Preliminary Geotechnical Evaluation Report

Former Peterson Property
Shoreview Lane and 3rd Street SE
Gaylord, Minnesota

Prepared for

Gaylord EDA

Professional Certification:
I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

RAY A. HUBER
LICENSED PROFESSIONAL ENGINEER
15329
STATE OF MINNESOTA

Ray A. Huber, PE
Vice President – Principal Engineer
License Number: 15329
April 23, 2013

Project MA-13-00445

Braun Intertec Corporation

BRAUN INTERTEC

Braun Intertec Corporation
11001 Hampshire Ave S
Minneapolis, MN 55438

Phone: 952.995.2000
Fax: 952.995.2020
Web: braunintertec.com

April 23, 2013 Project MA-13-00445

Mr. Chuck Klimmik
Gaylord EDA
600 Main Ave.
Gaylord, MN 55334

Re: Preliminary Geotechnical Evaluation
Former Peterson Property
Shoreview Lane and 3rd Street SE
Gaylord, Minnesota

Dear Mr. Klimmik:

We are pleased to present this Preliminary Geotechnical Evaluation Report for the above referenced project. A summary of our results and a summary of our recommendations in light of the geotechnical issues influencing design and construction is presented below. More detailed information and recommendations follow.

Summary of Results

We performed a total of five standard penetration borings across the site for our preliminary geotechnical evaluation. The soil borings indicate the general soil profile across the site consists of 2 to 4 feet of topsoil underlain by glacial tills. These glacial tills consisted primarily of sandy lean clays ranging in consistency from rather soft to very stiff.

Groundwater was not observed at any of the boring locations, and static groundwater levels are anticipated to be below the exploration depths. However, there is the potential for limited zones of perched groundwater in the clay tills that may be encountered in onsite excavations.

Summary of Preliminary Recommendations

Based on the soil boring results, it is our opinion the native glacial soils are generally suitable for support of a typical one story structure using typical spread footing foundations and slab-on-grade floors. For preliminary design of spread footings, we recommend a soil bearing capacity of 4,000 pounds per square foot (psf).

For pavement support, subgrade preparation will likely consist of stripping surficial topsoils and surface compaction of the subgrade. However, subcutting and replacement of some subgrade soils is also possible, depending on the condition of the subgrade, time constraints and weather conditions at the time of construction.

Remarks

Thank you for making Braun Intertec your geotechnical consultant for this project. If you have questions about this report, or if there are other services that we can provide in support of our work to date, please call Dan Messner at 507.445.4913 or Ray Huber at 952.995.2260.

Sincerely,

BRAUN INTERTEC CORPORATION

(for)

Daniel D. Messner
Associate Principal – Operations Manager

Ray A. Huber, PE
Vice President – Principal Engineer

Prelim Geo Report-Former Peterson Property

Table of Contents

Description **Page**

A. Introduction 1
- A.1. Project Description 1
- A.2. Purpose 1
- A.3. Background Information and Reference Documents 1
- A.4. Site Conditions 1
- A.5. Scope of Services 1
  - A.5.a. Staking and Surveying 2
  - A.5.b. Subsurface Exploration 2
  - A.5.c. Laboratory Testing 2
  - A.5.d. Geotechnical Evaluation, Analysis and Reporting 2

B. Results 3
- B.1. Exploration Logs 3
  - B.1.a. Log of Boring Sheets 3
  - B.1.b. Geologic Origins 3
- B.2. Geologic Profile 3
  - B.2.a. Soils 3
  - B.2.b. Groundwater 3
- B.3. Laboratory Test Results 4

C. Basis for Recommendations 4
- C.1. Design Details 4
  - C.1.a. Building Structure Loads 4
  - C.1.b. Pavements and Traffic Loads and Utilities 4
  - C.1.c. Anticipated Grade Changes 5
  - C.1.d. Precautions Regarding Changed Information 5

D. Preliminary Recommendations 5
- D.1. Building Subgrade Preparation 5
  - D.1.a. Excavations 5
  - D.1.b. Excavation Dewatering 6
  - D.1.c. Selecting Excavation Backfill and Additional Required Fill 6
  - D.1.d. Placement and Compaction of Backfill and Fill 6
- D.2. Spread Footings 7
  - D.2.a. Embedment Depth 7
  - D.2.b. Net Allowable Bearing Pressure 7
  - D.2.c. Settlement 7
- D.3. Interior Slabs 7
- D.4. Pavements 8
  - D.4.a. Pavement Subgrade Preparation 8
  - D.4.b. Clay Subgrade 8

Table of Contents (continued)

Description **Page**

D.4.c. Sand Subgrade 8
D.4.d. Subgrade Proofroll 9
D.4.e. Design Sections 9
D.5. Frost Protection 10
D.5.a. General 10
D.5.b. Exterior Slabs and Pavements 11
D.5.c. Isolated Footing and Piers 12
D.6. Utilities 12
D.6.a. Excavation and Backfill 12
D.6.b. Corrosion Potential 13
E. Procedures 13
E.1. Penetration Test Borings 13
E.2. Material Classification and Testing 13
E.2.a. Visual and Manual Classification 13
E.2.b. Laboratory Testing 13
E.3. Groundwater Measurements 13
F. Qualifications 14
F.1. Variations in Subsurface Conditions 14
F.1.a. Material Strata 14
F.1.b. Groundwater Levels 14
F.2. Continuity of Professional Responsibility 14
F.2.a. Plan Review 14
F.2.b. Construction Observations and Testing 15
F.3. Use of Report 15
F.4. Standard of Care 15

Appendix

Boring Location Sketch
Log of Boring Sheets ST-1 through ST-5
Descriptive Terminology

A. Introduction

A.1. Project Description

This Preliminary Geotechnical Evaluation Report addresses the former Peterson Property parcel located to the south of Railroad Ave, in Gaylord, Minnesota for future development. The parcel is approximately 10 acres in size and is currently an open field.

