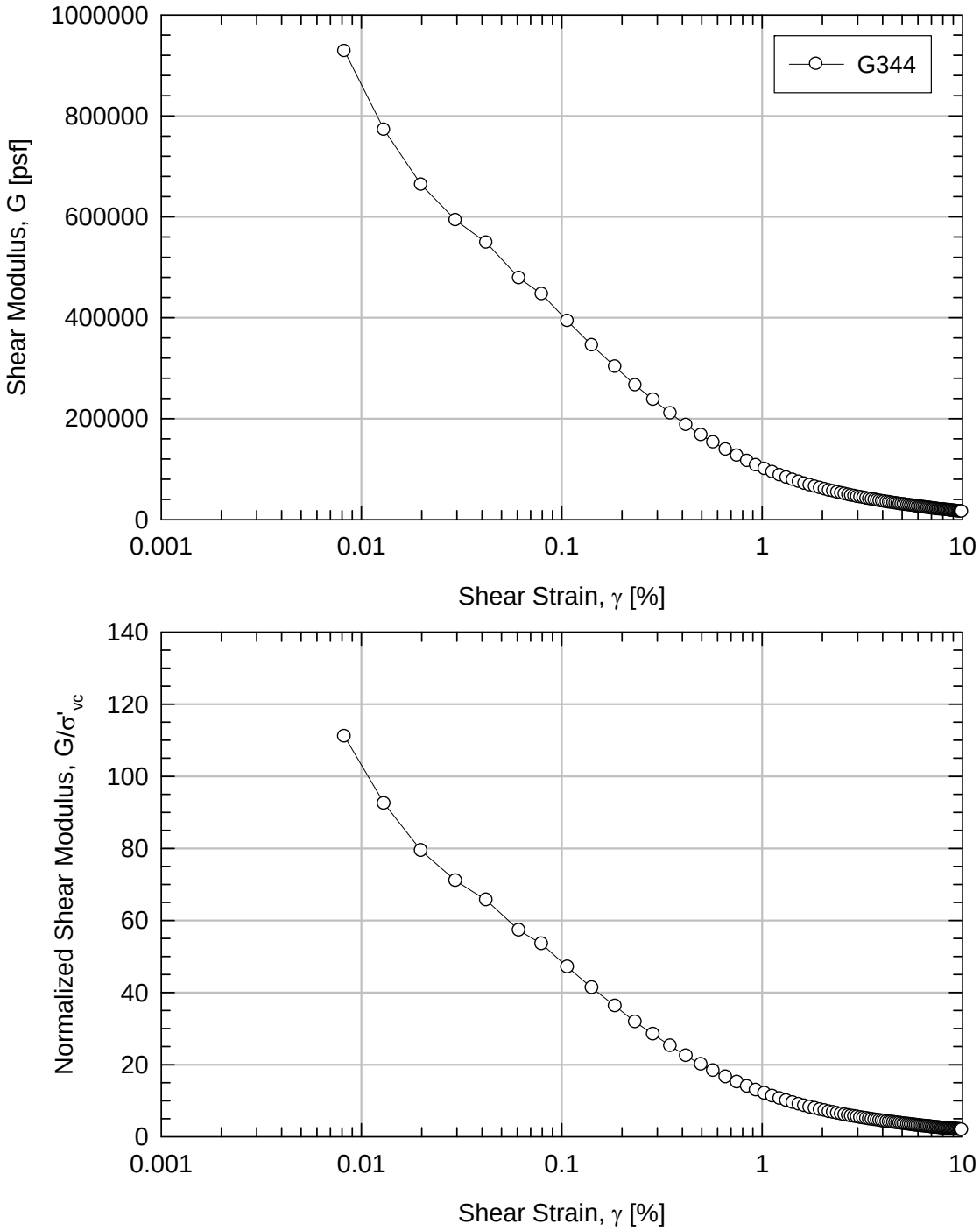

Figure 5.4.25 Shear modulus and normalized shear modulus versus shear strain for test DSS G344 on sample AARW-11-43 UP-2 23-25 ft.

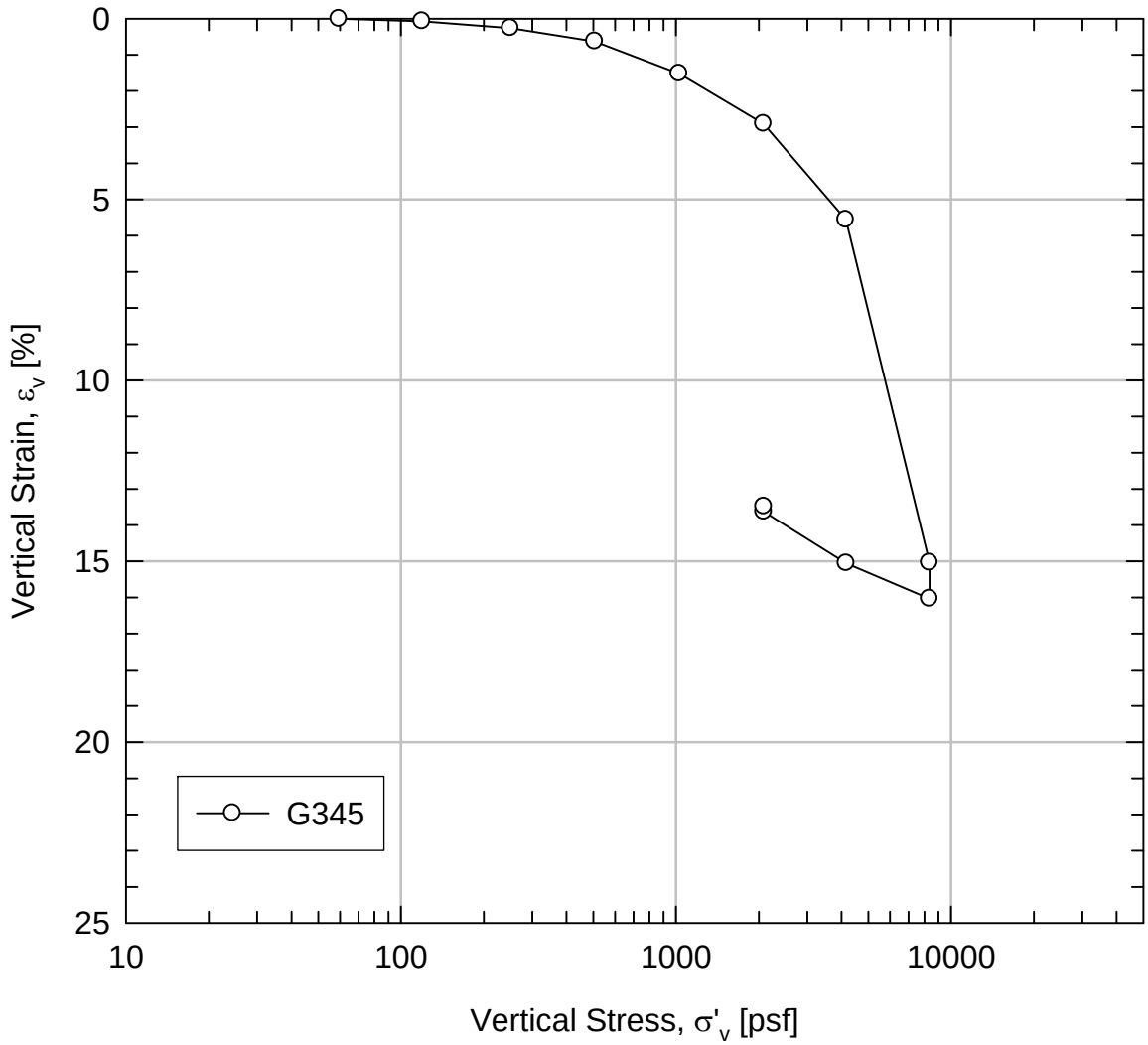

Figure 5.4.26 Vertical strain versus vertical effective stress for test DSS G345 on sample AARW-11-43 UP-2 23-25 ft.

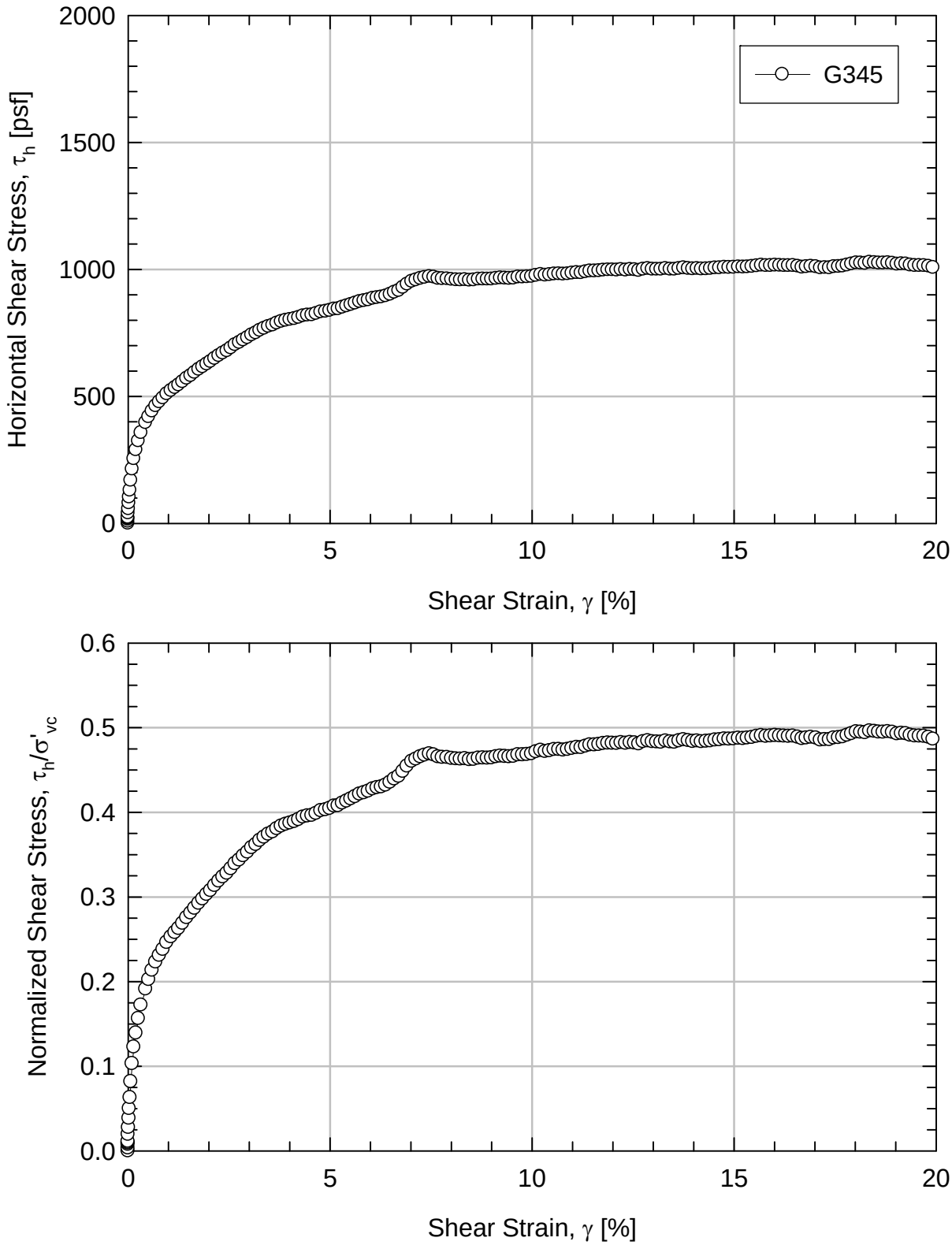

Figure 5.4.27 Horizontal shear stress and normalized shear stress versus shear strain for test DSS G345 on sample AARW-11-43 UP-2 23-25 ft.

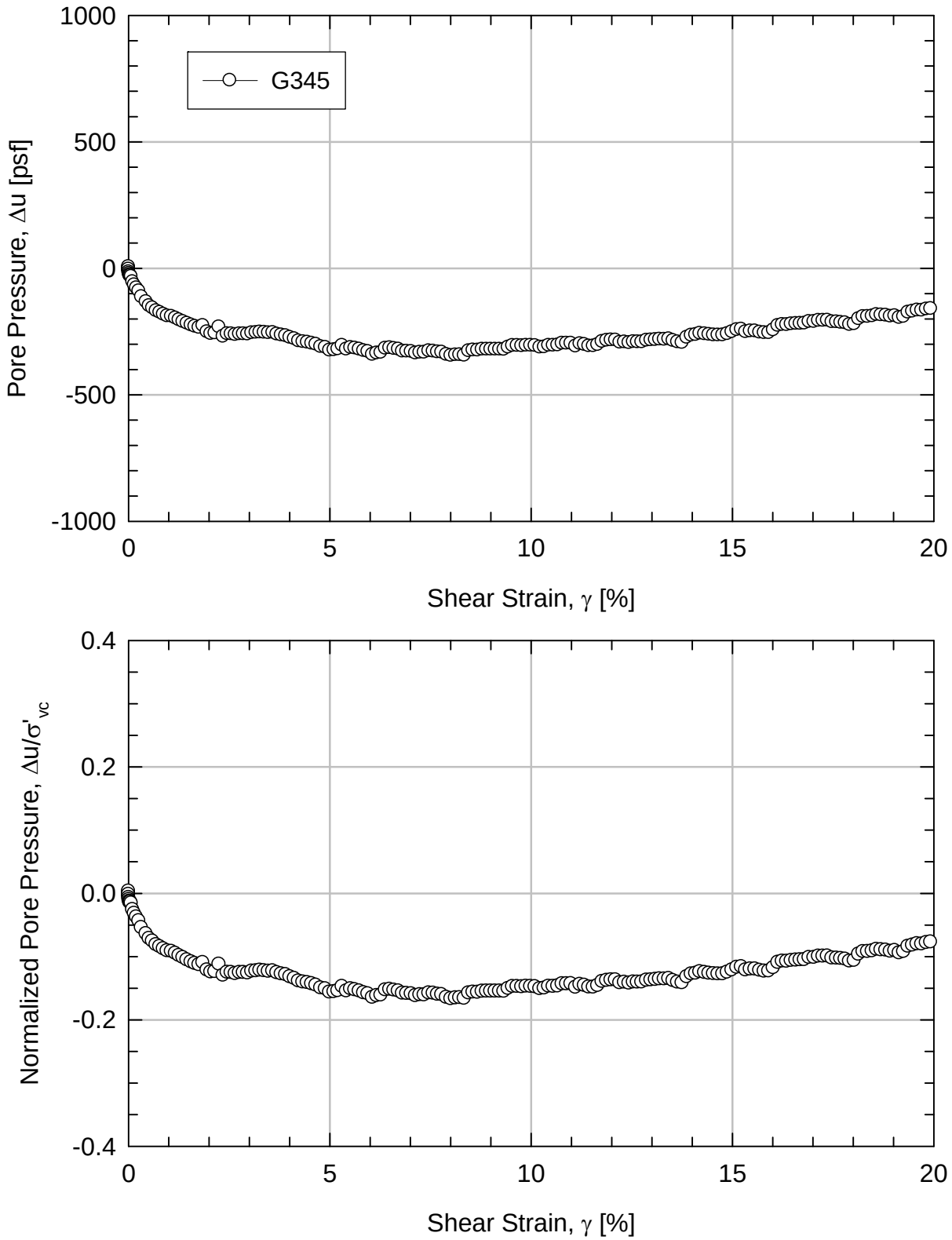

Figure 5.4.28 Pore pressure and normalized pore pressure versus shear strain for test DSS G345 on sample AARW-11-43 UP-2 23-25 ft.

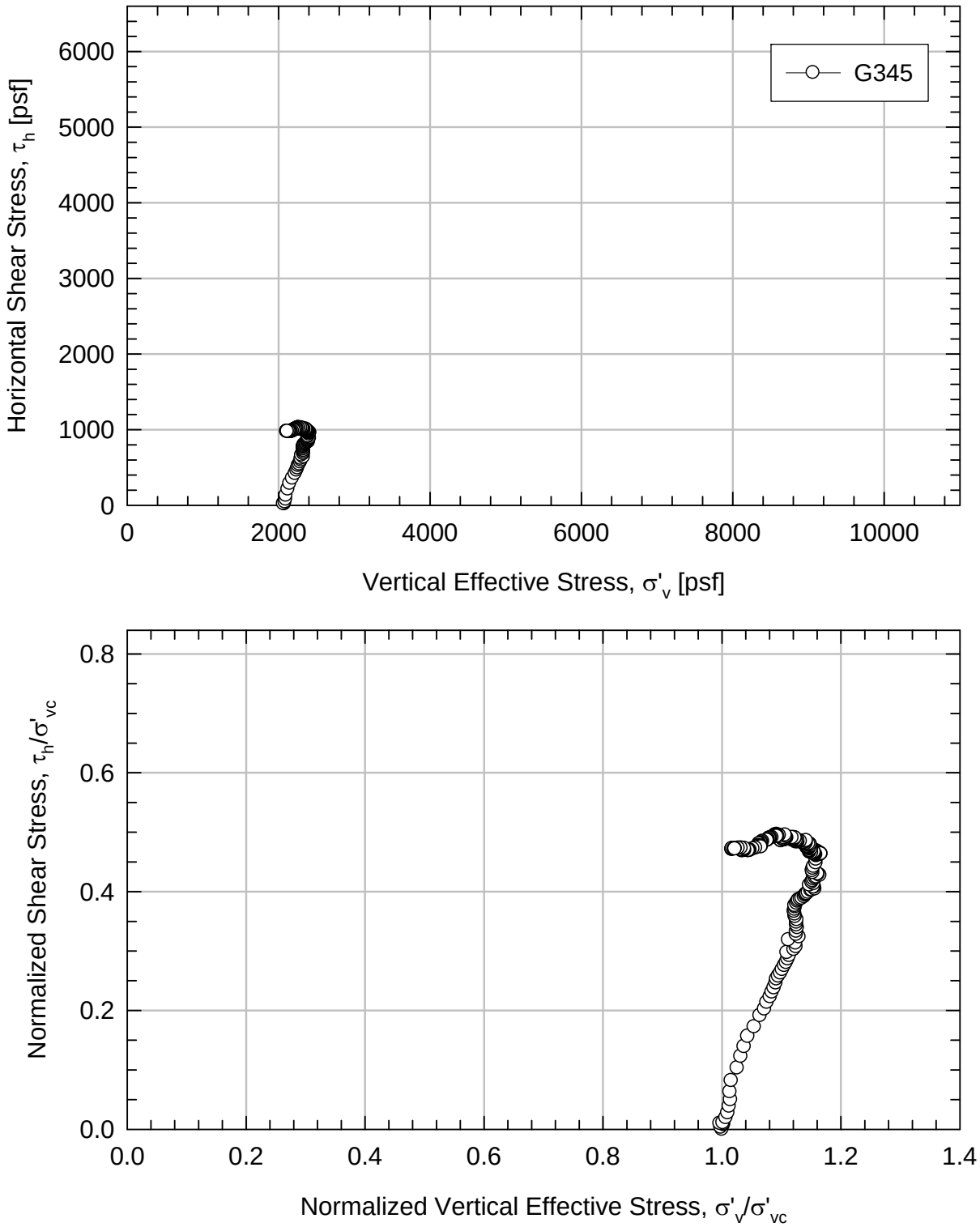

Figure 5.4.29 Horizontal shear stress versus vertical effective stress and normalized shear stress versus normalized vertical effective stress for test DSS G345 on sample AARW-11-43 UP-2 23-25 ft.

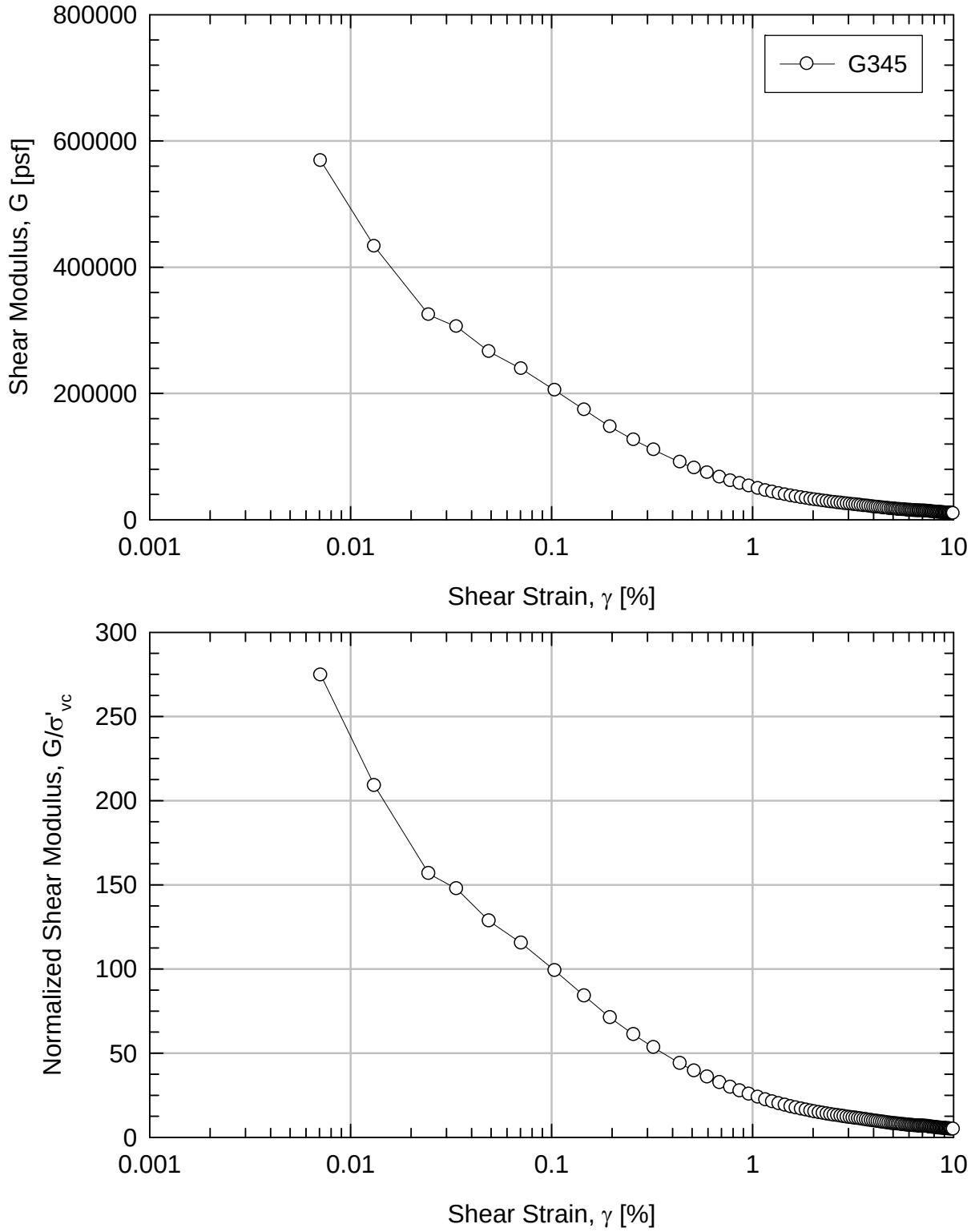

Figure 5.4.30 Shear modulus and normalized shear modulus versus shear strain for test DSS G345 on sample AARW-11-43 UP-2 23-25 ft.

