**ANDERSON - JOHNSON ASSOCIATES, INC.**

LANDSCAPE ARCHITECTURE • SITE PLANNING • CIVIL ENGINEERING

# Soils Reports

(Subsurface Exploration for Structural Properties)

# Geotechnical Evaluation Report

Proposed Southdale Courts Relocation Project
County Project: 0031825
1800 West Old Shakopee Road
Bloomington, Minnesota

*Prepared for*

# Hennepin County Facility Services Department

**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.

Joseph L. Westphal, PE
Project Engineer
License Number: 49833
June 20, 2016

JOSEPH L. WESTPHAL
LICENSED PROFESSIONAL ENGINEER
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STATE OF MINNESOTA

Project B1602323

Braun Intertec Corporation

BRAUN INTERTEC
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June 20, 2016

Project B1602323

Mr. Lee F. Anderson
Hennepin County Facility Services Department
A-2208 Hennepin County Government Center
300 South Sixth Street, (MC: 228)
Minneapolis, MN 55487-0228

Re: Geotechnical Evaluation Report
Proposed Southdale Courts Relocation Project
1800 West Old Shakopee Road
Bloomington, Minnesota

Dear Mr. Anderson:

We have completed the Geotechnical Evaluation Report for the proposed Courtroom addition to the existing City Hall facility in Bloomington, Minnesota. The proposed project includes the construction of a one- to two-story addition at the southwest corner of the existing building. The addition will consist of two courtroom facilities with associated office and public spaces.

Please see the attached report for a detailed discussion of the field exploration results and our recommendations. The report should be read in its entirety.

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 Joe Westphal at 952.995.2238 or Brad McCarter at 952.995.2310.

Sincerely,

BRAUN INTERTEC CORPORATION

Joseph L. Westphal, PE
Project Engineer

for:

Bradley J. McCarter, PE
Associate Principal - Senior Engineer

c: Mr. Jeffery Houle; Hennepin County
Mr. Joel Dunning; Wold Architects and Engineers

AA EOE

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# A. Introduction

## A.1. Project Description

This Geotechnical Evaluation Report addresses the proposed building addition and site improvements at the current Bloomington City Hall building located at 1800 West Old Shakopee Road in Bloomington, Minnesota. The project is still in the design phase with two options being considered for the proposed building addition, each of which would add two courtroom facilities with associated office space for employees, clerical, and support staff. The primary difference between the two options is the number of stories: a two-story layout identified as "Option 1.5" or a single story layout identified as "Option 4."

As part of this investigation, a Phase II Environmental Site Assessment (ESA) was completed simultaneously by Braun Intertec. The Phase II ESA report will be provided under separate cover.

## A.2. Purpose

The purpose of this geotechnical evaluation was to provide Hennepin County and their design team with geotechnical information and recommendations regarding the design and construction of the proposed addition.

## A.3. Scope of Services

Our scope of services for this project was originally submitted as a Proposal for Geotechnical Evaluation and Environmental Services, dated March 17, 2016. We received an email confirmation prior to the start of site work and written authorization to proceed on April 6, 2016 from Mr. Lee Anderson. Tasks performed in accordance with our authorized scope of services included:

- Staking the boring locations and determining ground surface elevations at those locations.

- Coordinating the locating of underground utilities near the boring locations.

- Performing sixteen (16) standard penetration test (SPT) borings to a nominal depths ranging from 15 to 20 feet below grade at the requested locations.

- Classifying samples taken from the SPT borings and preparing Log of Boring sheets.

- Performing limited laboratory testing on selected penetration test samples.

- Preparing this report containing a boring location sketch, exploration logs, a summary of the geologic materials encountered, results of laboratory tests, and our geotechnical recommendations for structure subgrade preparation and for use in the design and construction of foundations, floor slabs, exterior slabs, pavements, and utilities.

## A.4. Background Information and Reference Documents

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

- A soil boring diagram, prepared by Wold Architects and Engineers (Wold) and undated.

- Aerial photographs of the project area using Google Earth®.

- Aerial photographs from the Phase I Environmental Site Assessment Report

- Surficial Geology of the Twin Cities Metropolitan Area, Minnesota map prepared by the University of Minnesota, Minnesota Geological Survey. The map is identified as Map M-178, compiled by Gary N. Meyer and is dated 2007.

- Concept plans and layouts for "Option 1.5" and "Option 4," prepared by Wold, dated May 10, 2016.

## A.5. Site Conditions

The existing building is a multi-story, slab on grade structure supported on traditional spread footing foundations, with a main floor elevation of 824 feet Mean Sea Level (MSL). The southwestern portion of the existing building has a below grade parking garage with an access ramp near the proposed addition.

