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brownfield development
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dewatering
drilling
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facility asset management
forensic engineering
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property condition assessment
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remediation
risk assessment
roof system management
sealant/waterproofing
settlement analysis
slope stability
storm water management
structural steel/welding
underground storage tank

# PRELIMINARY GEOTECHNICAL EVALUATION REPORT

PROPOSED UPTOWN AT
RIVERSEDGE DEVELOPMENT
BAY CITY, MICHIGAN

SME Project No. BG53782
May 3, 2007


Soil and Materials Engineers, Inc.

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May 3, 2007

Mr. Michael Brandow
Economic Development Project Manager
City of Bay City
301 Washington Avenue
Bay City, Michigan 48708

RE: Preliminary Geotechnical Evaluation
Proposed UpTown at RiversEdge Development
Bay City, Michigan
SME Project No. BG53782

Dear Mr. Brandow:

We have completed our preliminary geotechnical evaluation for the proposed UpTown at RiversEdge development in Bay City, Michigan. This report presents the results of our observations and analysis, and our preliminary comments and recommendations for subgrade preparation for slabs on grade, pavements, and foundation design considerations. Furthermore, our report contains a brief discussion regarding construction considerations related to the geotechnical conditions disclosed by the soil borings.

***The preliminary recommendations contained in the report are for planning purposes only and should not be used for final design***. The client and key members of the design team, including SME, should discuss the issues covered in this report so that the issues are understood for development of the next phases of evaluation in a manner consistent with the owners' budget, tolerance of risk, and expectations for performance and maintenance.

We appreciate the opportunity to assist you during the preliminary phase of this project. If you have any questions regarding this report, please contact us.

Very truly yours,

**SOIL AND MATERIALS ENGINEERS, INC.**

J. William Coberly

J. William Coberly, CET
Vice President

Attachment: Preliminary Geotechnical Evaluation Report
Enclosures: 3 copies
Distribution: 1 copy – Jack Wheatley-Rowe, Inc.

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Plymouth
Bay City
Grand Rapids
Kalamazoo
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Toledo
Traverse City

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## SUMMARY

The report conclusions and ***preliminary*** recommendations are summarized as follows:

1. Historically, the site has been filled to reclaim land along the Saginaw River. This has resulted in the soil conditions generally consisting of mixed fill overlying medium to hard natural clays with occasional interbedded layers of wood, peat, and natural sands, which extend about 80 to 90 feet below the existing ground surface. Varying amounts of organics were observed in the natural clays encountered above a depth of about 50 feet. Sandy clay till (hardpan) was encountered below a depth of about 85 feet and extended to the explored depths of the deeper soil borings.
2. Relatively shallow fill (1 to 6 feet) was encountered overlying very stiff to hard natural clays in soil borings B14 and B16 (east of Water Street). Shallow spread foundations bearing on the natural clays encountered just beneath the fill are feasible in this area of the site.
3. It may be feasible to construct shallow footings on the existing fill, provided some type of ground improvement method is used to reduce the potential for long-term settlement of the fill, organic soils, and underlying soft clays. Methods for ground improvement could consist of surcharging, deep dynamic compaction, stone columns, or a combination thereof. Additional evaluation of the existing soil conditions will be required to better determine the type and extent of ground improvement methods best suited to the specific structure(s).
4. If various type of ground improvement techniques are not considered to be viable, then deep foundations consisting of drilled piers, steel H-pile, auger cast-in-place (ACIP) piles, or concrete filled pipe piles bearing in the sandy clay hardpan are generally recommended for support of structure(s) located in areas of the site containing deep fill or buried organic soils. Driven or drilled piles extending to the hard/dense till (hardpan) are expected to achieve working load capacities in the range of about 50 to 150 tons per pile, depending on the type and size of the piles. For drilled concrete piers (caissons) bearing on/in the hardpan, maximum net allowable end bearing pressures ranging from about 20 to 40 ksf are feasible. Hardpan was generally encountered at about elevation 506 to 500 feet, or about 80 to 90 feet below the existing ground surface.
5. There are increased risks of settlement, cracking, and faulting associated with placing grade slabs and pavements on the existing fill, especially if underlain by organics. Additional borings will be required to further evaluate the existing fill/organic materials in an effort to better evaluate the extent and magnitude of potential settlements and methods to mitigate the affect of settlements on pavements and grade slabs.

The summary presented above includes selected elements of our ***preliminary*** findings and recommendations and is provided solely for purposes of overview. It does not present crucial details needed for the proper application of our findings and recommendations. It should therefore not be considered apart from the entire text of this report and appendices, with all the qualifications and considerations mentioned therein, which are best evaluated with the active participation of SME. ***Additional soil borings will be required once specific development options have been finalized***.

REPORT PREPARED BY:

Joseph L. Noykos, P.E.
Project Geotechnical Engineer

REPORT REVIEWED BY:

Timothy H. Bedenis, P.E.
Principal

# 1.0 INTRODUCTION

This report presents the results of our preliminary geotechnical evaluation for the proposed UpTown at RiversEdge development in Bay City, Michigan. This evaluation was conducted in general accordance with the scope of services outlined in our proposal dated August 23, 2006 (SME Proposal Number B06-0127). Please refer to that proposal for the specific scope of services.

## 1.1 Site Conditions

The UpTown at RiversEdge project encompasses approximately 48 acres along the Saginaw River in Bay City, Michigan. The property extends from the Saginaw River east to Saginaw Street between 13th Street to the north and the Breaker Cove condominium complex to the south. The site is a former industrial area where a majority of the former buildings have been demolished. Some buildings, generally located on the east side of the site, still exist. Existing site grades vary from about elevation 582 feet to 598 feet, or about 16 feet.

## 1.2 Project Description

The UpTown at RiversEdge property is being offered to potential developers for multipurpose use. A mixture of business space, tourism, and single and multi-family housing have been promoted by the City of Bay City. This includes the potential reuse of some of the existing buildings that are believed to be supported on piling. Proposed buildings will likely range from relatively lightly loaded, single to two-story, wood framed structures to heavily loaded, multi-storied, steel-framed buildings. Information regarding the number, location, and orientation of potential structures is unknown at this time.

## 1.3 Previous Site Evaluation(s)

SME has performed numerous soil borings throughout the property including at the former American Hoist site, and for sheetpile design proposed along the west bank of the Saginaw River. Additional soil borings have been performed by Arthur D. Little, Roy F. Westin, Inc., and AKT Peerless. SME performed a cursory review of the two Baseline Environmental Assessment (BEA) reports prepared by AKT Peerless, Inc., dated March 29, 2002 (AKT Peerless Inc., Project Numbers 3550F and 3522F), which included a compilation of all the geotechnical and environmental evaluations performed at the site, including any soil borings.

A Preliminary Geotechnical Evaluation report was performed at the site by SME in 1992 for the then proposed US EPA Boat Research Facilities. The report, soil boring logs, and laboratory data results were thoroughly reviewed in preparation of this report. Copies of applicable boring logs are included in Appendix A.

## 2.0 EVALUATION PROCEDURES

### 2.1 Field Exploration

A total of ten (10) soil borings were drilled for this evaluation from October 27 through November 10, 2006. Soil borings B4, B8, B12, and B14 were extended about 90 to 95 feet below the existing ground surface. Borings B9, B13, and B16 were extended about 35 feet below the existing ground surface. The remaining soil borings (B1, B2, B5, and B6) were "blind-drilled" to about 78 feet below the existing ground surface, at which depth samples were taken at 5-foot intervals to about 83 to 90 feet. Several soil borings (B3, B7, and B10) were performed by SME in May of 2002 in support of a Preliminary Geotechnical Evaluation report dated June 15, 1992. The previous soil borings were generally extended about 80 to 89 feet below the ground surface.

The number, locations and depths of the soil borings for this evaluation were determined by SME, with input from the City of Bay City, based on the subsurface soil and groundwater conditions encountered during the performance of the preliminary geotechnical evaluation in May of 1992. The soil borings were located in the field by SME prior to drilling by cross-taping methods from existing site features as referenced on a "Letter of Map Amendment" dated December 29, 2005 prepared by Rowe, Inc. Additionally, the approximate latitude and longitude of each of the ten soil borings drilled for this evaluation was obtained by utilizing a hand-held, global positioning device (GPS). The approximate surface elevation at each of the borings was determined to the nearest 0.1 foot by SME and is presented on each individual soil boring log. The approximate soil boring locations, as well as approximate GPS coordinates, are provided on the Soil Boring Location Diagram included in Appendix A.

The soil borings were drilled using a rotary-type, truck-mounted drill rig, and were advanced to the sampling depths using either continuous flight hollow-stem augers, or wash-rotary drilling techniques. The soil borings included soil sampling based upon Split-Barrel Sampling Procedures. At the completion of the soil borings, the boreholes were backfilled with a mixture of auger cuttings and cement/bentonite grout. The samples were sealed in glass jars in the field by the driller and returned to the laboratory for further examination and testing.

Groundwater measurements were recorded during drilling and immediately after completion of the drilling operations. At the deeper soil borings, beyond depths of about 35 feet, wash-rotary drilling techniques were utilized. Therefore, the groundwater measurements reported after the drilling operations are likely inaccurate. Since the boreholes were backfilled shortly after drilling, long-term water level information is not available from the soil borings.

The soil boring logs include materials encountered, penetration resistances, and pertinent field observations made during the drilling operations. The soil boring logs are included in Appendix A.

## 2.2 Laboratory Testing

The general laboratory testing program consisted of performing visual soil classification, moisture content, hand penetrometer, and Torvane shear tests on portions of cohesive samples obtained.

The soil samples were visually classified in general accordance with the Unified Soil Classification System (USCS). The estimated group symbol, according to the USCS, is shown in parentheses following the textural description of the various strata on the soil boring logs contained in Appendix A. The appended General Notes sheet includes a brief summary of the general method of describing the soil and assigning an appropriate USCS group symbol.

In the hand penetrometer test, the unconfined compressive strength of a cohesive soil sample is estimated by measuring the resistance of the sample to penetration of a small calibrated spring-loaded cylinder. The maximum capacity of the penetrometer is 4.5 tsf. The shear strength reported on the soil boring logs is theoretically one-half of the unconfined compressive strength.

In the Torvane shear test, a small vane is inserted into a relatively cohesive soil sample and a torque is applied through the vanes. The shearing strength, or Torvane shear strength, of the soil is then determined from the maximum torque measured. Theoretically, the Torvane shear strength is equal to one-half the unconfined compressive strength. The results of the laboratory testing are included on the soil boring logs contained in Appendix A.

Soil samples retained over a long period of time, even sealed in jars, are subject to moisture loss and are no longer representative of the conditions initially encountered in the field. Therefore, soil samples are normally retained in our laboratory for 60 days and then disposed, unless instructed otherwise.

# 3.0 SUBSURFACE CONDITIONS

## 3.1 Soil Conditions

The site is located along the Saginaw River and has been historically filled to reclaim the land for industrial use and for access to the river. In addition, the fill was placed over the floodplain of the river which contains occasional layers of organic soils (i.e., peat, wood, and organic silt). The following gives a generalized summary description of the soils encountered in the soil borings performed at the subject site, beginning at the ground surface and proceeding downward:

**Stratum 1: Fill.** Mixed sand and clay fill with varying amounts of organics, crushed limestone, and foundry slag was encountered at the majority of the soil borings extending from the existing ground surface, or from just beneath the existing ground surface, to about 6 to 28 feet. Standard Penetration Resistances (N-values) obtained in the existing fill ranged from about 2 blows per foot (bpf) to greater than 50 blows per 2 inches. The magnitude and range of N-values indicate the fill was likely placed in an uncontrolled manner, with the higher N-values indicative of debris within the fill matrix.

**Stratum 2: Natural Clay and/or Clayey Silt (CL-OL, ML-CL).** Natural, brown/gray, silty clays or clayey silts with varying amounts of fine sand, organics, and shell fragments were encountered extending from beneath the fill materials to about 40 to 60 feet below the existing ground surface at all but four of the soil borings (B12, B13, B14, and B16). Shear strengths in the clay stratum ranged from about 0.5 to 0.8 kips per square foot (ksf), indicating a soft to medium condition. Associated moisture contents ranged from about 40 to 50 percent. N-values in the clays and silts ranged from about 2 to 7 bpf.

**Stratum 3: Fine to Coarse Sand (SP, SP-SM).** Fine to coarse sand was encountered extending from beneath the Stratum 2 soils to about 50 to 65 feet below the existing ground surface at soil borings B9, B12, B13, B14, and B16. N-values in the sands ranged from about 5 to 28 bpf, indicating a loose to medium dense condition

**Stratum 4: Medium to Stiff Silty/Sandy Clay (CL).** Natural, gray silty/sandy clays were generally encountered extending from beneath the Stratum 3 materials to about 80 to 90 feet below the existing ground surface. Shear strengths in the clays ranged from about 1.5 to 0.7 ksf, indicating a stiff to medium hard condition. Associated moisture contents ranged from about 15 to 30 percent. Generally, the strength of this particular stratum decreased with depth.

**Stratum 5: Sandy Clay Till (CL-Hardpan).** Sandy clay till (commonly termed 'hardpan') was encountered extending from beneath the overlying softer clays to the explored depths of the deeper soil borings. Shear strengths in the hardpan were in excess of 4.5 ksf, with N-values of 58 bpf to nearly 300 blows per 2 inches. Associated moisture contents were on the order of about 10 percent, or less.

The soil descriptions and properties, in addition to groundwater conditions observed by the driller, are graphically presented in the soil boring logs appended to this report along with the Soil Boring Location diagram. Please refer to the soil boring logs for the soil conditions encountered at the specific soil boring locations. Stratification lines on the appended soil boring logs indicate a general transition between soil types. They are not intended to show an area of exact geological change. The soil descriptions are based on visual classification of the soils encountered.

## 3.2 Groundwater Conditions

Groundwater was encountered at all but four (B1, B5, B6, and B14)of the ten soil borings drilled for this evaluation. During the drilling activities, groundwater, where encountered, was generally reported at about 6 to 12 feet below the existing ground surface. Upon completion of the drilling activities, groundwater was encountered at about 10 to 24 feet below the existing ground surface. Reference should be made to the individual soil boring logs for specific groundwater information. At the deeper soil borings, beyond depths of about 35 feet, wash-rotary drilling techniques were utilized. Therefore, the groundwater measurements reported after the drilling operations are likely inaccurate for these particular borings.

In cohesive soils, such as those designated as CL, CL-OL, and ML, a long time may be required for the water level in the borehole to reach an equilibrium position. Thus, the short-term groundwater level readings at the soil boring locations during and after drilling may not represent the existing groundwater level. Therefore, the use of groundwater monitoring wells (piezometers) is necessary to accurately determine the hydrostatic water level.

Hydrostatic and perched groundwater levels and the elevations and volumes of groundwater should be expected to fluctuate throughout the year, based on variations in precipitation, evaporation, run-off, elevation of the Saginaw River, and other factors. The lack and/or depth of groundwater indicated by the soil borings, and presented in this section, represent conditions at the time the readings were taken. The actual groundwater levels at the time of construction may vary.

# 4.0 PRELIMINARY ANALYSIS AND RECOMMENDATIONS

## 4.1 Preliminary Foundation Recommendations

The following sections address preliminary recommendations for shallow and deep foundations.

### 4.1.1 Shallow Spread Foundations

Shallow spread foundations bearing at relatively shallow depths on natural soils are considered to be feasible only at relatively small portions of the site. Natural very stiff to hard clays were encountered at about 1 to 6 feet below the existing ground surface at soil borings B14 and B16 (east of Water Street), or about elevation 592 feet. However, due to the limited data in this area, the lateral extent of these relatively shallow natural clay soils is not fully defined. Additional soil borings would be required to better determine the specific areas where the fill is shallow enough to allow construction of footings on the natural soils.

Construction of shallow footings in the deep fill areas on or over the existing fill materials could be feasible, but the approach will need to address the potential for long-term settlements. Consolidation settlement of the existing fill materials, organic soils, and underlying soft natural clays (where present) will occur if site grades are increased at areas of the site west of Water Street. Additional consolidation could also occur due the structural loads of the proposed buildings. The amount of consolidation settlement will depend on the anticipated structural loads, and more specifically, the depth of additional fill required to attain design site grades. Due to the varying thickness and uniformity of the existing fill, organic soils, and underlying soft clays, settlements at the surface will vary across the site (i.e. non-uniform).

To reduce post construction settlement at areas of the site where site grades will be increased, the subgrade could be surcharged. Surcharging includes the placement of excess fill above the final grade levels in an effort to preconsolidate compressible soils, such as the underlying fill materials, organic soils, and soft clays. The amount of surcharge and time required to suitably consolidate the underlying soils are dependent on the anticipated structural loads, depth of fill required to attain final grades, and the actual compressibility characteristics of these soils. These characteristics can vary and therefore the magnitude and rate of settlement should be monitored during fill placement and the period of surcharging. Additional soil borings and laboratory tests will be required to more accurately define the surcharging program and resultant consolidation of the underlying soils.

There are other ground improvement techniques which could be used to improve the existing fills sufficiently to allow construction of lightly-loaded buildings supported on shallow spread footings. Two of these techniques are deep dynamic compaction (DDC) and stone columns.

The DDC is a method to densify deep fill which consists of dropping a heavy weight from a crane. The energy from the falling weight densifies the soils upon impacting the ground surface. The drops are repeated many times over the area to be treated resulting in a denser and more uniform mass of fill. Stone columns consist of cylindrical shaped columns of aggregate which are installed through the fill and organics and into the underlying natural soils. The columns are placed below the proposed foundations and on a grid pattern below proposed floor slabs. The loads from the building(s) are transmitted through the stone columns and into the more stable natural soils.

If the site is improved as described above, the footings ***could*** be constructed directly on top, or over, the existing fill materials. Depending on the final grade levels and specific building layout(s), it may be necessary to place a geogrid aggregate mat at the surface above the stone columns. The footings and slabs would then be constructed over the aggregate mat.

***It should be noted that there will be some level of risk of settlement and subsequent poor structural performance after site improvements due largely to the variability of the existing fill materials. Quantifying such risk is difficult at this time. Extensive on-site evaluation and testing of the foundation bearing soils will be required to better define the geologic conditions and mitigate the potential risks.***

At areas of the site where aggregate stockpiles were present, such as the northern portion of the site (former Bay Aggregate facility), some consolidation of the underlying fill and organic soils may have occurred. There exists the possibility in this particular area that shallow foundations bearing on the fill and underlying organics may be feasible. However, extensive historic research and mapping of the former stockpiles would be required to estimate the vertical and lateral extent of such consolidation. Additional soil borings and specialized in-situ testing (such as pressuremeters) would also be required.

#### 4.1.2 Deep Foundations

Where the fill and organic soils are relatively deep and ground improvement methods (i.e., surcharging, deep dynamic compaction, stone columns, etc) are determined to be impractical, then the proposed structure(s) should be supported on deep foundations. Deep foundation systems may consist of driven piles (i.e., steel H-piles, concrete filled steel pipe piles), auger cast-in-place piles (ACIP piles), drilled piers (caissons), or a combination of each. Deep foundations shall extend through the existing fill, underlying organic soils, and soft natural clays to bear in the sandy clay hardpan soils generally encountered at about 80 to 90 feet below the existing ground surface, or about elevation 506 to 500 feet.

***Driven Piles***

For 10 to 12 inch steel H-piles or concrete filled steel pipe piles bearing in the sandy clay hardpan, we preliminarily recommend pile working load capacities in the range of about 75 to 150 tons per pile. We anticipate that pile tip penetration into the hardpan for the above load range could be on the order of about 5 to 10 feet. This will depend on the specific structural loading conditions, soil conditions, and the pile type driving system. For piles with design working load capacities near the lower end of this range, we generally believe a lighter pile section may be utilized with less embedment into the hardpan. For piles with working load capacities at the upper end of this range, relatively heavier piles sections and greater depths of embedment into the hardpan should be expected.

We estimate total settlement for pile foundations bearing in hardpan to be about ½ inch, utilizing the preliminary pile working load capacities as described above. The settlement estimate provided is based on the available soil boring information and our experience with similar type soils and pile foundation systems utilized along the Saginaw River front. Specific recommendations regarding construction, capacities, and tip depth can be provided once additional information is available regarding structure type, size, useage, and anticipated loads. Additional soil borings, specific to the development type and location, will be required to finalize our preliminary recommendations.

***Auger Cast-In-Place (ACIP) Piles***

An auger cast-in-place (ACIP) pile may also be used. ACIP piles are installed by rotating a hollow-stem, continuous-flight auger into the ground until a specified depth or penetration has been achieved. Once the desired tip depth has been achieved, a sand-cement grout with various admixtures is pumped under pressure through the auger stem as the auger is slowly withdrawn from the borehole. The key to a successful installation is continuous coordination of the rate of auger withdrawal with an adequate grout head (pressure) to support the borehole and ensure that all voids are completely filled with grout.

Auger cast pile capacities typically include a combination of both side friction and end-bearing. We estimate that ACIP piles ranging from 14 to 18 inches in diameter and extending to the hardpan soils, or just into the hardpan, are expected to obtain working load capacities in the range of about 50 to 100 tons per pile. Specific recommendations regarding construction, capacities, and tip depth can be provided once additional information is available regarding structure type, size, useage, and anticipated loads. Additional soil borings, specific to the development type and location on the site, will be required to finalize our preliminary recommendations.

***Drilled Piers (Caissons)***

A drilled pier foundation system (such as caissons or auger cast piles) may be used in lieu of driven piles. For caissons bearing on hardpan, maximum net allowable soil bearing pressures ranging from about 20 to 40 ksf are feasible. The use of 'belled' caissons may be used provided the upper portion of the shaft can be adequately sealed to prevent groundwater infiltration, sloughing of the shaft sidewalls, and proper excavation of the bell. However, based our experience with hardpan soils in the area, the presence of cobbles, boulders, or rock fragments may be possible. Therefore, the use of straight shaft caissons should be utilized wherever possible. Preliminarily, we estimate total settlement of caisson foundations bearing in, or on, the hardpan soils to be less than about ½ to 1 inch. Differential settlements between adjacent columns supported on caissons should be less than one-half of this value.

Typically, nominal shaft diameters of at least 36 inches are recommended to facilitate access to the bearing surface for cleaning and observation. Based on the observed groundwater and soil conditions, it will likely be necessary to install temporary steel casings to prevent groundwater infiltration and caving soils from entering the shaft excavation ('dry' method). Concrete may be placed by the free-fall method for a 'dry' excavation. If temporary casing is not used, it will be necessary to use a polymer-based slurry to support the excavation ('wet' method) with concrete being placed by tremie methods. Please note the 'wet' method of construction is generally slower than the 'dry' method.

As with a driven pile foundation system, specific recommendations regarding construction, capacities, and tip depth can be provided once additional information is available regarding structure type, size, useage, and anticipated loads. Additional soil borings, specific to the development type and location, will be required to finalize our preliminary recommendations.

## 4.2 Construction Considerations

Groundwater seepage is expected for excavations extending more than about 6 to 8 feet below the existing ground surface. Standard sump pit and pumping procedures should be adequate to control seepage in areas away from the Saginaw River. More rigorous dewatering techniques such as well points, or submersible pumps in slotted casings will likely be required for excavations extending more than about 1 foot below the average water level of the near Saginaw River.

The contractor must provide an adequately constructed and braced shoring system for employees working in an excavation that may expose employees to the danger of moving ground. If material is stored or heavy equipment is operated near an excavation, stronger shoring must be used to resist the increased pressure due to the superimposed loads.

The contractor should take precautions to protect adjacent utilities, roadways and structures during construction.

### 4.2.1 General Site Preparation and Engineered Fill

Preliminary recommendations regarding general site preparation are presented in the "Analysis and Recommendations" section of the Uptown Marina-Preliminary Seawall Design Report included in Appendix B. The recommendations contained in the referenced report are considered preliminary. Test pits and/or additional borings will be necessary once specific information regarding potential site developments have been determined.

### 4.2.2 Subsurface Utilities

Based on the borings performed at the subject site, we would expect the majority of proposed subsurface utilities will be supported on uncontrolled and undocumented fill overlying organic soil. The fill materials extended from about 6 to 28 feet below the existing ground surface. If site grades are not raised more than one foot in areas where the fill is underlain by compressible organic soil, the fill may be suitable for support of proposed utilities. If site grades are raised in areas underlain by organic soil, some settlement should be expected which could be detrimental to the utilities. Once the site plans have been developed, soil borings and test pits should be drilled and excavated to evaluate soil and groundwater conditions at the specific subsurface utility locations.

The existing fill soils are susceptible to disturbance during construction. Therefore, we recommend placement of a crushed aggregate or crushed concrete stabilization layer to protect the exposed subgrade prior to placement of the bedding materials, and installation of the utility. The placement of such a layer will also aid in providing a uniform subgrade on which to install the utility. The thickness and necessity of the crushed materials will depend on the particular conditions encountered during excavation.

The existing fill materials are moderately susceptible to caving and sloughing in open-cut trenches. Therefore, the use of trench boxes or shields will likely be required.

## 5.0 UPTOWN MARINA REPORT - PRELIMINARY SEAWALL DESIGN

A report was provided to address preliminary seawall design and site preparations for improvements associated with development of a marina within the Uptown at Rivers Edge Development. The recommendations contained within this preliminary report are for planning purposes only for the proposed specific marina development plans available at the time the report was prepared. Final plans and specifications for the marina should be developed for construction, once the final site plan has been reviewed and approved.

The recommendation and conclusions are applicable only at the site under consideration at the time the preliminary report was prepared. This report should not be used to develop cost estimates for site development activities including seawall construction at other locations within the Uptown at Rivers Edge Development. Other developments will require soil borings and preparation of recommendations specific to other sites. See Appendix B for the report.

## 6.0 GENERAL COMMENTS

### Basis of Preliminary Geotechnical Report

This report has been prepared in accordance with generally accepted geotechnical engineering practices to assist in the developmental phase of this project. If the site plan or the project's design criteria are changed, the recommendations contained in this report shall not be considered valid unless the variations are reviewed, additional soil borings have been completed, and the conclusions of this report are modified or approved in writing by our office.

The discussions and recommendations submitted in this preliminary report are based on the available project information, described in this report, the data obtained from the fourteen soil borings performed at the approximate locations indicated on the appended location plan, historic soil borings, and our experience along the Saginaw River. This report does not reflect variations which may occur between or away from the soil borings. The nature and extent of the variations may not become evident until the time of construction. If significant variations become evident, it may be necessary for us to reevaluate the recommendations of this report.

In the process of obtaining and testing samples and preparing this preliminary report, procedures are followed that represent reasonable and accepted practice in the field of soil and foundation engineering. Specifically, field logs are prepared during the drilling and sampling operations that describe field occurrences, sampling locations, and other information. Samples obtained in the field are frequently subjected to additional testing and reclassification in the laboratory and differences may exist between the field logs and the report logs. The engineer preparing the report reviews the field logs, laboratory classifications, and test data and then prepares the final report logs. Our recommendations are based on the contents of the report logs and the information contained therein.

## Design, Plan and Specification Review

As part of our continued service to the project, we should be retained to review the design details, project plans and specifications to verify the project factors affecting subgrade, foundation and pavement performance are consistent with the design recommendations set forth in this report.

## Project Information for the Client

This report presents the results of our observations and analyses, our recommendations for subgrade preparation, foundations design, and construction considerations. Implementation of our recommendations may affect the design, construction and performance of the structure and related facilities along with the potential inherent risks involved with the proposed construction. The client and key members of the design team, including SME, should discuss the issues covered in this report so that the issues are understood and applied in a manner consistent with the owner's budget, tolerance of risk and expectations for performance and maintenance

**Field Verification of Geotechnical Conditions**

The site earthwork operations should be observed and tested by SME to verify subgrade soils are suitable for construction of foundations, slabs-on-grade, pavements and placement of engineered fill, and to verify engineered fill for the structure, pavements and other structures is properly placed and compacted. The foundation construction activities should be observed by SME, and the foundation bearing soils tested by SME to verify conditions are as anticipated. As geotechnical engineering firm that performed the geotechnical evaluation for this project, SME is well suited to verify the recommendations of this report are properly incorporated in the design of this project, and properly implemented during construction.

**Project Information for Contractor**

This report and any future addenda or reports should be made available to bidders prior to submitting their proposals and to the successful contractor and subcontractors for their information only and to supply them with facts relative to the subsurface evaluation and laboratory test results. If the contractor encounters conditions during construction which differ from those presented in this report, he/she should promptly notify the owner so that the geotechnical engineer can be contacted to verify those conditions. Subsequently, the contractor should describe the nature and extent of the differing conditions in writing. We recommend the construction contract include provisions for dealing with differing conditions and contingency funds should be reserved for potential problems during earthwork and foundation construction. We would be pleased to assist you in the contract provisions based on our experience.

Furthermore, the contractor should be prepared to handle environmental conditions at this site which may affect the excavation, removal, or disposal of soil, dewatering of excavations, and health and safety of workers. Any environmental assessment reports prepared for this property should be made available for review by bidders and the successful contractor.

**Third Party Reliance/Reuse of This Report**

This report has been prepared solely for the use of the client for the project specifically described in this report. Other parties who are not involved with this current project and have interests in this site for future development cannot rely on the recommendations provided in this report. Therefore, SME is not responsible for the suitability of the field exploration, scope of services or interpretation by others of our soil boring logs and the recommendations provided herein. SME would be pleased to evaluate the information developed from this evaluation for other developments at this site, provided the client who retained SME for this evaluation allows SME to use that information, confirmed in writing from that client. However, this does not include modifying this original report and changing the date to accommodate other parties since the new project may require further field exploration, laboratory tests and analysis to adequately address the needs of the new project. Furthermore, other parties who engage SME's service must be bound by the SME's general terms and conditions prior to proceeding with future evaluations.

## APPENDIX A

1. IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT
2. SOIL BORING LOCATION DIAGRAM
3. GENERAL NOTES
4. UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)
5. SOIL BORING LOGS
   - 2006 SOIL BORINGS (B1, B2, B4, B5, B6, B8, B9, B12, B13, B14, AND B16)
   - 1992 SOIL BORINGS (B3, B7, AND B10)

# Important Information About Your
# Geotechnical Engineering Report

*Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.*

*The following information is provided to help you manage your risks.*

## Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

## Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

## A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

## Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

## Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

## A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

## A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

## Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

## Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

## Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

## Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

## Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

## Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

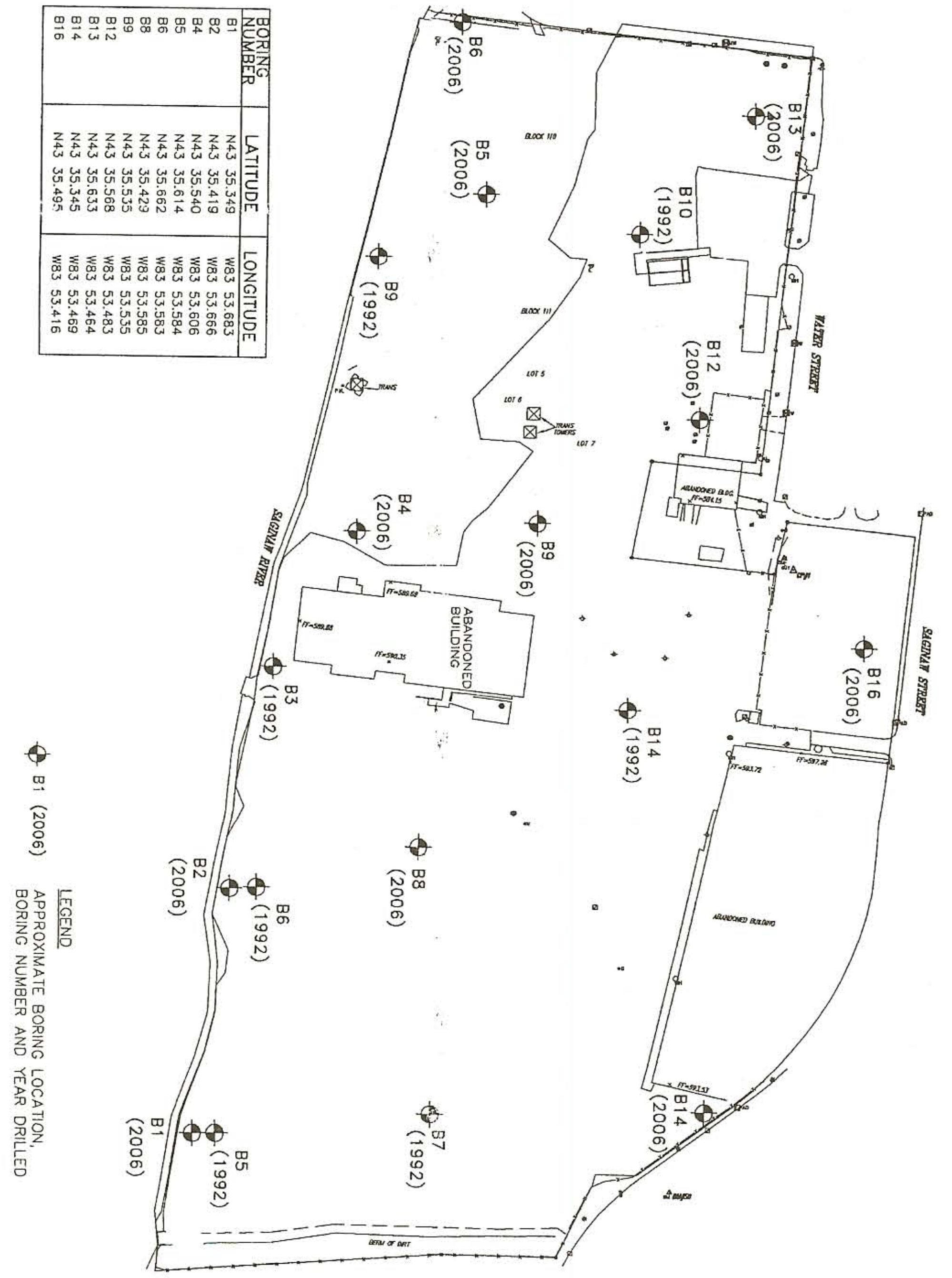
Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.

ASFE
The Best People on Earth

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@asfe.org www.asfe.org

NOTE:
DRAWING INFORMATION TAKEN FROM A LETTER OF MAP AMENDMENT (DATED DECEMBER 29, 2005), PREPARED BY ROWE INCORPORATED.

| BORING NUMBER | LATITUDE | LONGITUDE |
|---|---|---|
| B1 | N43 35.349 | W83 53.683 |
| B2 | N43 35.419 | W83 53.666 |
| B4 | N43 35.540 | W83 53.606 |
| B5 | N43 35.614 | W83 53.584 |
| B6 | N43 35.662 | W83 53.583 |
| B8 | N43 35.429 | W83 53.585 |
| B9 | N43 35.535 | W83 53.535 |
| B12 | N43 35.568 | W83 53.483 |
| B13 | N43 35.633 | W83 53.464 |
| B14 | N43 35.345 | W83 53.469 |
| B16 | N43 35.495 | W83 53.416 |




sme
PLYMOUTH – BAY CITY – GRAND RAPIDS
KALAMAZOO – LANSING – SHELBY TWP.
TOLEDO – TRAVERSE CITY

| | |
|---|---|
| DATE: | 12-01-06 |
| SCALE: | 1" = 200' |
| DRAFTER: | RJAIN |
| JOB: | BG53782 |

BORING LOCATION DIAGRAM
PRELIMINARY GEOTECHNICAL EVALUATION
PROPOSED UPTOWN AT RIVERS EDGE
BAY CITY, MICHIGAN

Jan 09, 2007 – 3:55PM – mondrilo
S:\53000\BG53782\53782-01.dwg

Figure No. 1

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# general notes

## Drilling and Sampling Symbols

| | | | |
|---|---|---|---|
| SS - | Split-Spoon-1 3/8" I.D., 2" O.D. except where noted | NR - | No Recovery |
| LS - | Liner Sample | RC - | Rock Core with diamond bit. NX size, except where noted |
| AS - | Power Auger Sample | RB - | Rock Bit |
| ST - | Shelby Tube-2" O.D., except where noted | VS - | Vane Shear |
| PS - | Piston Sample-3" diameter | PM - | Pressuremeter |
| WS - | Wash Sample | | |
| HA - | Hand Auger Sample | GP - | Geoprobe |
| BS - | Bag or Bottle Sample | PID - | Photo Ionization Device |
| CS - | Continuous Sampler | FID - | Flame Ionization Device |

Standard Penetration 'N' - Blows per foot of a 140 pound hammer falling 30 inches on a 2 inch O.D. split spoon, except where noted (based on ASTM D1586).