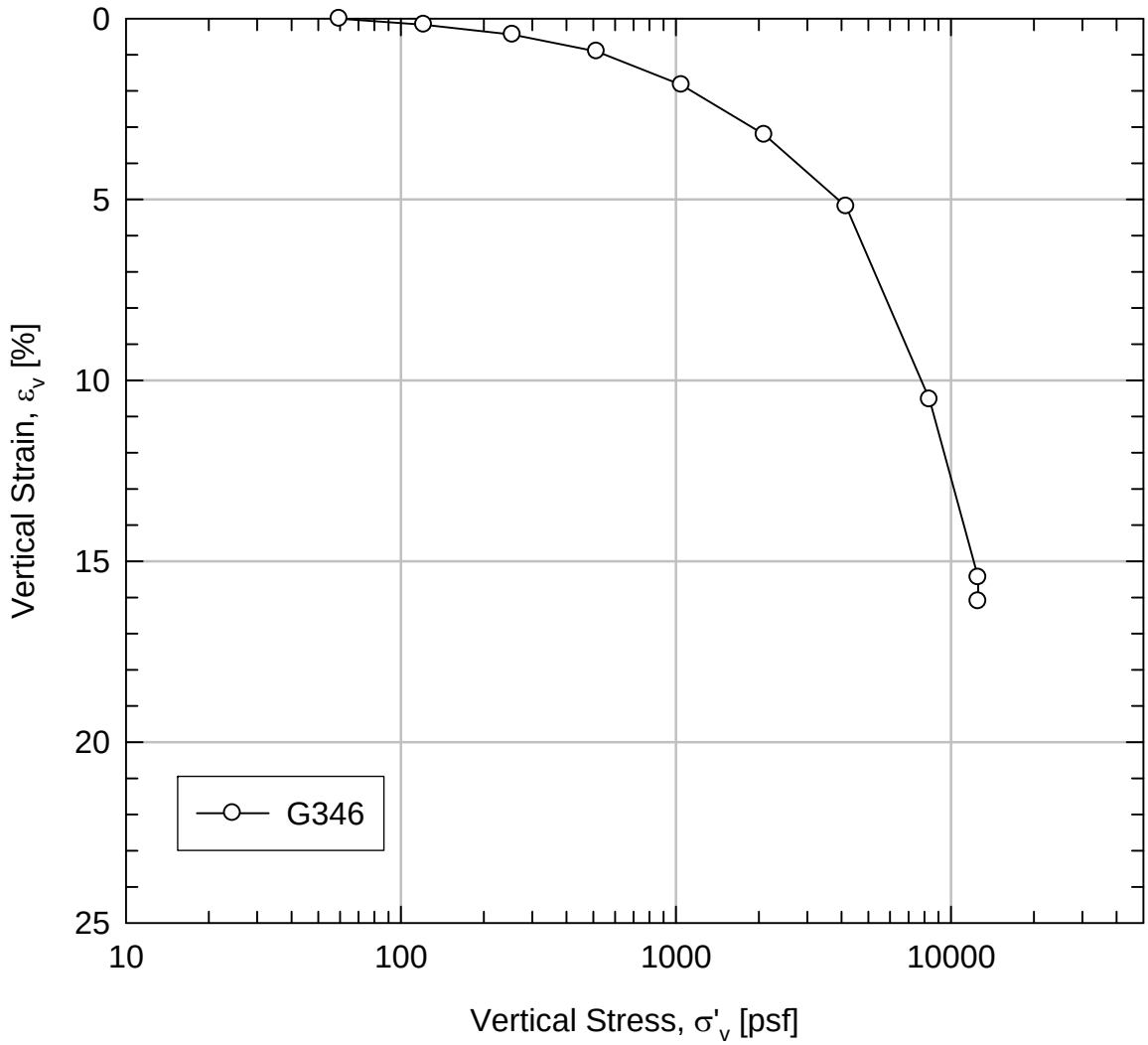

Figure 5.4.31 Vertical strain versus vertical effective stress for test DSS G346 on Sample AAB-01-16 UP-1 13-15 ft.

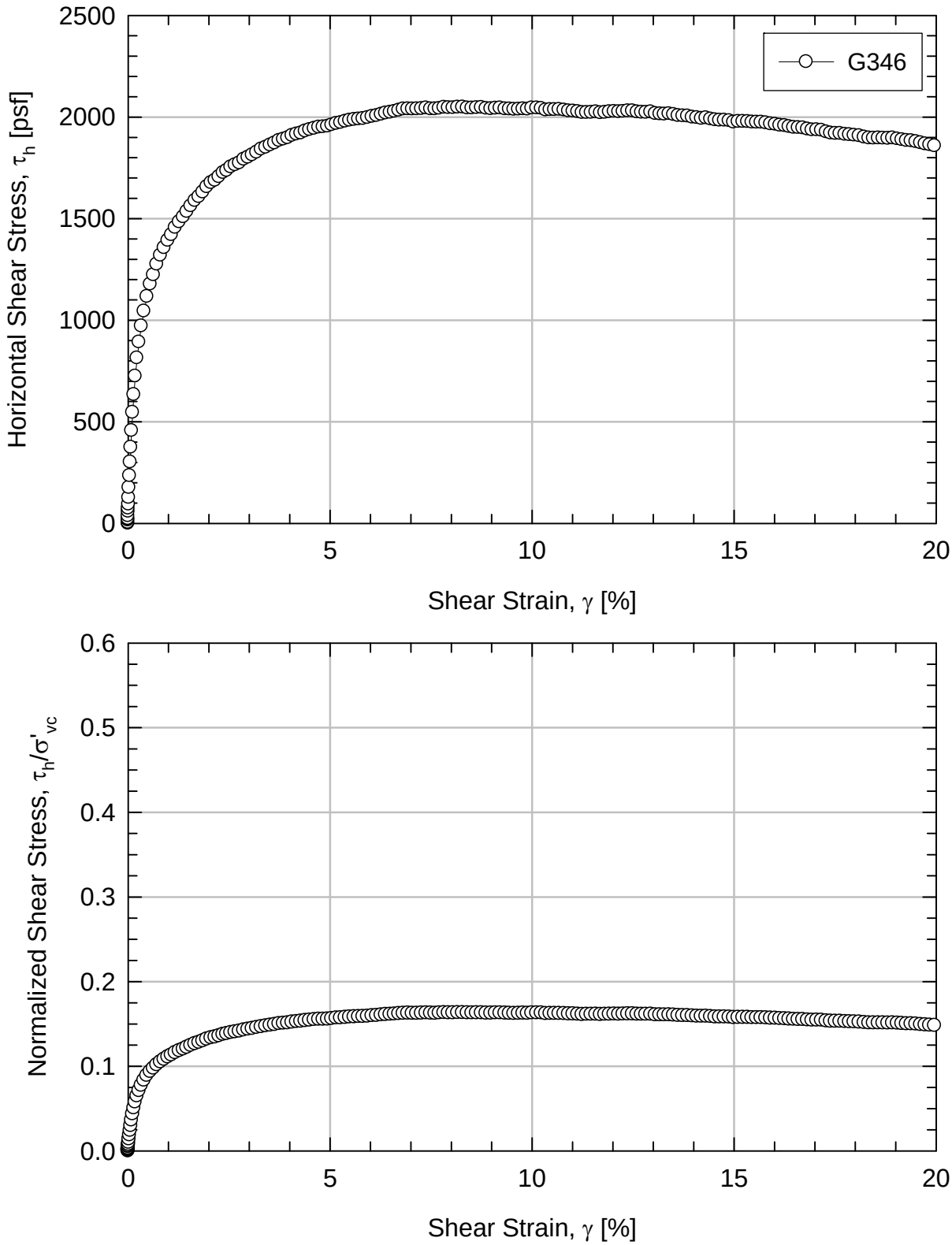

Figure 5.4.32 Horizontal shear stress and normalized shear stress versus shear strain for test DSS G346 on Sample AAB-01-16 UP-1 13-15 ft.

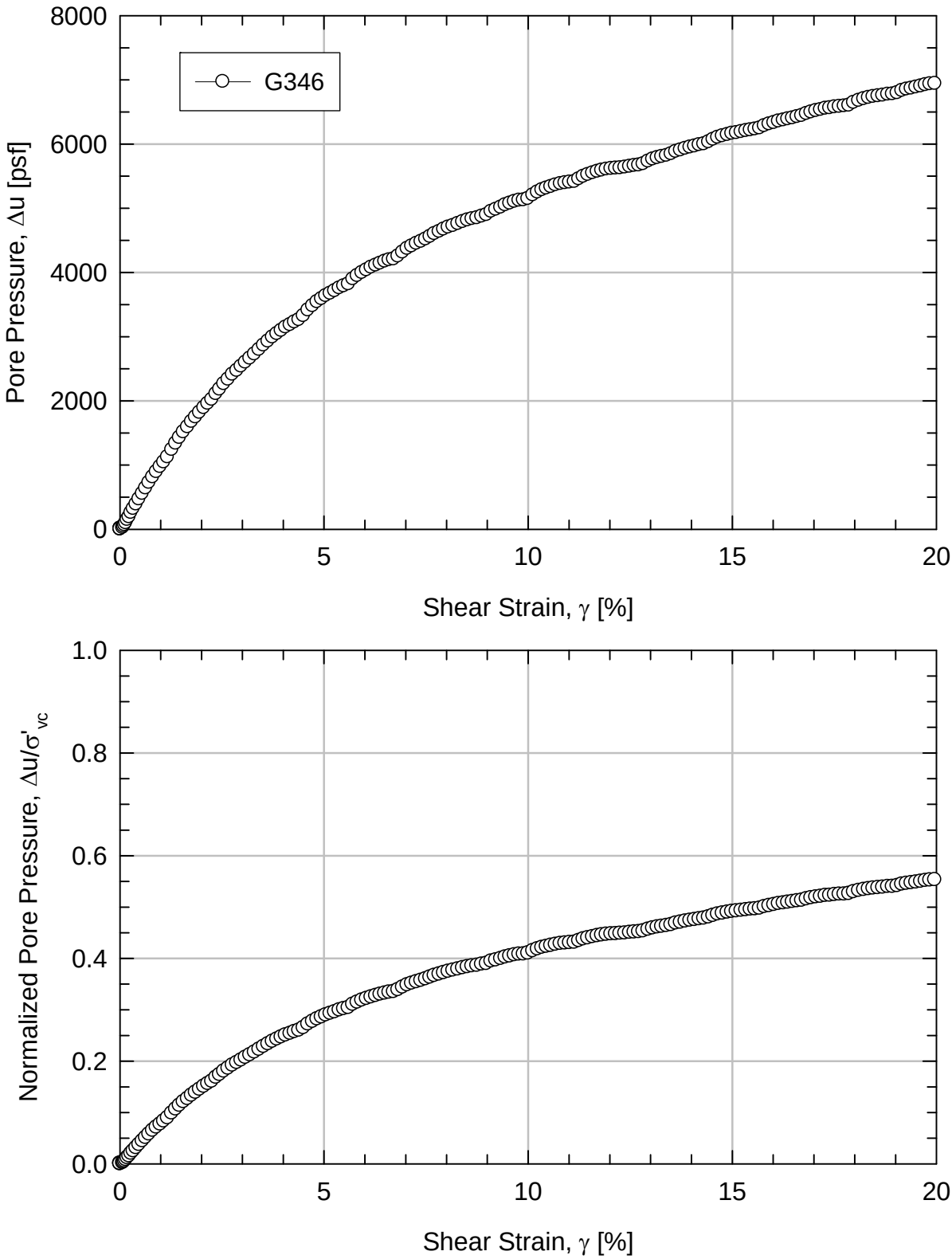

Figure 5.4.33 Pore pressure and normalized pore pressure versus shear strain for test DSS G346 on Sample AAB-01-16 UP-1 13-15 ft.

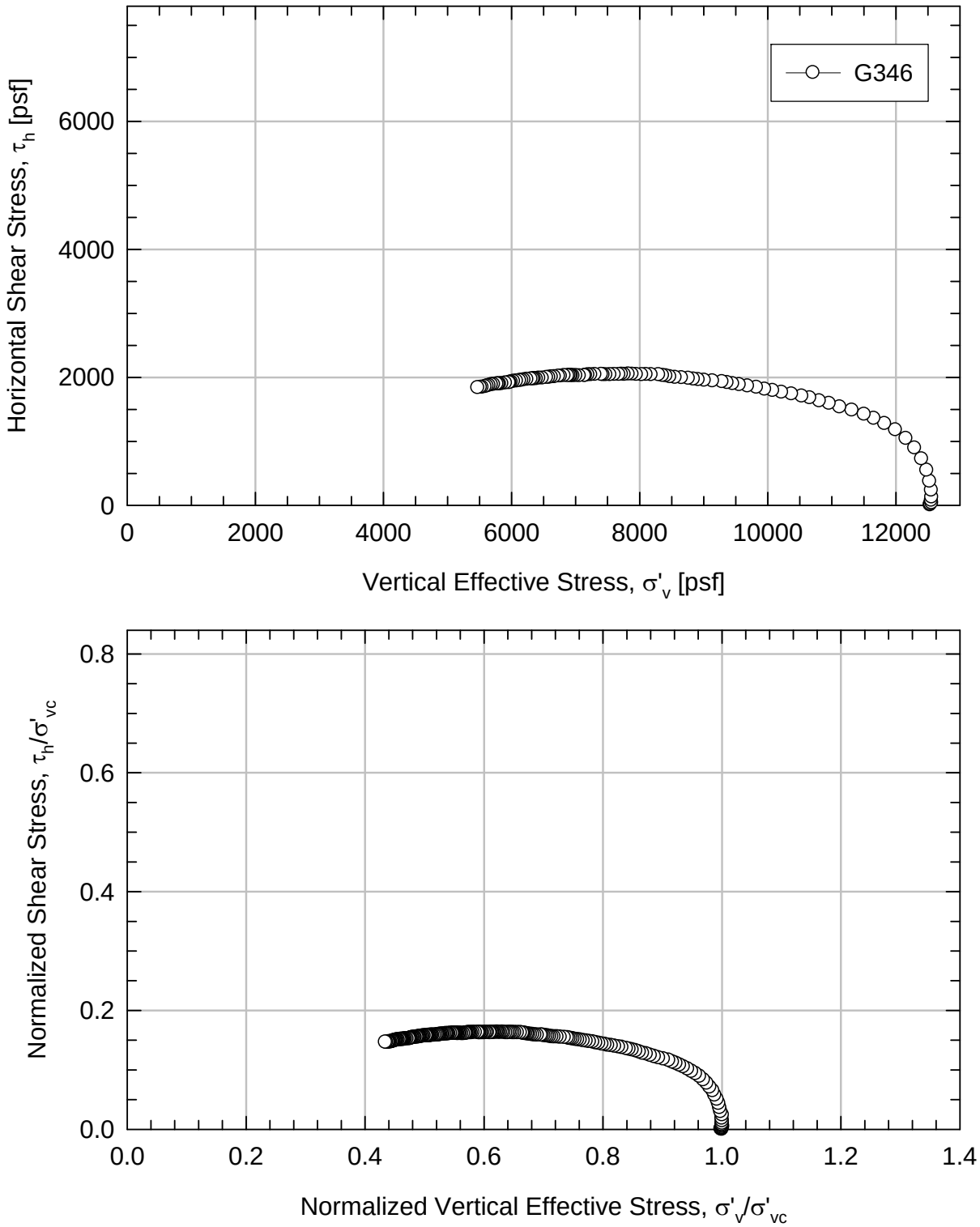

Figure 5.4.34 Horizontal shear stress versus vertical effective stress and normalized shear stress versus normalized vertical effective stress for test DSS G346 on Sample AAB-01-16 UP-1 13-15 ft.

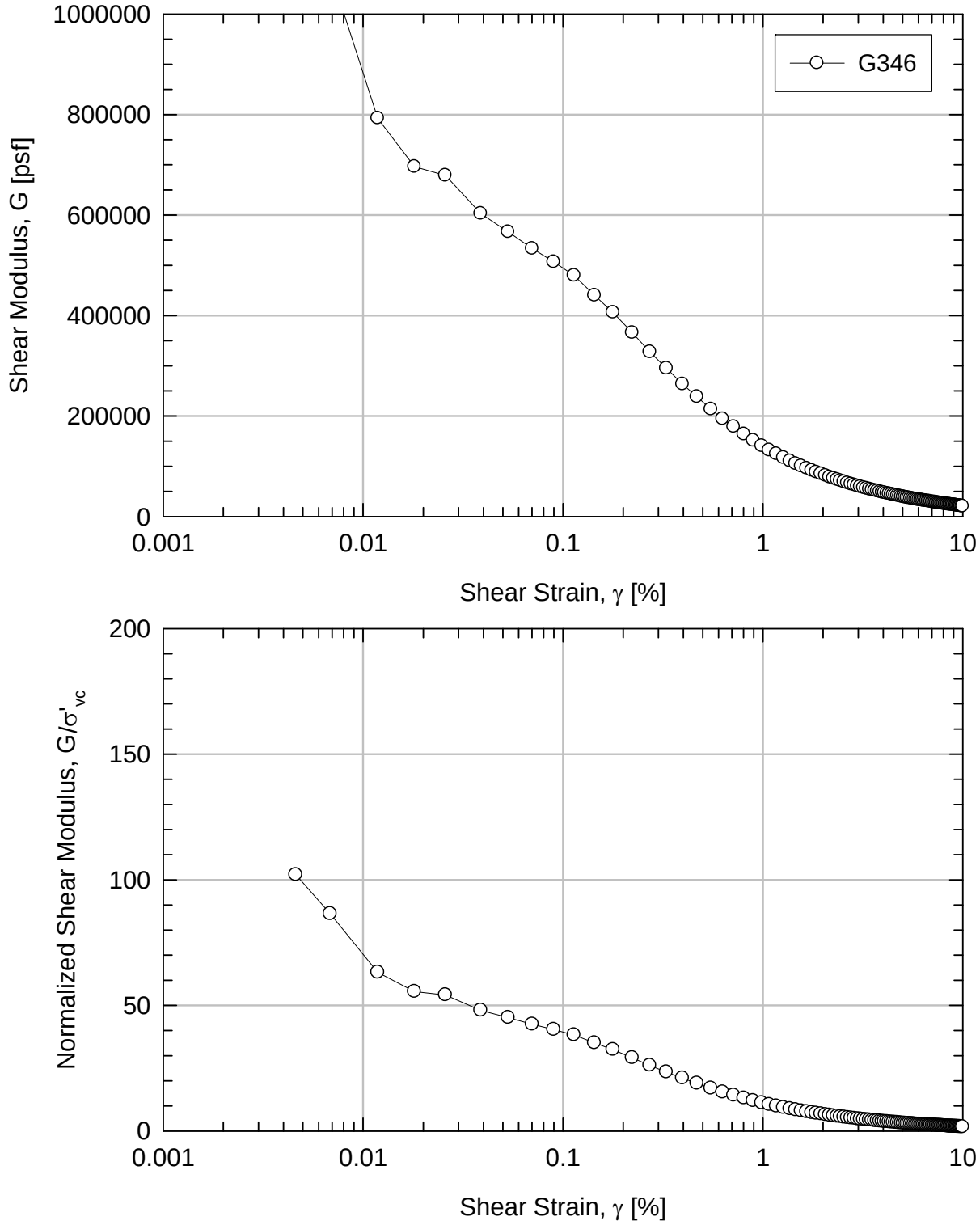

Figure 5.4.35 Shear modulus and normalized shear modulus versus shear strain for test DSS G346 on Sample AAB-01-16 UP-1 13-15 ft.

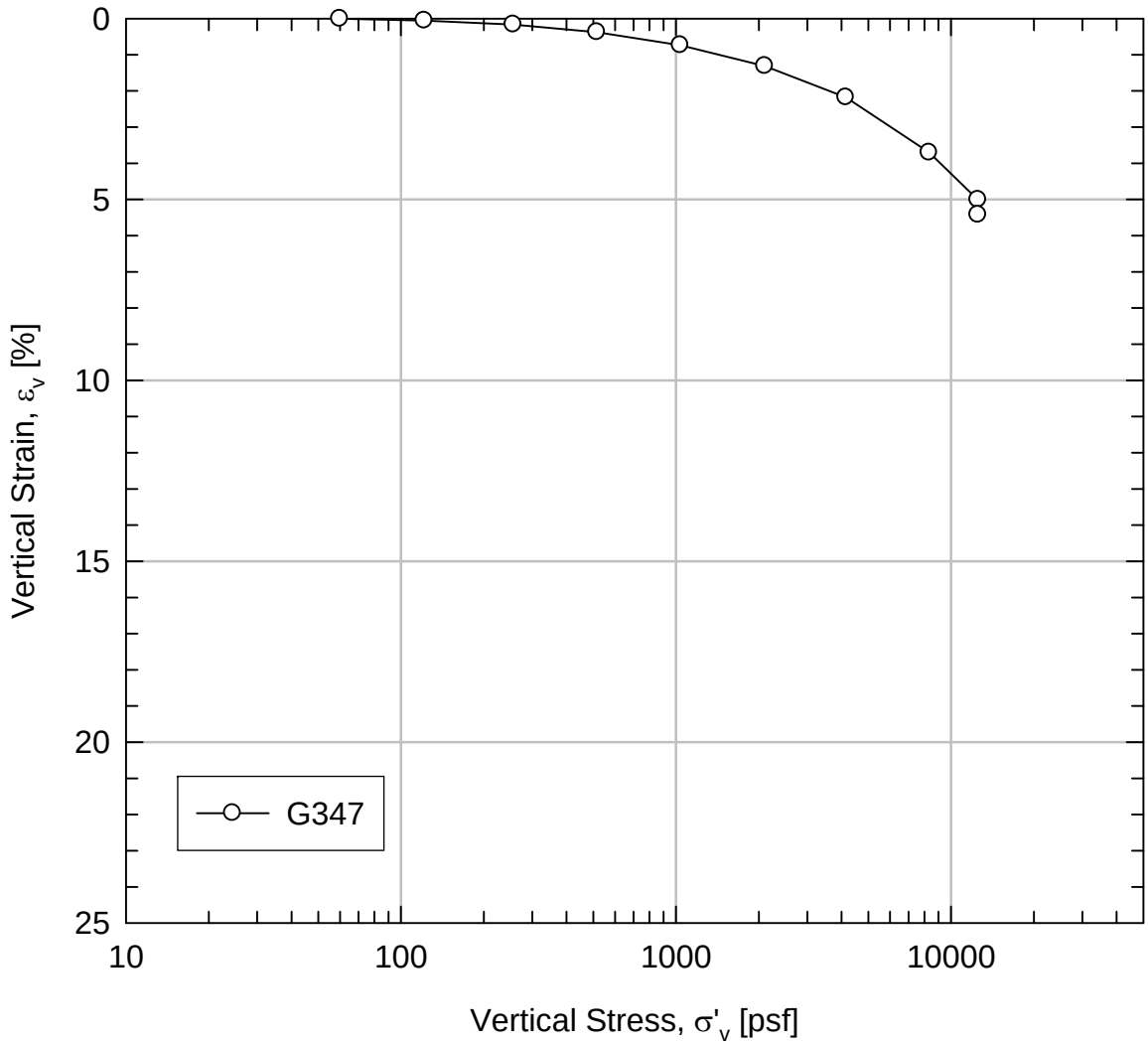

Figure 5.4.36 Vertical strain versus vertical effective stress for test DSS G347 on Sample AARW-01-04 UP-2 43-45 ft.