The proposed addition will occur in the southwest corner of the site, which is currently being used for surficial parking and drive lanes with small landscaped areas. The paved areas consist of bituminous pavement with concrete curb and gutter. The ground surface is relatively flat with elevations at the boring locations ranging from about 822 1/2 to 828 feet MSL.

# B. Results

## B.1. Boring Locations and Elevations

We performed 16 SPT borings (denoted as ST-1 to ST-16) for the project. The boring locations were determined by Wold based on the proposed location of site improvements and slightly modified in the field by Braun Intertec based on site access constraints. The SPT borings were staked by Braun Intertec personnel and performed at the approximate locations shown on the Soil Boring Location Sketch included in the Appendix.

Exploration locations and surface elevations at the exploration locations were determined using Global Positioning System (GPS) technology that utilizes the Minnesota Department of Transportation's (MnDOT's) permanent GPS Virtual Reference Network.

## B.2. Exploration Logs

### B.2.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 tests performed within them, laboratory tests performed on penetration test samples retrieved from them, and groundwater measurements.

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.2.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) available common knowledge of the geologic processes and environments that have impacted the site and surrounding area in the past, and (4) our experience at other sites in the area.

## B.3. Geologic Profile

### B.3.a. Geologic Materials

Based on the Surficial Geology Map for Hennepin County, near surface soils are expected to consist of sandy alluvial deposits, typically covered by artificial fill where land is developed.

The geology observed in samples retrieved from the SPT borings completed for this project was similar to that anticipated and generally consisted of a variable existing fill layer under the surficial topsoil or pavement that was further underlain by native alluvial soils to the boring termination depths. The following subsections describe the observed strata in greater detail.

### B.3.b. Pavement

A surficial pavement section consisting of bituminous underlain with aggregate base material was encountered at many of the boring locations. The following Table 1 summarizes the approximate measured bituminous and aggregate base thicknesses at the boring locations as measured to the nearest 1 inch.

**Table 1. Approximate Pavement Section Thicknesses**

| Boring | Bituminous Pavement (inches) | Aggregate Base* (inches) |
|---|---|---|
| ST-1 | 4 | 12 |
| ST-4 | 5 | 8 |
| ST-6 | 4 | 8 |
| ST-7 | 5 | 12 |
| ST-8 | 4 | 6 |
| ST-14 | 5 | 8 |
| ST-15 | 4 | 8 |
| ST-16 | 4 | 8 |

*Testing was not performed to evaluate whether the aggregate base complies with any regulatory specifications.

### B.3.c. Topsoil and Existing Fill

As an exception to the surficial pavements discussed above, approximately 1/2 to 1-foot of silty sand (SM), silty clayey sand (SC-SM), or sandy lean clay (CL) existing topsoil fill was encountered at the boring locations. The topsoil was generally dark brown to black in color.

Underlying the surficial pavement or existing topsoil fill discussed above, existing fill was generally observed in the borings to between 2 1/2 and 13 1/2 feet below grade. The existing fill generally consisted of silty clayey sand (SC-SM), silty sand (SM), and poorly graded sand with silt (SP-SM) that occasionally included clayey sand inclusions. The existing fill was generally dark brown in color and contained variable amounts of gravel. The existing fill was generally observed to be in a moist condition.

Varying amounts of construction debris (predominately concrete) was encountered within the existing fill in Borings ST-2, ST-3, ST-5, ST-9, ST-11, ST-14, and ST-16. This is relatively common at sites in developed urban areas.

Approximately 2 1/2 to 5 feet of buried silty sand or silty clayey sand topsoil was observed beneath the fill at Borings ST-9, ST-13, and ST-14.

### B.3.d. Alluvial Deposits

Underlying the existing fill and/or buried topsoil discussed above, alluvial sand deposits were observed to the boring termination depths. The alluvium generally included silty clayey sand, silty sand, and poorly graded sand with silt near the overlying materials and transitioned to poorly graded sand (SP) with depth. The native soils were generally brown to light brown in color and were judged to be in a dry to moist condition.

### B.3.e. Penetration Resistance Tests

The results of our penetration resistance testing from the borings are summarized below in Table 2. Comments are provided to qualify the significance of the results.