## Particle Sizes

| | | |
|---|---|---|
| Boulders | - | Greater than 12 inches (305 mm) |
| Cobbles | - | 3 inches (76.2 mm) to 12 inches (305 mm) |
| Gravel-Coarse | - | 3/4 inches (19.05 mm) to 3 inches (76.2 mm) |
| Fine | - | No. 4 (4.75 mm) to 3/4 inches (19.05 mm) |
| Sand-Coarse | - | No. 10 (2.00 mm) to No. 4 (4.75 mm) |
| Medium | - | No. 40 (0.425 mm) to No. 10 (2.00 mm) |
| Fine | - | No. 200 (0.074 mm) to No. 40 (0.425 mm) |
| Silt | - | (0.005 mm) to (0.074 mm) |
| Clay | - | Less than (0.005 mm) |

## Depositional Features

| | | |
|---|---|---|
| Parting | - | as much as 1/16 inch (1.6 mm) thick |
| Seam | - | 1/16 inch (1.6 mm) to 1/2 inch (12.7 mm) thick |
| Layer | - | 1/2 inch (12.7 mm) to 12 (305 mm) inch thick |
| Stratum | - | greater than 12 inches (305 mm) thick |
| Pocket | - | small, erratic deposit of limited lateral extent |
| Lens | - | lenticular deposit |
| Varved | - | alternating seams or layers of silt and/or clay and sometimes fine sand |
| Occasional | - | one or less per foot (305 mm) of thickness |
| Frequent | - | more than one per foot (305 mm) of thickness |
| Interbedded | - | applied to strata of soil or beds of rock lying between or alternating with other strata of a different nature |

Groundwater levels indicated on the boring logs are the levels measured in the boring at times indicated. The accurate determination of groundwater levels may not be possible with short term observations especially in low permeability soils. The groundwater levels shown may fluctuate throughout the year with variation in precipitation, evaporation, and runoff.

## Classification

### Cohesionless Soils (Blows per foot or 0.3m)

| | | |
|---|---|---|
| Very Loose | : | 0 to 4 |
| Loose | : | 5 to 9 |
| Medium Dense | : | 10 to 29 |
| Dense | : | 30 to 49 |
| Very Dense | : | 50 to 80 |
| Extremely Dense | : | Over 80 |

### Cohesive Soils

| Consistency | | Shear Strength |
|---|---|---|
| Very Soft | : | 0.25 kips/ft$^2$ (12.0 kPa) or less |
| Soft | : | 0.25 to 0.49 kips/ft$^2$ (12.0 to 23.8 kPa) |
| Medium | : | 0.50 to 0.99 kips/ft$^2$ (23.9 to 47.7 kPa) |
| Stiff | : | 1.00 to 1.99 kips/ft$^2$ (47.8 to 95.6 kPa) |
| Very Stiff | : | 2.00 to 3.99 kips/ft$^2$ (95.7 to 191.3 kPa) |
| Hard | : | 4.00 kips/ft$^2$ (191.4 kPa) or greater |

### Soil Constituents

| | | |
|---|---|---|
| Trace | : | Less than 5% |
| Trace to Some | : | 5% to 12% |
| Some | : | 12% to 25% |
| Use Descriptor (ie., Silty, Clayey, etc.) | : | 25% to 50% |

### Soil Description

If clay content sufficiently dominates soil properties, then clay becomes the primary noun with the other major soil constituent as modifier : i.e. silty clay. Other minor soil constituents may be added according to estimates of soil constituents present, i.e., silty clay, trace to some sand, trace gravel.

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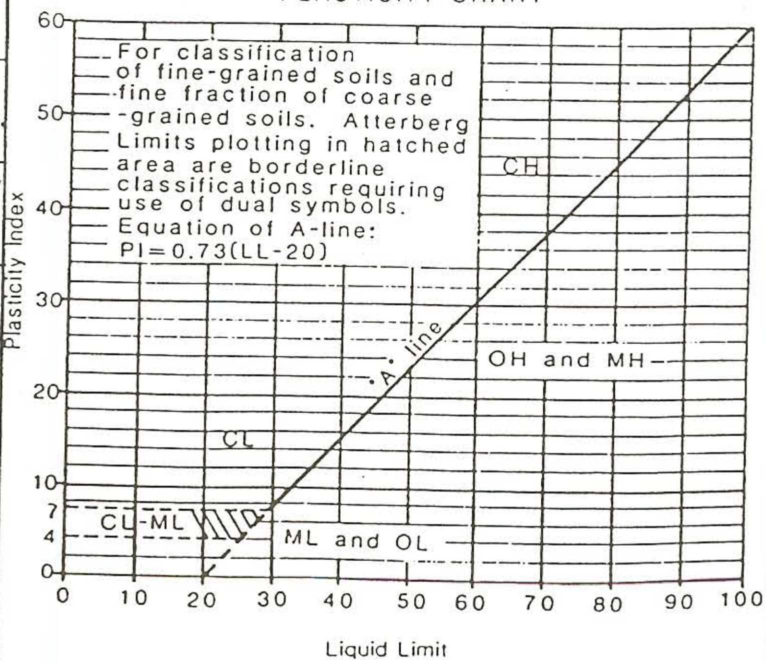
# unified soil classification system

| Major divisions | | | Group symbols | Typical names | Laboratory classification criteria | |
|---|---|---|---|---|---|---|
| Coarse-grained soils (More than half of material is larger than No. 200 sieve size) | Gravels (More than half of coarse fraction larger than No. 4 sieve size) | Clean gravels (Little or no fines) | GW | Well-graded gravels, gravel-sand mixtures, little or no fines | Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows: Less than 5% . . . . . . GW,GP,SW,SP; More than 12% . . . . . GM,GC,SM,SC; 5 to 12% . . . . . Borderline cases requiring dual symbols | $Cu = \frac{D_{60}}{D_{10}}$ greater than 4; $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3 |
| | | | GP | Poorly graded gravels, gravel-sand mixtures, little or no fines | | Not meeting all gradation requirements for GW |
| | | Gravels with fines (Appreciable amount of fines) | GM d / u | Silty gravels, gravel-sand-silt mixtures | | Atterberg limits below "A" line or P.I. less than 4 — Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols |
| | | | GC | Clayey gravels, gravel-sand-clay mixtures | | Atterberg limits above "A" line with P.I. greater than 7 |
| | Sands (More than half of coarse fraction is smaller than No. 4 sieve size) | Clean sands (Little or no fines) | SW | Well-graded sands, gravelly sands, little or no fines | | $Cu = \frac{D_{60}}{D_{10}}$ greater than 6; $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3 |
| | | | SP | Poorly graded sands, gravelly sands, little or no fines | | Not meeting all gradation requirements for SW |
| | | Sands with fines (Appreciable amount of fines) | SM d / u | Silty sands, sand-silt mixtures | | Atterberg limits below "A" line or P.I. less than 4 — Limits plotting in hatched zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols |
| | | | SC | Clayey sands, sand-clay mixtures | | Atterberg limits above "A" line with P.I. greater than 7 |
| Fine-grained soils (More than half of material is smaller than No. 200 sieve) | Silts and clays (Liquid limit less than 50) | | ML | Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity | PLASTICITY CHART | |
| | | | CL | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays | | |
| | | | OL | Organic silts and organic silty clays of low plasticity | | |
| | Silts and clays (Liquid limit greater than 50) | | MH | Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts | | |
| | | | CH | Inorganic clays of high plasticity, fat clays | | |
| | | | OH | Organic clays of medium to high plasticity, organic silts | | |
| | Highly organic soils | | Pt | Peat and other highly organic soils | | |

PLASTICITY CHART



# soil and materials engineers, inc.

**PROJECT NAME:** UPTOWN AT RIVERS EDGE
**A/E:**
**PROJECT LOCATION:** BAY CITY, MICHIGAN
**BY:** JLN **DATE:** 11/7/06 **BORING** B1
**CLIENT:** CITY OF BAY CITY
**PROJECT NUMBER:** BG53782 **SHEET:** 1

PROFILE DESCRIPTION
EASTING=
NORTHING=
GROUND SURFACE ELEVATION= 588±

LEGEND
- ▽ HAND PENETROMETER TEST
- ⊠ TORVANE SHEAR TEST
- ○ UNCONFINED COMPRESSION TEST
- ⊡ VANE SHEAR TEST
- ✕ REMOLDED VANE SHEAR
- ⊕ TRIAXIAL TEST

| DEPTH (FEET) | PROFILE DESCRIPTION | SAMPLE TYPE/NUMBER INTERVAL | BLOWS PER SIX INCHES | STANDARD PENETRATION TEST RESISTANCES (N-values) -- ○ | MOISTURE, % -- ◆ | SHEAR STRENGTH (KSF) |
|---|---|---|---|---|---|---|
| 80 | Silty Clay- Trace Sand and Gravel- Medium (CL) | SS1 | 8 / 7 / 6 | ○ | ◆ | ⊠ |
| 85 | Sandy Clay- Some Silt- Trace to Some Gravel- Gray- Hard (CL-Hardpan) | SS2 | 25 / 31 / 37 | ○68 → | ◆ | 4.5+ ▽ |
| 90 | | SS3 | 26 / 110/1" | ○110/1" → | ◆ | 4.5+ ▽ |
| 90 | END OF BORING AT 90 FEET | | | | | |

Chart scales: N-values 10, 20, 30, 40, 50; Natural dry density (pcf) -- ■ 90, 100, 110; Moisture % 0, 10, 20, 30, 40; Atterberg limits ├─┤; Shear strength (KSF) 0.0, 1.0, 2.0, 3.0, 4.0, 5.0. Depth scale 80–110.

**WATER LEVEL OBSERVATIONS**
- GROUNDWATER ENCOUNTERED DURING DRILLING
- GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

**Notes:** 1) SOIL SAMPLES WERE NOT OBTAINED TO A DEPTH OF 78.5 FEET.
2) SOIL BORING LOCATED AT N43.35349 AND W83.53683.

**DRILLER:** SME-JB **DRILL METHOD:** HOLLOW STEM **WATER LEVEL DURING DRILLING:** NONE **WATER LEVEL HOURS AFTER COMPLETION:**
**RIG NO.:** 26 **BACKFILL METHOD:** BENTONITE **WATER LEVEL UPON COMPLETION:** NONE **CAVE OF BOREHOLE AT**

# soil and materials engineers, inc.

PROJECT NAME: UPTOWN AT RIVERS EDGE — A/E:

PROJECT LOCATION: BAY CITY, MICHIGAN — BY: JLN — DATE: 11/9/06 — BORING B2

CLIENT: CITY OF BAY CITY — PROJECT NUMBER: BG53782 — SHEET: 1

PROFILE DESCRIPTION

EASTING=
NORTHING=

GROUND SURFACE ELEVATION= 587±

STANDARD PENETRATION TEST RESISTANCES (N-values) -- ○ (10, 20, 30, 40, 50)

NATURAL DRY DENSITY -- ■ (pcf) (90, 100, 110)

MOISTURE, % -- ◆ ; ATTERBERG ├─┤ LIMITS (0, 10, 20, 30, 40)

LEGEND
- ▽ HAND PENETROMETER TEST
- ⊠ TORVANE SHEAR TEST
- ○ UNCONFINED COMPRESSION TEST
- ▣ VANE SHEAR TEST
- ✕ REMOLDED VANE SHEAR
- ⊕ TRIAXIAL TEST

SHEAR STRENGTH (KSF) (0.0, 1.0, 2.0, 3.0, 4.0, 5.0)

| DEPTH (FEET) | PROFILE DESCRIPTION | SAMPLE TYPE/NUMBER INTERVAL | BLOWS PER SIX INCHES |
|---|---|---|---|
| 80 | Silty Clay- Trace Sand and Gravel- Medium (CL) | SS1 | 4 5 5 |
| | The driller reported Fine to Medium Sand | | |
| 83 | END OF BORING AT 83 FEET | | |

Depth scale: 80, 85, 90, 95, 100, 105, 110

WATER LEVEL OBSERVATIONS
- GROUNDWATER ENCOUNTERED DURING DRILLING
- GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

Notes:
1) SOIL SAMPLES WERE NOT OBTAINED TO A DEPTH OF 78.5 FEET.
2) THE DRILLER REPORTED SAMPLER REFUSAL AT 83 FEET DUE TO CAVE-IN OF BOREHOLE.
3) SOIL SAMPLES COULD NOT BE EXTRACTED BELOW A DEPTH OF 83 FEET.
4) SOIL BORING LOCATED AT N43.35419 AND W83.53666.

DRILLER: SME-JB — DRILL METHOD: HOLLOW STEM — WATER LEVEL DURING DRILLING: NONE — WATER LEVEL — HOURS AFTER COMPLETION:

RIG NO.: 26 — BACKFILL METHOD: BENTONITE — WATER LEVEL UPON COMPLETION: NONE — CAVE OF BOREHOLE AT

# soil and materials engineers, inc.

**PROJECT NAME:** UPTOWN AT RIVERS EDGE
**PROJECT LOCATION:** BAY CITY, MICHIGAN
**CLIENT:** CITY OF BAY CITY

**A/E:**
**BY:** JLN **DATE:** 10/30/06
**PROJECT NUMBER:** BG53782

**BORING B4**
**SHEET:** 1

EASTING=
NORTHING=
GROUND SURFACE ELEVATION= 584±

LEGEND
- ▽ HAND PENETROMETER TEST
- ⊠ TORVANE SHEAR TEST
- ○ UNCONFINED COMPRESSION TEST
- ▣ VANE SHEAR TEST
- × REMOLDED VANE SHEAR
- ⊕ TRIAXIAL TEST

STANDARD PENETRATION TEST RESISTANCES (N-values) -- ○ (10, 20, 30, 40, 50)
NATURAL DRY DENSITY -- ■ (pcf) (90, 100, 110)
MOISTURE, % -- ◆ ATTERBERG ├─┤ LIMITS (0, 10, 20, 30, 40)
SHEAR STRENGTH (KSF) (0.0, 1.0, 2.0, 3.0, 4.0, 5.0)

| DEPTH (FEET) | PROFILE DESCRIPTION | SAMPLE TYPE/NUMBER | BLOWS PER SIX INCHES | N-value | Moisture, % | Shear test |
|---|---|---|---|---|---|---|
| 0–14.5 | Crushed Limestone- Some Gravel and Sand- Trace to Some Silt- Trace Wood, Organics and Clay- Gray- Moist to Wet- Extremely Dense (GP/Fill) | SS1 | | 50/5" | | |
| | | SS2 | | 50/5" | | |
| | | SS3 | | 50/3" | | |
| | | SS4 | | 50/2" | | |
| | | SS5 | 2 2 2 | | | |
| 14.5–28 | Organic Silty Clay- Trace to Some Gravel- Trace Sand and Concrete Rubble- Brown/Black (OL/Fill) | SS6 | 2 2 2 | | 50.5 | |
| | | SS7 | 2 2 3 | | 43.3 | ⊠ |
| 28–35 | Silty Clay- Trace to Some Organics- Trace Fine Sand and Shell Fragments- Gray- Medium (CL-OL) | SS8 | 2 2 2 | | ◆ | ⊠ |
| | | SS9 | 2 2 2 | | ◆ | ⊠ |

WATER LEVEL OBSERVATIONS
- ▽ GROUNDWATER ENCOUNTERED DURING DRILLING
- ▽ GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

Notes: 1) SOIL BORING LOCATED AT N43.35540 AND W83.53606.

DRILLER: SME-JB DRILL METHOD: HOLLOW STEM WATER LEVEL DURING DRILLING: 6 FT WATER LEVEL HOURS AFTER COMPLETION:
RIG NO.: 26 BACKFILL METHOD: BENTONITE WATER LEVEL UPON COMPLETION: 15 FT CAVE OF BOREHOLE AT

**soil and materials engineers, inc.**

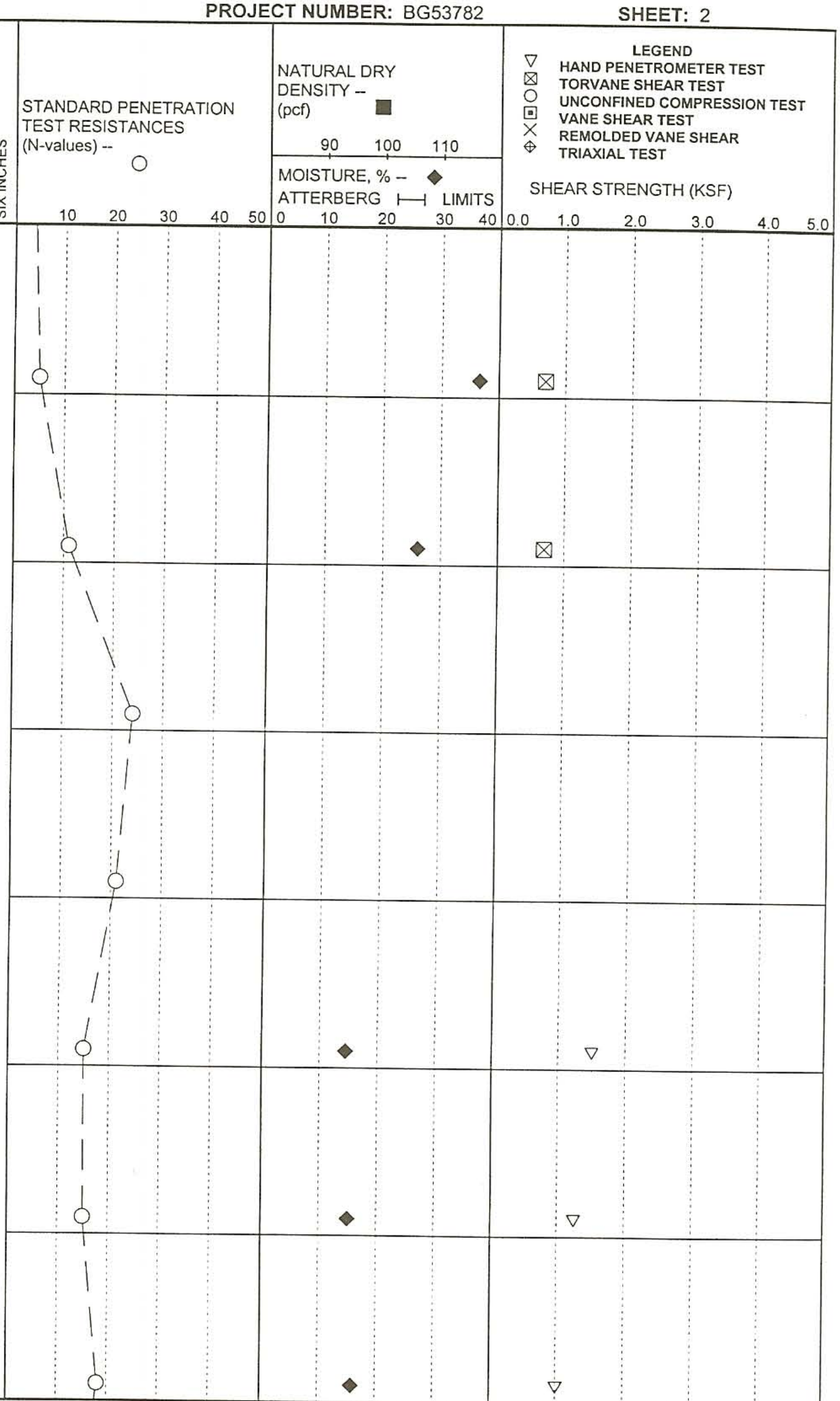
**PROJECT NAME:** UPTOWN AT RIVERS EDGE
**PROJECT LOCATION:** BAY CITY, MICHIGAN
**CLIENT:** CITY OF BAY CITY

**A/E:**
**BY:** JLN **DATE:** 10/30/06
**PROJECT NUMBER:** BG53782

**BORING B4**
**SHEET:** 2

EASTING=
NORTHING=
GROUND SURFACE ELEVATION= 584±

| DEPTH (FEET) | PROFILE DESCRIPTION | SAMPLE TYPE/NUMBER INTERVAL | BLOWS PER SIX INCHES |
|---|---|---|---|
| 35–48 | Silty Clay- Trace to Some Organics- Trace Fine Sand and Shell Fragments- Gray- Medium (CL-OL) | SS10 | 2 2 3 |
| | | SS11 | 2 5 6 |
| 48–58 | Fine to Coarse Sand- Trace Silt and Gravel- Gray- Wet- Medium Dense (SP) | SS12 | 6 9 15 |
| | | SS13 | 3 7 14 |
| 58–70 | Silty Clay- Trace Fine Sand and Gravel- Gray- Stiff to Medium (CL) | SS14 | 6 6 9 |
| | | SS15 | 6 7 9 |
| | | SS16 | 6 8 10 |




**WATER LEVEL OBSERVATIONS**

- GROUNDWATER ENCOUNTERED DURING DRILLING
- GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

**Notes:** 1) SOIL BORING LOCATED AT N43.35540 AND W83.53606.

**DRILLER:** SME-JB **DRILL METHOD:** HOLLOW STEM **WATER LEVEL DURING DRILLING:** 6 FT **WATER LEVEL** **HOURS AFTER COMPLETION:**

**RIG NO.:** 26 **BACKFILL METHOD:** BENTONITE **WATER LEVEL UPON COMPLETION:** 15 FT **CAVE OF BOREHOLE AT**

# soil and materials engineers, inc.

**PROJECT NAME:** UPTOWN AT RIVERS EDGE **A/E:**
**PROJECT LOCATION:** BAY CITY, MICHIGAN **BY:** JLN **DATE:** 10/30/06 **BORING** B4
**CLIENT:** CITY OF BAY CITY **PROJECT NUMBER:** BG53782 **SHEET:** 3

PROFILE DESCRIPTION
EASTING=
NORTHING=
GROUND SURFACE ELEVATION= 584±

LEGEND: ▽ HAND PENETROMETER TEST; ⊠ TORVANE SHEAR TEST; ○ UNCONFINED COMPRESSION TEST; ⊡ VANE SHEAR TEST; X REMOLDED VANE SHEAR; ⊕ TRIAXIAL TEST

STANDARD PENETRATION TEST RESISTANCES (N-values) -- ○
NATURAL DRY DENSITY -- (pcf) ■
MOISTURE, % -- ◆
ATTERBERG LIMITS ├─┤
SHEAR STRENGTH (KSF)

| DEPTH (FEET) | PROFILE DESCRIPTION | SAMPLE TYPE/NUMBER INTERVAL | BLOWS PER SIX INCHES | Other |
|---|---|---|---|---|
| 70–82 | Silty Clay- Trace Fine Sand and Gravel- Gray- Stiff to Medium (CL) | | | |
| 75 | | SS17 | 4 5 9 | |
| 80 | | SS18 | 4 4 5 | |
| 82–90 | Sandy Clay- Some Silt- Trace to Some Gravel- Gray- Hard (CL-Hardpan) | | | |
| 85 | | SS19 | 13 12 13 | 4.5+ ▽ |
| 90 | | SS20 | | 100/1" → |
| 90 | END OF BORING AT 90 FEET | | | |

WATER LEVEL OBSERVATIONS
- GROUNDWATER ENCOUNTERED DURING DRILLING
- GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

Notes: 1) SOIL BORING LOCATED AT N43.35540 AND W83.53606.

DRILLER: SME-JB DRILL METHOD: HOLLOW STEM WATER LEVEL DURING DRILLING: 6 FT WATER LEVEL HOURS AFTER COMPLETION:
RIG NO.: 26 BACKFILL METHOD: BENTONITE WATER LEVEL UPON COMPLETION: 15 FT CAVE OF BOREHOLE AT

# soil and materials engineers, inc.

**PROJECT NAME:** UPTOWN AT RIVERS EDGE
**A/E:**
**PROJECT LOCATION:** BAY CITY, MICHIGAN
**BY:** JLN **DATE:** 11/9/06 **BORING** B5
**CLIENT:** CITY OF BAY CITY
**PROJECT NUMBER:** BG53782 **SHEET:** 1

PROFILE DESCRIPTION
EASTING=
NORTHING=
GROUND SURFACE ELEVATION= 585±

STANDARD PENETRATION TEST RESISTANCES (N-values) -- ○ (scale 10, 20, 30, 40, 50)

NATURAL DRY DENSITY -- ■ (pcf) (scale 90, 100, 110)
MOISTURE, % -- ◆
ATTERBERG ├─┤ LIMITS (scale 0, 10, 20, 30, 40)

LEGEND
▽ HAND PENETROMETER TEST
⊠ TORVANE SHEAR TEST
○ UNCONFINED COMPRESSION TEST
⊡ VANE SHEAR TEST
╳ REMOLDED VANE SHEAR
⊕ TRIAXIAL TEST

SHEAR STRENGTH (KSF) (scale 0.0, 1.0, 2.0, 3.0, 4.0, 5.0)

| DEPTH (FEET) | SYMBOLIC PROFILE | PROFILE DESCRIPTION | SAMPLE TYPE/NUMBER INTERVAL | BLOWS PER SIX INCHES | STANDARD PENETRATION TEST RESISTANCES (N-values) | MOISTURE, % | SHEAR STRENGTH (KSF) |
|---|---|---|---|---|---|---|---|
| 78.5–80 | hatched | Sandy Clay- Some Silt- Trace to Some Gravel- Gray- Hard (CL-Hardpan) | SS1 | 10 / 19 / 24 | ○ | ◆ | 4.5+ ▽ |
| 83.5–85 | hatched | | SS2 | 15 / 25 / 33 | ○58 → | ◆ | 4.5+ ▽ |
| 88.5–90 | hatched | | SS3 | 24 / 100/5" | ○100/5" → | ◆ | 4.5+ ▽ |
| 90 | | END OF BORING AT 90 FEET | | | | | |

Depth scale: 80, 85, 90, 95, 100, 105, 110

WATER LEVEL OBSERVATIONS
- GROUNDWATER ENCOUNTERED DURING DRILLING
- GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

**Notes:** 1) SOIL SAMPLES WERE NOT OBTAINED TO A DEPTH OF 78.5 FEET.
2) SOIL BORING LOCATED AT N43.35614 AND W83.53584.

**DRILLER:** SME-JB **DRILL METHOD:** HOLLOW STEM **WATER LEVEL DURING DRILLING:** NONE **WATER LEVEL** **HOURS AFTER COMPLETION:**
**RIG NO.:** 26 **BACKFILL METHOD:** BENTONITE **WATER LEVEL UPON COMPLETION:** NONE **CAVE OF BOREHOLE AT**

# soil and materials engineers, inc.

**PROJECT NAME:** UPTOWN AT RIVERS EDGE
**A/E:**
**PROJECT LOCATION:** BAY CITY, MICHIGAN
**BY:** JLN **DATE:** 11/10/06 **BORING** B6
**CLIENT:** CITY OF BAY CITY
**PROJECT NUMBER:** BG53782 **SHEET:** 1

PROFILE DESCRIPTION
EASTING=
NORTHING=
GROUND SURFACE ELEVATION= 582±

STANDARD PENETRATION TEST RESISTANCES (N-values) -- ○

NATURAL DRY DENSITY -- ■ (pcf)
MOISTURE, % -- ◆
ATTERBERG ├─┤ LIMITS

LEGEND
▽ HAND PENETROMETER TEST
⊠ TORVANE SHEAR TEST
○ UNCONFINED COMPRESSION TEST
⊡ VANE SHEAR TEST
✕ REMOLDED VANE SHEAR
⊕ TRIAXIAL TEST

SHEAR STRENGTH (KSF)

| DEPTH (FEET) | PROFILE DESCRIPTION | SAMPLE TYPE/NUMBER INTERVAL | BLOWS PER SIX INCHES | SPT N-value | Shear Strength (KSF) |
|---|---|---|---|---|---|
| 76–82 | Sandy Clay- Some Silt- Trace to Some Gravel- Gray- Hard (CL) | SS1 | 12 / 18 / 19 | | 4.5+ ▽ |
| 82–90 | Sandy Clay- Some Silt- Trace to Some Gravel- Gray- Hard (CL-Hardpan) | SS2 | 17 / 25 / 38 | 64 → | 4.5+ ▽ |
| | | SS3 | 106/4" | 106/4" → | 4.5+ ▽ |
| 90 | END OF BORING AT 90 FEET | | | | |

WATER LEVEL OBSERVATIONS
- GROUNDWATER ENCOUNTERED DURING DRILLING
- GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

Notes: 1) SOIL SAMPLES WERE NOT OBTAINED TO A DEPTH OF 76 FEET.
2) SOIL BORING LOCATED AT N43.35662 AND W83.53583.

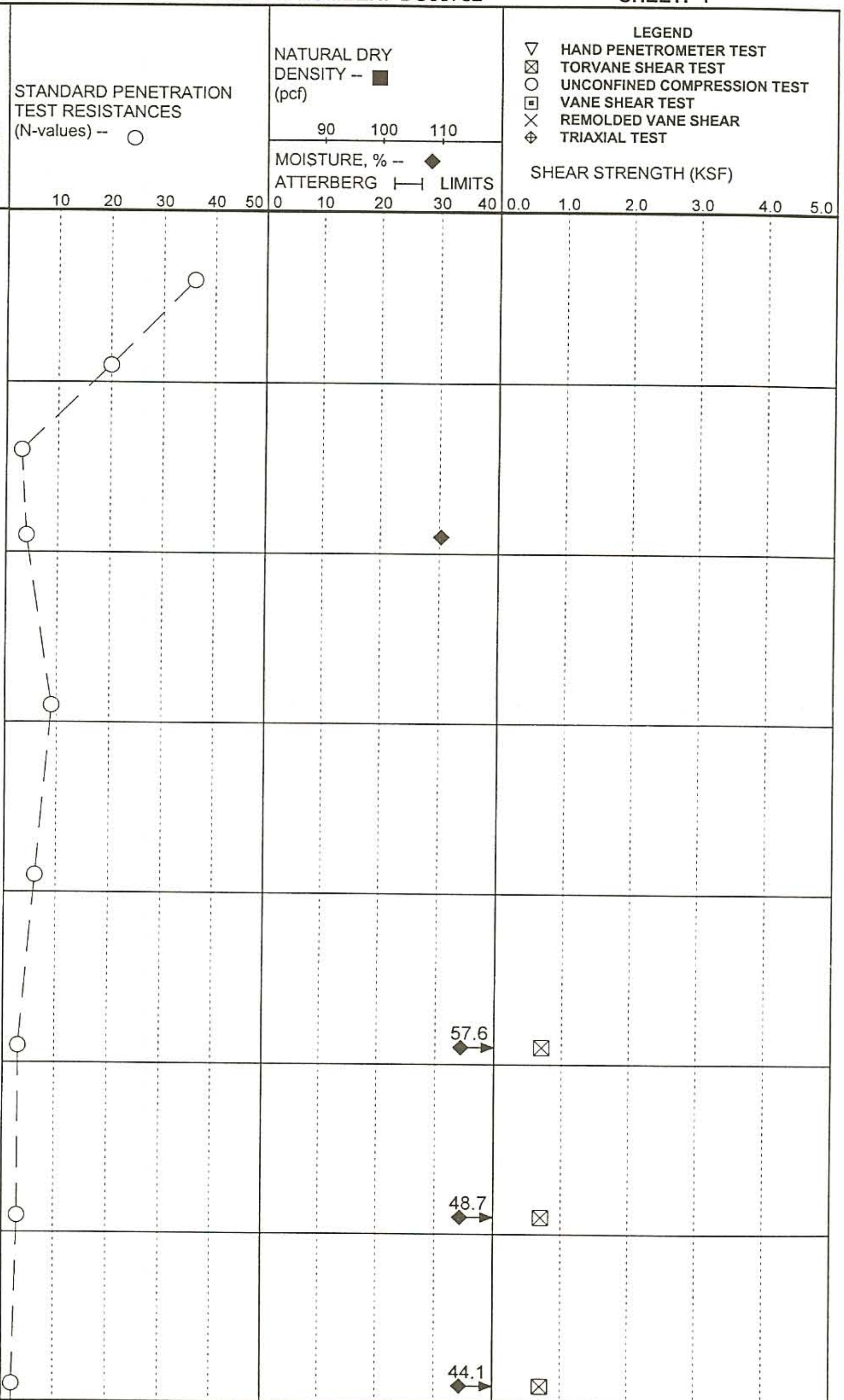
DRILLER: SME-JB | DRILL METHOD: HOLLOW STEM | WATER LEVEL DURING DRILLING: NONE | WATER LEVEL | HOURS AFTER COMPLETION:
RIG NO.: 26 | BACKFILL METHOD: BENTONITE | WATER LEVEL UPON COMPLETION: NONE | CAVE OF BOREHOLE AT

# soil and materials engineers, inc.

**PROJECT NAME:** UPTOWN AT RIVERS EDGE
**A/E:**
**PROJECT LOCATION:** BAY CITY, MICHIGAN
**BY:** JLN **DATE:** 11/1/06 **BORING B8**
**CLIENT:** CITY OF BAY CITY
**PROJECT NUMBER:** BG53782 **SHEET:** 1

EASTING=
NORTHING=
GROUND SURFACE ELEVATION= 589±

| DEPTH (FEET) | PROFILE DESCRIPTION | SAMPLE TYPE/NUMBER INTERVAL | BLOWS PER SIX INCHES |
|---|---|---|---|
| 0 | Driller reported 6 inches of Gravel | | |
| | Fine to Medium Sand- Some Silt- Trace to Some Foundry Sand, Slag, Brick and Concrete- Trace Organics and Clay- Black- Moist- Dense to Medium Dense (SP-SM/Fill) | SS1 | 8, 12, 24 |
| 5 | | SS2 | 8, 10, 10 |
| | | SS3 | 3, 2, 1 |
| 10 | Organic Silty Clay- Trace to Some Sand- Trace Shell Fragments- Frequent Pockets of Fine to Medium Sand- Trace Gravel- Dark Gray/Black (OL/Fill) | SS4 | 4, 2, 2 |
| 15 | Wood | SS5 | 4, 4, 5 |
| 20 | Fine to Medium Sand- Trace Gravel- Frequent Organic Silty Clay Layers- Dark Gray- Wet- Loose (SP-SM) | SS6 | 1, 2, 4 |
| 25 | Silty Clay- Trace to Some Organics- Trace Fine Sand and Shell Fragments- Gray- Medium (CL-OL) | SS7 | 1, 1, 2 |
| 30 | | SS8 | 1, 1, 2 |
| 35 | | SS9 | 1, 1, 1 |




WATER LEVEL OBSERVATIONS
- ▼ GROUNDWATER ENCOUNTERED DURING DRILLING
- ▽ GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

Notes: 1) SOIL BORING LOCATED AT N43.35429 AND W83.53585

**DRILLER:** SME-JB **DRILL METHOD:** HOLLOW STEM **WATER LEVEL DURING DRILLING:** 12 FT **WATER LEVEL HOURS AFTER COMPLETION:**
**RIG NO.:** 26 **BACKFILL METHOD:** BENTONITE **WATER LEVEL UPON COMPLETION:** 23 FT **CAVE OF BOREHOLE AT**

# soil and materials engineers, inc.

**PROJECT NAME:** UPTOWN AT RIVERS EDGE
**A/E:**
**PROJECT LOCATION:** BAY CITY, MICHIGAN
**BY:** JLN **DATE:** 11/1/06 **BORING** B8
**CLIENT:** CITY OF BAY CITY
**PROJECT NUMBER:** BG53782 **SHEET:** 2

EASTING=
NORTHING=
GROUND SURFACE ELEVATION= 589±

LEGEND: ▽ HAND PENETROMETER TEST; ⊠ TORVANE SHEAR TEST; ○ UNCONFINED COMPRESSION TEST; ⊡ VANE SHEAR TEST; X REMOLDED VANE SHEAR; ⊕ TRIAXIAL TEST