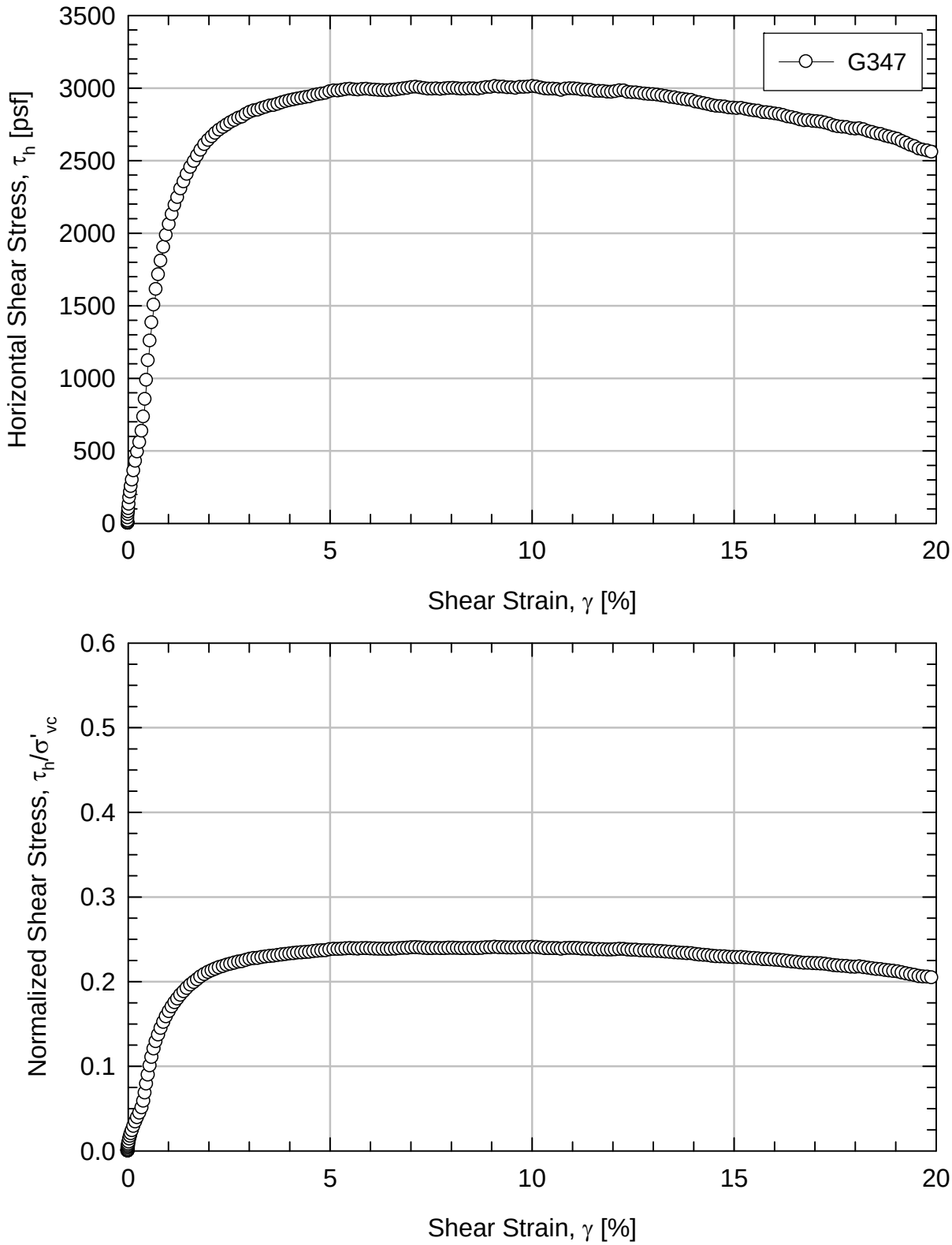

Figure 5.4.37 Horizontal shear stress and normalized shear stress versus shear strain for test DSS G347 on Sample AARW-01-04 UP-2 43-45 ft.

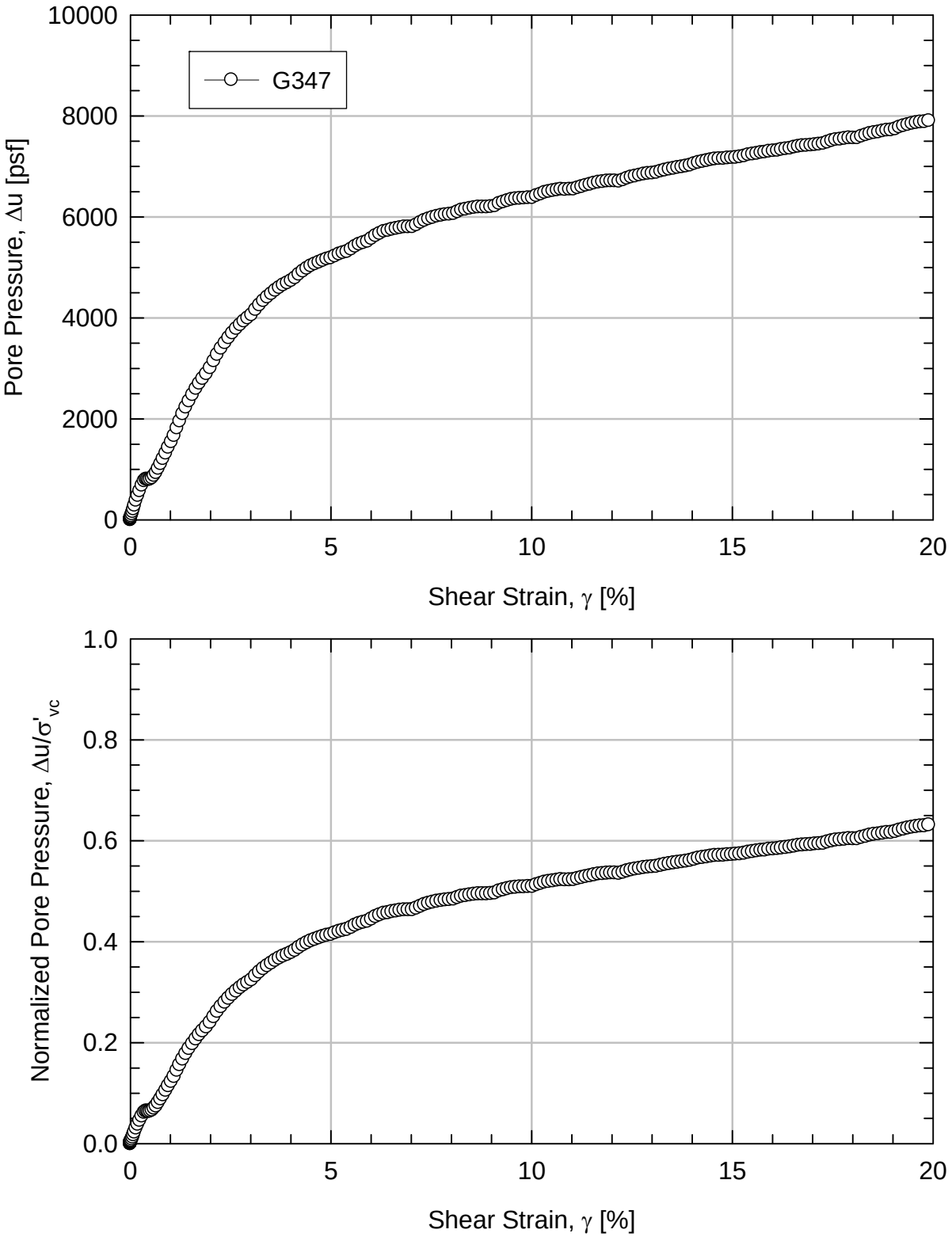

Figure 5.4.38 Pore pressure and normalized pore pressure versus shear strain for test DSS G347 on Sample AARW-01-04 UP-2 43-45 ft.

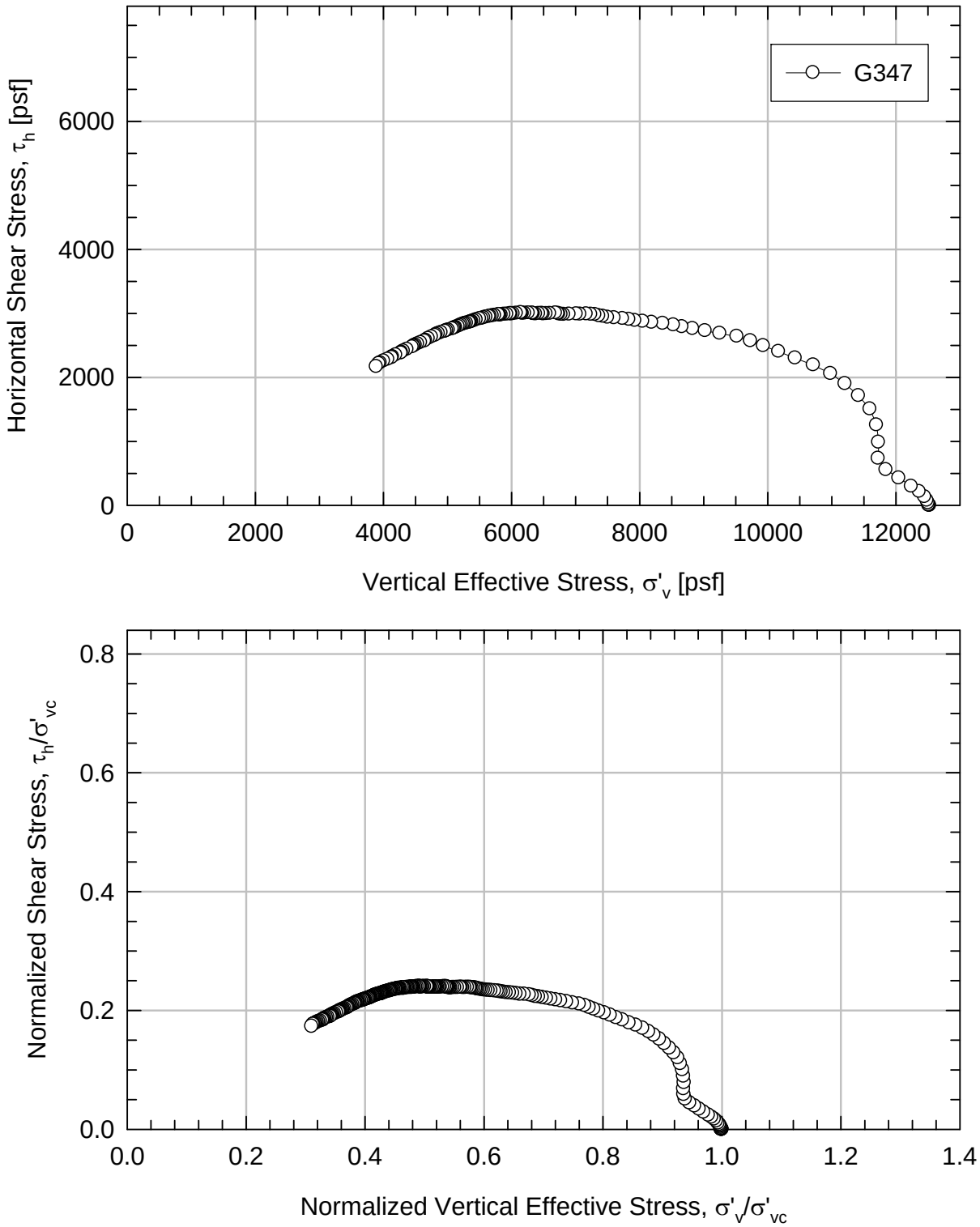

Figure 5.4.39 Horizontal shear stress versus vertical effective stress and normalized shear stress versus normalized vertical effective stress for test DSS G347 on Sample AARW-01-04 UP-2 43-45 ft.

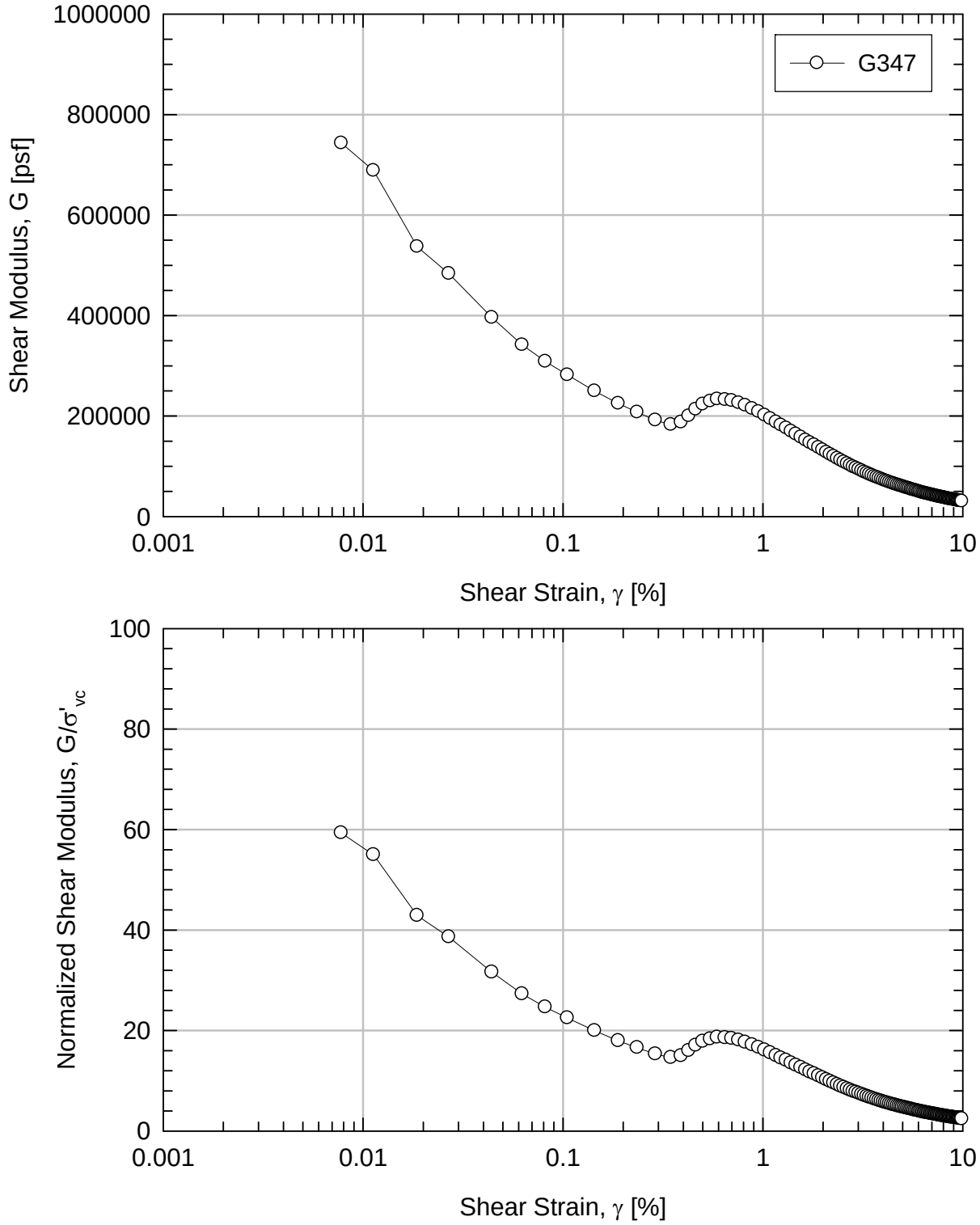

Figure 5.4.40 Shear modulus and normalized shear modulus versus shear strain for test DSS G347 on Sample AARW-01-04 UP-2 43-45 ft.

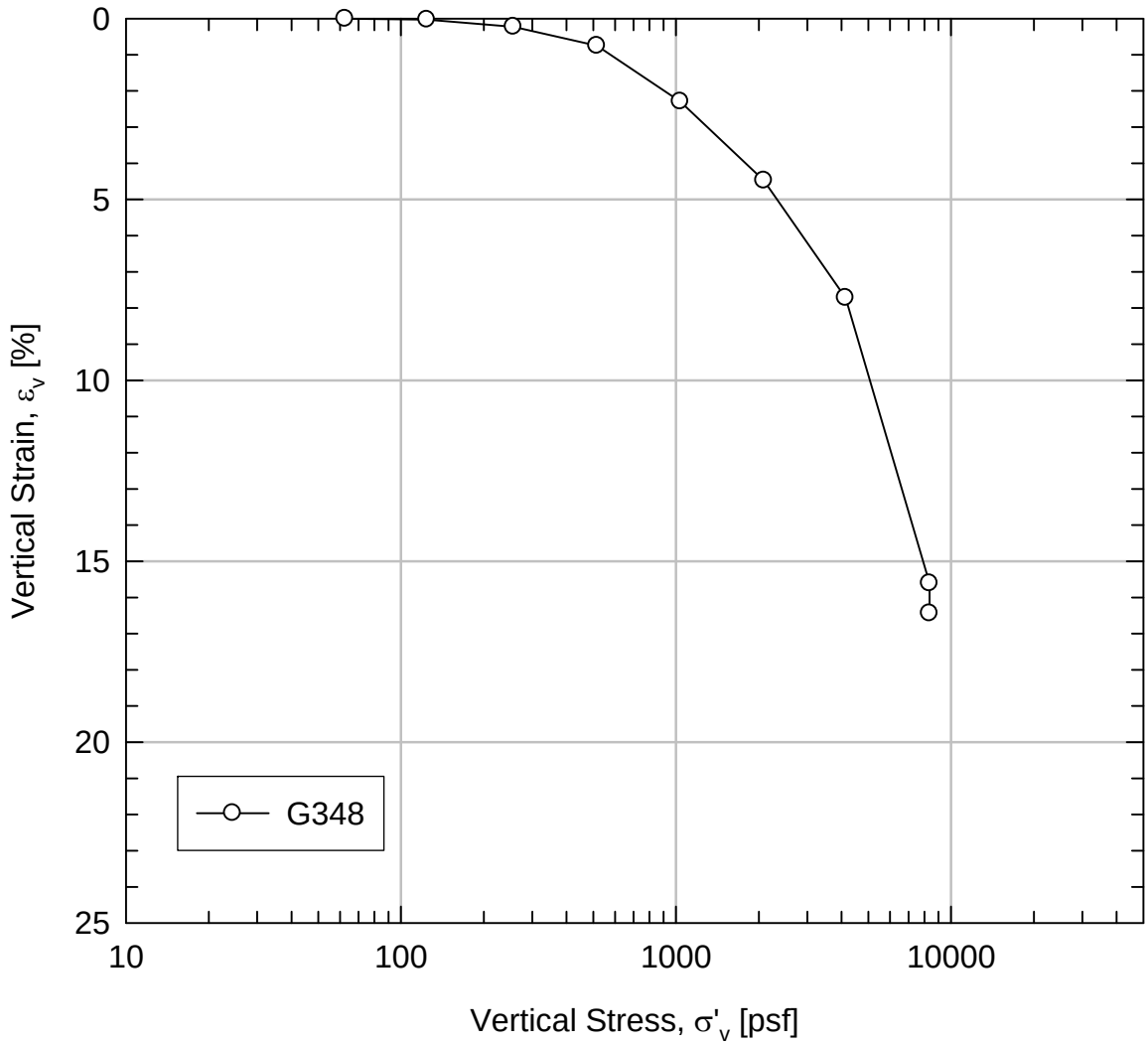

Figure 5.4.41 Vertical strain versus vertical effective stress for test DSS G348 on Sample AAB-02-22A UP-1 43-45 ft.

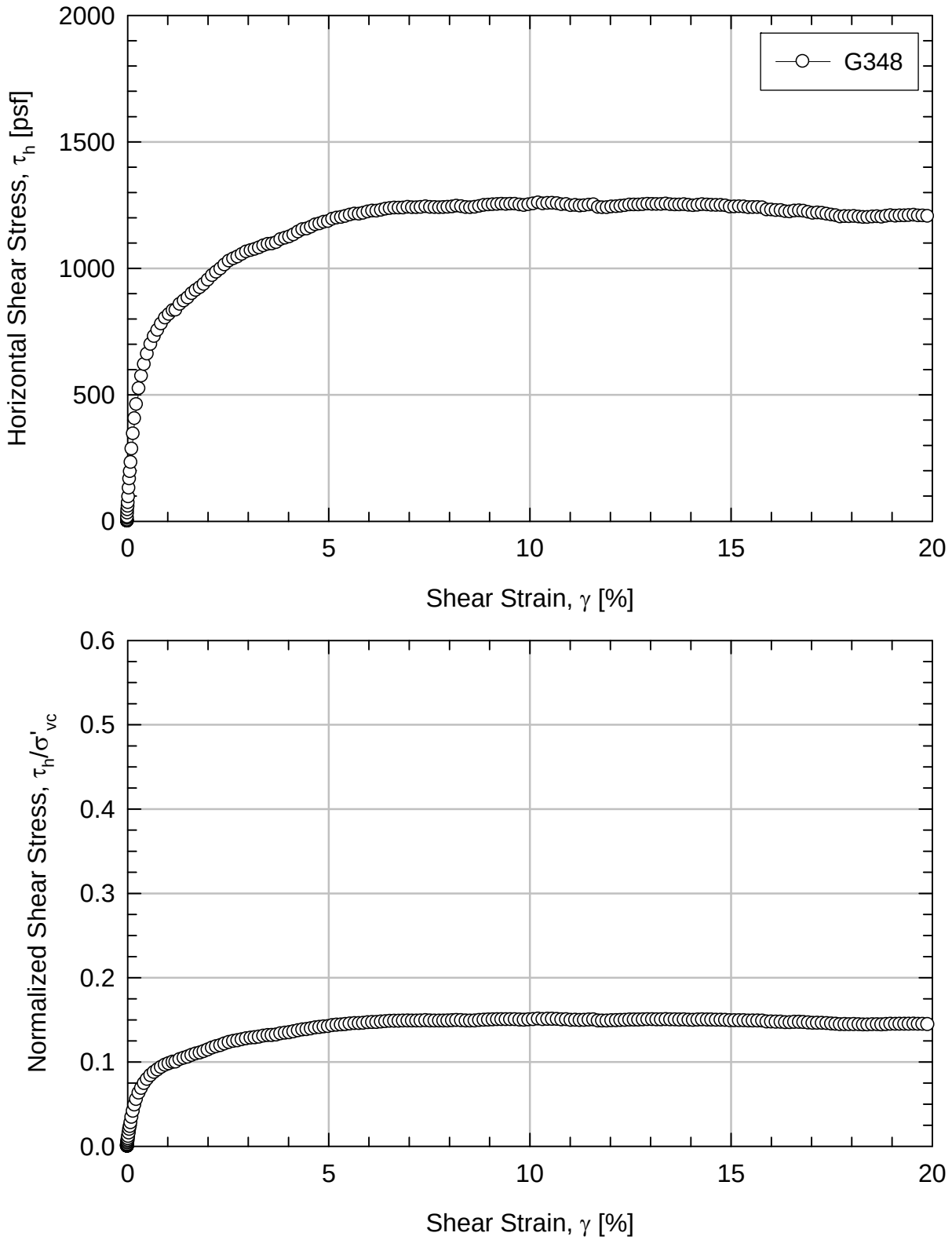

Figure 5.4.42 Horizontal shear stress and normalized shear stress versus shear strain for test DSS G348 on Sample AAB-02-22A UP-1 43-45 ft.

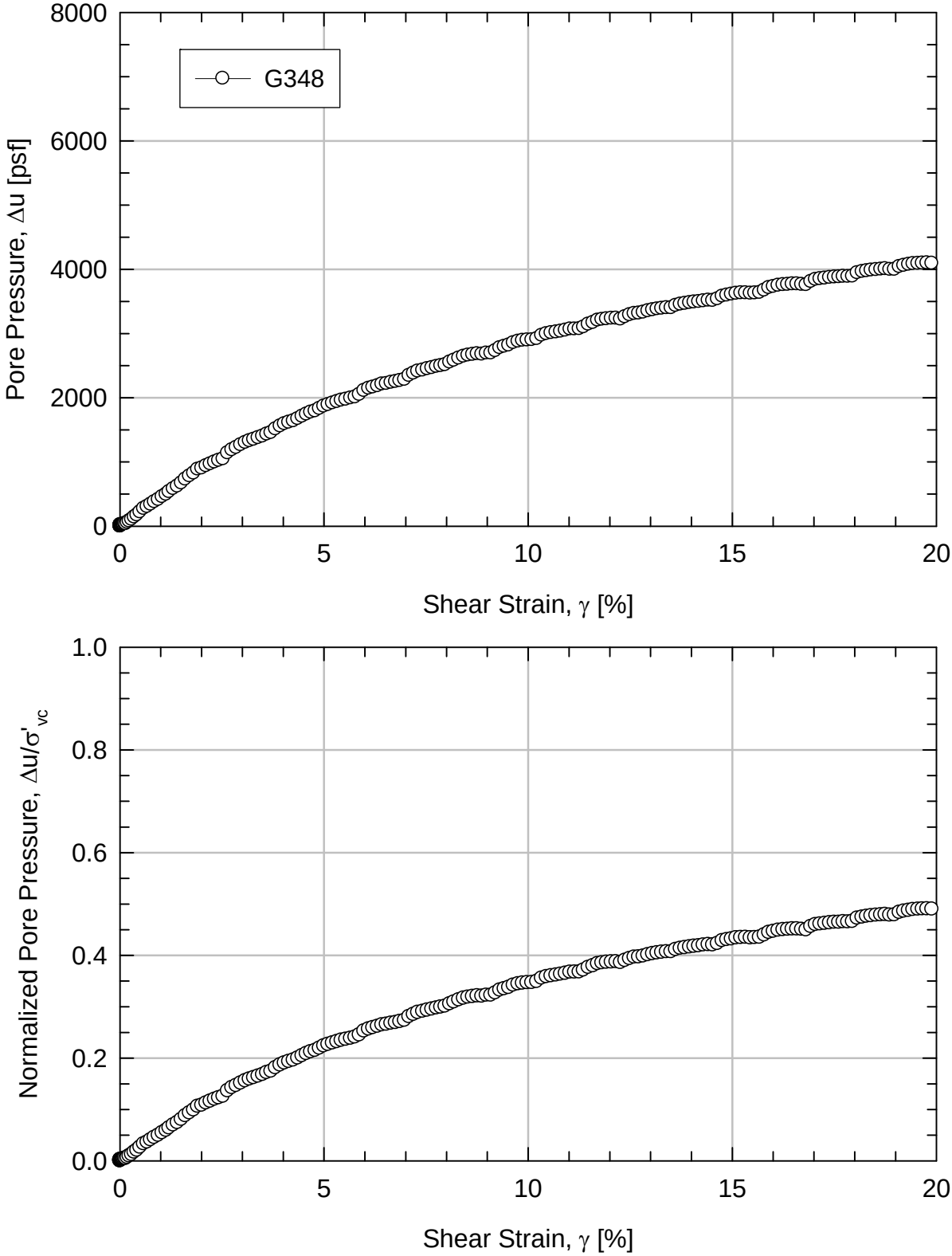

Figure 5.4.43 Pore pressure and normalized pore pressure versus shear strain for test DSS G348 on Sample AAB-02-22A UP-1 43-45 ft.