A.2. Purpose

The purpose of our preliminary geotechnical evaluation is to characterize subsurface geologic conditions at selected exploration locations and evaluate their impact on the design and construction for future development.

A.3. Background Information and Reference Documents

To facilitate our evaluation, we were provided with or reviewed the following information or documents:

- Aerial map of the property. We also used these aerial maps to create the attached Soil Boring Location Sketch.
- Legal description of property.
- No preliminary, proposed or existing site plans were provided for our evaluation.

A.4. Site Conditions

Our referenced documents and past project experience in the general area indicate that the site is underlain with glacial tills. Currently, the site exists as an open field.

A.5. Scope of Services

Our scope of services for this project was originally submitted as a Proposal for Geotechnical Evaluation, dated January 30, 2013. We received authorization to proceed from the City of Gaylord Economic Development Authority on March 6, 2013. Tasks completed in accordance with our authorized scope of services are described below. The nature of and factors contributing to deviations from our proposed

scope of services are also noted. Our scope of services was performed under the terms of our June 15, 2006, General Conditions.

A.5.a. Staking and Surveying

Exploration locations and surface elevations at the exploration locations were surveyed by Sibley Surveyors located in Gaylord, Minnesota.

A.5.b. Subsurface Exploration

We performed 5 standard penetration test borings at the locations shown on the Soil Boring Location Sketch in the Appendix. The borings were extended to nominal depths of 15 feet. The borings were performed using a safety hammer.

Prior to commencing with our subsurface exploration activities, we cleared the exploration locations of underground utilities through Gopher State One Call.

A.5.c. Laboratory Testing

We performed moisture contents, and sieve analyses (#200 only) on selected penetration test samples. These results are provided on the boring logs which are attached in the Appendix, and also in Section B.3 below.

A.5.d. Geotechnical Evaluation, Analysis and Reporting

Information obtained from the laboratory testing was used to identify the geotechnical issues influencing design and construction, qualify the nature of their impact, and outline alternatives for their mitigation. Upon reviewing our results, we developed baseline recommendations for:

- Structure subgrade preparation, including excavations and ground improvement.
- Selecting, placing and compacting on-site or imported earth materials.
- Designing foundations, slabs, and pavements.
- Providing quality control and evaluating differing site conditions during construction.

B. Results

B.1. Exploration Logs

B.1.a. Log of Boring Sheets

Log of Boring sheets for our penetration test borings are included in the Appendix. The logs identify and describe the geologic materials that were penetrated, and present the results of penetration resistance and laboratory tests performed on penetration test samples retrieved from them.

Strata boundaries were inferred from changes in the penetration test samples and the auger cuttings. Because sampling was not performed continuously, the strata boundary depths are only approximate. The boundary depths likely vary away from the boring locations, and the boundaries themselves may also occur as gradual rather than abrupt transitions.

B.1.b. Geologic Origins

Geologic origins assigned to the materials shown on the logs and referenced within this report were based on: (1) a review of the background information and reference documents cited above, (2) visual classification of the various geologic material samples retrieved during the course of our subsurface exploration, (3) penetration resistances, (4) laboratory test results, and (5) available common knowledge of the geologic processes and environments that have impacted the site and surrounding area in the past.

B.2. Geologic Profile

B.2.a. Soils

The borings initially encountered black clays that were classified as topsoil. The topsoil ranged in depth 2 to 4 feet with traces of organics.

Below the topsoil, sandy lean clay glacial tills were encountered. These soils had penetration resistances that ranged from 5 to 20 blows per foot, indicating that these tills were rather soft to rather stiff in consistency.

B.2.b. Groundwater

Groundwater was not observed as our borings were advanced. Based on the moisture contents of the geologic materials encountered, it appears that groundwater was below the depths explored.

Seasonal and annual fluctuations of groundwater, however, should be anticipated. The depths/elevations at which perched groundwater may be encountered may be variable as well.

B.3. Laboratory Test Results

Results of our laboratory tests are presented below in Table 1.

Table 1. Laboratory Classification Test Results

Location	Sample Depth (ft)	Classification	Moisture Content (%)	Percent Passing a #200 Sieve
ST-1	2.5-4.5	Sandy Lean Clay	23	-
ST-2	5-7	Sandy Lean Clay	25	60
ST-3	5-7	Sandy Lean Clay	25	-
ST-4	5-7	Lean Clay with Sand	23	76
ST-5	7.5-9.5	Sandy Lean Clay	22	-

C. Basis for Recommendations

C.1. Design Details

C.1.a. Building Structure Loads

We understand the future development of the property may consist of one story structures with associated site improvements. However, actual buildings and site design and layout have not been determined.

For the purposes of this report, we have assumed that bearing wall loads associated with the structure would be approximately 5 kips per lineal foot (klf) and column loads would be approximately 100 kips (100,000 pounds) per column.

C.1.b. Pavements and Traffic Loads and Utilities

Light-duty pavement areas will have a bituminous section. We have assumed that light-duty pavements will be subjected to no more than 35,000 equivalent 18-kip single axle loads (ESALs) over an assumed design life.

Heavy-duty pavement areas will also have a bituminous section. We have assumed that heavy-duty pavements will be subjected to no more than 100,000 ESALs over an assumed design life.

The native soils encountered below the topsoil generally appear suitable for support of underground utilities.

C.1.c. Anticipated Grade Changes

We are assuming that any new structure will be constructed near the existing ground elevation.

C.1.d. Precautions Regarding Changed Information

We have attempted to describe our understanding of the proposed construction to the extent it was reported to us by others. Depending on the extent of available information, assumptions may have been made based on our experience with similar projects. If we have not correctly recorded or interpreted the project details, we should be notified. New or changed information could require additional evaluation, analyses and/or recommendations.

D. Preliminary Recommendations

In accordance with our findings, below are our recommendations for building subgrade preparation for spread footings, interior slabs, exterior slabs, pavements, frost protection, utilities, and construction quality control.