STANDARD PENETRATION TEST RESISTANCES (N-values) -- ○ (10, 20, 30, 40, 50)
NATURAL DRY DENSITY -- (pcf) ■ (90, 100, 110)
MOISTURE, % -- ◆ ; ATTERBERG ├─┤ LIMITS (0, 10, 20, 30, 40)
SHEAR STRENGTH (KSF) (0.0, 1.0, 2.0, 3.0, 4.0, 5.0)

| DEPTH (FEET) | PROFILE DESCRIPTION |
|---|---|
| 35–60 | Silty Clay- Trace to Some Organics- Trace Fine Sand and Shell Fragments- Gray- Medium (CL-OL) |
| 60–67 | Fine to Medium Sand- Trace to Some Silt- Trace Shell Fragments and Clay- Frequent Organic Silty Clay Layers- Gray- Wet- Medium Dense (SP-SM) |
| 67–70 | Silty Clay- Trace Fine Sand and Gravel- Gray- Stiff to Medium (CL) |

| SAMPLE TYPE/NUMBER | BLOWS PER SIX INCHES | MOISTURE, % | SHEAR TEST |
|---|---|---|---|
| SS10 | 1 1 1 | 40.8 | ⊠ |
| SS11 | 1 2 1 | 46.9 | ⊠ |
| SS12 | 1 1 2 | 42.7 | ⊠ |
| SS13 | 1 1 1 | ◆ | ⊠ |
| SS14 | WH 1 1 | | |
| SS15 | 5 4 10 | | |
| SS16 | 3 4 5 | ◆ | ▽ |

**WATER LEVEL OBSERVATIONS**
GROUNDWATER ENCOUNTERED DURING DRILLING
GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

**Notes:** 1) SOIL BORING LOCATED AT N43.35429 AND W83.53585

**DRILLER:** SME-JB **DRILL METHOD:** HOLLOW STEM **WATER LEVEL DURING DRILLING:** 12 FT **WATER LEVEL HOURS AFTER COMPLETION:**
**RIG NO.:** 26 **BACKFILL METHOD:** BENTONITE **WATER LEVEL UPON COMPLETION:** 23 FT **CAVE OF BOREHOLE AT**

# soil and materials engineers, inc.

**PROJECT NAME:** UPTOWN AT RIVERS EDGE  **A/E:**

**PROJECT LOCATION:** BAY CITY, MICHIGAN  **BY:** JLN  **DATE:** 11/1/06  **BORING** B8

**CLIENT:** CITY OF BAY CITY  **PROJECT NUMBER:** BG53782  **SHEET:** 3

PROFILE DESCRIPTION

EASTING=
NORTHING=

GROUND SURFACE ELEVATION= 589±

STANDARD PENETRATION TEST RESISTANCES (N-values) -- ○

NATURAL DRY DENSITY -- (pcf) ■ (90, 100, 110)

MOISTURE, % -- ◆ ; ATTERBERG ├─┤ LIMITS (0, 10, 20, 30, 40)

LEGEND
▽ HAND PENETROMETER TEST
⊠ TORVANE SHEAR TEST
○ UNCONFINED COMPRESSION TEST
⊡ VANE SHEAR TEST
╳ REMOLDED VANE SHEAR
⊕ TRIAXIAL TEST

SHEAR STRENGTH (KSF) (0.0, 1.0, 2.0, 3.0, 4.0, 5.0)

| DEPTH (FEET) | PROFILE DESCRIPTION | SAMPLE TYPE/NUMBER INTERVAL | BLOWS PER SIX INCHES | SHEAR STRENGTH (KSF) |
|---|---|---|---|---|
| 70–78.5 | Silty Clay- Trace Fine Sand and Gravel- Gray- Stiff to Medium (CL) | SS17 | 4 5 5 | ⊠ |
| 78.5–82 | Sandy Clay- Some Silt- Trace to Some Gravel- Gray- Hard (CL) | SS18 | 4 5 10 | 4.5+ ▽ |
| 82–90 | Sandy Clay- Some Silt- Trace to Some Gravel- Gray- Hard (CL- Hardpan) | SS19 | 13 15 22 | 4.5+ ▽ |
| | | SS20 | 22 51 76 | 4.5+ ▽ |
| 90 | END OF BORING AT 90 FEET | | | |

○127 →

WATER LEVEL OBSERVATIONS
- GROUNDWATER ENCOUNTERED DURING DRILLING
- GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

Notes: 1) SOIL BORING LOCATED AT N43.35429 AND W83.53585

DRILLER: SME-JB  DRILL METHOD: HOLLOW STEM  WATER LEVEL DURING DRILLING: 12 FT  WATER LEVEL  HOURS AFTER COMPLETION:

RIG NO.: 26  BACKFILL METHOD: BENTONITE  WATER LEVEL UPON COMPLETION: 23 FT  CAVE OF BOREHOLE AT

# soil and materials engineers, inc.

**PROJECT NAME:** UPTOWN AT RIVERS EDGE | **A/E:**

**PROJECT LOCATION:** BAY CITY, MICHIGAN | **BY:** JLN | **DATE:** 11/1/06 | **BORING** B9

**CLIENT:** CITY OF BAY CITY | **PROJECT NUMBER:** BG53782 | **SHEET:** 1

PROFILE DESCRIPTION

EASTING=
NORTHING=

GROUND SURFACE ELEVATION= 587±

| DEPTH (FEET) | PROFILE DESCRIPTION | SAMPLE TYPE/NUMBER INTERVAL | BLOWS PER SIX INCHES |
|---|---|---|---|
| 0 | The driller reported 3 inches of Gravel | | |
| | Silty Clay- Some Sand- Trace Gravel and Organics- Trace to Some Concrete and Brick Rubble- Occasional Pockets of Sand- Brown- Hard (CL/Fill) | SS1 | 7 7 9 |
| 5 | | SS2 | 10 9 14 |
| | Fine to Medium Sand- Some Silt- Trace to Some Clay, Foundry Sand and Slag- Trace Organics- Gray/Black- Wet- Loose to Very Loose (SP-SM/Fill) | SS3 | 2 3 2 |
| 10 | | SS4 | 2 2 2 |
| 15 | Wood | SS5 | 2 26 38 |
| 20 | Fine to Medium Sand- Trace Silt, Gravel and Shell Fragments- Gray- Wet- Loose (SP) | SS6 | 2 3 3 |
| 25 | Silty Clay- Trace to Some Organics- Trace Fine Sand and Shell Fragments- Gray- Medium (CL-OL) | SS7 | 2 2 2 |
| 30 | | SS8 | 3 4 3 |
| 35 | END OF BORING AT 35 FEET | SS9 | 3 3 3 |

STANDARD PENETRATION TEST RESISTANCES (N-values) -- ○

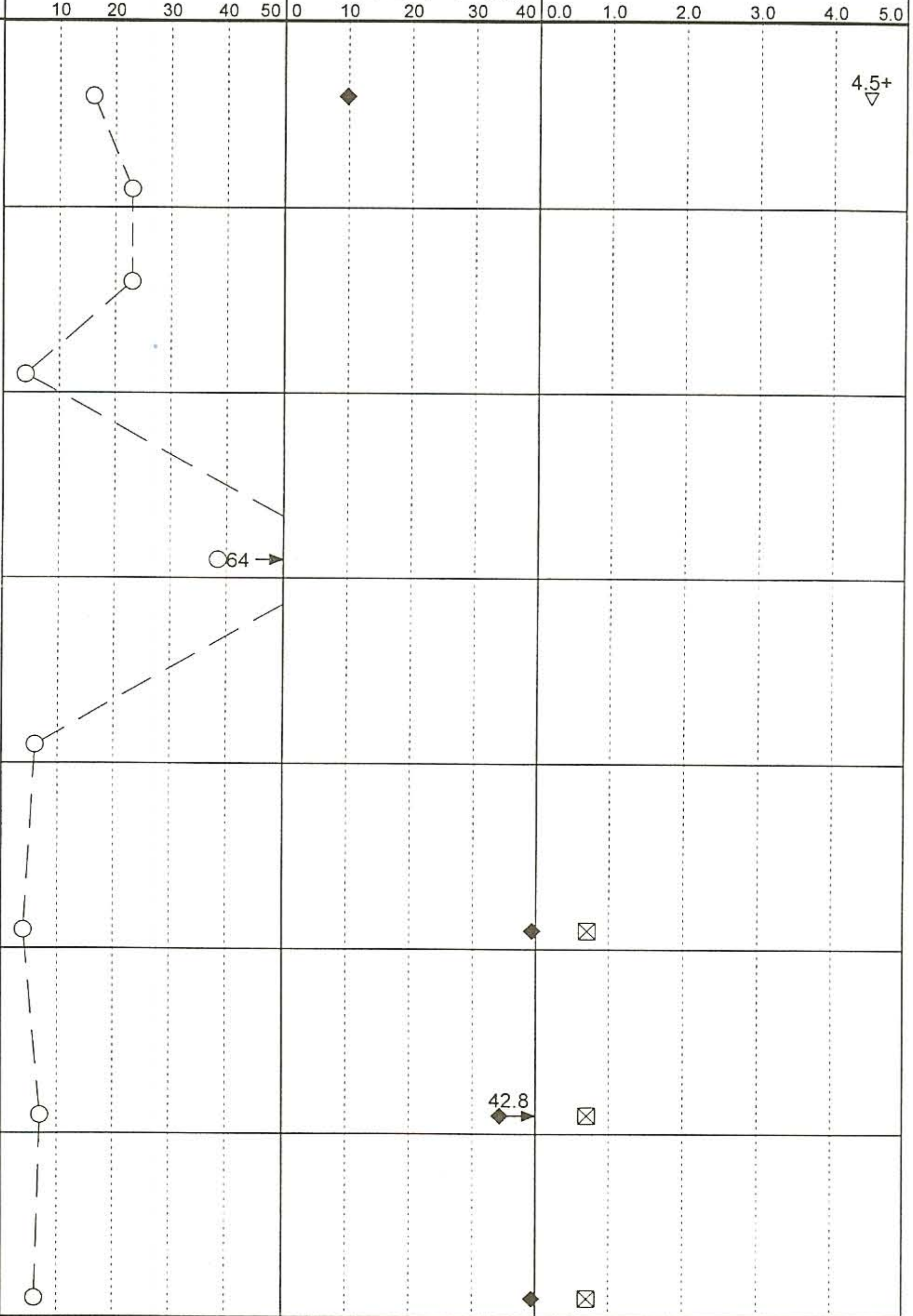
NATURAL DRY DENSITY -- ■ (pcf) 90 100 110

MOISTURE, % -- ◆

ATTERBERG ├─┤ LIMITS

LEGEND
▽ HAND PENETROMETER TEST
⊠ TORVANE SHEAR TEST
○ UNCONFINED COMPRESSION TEST
▣ VANE SHEAR TEST
✕ REMOLDED VANE SHEAR
⊕ TRIAXIAL TEST

SHEAR STRENGTH (KSF)




WATER LEVEL OBSERVATIONS
GROUNDWATER ENCOUNTERED DURING DRILLING
GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

**Notes:** 1) SOIL BORING LOCATED AT N43.35535 AND W83.53535

**DRILLER:** SME-JR | **DRILL METHOD:** HOLLOW STEM | **WATER LEVEL DURING DRILLING:** 6 FT | **WATER LEVEL** | **HOURS AFTER COMPLETION:**

**RIG NO.:** 34 | **BACKFILL METHOD:** BENTONITE | **WATER LEVEL UPON COMPLETION:** 10 FT | **CAVE OF BOREHOLE AT**

# soil and materials engineers, inc.

**PROJECT NAME:** UPTOWN AT RIVERS EDGE **A/E:**
**PROJECT LOCATION:** BAY CITY, MICHIGAN **BY:** JLN **DATE:** 11/1/06 **BORING** B9
**CLIENT:** CITY OF BAY CITY **PROJECT NUMBER:** BG53782 **SHEET:** 2

| DEPTH (FEET) | SYMBOLIC PROFILE | PROFILE DESCRIPTION<br>EASTING=<br>NORTHING=<br>GROUND SURFACE ELEVATION= 587± | SAMPLE TYPE/NUMBER INTERVAL | BLOWS PER SIX INCHES | STANDARD PENETRATION TEST RESISTANCES (N-values) -- ○<br>10 20 30 40 50 | NATURAL DRY DENSITY -- ■ (pcf) 90 100 110<br>MOISTURE, % -- ◆<br>ATTERBERG ├─┤ LIMITS<br>0 10 20 30 40 | LEGEND<br>▽ HAND PENETROMETER TEST<br>⊠ TORVANE SHEAR TEST<br>○ UNCONFINED COMPRESSION TEST<br>⊡ VANE SHEAR TEST<br>X REMOLDED VANE SHEAR<br>⊕ TRIAXIAL TEST<br>SHEAR STRENGTH (KSF)<br>0.0 1.0 2.0 3.0 4.0 5.0 |
|---|---|---|---|---|---|---|---|
| 35 | | | | | | | |
| 40 | | | | | | | |
| 45 | | | | | | | |
| 50 | | | | | | | |
| 55 | | | | | | | |
| 60 | | | | | | | |
| 65 | | | | | | | |
| 70 | | | | | | | |

WATER LEVEL OBSERVATIONS
- ▽ GROUNDWATER ENCOUNTERED DURING DRILLING
- ▽ GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

Notes: 1) SOIL BORING LOCATED AT N43.35535 AND W83.53535

**DRILLER:** SME-JR **DRILL METHOD:** HOLLOW STEM **WATER LEVEL DURING DRILLING:** 6 FT **WATER LEVEL** **HOURS AFTER COMPLETION:**

**RIG NO.:** 34 **BACKFILL METHOD:** BENTONITE **WATER LEVEL UPON COMPLETION:** 10 FT **CAVE OF BOREHOLE AT**

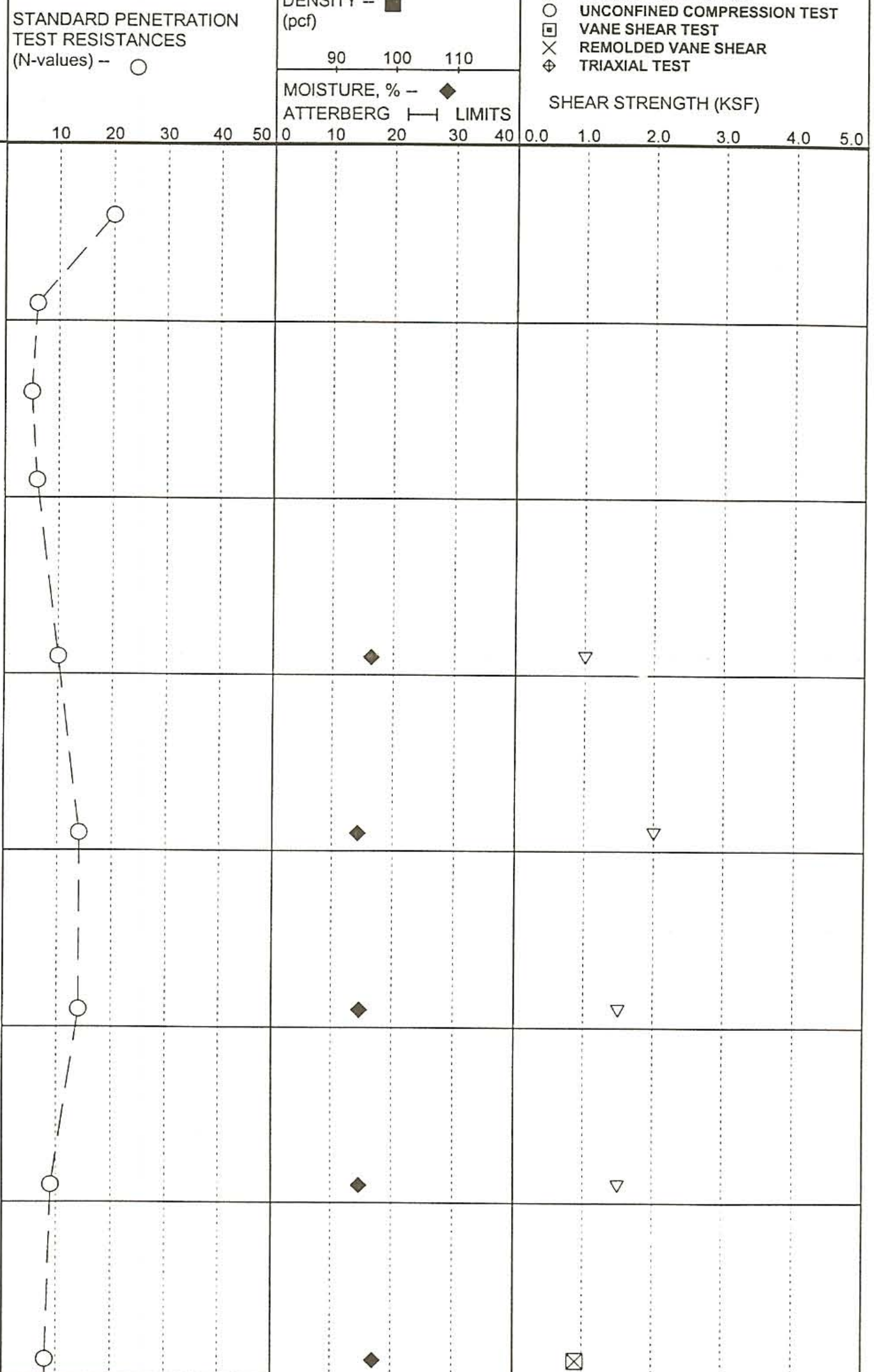
# soil and materials engineers, inc.

**PROJECT NAME:** UPTOWN AT RIVERS EDGE
**A/E:**
**PROJECT LOCATION:** BAY CITY, MICHIGAN
**BY:** JLN **DATE:** 10/31/06 **BORING** B12
**CLIENT:** CITY OF BAY CITY
**PROJECT NUMBER:** BG53782 **SHEET:** 1

PROFILE DESCRIPTION
EASTING=
NORTHING=
GROUND SURFACE ELEVATION= 588±

| DEPTH (FEET) | PROFILE DESCRIPTION |
|---|---|
| 0 | Driller reported 12 inches of Mixed Crushed Limestone, Gravel and Sand Fill |
| | Fine to Medium Sand- Some Silt- Trace to Some Foundry Sand, Slag, Brick and Concrete- Trace Organics and Clay- Black- Moist- Medium Dense (SP- SM/Fill) |
| 5 | Peat with Wood (Pt) |
| 14 | Silty Clay- Trace to Some Sand- Trace Gravel- Gray- Stiff to Very Stiff (CL) |
| 33 | Silty Clay- Trace Sand and Gravel- Gray- Medium (CL) |
| 35 | |

| SAMPLE TYPE/NUMBER INTERVAL | BLOWS PER SIX INCHES |
|---|---|
| SS1 | 19 14 6 |
| SS2 | 2 3 3 |
| SS3 | 2 2 3 |
| SS4 | 2 3 3 |
| SS5 | 3 4 6 |
| SS6 | 3 6 8 |
| SS7 | 3 5 9 |
| SS8 | 3 4 5 |
| SS9 | 3 4 4 |




**LEGEND**
- ▽ HAND PENETROMETER TEST
- ⊠ TORVANE SHEAR TEST
- ○ UNCONFINED COMPRESSION TEST
- ▣ VANE SHEAR TEST
- × REMOLDED VANE SHEAR
- ⊕ TRIAXIAL TEST

**WATER LEVEL OBSERVATIONS**
- GROUNDWATER ENCOUNTERED DURING DRILLING
- GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

**Notes:** 1) SOIL BORING LOCATED AT N43.35568 AND W83.53483

**DRILLER:** SME-JB **DRILL METHOD:** HOLLOW STEM **WATER LEVEL DURING DRILLING:** 6 FT **WATER LEVEL** **HOURS AFTER COMPLETION:**
**RIG NO.:** 26 **BACKFILL METHOD:** BENTONITE **WATER LEVEL UPON COMPLETION:** **CAVE OF BOREHOLE AT**

# soil and materials engineers, inc.

**PROJECT NAME:** UPTOWN AT RIVERS EDGE **A/E:**

**PROJECT LOCATION:** BAY CITY, MICHIGAN **BY:** JLN **DATE:** 10/31/06 **BORING** **B12**

**CLIENT:** CITY OF BAY CITY **PROJECT NUMBER:** BG53782 **SHEET:** 2

PROFILE DESCRIPTION

EASTING=
NORTHING=

GROUND SURFACE ELEVATION= 588±

STANDARD PENETRATION TEST RESISTANCES (N-values) -- ○

NATURAL DRY DENSITY -- (pcf) ■ (90, 100, 110)

MOISTURE, % -- ◆
ATTERBERG ⊢⊣ LIMITS (0, 10, 20, 30, 40)

LEGEND
- ▽ HAND PENETROMETER TEST
- ⊠ TORVANE SHEAR TEST
- ○ UNCONFINED COMPRESSION TEST
- ⊡ VANE SHEAR TEST
- ✕ REMOLDED VANE SHEAR
- ⊕ TRIAXIAL TEST

SHEAR STRENGTH (KSF) (0.0, 1.0, 2.0, 3.0, 4.0, 5.0)

| DEPTH (FEET) | PROFILE DESCRIPTION | SAMPLE TYPE/NUMBER INTERVAL | BLOWS PER SIX INCHES |
|---|---|---|---|
| 35–70 | Silty Clay- Trace Sand and Gravel- Gray- Medium (CL) | | |
| 40 | | SS10 | 3 3 5 |
| 45 | | SS11 | 2 3 4 |
| 50 | | SS12 | 2 3 2 |
| 55 | | SS13 | 3 4 5 |
| 60 | | SS14 | 3 3 4 |
| 65 | | SS15 | 3 4 5 |
| 70 | | SS16 | 3 4 6 |

WATER LEVEL OBSERVATIONS
- GROUNDWATER ENCOUNTERED DURING DRILLING
- GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

Notes: 1) SOIL BORING LOCATED AT N43.35568 AND W83.53483

DRILLER: SME-JB DRILL METHOD: HOLLOW STEM WATER LEVEL DURING DRILLING: 6 FT WATER LEVEL HOURS AFTER COMPLETION:

RIG NO.: 26 BACKFILL METHOD: BENTONITE WATER LEVEL UPON COMPLETION: CAVE OF BOREHOLE AT

# soil and materials engineers, inc.

**PROJECT NAME:** UPTOWN AT RIVERS EDGE
**A/E:**
**PROJECT LOCATION:** BAY CITY, MICHIGAN
**BY:** JLN **DATE:** 10/31/06 **BORING** B12
**CLIENT:** CITY OF BAY CITY
**PROJECT NUMBER:** BG53782 **SHEET:** 3

PROFILE DESCRIPTION
EASTING=
NORTHING=
GROUND SURFACE ELEVATION= 588±

STANDARD PENETRATION TEST RESISTANCES (N-values) -- ○
NATURAL DRY DENSITY -- (pcf) ■ (90, 100, 110)
MOISTURE, % -- ◆
ATTERBERG ⊢⊣ LIMITS (0, 10, 20, 30, 40)

LEGEND
▽ HAND PENETROMETER TEST
⊠ TORVANE SHEAR TEST
○ UNCONFINED COMPRESSION TEST
⊡ VANE SHEAR TEST
✕ REMOLDED VANE SHEAR
⊕ TRIAXIAL TEST

SHEAR STRENGTH (KSF) (0.0, 1.0, 2.0, 3.0, 4.0, 5.0)

| DEPTH (FEET) | PROFILE DESCRIPTION | SAMPLE TYPE/NUMBER | BLOWS PER SIX INCHES | N-value | SHEAR STRENGTH (KSF) |
|---|---|---|---|---|---|
| 70–86 | Silty Clay- Trace Sand and Gravel- Gray- Medium (CL) | SS17 | 4, 5, 6 | | ⊠ |
| | | SS18 | 3, 4, 5 | | ⊠ |
| | | SS19 | 3, 4, 4 | | ⊠ |
| 86–95 | Sandy Clay- Some Silt- Trace to Some Gravel- Gray- Hard (CL- Hardpan) | SS20 | 21, 33, 41 | 74 → | 4.5+ ▽ |
| | | SS21 | 30, 36, 43 | 79 → | 4.5+ ▽ |
| 95 | END OF BORING AT 95 FEET | | | | |

WATER LEVEL OBSERVATIONS
- GROUNDWATER ENCOUNTERED DURING DRILLING
- GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

Notes: 1) SOIL BORING LOCATED AT N43.35568 AND W83.53483

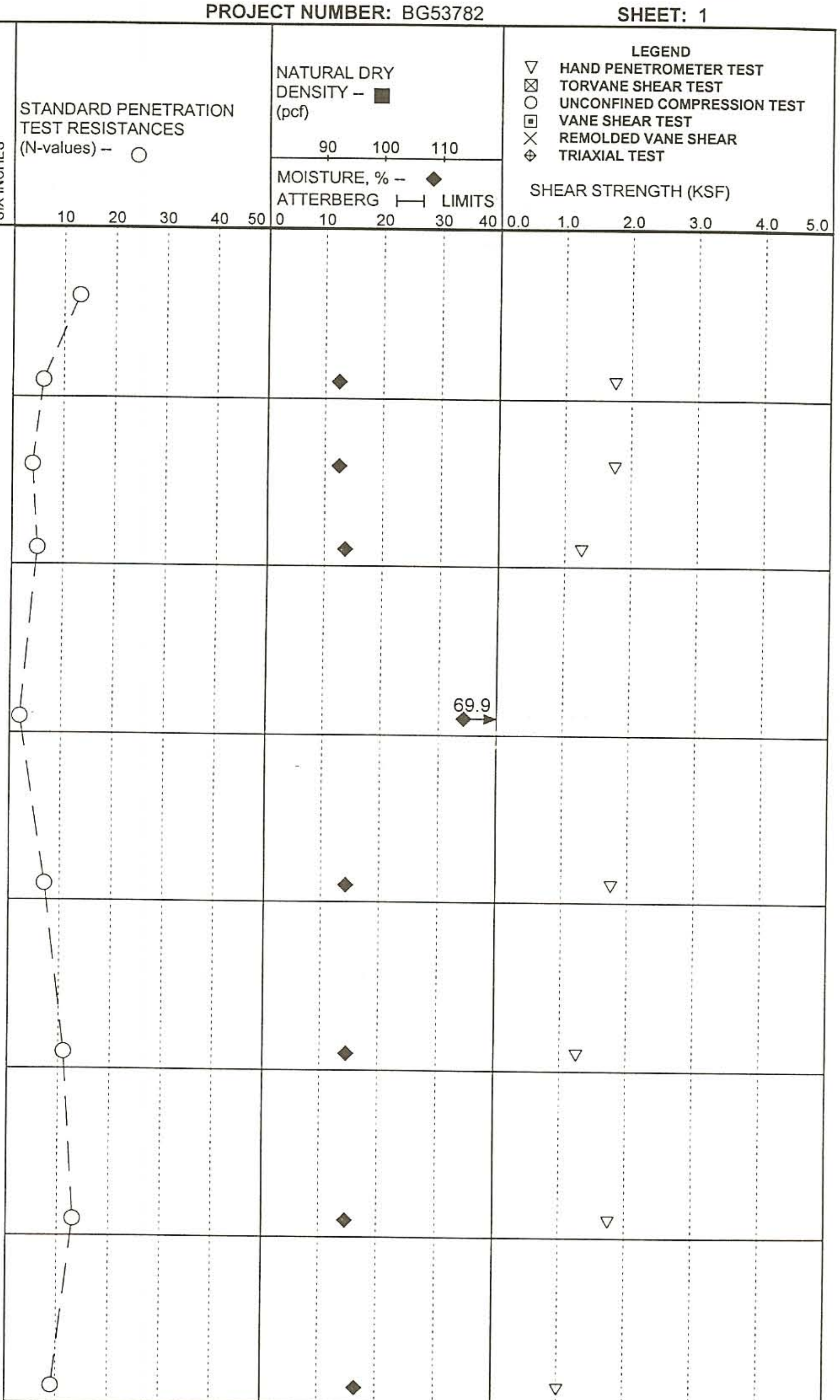
**DRILLER:** SME-JB **DRILL METHOD:** HOLLOW STEM **WATER LEVEL DURING DRILLING:** 6 FT **WATER LEVEL** **HOURS AFTER COMPLETION:**
**RIG NO.:** 26 **BACKFILL METHOD:** BENTONITE **WATER LEVEL UPON COMPLETION:** **CAVE OF BOREHOLE AT**

# soil and materials engineers, inc.

**PROJECT NAME:** UPTOWN AT RIVERS EDGE **A/E:**
**PROJECT LOCATION:** BAY CITY, MICHIGAN **BY:** JLN **DATE:** 11/1/06 **BORING** B13
**CLIENT:** CITY OF BAY CITY **PROJECT NUMBER:** BG53782 **SHEET:** 1

EASTING=
NORTHING=
GROUND SURFACE ELEVATION= 593±

| DEPTH (FEET) | PROFILE DESCRIPTION | SAMPLE TYPE/NUMBER INTERVAL | BLOWS PER SIX INCHES |
|---|---|---|---|
| 0 – 4 | Clayey Sand- Some Organics and Silt- Trace to Some Foundry Sand and Slag- Black- Moist- Medium Dense (SC-SM/Fill) | SS1 | 7 6 7 |
| 4 – 12 | Silty Clay- Some Sand- Trace Gravel- Brown- Stiff (CL/FIll) | SS2 | 2 3 3 |
| | | SS3 | 2 2 2 |
| | | SS4 | 3 2 3 |
| 12 – 14 | Wood | | |
| 14 – 17 | Peat (Pt) | SS5 | 2 1 1 |
| 17 – 35 | Silty Clay- Trace Sand and Gravel- Gray- Stiff (CL) | SS6 | 3 3 4 |
| | | SS7 | 5 6 5 |
| | | SS8 | 6 6 7 |
| | | SS9 | 4 5 4 |
| 35 | END OF BORING AT 35 FEET | | |




WATER LEVEL OBSERVATIONS
- GROUNDWATER ENCOUNTERED DURING DRILLING
- GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

Notes: 1) SOIL BORING LOCATED AT N43.35633 AND W83.53464

DRILLER: SME-JR DRILL METHOD: HOLLOW STEM WATER LEVEL DURING DRILLING: 12 FT WATER LEVEL HOURS AFTER COMPLETION:
RIG NO.: 34 BACKFILL METHOD: BENTONITE WATER LEVEL UPON COMPLETION: 24 FT CAVE OF BOREHOLE AT

# soil and materials engineers, inc.

PROJECT NAME: UPTOWN AT RIVERS EDGE
A/E:
PROJECT LOCATION: BAY CITY, MICHIGAN
BY: JLN DATE: 11/1/06 BORING B13
CLIENT: CITY OF BAY CITY
PROJECT NUMBER: BG53782 SHEET: 2

| DEPTH (FEET) | SYMBOLIC PROFILE | PROFILE DESCRIPTION<br>EASTING=<br>NORTHING=<br>GROUND SURFACE ELEVATION= 593± | SAMPLE TYPE/NUMBER INTERVAL | BLOWS PER SIX INCHES | STANDARD PENETRATION TEST RESISTANCES (N-values) -- ○<br>10 20 30 40 50 | NATURAL DRY DENSITY -- (pcf) ■<br>90 100 110<br>MOISTURE, % -- ◆<br>ATTERBERG ├─┤ LIMITS<br>0 10 20 30 40 | LEGEND<br>▽ HAND PENETROMETER TEST<br>⊠ TORVANE SHEAR TEST<br>○ UNCONFINED COMPRESSION TEST<br>⊡ VANE SHEAR TEST<br>╳ REMOLDED VANE SHEAR<br>⊕ TRIAXIAL TEST<br>SHEAR STRENGTH (KSF)<br>0.0 1.0 2.0 3.0 4.0 5.0 |
|---|---|---|---|---|---|---|---|
| 35 | | | | | | | |
| 40 | | | | | | | |
| 45 | | | | | | | |
| 50 | | | | | | | |
| 55 | | | | | | | |
| 60 | | | | | | | |
| 65 | | | | | | | |
| 70 | | | | | | | |

WATER LEVEL OBSERVATIONS
- GROUNDWATER ENCOUNTERED DURING DRILLING
- GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

Notes: 1) SOIL BORING LOCATED AT N43.35633 AND W83.53464

DRILLER: SME-JR DRILL METHOD: HOLLOW STEM WATER LEVEL DURING DRILLING: 12 FT WATER LEVEL HOURS AFTER COMPLETION:
RIG NO.: 34 BACKFILL METHOD: BENTONITE WATER LEVEL UPON COMPLETION: 24 FT CAVE OF BOREHOLE AT

# soil and materials engineers, inc.

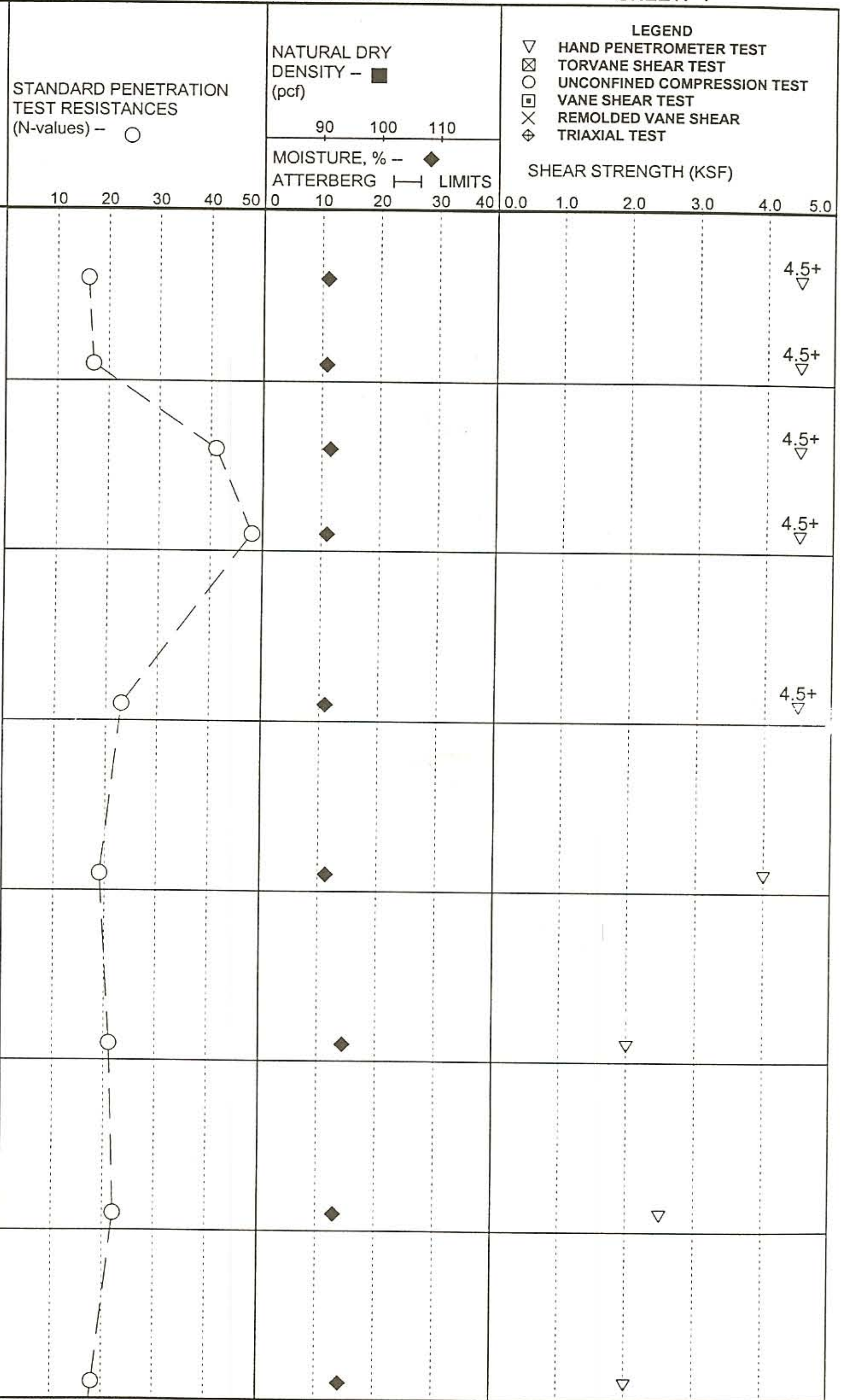
| | | | |
|---|---|---|---|
| **PROJECT NAME:** UPTOWN AT RIVERS EDGE | **A/E:** | | |
| **PROJECT LOCATION:** BAY CITY, MICHIGAN | **BY:** JLN | **DATE:** 11/8/06 | **BORING** B14 |
| **CLIENT:** CITY OF BAY CITY | **PROJECT NUMBER:** BG53782 | | **SHEET:** 1 |

