100% Submission
Final Geotechnical Structure Soils Report
Branford Station Platform and Tower
Shore Line East Railroad
Branford, Connecticut

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April 14, 2011
File No. 0183-007.0

100% Submittal
SHORE LINE EAST RAIL ROAD
BRANFORD STATION PLATFORM AND TOWER
FINAL SOIL STRUCTURE REPORT

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1.0 INTRODUCTION

This report provides geotechnical design and construction recommendations for the proposed Shore Line East Railroad North Platform and Tower located in Branford, Connecticut. The proposed platform and tower are part of the Shore Line East Railroad Expansion Project (State Project No. 310-0048), which includes proposed platforms and towers at Branford, Madison, Clinton, and Westbrook Stations; a proposed parking garage at Madison Station; and surface parking at Branford.

The platform and tower will be part for the new proposed Branford Station. The proposed station is located approximately half a mile west of the exiting Branford Station and 400 feet (ft) west of the intersection of Maple Street and Kirkham Street in Branford, Connecticut. The site location is depicted on Figure 1 (Appendix 1) and a plan view of the proposed construction is shown on Figure 2 (Appendix 1).

Baker Engineering NY, Inc. (Baker) is the prime designer for the platform and towers. Geo**Design**, Inc. is working as a Geotechnical Sub-Consultant to Baker. Diversified Technology Consultants (DTC) is working as an Environmental Sub-Consultant to Baker.

1.1 Project Datum

The project horizontal datum is the Connecticut Coordinate System NAD 1927 in feet and the vertical datum is N.G.V.D. 1929 in feet.

1.2 Design Method

Foundation recommendations are in accordance with the 2003 International Building Code (IBC), 2005 Connecticut Supplement, and 2009 Connecticut Amendment. Recommendations are also based on the ConnDOT Geotechnical Engineering Manual (2005 Edition) and ConnDOT Standard Specifications for Roads, Bridges, and Incidental Construction, Form 816 (2004). The American Society for Testing and Materials (ASTM), American Railway Engineering and Maintenance-of-Way Association (AREMA), and U.S. Department of Transportation Federal Highway Administration (FHWA) publications were followed as reference standards.

2.0 EXISTING CONDITIONS

Railroad tracks traverse across the site in the east-west direction. The rail line is set on about 2 to 3 ft of crushed stone ballast that slopes away from the track at about 2H:1V (horizontal to vertical) to the surrounding grades (approximately Elevation (El.) 11.5). Existing underground fiber optic cables and Amtrak Catenary (CAT) Towers (Nos. 81-3, 81-4, 81-5, and 81-6) are located on the north and south sides of the tracks.

A micropile supported passenger platform and tower foundation are located south of the tracks. This south side platform is approximately 205 ft long by 12 ft wide with stairs that lead from the surrounding track grades (approximately El. 11.5) to the top of platform elevation (El. 16.5). The tower foundation is approximately 55 ft long by 20 ft wide and was designed and constructed to support a proposed stair/elevator tower and the south end of the proposed overpass pedestrian bridge.

The 1892 and 1942 historic topographic maps of the project area indicate that the south side of the railroad tracks consisted of a tidal stream surrounded by wetlands, which extended slightly north of the tracks.

3.0 PROPOSED CONSTRUCTION

The proposed site features and construction information were provided by Baker.

The proposed passenger platform will be located on the north side of the existing tracks. The platform will be approximately 224 ft long by 12 ft wide with stairs on the west that lead from the surrounding track grades (approximately El. 12) to the top of platform elevation (El. 18). The edge of the platform will be about 5.7 ft from the nearest track centerline, with the edge of platform foundation at about 11.5 ft from the nearest track centerline.

The proposed stair/elevator tower will be located on the north side of the existing tracks at the east end of the proposed platform. The tower will be approximately 50 ft long by 14 ft wide by 34 ft high and consists of concrete ramps and stairs, with an elevator located on the west side of the structure. The tower will have a parking lot entrance/exit at approximate El. 16.5 feet, which will lead to a platform entrance/exit floor at El. 16.5 feet. The bottom of elevator pit is to be about 5.5 feet below the tower entrance floor level. The tower will support the north end of an overpass pedestrian bridge, which will connect the north and south platforms.

Existing grades surrounding the lengths of the proposed platform and tower are at about El. 11.5 feet. The proposed bottom of pile cap foundations range between approximate El. 8.5 and 11.5 feet. The proposed pile caps will be located adjacent to the existing Catenary Tower foundations.

4.0 SUBSURFACE DATA

4.1 Geologic Mapping

Published surficial and bedrock geological maps (*Surficial Geologic Map of the Branford Quadrangle, Connecticut, Richard Foster Flint, 1960, 1961, and 1962 (1:24,000 scale) and Bedrock Geological Map of Connecticut, John Rogers, 1985 (1:125,000)*) were consulted to obtain information on the regional geology in the area of the proposed platform and tower. The surficial material below the rail road tracks was mapped as Artificial Fill. South of the tracks the surficial material was mapped as Swamp Deposits, containing silt, sand, clay, and organic material. North of the tracks the surficial material was mapped as Ice Contact Stratified Drift, containing sand, gravel, silt, and clay. The bedrock was mapped as Branford Gneiss and described as gray to white, well foliated Granitic Gneiss.

4.2 August 2000 Subsurface Exploration

In August 2000, Wang Engineering, Inc. (WEI) performed a preliminary subsurface exploration for the proposed Shoreline East Branford Railroad Station. Four test borings (BN-1, BN-2, BN-3, and BN-4) were performed in the general vicinity of the proposed structures. The boring locations are shown on Figure 2 (Appendix 1) and the boring logs are included in Appendix 2.

WEI boring logs indicated that explorations were advanced with hollow stem augers to depths ranging from 47 to 65 ft (El. -35 to -54) below the ground surface. Soil samples and relative densities/consistencies were obtained in the above test borings by split barrel sampling procedures. Test Boring BN-4 was carried to refusal on bedrock (inferred bedrock) based on split barrel sampling. Observation wells were installed in Test Borings BN-2 and BN-4.

4.3 October 2008 Subsurface Explorations and Infiltration Tests

In October of 2008, Geo**Design** submitted a Geotechnical report for Proposed Surface Parking, Culvert, and Roadway. For reference, this report is attached in Appendix 5.

4.4 October 2010 Subsurface Exploration

A Geo**Design** representative observed and logged three supplemental test borings (RR-11, RR-12, and RR-13) that were performed by SoilTesting, Inc. from October 14 to October 20, 2010. Samples for environmental purposes were retrieved from above the water table (or before water was introduced into the holes) by DTC out of the Hamden, Connecticut office. The test borings were performed to explore the underlying soils and conditions in the areas of the proposed platform and tower. Exploration locations are depicted on Figure 2 in Appendix 1, and boring locations and elevations were surveyed by ConnDOT. The boring logs are included in Appendix 2.

Explorations were advanced with hollow stem augers into natural soils, and using open hole with mud thereafter. Boring depths ranged from 64 to 95 ft (El. -52 to -87) below the ground surface. Representative soil samples and relative densities were obtained in the above test borings by split barrel sampling procedures in general accordance with ASTM Specification D-1586 (standard penetrations testing). The split-barrel sampling procedure utilizes a standard 2-inch O.D. split-barrel sampler that is driven into the bottom of the boring with a 140-pound hammer falling a distance of 30 inches. The number of blows required to advance the sampler the middle 12-inches of a normal 24-inch penetration is recorded as the Standard Penetration Resistance Value (N). These "N" values are indicated on the boring logs and profiles at their depth of occurrence and provide an indication of the relative density of the material.

Test borings were carried to refusal on bedrock or inferred bedrock (as determined by refusal) based on split barrel sampling and roller bit refusal. The presence of bedrock was verified in Test Boring B-3 by rock core drilling. The core samples were drilled using a five foot NX core barrel. The core times were recorded every foot of core length and rock quality was determined using visual classification.

A two-inch diameter PVC observation well was installed upon completion of Test Boring RR-13 to measure stabilized groundwater levels. The well was installed approximately 14 ft below grade and constructed with a ten foot 0.01-inch slotted screen and a solid riser. The screen was surrounded with filter pack sand and sealed with bentonite. The observation well was secured with a locking protective standpipe and concrete collar.

5.0 SUBSURFACE CONDITIONS

5.1 Generalized Subsurface Profile

The test boring explorations were consistent with published historic topographic maps and geologic mappings. Spatially, the soil stratums encountered in the August 2000 and October 2010 subsurface explorations were generally similar in color, consistency, and density. A subsurface profile (Figures 3) is provided in Appendix 1 and the boring logs in Appendix 2 for more details.

The generalized subsurface profile in the areas of the proposed platform and tower, as inferred from the available subsurface exploration data, is summarized as follows:

- **Railroad Ballast** - 1 to 2 feet thick; over
- **Fill** - 5 to 10 feet thick; over
- **Alluvial Deposit** - 5 to 8 feet thick; over
- **Swamp Deposit** - 5 to 11 feet; over
- **Glaciolacustrine Deposit** - 15 to 27 feet; over
- **Glacial Till** - 12 to 19 feet thick; over
- **Bedrock** - Encountered 62 (El. 51) to 65 (El. 57) feet below the ground surface.

The **Railroad Ballast** generally consisted of medium dense, blackish brown fine to coarse sand with varying amounts of fine to coarse gravel and silt.

The **Fill** generally consisted of very loose to dense (generally loose), dark brown fine to coarse sand and silt (35 to 50%) with trace (0 to 10%) amounts of fine gravel. Trace (0 to 10%) amounts of asphalt and organics were also encountered in the Fill.

The **Alluvial Deposit** generally consisted of very loose to medium dense (generally loose), dark brown fine to coarse sand with varying amounts of fine to coarse gravel (0 to 50%) and silt (0 to 50%). Spatially, the deposit appeared to change with depth, and in the west to east direction, from a sand and gravel mixture to a silty sand. Trace (0 to 10%) amounts of organic fibers were observed in the silty sands.

The **Swamp Deposit** generally consisted of very soft to soft (generally very soft), gray organic clayey silt with trace (0 to 10%) amounts of organic fibers and shells. Interbedded layers of peat were also observed in the Swamp Deposit.

The **Glaciolacustrine Deposit** generally consisted of soft to very stiff (generally medium to stiff), gray to brown, silt and clay with trace (0 to 10%) amounts of fine sand. Distinct varved layering was observed in the lower thirteen to eighteen feet of the deposit.

The **Glacial Till** generally consisted of medium dense to very dense, reddish brown fine to coarse sand with varying amounts of gravel (10 to 50%) and fines (10 to 50%). The relative density of the deposit appeared to increase with depth.

Bedrock was encountered between approximate El. 51 to 57 and was encountered progressively deeper in the west to east direction. The top of the Bedrock appeared to be decomposed. Augers were advanced through the decomposed bedrock with relative ease and split barrel sampling indicated a consistency of very dense.

Three Bedrock cores were performed below the decomposed bedrock in Test Boring RR-13. The Core Recovery and Rock Quality Designation (RQD), a measure of rock mass quality, ranged from 98 to 100% and 42 to 70%, respectively. The rock quality generally improved with depth. The rock type was classified as fair to poor quality, soft to hard, slightly to moderately weathered, medium to coarse grained, Granitic Gneiss.

5.2 Groundwater

Groundwater was encountered 6 to 9 ft below the ground surface during drilling (approximate El. 2 to 3). Groundwater levels were measured on October 18, 2010 and October 19, 2010 in the observation well installed in Test Boring RR-13. Groundwater was measured at about 5 ft below existing ground surface or at approximate El. 3. Groundwater conditions will vary depending on

factors such as temperature, season, precipitation, construction activity, and other conditions, which may be different from those at the time of these readings.

6.0 LABORATORY TEST RESULTS

Geotechnical index and strength tests were performed by Wang Engineering, Inc. on select soil samples from the August 2000 Subsurface Exploration. Due to the consistency between the soil stratums encountered in the August 2000 and October 2010 subsurface explorations, the existing laboratory test results were referenced to verify field classifications and determine approximate soil strength and consolidation behavior from the October 2010 explorations. The results of these tests are discussed below and are included in Appendix 3.

6.1 Geotechnical Index Tests

The gradation analysis performed on a sample from the Alluvial Deposit (BN-2 10 to 12 ft) indicated a gravel content of 20%, sand content of 63%, silt content of 13%, and clay content of 4%. The natural water content was 20%.

The gradation analysis performed on a sample from the Swamp Deposit (BN-3 15 to 17) indicated a gravel content of 0%, sand content of 2%, silt content of 69%, and clay content of 29%. The Atterberg Limits indicated a liquid limit of 99%, plastic limit 60%, and natural water content of 75%.

The gradation analyses performed on samples from the Glaciolacustrine Deposit (BN-1 30 to 32 ft, BN-1 35 to 37 ft, BN-2 35 to 37 ft, and BN-4 35 to 37 ft) indicated a gravel content of 0%, sand content of 4 to 6%, silt content of 56 to 60%, and clay content of 36 to 38%. The Atterberg Limits indicated a liquid limit of 35 to 42%, plastic limit of 18 to 24%, and natural water content of 32 to 39%.

The gradation analysis performed on a sample from the Glacial Till (BN-4 45 to 47 ft) indicated a gravel content of 22%, sand content of 60%, silt content of 14%, and clay content of 4%.

These results are generally consistent with the visual classifications from the August 2000 and October 2010 subsurface explorations.

6.2 Unconfined Compression Test

An unconfined compression test (ASTM D 2166-91) was performed on a sample from the Swamp Deposit (BN-3 15 to 17 ft). The test indicated an unconfined compressive strength of 0.39 tsf and modulus of elasticity of 8.96 tsf.

7.0 EXISTING MICROPILE DESIGN AND LOAD TEST DATA

The micropiles that support the existing southside passenger platform and tower foundation were designed by Layne GeoConstruction (Layne) in February 2004. As part of the design, Layne performed a load test in April 2004 to confirm the micropile capacities and design assumptions. Refer to Appendix 4 for the exiting micropile submittal documents, including existing platform and tower micropile design and load test. The above submittal also includes the results of load tests performed on four production piles in July 2004.

The micropiles supporting the exiting platform and tower were designed for allowable capacities of 45 and 93 kips, respectively. The micropiles were designed as eight-inch diameter steel reinforced gravity-grouted piles supported within the Glacial Till stratum. Design allowable bond strengths were 18 psi for the Glacial Till and 5 psi for the Glaciolacustrine Deposit. Resistance from the Fill and Swamp Deposits were neglected.

The design test pile was approximately 60 ft long with bond lengths of approximately 19 ft and 15 ft in the Glaciolacustrine Deposit and Glacial Till, respectively. Casing (9-5/8 inch) was installed through the Fill and Swamp Deposits for the design load test in order to establish an unbonded zone. The design load test results show approximate axial deflections of 0.12 and 0.28 inches for axial loads of 93 kips and 186 kips, respectively. The above deflections also include the elastic compression of the micropile itself.

8.0 GEOTECHNICAL ISSUES

The following geotechnical issues have been identified and are based on the site soil conditions and preliminary drawings provided by Baker.

- The relatively thick loose Fill and compressible Swamp Deposits precludes the use of shallow foundations for support of the proposed platform and tower. Ground improvement, such a deep dynamic compaction, vibroflotation, or stone columns, are similarly unsuitable due to the depth and nature of the Fill and Swamp Deposits. Thus, the platform and tower will need to be supported on deep foundations bearing in Glacial Till or on Bedrock.

- To avoid the need for excavation support adjacent to the rail (per AREMA), the pile caps are proposed above the zone of railroad influence as depicted on Figure 4, Appendix 1. This places the bottom of pile caps above the 42-inch frost depth. Recommendations to allow for surface runoff, and to reduce effects of freeze/thaw are provided herein.

- Pile cap excavations will need to work around and support the existing Amtrak CAT Tower Nos. 81-3 and 81-5.

9.0 GEOTECHNICAL RECOMMENDATIONS

9.1 Foundation Type

We recommend that the proposed platform and tower be supported on micropiles; spaced at a minimum of three diameters on center. Micropiles generally have more advantages for railroad applications than conventional piles or drilled shafts. The specific advantages in relation to this project are as follows:

- The drilling and grouting equipment used for micropile installation is relatively small and can be mobilized in the restrictive areas (low overhead and setback conditions) adjacent to the railroad tracks.

- Micropiles can be installed on an incline (batter angle) to achieve increased lateral capacities.

- The proper drilling and grouting procedures associated with micropile instillation will not damage the tracks, catenary towers, or other existing structures with excessive vibrations or heaving.

- Micropiles can be installed through the Fill (possible obstructions) and Swamp Deposits (weak soils) without damaging the integrity of the pile.

- Micropile installation will produce fewer spoils than large diameter drilled shafts; reducing the handing cost of contaminated soils and installation spoils (if present).

The existing platform and tower foundation, located south of the tracks, are supported on micropiles. The load tests from the design and construction of those micropiles can be used to supplement the design of micropiles for the proposed platform and tower.

9.2 Bearing Strata

Based on the site soil conditions and load test data from the exiting platform and tower micropiles, we anticipate the micropiles will attain ample capacity in the Glacial Till stratum. We estimate the top of the Glacial Till stratum to be at approximate El. -39. Although the micropile design shall be up to the contractor, we recommend leaving the drill casing in place through the Fill and Swamp Deposits to maintain the borehole integrity during construction; thus eliminating potential collapsing, squeezing of weak soils, and/or loss of ground. We estimate the bottom of the Fill and Swamp to be at approximate El. -14. The steel casing will also decrease the

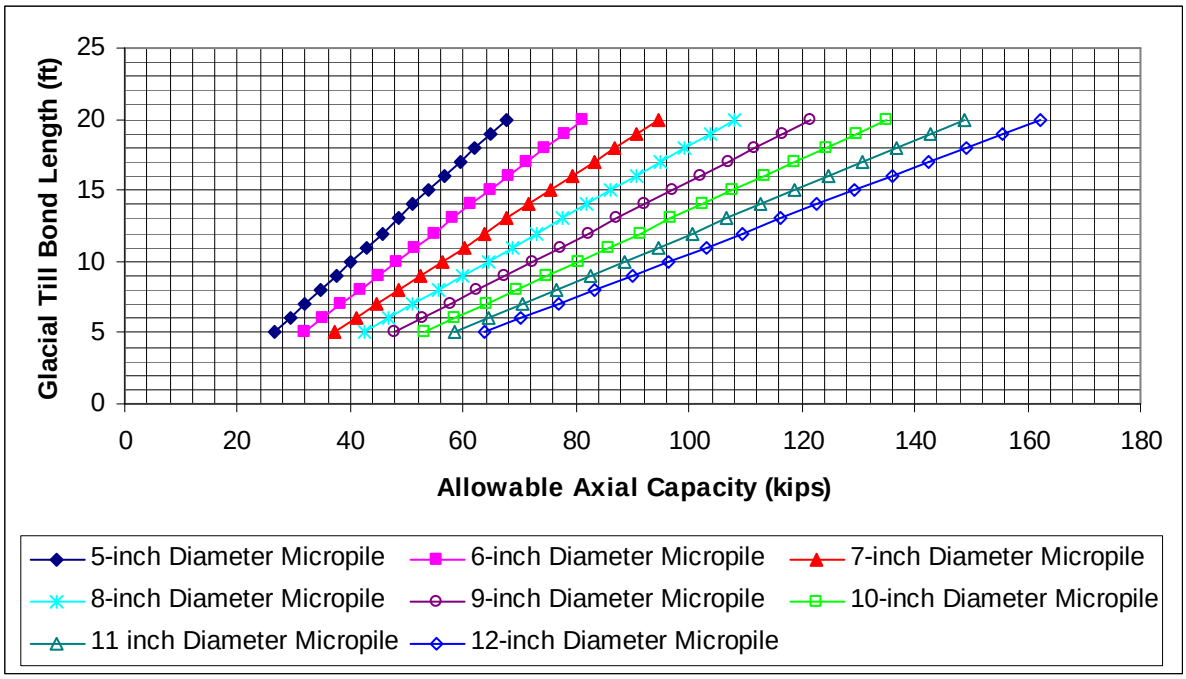
downdrag force on the micropiles, as discussed in Section 9.5. Lateral capacities are discussed in Section 9.4, which neglect the bending resistance of steel reinforcement and casing.

9.3 Geotechnical Axial Capacity

We estimated the geotechnical axial capacity for various micropile diameters (5- to 12-inches) versus Glacial Till bond length (refer to the following figure). For example, a 95 kip, 8-inch diameter micropile, will require an embedment of 17 ft into the Glacial Till stratum. The axial capacities include a constant bond length of 15 ft for the Glaciolacustrine Deposit.

The allowable bond resistances for the Glacial Till (14.5 psi) and Glaciolacustrine Deposit (4.5 psi) are based on a factor of safety of 2.5. The above bond resistances are higher than the recommended values in FHWA-SA-97-070, Micropile Design and Construction Guidelines, but were justified based on the in-situ static load tests performed on the existing platform and tower micropiles. However, we reduced the allowable bond resistances used for the existing micropile design (i.e. Glacial Till – from 18 psi to 14.5 and Glaciolacustrine Deposit – from 5 psi to 4.5 psi) to account for the variability of the means and methods of the micropile installation.

We recommend a minimum of one verification test be performed on a micropile from the proposed tower foundation located on the northeast end of the platform to verify the design parameters. We further recommend that 5-percent of the piles be proof tested.

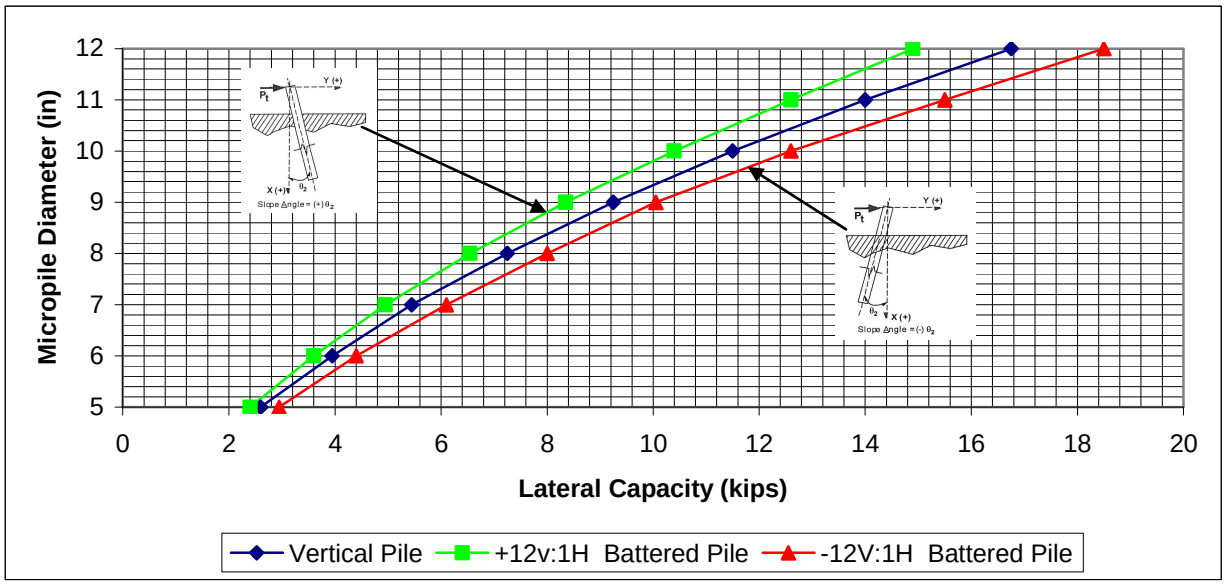


9.4 Geotechnical Lateral Capacity

We estimated the geotechnical lateral capacities for vertical and battered micropiles ranging from 5- to 12-inches in diameter (refer to the following figure). For example, a 7-inch diameter vertical micropile has a lateral capacity of 5.5 kips. Lateral capacities were estimated as half the lateral load required to deflect the top of the pile one inch (per the 2003 IBC). The lateral capacities for battered micropiles are based on lateral loads perpendicular to the ground surface and do not take into account the additional lateral capacity from axial compression.

The micropiles were modeled using the LPILE Plus V.5.0 software (Ensoft, Inc.). The model conservatively neglected the bending resistance of structural steel reinforcing and steel casing, and assumed a controlling modulus of elasticity of 4,495 ksi for the micropile grout. Once the structural design of the micropiles is complete geotechnical and structural can coordinate the final pile selection. If additional lateral capacity is required, a larger pile can be selected or the pile analyses can be adjusted to include the bending resistance of the structural steel reinforcing and/or casing.

Should battered piles be used to support the proposed platform and tower, interference with temporary sheet piles (to remain) located adjacent to Amtrak rail lines should be considered during minipile design.

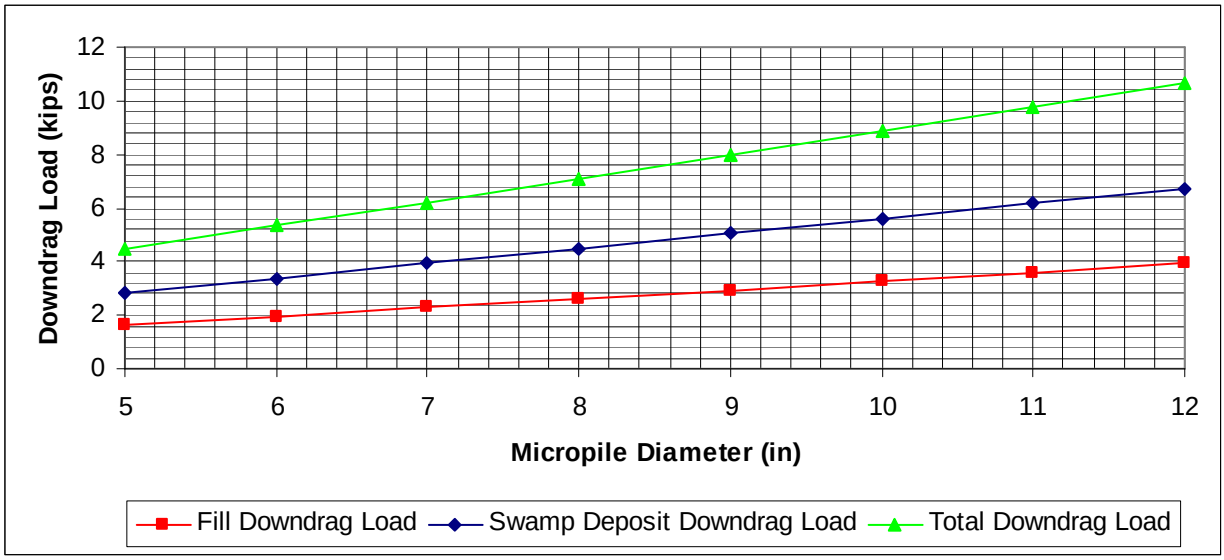


9.5 Downdrag Loads

Downdrag loads (also referred to as negative skin friction) consist of downward (settlement-induced) frictional forces from soils against the surface of deep foundation elements. We anticipate there will be downdrag loads on the micropiles from secondary compression of the Fill and Swamp Deposits. We estimated the downdrag loads for micropiles ranging from 5- to 12-inches in diameter (refer to the following figure). For example, a 9-inch diameter micropile will have 8 kips of *total* down drag load.

The downdrag analyses were performed assuming permanent steel casing will be installed though the Fill and Swamp Deposits. The steel casing will reduce the soil to pile fictional interface, which will ultimately decrease the downdrag loads. The downdrag loads are relatively small compared to pile axial capacities, thus additional measures will <u>not</u> be required to decrease the soil to pile fictional interface (i.e. bitumen coating).

The key issues associated with these downdrag loads are how to appropriately consider them with other loads for design (e.g., transient live load). These downdrag loads are additive to dead loads, but live loads cause temporary deformation and downward movement of piles relative to the soil, which reduces or eliminates drag load during live loading. Thus, during final design each loading case should be reviewed to determine the applicability of drag loads.



9.6 Pile Cap Protection

Since the pile caps are proposed above the zone of railroad influence, the bottom of pile caps will be above or nominally within the 42-inch frost depth. Since the platform and tower are founded on piles, settlement and heave due to cycles of freeze/thaw is not a concern; however, we do recommend protecting the pile caps and shallow subgrade conditions from damage due to freeze/thaw.

We recommend a 6-inch layer of Free-Draining Material (Form 816, Section 2.08) below the pile caps. We further recommend a drain be installed along the length of pile cap facing the railroad. This drain should consist of perforated pipe surrounded by crushed stone and filter fabric, installed at the approximate bottom of pipe cap elevation. The pipe must be pitched for gravity flow discharge away from the rail and platform.

9.7 Seismic Design Category

The Swamp Deposit is greater than 10 ft thick in some areas. The material has a plasticity index greater than 20, moisture content greater than 40%, and an undrained shear strength less than 500 psf. Therefore, the applicable site class is considered to be Site Class E per the 2003 IBC. Per Appendix K to the 2009 Connecticut Building Code Supplement, S_S equals 0.233 and S_1 equals 0.061.

To determine the project "Seismic Design Category" per IBC Tables 1616.3(1) and 1616.3(2), we compute S_{DS} for the site as 0.39g, and S_{D1} as 0.14g. Assuming the proposed rail platform and stair/elevator tower are classified as Seismic Use Group II, the project would be considered Seismic Design Category C.

9.8 Liquefaction

Soil liquefaction is the action of soils suddenly moving from a solid to liquid state when stressed by cyclic loading. Earthquake loading is the common cause of soil liquefaction. The usual result is settlement and in extreme cases, collapse of structures during an earthquake. The Liquefaction potential is a function of grain size distribution, water table elevation, soil density, depth to bedrock, peak ground acceleration, and earthquake magnitude.

A Standard Penetration Test (SPT) based liquefaction analysis was conducted using the Seed and Idriss method (LiquefyPro, CivilTech Software). A design peak ground acceleration of 0.16g (S_{DS}/2.5) was used for the analysis, which was based on the 2003 IBC. A mean earthquake magnitude of 5.5, estimated using the USGS 2008 Interactive Seismic Hazard Deaggregation website for Branford, Connecticut, was used for the analysis. The results of the grain size analyses were used to estimate the fines content of the strata.

The in-situ soils are not susceptible to liquefaction, but settlements up to one and one-quarter inches (1.25 inches) are expected at the ground surface for the above design earthquake assumptions.

10.0 CONSTRUCTION CONSIDERATIONS

10.1 Temporary Earth Support

The current design does not require excavation and shoring adjacent ot the rail lines. However, we still recommend including a note in the plans and specifications identifying that Temporary Earth Support systems will be required in accordance with AREMA requirements, if excavations extend into zones 2 or 3 (see Figure 4, Appendix 1).

Should temporary earth support be required, a Connecticut licensed Professional Engineer should design all temporary earth support systems. Below are minimum geotechnical parameters recommended for each stratum to be used in sheeting design:

- Groundwater at El. 3 feet
- Moist unit weight of Fill and Alluvial Deposits equal to 115 psf;
- Saturated unit weight of Fill and Alluvial Deposits equal to 128 psf;
- Saturated unit weight of Swamp Deposits equal to 100 psf;
- Saturated unit weight of Glaciolacustrine Deposits equal to 118 psf;
- Drained Friction Angle of Fill and Alluvial Deposits equal to 29 degrees;
- Drained Friction Angle of Swamp Deposits equal to 27 degrees;

- Drained Friction Angle of Glaciolacustrine Deposits equal to 29 degrees;
- Undrained shear strength of Swamp Deposits equal to 350 psf;
- Undrained shear strength of Glaciolacustrine Deposits equal to 900 psf;
- Coefficient of active earth pressure for Fill and Alluvial Deposits equal to 0.31;
- Coefficient of active earth pressure for Swamp Deposits equal to 0.38;
- Coefficient of active earth pressure for Glaciolacustrine Deposits equal to 0.35;
- Coefficient of passive earth pressure for Fill and Alluvial Deposits equal to 4.5;
- Coefficient of undrained active and passive earth pressures equal to 1.0;
- Coefficient of Friction between granular soils (sands and gravels) and sheeting = 0.25;
- Coefficient of Friction between fine grained soils (silts and clays) and sheeting = 0;
- Cooper E80 Surcharge Loading in Accordance with AREMA;

10.2 Monitoring of Railroad Tracks

Micro-pile installations may potentially induce vibrations and/or cause settlement of the nearby rails. We recommend the railroad tracks be monitored for vibration and settlement in accordance with Amtrak requirements. Special provisions will be required for vibration and settlement monitoring.

10.3 Impact on Catenary Foundations

Existing CAT Tower Nos. 81-3 and 81-5 may interfere with the proposed platform foundation construction. Baker provided the following information on each of the CAT towers:

Tower No.	Catalogue No.	Diameter (in)	Total Length (ft)	Length Above Grade (ft)	Length Below Grade (ft)
81-3	B9200-14	18	14	2.4	11.6
81-5	B9200-14	18	14	3	11

With the existing ground surface at about El. 12 (Tower 81-3) and El. 10 (Tower 81-5) feet, this places the bottom of the CAT Towers at about El. 0 and El. -1 ft, respectively. To reach the bottom of the pile cap foundation and recommended free-draining layer (approximate El. 11 and El. 9.5 ft), this would leave a CAT Tower foundation embedment of about 11 and 10.5 feet, respectively.

We anticipate that excavations for pile cap installations will not be significant enough to compromise the towers. However, with nearby construction and installation of micropiles, the construction contractor will need to provide a means of monitoring for movement and protecting the towers during construction. Alternatively, the structural design could be modified by Baker to span the foundations and foundation excavation beyond the CAT Towers and/or to limit construction activity immediately adjacent to the existing CAT Towers. In either case, special provisions will need to identify that monitoring, protection, and/or temporary support (all by the contractor) of the existing CAT Towers must consider all the applicable loadings on the tower (i.e. dead, live, wind, ice, lateral, etc.) as defined by AREMA.

10.4 Miscellaneous Minor Site Structures

For minor lightweight structures around the site (i.e. stair cases, short retaining walls, etc.) which will bear on uninvestigated soils, we recommend the following design guidance:

- Allowable bearing pressure of 1.0 TSF,
- Anticipate up to about 1.5-inches of settlement,
- Minimum bearing depth must be below frost depth of 42-inches below final grade,
- Require (during construction) that exposed subgrade and intended bearing soils are characterized and determined to be satisfactory.
- Proof role and compact exposed subgrade,
- Remove observed weak soils under proof rolling and compaction efforts, and replace with Granular Fill.

10.5 Re-use of On-site Materials

The existing Fill is not suitable for re-use as Granular Fill (Form 816, Section 2.13) or Compacted Granular Fill (Form 816, Section 2.14) due to the presence of organic matter and high silt content. Off site sources for Granular Fill and Compacted Granular Fill should be anticipated and should follow requirements of Form 816 Section 2.13 and 2.14.

Fill removed from excavations may require special handling and disposal authorization to meet environmental regulations as determined by DTC Environmental Group. If environmental regulations do not govern disposal, the material may be reused onsite as general fill.

11.0 SPECIAL PROVISIONS

A Special Provision will be required for Micropile installation.

A Special Provision will be required to identify that monitoring and temporary support of CAT Towers Nos. 81-3 and 81-5 are designed (by Contractor) in accordance with AREMA, as discussed in Section 10.2 of this report.

A Special Provision will be required for monitoring of the railroad tracks for vibration and settlement, including criteria and limitations.

Environmental issues, controls, and special provisions should be addressed by DTC Environmental Group.

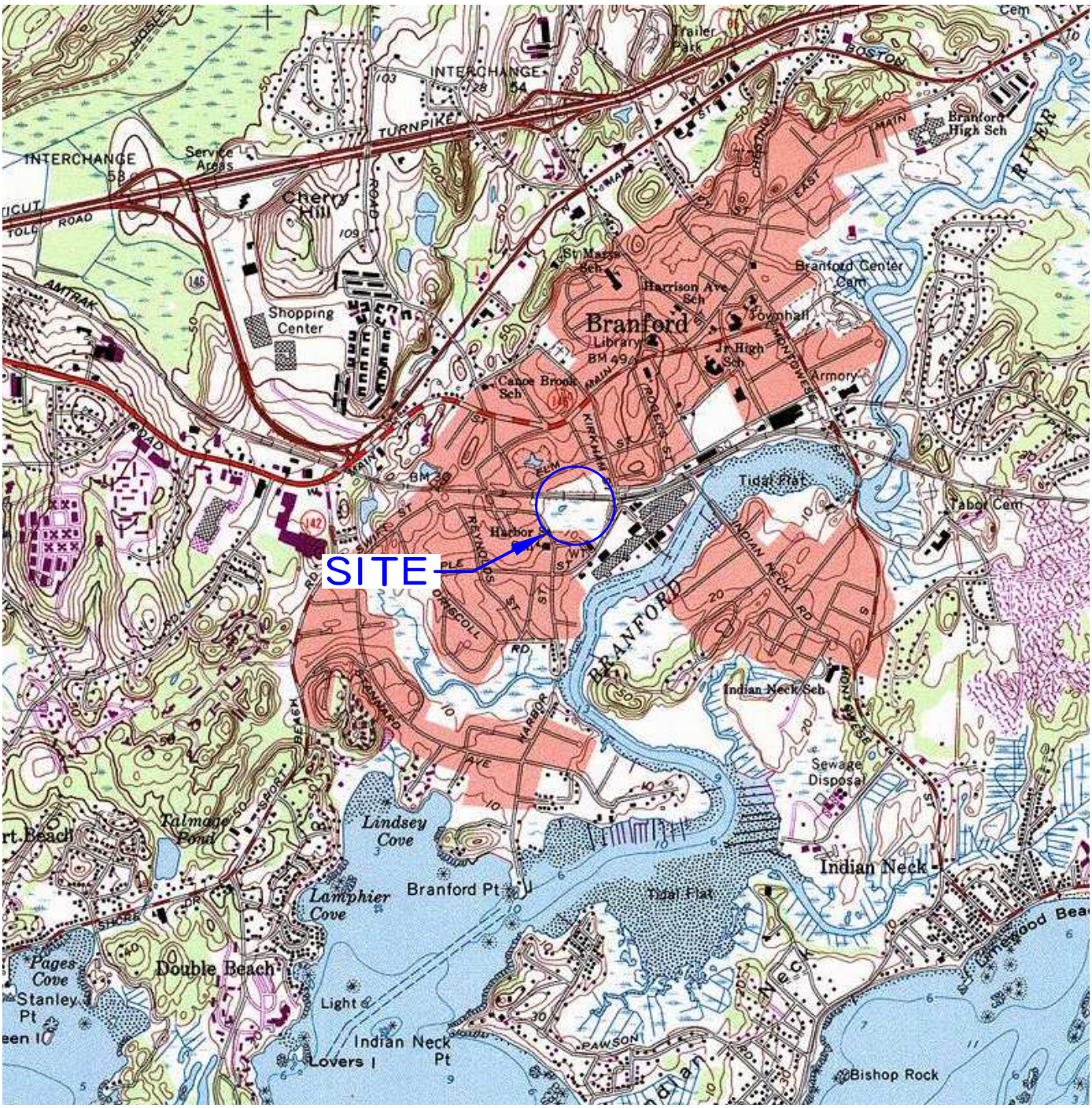
12.0 LIMITATIONS

This report is subject to the limitations included in Appendix 6.

Appendix 1

Figures

- Figure 1 - Site Location Plan
- Figure 2 - Boring Location Plan
- Figure 3 - Subsurface Profile
- Figure 4 – Amtrak’s Normal Requirements for Sheet Piling Adjacent to Tracks

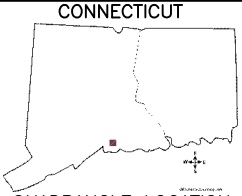


GEODESIGN INCORPORATED

GEOTECHNICAL ENGINEERS • ENVIRONMENTAL CONSULTANTS
984 SOUTHFORD ROAD • MIDDLEBURY CONNECTICUT 06762
TELEPHONE: (203)758-8836 FACSIMILE: (203)758-8842

DRAWN BY: SMC | REVIEWED BY: MGB

CONNECTICUT



QUADRANGLE LOCATION

SITE LOCATION PLAN
SHORELINE EAST
BRANFORD, CONNECTICUT

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

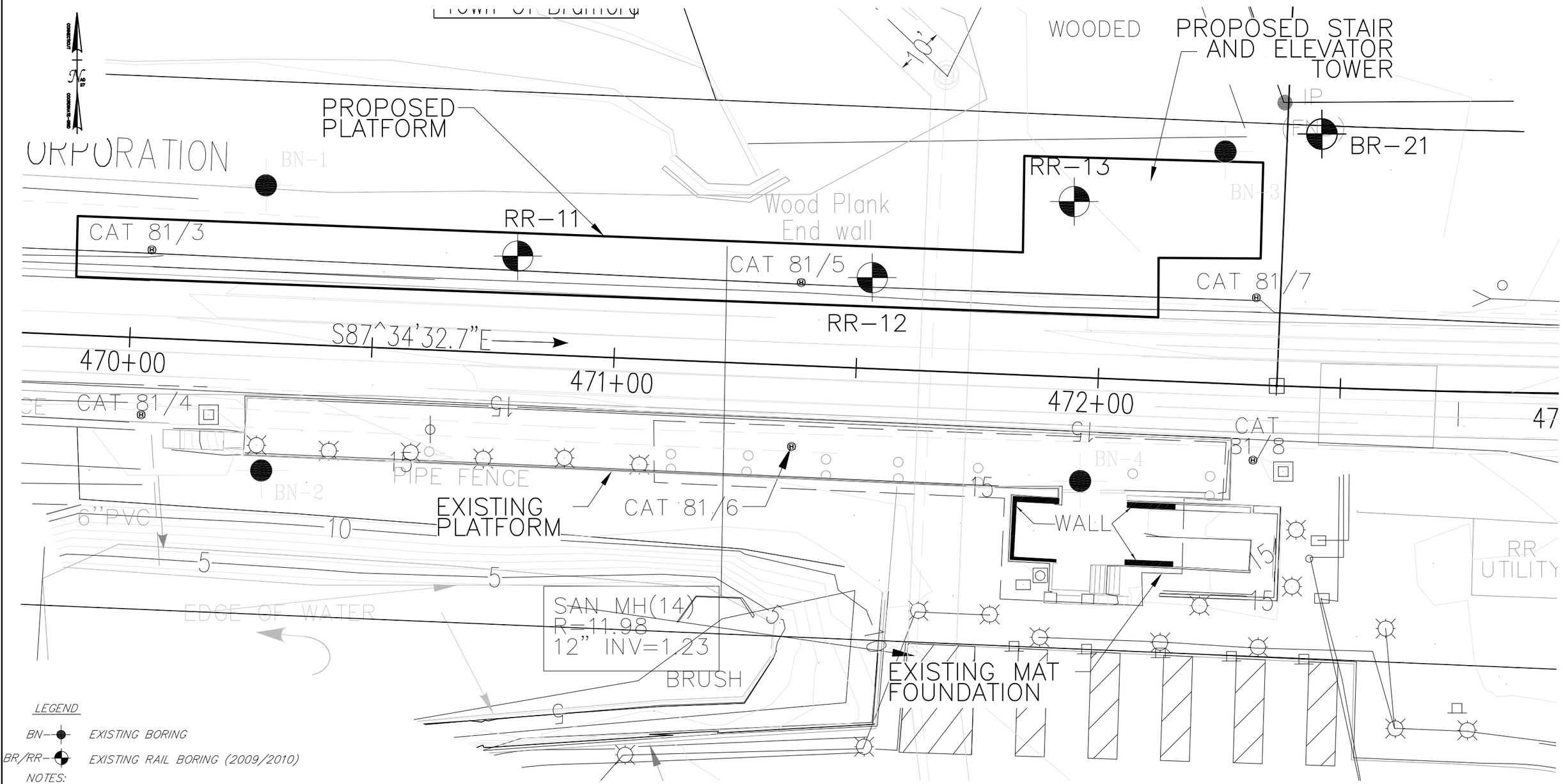
SCALE IN FEET

0 1000 2000 4000

PROJECT NO. 183-07.0

DATE: 6-30-08

FIGURE NO. 1



LEGEND

BN— EXISTING BORING

BR/RR— EXISTING RAIL BORING (2009/2010)

NOTES:

1) BASE MAP PROVIDED BY MICHAEL BAKER CORPORATION VIA FTP SITE. ORIGINAL PLAN DRAWN TO TRUE SCALE.

2) EXISTING BORING LOCATIONS INTERPOLATED FROM SCALE DRAWINGS. LOCATIONS ARE ACCURATE TO THE DEGREE IMPLIED BY THE METHOD USED.

3) BORING LOCATIONS ARE PRELIMINARY AND MAY CHANGE AT THE DIRECTION OF THE ENGINEER.

DESIGNED BY RTS						
DRAWN BY SMC						
CHECKED BY MPT	NO.	DATE		DRWN.	CHKD	APPVD
			REVISIONS			

SCALE: 1" = 20'

20' 10' 0 20'

GEODESIGN INCORPORATED
D/B/A GEODESIGN INC., PC
GEOTECHNICAL ENGINEERS • ENVIRONMENTAL CONSULTANTS
984 SOUTHFORD ROAD • MIDDLEBURY CONNECTICUT 06762
TELEPHONE: (203)758-8836 FACSIMILE: (203)758-8842

PROJECT
DEPARTMENT OF TRANSPORTATION
SHORE LINE EAST
RAILROAD STATIONS

DWG. TITLE
RAILROAD BORING LOCATION PLAN
BRANFORD, CONNECTICUT

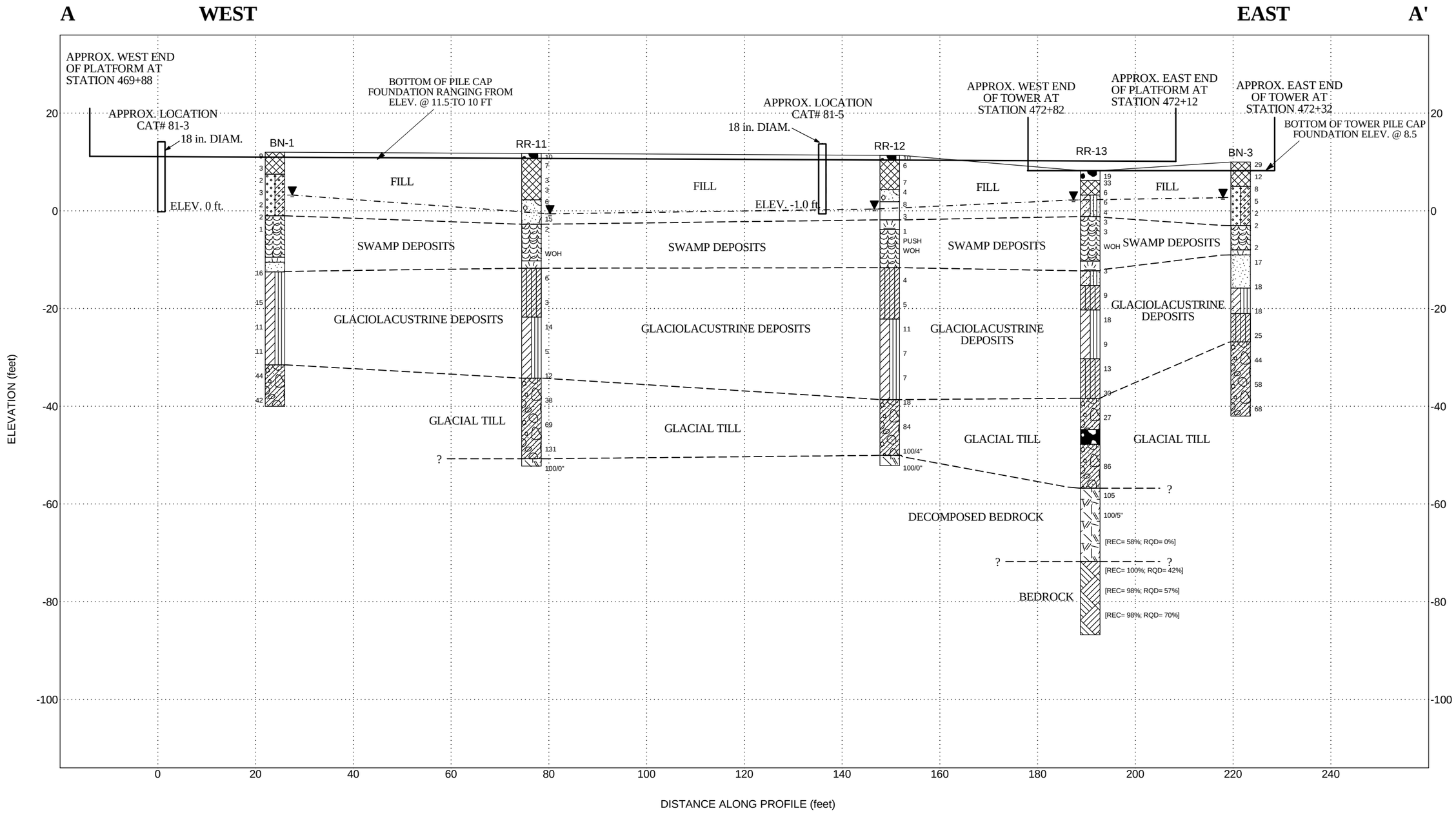
FILE NO. 183-007.0

SCALE 1" =20' DATE 12/28/2010

FIGURE: 2

SHEET OF

M:\CL\0183\07\(CURRENT as of 5-16-07) WORKING DWGS\CURRENT (5-18-07) Branford Station.dwg[NEW RAILROAD BORINGS]



GEODESIGN INCORPORATED

Geotechnical | Construction | Environmental
Engineers & Scientists

984 Southford Road - Middlebury, Connecticut 06762
Telephone: 203.758.8836 Fax: 203.758.8842

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.

Date: 01-18-11 | Drawn By: RPJ | Reviewed By: DFL

SUBSURFACE PROFILE

Shore Line East
Branford - Platforms and Towers
Branford, CT

File No.: 0183-007.00 | Figure No.: 3

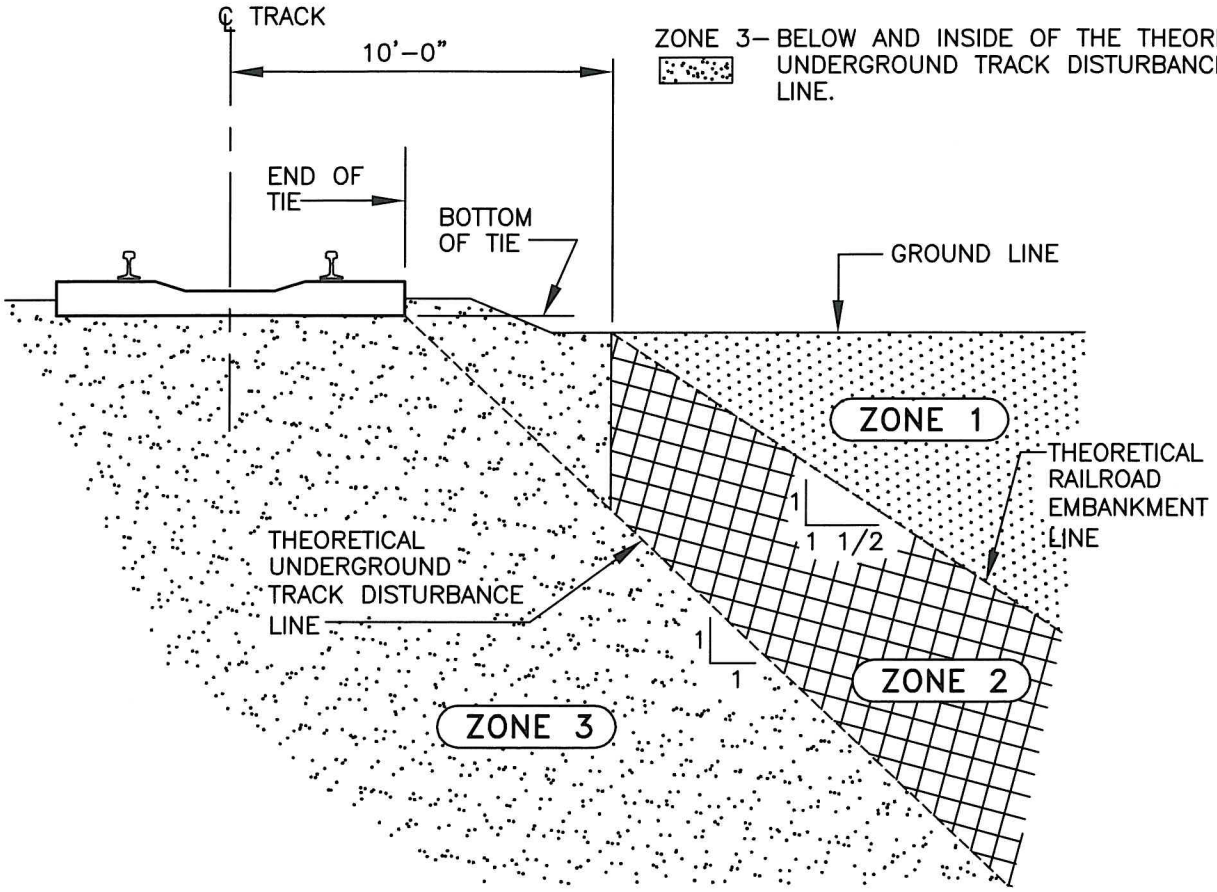
GEO STANDARD 11 X 17 (2/19/04) BRANFORD RAIL BORING LOGS 10-2010.GPJ FBNWNL01.GDT 1/14/11

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.

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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
Dwg. No.	Figure 4

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

Appendix 2

Boring Logs

- August 2000 Wang Engineering, Inc. Boring Logs
- October 2010 GeoDesign, Inc. Boring Logs

PD&W	SM - 001 - M REV. 1/94 BORING REPORT	Hole No. BN-1
DRILLER	STATE OF CONNECTICUT	Line & Station
Liviu Iordache	DEPARTMENT OF TRANSPORTATION	Offset
INSPECTOR	TOWN: Branford, Connecticut	N. Coordinate 160819.00
Wang Engineering, Inc.	PROJECT NAME: SHORELINE EAST STATIONS	E. Coordinate 581221.00
SOILS ENGINEER	PROJECT NUMBER: 310-0007	Baker Engineering NY, Inc.
	BORING CONTRACTOR: Soiltesting, Inc.	PRIME DESIGNER

Surface Elevation: 12.00
Date Started: 30 August 2000
Date Finished: 30 August 2000

Groundwater Observations
@ 8.75 ft after 0.0 hours
@ NA ft after NA hours

	Casing				Auger		Mud	Sampler		Core Barrel			
Utilized						X		X					
Type	BW	NW	HW	Pipe	Solid	Hollow		SS		B(st)	B(dt)	NX(st)	NX(dt)
Size I.D. (in)	2-3/8	3	4	2-1/2		3.75		1-3/8		1-3/8	1-3/8	2-1/6	2-1/6
Hammer (lb)	300	300	300	300			Bit	140		Type		Diamond	
Fall (ft)	24	24	24	24				30		of bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. inch	REC inch	Type	BLOWS PER 6 INCHES ON SAMPLER 0-6	6-12	12-18	18-24	STRATA CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOIL REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
		0.0-2.0	1	24	6	SS	7	5	4	3		Loose to very loose, gray to black SAND and GRAVEL, little slag, cinders -FILL-
		2.5-4.5	2	24	6	SS	3	1	2	2	7.5	
5											4.5	Very loose, brown, fine to coarse SAND, trace to little clay
		5.0-7.0	3	24	0	SS	2	1	1	2		
		7.5-9.5	4	24	3	SS	2	1	2	2		
10												
		10.0-12.0	5	24	2	SS	1	1	1	1		
		12.5-14.5	6	24	10	SS	1	1	1	1	-1.0	
15											13.0	Very soft, light gray to gray, ORGANIC CLAY, little gastropod bioclasts
		15.0-17.0	7	24	24	SS	0	0	1	1		
20												
		20.0-22.0	1	24	0	D					-9.5	
		22.0-24.0	2	24	24	D					21.5	Dark brown, fibrous PEAT
											-12.5 22.5	Gray, coarse SAND
25		24.0-26.0	8	24	18	SS	5	7	9	8	24.5	Stiff, gray to reddish brown to brown, CLAYEY SILT to SILTY CLAY, little sand as less than 1/8"-thick intercalations
30												
		30.0-32.0	9	24	24	SS	6	7	8	9		
35												
		35.0-37.0	10	24	24	SS	4	5	6	6		
40												
		40.0-42.0	11	24	24	SS	4	5	6	8	-31.5	
45											43.5	Dense, brown, coarse SAND, trace to some gravel, cobble, generally coarser with depth
		45.0-47.0	12	24	12	SS	9	22	22	23		
50												
		50.0-52.0	13	24	12	SS	8	19	23	27	-40.0	
55											52.0	Bottom of Exploration at 52.00 ft. Borehole backfilled with drill cuttings.