The recommendations in this report should be considered preliminary. The recommendations provided in this report may change or be revised based on additional soil boring information and/or building or site design information.

D.1. Building Subgrade Preparation

D.1.a. Excavations

For building pad preparation, we recommend that the vegetation, topsoil and any soft clay glacial tills be removed from below the proposed building area and oversize areas.

After excavation of the unsuitable soils, the native glacial soils should be suitable for support of foundations or engineered fill. However, we do recommend that soils encountered after site stripping be surface compacted with a self propelled sheepsfoot compactor prior to fill or foundation placement.

Table 2 outlines the preliminary anticipated excavation depths at the soils borings. We recommend the excavation depths be reviewed after the proposed building loads and grades are available. The excavation depths may need to be revised.

Table 2. Preliminary Anticipated Excavation Depths

Boring	Ground Surface Elevation	Anticipated Depth of Excavation (feet)	Approximate Bottom Elevation (Estimated)
ST-1	982.9	2 1/2	980-1/2
ST-2	983.2	3 1/2	979-1/2
ST-3	982.1	3	979
ST-4	985.1	2 1/2	982-1/2
ST-5	982.9	2 1/2	980-1/2

It should be anticipated that the excavation depths may vary slightly between soil boring locations. The proposed building locations and design are considered preliminary. Consequently, once building and site layouts are finalized, it may be recommended that additional soil borings or test pits be performed to better define the expected depths of the soil correction areas.

D.1.b. Excavation Dewatering

Based on the soil borings, we do not anticipate any need for removing groundwater from the excavation. However, if surface water or perched water enters the excavation, the water should be removed because of the clay nature of the soils. Sump pumps should be adequate to remove the water.

D.1.c. Selecting Excavation Backfill and Additional Required Fill

Any fill can consist of debris free, non-organic mineral soils with a plastic index not exceeding 20.

D.1.d. Placement and Compaction of Backfill and Fill

We recommend spreading backfill and fill in loose lifts of approximately 8-12 inches. We recommend compacting backfill and fill in accordance with the criteria presented below in Table 3. The relative compaction of utility backfill should be evaluated based on the structure below which it is installed, and vertical proximity to that structure.

Table 3. Compaction Recommendations Summary

Reference	Relative Compaction, percent (ASTM D 698 – standard Proctor)	Moisture Content Variance from Optimum, percentage points
Below foundations	98	-1 to +3
Below slabs	95	-1 to +3
Below landscaped surfaces	90	-1 to +3
Within 3 feet of pavement	100	-2 to +1
Below 3 feet of pavement areas	95	-2 to +1

D.2. Spread Footings

D.2.a. Embedment Depth

For frost protection, we recommend embedding perimeter footings 42 inches below the lowest exterior grade. Interior footings may be placed directly below floor slabs. We recommend embedding building footings not heated during winter construction, and other unheated footings associated with canopies, stoops or sidewalks 60 inches below the lowest exterior grade.

D.2.b. Net Allowable Bearing Pressure

We recommend sizing spread footings to exert a net allowable bearing pressure of 4,000 pounds per square foot (psf). This value includes a safety factor of at least 3.0 with regard to bearing capacity failure.

D.2.c. Settlement

We estimate that total and differential settlements among the footings will amount to less than 1 and 1/2 inch, respectively, under the assumed loads.

D.3. Interior Slabs

For a clay subgrade we recommend after stripping topsoil, the medium to stiff glacial clay or engineered fill placed up to the floor subgrade will be suitable for floor support.

We recommend using a modulus of subgrade reaction, k, of 100 pounds per square inch per inch of deflection (pci) to design the slabs.

If floor coverings or coatings less permeable than the concrete slab will be used, consideration should be given to placing a vapor retarder or vapor barrier immediately beneath the slab. Some contractors prefer to bury the vapor retarder or barrier beneath a layer of sand to reduce curling and shrinkage, but this practice risks trapping water between the slab and vapor retarder or barrier.

Regardless of where the vapor retarder or barrier is placed, floor covering manufacturers should be consulted regarding the appropriate type, use and installation of the vapor retarder or barrier to preserve warranty assurances.

D.4. Pavements

D.4.a. Pavement Subgrade Preparation

Typical subgrade preparation involves the stripping of vegetation and topsoil. We recommend evaluating the existing fill for the presence of debris, organics or soft clays. If any of these are present within the top three feet of the proposed pavement surface, we recommend that it be removed. After topsoil, debris or soft clays have been removed, the existing clay subgrade should be surface compacted with a self propelled sheepsfoot compactor. It is then our opinion that there are two approaches for constructing the pavements. The first of these approaches would be to place the aggregate base directly on top of the clay subgrade and the second approach would be to place a sand subbase below the aggregate base. These options are further discussed below.

D.4.b. Clay Subgrade

Pavements supported directly on the existing clay soils are generally less expensive initially, but would likely require slightly more maintenance since they are highly susceptible to volume changes upon freezing and thawing and possible settlement.

With this approach, the pavement section (aggregate base and bituminous pavement) would be placed directly on top of the prepared clay subgrade. Once grade is established, we recommend proofrolling the subgrade. If unstable areas are detected, we would recommend that the proposed paved areas be moisture conditioned (disked and dried) in the upper two feet. The moisture conditioned soils should then be recompacted full depth to 100 percent of standard Proctor density. We recommend that the moisture content be no more than 1 percent over that soil's optimum moisture content. A proofroll should then be performed on the subgrade prior to placement of the aggregate base. Draintile should be placed in low areas and as finger drains around catch basins.

D.4.c. Sand Subgrade

A sand subbase may also be another subgrade preparation option. A sand subbase incorporated into the pavement section(s) is one option to reduce maintenance and provide slightly longer pavement life. A sand subbase will improve subgrade strength and reduce frost heave. The sands drain more freely

than the clayey soils on which they lie, and because the sand could act as a reservoir for surface drainage and groundwater, we recommend that draintile be installed in areas where a sand cushion is placed over frost susceptible soils.