**Table 2. Penetration Resistance Data Summary**

| Geologic Material | Classification | Range of Penetration Resistances | Comments |
|---|---|---|---|
| Existing Fill | SM, SC-SM | 4 to 45 BPF* | Variably Compacted and Containing Debris |
| Buried Topsoil | SM, SC-SM | 4 to 13 BPF | Slightly Organic to Organic |
| Native Soils | SP, SP-SM, SM, SC-SM | 4 to 26 BPF | Locally Very Loose to Medium Dense, Generally Loose |

*BPF=blows per foot

#### B.3.f. Groundwater

Groundwater was not observed as our soil borings were advanced. After the last sample was taken at Boring ST-5, the boring was continued and blind drilled to a depth of 35 feet to check for groundwater presence at depth. However, groundwater was not encountered. Based on the moisture contents of the soil samples retrieved from the borings and our previous experiences in this area, we anticipate groundwater is currently below the depths explored. Seasonal and annual groundwater fluctuations, however, should be anticipated.

### B.4. Organic Vapor Measurements

At the time they were performed, materials retrieved from the soil borings were screened with a photoionization detector (PID) to detect volatile organic compounds (VOCs). Screening of the geologic materials encountered by the borings did not detect organic vapor concentrations above background levels. PID readings are shown on the right side of the Log of Boring Sheets included in the Appendix, adjacent to the tested samples. This is for informational purposes only. Environmental considerations at this site are addressed under separate cover.

### B.5. Laboratory Test Results

We performed mechanical analyses through the #200 sieve and moisture content tests in accordance with American Society for Testing and Materials (ASTM) procedures on select samples recovered from the SPT borings to further classify the materials and help determine their engineering properties. The laboratory test results are shown on the Log of Boring Sheets included in the Appendix, across from the associated soil samples.

## C. Basis for Recommendations

### C.1. Design Details

#### C.1.a. Building Addition and Loads

The project is in preliminary/conceptual stages, thus, no civil or structural plans are available. Additionally, as described in Section A.1, the project may consist of a one- or two- story layout option. The building loads will vary with the final design layout.

Assuming load estimations based on a two-story structure, the building addition would have maximum individual column loads of less than 300 kips and continuous (wall) loads of less than 10 kips per lineal foot (KLF). We have assumed interior floor slabs will support live loads of less than 150 pounds per square foot (PSF).

These values need to be verified and re-evaluated once final design plans have been established. A taller structure will result in higher anticipated loads.

### C.1.b. Site Grading

We understand the building addition finished floor elevation (FFE) will match the existing building grade of 824 feet MSL. Thus, earthwork cuts and fills of less than about 3 feet are anticipated across the site to reach finished grades. However, excavations will extend deeper for soil corrections within the building pad addition and for the buried infiltration system.

### C.1.c. Pavements

Information regarding anticipated traffic intensities was not available at this time. We have assumed that pavements at this site would be subjected to medium-duty loads from vehicle traffic and some daily delivery/garage truck type loading. Thus, we have assumed traffic loading will be less than 100,000 equivalent 18-kip single axle loads (ESALs) over an assumed design life of 20 years.

### C.1.d. Utilities

We assume existing standard below grade utilities, including storm sewer, sanitary sewer and watermain pipes may be relocated as part of the project. Furthermore, separate water and sewer services may be installed as part of the addition. Utility plans and invert elevations have not been provided at this time. We have assumed utility bearing depths will be within 8 to 12 feet of existing site grades.

Based on conversations with the design team, we understand the storm water improvements will include a buried infiltrations system below surface parking lot(s). We understand the buried system will likely have an invert elevation of about 815 feet MSL or about 10 feet below the ground surface, in the area of ST-5 to ST-8, ST-15, and ST-16.

### C.1.e. 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. This is conceptual design information, thus, 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. Additional evaluation and analysis will be necessary once final design plans have been established.

## C.2. Considerations Impacting Design and Construction

### C.2.a. Building Support

The soil boring results and our engineering analysis indicate the proposed exterior building addition can be supported with spread footing foundations and ground supported slabs with estimated post construction settlement amounts within typical allowable limits. However, to prepare the subgrade for building support, soil correction excavations and backfilling will be required to remove pavements, topsoil fill, existing utilities, undocumented fill, and buried topsoil.

### C.2.b. Building Pad Preparation

The borings encountered a layer of topsoil fill and undocumented fill ranging in depth from 2 1/2 to 13 1/2 feet below existing grade over native soils. A layer of buried topsoil was encountered below the fill in three of the soils borings, but could extend into other areas. Since the fill was either placed in landscaped areas or as undocumented fill, there is a risk the material was not placed in a manner suitable for building support and should be removed from below the building addition to help reduce the risk of settlement.

After removal and replacement of the unsuitable soils, the underlying native soils are anticipated to generally be suitable for building support.

Groundwater appears to be below the anticipated excavation depths and is not anticipated to adversely effect on site excavations.