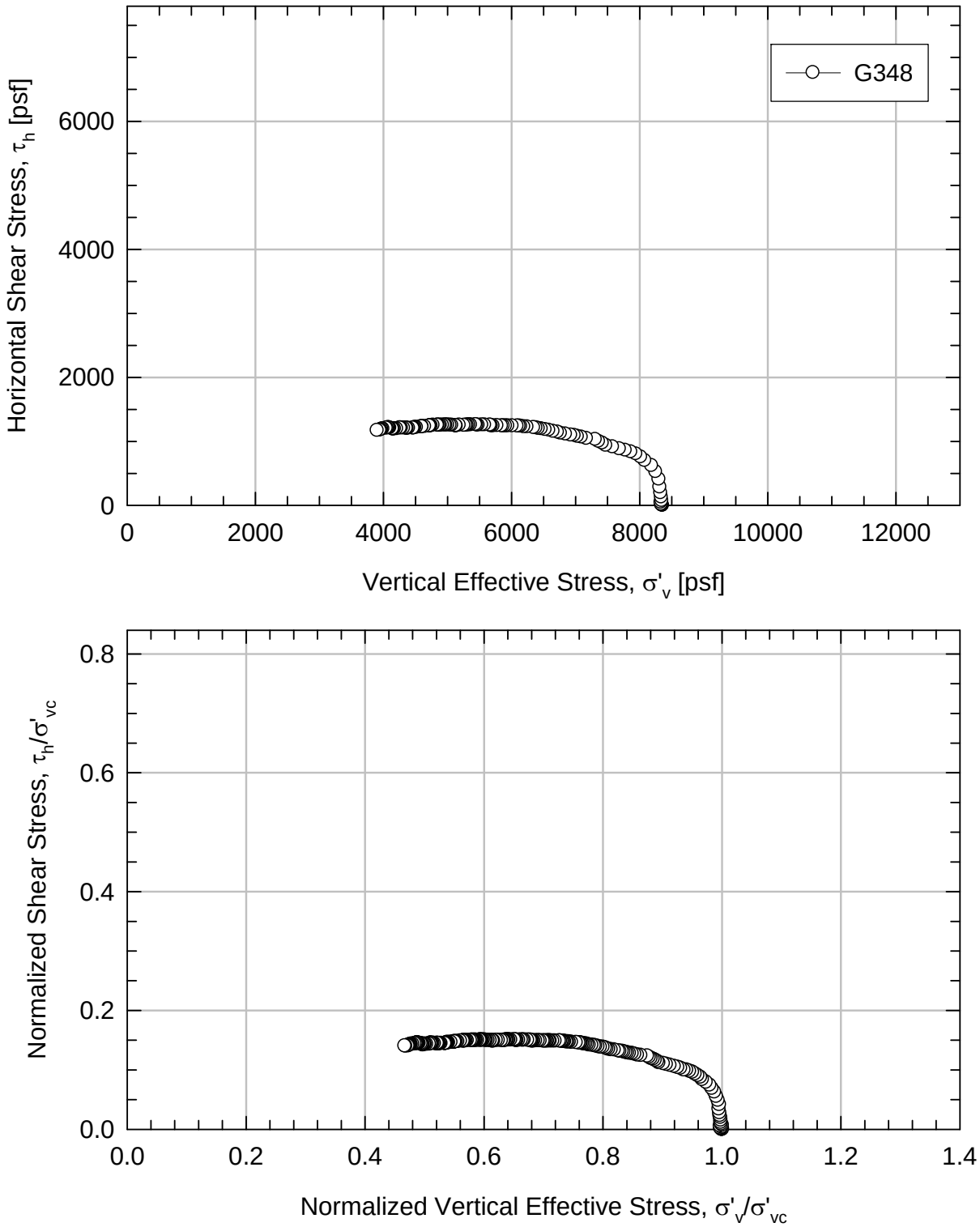

Figure 5.4.44 Horizontal shear stress versus vertical effective stress and normalized shear stress versus normalized vertical effective stress for test DSS G348 on Sample AAB-02-22A UP-1 43-45 ft.

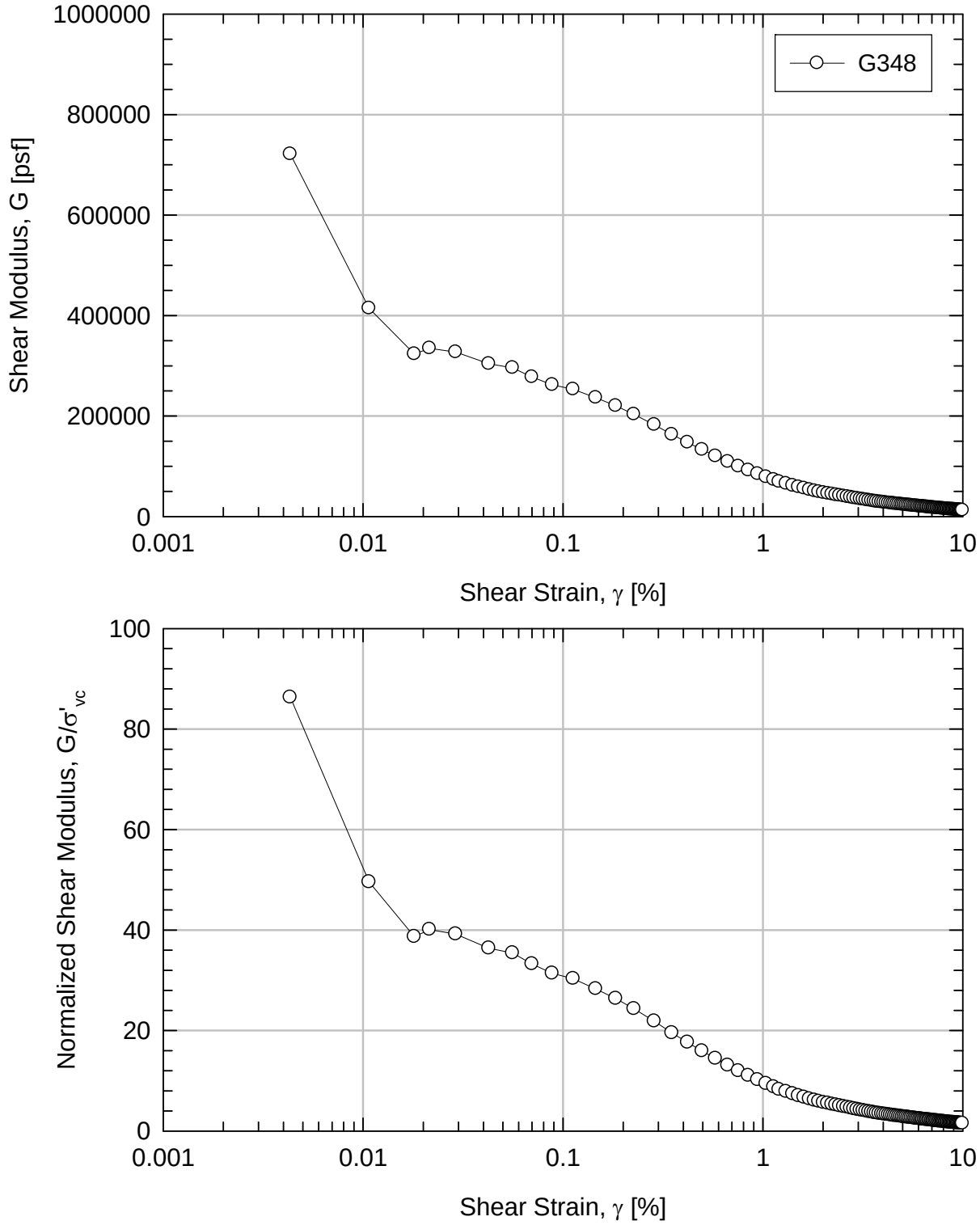

Figure 5.4.45 Shear modulus and normalized shear modulus versus shear strain for test DSS G348 on Sample AAB-02-22A UP-1 43-45 ft.

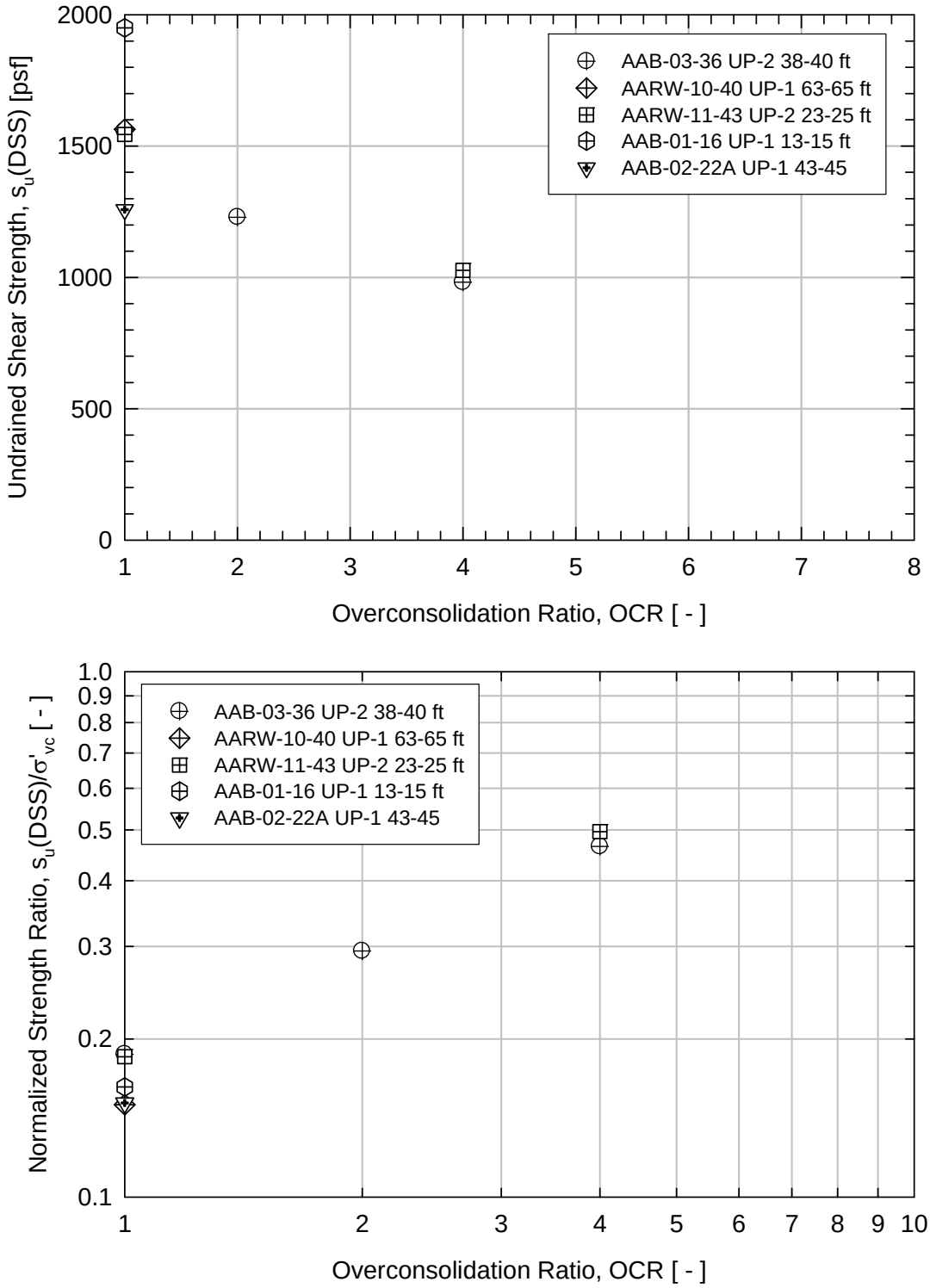

Figure 5.4.46 Summary of undrained shear strength and normalized undrained shear strength values versus OCR from SHANSEP DSS tests

Index Tests

GeoTesting express
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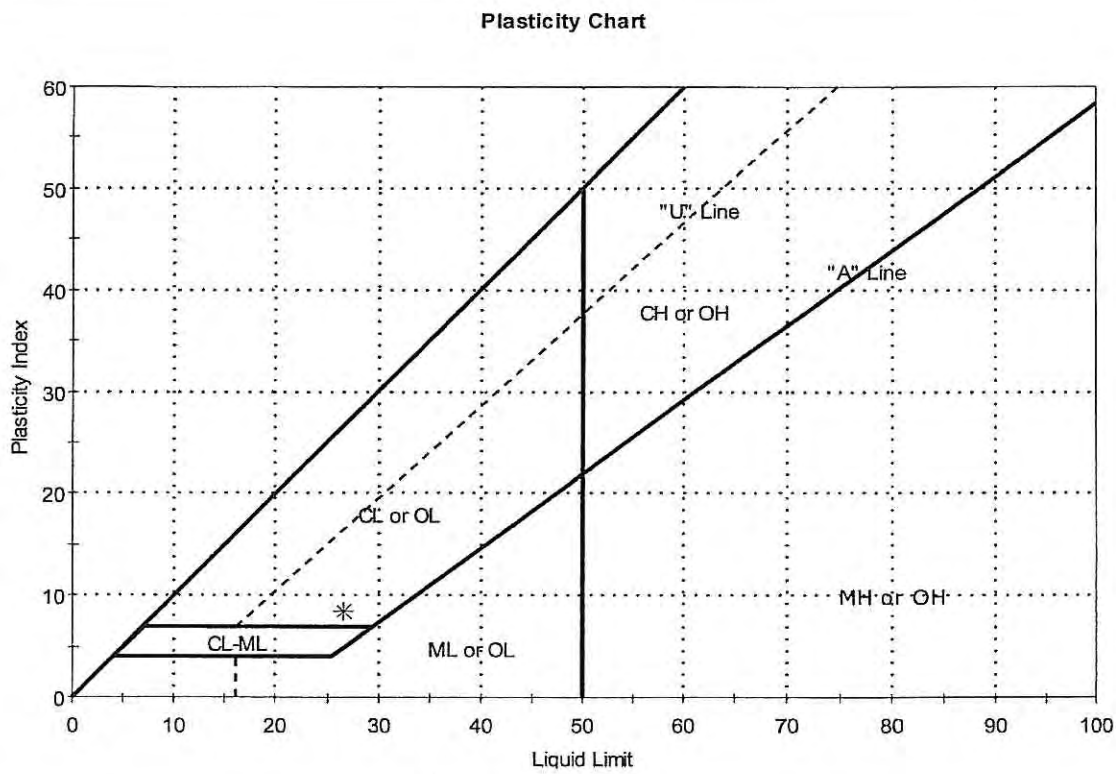
Client:	GeoDesign, Inc.		
Project:	Amtrak Access Road		
Location:	Newington, West Hartford, & Hartford	Project No:	GTX-8565
Boring ID: AAB-02-22A	Sample Type: jar	Tested By:	ap
Sample ID:S-4	Test Date: 10/14/08	Checked By:	jdt
Depth : 30-32 ft	Test Id: 139606		
Test Comment: ---			
Sample Description: Moist, reddish gray clay			
Sample Comment: ---			

Atterberg Limits - ASTM D 4318-05



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
*	S-4	AB-02-22	30-32 ft	23	27	18	9	0	

Sample Prepared using the WET method

Dry Strength: HIGH
Dilentancy: SLOW
Toughness: LOW

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GeoTesting express
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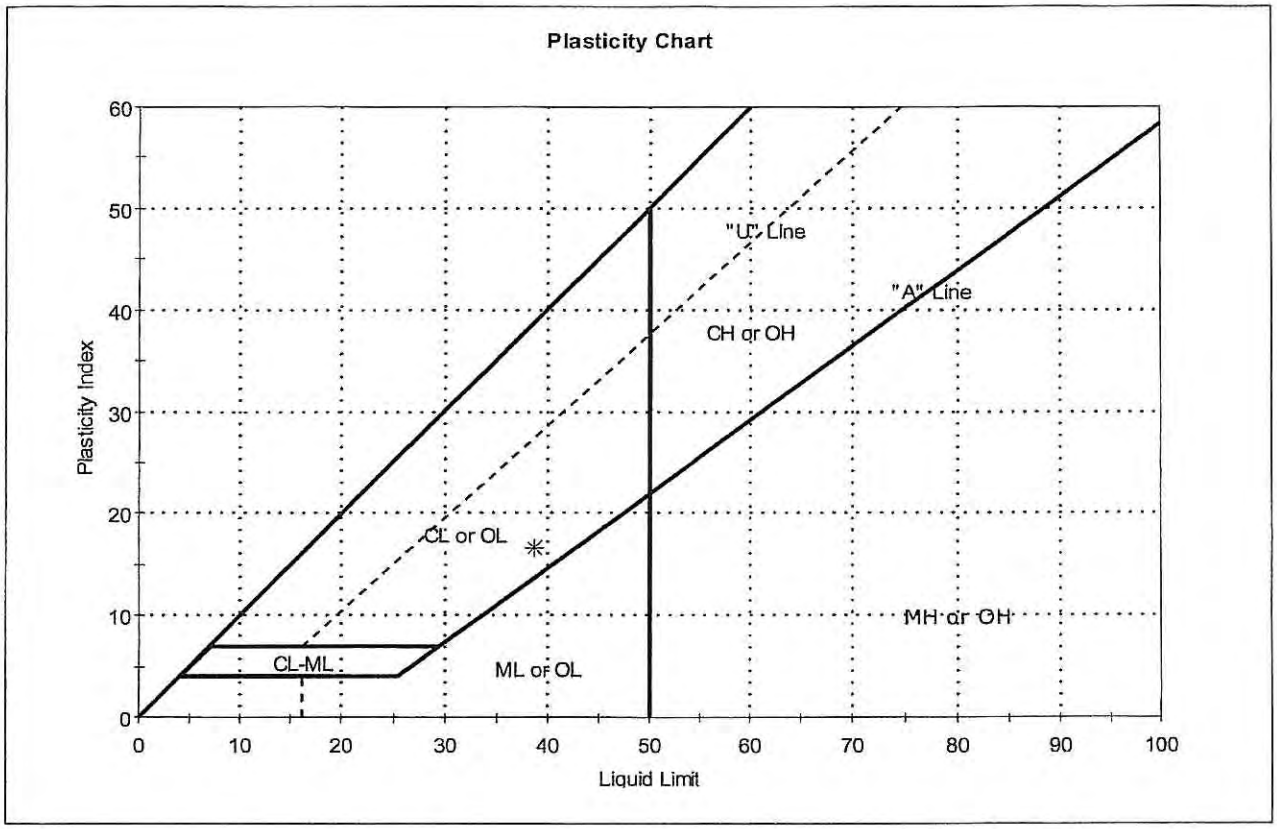
Client:	GeoDesign, Inc.		
Project:	Amtrak Access Road		
Location:	Newington, West Hartford, & Hartford	Project No:	GTX-8565
Boring ID: AAB-02-22A	Sample Type: jar	Tested By:	ap
Sample ID:S-6	Test Date: 10/17/08	Checked By:	jdt
Depth : 40-42 ft	Test Id: 140179		
Test Comment: ---			
Sample Description: Moist, dark brown clay			
Sample Comment: ---			

Atterberg Limits - ASTM D 4318-05



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
*	S-6	AB-02-22	40-42 ft	41	39	22	17	1	

Sample Prepared using the WET method

Dry Strength: VERY HIGH
Dilentancy: SLOW
Toughness: LOW

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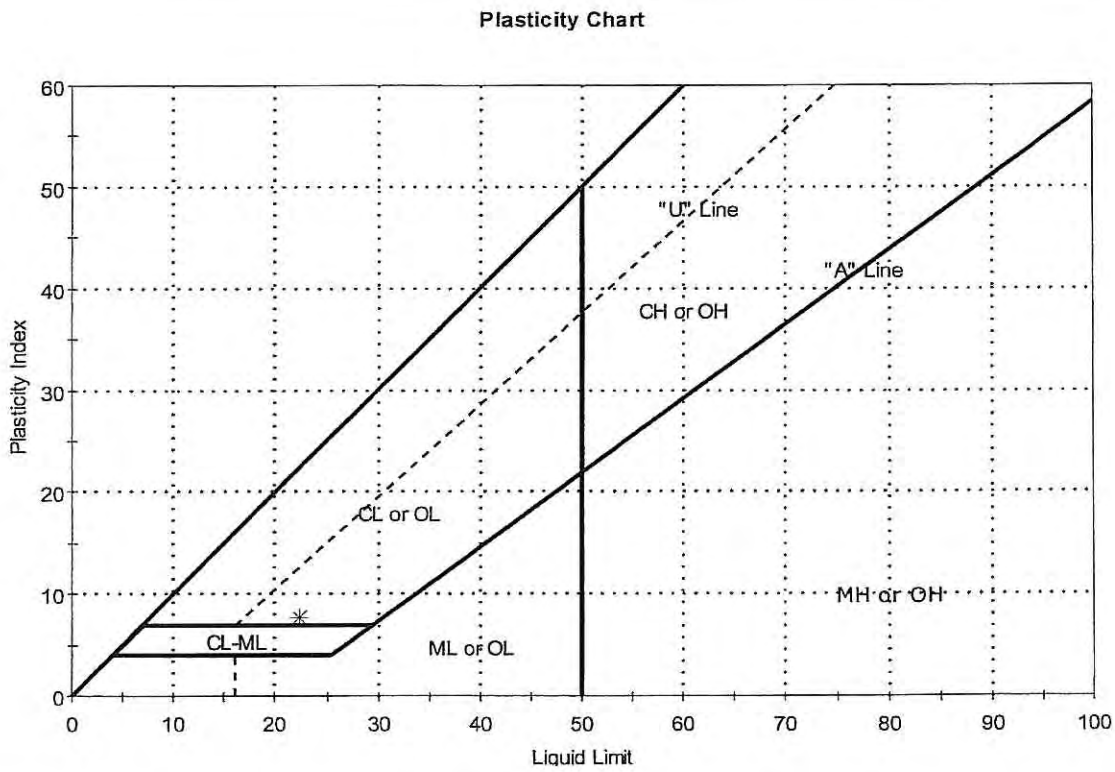
GeoTesting express
a subsidiary of Geocomp Corporation

Client:	GeoDesign, Inc.		
Project:	Amtrak Access Road		
Location:	Newington, West Hartford, & Hartford	Project No:	GTX-8565
Boring ID: AAB-02-23B	Sample Type: jar	Tested By:	ap
Sample ID:S-16	Test Date: 10/22/08	Checked By:	jdt
Depth : 70-72 ft	Test Id: 139607		
Test Comment: ---			
Sample Description: Moist, reddish brown clay			
Sample Comment: ---			

Atterberg Limits - ASTM D 4318-05



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
*	S-16	AB-02-23	70-72 ft	24	22	15	7	1	