With this approach, the subgrade soils would be subcut to allow for placement of a section of 12 to 18 inches of sand (depending upon the level of traffic) meeting the MN/DOT Specification 3149.2B2 for Select Granular Borrow with no more than 12 percent passing the number 200 sieve (fines) respectively for the pavements. The bottom of the excavation should then be disked, dried and recompacted in order to provide a "crust" on which to place the sand subbase.

We recommend tapering the sand subgrade at a slope of 20:1 (H:V) in areas where the sand subbase transitions to areas without a sand subbase. This will provide a gradual area over which differential frost heave may occur between the 2 different pavement sections.

Fill and backfill placed below paved areas should be compacted to between 95 and 100 percent of the standard Proctor density depending on the depth below finished grade. Draintile should be placed in low areas and as finger drains around catch basins in urban section areas. The draintile should be placed in small trenches extended at least 8 inches below the granular subbase layer.

D.4.d. Subgrade Proofroll

Prior to placing aggregate base material, we recommend proof-rolling pavement subgrades to determine if the subgrade materials are loose, soft or weak, and in need of further stabilization, compaction or subexcavation and recompaction or replacement. A second proof-roll should be performed after the aggregate base material is in place, and prior to placing bituminous or concrete pavement.

D.4.e. Design Sections

After the site has been graded, we anticipate the subgrade soils will generally consist of sandy lean clay tills. Laboratory tests to determine an R-value for pavement design were not included in the scope of this project. Based on our experience with similar projects in the area, however, it is our opinion that an R-value of 10 can be assumed for design purposes.

Based upon the aforementioned traffic loads and an R-value of 10, we recommend the following bituminous pavement sections as indicated in Table 4 below.

Table 4. Recommended Pavement Sections

Component	Light Duty Thickness, in		Heavy Duty Thickness, in	
	Option		Option	
	Clay Subgrade	Sand Subbase	Clay Subgrade	Sand Subbase
Bituminous	3	3	4	4
Aggregate Base	8	6	9	7
Sand Subbase	N/A	12	N/A	18

The above pavement designs are based upon a 20-year performance life. This is the amount of time before major reconstruction is anticipated. This performance life assumes maintenance, such as seal coating and crack sealing, is routinely performed. The actual pavement life will vary depending on variations in weather, traffic conditions and maintenance.

D.5. Frost Protection

D.5.a. General

All or some of the exterior slabs, as well as pavements, will be underlain with native clay soils, which are considered to be moderately to highly frost susceptible. Soils of the type can retain moisture and heave upon freezing. In general, this characteristic is not an issue unless these soils become saturated due to surface runoff or infiltration or are excessively wet is-situ. Once frozen, unfavorable amounts of general and isolated heaving of the soils and the surface structures supported on them could develop. This type of heaving could impact design drainage patterns and the performance of exterior slabs and pavements, as well as any isolated exterior footings and piers. To address most of the heave related issues, we recommend that general site grades and grades for exterior surface features be set to direct surface drainage away from buildings, across large paved areas and away from walkways to limit the potential for saturation of the subgrade and any subsequent heaving. General grades should also have enough “slope” to tolerate potential larger areas of heave which may not fully settle when thawed.

It should be noted that general runoff and infiltration from precipitation are not the only sources of water that can saturate subgrade soils and contribute to frost heave. Roof drainage and the irrigation of landscaped areas in close proximity to exterior slabs, pavements, and isolated footings and piers, contribute as well.

D.5.b. Exterior Slabs and Pavements

Even small amounts of frost-related differential movement at walkway joints or cracks can create tripping hazards. Several subgrade improvement options can be explored to address this condition. The most conservative and potentially most costly subgrade improvement option to help limit the potential for heaving, but not eliminate it, would be to remove any frost-susceptible soils present below the exterior slabs' "footprint" down to the bottom-of-footing grades or to a maximum depth of 5 feet below subgrade elevations, whichever is less. We recommend the resulting excavation then be refilled with sand or sandy gravel having less than 50 percent of the particles by weight passing the #40 sieve and less than 5 percent of the particles by weight passing a #200 sieve. The bottom of the excavation should be sloped toward one or more collection points so that any water entering the backfill can be collected and removed. A series of perforated drainpipes will need to be installed to collect and dispose of the infiltrating water and/or groundwater that could accumulate within the backfill. The piping should be connected to a storm sewer or a sump to remove any accumulated water, or "daylighted" if grades permit. If the water is not removed, it is our opinion this option will not be effective in controlling heave.

Another subgrade improvement option would be to build in a transition zone between those soils considered to be frost-susceptible and those that are not to somewhat control where any differential movement may occur. Such transitions could exist between exterior slabs and pavements, between entry way slabs and sidewalks, and along the sidewalks themselves. For this option, the frost-susceptible soils in critical areas would be removed to a depth of at least 5 feet below grade as discussed above. The excavation below the footprint of the sidewalks or other slabs would then be sloped upward at a gradient no steeper than 3:1 (horizontal : vertical) toward the less critical areas. Provisions for draining the backfill in this case, too, would be required. If accumulating water is not removed, it is our opinion this option will also be ineffective in controlling heave.

Regardless of what is done to the walkway or pavement area subgrade, it will be critical the end-user develop a detailed maintenance program to seal and/or fill any cracks and joints that may develop during the useful life of the various surface features. Concrete and bituminous will experience episodes of normal thermo-expansion and thermo-contraction during its useful life. During this time, cracks may develop and joints may open up, which will expose the subgrade and allow any water flowing overland to enter the subgrade and either saturate the subgrade soils or to become perched atop it. This occurrence increases the potential for heave due to freezing conditions in the general vicinity of the crack or joint. This type of heave has the potential to become excessive if not addressed as part of a maintenance program. Special attention should be paid to areas where dissimilar materials abut one another, where construction joints occur and where shrinkage cracks develop.