Casing Size	From	To	Feet of Earth	Rock
			52.0 ft	0.0 ft
			No. of Samples	
			15	

NOTES:

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test SS=Split Spoon
PROPORTIONS USED: Trace=1-10% Little=10-20%, Some=20-35%, And=35-50%

Hole No. BN-1
Sheet 1 of 1

CT_DOT BRANF2.GPJ CT_DOT.GDT 10/13/00

PD&W	SM - 001 - M REV. 1/94 BORING REPORT	Hole No. BN-2
DRILLER	STATE OF CONNECTICUT	Line & Station
Liviu Iordache	DEPARTMENT OF TRANSPORTATION	Offset
INSPECTOR	TOWN: Branford, Connecticut	N. Coordinate 160760.00
Wang Engineering, Inc.	PROJECT NAME: SHORELINE EAST STATIONS	E. Coordinate 581220.00
SOILS ENGINEER	PROJECT NUMBER: 310-0007	Baker Engineering NY, Inc.
	BORING CONTRACTOR: Soiltesting, Inc.	PRIME DESIGNER

Surface Elevation: 11.75
Date Started: 31 August 2000
Date Finished: 31 August 2000

Groundwater Observations
@ 8.50 ft after 0.0 hours
@ 8.50 ft after 24.0 hours

	Casing				Auger		Mud	Sampler		Core Barrel			
Utilized						X		X					
Type	BW	NW	HW	Pipe	Solid	Hollow		SS		B(st)	B(dt)	NX(st)	NX(dt)
Size I.D. (in)	2-3/8	3	4	2-1/2		3.75		1-3/8		1-3/8	1-3/8	2-1/6	2-1/6
Hammer (lb)	300	300	300	300			Bit	140		Type		Diamond	
Fall (ft)	24	24	24	24				30		of bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. inch	REC inch	Type	BLOWS PER 6 INCHES ON SAMPLER 0-6	6-12	12-18	18-24	STRATA CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOIL REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
		0.0-2.0	1	24	14	SS	2	4	8	6	10.3	Medium dense, dark brown and black, coarse SAND, trace to little gravel, slag, cinders -FILL-
		2.5-4.5	2	24	4	SS	5	6	7	7	1.5	Medium dense, brown, CLAYEY SAND
5		5.0-7.0	3	24	4	SS	5	5	7	21		
		7.5-9.5	4	24	6	SS	8	5	5	7	2.0	
10		10.0-12.0	5	24	19	SS	1	1	1	3	9.8	Very loose, brown sand, little gravel and silt
		12.5-14.5	6	24	15	SS	2	1	2	3	-2.3	
15											14.0	Very soft, gray, ORGANIC CLAY
20												
		20.0-22.0	7	24	24	SS	1	1	2	3	-10.3	
											22.0	Dark brown PEAT
25											23.0	Medium dense, gray, CLAYEY SAND
		25.0-27.0	8	24	20	SS	2	4	6	7	-14.3	
											26.0	Dark brown, ORGANIC SILT to PEAT
30											27.0	Medium stiff to stiff, brown, CLAYEY SILT to SILTY CLAY
		30.0-32.0	9	24	24	SS	3	4	7	10		
35												
		35.0-37.0	10	24	24	SS	5	3	4	4		
40												
		40.0-42.0	11	24	24	SS	5	4	5	7	-30.3	
45											42.0	Dense, brown, coarse SAND, little to some pebble
		45.0-47.0	12	24	16	SS	7	13	17	29	-35.3	
50											47.0	Bottom of Exploration at 47.00 ft. Borehole backfilled with drill cuttings.
55												

Casing Size	From	To	Feet of Earth	Rock
			47.0 ft	0.0 ft
			No. of Samples	
			12	

NOTES:

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test SS=Split Spoon
PROPORTIONS USED: Trace=1-10% Little=10-20%, Some=20-35%, And=35-50%

Hole No. BN-2
Sheet 1 of 1

CT_DOT BRANF2.GPJ CT_DOT.GDT 10/13/00

PD&W	SM - 001 - M REV. 1/94 BORING REPORT	Hole No. BN-3
DRILLER	STATE OF CONNECTICUT	Line & Station
Liviu Iordache	DEPARTMENT OF TRANSPORTATION	Offset
INSPECTOR	TOWN: Branford, Connecticut	N. Coordinate 160826.00
Wang Engineering, Inc.	PROJECT NAME: SHORELINE EAST STATIONS	E. Coordinate 581419.00
SOILS ENGINEER	PROJECT NUMBER: 310-0007	Baker Engineering NY, Inc.
	BORING CONTRACTOR: Soiltesting, Inc.	PRIME DESIGNER

Surface Elevation: 10.00
Date Started: 30 August 2000
Date Finished: 30 August 2000

Groundwater Observations
@ 7.25 ft after 0.0 hours
@ 7.30 ft after 24.0 hours

	Casing				Auger		Mud	Sampler		Core Barrel			
Utilized						X		X					
Type	BW	NW	HW	Pipe	Solid	Hollow		SS		B(st)	B(dt)	NX(st)	NX(dt)
Size I.D. (in)	2-3/8	3	4	2-1/2		3.75		1-3/8		1-3/8	1-3/8	2-1/6	2-1/6
Hammer (lb)	300	300	300	300			Bit	140		Type		Diamond	
Fall (ft)	24	24	24	24				30		of bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. inch	REC inch	Type	BLOWS PER 6 INCHES ON SAMPLER 0-6	6-12	12-18	18-24	STRATA CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOIL REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
		0.0-2.0	1	24	14	SS	18	19	10	7		Medium dense, reddish brown to black and brown, fine SAND, some silt, little gravel, slag, cinders
		2.5-4.5	2	24	4	SS	5	8	4	4	5.0	-FILL-
5		5.0-7.0	3	24	0	SS	9	5	3	3	5.0	Very loose to loose, brown,fine to coarse SAND, some silt, little comminuted organic matter
		7.5-9.5	4	24	0	SS	4	3	2	1		
10		10.0-12.0	5	24	1	SS	2	1	1	1	-3.0	
		12.5-14.5	6	24	14	SS	2	1	1	1	13.0	Very soft, dark gray to gray, ORGANIC SILTY CLAY, little silt, waterlogged phytoclasts
15		15.0-17.0	1	24	23	D						
		17.0-19.0	7	24	20	SS	0	1	1	3	-8.0	
											18.0	Dark brown, fibrous PEAT
20		20.0-22.0	8	24	15	SS	3	8	9	7	19.0	Medium dense, brown, coarse SAND, some pebble-size gravel
25		25.0-27.0	9	24	24	SS	3	4	14	12	-15.8	
											25.8	Medium dense, brown SILT with intercalations of sand laminae
30		30.0-32.0	10	24	24	SS	4	8	10	12	-21.0	
											31.0	Very stiff, brown, CLAYEY SILT to SILTY CLAY, trace gravel
35		35.0-37.0	11	24	24	SS	5	10	15	27	-26.8	
											36.8	Dense to very dense, brown SAND and GRAVEL within a clayey matrix, trace cobble
40		40.0-42.0	12	24	24	SS	18	21	23	25		
45		45.0-47.0	13	24	24	SS	11	23	35	27		
50		50.0-52.0	14	24	20	SS	24	30	38	65	-42.0	
											52.0	Bottom of Exploration at 52.00 ft. Borehole backfilled with drill cuttings.
55												

Casing Size	From	To	Feet of Earth	Rock
			52.0 ft	0.0 ft
			No. of Samples	
			15	

NOTES:

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test SS=Split Spoon
PROPORTIONS USED: Trace=1-10% Little=10-20%, Some=20-35%, And=35-50%

Hole No. BN-3
Sheet 1 of 1

CT_DOT_BRANF2.GPJ CT_DOT.GDT 10/13/00

PD&W	SM - 001 - M REV. 1/94 BORING REPORT	Hole No. **BN-4**
DRILLER	STATE OF CONNECTICUT	Line & Station
Liviu Iordache	DEPARTMENT OF TRANSPORTATION	Offset
INSPECTOR	TOWN: **Branford, Connecticut**	N. Coordinate **160758.00**
Wang Engineering, Inc.	PROJECT NAME: **SHORELINE EAST STATIONS**	E. Coordinate **581389.00**
SOILS ENGINEER	PROJECT NUMBER: **310-0007**	**Baker Engineering NY, Inc.**
	BORING CONTRACTOR: **Soiltesting, Inc.**	PRIME DESIGNER

Surface Elevation: **11.00**
Date Started: **31 August 2000**
Date Finished: **31 August 2000**

Groundwater Observations
@ **8.00** ft after **0.0** hours
@ **NA** ft after **NA** hours

	Casing				Auger		Mud	Sampler		Core Barrel			
Utilized						X		X					
Type	BW	NW	HW	Pipe	Solid	Hollow		SS		B(st)	B(dt)	NX(st)	NX(dt)
Size I.D. (in)	2-3/8	3	4	2-1/2		3.75		1-3/8		1-3/8	1-3/8	2-1/6	2-1/6
Hammer (lb)	300	300	300	300			Bit	140		Type		Diamond	
Fall (ft)	24	24	24	24				30		of bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. inch	REC inch	Type	BLOWS PER 6 INCHES ON SAMPLER 0-6	6-12	12-18	18-24	STRATA CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOIL REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
		0.0-2.0	1	24	12	SS	7	5	6	8		Medium dense, black, coarse SAND, little slag -FILL-
		2.5-4.5	2	24	3	SS	7	6	4	3	1.0 / 6.3	Medium dense, brown, coarse SAND, trace pebble
5		5.0-7.0	3	24	20	SS	1	1	2	2	4.8 / 3.8	Stiff, brown, SILTY CLAY, little sand, trace gravel
		7.5-9.5	4	24	6	SS	4	4	3	3	7.3	Very loose, brown, coarse SAND
10		10.0-12.0	5	24	10	SS	2	2	2	2		
		12.5-14.5	6	24	18	SS	10	3	2	4	-2.3 / 13.3	Very soft to soft, gray, ORGANIC CLAY, little gastropod bioclasts, watterlogged phytoclasts
15												
20												
		20.0-22.0	7	24	24	SS	2	0	1	2	-11.0 / 22.0	Dark brown, ORGANIC SILT to PEAT
25											-14.4 / 23.0	Medium dense, brown to gray, coarse SAND
		25.0-27.0	8	24	20	SS	8	8	9	10	25.4	Dark brown PEAT
											-17.7 / 25.8	Medium dense, gray, coarse SAND
30		30.0-32.0	9	24	24	SS	9	13	18	19	28.7	Stiff to very stiff, brown, CLAYEY SILT to SILTY CLAY with thin, sandy intercalations, trace gravel
35		35.0-37.0	10	24	24	SS	6	8	12	12		
40		40.0-42.0	11	24	24	SS	3	3	4	5		
45		45.0-47.0	12	24	22	SS	21	24	16	14	-32.5 / 43.5	Dense, brown, coarse SAND, little to some pebble and cobble
50												
55												

Casing Size	From	To	Feet of Earth	Rock
			65.0 ft	**0.4** ft
			No. of Samples	
			14	

NOTES:

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test SS=Split Spoon
PROPORTIONS USED: Trace=1-10% Little=10-20%, Some=20-35%, And=35-50%

Hole No. **BN-4**
Sheet **1** of **2**

PD&W	SM - 001 - M REV. 1/94 BORING REPORT	Hole No. BN-4
DRILLER	STATE OF CONNECTICUT	Line & Station
Liviu Iordache	DEPARTMENT OF TRANSPORTATION	Offset
INSPECTOR	TOWN: Branford, Connecticut	N. Coordinate 160758.00
Wang Engineering, Inc.	PROJECT NAME: SHORELINE EAST STATIONS	E. Coordinate 581389.00
SOILS ENGINEER	PROJECT NUMBER: 310-0007	Baker Engineering NY, Inc.
	BORING CONTRACTOR: Soiltesting, Inc.	PRIME DESIGNER

Surface Elevation: 11.00
Date Started: 31 August 2000
Date Finished: 31 August 2000

Groundwater Observations
@ 8.00 ft after 0.0 hours
@ NA ft after NA hours

	Casing				Auger		Mud	Sampler		Core Barrel			
Utilized						X		X					
Type	BW	NW	HW	Pipe	Solid	Hollow		SS		B(st)	B(dt)	NX(st)	NX(dt)
Size I.D. (in)	2-3/8	3	4	2-1/2		3.75		1-3/8		1-3/8	1-3/8	2-1/6	2-1/6
Hammer (lb)	300	300	300	300			Bit	140		Type		Diamond	
Fall (ft)	24	24	24	24				30		of bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. inch	REC inch	Type	BLOWS PER 6 INCHES ON SAMPLER 0-6	6-12	12-18	18-24	STRATA CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOIL REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
		55.0-57.0	13	24	20	SS	12	13	34	51		
60												
65											-54.0	
		65.0-65.4	14	5	3	SS	100/5"				65.0 65.4	Gray to white, slightly fractured, foliated GRANITIC GNEISS -BEDROCK- Bottom of Exploration at 65.42 ft. Borehole backfilled with drill cuttings.
70												
75												
80												
85												
90												
95												
100												
105												
110												

Casing Size	From	To	Feet of Earth	Feet of Rock
			65.0 ft	0.4 ft
			No. of Samples	
			14	

NOTES:

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test SS=Split Spoon
PROPORTIONS USED: Trace=1-10% Little=10-20%, Some=20-35%, And=35-50%

Hole No. BN-4
Sheet 2 of 2

Connecticut DOT Boring Report

Inspector: R. Janeiro	Town: Branford	Hole No.: RR-11	
Engineer: GeoDesign, Inc.	Project No.: 310-0048	Stat./Offset:	
Start Date: 10-17-10	Route No.:	Northing: 160804.4	
Finish Date: 10-19-10	Bridge No.:	Easting: 581272.95	
		Surface Elevation: 11.8	

Project Description: Shore Line East - 0183-007.00

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

Groundwater Observations: @9 ft. after 0 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	8 6 4 3	24	1		Railroad Ballast	Piece of coarse Railroad Gravel jammed in sample tip (no recovery)	
						Fill	Loose, Top 3": black fine to coarse SAND and SILT, trace fine Gravel, trace Wood fragments Bottom 2": dark brown fine to coarse SAND and SILT, trace fine Gravel	10
	S-2	9 4 3 2	24	5				
5	S-3	4 1 2 3	24	6			Very loose, dark brown fine to coarse SAND and SILT, trace fine Gravel, (moist)	5
	S-4	2 2 1 1	24	5			Very loose, Top 3": dark brown fine to coarse SAND and SILT Bottom 2": light brown fine to medium SAND, little Silt, (wet)	
10						Sand & Gravel		
	S-5	6 3 3 5	24	4			Loose, dark brown fine to coarse SAND, little fine Gravel, trace Silt	0
	S-6	6 7 8 10	24	13			Medium dense, dark brown fine to coarse SAND and fine to coarse GRAVEL, trace Silt	
15						Organic Clayey Silt		
	S-7	1 1 1 1	24	12			Very soft, gray ORGANIC Clayey SILT, trace Shells	-5
20	S-8	WOR /12" WOH /12"	24	20			Very soft, gray ORGANIC Clayey SILT, trace Shells, trace Organic fibers, with Peat fragments at sample tip	-10
						Peat		
						Clay & Silt		
25								

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: 64ft Rock: ft	NOTES: Augers advanced to 16 feet below grade; then mud is introduced prior to taking S-7. Rig chatter from 13 feet to 14.5 feet, and 47 feet to 58 feet. Intermittent auger grinding/chatter from 62.5 feet to end of boring.	Sheet 1 of 3
No. of Soil Samples: 11 No. of Core Runs: ---		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Inspector: R. Janeiro	Town: Branford	Hole No.: RR-11	
Engineer: GeoDesign, Inc.	Project No.: 310-0048	Stat./Offset:	
Start Date: 10-17-10	Route No.:	Northing: 160804.4	
Finish Date: 10-19-10	Bridge No.:	Easting: 581272.95	
		Surface Elevation: 11.8	

Project Description: Shore Line East - 0183-007.00

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

Groundwater Observations: @9 ft. after 0 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)
25	S-9	2 2 4 5	24	19		Clay & Silt *(con't)*	Medium, gray-brown CLAY and SILT, little fine to medium Sand	-15
30	S-10	WOH /12" 3 4	24	20			Soft, red-brown CLAY and SILT	-20
						Clay & Silt (varved)		
35	S-11	5 6 8 6	24	21			Stiff, red-brown Silty CLAY layered up to 1/4" thick, varved with CLAY and SILT layered up to 1/4" thick	-25
40	S-12	2 2 3 4	24	24			Medium, red-brown Silty CLAY layered up to 1/2" thick, varved with CLAY and SILT layered up to 3/8" thick, with occasional fine SAND and SILT partings up to 1/8" thick	-30
45	S-13	2 5 7 13	24	18		Glacial Till	Top 9": Stiff, red-brown CLAY and SILT, with occasional fine SAND and SILT partings up to 1/8" thick Bottom 9": Medium dense, red-brown fine to coarse SAND and SILT, trace Clay	-35
50								

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: 64ft Rock: ft	NOTES: Augers advanced to 16 feet below grade; then mud is introduced prior to taking S-7. Rig chatter from 13 feet to 14.5 feet, and 47 feet to 58 feet. Intermittent auger grinding/chatter from 62.5 feet to end of boring.	Sheet 2 of 3
No. of Soil Samples: 11 No. of Core Runs: ---		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Inspector:	R. Janeiro	Town:	Branford	Hole No.:	RR-11
Engineer:	GeoDesign, Inc.	Project No.:	310-0048	Stat./Offset:	
Start Date:	10-17-10	Route No.:		Northing:	160804.4
Finish Date:	10-19-10	Bridge No.:		Easting:	581272.95
				Surface Elevation:	11.8

Project Description: Shore Line East - 0183-007.00

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

Groundwater Observations: @9 ft. after 0 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)
50	S-14	23 21 17 21	24	13		Glacial Till *(con't)*	Top 7": dense, red-brown fine to coarse SAND and fine to coarse GRAVEL, some Silt, trace Clay Bottom 6": hard, red-brown CLAY & SILT and fine to coarse SAND, trace fine Gravel	-40
55	S-15	32 31 38 30	24	14			Very dense, brown fine to coarse SAND, some fine to coarse Gravel (decomposed Rock), little Silt	-45
60	S-16	84 98 33 100/3"	21	11			Very dense, brown fine to coarse SAND and SILT, trace fine to coarse Gravel, with decomposed Rock in sample tip	-50
						Decomposed Bedrock		
	S-17	100/0"	0	0			No Recovery	
65							END OF BORING 64ft	-55
70								-60
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: 64ft Rock: ft	NOTES: Augers advanced to 16 feet below grade; then mud is introduced prior to taking S-7. Rig chatter from 13 feet to 14.5 feet, and 47 feet to 58 feet. Intermittent auger grinding/chatter from 62.5 feet to end of boring.	Sheet 3 of 3
No. of Soil Samples: 11 No. of Core Runs: ---		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Inspector: R. Janeiro	Town: Branford	Hole No.: RR-12
Engineer: GeoDesign, Inc.	Project No.: 310-0048	Stat./Offset:
Start Date: 10-19-10	Route No.:	Northing: 160799.96
Finish Date: 10-20-10	Bridge No.:	Easting: 581346.11
		Surface Elevation: 11.4

Project Description: Shore Line East - 0183-007.00

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

Groundwater Observations: @8 ft. after 0 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 6 5	24	6		Railroad Ballast Fill	Medium dense, black fine to coarse SAND and SILT, trace fine to coarse Gravel (Railroad Ballast)	10
	S-2	3 2 4 2	24	5			Loose, brown fine to coarse SAND, some Silt, trace fine Gravel	
5	S-3	4 4 3 4	24	6			Loose, dark brown fine to coarse SAND and SILT, trace fine Gravel, (moist)	5
	S-4	4 2 2 4	24	6		Sand & Gravel	Loose, brown fine to coarse SAND, little fine to coarse Gravel, trace Silt, (wet)	
10	S-5	WOH 5 3 2	24	7		Silty Sand with Organics	Loose, red-brown fine to coarse SAND, some Silt, little fine Gravel, trace Organic fibers	0
	S-6	1 2 1 2	24	14		Peat	Very loose, dark brown Top 5": fine to coarse SAND and SILT, trace Clay Middle 3": fine to medium SAND, trace Silt Bottom 6": PEAT (Organic odor)	
15	S-7	WOH /12" 1 1	24	23		Organic Silty Clay	Top 2": Very loose, dark brown PEAT (Organic odor) Bottom 21": Very soft, gray ORGANIC Silty CLAY, trace Organics (Organic odor)	-5
	UP-1	P U S H	24	24				
20	S-8	W O H /24"	24	24			Very soft, gray ORGANIC Clayey SILT, trace Organics (Organic odor)	-10
						Clay & Silt		
25								

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: 63.5ft Rock: ft	NOTES: Augers advanced to 15 feet below grade; then open hole (with mud) to end of boring. Rig chatter from 52 feet to 63.5 feet below grade.	Sheet 1 of 3
No. of Soil Samples: 11 No. of Core Runs: ---		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Inspector: R. Janeiro	Town: Branford	Hole No.: RR-12
Engineer: GeoDesign, Inc.	Project No.: 310-0048	Stat./Offset:
Start Date: 10-19-10	Route No.:	Northing: 160799.96
Finish Date: 10-20-10	Bridge No.:	Easting: 581346.11
Project Description: Shore Line East - 0183-007.00		Surface Elevation: 11.4
Casing Size/Type:	Sampler Type/Size: SS / 1-3/8" (ID)	Core Barrel Type:
Hammer Wt.: 300 lb. Fall: 24in.	Hammer Wt.: 140 lb. Fall: 30 in.	

Groundwater Observations: @8 ft. after 0 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)
25	S-9	WOH 2 2 7	24	24		Clay & Silt *(con't)*	Soft to medium, brown-gray Clayey SILT, trace fine Sand	-15
30	S-10	2 2 3 4	24	23			Medium, blackish-brown CLAY and SILT	-20
						Clay & Silt (varved)		
35	S-11	5 5 6 9	24	21			Stiff, red-brown Silty CLAY layered up to 3/8" thick, varved with SILT and CLAY layered up to 1/4" thick, with occasional fine SAND and SILT partings up to 1/8" thick	-25
40	S-12	3 3 4 6	24	24			Medium, red-brown Silty CLAY layered up to 3/4" thick, varved with CLAY and SILT layered up to 1/4" thick, with occasional fine SAND and SILT partings up to 1/8" thick	-30
45	S-13	4 3 4 7	24	24			Medium, red-brown Silty CLAY layered up to 3/4" thick, varved with CLAY and SILT layered up to 3/16" thick, with occasional fine SAND and SILT partings up to 1/16" thick	-35
50								

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: 63.5ft Rock: ft	NOTES: Augers advanced to 15 feet below grade; then open hole (with mud) to end of boring. Rig chatter from 52 feet to 63.5 feet below grade.	Sheet 2 of 3
No. of Soil Samples: 11 No. of Core Runs: ---		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Inspector: R. Janeiro	Town: Branford	Hole No.: RR-12	
Engineer: GeoDesign, Inc.	Project No.: 310-0048	Stat./Offset:	
Start Date: 10-19-10	Route No.:	Northing: 160799.96	
Finish Date: 10-20-10	Bridge No.:	Easting: 581346.11	
		Surface Elevation: 11.4	

Project Description: Shore Line East - 0183-007.00

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

Groundwater Observations: @8 ft. after 0 hours

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)
50	S-14	10 8 10 27	24	12		Glacial Till	Medium dense, red-brown fine to coarse SAND and SILT, little fine to coarse Gravel, trace Clay	-40
55	S-15	56 47 37 29	24	13			Very dense, red-brown fine to coarse SAND and SILT, some fine to coarse Gravel (decomposed Rock), trace Clay	-45
60	S-16	21 38 100/4"	16	7			Very dense, red-brown SILT and fine to coarse SAND, little fine Gravel, trace Clay, (decomposed Rock jammed in sample tip)	-50
						Decomposed Bedrock		
	S-17	100/0"	0	0			END OF BORING 63.5ft	
65								-55
70								-60
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: 63.5ft Rock: ft	NOTES: Augers advanced to 15 feet below grade; then open hole (with mud) to end of boring. Rig chatter from 52 feet to 63.5 feet below grade.	Sheet 3 of 3
No. of Soil Samples: 11 No. of Core Runs: ---		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Inspector: R. Janeiro	Town: Branford	Hole No.: RR-13	
Engineer: GeoDesign, Inc.	Project No.: 310-0048	Stat./Offset:	
Start Date: 10-14-10	Route No.:	Northing: 160815.66	
Finish Date: 10-15-10	Bridge No.:	Easting: 581387.79	
		Surface Elevation: 8.2	

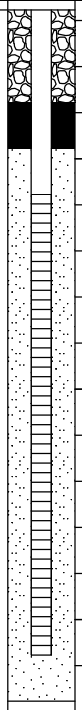
Project Description: Shore Line East - 0183-007.00

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

Groundwater Observations: @6 ft. after 0 hours, @4.9 ft. after 10/18/10 hours, @4.8 ft. after 10/19/10 hours

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes
0	S-1	3 7 12 12	24	8		Railroad Ballast	Medium dense, brown fine to coarse SAND, some fine to coarse Gravel (Railroad Ballast), little Silt, trace Roots
	S-2	21 17 16 9	24	9		Fill	Dense, blackish-brown fine to coarse SAND, some Silt, little Asphalt fragments, trace fine Gravel
5	S-3	2 3 3 4	24	6		Silty Sand with Organics	Loose, dark brown fine to coarse SAND, and Silt, trace Wood, (wet at tip)
	S-4	2 2 4 6	24	8			Loose, black fine to coarse SAND, little Silt, trace fine Gravel, trace Organic fibers
	S-5	6 3 1 1	24	10			Top 7": very loose, dark red-brown fine to coarse SAND, little Silt, trace fine Gravel, trace Organic fibers Bottom 3": soft, gray ORGANIC Clayey SILT, trace Organics
10	S-6	2 1 2 1	24	0		Organic Clayey Silt	No recovery
	S-7	WOH 1 2 2	24	16			Soft, gray Organic Clayey SILT, trace Organics
15	S-8	WOR /12" WOH /12"	24	24			Very soft, gray ORGANIC CLAY, trace Organics
						Peat	
20	S-9	1 1 2 2	24	15		Sandy Silt & Clay	Top 4": Very loose, dark brown PEAT, (Organic odor) Bottom 11": soft, gray SILT and CLAY, some fine to medium Sand, trace Organics
						Clayey Silt	
25							

Well Construction



Elevation (ft): 5, 0, -5, -10, -15

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: 75ft Rock: 23ft	NOTES: Augers advanced to 10 feet below grade; then open hole (with mud) to end of boring. Rig chatter from 52 feet to 53 feet, 63 feet to 64.5 feet, and 68 feet to 70 feet below grade. Observation well offset 5 feet east from boring location.	Sheet 1 of 4
No. of Soil Samples: 11 No. of Core Runs: 4		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Inspector: R. Janeiro	Town: Branford	Hole No.: RR-13	
Engineer: GeoDesign, Inc.	Project No.: 310-0048	Stat./Offset:	
Start Date: 10-14-10	Route No.:	Northing: 160815.66	
Finish Date: 10-15-10	Bridge No.:	Easting: 581387.79	
Project Description: Shore Line East - 0183-007.00		Surface Elevation: 8.2	
Casing Size/Type:	Sampler Type/Size: SS / 1-3/8" (ID)	Core Barrel Type:	
Hammer Wt.: 300 lb. Fall: 24in.	Hammer Wt.: 140 lb. Fall: 30 in.		

Groundwater Observations: @6 ft. after 0 hours, @4.9 ft. after 10/18/10 hours, @4.8 ft. after 10/19/10 hours

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Well Construction	Elevation (ft)
25	S-10	2 4 5 5	24	20		Clayey Silt *(con't)*	Loose, dark blackish-brown Clayey SILT		
						Clay & Silt (varved)			-20
30	S-11	5 8 10 9	24	22			Very stiff, brown CLAY and SILT layered up to 1/4" thick, varved with brown CLAY layered up to 3/16" thick, with occasional fine to medium SAND partings up to 1/16" thick		-25
35	S-12	4 4 5 6	24	19			Stiff, red-brown Silty CLAY layered up to 1/2" thick, varved with CLAY and SILT layered up to 1/8" thick, with occasional fine SAND and SILT partings up to 1/16" thick		-30
						Silty Clay			
40	S-13	4 5 8 9	24	24			Stiff, brown Silty CLAY, with occasional CLAY and SILT seams layered up to 3/16" thick, with occasional fine SAND and SILT partings up to 1/16" thick		-35
45	S-14	7 8 22 32	24	24			Top 12": very stiff, red-brown Silty CLAY, with occasional fine SAND and SILT seams up to 1" thick Middle 7": very stiff, red-brown CLAY and SILT, some fine to coarse Sand Bottom 5": dense, red-brown fine to coarse SAND, some Silt, little fine to coarse Gravel, (full spoon +)		-40
						Glacial Till			
50									

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: 75ft Rock: 23ft	NOTES: Augers advanced to 10 feet below grade; then open hole (with mud) to end of boring. Rig chatter from 52 feet to 53 feet, 63 feet to 64.5 feet, and 68 feet to 70 feet below grade. Observation well offset 5 feet east from boring location.	Sheet 2 of 4
No. of Soil Samples: 11 No. of Core Runs: 4		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Inspector: R. Janeiro	Town: Branford	Hole No.: RR-13	
Engineer: GeoDesign, Inc.	Project No.: 310-0048	Stat./Offset:	
Start Date: 10-14-10	Route No.:	Northing: 160815.66	
Finish Date: 10-15-10	Bridge No.:	Easting: 581387.79	
Project Description: Shore Line East - 0183-007.00		Surface Elevation: 8.2	
Casing Size/Type:	Sampler Type/Size: SS / 1-3/8" (ID)	Core Barrel Type:	
Hammer Wt.: 300 lb. Fall: 24in.	Hammer Wt.: 140 lb. Fall: 30 in.		

Groundwater Observations: @6 ft. after 0 hours, @4.9 ft. after 10/18/10 hours, @4.8 ft. after 10/19/10 hours

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Well Construction	Elevation (ft)
50	S-15	14 11 16 57	24	16		Glacial Till *(con't)*	Medium dense, red-brown fine to coarse SAND, some Silty Clay seams up to 1.5" thick, little fine to coarse Gravel, with pieces of decomposed Rock, (piece of coarse Gravel jammed in sample tip)		
						Boulder (Inferred)			-45
55						Glacial Till			-50
60	S-16	16 22 64 33	24	8			Very dense, brown fine to coarse SAND and SILT, some fine to coarse Gravel, with decomposed Rock fragments		-55
65	S-17	53 51 54 85	24	12		Decomposed Bedrock	Very dense, mixed-color decomposed ROCK (Gneiss), with a more competent piece in sample tip		-60
70	S-18	100/5"	5	4			Very dense, light brown fine to coarse SAND and Silt, with pieces of decomposed Rock		-65
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: 75ft Rock: 23ft	NOTES: Augers advanced to 10 feet below grade; then open hole (with mud) to end of boring. Rig chatter from 52 feet to 53 feet, 63 feet to 64.5 feet, and 68 feet to 70 feet below grade. Observation well offset 5 feet east from boring location.	Sheet 3 of 4
No. of Soil Samples: 11 No. of Core Runs: 4		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Inspector: R. Janeiro	Town: Branford	Hole No.: RR-13	
Engineer: GeoDesign, Inc.	Project No.: 310-0048	Stat./Offset:	
Start Date: 10-14-10	Route No.:	Northing: 160815.66	
Finish Date: 10-15-10	Bridge No.:	Easting: 581387.79	
Project Description: Shore Line East - 0183-007.00		Surface Elevation: 8.2	
Casing Size/Type:	Sampler Type/Size: SS / 1-3/8" (ID)	Core Barrel Type:	
Hammer Wt.: 300 lb. Fall: 24in.	Hammer Wt.: 140 lb. Fall: 30 in.		

Groundwater Observations: @6 ft. after 0 hours, @4.9 ft. after 10/18/10 hours, @4.8 ft. after 10/19/10 hours

Depth (ft)	SAMPLES: Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Well Construction	Elevation (ft)
75						Decomposed Bedrock *(con't)*			
	C-1		60	35	0		Very Poor Quality, Soft, Extremely Weathered, Medium Grained, white-green, GNEISS, very close jointing, [Core Times (min./ft.): 4.5,5,8,4,4]		-70
80						Bedrock			
	C-2		60	60	42		Poor Quality, Soft to Moderately Hard, Moderately Weathered, Medium Grained, white-green, GRANITIC GNEISS, close to moderate jointing, [Core Times (min./ft.): 3.5,3,3.5,4,3]		-75
85									
	C-3		60	59	57		Fair Quality, Soft to Moderately Hard, Moderately Weathered, Medium Grained, white-green, GRANITIC GNEISS, close to moderate jointing, [Core Times (min./ft.): 2,2.5,3,2.5,3]		-80
90									
	C-4		60	59	70		Fair Quality, Soft to Hard, Slightly to Moderately Weathered, Coarse Grained, white/tan/green, GRANITIC GNEISS, close to moderate jointing, [Core Times (min./ft.): 2,3,2.5,2,2.5]		-85
95							END OF BORING 95ft		-90
100									

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: 75ft Rock: 23ft	NOTES: Augers advanced to 10 feet below grade; then open hole (with mud) to end of boring. Rig chatter from 52 feet to 53 feet, 63 feet to 64.5 feet, and 68 feet to 70 feet below grade. Observation well offset 5 feet east from boring location.	Sheet 4 of 4
No. of Soil Samples: 11 No. of Core Runs: 4		SM-001-M REV. 1/02

Appendix 3

Laboratory Test Results

- Summary of Geotechnical Index Properties
- Grain-Size Analyses
- Atterberg Limits
- Unconfined Compression Test

SUMMARY OF GEOTECHNICAL INDEX PROPERTIES

Client: Baker Engineering NY, Inc.
Project: Shore Line East--Branford Station
WEI Job No: 707-06-01

Boring No.	Sample No.	Depth ft	Description	Facies	Clay < 0.002 mm (%)	Silt 0.002 to 0.075 mm (%)	Fine sand 0.075 to 0.425 mm (%)	Coarse sand 0.425 to 2.0 mm (%)	Gravel 2.0 to 75 mm (%)	Water Content (%)	Liquid Limit (%)	Plastic Limit (%)
BN-2	s5	10 to 12	*Very loose, brown sand, little gravel and silt*	Fill	4.6	12.8	25.4	37.6	19.6	20	NA	NA
BN-3	ST1	15 to 17	*Soft, dark gray, organic, silty clay*	Marsh mud	29.4	69.2	1.0	0.4	0.0	75	99	60
BN-1	s10	35 to 37	*Stiff, brown, clayey silt*	Estuarine mud	36.2	59.8	3.6	0.4	0.0	32	NA	NA
BN-1	s9	30 to 32	*Stiff, reddish brown, clayey silt*	Estuarine mud	NA	NA	NA	NA	NA	32	35	18
BN-2	s10	35 to 37	*Medium stiff to stiff, brown, clayey silt*	Estuarine mud	NA	NA	NA	NA	NA	39	42	24
BN-4	s10	35 to 37	*Stiff to very stiff, brown,clayey silt*	Estuarine mud	37.9	56.1	3.7	2.0	0.3	33	NA	NA
BN-4	s12	45 to 47	*Dense, brown sand, some gravel*	Glacial outwash	4.4	13.8	27.6	32.1	22	NA	NA	NA

Facies Descriptions

Wang Engineering, Inc. February 2001 Report	GeoDesign, Inc. January 2011 Report
Fill	Alluvial Deposit
Marsh Mud	Swamp Deposit
Estuarine Mud	Glaciolacustrine Deposit
Glacial Outwash	Glacial Till

Prepared by: _____ Date: 10-30-00

Checked by: _____ Date: 10/30/00

Note:

The above table can be used to decipher from the facies descriptions in the above table and those in GeoDesign Inc.'s January 2011 Report.

WANG ENGINEERING, INC.

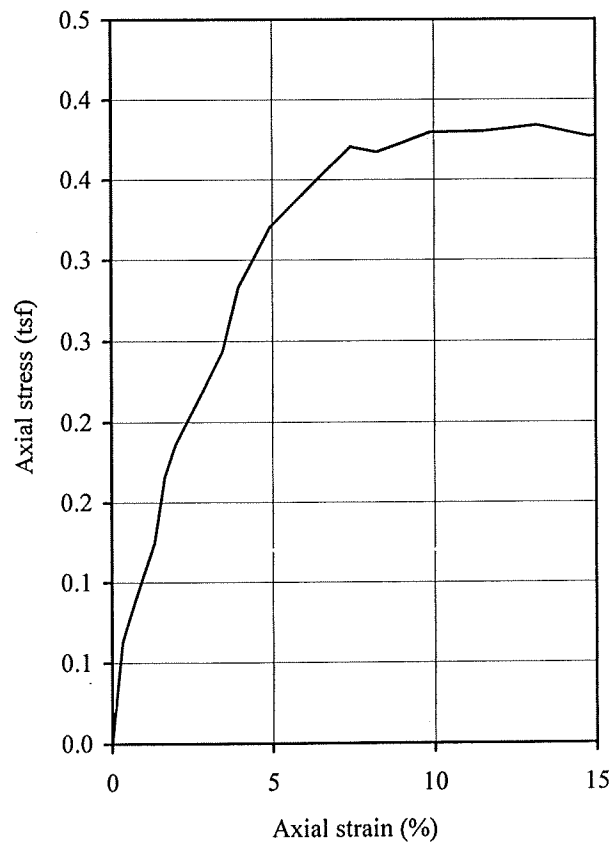
UNCONFINED COMPRESSIVE STRENGTH
(ASTM D 2166-91)

Project: Shore Line East--Branford Station
Client: Baker Engineering, Inc.
WEI Job No.: 707-06-01
Sample: BN-3, ST1, 15 to 17 ft

Analyst name: *Koshy Jacob*
Test date: *29-Sep-00*
Sample description: *Soft to very soft, gray, organic silty clay*

Initial height h_0 =	*6.06*	in	Initial water content w =	83.68%	
Initial diameter d_0 =	*2.86*	in	Initial unit weight g =	92.41	pcf
Mass of wet sample and tare M_i =	*955.70*	g	Initial dry unit weight g_d =	50.31	pcf
Mass of dry sample and tare M_d =	*526.45*	g	Initial void ratio e_0 =	2.29	
Mass of tare M_t =	*13.50*	g	Initial degree of saturation S_r =	97%	
Mass of sample Ms=	942.20	g	Young's modulus E =	8.96	tsf
Estimated specific gravity G_s =	2.65		Unconfined compressive strength q_u =	0.39	tsf

Displacement (in) Δh	Force (lbs) F	Strain (%) e	Stress (tsf) s
0.00	*0.00*	0.0	0.0
0.02	*5.63*	0.3	0.1
0.04	*7.50*	0.7	0.1
0.06	*9.38*	1.0	0.1
0.08	*11.25*	1.3	0.1
0.10	*15.00*	1.6	0.2
0.12	*16.88*	2.0	0.2
0.15	*18.75*	2.5	0.2
0.18	*20.63*	3.0	0.2
0.21	*22.50*	3.5	0.2
0.24	*26.25*	4.0	0.3
0.27	*28.13*	4.5	0.3
0.30	*30.00*	4.9	0.3
0.35	*31.88*	5.8	0.3
0.40	*33.75*	6.6	0.4
0.45	*35.63*	7.4	0.4
0.50	*35.63*	8.2	0.4
0.60	*37.50*	9.9	0.4
0.70	*38.25*	11.5	0.4
0.80	*39.38*	13.2	0.4
0.90	*39.38*	14.8	0.4
1.00	*41.25*	16.5	0.4



Prepared by: KJacob Date: 10-30-00

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WANG ENGINEERING, INC.

SOIL PARTICLE SIZE ANALYSIS

ASTM D 422-93

Client: Baker Engineering NY, Inc.
Project: Shore Line East--Branford Station
WEI Job No: 707-06-01
Soil Sample: BN-1, s10, 35 to 37ft
Sample description: *Stiff, brown, clayey silt, trace sand*

Prepared by: Koshy Jacob
2-Oct-00

	Grain size (mm) d	Separate percent finer by weight p	Combined percent finer by weight p_c
Sieve analysis	9.525	100.00	100.00
Mass passing No. 10 sieve W_{N10} (g) = *102.26*	4.750	100.00	100.00
Total sample mass W_{tot} (g) = *102.30*	2.000	99.96	99.96
	0.425	99.55	99.55
	0.180	98.54	98.54
	0.150	98.38	98.38
	0.075	95.90	95.90
Hydrometer analysis	0.0479	91.65	91.61
	0.0372	87.67	87.64
	0.0268	83.69	83.66
	0.0172	79.72	79.69
	0.0099	73.75	73.72
	0.0074	68.78	68.75
	0.0054	62.81	62.79
	0.0039	53.86	53.84
	0.0028	44.71	44.69
	0.0020	36.75	36.74
	0.0012	28.01	28.00
	0.0009	23.62	23.61

Grain Size Parameters

Clay (%) = 36.8
Silt (%) = 59.1
Fine sand (%) = 3.7
Coarse sand (%) = 0.4
Gravel (%) = 0.0

D_{10} = 0.000 mm
D_{30} = 0.001 mm
D_{60} = 0.005 mm

Prepared by: KJacob Date: 10-30-00
Checked by: [illegible] Date: 10/30/00

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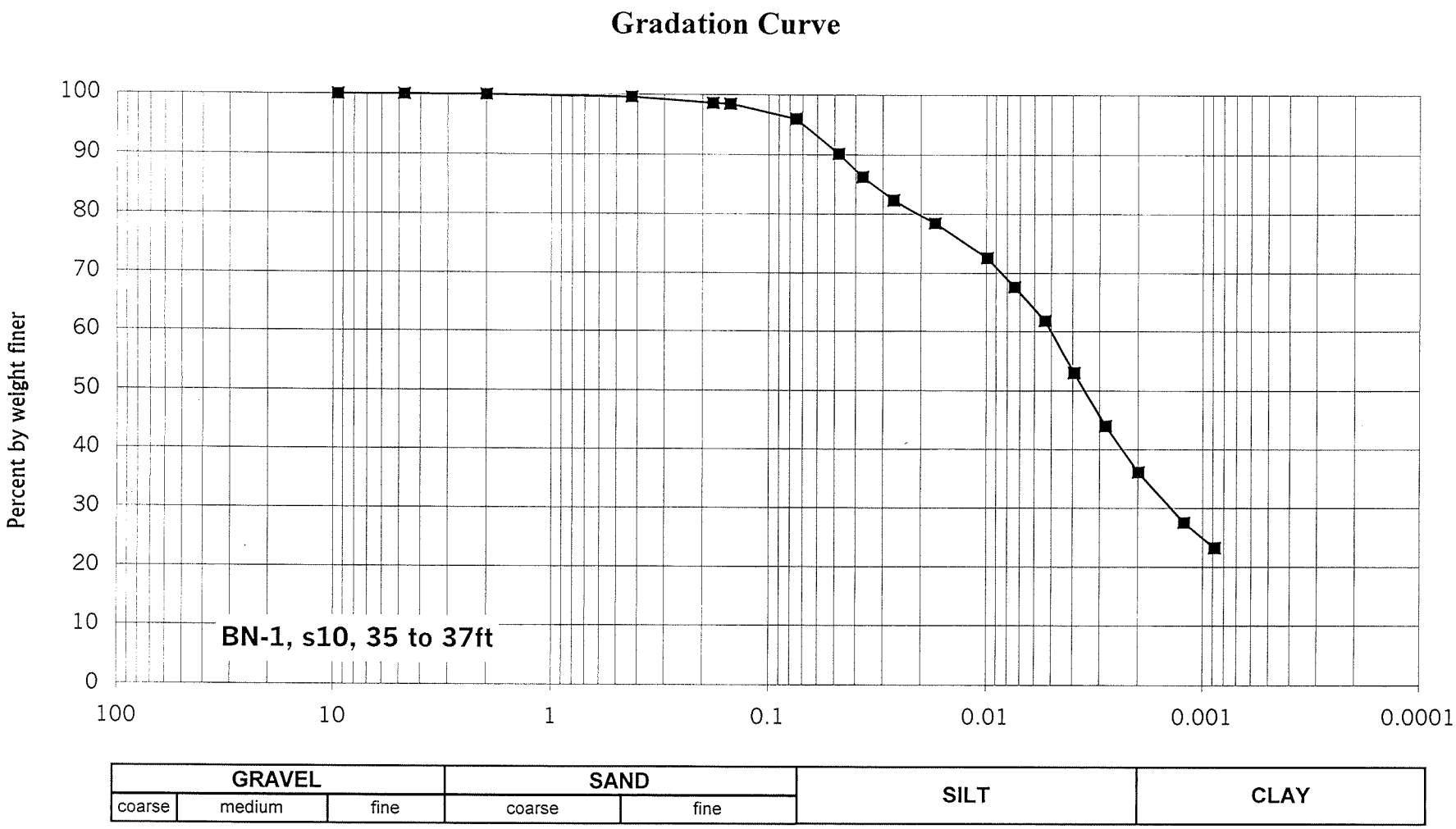
WANG ENGINEERING, INC.

Gradation Curve (ASTM D 422-93)



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WANG ENGINEERING, INC.

LIQUID LIMIT

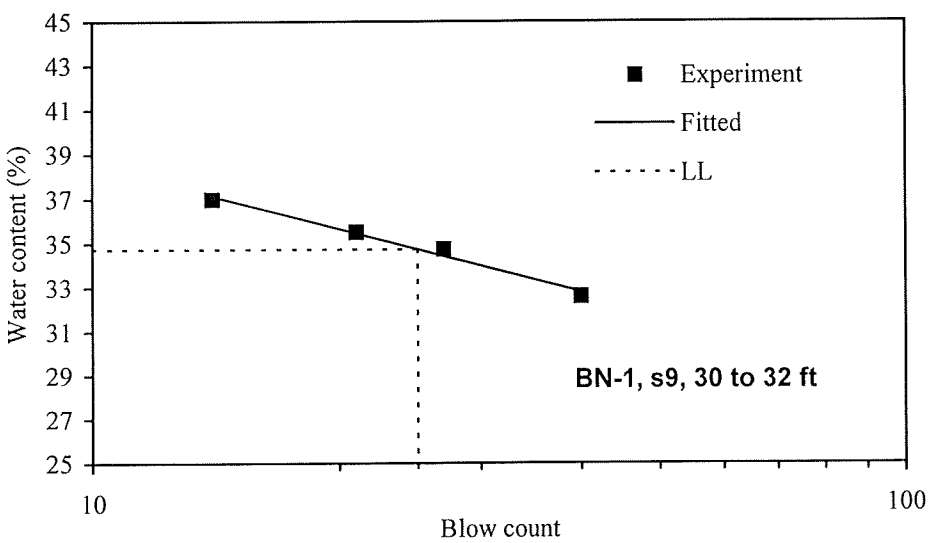
ASTM D 4318-87

Client: Baker Engineering NY, Inc.
Project: Shore Line East--Branford Station
WEI Job No: 707-06-01

Analyst name: *Koshy Jacob*
Test date: *2-Oct-00*
Soil Sample: *BN-1, s9, 30 to 32 ft*
Sample description: *Stiff, reddish brown, clayey silt*

Set number	Tare mass (g) W_c	Tare with wet soil (g) W_w	Tare with dry soil (g) W_d	Blow count N	Water content (%) w	Water content fitted (%)
1	*11.94*	*21.46*	*19.12*	*40*	32.59	32.81
2	*11.84*	*22.39*	*19.67*	*27*	34.74	34.43
3	*11.81*	*23.83*	*20.68*	*21*	35.51	35.46
4	*11.71*	*24.34*	*20.93*	*14*	36.98	37.13

Liquid limit (%) = 34.74
Slope of flow line = 0.119



Prepared by: Jacob Date: 10-30-00

Checked by: [signature] Date: 10/30/00

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WANG ENGINEERING, INC.

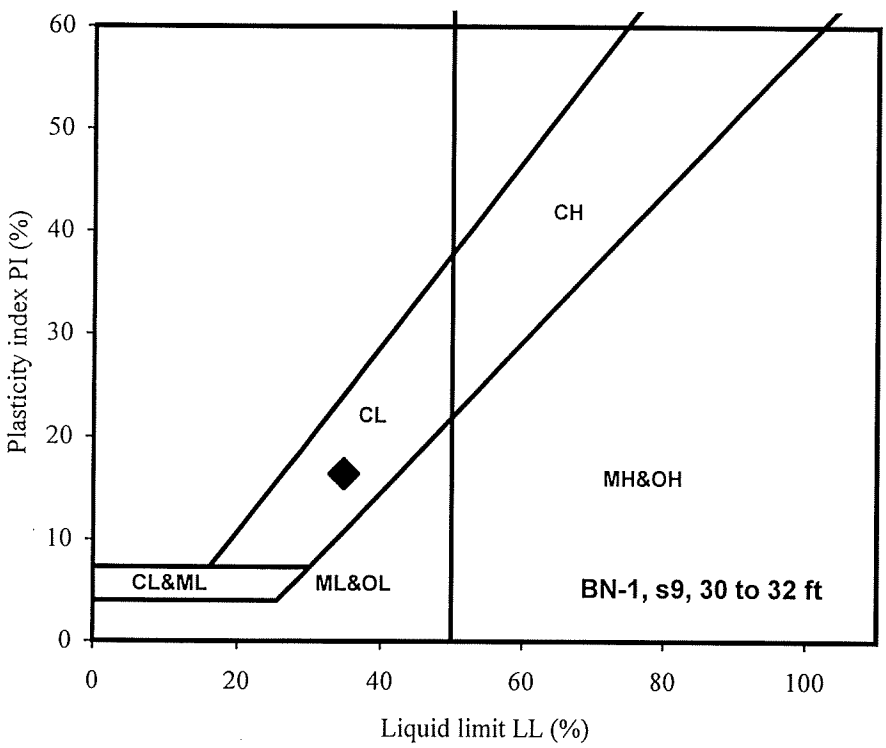
PLASTICITY CHART

ASTM D 2487-93

Client: **Baker Engineering NY, Inc.**
Project: **Shore Line East--Branford Station**
WEI Job No: **707-06-01**

Analyst name: *Koshy Jacob*
Test date: *2-Oct-00*
Soil Sample: *BN-1, s9, 30 to 32 ft*
Sample description: *Stiff, reddish brown, clayey silt*

Liquid limit (%) = ***34.7***
Plastic limit (%) = ***18.3***
Plasticity index (%) = ***16.4***



Prepared by: KJacob Date: 10-30-00

Checked by: [signature] Date: 10/30/00

WANG ENGINEERING, INC.

LIQUID LIMIT

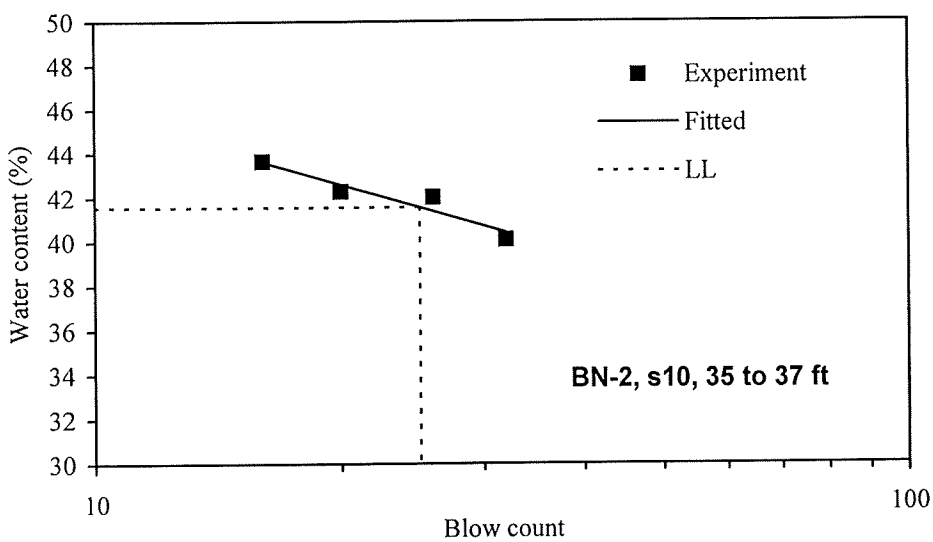
ASTM D 4318-87

Client: Baker Engineering NY, Inc.
Project: Shore Line East--Branford Station
WEI Job No: 707-06-01

Analyst name: *Koshy Jacob*
Test date: *16-Oct-00*
Soil Sample: *BN-2, s10, 35 to 37 ft*
Sample description: *Medium stiff to stiff, brown, clayey silt*

Set number	Tare mass (g) W_c	Tare with wet soil (g) W_w	Tare with dry soil (g) W_d	Blow count N	Water content (%) w	Water content fitted (%)
1	*11.84*	*24.84*	*21.12*	*32*	40.09	40.42
2	*11.77*	*25.73*	*21.60*	*26*	42.01	41.38
3	*11.75*	*24.00*	*20.36*	*20*	42.28	42.60
4	*12.04*	*27.44*	*22.76*	*16*	43.66	43.63

Liquid limit (%) = 41.57
Slope of flow line = 0.110



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WANG ENGINEERING, INC.

PLASTIC LIMIT

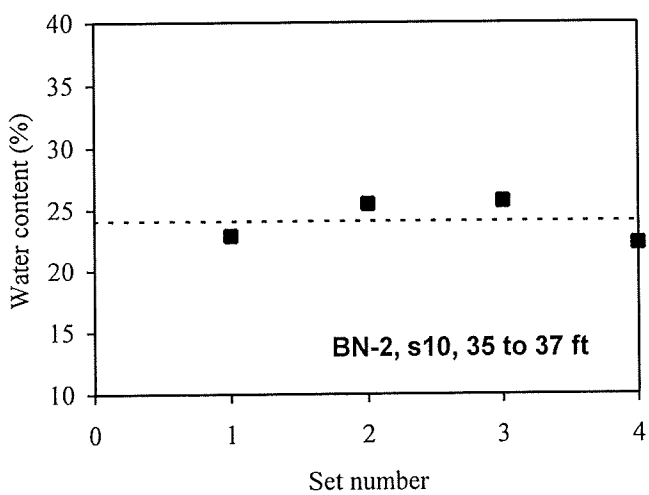
ASTM D 4318-87

Client: Baker Engineering NY, Inc.
Project: Shore Line East--Branford Station
WEI Job No: 707-06-01

Analyst name: *Koshy Jacob*
Test date: *16-Oct-00*
Soil Sample: *BN-2, s10, 35 to 37 ft*
Sample description: *Medium stiff to stiff, brown, clayey silt*

Set number	Mass of container (g) M_c	Mass of container with wet soil (g) M_w	Mass of container with dry soil (g) M_d	Water content (%) w
1	*12.00*	*17.00*	*16.07*	22.85
2	*11.67*	*14.63*	*14.03*	25.42
3	*11.85*	*14.69*	*14.11*	25.66
4	*12.09*	*14.95*	*14.43*	22.22

Plastic limit (%) = 24.04



Prepared by: Jacob Date: 10-30-00

Checked by: [signature] Date: 10/30/00

WANG ENGINEERING, INC.

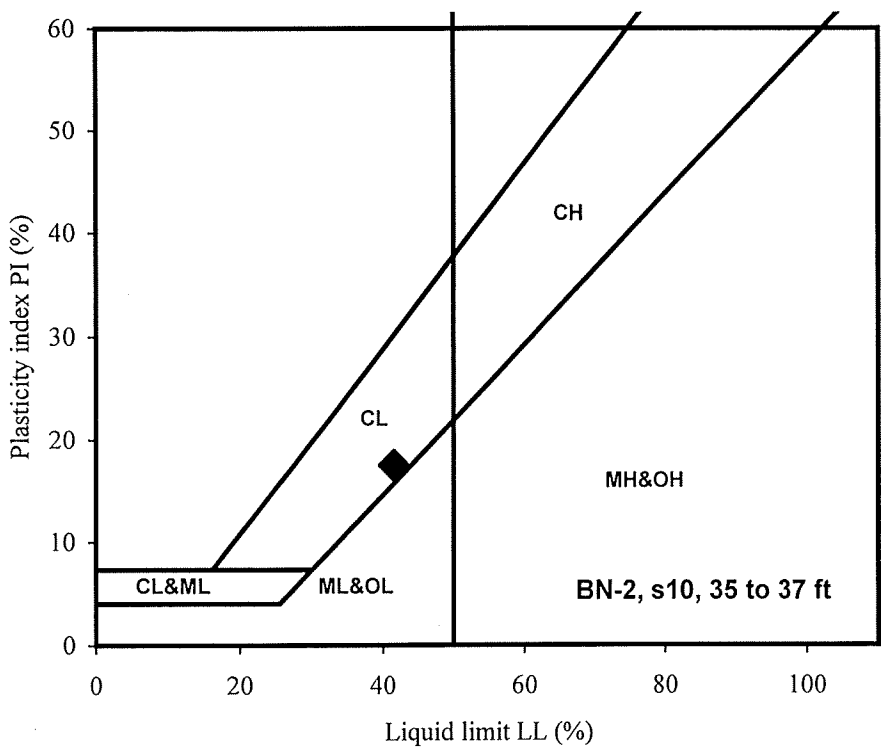
PLASTICITY CHART

ASTM D 2487-93

Client: Baker Engineering NY, Inc.
Project: Shore Line East--Branford Station
WEI Job No: 707-06-01

Analyst name: *Koshy Jacob*
Test date: *16-Oct-00*
Soil Sample: *BN-2, s10, 35 to 37 ft*
Sample description: *Medium stiff to stiff, brown, clayey silt*

Liquid limit (%) = *41.6*
Plastic limit (%) = *24.0*
Plasticity index (%) = *17.5*



Prepared by: KJacob Date: 10-30-00

Checked by: Date: 10/30/00

WANG ENGINEERING, INC.