### C.2.c. Undermining/Loading of Existing Foundations

Excavations for soil corrections of the building addition are anticipated to extend near the bearing depths of the spread footings of the existing building, which we anticipate are supported on suitable native soils or engineered fill. During excavation and construction of the new addition, care should be taken not to undermine the foundations of the existing building. Precautions as outlined in this report should be followed to reduce the risk of undermining any existing footings.

Similarly, building addition foundation units are anticipated near the existing poured concrete retaining walls associated with the access ramp for the underground parking garage. We assume the existing retaining wall design did not account for increased loading from future structures, therefore it is critical that the building addition foundation design does not add loads to the in-place retaining walls. Thus, consideration should be given for the new footing to bear at the same elevation of the existing footings.

### C.2.d. Reuse of On-site Soils

A portion of the existing fill removed during soil corrections is anticipated to consist of topsoil fill or buried topsoil (organic soils), which are not recommended for reuse as engineered fill. With the exception of organic soils, the on-site non-organic soils (fill and native) are generally anticipated to be suitable for reuse as engineered fill, assuming they are properly moisture conditioned. The borings and laboratory tests indicated the on-site soils are in a dry to moist condition and moisture conditioning should be anticipated to properly compact the soil as fill and backfill.

Concrete debris was noted throughout the fill, with lesser amounts of bituminous debris. Any concrete debris over 3 inches should be removed, prior to reuse. Bituminous debris is not recommended below the proposed building additions. The reuse of on-site soil assumes the soil is free of environmental contaminates. Contamination levels and recommendations for material placement/disposal can be found in the Phase II ESA Report, issued under separate cover and should be considered along with the recommendations of this report.

### C.2.e. Disturbance of On-site Soils

Native silty sand (SM) and silty clayey sand (SC-SM) was encountered in the soil borings below the fill. Silty and clayey soils have the potential to become disturbed during construction activities, especially if they are wet. Care should be taken not to disturb previously prepared subgrades.

### C.2.f. Pavement Areas

If pavements are reconstructed or new pavements added, we anticipate the non-organic existing fill soils and alluvial soils will generally be suitable for pavement support. Subgrade preparation in the pavement areas should be anticipated to generally consist of topsoil stripping (or removal of existing pavement), surface compaction of the exposed subgrades, and grading as needed.

## D. Recommendations

In accordance with our findings and discussions with the design team, the following sections provide our geotechnical recommendations for subgrade preparation and for use in the design and construction of foundations, floor slabs, exterior slabs, utilities, and pavements.

## D.1. Building Subgrade Preparation

### D.1.a. Soil Correction Excavations

For building pad preparation, we recommend removing any pavements, topsoil fill, buried topsoil, and existing fill soils from below the building foundations, slabs and oversize area. We also recommend any existing utilities be removed and relocated outside the building pad area.

The foundations and slabs can then be supported directly on new structural fill following the soil correction of the building pad. However, prior to fill or foundation placement we recommend the excavation bottom be observed by a geotechnical engineer, or their representative, to observe that the bottom soils are suitable for fill and/or foundation support.

Table 3 provides the anticipated soil correction depths at the soil boring locations in the area of the proposed addition. The final amount of correction will depend on the building addition option selected. Deeper excavations should be anticipated for removal of existing utilities and associated trench backfill. The values reference a floor elevation of 824 feet MSL and have been rounded down to the nearest 1/2-foot.

**Table 3. Anticipated Excavation Depths for Soil Correction**

| Boring | Ground Surface Elevation | Anticipated Depth of Excavation (feet) | Approximate Bottom Elevation (Estimated) | Approximate Depth Below Floor Elevation (824) |
|---|---|---|---|---|
| ST-1 | 823.5 | 9 | 814 1/2 | 9 1/2 |
| ST-2 | 823.9 | 12 | 811 1/2 | 12 1/2 |
| ST-3 | 824.2 | 7 1/2 | 816 1/2 | 7 1/2 |
| ST-4 | 824.2 | 4 1/2 | 819 1/2 | 4 1/2 |
| ST-5 | 826.4 | 5 | 821 | 3 |
| ST-8 | 825 | 4 1/2 | 820 1/2 | 3 1/2 |
| ST-9 | 823.6 | 14 1/2 | 809 | 15 |
| ST-10 | 823.8 | 11 | 812 1/2 | 11 1/2 |
| ST-11 | 823.5 | 13 1/2 | 810 | 14 |
| ST-12 | 823.1 | 7 | 816 | 8 |
| ST-13 | 823.1 | 9 1/2 | 813 1/2 | 10 1/2 |
| ST-14 | 822.7 | 9 | 813 1/2 | 10 1/2 |

Excavation depths will vary between the boring locations. Portions of the excavations may also be deeper than indicated by the borings. Contractors should also be prepared to extend excavations if deeper fill is encountered.