The on-going performance of pavements is impacted by conditions under which the pavement is asked to perform. These conditions include the environmental conditions, the actual use conditions and the level of ongoing maintenance performed. With regard to bituminous pavements in particular, because of normal thermo expansion and contraction, it is not unusual to have cracking develop within the first few years of placement and for the cracking to continue throughout the life of the pavement. A regular maintenance plan should be developed for filling cracks in bituminous pavements to lessen the potential impacts for cold weather distress due to frost heave or warm weather distress due to wetting and softening of the subgrade. It is also not unusual for bituminous pavements to require a seal coat within the first 5 to 10 years to increase the long-term performance.

D.5.c. Isolated Footing and Piers

Soils classifying as “silt” (USCS symbols ML or MH), “clay” (CL or CH), or as being “silty” or “clayey” (including but not limited to SP-SM, SC-SM, SM or SC), have the potential for adhering to poured concrete or masonry block features built through the normal frost zone. In freezing conditions, this soil adhesion could result in the concrete or masonry construction being lifted out of the ground. This lifting action is also known as heave due to adfreezing. The potential for experiencing the impacts of adfreezing increases with poor surface drainage in the area of below grade elements, in areas of poorly compacted clayey or silty soils and in areas of saturated soils. To limit the impacts of adfreeze, we recommend placing a low friction separation barrier, such as high density insulation board, between the backfill and the element. Extending isolated piers deeper into the frost-free zone, enlarging the bottom of the piers and then providing tension reinforcement can also be considered. Recommendations for specific foundation conditions can be provided as needed.

D.6. Utilities

D.6.a. Excavation and Backfill

The glacial till soils generally appear suitable for utility support. If the utilities encounter soft clay at the invert grade, the trench should be subcut an extra 1 to 2 feet and replaced with crushed rock. Fill and backfill for utility trenches should be compacted to between 90 and 100 percent of the Proctor density depending on the depth below finished grade and location.

D.6.b. Corrosion Potential

The onsite clay soils are considered moderately corrosive to metallic utilities. We recommend any metallic piping be protected from corrosion or non-metallic piping be used for the utilities.

E. Procedures

E.1. Penetration Test Borings

The penetration test borings were drilled with an all terrain vehicle-mounted core and auger drill equipped with hollow-stem auger. The borings were performed in accordance with ASTM D 1586. Penetration test samples were taken at 2 1/2-foot intervals. Actual sample intervals and corresponding depths are shown on the boring logs.

E.2. Material Classification and Testing

E.2.a. Visual and Manual Classification

The geologic materials encountered were visually and manually classified in accordance with ASTM Standard Practice D 2488. A chart explaining the classification system is attached. Samples were placed in jars or bags and returned to our facility for review and storage.

E.2.b. Laboratory Testing

The results of the laboratory tests performed on geologic material samples are noted on or follow the appropriate attached exploration logs. The tests were performed in accordance with ASTM or AASHTO procedures.

E.3. Groundwater Measurements

The drillers checked for groundwater as the penetration test borings were advanced, and again after auger withdrawal. The boreholes were then backfilled.

F. Qualifications

F.1. Variations in Subsurface Conditions

F.1.a. Material Strata

Our evaluation, analyses and recommendations were developed from a limited amount of site and subsurface information. It is not standard engineering practice to retrieve material samples from exploration locations continuously with depth, and therefore strata boundaries and thicknesses must be inferred to some extent. Strata boundaries may also be gradual transitions, and can be expected to vary in depth, elevation and thickness away from the exploration locations.

Variations in subsurface conditions present between exploration locations may not be revealed until additional exploration work is completed, or construction commences. If any such variations are revealed, our recommendations should be re-evaluated. Such variations could increase construction costs, and a contingency should be provided to accommodate them.

F.1.b. Groundwater Levels

Groundwater measurements were made under the conditions reported herein and shown on the exploration logs, and interpreted in the text of this report. It should be noted that the observation periods were relatively short, and groundwater can be expected to fluctuate in response to rainfall, flooding, irrigation, seasonal freezing and thawing, surface drainage modifications and other seasonal and annual factors.

F.2. Continuity of Professional Responsibility

F.2.a. Plan Review

This report is based on a limited amount of information, and a number of assumptions were necessary to help us develop our recommendations. It is recommended that our firm review the geotechnical aspects of the designs and specifications, and evaluate whether the design is as expected, if any design changes have affected the validity of our recommendations, and if our recommendations have been correctly interpreted and implemented in the designs and specifications.

F.2.b. Construction Observations and Testing

It is recommended that we be retained to perform observations and tests during construction. This will allow correlation of the subsurface conditions encountered during construction with those encountered by the borings, and provide continuity of professional responsibility.