SOIL PARTICLE SIZE ANALYSIS

ASTM D 422-93

Client: Baker Engineering NY, Inc.
Project: Shore Line East--Branford Station
WEI Job No: 707-06-01
Soil Sample: BN-2, s5, 10 to 12 ft
Sample description: *Very loose, brown sand, little gravel and silt*

Prepared by: Koshy Jacob
2-Oct-00

	Grain size (mm) d	Separate percent finer by weight p	Combined percent finer by weight p_c
Sieve analysis	9.525	94.79	94.79
Mass passing No. 10 sieve W_{N10} (g) = *140.35*	4.750	87.91	87.91
Total sample mass W_{tot} (g) = *174.50*	2.000	80.43	80.43
	0.425	42.84	42.84
	0.180	26.27	26.27
	0.150	23.60	23.60
	0.075	17.44	17.44
Hydrometer analysis	0.0650	20.28	16.31
	0.0498	18.27	14.69
	0.0354	16.26	13.08
	0.0226	13.24	10.65
	0.0123	12.23	9.84
	0.0091	11.23	9.03
	0.0066	10.22	8.22
	0.0045	8.21	6.61
	0.0033	7.00	5.63
	0.0023	5.99	4.82
	0.0014	5.20	4.18
	0.0010	3.78	3.04

Grain Size Parameters

Clay (%) = 4.6
Silt (%) = 12.8
Fine sand (%) = 25.4
Coarse sand (%) = 37.6
Gravel (%) = 19.6

D_{10} = 0.014 mm
D_{30} = 0.218 mm
D_{60} = 0.862 mm

Prepared by: _____ Date: 10-30-00
Checked by: _____ Date: 10/30/00

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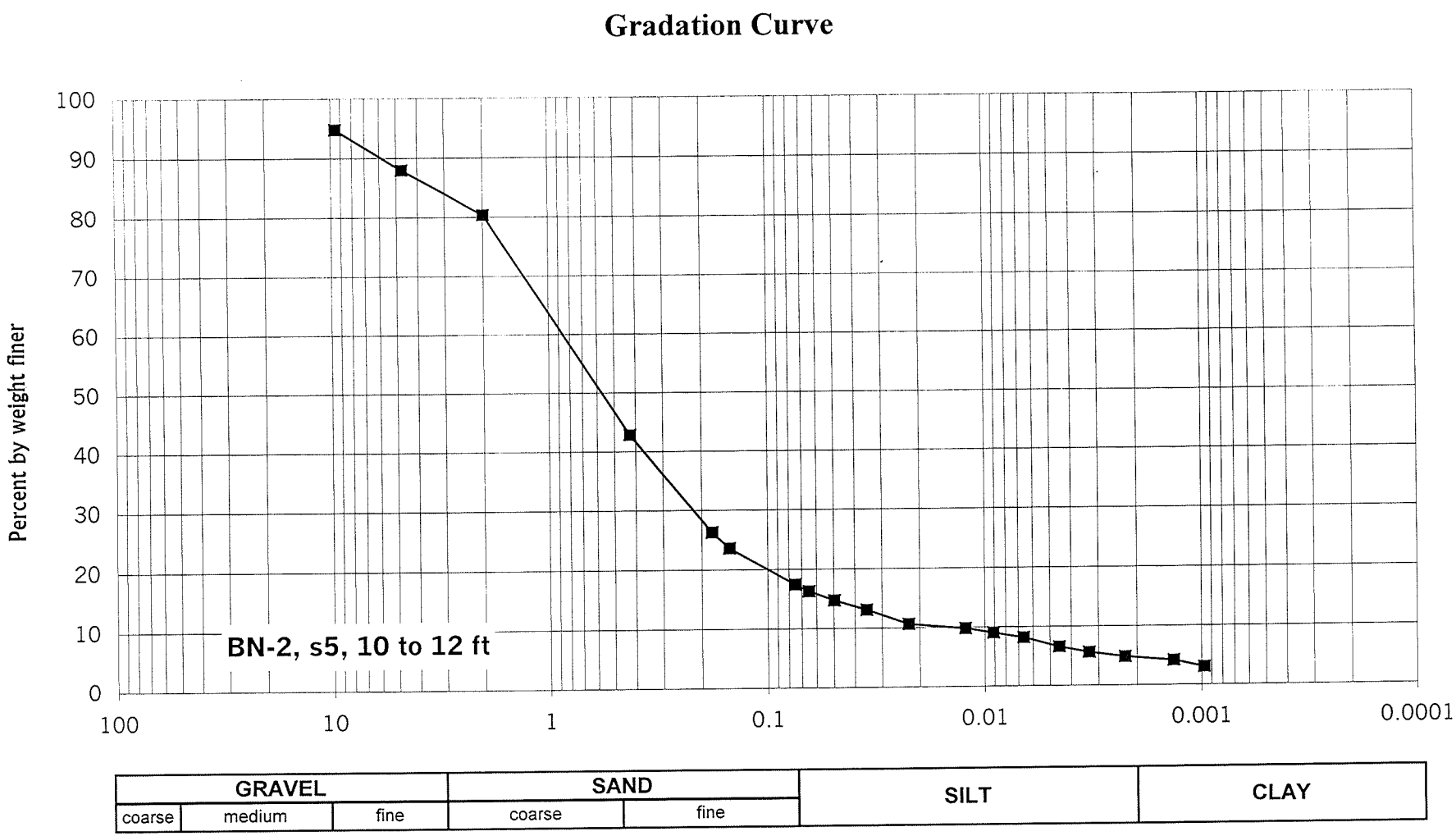
WANG ENGINEERING, INC.

Gradation Curve (ASTM D 422-93)



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WANG ENGINEERING, INC.

LIQUID LIMIT

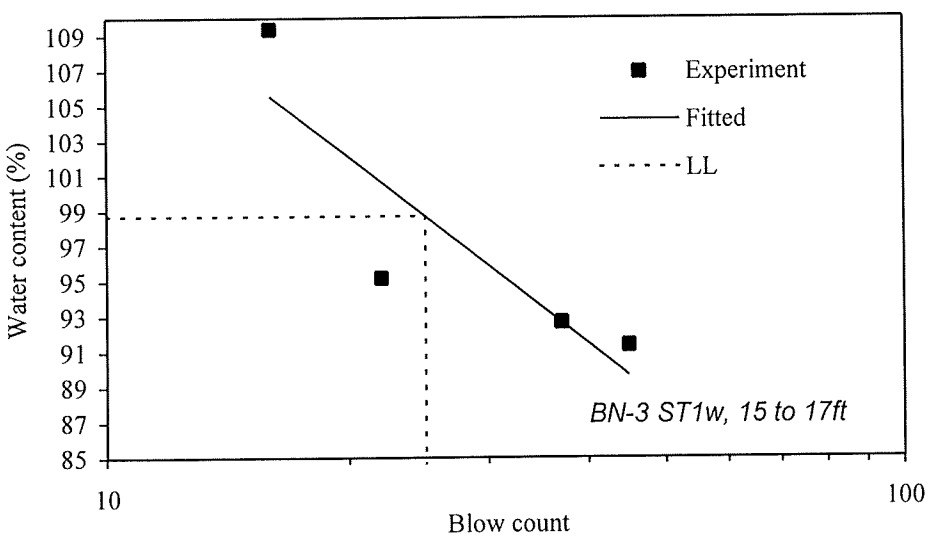
ASTM D 4318-87

Client: Baker Engineering NY, Inc.
Project: Shore Line East--Branford Station
WEI Job No: 707-06-01

Analyst name: *Koshy Jacob*
Test date: *2-Oct-00*
Soil Sample: *BN-3 ST1w, 15 to 17ft*
Sample description: *Dark gray, organic, silty clay*

Set number	Tare mass (g) W_c	Tare with wet soil (g) W_w	Tare with dry soil (g) W_d	Blow count N	Water content (%) w	Water content fitted (%)
1	*11.67*	*21.20*	*16.65*	*45*	91.37	89.67
2	*11.77*	*20.71*	*16.41*	*37*	92.67	92.68
3	*12.09*	*25.83*	*19.13*	*22*	95.17	100.67
4	*12.20*	*22.02*	*16.89*	*16*	109.38	105.57

Liquid limit (%) = 98.71
Slope of flow line = 0.154



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Checked by: [signature] Date: 10/30/00

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WANG ENGINEERING, INC.

PLASTIC LIMIT

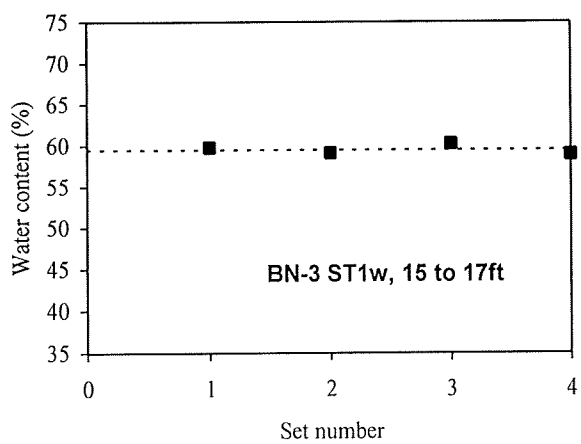
ASTM D 4318-87

Client: Baker Engineering NY, Inc.
Project: Shore Line East--Branford Station
WEI Job No: 707-06-01

Analyst name: *Koshy Jacob*
Test date: *2-Oct-00*
Soil Sample: *BN-3 ST1w, 15 to 17ft*
Sample description: *Dark gray, organic, silty clay*

Set number	Mass of container (g) M_c	Mass of container with wet soil (g) M_w	Mass of container with dry soil (g) M_d	Water content (%) w
1	*12.24*	*15.10*	*14.03*	59.78
2	*11.84*	*14.37*	*13.43*	59.12
3	*12.29*	*15.19*	*14.10*	60.22
4	*11.96*	*15.44*	*14.15*	58.90

Plastic limit (%) = 59.51



Prepared by: _____ Date: 10-30-00

Checked by: _____ Date: 10/20/00

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WANG ENGINEERING, INC.

LIQUID LIMIT

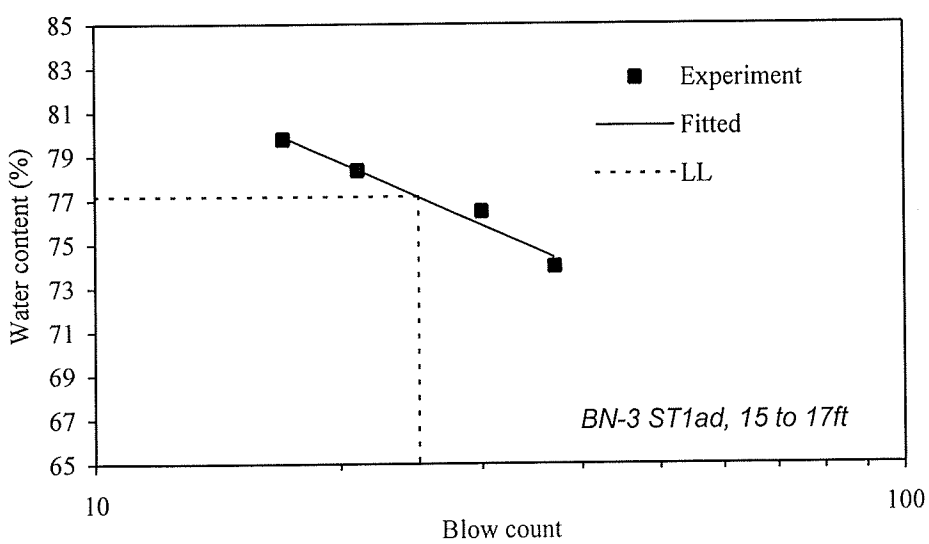
ASTM D 4318-87

Client: **Baker Engineering NY, Inc.**
Project: **Shore Line East--Branford Station**
WEI Job No: **707-06-01**

Analyst name: *Koshy Jacob*
Test date: *2-Oct-00*
Soil Sample: *BN-3 ST1ad, 15 to 17ft*
Sample description: *Dark gray, organic, silty clay*

Set number	Tare mass (g) W_c	Tare with wet soil (g) W_w	Tare with dry soil (g) W_d	Blow count N	Water content (%) w	Water content fitted (%)
1	*11.82*	*21.58*	*17.43*	*37*	73.98	74.40
2	*12.03*	*19.76*	*16.41*	*30*	76.48	75.88
3	*11.75*	*20.24*	*16.51*	*21*	78.36	78.41
4	*11.85*	*24.65*	*18.97*	*17*	79.78	79.90

Liquid limit (%) = 77.17
Slope of flow line = 0.092



Prepared by: KJacob Date: 10-30-00

Checked by: Date: 10/30/00

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WANG ENGINEERING, INC.

PLASTIC LIMIT

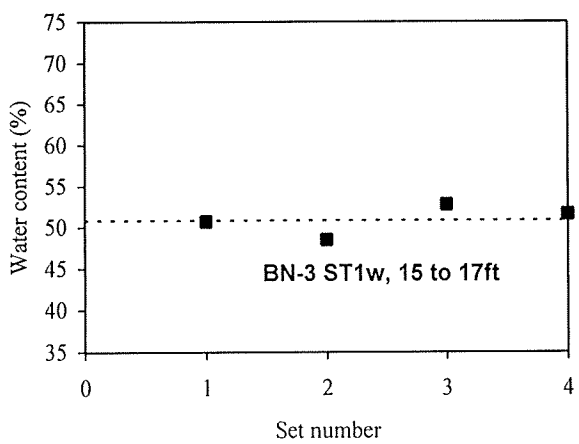
ASTM D 4318-87

Client: Baker Engineering NY, Inc.
Project: Shore Line East--Branford Station
WEI Job No: 707-06-01

Analyst name: *Koshy Jacob*
Test date: *2-Oct-00*
Soil Sample: *BN-3 ST1w, 15 to 17ft*
Sample description: *Dark gray, organic, silty clay*

Set number	Mass of container (g) M_c	Mass of container with wet soil (g) M_w	Mass of container with dry soil (g) M_d	Water content (%) w
1	*12.04*	*15.31*	*14.21*	50.69
2	*12.01*	*15.90*	*14.63*	48.47
3	*11.71*	*15.88*	*14.44*	52.75
4	*12.22*	*15.57*	*14.43*	51.58

Plastic limit (%) = 50.87



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Checked by: _____ Date: 10/30/00

PLASTIC LIMIT

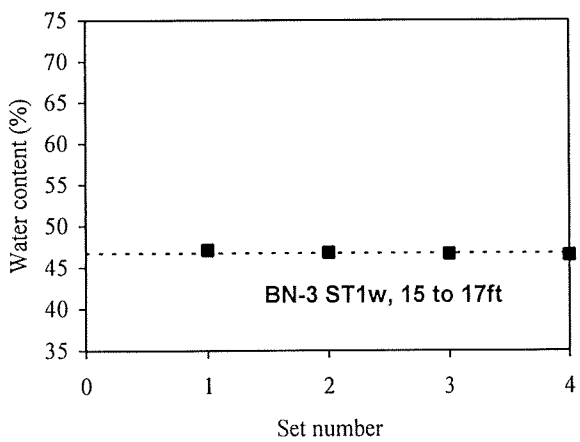
ASTM D 4318-87

Client: **Baker Engineering NY, Inc.**
Project: **Shore Line East--Branford Station**
WEI Job No: **707-06-01**

Analyst name: *Koshy Jacob*
Test date: *2-Oct-00*
Soil Sample: *BN-3 ST1w, 15 to 17ft*
Sample description: *Dark gray, organic, silty clay*

Set number	Mass of container (g) M_c	Mass of container with wet soil (g) M_w	Mass of container with dry soil (g) M_d	Water content (%) w
1	*11.76*	*15.79*	*14.50*	47.08
2	*11.88*	*15.52*	*14.36*	46.77
3	*12.17*	*15.44*	*14.40*	46.64
4	*12.13*	*16.29*	*14.97*	46.48

Plastic limit (%) = 46.74



Prepared by: Jacob Date: 10-30-00
Checked by: [illegible] Date: 10/30/00

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WANG ENGINEERING, INC.

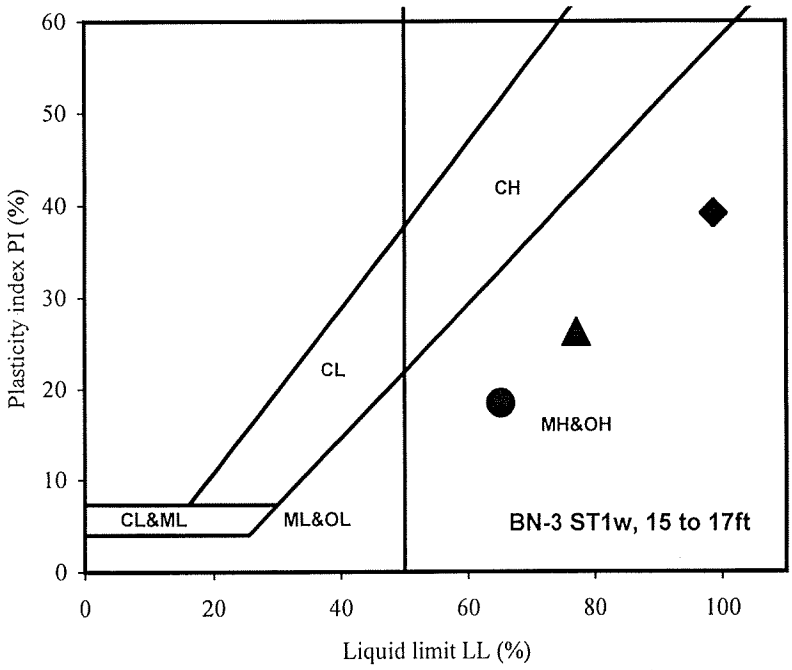
PLASTICITY CHART

ASTM D 2487-93

Client: Baker Engineering NY, Inc.
Project: Shore Line East--Branford Station
WEI Job No: 707-06-01

Analyst name: *Koshy Jacob*
Test date: *2-Oct-00*
Soil Sample: *BN-3 ST1w, 15 to 17ft*
Sample description: *Dark gray, organic, silty clay*

wet ◆	Liquid limit (%) = *98.7* Plastic limit (%) = *59.5* Plasticity index (%) = *39.2*
air dry ▲	Liquid limit (%) = *77.2* Plastic limit (%) = *50.9* Plasticity index (%) = *26.3*
oven dry ●	Liquid limit (%) = *65.2* Plastic limit (%) = *46.7* Plasticity index (%) = *18.5*



Prepared by: _____ Date: 10-30-00

Checked by: _____ Date: 10/30/00

WANG ENGINEERING, INC.

SOIL PARTICLE SIZE ANALYSIS

ASTM D 422-93

Client: Baker Engineering NY, Inc.
Project: Shore Line East--Branford Station
WEI Job No: 707-06-01
Soil Sample: BN-3, ST1, 15 to 17 ft
Sample description: *Dark gray, organic silty clay*

Prepared by: Koshy Jacob
2-Oct-00

	Grain size (mm) d	Separate percent finer by weight p	Combined percent finer by weight p_c
Sieve analysis	9.525	100.00	100.00
Mass passing No. 10 sieve W_{N10} (g) = *241.30*	4.750	100.00	100.00
Total sample mass W_{tot} (g) = *241.30*	2.000	100.00	100.00
	0.425	99.65	99.65
	0.180	99.03	99.03
	0.150	99.01	99.01
	0.075	98.61	98.61
Hydrometer analysis	0.0474	95.26	95.26
	0.0369	91.21	91.21
	0.0265	87.17	87.17
	0.0172	81.10	81.10
	0.0096	67.95	67.95
	0.0076	58.84	58.84
	0.0055	50.75	50.75
	0.0040	42.66	42.66
	0.0029	36.37	36.37
	0.0021	30.31	30.31
	0.0013	22.42	22.42
	0.0009	18.97	18.97

Grain Size Parameters

Clay (%) = 29.4
Silt (%) = 69.2
Fine sand (%) = 1.0
Coarse sand (%) = 0.4
Gravel (%) = 0.0

D_{10} = 0.000 mm
D_{30} = 0.002 mm
D_{60} = 0.008 mm

Prepared by: _____ Date: 10-30-00
Checked by: _____ Date: 10/30/00

WANG ENGINEERING, INC.

PLASTIC LIMIT

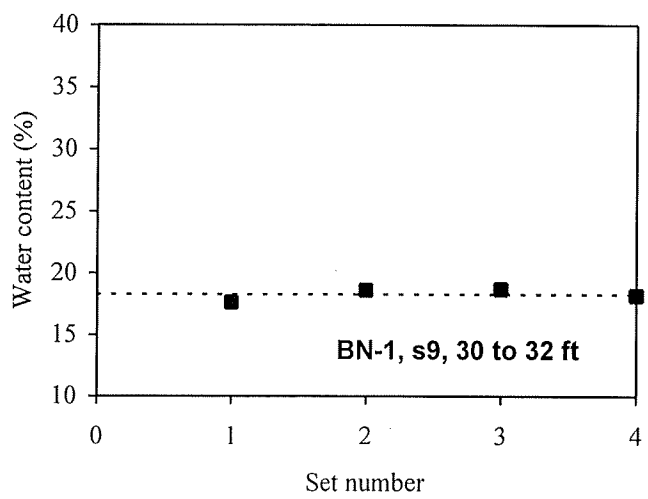
ASTM D 4318-87

Client: Baker Engineering NY, Inc.
Project: Shore Line East--Branford Station
WEI Job No: 707-06-01

Analyst name: *Koshy Jacob*
Test date: *2-Oct-00*
Soil Sample: *BN-1, s9, 30 to 32 ft*
Sample description: *Stiff, reddish brown, clayey silt*

Set number	Mass of container (g) M_c	Mass of container with wet soil (g) M_w	Mass of container with dry soil (g) M_d	Water content (%) w
1	*11.47*	*14.67*	*14.19*	17.65
2	*12.21*	*16.03*	*15.43*	18.63
3	*12.24*	*16.30*	*15.66*	18.71
4	*11.71*	*16.32*	*15.61*	18.21

Plastic limit (%) = 18.30

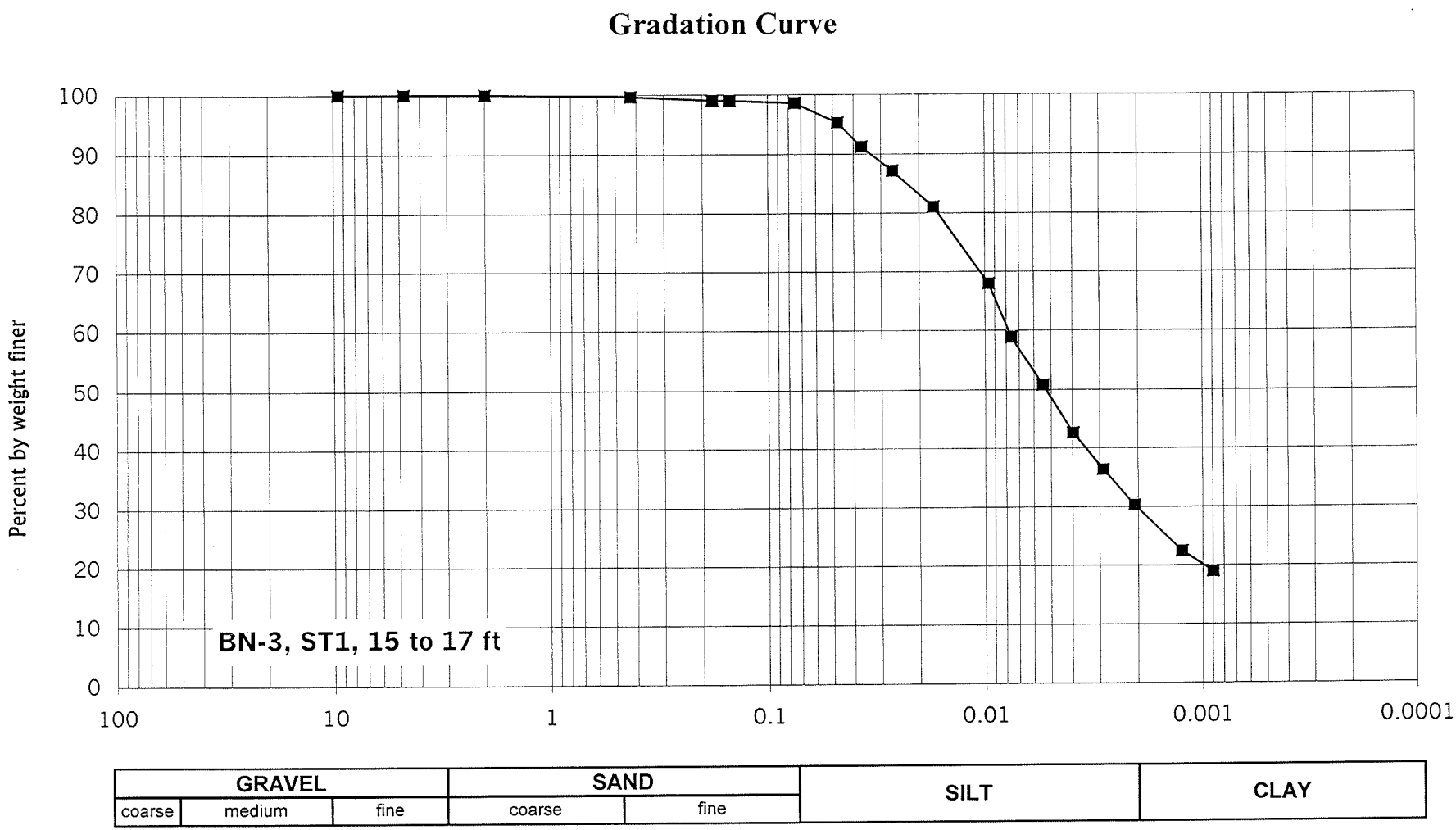


Prepared by: KJacob Date: 10-30-00

Checked by: [signature] Date: 10/30/00

WANG ENGINEERING, INC.

Gradation Curve (ASTM D 422-93)



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WANG ENGINEERING, INC.

SOIL PARTICLE SIZE ANALYSIS

ASTM D 422-93

Client: Baker Engineering NY, Inc.
Project: Shore Line East--Branford Station
WEI Job No: 707-06-01
Soil Sample: BN-4, s10, 35 to 37ft
Sample description: *Stiff to very stiff, brown, clayey silt, trace sand*

Prepared by: Koshy Jacob
20-Oct-00

	Grain size (mm) d	Separate percent finer by weight p	Combined percent finer by weight p_c
Sieve analysis	9.525	100.00	100.00
Mass passing No. 10 sieve W_{N10} (g) = *105.51*	4.750	100.00	100.00
Total sample mass W_{tot} (g) = *105.80*	2.000	99.73	99.73
	0.425	97.77	97.77
	0.180	96.28	96.28
	0.150	95.97	95.97
	0.075	94.05	94.05
Hydrometer analysis	0.0488	91.81	91.56
	0.0375	89.79	89.54
	0.0269	86.75	86.51
	0.0174	81.19	80.97
	0.0099	77.65	77.43
	0.0075	67.53	67.35
	0.0054	61.46	61.29
	0.0040	53.87	53.73
	0.0029	45.28	45.15
	0.0021	38.61	38.51
	0.0012	31.53	31.44
	0.0009	28.08	28.00

Grain Size Parameters

Clay (%) = 37.9
Silt (%) = 56.1
Fine sand (%) = 3.7
Coarse sand (%) = 2.0
Gravel (%) = 0.3

D_{10} = 0.000 mm
D_{30} = 0.001 mm
D_{60} = 0.005 mm

Prepared by: KJacob Date: 10-30-00
Checked by: [illegible] Date: 10/30/00

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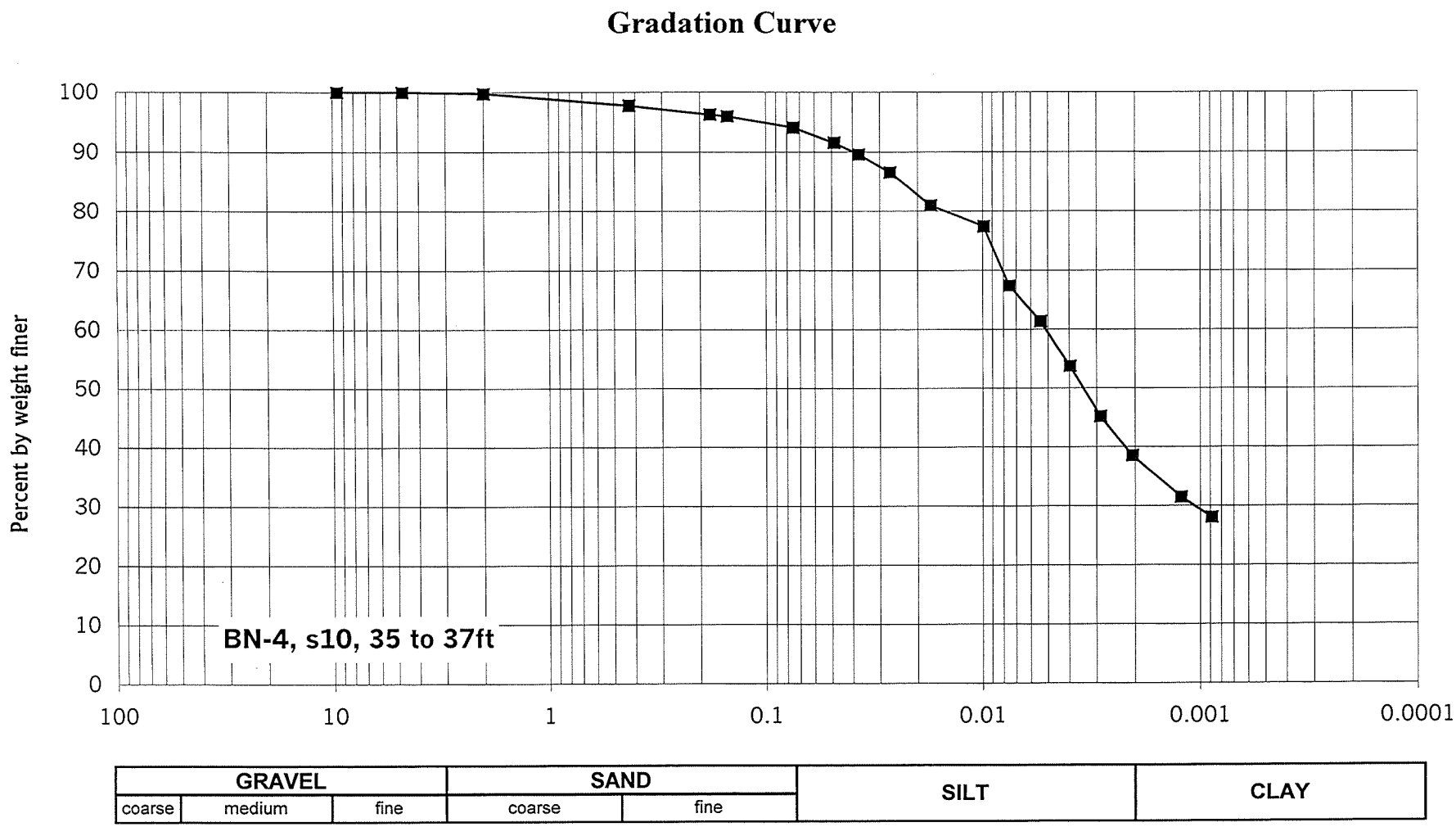
WANG ENGINEERING, INC.

Gradation Curve (ASTM D 422-93)



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WANG ENGINEERING, INC.

SOIL PARTICLE SIZE ANALYSIS

ASTM D 422-93

Client: Baker Engineering NY, Inc.
Project: Shore Line East - Branford Station
WEI Job No: 707-06-01
Soil Sample: BN-4, s12, 45 to 47 ft

Sample description: *Dense, brown sand, some gravel*

Prepared by: Koshy Jacob
2-Oct-00

	Grain size (mm) d	Separate percent finer by weight p	Combined percent finer by weight p_c
Sieve analysis	9.525	100.00	100.00
Mass passing No. 10 sieve W_{N10} (g) = *152.20*	4.750	96.03	96.03
Total sample mass W_{tot} (g) = *195.15*	2.000	77.99	77.99
	0.425	45.86	45.86
	0.180	26.58	26.58
	0.150	23.71	23.71
	0.075	18.28	18.28
Hydrometer analysis	0.0654	18.24	14.22
	0.0501	16.23	12.66
	0.0356	14.22	11.09
	0.0226	13.22	10.31
	0.0131	12.22	9.53
	0.0090	11.21	8.74
	0.0065	9.20	7.18
	0.0045	8.20	6.39
	0.0033	6.99	5.45
	0.0023	5.98	4.67
	0.0014	5.19	4.05
	0.0010	3.77	2.94

Grain Size Parameters

Clay (%) = 4.4
Silt (%) = 13.8
Fine sand (%) = 27.6
Coarse sand (%) = 32.1
Gravel (%) = 22.0

D_{10} = 0.018 mm
D_{30} = 0.210 mm
D_{60} = 0.840 mm

Prepared by: KJacob Date: 10-30-02

Checked by: [signature] Date: 10/30/02

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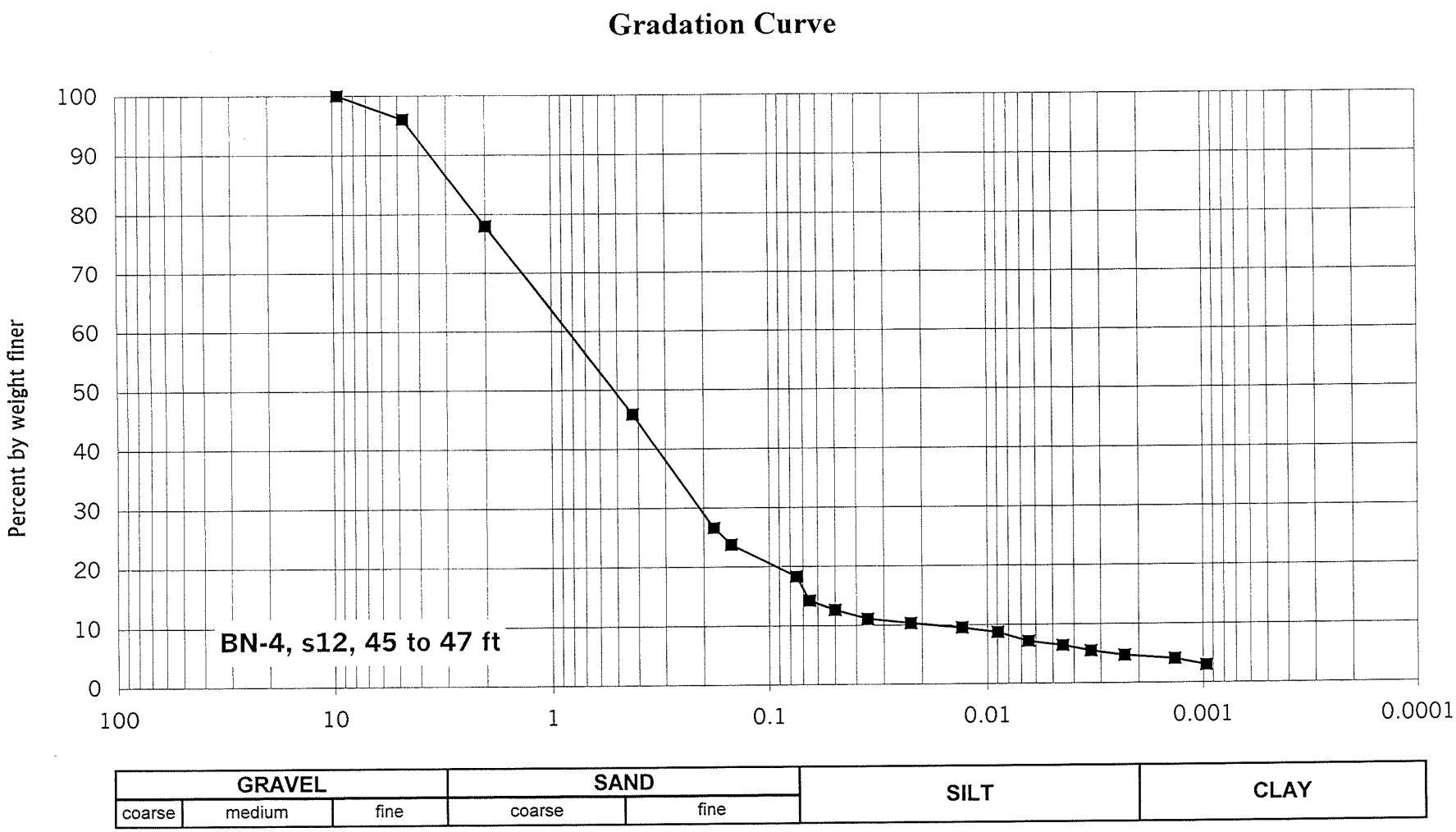
WANG ENGINEERING, INC.

Gradation Curve (ASTM D 422-93)



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WANG ENGINEERING, INC.

WATER CONTENT
(ASTM D 2216-92)

Client:	**Baker Engineering NY, Inc.**
Project:	**Shore Line East - New Branford Station**
WEI Job No:	**707-06-01**
Sample Type:	**Split Spoon**
Analyist:	*Koshy Jacob*
Test Date:	*10/5/2000*

Boring # BN-1

	6 12.5 to 14.5 ft	7 15 to 17 ft	8 24 to 26 ft	9 30 to 32 ft
Mass of tare and wet soil (g) $W_{w=}$	*26.61*	*25.43*	*33.84*	*31.18*
Mass of tare and dry soil (g) $W_{d=}$	*20.42*	*19.54*	*29.60*	*26.54*
Mass of tare (g) W_t =	*11.83*	*11.81*	*11.54*	*11.85*
Water content w =	**72%**	**76%**	**23%**	**32%**

	10 35 to 37 ft	11 40 to 42 ft
Mass of tare and wet soil (g) $W_{w=}$	*29.62*	*29.35*
Mass of tare and dry soil (g) $W_{d=}$	*25.26*	*24.95*
Mass of tare (g) W_t =	*11.77*	*11.79*
Water content w =	**32%**	**33%**

Prepared by: KJacob Date: 10-30-00

Checked by: [illegible] Date: 10/30/00

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WANG ENGINEERING, INC.

WATER CONTENT
(ASTM D 2216-92)

Client:	**Baker Engineering NY, Inc.**
Project:	**Shore Line East - New Branford Station**
WEI Job No:	**707-06-01**
Sample Type:	**Split Spoon**
Analyist:	*Koshy Jacob*
Test Date:	*10/5/2000*

Boring # BN-2

	2 2.5 to 4.5 ft	4 7.5 to 9.5 ft	5 10 to 12 ft	6 12.5 to 14.5 ft
Mass of tare and wet soil (g) $W_{w=}$	*35.11*	*32.50*	*31.64*	*29.26*
Mass of tare and dry soil (g) $W_{d=}$	*31.60*	*30.46*	*28.40*	*26.23*
Mass of tare (g) W_t =	*11.94*	*11.80*	*11.85*	*12.26*
Water content w =	**18%**	**11%**	**20%**	**22%**

	7 15 to 17 ft	8 20 to 22 ft	9 30 to 32 ft	10 35 to 37 ft
Mass of tare and wet soil (g) $W_{w=}$	*25.42*	*25.70*	*31.58*	*23.88*
Mass of tare and dry soil (g) $W_{d=}$	*20.08*	*22.12*	*27.94*	*20.46*
Mass of tare (g) W_t =	*12.15*	*12.18*	*12.04*	*11.74*
Water content w =	**67%**	**36%**	**23%**	**39%**

	11 40 to 42 ft	12 50 to 52 ft
Mass of tare and wet soil (g) $W_{w=}$	*29.56*	*29.57*
Mass of tare and dry soil (g) $W_{d=}$	*24.73*	*27.71*
Mass of tare (g) W_t =	*12.00*	*11.96*
Water content w =	**38%**	**12%**

Prepared by: _____ Date: 10-30-00

Checked by: _____ Date: 10/30/00

WATER CONTENT
(ASTM D 2216-92)

Client:	**Baker Engineering NY, Inc.**
Project:	**Shore Line East - New Branford Station**
WEI Job No:	**707-06-01**
Sample Type:	**Split Spoon**
Analyist:	*Koshy Jacob*
Test Date:	*10/5/2000*

Boring # BN-3

	1 0 to 2 ft	5 10 to 12 ft	6 12.5 to 14.5 ft	7 17 to 19 ft
Mass of tare and wet soil (g) W_w =	*36.64*	*19.58*	*22.57*	*169.54*
Mass of tare and dry soil (g) W_d =	*34.43*	*16.75*	*16.34*	*144.32*
Mass of tare (g) W_t =	*11.80*	*11.91*	*11.87*	*138.23*
Water content w =	**10%**	**58%**	**139%**	**414%**

	8 20 to 22 ft	9 25 to 27 ft	10 30 to 32 ft	11 35 to 37 ft
Mass of tare and wet soil (g) W_w =	*32.13*	*32.26*	*27.28*	*28.56*
Mass of tare and dry soil (g) W_d =	*29.57*	*28.70*	*24.29*	*24.87*
Mass of tare (g) W_t =	*12.05*	*11.84*	*11.82*	*11.93*
Water content w =	**15%**	**21%**	**24%**	**29%**

	12 45 to 47 ft	13 50 to 52 ft
Mass of tare and wet soil (g) W_w =	*31.92*	*26.87*
Mass of tare and dry soil (g) W_d =	*29.92*	*25.45*
Mass of tare (g) W_t =	*11.92*	*11.77*
Water content w =	**11%**	**10%**

Prepared by: _____ Date: 10-30-00

Checked by: _____ Date: 10/30/00

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WANG ENGINEERING, INC.

WATER CONTENT
(ASTM D 2216-92)

Client:	**Baker Engineering NY, Inc.**
Project:	**Shore Line East - New Branford Station**
WEI Job No:	**707-06-01**
Sample Type:	**Split Spoon**
Analyist:	*Koshy Jacob*
Test Date:	*10/5/2000*

Boring # BN-4

	3 5 to 7 ft	4 7.5 to 9.5 ft	5 10 to 12 ft	6 12.5 to 14.5 ft
Mass of tare and wet soil (g) W_w =	*30.81*	*35.20*	*27.92*	*43.17*
Mass of tare and dry soil (g) W_d =	*27.24*	*32.71*	*25.18*	*26.81*
Mass of tare (g) W_t =	*11.67*	*11.74*	*11.86*	*11.95*
Water content w =	**23%**	**12%**	**21%**	**110%**

	7 20 to 22 ft	8 25 to 27 ft	9 30 to 32 ft	10 35 to 37 ft
Mass of tare and wet soil (g) W_w =	*34.80*	*29.07*	*35.81*	*28.23*
Mass of tare and dry soil (g) W_d =	*25.25*	*26.95*	*31.34*	*24.15*
Mass of tare (g) W_t =	*12.09*	*11.91*	*11.78*	*11.94*
Water content w =	**73%**	**14%**	**23%**	**33%**

	11 40 to 42 ft
Mass of tare and wet soil (g) W_w =	*33.74*
Mass of tare and dry soil (g) W_d =	*27.37*
Mass of tare (g) W_t =	*11.89*
Water content w =	**41%**

Prepared by: Jacob Date: 10-30-00

Checked by: [illegible] Date: 10/30/00

Appendix 4

Load Test Results

- Branford Railroad Station Micro-Pile Submittal Documents for Platform and Building Support Piles, Submitted by Layne GeoConstruction on February 11, 2004

Branford Railroad Station

MICRO-PILE SUBMITTAL DOCUMENTS

RECEIVED
JUN 15 2004
BAKER ENGINEERING NY INC.
ROCKY HILL, CT

FOR:
PLATFORM AND BUILDING SUPPORT PILES

OWNER:
CONNECTICUT DEPARTMENT OF TRANSPORTATION

CONTRACTOR/ENGINEER:
BANTON CONSTRUCTION COMPANY, INC.

SUBMITTED BY:
SPECIALTY GEOTECHNICAL CONTRACTOR

Layne
GeoConstruction

A Division of Layne Christensen Company
22537 Coleman's Mill Road
Ruther Glen, VA 22546
804-448-8060
Fax: 804-448-1771

Created: 02/11/04
Revised: 06/14/04

Layne
GeoConstruction

SUBMITTAL DOCUMENTS
FOR:

BRANFORD RAILROAD STATION
PLATFORM AND BUILDING SUPPORT PILES

Table of Contents

Description	Section
Pile Installation Procedure	1
Pile Design Calculations	2
Pile Drawing	3
Pile Testing Procedure	4
Pile Test Drawings	5
Verification Test Results	6
Working Drawings	7

PROPRIETARY INFORMATION

Branford Railroad Station – Micro-Pile Submittal Documents are proprietary information of the Layne GeoConstruction. This information shall not be released without written authorization of the Layne GeoConstruction.

Layne GeoConstruction

SECTION 1 - PILE INSTALLATION PROCEDURE

1. MICROPILE DESIGN INFORMATION

All design calculations have been prepared and stamped by a Professional Engineer licensed in the state of Connecticut. Calculations were prepared per the project specifications and the FHWA "Micropile Design and Construction Guidelines Manual", Report No. FHWA-SA-97-070.

Type I Piles:
Design Load: 45 kips in compression
Test Load: 112.5 kips in compression (2.5xDL)
Design Depth: 46 feet from elevation 8.0'

Type II Piles:
Design Load: 93 kips in compression
Test Load: 232.5 kips in compression (2.5xDL)
Design Depth: 57 feet from elevation 8.0'

2. MATERIALS

2.1 Pile steel casings will consist of new 5.5" Outside Diameter, 0.361" wall, grade 80 KSI, structural grade, flush joint threaded casing supplied by Star Iron Works of Punxsutawney, PA. Coupon sample test reports will be submitted for casing used on site to assure strength conformance with project specifications. Star Iron has been a major supplier to Layne Christensen for 40 years. Casing will be stored in a suitable location on site so as not to interfere with production operations. Casing will be unloaded on site with a forklift and be stored on cribbing out of any standing water.

2.2 Standard hook bar for pile to footing connection will be #5, grade 60 ksi continuously deformed bar with standard hook. Mill certifications will be submitted upon receipt from the manufacturer. Please refer to figures attached. Hook bars will be stored in a suitable location on site so as not to interfere with production operations. Hook bars will be unloaded on site with a forklift and be stored on cribbing out of any standing water.

2.3 Grout will consist of 0.45 W/C ratio by weight (5.0 gallons of water per 94 pounds) of ASTM C150, Portland Type I/II cement. Grout will attain minimum cube strength of 4,000 psi in 28 days. A compressive strength report from a recent project using this grout mix is included for reference.

3. INSTALLATION

3.1 The micropile will consist of a sacrificial bit attached directly to flush joint threaded casing. The casing will be installed the full height of the pile and permanently left in place as the reinforcing.

3.2 Drilling will be performed with a Tecniwell TW1400 and MC600 hydraulic drill rigs. Drill cuttings will be removed from the hole by water flush as the hole is advanced. The water source and the drill cuttings control will be provide by the General Contractor, Banton Construction. Banton has asked Layne to include the following to address the

comment regarding the water source and drill cuttings control. Any additional questions or comments beyond what is included below should be directed to the general contractor.

Water source:

Water will be provided from one of two sources. The first will be a Pool Water truck and the second is a constant water source currently scheduled for construction. It is anticipated that the pool water truck will only be necessary for test pile installation and the constant water source will be on line for production work.

Cuttings control:

Excessive water will be pumped into a sedimentation dumpster or lined retaining pond. Water will then be pumped out through a second filtering device such as a dirt bag or hay bale stack.

3.3 Drilling will be performed from the bottom elevation of the footing. Water will be flushed through the casing and up the annulus of the drill hole. The water head created in the drill hole will exert pressure on the drill hole and assist in keeping the hole open. The drill flush will be a mixture of soil and water and will have a higher unit weight than water. This will assist in keeping the hole open. Drilling will be conducted by an experienced operator with experience installing this type of micropile. The driller will control the drilling penetration rate to minimize over excavation of material and maximize up-hole velocity in an attempt to prevent hole blockage. Drilling will be monitored by the site supervisor and small changes may be made to enhance the efficiency and quality of the drilling process.

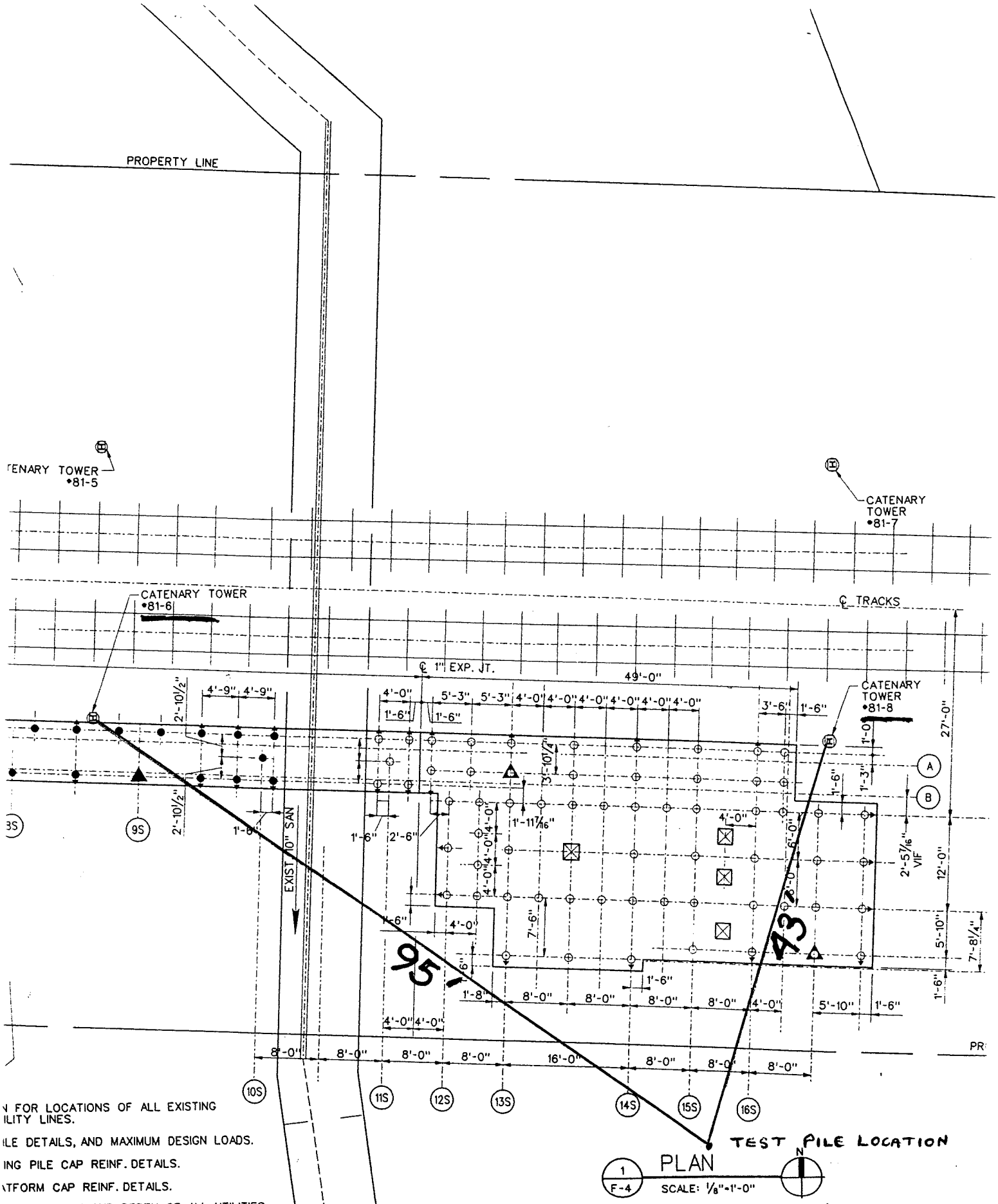
3.4 When the design depth is reached with the steel casing, the water flush will be switched to grout at the controls of the drill. This switch will happen quickly so as to continue the flow of flushing medium up the annulus of the drill hole. Grout will be pumped until a thick grout mix is seen exiting the top of the drill hole. If grout does not exit the top of the hole after pumping 200% of the theoretical volume of the pile, grouting will stop. The pile will be allowed to set overnight. The next day a tremie pipe will be inserted along the casing to the top of the grout or as deep as practical. Grout will be pumped until the annulus around the reinforcing material is full and grout exits the top of the hole.

3.5 Grout will be mixed using a Tecniwell TWM12 grout plant to the mix specification noted above. Grout unit weight will be checked every other pile with a mud balance to confirm proper grout mix. Nine 2" x 2" grout cubes will be taken daily to confirm grout strength. These cubes will be broken at 7 and 28 days by an independent testing laboratory.

3.6 Upon completion of grouting operations the casing will be cut to the proper elevation and the connection hook bar will be inserted within the pile casing to the proper depth.

3.7 The battered piles will be installed per the same steps as outlined above. The drill rig will be set on the hole and the mast set at the appropriate angle with a smart level. A smart level is a digital level accurate up to 0.1 degrees. The angle of inclination of the battered piles is 1h:12v, which corresponds to 4.8 degrees of the vertical.

3.8 Details of micropile installation will be recorded on a micropile installation log included in this submittal.



N FOR LOCATIONS OF ALL EXISTING
ILITY LINES.

ILE DETAILS, AND MAXIMUM DESIGN LOADS.

ING PILE CAP REINF. DETAILS.

ATFORM CAP REINF. DETAILS.

FY LOCATION AND DEPTH OF ALL UTILITIES
APG PILES AND NOTIFY THE ENGINEER OF ANY

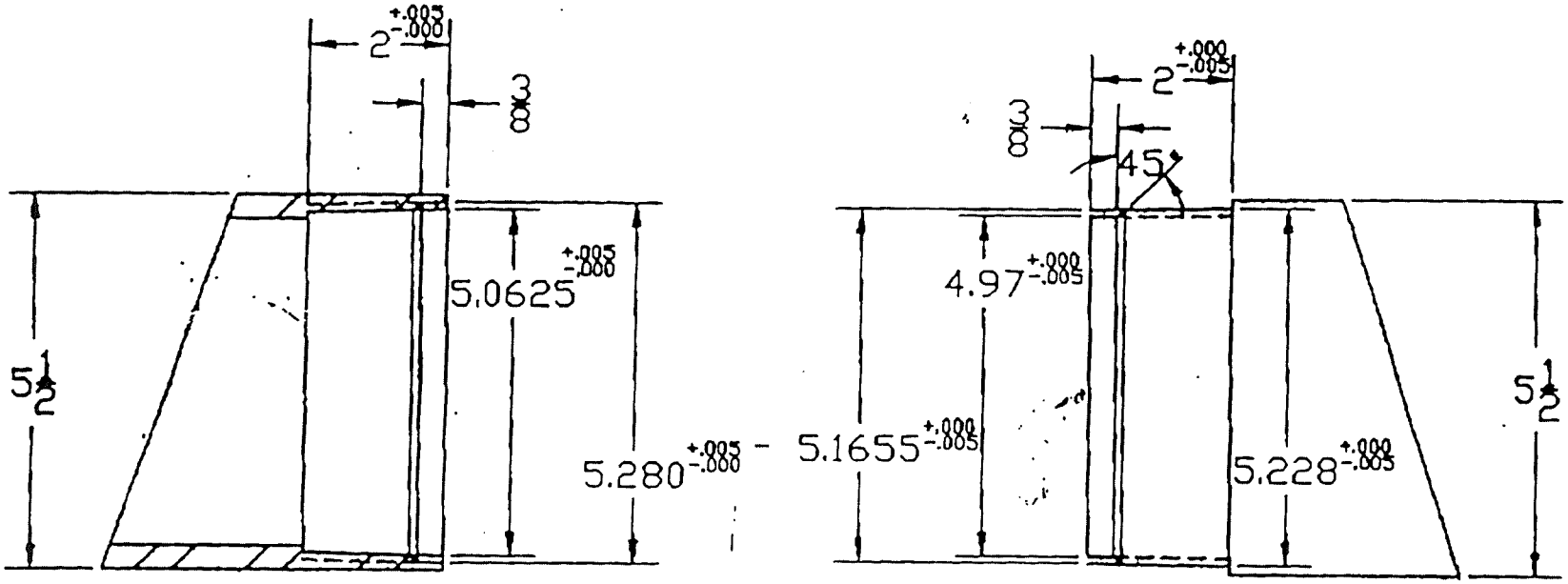
NNECTICUT
ENT OF TRANSPORTATION
Y, INC.

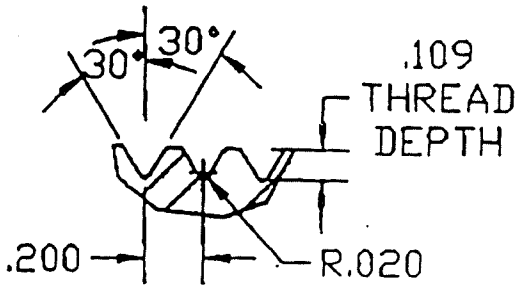
STATE OF CONNECTICUT PROFESSIONAL ENGINEER

PROJECT TITLE:
DEPARTMENT OF TRANSPORTATION
SHORE LINE EAST
RAILROAD STATIONS

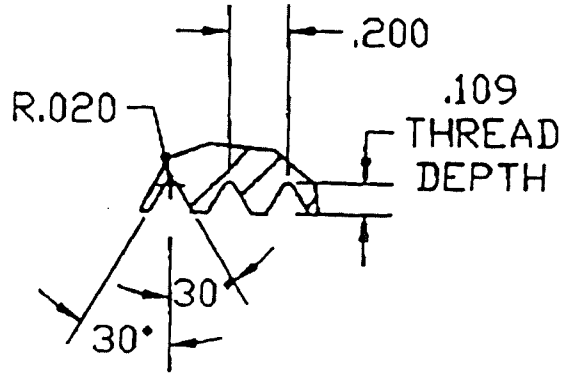
TOWN: BRANFORD

DRAWING TITLE: PILE LAYOUT





5 T.P.I.
3/8" T.P.F.
R.H.



STANDARD O.D.	5 1/2'
STANDARD I.D.	4.778
MIN. O.D.	5 1/2'
MIN. I.D.	PIN:4.778 BOX:4.778

REV.	ECN #	DATE	DRAWN BY	DATE	CHECKED BY	DATE
1		5/15/02				

Tolerances unless otherwise noted
.XX ± 0.060 X ± 0°
.XXX ± 0.030 Bend Rad. Imp. Dim.
.XXXX ± 0.015 Finish = 500 RMS
Angles ± 1/2°

STAR Iron Works, Inc.
Punxsutawney, PA

MATERIAL:

TITLE: 5 1/2' CASING THREADS.