### D.1.b. Excavation Oversizing

To provide lateral support to replacement backfill, additional required fill and the structural loads they will support, we recommend oversizing (widening) the excavations 1 foot horizontally beyond the outer edges of the building perimeter footings for each foot the excavations extend below bottom-of-footing elevations (1H:1V oversizing).

### D.1.c. Excavations Near Existing Foundations

While the existing foundations are anticipated to be supported on suitable native soils or engineered fill, (a corrected pad) excavations to perform soil corrections for the building additions will extend near or below existing footing grades. The exact depth and proximity of these excavations to the existing footings will not be known until construction. To help prevent undermining of the existing foundations, we recommend soil correction or other excavations within 5 feet horizontally of the existing building footings only extend down to the tops of the existing footings. After reaching this depth, a geotechnical engineer should then observe the excavation bottom to evaluate the suitability of the soils near the existing foundation for support of the new floor slab and foundation.

If additional excavations are required below existing footing, we recommend they not enter the zone extending within a 1 1/2H:1V slope outward and downward from the bottom of the existing foundation. If this is not possible, underpinning or other methods of supporting and preventing undermining of the existing foundation may be required.

### D.1.d. Selecting Excavation Backfill and Additional Required Fill

On-site, non-organic soils may be used as structural backfill, assuming they can be properly compacted. If imported soils are needed, we recommend they consist of sands with less than 25 percent by weight passing the #200 sieve for uniformity with on-site soils. Any material to be used as engineered should be tested and approved by a geotechnical engineer prior to placement.

### D.1.e. Placement and Compaction of Backfill and Fill

We recommend the backfill and fill be placed in lifts not exceeding 8 inches in thickness. We recommend fill soils be compacted to the minimum densities summarized in Table 4, determined in accordance with American Society for Testing and Materials (ASTM) Test Method D 698 (standard Proctor). Granular fill classified as SP or SP-SM (with less than 12 percent by weight passing the #200 sieve) should be placed within 65 percent to 105 percent of its optimum moisture content as determined by the standard Proctor. Remaining fill soils should be placed within 3 percentage points above and 1 percentage point below its optimum moisture content as determined by the standard Proctor.

**Table 4. Compaction Recommendations Summary**

| Location | Minimum Compaction (Standard Proctor) |
|---|---|
| Below Foundations | 98% |
| Below Interior and Exterior Slabs | 95% |
| Landscape Areas | 90% |
| Within 3 feet of Pavement | 100% |
| Below 3 feet in Pavement Areas | 95% |

### D.1.f. Excavation Side Slopes

Most of the on-site soils generally appear to consist of soils meeting OSHA Type C soils which require a 1 1/2H:1V slope per OSHA. An OSHA approved competent person should review the excavation conditions in the field. If site constraints do not allow the construction of temporary slopes with these dimensions, then temporary shoring may be required, and we should be consulted for additional recommendations.

All excavations must comply with the requirements of OSHA 29 CFR, Part 1926, Subpart P, "Excavations and Trenches." This document states that excavation safety is the responsibility of the contractor. Reference to these OSHA requirements should be included in the project specifications.

## D.2. Spread Footings

### D.2.a. Embedment Depth

For frost protection, we recommend embedding perimeter footings a minimum depth of 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 or stoops a minimum of depth 60 inches below the lowest exterior grade.

For new building foundations constructed adjacent to the foundations and in-place retaining walls of the existing structures, we recommend the new foundations be constructed to bear at approximately the same elevation as the existing foundations. Foundations constructed above existing foundations can exert detrimental stresses on existing foundations and walls.

### D.2.b. Net Allowable Bearing Pressure

We anticipate foundations for the building addition will bear on new engineered fill following soil corrections and/or native alluvium. We recommend sizing spread footings bearing on these materials to exert a net allowable bearing pressure of 4,000 psf, including all transient loads. This value includes a safety factor of at least 3.0 with regard to bearing capacity failure. We recommend column footings be a minimum of 3 feet square and strip footings at least 2 feet wide.

### D.2.c. Settlement

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

Because the existing building will not likely settle along with the proposed addition, approximately up to 1/2-inch of differential settlement could occur between the existing building and the addition. To accommodate this settlement, we recommend this be accounted for during design.

## D.3. Interior Slabs

### D.3.a. Subgrade Modulus

Anticipating slabs will be placed on native clean sands or compacted clean sand fill, we recommend using a modulus of subgrade reaction, k, of 150 pounds per square inch per inch of deflection (pci) to design the slabs. If 6 inches of compacted aggregate base (such as MnDOT Class 5 aggregate base) is placed immediately below the floor slab, the k-value can be increased by 50 pounds per square inch. The clean sands on this site will likely not be stable for support of construction equipment. The aggregate will also help provide a more stable working surface for construction.