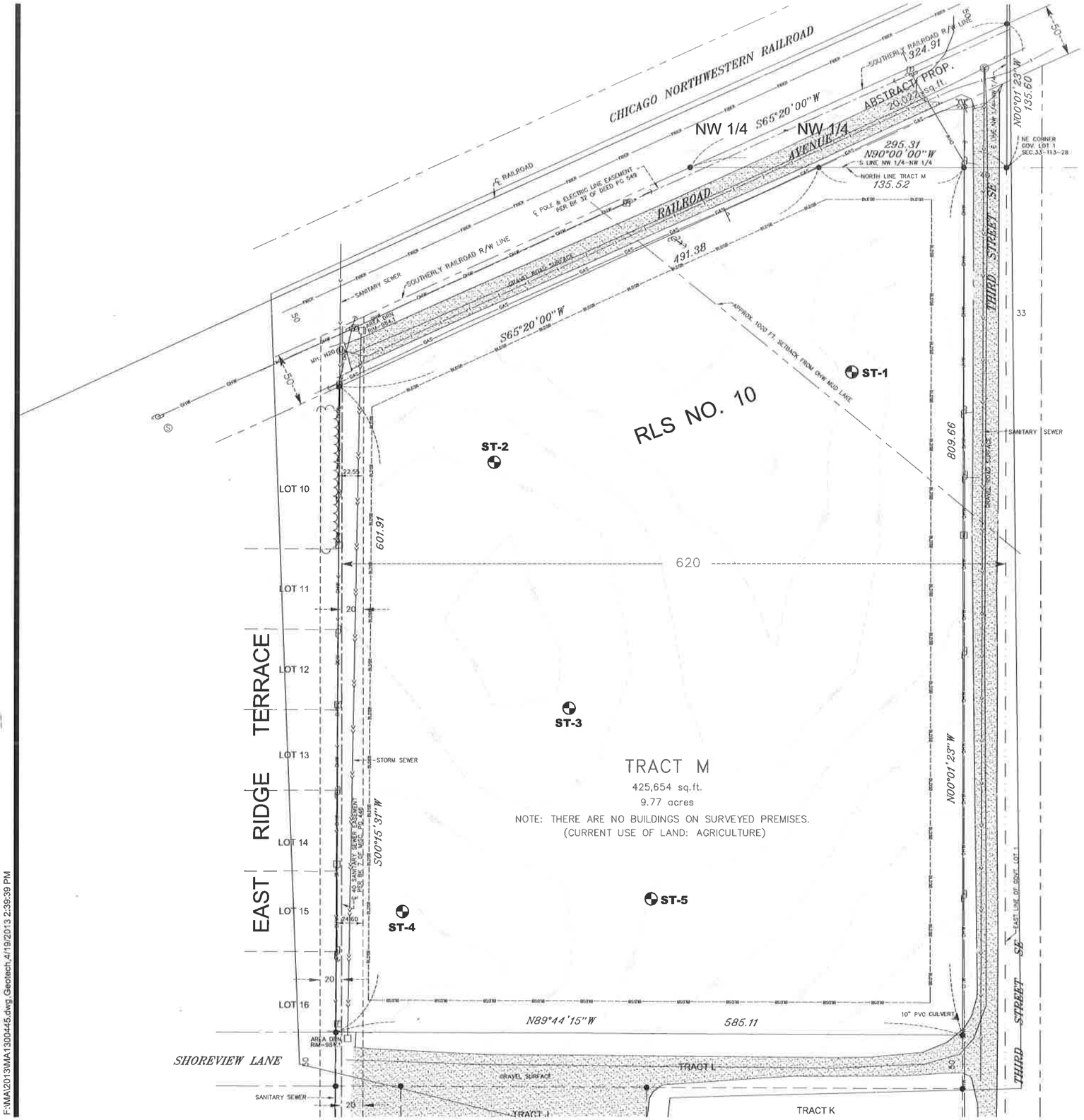
F.3. Use of Report

This report is for the exclusive use of the parties to which it has been addressed. Without written approval, we assume no responsibility to other parties regarding this report. Our evaluation, analyses and recommendations may not be appropriate for other parties or projects.

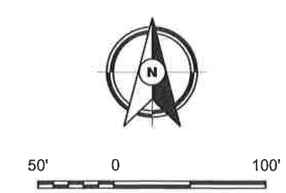
F.4. Standard of Care

In performing its services, Braun Intertec used that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality. No warranty, express or implied, is made.

Appendix



DENOTES APPROXIMATE LOCATION OF STANDARD PENETRATION TEST BORING



BRAUN INTERTEC

11001 Hampshire Avenue So.
Minneapolis, MN 55438
PH. (952) 995-2000
FAX (952) 995-2020

Base Dwg Provided By:
SIBLEY SURVEYORS, INC.

SOIL BORING LOCATION SKETCH
GEOTECHNICAL EVALUATION
PETERSON PROPERTY
10 ACRE PARCEL
GAYLORD, MINNESOTA

Project No:	MA1300445
Drawing No:	MA1300445
Scale:	1"= 100'
Drawn By:	JAG
Date Drawn:	4/19/13
Checked By:	DDM
Last Modified:	4/19/13
Sheet: of	Fig:

F:\MA\2013\MA1300445.dwg,Geotech,4/19/2013 2:39:39 PM

BRAUN INTERTEC

LOG OF BORING

Braun Project MA-13-00445
PRELIMINARY GEOTECHNICAL EVALUATION
Former Peterson Property
Shoreview Lane & 3rd Street SE
Gaylord, Minnesota

BORING: **ST-1**

LOCATION: See attached sketch.

DRILLER:

METHOD: 3 1/4" HSA, Safety Hammer

DATE: **3/11/12**

SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	qp tsf	MC %	Tests or Notes
982.9	0.0							
		CL	LEAN CLAY, trace of roots, black, moist. (Topsoil)					Benchmark: Elevations were obtained using GPS and the State of Minnesota's permanent base station network.
980.7	2.2							
		CL	SANDY LEAN CLAY, trace of Gravel, light brown, moist, rather stiff. (Glacial Till)	10				
977.9	5.0							
		CL	SANDY LEAN CLAY, trace of Gravel, brown to 12 feet then gray, wet, rather stiff to stiff. (Glacial Till)	10		1 3/4	23	
				15		2		
				17		2		
				16		2 1/2		
967.9	15.0							
			END OF BORING.					
			Water not observed with 15 feet of hollow-stem auger in the ground.					
			Boring immediately backfilled.					

LOG OF BORING N:\GINT\PROJECTS\MANKATO\2013\00445.GPJ BRAUN_V8_CURRENT.GDT 4/22/13 15:27

BRAUN INTERTEC

LOG OF BORING

Braun Project MA-13-00445
PRELIMINARY GEOTECHNICAL EVALUATION
Former Peterson Property
Shoreview Lane & 3rd Street SE
Gaylord, Minnesota

BORING: **ST-2**

LOCATION: See attached sketch.