DRAWN BY: DL DATE: 9/10/97

SCALE: NTS DWG. NO. 5439-001 PART NO. SHEET 1 REV. 0

MTEC
MECHANICAL
TESTING
SERVICES

CERTIFICATE OF TEST

ATTENTION : RAY VETTERS
CUSTOMER : SAGINAW PIPE CO. INC.
46 NORTH MAIN
KINGWOOD, TX 77339

8676 TAUB ROAD
Houston, TX 77064
281/469-2609

LAB# : W0301766
DATE : 02/27/03

PO NO :MEMO 2.26/03
MARKED :456
MATL. TYPE : LOW ALLOY
QTC : 5 1/2" OD X .361" W

TEST DATA

TENSILE

UTS PSI	YS.2%PSI	%EL 4D	%RA	BAR DIA.	ORIEN.	LOC.
106,900	94,900	27.30	72.70	0.249	LONG	MW

Cheryl Blanar
MTEC Representative

PATRIOT ENGINEERING
and Environmental Co. LLC.
600 N. Weinbach Ave., Suite 920
Evansville, Indiana 47711
(812) 477-0050 Fax (812) 477-0094

REPORT OF COMPRESSIVE STRENGTH

Project Name: Petersburgh Generating Station
Client: Layne Construction
Project No.: 03-03-0304
Set: 1

Project Information

Date of Concrete Placement: 4/8/03
Structure Type: Micro Pile
Location of Placement: Ra-31.19(F9)-104
Concrete Contractor:

Supplier Information

Concrete Supplier: Lehigh
Mix ID No.: 0.44
Ticket No.:
Truck No.:
Batch Time: 10:30

Plastic Concrete Information

Air Temp: Slump:
Conc. Temp: Air Content %:
Total cubic yards placed: 54.00
Unit Weight: Yield:

Hardened Concrete Data

Test Cylinders Cast By: Client
Specified Strength @ 28 days: 5500
Sample Size: 2x2 Cubes
Date Received: 4/15/03

COMPRESSIVE STRENGTH INFORMATION

Cylinder Number	Date Tested	Age at time of test (Days)	Load (lbs.)	Compressive Strength (psi)
31004	4/15/03	7	20,240	5060
31005	4/15/03	7	21,440	5360
31006	5/6/03	28	38,360	9590
31007	5/6/03	28	38,930	9730
31008	sp	sp		
31009	sp	sp		
31010	sp	sp		
31011	sp	sp		
31012	sp	sp		
			28 day Average	9660

Reported By: Jeff Young

SECTION 2 – PILE DESIGN CALCULATIONS

SHORE LINE EAST BRANFORD STATION, DOT of CONNECTICUT
DRILLED MINI-PILE DESIGN

Shoreline East Railroad, Branford Station
Drilled mini-piles

Project No. *(Revision 1)*
Date:2/9/04
Designed by: RH
Checked by: TH

Geotechnical Information

Boring BN-1 **GS el. 12.0**
GW at 8.75 ft

Depth	N	Soil Description
0-4.5	9,3	Fill-Sand & Gravel, gray to black
4.5-13	2,3,2	Bn f-c Sand
13-21.5	2,1	Lg gray to gray Organic Clay
21.5-22.5		Dk bn fibrous Peat
22.5-24.5		Gray c Sand
24.5-43.5	16,15,11,11	Gray to red-bn to bn Clayey Silt to Silty Clay
43.5-52	44,42	Bn c Sand tr to sm Gravel, Cobble

Boring BN-2 **GS el. 11.75** **(Use for 45-kip pile design)**
GW at 8.5 ft

Depth	N	Soil Description
0-1.5	12	Fill-dk bn & black c Sand
1.5-9.8	13,12,10	Bn Clayey Sand
9.8-14	2,3	Bn Sand
14-22	3	Gray Organic Clay
22-23		Dk bn Peat
23-26	10	Gray Clayey Sand
26-27		Dk bn Organic Silt to Peat
27-42	11,7,9	Bn Clayey Silt to Silty Clay
42-47	30	C Sand, little to sm pebble

Boring BN-3 **GS el. 10**
GW at 7.25 ft

Depth	N	Soil Description
0-5	29,12	Fill-red-bn to black & bn f Sand
5-13	8,5,2	Bn f-c Sand, sm Silt
13-18	2,2	Dk gray to gray Organic Silty Clay
18-19		Dk bn fibrous Peat
19-25.8	17,18	Bn c Sand sm pebble Gravel
25.8-31	18	Bn Silt w/Sand laminate
31-36.8	25	Bn Clayey Silt to Silty Clay
36.8-52	34,58,68	Bn Sand & Gravel w/ Clayey matrix tr. Cobble

STATE OF CONNECTICUT
KIT-YEE HON
No. 18440
LICENSED
PROFESSIONAL ENGINEER
2/12/04

SHORE LINE EAST BRANFORD STATION, DOT of CONNECTICUT

DRILLED MINI-PILE DESIGN

Shoreline East Railroad, Branford Station
Drilled mini-piles

Project No.
Date: 2/9/04
Designed by: RH
Checked by: TH

Boring BN-4 **GS el. 11** **(Use for 93-kip pile design)**
GW at 8 ft

Depth	N	Soil Description
0-1	11	Fill-Bn c Sand
1-4.8	10	Bn c Sand tr. Pebble
4.8-7.3	3	Silty Clay
7.3-13.3	7,4	Bn c Sand
13.3-22	5,1	Gray Organic Clay
22-23		Dk bn Organic Silt to Peat
23-25.4		Bn to gray c Sand
25.4-25.8		Dk bn Peat
25.8-28.7	17	Gray c Sand
28.7-43.5	21,20,7	Bn Clayey Silt to Silty Clay
43.5-65	40,47	Bn c Sand lt to sm pebble and cobble
65-65.4	100/5"	Gray to white Granite Gneiss

Pile Design (use Service Load Design):

Pile Data: Pile diameter to be 8 inches
Pile design capacity: P1=45 kips
P2=93 kips
Bearing strata at med stiff to stiff Clay and dense Sand layers
Reinforcing steel to be 5.5" OD, 0.361" wall thickness N-80 steel pipe.

Structural Design:

For P2 with design load (DL)= 93 kips
For N-80 steel; Fy= 80 ksi.
Max. allowable comp. stress of steel=0.47 Fy (FWHA Micropile Design Manual)
= 37.6 ksi.
Assume min load to be carried by steel is 40% of DL
= 93x0.4
= 37.2 kips
Min area of steel required; As= 37.2/37.6
= 0.99 sq. in.

X-section area of steel=(5.5-0.361)x3.14x0.361
= 5.83 sq. in.
One 5.5" OD, 0.361" wall thickness casing provides As=5.83 sq. in>0.99 sq. in. (OK)

For 8" diameter pile
Pile gross area =8x8x3.14/4= 50.2 sq. in.
Net grout area, An=67-5.8= 44.4 sq. in.

Shoreline East Railroad, Branford Station
Drilled mini-piles

Project No.
Date: 2/9/04
Designed by: RH
Checked by: TH

Min comp. strength of grout; f'c= 4,000 psi.
Allowable grout strength=4,000x0.4 (FWHA Micropile Design Manual)
= 1600 psi
= 1.6 ksi
Comp. Capacity of grout=1.6x44.4
= 71 kips
Comp. Capacity of steel=5.83x37.6
= 219 kips
Total compressive structural capacity of pile=71+219
= 290 kips>93 kips (OK)

Use the same structural element for 45-kip pile 290kips >45 kips (OK)

To address the corrosion protection for the steel casing, in fact this pile has a grout cover of 1.25" around the steel casing.
Assume groutcover protection being ineffective, we are analysing the pile with an reduction of 1/16" of steel casing thickness.

The net Outside diameter of the steel casing=5.5"-1/8"=	5.375 in
The wall thickness is reduced to 0.361-0.0625=	0.2985 in
The net X-section area=(5.375-0.2985)x3.14x0.2985=	4.76 sq. in.
The allowable comp. Stress of steel=	37.6 ksi.
the X-section of grout area inside the casing=	17.9 sq. in.
The allowable comp. Stress of grout=	1.6 ksi.
The total pile capacity=37.6x4.76+1.6x17.9=	208 kips

The resulted structural pile capacity of 208 kips >93 (DL)kips (OK)

Geotechnical Design:

Use BN-2 and Bn-4 for geotechnical design
BN-2 and BN-4 are located in the 45 kips piles and 93 kips piles group areas respectively
At BN-2, bearing stratum starts at 27 ft from GS
Assume the friction capacity of Clayey Silt and Silty Clay to be 5 psi and that of dense Sand to be 18 psi.
(The skin friction values we adopted were based partly on our experience in pile design and partly from the literatures of "Lateral Support System & Underpinning Vol. 1;Design & Construction Report" #FHWA-RD-75-128 by Goldberg & et. And "Ground Anchors & Anchored Structure" by Petros P. Xanthakos. See attached pages)
a) To determine the allowable skin friction in Clayey Silt and Silty Clay which is classified as stiff to very stiff.
Entering the top chart in Fig 4-24, page 173 of "Ground Anchors & Anchored Structure"(attached) with 5m bond length at stiff without postgrouting,
we have ultimate skin friction of 140 kN/m^2=20.3 psi.
Applying FS=2.5
The max allowable skin friction in Clay=20.3/2.5=8 psi.
We use 5 psi for design.

Shoreline East Railroad, Branford Station
Drilled mini-piles

Project No.
Date: 2/9/04
Designed by: RH
Checked by: TH

b) To determine the allowable skin friction in Sand & Sand/Gravel stratum which is classified as dense to very dense.

Entering the chart in Fig 4-24, page 204 of "Lateral Support System & Underpinning, Vol 1 Design & Construction Report #FHWA-RD-75-128" by D. Goldberg & et.(attached) with 15 ft bond length, we have an ultimate load=160 kips

Assume 6" diameter and 15 ft bond length
The ultimate stress=160x1000/(6x3.14x15x12)=47 psi.
Applying FS=2.5

The max allowable skin friction=47/2.5=18.8 psi

We use 18 psi for design.

This design parameters will be checked by the verification testing program.
The piles are designed as a friction pile with end bearing capacity neglected

Capacity in Silt & Clay/ft=5x8x3.14x12/1000
= 1.5 kips/ft

Capacity in Sand per ft.=18x8x3.14x12/1000
= 5.4 kips/ft

At BN-2 with pile capacity=45 kips
Thickness of Silt & Clay layer=42-27=15 ft.
Comp. Capacity in Silt & Clay layer=1.5x15 kips
= 22.6 kips
The remaining load=45-22.6= 22.4 kips

Min depth required in Sand=22.4/5.4 ft
= 4.15 ft
Use 6 ft
Min pile length from existing GS=42+6=48 ft. from Ground Surface

At BN-4 with pile capacity=93 kips
Thickness of Silt & Clay layer=43.5-29=14.5 ft.
Comp capacity in Silt & Clay layer=1.5x14.5
= 21.75 kips
The remaining load=93-21.75= 71.25 kips

Min depth required in Sand=71.25/5.4
= 13.19 ft
Use 15 ft
Min pile length from existing GS=43.5+15=59 ft. from ground surface
Use 60 ft pile

Pile capacity during seismic:

According to the BOCA National Building Code, 1993, P171
The effective peak acceleration coefficient (Aa) in the area=0.1
Seismic site design coefficient=0.1g

Shoreline East Railroad, Branford Station
Drilled mini-piles

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Base on the design example on FHWA-SA-97-070 P5-93
For LFD design, at seismic calculation use coeff g=1.00
Assume the load factor of LFD=1.5
It converts to a FS (SLD)=1.5/1.0=1.5
The allowable skin friction in Clay=5x2.5/1.5=8.3 psi.
The allowable skin friction in Sand=18x2.5/1.5=30 psi.

For siemic loading
(Bond length includes 15 ft in Clay and 16 ft in Sand)
Pile design strength= 8x3.14x(8.3x15x12+30x15x12)/1000
= 173 kips

Reinforcement connected into pile cap

The 5.5" OD steel casing to be 6" into the pile cap
the bearing area of the pile in the pile cap will be:
= 5.5^2x3.14/4
= 23.7 sq. in.

At the design load of 93 kips, the bearing stress will be
= 93/23.7
= 3.9 ksi.
Assume f'c of concrete in pile cap = 4,000 psi.
The max. allowable compressive stress inside concrete=1.25x4 ksi
= 5 ksi. >3.9 ksi. (OK)

Check punching shear

Assume the pile cap thickness to be 24 inches with 2 layers of reinforcements
The top reinforcement bars to be 3" below the top of pile cap and the bottom layer of reinforcement bars to be 6" above the bottom of pile cap.
The punching shear cone have a vertical distance of 24-6-3=15" between 2 layers of steel.

Assume a 45-degree shear cone
To determine the shear cone surface area
The shear cone area will be a fan shape when the cone is open up

The radius of small circle=(5.5/2)x(2)^0.5
= 3.9 in
The arc length of small circle in the fan area=5.5x3.14= 17.3 in
The circumference of the small circle=3.9x2x3.14= 24.4 in
The center angle of the fan area=360x(17.27/24.42)= 254.6 degrees
The radius of large circle=(15)x(2)^0.5+3.9
= 25 in
The fan sector area in the large circle:
= (25.1x2)^2x(3.14/4)x(254.56/360)
= 1398.8 sq. in.
The fan sector area in the small circle:
= (3.9x2)^2x(3.14/4)x(254.56/360)
= 33.8 sq. in.
The net shear surface area=1398.8-33.8= 1365 sq. in.

Shoreline East Railroad, Branford Station
Drilled mini-piles

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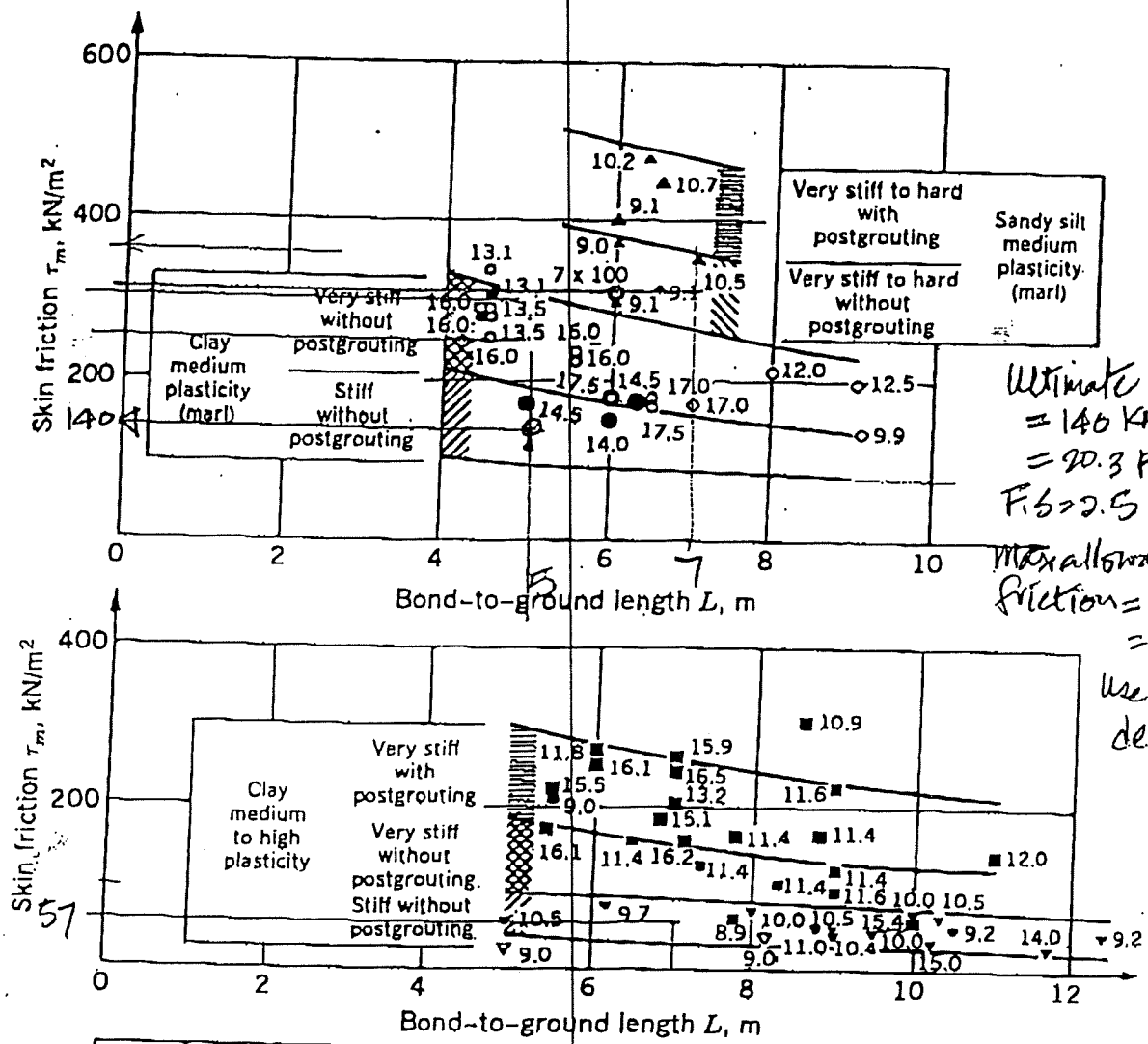
Assume the f'c of concrete in pile cap=4,000 psi.
Assume allowable shear stress in concrete=2(f'c)^0.5= 126 psi.
The max. allowable punching shear force=126x1365/1000
= 173 kips>93 kips (OK)
No additional bearing plate is required.
Provides one #5 grade 60 bar standard hook bar embedded 5 ft into pile.

Summary:

1) *Pile to be 8-in in diameter.*
2) *Reinforcement to be 5.5" OD, 0.361" wall thickness N-80 steel casing, full length.*
3) *Min grout compressive strength to be 4,000 psi at 28 days.*
4) *Provide one #5 standard hook bar grade 60 into concrete pile cap.*
5) *Pile length for 45-kips pile to be 48 ft from existing ground surface*
6) *Pile length for 93-kips pile to be 60 ft from existing ground surface*
7) *Total of 110 piles; which includes 47, 45-kip and 63, 93-kip piles.*
8) *This pile design will be checked by the results of the verification test.*

GROUND ANCHORS & ANCHORED STRUCTURES by Petros P. Xanthakos

1 KN/m² = 0.145 psi



Ultimate skin friction = 140 KN/m² = 20.3 psi

F.S. = 2.5

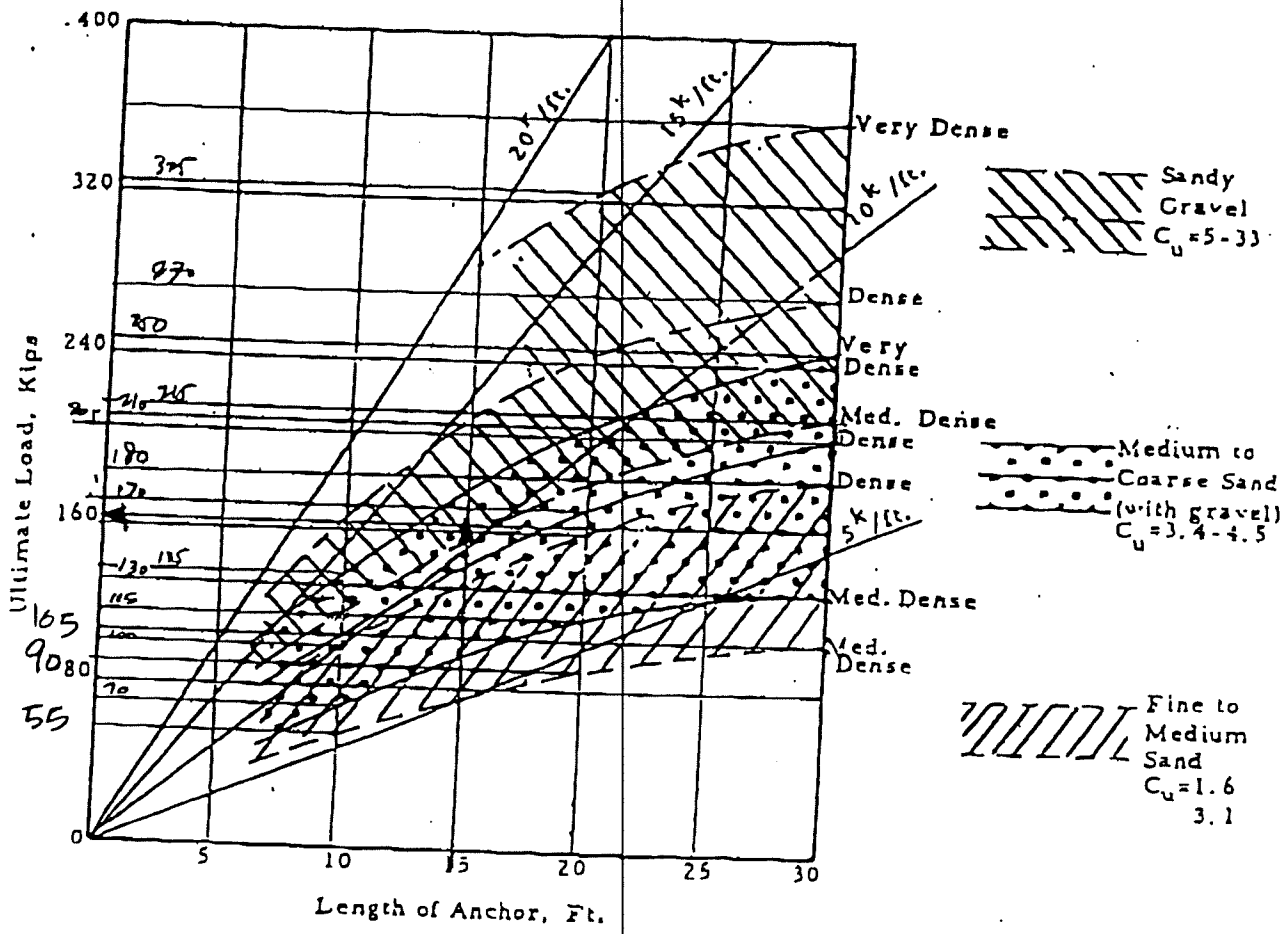
Max allowable skin friction = 20.3/2.5 = 8 psi

Use 5 psi for design

Failure load was reached	Failure load was not reached	Post-grouting	Type of soil	W_L%	I_P%	I_C%
▲	△	Without	Silt, very sandy (marl) medium plasticity	~ 45	~ 22	~ 1.25
▲	△	With				
●	○	Without	Clay (marl) medium plasticity	32–45	14–25	1.03–1.14
●	○	With				
●	○	Without		36–45	14–17	1.3–1.5
●	○	With				
	○	Without	Silt medium plasticity	23–28	5–11	0.7–0.85
■		Without	Clay medium to high plasticity	48–58	23–35	1.1–1.2
■		With				
▼	▽	Without		45–59	16–32	0.8–1.0

Fig. 4-24 Bond resistance in cohesive soil for various fixed anchor lengths with or without postgrouting. (From Ostermayer, 1974.)

Lateral Support System & Underpinning Vol. 1
Design & Construction Report # FHWA-RD-75-128
by D. Goldberg & et.



NOTE: 1 ft. = .305 m
1 in. = 2.54 cm
1 k/ft = 14.6 kN/m

Diameter of Anchor 4"-6"
Depth of Overburden ≥ 13 feet

Figure 95. Load capacity of anchors in cohesionless soil showing effects of relative density, gradation, uniformity, and anchor length (after Ostermayer, 1974).

In Dense to V. dense Sand/Sm pebble & cobble
Assume 15 ft bond Length
At Ultimate Load: 160k ϕ=6"

Ultimate stress = $\frac{160 \times 1000}{6 \times \pi \times 15 \times 12}$ = 47.1 psi

F.S = 2.5 max allowable skin friction = 18.9 psi.
We use 15 psi. for design

SHORE LINE EAST BRANFORD STATION
DOT OF CONNECTICUT

Shoreline East Railroad, Branford Station
Pile Load Test
Anchor Pile Design

Project No.
Date:2/10/04
Designed by: RH
Checked by: TH

Pile Design Load (DL)= 93 kips
The max. test load= 2.5xDL= 233 kips

The anchor pile will be subjected to tension load of
= 233x0.5= 116 kips
Increase by 10% to take care of eccentricity
= 116x1.1= 128 kips

The tension load will be taken by steel bar of grade 150
Fy= 150 ksi
Max. allowable tensile stress=150x0.8
= 120 ksi
Min. X-section area of steel bar=128/120
= 1.07 sq. in.
1-1/4 inch diameter threaded bar provides As=1.25 sq. in.>1.07 sq. in. (OK)
Use one 1-1/4 inch diameter threaded bar for reinforcement

Assume the allowable bond stress between bar and grout; fc
fc= 200 psi
Skin area of bar per ft=1.25x3.14x12
= 47.1 sq. in.
The min. required bond length=128x1000/(47x200)
= 14 ft
Check the bond stress in Clay
The bond capacity of pile in Silt/Clay=1.5 kips/ft
The bond capacity of pile in dense Sand=5.4 kips/ft
Assume the thickness of Silt/Clay stratum being 15 ft.

Load carried by Silt/Clay layer=15x1.5
= 22.5 kips
Load carried by dense Sand layer=(128-22.5)/4.5
= 23 ft
Total length of anchor pile=43.5+23
= 67 ft

Summary:

1) *Anchor pile to be a min. of 8-inch in diameter.*
2) *One 1-1/4 inch diameter, grade 150 threaded bar reinforcement, full length.*
3) *Install one telltale at 1 ft below the top of Clay bearing stratum.*
4) *The center of anchor pile to be 8 ft away from the center of tested pile*
5) *A 175-ton hydraulic jack to be used in the test.*
6) *Pile load test set up as shown in the Figure "Drilled Micropile Load Test Set-Up".*
7) *Prefer to use tension test for proof test with tension thread bar of 1-3/8 inch, grade 150.*

SECTION 3 – PILE DRAWING

LARGE 24"X36" WORKING DRAWINGS ARE INLUDED AT THE END OF THIS SUBMITTAL

Layne
GeoConstruction

SECTION 4 – PILE TESTING PROCEDURE

OVERVIEW

Layne GeoConstruction will install one test pile at a suitable location on the project site. This location will be chosen in conjunction with Banton Construction and the on-site engineer. The test pile will be tested in compression in an attempt to confirm pile capacities and assumptions. Calibration records for the hydraulic ram and load cell will be submitted separately prior to testing operations.

4. VERIFICATION TEST PROGRAM

4.1 One test pile will be installed in the area designated by the engineer. A 9 5/8" casing will be installed through the upper fill/organic soil layers to the bottom of the lower peat layer. This casing will be installed via water flush to the required elevation in order to establish an unbonded zone for the verification test pile. The annulus between the casing and the insitu soil will be ungrouted. The 5 ½" pile casing will be installed through the 9 5/8" casing using methods outlined in the pile installation procedure. The bottom of the peat layer will be determined from boring information and reaction anchor drilling data. Pile testing will not be conducted until the grout has reached its' required strength.

4.2 Compression Test

4.2.1 The installation of the test pile will be as outlined in the project submittals and as modified above.

4.2.2 Two reaction piles will be used as reaction anchors and installed at a distance of 8' on either side of the pile to be tested. These piles will be installed using the same procedures as outlined for the test pile with an internal bar installed within the casing to act as a tension element. The reaction piles will be installed first and the test pile last. The compression test load frame setup is detailed in figure 3.

4.2.3 Prepare test frame and associated temporary hardware for compression testing.

4.2.4 Place preload in tension equal to 1.4 x pile design load on each adjacent reaction pile.

4.2.5 The top of the test pile will be cut and ground flat. A steel plate will be centered on top the test pile and tack welded to the pile casing. The hydraulic ram and load cell will be positioned on the plate. Hydraulic ram for testing will be a 150 ton capacity center hole ram. A load cell will be used to monitor the creep test load. Calibration data for the hydraulic ram and load cell will be provided prior to the test.

4.2.6 Set up 4 dial indicators readable to 0.001" on lower bearing plate. The dial indicators will be positioned @ 90° from one another.

4.2.7 Conduct compression test as outlined in ASTM D1143, with modified loading schedule shown below. Record data on the logs attached with this submittal.

Compression Test
AL=Alignment Load; DL=Design Load= 93 kips

Sequence	Load (kip)	Hold time (min)	Remarks
1	AL=5	1	
2	23	1	
3	47	1	
4	5	1	
5	23	1	
6	47	1	
7	70	1	
8	5	1	
9	23	1	
10	47	1	
11	70	1	
12	93	1	
13	5	1	
14	23	1	
15	47	1	
16	70	1	
17	93	1	
18	124	60	creep test
19	163	1	
20	186	1	
21	209	1	
22	233	10	
23	5	1	

For creep test, pile movement at top shall be recorded
at 1,2,3,4,5,6,10,20,30,50, and 60 minutes.

5. PROOF TEST PROGRAM

5.1 Four proof tests will be conducted on four piles in the production area. Two tests will be conducted on Type I piles and two on Type II piles. Tests on the Type II piles will be conducted to a load of 1.67 x DL of the pile in compression to confirm compression load capacity of the production piles. The piles to be tested are shown on Figure 1, Micropile Layout Plan included in Section 7 of this submittal. Layne requests proof tests on Type 1 piles be conducted to a load of 1.67 x DL of the pile in **Tension**. Layne requests this change due to the fact that the Type I piles alternate between battered and vertical. The reaction anchors for the compression test must be vertical piles. A tension test requires no reaction anchors. The tension test will verify the installation procedures and the assumed bond values in exactly the same fashion as the compression test. Please note

the proof test locations are different than the project drawings. Compression proof testing of Type II micropiles will be conducted per the same testing procedures noted above in the verification micropile section. Tension proof testing of Type I micropiles will be conducted per the procedure outlined below.

5.2 Tensile Test

5.2.1 The installation of the test pile will be as outlined in the project submittals.

5.2.2 Prepare test frame and associated temporary hardware for tension testing.

5.2.3 Place support system for test frame consisting of timber cribbing.

5.2.4 Lay test frame across timber cribbing and center over pile. Test frame will consist of 2 each W36 x 150, A36 steel beams 24 ft in length. The tension test load frame setup is detailed in figure 2.

5.2.5 A 1 3/8", grade 150 threadbar will be installed in the pile to pull on.

5.2.6 Align hydraulic center hole jack over pile tension bar on top of test frame. Hydraulic jack for testing will be a 150 ton capacity Dudgeon center hole ram. A load cell will be used to monitor the creep test load. Load cell and Jack calibration are included in this submittal.

5.2.7 Place temporary plate and hardware on top of ram to tension bar.

5.2.8 Set up dial gauges readable to 0.001" on lower bearing plate. The dial indicators will be positioned @ 90° from one another.

5.2.9 Perform tension testing in accordance with ASTM D3689, with modified loading schedule shown below. Record data on the appropriate logs.

Tension test
AL=Alignment Load; DL=Design Load= 93 kips

Sequence	Load (kip)	Hold time (min)	Remarks
1	5	1	
2	23	1	
3	47	1	
4	70	1	
5	93	1	
6	124	10	creep test
7	155	1	
8	5	1	

Tension test
AL=Alignment Load; DL=Design Load= 45 kips

Sequence	Load (kip)	Hold time (min)	Remarks
1	2	1	
2	11	1	
3	22	1	
4	33	1	
5	45	1	
6	60	10	creep test
7	75	1	
8	2	1	

Layne GeoConstruction

PILE LOAD TEST DATA

3/30/2004

Pile No.		1			Pile Type:		Drilled Micropile			Test No.		1						
Pile size:		8	inches		Strain Gage Factor:					Date:					Design Load = 93 kips			
Pile Butt Elev.					Load Cell Factor,K:		lb/digit			Page:		1						
Date	Time	Time el.	Pres.	Gage	Load	Cell	Dial	Gage 1	Dial	Gage 2	Dial	Gage 3	Dial	Gage 4	Average	Piano	Left (in)	Right(in)	Comments
		(min)	Reading	kips	Reading	kips	Reading	Deflect'n	Reading	Deflect'n	Reading	Deflect'n	Reading	Deflect'n	Deflect'n	wire	Support	Support	
		0		5															
		1		23															
		1		47															
		1		5															
		1		23															
		1		47															
		1		70															
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		1		70															
		1		93															
		1		**124**															creep test
		2		124															
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		30		124															
		50		124															
		60		124															
		1		163															
		1		186															
		1		209															
		1		**233**															
		2		233															
		3		233															
		4		233															
		5		233															
		10		233															
		1		5															

BRANDFORD STATION-PROOF LOAD TEST DATA

3/30/2004

Pile No.				Pile Type:	Drilled micropile				Test No.					Design Load = 45 kips				
Pile size:	8	inches		Strain Gage Factor:					Date:									
Pile Butt Elev.				Load Cell Factor,K:		lb/digit			Page:		1							
Date	Time	Time el.	Pres.	Gage	Load	Cell	Dial	Gage 1	Dial	Gage 2	Dial	Gage 3	Dial	Gage 4	Average	Piano	Left (in)	Right(in)	Comments
		(min)	Reading	kips	Reading	kips	Reading	Deflect'n	Reading	Deflect'n	Reading	Deflect'n	Reading	Deflect'n	Deflect'n	wire	Support	Support	
		1		2															
		1		11															
		1		22															
		1		33															
		1		45															
		1		60															creep test
		2		60															
		3		60															
		4		60															
		5		60															
		6		60															
		10		60															
		1		75															
		1		2															

BRANDFORD STATION-PROOF LOAD TEST DATA

3/30/2004

Pile No.					Pile Type:		Drilled micropile			Test No.					Design Load = 93 kips				
Pile size:		8	inches		Strain Gage Factor:					Date:									
Pile Butt Elev.					Load Cell Factor,K:			lb/digit		Page:		1							
Date	Time	Time el.	Pres.	Gage	Load	Cell	Dial	Gage 1	Dial	Gage 2	Dial	Gage 3	Dial	Gage 4	Average	Piano	Left (in)	Right(in)	Comments
		(min)	Reading	kips	Reading	kips	Reading	Deflect'n	Reading	Deflect'n	Reading	Deflect'n	Reading	Deflect'n	Deflect'n	wire	Support	Support	
		1		5															
		1		23															
		1		47															
		1		70															
		1		93															
		1		124															creep test
		2		124															
		3		124															
		4		124															
		5		124															
		6		124															
		10		124															
		1		155															
		1		5															

SINCE F&R 1881

Attachment 1

HYDRAULIC RAM SYSTEM CORRELATION

Project No.: F60-0012T
Control No.: 60-04-88784-2
Ram ID: S9382
Gauge ID.: Wika 1506654
Correlation Standards: Forney Hydraulic Universal Testing Machine
Calibrated 5-10-03 with equipment traceable to NIST

Load, Lbs	Reading 1	Reading 2	Reading 3	Average Gauge Reading
0	0	0	0	0
30,000	950	950	900	933
60,000	1,900	1,900	1,900	1,900
90,000	2,850	2,850	2,850	2,850
120,000	3,850	3,850	3,850	3,850
150,000	4,800	4,800	4,800	4,800
180,000	5,750	5,750	5,750	5,750
210,000	6,700	6,750	6,750	6,733
240,000	7,750	7,750	7,750	7,750
270,000	8,700	8,700	8,700	8,700

Attachment 1

HYDRAULIC RAM SYSTEM CORRELATION

Project No.: F60-0012T
Control No.: 60-04-88784
Ram ID.: #S9382
Load Cell ID.: #1898
Correlation Standards: Forney Hydraulic Universal Testing Machine
Calibrated 5-10-03 with equipment traceable to NIST

Load, Lbs	Reading 1	Reading 2	Reading 3	Average Gauge Reading
0	360	351	364	358
30,000	2,260	2,266	2,262	2,263
60,000	4,120	4,142	4,140	4,134
90,000	5,950	5,960	6,000	5,970
120,000	7,820	7,830	7,840	7,830
150,000	9,700	9,705	9,690	9,698
180,000	11,490	11,550	11,510	11,517
210,000	13,320	13,340	13,366	13,342
240,000	15,250	15,210	15,240	15,233
270,000	17,110	17,060	17,100	17,090

SECTION 5 – PILE TEST DRAWINGS

LARGE 24"X36" WORKING DRAWINGS ARE INLUDED AT THE END OF THIS SUBMITTAL

Layne
GeoConstruction

SECTION 6 – VERIFICATION TEST RESULTS

Layne GeoConstruction *a Division of Layne Christensen Company*

22537 Coleman's Mill Road • Ruther Glen, Virginia 22546 • (804) 448-8060 • Fax: (804) 448-1771

April 15, 2004

Banton Construction Company, Inc.
339 Washington Ave
North Haven, CT 06473

Attention: Mr. Steve Ryan

Reference: Shoreline East Railroad Upgrade
Drilled Micropiles – Micropile Test Data

Dear Mr. Ryan:

Layne GeoConstruction is pleased to present the calibration reports and load test data for the verification pile test conducted on April 13, 2004 at the Branford Station project site. Layne's micropile design engineer, Rupert K. Hon has reviewed the data and finds it meets the acceptance criteria contained in the project specifications.

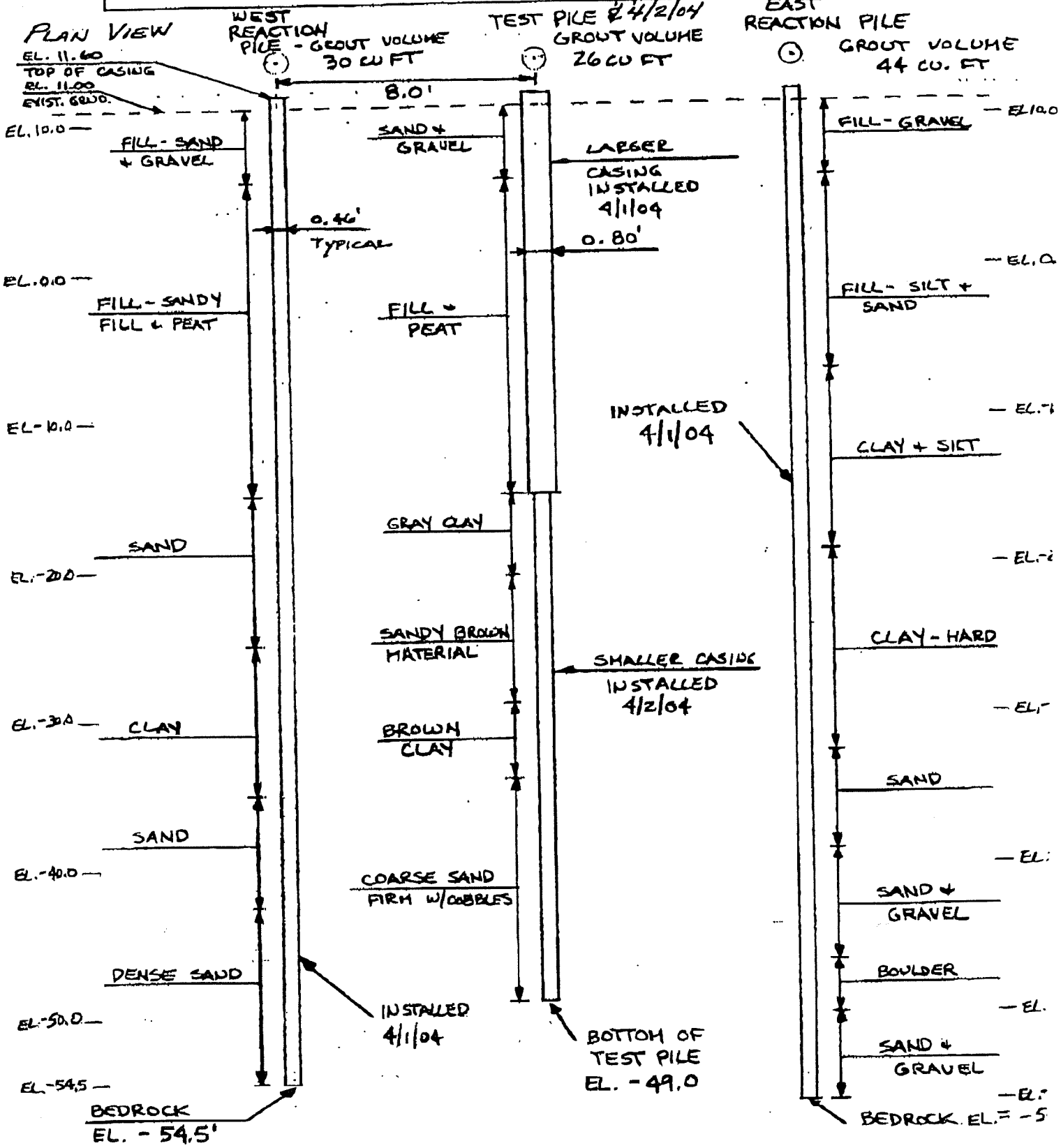
Should you have any questions or require further information please contact me at 804-448-8060.

Sincerely,
Layne GeoConstruction

Timothy J. Myers
Project Manager

Test Pile Data:				
The Test Pile was installed on 4/2/04				
The Test Pile was located approximately 40 ft from the tracks and at South east of Boring BN-4				
Pile Data:				
	Pile diameter=8 inches			
	Exterior 9 5/8"OD, 0.545" wall N-80 steel casing was installed to a depth of 26 ft.			
	The reinforcing steel is 5.5"OD, 0.361" wall thickness N-80 steel casing			
	The pile is 60 ft long			
	The bearing strata are Brown Clay and Sand layers.			
	The grout take was 26 cu. Ft.			
	The theoretical pile vol=21 cu ft			
	Grout vol factor=26/21=1.23			
	Sp. Gr=1.63			
	The required grout strength=4,000 psi.			
	Grout cube breaks by DOT were 8150 and 7950 psi			
	Ave. grout strength=	(8150+7950)/2		
	=	8050	psi	
Anchors were locked off at 130 kips				
Anchor piles were 65 and 66 ft seating on bedrock				
One 1 1/4" diameter grade 150 threaded bar full length				
	Elastic shortening:			
	Max test load=	233	kips	
	Top portion of pile:			
	Pile length=	26	ft	
	9 5/8" OD, t=0.545" As=		15.5386	in^2
	5.5" OD, t=.361"; As=		5.8	in^2
	Grout area; Ag=		51.38429	in^2
	Modulus of elasticity; Es=		29,000	ksi
	Modulus of elasticity; Eg=		5114.142	ksi
	Combined Ec=(Es*As+Eg*Ag)/(As+Ag)			
		=	12122.81	ksi
	deflection 1=PL/AE=		0.082459	in
	Lower portion of pile			
	Pile length=	34	ft	
	5.5" OD, t=.361"; As=		5.8	in^2
	Grout area; Ag=		51.38429	in^2
	Combined EcAc=		430986.5	
	deflection 2=PL/AE=		0.220573	in
	Total theoretical elastic shortening=		0.303032	in
	(This is assumed that total test load was transferred down to the tip of pile)			
	Total load test deflection=		0.384	in
	Net deflection=0.384-0.303=		0.080968	in

CLIENT CDOT – CONSTRUCTION	STV INCORPORATED			
PROJECT BRANFORD RR STATION	MADE	CHK.	REV.	JOB NO. 310-019
SUBJECT TEST PILE DATA	S. BOMBERO	AMT		SHT. NO.
	4/1/04	4/2/04		



Layne GeoConstruction Company

A Division of Layne Christensen Co

Drill Log

Hole #: Test Pile

Project #: 40-0081

Project Name: Shoreline East RR Branford Ct.

Date: 4/2/04

Driller: Travis McKinley

Station #: Test

DESCRIPTION	DRILLING			REDRILL			REMARKS
	FROM	TO	TOTAL	FROM	TO	TOTAL	
Sand & Gravel	0	5'	5'				
Sand Fill & Peat	5'	26'	21				
Gray Clay	26'	31½	5½				
Brown Sand & Clay	31½	40	8½				
Brown Clay	40	45	5'				
Sand & Cobbles	45	60	15'				
		Bottom of Hole 60'					
		Notes - 26' of 9 5/8" Casing (Bond Breaker)					
		- 60' of 5½" Casing					
		- 26 Cu Ft Grout in the Hole					

COMMENTS:

Layne GeoConstruction Company

A Division of Layne Christensen Co

Drill Log

Hole #: #1 Reaction Pile

Project #: 40-0081

Project Name: Shoreline East RR
Branford, Ct

Date: 4/1/04

Driller: Travis McKinley

Station #: Test

DESCRIPTION	DRILLING			REDRILL			REMARKS
	FROM	TO	TOTAL	FROM	TO	TOTAL	
Fill (Sand & Gravel)	0	5'	5'				
Fill & Peat	5'	26	21'				
Sand (Silt)	26'	36	10'				
Clay (Brown)	36'	46'	10'				
Sand (Reddish Brown)	46'	53½	7½				
Sand & Cobbles	53½	65½	12'				

Bottom of Hole 65½'

Notes
- 65½' of 5½" Casing
- Pumped 30 cu Ft Grout in Hole
- Installed 1 3/8" Bar full Depth of the Hole

COMMENTS:

Layne GeoConstruction Company

A Division of Layne Christensen Co

Drill Log

Hole #: #2 Reaction Pile

Project #: 40-0081

Project Name: Shoreline East RR Branford Ct.

Date: 4/1/04

Driller: Travis McKinley

Station #: Test

DESCRIPTION	DRILLING			REDRILL			REMARKS
(Fill)	FROM	TO	TOTAL	FROM	TO	TOTAL	
Sand & Gravel	0	5'	5'				
Fill - Silty Sand	5'	18'	13'				
Clay & Silt	18'	30	12'				
Clay (Stiff)	30'	43 1/2	13 1/2				
Sand (Brown)	43.5	50	6 1/2				
Sand & Gravel	50	57 1/2	7 1/2				
Boulder	57 1/2	61	3 1/2				
Sand & Cobbles	61	67	6'				
		Bottom of Hole 67'					

Notes -
- 67' of 5 1/2" Casing
- 44 Cu Ft Grout in Hole
- Stopped returning water from Hole After 31 cu Ft Grout was Pumped
- Installed 1 3/8" Bar full Depth of the Hole

COMMENTS:

GROUTING REPORT

Project: Shoreline East RR Hole No. Test Hole Size 8"

Top Elev., Collar: _____ Rock: _____ Station: _____ Area: _____

Date, Start: 4/1/04 Complete: 4/2/04 Total, Bags: _____ Connections: _____

Contractor: Layne Geo Const Driller: Travis McKinley Sheet 1 of 1

Date	Zone	Stage	Depth	Pressure	W/C	Time	Bags Period	Bags Per Hr.	Bags Total	Connections	Remarks	Inspection
4/1		1	65½		.45		cu.	Ft.	30		Reaction #1	
4/1		1	67		.45		cu.	Ft.	44		Reaction #2 ← (No Return from Hole after Pumping 31 cu Ft.)	
4/2		1	60		.45		cu.	Ft.	26		Test Pile	

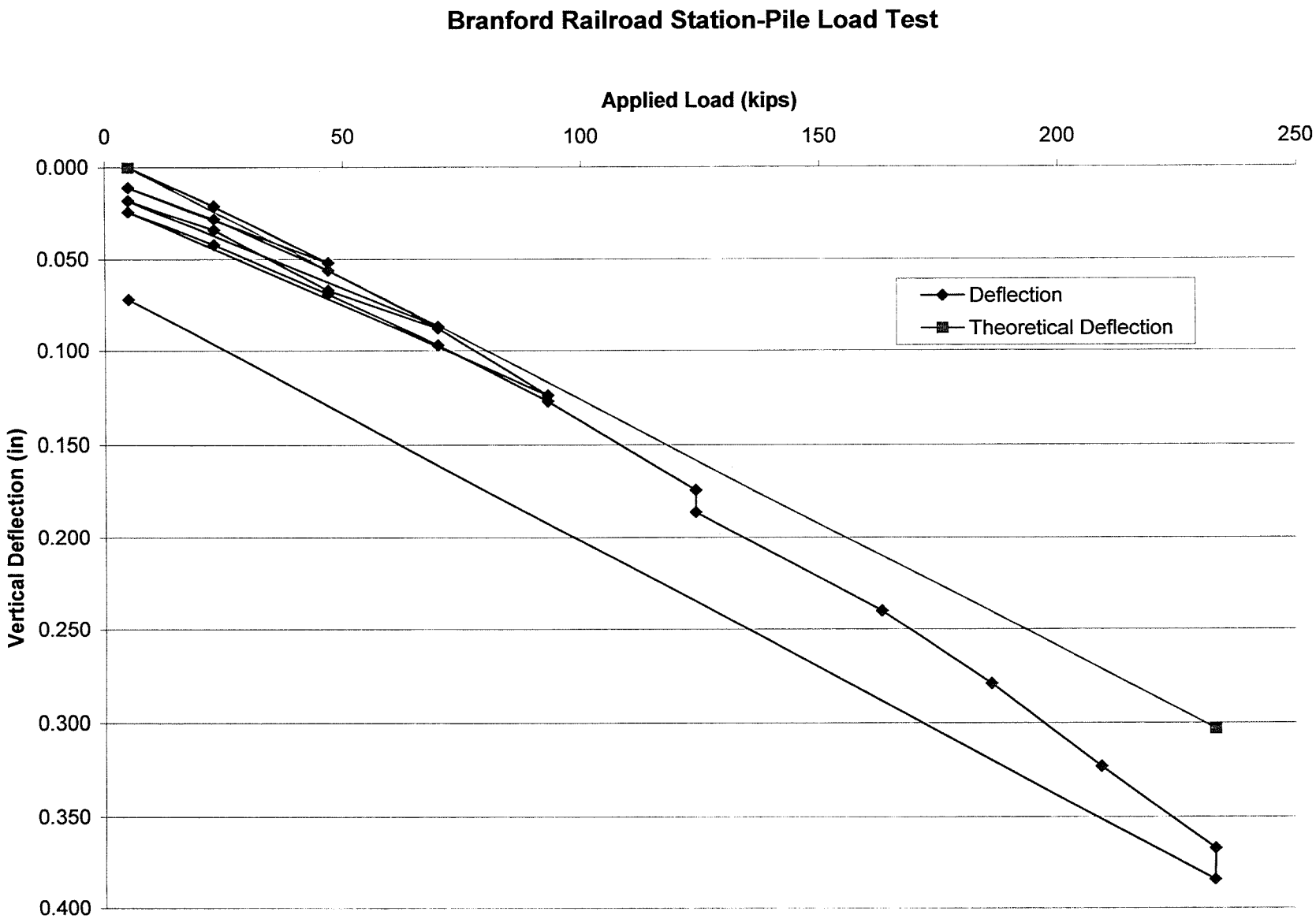
BRANFORD RAILRAOD STATION
PILE LOAD TEST DATA

6/4/2004

Test Pile No.		1			Pile Type:		Drilled mini-pile			Test No.			1			**Max. test load:**		**233**	**kips**
Pile diameter:		8	inches		Pressure Gage #2:1506654					Date:			4/13/04			Reinforcement:			
Pile Butt Elev: Ground surface					Load Cell Factor,K:			lb/digit		Page:			1			9 5/8"OD, exterior steel casing			
Compression test																5.5"OD,0.361"wall,N-80 interior casing			
Date	Time	Time el.	Pres.	Gage	Load	Cell	Dial	Gage 1	Dial	Gage 2	Dial	Gage 3	Dial	Gage 4	Average		Piano	Comments	
		(min)	Reading	kips	Reading	kips	Reading	Deflect'n	Reading	Deflect'n	Reading	Deflect'n	Reading	Deflect'n	Deflect'n		wire		
13-Apr	11:07	0	150	5	548		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.000		2.20	raining	
		1	750	23	1600		0.0230	0.0230	0.0180	0.0180	0.0200	0.0200	0.0210	0.0210	0.021				
		1	1500	47	2910		0.0600	0.0600	0.0400	0.0400	0.0520	0.0520	0.0540	0.0540	0.052				
		1	150	5	700		0.0100	0.0100	0.0090	0.0090	0.0120	0.0120	0.0120	0.0120	0.011		2.20		
		1	750	23	1670		0.0320	0.0320	0.0250	0.0250	0.0280	0.0280	0.0280	0.0280	0.028				
		1	1500	47	2970		0.0620	0.0620	0.0520	0.0520	0.0530	0.0530	0.0550	0.0550	0.056		2.21		
		1	2200	70	4249		0.0960	0.0960	0.0810	0.0810	0.0830	0.0830	0.0860	0.0860	0.087				
		1	150	5	666		0.0180	0.0180	0.0170	0.0170	0.0180	0.0180	0.0170	0.0170	0.018		2.22		
		1	750	23	1642		0.0390	0.0390	0.0300	0.0300	0.0345	0.0345	0.0340	0.0340	0.034				
		1	1500	47	3015		0.0900	0.0900	0.0570	0.0570	0.0600	0.0600	0.0620	0.0620	0.067				
		1	2200	70	4250		0.0980	0.0980	0.0820	0.0820	0.0850	0.0850	0.0875	0.0875	0.088				
		1	2950	93	5680		0.1360	0.1360	0.1180	0.1180	0.1200	0.1200	0.1230	0.1230	0.124		2.22		
		1	150	5	750		0.0250	0.0250	0.0240	0.0240	0.0250	0.0250	0.0230	0.0230	0.024				
		1	750	23	1750		0.0480	0.0480	0.0380	0.0380	0.0420	0.0420	0.0415	0.0415	0.042				
		1	1500	47	3000		0.0770	0.0770	0.0640	0.0640	0.0675	0.0675	0.0680	0.0680	0.069				
		1	2200	70	4100		0.1080	0.1080	0.0910	0.0910	0.0940	0.0940	0.0960	0.0960	0.097				
		1	2950	93	5300		0.1400	0.1400	0.1210	0.1210	0.1220	0.1220	0.1250	0.1250	0.127				
	11:37	1	4000	124	5850		0.1880	0.1880	0.1680	0.1680	0.1675	0.1675	0.1730	0.1730	0.174				
		2	4000	124	5304		0.1920	0.1920	0.1700	0.1700	0.1710	0.1710	0.1760	0.1760	0.177		2.23		
		3	4000	124	5304		0.1940	0.1940	0.1730	0.1730	0.1710	0.1710	0.1780	0.1780	0.179				
		4	4000	124	5250		0.1950	0.1950	0.1740	0.1740	0.1740	0.1740	0.1780	0.1780	0.180				
		5	4000	124	5250		0.1950	0.1950	0.1750	0.1750	0.1740	0.1740	0.1780	0.1780	0.181				
	11:43	6	4000	124	5300		0.1960	0.1960	0.1760	0.1760	0.1750	0.1750	0.1790	0.1790	0.182				
	11:47	10	4000	124	5300		0.1970	0.1970	0.1760	0.1760	0.1750	0.1750	0.1795	0.1795	0.182				
	11:57	20	4000	124	5300		0.2000	0.2000	0.1790	0.1790	0.1770	0.1770	0.1820	0.1820	0.185		2.33		
	12:07	30	4000	124	5300		0.2010	0.2010	0.1820	0.1820	0.1780	0.1780	0.1820	0.1820	0.186				
	13:07	50	4000	124	5300		0.2020	0.2020	0.1830	0.1830	0.1780	0.1780	0.1810	0.1810	0.186		2.33		
	13:37	60	4000	124	5300		0.2020	0.2020	0.1840	0.1840	0.1785	0.1785	0.1810	0.1810	0.186				
		1	5200	163			0.2580	0.2580	0.2370	0.2370	0.2300	0.2300	0.2340	0.2340	0.240				
		1	5950	186			0.3000	0.3000	0.2750	0.275	0.2670	0.2670	0.2740	0.2740	0.279				
		1	6700	209			0.3470	0.3470	0.3170	0.3170	0.3090	0.3090	0.3200	0.3200	0.323				
	13:45	1	7500	233			0.3920	0.3920	0.3620	0.3620	0.3500	0.3500	0.3640	0.3640	0.367				
		2	7500	233			0.3970	0.3970	0.3660	0.3660	0.3550	0.3550	0.3690	0.3690	0.372				
		3	7500	233			0.4000	0.4000	0.3740	0.3740	0.3690	0.3690	0.3770	0.3770	0.380		2.37		
		4	7500	233			0.4070	0.4070	0.3750	0.3750	0.3640	0.3640	0.3775	0.3775	0.381				
		5	7500	233			0.4080	0.4080	0.3760	0.3760	0.3645	0.3645	0.3780	0.3780	0.382				
	13:55	10	7500	233	11390		0.4100	0.4100	0.3770	0.3770	0.3670	0.3670	0.3810	0.3810	0.384				
	14:00	1	150	5	700		0.0750	0.0750	0.0740	0.0740	0.0730	0.0730	0.0660	0.0660	0.072				

STATE OF CONNECTICUT
KIT-YEE HON
No. 16440
LICENSED PROFESSIONAL ENGINEER

6/4/04


Branford Railroad Station-Pile Load Test
Applied Load (kips)
0
50
100
150
200
250
0.000
0.050
0.100
0.150
0.200
0.250
0.300
0.350
0.400
Vertical Deflection (in)
Deflection
Theoretical Deflection

Attachment 1

HYDRAULIC RAM SYSTEM CORRELATION

Project No.: F60-0012T
Control No.: 60-04-88784
Ram ID.: #S9382
Load Cell ID.: #1898
Correlation Standards: Forney Hydraulic Universal Testing Machine
Calibrated 5-10-03 with equipment traceable to NIST

Load, Lbs	Reading 1	Reading 2	Reading 3	Average Gauge Reading
0	360	351	364	358
30,000	2,260	2,266	2,262	2,263
60,000	4,120	4,142	4,140	4,134
90,000	5,950	5,960	6,000	5,970
120,000	7,820	7,830	7,840	7,830
150,000	9,700	9,705	9,690	9,698
180,000	11,490	11,550	11,510	11,517
210,000	13,320	13,340	13,366	13,342
240,000	15,250	15,210	15,240	15,233
270,000	17,110	17,060	17,100	17,090

Attachment 1

HYDRAULIC RAM SYSTEM CORRELATION

Project No.: F60-0012T
Control No.: 60-04-88784-2
Ram ID: S9382
Gauge ID.: Wika 1506654
Correlation Standards: Forney Hydraulic Universal Testing Machine
Calibrated 5-10-03 with equipment traceable to NIST