### D.3.b. Moisture Vapor Protection

If floor coverings or coatings less permeable than the concrete slab will be used, we recommend that a vapor retarder or vapor barrier be placed immediately beneath the slab. Floor covering manufacturers regarding the appropriate type, use, and installation of the vapor retarder or barrier to preserve warranty assurances.

## D.4. Rammed Aggregate Piers

Based on the anticipated depth of excavations that would be needed to remove the existing fill and organics from the building area, it appears that conventional soil corrections would be significant. Thus, as an alternative, subgrade improvements consisting of the installation of rammed aggregate piers could be performed to prepare portions of the building pad. They have been used on a variety of projects in Minnesota and throughout the Midwest, and are ideal in situations with previously placed fill or soft soils within 20 feet of the ground surface.

A subgrade improved with rammed aggregate piers will reduce the potential for detrimental settlement associated with the existing fill to occur, provide adequate bearing capacity, reduce potential impacts to adjacent site features, and reduce the volume of subgrade soils disturbed at this site.

### D.4.a. Typical Installation

Rammed aggregate piers are constructed by auguring a hole, removing the volume of soil from the hole, and building a column of clean, open graded aggregate. The column is constructed with aggregate placed in lifts using a compactor from the bottom up. The vibratory energy and ramming action causes the aggregate to interlock, forming a stiff pier that provides soil reinforcement and increases shear resistance. Installation of rammed aggregate piers is typically performed relatively quickly by a qualified contractor. We recommend that rammed aggregate piers be designed by a licensed engineer and installed by a specialty contractor with proven experience with this type of construction and in this region. An independent testing firm should be retained to observe the installation of the rammed aggregate piers. The observations should include installed length, consistency of soil profile with the geotechnical evaluation confirmation of the materials, and confirmation of installation techniques. Without field monitoring of installation we recommend that the factor of safety be increased.

We recommend rammed aggregate piers be installed under both foundations and floor slabs for the building. The rammed aggregate piers should extend through the existing fill to bear on the underlying alluvial soils.

### D.4.b. Net Allowable Bearing Pressure

After reinforcement with Rammed Aggregate Piers, the foundations may be designed as conventional spread footings, following the recommendations presented in section D.2.

#### D.4.c. Floor Slabs

We understand there is considerable cost savings to be gained by not performing soil corrections or installing rammed aggregate piers for support of floor slabs. In doing this there is some risk of detrimental settlement that could occur relative to the slabs. The risks include the possibility of buried debris, organics, poorly compacted fill, or other conditions which could allow soils to settle and lead to slab damage. However, due to the relatively light loads that the slabs will support, we believe this risk of settlement to be minimal. The owner must be willing to accept this risk if no corrective action is taken in slab areas.

If the owner is willing to accept this risk, the floor slab may be a conventional concrete slab-on-grade following recommendations in section D.3.

## D.5. Exterior Slabs

Though not necessarily designed to accommodate dead and live load surcharges or vehicles, exterior slabs can be subjected to both. Settlement of exterior slabs on poorly compacted foundation backfill, utility backfill, and other compressible naturally deposited soils or fills can also contribute to unfavorable surface drainage conditions and frost-related damage to the slabs and adjacent structures, including buildings and pavements. Subgrades supporting exterior slabs should therefore be prepared in accordance with the excavation and backfilling recommendations provided above in Section D.1. To accommodate the potential for exterior slabs bearing unanticipated traffic loads, we recommend compacting fill and backfill to 100 percent standard Proctor density. Below 3 feet of the exterior slab elevation, 95 percent relative compaction is acceptable. Additional commentary on the risks associated with frost, and recommendations for helping mitigate those risks, is provided in Section D.7.

## D.6. Pavements

#### D.6.a. Subgrade Preparation

For construction or reconstruction of paved areas, we first recommend stripping of existing pavements and other unsuitable or organic soils, if encountered. After stripping, we recommend the subgrade be surface compacted with a large self-propelled vibratory compactor. We recommend the existing subgrade be moisture conditioned to near optimum moisture content and surface compacted to a minimum of 100 percent of standard Proctor density if within 3 feet of the proposed pavement subgrade. If below 3 feet, surface compaction of 95 percent should be adequate.

If there are areas where the subgrade cannot be compacted, we recommend the upper 2 feet of the resulting subgrade be scarified to a moisture content not more than 2 percent above optimum and compacted to a minimum of 100 percent its standard Proctor maximum dry density. If there are areas that still cannot be compacted, we recommend that the unstable materials be subexcavated to a depth of 2 to 3 feet and be replaced by materials that can be compacted. However, actual subcut depths and replacement material should be reviewed by a geotechnical engineer in the field. Depending on the depth of the subcut and underlying material, suitable subcut backfill material could consist of MnDOT Granular Borrow, aggregate base, larger crushed aggregate, geogrid, or geotextile fabric.