DRILLER:

METHOD: 3 1/4" HSA, Safety Hammer

DATE: **3/11/13**

SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	qp tsf	MC %	Tests or Notes
983.2	0.0							
		CL	LEAN CLAY, with roots, black, moist. (Topsoil)	10				
979.6	3.6							
		CL	SANDY LEAN CLAY, trace of Gravel, gray, wet, medium. (Glacial Till)	6		3/4	25	P200=60%
				7		3/4		
973.7	9.5							
		CL	SANDY LEAN CLAY, with Gravel, brown to 13 feet then gray, wet, medium to stiff. (Glacial Till)	13		1 1/2		
				7		1/2		
968.2	15.0							
			END OF BORING.					
			Water not observed with 15 feet of hollow-stem auger in the ground.					
			Boring immediately backfilled.					

LOG OF BORING N:\GINT\PROJECTS\MANKATO\2013\00445.GPJ BRAUN_V8_CURRENT.GDT 4/22/13 15:27

BRAUN INTERTEC

LOG OF BORING

Braun Project MA-13-00445
PRELIMINARY GEOTECHNICAL EVALUATION
Former Peterson Property
Shoreview Lane & 3rd Street SE
Gaylord, Minnesota

BORING: **ST-3**

LOCATION: See attached sketch.

DRILLER:

METHOD: 3 1/4" HSA, Safety Hammer

DATE: **3/11/13**

SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	qp tsf	MC %	Tests or Notes
982.1	0.0							
		CL	LEAN CLAY, black, moist. (Topsoil)					
979.1	3.0			11				
		CL	SANDY LEAN CLAY, trace of Gravel, brown to gray, wet, rather soft to rather stiff. (Glacial Till)					
				5		1/2	25	
				10		1		
				11		2 1/4		
970.1	12.0							
		CL	SANDY LEAN CLAY, trace of Gravel, gray, wet, stiff. (Glacial Till)	13		1		
967.1	15.0							
			END OF BORING.					
			Water not observed with 15 feet of hollow-stem auger in the ground.					
			Boring immediately backfilled.					

LOG OF BORING N:\GINT\PROJECTS\MANKATO\2013\00445.GPJ BRAUN_V8_CURRENT.GDT 4/22/13 15:27

BRAUN INTERTEC

LOG OF BORING

Braun Project MA-13-00445
PRELIMINARY GEOTECHNICAL EVALUATION
Former Peterson Property
Shoreview Lane & 3rd Street SE
Gaylord, Minnesota

BORING: **ST-4**

LOCATION: See attached sketch.

DRILLER:

METHOD: 3 1/4" HSA, Safety Hammer

DATE: **3/11/13**

SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
985.1	0.0	CL	LEAN CLAY, black, moist. (Topsoil)				
982.6	2.5	CL	SANDY LEAN CLAY, light gray, dry to moist, stiff. (Glacial Till)	16			
980.1	5.0	CL	LEAN CLAY with SAND, trace of Gravel, brown to gray, wet, rather stiff. (Glacial Till)	11		23	P200=76%
975.6	9.5	CL	SANDY LEAN CLAY, trace of Gravel and sand seams, brown, wet, rather stiff. (Glacial Till)	12			
970.1	15.0		END OF BORING. Water not observed with 15 feet of hollow-stem auger in the ground. Boring immediately backfilled.	12			

LOG OF BORING N:\GINT\PROJECTS\MANKATO\2013\00445.GPJ BRAUN_V8_CURRENT.GDT 4/22/13 15:27

BRAUN INTERTEC

LOG OF BORING

Braun Project MA-13-00445
PRELIMINARY GEOTECHNICAL EVALUATION
Former Peterson Property
Shoreview Lane & 3rd Street SE
Gaylord, Minnesota

BORING: **ST-5**

LOCATION: See attached sketch.

DRILLER:

METHOD: 3 1/4" HSA, Safety Hammer

DATE: **3/11/13**

SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	qp tsf	MC %	Tests or Notes
982.9	0.0							
		CL	LEAN CLAY, trace of roots, black, moist. (Topsoil)					
980.4	2.5							
		CL	SANDY LEAN CLAY, light brown, moist, rather stiff to stiff. (Glacial Till)	12				
				14				
975.4	7.5							
		CL	SANDY LEAN CLAY, brown, wet, stiff. (Glacial Till)	14		1 1/2	22	
				14		1 1/2		
970.9	12.0							
		CL	SANDY LEAN CLAY, trace of Gravel, gray, wet, stiff. (Glacial Till)	20		2 1/2		
967.9	15.0							
			END OF BORING.					
			Water not observed with 15 feet of hollow-stem auger in the ground.					
			Boring immediately backfilled.					

LOG OF BORING N:\GINT\PROJECTS\MANKATO\2013\00445.GPJ BRAUN_V8_CURRENT.GDT 4/22/13 15:27

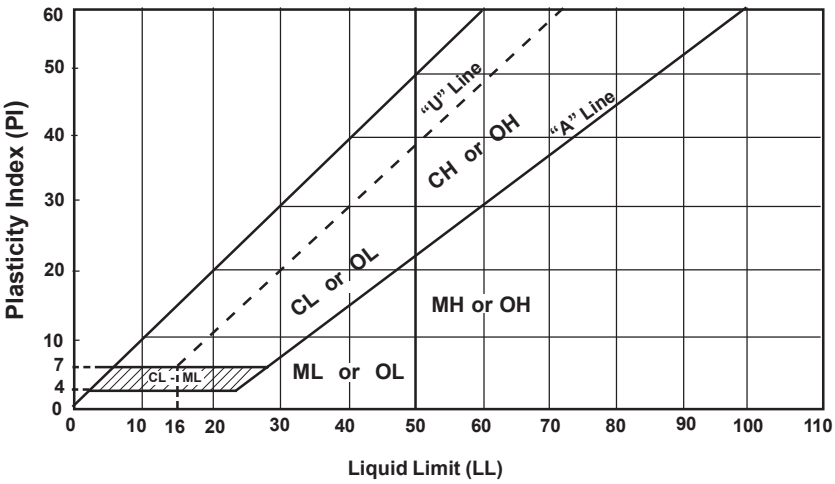
BRAUN INTERTEC

Descriptive Terminology of Soil

Standard D 2487 - 00
Classification of Soils for Engineering Purposes (Unified Soil Classification System)