Load, Lbs	Reading 1	Reading 2	Reading 3	Average Gauge Reading
0	0	0	0	0
30,000	950	950	900	933
60,000	1,900	1,900	1,900	1,900
90,000	2,850	2,850	2,850	2,850
120,000	3,850	3,850	3,850	3,850
150,000	4,800	4,800	4,800	4,800
180,000	5,750	5,750	5,750	5,750
210,000	6,700	6,750	6,750	6,733
240,000	7,750	7,750	7,750	7,750
270,000	8,700	8,700	8,700	8,700

SECTION 7 – WORKING DRAWINGS

Layne GeoConstruction

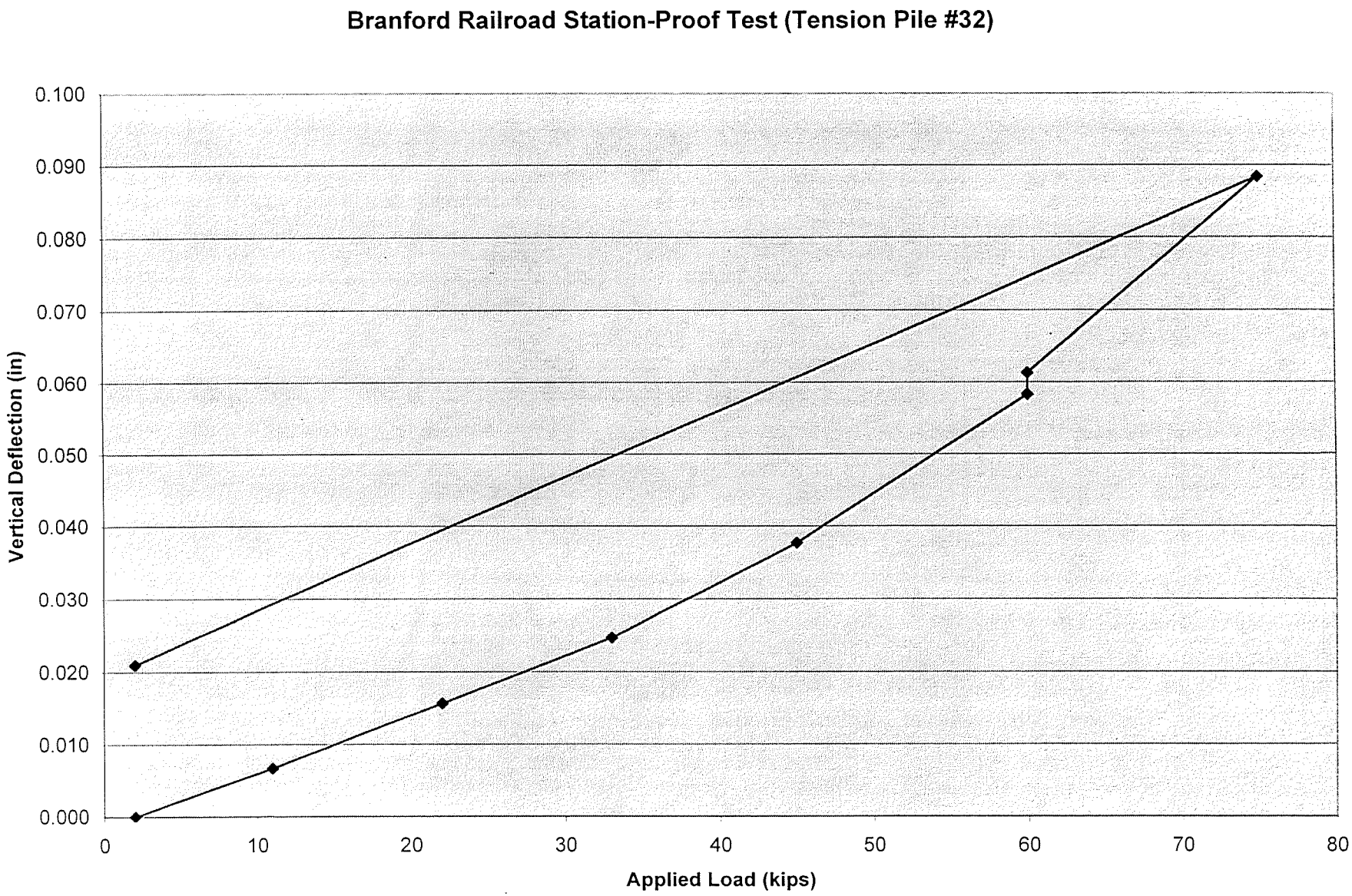
BRANFORD RAILRAOD STATION
PILE LOAD TEST DATA

7/22/2004

Test Pile No.		32			Pile Type:		Drilled mini-pile			Test No.		1		Max. test load:		75	kips	
Pile diameter:		8	inches		Pressure Gage					Date:		7/13/04		Reinforcement:				
Pile Butt Elev: Ground surface					Load Cell Factor,K:		lb/digit			Page:		1		5.5"OD,0.361"wall,N-80 steeel casing				
Tension test																		
Date	Time	Time el.	Pres.	Gage	Load	Cell	Dial	Gage 1	Dial	Gage 2	Dial	Gage 3	Dial	Gage 4	Average		Piano	Comments
		(min)	Reading	kips	Reading	kips	Reading	Deflect'n	Reading	Deflect'n	Reading	Deflect'n	Reading	Deflect'n	Deflect'n		wire	
13-Jul		0	50	2	177		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000			0.000		3.62	
		1	350	11	272		0.0030	0.0030	0.0060	0.0060	0.0110	0.0110			0.007		3.63	
		1	760	22	382		0.0170	0.0170	0.0150	0.0150	0.0150	0.0150			0.016		3.64	
		1	1050	33	499		0.0250	0.0250	0.0240	0.0240	0.0250	0.0250			0.025		3.64	
		1	1400	45	604		0.0400	0.0400	0.0370	0.0370	0.0360	0.0360			0.038		3.67	
		1	1900	60	745		0.0600	0.0600	0.0590	0.0590	0.0560	0.0560			0.058		3.70	
		2	1900	60	734		0.0600	0.0600	0.0590	0.0590	0.0560	0.0560			0.058		3.70	
		4	1900	60	723		0.0600	0.0600	0.0590	0.0590	0.0560	0.0560			0.058		3.70	
		8	1900	60	792		0.0650	0.0650	0.0630	0.0630	0.0610	0.0610			0.063		3.71	pump up
		10	1900	60	745		0.0600	0.0600	0.0630	0.0630	0.0610	0.0610			0.061		3.71	
		1	2350	75	893		0.0920	0.0920	0.0890	0.0890	0.0840	0.0840			0.088		3.73	
		1	50	2	207		0.0320	0.0320	0.0170	0.0170	0.0140	0.0140			0.021		3.63	

STATE OF CONNECTICUT
KIT-YEE HON
No. 16449
LICENSED PROFESSIONAL ENGINEER

7/22/04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0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
0
10
20
30
40
50
60
70
80
Applied Load (kips)

BRANFORD RAILRAOD STATION
PILE LOAD TEST DATA

7/22/2004

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Tension test																			
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		1	350	11	270		0.0060	0.0060	0.0050	0.0050	0.0050	0.0050			0.005		3.63		
		1	760	22	371		0.0150	0.0150	0.0120	0.0120	0.0120	0.0120			0.013		3.64		
		1	1050	33	476		0.0250	0.0250	0.0220	0.0220	0.0220	0.0220			0.023		3.64		
		1	1400	45	591		0.0360	0.0360	0.0350	0.0350	0.0340	0.0340			0.035		3.67		
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		2	1900	60	732		0.0580	0.0580	0.0560	0.0560	0.0530	0.0530			0.056		3.70		
		4	1900	60	723		0.0580	0.0580	0.0570	0.0570	0.0530	0.0530			0.056		3.70		
		8	1900	60	789		0.0620	0.0620	0.0600	0.0600	0.0630	0.0630			0.062		3.71	pump up	
		10	1900	60	775		0.0640	0.0640	0.0610	0.0610	0.0630	0.0630			0.063		3.71		
		1	2350	75	907		0.0880	0.0880	0.0820	0.0820	0.0860	0.0860			0.085		3.73		
		1	50	2	105		0.0140	0.0140	0.0250	0.0250	0.0140	0.0140			0.018		3.63		

STATE OF CONNECTICUT
KIT-YEE HON
No. 16440
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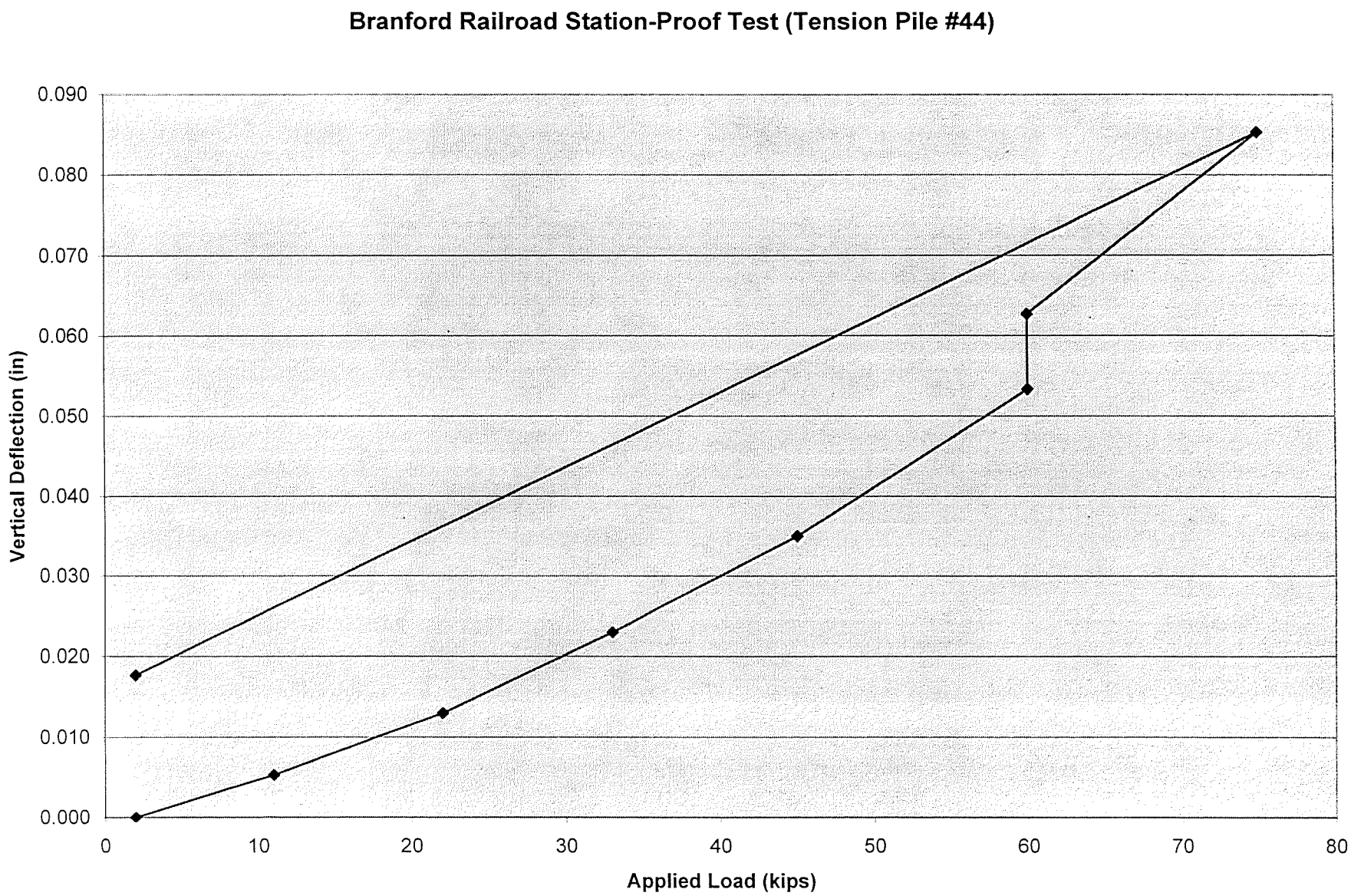
PROFESSIONAL ENGINEER

7/22/04


Branford Railroad Station-Proof Test (Tension Pile #44)
Vertical Deflection (in)
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
0
10
20
30
40
50
60
70
80
Applied Load (kips)

BRANFORD RAILRAOD STATION
PILE LOAD TEST DATA

7/22/2004

Test Pile No.	100			Pile Type:	Drilled mini-pile			Test No.		3		Max. test load:	155	kips				
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Compression test																		
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		1	2200	70	4096		1.9300	0.0700	1.9290	0.0710	1.9120	0.0880			0.076		3.88	
		1	2900	93	5246		1.9030	0.0970	1.9030	0.0970	1.8810	0.1190			0.104		3.86	
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		4	3900	124	6954		1.8590	0.1410	1.8590	0.1410	1.8260	0.1740			0.152		3.82	
		8	3900	124	7240		1.8540	0.1460	1.8530	0.1470	1.8180	0.1820			0.158		3.81	pump up
		10	3900	124	7179		1.8520	0.1480	1.8520	0.1480	1.8160	0.1840			0.160		3.81	
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		1	150	5	732		1.9600	0.0400	1.9620	0.0380	1.9480	0.0520			0.043		3.93	

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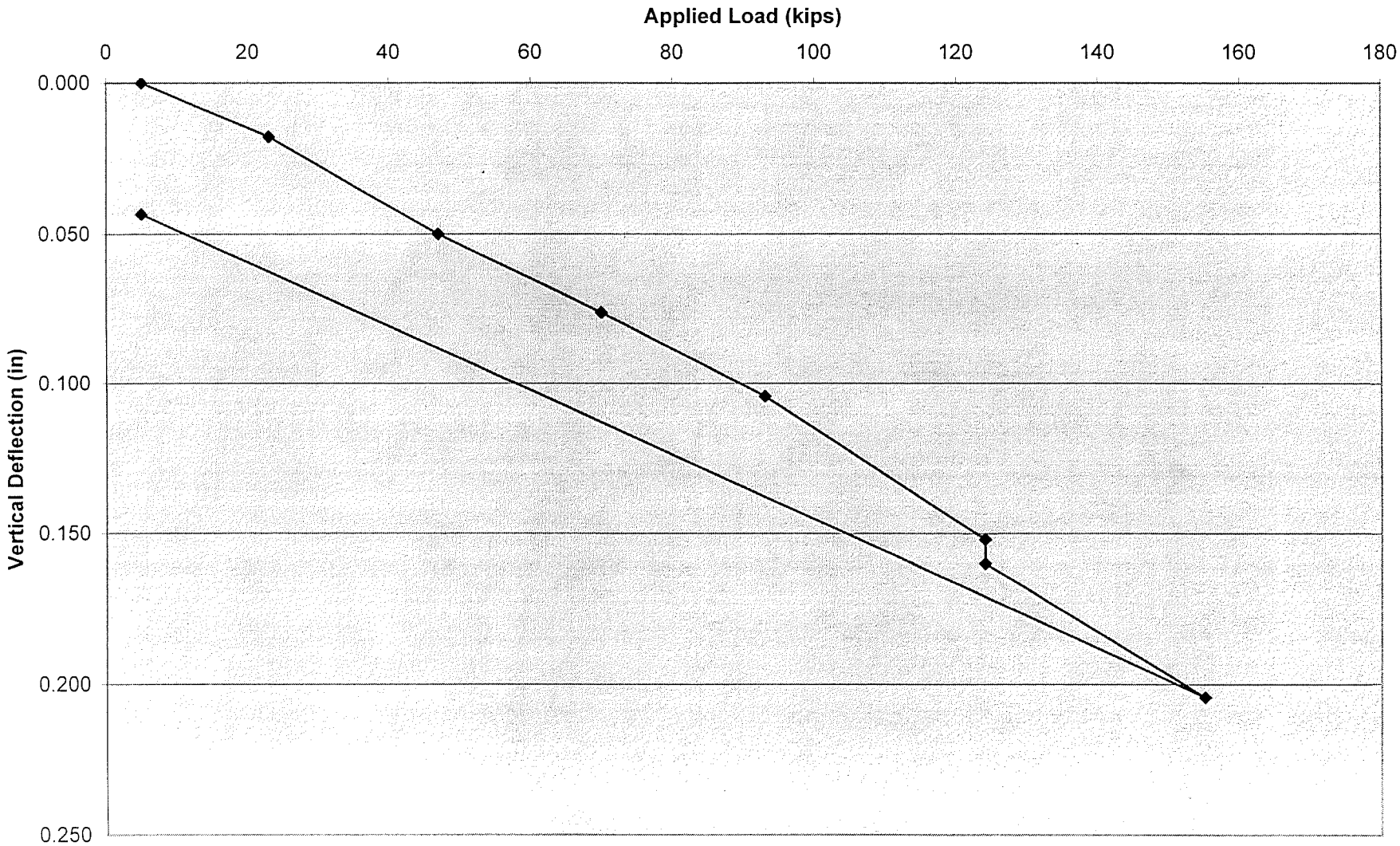
PROFESSIONAL ENGINEER

7/22/04

Branford Railroad Station-Proof Test (Compression pile #100)



BRANFORD RAILRAOD STATION
PILE LOAD TEST DATA

7/22/2004

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Pile diameter:		8	inches		Pressure Gage					Date:		7/15/04		Reinforcement:				
Pile Butt Elev: Ground surface					Load Cell Factor,K:			lb/digit		Page:		1		5.5"OD,0.361"wall,N-80 steeel casing				
Compression test																		
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		(min)	Reading	kips	Reading	kips	Reading	Deflect'n	Reading	Deflect'n	Reading	Deflect'n	Reading	Deflect'n	Deflect'n		wire	
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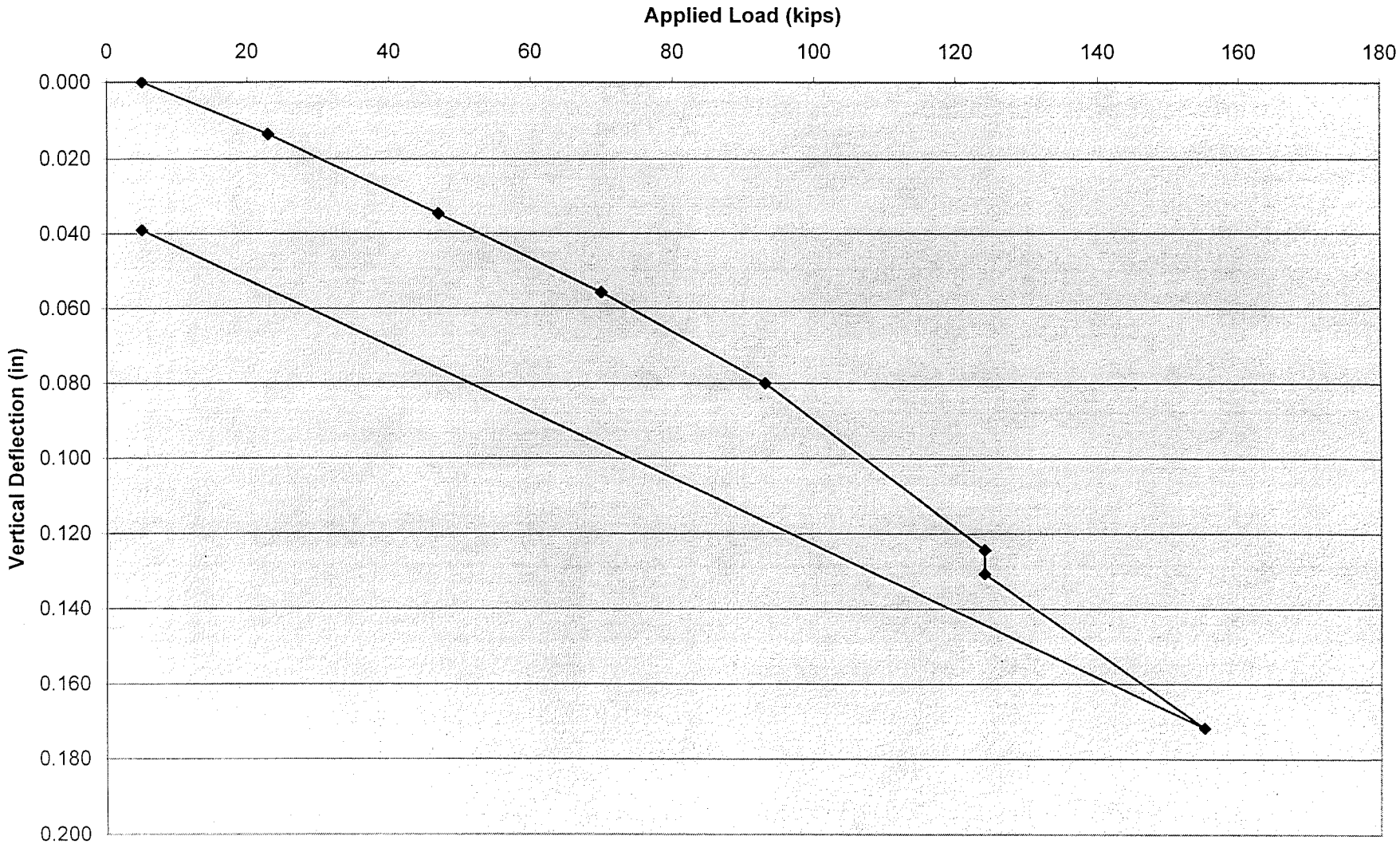
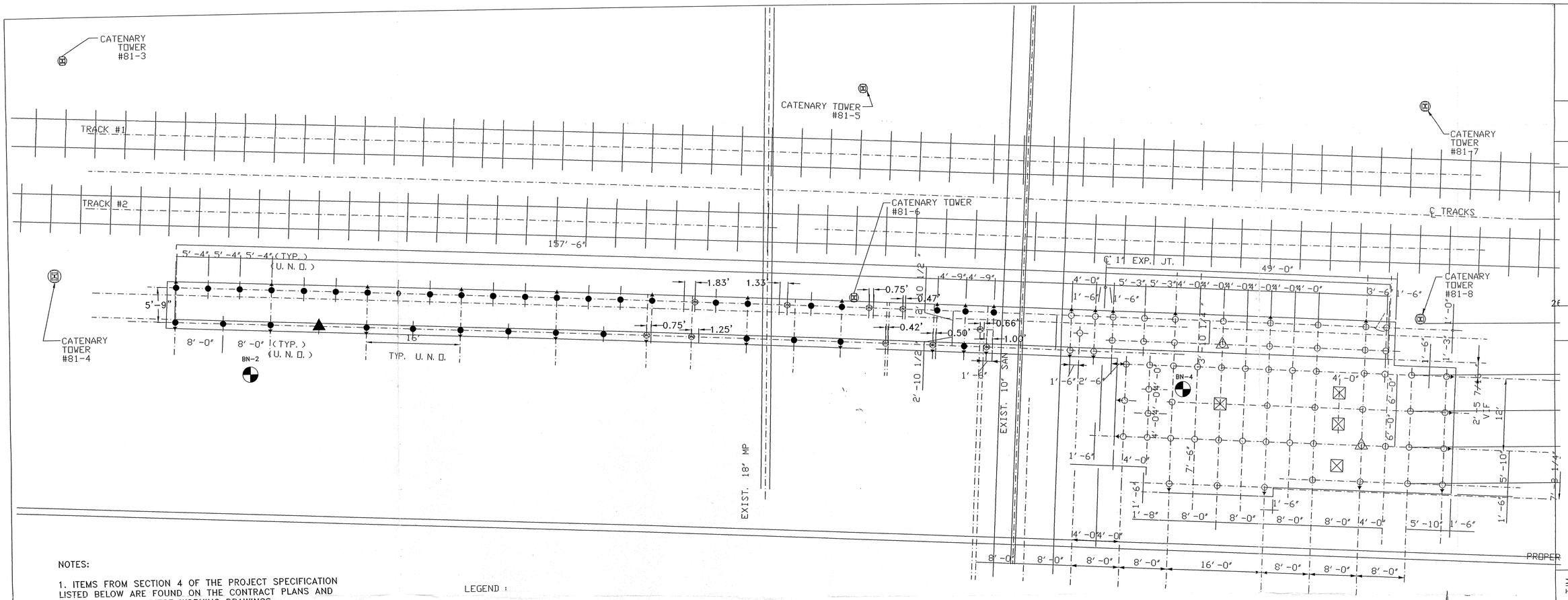
		4	3900	124	5578		0.9450	0.0550	0.8650	0.1350	0.8140	0.1860			0.125		2.93	
		8	3900	124	5926		0.9430	0.0570	0.8600	0.1400	0.8080	0.1920			0.130		2.91	pump up
		10	3900	124	5866		0.9420	0.0580	0.8590	0.1410	0.8070	0.1930			0.131		2.91	
		1	4850	155	7466		0.9250	0.0750	0.8120	0.1880	0.7480	0.2520			0.172		2.90	
		1	150	5	456		0.9880	0.0120	0.9570	0.0430	0.9380	0.0620			0.039		2.99	

STATE OF CONNECTICUT
KIT-YEE HON
No. 16440
LICENSED
PROFESSIONAL ENGINEER

7/22/04

Branford Railroad Station-Proof Test (Compression Pile #62)





NOTES:

1. ITEMS FROM SECTION 4 OF THE PROJECT SPECIFICATION LISTED BELOW ARE FOUND ON THE CONTRACT PLANS AND NOT INCLUDED IN THESE WORKING DRAWINGS.

4.a ITEMS 1,2,3,4 AND 5
4.b ITEMS 1 AND 2
4.e
4.j

2. BORING LOCATIONS ARE ESTIMATED.

3. PROOF TEST LOCATIONS ARE DIFFERENT THAN PROJECT DRAWINGS.

4. ALL SURVEY AND LAYOUT TO BE PERFORMED BY GC.

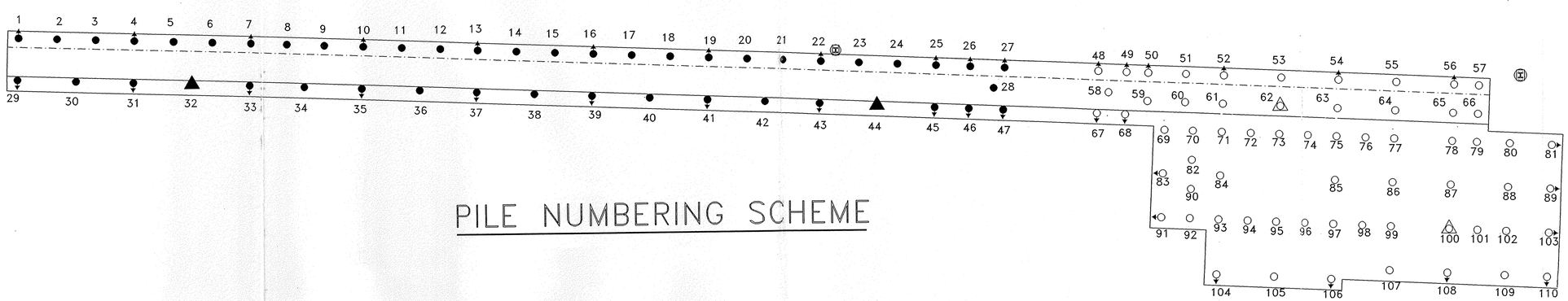
5. VERIFICATION TEST PILE LOCATION HAS BEEN SUBMITTED BY GC.

LEGEND :

PILE TYPE:	TYPE I	TYPE II
BATTERED MICROPILE (1: 12).	▲●	▲○
VERTICAL MICROPILE.	●	○
PILE LOAD TEST LOCATION.	▲	△
ASBUILT LOCATION OF PILE	⊗ DIMENSION INDICATES DISTANCE FROM ORIGINAL LOCATION	

MICROPILE LAYOUT PLAN

SCALE: 1/8 "=1' -0"



PILE NUMBERING SCHEME

PROJ MGR:	TJM
DESIGNED BY:	TJM
REVIEWED BY:	RKH
OPERATOR:	TJM
DATE:	03/08/04

SHORELINE EAST RAILROAD
BRANFORD STATION
BRANFORD, CT

MICROPILE ASBUILT LOCATION PLAN

JOB NO. 40-0081

FIGURE NO. 3

REV. NO.	DESCRIPTION	BY	DATE

Layne GeoConstruction

FILE: BRANFORD PILES 030304.DWG

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Banton Construction Company, Inc.

TRANSMITTAL
No. 00529

339 Washington Avenue
North Haven , CT 06473

Phone: 203-234-2353
Fax: 203-234-0010

PROJECT: Shoreline East 310-0019

DATE: 8/3/2004

TO: Baker Engineering NY, Inc.
2096-B Silas Deane Highway
Rocky Hill , CT 06067

REF: Micropile Asbuilts

RECEIVED
AUG 05 2004
BAKER ENGINEERING NY INC.
ROCKY HILL, CT

PHONE: 860-563-3044 **FAX:** 860-529-6627

ATTN: David Tudryn

WE ARE SENDING:	SUBMITTED FOR:	ACTION TAKEN:
☐ Shop Drawings	☐ Approval	☐ Approved as Submitted
☐ Letter	☑ Your Use	☐ Approved as Noted
☐ Prints	☐ As Requested	☐ Returned After Loan
☐ Change Order	☐ Review and Comment	☐ Resubmit
☐ Plans		☐ Submit
☐ Samples	**SENT VIA:**	☐ Returned
☐ Specifications	☑ Attached	☐ Returned for Corrections
☑ Other: Asbuilts	☐ Separate Cover Via:	☐ Due Date:

ITEM NO.	COPIES	DATE	ITEM	NUMBER	REV. NO.	DESCRIPTION	STATUS
1	2	8/3/2004				Micropile Asbuilt Drawings	
2	2	8/3/2004				Proof Test Results	

Remarks:

CC: 2341-1004, J. Bernick (DOT), Branford Site

Signed: _____
Craig Matava

Expedition ®

Appendix 5

GeoDesign's October 2008 Geotechnical Report

GEOTECHNICAL REPORT
CT DOT PROJECT NO. 310-0007
SHORE LINE EAST – BRANFORD PARKING
PROPOSED SURFACE PARKING, CULVERT AND ROADWAY
BRANFORD, CONNECTICUT

Prepared for:
Michael Baker Corporation
2096 Silas Deane Hwy # B
Rocky Hill, CT 06067

Prepared By:
Geo**Design**, Inc.
984 Southford Road
Middlebury, CT 06762

File No. 0183-007.0
October 21, 2008

SHORE LINE EAST
BRANFORD SURFACE PARKING, CULVERT, AND ROADWAY
STATE PROJECT 310-0007

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1.0 INTRODUCTION

This is a Roadway and Structure Soils Report for the proposed surface parking, "Kiss-and-Ride" roadway, and culvert at Branford Station, in Branford, Connecticut. This work is part of the Shore Line East Railroad Expansion for the State of Connecticut Department of Transportation (ConnDOT), State Project Number 310-0007.

The Shore Line East Railroad Expansion includes proposed platforms at Branford, Madison, Clinton, and Westbrook Stations; a proposed parking garage at Madison Station; and proposed surface parking at Branford Station. Baker Engineering NY, Inc. (Baker) is the Prime Designer for the Shore Line East Railroad Expansion. Geo**Design**, Inc. (Geo**Design**) is the Geotechnical subconsultant for Baker.

The Branford site is depicted on Figure 1 – Site Location Plan, Appendix 1.

1.1 Datum

All elevations herein are in feet and refer to NGVD 1929 datum.

2.0 PROPOSED CONSTRUCTION

2.1 South of Railroad Tracks

Surface parking is proposed south of the existing railroad tracks. The proposed surface parking site will have a 320-vehicle capacity. South and southeast of the proposed surface parking are a proposed detention basin and culvert, respectively. The culvert will be a precast arch-culvert supported by piles and will serve as a bridge access connecting the new and existing parking areas. According to a Branford Parking Lot Grading Plan (Drawing No. BRP_C-105, dated May 5, 2008, Appendix 1), proposed grades will require up to four-foot cuts on the west, and up to six-foot fills on the east and adjacent to the culvert. Average fill and cut thicknesses are both 2.5 feet.

2.2 North of Railroad Tracks

North of the railroad tracks a "Kiss-and-Ride" roadway is proposed and will include 0.09 acres of porous pavement, 0.25 acres of grass area, and 0.39 acres of impervious pavement. Proposed grades range between Elevation (El.) 26 on the northeast and El. 18 feet on the south, which will require up to eight feet of fill.

3.0 EXISTING CONDITIONS AND HISTORIC USES

3.1 South of Railroad Tracks

The area south of the railroad tracks currently consists of brush/woods, and is bounded by an existing lot to the east, and West End Avenue to the south. The existing grades south of the tracks increase from the southeast to northwest from about El. 7 to 18 feet.

An 1892 historic topographic map of the project area indicates the south side of the railroad tracks consisted of a tidal stream surrounded by wetlands. The small stream flowed into the Branford River to the southeast. A 1949 topographic map shows nearby construction which interrupted stream flow and the project site is shown as a wetland area.

About 10% to 20% of the surface west of the existing parking lot is covered by pieces of reinforced concrete up to 10-feet long, steel tanks up to six feet in diameter, abandoned vehicle frames, etc. Based on the type of rebar and concrete visible, and the growth of trees intermingled in the debris, it is assumed that the fill and debris were likely deposited decades ago.

3.2 North of Railroad Tracks

The area north of the railroad tracks currently consists of an open grass area and single family house. The area is bounded by the tracks to the south, Kirkham Street to the east, and private properties to the north and west. The elevation decreases steeply from El. 25 to 15 feet on the east, and then becomes gradual from El. 15 to 11 feet toward the west.

North of the railroad tracks, the 1892 and 1949 historic topographic maps indicate organic deposits were present slightly north of the tracks.

4.0 SUBSURFACE EXPLORATIONS

4.1 GeoDesign Borings

Between April 3rd and April 9th, 2008, a Geo**Design** representative was on-site to observe the making of sixteen (16) borings and to perform three infiltration tests. Borings were located in the field by tape measurements and visual estimation. Locations should be considered accurate only to the degree implied by the method used. Approximate boring locations to the south of the tracks are shown on Figure 2, Appendix 1; and boring locations to the north of the tracks are shown on Figure 3. Boring logs are attached (Appendix 2).

New England Borings Contractors, Inc. performed the borings and a Geo**Design** representative observed and logged the data. Eleven borings, designated BR-2, and BR-10 through BR-19, were performed for the proposed surface parking and culvert. Five borings designated BR-4,

BIT-1, -2, -3, and -5 were performed for the proposed "Kiss-and-Ride" roadway to the north of the tracks. Infiltration tests were performed in three of the BIT borings.

Samples were obtained with a 1-3/8th-inch split spoon sampler in general compliance with ASTM 1586. Standard Penetration Test (SPT) sampling was typically semi-continuous (0-2, 2-4, 5-7, 7-9, 10-12, 12-14 ft. etc.) through strata above granular natural deposits. The typical sampling interval changed to five feet in natural granular deposits. Borings typically terminated in medium dense to very dense granular deposits.

4.2 Borings by Others

Borings BN-1, -2, -3, and -4 were drilled for construction of the existing Branford Railroad Station (ConnDOT Project No. 310-0019) August 2000. A copy of the boring logs and location plan are attached (Appendix 3) for information.

5.0 GENERALIZED SUBSURFACE PROFILES

5.1 General

The subsurface profiles north and south of the railroad tracks are discussed separately because of wide variation in conditions and proposed construction. The subsurface profiles may be generalized from conditions encountered in the 2008 borings, data from the 2000 borings, and historic topographic/geologic mapping.

5.2 Subsurface Profile: Surface Parking and Culvert (South of tracks)

From the 11 test borings performed on the south side of the site, the thickness of existing Fill (above the Organics) ranges from 5 to 18 feet, averaging about 13 feet thick. Below the Fill is 2- to 17-feet of Organics overlying a granular natural deposit of Silty Sand. Borings were terminated in dense to very dense granular deposits. See Figure 4 for a generalized profile through the south side of the site, as indicated on Figure 2. Each of the strata encountered in the borings are discussed below.

5.2.1 Fill

Surficial Fill consisted of a variety of fine to medium Sand, Silt, and miscellaneous debris including Ash, Slag, Glass, Concrete, Ceramic, Cinders, Wood, Organic Silt, and Brick. The thickness of Fill ranged from 5 to 18 feet with an average thickness of 13 feet. SPT N-Values ranged from 5 to 100.

5.2.2 Organics

Organics observed were in the form of Peat and Organic Silt (Peat/O.S.). The Peat/O.S. was comprised of brown/black fibrous Peat and/or Organic Silt, trace Root Fibers, and/or trace Shells. The top of the Peat/O.S. layer varied from about El. -5 to 5 feet. The thickness of Peat/O.S. layer ranged from 2 to 14 feet with an average thickness of about 9 feet. A Peat/O.S. layer up to 14 feet thick was encountered on the east side of the proposed surface parking, and up to 14 feet thick at the proposed culvert (Borings BR-18, and -19). SPT N-Values within the Peat/O.S., ranged from 0 to 10.

In Boring BR-19 only, an additional 13 feet of inorganic Clayey Silt was encountered below the Peat/O.S. layer from 23 to 36 feet deep, with SPT N-Values ranging from 5 to 13.

5.2.3 Granular Deposits

Silty Sand was encountered below the Peat/O.S. and generally consisted of gray-brown over red-brown fine to medium Sand, trace to some Silt. SPT N-Values ranged from 5 to 27. The top of the Silty Sand layer varied from about El. -4 to -14.5 feet.

In Boring BR-19 only, Gravelly Silty Sand was encountered at 36 feet below ground surface and consisted of red-brown fine to medium Sand, trace to little fine Gravel, trace to little Silt. SPT N-Values in the Gravelly Silty Sand ranged from 30 to 57.

The 2000 Boring BN-4 was terminated on inferred bedrock at El. -54 feet.

5.2.4 Groundwater

Groundwater was observed in each of the bore holes at depths ranging from five to ten feet below ground surface (about El. 0 to 9 feet). The top of groundwater was generally within the Fill layer.

5.3 Subsurface Profile: Roadway Borings and Infiltration Tests (North of tracks)

In general, the subsurface data for the borings to the north of the railroad tracks consisted of approximately 9 to 16-feet of Fill, over a variable occurrence of Peat/O.S. ranging in thickness from 3.5 to 4.5-feet, over a Granular Natural Deposit of Gravelly Silty Sand. The borings were terminated below the organics in the Gravelly Silty Sand and Silty Sand. From the completed borings the Silty Sand was at least five feet thick and as much as 19 feet thick. The strata encountered in the borings are discussed below.

5.3.1 Fill

The Fill material consisted of fine to medium Sand, little to some Silt, and trace miscellaneous debris including Ash, Slag, Cinders, Wood, and Brick. The thickness of Fill ranged from 9 to 16 feet with an average thickness of 11 feet. SPT N-Values ranged from 5 to 46.

5.3.2 Organics

The Peat/O.S. was encountered in two of the northern borings (Borings BIT-2 and BIT-5) and comprised of gray/black Peat and/or Organic Silt, trace Root Fibers. Peat/O.S. was also encountered in two of the 2000 borings (BN-1 and BN-3). The thickness of Peat/O.S. layer was 3.5 (BIT-2), 4.5 (BIT-5), 5 (BN-1) and 7 (BN-3) feet. The top of the layer was encountered at El. 2 and 2.5 feet respectively. SPT N-Values within the Peat/O.S., ranged from 2 to 11.

5.3.3 Granular Deposits

Gravelly Silty Sand or Silty Sand was encountered below the Fill or Peat/O.S. The top of Granular Deposits were observed at Elevations ranging from El. -3 to 5 feet. The Silty Sand was generally medium dense and consisted of brown fine to medium Sand, trace to little Silt. A Stiff, inorganic Silt & Clay layer was noted from El. -12.5 to -31.5 in 2000 boring BN-1.

The Gravelly Silty Sand was generally dense to very dense and consisted of red-brown fine to medium Sand, little to some fine to coarse Gravel, and little to some Silt. The Gravelly Silty Sand layer was as thick as 15 feet (2000 Boring BN-3).

5.3.4 Groundwater

Groundwater was observed in three of the northern borings from approximate El. 1.5 to 4.5 feet, and in the 2000 borings BN-1 and BN-3 at about El. 3.5 feet. Groundwater was not observed in Borings BIT-1 and BIT-3, which extended to El. 1 and -1 feet, respectively.

5.3.5 In-situ Infiltration Test Results

Infiltration rates after a 60-minute falling head test inside four inch casing, ranged from 1.5 to 4.9 in/hour. Average infiltration rate was approximately three in/hour. In accordance with Connecticut Department of Environmental Protection Strom Water Quality Manual 2004 infiltration rates must incorporate a factor of safety of 2.0. See Section 8.3.5 for further discussion about infiltration findings and design for infiltration.

6.0 LABORATORY TESTING RESULTS

6.1 General

Laboratory testing, including consolidation, water content, and organic content tests, were performed on a thin-walled Peat/O.S. piston sample obtained from Boring BR-14 from 14 to 16 feet deep (El. 1.5 to 3.5 feet). Test results are attached in Appendix 4.

6.2 Results

Compression test results on a sample of the Peat/O.S. from boring BR-14 (east of the proposed parking and west of the proposed culvert) indicates an over consolidation ratio (OCR) of about 2.3. Over consolidation is when the laboratory results indicate a pre-consolidation pressure greater than our estimated existing stresses. The test indicated a pre-consolidation pressure of 1.36 tsf, while we estimate the existing overburden stress to range between about 0.5 to 0.8 tsf. An over consolidated condition is reasonable due to the history of this site, and the past presence of a building structure.

The water content of the sample was 71.6%.

Two organic content tests were performed on Peat/O.S. and the organic content was found to be 4 and 6.5% by weight.

Compression tests from undisturbed samples were not available from other locations south of the tracks or from the north of the tracks or east of the culvert. However, by review of low SPT-N values, it is inferred that the Peat/O.S. is also normally consolidated (not over-consolidated) at these locations. The variable nature of the Peat/O.S. appears to range from normally consolidated to over-consolidated due to the variable historic use of the site (placement of fill and stockpiling of materials).

7.0 SUBGRADE EVALUATION AND GEOTECHNICAL DISCUSSION

This section discusses the geotechnical issues identified on the site, and their implications. The sections below include the areas south of the tracks, the areas west and east of the culvert, and the area north of the tracks, respectively.

New site grading will result in both cuts and fills. Existing grades reduced by cut/excavation will result in a decrease in overburden stress to the subsurface soils and settlements are not expected at these locations. Placement of new/additional fill above existing grades will increase vertical effective overburden stresses above existing pressures and a range of settlements will occur within the organic soils, depending on the degree to which those soils were historically loaded. The variable nature and thickness of the organics (Peat/O.S.) will have a variable

response to the placement of new/additional fill. Depending on site location and variable subsurface conditions, the consolidation settlement of the Peat/O.S. will range from recompression, to normal/primary consolidation, to secondary consolidation.

7.1 Proposed Surface Parking (South Side of Tracks)

Site improvements for the parking area include re-grading and paving of the parking area. The underlying Peat/O.S. will have an affect on these improvements. The proposed grades for the parking area south of the tracks includes cuts to the west, one- to three-foot thick fills in the central portion of the site, and fills of three- to six-feet to the east of the site (at the approach areas to the new culvert); refer to Figure 5 in Appendix 1.

7.1.1 Site Grading and Estimated Settlements

Cuts for grading will remove existing granular Fill, which will result in a release of stress on the organics (Peat/O.S.). We anticipate settlements will be negligible in cut areas as loads will be reduced. We evaluated rebound of the Peat/O.S. and concluded that the rebound at the cut areas can be considered negligible.

However, placement of new fill will result in increased loads and stress to the subsurface soils. Increased stresses will induce both reconsolidation and normal consolidation of the compressible soils. Secondary consolidation will also be observed at the completion of primary consolidation. The magnitudes and rates of reconsolidation, normal consolidation and secondary consolidation will vary across the site as a function of the depth, thickness, and variable nature of the compressible soil.

Based on conditions at BR-14 (an area of suspected historic stockpiling), where a compression test was performed, approximately nine feet of fill would be necessary to load the Peat/O.S. past the point of reconsolidation to achieve a normally consolidated state. At most, approximately six feet of site grading fill is proposed in this area, and the Peat/O.S. layer at this location will remain in an over-consolidated state. Therefore, limited settlements will occur during recompression at this location. It should be noted that the records and evidence (the limits) of historic fill placement are not well known.

In contrast, the subsurface conditions towards the east of the parking area and approaching the new culvert indicate normally consolidated soils. At these locations, the placement of new grading fill (ranging from one to six feet) will result in an estimated 6 to 10 inches of primary settlement and up to 8 inches of secondary settlement; thus total settlements approaching 14 to 16 inches. The estimated time to complete primary settlement is 2 to 4 months. Secondary consolidation of the Peat/O.S. will begin at the completion of primary consolidation. The secondary settlements will approach 8 inches for a 25-year period.

To reduce differential settlements, the pavement may be constructed after the majority of primary consolidation has occurred. We have estimated the consolidation settlements of the Peat/O.S. for proposed grading conditions with no-build, as well as with three alternate scenarios.

7.1.1.1 Settlements without Subgrade Improvement

Grading the site without consideration for settlements is an option but it will result in potentially wide variations in total and differential settlement in response to variable subsurface conditions and variable loading from new fill.

We estimate 0.5 to 1.5 inches of recompression settlement (expulsion of pore-water) in fill areas where the soils are already (and will remain) over-consolidated. These settlements will occur over a period of approximately 1 to 36 weeks after additional fill is placed. Settlement rates are largely influenced by the variable thickness and nature of the Peat/O.S., and increased stresses from new loads on the Peat/O.S. layer. In contrast, we estimate 6 to 10 inches of primary settlement (expulsion of pore-water) in fill areas where the soils are normally consolidated. These settlements will occur over a period of approximately 8 to 16 weeks after additional fill is placed. Therefore, from the west of the site, where the Peat/O.S. is thinner, to the east of the site where the Peat/O.S. is at its thickest and varies in stress history, differential settlements could approach 12 inches over a variable time frame, and greater time must be allowed for settlements.

7.1.1.2 Preloading/Surcharging

Based on the significant variability of the Peat/O.S. and historic site usage, a preload/surcharge program with settlement monitoring can be utilized at this site. The intent is to preload (at a minimum) with a load equal to the weight of required filling and surcharging or greater than the final required load. Surcharging would go beyond preloading and place more/temporary fill than is required by grading, with the intent to further load the compressible soils for a portion of the construction period. The preloading/surcharging program will increase the rate of consolidation, account for primary and potentially some secondary settlements, and overcome widely variable subsurface conditions.

However, the influence and efficiency of preloading/surcharging will be dependent on several factors including whether the Peat/O.S. is over-consolidated or normally consolidated, construction schedule(s), the overall site material balance, and cost.

Over-consolidated areas will receive the least benefit from preloading/surcharging and normally consolidated areas will receive the most benefit. At a minimum, the thickness of the preload should account for all of the anticipated primary settlement. A larger thickness of surcharge (e.g.

up to twice the site grading fill thickness) can be used but would require disposal or reuse of the excess material once primary and some secondary consolidation is complete.

7.1.1.3 GeoGrids

If placement of asphalt pavement cannot be delayed until after significant settlement has occurred, consideration should also be given to use of geogrids. The use of bi-axial geogrids between the existing Fill and proposed fill placement can help to reduce differential (not total) settlement due to variations in the nature of the Peat/O.S.

Geogrids can also help to improve the subgrade modulus (pavement structure) at locations where site grading may potentially cut into or is close to the organic deposits. Several analyses were made by Tensar International Corporation to evaluate the benefit of using a bi-axial geogrid (Tensar BX 1100) in the pavement subgrade. The results are provided in Appendix 5 and show the influence of a biaxial geogrid on pavement thickness, structural number, and serviceability (in terms of equivalent single axle loads).

7.1.1.4 Utilities

Depending on how settlements are managed, consideration will need to be given to managing the influence of settlements on utilities such as drainage systems and electrical service. Drainage systems may need to be constructed with specific inverts and greater slopes to maintain positive drainage at locations where differential settlements will be significant. Electrical (and other) utilities will need to account for settlements and connection points and may need to incorporate flexible connections.

7.2 Proposed Culvert Area (South Side of Tracks)

Borings BR-18 and BR-19 were performed on the west and east side of the proposed culvert, respectively. We encountered deposits of Peat/O.S. up to 14 feet thick in the borings for the culvert. Although consolidation testing of the Peat/O.S. to the west of the culvert indicated some of the material was over-consolidated, the observed SPT-N values of the culvert borings were noticeably lower. By inference the Peat/O.S. at this location is expected to be normally consolidated.

We also note that the subsurface conditions vary from the west to east at the culvert. To the west, the Peat/O.S. is underlain by sand and to the east it is underlain by clayey silt. Therefore, the Peat/O.S. to the west will be drained from above and below during consolidation resulting in a shorter drainage path and time required for consolidation, while the Peat/O.S. to the east will exhibit single drainage during consolidation and will require more time for consolidation to occur.

We understand that the culvert has been designed as a pile supported structure to satisfy environmental permitting requirements. Piles must gain their capacity from the Sand & Gravel stratum found below the Peat/O.S. The Sand & Gravel stratum was encountered at El. -27 feet, 34 feet below existing grades. Up to six feet of fill is proposed at the west and east of the culvert, hence, the piles must be designed for the down-drag forces as a result of the new fill compressing the normally consolidated Peat/O.S. Furthermore, the Peat/O.S. will provide little lateral support, so the piles must be embedded into the very dense Sand & Gravel layer to provide adequate lateral capacity.

7.2.1 Site Grading and Estimated Settlement (East and West of Culvert)

Roadway access west and east of the culvert will require up to six feet of new embankment fill. The primary settlement of the normally consolidated Peat/O.S. is estimated to range from seven to ten inches and is expected to occur over a period of approximately 12 months. In addition to primary consolidation/settlement, the fibrous nature of the Peat/O.S. can result in secondary consolidation/settlement. Consolidation of the Peat/O.S. will begin at the completion of primary consolidation. The secondary settlements will approach 8 to 12 inches for a 25-year period. Therefore, estimates of total settlements are 20 to 24 inches.

To reduce differential settlements, the access/approaches to the culvert may be constructed/finalized after primary consolidation (and after secondary consolidation if surcharging is performed). Similar to the evaluations made in Section 7.1.1, we have estimated the consolidation settlements of the Peat/O.S. for proposed grading conditions with no build, as well as with three alternate scenarios.

7.2.1.1 Settlements without Subgrade Improvement

Grading the site without geotechnical subgrade improvement is an option but it will result in potentially significant settlement in response to variable subsurface conditions, site usage, and loading from new fill. The differential settlements between the compressible fill and the pile-supported culvert will be significant. We estimate five to eight inches of settlement in fill areas. These settlements will occur over a period of approximately four to eight months after additional fill is placed. Secondary consolidation will result in an additional 12 inches of settlement over a 25-year period. The variable nature and depositional sequence of the organics presents the risk of differential settlements for both pavement structures and utilities.

7.2.1.2 Preloading/Surcharging

Based on the variability of the Peat/O.S. and consolidation drainage conditions from the west to the east side of the culvert, a preload/surcharge program (surcharging with a load equal to or

greater than the final required load) with settlement monitoring can be utilized. Refer to Section 7.1.1.2 for additional information on preloading/surcharging. At the east side of the culvert, consideration should be given to the local use of vertical sand drains installed at approximate ten foot spacing to shorten the time required for primary consolidation. It was previously described that the drainage path (for expulsion of consolidation water) is greater on the east side. In this case, vertical sand drains can shorten the drainage path and significantly reduce (by half or more) the time required to complete primary consolidation.

7.2.1.3 GeoGrids

If placement of asphalt pavement cannot be delayed until after consolidation settlement has occurred, consideration should be given to use of Geogrids at the approaches to the culvert. Geogrids will not eliminate the effects of settlement but the use of bi-axial geogrids between the existing fill and proposed fill placement can help to reduce the effects of differential (not total) settlement. Several analyses were made by Tensar International Corporation to evaluate the benefit of using a bi-axial geogrid (Tensar BX 1100) in the pavement subgrade. The results are provided in Appendix 5 and show the influence of a biaxial geogrid on pavement thickness, structural number, and serviceability (in terms of equivalent single axle loads).

7.2.1.4 Utilities

Depending on how settlements are managed, consideration will need to be given to managing the influence of settlements on utilities such as drainage systems and electrical service. Drainage systems may need to be constructed with specific inverts and greater slopes to maintain positive drainage at locations where differential settlements will be significant. Electrical (and other) utilities will need to account for settlements and rigid connection points and may need to incorporate flexible connections.

7.3 Roadway (North Side of Tracks)

North of the tracks, the Peat/O.S. stratum is thinner than the areas south of the tracks, and it was not encountered in some locations. The compressible Peat/O.S. stratum was only observed in Borings BIT-2 and BIT-5. Based on the historic mapping and review of the 2000 series borings, we expect the Peat/O.S. layer to continue and increase in thickness south of BIT-5, where borings were not performed. Because of the historic site usage, we do not anticipate the Peat/O.S. on the north and south sides of the tracks to react similarly under loading. Although the Peat/O.S. layer is thinner, we suspect it to be normally to slightly over-consolidated. However, the variable presence of the organics presents the risk of differential settlements for both pavement structures and utilities.

7.3.1 Settlements without Subgrade Improvement

Proposed grading requires up to eight feet of additional fill. Grading the site without geotechnical subgrade improvement is an option, but it will result in some differential settlement in response to loading from new fill over the discontinuous Peat/O.S. Assuming a five foot thick layer of normally consolidated Peat/O.S., we estimate about four to six inches of settlement when applying an additional eight feet of fill. This settlement is expected to occur in over a period of about two to four months. Settlement rates are largely influenced by the Peat/O.S. thickness, and increased stresses from new loads on the Peat/O.S. layer.

7.3.2 Mitigation of Settlement by Preloading/Surcharging, GeoGrids and Utilities

Similar to discussions in Sections 7.1 and 7.2, the total and differential settlements can be mitigated through the use of preloading/surcharging, incorporation of geogrids and design of utilities to account for changing pipe slopes and transition points from settlement areas to rigid connections.

8.0 RECOMMENDATIONS

8.1 Surface parking (South Side of Tracks); East and West Culvert approaches, and Drop-off Area (North Side of Tracks)

Section 7 of this report included a discussion of total and differential settlements, and means to mitigate or reduce the influence of the settlements on final site grading. Estimated settlements for the proposed site grading and construction vary significantly as presented in the following Table 8-1 and Figure 5 in Appendix 1.

Table 8-1: Estimated Settlements by Area

Location (Area)	Primary Settlement (feet)	Duration Primary (months)	Secondary Settlement* (feet)	Total Estimated Settlement (feet)
North of Tracks (Area 4)	0.24	0.5	0.28	0.5
South of Tracks – West (Cut Area)	Cut - None	N/A	Cut - None	N/A
South of Tracks – Central (Area 1)	0.36	3	0.78	1.1
South of Tracks – East (Area 2)	0.69	1	0.98	1.7
West of Culvert (Area 2)	0.90	3	0.78	1.7
East of Culvert (Area 3)	0.90	11	0.90	1.8

**Duration of secondary settlement is the service life of the constructed facility.*

The lowest range of settlements is in areas where the organics (Peat/O.S.) have already been consolidated under stockpile loads from prior site usage. Under new fill loading, the Peat/O.S. at these locations will only exhibit reconsolidation settlements. The higher range of settlements is associated with the Peat/O.S. that has not historically been loaded to significant stresses. The Peat/O.S. at these locations will exhibit normal consolidation in response to new/additional placement of site grading fill.

Due to the variable thickness and past stress history of the Peat/O.S., the required site grading plan will result in a range of total settlements. In general, the shorter settlement times are associated with limited fill areas and longer times are related to the east portion of the site with significant new fill and a thicker Peat/O.S. deposit.

8.1.1 Recommendations for Managing the Organics

Selecting an alternative for managing the settlement and differential settlement at the site depends on several cost-benefit factors and on ConnDOT tolerance for differential settlements, corresponding reduced pavement performance/life, the project construction schedule, and cost. In general, we recommend a preload/surcharge program with settlement monitoring as described below.

8.1.2 Preload and Surcharge Program

Significant differential settlements will occur as a result of variations in site subsurface conditions, historic site usage and variable grading requirements. We recommend a preloading/surcharge program with settlement monitoring. At a minimum, a preload program would consist of placing controlled/compacted fill across the site as indicated in Figure 6 (Appendix 1). The minimum thickness of the fill should include the thickness of fill to meet required grades, plus an *additional* thickness of compacted fill to account for anticipated settlements. If cost, schedule and material balance can be adjusted, additional surcharge fill can be placed up to the maximum thickness identified in Figure 6 and Table 8-2 below.

Table 8-2: Thickness of Preload and Surcharge by Area

Location (Area)	Minimum Thickness of Preload (feet)	Maximum Thickness of Surcharge above Preload (feet)	Total Thickness of Preload plus Surcharge (feet)
North of Tracks (Area 4)	8	None Required	8
South of Tracks – West (Cut Area)	Cut - None	Cut - None	Cut -None
South of Tracks – Central (Area 1)	2 to 4	2	4 to 6

South of Tracks – East (Area 2)	4 to 8	2 to 4	6 to 12
West of Culvert (Area 2)	8	4	12
East of Culvert (Area 3)	2 to 4	2 to 4	4 to 8

Settlement monitoring platforms should be placed prior to filling. The actual magnitude and rate of settlement should be monitored periodically and used as the basis for adjusting (adding/removing fill) to reach the required final grade. If surcharge is used, the settlement monitoring should be used to define the transition from end of primary consolidation to the start of secondary consolidation.

Based on the subsurface data and settlement estimates, we recommend the preload fill be placed as indicated on Figure 6 (Appendix 1). The recommended minimum fill placement and consolidation periods will account for completion of primary consolidation.

Due to the nature of the Peat/O.S., secondary consolidation can be expected over the life of the project. If there is sufficient time in the construction schedule and project budget, some amount of secondary settlement can be reduced by designing for the placement of additional surcharge fill. Settlement monitoring can be used to track secondary settlement while surcharge fill is in place. During final design, the remainder of estimated secondary settlement (and differential settlement) should be accounted for in the design of utilities (e.g. pipe inverts and slopes, connections, etc.).