PROFILE DESCRIPTION

EASTING=
NORTHING=

GROUND SURFACE ELEVATION= 594±

| DEPTH (FEET) | PROFILE DESCRIPTION | SAMPLE TYPE/NUMBER INTERVAL | BLOWS PER SIX INCHES |
|---|---|---|---|
| 0 | The driller reported 10 inches of Mixed Coarse Sand and Gravel Fill- Brown | SS1 | 5 7 9 |
| 5 | Silty Clay- Some Sand- Trace Gravel- Brown- Hard (CL) | SS2 | 4 7 10 |
| | | SS3 | 10 15 26 |
| 10 | | SS4 | 12 19 29 |
| 15 | Silty Clay- Trace to Some Sand- Trace Gravel- Gray- Hard to Very Stiff (CL) | SS5 | 7 9 14 |
| 20 | | SS6 | 4 7 12 |
| 25 | | SS7 | 5 8 13 |
| 30 | | SS8 | 6 9 13 |
| 35 | | SS9 | 4 7 11 |




WATER LEVEL OBSERVATIONS

- GROUNDWATER ENCOUNTERED DURING DRILLING
- GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

Notes: 1) SOIL BORING LOCATED AT N43.35345 AND W83.53469

| | | | |
|---|---|---|---|
| DRILLER: SME-JB | DRILL METHOD: HOLLOW STEM | WATER LEVEL DURING DRILLING: NONE | WATER LEVEL HOURS AFTER COMPLETION: |
| RIG NO.: 34 | BACKFILL METHOD: BENTONITE | WATER LEVEL UPON COMPLETION: NONE | CAVE OF BOREHOLE AT |

# soil and materials engineers, inc.

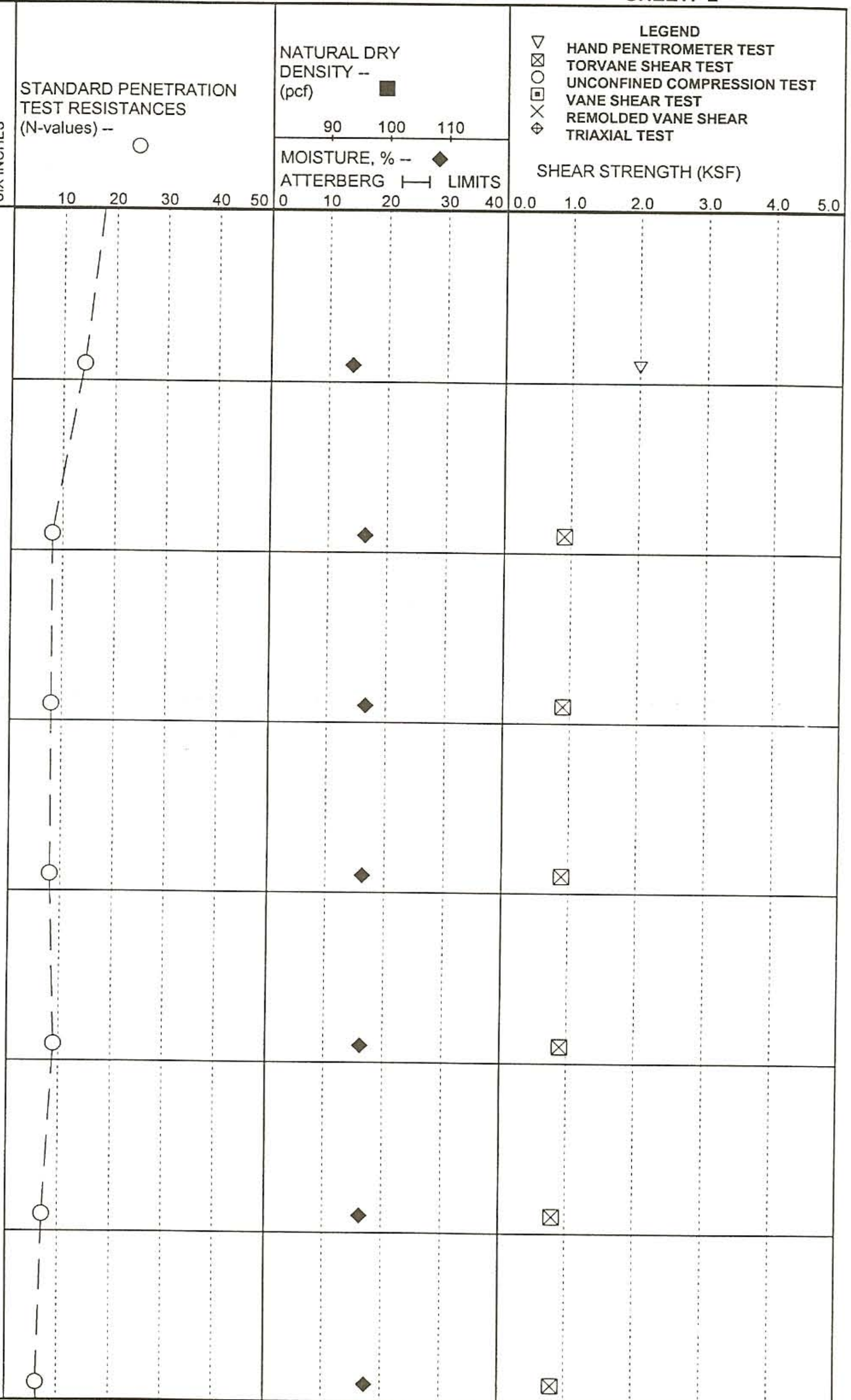
**PROJECT NAME:** UPTOWN AT RIVERS EDGE
**PROJECT LOCATION:** BAY CITY, MICHIGAN
**CLIENT:** CITY OF BAY CITY

**A/E:**
**BY:** JLN **DATE:** 11/8/06
**PROJECT NUMBER:** BG53782

**BORING** B14
**SHEET:** 2

PROFILE DESCRIPTION
EASTING=
NORTHING=
GROUND SURFACE ELEVATION= 594±

| DEPTH (FEET) | PROFILE DESCRIPTION | SAMPLE TYPE/NUMBER INTERVAL | BLOWS PER SIX INCHES |
|---|---|---|---|
| 35–43.5 | Silty Clay- Trace to Some Sand- Trace Gravel- Gray- Hard to Very Stiff (CL) | | |
| ~40 | | SS10 | 4 5 9 |
| 43.5–70 | Silty Clay- Trace Sand and Gravel- Gray- Medium (CL) | | |
| ~45 | | SS11 | 3 4 4 |
| ~50 | | SS12 | 3 4 4 |
| ~55 | | SS13 | 2 4 4 |
| ~60 | | SS14 | 3 4 5 |
| ~65 | | SS15 | 2 4 4 |
| ~70 | | SS16 | 2 3 3 |




WATER LEVEL OBSERVATIONS
- GROUNDWATER ENCOUNTERED DURING DRILLING
- GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

Notes: 1) SOIL BORING LOCATED AT N43.35345 AND W83.53469

DRILLER: SME-JB
RIG NO.: 34
DRILL METHOD: HOLLOW STEM
BACKFILL METHOD: BENTONITE
WATER LEVEL DURING DRILLING: NONE
WATER LEVEL UPON COMPLETION: NONE
WATER LEVEL HOURS AFTER COMPLETION:
CAVE OF BOREHOLE AT

# soil and materials engineers, inc.

**PROJECT NAME:** UPTOWN AT RIVERS EDGE
**A/E:**
**PROJECT LOCATION:** BAY CITY, MICHIGAN
**BY:** JLN **DATE:** 11/8/06 **BORING B14**
**CLIENT:** CITY OF BAY CITY
**PROJECT NUMBER:** BG53782 **SHEET:** 3

PROFILE DESCRIPTION

EASTING=
NORTHING=

GROUND SURFACE ELEVATION= 594±

| DEPTH (FEET) | PROFILE DESCRIPTION | SAMPLE TYPE/NUMBER INTERVAL | BLOWS PER SIX INCHES | STANDARD PENETRATION TEST RESISTANCES (N-values) | SHEAR STRENGTH (KSF) |
|---|---|---|---|---|---|
| 70–91 | Silty Clay- Trace Sand and Gravel- Gray- Medium (CL) | SS17 | 2 3 4 | | ⊠ |
| | | SS18 | 3 4 5 | | ⊠ |
| | | SS19 | 4 4 6 | | ⊠ |
| | | SS20 | 2 3 9 | | ⊠ |
| 91–95 | Sandy Clay- Some Silt- Trace to Some Gravel- Gray- Hard (CL-Hardpan) | SS21 | 19 26 46 | 72 → | 4.5+ ▽ |
| 95 | END OF BORING AT 95 FEET | | | | |

Scale headings: STANDARD PENETRATION TEST RESISTANCES (N-values) -- ○: 10 20 30 40 50. NATURAL DRY DENSITY -- (pcf) ■: 90 100 110. MOISTURE, % -- ◆; ATTERBERG ├─┤ LIMITS: 0 10 20 30 40. SHEAR STRENGTH (KSF): 0.0 1.0 2.0 3.0 4.0 5.0.

LEGEND
▽ HAND PENETROMETER TEST
⊠ TORVANE SHEAR TEST
○ UNCONFINED COMPRESSION TEST
⊡ VANE SHEAR TEST
X REMOLDED VANE SHEAR
⊕ TRIAXIAL TEST

WATER LEVEL OBSERVATIONS
GROUNDWATER ENCOUNTERED DURING DRILLING
GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

**Notes:** 1) SOIL BORING LOCATED AT N43.35345 AND W83.53469

**DRILLER:** SME-JB **DRILL METHOD:** HOLLOW STEM **WATER LEVEL DURING DRILLING:** NONE **WATER LEVEL HOURS AFTER COMPLETION:**
**RIG NO.:** 34 **BACKFILL METHOD:** BENTONITE **WATER LEVEL UPON COMPLETION:** NONE **CAVE OF BOREHOLE AT**

**soil and materials engineers, inc.**

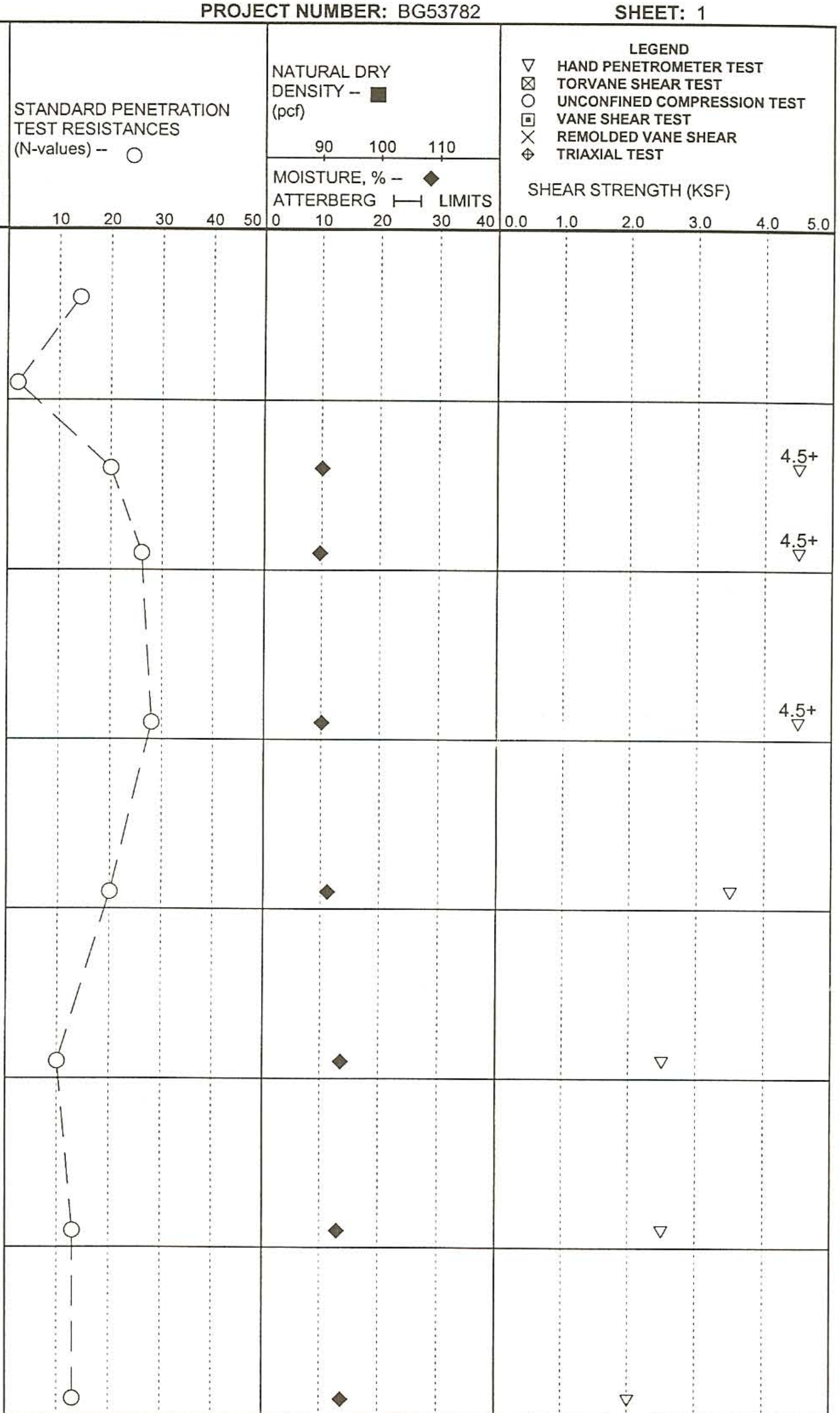
| | | | |
|---|---|---|---|
| **PROJECT NAME:** UPTOWN AT RIVERS EDGE | **A/E:** | | |
| **PROJECT LOCATION:** BAY CITY, MICHIGAN | **BY:** JLN | **DATE:** 10/27/06 | **BORING** B16 |
| **CLIENT:** CITY OF BAY CITY | **PROJECT NUMBER:** BG53782 | | **SHEET:** 1 |

PROFILE DESCRIPTION

EASTING=
NORTHING=

GROUND SURFACE ELEVATION= 598±

| DEPTH (FEET) | PROFILE DESCRIPTION | SAMPLE TYPE/NUMBER | BLOWS PER SIX INCHES |
|---|---|---|---|
| 0 | Fine to Medium Sand- Some Foundry Sand and Slag- Trace to Some Silt- Trace Clay and Organics- Brown/Black- Moist- Medium Dense (SP-SM/Fill) | SS1 | 11 7 7 |
| | Sandy Clay- Some Silt- Trace to Some Gravel- Frequent Pockets of Wet Sand- Trace Organics- Brown (CL/Fill) | SS2 | 1 1 1 |
| 5 | | | |
| | Silty Clay- Some Sand- Trace Gravel- Frequent Wet Fine Sand Seams- Brown/Gray- Hard (CL) | SS3 | 5 9 11 |
| 10 | | SS4 | 8 12 14 |
| 15 | | SS5 | 9 13 15 |
| | Silty Clay- Trace to Some Sand- Trace Gravel- Gray- Very Stiff (CL) | | |
| 20 | | SS6 | 5 8 12 |
| 25 | | SS7 | 4 4 6 |
| 30 | | SS8 | 3 5 8 |
| 35 | END OF BORING AT 35 FEET | SS9 | 6 6 7 |




WATER LEVEL OBSERVATIONS

- GROUNDWATER ENCOUNTERED DURING DRILLING
- GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

**Notes:** 1) SOIL BORING LOCATED AT N43.35495 AND W83.53416

| | | | |
|---|---|---|---|
| **DRILLER:** SME-JR | **DRILL METHOD:** HOLLOW STEM | **WATER LEVEL DURING DRILLING:** 10 FT | **WATER LEVEL HOURS AFTER COMPLETION:** |
| **RIG NO.:** 34 | **BACKFILL METHOD:** BENTONITE | **WATER LEVEL UPON COMPLETION:** 24 FT | **CAVE OF BOREHOLE AT** |

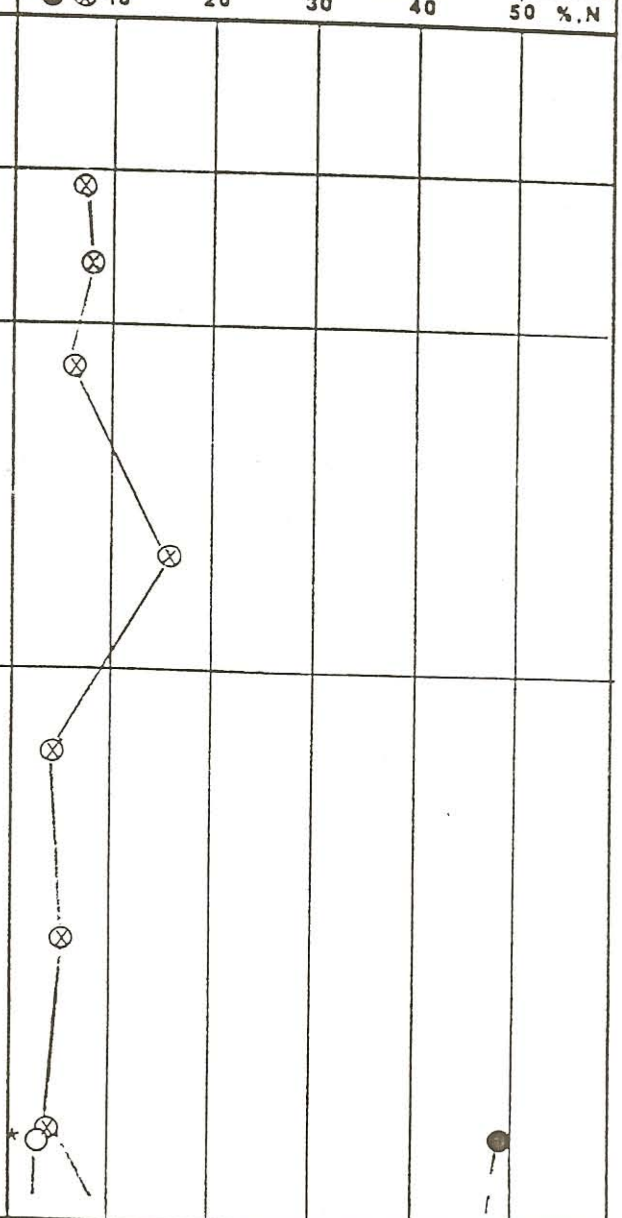
## BORING LOG NO. 3

| | |
|---|---|
| OWNER: USEPA | ARCHITECT / ENGINEER: ELLIS, NAEYAERT, GENHEIMER, AND ASSOCIATES |
| LOCATION: BAY CITY, MICHIGAN | PROJECT NAME: USPEA CENTER FOR ECOLOGY, RESEARCH, AND TRAINING |

LEGEND
- ⊗ STANDARD PENETRATION, "N" (BLOWS/FT.)
- ● NATURAL WATER CONTENT, %
- ATTERBERG LIMITS △ - - ● - - ✕ (P.L.% … L.L.%)
- ○ UNCONFINED COMPRESSIVE STRENGTH (tsf)
- *○ CALIBRATED HAND PENETROMETER STRENGTH (tsf)

SCALE: *○○ 1, 2, 3, 4, 5 tsf; ● ⊗ 10, 20, 30, 40, 50 %,N

| SAMPLE NUMBER | SAMPLE TYPE | DEPTH IN FEET | DESCRIPTION OF MATERIAL | UNIT DRY WT. LBS/FT³ |
|---|---|---|---|---|
| | | | SURFACE ELEVATION | |
| 1 | SS | | Fine to Medium Sand-Trace Gravel and Silt-Brown-Medium Dense (SM) (FILL) | |
| 2 | SS | 5 | Clayey Sand-Some Sand-Trace Wood, Wire, Brick, Côncrete, and Organic Material-Black Loose (CL) (FILL) | |
| 3 | SS | | | |
| 4 | SS | 10 | Fine to Medium Sand-Trace Silt-Brown-Loose to Medium Dense (SM) (Possible Fill) | |
| 5 | SS | 15 | | |
| 6 | SS | 20 | Clayey Silt-Trace Sand and Shells-Brown/Gray Soft to Very Soft (ML-CL) | |
| 7 | SS | 25 | | |
| 8 | SS | 30 | | |



NOTE: The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

MINERAL WELL PERMIT NO.

WATER LEVEL OBSERVATIONS

- 8.0' WHILE SAMPLING OR WHILE DRILLING
- ____ IMMEDIATELY AFTER COMPLETION
- ____ ____ AFTER COMPLETION

| | |
|---|---|
| BORING STARTED | 5-7-92 |
| BORING COMPLETED | 5-7-92 |

RIG: GLD-AD2 DRAWN BY: MH
FOREMAN: KC APPROVED: RCT/JWC
JOB: B17908 SHEET: 1/3

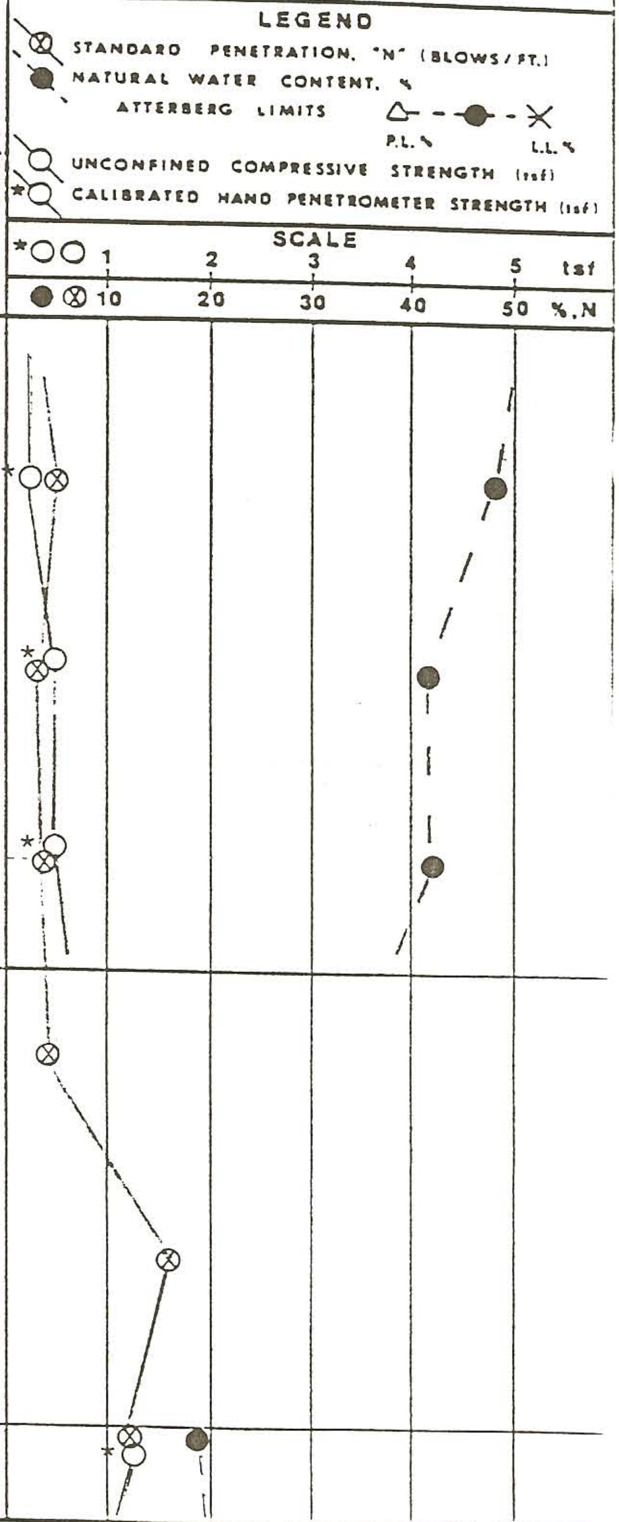
NOTE: Boring backfilled with natural soils unless otherwise noted.

soil and materials engineers, inc

## BORING LOG NO. 3

| OWNER | ARCHITECT / ENGINEER |
|---|---|
| USEPA | ELLIS, NAEYAERT, GENHEIMER & ASSOCIATES |
| **LOCATION** | **PROJECT NAME** |
| BAY CITY, MICHIGAN | USPEA CENTER FOR ECOLOGY, RESEARCH, & TRAINING |

| SAMPLE NUMBER | SAMPLE TYPE | SAMPLE DISTANCE | DEPTH IN FEET | DESCRIPTION OF MATERIAL | UNIT DRY WT. LBS/FT³ |
|---|---|---|---|---|---|
| | | | | SURFACE ELEVATION | |
| 9 | SS | | 35 | Clayey Silt-Trace Sand and Shells-Brown/Gray-Soft to Very Soft (ML-CL) | |
| 10 | SS | | 40 | | |
| 11 | SS | | 45 | | |
| 12 | SS | | 50 | Fine to Coarse Sand-Trace Gravel and Clay-Brown-Wet-Very Loose to Medium Dense (SP) | |
| 13 | SS | | 55 | | |
| 14 | SS | | 60 | Sandy Clay-Trace Gravel-Brown-Medium to Stiff (CL) | |




NOTE: The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

MINERAL WELL PERMIT NO.

**WATER LEVEL OBSERVATIONS**

8.0' WHILE SAMPLING OR WHILE DRILLING
IMMEDIATELY AFTER COMPLETION
AFTER COMPLETION

| | |
|---|---|
| BORING STARTED | 5-7-92 |
| BORING COMPLETED | 5-7-92 |

RIG: GLD-AD2 DRAWN BY: MH
FOREMAN: KC APPROVED: RCT/JWC
JOB: B17908 SHEET: 2/3

NOTE: Boring backfilled with natural soils unless otherwise noted.

soil and materials engineers, inc

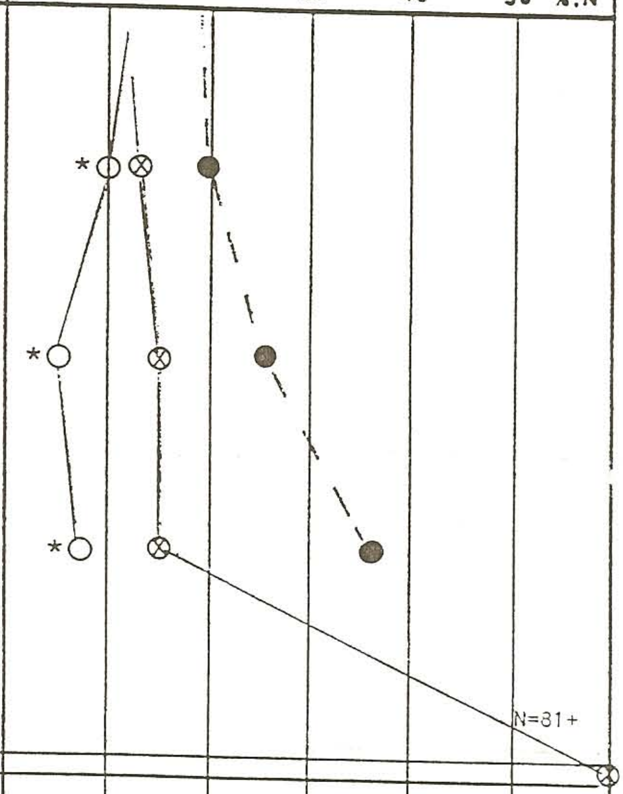
# BORING LOG NO. 3

| OWNER | ARCHITECT / ENGINEER |
|---|---|
| USEPA | ELLIS, NAEYAERT, GENHEIMER & ASSOCIATES |
| LOCATION | PROJECT NAME |
| BAY CITY, MICHIGAN | USEPA CENTER FOR ECOLOGY, RESEARCH & TRAINING |

LEGEND
- ⊗ STANDARD PENETRATION, "N" (BLOWS/FT.)
- ● NATURAL WATER CONTENT, %
- ATTERBERG LIMITS △ - - ● - - X (P.L.% , L.L.%)
- ○ UNCONFINED COMPRESSIVE STRENGTH (tsf)
- *○ CALIBRATED HAND PENETROMETER STRENGTH (tsf)

SCALE: *○○ 1, 2, 3, 4, 5 tsf; ● ⊗ 10, 20, 30, 40, 50 %,N

| SAMPLE NUMBER | SAMPLE TYPE | DEPTH IN FEET | DESCRIPTION OF MATERIAL | UNIT DRY WT. LBS/FT³ |
|---|---|---|---|---|
| | | | SURFACE ELEVATION | |
| 15 | SS | 61–65 | Sandy Clay-Trace Gravel-Brown-Medium to Stiff (CL) | |
| 16 | SS | 70 | | |
| 17 | SS | 75 | | |
| 18 | SS | 80 | Sandy Clay-Some Gravel-Gray-Hard (CL) (Hardpan) | |
| | | | END OF BORING AT 80' | |
| | | 85 | NOTE: Borehole grouted with cement/bentonite mixture. | |
| | | 90 | | |




NOTE: The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

MINERAL WELL PERMIT NO.

WATER LEVEL OBSERVATIONS

8.0'' WHILE SAMPLING OR WHILE DRILLING
______ IMMEDIATELY AFTER COMPLETION
______ ______ AFTER COMPLETION

| BORING STARTED | 5-7-92 |
|---|---|
| BORING COMPLETED | 5-7-92 |

RIG: GLD-AD2 DRAWN BY: MH
FOREMAN: KC APPROVED: RCT/JWC
JOB: B17908 SHEET:3/3

NOTE: Boring backfilled with natural soils unless otherwise noted.

soil and materials engineers, inc

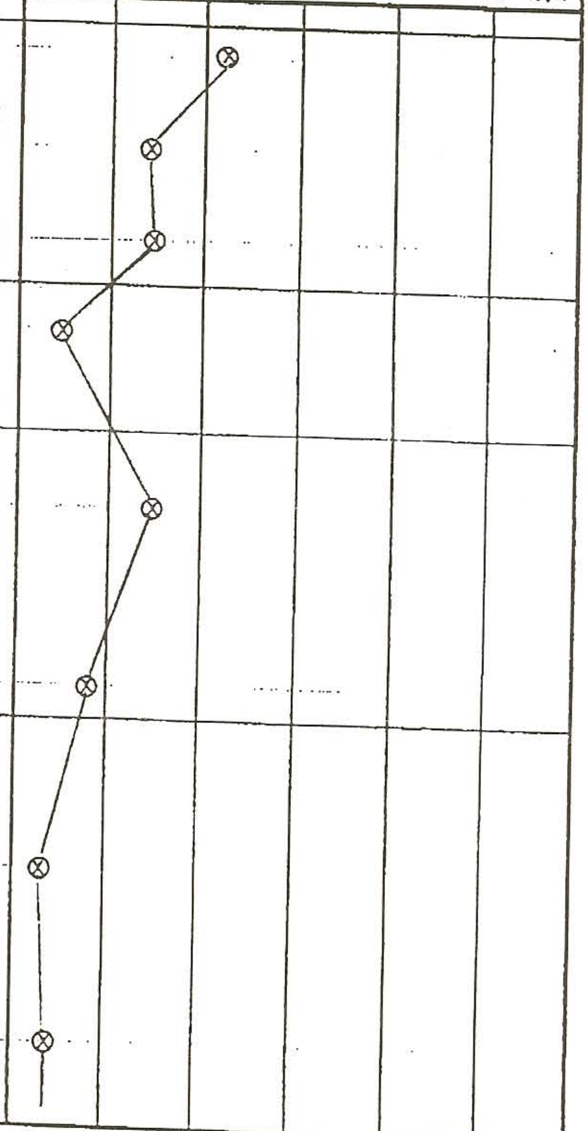
# BORING LOG NO. 5

| | |
|---|---|
| OWNER: USEPA | ARCHITECT / ENGINEER: ELLIS, NAEYAERT, GENHEIMER & ASSOCIATES |
| LOCATION: BAY CITY, MICHIGAN | PROJECT NAME: USEPA CENTER FOR ECOLOGY, RESEARCH & TRAINING |

**LEGEND**
- ⊗ STANDARD PENETRATION, "N" (BLOWS/FT.)
- ● NATURAL WATER CONTENT, %
- ATTERBERG LIMITS △ - - ● - - ✕ (P.L. %, L.L. %)
- ○ UNCONFINED COMPRESSIVE STRENGTH (tsf)
- *○ CALIBRATED HAND PENETROMETER STRENGTH (tsf)

SCALE: *○○ 1, 2, 3, 4, 5 tsf; ● ⊗ 10, 20, 30, 40, 50 %, N

| SAMPLE NUMBER | SAMPLE TYPE | DEPTH IN FEET | DESCRIPTION OF MATERIAL | UNIT DRY WT. LBS/FT³ |
|---|---|---|---|---|
| | | | SURFACE ELEVATION | |
| | | | Driller reported 0.8' of Gray Fine to Medium Sand and Gravel (FILL) | |
| 1 | SS | | Fine to Coarse Sand-Trace Cinders, Gravel, Organics, and Clay-Black-Medium Dense (SC) (FILL) | |
| 2 | SS | 5 | | |
| 3 | SS | | | |
| 4 | SS | 10 | Silty Clay-Trace Wood and Gravel-Brown (CL) (FILL) | |
| 5 | SS | 15 | Fine to Medium Sand-Trace Silt-Brown-Medium Dense to Loose (SP) (Possible Fill) | |
| 6 | SS | 20 | | |
| 7 | SS | 25 | Clayey Silt-Trace Sand and Shells-Brown/Gray-Soft (ML-CL) | |
| 8 | SS | 30 | | |



NOTE: The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

MINERAL WELL PERMIT NO.

**WATER LEVEL OBSERVATIONS**

8.0' WHILE SAMPLING OR WHILE DRILLING
____ IMMEDIATELY AFTER COMPLETION
____ ____ AFTER COMPLETION

| | |
|---|---|
| BORING STARTED | 5-4-92 |
| BORING COMPLETED | 5-4-92 |

RIG: GLD-AD2 DRAWN BY: MH
FOREMAN: KC APPROVED: RCT/JWC
JOB: B17908 SHEET: 1/3

NOTE: Boring backfilled with natural soils unless otherwise noted.

soil and materials engineers, inc

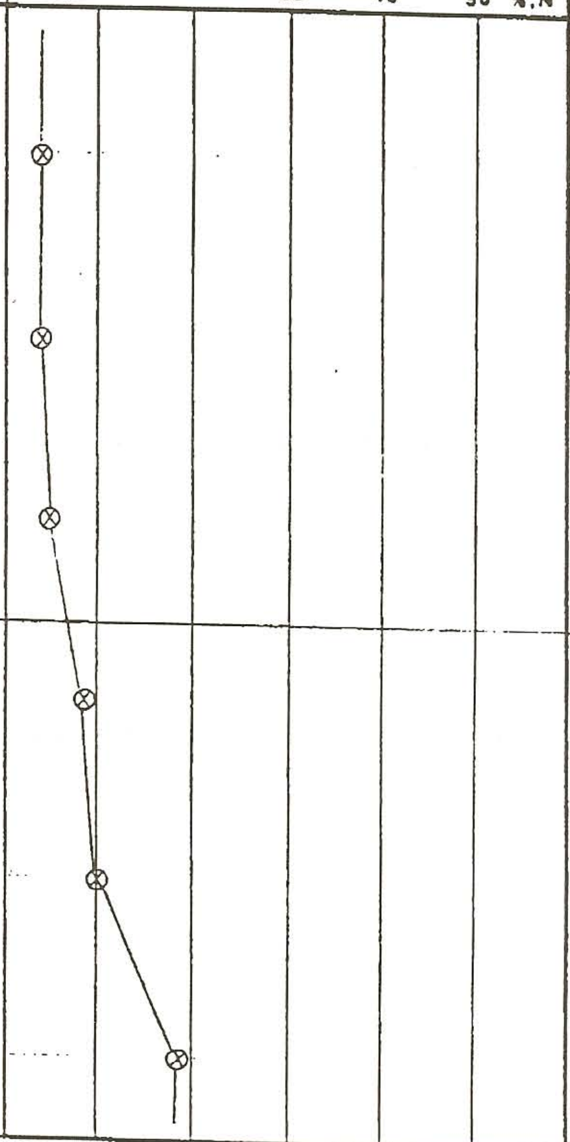
# BORING LOG NO. 5

| OWNER | ARCHITECT / ENGINEER |
|---|---|
| USEPA | ELLIS, NAEYAERT, GENHEIMER & ASSOCIATES |
| **LOCATION** | **PROJECT NAME** |
| BAY CITY, MICHIGAN | USEPA CENTER FOR ECOLOGY, RESEARCH, & TRAINING |

**LEGEND**
- ⊗ STANDARD PENETRATION, "N" (BLOWS/FT.)
- ● NATURAL WATER CONTENT, %
- ATTERBERG LIMITS △ - - ● - - ✕ (P.L. % ... L.L. %)
- ○ UNCONFINED COMPRESSIVE STRENGTH (tsf)
- *○ CALIBRATED HAND PENETROMETER STRENGTH (tsf)

SCALE: *○○ 1, 2, 3, 4, 5 tsf; ● ⊗ 10, 20, 30, 40, 50 %,N

| SAMPLE NUMBER | SAMPLE TYPE | DEPTH IN FEET | DESCRIPTION OF MATERIAL | UNIT DRY WT. LBS/FT³ |
|---|---|---|---|---|
| | | 31 | SURFACE ELEVATION | |
| 9 | SS | 35 | Clayey Silt-Trace Sand and Shells Brown/Gray-Soft . (ML-CL) | |
| 10 | SS | 40 | | |
| 11 | SS | 45 | | |
| 12 | SS | 50 | Fine to Coarse Sand-Trace Gravel and Clay Brown-Loose to Medium Dense (SP) | |
| 13 | SS | 55 | | |
| 14 | SS | 60 | | |



NOTE: The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

MINERAL WELL PERMIT NO.