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [a]				Soils Classification	
				Group Symbol	Group Name [b]
Coarse-grained Soils more than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels 5% or less fines [e]	$C_u \geq 4$ and $1 \leq C_c \leq 3$ [c]	GW	Well-graded gravel [d]
			$C_u < 4$ and/or $1 > C_c > 3$ [c]	GP	Poorly graded gravel [d]
		Gravels with Fines More than 12% fines [e]	Fines classify as ML or MH	GM	Silty gravel [d f g]
			Fines classify as CL or CH	GC	Clayey gravel [d f g]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands 5% or less fines [i]	$C_u \geq 6$ and $1 \leq C_c \leq 3$ [c]	SW	Well-graded sand [h]
			$C_u < 6$ and/or $1 > C_c > 3$ [c]	SP	Poorly graded sand [h]
		Sands with Fines More than 12% [i]	Fines classify as ML or MH	SM	Silty sand [f g h]
			Fines classify as CL or CH	SC	Clayey sand [f g h]
Fine-grained Soils 50% or more passed the No. 200 sieve	Silts and Clays Liquid limit less than 50	Inorganic	PI > 7 and plots on or above "A" line [j]	CL	Lean clay [k l m]
			PI < 4 or plots below "A" line [j]	ML	Silt [k l m]
		Organic	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OL	Organic clay [k l m n]
				OL	Organic silt [k l m o]
	Silts and clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" line	CH	Fat clay [k l m]
			PI plots below "A" line	MH	Elastic silt [k l m]
		Organic	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OH	Organic clay [k l m p]
				OH	Organic silt [k l m q]
Highly Organic Soils		Primarily organic matter, dark in color and organic odor		PT	Peat

a. Based on the material passing the 3-in (75mm) sieve.
b. If field sample contained cobbles or boulders, or both, add "with cobbles or boulders or both" to group name.
c. $C_u = D_{60} / D_{10}$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$
d. If soil contains ≥15% sand, add "with sand" to group name.
e. Gravels with 5 to 12% fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay
f. If fines classify as CL-ML, use dual symbol GC-GM or SC-SM.
g. If fines are organic, add "with organic fines" to group name.
h. If soil contains ≥ 15% gravel, add "with gravel" to group name.
i. Sands with 5 to 12% fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay
j. If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.
k. If soil contains 10 to 29% plus No. 200, add "with sand" or "with gravel" whichever is predominant.
l. If soil contains ≥ 30% plus No. 200, predominantly sand, add "sandy" to group name.
m. If soil contains ≥ 30% plus No. 200 predominantly gravel, add "gravelly" to group name.
n. PI ≥ 4 and plots on or above "A" line.
o. PI < 4 or plots below "A" line.
p. PI plots on or above "A" line.
q. PI plots below "A" line.



Laboratory Tests

DD	Dry density, pcf	**OC**	Organic content, %
WD	Wet density, pcf	**S**	Percent of saturation, %
MC	Natural moisture content, %	**SG**	Specific gravity
LL	Liqiuid limit, %	**C**	Cohesion, psf
PL	Plastic limit, %	∅	Angle of internal friction
PI	Plasticity index, %	**qu**	Unconfined compressive strength, psf
P200	% passing 200 sieve	**qp**	Pocket penetrometer strength, tsf

Particle Size Identification

Boulders ..... over 12"
Cobbles ..... 3" to 12"
Gravel
Coarse ..... 3/4" to 3"
Fine ..... No. 4 to 3/4"
Sand
Coarse ..... No. 4 to No. 10
Medium ..... No. 10 to No. 40
Fine ..... No. 40 to No. 200
Silt ..... < No. 200, PI < 4 or below "A" line
Clay ..... < No. 200, PI ≥ 4 and on or above "A" line

Relative Density of Cohesionless Soils

Very loose ..... 0 to 4 BPF
Loose ..... 5 to 10 BPF
Medium dense ..... 11 to 30 BPF
Dense ..... 31 to 50 BPF
Very dense ..... over 50 BPF

Consistency of Cohesive Soils

Very soft ..... 0 to 1 BPF
Soft ..... 2 to 3 BPF
Rather soft ..... 4 to 5 BPF
Medium ..... 6 to 8 BPF
Rather stiff ..... 9 to 12 BPF
Stiff ..... 13 to 16 BPF
Very stiff ..... 17 to 30 BPF
Hard ..... over 30 BPF

Drilling Notes

Standard penetration test borings were advanced by 3 1/4" or 6 1/4" ID hollow-stem augers unless noted otherwise, Jetting water was used to clean out auger prior to sampling only where indicated on logs. Standard penetration test borings are designated by the prefix "ST" (Split Tube). All samples were taken with the standard 2" OD split-tube sampler, except where noted.

Power auger borings were advanced by 4" or 6" diameter continuous-flight, solid-stem augers. Soil classifications and strata depths were inferred from disturbed samples augered to the surface and are, therefore, somewhat approximate. Power auger borings are designated by the prefix "B."

Hand auger borings were advanced manually with a 1 1/2" or 3 1/4" diameter auger and were limited to the depth from which the auger could be manually withdrawn. Hand auger borings are indicated by the prefix "H."

BPF: Numbers indicate blows per foot recorded in standard penetration test, also known as "N" value. The sampler was set 6" into undisturbed soil below the hollow-stem auger. Driving resistances were then counted for second and third 6" increments and added to get BPF. Where they differed significantly, they are reported in the following form: 2/12 for the second and third 6" increments, respectively.

WH: WH indicates the sampler penetrated soil under weight of hammer and rods alone; driving not required.

WR: WR indicates the sampler penetrated soil under weight of rods alone; hammer weight and driving not required.

TW indicates thin-walled (undisturbed) tube sample.

Note: All tests were run in general accordance with applicable ASTM standards.