### D.6.b. Design Sections

Laboratory tests to determine an R-value for pavement design were not included in the scope of this project. Based on the results of our borings and our experience with similar soils, we recommend an R-value of 30 be assumed for the site.

Based upon the assumed traffic loads and an R-value of 30, we recommend that new pavement sections include the materials and minimum thicknesses per Table 5.

**Table 5. Recommended Bituminous and Concrete Pavement Sections**

| Pavement Type | Layer | Thickness (inches) | MnDOT Specification |
|---|---|---|---|
| Flexible Pavement | Bituminous | 1 1/2 (Wear Course) | 2360 |
| | | 2 1/2 (Base Course) | |
| | Aggregate Base | 8 | 3138 |
| Rigid Pavement | Concrete* | 5 | 2301 |
| | Aggregate Base | 6 | 3138 |

*Concrete designs are based on a modulus of subgrade reaction (k) of 150 pci. Concrete at entrance canopies or other areas exposed to high volume turning should be reinforced.

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.6.c. Materials

We recommend that the bituminous wear and base courses meet the requirements of Specification 2360, Type SP. We recommend the aggregate gradations for the asphalt mixes meet Gradation B for the base course and Gradation A for the surface course. We recommend the Performance Graded Asphalt cement be a PG 64-28.

In accordance with the above recommendations, we recommend specifying the follow mixes:

- Base Course: SPNWB330E
- Wear Course: SPWEA340E

We recommend the aggregate base be compacted to a minimum of 100 percent of its maximum standard Proctor dry density. We recommend that the bituminous pavement be compacted to at least 92 percent of the maximum theoretical Rice density.

We recommend specifying concrete for pavements that has a minimum 28-day compressive strength of 4,000 psi, and a modulus of rupture (Mr) of at least 600 psi. We also recommend Type I cement meeting the requirements of ASTM C 150. We recommend specifying 5 to 7 percent entrained air for exposed concrete to provide resistance to freeze-thaw deterioration. We also recommend using a water/cement ratio of 0.45 or less for concrete exposed to deicers.

### D.6.d. Subgrade Drainage

We recommend installing perforated drainpipes throughout pavement areas at low points and about catch basins. The drainpipes should be placed in small trenches extended at least 8 inches below the aggregate base material.

## D.7. Frost Protection

Much of the exterior slabs and pavements will likely be underlain with sandy soils that are considered to be non- to slightly-frost susceptible. However, existing silty sand fill soils with clayey lenses and existing silty clayey sand fill were also observed near the ground surface. Soils of these types can retain moisture or heave upon freezing. However, once frozen, any excess water that drains to this soil will not infiltrate. If this water is not properly drained from the site, this undrained water will freeze and unfavorable amounts of general and isolated heaving of the related surface features could also develop. This type of heaving could impact design drainage patterns and the performance of the paved areas or exterior slabs. To address most of the heave related issues, we recommend the general site grades and grades for 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" shown to tolerate potential larger areas of heave which may not fully settle when thawed.

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 4 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. We anticipate such soils will be available on site.

An important geometric aspect of the excavation and replacement approach described above is sloping the banks of the excavations to create a more gradual transition between the unexcavated soils considered to be frost-susceptible and the excavation backfill which is not, to attenuate differential movement that may occur along the excavation boundary. We recommend 3H:1V banks along transitions between frost-susceptible and non-frost-susceptible soils.

Another option is to only protect critical areas, such as doorways and entrances, via stoops or localized excavations with sloped transitions between frost-susceptible and non-frost-susceptible soils as described above.

Regardless of what is done to the 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 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.

## D.8. Utilities

### D.8.a. Subgrade Stabilization

The soils encountered at typical utility invert elevations generally appear suitable for pipe support and we anticipate that utilities can be installed per the manufacturer's bedding requirements. However, if unstable or organic soils are encountered at pipe invert elevations, they should be subcut and replaced with crushed aggregate. Typical subcut depths below pipe invert grades are 1 to 2 feet, depending on the geologic conditions and proposed construction. We recommend a geotechnical engineer observe any utility trench excavations.

### D.8.b. Excavation Side Slopes

We recommend excavation side slopes be constructed in accordance with the recommendations provided in Section D.1.f. or trench boxes may be needed.