**WATER LEVEL OBSERVATIONS**

8.0' WHILE SAMPLING OR WHILE DRILLING
____ IMMEDIATELY AFTER COMPLETION
____ ____ AFTER COMPLETION

| BORING STARTED | 5-4-92 |
|---|---|
| BORING COMPLETED | 5-4-92 |

RIG: GLD-AD2 DRAWN BY: MH
FOREMAN: KC APPROVED: RCT/JWC
JOB: B17908 SHEET: 2/3

NOTE: Boring backfilled with natural soils unless otherwise noted.

soil and materials engineers, inc

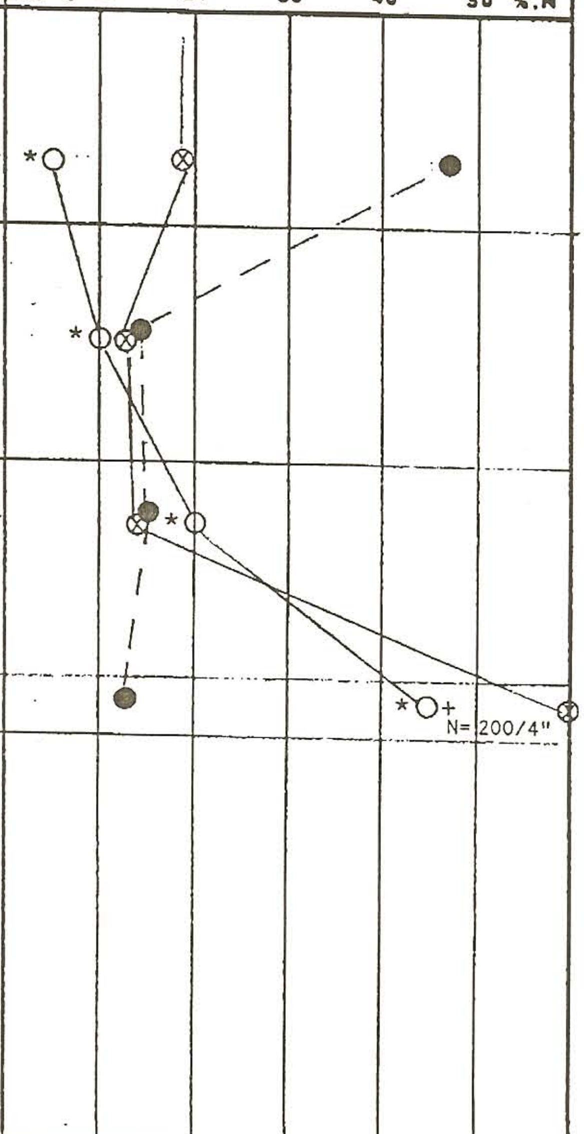
# BORING LOG NO. 5

| OWNER | ARCHITECT / ENGINEER |
|---|---|
| USEPA | ELLIS, NAEYAERT, GENHEIMER, & ASSOCIATES |
| **LOCATION** | **PROJECT NAME** |
| BAY CITY, MICHIGAN | USEPA CENTER FOR ECOLOGY, RESEARCH AND TRAINING |

**LEGEND**
- STANDARD PENETRATION, "N" (BLOWS / FT.)
- NATURAL WATER CONTENT, %
- ATTERBERG LIMITS: P.L. % — L.L. %
- UNCONFINED COMPRESSIVE STRENGTH (tsf)
- * CALIBRATED HAND PENETROMETER STRENGTH (tsf)

SCALE: 1, 2, 3, 4, 5 tsf; 10, 20, 30, 40, 50 %, N

| SAMPLE NUMBER | SAMPLE TYPE | DEPTH IN FEET | DESCRIPTION OF MATERIAL (SURFACE ELEVATION) | UNIT DRY WT. LBS/FT³ |
|---|---|---|---|---|
| | | 61 | Fine to Coarse Sand-Trace Gravel and Clay-Brown-Loose to Medium Dense (SP) | |
| 15 | SS | 65 | | |
| 16 | SS | 70 | Sandy Clay-Some Gravel-Brown-Stiff (CL) | |
| 17 | SS | 75 | Sandy Clay-Trace Gravel-Brown-Very Stiff (CL) | |
| 18 | SS | 80 | Sandy Clay-Trace to Some Gravel-Gray-Hard (CL) (Hardpan) | |
| | | | Driller reported auger refusal at 80' | |
| | | | END OF BORING AT 80' | |
| | | 85 | | |
| | | | NOTE: Borehole grouted with bentonite/cement mixture. | |
| | | 90 | | |




NOTE: The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

MINERAL WELL PERMIT NO.

**WATER LEVEL OBSERVATIONS**

| | |
|---|---|
| 8.0' | WHILE SAMPLING OR WHILE DRILLING |
| ____ | IMMEDIATELY AFTER COMPLETION |
| ____ ____ | AFTER COMPLETION |

| | |
|---|---|
| BORING STARTED | 5-4-92 |
| BORING COMPLETED | 5-4-92 |

RIG: GLD-AD2 — DRAWN BY: MH
FOREMAN: KC — APPROVED: RCT/JWC
JOB: B17908 — SHEET: 3/3

NOTE: Boring backfilled with natural soils unless otherwise noted.

soil and materials engineers, inc

# BORING LOG NO. 6

| | |
|---|---|
| OWNER: USEPA | ARCHITECT / ENGINEER: ELLIS, NAEYAERT, GENHEIMER & ASSOCIATES |
| LOCATION: BAY CITY, MICHIGAN | PROJECT NAME: USEAP CENTER FOR ECOLOGY, RESEARCH & TRAINING |

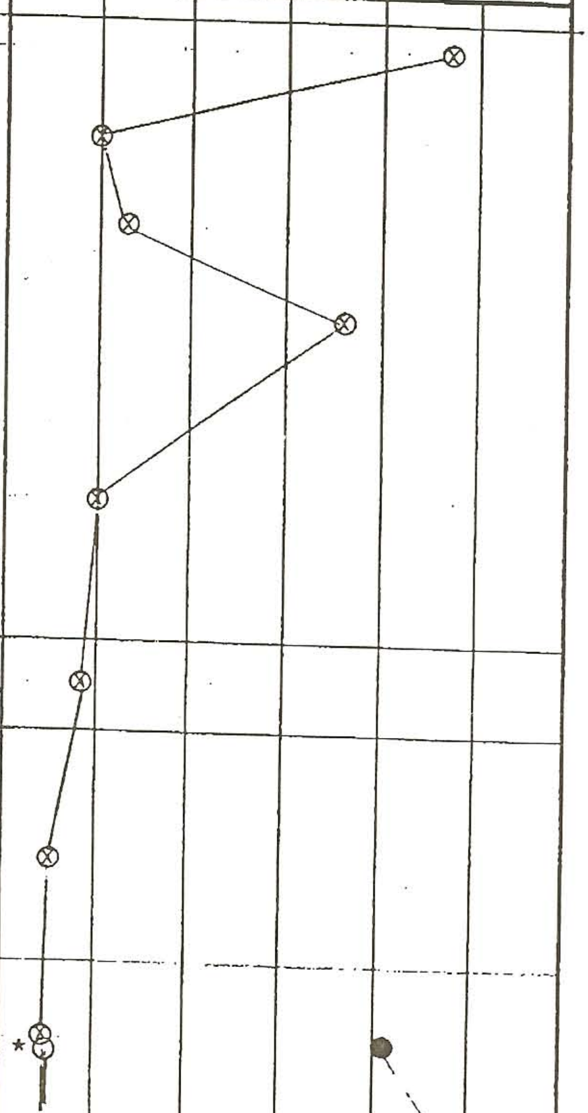
**LEGEND**

- ⊗ STANDARD PENETRATION, "N" (BLOWS/FT.)
- ● NATURAL WATER CONTENT, %
- ATTERBERG LIMITS △- - -●- - -✕ (P.L. % ... L.L. %)
- ○ UNCONFINED COMPRESSIVE STRENGTH (tsf)
- *○ CALIBRATED HAND PENETROMETER STRENGTH (tsf)

SCALE: *○○ 1, 2, 3, 4, 5 tsf; ●⊗ 10, 20, 30, 40, 50 %,N

| SAMPLE NUMBER | SAMPLE TYPE | DEPTH IN FEET | DESCRIPTION OF MATERIAL |
|---|---|---|---|
| | | | SURFACE ELEVATION |
| | | | Driller reported 0.7' of Fine to Medium Sand and Gravel. |
| 1 | SS | | |
| 2 | SS | | |
| | | 5 | Fine to Medium Sand and Slag-Trace Gravel, Wood, Brick, and Silt-Black-Medium Dense to Dense (SP-SM) (FILL) |
| 3 | SS | | |
| 4 | SS | | |
| | | 10 | |
| 5 | SS | | |
| | | 15 | |
| 6 | SS | | Fine to Medium Sand-Trace Silt and Shells-Black-Loose (SM) |
| | | 20 | Fine to medium Sand-Trace Silt-Brown-Loose (SP) |
| 7 | SS | | |
| | | 25 | |
| 8 | SS | | Clayey Silt-Trace Sand and Shells-Gray-Soft to medium (ML-CL) |
| | | 30 | |

UNIT DRY WT. LBS/FT³



NOTE: The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

MINERAL WELL PERMIT NO.

**WATER LEVEL OBSERVATIONS**

8.0' WHILE SAMPLING OR WHILE DRILLING
____ IMMEDIATELY AFTER COMPLETION
____ ____ AFTER COMPLETION

| | |
|---|---|
| BORING STARTED | 5-5-92 |
| BORING COMPLETED | 5-5-92 |
| RIG: GLD-AD2 | DRAWN BY: MH |
| FOREMAN: KC | APPROVED: RCT/JWC |
| JOB: B17908 | SHEET: 1/3 |

NOTE: Boring backfilled with natural soils unless otherwise noted.

soil and materials engineers, inc

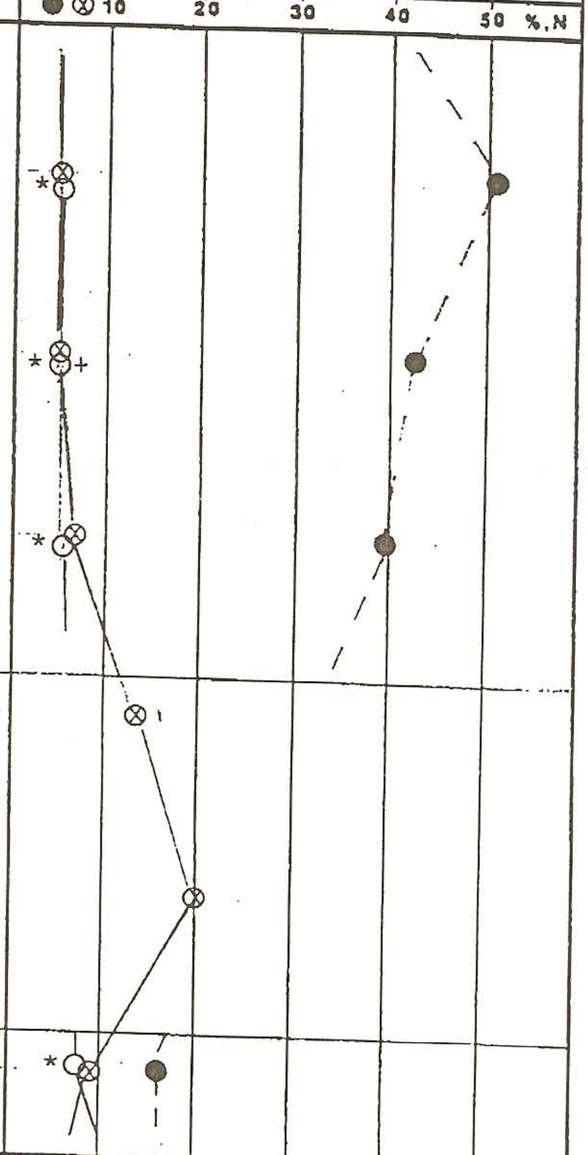
BORING LOG NO. 6

| OWNER | ARCHITECT / ENGINEER |
|---|---|
| USEPA | ELLIS, NAEYAERT, GENHEIMER & ASSOCIATES |
| LOCATION | PROJECT NAME |
| BAY CITY, MICHIGAN | USEPA CENTER FOR ECOLOGY, RESEARCH & TRAINING |

LEGEND: STANDARD PENETRATION, "N" (BLOWS/FT.); NATURAL WATER CONTENT, %; ATTERBERG LIMITS (P.L.% — L.L.%); UNCONFINED COMPRESSIVE STRENGTH (tsf); *CALIBRATED HAND PENETROMETER STRENGTH (tsf)

SCALE: 1, 2, 3, 4, 5 tsf; 10, 20, 30, 40, 50 %, N

| SAMPLE NUMBER | SAMPLE TYPE | DEPTH IN FEET | DESCRIPTION OF MATERIAL |
|---|---|---|---|
| | | | SURFACE ELEVATION |
| 9 | SS | 35 | Clayey Silt-Trace Sand and Shells-Gray-Soft to Medium (ML-CL) |
| 10 | SS | 40 | |
| 11 | SS | 45 | |
| 12 | SS | 50 | Fine to Coarse Sand-Trace Gravel and Clay-Brown-Medium Dense (SP) |
| 13 | SS | 55 | |
| 14 | SS | 60 | Sandy Clay-Trace Gravel-Gray/Brown-Medium to Very Soft (CL) |



NOTE: The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

MINERAL WELL PERMIT NO.

WATER LEVEL OBSERVATIONS

8.0' WHILE SAMPLING OR WHILE DRILLING
_____ IMMEDIATELY AFTER COMPLETION
_____ AFTER COMPLETION

| | |
|---|---|
| BORING STARTED | 5-5-92 |
| BORING COMPLETED | 5-5-92 |
| RIG: GLD-AD2 | DRAWN BY: MH |
| FOREMAN: KC | APPROVED: RCT/JWC |
| JOB: B17908 | SHEET: 2/3 |

NOTE: Boring backfilled with natural soils unless otherwise noted.

soil and materials engineers, inc

OWNER
USEPA

**BORING LOG NO.** 6

ARCHITECT / ENGINEER
ELLIS, NAEYAERT, GENHEIMER & ASSOCIATES

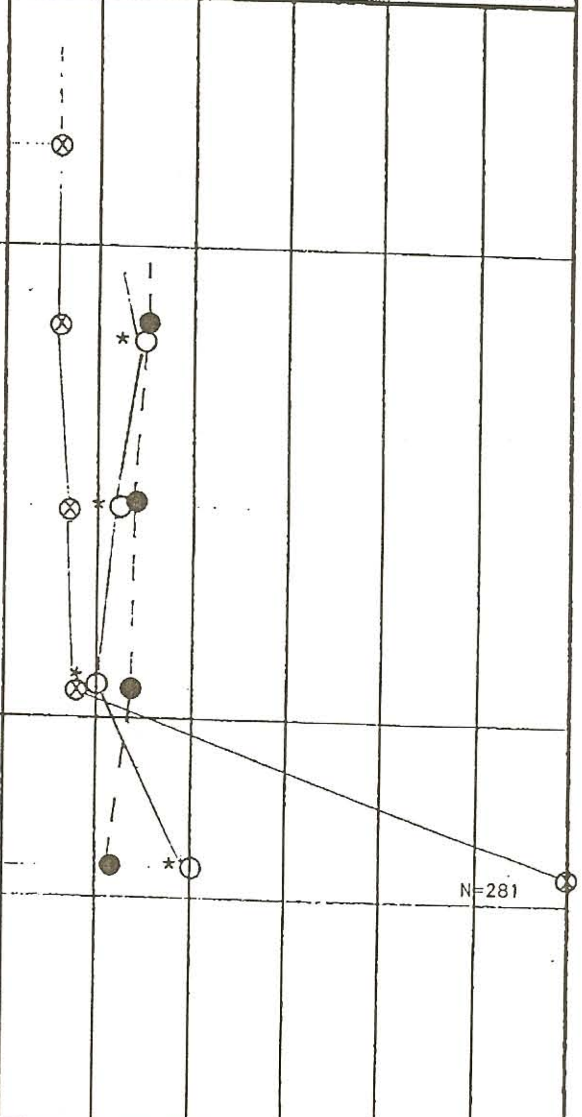
LOCATION
BAY CITY, MICHIGAN

PROJECT NAME
USEPA CENTER FOR ECOLOGY, RESEARCH, & TRAINING

**LEGEND**
- ⊗ STANDARD PENETRATION, "N" (BLOWS/FT.)
- ● NATURAL WATER CONTENT, %
- ATTERBERG LIMITS △ - - ● - - ✕ (P.L. % — L.L. %)
- ○ UNCONFINED COMPRESSIVE STRENGTH (tsf)
- *○ CALIBRATED HAND PENETROMETER STRENGTH (tsf)

SCALE: *○○ 1, 2, 3, 4, 5 tsf; ●⊗ 10, 20, 30, 40, 50 %,N

| SAMPLE NUMBER | SAMPLE TYPE | SAMPLE DISTANCE | DEPTH IN FEET | DESCRIPTION OF MATERIAL | UNIT DRY WT. LBS/FT³ |
|---|---|---|---|---|---|
| | | | | SURFACE ELEVATION | |
| | | | 61 | Sandy Clay-Trace Gravel-Gray/Brown-Medium to Very Soft (CL) | |
| 15 | SS | | 65 | | |
| 16 | SS | | 70 | Sandy Clay-Trace Gravel-Brown-Stiff (CL) | |
| 17 | SS | | 75 | | |
| 18 | SS | | 80 | Sandy Clay-Trace Gravel-Gray-Very Stiff to Hard (CL) (Hardpan) | |
| 19 | SS | | 85 | END OF BORING AT 85' | |
| | | | | NOTE: Borehole grouted with cement/bentonite mixture. | |




NOTE: The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

MINERAL WELL PERMIT NO.

**WATER LEVEL OBSERVATIONS**

8.0' WHILE SAMPLING OR WHILE DRILLING
IMMEDIATELY AFTER COMPLETION
AFTER COMPLETION

| | |
|---|---|
| BORING STARTED | 5-5-92 |
| BORING COMPLETED | 5-5-92 |

RIG: GLD-AD2 DRAWN BY: MH
FOREMAN: KC APPROVED: RCT/JWC
JOB: B17908 SHEET: 3/3

NOTE: Boring backfilled with natural soils unless otherwise noted.

sme
soil and materials engineers, inc

# BORING LOG NO. 7

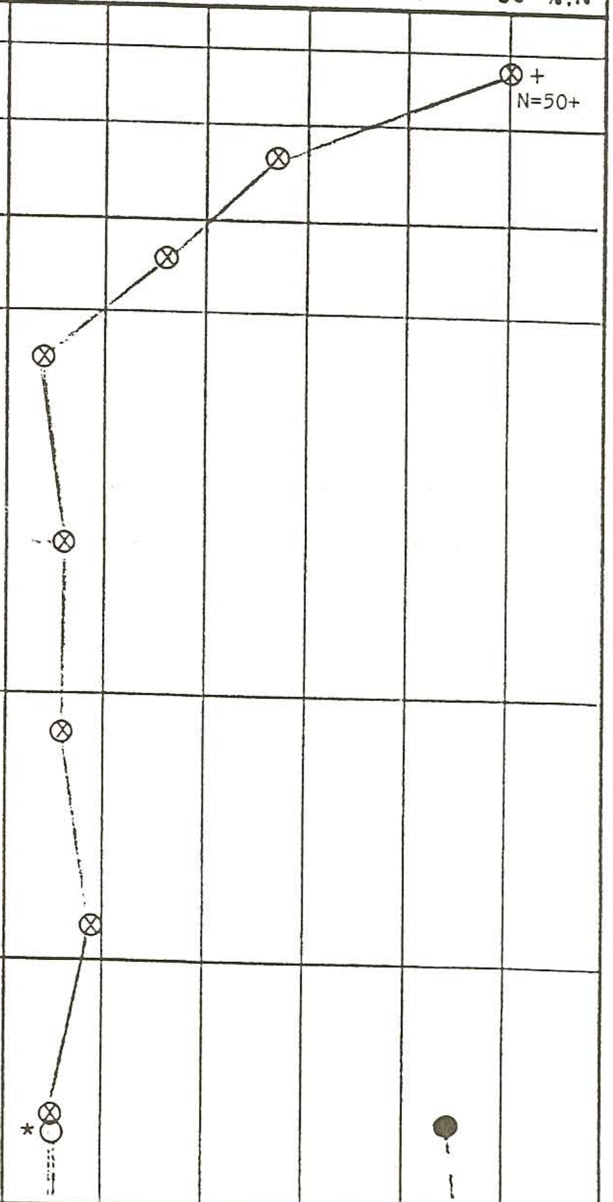
| OWNER | ARCHITECT / ENGINEER |
|---|---|
| USEPA | ELLIS, NAEYAERT, GENHEIMER & ASSOCIATES |
| **LOCATION** | **PROJECT NAME** |
| BAY CITY, MICHIGAN | USEPA CENTER FOR ECOLOGY RESEARCH AND TRAINING |

**LEGEND**

- STANDARD PENETRATION "N" (BLOWS / FT.)
- NATURAL WATER CONTENT, %
- ATTERBERG LIMITS: P.L. % — L.L. %
- UNCONFINED COMPRESSIVE STRENGTH (tsf)
- * CALIBRATED HAND PENETROMETER STRENGTH (tsf)

**SCALE**: 1, 2, 3, 4, 5 tsf; 10, 20, 30, 40, 50 %, N

| SAMPLE NUMBER | SAMPLE TYPE | DESCRIPTION OF MATERIAL |
|---|---|---|
| | | SURFACE ELEVATION |
| | | Driller reported 1.0' of White Fine to Coarse Sand and Gravel (FILL) |
| 1 | SS | Fine to Medium Sand-Some Clay-Brown-Very Dense (SC) (FILL) |
| 2 | SS | Fine to Medium Sand-Trace Silt-Brown/Black Medium Dense (SM)(FILL) |
| 3 | SS | Clayey Sand-Trace Gravel-Brown-Medium Dense (SC)(FILL) |
| 4 | SS | Fine to Medium Sand-Trace Gravel, Silt, Metal, Wood, Concrete and Brick Fragments, and Shells-Black-Very Loose to Loose-Wet (SM)(FILL) |
| 5 | SS | |
| 6 | SS | Silty Sand-Trace Gravel and Shells-Black-Loose (SM) |
| 7 | SS | |
| | | Clayey Silt-Trace Sand and Shells-Gray-Soft to Medium (ML-CL) |
| 8 | SS | |




NOTE: The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

MINERAL WELL PERMIT NO.

**WATER LEVEL OBSERVATIONS**

8.0' WHILE SAMPLING OR WHILE DRILLING
____ IMMEDIATELY AFTER COMPLETION
____ ____ AFTER COMPLETION

| | |
|---|---|
| BORING STARTED | 5-5-92 |
| BORING COMPLETED | 5-5-92 |

RIG: GLD-AD2 DRAWN BY: MH
FOREMAN: KC APPROVED: RCT/JWC
JOB: B17908 SHEET: 1/3

NOTE: Boring backfilled with natural soils unless otherwise noted.

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# BORING LOG NO. 7

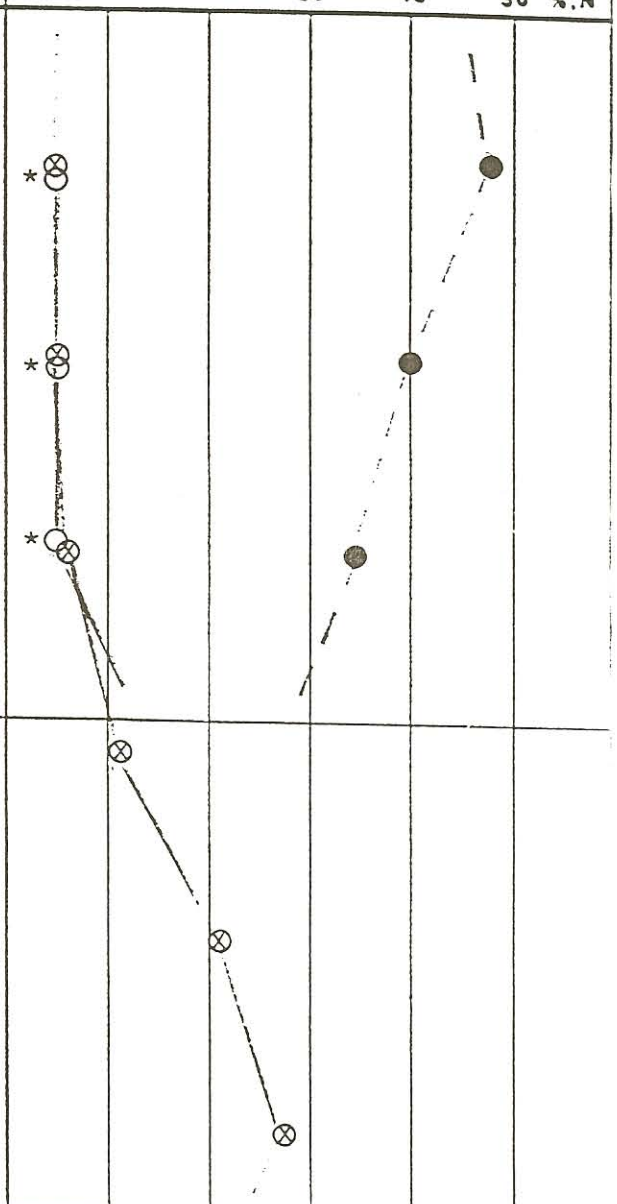
| | |
|---|---|
| OWNER<br>USEPA | ARCHITECT / ENGINEER<br>ELLIS, NAEYAERT, GENHEIMER & ASSOCIATES |
| LOCATION<br>BAY CITY, MICHIGAN | PROJECT NAME<br>USEPA CENTER FOR ECOLOGY RESEARCH AND TRAINING |

**LEGEND**

- STANDARD PENETRATION, "N" (BLOWS / FT.)
- NATURAL WATER CONTENT, %
- ATTERBERG LIMITS (P.L. %, L.L. %)
- UNCONFINED COMPRESSIVE STRENGTH (tsf)
- * CALIBRATED HAND PENETROMETER STRENGTH (tsf)

SCALE: *○○ 1, 2, 3, 4, 5 tsf; ●⊗ 10, 20, 30, 40, 50 %,N

| SAMPLE NUMBER | SAMPLE TYPE | DEPTH IN FEET | DESCRIPTION OF MATERIAL | UNIT DRY WT. LBS/FT³ |
|---|---|---|---|---|
| | | | SURFACE ELEVATION | |
| | | 31 | | |
| 9 | SS | 35 | Clayey Silt-Trace Sand and Shells-Gray-Soft to Medium (ML-CL) | |
| 10 | SS | 40 | | |
| 11 | SS | 45 | | |
| 12 | SS | 50 | Fine to Coarse Sand-Trace Gravel and Clay-Brown-Medium Dense (SP) | |
| 13 | SS | 55 | | |
| 14 | SS | 60 | | |



NOTE: The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

MINERAL WELL PERMIT NO.

**WATER LEVEL OBSERVATIONS**

8.0' WHILE SAMPLING OR WHILE DRILLING
IMMEDIATELY AFTER COMPLETION
AFTER COMPLETION

| | |
|---|---|
| BORING STARTED | 5-5-92 |
| BORING COMPLETED | 5-5-92 |

RIG: GLD-AD2 DRAWN BY: MH
FOREMAN: KC APPROVED: RCT/JWC
JOB: B17908 SHEET: 2/3

NOTE: Boring backfilled with natural soils unless otherwise noted.

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# BORING LOG NO. 7

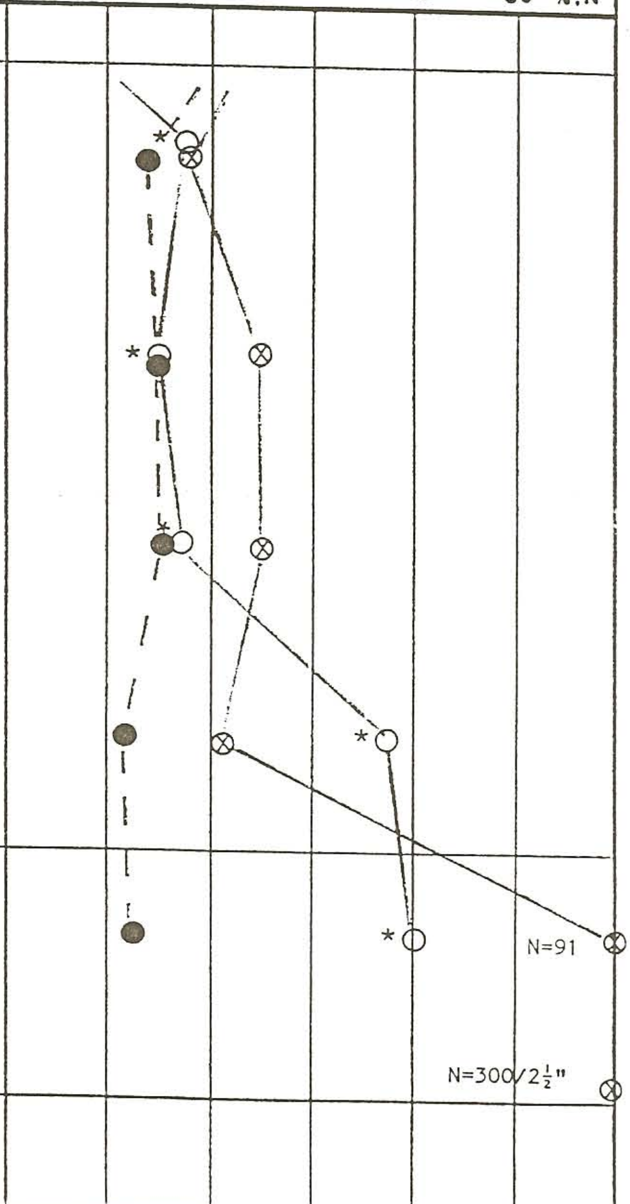
| OWNER | ARCHITECT / ENGINEER |
|---|---|
| USEPA | ELLIS NAEYAERT, GENHEIMER & ASSOCIATES |
| **LOCATION** | **PROJECT NAME** |
| BAY CITY, MICHIGAN | USEPA CENTER FOR ECOLOGY, RESEARCH, AND TRAINING |

**LEGEND**
- ⊗ STANDARD PENETRATION, "N" (BLOWS/FT.)
- ● NATURAL WATER CONTENT, %
- ATTERBERG LIMITS △ - - ● - - ✕ (P.L. % — L.L. %)
- ○ UNCONFINED COMPRESSIVE STRENGTH (tsf)
- *○ CALIBRATED HAND PENETROMETER STRENGTH (tsf)

**SCALE**: *○ ○ 1 2 3 4 5 tsf; ● ⊗ 10 20 30 40 50 %, N

SURFACE ELEVATION

| SAMPLE NUMBER | SAMPLE TYPE | SAMPLE DISTANCE | DEPTH IN FEET | DESCRIPTION OF MATERIAL | UNIT DRY WT. LBS/FT³ |
|---|---|---|---|---|---|
| | | | 61 | Fine to Coarse Sand-Trace Gravel and Clay-Brown-Medium Dense (SP) | |
| 15 | SS | | 65 | Sandy Clay-Trace Gravel-Brown-Stiff to Very Stiff (CL) | |
| 16 | SS | | 70 | | |
| 17 | SS | | 75 | | |
| 18 | SS | | 80 | | |
| 19 | SS | | 85 | Sandy Clay-Trace Gravel-Gray-Hard (CL) (Hardpan) | |
| 20 | SS | | | | |
| | | | 90 | END OF BORING AT 88.5' NOTE: Borehole grouted with bentonite/cement mixture. | |




NOTE: The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

MINERAL WELL PERMIT NO.

**WATER LEVEL OBSERVATIONS**

8.0' WHILE SAMPLING OR WHILE DRILLING
____ IMMEDIATELY AFTER COMPLETION
____ ____ AFTER COMPLETION

| | |
|---|---|
| BORING STARTED | 5-5-92 |
| BORING COMPLETED | 5-5-92 |

RIG: GCD-AD2 DRAWN BY: MH
FOREMAN: KC APPROVED: RCT/JWC
JOB: B17908 SHEET: 3/3

NOTE: Boring backfilled with natural soils unless otherwise noted.