8.1.3 Settlement Monitoring

We recommend settlement monitoring platforms be established prior to both preload fill and final fill placement and grading. Platforms should consist of 1-inch diameter rigid steel or aluminum vertical rod mechanically set or welded to a minimum 2ft by 2ft plate. The rod should be protected with schedule 40 PVC riser of minimum inside diameter of 1.5 inches. The rod and riser height should be set to exceed the final site grade by three feet. We recommend each settlement plate be set on firm strata above the organics. Backfill should be placed around the riser and brought up to final site grade. Final site grade should be recorded on the rod, and settlement readings taken directly from the rod (based on a stable benchmark located outside the area of settlement influence), with PVC riser incrementally cut as necessary to facilitate readings.

An alternative settlement plate may consist of similar durable steel plate construction; however, placement will be at the completed ground surface (at final grade). This alternate plate and monitoring/surveying from an offsite benchmark (not affected by construction or settlement) may only be used if fill placement from organics to final grade is rapid (within say five days).

Combinations of the above settlement plates may be used upon approval of the Engineer.

8.1.4 Consideration of Construction Cost and Schedule in Final Design

As project design is developed further, we recommend an assessment be made of the construction cost, schedule requirements and site material balance (cut versus fill volumes). If construction schedules can be increased, an evaluation should be made of the benefits of increasing the duration of preloading/surcharging (under maximum fill loads) to allow for some degree of secondary consolidation settlement to occur. Allowing some secondary consolidation to occur (during surcharge) will reduce the remaining total and differential settlements to be accounted for in site grading, utility design, and pavement performance.

8.1.5 Consideration of Vertical Sand Drains East of Culvert

The time required for consolidation settlements varies as indicated in Table 8-1. The duration of primary consolidation is generally three months or less, which is a reasonable time within a construction schedule. However, the duration of settlement at the east side of the culvert is on the order of 11 months. This time is primarily controlled by the thickness of the compressible strata, the length of drainage path for expelled pore water to reach a free-draining surface, and the permeability of the compressible material.

If required in the construction schedule, the time-rate of consolidation at the east side of the culvert could be reduced by installing vertical sand drains into the compressible strata, at a ten foot spacing (grid spacing), thereby reducing the drainage path for expelled pore water to dissipate. The drains can be constructed by drilling conventional boreholes into the Peat/O.S. and backfilling them with sand. The sand drains should be constructed to discharge to a free-draining gravel layer or the ground surface. This would reduce the time to complete primary consolidation from approximately 11 months to three months.

8.2 Culvert Foundation Recommendations (South Side of Tracks)

8.2.1 Culvert Foundation Recommendations

In addition to pre-determined environmental permitting requirements for the culvert to be pile-supported, the anticipated long-term consolidation settlements at the stream area also requires pile foundations to support the proposed concrete arch culvert. The piles will carry the loads through the compressible Peat/O.S. to the underlying dense and stable Sand & Gravel, which will result in negligible settlement of the structure. Due to the variation of bedrock surface elevation, there is a limited chance that piles may encounter bedrock before reaching the design penetration in the Sand & Gravel stratum. However, end bearing piles driven onto the bedrock surface will have sufficient axial capacity for the proposed design.

We recommend steel H-piles developing side friction in the very dense Sand & Gravel, encountered at approximate El. -31 ft. We recommend a tip elevation of El. -46 ft. (a minimum 15-foot embedment). Final driving resistance should be determined based on a Wave Equation Analysis for Piles (WEAP) to evaluate proposed pile driving equipment and stresses in the piles.

Based on the proposed pile layout geometry on Fig. No. 0LISP7 (prepared by Baker Engineering dated June 2008 and attached in Appendix 1), we estimate an allowable axial load capacity (service load) will be nine tons per pile and the allowable lateral load capacity will be about five tons. We calculate downdrag from the proposed fill placement and consolidation of the organics will add about three tons per pile for the recommended pile.

We recommend HP 10 x 42 piles driven to practical refusal. This pile has an allowable structural capacity of 22 tons assuming nine ksi stress and a 1/8 inch loss for corrosion and an allowable axial capacity of six tons based on geotechnical criteria. Point protection should be installed on each pile tip to facilitate potential hard driving through fill and to refusal. Minimum pile spacing is three diameters, or about 3 feet. 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. This installation criteria analysis may be performed by Geo**Design**, or by the Contractor's engineer and submitted for review.

Dynamic Pile Driving Analysis (PDA) on each pile type should be required.

8.2.2 Temporary Lateral Earth Support

Temporary Lateral Earth Support (sheeting) to be left in place and temporary dewatering will be required to construct the culvert. We anticipate sheeting must retain up to between 12 and 18 feet of earth (depending on preload and surcharge programs) and hydrostatic uplift pressures equal to high tide waterline. Bottom of Pilecap Elevation is anticipated at El. -0.25 feet (Fig. No. BRP_S-100 prepared by Baker Engineering and dated May 5, 2008 and attached in Appendix 1).

The contractor should submit temporary excavation support sheeting and dewatering designs prepared by a Connecticut Licensed Professional Engineer.

8.2.3 Lateral Earth Pressures for Abutments and Wingwalls

We recommend that walls subject to unbalanced earth pressures be designed for the following minimum lateral soil pressures (calculated on the basis of an equivalent fluid pressure in pounds per cubic foot):

Active Case = 35 pcf
At Rest Case = 55 pcf

The active case would apply to the wing walls and assume level backfill. The at-rest case would be used for those cases where walls are rigidly braced, such as rigidly connected deck/abutments. The above pressures are generally based on an assumed level backfill consisting of Pervious Structure Backfill (ConnDOT Form 816, Article M.02.05) with a total weight of 125 pcf and an internal friction angle of 34 degrees. Corresponding active and at-rest earth pressure coefficients are 0.28 and 0.44, respectively.

Walls subject to surcharge loads from live or dead loads must also be designed for an additional uniform lateral pressure over the entire height of the wall equal to the applicable earth pressure coefficient (active or at-rest case) times the magnitude of the surcharge. Please contact Geo**Design** for recommended pressure distribution for specific cases of retaining walls with sloped backfill and/or specific surcharge loading.

The foregoing recommendations do not include hydrostatic pressures on the walls. To achieve this condition, free draining backfill (Pervious Structure Backfill) must be used for wall backfill. Foundation drains are required for any abutments and wing walls. Foundation drains should be fitted with rodent screens. Foundation drains that discharge to tidal waters and/or streams subject to flooding should utilize flap valves to minimize back charging of wall backfill.

8.3 Parking Area and Roadway Recommendations

8.3.1 Sloping Fill

Based on construction cost, schedule requirements and site material balance; moreover, the duration and influence of the preload/surcharge program, we recommend placing additional fill and modifying site grading necessary to maintain positive drainage of roadways/parking as secondary settlements occur over time.

8.3.2 Geogrids

Geogrids can help to attenuate the affects of differential settlement on pavement structures and they can be a cost-effective component of an economical pavement structure design. At the direction of the Engineer, geogrids may be placed following cuts, or prior to fill or sub-base placement.

We recommend Biaxial (BX-1100 or greater) as manufactured by Tensar or approved equal. Installation shall be in accordance with the manufacturer's specifications and criteria, and applicable criteria and specifications of AASHTO and CDOT.

8.3.3 North Side of Tracks

On the east side of the site is an existing 1V:4H slope. Following clearing and grubbing, and prior to placement of the proposed fill, the slope should be benched to create a level surface. Benching will improve the compaction of fill, provide stability and keep the fill from sliding along the existing slope.

8.3.4 Subgrade Preparation for Pavement Sections

We recommend that the subgrade for all parking and roadway pavement sections consist of a free-draining material with appropriate subgrade slopes and/or underdrains to promote positive drainage. The pavement section and subgrade should be designed for periodic flooding as the 25-year flood level is El. 10.8 feet which would be within a typical pavement section for the finish grade of the surface parking south of the tracks.

8.3.5 North-side Proposed Fill Placement and Infiltration Rates

We note that infiltration tests were performed at three to five feet below ground surface and aware that the finished grades will be several feet above existing ground surface. In consideration of a potentially restrictive infiltration rate and requirements for trench construction four feet above the seasonal high water table, Baker may wish to consider constructing a portion or all of the infiltration galleries within the proposed site grade backfill. The gradation and permeability of site backfill materials may be selected to meet the design requirements for handling infiltration water within the proposed fills.

8.3.6 Proposed Utilities

We understand 12-inch and 18-inch Class V Reinforced Concrete Pipe (RCP) are proposed beneath the "Kiss-and-Ride" roadway. Due to the anticipated settlements and the potential for differential settlements in this area, we recommend manhole inverts and sufficient pipe slopes that account for settlements. Consideration should also be given to flexible pipe in place of the RCP pipe, and flexible pipe joints and utility connections that allow for rotation between sections and rigid structures.

8.4 Other Site Recommendations

8.4.1 Site Preparation

Before grading begins at the site, clearing and grubbing should be completed first to remove debris, topsoil, shrubs, and trees. Vegetative root systems should be removed in their entirety. Debris and surficial soils should be characterized to establish appropriate disposal protocol.

8.4.2 Disposal of On-Site Fills

Existing onsite Fill is unsuitable for reuse, due to its high presence of miscellaneous materials. The Fill in the cut areas will need to be disposed of properly in accordance with CT environmental standards, if applicable. Otherwise, with the approval of the engineer, the fill can be re-used on site if it is screened and culled of large objects and deleterious materials.

8.4.3 Off-Site Soils

Soils for fill placement will need to be obtained from an offsite source. In areas of new grading fill, the fill gradation must comply with ConnDOT Standard Specifications (Form 816), Section M.02.01 for Granular Fill.

8.4.4 Fill Placement

Fill placement must be in accordance with the Subgrade ConnDOT Standard Specification (Form 816), Section 2.09.

8.4.5 Ancillary Structures

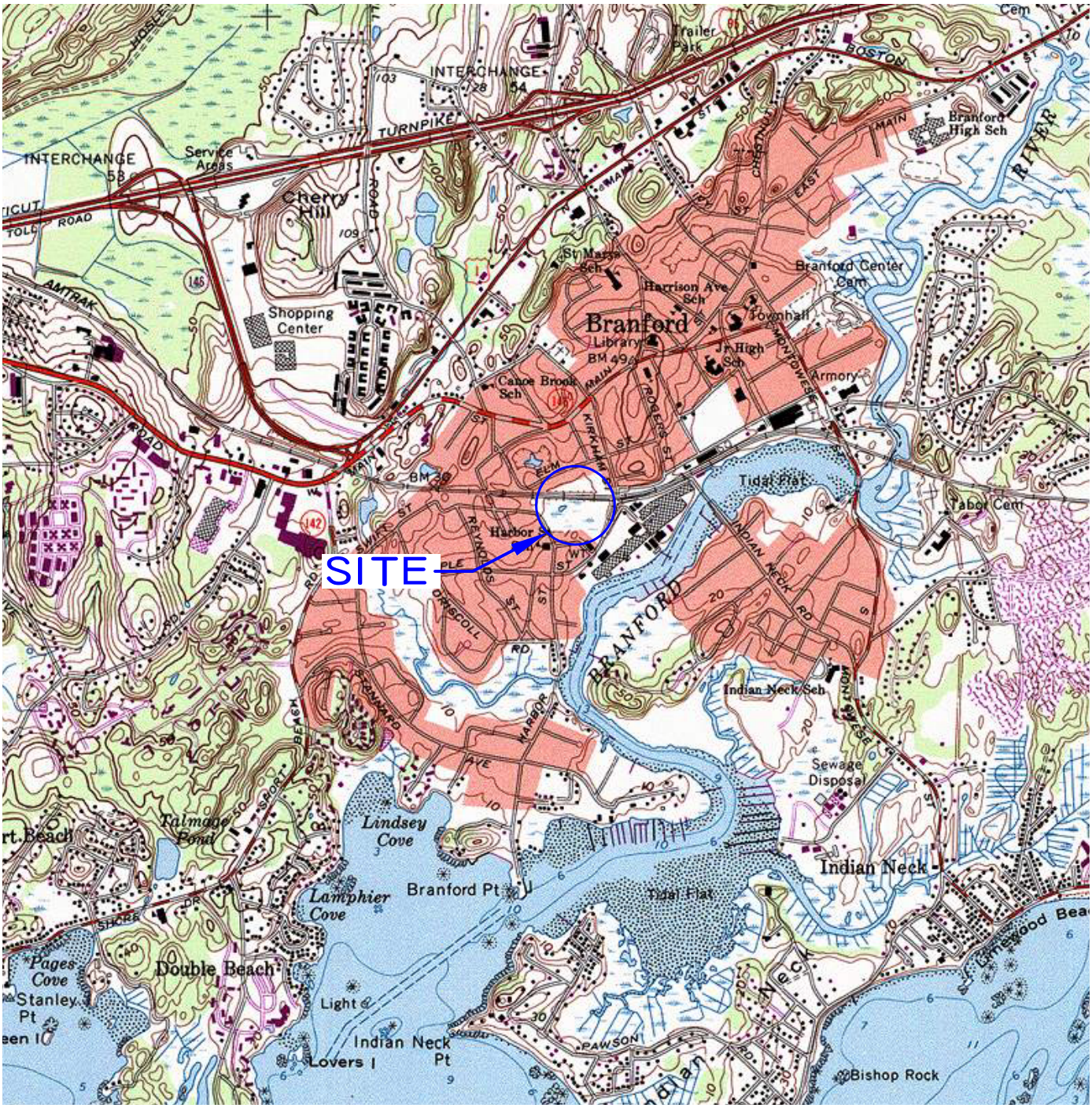
Based on our experience with the lighting structures at the Shore Line East Railroad Madison Station Parking Construction we recommend that lighting structures are mounted on pedestals bearing on the underlying the granular materials. Geo**Design** recommends additional study to develop site specific recommendations for these structures.

9.0 LIMITATIONS

This report is subject to the summary of limitations presented in Appendix 6.

Appendix 1

Figures



GEODESIGN INCORPORATED

GEOTECHNICAL ENGINEERS • ENVIRONMENTAL CONSULTANTS
984 SOUTHFORD ROAD • MIDDLEBURY CONNECTICUT 06762
TELEPHONE: (203)758-8836 FACSIMILE: (203)758-8842

DRAWN BY: SMC | REVIEWED BY: MGB

CONNECTICUT

QUADRANGLE LOCATION

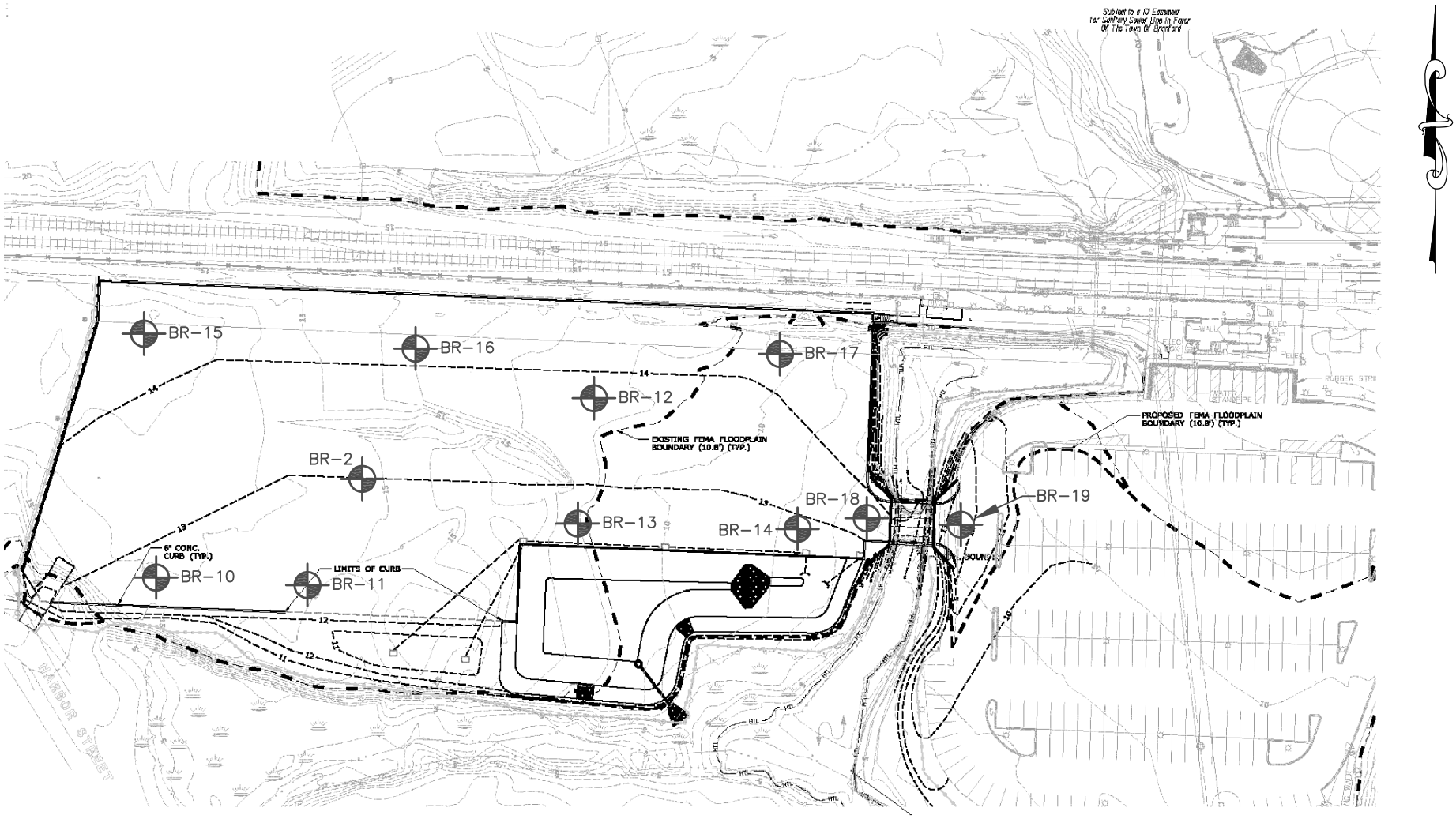
SITE LOCATION PLAN
SHORELINE EAST
BRANFORD, CONNECTICUT

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

SCALE IN FEET
0 1000 2000 4000

PROJECT NO. 183-07.0
DATE: 6-30-08
FIGURE NO. 1

ACAD FILE No. M:\183\07\SITE MAP - BRANFORD FIG 1.dwg



LEGEND

BR-10 BORING LOCATION

FIGURE NO. 2

GEODESIGN INCORPORATED
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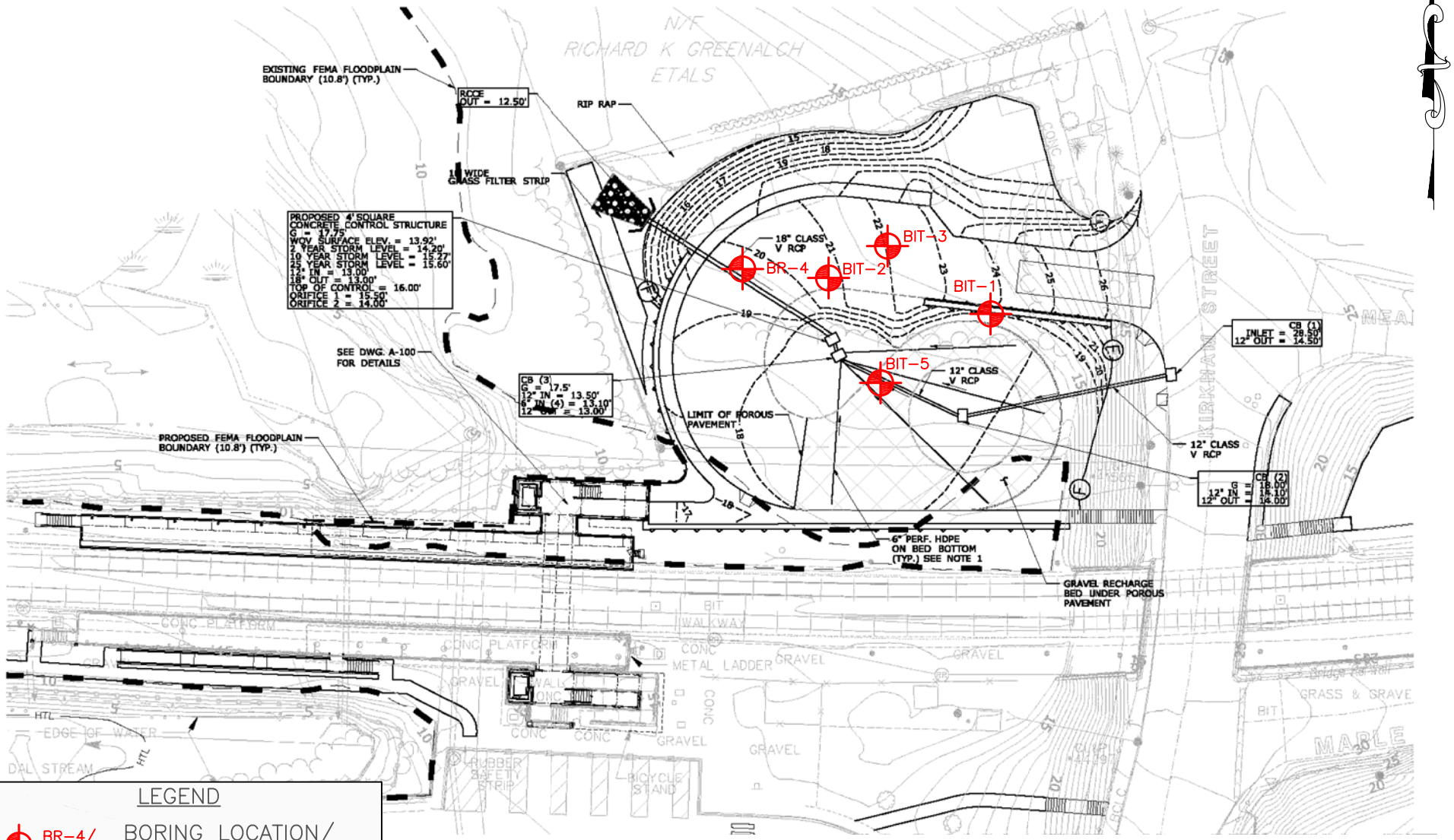
TELEPHONE: (203)758-8836 FAX: (203)758-8842

SCALE IN FEET
1" = 100'
0 50 100' 200'

DATE: 7/1/2008	DRAWN BY: MJV
JOB NO: 0183-7.0	REVIEWED BY: MGB

BRANFORD PARKING LOT BORING LOCATION PLAN
BRANFORD, CT

File Location: M:\CL\0183\07\7.2 Branford Parking\Report and Analysis\Figures



LEGEND

BR-4/ BIT-1 — BORING LOCATION/ INFILTRATION TEST

FIGURE NO. 3

GEODESIGN INCORPORATED
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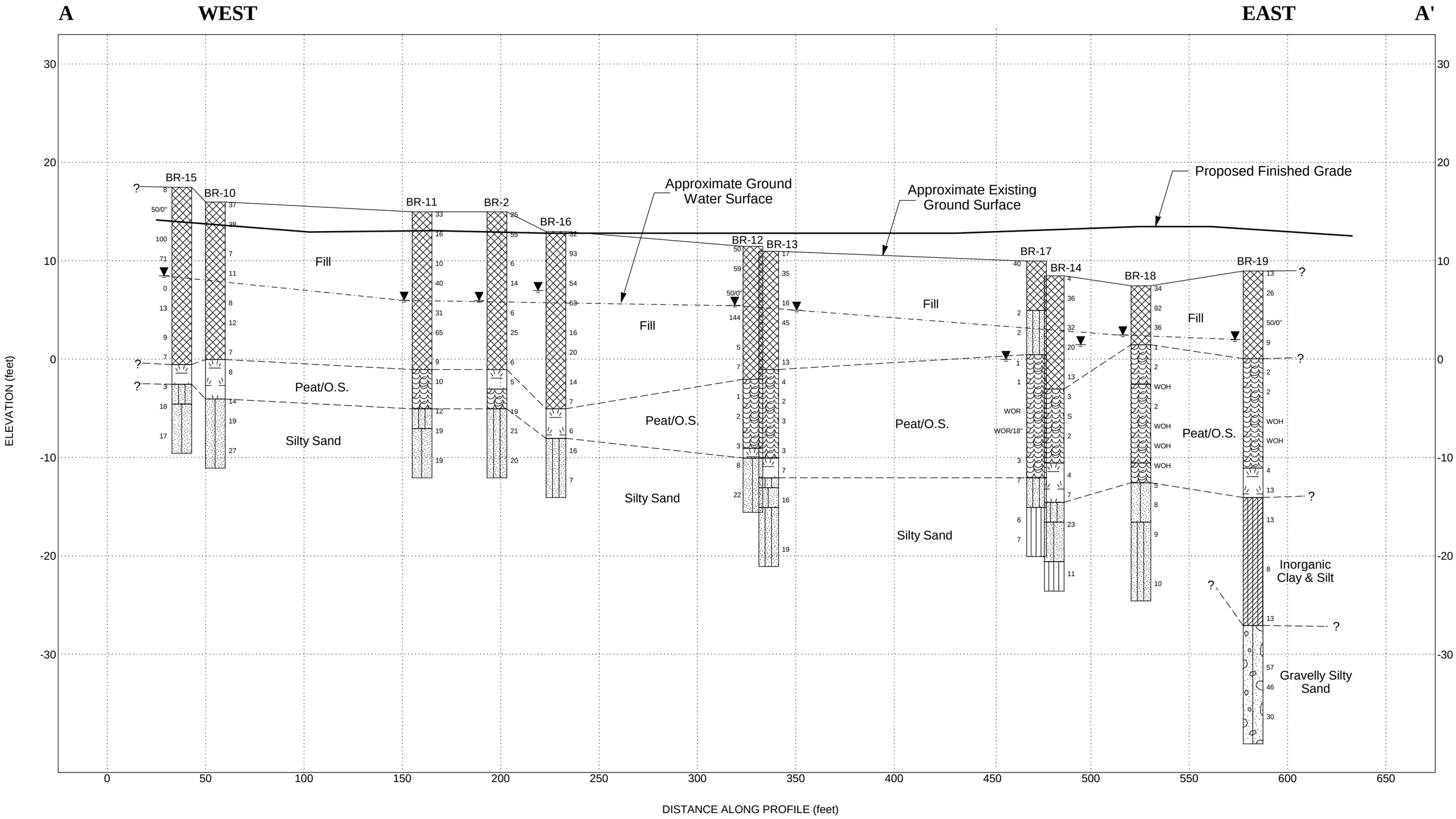
984 SOUTHFORD ROAD • MIDDLEBURY, CONNECTICUT 06762
TELEPHONE: (203)758-8836 FAX: (203)758-8842

SCALE IN FEET
1" = 60'
0 30 60' 120'

DATE: 7/1/2008	DRAWN BY: MJV
JOB NO: 0183-7.0	REVIEWED BY: MGB

BRANDFORD STATION BORING LOCATION/INFILTRATION TEST PLAN BRANDFORD, CT

File Location: M:\CL\0183\07\7.2 Branford Parking\Report and Analysis\Figure 2



GEODESIGN INCORPORATED
Geotechnical Engineers and Environmental Consultants
984 Southford Road
Middlebury, Connecticut 06762
Telephone: 203-758-8836 Fax: 203-758-8842

0 50
Horizontal Scale (feet)

Vertical Exaggeration: 5x

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.

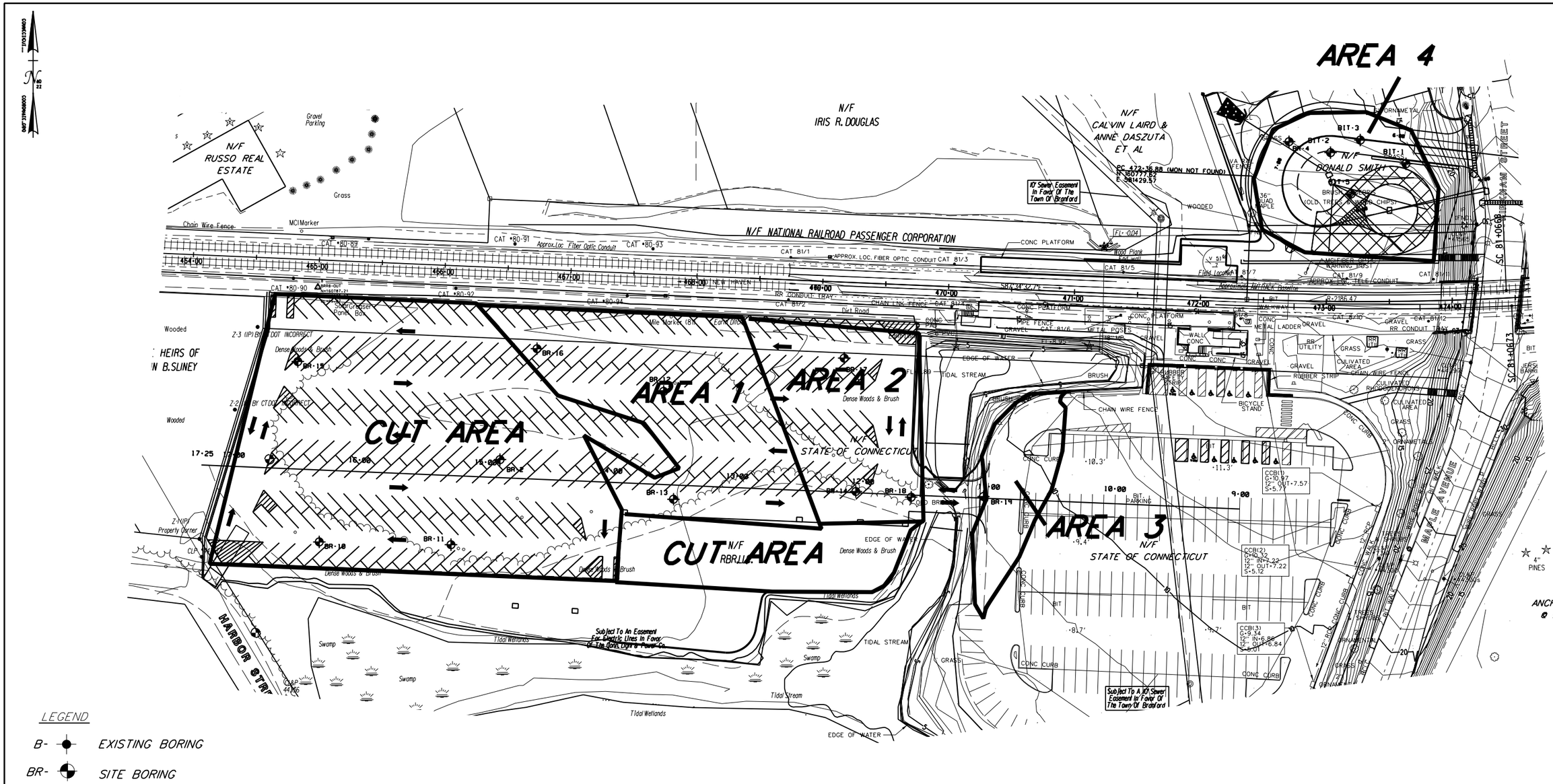
Date: 10-14-08 | Drawn By: MGB/DSF | Reviewed By: RTS

SUBSURFACE PROFILE A-A'

Shore Line East Railroad Expansion
Branford Parking

File No.: 0183-07.0 | Figure No.: 4

GEO STANDARD 11 X 17 (2/19/04) BRANFORD BORING LOGS 4-2008.GPJ FBNWNL01.GDT 9/17/08



NOTES:
1) BASE MAP PROVIDED BY MICHAEL BAKER CORPORATION VIA FTP SITE. ORIGINAL PLAN DRAWN TO TRUE SCALE.
2) SEE REPORT FOR FURTHER INFORMATION ABOUT AREA DESIGNATIONS.

DESIGNED BY RTS						
DRAWN BY SMC						
CHECKED BY MPT	NO.	DATE		DRWN.	CHKD	APPVD
			REVISIONS			

SCALE: 1" = 100'

100' 50' 0 100'

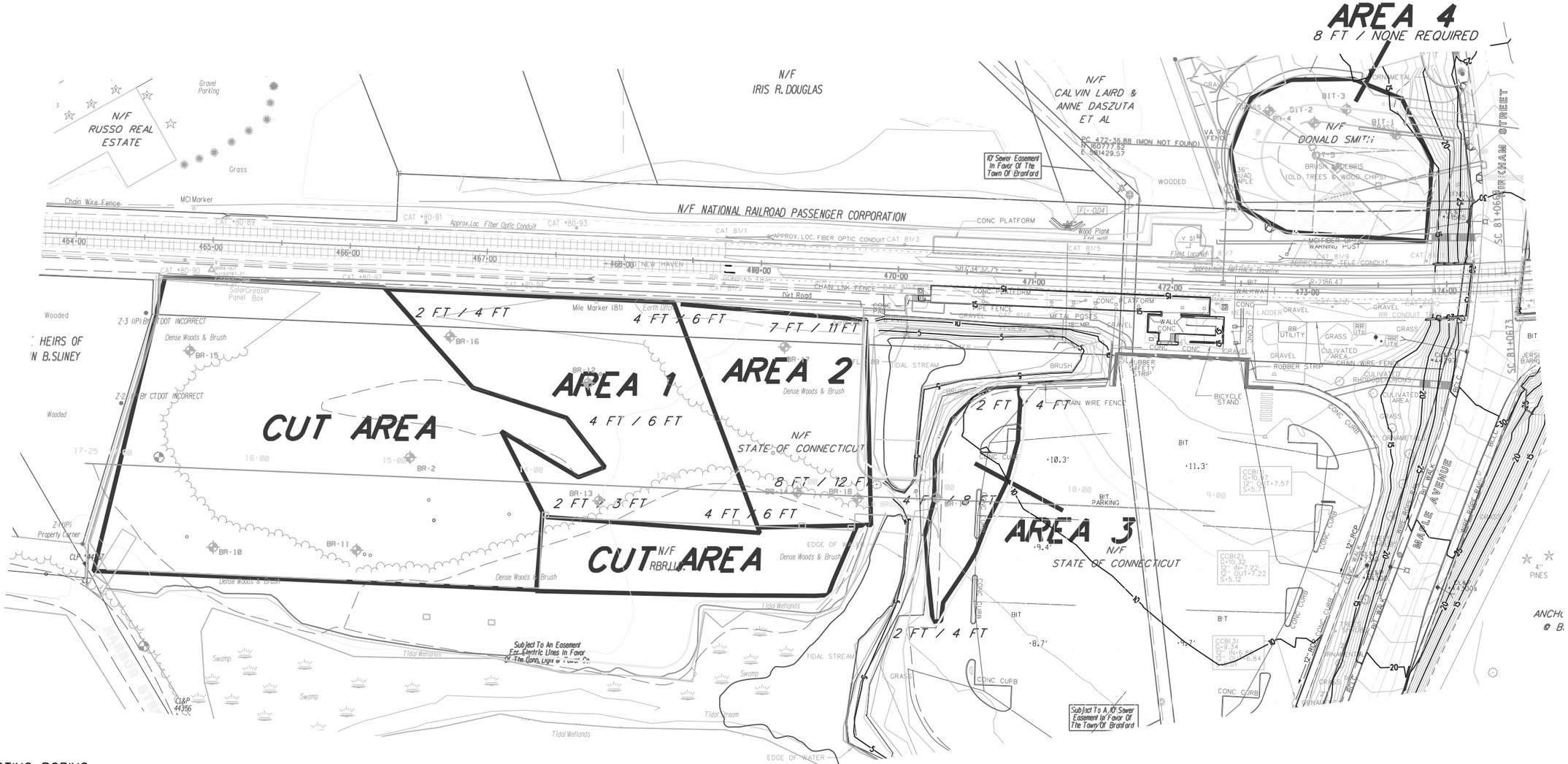
GEODESIGN INCORPORATED
D/B/A GEODESIGN INC., PC
GEOTECHNICAL ENGINEERS • ENVIRONMENTAL CONSULTANTS
984 SOUTHFORD ROAD • MIDDLEBURY CONNECTICUT 06762
TELEPHONE: (203)758-8836 FACSIMILE: (203)758-8842

PROJECT
DEPARTMENT OF TRANSPORTATION
SHORE LINE EAST
RAILROAD STATIONS

DWG. TITLE
AREA DESIGNATIONS FOR FINAL GRADING

FILE NO. 183-007.0
SCALE 1" =100'
DATE 10-20-08
FIGURE NO. 5

Fig 5 - Area designations.dgn 10/21/2008 1:11:37 PM



LEGEND

B- EXISTING BORING

BR- SITE BORING

AREA 1

4 FT / 6 FT

4 FT = MIN FILL TO FINISH GRADE PLUS ESTIMATED SETTLEMENT (PRELOAD).
6 FT = MAX FILL ALLOWED FOR SURCHARGE

MONITORING REQUIREMENTS FOR PRE-LOAD*

CUT AREAS DO NOT REQUIRE SETTLEMENT MONITORING
AREA 1: MONITORING FOR 1 MONTH
AREA 2: MONITORING FOR 3 MONTHS
AREA 3: MONITORING FOR 1 YEAR (W/O SAND DRAINS)
AREA 3: MONITORING FOR 3 MONTHS (W/SAND DRAINS @ 10 FT SPACING)
AREA 4: MONITORING FOR 2 WEEKS
* DURATION OF MONITORING MAY BE ADJUSTED BY ENGINEER BASED ON OBSERVED RATE AND MAGNITUDE OF SETTLEMENTS. DURATION OF MONITORING WILL INCREASE IF SURCHARGE IS USED.

NOTES:
1) BASE MAP PROVIDED BY MICHAEL BAKER CORPORATION VIA FTP SITE. ORIGINAL PLAN DRAWN TO TRUE SCALE.
2) SEE REPORT FOR FURTHER INFORMATION ABOUT SETTLEMENT MONITORING AND SAND DRAINS.
3) SEE REPORT FOR LIMITATIONS.

DESIGNED BY RTS						
DRAWN BY SMC						
CHECKED BY MPT	NO.	DATE		DRWN.	CHKD	APPVD
			REVISIONS			

SCALE: 1" = 100'
100' 50' 0 100'

GEODESIGN INCORPORATED
D/B/A GEODESIGN INC., PC
GEOTECHNICAL ENGINEERS • ENVIRONMENTAL CONSULTANTS
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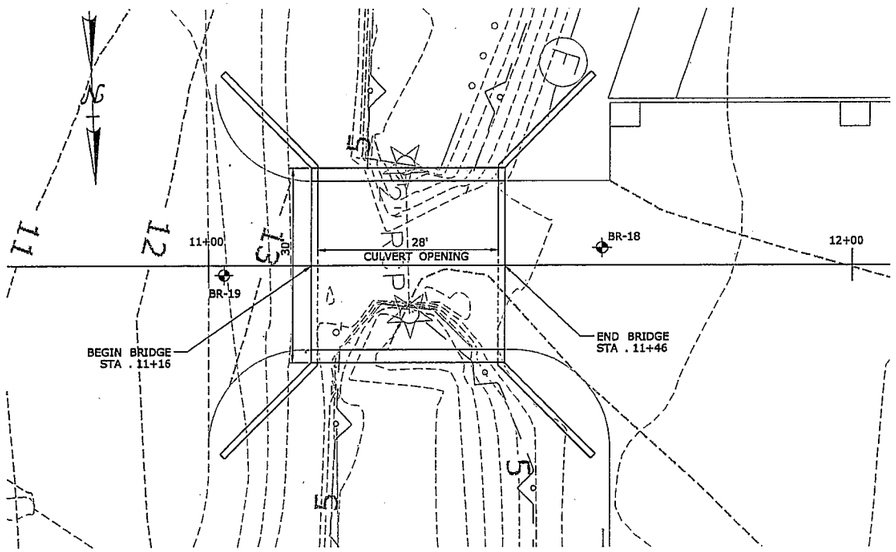
TELEPHONE: (203)758-8836 FACSIMILE: (203)758-8842

PROJECT
DEPARTMENT OF TRANSPORTATION
SHORE LINE EAST
RAILROAD STATIONS

DWG. TITLE
SITE GRADING AND PRELOAD
SURCHARGE ZONES

FILE NO. 183-007.0
SCALE 1" =100'
DATE 10-20-08
FIGURE NO. 6



PLAN

TABLE OF QUANTITIES		
ITEM	Unit	Total
Turbidity Control Curtains	L.S.	1
Channel Excavation - Earth	C.Y.	100
Structure Excavation - Earth (Complete)	C.Y.	200
Subbase	C.Y.	30
Pervious Structure Backfill	C.Y.	200
Sedimentation Control System	L.F.	140
Processed Aggregate Base	Ton	40
Superpave 0.375"	Ton	15
Superpave 0.500"	Ton	15
Class "A" Concrete	C.Y.	55
Precast Concrete Arches	L.S.	1
Deformed Steel Bars	LB.	6600
Deformed Steel Bars - Epoxy Coated	LB.	1900
Membrane Waterproofing (Woven Glass Fabric)	S.Y.	80
Sand Cushion (Bridge)	C.Y.	14
Dampproofing	S.Y.	72
Temporary Sheet Piling	S.F.	4800
Sheet Piling Material Left In Place	S.F.	2400

CONCRETE DISTRIBUTION		
Superstructure (Parapets)	C.Y.	15
Substructure (Wingwalls)	C.Y.	0
Footings	C.Y.	40
TOTAL	C.Y.	55

GENERAL NOTES

SPECIFICATIONS: Connecticut Department of Transportation Form 816 (2004), Supplemental Specifications dated January 2008, and Special Provisions.

DESIGN SPECIFICATIONS: AASHTO LRFD Bridge Design Specifications (AASHTO 2004), with the Interim Specifications up to and including 2008, as supplemented by the Connecticut Department of Transportation Bridge Design Manual (2003).

ALLOWABLE DESIGN STRESSES:

Class "A" — Based on f'c = 3000 psi.

Reinforcement (ASTM A615 Grade 60) — f_y = 60 ksi.

LIVE LOAD: HL - 93

FUTURE PAVING ALLOWANCE: None

FOUNDATION PRESSURES AND PILE LOADS: The various Limit State Load Combinations noted on the substructure plan sheets refer to the Load Combinations and Load Factors as given in the AASHTO LRFD Bridge Design Specifications.

DIMENSIONS: All dimensions shown on the plans are in inches unless noted otherwise. All elevations are given in feet. When elevations are given to less than three decimal places, the omitted digits shall be assumed to be zeros.

REMAIN-IN-PLACE FORMS: The use of remain in place forms on this structure is not allowed.

CLASS "A" CONCRETE: Class "A" Concrete shall be used for the cast-in-place Concrete Arch Footings, Parapets, and Wingwalls.

JOINT SEAL: See Special Provisions.

EXPOSED EDGES: Exposed edges of concrete shall be beveled 1" x 1" unless dimensioned otherwise.

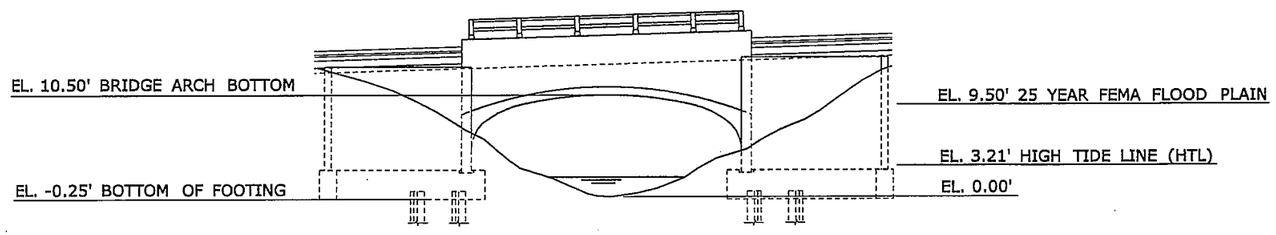
CONCRETE COVER: All reinforcement shall have 2" clear cover unless dimensioned otherwise.

REINFORCEMENT: All reinforcement shall be ASTM A615 Grade 60.

EPOXY COATED REINFORCING BARS: All reinforcement in the Parapets, including the wingwall parapets, shall be epoxy coated unless otherwise noted. These bars shall be included in the pay item for "Deformed Steel Bars - Epoxy Coated."

PREFORMED EXPANSION JOINT FILLER: The cost of furnishing and installing Preformed Expansion Joint Filler shall be included in the cost of the item "Class 'A' Concrete."

CONSTRUCTION JOINTS: Construction joints, other than those shown on the plans, will not be permitted without the prior approval of the Engineer.



ELEVATION (LOOKING SOUTH)

SCALE : 1"=20'

NOTICE TO BRIDGE INSPECTORS

The Department's Bridge Safety procedures require this bridge to be inspected for , but not limited to , all appropriate components indicated in the governing manuals for bridge inspection. Attention must be given to inspecting the following special components and details. (The listing for components for specific attention shall not be construed to reduce the importance of inspection of any other component of the structure.) The frequency of inspection of this structure shall be in accordance with the governing manuals for bridge inspection, unless otherwise directed by the Manager of Bridge Safety and Evaluation

Component or Detail	Structure Sheet Reference

LEGEND

- = EXISTING GRADE
- = PROPOSED GRADE
- = WATERCOURSE LIMITS
- HTL — HTL = HIGH TIDE LINE (3.21' NVGD)
- = WETLAND LIMITS
- = EXISTING FEMA FLOODPLAIN BOUNDARY
- = PROPOSED FEMA FLOODPLAIN BOUNDARY

SCALE IN FEET

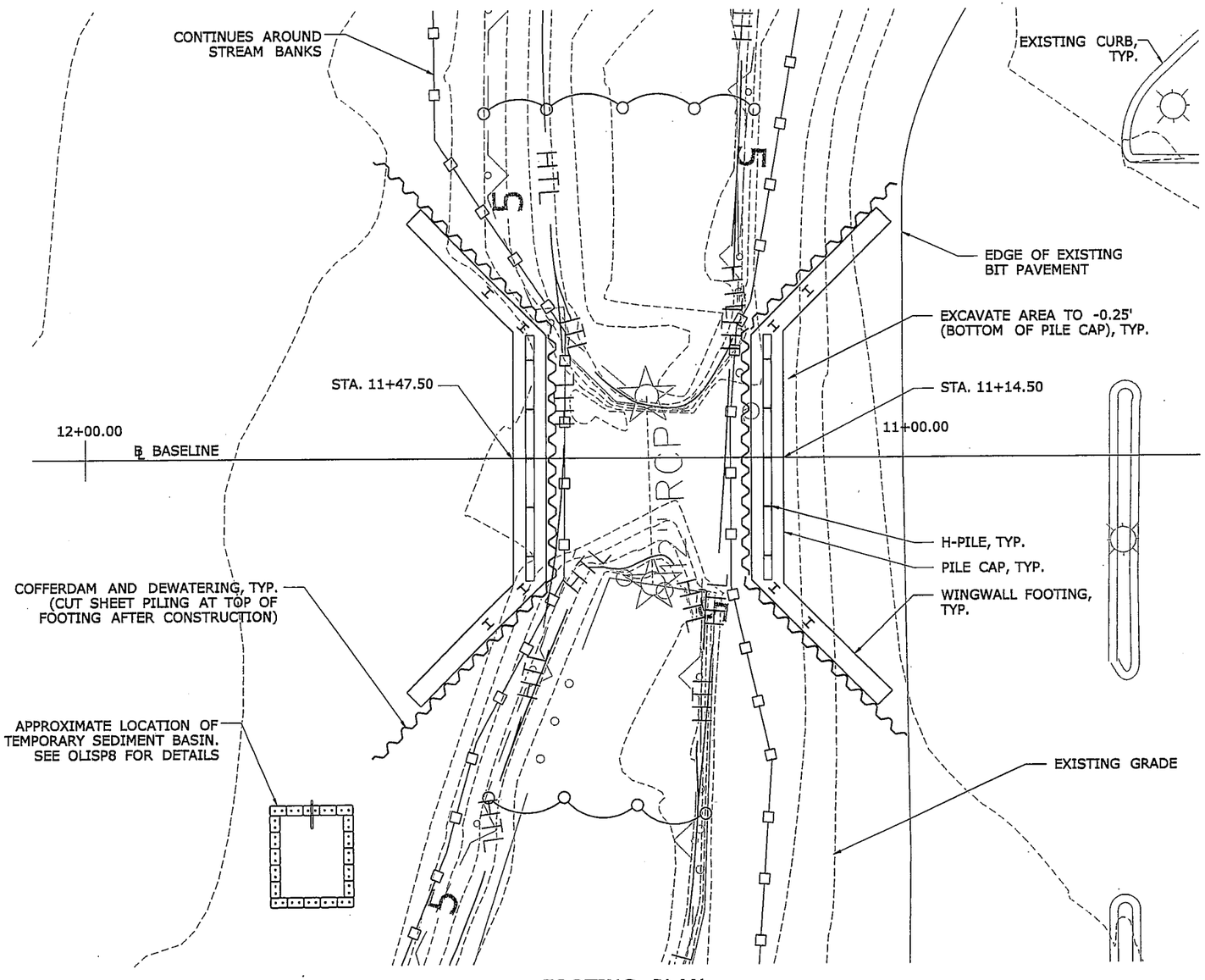
0 15 30

SCALE 1"=30'

CONNECTICUT COORDINATE GRID

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

PROJECT TITLE: SHORE LINE EAST RAILROAD STATIONS	Baker — BAKER ENGINEERING NY, INC. 2096-B BLAS DEANE HIGHWAY ROCKY HILL, CT 06067
TOWN: BRANFORD	PROJECT NO. 310-0047/0048
TITLE: BRANFORD PARKING LOT BRIDGE PLAN	DATE: MAY 5, 2008
	FIG. NO. BRP_S-100



FOOTING PLAN

NOTES

1. ALL EARTH MATERIAL DREDGED DURING REMOVAL OF EXISTING 12" RCP SHALL BE PLACED IN A DEWATERING CONTAINMENT AREA FOR DEWATERING EARTH MATERIALS AS SPECIFIED IN THE 2002 CONNECTICUT GUIDELINES FOR SOIL EROSION AND SEDIMENT CONTROL.

LEGEND

- = WATERCOURSE LIMITS
- HTL — HTL = HIGH TIDE LINE (3.21' NVGD)
- = WETLAND LIMITS
- = SEDIMENT CONTROL SYSTEM
- = TURBITITY CURTAIN

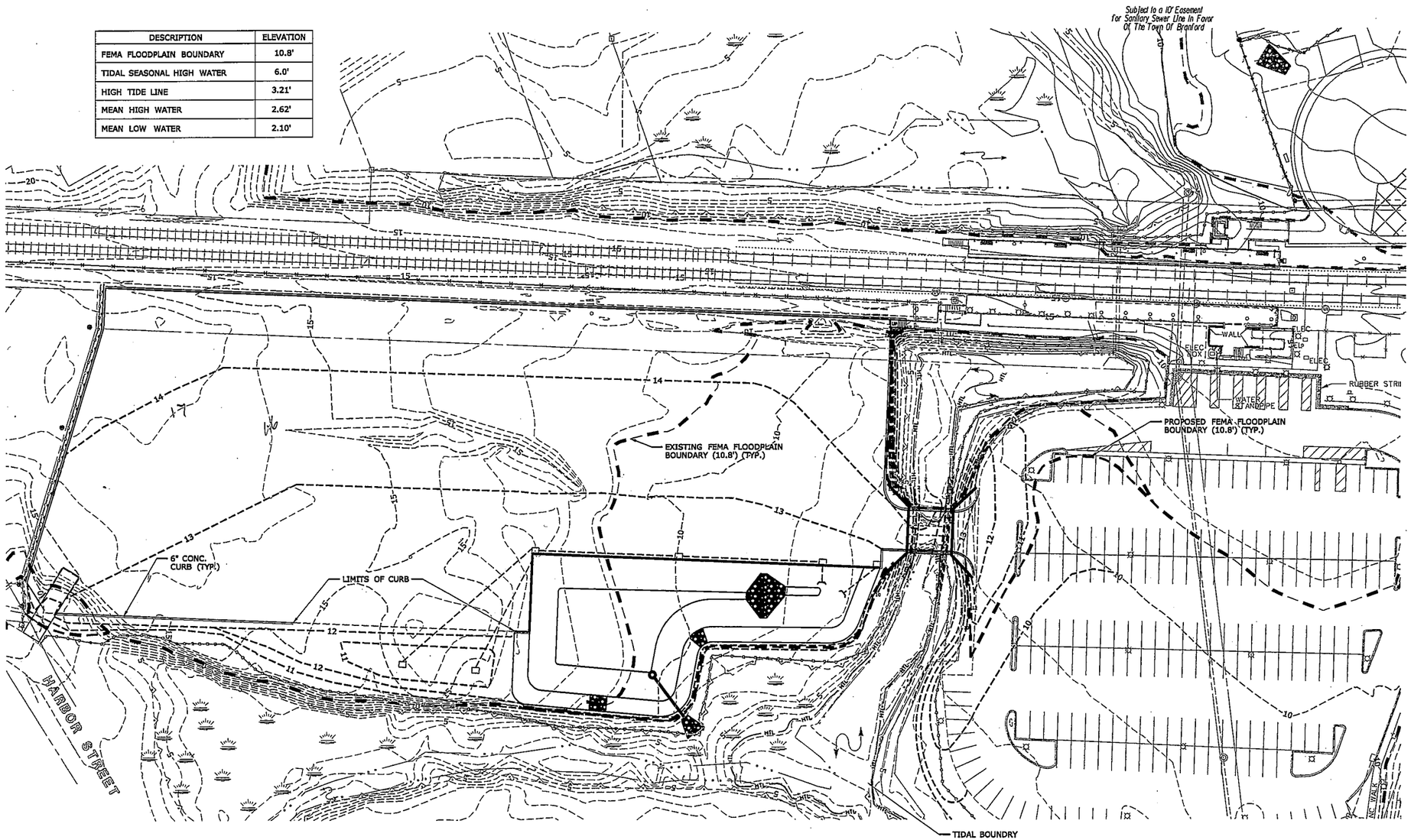
SCALE IN FEET
0 10 20
SCALE 1"=20'

N COORDINATE GRID CONNECTICUT

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

PROJECT TITLE: SHORE LINE EAST RAILROAD STATIONS	Baker — BAKER ENGINEERING NY, INC. 2095-B SILAS DEANE HIGHWAY ROCKY HILL, CT 06067
TOWN: BRANFORD	PROJECT NO. 310-0047/0048
TITLE: BRANFORD PARKING LOT CULVERT FOOTING PLAN	DATE: JUNE 2008
	FIG. NO. OLISP7

DESCRIPTION	ELEVATION
FEMA FLOODPLAIN BOUNDARY	10.8'
TIDAL SEASONAL HIGH WATER	6.0'
HIGH TIDE LINE	3.21'
MEAN HIGH WATER	2.62'
MEAN LOW WATER	2.10'



LEGEND

- = EXISTING GRADE
- = PROPOSED GRADE
- = WATERCOURSE LIMITS
- HTL — HTL = HIGH TIDE LINE (3.21' NVGD)
- = WETLAND LIMITS
- = EXISTING FEMA FLOODPLAIN BOUNDARY
- = PROPOSED FEMA FLOODPLAIN BOUNDARY

SCALE IN FEET

0 100 200

N

COORDINATE GRID

CONNECTICUT

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

PROJECT TITLE: SHORE LINE EAST RAILROAD STATIONS	Baker — BAKER ENGINEERING NY, INC. 2206-B SILAS DEANE HIGHWAY ROCKY HILL, CT 06067
TOWN: BRANFORD	PROJECT NO. 310-0047/0048
TITLE: BRANFORD PARKING LOT GRADING PLAN	DATE: MAY 5, 2008
	FIG. NO. BRP_C-105

Appendix 2

Boring Logs

Driller: Oren Cone	**Connecticut DOT Boring Report**	Hole No.: BIT-1
Inspector: Bob Marshall	Town: Branford	Stat./Offset:
Engineer: Geo**Design**, Inc.	Project No.: 310-0007	Northing:
Start Date: 4-3-08	Route No.:	Easting:
Finish Date: 4-3-08	Bridge No.:	Surface Elevation: 14
Project Description:		
Casing Size/Type: 4" FJ	Sampler Type/Size: SS 1 3/8" ID	Core Barrel Type:
Hammer Wt.: 300lb Fall: 24in.	Hammer Wt.: 140lb Fall: 30in.	
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	S-1	4 10 12 5	24	18		Topsoil Fill	Medium dense, brown Top 6": TOPSOIL Bottom 12": fine to medium SAND, little Silt, trace fine to coarse Gravel	
	S-2	10 10 11 9	24	3			Medium dense, brown fine to medium SAND, little Silt, trace fine to coarse Gravel	10
5	S-3	10 11 7 5	24	6			Medium dense, brown fin to medium SAND, little fine to coarse Gravel, little Silt, trace Brick fragments	
	S-4	2 10 19 22	24	6			Medium dense, brown fin to medium SAND, little fine to coarse Gravel, little Silt, trace Brick fragments	5
10	S-5	16 19 16 17	24	7		Gravelly Silty Sand	Dense, red brown fine to medium SAND, some fine to coarse Gravel, some Silt	
							END OF BORING 13ft	0
15								
								-5
20								
								-10
25								

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: 13ft Rock: ft	NOTES: Casing refusal at 13 feet below grade.	Sheet 1 of 1
No. of Soil Samples: 5 No. of Core Runs: ---		SM-001-M REV. 1/02

Driller: Oren Cone	**Connecticut DOT Boring Report**	Hole No.: BIT-2
Inspector: Bob Marshall	Town: Branford	Stat./Offset:
Engineer: Geo**Design**, Inc.	Project No.: 310-0007	Northing:
Start Date: 4-3-08	Route No.:	Easting:
Finish Date: 4-3-08	Bridge No.:	Surface Elevation: 13
Project Description:		
Casing Size/Type: 4" FJ/3 1/4" HSA	Sampler Type/Size: SS 1 3/8" ID	Core Barrel Type:
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.	
Groundwater Observations: @12.2		

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	4 3 4 4	24	6		Topsoil Fill	Loose, brown Top 4": TOPSOIL Bottom 2": fine to medium SAND, little Silt, trace fine Gravel	
	S-2	6 10 11 11	24	3			Medium dense, orange brown fine to medium SAND, little Sit, trace Wood fragments	10
5	S-3	25 20 11 5	24	7			Dense, brown fine to medium SAND, some Silt, little Ash/Cinders	
	S-4	22 19 16 14	24	6			Dense, brown fine to medium SAND, little SIlt, little Brick fragments, trace Ash/Cinders	5
10	S-5	2 6 5 3	24	24			Medium dense, Top 18": dark brown fine to medium SAND, little Silt, trace Ash/Cinders gray brown ORGANIC SILT and PEAT	
	S-6	1 2 4 4	24	24		Organic Silt with Organic Fibers	Loose, gray ORGANIC SILT with interbedded Organic Fibers	0
15	S-7	7 12 36 50/4"	22	22		Gravelly Silty Sand	Very dense Top 12": dark brown to black fine to medium SAND, little Silt brown to orange brown fine to coarse SAND and fine to coarse GRAVEL (tip of spoon), little Silt	-5
20	S-8	24 27 76 81	24	20			Very dense, Top 10": red brown fine to coarse SAND, trace Silt Bottom 10": fine to medium SAND, some Silt, little fine to coarse Gravel	
							END OF BORING 22ft	-10
25								

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: 22ft Rock: ft	NOTES: Falling head test attempted at 4.2 feet with leakage around outside casing. Relocated 5 feet north with similar leakage. Water level in augers 10 minutes after completion of boring measured 12.2 feet and rising.	Sheet 1 of 1
No. of Soil Samples: 8 No. of Core Runs: ---		SM-001-M REV. 1/02

Driller: Oren Cone	**Connecticut DOT Boring Report**		Hole No.: BIT-3
Inspector: Bob Marshall	Town: Branford		Stat./Offset:
Engineer: Geo**Design**, Inc.	Project No.: 310-0007		Northing:
Start Date: 4-3-08	Route No.:		Easting:
Finish Date: 4-4-08	Bridge No.:		Surface Elevation: 14
Project Description:			
Casing Size/Type: 3 1/4" HSA	Sampler Type/Size: SS 1 3/8" ID		Core Barrel Type:
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
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	S-1	6 6 6 10	24	18		Topsoil / Fill	Medium dense, brown Top 2": TOPSOIL Bottom 16": brown fine to medium SAND, some Silt, trace fine Gravel, trace Ash/Cinders	
	S-2	11 12 14 19	24	6			Medium dense, brown fine to medium SAND, little Silt, trace Ash/Cinders	10
5	S-3	14 18 19 19	24	5			Dense, brown fine to medium SAND, some Silt, trace Ash/Cinders	
	S-4	18 22 24 31	24	0			Dense, no recovery	5
10	S-5	24 22 21 30	24	12		Silty Gravelly Sand	Dense, red brown fine to medium SAND, little Silt	
	S-6	18 24 26 32	24	16			Very dense, red brown fine to medium SAND, little fine Gravel, trace (+) Silt	0
15	S-7	100/0"	0	0			END OF BORING 15ft	
20								-5
25								-10

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: 15ft Rock: ft	NOTES: Falling head test performed at 4 feet. Boring relocated 4 feet north following falling head test. Spoon and auger refusal at 15 feet below grade. Hole collapsed to 7 feet upon auger removal.	Sheet 1 of 1
No. of Soil Samples: 6 No. of Core Runs: ---		SM-001-M REV. 1/02

Driller: Oren Cone	**Connecticut DOT Boring Report**		Hole No.: BIT-5
Inspector: Bob Marshall	Town: Branford		Stat./Offset:
Engineer: Geo**Design**, Inc.	Project No.: 310-0007		Northing:
Start Date: 4-7-08	Route No.:		Easting:
Finish Date: 4-7-08	Bridge No.:		Surface Elevation: 13
Project Description:			
Casing Size/Type: 4" FJ/3 1/4" HSA	Sampler Type/Size: SS 1 3/8" ID		Core Barrel Type:
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @9			

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 3 5 4	24	18		Topsoil Fill	Loose, Top 6": TOPSOIL Bottom 12": brown fine to medium SAND, some (-) Silt, little fine to coarse Gravel	
	S-2	5 7 7 18	24	9			Loose, black to orange brown ASH/SLAG, little fine to medium Sand, little Silt	10
5	S-3	6 7 8 11	24	12			Medium dense, brown fine to medium SAND, little Silt, trace fine Gravel, trace Brick fragments	
	S-4	9 7 3 3	24	1			Loose, brown fine to medium SAND, little Silt	5
10	S-5	1 2 2 1	24	20		Peat	Very loose, gray/black ORGANIC SILT and PEAT	
	S-6	2 2 4 4	24	20		Organic Silt with Organic Fibers	Loose, gray ORGANIC SILT with interbedded Organics	0
15	S-7	3 6 5 18	24	18		Clayey Silt Silty Sand	Stiff, Top 12": red-brown Clayey SILT, trace fine Gravel, trace fine to medium Sand Bottom 6": orange-brown fine to medium SAND, trace fine to coarse Gravel, trace Silt	-5
20	S-8	50/1"	1	0			Very dense, spoon refusal END OF BORING 20.1ft	-10
25								

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: 20.1ft Rock: ft	NOTES: Falling head test performed at 5 feet. Auger refusal at 20.1 feet. Borehole collapsed to 9 feet upon casing removal.	Sheet 1 of 1
No. of Soil Samples: 7 No. of Core Runs: ---		SM-001-M REV. 1/02

Driller: Tim Carpenter	**Connecticut DOT Boring Report**	Hole No.: BR-10
Inspector: Bob Marshall	Town: Branford	Stat./Offset:
Engineer: Geo**Design**, Inc.	Project No.: 310-0007	Northing:
Start Date: 4-7-08	Route No.:	Easting:
Finish Date: 4-7-08	Bridge No.:	Surface Elevation: 15
Project Description:		
Casing Size/Type: 3 1/4" HSA	Sampler Type/Size: SS 1 3/8" ID	Core Barrel Type:
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.	