Sample Prepared using the WET method

Dry Strength: HIGH
Dilentancy: SLOW
Toughness: LOW

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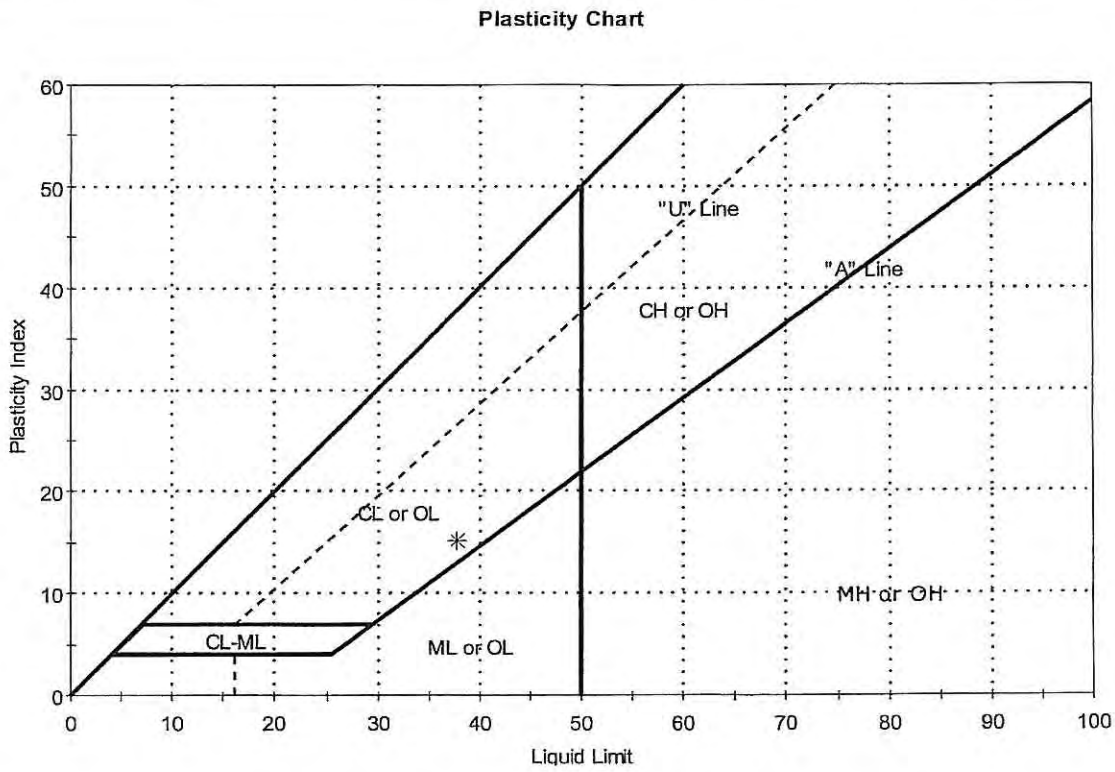
GeoTesting express
a subsidiary of Geocomp Corporation

Client:	GeoDesign, Inc.		
Project:	Amtrak Access Road		
Location:	Newington, West Hartford, & Hartford	Project No:	GTX-8565
Boring ID: AAB-02-24	Sample Type: jar	Tested By:	ap
Sample ID:S-12	Test Date: 10/17/08	Checked By:	jdt
Depth : 40-42 ft	Test Id: 139608		
Test Comment: ---			
Sample Description: Moist, dark brown clay			
Sample Comment: ---			

Atterberg Limits - ASTM D 4318-05



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
*	S-12	AAB-02-2	40-42 ft	37	38	23	15	1	

Sample Prepared using the WET method

Dry Strength: VERY HIGH
Dilentancy: SLOW
Toughness: LOW

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GeoTesting express
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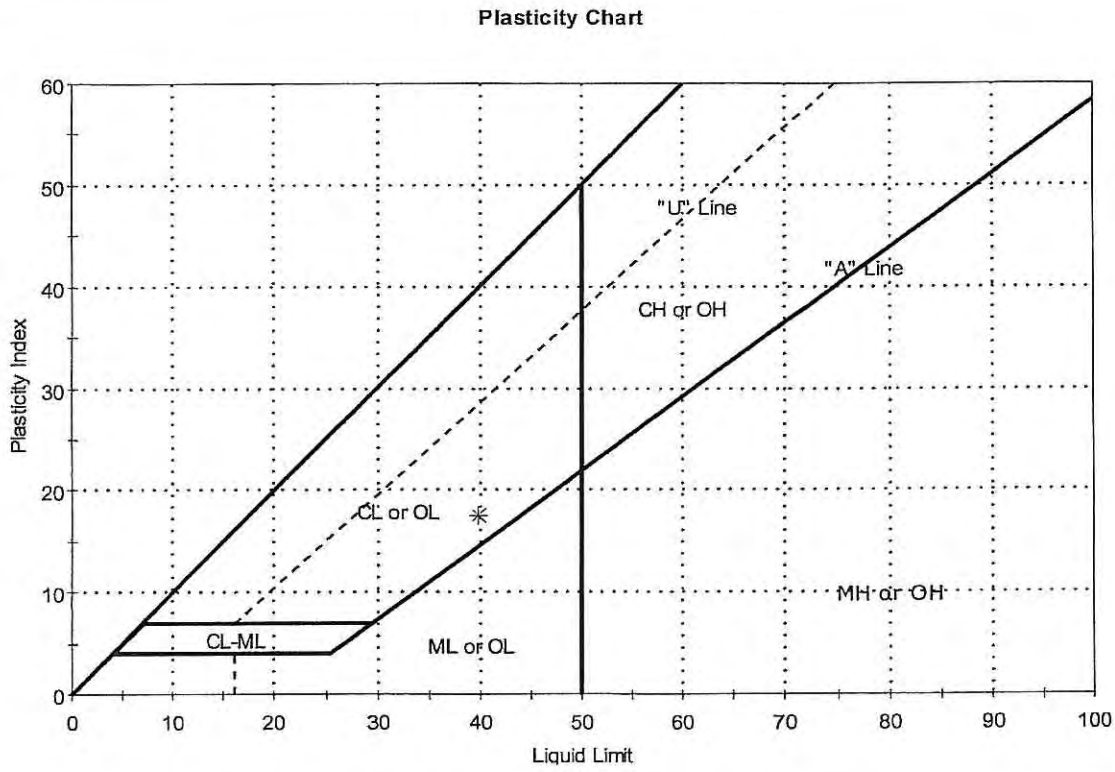
Client:	GeoDesign, Inc.				
Project:	Amtrak Access Road				
Location:	Newington, West Hartford, & Hartford			Project No:	GTX-8565
Boring ID:	AARW-06-26	Sample Type:	jar	Tested By:	ap
Sample ID:	S-15	Test Date:	10/17/08	Checked By:	jdt
Depth :	50-52 ft	Test Id:	139594		
Test Comment:	---				
Sample Description:	Moist, dark brown clay				
Sample Comment:	---				

Atterberg Limits - ASTM D 4318-05



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
*	S-15	ARW-06-2	50-52 ft	44	40	22	18	1	

Sample Prepared using the WET method

Dry Strength: VERY HIGH
Dilentancy: SLOW
Toughness: LOW

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Gradation (Hydrometer)

GeoTesting express
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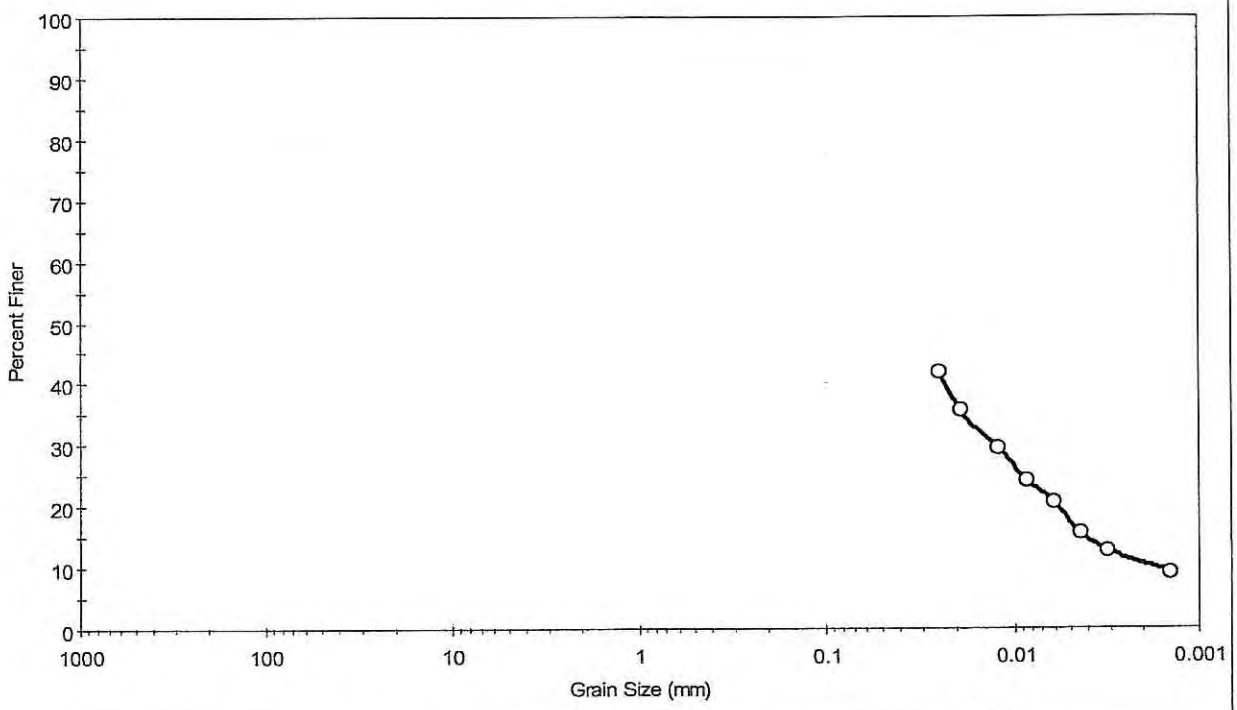
Client:	GeoDesign, Inc.		
Project:	Amtrak Access Road		
Location:	Newington, West Hartford, & Hartford	Project No:	GTX-8565
Boring ID: AAB-02-22A	Sample Type: jar	Tested By:	ap
Sample ID:S-4	Test Date: 10/17/08	Checked By:	mpd
Depth : 30-32 ft	Test Id: 139634		
Test Comment:	---		
Sample Description:	Moist, reddish gray clay with sand		
Sample Comment:	---		

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	—	—	—

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0259	42		
---	0.0197	36		
---	0.0125	30		
---	0.0087	24		
---	0.0063	21		
---	0.0045	16		
---	0.0032	13		
---	0.0015	9		

Coefficients

D_{85} =N/A	D_{30} =0.0126 mm
D_{60} =N/A	D_{15} =0.0041 mm
D_{50} =N/A	D_{10} =0.0017 mm
C_u =N/A	C_c =N/A

Classification

ASTM N/A

AASHTO ()

Sample/Test Description

Sand/Gravel Particle Shape :

Sand/Gravel Hardness :

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GeoTesting express
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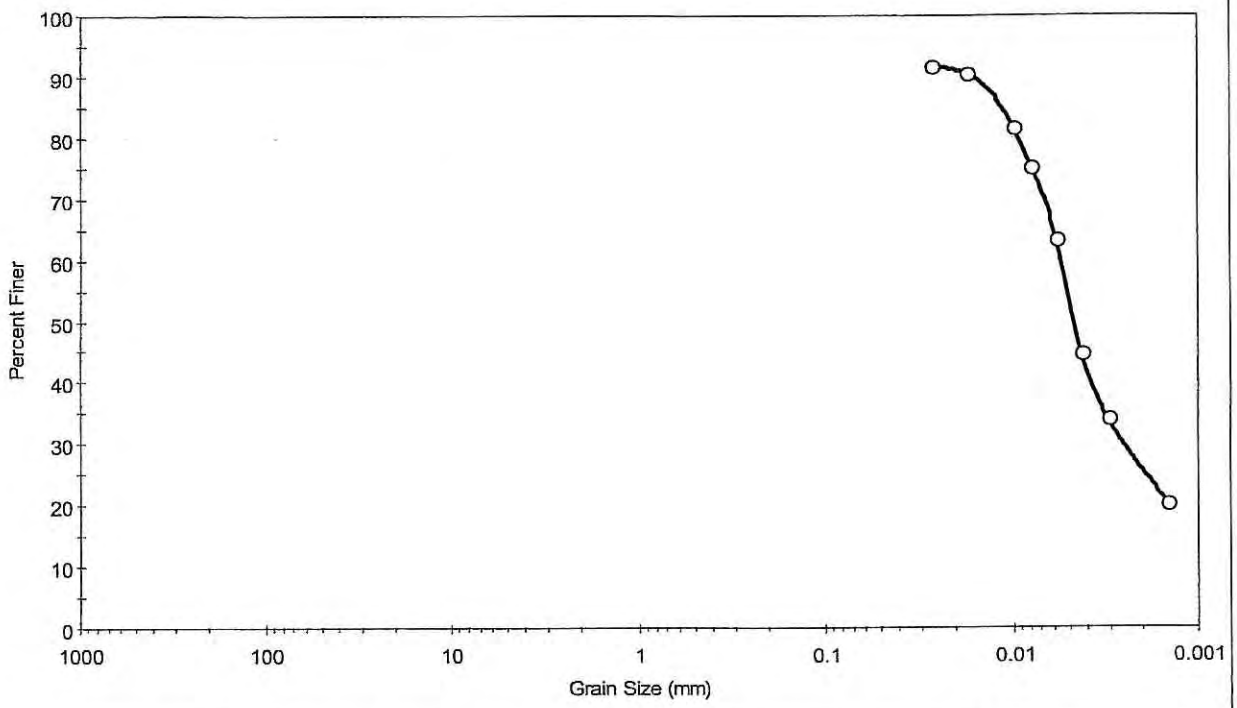
Client:	GeoDesign, Inc.		
Project:	Amtrak Access Road		
Location:	Newington, West Hartford, & Hartford	Project No:	GTX-8565
Boring ID: AAB-02-24	Sample Type: jar	Tested By:	ap
Sample ID:S-12	Test Date: 10/17/08	Checked By:	mpd
Depth : 40-42 ft	Test Id: 139635		
Test Comment:	---		
Sample Description:	Moist, dark brown clay		
Sample Comment:	---		

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	—	—	—

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0269	92		
---	0.0176	90		
---	0.0099	82		
---	0.0080	75		
---	0.0058	63		
---	0.0043	45		
---	0.0031	34		
---	0.0015	20		

Coefficients

D_{85} =0.0122 mm D_{30} =0.0025 mm
D_{60} =0.0055 mm D_{15} =N/A
D_{50} =0.0047 mm D_{10} =N/A
C_u =N/A C_c =N/A

Classification

ASTM N/A

AASHTO ()

Sample/Test Description

Sand/Gravel Particle Shape :

Sand/Gravel Hardness :

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GeoTesting express
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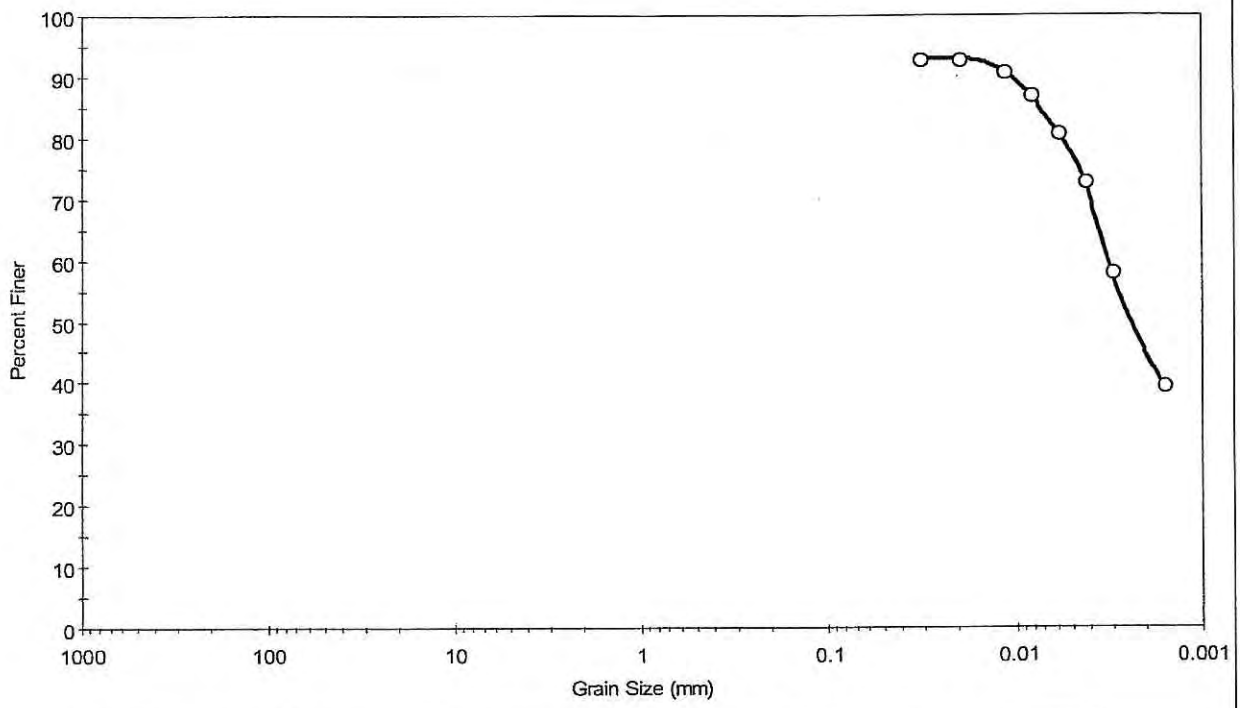
Client:	GeoDesign, Inc.		
Project:	Amtrak Access Road		
Location:	Newington, West Hartford, & Hartford	Project No:	GTX-8565
Boring ID: AARW-06-26	Sample Type: jar	Tested By:	ap
Sample ID:S-15	Test Date: 10/17/08	Checked By:	mpd
Depth : 50-52 ft	Test Id: 139627		
Test Comment:	---		
Sample Description:	Moist, dark brown clay		
Sample Comment:	---		

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	—	—	—

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0326	93		
---	0.0203	93		
---	0.0118	91		
---	0.0084	87		
---	0.0060	81		
---	0.0043	73		
---	0.0031	58		
---	0.0016	39		

Coefficients

D_{85} =0.0076 mm D_{30} =N/A
D_{60} =0.0032 mm D_{15} =N/A
D_{50} =0.0023 mm D_{10} =N/A
C_u =N/A C_c =N/A

Classification

ASTM N/A

AASHTO ()

Sample/Test Description

Sand/Gravel Particle Shape :

Sand/Gravel Hardness :

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Moisture Contents

GeoTesting express
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Client:	GeoDesign, Inc.		
Project:	Amtrak Access Road		
Location:	Newington, West Hartford, & Hartford	Project No:	GTX-8565
Boring ID: ---	Sample Type: ---	Tested By:	ap
Sample ID:---	Test Date: 10/23/08	Checked By:	jdt
Depth : ---	Sample Id: ---		

Moisture Content of Soil - ASTM D 2216-05

Boring ID	Sample ID	Depth	Description	Moisture Content,%
AAB-01-16	S-5	10-12 ft	Moist, dark brown clay	49.3
AAB-02-22A	S-5	35-37 ft	Moist, dark reddish gray clay	46.4
AAB-02-22A	S-8	50-52 ft	Moist, reddish brown silty clay with gravel	36.6
AAB-02-23B	S-15	65-67 ft	Moist, reddish brown silty clay	28.7
AAB-02-24	S-11	35-37 ft	Moist, reddish brown clay	47.6
AAB-03-36	S-15	55-57 ft	Moist, reddish gray clay	60.6
AAB-03-36	S-21	85-87 ft	Moist, reddish brown clay	52.3
AAB-03-36	S-27	115-117 ft	Moist, reddish brown clay	39.4

Notes: Temperature of Drying : 110° Celsius

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Client:	GeoDesign, Inc.		
Project:	Amtrak Access Road		
Location:	Newington, West Hartford, & Hartford	Project No:	GTX-8565
Boring ID: ---	Sample Type: ---	Tested By:	ap
Sample ID:---	Test Date: 10/23/08	Checked By:	jdt
Depth : ---	Sample Id: ---		

Moisture Content of Soil - ASTM D 2216-05

Boring ID	Sample ID	Depth	Description	Moisture Content,%
AARW-06-25	S-10	30-32 ft	Moist, reddish brown clay	43.9
AARW-06-26	S-12	35-37 ft	Moist, dark brown clay	0
AARW-06-26	S-18	65-67 ft	Moist, reddish brown clay	29.4
AARW-10-40	S-7	20-22 ft	Moist, gray clay	38.3
AARW-10-40	S-13	50-52 ft	Moist, gray clay	59.8
AARW-10-40	S-18	75-77 ft	Moist, reddish gray clay	50.9
AARW-10-40	S-21	90-92 ft	Moist, reddish brown clay	45.4
AARW-10-40	S-25	110-112 ft	Moist, dark reddish brown silty clay	41.3

Notes: Temperature of Drying : 110° Celsius

Appendix 4

Pre-Existing Subsurface Data
(Boring Logs and Laboratory Data)

SB-52
SB-53

Existing Boring Logs

Driller: Mike St. John/NEBC	**Connecticut DOT Boring Report**	Hole No.: **SB-52**
Inspector: Ryan Tinsley	Town: West Hartford / Hartford, CT	Stat./Offset:
Engineer: Baker Engineering	Project No.: 171-0305	Northing: 827379.8
Start Date: 7-8-03	Route No.:	Easting: 1007121.6
Finish Date: 7-9-03	Bridge No.:	Surface Elevation: 64.2
Project Description: New Britain to Hartford Busway		
Casing Type/Size: HW 4" ID	Sampler Type/Size: SS/ 1-3/8 " ID	Core Barrel Type: NQ/1 7/8" ID
Hammer Wt.: 300 Fall: 24	Hammer Wt.: 140 Fall: 30	
Groundwater Obs. @ 18.0' after: 0 hours, @29.2 after: 24 hours, @28.0 after: 48 hours		

Baker Info: S.O. Number: B25624LPDSOIL41802/42002 File: northern Template: CDOT_E (LD4 1/03)

Depth (ft.)	SAMPLES Sample Type/No.	Blows on Sampler per 0.5 ft.	Pen. (ft.)	Rec. (ft./%)	RQD (ft./%)	Generalized Strata Description	Material Description and Notes	Elevation (ft.)
0	A-N		1.5					64
1								63
2	S-1	6 5 3	1.5	1.3			WELL-GRADED SAND WITH GRAVEL (SW) - brown, black and tan fine to coarse sand, some fine to coarse gravel; dry, loose, NP; (FILL).	62
3	A-N		1.5					61
4								60
5	S-2	12 16 18	1.5	1.0			WELL-GRADED SAND WITH GRAVEL (SW) - brown, black and tan fine to coarse sand, some fine to coarse gravel; dry, dense, NP; (FILL).	59
6	A-N		1.5					58
7								57
8	S-3	13 15 11	1.5	1.5			WELL-GRADED SAND WITH GRAVEL (SW) - brown, black and tan fine to coarse sand, some fine to coarse gravel; dry, medium dense, NP; (FILL).	56
9	A-N		1.0					55
10	S-4	10 10 9	1.5	0.2			WELL-GRADED SAND WITH GRAVEL (SW) - brown, black and tan fine to coarse sand, some fine to coarse gravel; dry, medium dense, NP; (FILL).	54
11								53
12	W-N		2.0					52
13								51
						13.5'	ELEV. 50.7	
14	S-5	6 6 8	1.5	1.0			WELL-GRADED SAND WITH GRAVEL (SW) - tan, brown and black fine to coarse sand, some fine to coarse rounded gravel; moist, medium dense, NP; (ALLUVIUM).	50
15								49
16	W-N		1.5					48
17	S-6	5 6 7	1.5	0.7			WELL-GRADED SAND WITH GRAVEL (SW) - tan, brown and black fine to coarse sand, some fine to coarse rounded gravel; moist, medium dense, NP; (ALLUVIUM).	47
18								46
19	W-N		1.5					45
		11					WELL-GRADED SAND WITH GRAVEL (SW) - tan,	

Sample Type: S=Split Spoon C=Core UP=Undisturbed Piston V=Vane Shear Test A=Auger
Proportions Used: Trace = 1 - 10%, Little = 10 -20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 100.0' Rock: 10.0' No. of Samples: 22	NOTES:	Sheet **1** of **6** SM-001-M REV. 1/02