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## BORING LOG NO. 9

| OWNER | ARCHITECT / ENGINEER |
|---|---|
| USEPA | ELLIS, NAEYAERT, GENHEIMER & ASSOCIATES |
| **LOCATION** | **PROJECT NAME** |
| BAY CITY, MICHIGAN | USEPA CENTER FOR ECOLOGY, RESEARCH, AND TRAINING |

**LEGEND**

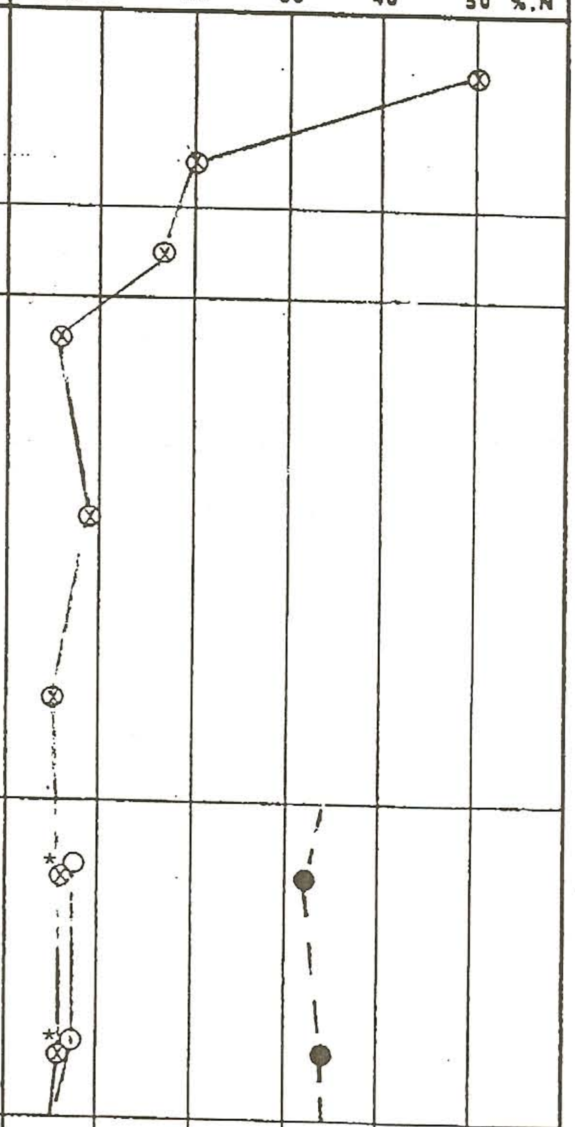
- ⊗ STANDARD PENETRATION, "N" (BLOWS/FT.)
- ● NATURAL WATER CONTENT, %
- ATTERBERG LIMITS △ - - ● - ✕ (P.L.% , L.L.%)
- ○ UNCONFINED COMPRESSIVE STRENGTH (tsf)
- *○ CALIBRATED HAND PENETROMETER STRENGTH (tsf)

**SCALE**

*○○ 1 2 3 4 5 tsf

● ⊗ 10 20 30 40 50 %,N

| SAMPLE NUMBER | SAMPLE TYPE | DEPTH IN FEET | DESCRIPTION OF MATERIAL | UNIT DRY WT. LBS/FT³ |
|---|---|---|---|---|
| | | | SURFACE ELEVATION | |
| 1 | SS | | Fine to Coarse Gravel-Trace Sand and Clay-Brown-Medium Dense to Very Dense (GP)(FILL) | |
| 2 | SS | 5 | | |
| 3 | SS | | Fine to Medium Sand-Trace Silt-Brown-Medium Dense (SP)(FILL) | |
| 4 | SS | 10 | Fine to Medium Sand-Trace to Some Silt-Trace Shells-Brown-Loose (SM) | |
| 5 | SS | 15 | | |
| 6 | SS | 20 | | |
| 7 | SS | 25 | Clayey Silt-Trace Sand and Shells-Gray-Medium (ML) | |
| 8 | SS | 30 | | |



NOTE: The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

MINERAL WELL PERMIT NO.

**WATER LEVEL OBSERVATIONS**

3.0' WHILE SAMPLING OR WHILE DRILLING

IMMEDIATELY AFTER COMPLETION

AFTER COMPLETION

| | |
|---|---|
| BORING STARTED | 5-19-92 |
| BORING COMPLETED | 5-19-92 |

RIG: GLD-AD2 DRAWN BY: MH

FOREMAN: KC APPROVED: RCT/JWC

JOB: B17908 SHEET: 1/3

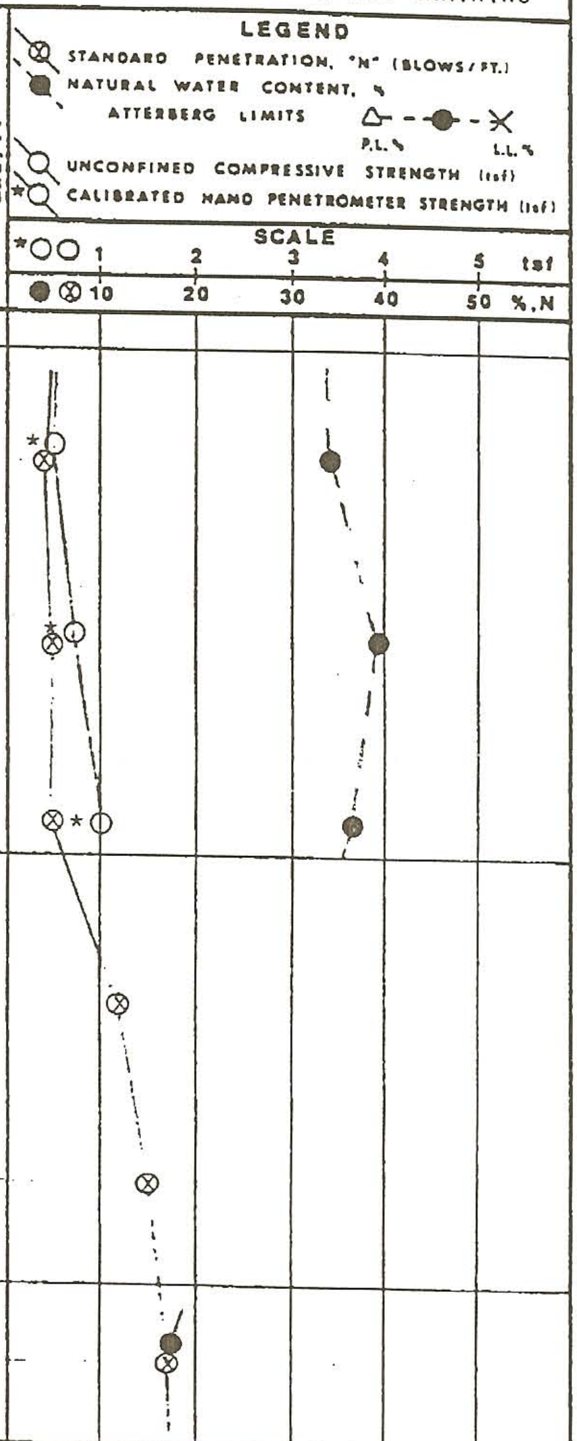
NOTE: Boring backfilled with natural soils unless otherwise noted.

soil and materials engineers, inc

# BORING LOG NO. 9

| OWNER | ARCHITECT / ENGINEER |
|---|---|
| USEPA | ELLIS, NAEYAERT, GENHEIMER, AND ASSOCIATES |
| **LOCATION** | **PROJECT NAME** |
| BAY CITY, MICHIGAN | USEPA CENTER FOR ECOLOGY, RESEARCH, AND TRAINING |

| SAMPLE NUMBER | SAMPLE TYPE | SAMPLE DISTANCE | DEPTH IN FEET | DESCRIPTION OF MATERIAL | UNIT DRY WT. LBS/FT³ |
|---|---|---|---|---|---|
| | | | | SURFACE ELEVATION | |
| | | | 31 | (Continued from Page 1 of 3.) | |
| 9 | SS | | 35 | Clayey Silt-Trace Sand-Brown-Gray-Medium (ML-CL) | |
| 10 | SS | | 40 | | |
| 11 | SS | | 45 | | |
| 12 | SS | | 50 | Fine to Coarse Sand-Trace Gravel and Clay-Brown-Medium Dense (SP) | |
| 13 | SS | | 55 | | |
| 14 | SS | | 60 | Sandy Clay-Trace Gravel-Brown-Stiff (CL) | |




NOTE: The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

MINERAL WELL PERMIT NO.

**WATER LEVEL OBSERVATIONS**

3.0' WHILE SAMPLING OR WHILE DRILLING

____ IMMEDIATELY AFTER COMPLETION

____ ____ AFTER COMPLETION

| | |
|---|---|
| BORING STARTED | 5-19-92 |
| BORING COMPLETED | 5-19-92 |
| RIG: GLD-AD2 | DRAWN BY: MH |
| FOREMAN: KC | APPROVED: RCT/JWC |
| JOB: B17908 | SHEET: 2/3 |

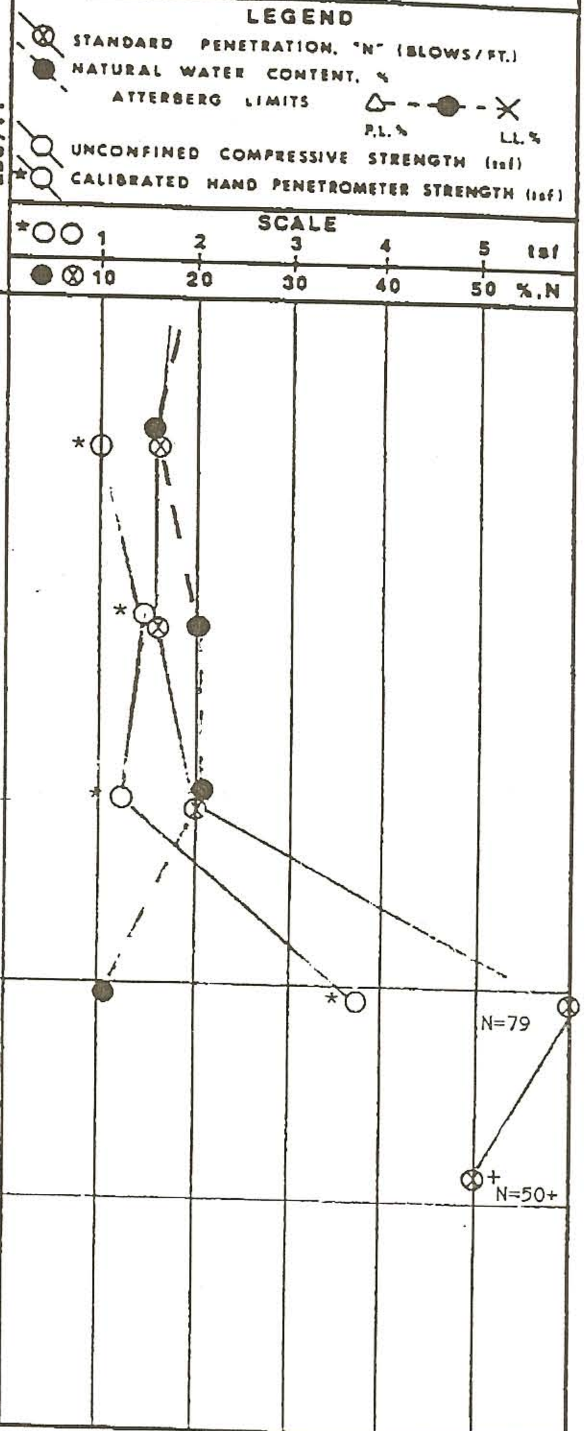
NOTE: Boring backfilled with natural soils unless otherwise noted.

sme soil and materials engineers, inc

# BORING LOG NO. 9

| OWNER | ARCHITECT / ENGINEER |
|---|---|
| USEPA | ELLIS, MEYAERT, GENHEIMER, AND ASSOCIATES |
| **LOCATION** | **PROJECT NAME** |
| BAY CITY, MICHIGAN | USEPA CENTER FOR ECOLOGY, RESEARCH, AND TRAINING |

| SAMPLE NUMBER | SAMPLE TYPE | SAMPLE DISTANCE | DEPTH IN FEET | DESCRIPTION OF MATERIAL (SURFACE ELEVATION) | UNIT DRY WT. LBS/FT³ |
|---|---|---|---|---|---|
| | | | 61 | | |
| 15 | SS | | | | |
| | | | 65 | Sandy Clay-Trace Gravel-Brown-Stiff (CL) | |
| 16 | SS | | | | |
| | | | 70 | | |
| 17 | SS | | | | |
| | | | 75 | | |
| 18 | SS | | | | |
| | | | 80 | Sandy Clay-Trace Gravel-Gray-Very Stiff to Hard (CL) (Hardpan) | |
| 19 | SS | | | | |
| | | | 85 | END OF BORING AT 85' | |
| | | | | NOTE: Borehole grouted with bentonite/cement mixture. | |
| | | | 90 | | |




NOTE: The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

MINERAL WELL PERMIT NO.

**WATER LEVEL OBSERVATIONS**

3.0' WHILE SAMPLING OR WHILE DRILLING
IMMEDIATELY AFTER COMPLETION
AFTER COMPLETION

| BORING STARTED | 5-19-92 |
|---|---|
| BORING COMPLETED | 5-19-92 |

RIG: GLD-AD2 DRAWN BY: MH
FOREMAN: KC APPROVED: RCT/JWC
JOB: B17908 SHEET: 3/3

NOTE: Boring backfilled with natural soils unless otherwise noted.

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# BORING LOG NO. 10

| OWNER | ARCHITECT / ENGINEER |
|---|---|
| USEPA | ELLIS, NAEYAERT, GENHEI FR & ASSOCIATES |
| LOCATION | PROJECT NAME |
| BAY CITY, MICHIGAN | USEPA CENTER FOR ECOLOGY, RESEARCH, AND TRAINING |

**LEGEND**

- ⊗ STANDARD PENETRATION, "N" (BLOWS/FT.)
- ● NATURAL WATER CONTENT, %
- ATTERBERG LIMITS △ - - ● - - ✕ (P.L. % … L.L. %)
- ○ UNCONFINED COMPRESSIVE STRENGTH (tsf)
- *○ CALIBRATED HAND PENETROMETER STRENGTH (tsf)

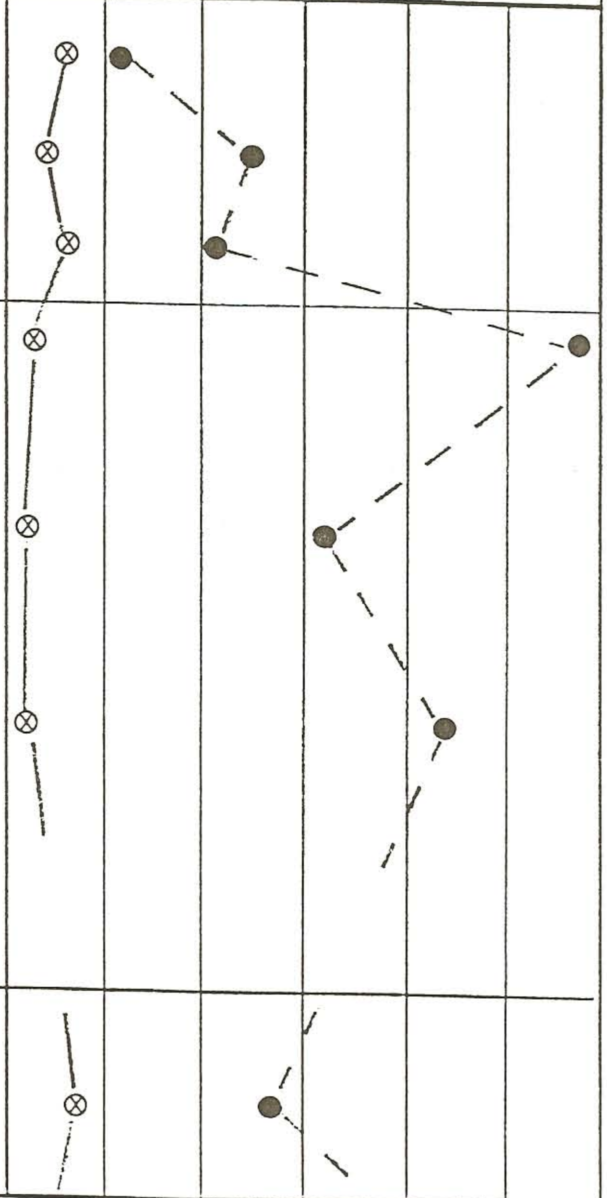
**SCALE**

*○○ 1 2 3 4 5 tsf

● ⊗ 10 20 30 40 50 %,N

SURFACE ELEVATION

| SAMPLE NUMBER | SAMPLE TYPE | DEPTH IN FEET | DESCRIPTION OF MATERIAL | UNIT DRY WT. LBS/FT³ |
|---|---|---|---|---|
| 1 | SS | | Sandy Clay-Trace Gravel, Cinders, Brick, and Wood-Brown (CL)(FILL) | |
| 2 | SS | 5 | | |
| 3 | SS | | | |
| 4 | SS | 10 | Clayey Silt-Trace Sand, Shells, and Organic Material-Brown/Gray-Very Soft (ML-CL) | |
| 5 | SS | 15 | | |
| 6 | SS | 20 | | |
| 7 | ST | 25 | | |
| 8 | SS | 30 | Fine to Medium Sand-Trace Clay and Gravel-Brown Loose (SC) | |



NOTE: The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

MINERAL WELL PERMIT NO.

**WATER LEVEL OBSERVATIONS**

3.5' WHILE SAMPLING OR WHILE DRILLING

_____ IMMEDIATELY AFTER COMPLETION

_____ _____ AFTER COMPLETION

| | |
|---|---|
| BORING STARTED | 5-20-92 |
| BORING COMPLETED | 5-20-92 |

RIG: GLD-RD2 DRAWN BY: MH

FOREMAN: KC APPROVED: RCT/JWC

JOB: B17908 SHEET: 1/3

NOTE: Boring backfilled with natural soils unless otherwise noted.

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# BORING LOG NO.10

| OWNER | ARCHITECT / ENGINEER |
|---|---|
| USEPA | ELLIS, NAEYAERT, GENHEIMER & ASSOCIATES |
| LOCATION | PROJECT NAME |
| BAY CITY, MICHIGAN | USEPA CENTER FOR ECOLOGY, RESEARCH, AND TRAINING |

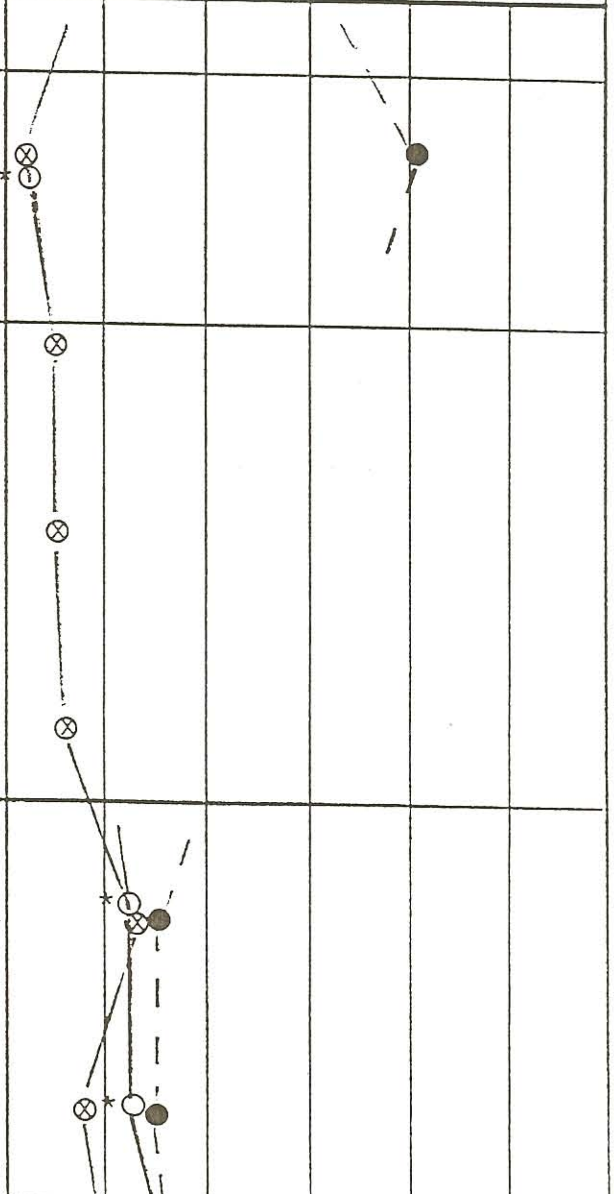
**LEGEND**

- ⊗ STANDARD PENETRATION, "N" (BLOWS/FT.)
- ● NATURAL WATER CONTENT, %
- ATTERBERG LIMITS △ - - ● - - ✕ (P.L. %, L.L. %)
- ○ UNCONFINED COMPRESSIVE STRENGTH (tsf)
- *○ CALIBRATED HAND PENETROMETER STRENGTH (tsf)

SCALE: *○○ 1, 2, 3, 4, 5 tsf; ● ⊗ 10, 20, 30, 40, 50 %, N

| SAMPLE NUMBER | SAMPLE TYPE | DEPTH IN FEET | DESCRIPTION OF MATERIAL | UNIT DRY WT. LBS/FT³ |
|---|---|---|---|---|
| | | 31 | Fine to Medium Sand-Trace Clay and Gravel-Brown-Loose (SC) | |
| 9 | SS | 35 | Clayey Silt-Trace Sand-Occasional Sand Seams Brown-Soft (ML) | |
| 10 | SS | 40 | | |
| 11 | SS | 45 | Fine to Coarse Sand-Trace Clay, Shells, and Gravel-Brown-Loose (SC) | |
| 12 | SS | 50 | | |
| 13 | SS | 55 | Sandy Clay-Trace Gravel-Brown-Gray-Stiff (CL) | |
| 14 | SS | 60 | | |

SURFACE ELEVATION



NOTE: The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

MINERAL WELL PERMIT NO.

**WATER LEVEL OBSERVATIONS**

3.5' WHILE SAMPLING OR WHILE DRILLING

____ IMMEDIATELY AFTER COMPLETION

____ ____ AFTER COMPLETION

| | |
|---|---|
| BORING STARTED | 5-20-92 |
| BORING COMPLETED | 5-20-92 |
| RIG: GLD-AD2 | DRAWN BY: MR |
| FOREMAN: KC | APPROVED: RCT/JWC |
| JOB: B17908 | SHEET: 2/3 |

NOTE: Boring backfilled with natural soils unless otherwise noted.

sme

soil and materials engineers, inc

# BORING LOG NO. 10

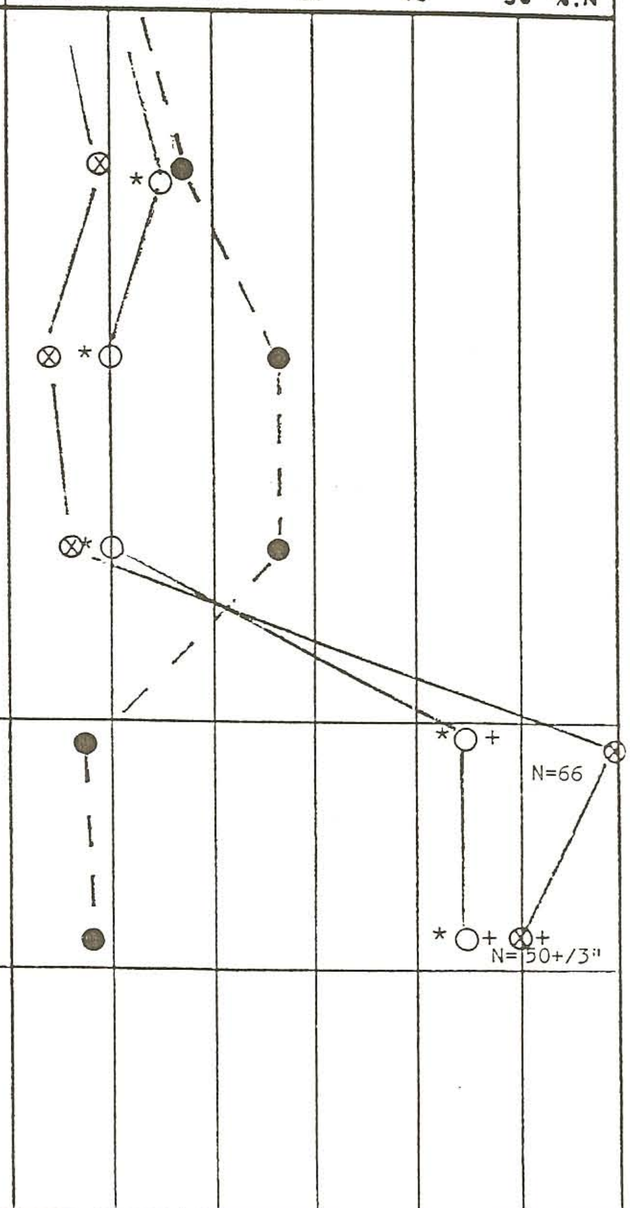
| OWNER | ARCHITECT / ENGINEER |
|---|---|
| USEPA | ELLIS, NAEYAERT, GENHEIMER & ASSOCIATES |
| LOCATION | PROJECT NAME |
| BAY CITY, MICHIGAN | USEPA CENTER FOR ECOLOGY RESEARCH & TRAINING |

**LEGEND**

- ⊗ STANDARD PENETRATION, "N" (BLOWS/FT.)
- ● NATURAL WATER CONTENT, %
- ATTERBERG LIMITS △ - - ● - - ✕ (P.L. % — L.L. %)
- ○ UNCONFINED COMPRESSIVE STRENGTH (tsf)
- *○ CALIBRATED HAND PENETROMETER STRENGTH (tsf)

SCALE: *○ ○ 1, 2, 3, 4, 5 tsf; ● ⊗ 10, 20, 30, 40, 50 %, N

| SAMPLE NUMBER | SAMPLE TYPE | DEPTH IN FEET | DESCRIPTION OF MATERIAL | UNIT DRY WT. LBS/FT³ |
|---|---|---|---|---|
| | | | SURFACE ELEVATION | |
| 15 | SS | 61–65 | Sandy Clay-Trace Gravel-Brown-Gray-Stiff (CL) | |
| 16 | SS | 70 | | |
| 17 | SS | 75 | | |
| 18 | SS | 80 | Sandy Clay-Trace to Some Gravel-Gray-Hard (CL) (Hardpan) | |
| 19 | SS | 85 | | |
| | | 90 | END OF BORING AT 85'<br>NOTE: Borehole grouted with bentonite/cement mixture. | |




NOTE: The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

MINERAL WELL PERMIT NO.

**WATER LEVEL OBSERVATIONS**

3.5' WHILE SAMPLING OR WHILE DRILLING
_____ IMMEDIATELY AFTER COMPLETION
_____ _____ AFTER COMPLETION

| | |
|---|---|
| BORING STARTED | 5-20-92 |
| BORING COMPLETED | 5-20-92 |
| RIG: GLD-AD2 | DRAWN BY: MH |
| FOREMAN: KC | APPROVED: RCT/JWC |
| JOB: B17908 | SHEET: 3/3 |

NOTE: Boring backfilled with natural soils unless otherwise noted.

soil and materials engineers, inc

# BORING LOG NO. 14

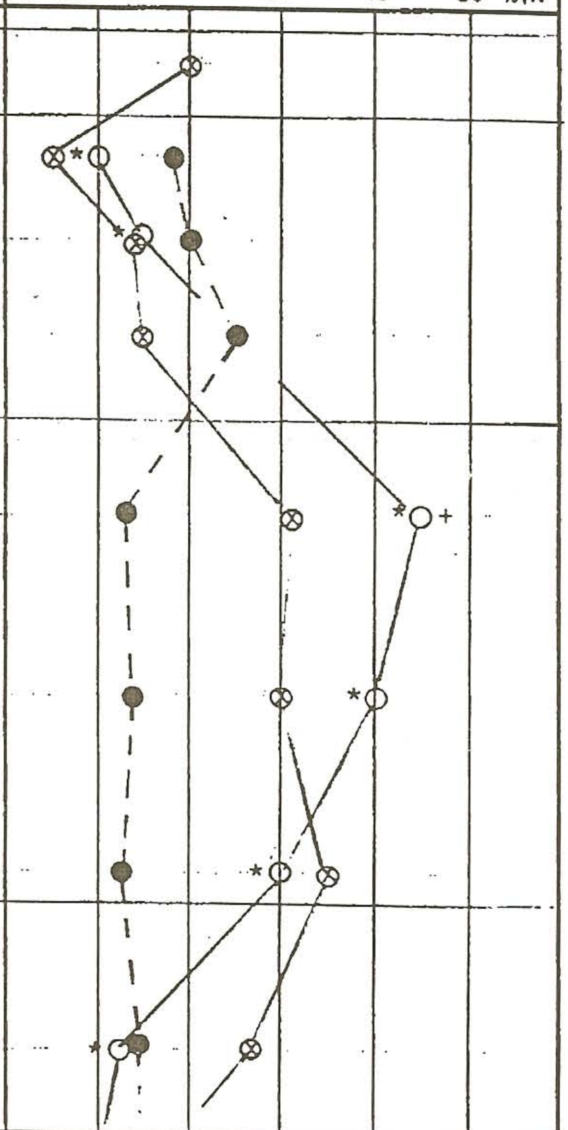
| OWNER | ARCHITECT / ENGINEER |
|---|---|
| USEPA | ELLIS, MAEYAERT, GENHEIMER, AND ASSOCIATES |
| **LOCATION** | **PROJECT NAME** |
| BAY CITY, MICHIGAN | USEPA CENTER FOR ECOLOGY, RESEARCH, AND TRAINING |

**LEGEND**

- STANDARD PENETRATION, "N" (BLOWS/FT.)
- NATURAL WATER CONTENT, %
- ATTERBERG LIMITS (P.L. % — L.L. %)
- UNCONFINED COMPRESSIVE STRENGTH (tsf)
- CALIBRATED HAND PENETROMETER STRENGTH (tsf)

SCALE: 1, 2, 3, 4, 5 tsf; 10, 20, 30, 40, 50 %, N

| SAMPLE NUMBER | SAMPLE TYPE | DEPTH IN FEET | DESCRIPTION OF MATERIAL | UNIT DRY WT. LBS/FT³ |
|---|---|---|---|---|
| | | | SURFACE ELEVATION | |
| | | | Driller reported 0.6' of Fine to Medium Sand and Gravel-Fill. | |
| 1 | SS | | Fine to Medium Sand-Trace Gravel, Brick, and Concrete Fragments-Black/Brown-Medium Dense (SP) (FILL) | |
| 2 | SS | 5 | Sandy Clay-Trace Gravel and Wood Fragments-Gray/Brown-Stiff (CL) (FILL) | |
| 3 | SS | | | |
| 4 | SS | 10 | | |
| 5 | SS | 15 | Sandy Clay-Trace Gravel-Gray-Very Stiff to Hard (CL) | |
| 6 | SS | 20 | | |
| 7 | SS | 25 | | |
| 8 | SS | 30 | Silty Clay-Trace to Some Sand-Trace Gravel-Gray-/Brown-Stiff (CL) | |



NOTE: The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

MINERAL WELL PERMIT NO.

**WATER LEVEL OBSERVATIONS**

None WHILE SAMPLING OR WHILE DRILLING
None IMMEDIATELY AFTER COMPLETION
______ ______ AFTER COMPLETION

| | |
|---|---|
| BORING STARTED | 4-24-92 |
| BORING COMPLETED | 4-24-92 |

RIG: GLD-AD-2 DRAWN BY: MH
FOREMAN: KC APPROVED: RCT/JWC
JOB: B17908 SHEET: 1/2

NOTE: Boring backfilled with natural soils unless otherwise noted.

sme soil and materials engineers, inc

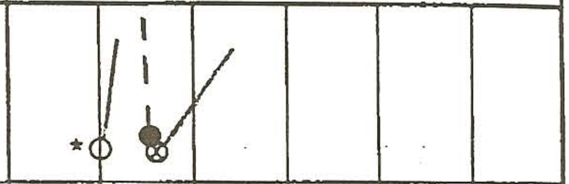
# BORING LOG NO. 14

| OWNER | ARCHITECT / ENGINEER |
|---|---|
| USEPA | ELLIS, NAEYAERT, GENHEIMER, AND ASSOCIATES |
| **LOCATION** | **PROJECT NAME** |
| BAY CITY, MICHIGAN | USEPA CENTER FOR ECOLOGY, RESEARCH, AND TRAINING |

**LEGEND**
- ⊗ STANDARD PENETRATION, "N" (BLOWS/FT.)
- ● NATURAL WATER CONTENT, %
- ATTERBERG LIMITS △- - -●- - -× (P.L.% ... L.L.%)
- ○ UNCONFINED COMPRESSIVE STRENGTH (tsf)
- *○ CALIBRATED HAND PENETROMETER STRENGTH (tsf)

SCALE: *○○ 1, 2, 3, 4, 5 tsf; ●⊗ 10, 20, 30, 40, 50 %,N

| SAMPLE NUMBER | SAMPLE TYPE | SAMPLE DISTANCE | DEPTH IN FEET | DESCRIPTION OF MATERIAL (SURFACE ELEVATION) | UNIT DRY WT. LBS/FT³ |
|---|---|---|---|---|---|
| | | | 31 | Silty Clay-Trace to Some Sand-Trace Gravel-Gray/Brown-Stiff (CL) | |
| 9 | SS | | 35 | | |
| | | | | END OF BORING AT 35' | |
| | | | 40 | | |
| | | | 45 | | |
| | | | 50 | | |
| | | | 55 | | |
| | | | 60 | | |



NOTE: The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

MINERAL WELL PERMIT NO.

**WATER LEVEL OBSERVATIONS**

| | |
|---|---|
| None | WHILE SAMPLING OR WHILE DRILLING |
| None | IMMEDIATELY AFTER COMPLETION |
| | AFTER COMPLETION |

| | |
|---|---|
| BORING STARTED | 4-24-92 |
| BORING COMPLETED | 4-24-92 |

| | |
|---|---|
| RIG: GLD-AD-2 | DRAWN BY: MH |
| FOREMAN: KC | APPROVED: RCT/JWC |
| JOB: 817908 | SHEET: 2/2 |

NOTE: Boring backfilled with natural soils unless otherwise noted.

sme soil and materials engineers, inc

## APPENDIX B

PRELIMINARY SEAWALL DESIGN, UPTOWN MARINA,
SME PROJECT NUMBER BG54204

Soil and Materials Engineers, Inc.
13019 Pauline Drive
Shelby Township, MI 48315-3122

tel (586) 731-3100
fax (586) 731-3582
www.sme-usa.com



March 29, 2007

Mr. Jack Wheatley
Rowe, Inc.
6211 Taylor Drive
Flint, Michigan 48507

RE: Preliminary Seawall Design
Uptown Marina
Bay City, Michigan
SME Project No. BG54204

Dear Mr. Wheatley:

Soil and Materials Engineers, Inc. (SME) has completed the geotechnical services for the proposed Uptown Marina seawall in Bay City, Michigan. This letter report transmits the preliminary seawall design and includes a general description of the field and laboratory services, general recommendations for construction of the wall, and construction notes to be included on the final design plans. Our evaluation was conducted in general accordance with the scope of services outlined in our October 27, 2006 *Proposal for Geotechnical Engineering Services* (B06-0162). Mr. Jack Wheatley of Rowe, Inc. (Rowe) authorized our services.

## PROJECT DESCRIPTION

The City of Bay City is planning a marina to be constructed as part of the Uptown at Rivers Edge project. The marina will be constructed along the east bank of the Saginaw River, along the west side of Saginaw Street at 11th Street.

Steel sheet pile seawalls will be constructed along the perimeter of the marina, as well as surrounding the proposed clubhouse (former foundry building). Based on information provided by Rowe, existing ground surface elevations range from about 583 feet to 589 feet (USGS).

We understand a final design site grade at about elevation 586 feet is proposed along the landward side of the seawall, with a bottom of basin elevation planned at about elevation 566 feet. Low water levels were assumed at elevation 576 feet, and a preliminary "stick-up" of 18 to 24 inches is possible. The top of the seawall will be capped with a standard steel cap.

Due to the proposed wall height, a tied-back seawall system will be required. A conventional deadman type anchor system has been provided.

## EVALUATION PROCEDURES

Three borings (R1 through R3) were drilled at the project site by SME on November 1, 2006. The borings extended to depths of 50 feet below the existing ground surface for a total of 150 linear feet of drilling. The approximate locations of the borings are shown on the appended Boring Location Diagram.

The planned number, depths, and locations of the borings were determined by Rowe and SME to meet the needs of the project. The borings were located in the field by SME. Ground surface elevations at the boring locations were obtained by SME, and are reported to the nearest 0.1 foot based on the finish floor elevation (FFE) of the former StressCon building, which was provided by Rowe.

The borings were drilled using a truck-mounted rotary drill rig and were advanced to the sampling depths using continuous-flight, solid-stem augers. The borings included soil sampling based upon the split-barrel sampling procedure. Soil samples collected from the borings were sealed in glass jars by the driller.

Groundwater level measurements were recorded during drilling and immediately after completion of the drilling operations at each of the borings. After drilling and collection of groundwater readings, the boreholes were backfilled with cement and bentonite grout. Therefore, long-term groundwater level information is not available from the borings.

Soil samples collected from the borings were returned to the SME laboratory for additional analyses. The general laboratory testing program consisted of performing visual soil classification on the recovered samples, along with moisture content and hand penetrometer or Torvane shear tests on portions of cohesive samples obtained.

The soil samples were visually classified in general accordance with the Unified Soil Classification System (USCS). The estimated group symbol, according to the USCS, is shown in parentheses following the textural description of the various strata on the boring logs appended to this report. The appended General Notes sheet includes a brief summary of the general method of describing the soil and assigning an appropriate USCS group symbol.