Groundwater Observations: @9' - wet sample, @7' - after boring completion

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		15
	S-1	7 14 23 36	24	3			Dense, black fine to medium SAND and ASH, trace coarse Gravel, trace Cinders, trace Organics	
	S-2	11 17 21 42	24	3			Dense, black ASH, some fine to medium Sand, little Cinders, little Slag, trace Organics	
5								10
	S-3	4 2 5 4	24	6			Loose, black ASH, little Organic Silt, trace Organic Fibers	
	S-4	5 4 7 8	24	6			Medium dense, black ASH, some Organic Silt, little fine to coarse Gravel-sized Cinders	
10								5
	S-5	3 4 4 4	24	12			Loose, black ASH, little Organic Silt, trace Glass fragments, trace Wood fragments	
	S-6	4 6 6 6	24	18			Medium dense, black ASH, little Organic Silt	
15								0
	S-7	3 4 3 4	24	18		Peat	Loose, Top 9": black ASH, little Organic Silt Bottom 9": blackish brown PEAT	
	S-8	4 4 4 4	24	6			Loose, blackish brown PEAT	
20						Silty Sand		-5
	S-9	4 6 8 10	24	20			Medium dense, red-brown fine to medium SAND, little (+) Silt	
	S-10	9 9 10 11	24	12			Medium dense, red-brown fine to medium SAND, little Silt	
25								-10

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: 27ft Rock: ft	NOTES:	Sheet 1 of 2
No. of Soil Samples: 11 No. of Core Runs: ---		SM-001-M REV. 1/02

Driller: Tim Carpenter	**Connecticut DOT Boring Report**		Hole No.: BR-10
Inspector: Bob Marshall	Town: Branford		Stat./Offset:
Engineer: Geo**Design**, Inc.	Project No.: 310-0007		Northing:
Start Date: 4-7-08	Route No.:		Easting:
Finish Date: 4-7-08	Bridge No.:		Surface Elevation: 15
Project Description:			
Casing Size/Type: 3 1/4" HSA	Sampler Type/Size: SS 1 3/8" ID		Core Barrel Type:
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		

Groundwater Observations: @9' - wet sample, @7' - after boring completion

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)
25	S-11	5 11 16 14	24	18		Silty Sand *(con't)*	Medium dense, red-brown fine to medium SAND, little (-) Silt, trace (-) fine Gravel	-10
							END OF BORING 27ft	
30								-15
35								-20
40								-25
45								-30
50								-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: 27ft Rock: ft	NOTES:	Sheet 2 of 2
No. of Soil Samples: 11 No. of Core Runs: ---		SM-001-M REV. 1/02

Driller: Tim Carpenter	**Connecticut DOT Boring Report**	Hole No.: BR-11
Inspector: Bob Marshall	Town: Branford	Stat./Offset:
Engineer: Geo**Design**, Inc.	Project No.: 310-0007	Northing:
Start Date: 4-4-08	Route No.:	Easting:
Finish Date: 4-7-08	Bridge No.:	Surface Elevation: 15
Project Description:		
Casing Size/Type: 3 1/4" HSA	Sampler Type/Size: SS 1 3/8" ID	Core Barrel Type:
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.	
Groundwater Observations: @9		

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								15
	S-1	6 12 21 30	24	18		Fill	Dense, black fine to medium SAND, some Silt, little Ash, little Cinders, trace Brick fragments	
	S-2	10 9 7 7	24	9			Medium dense, black ASH/CINDERS, little Silt, trace Brick fragments	
5								10
	S-3	4 4 6 7	24	18			Medium dense, black ASH/CINDERS, little Organic Silt, trace fine Sand, trace (-) Organics	
	S-4	6 11 29 36	24	9			Dense, black ASH, little Organic Silt, trace fine Sand, trace fine to coarse gravel-size Cinders	
10								5
	S-5	7 12 19 30	24	18			Dense, ASH, little Organic Silt, trace fine gravel-size Cinders	
	S-6	25 29 36 41	24	18			Very dense, black ASH, some Organic Silt	
15								0
	S-7	11 5 4 6	24	24			Loose, Top 12": black ASH/CINDERS, some Organic Silt, trace Organics	
						Organic Silt with Organic Fibers	Bottom 12": gray ORGANIC SILT with interbedded Organic fibers	
	S-8	4 5 5 6	24	24			Medium dense, gray ORGANIC SILT with interbedded Organic fibers	
20								-5
						Sandy Silt		
	S-9	6 5 7 7	24	18			Medium dense, red-brown SILT, trace fine Sand	
						Silty Sand		
	S-10	8 9 10 12	24	20			Medium dense, red-brown fine to medium SAND, some Silt	
25								-10

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	NOTES:	Sheet 1 of 2
Earth: 27ft Rock: ft		
No. of Soil Samples: 11 No. of Core Runs: ---		SM-001-M REV. 1/02

Driller: Tim Carpenter	**Connecticut DOT Boring Report**		Hole No.: BR-11
Inspector: Bob Marshall	Town: Branford		Stat./Offset:
Engineer: Geo**Design**, Inc.	Project No.: 310-0007		Northing:
Start Date: 4-4-08	Route No.:		Easting:
Finish Date: 4-7-08	Bridge No.:		Surface Elevation: 15
Project Description:			
Casing Size/Type: 3 1/4" HSA	Sampler Type/Size: SS 1 3/8" ID		Core Barrel Type:
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @9			

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)
25	S-11	10 9 10 11	24	20		Silty Sand *(con't)*	Medium dense, red-brown fine SAND, some Silt	-10
							END OF BORING 27ft	
30								-15
35								-20
40								-25
45								-30
50								-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: 27ft Rock: ft	NOTES:	Sheet 2 of 2
No. of Soil Samples: 11 No. of Core Runs: ---		SM-001-M REV. 1/02

Driller: Tim Carpenter	**Connecticut DOT Boring Report**	Hole No.: BR-12
Inspector: Bob Marshall	Town: Branford	Stat./Offset:
Engineer: Geo**Design**, Inc.	Project No.: 310-0007	Northing:
Start Date: 4-7-08	Route No.:	Easting:
Finish Date: 4-8-08	Bridge No.:	Surface Elevation: 13
Project Description:		
Casing Size/Type: 3 1/4" HSA	Sampler Type/Size: SS 1 3/8" ID	Core Barrel Type:
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.	
Groundwater Observations: @6		

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	9 14 36 25	24	12			Dense, black ASH/CINDERS, trace Organics	
	S-2	14 21 38 52	24	14			Very dense, black ASH	10
5	S-3	50/0"	0	0			Spoon refusal/no penetration/no recovery	
	S-4	32 56 88	18	0			Very dense, no recovery	5
10	S-5	7 3 2 3	24	12			Loose, black ASH, little Organic Silt, trace Cinders	
	S-6	16 4 3 2	24	18			Loose, Top 16": black ASH, trace Cinders, trace Organics Bottom 2": gray-black ORGANIC SILT with Organic fibers	0
						Organic Silt with Organic Fibers		
15	S-7	1/12" 1 1	24	18			Very loose, gray ORGANIC SILT with interbedded Organic fibers	
	S-8	1 1 1 1	24	24			Very loose, gray ORGANIC SILT with interbedded Organic fibers	-5
20	S-9	2 1 2 3	24	24		Peat	Very loose, Top 6": ORGANIC SILT Middle 12": dark brown PEAT Bottom 6": fine to medium SAND, some Silt	
						Silty Sand		
	S-10	2 3 5 13	24	16			Loose, gray fine to medium SAND, some Silt	-10
25								

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: 27ft Rock: ft	NOTES:	Sheet 1 of 2
No. of Soil Samples: 9 No. of Core Runs: ---		SM-001-M REV. 1/02

Driller: Tim Carpenter	**Connecticut DOT Boring Report**		Hole No.: BR-12
Inspector: Bob Marshall	Town: Branford		Stat./Offset:
Engineer: Geo**Design**, Inc.	Project No.: 310-0007		Northing:
Start Date: 4-7-08	Route No.:		Easting:
Finish Date: 4-8-08	Bridge No.:		Surface Elevation: 13
Project Description:			
Casing Size/Type: 3 1/4" HSA	Sampler Type/Size: SS 1 3/8" ID		Core Barrel Type:
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @6			

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)
25	S-11	6 10 12 12	24	18		Silty Sand *(con't)*	Medium dense, gray fine to medium SAND, little Silt, trace fine Gravel	
							END OF BORING 27ft	-15
30								-20
35								-25
40								-30
45								-35
50								

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: 27ft Rock: ft	NOTES:	Sheet 2 of 2
No. of Soil Samples: 9 No. of Core Runs: ---		SM-001-M REV. 1/02

Driller: Tim Carpenter	**Connecticut DOT Boring Report**		Hole No.: BR-13
Inspector: Bob Marshall	Town: Branford		Stat./Offset:
Engineer: Geo**Design**, Inc.	Project No.: 310-0007		Northing:
Start Date: 4-8-08	Route No.:		Easting:
Finish Date: 4-8-08	Bridge No.:		Surface Elevation: 12
Project Description:			
Casing Size/Type: 3 1/4" HSA	Sampler Type/Size: SS 1 3/8" ID		Core Barrel Type:
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @6			

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 7 10 13	24	20		Fill	Medium dense, brown/black/green ASH, little Cinders, trace Organics	
	S-2	12 14 21 24	24	22			Dense, black ASH, trace Cinders	10
5	S-3	5 10 6 5	24	4			Medium dense, black ASH, some Cinders, some Slag	
	S-4	5 20 25 2	24	2			Dense, black SLAG/CINDERS, little Ash	5
10	S-5	3 10 3 5	24	12			Medium dense, Top 6": black ASH/CINDERS Bottom 6": gray ORGANIC SILT, trace Organic fibers	0
						Organic Silt with Organic Fibers		
	S-6	2 2 2 2	24	20			Loose, gray ORGANIC SILT with interbedded Organic fibers	
15	S-7	1/12" 1 1	24	24			Very loose, gray ORGANIC SILT, trace Seashell fragments, trace Organic fibers	
	S-8	1 2 1 1	24	16			Very loose, gray ORGANIC SILT, trace Organic fibers	-5
20	S-9	1 1 2 3	24	24			Very loose, Top 12": gray ORGANIC SILT Bottom 12": brown PEAT	
						Peat		-10
	S-10	3 3 4 4	24	24			Loose, Top 12": brown PEAT Bottom 12": gray SILT, little fine to medium Sand	
						Sandy Silt		
						Silty Sand		
25								

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: ft	NOTES:	Sheet 1 of 2
No. of Soil Samples: 12 No. of Core Runs: ---		SM-001-M REV. 1/02

Driller: Tim Carpenter	**Connecticut DOT Boring Report**		Hole No.: BR-13
Inspector: Bob Marshall	Town: Branford		Stat./Offset:
Engineer: Geo**Design**, Inc.	Project No.: 310-0007		Northing:
Start Date: 4-8-08	Route No.:		Easting:
Finish Date: 4-8-08	Bridge No.:		Surface Elevation: 12
Project Description:			
Casing Size/Type: 3 1/4" HSA	Sampler Type/Size: SS 1 3/8" ID		Core Barrel Type:
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @6			

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)
25	S-11	13 12 4 4	24	18		Silty Sand *(con't)* / Sandy Silt	Medium dense, Top 2": gray-brown fine SAND, some Silt Bottom 16": gray-brown SILT, trace fine Sand	-15
30	S-12	5 8 11 12	24	20			Medium dense, red-brown SILT, trace fine Sand	-20
							END OF BORING 32ft	
35								-25
40								-30
45								-35
50								

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: ft	NOTES:	Sheet 2 of 2
No. of Soil Samples: 12 No. of Core Runs: ---		SM-001-M REV. 1/02

Driller: Tim Carpenter	**Connecticut DOT Boring Report**		Hole No.: BR-14
Inspector: Bob Marshall	Town: Branford		Stat./Offset:
Engineer: Geo**Design**, Inc.	Project No.: 310-0007		Northing:
Start Date: 4-9-08	Route No.:		Easting:
Finish Date: 4-9-08	Bridge No.:		Surface Elevation: 9
Project Description:			
Casing Size/Type: 3 1/4" HSA	Sampler Type/Size: SS 1 3/8" ID		Core Barrel Type:
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @7			

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 4	24	6		Fill	Loose, black ASH, little fine to medium Sand, trace Cinders, trace Organics	
	S-2	6 11 25 30	24	15			Dense, blackish gray ASH and fine to medium SAND, trace Cinders	5
5	S-3	14 16 16 12	24	20			Dense, black ASH and CINDERS, little fine to medium Sand	
	S-4	8 10 10 5	24	2			Medium dense, black CINDERS, some fine Gravel, little Ash, little fine to medium Sand	0
10	S-5	5 9 4 1	24	12			Medium dense, Top 9": black ASH and fine to medium SAND, little Cinders Bottom 3": gray SILT, little Organics	
	S-6	1 1 2 2	24	20		Organic Silt with Interbedded Organics	Very loose, gray ORGANIC SILT with interbedded Organics	-5
15	UP-1	P U S H	24	18			Gray ORGANIC SILT with interbedded Organics	
	S-7	1 1 1 1	24	20			Very loose, gray ORGANIC SILT with interbedded Organics	-10
20	S-8	1 2 2 4	24	24		Peat	Loose, brown PEAT	
	S-9	3 3 4 4	24	12		Sandy Silt	Loose, Top 6": brown PEAT Bottom 6": gray SILT, some fine to medium Sand	-15
25								

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: ft	NOTES:	Sheet 1 of 2
No. of Soil Samples: 12 No. of Core Runs: ---		SM-001-M REV. 1/02

Driller: Tim Carpenter	**Connecticut DOT Boring Report**		Hole No.: BR-14
Inspector: Bob Marshall	Town: Branford		Stat./Offset:
Engineer: Geo**Design**, Inc.	Project No.: 310-0007		Northing:
Start Date: 4-9-08	Route No.:		Easting:
Finish Date: 4-9-08	Bridge No.:		Surface Elevation: 9
Project Description:			
Casing Size/Type: 3 1/4" HSA	Sampler Type/Size: SS 1 3/8" ID		Core Barrel Type:
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @7			

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)
25	S-10	7 11 12 12	24	24		Silty Sand	Medium dense, Top 18": gray fine to medium SAND, some Silt Bottom 6": fine to medium SAND, little (-) Silt	
						Silt		-20
30	S-11	5 5 6 6	24	24			Medium dense, red-brown SILT, trace (-) fine Sand	
							END OF BORING 32ft	
								-25
35								
								-30
40								
								-35
45								
								-40
50								

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: ft	NOTES:	Sheet 2 of 2
No. of Soil Samples: 12 No. of Core Runs: ---		SM-001-M REV. 1/02

Driller: Tim Carpenter	**Connecticut DOT Boring Report**	Hole No.: BR-15
Inspector: Bob Marshall	Town: Branford	Stat./Offset:
Engineer: Geo**Design**, Inc.	Project No.: 310-0007	Northing:
Start Date: 4-8-08	Route No.:	Easting:
Finish Date: 4-8-08	Bridge No.:	Surface Elevation: 14
Project Description:		
Casing Size/Type: 3 1/4" HSA	Sampler Type/Size: SS 1 3/8" ID	Core Barrel Type:
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.	
Groundwater Observations: @9		

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 3 5 5	24	12		Fill	Loose, gray-black ASH, trace Cinders, trace Organic fibers	
	S-2	50/0"	0	0			Very dense, spoon refusal	
								10
5	S-3	16 60 40 19	24	24			Very dense, black ASH/CINDERS	
	S-4	10 41 30 23	24	16			Very dense, black ASH/CINDERS	
								5
10	S-5	2 1/12" 1	24	2			Very loose, black CINDERS, some ASH	
	S-6	3 7 6 6	24	12			Medium dense, black ASH, trace Cinders	
								0
15	S-7	4 4 5 6	24	6			Loose, black ASH, some fine to coarse Sand, little fine Gravel	
	S-8	6 4 3 3	24	20			Loose, Top 10": black ASH/CINDERS Bottom10": black fibrous PEAT	
						Peat		-5
20	S-9	2 1 2 2	24	18		Sandy Silt	Very loose, Top 12": black fine to medium SAND, some Silt Bottom 6": gray/black SILT, little fine Sand	
	S-10	8 8 10 13	24	20		Silty Sand	Medium dense, brown fine to medium SAND, little to some Silt	
								-10
25								

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: 27ft Rock: ft	NOTES: Augered beyond obstructions in fill prior to 5 foot sample	Sheet 1 of 2
No. of Soil Samples: 10 No. of Core Runs: ---		SM-001-M REV. 1/02

Driller: Tim Carpenter	**Connecticut DOT Boring Report**	Hole No.: BR-15
Inspector: Bob Marshall	Town: Branford	Stat./Offset:
Engineer: Geo**Design**, Inc.	Project No.: 310-0007	Northing:
Start Date: 4-8-08	Route No.:	Easting:
Finish Date: 4-8-08	Bridge No.:	Surface Elevation: 14
Project Description:		
Casing Size/Type: 3 1/4" HSA	Sampler Type/Size: SS 1 3/8" ID	Core Barrel Type:
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.	
Groundwater Observations: @9		

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)
25	S-11	6 10 7 10	24	18		Silty Sand *(con't)*	Medium dense, brown fine to medium SAND, little Silt	
							END OF BORING 27ft	
								-15
30								
								-20
35								
								-25
40								
								-30
45								
								-35
50								

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: 27ft Rock: ft	NOTES: Augered beyond obstructions in fill prior to 5 foot sample	Sheet 2 of 2
No. of Soil Samples: 10 No. of Core Runs: ---		SM-001-M REV. 1/02

Driller: Tim Carpenter	**Connecticut DOT Boring Report**		Hole No.: BR-16
Inspector: Bob Marshall	Town: Branford		Stat./Offset:
Engineer: Geo**Design**, Inc.	Project No.: 310-0007		Northing:
Start Date: 4-4-08	Route No.:		Easting:
Finish Date: 4-4-08	Bridge No.:		Surface Elevation: 13
Project Description:			
Casing Size/Type: 3 1/4" HSA	Sampler Type/Size: SS 1 3/8" ID		Core Barrel Type:
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @6			

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		
	S-1	7 1 31 37	24	18			Dense,black ASH, little fine Sand, little Silt	
	S-2	93	12	678			Very dense, black ASH, little fine Sand, trace Brick fragments	10
5								
	S-3	21 24 30 52	24	3			Very dense, gray black fine SAND, some Silt	
	S-4	20 27 36 42	24	0			Very dense, no recovery	5
10								
	S-5	10 7 9 11	24	0			Medium dense, no recovery	
	S-6	11 10 10 16	24	0			Medium dense, no recovery	0
15								
	S-7	10 7 7 8	24	18			Medium dense, black ASH, little fine Sand, trace Organic fibers	
	S-8	3 3 4 4	24	24		Peat	Loose, Top 12": black ASH, little fine Sand, trace Organic fibers Bottom 12": brown PEAT	-5
20								
	S-9	2 3 3 3	24	24		Sandy Silt	Loose, Top 12": black/brown PEAT Bottom 12": gray fine to medium SAND, little Silt	
	S-10	3 7 9 9	24	18			Medium dense, Top 17": gray fine SAND, some Silt Bottom 1": red brown SILT, little fine Sand	-10
25								

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: 27ft Rock: ft	NOTES:	Sheet 1 of 2
No. of Soil Samples: 11 No. of Core Runs: ---		SM-001-M REV. 1/02

Driller: Tim Carpenter	**Connecticut DOT Boring Report**		Hole No.: BR-16
Inspector: Bob Marshall	Town: Branford		Stat./Offset:
Engineer: Geo**Design**, Inc.	Project No.: 310-0007		Northing:
Start Date: 4-4-08	Route No.:		Easting:
Finish Date: 4-4-08	Bridge No.:		Surface Elevation: 13
Project Description:			
Casing Size/Type: 3 1/4" HSA	Sampler Type/Size: SS 1 3/8" ID		Core Barrel Type:
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @6			

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)
25	S-11	3 3 4 4	24	20		Sandy Silt *(con't)*	Loose, red brown SILT, trace fine Sand	
							END OF BORING 27ft	-15
30								-20
35								-25
40								-30
45								-35
50								

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: 27ft Rock: ft	NOTES:	Sheet 2 of 2
No. of Soil Samples: 11 No. of Core Runs: ---		SM-001-M REV. 1/02

Driller: Tim Carpenter	**Connecticut DOT Boring Report**		Hole No.: BR-17
Inspector: Bob Marshall	Town: Branford		Stat./Offset:
Engineer: Geo**Design**, Inc.	Project No.: 310-0007		Northing:
Start Date: 4-3-08	Route No.:		Easting:
Finish Date: 4-3-08	Bridge No.:		Surface Elevation: 13
Project Description:			
Casing Size/Type: 3 1/4" HSA	Sampler Type/Size: SS 1 3/8" ID		Core Barrel Type:
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @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)
0	S-1	7 14 26 75/3"	21	4		Fill	Dense, brown fine to medium SAND, some Silt, trace coarse Gravel, trace Cinders	
								10
5	S-2	0 1 1 1	24	3		Silty Sand	Very loose, blackish gray fine SAND, some Silt, trace coarse Gravel	
	S-3	1 1 1 1	24	5			Very loose, gray black fine SAND, some Silt	5
10	S-4	0 1 0 1	24	22		Organic Silt with Organic Fibers	Very loose, gray ORGANIC SILT interbedded with Organic fibers	
	S-5	0 1 0 1	24	20			Very loose, gray ORGANIC SILT, trace Seashell fragments, trace Organic fibers	0
15	S-6	- - -WOR/24"	24	24			Very loose, gray ORGANIC SILT, trace Seashell fragments, trace Organic fibers	
	S-7	- -WOR/18"1	24	24			Very loose, gray ORGANIC SILT, trace Seashell fragments, trace Organic fibers	-5
20	S-8	2 1 2 2	24	24			Very loose, dark brown ORGANIC SILT and PEAT fibers	
	S-9	3 3 4 5	24	20		Silty Sand	Loose, gray fine SAND, some (-) Silt	-10
25								

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: 30ft Rock: ft	NOTES:	Sheet 1 of 2
No. of Soil Samples: 11 No. of Core Runs: ---		SM-001-M REV. 1/02

Driller: Tim Carpenter	**Connecticut DOT Boring Report**	Hole No.: BR-17
Inspector: Bob Marshall	Town: Branford	Stat./Offset:
Engineer: Geo**Design**, Inc.	Project No.: 310-0007	Northing:
Start Date: 4-3-08	Route No.:	Easting:
Finish Date: 4-3-08	Bridge No.:	Surface Elevation: 13
Project Description:		
Casing Size/Type: 3 1/4" HSA	Sampler Type/Size: SS 1 3/8" ID	Core Barrel Type:
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.	
Groundwater Observations: @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)
25						Silt		
	S-10	2 2 4 6	24	22			Loose, red brown SILT, trace fine Sand	
								-15
	S-11	3 3 4 6	24	24			Loose, red brown SILT, trace fine Sand, (slight localized plasticity)	
30							END OF BORING 30ft	
								-20
35								
								-25
40								
								-30
45								
								-35
50								

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	NOTES:	Sheet 2 of 2
Earth: 30ft Rock: ft		
No. of Soil Samples: 11 No. of Core Runs: ---		SM-001-M REV. 1/02

Driller: Tim Carpenter	**Connecticut DOT Boring Report**		Hole No.: BR-18
Inspector: Bob Marshall	Town: Branford		Stat./Offset:
Engineer: Geo**Design**, Inc.	Project No.: 310-0007		Northing:
Start Date: 4-3-08	Route No.:		Easting:
Finish Date: 4-3-08	Bridge No.:		Surface Elevation: 10
Project Description:			
Casing Size/Type: 3 1/4" HSA	Sampler Type/Size: SS 1 3/8" ID		Core Barrel Type:
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @5			

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								10
	S-1	8 13 21 34	24	20		Fill	Dense, gray black fine to medium SAND, little Silt, trace Ash/Cinders	
	S-2	41 92	12	10			Very dense, black ASH, trace Ceramic fragments	
5	S-3	23 21 15 13	24	18			Dense, black ASH/CINDERS, trace Wood and Brick fragments	5
	S-4	- 1/12" 1 1	24	16		Organic Silt & Peat	Very loose, gray black fine to medium SAND and ORGANIC SILT interbedded with fibrous Organics	
	S-5	1 1 1 1	24	20			Very loose, brown to gray brown ORGANIC SILT and PEAT	
10								0
	S-6	- - - 1/24"	24	20		Organic Silt with Organic Fibers	Very loose, gray ORGANIC SILT with Seashell fragments, trace interbedded Organic fibers	
	S-7	1 1 1 1	24	24			Very loose, gray ORGANIC SILT with Seashell fragments, trace interbedded Organic fibers	
15	S-8	- - - 1/24"	24	22			Very loose, gray ORGANIC SILT, trace Seashell fragments	-5
	S-9	-WOH/12"- 1/12"	24	24			Very loose, gray ORGANIC SILT	
	S-10	- 1/12" - 1/12"	24	24		Organic Silt & trace Peat	Very loose, gray ORGANIC SILT, trace fibrous Peat	
20								-10
	S-11	1 2 3 4	24	18		Silty Sand	Loose, gray to brown fine SAND and ORGANIC SILT, interbedded with gray Clayey Silt	
	S-12	3 3 5 6	24	20			Loose, gray fine to medium SAND, little Silt, interbedded with gray Clayey Silt	
						Sandy Silt		
25								-15

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: ft	NOTES:	Sheet 1 of 2
No. of Soil Samples: 14 No. of Core Runs: ---		SM-001-M REV. 1/02

Driller: Tim Carpenter	**Connecticut DOT Boring Report**		Hole No.: BR-18
Inspector: Bob Marshall	Town: Branford		Stat./Offset:
Engineer: Geo**Design**, Inc.	Project No.: 310-0007		Northing:
Start Date: 4-3-08	Route No.:		Easting:
Finish Date: 4-3-08	Bridge No.:		Surface Elevation: 10
Project Description:			
Casing Size/Type: 3 1/4" HSA	Sampler Type/Size: SS 1 3/8" ID		Core Barrel Type:
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @5			

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)
25	S-13	2 4 5 6	24	16		Sandy Silt *(con't)*	Loose, red brown SILT, trace fine Sand, (slight plasticity)	-15
30	S-14	4 5 5 6	24	18			Medium dense, red brown SILT, trace fine Sand	-20
							END OF BORING 32ft	
35								-25
40								-30
45								-35
50								-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: 32ft Rock: ft	NOTES:	Sheet 2 of 2
No. of Soil Samples: 14 No. of Core Runs: ---		SM-001-M REV. 1/02

Driller: Oren Cone	**Connecticut DOT Boring Report**		Hole No.: BR-19
Inspector: Bob Marshall	Town: Branford		Stat./Offset:
Engineer: Geo**Design**, Inc.	Project No.: 310-0007		Northing:
Start Date: 4-4-08	Route No.:		Easting:
Finish Date: 4-7-08	Bridge No.:		Surface Elevation: 10
Project Description:			
Casing Size/Type: 4" FJ	Sampler Type/Size: SS 1 3/8" ID		Core Barrel Type:
Hammer Wt.: 200lb Fall: 24in.	Hammer Wt.: 140lb Fall: 30in.		
Groundwater Observations: @7 after 0 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		10
	S-1	6 7 6 6	24	4			Medium dense, fine to medium SAND, little Silt, little Ash/Cinders, trace fine Gravel	
	S-2	10 12 14 14	24	4			Medium dense, fine to medium SAND, little Silt, little Ash/Cinders, trace fine Gravel	
5	S-3	50/0"	0	0			Very dense, spoon refusal	5
	S-4	10 5 4 3	24	6			Loose, black fine to medium SAND, some Silt, little fine to coarse Gravel, (with black Organic Silt in bottom of sample)	
						Organic Silt		
10								0
	S-5	2 1 1 1	24	10			Very loose, gray ORGANIC SILT with interbedded Organic fibers, trace Seashell fragments	
	S-6	1 1 1 1	24	24			Very loose, gray ORGANIC SILT with interbedded Organic fibers, trace Seashell fragments	
15								-5
	S-7	- 1/12" - 1/12"	24	2			Very loose, gray ORGANIC SILT with interbedded Organic fibers, trace Seashell fragments	
	S-8	- - -WOH/24"	24	24			Very loose, gray ORGANIC SILT with interbedded Organic fibers, trace Seashell fragments	
20								-10
						Peat		
	S-9	1 2 2 3	24	24			Very loose, brown fibrous PEAT	
	S-10	7 6 7 7	24	24			Medium dense, Top 12": brown fibrous PEAT Bottom 12": gray SILT and CLAY	
						Clayey Silt		
25								-15

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: 27ft Rock: ft	NOTES:	Sheet 1 of 3
No. of Soil Samples: 10 No. of Core Runs: ---		SM-001-M REV. 1/02

Driller: Oren Cone	**Connecticut DOT Boring Report**	Hole No.: BR-19
Inspector: Bob Marshall	Town: Branford	Stat./Offset:
Engineer: Geo**Design**, Inc.	Project No.: 310-0007	Northing:
Start Date: 4-4-08	Route No.:	Easting:
Finish Date: 4-7-08	Bridge No.:	Surface Elevation: 10
Project Description:		
Casing Size/Type: 4" FJ	Sampler Type/Size: SS 1 3/8" ID	Core Barrel Type:
Hammer Wt.: 200lb Fall: 24in.	Hammer Wt.: 140lb Fall: 30in.	
Groundwater Observations: @7 after 0 hours		

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)
25	S-11	3 5 8 9	24			Clayey Silt *(con't)*	Stiff red-brown Clayey SILT, trace fine Sand, locally SILT and CLAY	-15
30	S-12	3 3 5 6	24	12			Stiff red-brown SILT and CLAY, trace fine Sand	-20
35	S-13	2 3 10 16	24	24		Gravelly Silty Sand	Top 12": Stiff, red-brown Clayey SILT Bottom 12": Medium dense, red-brown fine to medium SAND, little Silt, trace fine Gravel	-25
40	S-14	45 26 31 36	24	20			Very dense, red-brown fine to medium SAND, little fine to coarse Gravel, little Silt	-30
	S-15	19 31 15 16	24	14			Dense, red-brown fine to medium SAND, little Silt, trace fine Gravel	
45	S-16	12 15 15 12	24	10			Dense, red-brown fine to medium SAND, trace fine Gravel, trace Silt	-35
50								-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: 27ft Rock: ft	NOTES:	Sheet 2 of 3
No. of Soil Samples: 10 No. of Core Runs: ---		SM-001-M REV. 1/02

Driller: Oren Cone	**Connecticut DOT Boring Report**	Hole No.: BR-19
Inspector: Bob Marshall	Town: Branford	Stat./Offset:
Engineer: Geo**Design**, Inc.	Project No.: 310-0007	Northing:
Start Date: 4-4-08	Route No.:	Easting:
Finish Date: 4-7-08	Bridge No.:	Surface Elevation: 10
Project Description:		
Casing Size/Type: 4" FJ	Sampler Type/Size: SS 1 3/8" ID	Core Barrel Type:
Hammer Wt.: 200lb Fall: 24in.	Hammer Wt.: 140lb Fall: 30in.	
Groundwater Observations: @7 after 0 hours		

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)
50	S-17	100/0"	0	0			Spoon refusal/no penetration/no recovery	-40
							END OF BORING 27ft	
55								-45
60								-50
65								-55
70								-60
75								-65

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	NOTES:	Sheet 3 of 3
Earth: 27ft Rock: ft		
No. of Soil Samples: 10 No. of Core Runs: ---		SM-001-M REV. 1/02

Driller: Tim Carpenter	**Connecticut DOT Boring Report**		Hole No.: BR-2
Inspector: Bob Marshall	Town: Branford		Stat./Offset:
Engineer: Geo**Design**, Inc.	Project No.: 310-0007		Northing:
Start Date: 4-7-08	Route No.:		Easting:
Finish Date: 4-7-08	Bridge No.:		Surface Elevation: 13
Project Description:			
Casing Size/Type: 3 1/4" HSA	Sampler Type/Size: SS 1 3/8" ID		Core Barrel Type:
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @9			

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 11 14 10	24	16		Fill	Medium dense, black ASH and CINDERS, trace Organics	
	S-2	12 24 31 20	24	8			Dense, black ASH, trace Cinders	10
5	S-3	4 2 4 5	24	2			Loose, black ASH/CINDERS	
	S-4	8 6 8 8	24	14			Medium dense, black ASH, little Organic Silt, trace Cinders	5
10	S-5	4 3 3 3	24	18			Loose, black ASH, little Organic Silt	
	S-6	7 11 14 20	24	18			Medium dense, black ASH, little Organic Silt, trace Cinders	0
15	S-7	2 2 4 2	24	18		Peat	Loose, Top 9": black ASH Bottom 9": brown PEAT	
	S-8	2 3 2 3	24	20		Organic Silt with Organic Fibers	Loose, gray ORGANIC SILT with interbedded Organics	-5
20	S-9	7 9 10 12	24	18		Silty Sand	Medium dense, brown fine to medium SAND, little Silt, trace fine Gravel	
	S-10	10 10 11 13	24	20			Medium dense, brown fine to medium SAND, little Silt	-10
25								

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: 27ft Rock: ft	NOTES:	Sheet 1 of 2
No. of Soil Samples: 11 No. of Core Runs: ---		SM-001-M REV. 1/02

Driller: Tim Carpenter	**Connecticut DOT Boring Report**		Hole No.: BR-2
Inspector: Bob Marshall	Town: Branford		Stat./Offset:
Engineer: Geo**Design**, Inc.	Project No.: 310-0007		Northing:
Start Date: 4-7-08	Route No.:		Easting:
Finish Date: 4-7-08	Bridge No.:		Surface Elevation: 13
Project Description:			
Casing Size/Type: 3 1/4" HSA	Sampler Type/Size: SS 1 3/8" ID		Core Barrel Type:
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @9			

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)
25	S-11	8 10 10 11	24	20		Silty Sand *(con't)*	Medium dense, brown fine to medium SAND, little Silt	
							END OF BORING 27ft	-15
30								-20
35								-25
40								-30
45								-35
50								

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: 27ft Rock: ft	NOTES:	Sheet 2 of 2
No. of Soil Samples: 11 No. of Core Runs: ---		SM-001-M REV. 1/02

Driller: Oren Cone	**Connecticut DOT Boring Report**		Hole No.: BR-4
Inspector: Bob Marshall	Town: Branford		Stat./Offset:
Engineer: Geo**Design**, Inc.	Project No.: 310-0007		Northing:
Start Date: 4-4-08	Route No.:		Easting:
Finish Date: 4-4-08	Bridge No.:		Surface Elevation: 13
Project Description:			
Casing Size/Type: 3 1/4" HSA	Sampler Type/Size: SS 1 3/8" ID		Core Barrel Type:
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @8.4' with augers at 15 after 0.2 hours			

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	S-1	2 3 4 4	24	18		Topsoil / Fill	Loose, brown Top 3": TOPSOIL Bottom 15": fine to medium SAND, some Silt	
	S-2	19 23 23 29	24	4			Dense, brown fine to medium SAND, little fine to coarse Gravel, little Silt, trace Ash/Cinders	10
5	S-3	14 15 21 35	24	0			Dense, no recovery	
	S-4	9 10 10 12	24	6			Medium dense, brown fine to coarse SAND, little Silt, trace Ash/Cinders	5
10	S-5	2 2 3 3	24	6			Loose, dark brown to black fine to coarse SAND, little Ash/Cinders, trace Silt, trace fine Gravel	
	S-6	3 3 4 6	24	4			Loose, dark brown to black fine to coarse SAND, little Ash/Cinders, trace Silt, trace fine Gravel, (Organic fibers in bottom 1/2")	0
15	S-7	2 3 15 28	24	14		Gravelly Silty Sand	Medium dense, brown to red brown fine to medium SAND, some (-) Silt, little fine to coarse Gravel	
								-5
20	S-8	34 46 38 44	24	22			Very dense, brown to red brown fine to medium SAND, little fine to coarse Gravel, little (-) Silt	
							END OF BORING 22ft	-10
25								

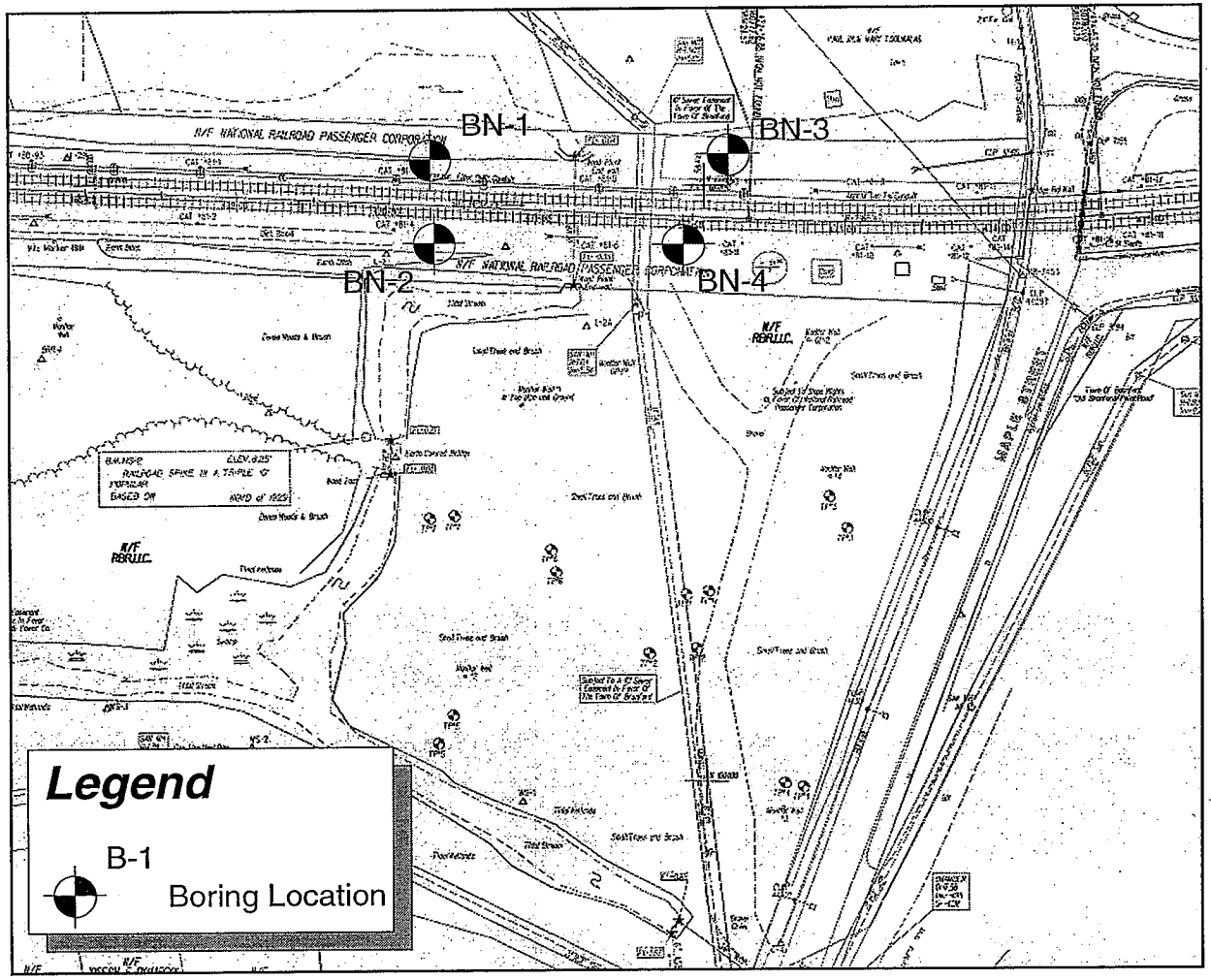
Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

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

Total Penetration in Earth: 22ft Rock: ft	NOTES:	Sheet 1 of 1
No. of Soil Samples: 8 No. of Core Runs: ---		SM-001-M REV. 1/02

Appendix 3

CT DOT Project 310-0019 Boring Logs
(For Information Only)



N

0 100 200 ft

Note:
Survey plan simplified after drawing provided by Baker Eng. NY, Inc.

SHORELINE EAST RAILROAD, BRANFORD STATION, BORING LOCATION PLAN

scale: 3 in = 400 ft	EXHIBIT 2	Drawn by: Liviu Iordache
Wang Engineering, INC. Geo-Environmental Engineers		450 Fenton, Unit 901 B West Chicago, IL 60185 630 231-7733
FOR BAKER ENGINEERING NY, INC.		707-06-01

PD&W	SM - 001 - M REV. 1/94 BORING REPORT	Hole No. BN-1
DRILLER	STATE OF CONNECTICUT	Line & Station
Liviu Iordache	DEPARTMENT OF TRANSPORTATION	Offset
INSPECTOR	TOWN: Branford, Connecticut	N. Coordinate 160819.00
Wang Engineering, Inc.	PROJECT NAME: SHORELINE EAST STATIONS	E. Coordinate 581221.00
SOILS ENGINEER	PROJECT NUMBER: 310-0007	Baker Engineering NY, Inc.
	BORING CONTRACTOR: Soiltesting, Inc.	PRIME DESIGNER

Surface Elevation: 12.00		Casing				Auger		Mud	Sampler		Core Barrel			
Date Started: 30 August 2000	Utilized						X		X					
Date Finished: 30 August 2000	Type	BW	NW	HW	Pipe	Solid	Hollow		SS		B(st)	B(dt)	NX(st)	NX(dt)
Groundwater Observations	Size I.D. (in)	2-3/8	3	4	2-1/2		3.75		1-3/8		1-3/8	1-3/8	2-1/6	2-1/6
@ 8.75 ft after 0.0 hours	Hammer (lb)	300	300	300	300			Bit	140		Type		Diamond	
@ NA ft after NA hours	Fall (ft)	24	24	24	24				30		of bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. inch	REC inch	Type	BLOWS PER 6 INCHES ON SAMPLER 0-6	6-12	12-18	18-24	STRATA CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOIL REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
		0.0-2.0	1	24	6	SS	7	5	4	3		Loose to very loose, gray to black SAND and GRAVEL, little slag, cinders -FILL-
		2.5-4.5	2	24	6	SS	3	1	2	2	7.5	
5		5.0-7.0	3	24	0	SS	2	1	1	2	4.5	Very loose, brown, fine to coarse SAND, trace to little clay
		7.5-9.5	4	24	3	SS	2	1	2	2		
10		10.0-12.0	5	24	2	SS	1	1	1	1		
		12.5-14.5	6	24	10	SS	1	1	1	1	-1.0	
15		15.0-17.0	7	24	24	SS	0	0	1	1	13.0	Very soft, light gray to gray, ORGANIC CLAY, little gastropod bioclasts
20		20.0-22.0	1	24	0	D					-9.5	
											-10.5 21.5	Dark brown, fibrous PEAT
		22.0-24.0	2	24	24	D					22.5	Gray, coarse SAND
25		24.0-26.0	8	24	18	SS	5	7	9	8	-12.5 24.5	Stiff, gray to reddish brown to brown, CLAYEY SILT to SILTY CLAY, little sand as less than 1/8"-thick intercalations
30		30.0-32.0	9	24	24	SS	6	7	8	9		
35		35.0-37.0	10	24	24	SS	4	5	6	6		
40		40.0-42.0	11	24	24	SS	4	5	6	8		
45											-31.5 43.5	Dense, brown, coarse SAND, trace to some gravel, cobble, generally coarser with depth
		45.0-47.0	12	24	12	SS	9	22	22	23		
50												

Casing Size	From	To	Feet of Earth	Feet of Rock
			52.0 ft	0.0 ft
			No. of Samples	
			15	

NOTES:

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test SS=Split Spoon

PROPORTIONS USED: Trace=1-10% Little=10-20%, Some=20-35%, And=35-50%

Hole No. BN-1

Sheet 1 of 2

CT_DOT_B_FORD2.GPJ CT_DOT.GDT 4/10/01

PD&W	SM - 001 - M REV. 1/94 BORING REPORT	Hole No. BN-1
DRILLER	STATE OF CONNECTICUT	Line & Station
Liviu Iordache	DEPARTMENT OF TRANSPORTATION	Offset
INSPECTOR	TOWN: Branford, Connecticut	N. Coordinate 160819.00
Wang Engineering, Inc.	PROJECT NAME: SHORELINE EAST STATIONS	E. Coordinate 581221.00
SOILS ENGINEER	PROJECT NUMBER: 310-0007	Baker Engineering NY, Inc.
	BORING CONTRACTOR: Soiltesting, Inc.	PRIME DESIGNER

		Casing				Auger		Mud	Sampler		Core Barrel			
Surface Elevation: 12.00	Utilized						X		X					
Date Started: 30 August 2000	Type	BW	NW	HW	Pipe	Solid	Hollow		SS		B(st)	B(dt)	NX(st)	NX(dt)
Date Finished: 30 August 2000	Size I.D. (in)	2-3/8	3	4	2-1/2		3.75		1-3/8		1-3/8	1-3/8	2-1/6	2-1/6
Groundwater Observations	Hammer (lb)	300	300	300	300			Bit	140		Type		Diamond	
@ 8.75 ft after 0.0 hours	Fall (ft)	24	24	24	24				30		of bit		Carbide	
@ NA ft after NA hours														

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. inch	REC inch	Type	BLOWS PER 6 INCHES ON SAMPLER 0-6	6-12	12-18	18-24	STRATA CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOIL REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
		50.0-52.0	13	24	12	SS	8	19	23	27	-40.0	
55											52.0	Bottom of Exploration at 52.00 ft. Borehole backfilled with drill cuttings.
60												
65												
70												
75												
80												
85												
90												
95												
100												

Casing Size	From	To	Feet of Earth	Feet of Rock
			52.0 ft	0.0 ft
			No. of Samples	
			15	

NOTES:

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test SS=Split Spoon
PROPORTIONS USED: Trace=1-10% Little=10-20%, Some=20-35%, And=35-50%

Hole No. BN-1
Sheet 2 of 2

CT_DOT B_FORD2.GPJ CT_DOT.GDT 4/10/01

PD&W	SM - 001 - M REV. 1/94 BORING REPORT	Hole No. BN-2
DRILLER	STATE OF CONNECTICUT	Line & Station
Liviu Iordache	DEPARTMENT OF TRANSPORTATION	Offset
INSPECTOR	TOWN: Branford, Connecticut	N. Coordinate 160760.00
Wang Engineering, Inc.	PROJECT NAME: SHORELINE EAST STATIONS	E. Coordinate 581220.00
SOILS ENGINEER	PROJECT NUMBER: 310-0007	Baker Engineering NY, Inc.
	BORING CONTRACTOR: Soiltesting, Inc.	PRIME DESIGNER

		Casing				Auger		Mud	Sampler		Core Barrel			
Surface Elevation: 11.75	Utilized						X		X					
Date Started: 31 August 2000	Type	BW	NW	HW	Pipe	Solid	Hollow		SS		B(st)	B(dt)	NX(st)	NX(dt)
Date Finished: 31 August 2000	Size I.D. (in)	2-3/8	3	4	2-1/2		3.75		1-3/8		1-3/8	1-3/8	2-1/6	2-1/6
Groundwater Observations	Hammer (lb)	300	300	300	300			Bit	140		Type		Diamond	
@ 8.50 ft after 0.0 hours	Fall (ft)	24	24	24	24				30		of bit		Carbide	
@ 8.50 ft after 24.0 hours														

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. inch	REC inch	Type	BLOWS PER 6 INCHES ON SAMPLER 0-6	6-12	12-18	18-24	STRATA CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOIL REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
		0.0-2.0	1	24	14	SS	2	4	8	6	10.3	Medium dense, dark brown and black, coarse SAND, trace to little gravel, slag, cinders
		2.5-4.5	2	24	4	SS	5	6	7	7	1.5	-FILL-
5												Medium dense, brown, CLAYEY SAND
		5.0-7.0	3	24	4	SS	5	5	7	21		
		7.5-9.5	4	24	6	SS	8	5	5	7		
10											2.0	
		10.0-12.0	5	24	19	SS	1	1	1	3	9.8	Very loose, brown sand, little gravel and silt
		12.5-14.5	6	24	15	SS	2	1	2	3	-2.3	
15											14.0	Very soft, gray, ORGANIC CLAY
20												
		20.0-22.0	7	24	24	SS	1	1	2	3	-10.3	
											-11.3 22.0	Dark brown PEAT
25											23.0	Medium dense, gray, CLAYEY SAND
		25.0-27.0	8	24	20	SS	2	4	6	7	-14.3	
											-15.3 26.0	Dark brown, ORGANIC SILT to PEAT
30											27.0	Medium stiff to stiff, brown, CLAYEY SILT to SILTY CLAY
		30.0-32.0	9	24	24	SS	3	4	7	10		
35												
		35.0-37.0	10	24	24	SS	5	3	4	4		
40												
		40.0-42.0	11	24	24	SS	5	4	5	7	-30.3	
											42.0	Dense, brown, coarse SAND, little to some pebble
45												
		45.0-47.0	12	24	16	SS	7	13	17	29	-35.3	
											47.0	Bottom of Exploration at 47.00 ft. Borehole backfilled with drill cuttings.
50												

Casing Size	From	To	Feet of Earth	Feet of Rock
			47.0 ft	0.0 ft
			No. of Samples	
			12	

NOTES:

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test SS=Split Spoon

PROPORTIONS USED: Trace=1-10% Little=10-20%, Some=20-35%, And=35-50%

Hole No. BN-2

Sheet 1 of 1

PD&W	SM - 001 - M REV. 1/94 BORING REPORT	Hole No. BN-3
DRILLER	STATE OF CONNECTICUT	Line & Station
Liviu Iordache	DEPARTMENT OF TRANSPORTATION	Offset
INSPECTOR	TOWN: Branford, Connecticut	N. Coordinate 160826.00
Wang Engineering, Inc.	PROJECT NAME: SHORELINE EAST STATIONS	E. Coordinate 581419.00
SOILS ENGINEER	PROJECT NUMBER: 310-0007	Baker Engineering NY, Inc.
	BORING CONTRACTOR: Soiltesting, Inc.	PRIME DESIGNER

Surface Elevation: 10.00
Date Started: 30 August 2000
Date Finished: 30 August 2000

Groundwater Observations
@ 7.25 ft after 0.0 hours
@ 7.30 ft after 24.0 hours

	Casing				Auger		Mud	Sampler		Core Barrel			
Utilized						X		X					
Type	BW	NW	HW	Pipe	Solid	Hollow		SS		B(st)	B(dt)	NX(st)	NX(dt)
Size I.D. (in)	2-3/8	3	4	2-1/2		3.75		1-3/8		1-3/8	1-3/8	2-1/6	2-1/6
Hammer (lb)	300	300	300	300			Bit	140		Type		Diamond	
Fall (ft)	24	24	24	24				30		of bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. inch	REC inch	Type	BLOWS PER 6 INCHES ON SAMPLER 0-6	6-12	12-18	18-24	STRATA CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOIL REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
		0.0-2.0	1	24	14	SS	18	19	10	7		Medium dense, reddish brown to black and brown, fine SAND, some silt, little gravel, slag, cinders -FILL-
		2.5-4.5	2	24	4	SS	5	8	4	4	5.0	
5		5.0-7.0	3	24	0	SS	9	5	3	3	5.0	Very loose to loose, brown,fine to coarse SAND, some silt, little comminuted organic matter
		7.5-9.5	4	24	0	SS	4	3	2	1		
10		10.0-12.0	5	24	1	SS	2	1	1	1	-3.0	
		12.5-14.5	6	24	14	SS	2	1	1	1	13.0	Very soft, dark gray to gray, ORGANIC SILTY CLAY, little silt, waterlogged phytoclasts
15		15.0-17.0	1	24	23	D						
		17.0-19.0	7	24	20	SS	0	1	1	3	-8.0	
											-9.0 18.0	Dark brown, fibrous PEAT
20		20.0-22.0	8	24	15	SS	3	8	9	7	19.0	Medium dense, brown, coarse SAND, some pebble-size gravel
25											-15.8	
		25.0-27.0	9	24	24	SS	3	4	14	12	25.8	Medium dense, brown SILT with intercalations of sand laminae
30											-21.0	
		30.0-32.0	10	24	24	SS	4	8	10	12	31.0	Very stiff, brown, CLAYEY SILT to SILTY CLAY, trace gravel
35											-26.8	
		35.0-37.0	11	24	24	SS	5	10	15	27	36.8	Dense to very dense, brown SAND and GRAVEL within a clayey matrix, trace cobble
40												
		40.0-42.0	12	24	24	SS	18	21	23	25		
45												
		45.0-47.0	13	24	24	SS	11	23	35	27		
50												