Driller: Mike St. John/NEBC	**Connecticut DOT Boring Report**	Hole No.: **SB-52**
Inspector: Ryan Tinsley	Town: West Hartford / Hartford, CT	Stat./Offset:
Engineer: Baker Engineering	Project No.: 171-0305	Northing: 827379.8
Start Date: 7-8-03	Route No.:	Easting: 1007121.6
Finish Date: 7-9-03	Bridge No.:	Surface Elevation: 64.2
Project Description: New Britain to Hartford Busway		
Casing Type/Size: HW 4" ID	Sampler Type/Size: SS/ 1-3/8 " ID	Core Barrel Type: NQ/1 7/8" ID
Hammer Wt.: 300 Fall: 24	Hammer Wt.: 140 Fall: 30	

Groundwater Obs. @ 18.0' after: 0 hours, @29.2 after: 24 hours, @28.0 after: 48 hours

Baker Info: S.O. Number: B25624LPDSOIL41802/42002 File: northern Template: CDOT E (LD4 1/03)

Depth (ft.)	Sample Type/No.	Blows on Sampler per 0.5 ft.	Pen. (ft.)	Rec. (ft./%)	RQD (ft./%)	Generalized Strata Description	Material Description and Notes	Elevation (ft.)
20	S-7	8 8	1.5	0.7			brown and black fine sand, some fine to coarse rounded gravel, some silt; moist, medium dense, NP; (ALLUVIUM).	44
21								43
22	W-N		1.5					42
23	S-8	12 6 5	1.5	0.5			WELL-GRADED SAND WITH GRAVEL (SW) - tan, brown and black fine to coarse sand, some fine to coarse gravel; moist, medium dense, NP; (ALLUVIUM).	41
24	W-N		1.0					40
25						25.0'	ELEV. 39.2	39
26	S-9	6 5 5	1.5	0.3			WELL-GRADED GRAVEL WITH SAND (GW) - tan to brown and black fine to coarse gravel, little fine to coarse sand; moist, loose, NP; (ALLUVIUM).	38
27	W-N		2.0					37
28						28.5'	ELEV. 35.7	36
29	S-10	4 4 3	1.5	1.0			SILTY CLAY WITH GRAVEL (CL-ML) - red and brown clay, some silt; moist, medium stiff, +PL.	35
30								34
31								33
32	W-N		5.0					32
33								31
34								30
35						35.0'	ELEV. 29.2	29
36	S-11	6 8 12	1.5	0.7			WELL-GRADED GRAVEL (GW) - reddish brown fine to coarse gravel; moist to wet, medium dense, NP.	28
37								27
38	W-N		3.5					26
39								25

Sample Type: S=Split Spoon C=Core UP=Undisturbed Piston V=Vane Shear Test A=Auger
Proportions Used: Trace = 1 - 10%, Little = 10 -20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 100.0' Rock: 10.0' No. of Samples: 22	NOTES:	Sheet **2** of **6** SM-001-M REV. 1/02

Driller: Mike St. John/NEBC	**Connecticut DOT Boring Report**	Hole No.: **SB-52**
Inspector: Ryan Tinsley	Town: West Hartford / Hartford, CT	Stat./Offset:
Engineer: Baker Engineering	Project No.: 171-0305	Northing: 827379.8
Start Date: 7-8-03	Route No.:	Easting: 1007121.6
Finish Date: 7-9-03	Bridge No.:	Surface Elevation: 64.2
Project Description: New Britain to Hartford Busway		
Casing Type/Size: HW 4" ID	Sampler Type/Size: SS/ 1-3/8 " ID	Core Barrel Type: NQ/1 7/8" ID
Hammer Wt.: 300 Fall: 24	Hammer Wt.: 140 Fall: 30	

Groundwater Obs. @ 18.0' after: 0 hours, @29.2 after: 24 hours, @28.0 after: 48 hours

Baker Info: S.O. Number: B25624LPDSOIL41802/42002 File: northern Template: CDOT E (LD4 1/03)

Depth (ft.)	SAMPLES Sample Type/No.	Blows on Sampler per 0.5 ft.	Pen. (ft.)	Rec. (ft./%)	RQD (ft./%)	Generalized Strata Description	Material Description and Notes	Elevation (ft.)
40						40.0'	ELEV. 24.2	24
41	S-12	2 3 3	1.5	1.3			SILTY CLAY (CL-ML) - red and brown clay, some silt; moist, medium stiff, +PL; (GLACIAL LAKE DEPOSIT).	23
42								22
43	W-N		3.5					21
44								20
45	S-13	2 2 3	1.5	1.0			SILTY CLAY (CL-ML) - red and brown clay, some silt; moist, medium stiff, +PL; (GLACIAL LAKE DEPOSIT).	19
46								18
47								17
48	W-N		3.5					16
49								15
50								14
51	ST-1		2.0	1.3				13
52								12
53	W-N		3.0					11
54								10
55	S-14	2 3 4	1.5	1.5			SILTY CLAY (CL-ML) - red and brown clay, some silt; moist, medium stiff, +PL; (GLACIAL LAKE DEPOSIT).	9
56								8
57								7
58	W-N		3.5					6
59								5

Sample Type: S=Split Spoon C=Core UP=Undisturbed Piston V=Vane Shear Test A=Auger
Proportions Used: Trace = 1 - 10%, Little = 10 -20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 100.0' Rock: 10.0' No. of Samples: 22	NOTES:	Sheet **3** of **6** SM-001-M REV. 1/02

Driller: Mike St. John/NEBC	**Connecticut DOT Boring Report**	Hole No.: **SB-52**
Inspector: Ryan Tinsley	Town: West Hartford / Hartford, CT	Stat./Offset:
Engineer: Baker Engineering	Project No.: 171-0305	Northing: 827379.8
Start Date: 7-8-03	Route No.:	Easting: 1007121.6
Finish Date: 7-9-03	Bridge No.:	Surface Elevation: 64.2
Project Description: New Britain to Hartford Busway		
Casing Type/Size: HW 4" ID	Sampler Type/Size: SS/ 1-3/8 " ID	Core Barrel Type: NQ/1 7/8" ID
Hammer Wt.: 300 Fall: 24	Hammer Wt.: 140 Fall: 30	
Groundwater Obs. @ 18.0' after: 0 hours, @29.2 after: 24 hours, @28.0 after: 48 hours		

Baker Info: S.O. Number: B25624LPDSOIL41802/42002 File: northern Template: CDOT E (LD4 1/03)

Depth (ft.)	SAMPLES Sample Type/No.	Blows on Sampler per 0.5 ft.	Pen. (ft.)	Rec. (ft./%)	RQD (ft./%)	Generalized Strata Description	Material Description and Notes	Elevation (ft.)
60	S-15	3 3 3	1.5	1.5			SILTY CLAY (CL-ML) - red and brown clay, some silt; moist, medium stiff, +PL; (GLACIAL LAKE DEPOSIT).	4
61								3
62	W-N		3.5					2
63								1
64								0
65	S-16	2 2 3	1.5	1.3			SILTY CLAY (CL-ML) - red and brown clay, some silt; moist, medium stiff, +PL; (GLACIAL LAKE DEPOSIT).	-1
66								-2
67	W-N		3.5					-3
68								-4
69								-5
70	S-17	55 80 100/.2	1.2	1.0		70.0'	ELEV. -5.8 SILTY SAND WITH GRAVEL (SM) - red to brown fine to medium sand, little silt, little fine to coarse gravel; moist, very dense, NP (TILL).	-6
71								-7
72	W-N		3.7					-8
73								-9
74								-10
75	S-18	100/0.1	0.1	0.0			NO RECOVERY	-11
76	W-N		4.9					-12
77								-13
78								-14
79								-15

Sample Type: S=Split Spoon C=Core UP=Undisturbed Piston V=Vane Shear Test A=Auger
Proportions Used: Trace = 1 - 10%, Little = 10 -20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 100.0' Rock: 10.0' No. of Samples: 22	NOTES:	Sheet **4** of **6** SM-001-M REV. 1/02

Driller: Mike St. John/NEBC	**Connecticut DOT Boring Report**	Hole No.: **SB-52**
Inspector: Ryan Tinsley	Town: West Hartford / Hartford, CT	Stat./Offset:
Engineer: Baker Engineering	Project No.: 171-0305	Northing: 827379.8
Start Date: 7-8-03	Route No.:	Easting: 1007121.6
Finish Date: 7-9-03	Bridge No.:	Surface Elevation: 64.2
Project Description: New Britain to Hartford Busway		
Casing Type/Size: HW 4" ID	Sampler Type/Size: SS/ 1-3/8 " ID	Core Barrel Type: NQ/1 7/8" ID
Hammer Wt.: 300 Fall: 24	Hammer Wt.: 140 Fall: 30	

Groundwater Obs. @ 18.0' after: 0 hours, @29.2 after: 24 hours, @28.0 after: 48 hours

Baker Info: S.O. Number: B25624LPDSOIL41802/42002 File: northern Template: CDOT_E (LD4 1/03)

Depth (ft.)	Sample Type/No.	Blows on Sampler per 0.5 ft.	Pen. (ft.)	Rec. (ft./%)	RQD (ft./%)	Generalized Strata Description	Material Description and Notes	Elevation (ft.)
80						80.0'	ELEV. -15.8	-16
81	S-19	27 65 95	1.5	0.7			GRAVELLY SILT WITH SAND (ML) - reddish brown silt, some fine to coarse gravel, some fine to coarse sand; moist, very dense, NP; (TILL).	-17
82								-18
83	W-N		3.5					-19
84								-20
85	S-20	120/0.3	0.3	0.2			GRAVELLY SILT WITH SAND (ML) - reddish brown silt, some fine to coarse gravel, some fine to coarse sand; moist, very dense, NP; (TILL).	-21
86								-22
87	W-N		4.7					-23
88								-24
89								-25
90	S-21	120/0.2	0.2	0.2			Lost drill water at 90.0'. GRAVELLY SILT WITH SAND (ML) - reddish brown silt, some fine to coarse gravel, some fine to coarse sand; moist, very dense, NP; (TILL).	-26
91								-27
92	W-N		4.8					-28
93								-29
94								-30
95	S-22	120/0.1	0.1	0.0			NO RECOVERY	-31
96								-32
97	W-N		4.9					-33
98								-34
99								-35

Sample Type: S=Split Spoon C=Core UP=Undisturbed Piston V=Vane Shear Test A=Auger
Proportions Used: Trace = 1 - 10%, Little = 10 -20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 100.0' Rock: 10.0' No. of Samples: 22	NOTES:	Sheet **5** of **6** SM-001-M REV. 1/02

Driller: Mike St. John/NEBC	**Connecticut DOT Boring Report**	Hole No.: **SB-52**
Inspector: Ryan Tinsley	Town: West Hartford / Hartford, CT	Stat./Offset:
Engineer: Baker Engineering	Project No.: 171-0305	Northing: 827379.8
Start Date: 7-8-03	Route No.:	Easting: 1007121.6
Finish Date: 7-9-03	Bridge No.:	Surface Elevation: 64.2
Project Description: New Britain to Hartford Busway		
Casing Type/Size: HW 4" ID	Sampler Type/Size: SS/ 1-3/8 " ID	Core Barrel Type: NQ/1 7/8" ID
Hammer Wt.: 300 Fall: 24	Hammer Wt.: 140 Fall: 30	

Groundwater Obs. @ 18.0' after: 0 hours, @29.2 after: 24 hours, @28.0 after: 48 hours

Baker Info: S.O. Number: B25624LPDSOIL41802/42002 File: northern Template: CDOT_E (LD4 1/03)

Depth (ft.)	SAMPLES Sample Type/No.	Blows on Sampler per 0.5 ft.	Pen. (ft.)	Rec. (ft./%)	RQD (ft./%)	Generalized Strata Description	Material Description and Notes	Elevation (ft.)
100				5.0	0.0	100.0'	ELEV. -35.8	-36
101							SILTSTONE WITH INTERBEDDED SANDSTONE; fine grained, red, hard, fresh to slightly weathered, calcite inclusions present.	-37
102	C-1		5.0					-38
103								-39
104								-40
105				100%	0%			
				4.5	0.0		SILTSTONE WITH INTERBEDDED SANDSTONE; fine-grained, red, hard, fresh to slightly weathered, calcite inclusions present. BASALT SEAM at 105.1'	-41
106								-42
107	C-2		5.0					-43
108								-44
109								-45
110				90%	0%		ELEV. -45.8	-46
							END OF BORING AT 110.0'	
111								-47
112								-48
113								-49
114								-50
115								-51
116								-52
117								-53
118								-54
119								-55

Sample Type: S=Split Spoon C=Core UP=Undisturbed Piston V=Vane Shear Test A=Auger
Proportions Used: Trace = 1 - 10%, Little = 10 -20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 100.0' Rock: 10.0' No. of Samples: 22	NOTES:	Sheet **6** of **6** SM-001-M REV. 1/02

Driller: Jeff Leavitt/NEBC	**Connecticut DOT Boring Report**	Hole No.: **SB-53**
Inspector: Mark Martin	Town: West Hartford / Hartford, CT	Stat./Offset:
Engineer: Baker Engineering	Project No.: 171-0305	Northing: 827458.6
Start Date: 7/8/03	Route No.:	Easting: 1007169.0
Finish Date: 7/10/03	Bridge No.:	Surface Elevation: 63.9
Project Description: New Britain to Hartford Busway		
Casing Type/Size: HW/4"	Sampler Type/Size: SS/1-3/8"	Core Barrel Type: NQ/1-7/8"
Hammer Wt.: 300 Fall: 24"	Hammer Wt.: 140 Fall: 30"	

Groundwater Obs. @ 25.0 after: 0 hours, @26.7 after: 24 hours, @26.6 after: 48 hours

Baker Info: S.O. Number: B25624LPDSOIL41802/42002 File: northern Template: CDOT_E (LD4 1/03)

Depth (ft.)	Sample Type/No.	Blows on Sampler per 0.5 ft.	Pen. (ft.)	Rec. (ft./%)	RQD (ft./%)	Generalized Strata Description	Material Description and Notes	Elevation (ft.)
0								
1	A-N		1.5					63
2	S-1	6 5 9	1.5	0.5			WELL GRADED SAND WITH SILT (SW-SM) - black, brown and tan fine to coarse sand, little silt; dry, medium dense, NP; (FILL).	62
3								61
4	A-N		1.5					60
5	S-2	8 20 12	1.5	0.7			WELL GRADED SAND WITH SILT (SW-SM) - black, brown and tan fine to coarse sand, little silt, trace coarse gravel; dry, dense, NP; (FILL).	59
6								58
7	A-N		1.5					57
8	S-3	6 9 9	1.5	0.1			WELL GRADED SAND WITH SILT (SW-SM) - brown and tan fine to coarse sand, little silt; dry, medium dense, NP; (FILL).	56
9								55
10	A-N		1.5					54
11	S-4	7 11 12	1.5	0.9			WELL GRADED SAND WITH SILT (SW-SM) - brown and tan fine to coarse sand, little silt; dry, medium dense, NP; (FILL).	53
12								52
13	W-N		1.5					51
14	S-5	10 7 7	1.5	0.0			No recovery in S-5	50
15								49
16	W-N		1.5					48
						16.5'	ELEV. 47.4	
17	S-6	9 11 11	1.5	0.7			POORLY GRADED GRAVEL (GP) - dark gray and black fine to medium gravel; moist, medium dense, NP; (FILL).	47
18								46
19	W-N		1.5					45
						19.5'	ELEV. 44.4	
		6						44

Sample Type: S=Split Spoon C=Core UP=Undisturbed Piston V=Vane Shear Test A=Auger

Proportions Used: Trace = 1 - 10%, Little = 10 -20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 80.0 Rock: 11.0 No. of Samples: 19	NOTES:	Sheet **1** of **5** SM-001-M REV. 1/02

Driller: Jeff Leavitt/NEBC	**Connecticut DOT Boring Report**	Hole No.: **SB-53**
Inspector: Mark Martin	Town: West Hartford / Hartford, CT	Stat./Offset:
Engineer: Baker Engineering	Project No.: 171-0305	Northing: 827458.6
Start Date: 7/8/03	Route No.:	Easting: 1007169.0
Finish Date: 7/10/03	Bridge No.:	Surface Elevation: 63.9
Project Description: New Britain to Hartford Busway		
Casing Type/Size: HW/4"	Sampler Type/Size: SS/1-3/8"	Core Barrel Type: NQ/1-7/8"
Hammer Wt.: 300 Fall: 24"	Hammer Wt.: 140 Fall: 30"	

Groundwater Obs. @ 25.0 after: 0 hours, @26.7 after: 24 hours, @26.6 after: 48 hours

Baker Info: S.O. Number: B25624LPDSOIL41802/42002 File: northern Template: CDOT E (LD4 1/03)

Depth (ft.)	Sample Type/No.	Blows on Sampler per 0.5 ft.	Pen. (ft.)	Rec. (ft./%)	RQD (ft./%)	Generalized Strata Description	Material Description and Notes	Elevation (ft.)
20	S-7	8 8	1.5	0.5			POORLY GRADED SAND WITH SILT (SP-SM) - tan and brown fine to medium sand, little silt; wet, medium dense, NP; (ALLUVIUM).	43
21								
22	W-N		1.5					42
						22.5'	ELEV. 41.4	
23	S-8	5 7 9	1.5	0.2			POORLY GRADED GRAVEL (GP) - dark gray coarse gravel; wet, medium dense, NP (ALLUVIUM).	41
24								40
25	W-N		1.5					39
						25.5'	ELEV. 38.4	
26	S-9	7 8 8	1.5	0.2			POORLY GRADED SAND WITH SILT (SP-SM) - tan and brown fine to medium sand, little silt; moist, medium dense, NP; (ALLUVIUM).	38
27								37
28	W-N		3.0			28.0'	ELEV. 35.9	36
							WOOD TIMBER, no sample possible from 28.5'-30.0'	
29						29.2'	ELEV. 34.7	35
30	S-10	5 6 5	1.5	1.0			POORLY GRADED SAND WITH WOOD (SP) - tan and brown fine to medium sand, some wood; wet, medium dense, NP (ALLUVIUM).	34
31								33
32								32
33	W-N		3.5					31
34								30
35						35.0'	ELEV. 28.9	29
36	S-11	5 7 11	1.5	0.9			LEAN CLAY (CL) - gray and reddish brown clay, trace fine sand; moist, very stiff, +PL; (GLACIAL LAKE DEPOSIT).	28
37								27
38	W-N		3.5					26
39								25
								24

Sample Type: S=Split Spoon C=Core UP=Undisturbed Piston V=Vane Shear Test A=Auger
Proportions Used: Trace = 1 - 10%, Little = 10 -20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 80.0 Rock: 11.0 No. of Samples: 19	NOTES:	Sheet **2** of **5** SM-001-M REV. 1/02

Driller: Jeff Leavitt/NEBC	**Connecticut DOT Boring Report**	Hole No.: **SB-53**
Inspector: Mark Martin	Town: West Hartford / Hartford, CT	Stat./Offset:
Engineer: Baker Engineering	Project No.: 171-0305	Northing: 827458.6
Start Date: 7/8/03	Route No.:	Easting: 1007169.0
Finish Date: 7/10/03	Bridge No.:	Surface Elevation: 63.9
Project Description: New Britain to Hartford Busway		
Casing Type/Size: HW/4"	Sampler Type/Size: SS/1-3/8"	Core Barrel Type: NQ/1-7/8"
Hammer Wt.: 300 Fall: 24"	Hammer Wt.: 140 Fall: 30"	

Groundwater Obs. @ 25.0 after: 0 hours, @26.7 after: 24 hours, @26.6 after: 48 hours

Baker Info: S.O. Number: B25624LPDSOIL41802/42002 File: northern Template: CDOT E (LD4 1/03)

Depth (ft.)	Sample Type/No.	Blows on Sampler per 0.5 ft.	Pen. (ft.)	Rec. (ft./%)	RQD (ft./%)	Generalized Strata Description	Material Description and Notes	Elevation (ft.)
40								
41	S-12	3 2 3	1.5	0.9			LEAN CLAY (CL) - gray and reddish brown clay; moist, medium stiff, +PL; (GLACIAL LAKE DEPOSIT).	23
42								22
43	W-N		3.5					21
44								20
45						45.0'	ELEV. 18.9	19
46	S-13	5 11 11	1.5	1.5			SILT (ML) - reddish brown silt, trace clay; wet, very stiff, +PL; (GLACIAL LAKE DEPOSIT).	18
47								17
48	W-N		3.5					16
49								15
50						50.0'	ELEV. 13.9	14
51	S-14	1 1 1	1.5	1.5			LEAN CLAY (CL) - reddish brown clay, trace silt; moist, very soft, +PL; (GLACIAL LAKE DEPOSIT).	13
52								12
53	W-N		3.5					11
54								10
55								9
56	S-15	2 4 4	1.5	1.5			CLAY WITH SILT (CL) - reddish brown clay, little silt; moist, medium stiff, +PL; (GLACIAL LAKE DEPOSIT).	8
57								7
58	W-N		3.5					6
59								5
								4

Sample Type: S=Split Spoon C=Core UP=Undisturbed Piston V=Vane Shear Test A=Auger
Proportions Used: Trace = 1 - 10%, Little = 10 -20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 80.0 Rock: 11.0 No. of Samples: 19	NOTES:	Sheet **3** of **5** SM-001-M REV. 1/02

Driller: Jeff Leavitt/NEBC	**Connecticut DOT Boring Report**	Hole No.: **SB-53**
Inspector: Mark Martin	Town: West Hartford / Hartford, CT	Stat./Offset:
Engineer: Baker Engineering	Project No.: 171-0305	Northing: 827458.6
Start Date: 7/8/03	Route No.:	Easting: 1007169.0
Finish Date: 7/10/03	Bridge No.:	Surface Elevation: 63.9
Project Description: New Britain to Hartford Busway		
Casing Type/Size: HW/4"	Sampler Type/Size: SS/1-3/8"	Core Barrel Type: NQ/1-7/8"
Hammer Wt.: 300 Fall: 24"	Hammer Wt.: 140 Fall: 30"	

Groundwater Obs. @ 25.0 after: 0 hours, @26.7 after: 24 hours, @26.6 after: 48 hours

Baker Info: S.O. Number: B25624LPDSOIL41802/42002 File: northern Template: CDOT E (LD4 1/03)

Depth (ft.)	Sample Type/No.	Blows on Sampler per 0.5 ft.	Pen. (ft.)	Rec. (ft./%)	RQD (ft./%)	Generalized Strata Description	Material Description and Notes	Elevation (ft.)
60–61	S-16	5 6 6	1.5	1.5			CLAY WITH SILT (CL) - reddish brown clay, little silt; moist, stiff, +PL; (GLACIAL LAKE DEPOSIT).	3
62–64	W-N		3.5					2, 1, 0
65–66	S-17	5 5 6	1.5	1.5			CLAY WITH SILT (CL) - reddish brown clay, little silt; moist, stiff, +PL; (GLACIAL LAKE DEPOSIT).	-1
67–69	W-N		3.5					-2, -3, -4
70						70.0'	ELEV. -6.1	-5
71	S-18	16 24 23	1.5	1.0			SANDY SILT (ML) - reddish brown silt, some fine sand; wet, dense, NP.	-6
72–74	W-N		3.5					-7, -8, -9
75–76	S-19	18 24 33	1.5	0.8			SILT WITH GRAVEL (ML) - reddish brown silt, little fine gravel; moist, hard, -PL.	-10, -11
77–79	W-N		3.5					-12, -13, -14, -15, -16

Sample Type: S=Split Spoon C=Core UP=Undisturbed Piston V=Vane Shear Test A=Auger

Proportions Used: Trace = 1 - 10%, Little = 10 -20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 80.0 Rock: 11.0

No. of Samples: 19

NOTES:

SM-001-M REV. 1/02

Driller: Jeff Leavitt/NEBC	**Connecticut DOT Boring Report**	Hole No.: **SB-53**
Inspector: Mark Martin	Town: West Hartford / Hartford, CT	Stat./Offset:
Engineer: Baker Engineering	Project No.: 171-0305	Northing: 827458.6
Start Date: 7/8/03	Route No.:	Easting: 1007169.0
Finish Date: 7/10/03	Bridge No.:	Surface Elevation: 63.9