In the hand penetrometer test, the unconfined compressive strength of a cohesive soil sample is estimated by measuring the resistance of the sample to penetration of a small, calibrated, spring-loaded cylinder. The maximum capacity of the penetrometer is 4.5 tons per square-foot (tsf). The shear strength reported on the boring logs is one-half of the unconfined compressive strength and is reported in units of kips per square-foot (ksf).

In the Torvane shear test, the shear strength of relatively soft cohesive soil is estimated by subjecting the sample to a torque applied through vanes inserted into the soil sample. The shear strength of the sample is read directly from the maximum torque required to shear the sample and is reported on the logs in units of ksf.

The appended boring logs include the drilling method(s), materials encountered, penetration resistances, and pertinent field observations made during the drilling operations, along with the results of the laboratory testing.

Soil samples retained over a long time, even in sealed jars, are subject to moisture loss and are no longer representative of the conditions initially encountered in the field. Therefore, soil samples are normally retained in our laboratory for 60 days and are then disposed, unless instructed otherwise.

## SUBSURFACE CONDITIONS

The soil conditions encountered at the boring locations generally consist of undocumented sand fill overlying natural clays and sands, extending to the explored depths of the borings. The following gives a generalized summary description of the soils encountered in the borings, beginning at the existing ground surface and proceeding downward:

**Stratum 1: Crushed Limestone.** Crushed limestone was encountered at the ground surface, extending to depths of 2.5 to 4 feet below the ground surface. Standard Penetration Test (SPT) resistances (N-values) of 35 to 44 blows per foot (bpf) were obtained in the crushed limestone fill, indicating a dense condition.

**Stratum 2: Sand Fill with Organics:** Sand fill, ranging in grain size and silt and clay content, was encountered beneath the crushed limestone, extending 17 to 21 feet below the ground surface. Organic soils were typically encountered within the fill. N-values of 3 to 21 bpf were obtained in the sand fill, indicating a very loose to medium dense condition.

**Stratum 3: Natural Clays with Organics.** Natural clays containing organics, such as shell fragments, were encountered below the Stratum 2 soils and extended to depths of about 43 to 47 feet at borings R1 and R2. Boring R3 was terminated in the Stratum 3a clays. Shear strengths ranged from 0.5 to 0.7 kips per square foot (ksf), with corresponding moisture contents of 30 to 45 percent. The Stratum 3 clays are in a medium condition.

**Stratum 4: Natural Inorganic Clays and Sands.** Natural inorganic silty clay was encountered beneath the Stratum 3 soils at boring R1, extending to the explored depth of the boring. Inorganic clays were not encountered at borings R2 and R3. Shear strengths of 2.5 to 3.0 ksf, and corresponding moisture contents of about 13 to 14 percent were obtained on the inorganic clays, indicating a very stiff condition.

Fine to coarse sand was encountered beneath the organic clays at boring R2, extending to the explored depth of the boring. A single N-value of 14 bpf was obtained in the sand, indicating a medium dense condition.

The soil descriptions and properties, in addition to groundwater conditions observed by the driller, are graphically presented on the boring logs appended to this report. Please refer to the boring logs for the soil conditions at the specific boring locations. Stratification lines on the boring logs indicate a general transition between soil types. They are not intended to show an area of exact geological change. The soil descriptions on the boring logs are based on visual classification of the soils encountered.

During drilling, groundwater was encountered in the borings at about 4 to 11 feet below the existing ground surface (elevations 578 to 579 feet). Just after drilling, groundwater was encountered at depths of about 10 to 13 feet (elevations 571 to 579 feet). Long-term groundwater levels are controlled by the surface water level of the adjacent Saginaw River. The groundwater levels encountered during drilling operations approximate the surface water levels observed in the river.

Hydrostatic groundwater levels and the elevations and volumes of groundwater should be expected to fluctuate throughout the year based on variations in precipitation, evaporation, surface run-off, and other factors. Higher levels of perched groundwater may be encountered at some locations where thin layers of near-surface sands overlay the relatively impermeable clays. The groundwater levels indicated by the borings and presented in this section represent conditions at the time the readings were taken. The actual groundwater levels at the time of construction may vary.

## ANALYSIS AND RECOMMENDATIONS

### Site Preparation and Engineered Fill

In pavement areas, and in areas to receive engineered fill, existing topsoil, trees, shrubs, root mats, and other deleterious materials should be cleared and removed to expose the underlying suitable inorganic subgrade soils.

Below-grade structures (e.g., foundations and utilities) from previous developments (if present) should be removed in their entirety within proposed building footprints. Alternatively, utilities may be abandoned in place and fully grouted beneath floor slabs, pavements and sidewalks. In these areas, to reduce development of hard spots in the subgrade, below-grade structures should be removed to a minimum depth of 2.5 feet below the final design subgrade levels. Due to the risk of differential settlement over abandoned utilities, we recommend utilities be completely removed from beneath foundations.

The existing fill materials encountered in the borings consist of undocumented fill overlying organic soils and/or clays containing organic materials, which extend to depths of 43 to 50 feet below the ground surface. These materials are considered unsuitable for the support of floor slabs and foundations.

Mass excavation (removal and replacement) of the fill and organic soils are not economically feasible for this site. The existing fill and organic soils have been in place for some time, and construction of flexible (asphalt) pavements and sidewalks at the site could be considered, since the loads imposed by passenger vehicle and pedestrian traffic are relatively low. Even though loads due to traffic are considered small, there is still a risk of settlement associated with construction of sidewalks and pavements over the existing organic soils. Typically, to provide a more uniform subgrade, thus reducing (but not eliminating) differential settlement, a layer of dense-graded crushed concrete (possibly in combination with a biaxial geogrid) would be recommended beneath the pavements and sidewalks. Assuming the existing dense-graded crushed limestone reported at all borings performed for this evaluation is consistent across the site, this material can serve as the recommended stabilization material, once properly prepared.

After removing unsuitable surficial materials (topsoil, existing pavements, root mats, etc.), we recommend several shallow test pits be excavated beneath proposed sidewalks and pavements. The purpose of the test pits would be to verify the depths of the dense-graded crushed limestone. In areas where the pavements and sidewalks are constructed in cut areas or near existing site grades, a minimum of two feet of crushed limestone is recommended. Following completion of the test pit operation, and prior to placing pavements, sidewalks and/or engineered fill (where required), the exposed subgrade should be thoroughly compacted. A vibratory steel-drum roller capable of generating a minimum of 30 tons of dynamic force is recommended for this purpose. We recommend at least three passes per unit roller width in each of two perpendicular directions (6 passes total) to provide uniform coverage. Water may need to be added to facilitate compaction. The compactive efforts should extend a minimum of 5 feet beyond the edges of the sidewalks and pavements. Following completion of compaction, the resulting subgrade should be thoroughly proofrolled in the presence of SME. A tandem axle dump truck, or similar rubber tired equipment should be used for the proofroll. Unsuitable areas identified during the proofroll should be improved by recompaction or removal and replacement.

Where engineered fill will be required to establish design site grades, conventional granular fill (MDOT Class II) or additional dense-graded crushed concrete or crushed limestone (such as MDOT 21AA) can be placed above the prepared crushed limestone.

Any fill placed within structural areas of the site should be an approved material, free of frozen soil, organics, or other deleterious materials. The fill should be spread in level layers not exceeding 9 inches in loose thickness and compacted to a minimum 95 percent of the maximum dry density as determined in accordance with the Modified Proctor Test. For non-structural (or greenbelt) areas of the site, we recommend proposed fill be placed and compacted to a minimum 90 percent of the maximum dry density based on the Modified Proctor Test. If the proposed fill contains more than 4 percent organics, we recommend such materials not be used for engineered fill. Wet sands will require drainage prior to their reuse as engineered fill.

Provided the soils meet the requirements listed above, some of the existing near-surface soils can be reused as general site fill. The existing near-surface sands consist primarily of clayey sands. These materials should not be reused as engineered fill above the tiebacks. MDOT Class II sand is recommended above the tiebacks and in areas where drainage is required.

Based on information provided to us by Rowe, we understand the existing site soils are environmentally impacted. Further, we understand a Due Care plan was provided by AZT/Peerless (AZT) for the adjacent Uptown at Rivers Edge. If the work performed by AZT also includes the proposed marina, the recommendations presented in their Due Care plan should be implemented. If the existing Due Care plan does not include the marina, SME's environmental team would be pleased to assist in developing a plan for this project. Based on our experience with similar project sites, excess soils that cannot be reused on site will likely require landfilling.

## Seawalls

A conventional tied-back sheetpile system is recommended for the seawall. SME has provided a preliminary sheetpile design. Modifications to the design presented herein will likely be required based on site constraints, readily available materials, and several other factors. The design section presented herein and depicted on the attachments should serve as a typical section for bidding purposes. We generally recommend allowing contractors to provide alternates based on their proposed means and methods, provided the alternates meet the minimum requirements provided by SME. Additional information is included in the attached figures. Our design is based on the following:

1. A uniformly distributed load of 100 psf was assumed at the top of the wall for nominal traffic conditions.
2. The design finish grades along the top of the wall will be established at about elevation 586 feet. The dredge line will be established at about elevation 566 feet. Low water at elevation 576 feet was assumed.
3. The seawall shall consist of a hot-rolled PZ22 section or equivalent ( minimum section modulus of 18.1 cubic inches). Cold-rolled sections are not recommended for this project due to the risk of raveling of wall backfill between the joints. The seawall should extend a minimum of 33 feet below the final design site grades behind (inland from) the seawall ***and*** a minimum of 13 feet below the final dredge line. At the time this report was prepared, a "stick up" of two feet or less was possible at the top of the wall, with a conventional steel pile cap proposed. On this basis, 35-foot long sheetpile sections will be required.
4. A continuous deadman system is required. The deadman as shown assumes the same section as the seawall (PZ22). The top of the wall should be installed a minimum of 2.5 feet below the ground surface to reduce the formation of hardspots. The deadman length as shown assumes three deadman sheetpile sections can be manufactured in the field from the 35 foot long seawall sheets. (Each deadman is approximately 11'-8" in length.)

5. The deadman is located beyond the intersection of the passive and active failure planes at a distance of approximately 36 feet from the front face of the seawall. The deadman could be located closer to the seawall. However, longer deadman sheets will be required.
6. Engineered fill placed over the tiebacks should consist of well-draining granular fill (MDOT Class II sand), placed in level layers not exceeding 9 inches in loose thickness and compacted to a minimum of 95% of the maximum dry density, as determined by the Modified Proctor test.
7. Based on the borings, the sheetpile sections may be vibrated in place, following pre-excavation through the surficial dense-graded crushed limestone. Obstructions such as rip-rap, cobbles, boulders, below-grade utilities, etc. were not encountered at the boring locations. However, these materials could be encountered during construction, and driving shoes are recommended to reduce damage to the tip of the pile. The contractor should also have a pile hammer on site if dense/hard soils are encountered where the pile cannot be advanced with the vibratory hammer.

Design details are included with this letter report. Typical AutoCAD details and sections are also available for downloading and reuse through the manufacturer's websites. The web addresses of manufacturers who offer standard AutoCAD details are provided below:

http://www.arcelor.com/sheetpiling/
http://www.skylinesteel.com/
http://www2.lbfosterco.com/web/PilingDownLoad.nsf/Webframe?OpenFrameset
http://www.sheet-piling.com/

SME was asked to provide notes for inclusion on project plans. Please note our recommendations are limited to design and construction of the components of the seawall. Environmental protocol, means and methods, soil disposal, etc. have not been addressed by SME. The following notes should be included on the project plans:

1. Contractor may submit seawall system alternate, provided the minimum requirements are met. Alternates must be designed and sealed by a professional engineer registered in the State of Michigan.
2. The structure is designed to be self-supporting and stable after fully completed. It is the contractor's sole responsibility to determine means and methods, erection procedures, and sequence to ensure the safety of the structures and its component parts during construction. This may include but is not limited to the addition of temporary bracing, guys, or tiedowns, bracing excavations to prevent cave-ins, and cofferdams. Such materials shall remain the contractor's property and shall be removed after completion of the project.

3. Existing conditions and all related dimensions indicated in the contract documents shall be field verified prior to fabrication and installation. Conditions that differ from those indicated in the plans shall be submitted to the Engineer for review prior to fabrication and construction.
4. The project plans show the approximate placement and size of the structural components only. Do not scale from the plans.
5. Prior to fabrication and construction, the contractor shall submit shop drawings to the Engineer for review. Shop drawings should include an actual plan layout of seawall and deadman piles, including tieback and waler locations showing the locations of any utility penetrations. Section details shall be provided and shall include sheetpile lengths and waler, tieback and sheet pile specifications (steel grade, section modulus, unit width and depth, method of attachment, tieback diameter, nut/plate dimensions, etc.).
6. Steel design, fabrications, and erection to be in accordance with the latest AISC Specifications for Structural Steel.
7. All welded connections shall be in accordance with the latest AWS specifications, utilizing E70XX electrodes. Certified welders shall perform welding.
8. Deadman sections may be fabricated in the field from longer sheetpile sections.
9. Horizontal splicing of sheetpiles is prohibited.
10. Manufacturer-supplied driving tips shall be provided to reduce the risk of damage to the pile tip during driving operations.
11. Manufacturer-supplied corners shall be used. Field-manufactured corner sections are prohibited.
12. Contractor is responsible for pre-excavating through existing crushed limestone and any underlying obstructions, rip-rap, etc.
13. Damaged piles identified by the Engineer shall be removed and replaced.
14. An allowable offset of ±2 inches from the design face of seawall is allowed. Contractor is responsible for installing template beam or other method of ensuring plan alignment.
15. A vertical deviation of ±2 inches is allowed. Contractor is responsible for maintaining vertical alignment during pile driving operations.
16. Sheetpile sections shall conform to ASTM A-572 Grade 50 hot-rolled steel. Submit sheet pile mill certifications to Engineer for verification.
17. Walers shall conform to ASTM A-572 Grade 50 steel.
18. Structural bolts shall be A-325.
19. Tiebacks shall be manufactured by DYWIDAG Systems International (DSI) or Williams Form Engineering Corporation, and shall conform to ASTM A-722 Grade 150. Locking nuts, couplers, and other items associated with tiebacks shall be manufacturer-supplied.
20. Tiebacks and tieback connections shall include a method of corrosion protection recommended by the manufacturer. Galvanizing shall not be the sole method of

corrosion protection. Field-installed corrosion protection (mastic, tar, etc.) shall be applied per manufacturer's specifications.

21. Backfill sheetpile sections above the walers and tiebacks with MDOT Class II sand compacted to 95% of the maximum dry density as determined by the Modified Proctor determination.

22. Fill voids between the back side of the seawall and the existing bank with lightweight flowable fill below the waler. Fill shall not be placed until deadman and tiebacks are in place. Each lift of flowable fill shall not exceed 4 feet. Do not place additional lifts until lower lifts have sufficiently cured.

23. Engineered fill along the inland side of the seawall shall not be placed until all components of the seawall system have been installed.

24. To avoid overstressing the walls and damaging the seawall components, compaction within 5 feet of the seawall and within 2 feet of the tiebacks should be obtained with hand-operated equipment.

## Construction Considerations

A conventional tieback and deadman system is recommended for the seawall, and excavations will be required to allow for installation of tiebacks and walers. Excavations should be sloped in accordance with federal, state, and local safety regulations. Based on the predominantly granular site soils, a minimum slope of 1V:3H is recommended. Shallower slopes could be required where sloughing and caving of loose sands occurs, particularly in combination with perched groundwater. Equipment and materials should not be stockpiled at the top of the cut.

Groundwater levels were encountered at depths of 4 to 12 feet below the ground surface. Accumulations from precipitation events, surface run-off, or perched conditions may also be encountered. For these conditions, we anticipate standard sump pit and pumping procedures will be adequate to control these accumulations on a localized basis. In excavation areas where water accumulates, a working surface of crushed aggregate or crushed concrete can be placed to stabilize the subgrade and facilitate construction. In excavations that extend more than about 1 foot below the static groundwater level, multiple pumps in slotted casings should be anticipated for localized control of groundwater. Due to the clayey soils encountered near the ground surface, dewatering using wells or wellpoints is generally considered impractical. Such materials exhibit low permeability characteristics, and closely-spaced wells would be required.

The contractor should remove ponded or standing water from areas where water collects and prevent surface water runoff from reaching footing excavations or the prepared subgrade. Subgrade soils, which become disturbed, should be removed and replaced with engineered fill. Under adverse weather conditions, areas of exposed subgrade at the site may be protected by placement of crushed concrete or crushed aggregate on the exposed subgrade. In addition, the placement of footing concrete should be done as soon as footing excavations have been completed and approved to reduce the potential for disturbance of the footing subgrade.

## GENERAL COMMENTS

This report has been prepared in accordance with generally accepted geotechnical engineering practices to assist in the planning and design of this project. This report provides a basis of design for the proposed seawall, based on the subsurface information collected during this evaluation. Several wall configurations are feasible, and the plan provided should be considered a basis of design, with contractors allowed to submit seawall alternates.

Although not available at the time this report was prepared, site constraints may be such that the location of the deadman system is not feasible. If the deadman is located closer to the face of the seawall, longer sheetpile sections will be required. Therefore, this report should not be used solely for the final design. If the project design criteria are changed, the conclusions and recommendations contained in this preliminary report are not considered valid unless the changes are reviewed, and the conclusions of this report (including the seawall design) are modified or approved in writing by our office.

The discussions and recommendations submitted in this report are based on the available project information, described in this report, and the data obtained from the three borings performed at the approximate locations indicated on the Boring Location Diagram. Variations in the soil conditions commonly occur between or away from the borings. The nature and extent of the variations may not become evident until the time of construction. If significant variations are observed during construction, SME should be contacted to reevaluate the recommendations of this report. SME should be retained to continue our services through construction to observe and evaluate the conditions relative to the recommendations made in this report.

In the process of obtaining and testing samples and preparing this report, procedures are followed that represent reasonable and accepted practice in the field of soil and foundation engineering. Specifically, field logs are prepared during the drilling and sampling operations that describe field occurrences, sampling locations, and other information. Samples obtained in the field are frequently subjected to additional testing and reclassification in the laboratory and differences may exist between the field logs and the report logs. The engineer preparing the report reviews the field logs, laboratory classifications, and test data and then prepares the report logs. Our recommendations are based on the contents of the report logs, and the information contained therein.

This report and any future addenda or reports regarding this site should be made available to bidders prior to submitting their proposals for their information only and to supply them with facts relative to the subsurface evaluation and laboratory test results. If the contractor encounters conditions during construction, which differ from those presented in this report, the contractor should promptly notify the owner so that the geotechnical engineer can be contacted to verify those conditions. We recommend the contractor describe the nature and extent of the differing conditions in writing. We also recommend the construction contract include provisions for dealing with differing conditions and contingency funds should be reserved for potential problems during earthwork and foundation construction. We would be pleased to assist you in developing the contract provisions based on our experience.

Furthermore, **based on our review of the project documents provided, the existing site soils are environmentally impacted.** The contractor should be prepared to handle environmental conditions encountered at this site, which may affect the excavation, removal, or disposal of soil, dewatering of excavations, and health and safety of workers. Any environmental assessment reports, Due Care plans, etc. prepared for this property should be made available for review by bidders and the successful contractor.

This report has been prepared solely for the use of the client for the project specifically described in this report. This report cannot be relied upon by other parties not involved in the project, described in this report, unless specifically allowed by SME in writing. If this report is used by parties other than our original Client and those associated with their project, SME is not responsible for the suitability of the field exploration, scope of services or recommendations made, for the new project. SME also is not responsible for the interpretation of our boring logs and the recommendations provided herein by other parties.

SME will evaluate this report for other parties and developments at this site, provided our original Client agrees to release this information in writing. However, before this report can be relied upon by other parties, SME must review the proposed development since the new project will likely require additional field exploration, laboratory tests, analysis and modifications to our recommendations to adequately address the needs of the new project.

We appreciate this opportunity to be of service. If you have questions or require additional information regarding our preliminary evaluation, please contact us.

Very truly yours,

**SOIL AND MATERIALS ENGINEERS, INC.**

Laurel M Johnson

Laurel M. Johnson, PE
Senior Project Engineer

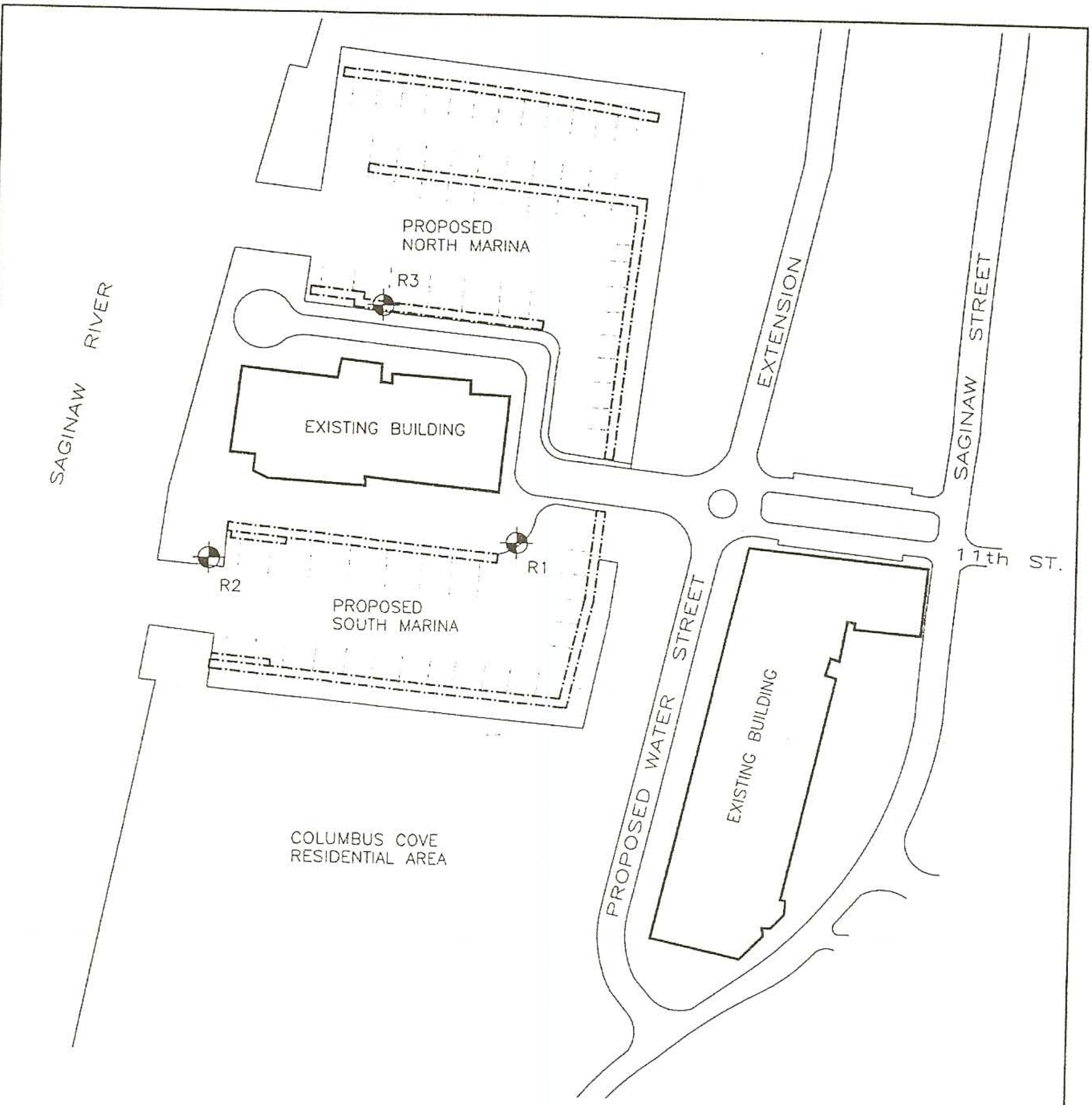
Timothy H. Bedenis

Timothy H. Bedenis, PE
Principal Consultant

Attachments: Important Information About Your Geotechnical Engineering Report
Boring Location Diagram
General Notes
Unified Soil Classification System (USCS)
Boring Logs (R1 through R3)
Design Details (Fig. 1 through Fig. 4)

Enclosures: One original

Distribution: Mr. J. William Coberly, CIT – SME Bay City (one original)




Nov 14, 2006 - 10:20am - ALEJANDR

**LEGEND**

⊕ APPROXIMATE BORING LOCATION

**NOTE:**

DRAWING INFORMATION TAKEN FROM A CONCEPTUAL LAYOUT PLAN BY UDA PROVIDED BY ROWE INC. DATED MAY 2004.

| | | | |
|---|---|---|---|
| sme<br>43980 PLYMOUTH OAKS BOULEVARD<br>PLYMOUTH, MICHIGAN 48170<br>(734) 454-9900 | BAY CITY<br>GRAND RAPIDS<br>KALAMAZOO<br>LANSING<br>PLYMOUTH<br>SHELBY TWP.<br>TOLEDO<br>TRAVERSE CITY | DATE 11-14-06<br>DRAWN BY MBA<br>SCALE 1" = 200'<br>JOB BG 54204 | BORING LOCATION DIAGRAM<br>PROPOSED UPTOWN MARINA<br>BAY CITY, MICHIGAN |

S:\54000\BG54204\54204.dwg

Figure No. 1

# Important Information About Your

# Geotechnical Engineering Report

**Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.**

**The following information is provided to help you manage your risks.**

## Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

## Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

## A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

## Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

## Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

## A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

## A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

## Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

## Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

## Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

## Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

## Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

## Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.

ASFE
The Best People on Earth

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@asfe.org www.asfe.org

soil and materials
engineers, inc.

# general notes

## Drilling and Sampling Symbols

SS - Split-Spoon-1 3/8" I.D., 2" O.D. except where noted
LS - Liner Sample
AS - Power Auger Sample
ST - Shelby Tube-2" O.D., except where noted
PS - Piston Sample-3" diameter
WS - Wash Sample
HA - Hand Auger Sample
BS - Bag or Bottle Sample
CS - Continuous Sampler

NR - No Recovery
RC - Rock Core with diamond bit. NX size, except where noted
RB - Rock Bit
VS - Vane Shear
PM - Pressuremeter

GP - Geoprobe
PID - Photo Ionization Device
FID - Flame Ionization Device

Standard Penetration 'N' - Blows per foot of a 140 pound hammer falling 30 inches on a 2 inch O.D. split spoon, except where noted (based on ASTM D1586).

## Particle Sizes

| | | |
|---|---|---|
| Boulders | - | Greater than 12 inches (305 mm) |
| Cobbles | - | 3 inches (76.2 mm) to 12 inches (305 mm) |
| Gravel-Coarse | - | 3/4 inches (19.05 mm) to 3 inches (76.2 mm) |
| Fine | - | No. 4 (4.75 mm) to 3/4 inches (19.05 mm) |
| Sand-Coarse | - | No. 10 (2.00 mm) to No. 4 (4.75 mm) |
| Medium | - | No. 40 (0.425 mm) to No. 10 (2.00 mm) |
| Fine | - | No. 200 (0.074 mm) to No. 40 (0.425 mm) |
| Silt | - | (0.005 mm) to (0.074 mm) |
| Clay | - | Less than (0.005 mm) |

## Depositional Features

| | | |
|---|---|---|
| Parting | - | as much as 1/16 inch (1.6 mm) thick |
| Seam | - | 1/16 inch (1.6 mm) to 1/2 inch (12.7 mm) thick |
| Layer | - | 1/2 inch (12.7 mm) to 12 (305 mm) inch thick |
| Stratum | - | greater than 12 inches (305 mm) thick |
| Pocket | - | small, erratic deposit of limited lateral extent |
| Lens | - | lenticular deposit |
| Varved | - | alternating seams or layers of silt and/or clay and sometimes fine sand |
| Occasional | - | one or less per foot (305 mm) of thickness |
| Frequent | - | more than one per foot (305 mm) of thickness |
| Interbedded | - | applied to strata of soil or beds of rock lying between or alternating with other strata of a different nature |

Groundwater levels indicated on the boring logs are the levels measured in the boring at times indicated. The accurate determination of groundwater levels may not be possible with short term observations especially in low permeability soils. The groundwater levels shown may fluctuate throughout the year with variation in precipitation, evaporation, and runoff.

## Classification

### Cohesionless Soils (Blows per foot or 0.3m)

| | | |
|---|---|---|
| Very Loose | : | 0 to 4 |
| Loose | : | 5 to 9 |
| Medium Dense | : | 10 to 29 |
| Dense | : | 30 to 49 |
| Very Dense | : | 50 to 80 |
| Extremely Dense | : | Over 80 |

### Cohesive Soils

| Consistency | | Shear Strength |
|---|---|---|
| Very Soft | : | 0.25 kips/ft² (12.0 kPa) or less |
| Soft | : | 0.25 to 0.49 kips/ft² (12.0 to 23.8 kPa) |
| Medium | : | 0.50 to 0.99 kips/ft² (23.9 to 47.7 kPa) |
| Stiff | : | 1.00 to 1.99 kips/ft² (47.8 to 95.6 kPa) |
| Very Stiff | : | 2.00 to 3.99 kips/ft² (95.7 to 191.3 kPa) |
| Hard | : | 4.00 kips/ft² (191.4 kPa) or greater |

### Soil Constituents

| | | |
|---|---|---|
| Trace | : | Less than 5% |
| Trace to Some | : | 5% to 12% |
| Some | : | 12% to 25% |
| Use Descriptor (i.e., Silty, Clayey, etc.) | : | 25% to 50% |

### Soil Description

If clay content sufficiently dominates soil properties, then clay becomes the primary noun with the other major soil constituent as modifier : i.e. silt clay. Other minor soil constituents may be added according to estimates o soil constituents present, i.e., silty clay, trace to some sand, trace gravel.

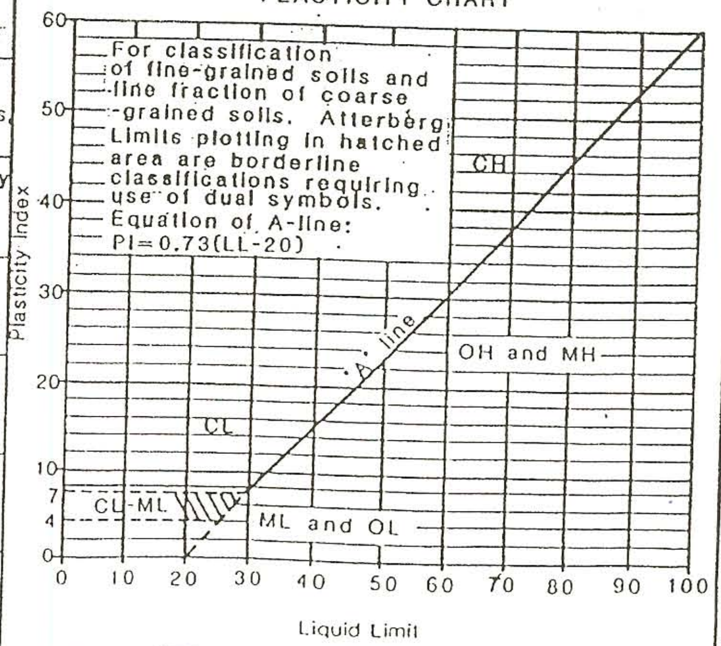
sme

soil and materials engineers, inc

# unified soil classification system

| Major divisions | | | Group symbols | | Typical names | Laboratory classification criteria | | |
|---|---|---|---|---|---|---|---|---|
| Coarse-grained soils (More than half of material is larger than No. 200 sieve size) | Gravels (More than half of coarse fraction larger than No. 4 sieve size) | Clean gravels (Little or no fines) | GW | | Well-graded gravels, gravel-sand mixtures, little or no fines | Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows: Less than 5% . . . GW,GP,SW,SP; More than 12% . . . GM,GC,SM,SC; 5 to 12% . . . Borderline cases requiring dual symbols | $C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D\ )^2}{D_{10} \times 60}$ between 1 and 3 | |
| | | | GP | | Poorly graded gravels, gravel-sand mixtures, little or no fines | | Not meeting all gradation requirements for GW | |
| | | Gravels with fines (Appreciable amount of fines) | GM | d | Silty gravels, gravel-sand-silt mixtures | | Atterberg limits below "A" line or P.I. less than 4 | Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols |
| | | | | u | | | | |
| | | | GC | | Clayey gravels, gravel-sand-clay mixtures | | Atterberg limits above "A" line with P.I. greater than 7 | |
| | Sands (More than half of coarse fraction is smaller than No. 4 sieve size) | Clean sands (Little or no fines) | SW | | Well-graded sands, gravelly sands, little or no fines | | $C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3 | |
| | | | SP | | Poorly graded sands, gravelly sands, little or no fines | | Not meeting all gradation requirements for SW | |
| | | Sands with fines (Appreciable amount of fines) | SM | d | Silty sands, sand-silt mixtures | | Atterberg limits below "A" line or P.I. less than 4 | Limits plotting in hatched zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols |
| | | | | u | | | | |
| | | | SC | | Clayey sands, sand-clay mixtures | | Atterberg limits above "A" line with P.I. greater than 7 | |
| Fine-grained soils (More than half of material is smaller than No. 200 sieve) | Silts and clays (Liquid limit less than 50) | | ML | | Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity | PLASTICITY CHART (see below) | | |
| | | | CL | | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays | | | |
| | | | OL | | Organic silts and organic silty clays of low plasticity | | | |
| | Silts and clays (Liquid limit greater than 50) | | MH | | Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts | | | |
| | | | CH | | Inorganic clays of high plasticity, fat clays | | | |
| | | | OH | | Organic clays of medium to high plasticity, organic silts | | | |
| | Highly organic soils | | Pt | | Peat and other highly organic soils | | | |

PLASTICITY CHART



# soil and materials engineers, inc.

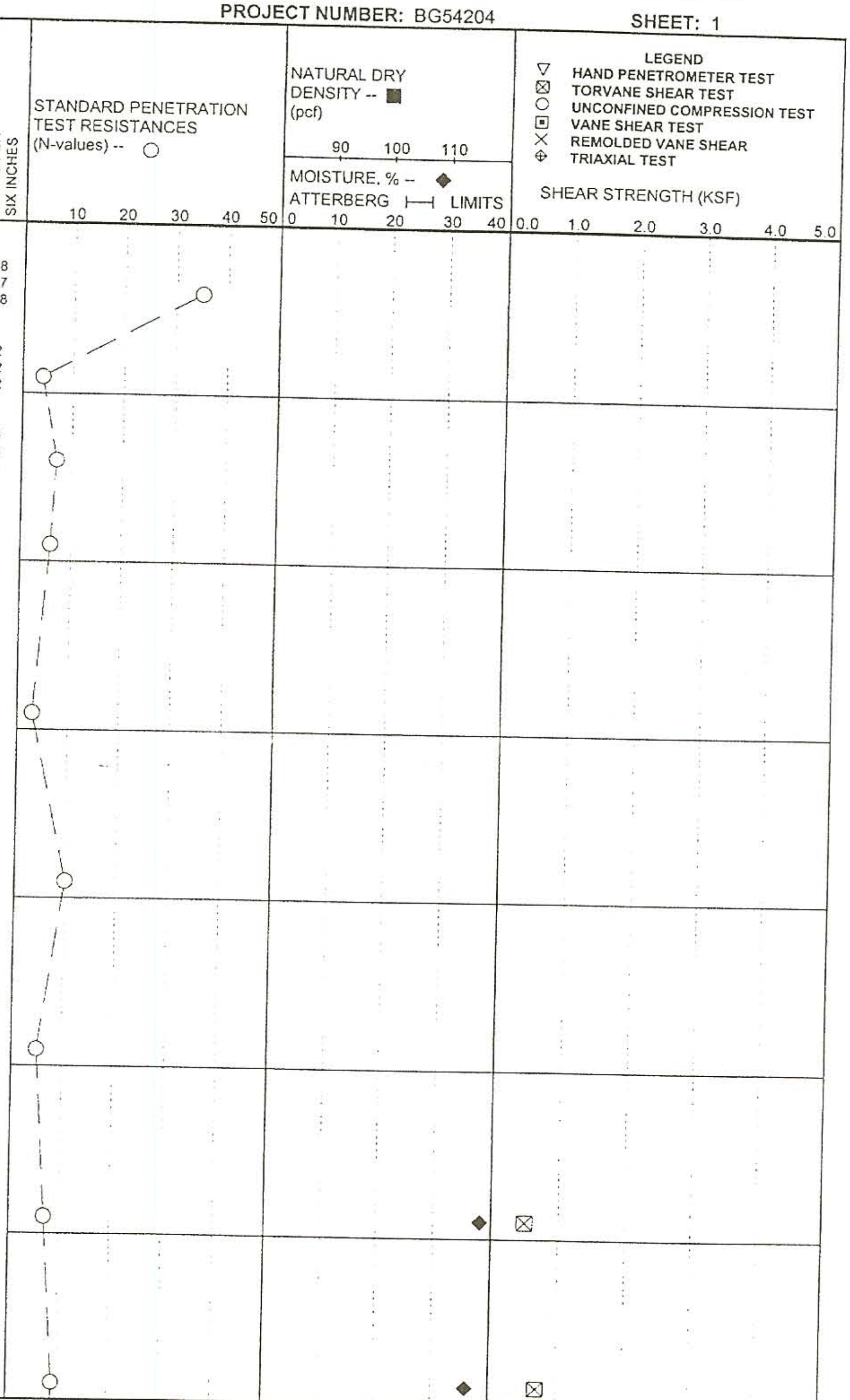
PROJECT NAME: UPTOWN MARINA
PROJECT LOCATION: BAY CITY, MICHIGAN
CLIENT: ROWE INCORPORATED