Casing Size	From	To	Feet of Earth	Rock
			52.0 ft	0.0 ft
			No. of Samples	
			15	

NOTES:

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test SS=Split Spoon
PROPORTIONS USED: Trace=1-10% Little=10-20%, Some=20-35%, And=35-50%

Hole No. BN-3
Sheet 1 of 2

PD&W	SM - 001 - M REV. 1/94 BORING REPORT	Hole No. BN-3
DRILLER	STATE OF CONNECTICUT	Line & Station
Liviu Iordache	DEPARTMENT OF TRANSPORTATION	Offset
INSPECTOR	TOWN: Branford, Connecticut	N. Coordinate 160826.00
Wang Engineering, Inc.	PROJECT NAME: SHORELINE EAST STATIONS	E. Coordinate 581419.00
SOILS ENGINEER	PROJECT NUMBER: 310-0007	Baker Engineering NY, Inc.
	BORING CONTRACTOR: Soiltesting, Inc.	PRIME DESIGNER

		Casing				Auger		Mud	Sampler		Core Barrel			
Surface Elevation: 10.00														
Date Started: 30 August 2000	Utilized						X		X					
Date Finished: 30 August 2000	Type	BW	NW	HW	Pipe	Solid	Hollow		SS		B(st)	B(dt)	NX(st)	NX(dt)
Groundwater Observations	Size I.D. (in)	2-3/8	3	4	2-1/2		3.75		1-3/8		1-3/8	1-3/8	2-1/6	2-1/6
@ 7.25 ft after 0.0 hours	Hammer (lb)	300	300	300	300			Bit	140		Type		Diamond	
@ 7.30 ft after 24.0 hours	Fall (ft)	24	24	24	24				30		of bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. inch	REC inch	Type	BLOWS PER 6 INCHES ON SAMPLER 0-6	6-12	12-18	18-24	STRATA CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOIL REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
		50.0-52.0	14	24	20	SS	24	30	38	65	-42.0	
55											52.0	Bottom of Exploration at 52.00 ft. Borehole backfilled with drill cuttings.
60												
65												
70												
75												
80												
85												
90												
95												
100												

Casing Size	From	To	Feet of Earth	Feet of Rock
			52.0 ft	0.0 ft
			No. of Samples	
			15	

NOTES:

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test SS=Split Spoon
PROPORTIONS USED: Trace=1-10% Little=10-20%, Some=20-35%, And=35-50%

Hole No. BN-3
Sheet 2 of 2

PD&W	SM - 001 - M REV. 1/94 BORING REPORT	Hole No. BN-4
DRILLER	STATE OF CONNECTICUT	Line & Station
Liviu Iordache	DEPARTMENT OF TRANSPORTATION	Offset
INSPECTOR	TOWN: Branford, Connecticut	N. Coordinate 160758.00
Wang Engineering, Inc.	PROJECT NAME: SHORELINE EAST STATIONS	E. Coordinate 581389.00
SOILS ENGINEER	PROJECT NUMBER: 310-0007	Baker Engineering NY, Inc.
	BORING CONTRACTOR: Soiltesting, Inc.	PRIME DESIGNER

Surface Elevation: 11.00
Date Started: 31 August 2000
Date Finished: 31 August 2000

Groundwater Observations
@ 8.00 ft after 0.0 hours
@ NA ft after NA hours

	Casing				Auger		Mud	Sampler		Core Barrel			
Utilized						X		X					
Type	BW	NW	HW	Pipe	Solid	Hollow		SS		B(st)	B(dt)	NX(st)	NX(dt)
Size I.D. (in)	2-3/8	3	4	2-1/2		3.75		1-3/8		1-3/8	1-3/8	2-1/6	2-1/6
Hammer (lb)	300	300	300	300			Bit	140		Type		Diamond	
Fall (ft)	24	24	24	24				30		of bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. inch	REC inch	Type	BLOWS PER 6 INCHES ON SAMPLER 0-6	6-12	12-18	18-24	STRATA CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOIL REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
		0.0-2.0	1	24	12	SS	7	5	6	8	10.0 / 1.0	Medium dense, black, coarse SAND, little slag -FILL-
		2.5-4.5	2	24	3	SS	7	6	4	3	6.3	Medium dense, brown, coarse SAND, trace pebble
5		5.0-7.0	3	24	20	SS	1	1	2	2	4.8 / 3.8	Stiff, brown, SILTY CLAY, little sand, trace gravel
		7.5-9.5	4	24	6	SS	4	4	3	3	7.3	Very loose, brown, coarse SAND
10		10.0-12.0	5	24	10	SS	2	2	2	2	-2.3	
		12.5-14.5	6	24	18	SS	10	3	2	4	13.3	Very soft to soft, gray, ORGANIC CLAY, little gastropod bioclasts, watterlogged phytoclasts
15												
20		20.0-22.0	7	24	24	SS	2	0	1	2	-11.0	
											-12.0 / 22.0	Dark brown, ORGANIC SILT to PEAT
											23.0 / -14.4	Medium dense, brown to gray, coarse SAND
25		25.0-27.0	8	24	20	SS	8	8	9	10	25.4	Dark brown PEAT
											25.8 / -17.7	Medium dense, gray, coarse SAND
30		30.0-32.0	9	24	24	SS	9	13	18	19	28.7	Stiff to very stiff, brown, CLAYEY SILT to SILTY CLAY with thin, sandy intercalations, trace gravel
35		35.0-37.0	10	24	24	SS	6	8	12	12		
40		40.0-42.0	11	24	24	SS	3	3	4	5	-32.5	
45		45.0-47.0	12	24	22	SS	21	24	16	14	43.5	Dense, brown, coarse SAND, little to some pebble and cobble
50												

Casing Size	From	To	Feet of Earth	Feet of Rock
			65.0 ft	0.4 ft
			No. of Samples	
			14	

NOTES:

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test SS=Split Spoon
PROPORTIONS USED: Trace=1-10% Little=10-20%, Some=20-35%, And=35-50%

Hole No. BN-4
Sheet 1 of 2

PD&W	SM - 001 - M REV. 1/94 BORING REPORT	Hole No. BN-4
DRILLER	STATE OF CONNECTICUT	Line & Station
Liviu Iordache	DEPARTMENT OF TRANSPORTATION	Offset
INSPECTOR	TOWN: Branford, Connecticut	N. Coordinate 160758.00
Wang Engineering, Inc.	PROJECT NAME: SHORELINE EAST STATIONS	E. Coordinate 581389.00
SOILS ENGINEER	PROJECT NUMBER: 310-0007	Baker Engineering NY, Inc.
	BORING CONTRACTOR: Soiltesting, Inc.	PRIME DESIGNER

Surface Elevation: 11.00
Date Started: 31 August 2000
Date Finished: 31 August 2000

Groundwater Observations
@ 8.00 ft after 0.0 hours
@ NA ft after NA hours

	Casing				Auger		Mud	Sampler		Core Barrel			
Utilized						X		X					
Type	BW	NW	HW	Pipe	Solid	Hollow		SS		B(st)	B(dt)	NX(st)	NX(dt)
Size I.D. (in)	2-3/8	3	4	2-1/2		3.75		1-3/8		1-3/8	1-3/8	2-1/6	2-1/6
Hammer (lb)	300	300	300	300			Bit	140		Type		Diamond	
Fall (ft)	24	24	24	24				30		of bit		Carbide	

DEPTH	Casing blows per foot	SAMPLE DEPTH IN FEET FROM - TO	NO.	PEN. inch	REC inch	Type	BLOWS PER 6 INCHES ON SAMPLER 0-6	6-12	12-18	18-24	STRATA CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOIL REMARKS (INCL. COLOR, LOSS OF WASH WATER, ETC.)
55												
		55.0-57.0	13	24	20	SS	12	13	34	51		
60												
65											-54.0	
		65.0-65.4	14	5	3	SS	100/5"				65.0 65.4	Gray to white, slightly fractured, foliated GRANITIC GNEISS -BEDROCK- Bottom of Exploration at 65.42 ft. Borehole backfilled with drill cuttings.
70												
75												
80												
85												
90												
95												
100												

Casing Size	From	To	Feet of Earth	Feet of Rock
			65.0 ft	0.4 ft
			No. of Samples	
			14	

NOTES:

SAMPLE TYPE CODING: D=Driven C=Core A=Auger UP=Undisturbed Piston V=Vane Test SS=Split Spoon
PROPORTIONS USED: Trace=1-10% Little=10-20%, Some=20-35%, And=35-50%

Hole No. BN-4
Sheet 2 of 2

CT_DOT_B_FORD2.GPJ CT_DOT.GDT 4/10/01

Appendix 4

Laboratory Test Results

GEO**DESIGN**, INC.

LABORATORY TESTING DATA SUMMARY

Project Name Shoreline East - Branford Parking Lot

Location (*town, state*) Branford, CT

Client/Company Name ConnDot

Project No. 183-07.0 (VTLAB00237)

Page 1 of 1

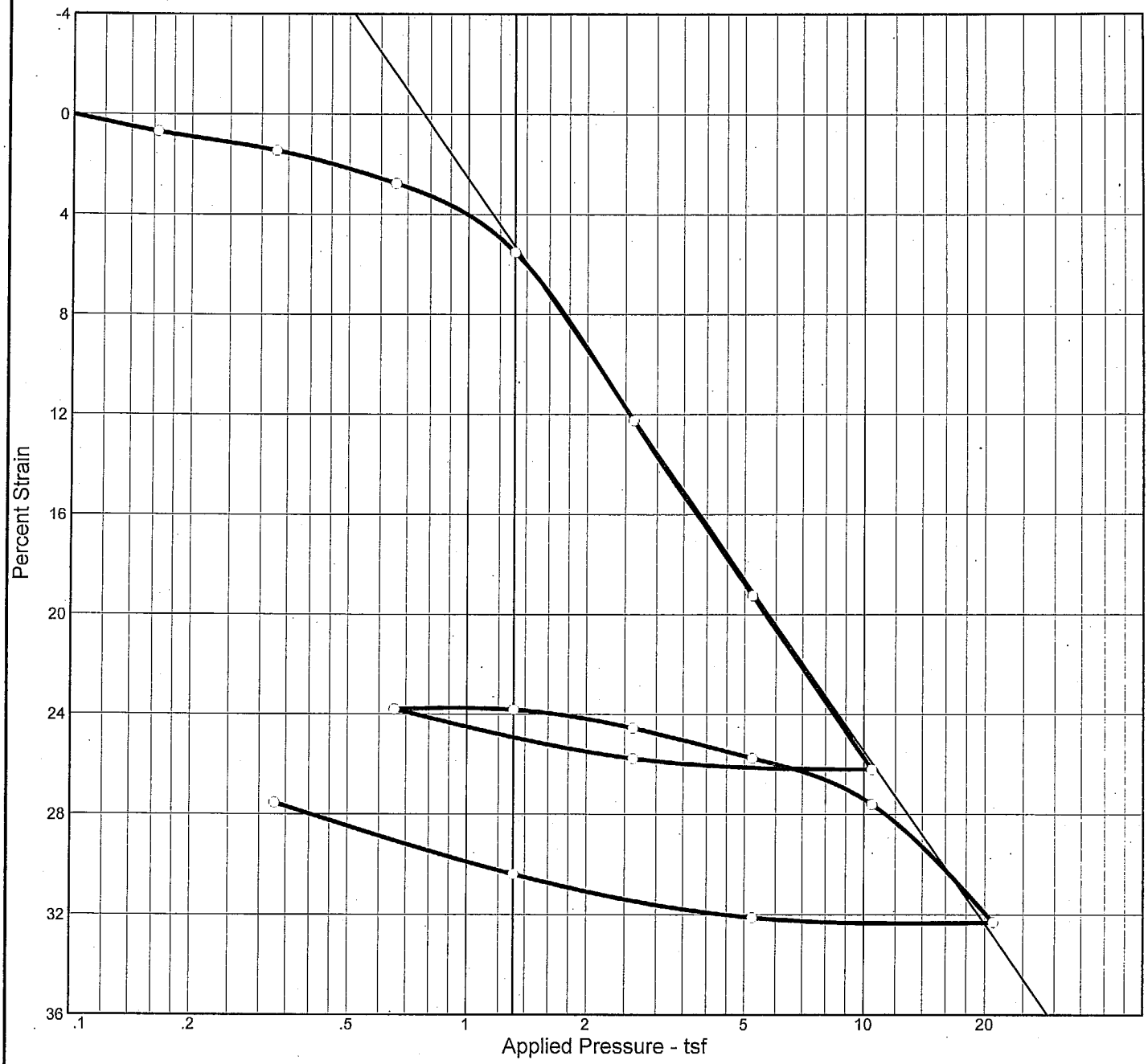
Date of Report 6/25/2008

Reviewed By JAG

Lab Project No. VTLAB00237

				IDENTIFICATION TESTS								STRENGTH TESTS					CONSOL					
Boring / Test Pit No.	Bag Sample - Yes/No	Sample No.	Depth (ft)	Water Content (%)	Liquid Limit (%)	Plastic Limit (%)	Washed Sieve -200 (%)	Hydrometer	Sieve - Hydrometer	g dry (pcf)	Organic Content	Lab Torvane/Penetrometer	s 3 (confining pressure)	Failure Criteria	(s 1 - s 3) at failure	Strain at failure (%)	Cc / 1+eo	Standard Proctor ASTM 698	Mod. Proctor ASTM D1557	Tube Extrusion & Log	Sample Type (e.g., jar, bag, etc	Comments
BR-14	N	UP-1	14' - 16'														X			X		
											4.0											15.5' Deep.
											6.5											14.25' Deep.

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
98.8 %	71.6 %	56.5			2.5	0.76	1.36	0.64	0.08	1.811

MATERIAL DESCRIPTION	USCS	AASHTO
Gray organic Silty CLAY		

Project No. 183-07 **Client:** ConnDot

Project: Shoreline East - Branford Parking Lot

Location: BR-14 UP-1 15'3" Deep

Remarks:

Tested By: JFW
Reviewed By: JAG
Date Tested: 6/18-19/08

Specific Gravity is Assumed
Overburden Pressure is estimated.

CONSOLIDATION TEST REPORT

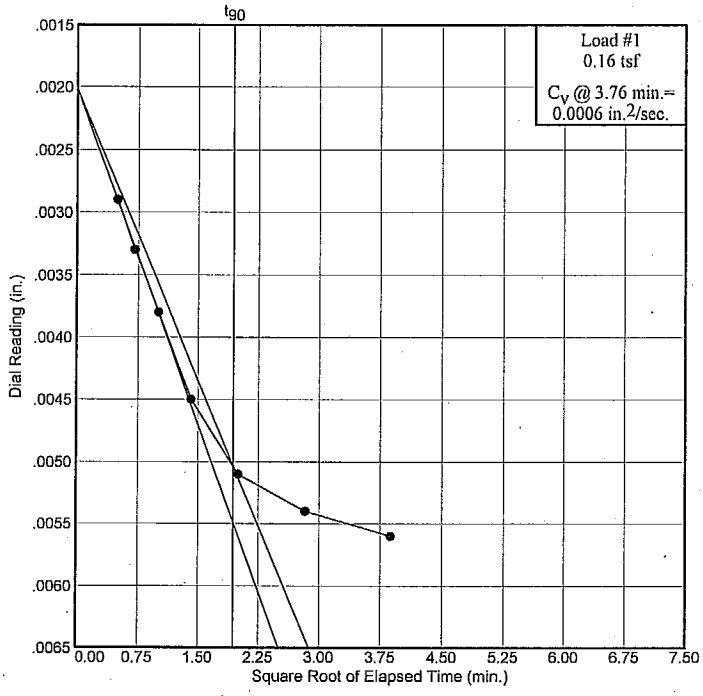
GeoDesign Incorporated

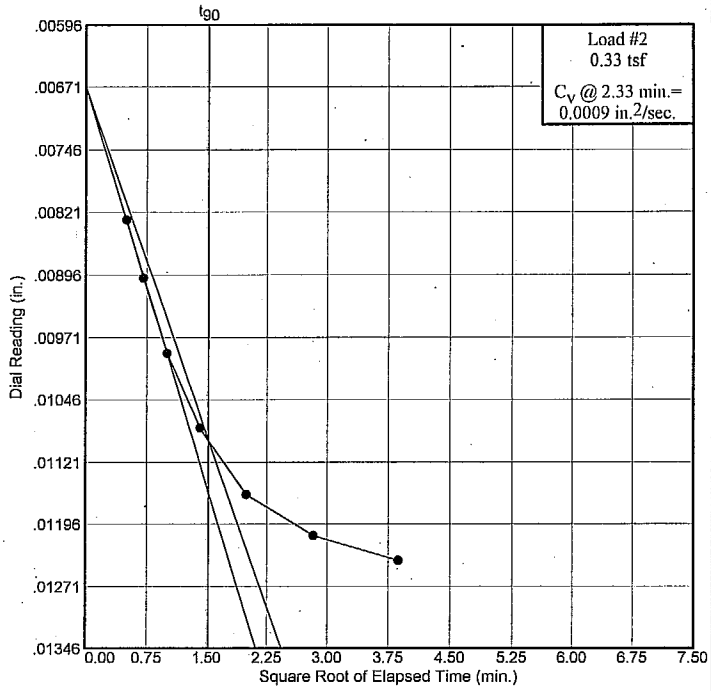
Plate

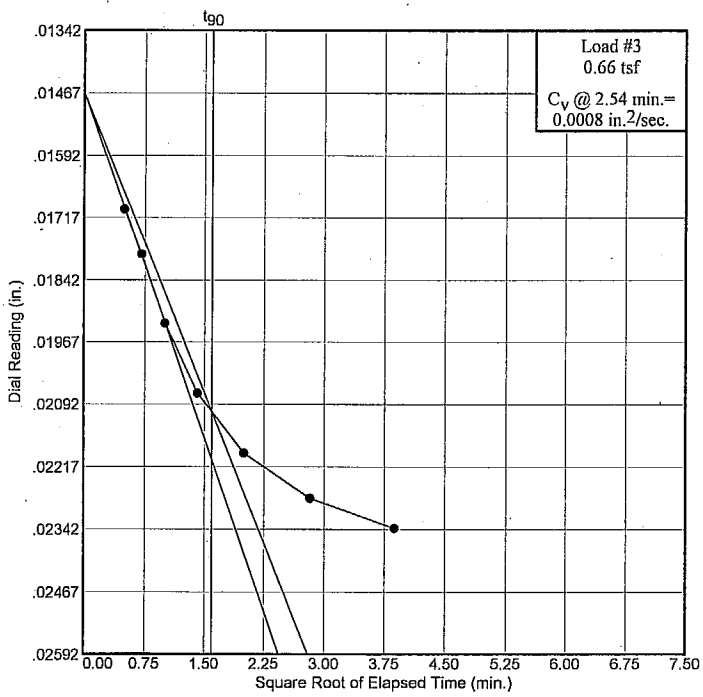
Dial Reading vs. Time

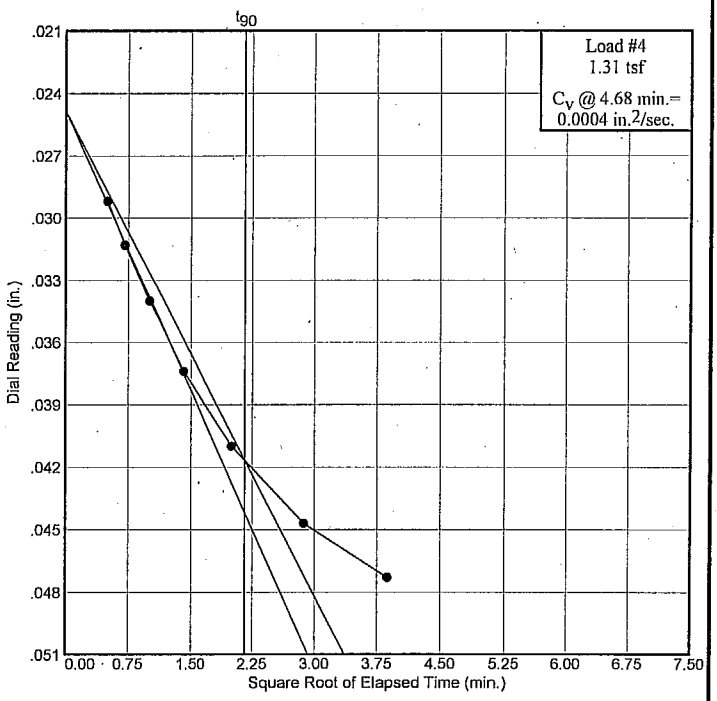
Project No.: 183-07
Project: Shoreline East - Branford Parking Lot

Location: BR-14 UP-1 15'3" Deep









Dial Reading vs. Time

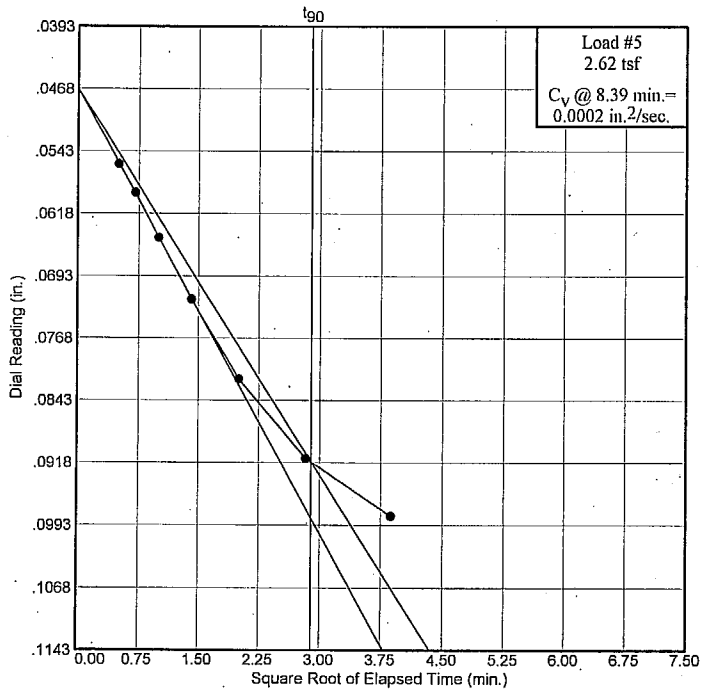
GeoDesign Incorporated

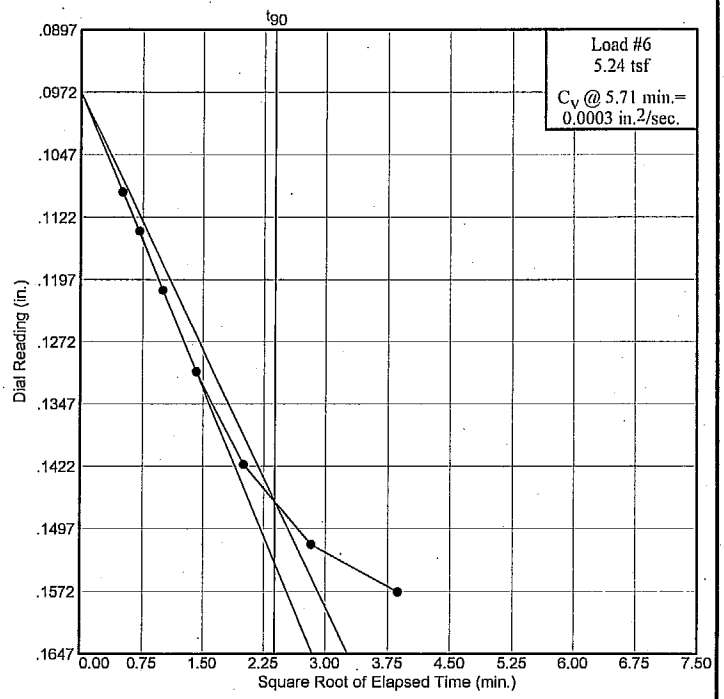
Plate

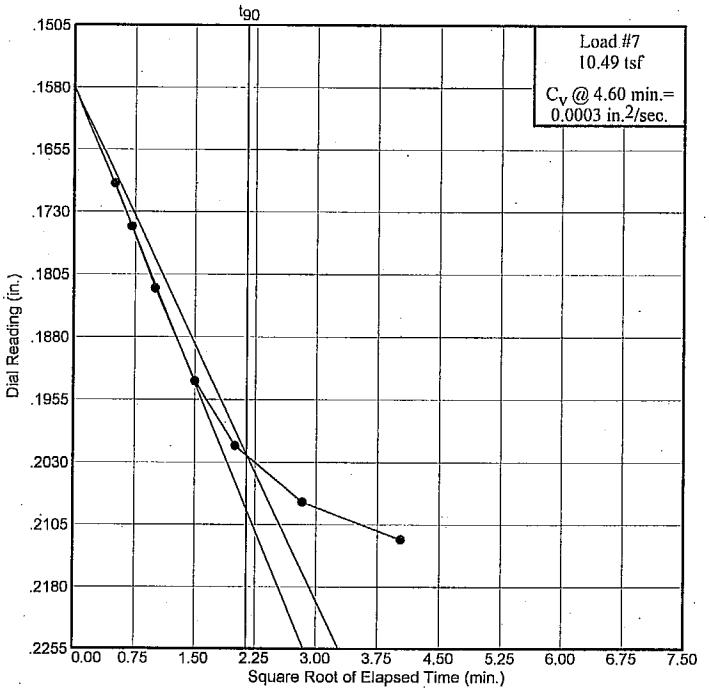
Dial Reading vs. Time

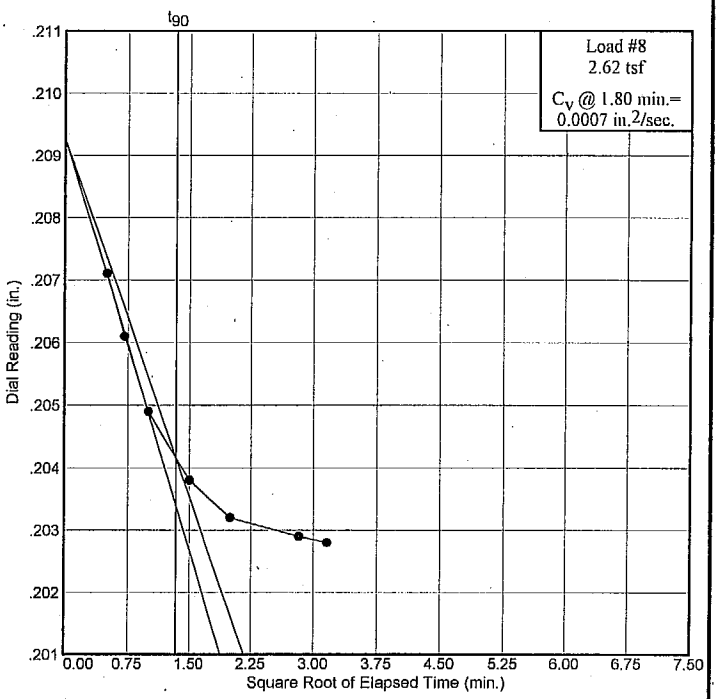
Project No.: 183-07
Project: Shoreline East - Branford Parking Lot

Location: BR-14 UP-1 15'3" Deep









Dial Reading vs. Time

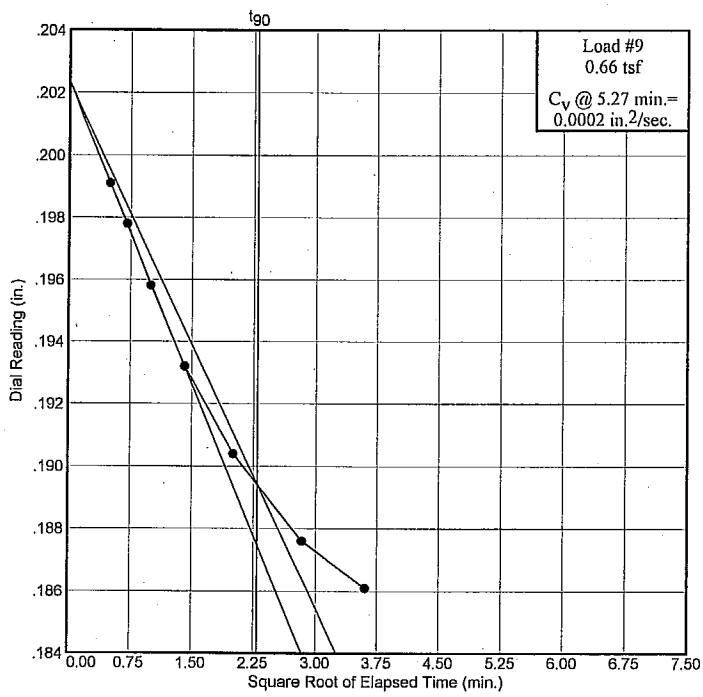
GeoDesign Incorporated

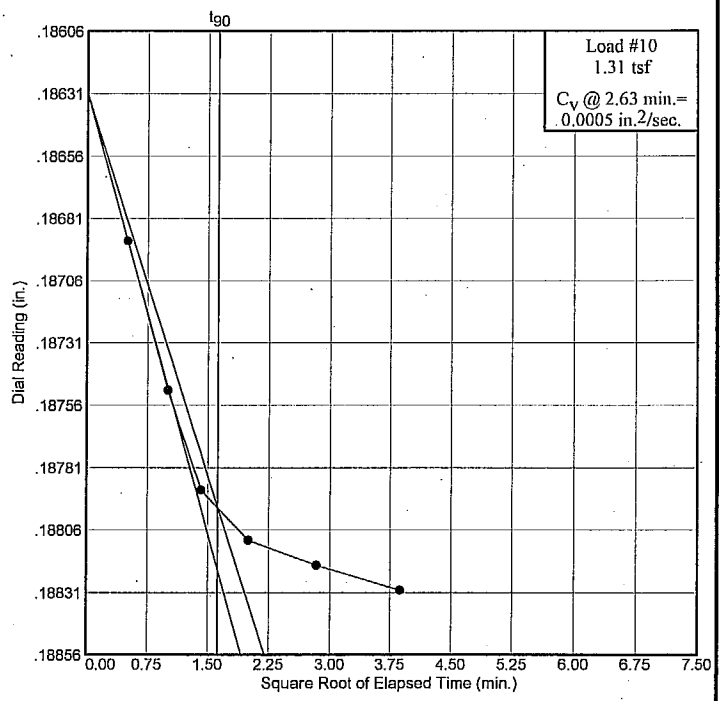
Plate

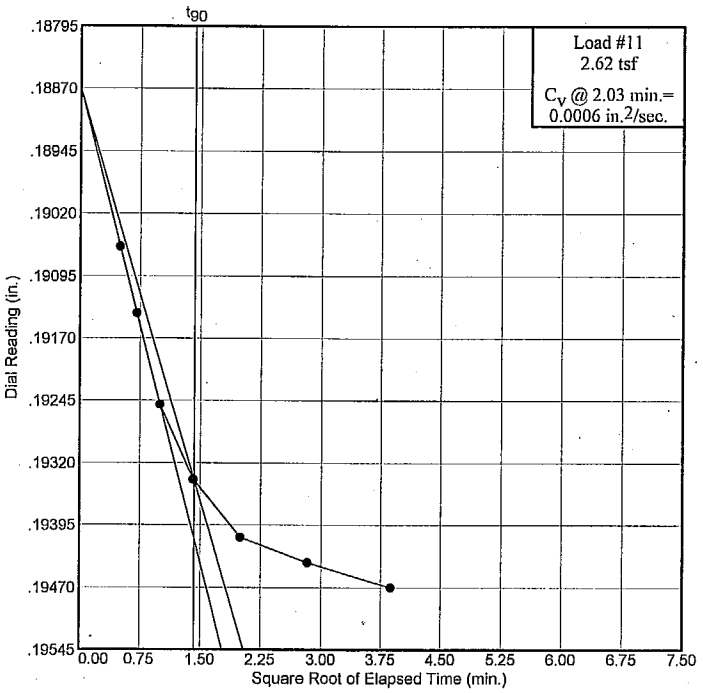
Dial Reading vs. Time

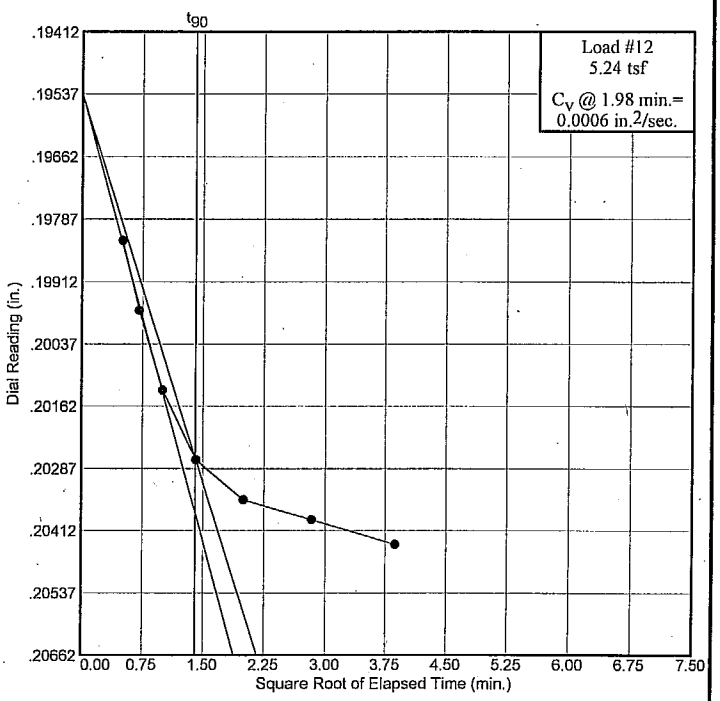
Project No.: 183-07
Project: Shoreline East - Branford Parking Lot

Location: BR-14 UP-1 15'3" Deep









Dial Reading vs. Time

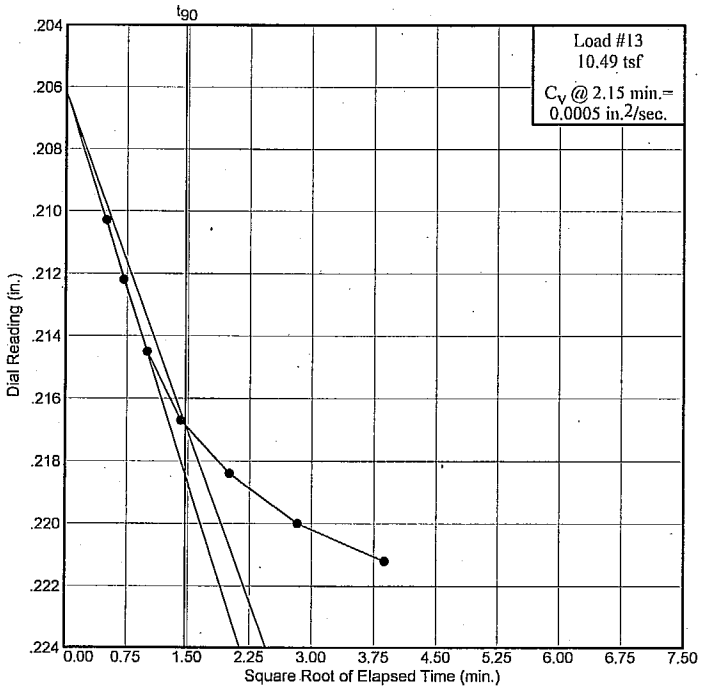
GeoDesign Incorporated

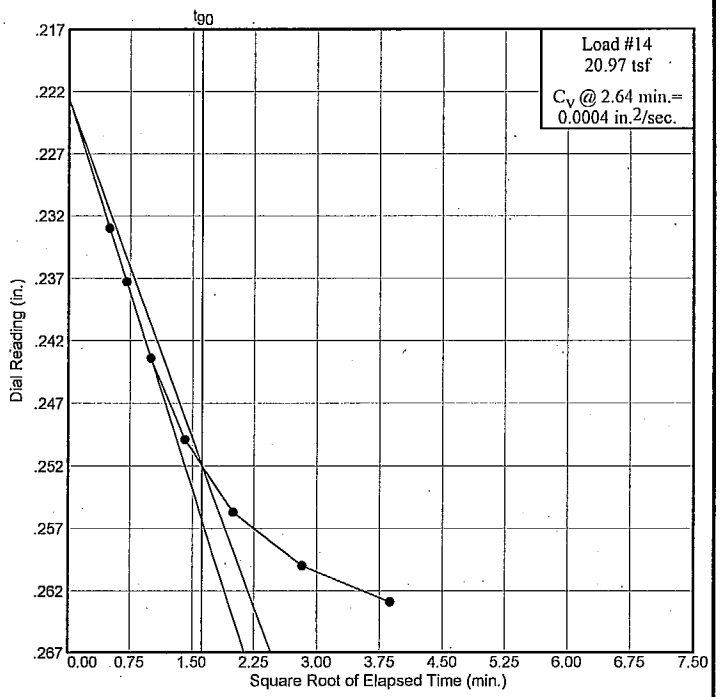
Plate

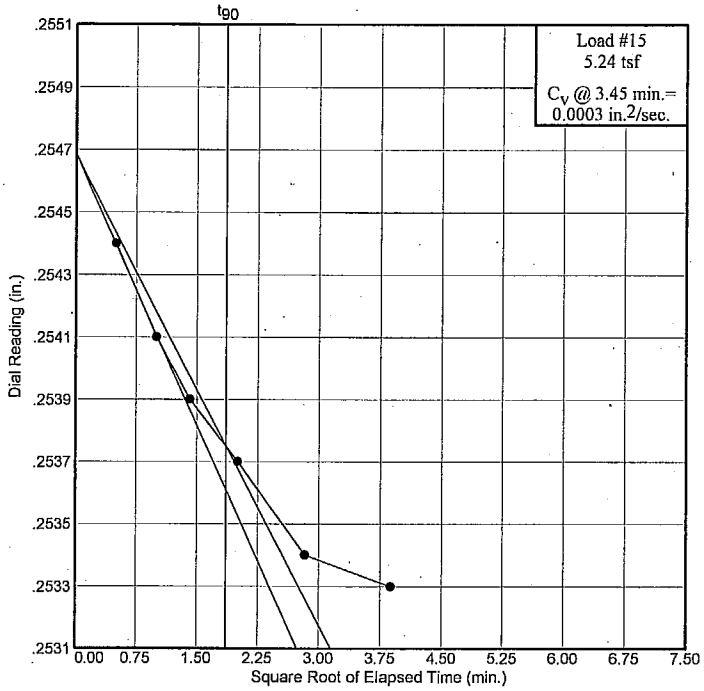
Dial Reading vs. Time

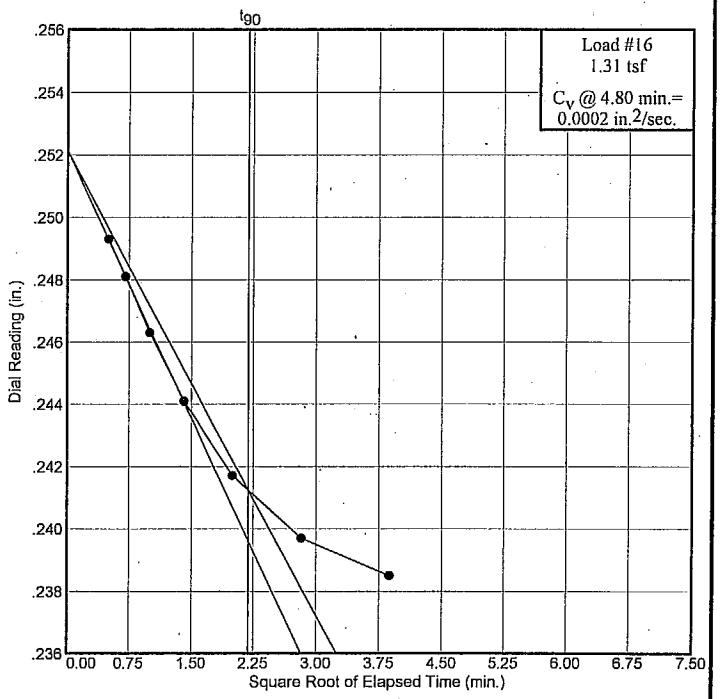
Project No.: 183-07
Project: Shoreline East - Branford Parking Lot

Location: BR-14 UP-1 15'3" Deep









Dial Reading vs. Time

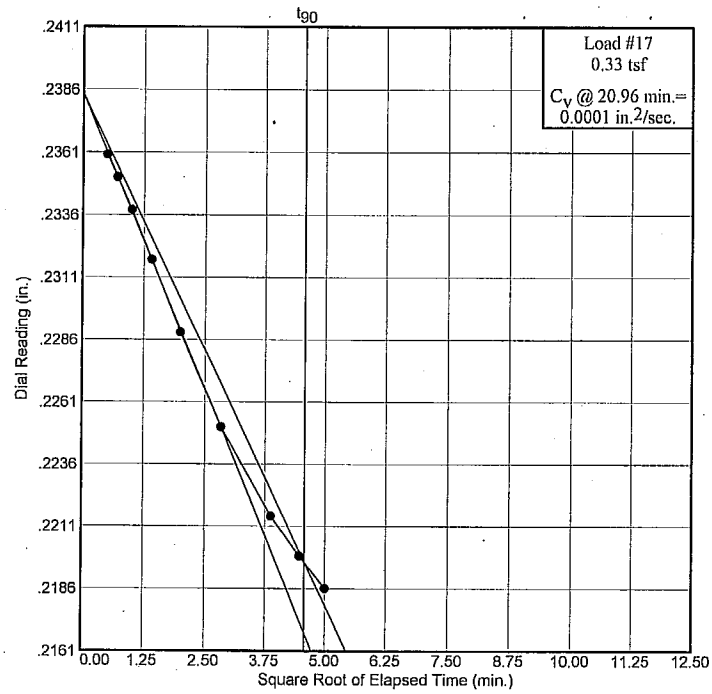
GeoDesign Incorporated

Plate

Dial Reading vs. Time

Project No.: 183-07
Project: Shoreline East - Branford Parking Lot

Location: BR-14 UP-1 15'3" Deep



Dial Reading vs. Time

GeoDesign Incorporated

Plate

7

GEODESIGN, INC.
LOG OF TUBE SAMPLE

Boring No.: BR-14
Sample No.: UP-1
Depth (ft): 14' to 16'
Lab/Test No.:

Project Name, Location: Shoreline East- Branford Parking Lot
Client: Conn Dot

Test Date 6/18-20/08
Proj. No. 183-07
Test By JFW
Lab Proj. No. 00237

Sample Depth (feet)	Sample Length (inches)		DESCRIPTION	Torvane (TSF)	Test Samples
	14'	3"	Gray/Black, Organic Silty CLAY,		
	14'1		Some f-m Sand, trace f. Gravel. (Possible		
	14'2		Slough) Strong Odor (PID = 2.3 ppm)		
	14'3	3"	Gray organic Silty CLAY, trace	0.27	W=70.8%
	14'4		to little organic fibers, trace		
	14'5		Shell fragments. (Organic Test Sample)		
	14'6	3"	Gray Organic Silty CLAY, trace	0.26	W=75.8%
	14'7		plant fibers, trace shell fragments		
	14'8				
	14'9	3"	Similar to above except trace (-)	0.29	W=76.4%
	14'10		Shell fragments		
	14'11				
	15'	2"	Gray Organic Silty CLAY	0.30	W=75.1%
	15'1				
	15'2	1"	Similar to above		W=69.1%
	15'3	1"	Similar to above (Consolidation)		W=71.6%
	15'4	2"	Similar to above w/ one shell piece	0.30	W=75.1%
	15'5		(Organic test sample)		
	15'6	1"	Similar to above	0.24	
	15'7		No Recovery		
	15'8		No Recovery		
	15'9		No Recovery		
	15'10		No Recovery		
	15'11		No Recovery		

Length of Sample Recovered:	19.10	in.
Weight of Tube & Wet Soil:	12.78	g / lb
Weight of Tube:	5.64	g / lb
Weight of Wet Soil:	7.14	g / lb
Diameter of Tube:	2.8735	in.
Total Unit Weight:	100.1	lbs/cu. ft.

GeoDesign, Inc.
Box 699 / 54 Main Street
Windsor, Vermont
802-674-2033

ORGANIC CONTENT DETERMINATION

Project Name	Shoreline East - Branford Parking Lot		
Site Location	Branford, CT	Test By	JFW
Project No.	183-07.0	Date Tested	6/20/2008
Client	ConnDot	Review By	JAG
Boring No.	BR-14		
Sample No.	UP-1		
Depth (ft)	14.25'		
Sample Description	Organic Silty CLAY		

ORGANIC CONTENT DETERMINATION
ASTM D 2974

Method A (Moisture Content)

Mass of Container A (g) - [used for oven]	3.90
Mass of Container A plus Moist Soil (g)	62.50
Mass of Container A plus Oven-Dried Sample (g)	37.78
Weight of water (g)	24.72
Weight of Oven-Dried Sample (g)	33.88
Natural Moisture Content (%)	73.0

Method C / D (C=440, D=750 degrees C)

Mass of Container B (g) - [used for muffle furnace]	77.34
Mass of Container B plus Oven-Dried Sample used for test (g)	111.24
Mass of Container B plus Ash (post-test) (g)	109.04
Mass of Oven-Dried Sample Used for Test (g)	33.90
Mass of Ash (g)	31.70
Ash Content (%)	93.5
Organic matter (%)	6.5

Notes

ORGANIC CONTENT DETERMINATION

Project Name	Shoreline East - Branford Parking Lot		
Site Location	Branford, CT	Test By	JFW
Project No.	183-07.0	Date Tested	6/20/2008
Client	ConnDot	Review By	JAG
Boring No.	BR-14		
Sample No.	UP-1		
Depth (ft)	15.5'		
Sample Description	Organic Silty CLAY		

ORGANIC CONTENT DETERMINATION
ASTM D 2974

Method A (Moisture Content)

Mass of Container A (g) - [used for oven]	77.34
Mass of Container A plus Moist Soil (g)	135.18
Mass of Container A plus Oven-Dried Sample (g)	110.27
Weight of water (g)	24.91
Weight of Oven-Dried Sample (g)	32.93
Natural Moisture Content (%)	75.6

Method C / D (C=440, D=750 degrees C)

Mass of Container B (g) - [used for muffle furnace]	77.34
Mass of Container B plus Oven-Dried Sample used for test (g)	110.27
Mass of Container B plus Ash (post-test) (g)	108.94
Mass of Oven-Dried Sample Used for Test (g)	32.93
Mass of Ash (g)	31.60
Ash Content (%)	96.0
Organic matter (%)	4.0

Notes

Appendix 5

Geogrids

TENSAR INTERNATIONAL CORPORATION
www.tensarcorp.com
1-800-TENSAR-1

Shore Line East

Branford, Connecticut, United States

Project Reference: CBR=0.8

DESIGNER

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203-758-8842 (FAX)
marie@geodesign.net

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Design Methodology

The aggregate fill thicknesses determined in the Results section below are based on the methodology prescribed in Giroud and Han (2004). The design method is intended for the calculation of the required unbound aggregate layer thickness for unpaved roads constructed on weak subgrades.

Validation of the thicknesses achieved for pavement sections reinforced with Tensar biaxial geogrids using this method were achieved through calibration with several sets of test data including the results obtained from work undertaken in the pavement test facility at North Carolina State University (Gabr, 2001).

Design Parameters

a) Trafficking Requirements

Property	Value
Axle Load (kips)	18
Tire Pressure (psi)	80
Axial Passes (Each)	1200
Maximum Rut Depth (in)	1.5

b) Pavement Soil Properties

Property	Value
Aggregate Fill CBR (%)	20
Field Subgrade CBR (%)	0.8

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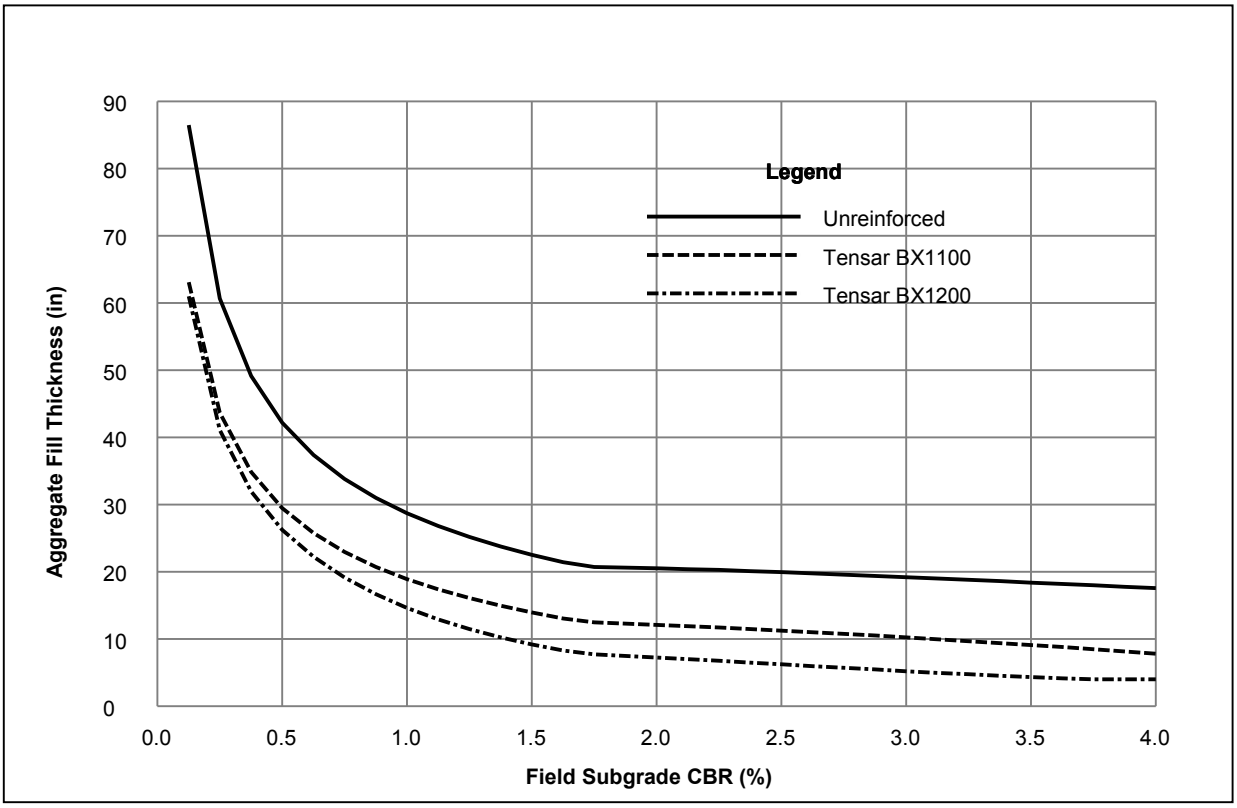
c) Geosynthetic Properties

Parameter	BX1100	BX1200
Geogrid type	Integrally formed, single layer	Integrally formed, single layer
Rib shape	Rectangular/ square	Rectangular/ square
Rib thickness (in)	0.03	0.05
Aperture stability modulus (m-N/degree)	0.32	0.65
Junction efficiency (%)	90	90
Aperture dimensions (in) - Machine direction - Cross machine	 1.0 1.3	 1.0 1.3
Thickness adjustment factor	1.0	1.0

Results



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Aggregate Fill Thickness Savings

Geosynthetic	Aggregate Fill Thickness (in)		Aggregate Fill Thickness Savings (in)	
	Calculated	Required	(in)	(%)
Unreinforced	32.63	33	N/A	N/A
Tensar™ BX1100	22.02	22	11	33
Tensar™ BX1200	18.11	19	14	42

References

1. Gabr M. (2001)
   Cyclic plate loading tests on geogrid reinforced roads.
   Research report to Tensar Earth Technologies Inc., N.C. State University

2. Giroud, J.P., and Han, J. (2004)
   Design method for geogrid-reinforced unpaved roads:
   Part 1 – Development of design method
   ASCE Journal of Geotechnical and Geoenvironmental Engineering

3. Giroud, J.P., and Han, J. (2004)
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TENSAR INTERNATIONAL CORPORATION
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1-800-TENSAR-1

Shore Line East

Branford, Connecticut, United States

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Design Parameters

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Property	Value
Axle Load (kips)	18
Tire Pressure (psi)	80
Axial Passes (Each)	1200
Maximum Rut Depth (in)	1.5

b) Pavement Soil Properties

Property	Value
Aggregate Fill CBR (%)	20
Field Subgrade CBR (%)	3.0

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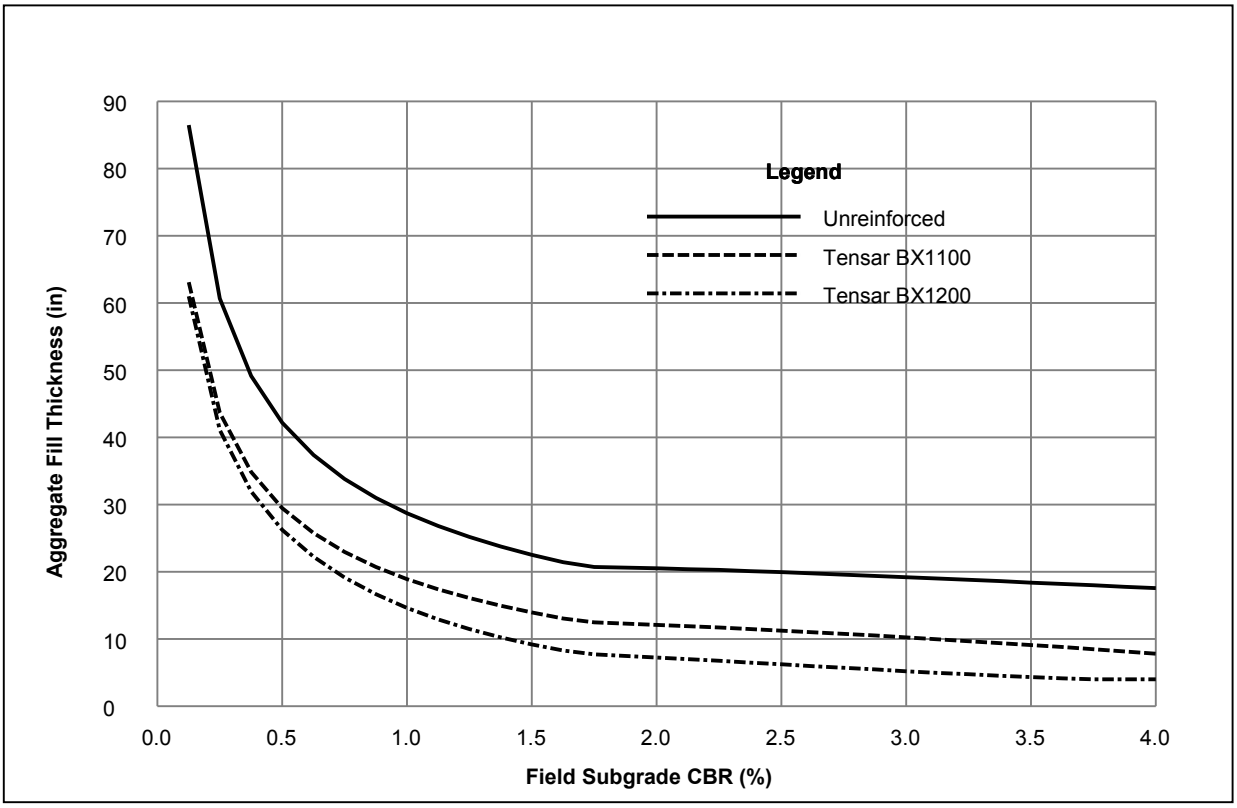

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Aggregate Fill Thickness Savings

Geosynthetic	Aggregate Fill Thickness (in)		Aggregate Fill Thickness Savings (in)	
	Calculated	Required	(in)	(%)
Unreinforced	19.23	20	N/A	N/A
Tensar™ BX1100	10.26	11	9	45
Tensar™ BX1200	5.24	6	14	70

References

1. Gabr M. (2001)
   Cyclic plate loading tests on geogrid reinforced roads.
   Research report to Tensar Earth Technologies Inc., N.C. State University

2. Giroud, J.P., and Han, J. (2004)
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Appendix 6

Limitations

GEOTECHNICAL LIMITATIONS

Explorations

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

2. 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.

3. 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 river levels, rainfall, temperature, and other factors occurring since the time measurements were made.

Review

4. In the event that any changes in the nature, design or location of the proposed surface parking, culvert, or "kiss & ride" 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

5. 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 the surface parking, culvert, and "kiss & ride" roadway at the proposed Shore Line East Branford Station, located in Branford Connecticut, in accordance with generally accepted soil and foundation engineering practices. No other warranty, express or implied, is made.

6. 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.

Appendix 6

Limitations

GEOTECHNICAL LIMITATIONS

Explorations

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

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3. 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 rainfall, temperature, and other factors occurring since the time measurements were made.

Review

4. In the event that any changes in the nature, design or location of the proposed structures are planned, 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**. It is recommended that this firm be provided the opportunity for a general review of final design and specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications.

Use of Report

5. This report has been prepared for the exclusive use of Michael Baker Engineering, Inc. and Connecticut Department of Transportation for specific application to the Branford Station and Tower located in Branford, CT, in accordance with generally accepted soil and foundation engineering practices. No other warranty, express or implied, is made.

6. This 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.