Project Description: New Britain to Hartford Busway

Casing Type/Size: HW/4"	Sampler Type/Size: SS/1-3/8"	Core Barrel Type: NQ/1-7/8"
Hammer Wt.: 300 Fall: 24"	Hammer Wt.: 140 Fall: 30"	

Groundwater Obs. @ 25.0 after: 0 hours, @26.7 after: 24 hours, @26.6 after: 48 hours

Baker Info: S.O. Number: B25624LPDSOIL41802/42002 File: northern Template: CDOT E (LD4 1/03)

Depth (ft.)	SAMPLES Sample Type/No.	Blows on Sampler per 0.5 ft.	Pen. (ft.)	Rec. (ft./%)	RQD (ft./%)	Generalized Strata Description	Material Description and Notes	Elevation (ft.)
80				1.2	0.0			
81								-17
82								-18
83	C-1		5.0					-19
84						83.8'	ELEV. -19.9	-20
				24%	0%			
85							SILTSTONE, SANDY; reddish brown, medium hard, slightly weathered.	-21
	C-2		1.0	0.5 / 50%	0.0 / 0%			
86								-22
				4.7	1.1	86.5'	ELEV. -22.6	
87						87.2'	0.7' - BASALT SEAM AT 86.5'	-23
							ELEV. -23.3	
88							SILTSTONE, SANDY; reddish brown, medium hard, slightly weathered.	-24
	C-3		5.0					
89								-25
90								-26
				94%	22%			
91							ELEV. -27.1	-27
							End of Boring at 91.0'	
92								-28
93								-29
94								-30
95								-31
96								-32
97								-33
98								-34
99								-35
								-36

Sample Type: S=Split Spoon C=Core UP=Undisturbed Piston V=Vane Shear Test A=Auger
Proportions Used: Trace = 1 - 10%, Little = 10 -20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 80.0 Rock: 11.0 No. of Samples: 19	NOTES:	Sheet **5** of **5** SM-001-M REV. 1/02

Existing Lab Data

LABORATORY TESTING DATA SHEET

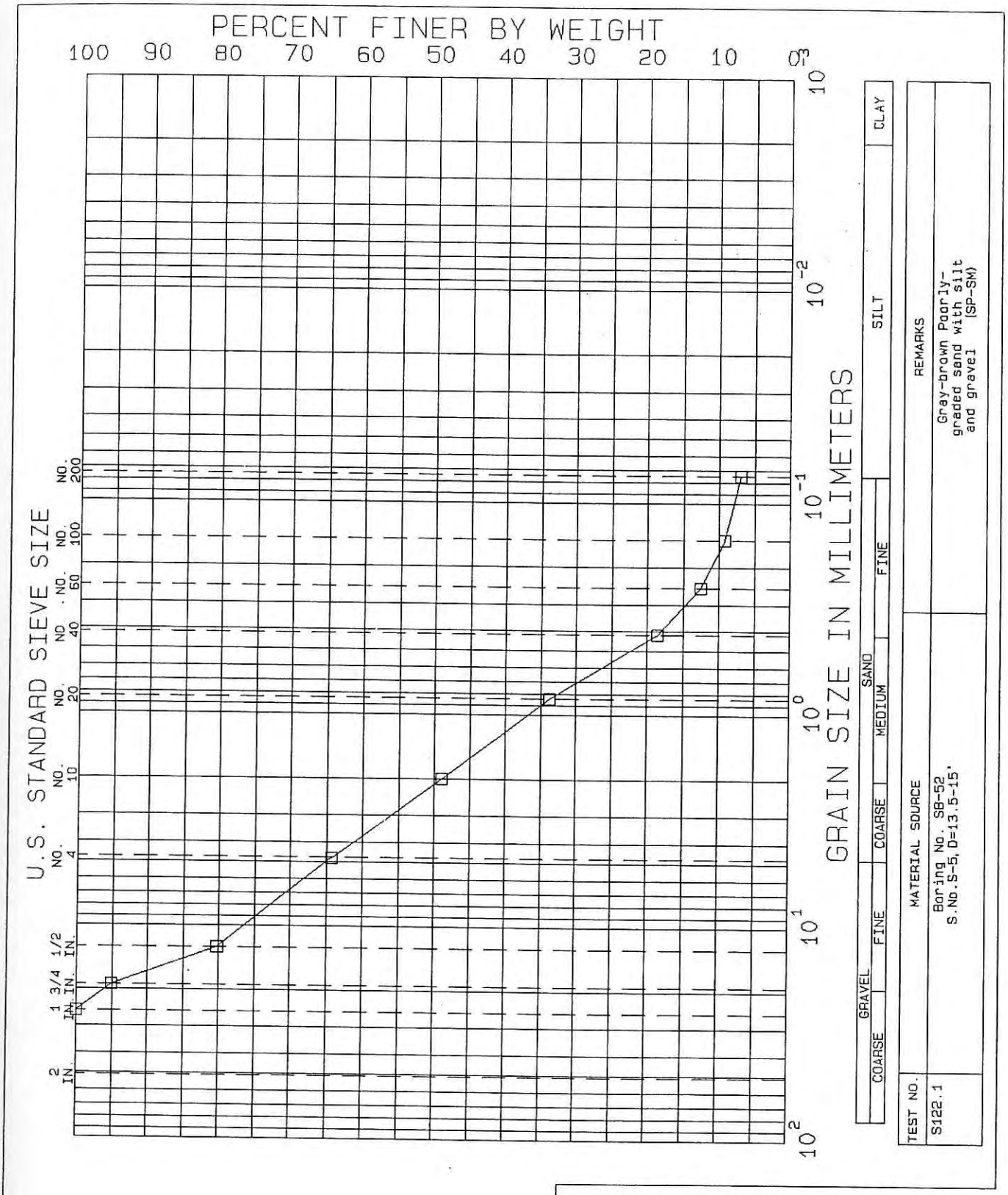
Project Name: NEW BRITAIN-HARTFORD BUSWAY CONNECTICUT
Project No.: L17828
Project Engineer: D. SCHULZE
Assigned By: D. GAFFNEY
Date: NOV.03
Reviewed By: Matthew Boley
Date Reviewed: 11/11/03

Boring/ Test Pit No.	Sample No.	Depth ft.	Lab No.	Identification Tests: Water Content %	LL %	PL %	Sieve -200 %	Hyd -2μ %	ORG %	G_s	Dry unit wt. pcf	Density: γ_d MAX (pcf) / W_{opt} (%)	Permeability cm/sec	Strength Tests: Torvane or Type Test	$\bar{\sigma}_c$ psf	Failure Criteria	$\sigma_1 - \sigma_3$ or τ psf	Strain %	Consol.: $\frac{C_c}{1 + e_0}$	Laboratory Log and Soil Description
SB-50	S-2	4.5-6.0	289	32.6																
SB-50	S-10	28.5-30.0	290	55.5																
SB-51	S-5	13.5-15.0	291	49.0																
SB-51	S-13	45.0-46.5	292	21.1																
SB-52	S-10	28.5-30.0	293	23.8																
SB-53	S-13	45.0-46.5	294	41.2																
SB-54	S-21	85.0-86.5	295	24.3																
SB-55	S-10	28.5-30.0	296	54.9																
SB-55	S-25	105.0-106.5	297	20.9																
SB-56	S-19	75.0-76.5	298	27.3																
SB-57	S-10	28.5-30.0	299	57.1																
SB-57	S-22	90.0-91.5	300	22.5																
SB-58	S-4	10.0-11.5	301	32.7																
SB-58	S-11	35.0-36.5	302	59.5																

LABORATORY TESTING DATA SHEET

Project Name: NEW BRITAIN-HARTFORD BUSWAY CONNECTICUT
Project No.: L17828 | Assigned By: D. GAFFNEY | Reviewed By: Don Schulze
Project Engineer: D. SCHULZE | Date: NOV.03 | Date Reviewed: 11/14/03

Boring/ Test Pit No	Sample No.	Depth ft.	Lab No.	Identification Tests: Water Content %	LL %	PL %	Sieve -200 %	Hyd -2μ %	ORG %	G_s	Dry unit wt. pcf	Density: γ_d MAX (pcf) / W_{opt} (%)	Permeability cm/sec	Strength Tests: Torvane or Type Test	$\bar{\sigma}_c$ psf	Failure Criteria	$\sigma_1 - \sigma_3$ or τ psf	Strain %	Consol.: $C_c / (1 + e_0)$	Laboratory Log and Soil Description
SB-49	S-10	28.5-30.0	117	48.0	41	24	100	50												Red-brown Lean clay (CL)
SB-49	S-17	65.0-66.5	118	7.8	20	13	42	12												Red-brown Sandy clay with gravel (CL)
SB-50	S-5	13.5-15.0	119	61.6	60	27	100	60												Brown Fat clay (CH)
SB-50	S-15	55.0-56.5	120	15.2	15	15	67													Red-brown Sandy silt (ML)
SB-51	S-3	7.5-9.0	121	36.2	59	26	99	62												Gray-brown Fat clay (CH)
SB-52	S-5	13.5-15.0	122	6.0	NP	NP	7													Gray-brown Poorly-graded sand with silt and gravel (SP-SM)
SB-52	S-14	55.0-56.5	123	63.2	37	22	99	39												Red-brown Lean clay (CL)
SB-52	S-17	70.0-71.2	124	15.3	NP	NP	24													Red-brown Silty sand with gravel (SM)
SB-53	S-4	10.5-12.0	125	2.9	*	*	9		* Insufficient sample for limit test											Gray Well-graded sand with silt and gravel (SW-SM)
SB-53	S-18	70.0-71.5	126	25.4	NP	NP	78	4												Red-brown Silt with sand (ML)



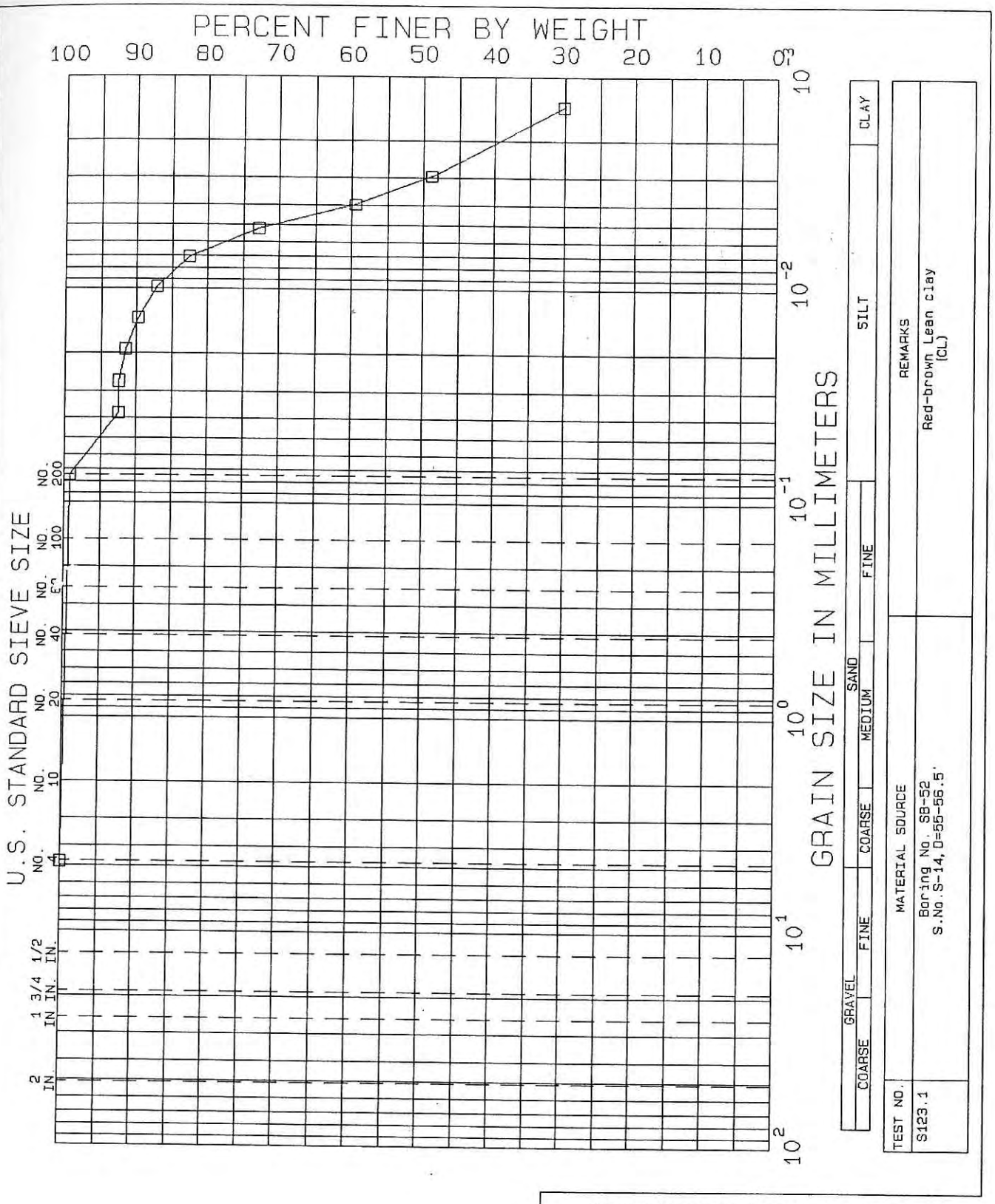
NEW BRITAIN-HARTFORD BUSWAY

CONNECTICUT

GRADATION TESTS

BORING NO.	SB-52	TEST SERIES	
SAMPLE	S-5	NO.	122
DEPTH	13.5-15'	DATE	Nov.03
TECH	PEC		
REVIEWER	MBP	FILE	L17828

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS



NEW BRITAIN-HARTFORD BUSWAY

CONNECTICUT

GRADATION TESTS

BORING NO.	SB-52	TEST SERIES	
SAMPLE	S-14	NO	123
DEPTH	55-56.5'	DATE	Nov.03
TECH.	CAG		
REVIEWER	MBP	FILE	L17828

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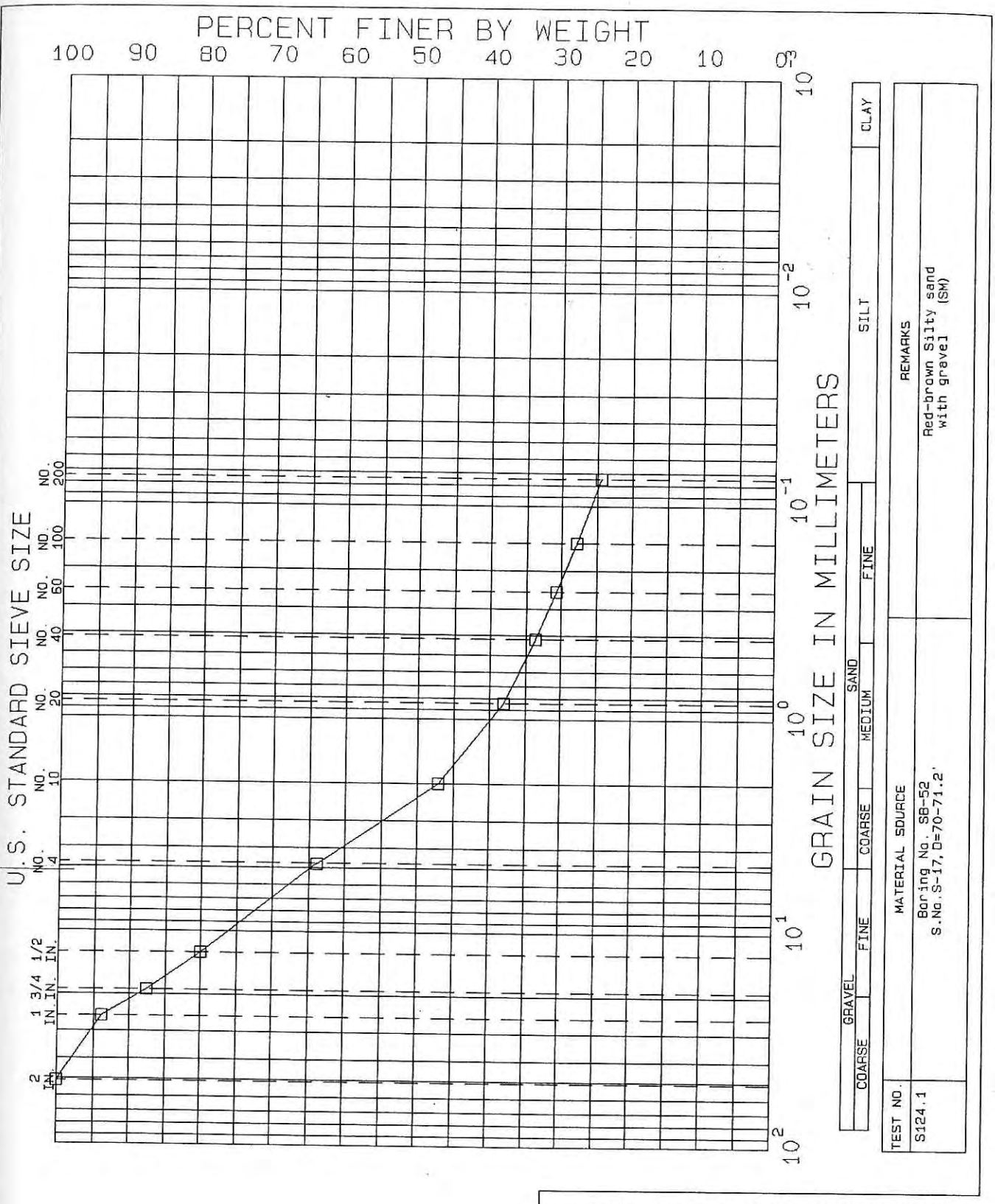
ENGINEERS AND SCIENTISTS



NEW BRITAIN-HARTFORD BUSWAY

CONNECTICUT

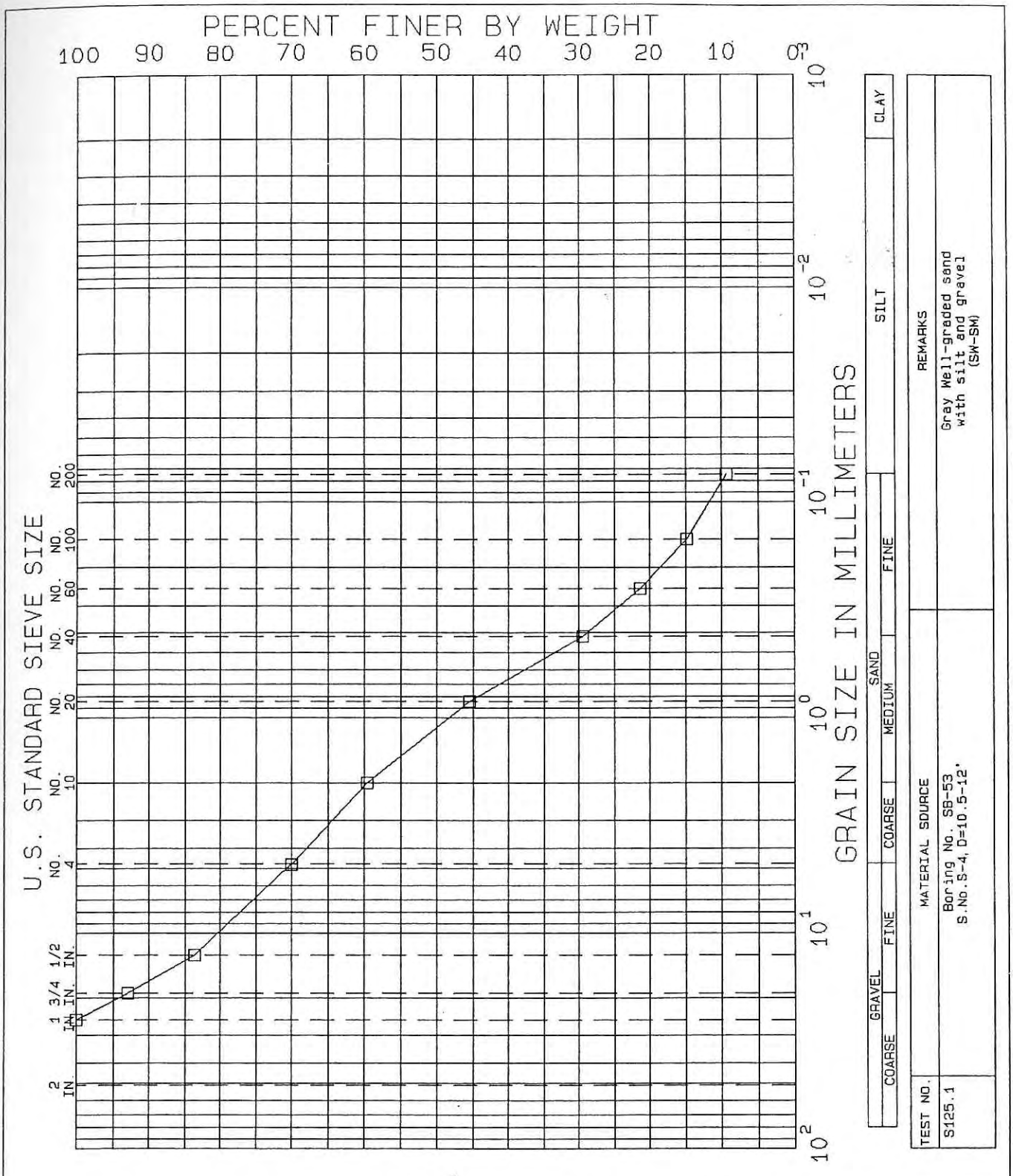
GRADATION TESTS

BORING NO. SB-52
SAMPLE S-17
DEPTH 70-71.2'
TECH PEC
REVIEWER MBP

TEST SERIES
NO. 124
DATE Nov.03

FILE L17828

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS

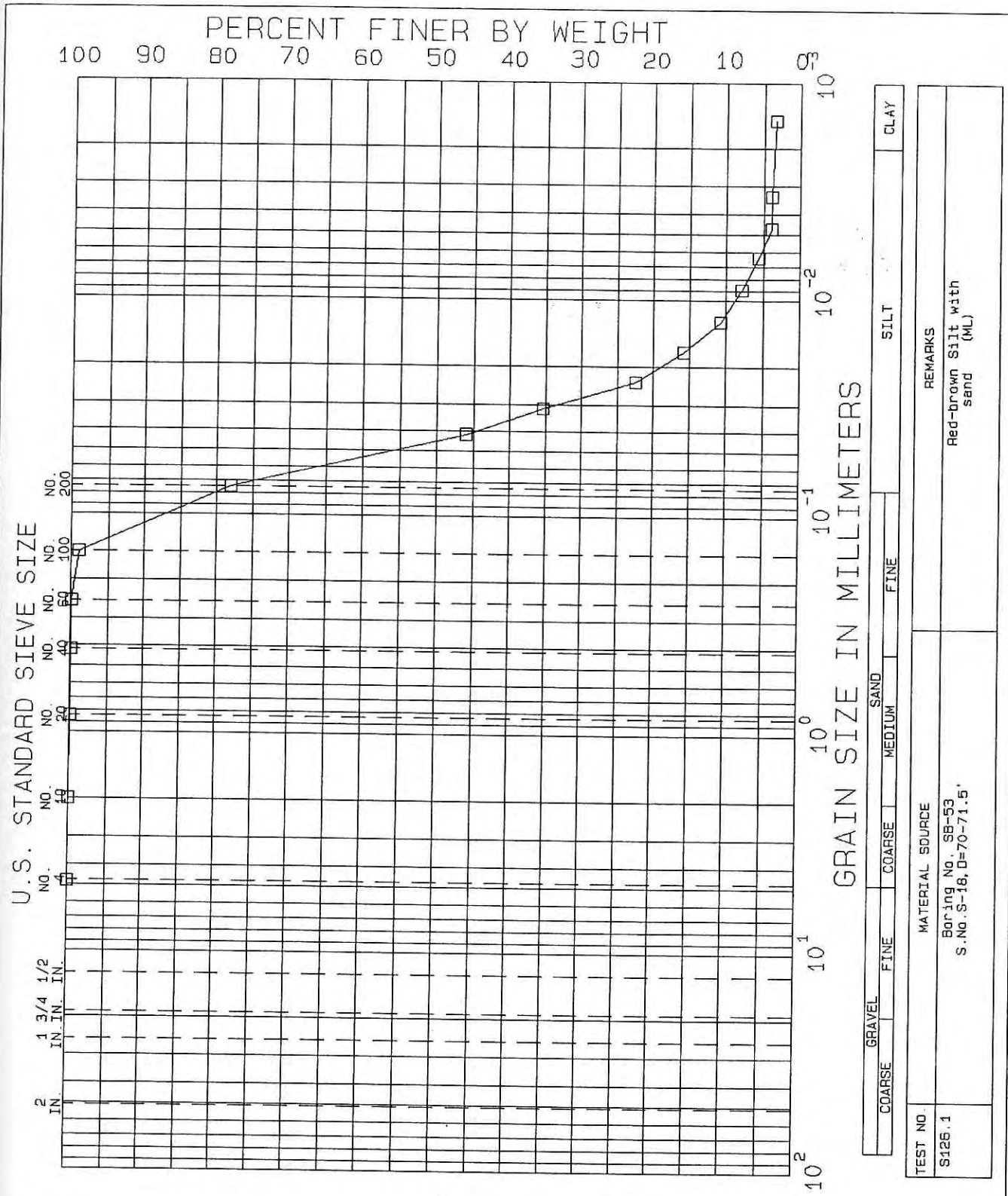


NEW BRITAIN-HARTFORD BUSWAY

CONNECTICUT

GRADATION TESTS

BORING NO	SB-53	TEST SERIES	
SAMPLE	S-4	NO	125
DEPTH	10.5-12'	DATE	Nov.03
TECH.	PEC		
REVIEWER	MBP	FILE	L17828



NEW BRITAIN-HARTFORD BUSWAY

CONNECTICUT

GRADATION TESTS

BORING NO. SB-53
SAMPLE S-18
DEPTH 70-71 5'
TECH CAG
REVIEWER MBP

TEST SERIES
NO. 126
DATE Nov.03

FILE L17828

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS

LABORATORY TESTING DATA SHEET

Project Name: NEW BRITAIN-HARTFORD BUSWAY CONNECTICUT
Project No.: L17828
Project Engineer: D. SCHULZE
Assigned By: D. Gaffney
Date: Nov.03
Reviewed By: Don Schulze
Date Reviewed: 11/24/03