A/E: ROWE INCORPORATED
BY: JLN DATE: 11/1/06
PROJECT NUMBER: BG54204

BORING R1
SHEET: 1

EASTING:
NORTHING:
GROUND SURFACE ELEVATION= 589±

| DEPTH (FEET) | PROFILE DESCRIPTION | SAMPLE TYPE/NUMBER INTERVAL | BLOWS PER SIX INCHES |
|---|---|---|---|
| 0 | Crushed Limestone Fill (GP/Fill) | SS1 | 18 17 18 |
| | Clayey Sand- Trace to Some Organics, Foundry Sand and Slag- Trace Silt and Gravel- Black- Moist- Very Loose (SC/Fill) | SS2 | 2 2 2 |
| 5 | Fine to Medium Sand- Trace to Some Silt- Trace Clay and Gravel- Brown- Moist- Loose (SP-SM/Fill) | SS3 | 3 3 4 |
| 10 | Clayey Sand- Some Silt- Trace to Some Organics, Wood and Shell Fragments- Frequent Organic Clayey Silt Seams and Layers- Dark Gray/Black- Moist to Wet- Loose (SP-SC/Fill) | SS4 | 1 2 4 |
| 15 | Fine to Medium Sand- Trace to Some Clay and Silt- Trace Organics and Root Fibers- Trace Shell Fragments- Dark Gray/ Black- Wet- Very Loose to Medium Dense (SP-SC/Fill) | SS5 | 2 1 2 |
| 20 | | SS6 | 4 5 5 |
| 25 | Silty Clay - Trace to Some Organics- Trace Fine Sand and Shell Fragments- Gray- Medium (CL-OL) | SS7 | 2 2 3 |
| 30 | | SS8 | 3 3 4 |
| 35 | | SS9 | 4 5 4 |




WATER LEVEL OBSERVATIONS
- GROUNDWATER ENCOUNTERED DURING DRILLING
- GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

Notes: SOIL BORING LOCATED AT N43 35454 AND W83 53547

DRILLER: SME-JR DRILL METHOD:
RIG NO.: 34 BACKFILL METHOD:

WATER LEVEL DURING DRILLING: 11 FT
WATER LEVEL UPON COMPLETION: 10 FT
WATER LEVEL HOURS AFTER COMPLETION:
CAVE OF BOREHOLE AT

# soil and materials engineers, inc.

PROJECT NAME: UPTOWN MARINA
PROJECT LOCATION: BAY CITY, MICHIGAN
CLIENT: ROWE INCORPORATED

A/E: ROWE INCORPORATED
BY: JLN DATE: 11/1/06
PROJECT NUMBER: BG54204

BORING R1
SHEET: 2

EASTING:
NORTHING:
GROUND SURFACE ELEVATION= 589±

| DEPTH (FEET) | PROFILE DESCRIPTION | SAMPLE TYPE/NUMBER INTERVAL | BLOWS PER SIX INCHES |
|---|---|---|---|
| 35–47 | Silty Clay- Trace to Some Organics- Trace Fine Sand and Shell Fragments- Gray- Medium (CL-OL) | SS10 | 4 4 4 |
| 47–50 | Silty Clay- Trace to Some Fine Sand- Trace Gravel- Gray- Very Stiff (CL) | SS11 | 8 7 10 |
| | | SS12 | 13 14 16 |
| 50 | END OF BORING AT 50 FEET | | |

STANDARD PENETRATION TEST RESISTANCES (N-values) -- ○ (10, 20, 30, 40, 50)

NATURAL DRY DENSITY -- (pcf) ■ (90, 100, 110)

MOISTURE, % -- ◆
ATTERBERG ├─┤ LIMITS (0, 10, 20, 30, 40)

LEGEND
▽ HAND PENETROMETER TEST
⊠ TORVANE SHEAR TEST
○ UNCONFINED COMPRESSION TEST
⊡ VANE SHEAR TEST
× REMOLDED VANE SHEAR
⊕ TRIAXIAL TEST

SHEAR STRENGTH (KSF) (0.0, 1.0, 2.0, 3.0, 4.0, 5.0)

Depth scale: 35, 40, 45, 50, 55, 60, 65, 70

WATER LEVEL OBSERVATIONS
GROUNDWATER ENCOUNTERED DURING DRILLING
GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

Notes: SOIL BORING LOCATED AT N43.35454 AND W83.53547

DRILLER: SME-JR
RIG NO.: 34
DRILL METHOD:
BACKFILL METHOD:
WATER LEVEL DURING DRILLING: 11 FT
WATER LEVEL UPON COMPLETION: 10 FT
WATER LEVEL HOURS AFTER COMPLETION:
CAVE OF BOREHOLE AT

# soil and materials engineers, inc.

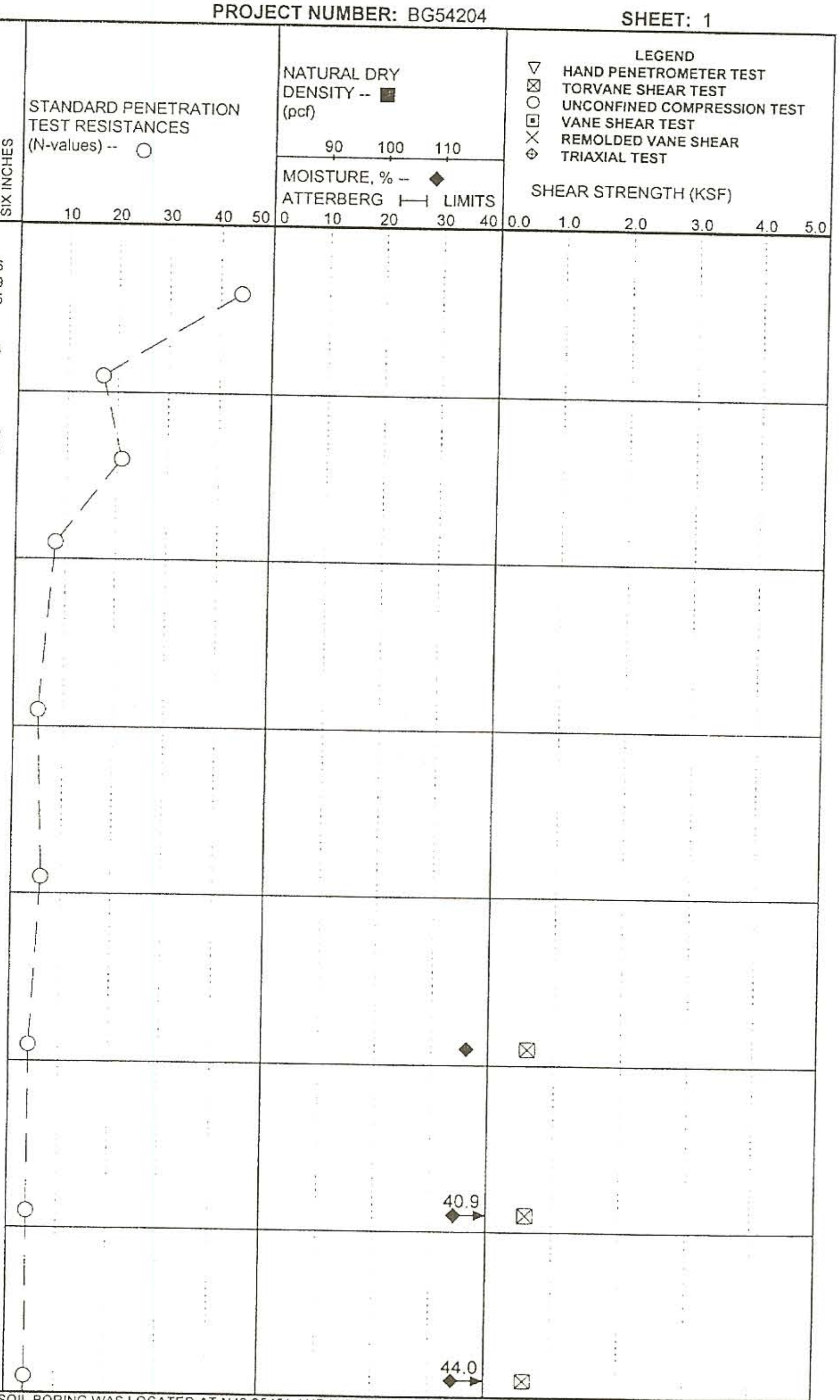
PROJECT NAME: UPTOWN MARINA
PROJECT LOCATION: BAY CITY, MICHIGAN
CLIENT: ROWE INCORPORATED

A/E: ROWE INCORPORATED
BY: JLN DATE: 10/31/06
PROJECT NUMBER: BG54204

BORING R2
SHEET: 1

EASTING:
NORTHING:
GROUND SURFACE ELEVATION= 587±

| DEPTH (FEET) | PROFILE DESCRIPTION | SAMPLE TYPE/NUMBER INTERVAL | BLOWS PER SIX INCHES |
|---|---|---|---|
| 0 | Crushed Limestone Fill (GP/Fill) | SS1 | 26 19 25 |
| 5 | Clayey Sand- Trace to Some Organics, Foundry Sand and Slag- Trace Silt and Gravel- Black- Moist to Wet- Medium Dense to Loose (SC/Fill) | SS2 | 14 8 9 |
| | | SS3 | 10 10 11 |
| 10 | | SS4 | 3 4 4 |
| 15 | | SS5 | 1 2 3 |
| 20 | | SS6 | 2 3 3 |
| 25 | Silty Clay- Trace to Some Organics- Trace Fine Sand and Shell Fragments- Gray- Medium (CL-OL) | SS7 | 2 2 2 |
| 30 | | SS8 | 3 2 2 |
| 35 | | SS9 | 2 2 2 |




WATER LEVEL OBSERVATIONS
- ▼ GROUNDWATER ENCOUNTERED DURING DRILLING
- ▽ GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

Notes: SOIL BORING WAS LOCATED AT N43 35451 AND W83 53646

DRILLER: SME-JR
RIG NO.: 34
DRILL METHOD:
BACKFILL METHOD:
WATER LEVEL DURING DRILLING: 8 FT
WATER LEVEL UPON COMPLETION: 13 FT
WATER LEVEL HOURS AFTER COMPLETION:
CAVE OF BOREHOLE AT

# soil and materials engineers, inc.

**PROJECT NAME:** UPTOWN MARINA
**PROJECT LOCATION:** BAY CITY, MICHIGAN
**CLIENT:** ROWE INCORPORATED

**A/E:** ROWE INCORPORATED
**BY:** JLN **DATE:** 10/31/06
**PROJECT NUMBER:** BG54204

**BORING** R2
**SHEET:** 2

EASTING:
NORTHING:
GROUND SURFACE ELEVATION= 587±

STANDARD PENETRATION TEST RESISTANCES (N-values) -- ○ (10, 20, 30, 40, 50)

NATURAL DRY DENSITY -- (pcf) ■ (90, 100, 110)

MOISTURE, % -- ◆
ATTERBERG ├─┤ LIMITS (0, 10, 20, 30, 40)

LEGEND
▽ HAND PENETROMETER TEST
⊠ TORVANE SHEAR TEST
○ UNCONFINED COMPRESSION TEST
⊡ VANE SHEAR TEST
✕ REMOLDED VANE SHEAR
⊕ TRIAXIAL TEST

SHEAR STRENGTH (KSF) (0.0, 1.0, 2.0, 3.0, 4.0, 5.0)

| DEPTH (FEET) | PROFILE DESCRIPTION | SAMPLE TYPE/NUMBER INTERVAL | BLOWS PER SIX INCHES |
|---|---|---|---|
| 35–47 | Silty Clay- Trace to Some Organics- Trace Fine Sand and Shell Fragments- Gray- Medium (CL-OL) | SS10 | 2 1 2 |
| | | SS11 | 2 2 2 |
| 47–50 | Fine to Coarse Sand- Trace Silt and Gravel- Brown- Wet- Medium Dense (SP) | SS12 | 6 7 7 |
| 50 | END OF BORING AT 50 FEET | | |

43.4

WATER LEVEL OBSERVATIONS
GROUNDWATER ENCOUNTERED DURING DRILLING
GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

Notes: SOIL BORING WAS LOCATED AT N43 35451 AND W83 53646

DRILLER: SME-JR
RIG NO.: 34
DRILL METHOD:
BACKFILL METHOD:
WATER LEVEL DURING DRILLING: 8 FT
WATER LEVEL UPON COMPLETION: 13 FT
WATER LEVEL HOURS AFTER COMPLETION:
CAVE OF BOREHOLE AT

soil and materials engineers, inc.

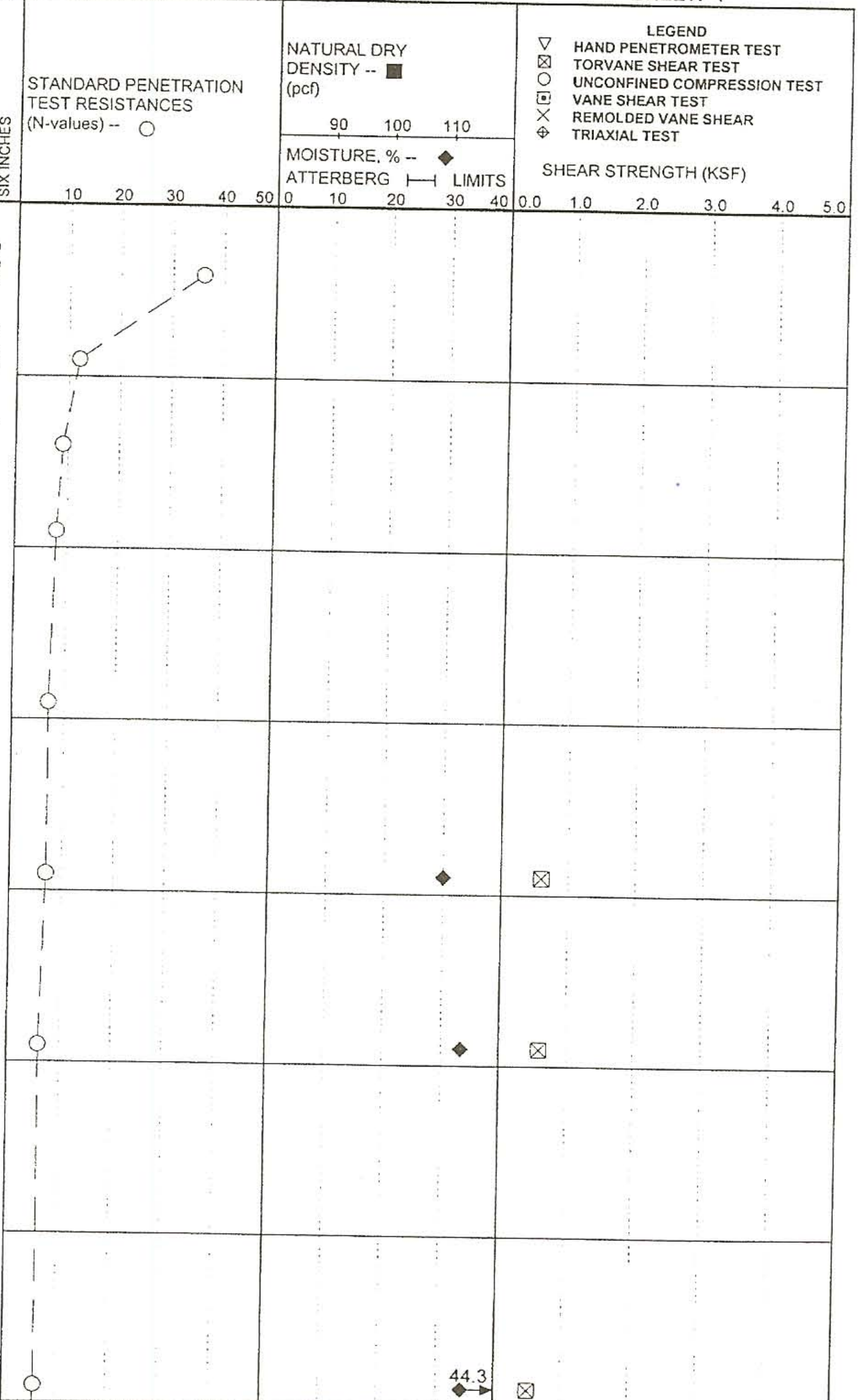
PROJECT NAME: UPTOWN MARINA
PROJECT LOCATION: BAY CITY, MICHIGAN
CLIENT: ROWE INCORPORATED

A/E: ROWE INCORPORATED
BY: JLN DATE: 10/31/06
PROJECT NUMBER: BG54204

BORING R3
SHEET: 1

EASTING:
NORTHING:
GROUND SURFACE ELEVATION= 583±

| DEPTH (FEET) | PROFILE DESCRIPTION | SAMPLE TYPE/NUMBER INTERVAL | BLOWS PER SIX INCHES |
|---|---|---|---|
| 0 | Crushed Limestone Fill (GP/Fill) | SS1 | 10 19 17 |
| 5 | Clayey Sand- Trace to Some Organics, Foundry Sand and Slag- Trace Silt and Gravel- Black- Moist to Wet- Medium Dense to Loose (SC/Fill) | SS2 | 5 6 6 |
| | | SS3 | 3 4 5 |
| 10 | | SS4 | 2 4 4 |
| 15 | | SS5 | 2 4 4 |
| 20 | Silty Clay- Trace to Some Organics- Trace Fine Sand and Shell Fragments- Gray- Medium (CL-OL) | SS6 | 3 4 3 |
| 25 | | SS7 | 3 4 3 |
| 30 | | SS8 | 2 3 3 |
| 35 | | SS9 | WH |




WATER LEVEL OBSERVATIONS
- ▼ GROUNDWATER ENCOUNTERED DURING DRILLING
- ▽ GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

Notes: SOIL BORING LOCATED AT N43.35514 AND W83.53588

DRILLER: SME-JR DRILL METHOD:
RIG NO.: 34 BACKFILL METHOD:

WATER LEVEL DURING DRILLING: 4 FT
WATER LEVEL UPON COMPLETION: 12 FT
WATER LEVEL HOURS AFTER COMPLETION:
CAVE OF BOREHOLE AT

# soil and materials engineers, inc.

PROJECT NAME: UPTOWN MARINA
PROJECT LOCATION: BAY CITY, MICHIGAN
CLIENT: ROWE INCORPORATED

A/E: ROWE INCORPORATED
BY: JLN DATE: 10/31/06
PROJECT NUMBER: BG54204

BORING R3
SHEET: 2

EASTING:
NORTHING:
GROUND SURFACE ELEVATION= 583±

LEGEND:
▽ HAND PENETROMETER TEST
⊠ TORVANE SHEAR TEST
○ UNCONFINED COMPRESSION TEST
▣ VANE SHEAR TEST
X REMOLDED VANE SHEAR
⊕ TRIAXIAL TEST

STANDARD PENETRATION TEST RESISTANCES (N-values) -- ○
NATURAL DRY DENSITY -- ■ (pcf) 90 100 110
MOISTURE, % -- ◆
ATTERBERG ├─┤ LIMITS
SHEAR STRENGTH (KSF)

| DEPTH (FEET) | PROFILE DESCRIPTION | SAMPLE TYPE/NUMBER INTERVAL | BLOWS PER SIX INCHES | MOISTURE, % | SHEAR STRENGTH TEST |
|---|---|---|---|---|---|
| 35–50 | Silty Clay- Trace to Some Organics- Trace Fine Sand and Shell Fragments- Gray- Medium (Cl-OL) | | | | |
| 40 | | SS10 | 3 3 3 | 42.8 | ⊠ |
| 45 | | SS11 | 2 3 2 | 41.4 | ▽ |
| 50 | | SS12 | 2 3 3 | 45.0 | ⊠ |
| 50 | END OF BORING AT 50 FEET | | | | |

WATER LEVEL OBSERVATIONS
- GROUNDWATER ENCOUNTERED DURING DRILLING
- GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

Notes: SOIL BORING LOCATED AT N43 35514 AND W83 53588

DRILLER: SME-JR
RIG NO.: 34
DRILL METHOD:
BACKFILL METHOD:
WATER LEVEL DURING DRILLING: 4 FT
WATER LEVEL UPON COMPLETION: 12 FT
WATER LEVEL HOURS AFTER COMPLETION:
CAVE OF BOREHOLE AT

Soil and Materials Engineers, Inc.

CLIENT: UPTOWN MARINA

FILE NUMBER: 8654204

DATE: 3/29/07

PROJECT: PLAN VIEWS / NOTES

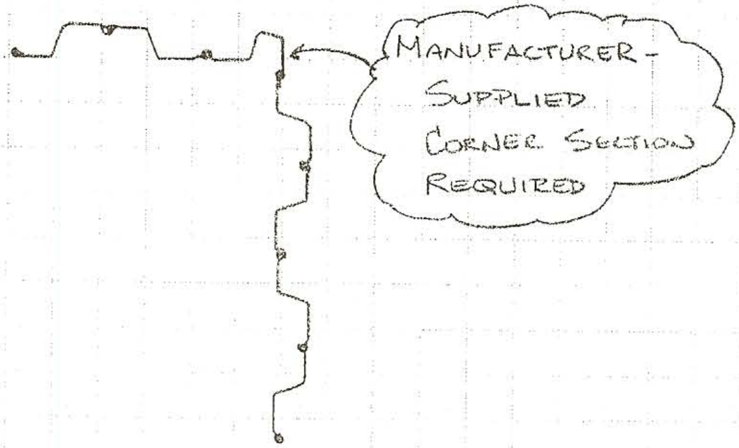
COMPUTED BY: LMJ

CHECKED BY: THB

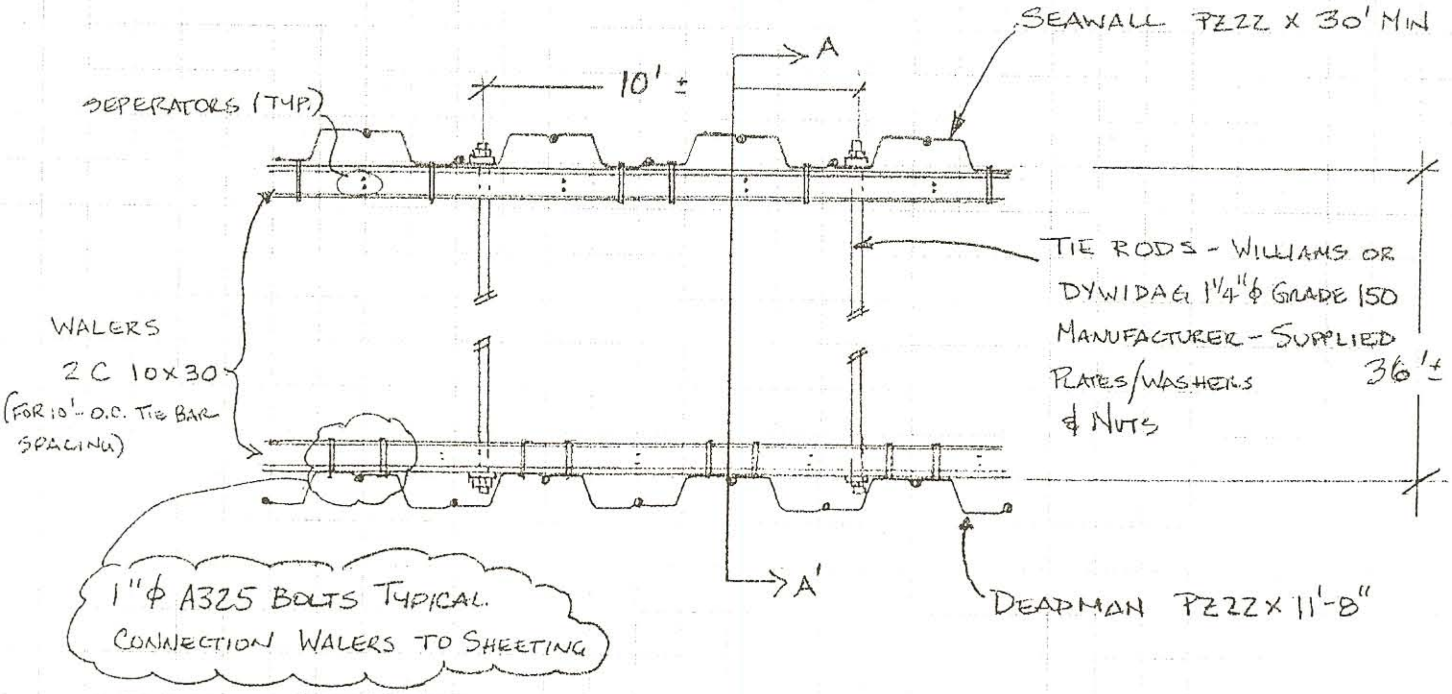
SUBMITTED DETAILS

FIG. 1

1) TYPICAL CORNER (NTS) NOTE: AUTOCAD DETAILS AVAILABLE FOR DOWNLOAD FROM SKYLINE STEEL, ARCELOR, OTHERS




2.) TYPICAL PLAN VIEW (NTS)



Soil and Materials Engineers, Inc.

CLIENT: UPTOWN MARINA

PROJECT: SECTION A-A'

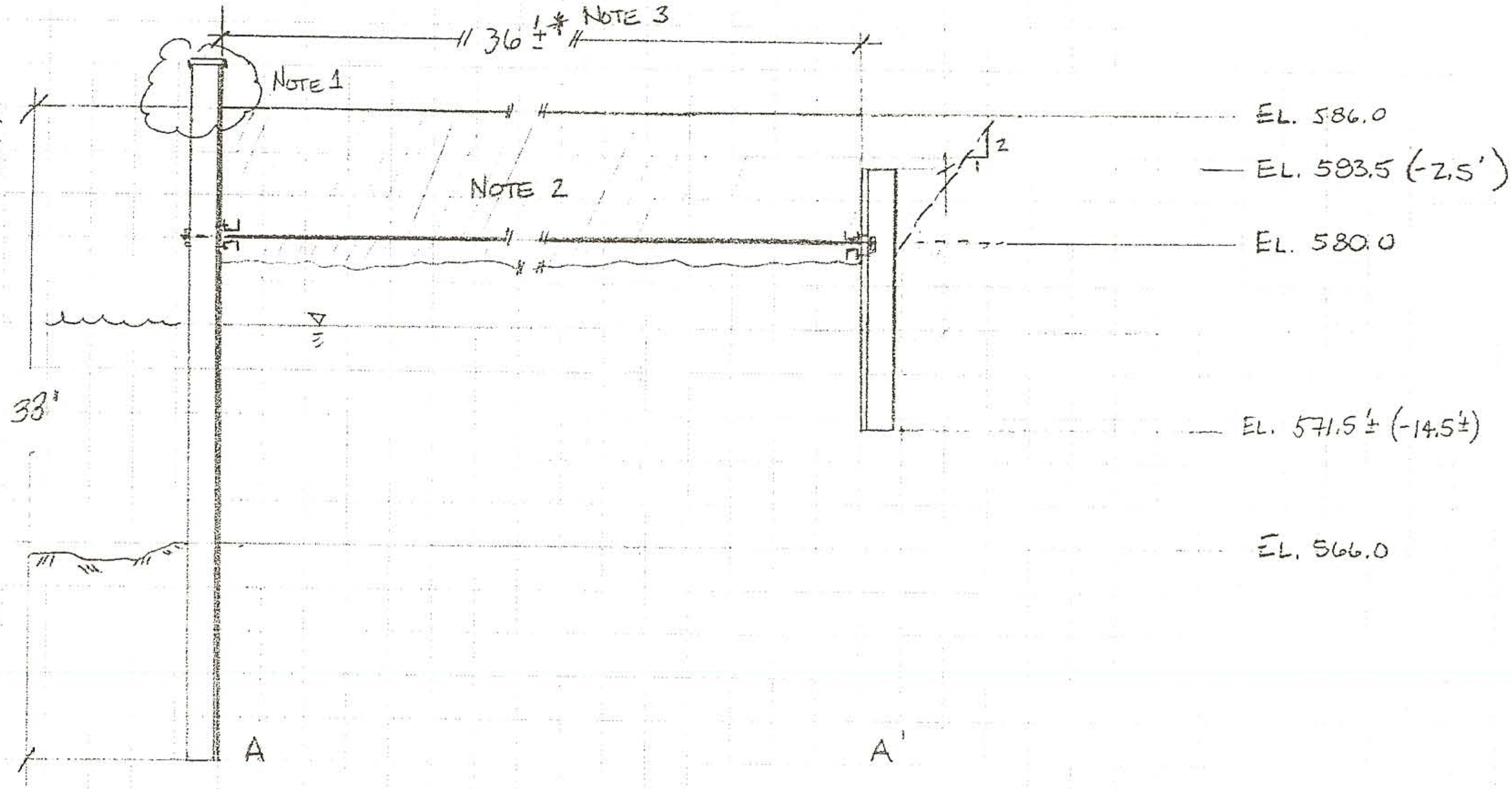
FILE NUMBER: BG54204

DATE: 3/29/07

COMPUTED BY: LMJ

CHECKED BY: THB

FIG. 2.




NOTE 1: ADD STICK-UP TO SEAWALL PILE LENGTH. WALL AS SHOWN IS CAPPED W/ STEEL CAP

NOTE 2: ENGINEERED FILL ABOVE AND BEDDING BELOW TIE RODS SHALL MEET THE REQUIREMENTS OF MDOT CLASS II, COMPACTED TO 95% OF THE MAXIMUM DRY DENSITY AS DETERMINED BY THE MODIFIED PROCTOR TEST.

NOTE 3: IF DEADMAN IS LOCATED AT A DISTANCE OF LESS THAN 36 FEET FROM THE BACK OF THE WALL, A LONGER SECTION WILL BE REQUIRED

VERT. SCALE 1/8" = 1'
HORIZ SCALE 1/4" = 1'

FIG. 3



DSI

## DYWIDAG Tie Rod System

The construction of heavy marine bulkheads for various docking facilities have, for many years, benefited from the use of Dywidag Tie Rods. Facilities such as barge and ship docks as well as offshore service bases have found the system to be a cost effective alternative to large diameter A36 tie rods with upset threads and turnbuckles.

The advantages of the Dywidag tie rod system are:

### Ease of Installation

The continuous rolled on threads provide contractors much more flexibility in selecting methods of installation. The rugged, self cleaning threads virtually eliminate assembly problems which result from damaged or dirty machine manufactured threads. THREADBARS® can be ordered slightly longer than necessary to accommodate the minor misalignments which normally occur during installation of sheet piling. They can easily be cut to the desired length eliminating the need to cut and re-weld upset rods to accommodate length changes.

The continuously threaded coupler makes it possible to join bar ends together simply by rolling the coupler from one bar onto the other eliminating the need to struggle with heavy turnbuckles. Proper coupler engagement is easily verified by measurement.

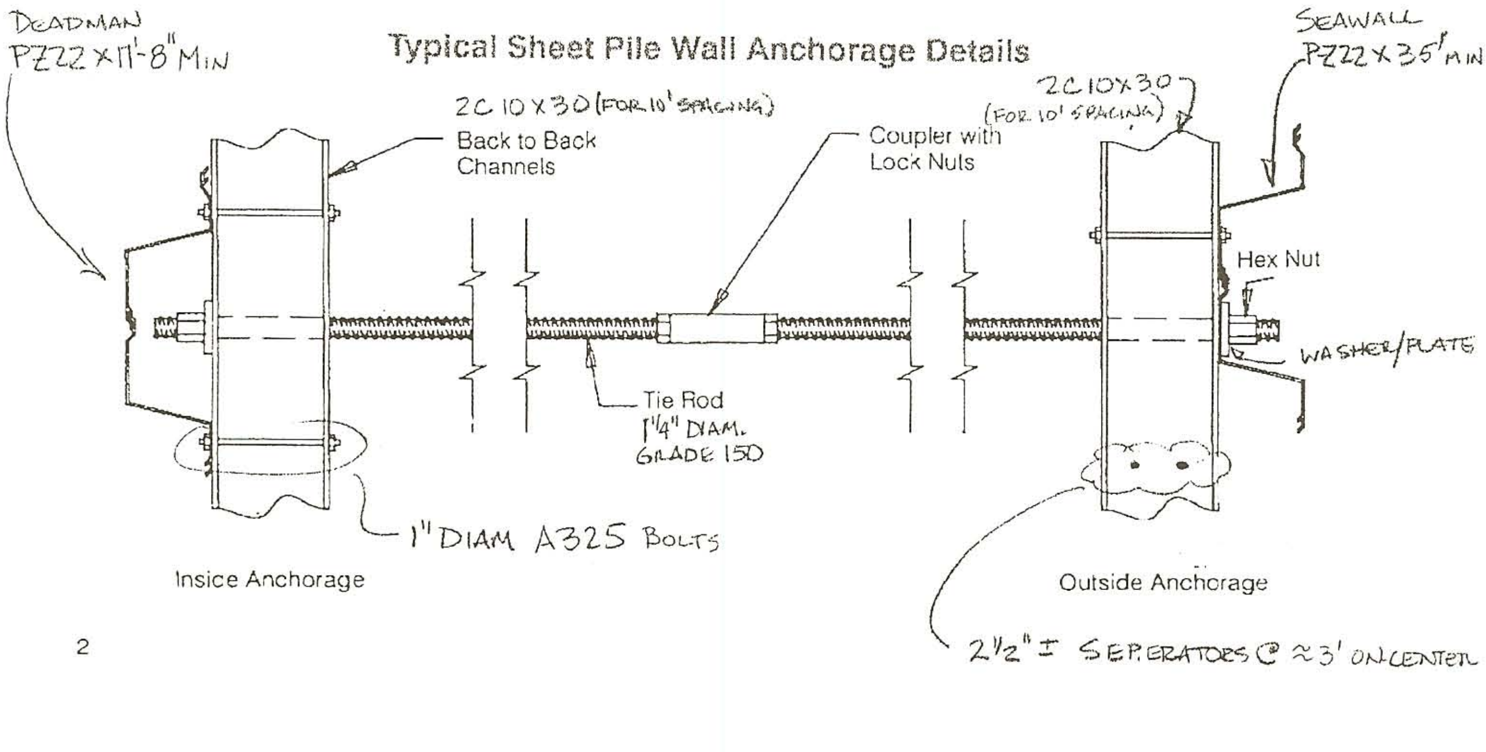
### Lower Cost

The ease and flexibility of installation which the system offers to the contractor is reflected in lower installed costs. Material costs for threadbars are normally less than for upset rods.

### Performance

The high strength to weight ratio together with the elimination of strength loss due to threading allow design engineers to specify a more efficient product. Anchor nuts and couplers for Dywidag reinforcing steel threadbars, develop 100% of the nominal ultimate strength of the bar.

### Typical Sheet Pile Wall Anchorage Details



**sme**

Soil and Materials Engineers, Inc.

CLIE[illegible] [illegible]PTOWN MARINA

PROJECT WALER DETAIL

FILE NUMBER B6454204

DATE 3/29/07

COMPUTED BY LMJ

CHECKED BY THB

FIG. 4