Boring/ Test Pit No.	Sample No.	Depth ft.	Lab No.	Identification Tests: Water Content %	LL %	PL %	Sieve -200 %	Hyd -2μ %	ORG %	G_s	Dry unit wt. pcf	Density: γ_d MAX (pcf) W_{opt} (%)	Perme-ability cm/sec	Strength Tests: Torvane or Type Test	$\bar{\sigma}_c$ psf	Failure Criteria	$\sigma_1 - \sigma_3$ or τ psf	Strain %	Consol.: $\frac{C_c}{1+e_0}$	Laboratory Log and Soil Description
SB-46	UP-1	30-32	390		Average Total Unit Weight (30.0-31.9') = 108.94 Pcf															Brown Varved Soil as follows: Fat Clay (CH) grading to Silt (ML)
		30.6		66.1	(Clay Portion)									Tv= 0.27 tsf						
		30.7		35.7	(Silt Portion)															
		30.8-30.9		48.6	(entire varve)															Varve thickness varies from 1-2.5" Clay portion varies from 0.375-0.875" in thickness and comprises approx. 25-40% of total varve
		31.0-31.1		60.5							65.7								0.26	
		31.1-31.2		39.6	34	29														
		31.1 31.2					100	15	SILT											
		31.2-31.3		68.0	88	30														
		31.4-31.5					100	87	CLAY	2.89										

labform1 xls

GZA GeoEnvironmental, Inc.
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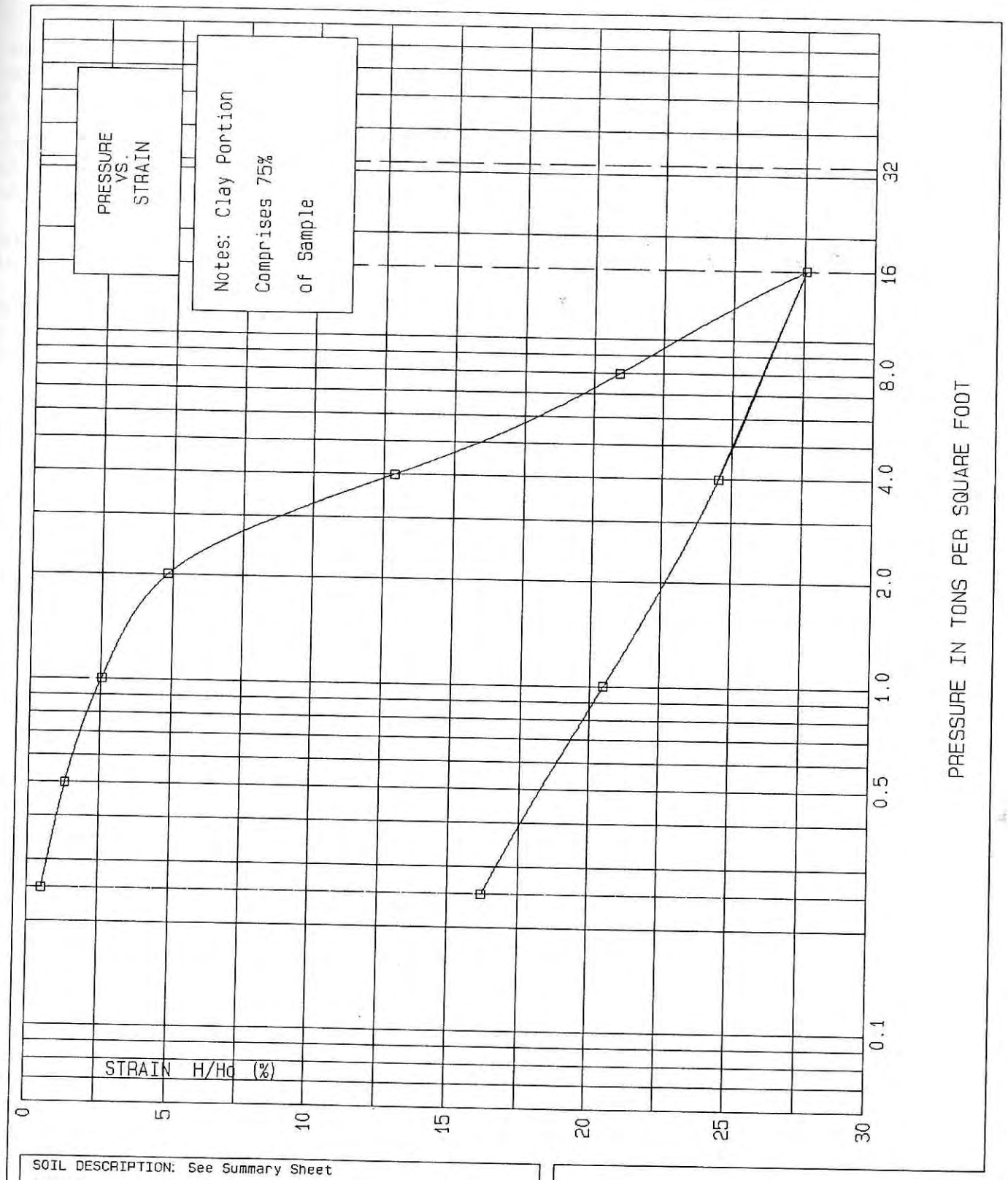

SOIL DESCRIPTION: See Summary Sheet

SAMPLE DIAM. 2.5 IN.	LIQUID LIMIT 0 %	PLASTIC LIMIT 0 %	SPECIFIC GRAVITY 2.89

	WATER CONTENT, %	DRY UNIT WEIGHT, pcf	VOID RATIO	SATURATION, %	SAMPLE HEIGHT, INCH
INITIAL	60.50	65.71			0.80
FINAL	46.80	78.58			0.67

NEW BRITAIN-HARTFORD BUSWAY

CONSOLIDATION TEST

FIGURE

BORING NO.	SB-46	TEST SERIES NO	390.1
SAMPLE	UP-1	DATE	11/19/03
DEPTH	31.0-31.1'		
TECH	MST		
REVIEWER	DAS	FILE	L17828

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS

umber L17828
ect Name ..... NEW BRITAIN-HARTFORD BUSWAY
Number 390.1
le Description .. See Summary Sheet
og Number SB-46
le Number UP-1
h ..... 31.0-31.1'

nician ..... MST
ewer ..... DAS

S: Clay Portion
rises 75%
ample

ecific Gravity ..... 2.8900E+00
ple Dry Weight ..... 6.7740E+01
ple Diameter ..... 2.5000E+00
tial Void Ratio ..... 0.0000E+00
tial Sample Height 8.0000E-01
al Sample Height 6.6900E-01
tial Water Content .... 6.0500E+01
al Water Content ..... 4.6800E+01
uid Limit ..... 0.0000E+00
stic Limit ..... 0.0000E+00
tial Saturation ..... 0.0000E+00
al Saturation ..... 0.0000E+00
data excluded
data included

crement er	Pressure (TSF)	Final Dial	Percent Strain	Void Ratio	T90 (min)	Cv (T90) (/10000) cm²/sec	C_α
1	0.125	17.0	0.00	1.744			
2	0.250	57.0	0.50	1.730	2.6	55.83	
3	0.500	121.0	1.30	1.709	6.3	22.74	0.0006
4	1.000	221.0	2.55	1.674	6.3	22.27	
5	2.000	402.0	4.81	1.612	6.3	21.48	
6	4.000	1049.0	12.90	1.390	23.0	5.27	
7	8.000	1689.0	20.90	1.171	13.0	7.75	0.007,
8	16.000	2222.0	27.56	0.988	9.0	9.31	
9	4.000	1981.0	24.55	1.071			
10	1.000	1656.0	20.49	1.182			
11	0.250	1314.0	16.21	1.299			

LABORATORY TESTING DATA SHEET

Project Name: NEW BRITAIN-HARTFORD BUSWAY CONNECTICUT
Project No.: L17828
Project Engineer: D. SCHULZE
Assigned By: D. Gaffney
Date: Feb.03
Reviewed By: [illegible]
Date Reviewed: 2/23/04

Boring/ Test Pit No.	Sample No.	Depth ft.	Lab No.	Identification Tests: Water Content %	LL %	PL %	Sieve -200 %	Hyd -2μ %	ORG %	G_s	Dry unit wt. pcf	Density: γ_d MAX (pcf) / W_{opt} (%)	Permeability cm/sec	Strength Tests: Torvane or Type Test	$\bar{\sigma}_c$ psf	Failure Criteria	$\sigma_1 - \sigma_3$ or τ psf	Strain %	Consol.: $\frac{C_c}{1+e_0}$	Laboratory Log and Soil Description
SB-52	ST-1	50.0-52.0	399		Average Total Unit Weight (50.0-51.3') = 117.8 Pcf															Red-brown Varved Soil as follows:
		50.1		48.7	(Clay Portion)									Tv= 0.24 tsf						Lean Clay (CL) grading to Silt (ML)
		50.5		23.2	(Silt Portion)									Tv= 0.20 tsf						
		50.5-50.6		43.7							79.3								0.15	Varve thickness varies from 0.25-0.5" Clay portion varies from 0.125-.25"
		50.7		41.6	(entire varve)									Tv= 0.25 tsf						in thickness and comprises approx. 35-50% of total varve
		50.0-51.3*		47.3	40	23														
		50.0-51.3*					100	47												* Note: Hydrometer, Specific Gravity, and Atterberg Limit samples taken from clay layers throughout the tube sample
		50.0-51.3*								2.83										

GZA GeoEnvironmental, Inc.
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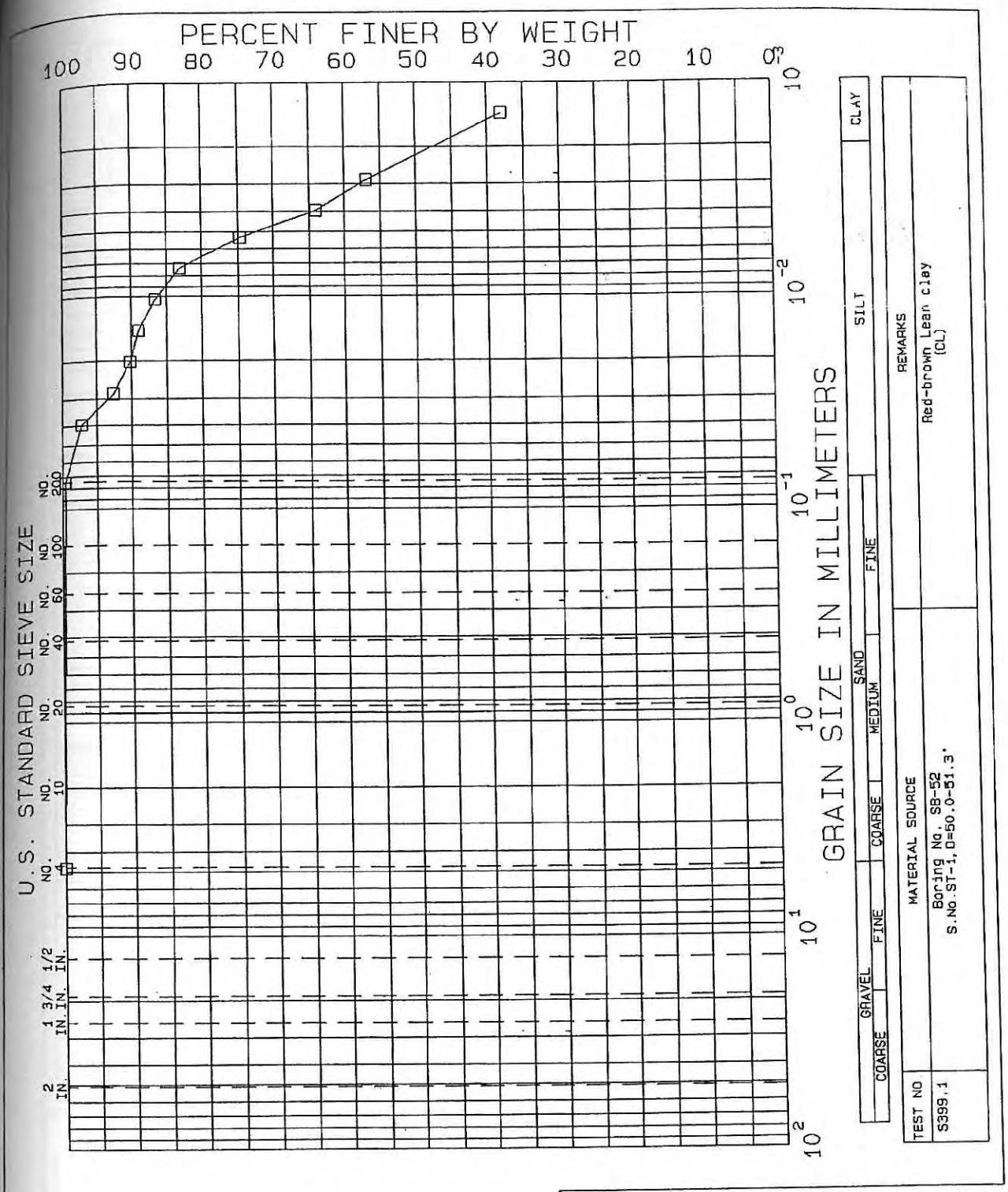
labform1.xls

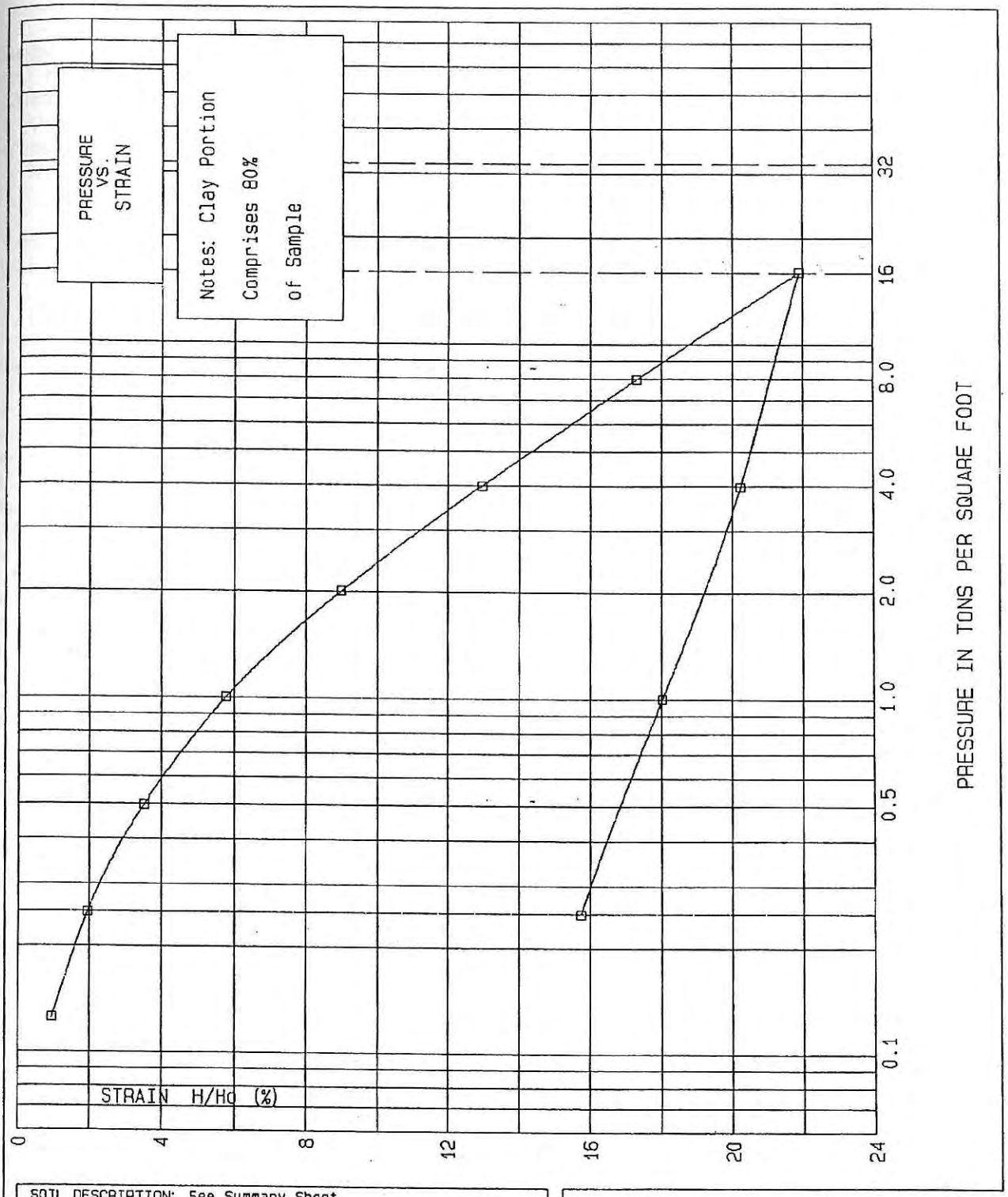


NEW BRITAIN-HARTFORD BUSWAY

CONNECTICUT

GRADATION TESTS

BORING NO.	SB-52	TEST SERIES	
SAMPLE	ST-1	NO.	399
DEPTH	50.0-51.3'	DATE	Feb.04
TECH.	PEC		
REVIEWER	MBP	FILE	L17828



SOIL DESCRIPTION: See Summary Sheet

SAMPLE DIAM.	LIQUID LIMIT	PLASTIC LIMIT	SPECIFIC GRAVITY
2.5 IN.	0 %	0 %	2.83

	WATER CONTENT, %	DRY UNIT WEIGHT, pcf	VOID RATIO	SATURATION, %	SAMPLE HEIGHT, INCH
INITIAL	43.70	79.26			0.80
FINAL	32.20	94.07			0.67

New Britain-Hartford Busway

CONSOLIDATION TEST

BORING NO.	SB-52	TEST SERIES NO.	C399.1
SAMPLE	ST-1	DATE	2/23/04
DEPTH	50.5-50.6'		
TECH.	MST		
REVIEWER	DAS	FILE	L17828

FIGURE

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS

Job Number L17828
Project Name ..... New Britain-Hartford Busway
Test Number C399.1
Sample Description .. See Summary Sheet
Boring Number SB-52
Sample Number ST-1
Depth ..... 50.5-50.6'

Technician ..... MST
Reviewer ..... DAS

NOTES: Clay Portion
Comprises 80%
of Sample

Specific Gravity ..... 2.8300E+00
Sample Dry Weight ..... 8.1700E+01
Sample Diameter ..... 2.5000E+00
Initial Void Ratio ..... 0.0000E+00
Initial Sample Height 8.0000E-01
Final Sample Height 6.7400E-01
Initial Water Content .... 4.3700E+01
Final Water Content ..... 3.2200E+01
Liquid Limit ..... 0.0000E+00
Plastic Limit ..... 0.0000E+00
Initial Saturation ..... 0.0000E+00
Final Saturation ..... 0.0000E+00
T50 data excluded
T90 data included

Increment umber	Pressure (TSF)	Final Dial	Percent Strain	Void Ratio	T90 (min)	Cv (T90) (/10000)	C_α
1	0.000	0.0	0.00	1.228			
2	0.125	75.0	0.94	1.207			
3	0.250	158.0	1.97	1.184	12.9	10.98	
4	0.500	283.0	3.54	1.149	12.3	11.22	0.0018
5	1.000	462.0	5.77	1.099	6.3	21.05	0.0024
6	2.000	719.0	8.99	1.028	8.4	14.90	
7	4.000	1036.0	12.95	0.940	6.3	18.36	
8	8.000	1384.0	17.30	0.843	6.3	16.68	
9	16.000	1752.0	21.90	0.740	4.0	23.58	0.0041
10	4.000	1619.0	20.24	0.777			
11	1.000	1443.0	18.04	0.826			
12	0.250	1259.0	15.74	0.877			

Appendix 5

Limitations

GEOTECHNICAL LIMITATIONS

Explorations and Data Review

1. The analyses and recommendations submitted in this report are based in part upon data obtained from widely spaced subsurface explorations. The nature and extent of variations between these explorations may not become evident until further explorations are made and construction occurs. If variations then appear evident, it will be necessary to reevaluate the recommendations of this report.

2. The analyses and recommendations submitted in this report are based in part upon review of plans and reports prepared by others. Plans and reports were transmitted as digital copies and drawings were reproduced at different scales than originally drawn. Plans may be incomplete and date back to approximately 100 years. Actual as-built foundation conditions may be different than represented on historic plans provided and as inferred by Geo**Design**.

3. The generalized soil and bedrock profile described in the text is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized and have been developed by interpretations of widely spaced explorations and samples; actual soil and bedrock transitions are probably more erratic. For specific information, refer to the boring logs.

4. The geologic and geomorphologic settings at this site are complex and the uncertain historic site usage have resulted in the varied distribution and stress history of cohesive strata across the site. Limited spacing of borings and lab testing can at best, only allow for estimates to be developed for duration and magnitude of consolidation settlements.

5. Water level readings have been made in the drill holes at times and under conditions stated on the boring logs. These data have been reviewed and interpretations have been made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in stream levels, rainfall, temperature, and other factors occurring since the time measurements were made. As with any site, there can be shallow perched groundwater conditions resulting from natural and manmade causes, that may exist at the site.

Review

6. In the event that any changes in the nature, design or location of the proposed structure or roadway, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing by Geo**Design**, Inc. It is recommended that this firm be provided the opportunity for a general review of design and specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications.

Use of Report

7. This report has been prepared for the exclusive use Michael Baker Corporation (Baker), the Connecticut Department of Transportation (ConnDOT), and other members of the design team for specific application to the construction of Bridge 02 (Amtrak over Trout Brook)

for the proposed Amtrak Access Road, located in Newington, West Hartford, and Hartford, Connecticut, in accordance with generally accepted soil and foundation engineering practices. No other warranty, express or implied, is made.

8. This final design soil and foundation engineering report has been prepared for this project by Geo**Design**. This report is for design purposes only and is not sufficient to prepare an accurate bid. Contractors wishing a copy of the report may secure it with the understanding that its scope is limited to design considerations only.