### D.8.c. Selection, Placement, and Compaction of Backfill

Utility backfill may consist of non-organic on-site soils that are readily compactable. The clayey or silty soils removed from the utility trenches will likely need to be moisture conditioned to allow for proper compaction as backfill or may need to be replaced with soils that can be properly compacted. Organic soils should not be used as trench backfill below structures or pavements.

We recommend placing and compacting utility backfill in accordance with the recommendations provided above in Section D.1.e. depending on what overlies the trench.

## D.9. Stormwater Improvements

We understand the project will require stormwater infiltration to meet requirements of the Nine Mile Creek watershed district. The buried infiltration system will likely infiltrate at a depth of about 10 feet below the ground surface in the area of ST-5 to ST-8, ST-15, and ST-16. Select samples from these soil borings were tested for grain size analysis and each was classified as SP or SP-SM soil. The results of the grain size analysis tests are attached in the appendix of this report.

We recommend using the infiltration rates presented in Table 6 below, which were obtained from Table 12.BIO.8 of the "Minnesota Storm Water Manual", Revised December 16, 2013, for infiltration basin design in conjunction with our opinion of expected levels. The rates below are based on soil classification and assume the soils are not saturated (i.e. above the local groundwater table).

**Table 6. Design Infiltration Rates**

| In Place Soil Types | Soil Description | Design Infiltration Rate (in/hr) |
|---|---|---|
| SP or SP-SM | Poorly Graded Sand or Poorly Graded Sand with Silt | 0.8† |
| SM | Silty Sand | 0.45 |
| SC or SC-SM | Clayey Sand or Silty Clayey Sand | 0.06 |

† The Minnesota Storm Water Manual does not provide an infiltration rate for soil meeting the ASTM Classification SP-SM, the provided rate represents our estimate.

It should be noted that soils meeting the ASTM Classification SP and SP-SM typically have higher infiltration rates than the values presented in the Minnesota Stormwater Manual. The accumulation of fine grained soils (silts and clays), topsoil or organic matter mixed into or washed onto the granular soil, will dramatically lower the permeability. These areas should be maintained and protected during construction. Additionally, when the system comes into use, organic matter and silt washed into the system can, over time, fill the soil pores and further reduce soil permeability. Proper maintenance is important for long term performance of infiltration systems.

If verification of the actual, in-place hydraulic conductivity/infiltration rate used for design is desired during or after construction, we recommend the testing of the hydraulic conductivity/infiltration rate be performed with a double ring Infiltrometer in accordance with ASTM D 3385 "Standard Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometers". We would be pleased to provide these services if required or requested. The tests should be performed directly on the planned infiltration basin subgrade.

## D.10. Construction Quality Control

### D.10.a. Special Inspection and Testing of Soils

We recommend having the excavation and placement of fill within the building pad be placed under the direction of Special Inspections as provided in Chapter 17, Section 1704.7 of the International Building Code. This requires the observation of soil or bedrock conditions below fill or footings, to evaluate if excavations extend to the anticipated soils and if fill material meets requirements for type of fill and compaction condition of fill. This work should include evaluation of the subgrade, note the preparation of the subgrade such as surface compaction, excavation oversizing, placement procedures and materials used for fill, and compaction testing of the fill.

This work should be carried out under the direction of a licensed geotechnical engineer. The purpose of these special inspections is to evaluate whether the work is being carried out in accordance with the approved Geotechnical Report for the project.

### D.10.b. Excavation Observations

We recommend having a geotechnical engineer observe any excavations related to subgrade preparation and spread footing, slab, and pavement construction. The purpose of the observations is to evaluate the competence of the geologic materials exposed in the excavations, and the adequacy of required excavation oversizing.

### D.10.c. Materials Testing

We recommend density tests be taken in excavation backfill and additional required fill placed below spread footings, slab construction, beside foundation walls, behind basement walls, and below pavements.

### D.10.d. Pavement Subgrade Proofroll

Prior to placing granular subbase and aggregate base material, we recommend proofrolling 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. Additional proofrolls should be performed after the granular subbase and aggregate base material is in place and prior to placing bituminous or concrete pavement.

We recommend that proofrolling of the pavement subgrades be observed by a geotechnical engineer to determine if the results of the procedure meet project specifications, or delineate the extent of additional pavement subgrade preparation work.

### D.10.e. Cold Weather Precautions

If site grading and construction is anticipated during cold weather, all snow and ice should be removed from cut and fill areas prior to additional grading. No fill should be placed on frozen subgrades. No frozen soils should be used as fill.

# E. Procedures

## E.1. Penetration Test Borings

The penetration test borings were drilled with a truck-mounted core 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- or 5-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 Test Method D 2488. A chart explaining the classification system is attached. Samples were sealed in jars 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 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 as noted on the boring logs.

# 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

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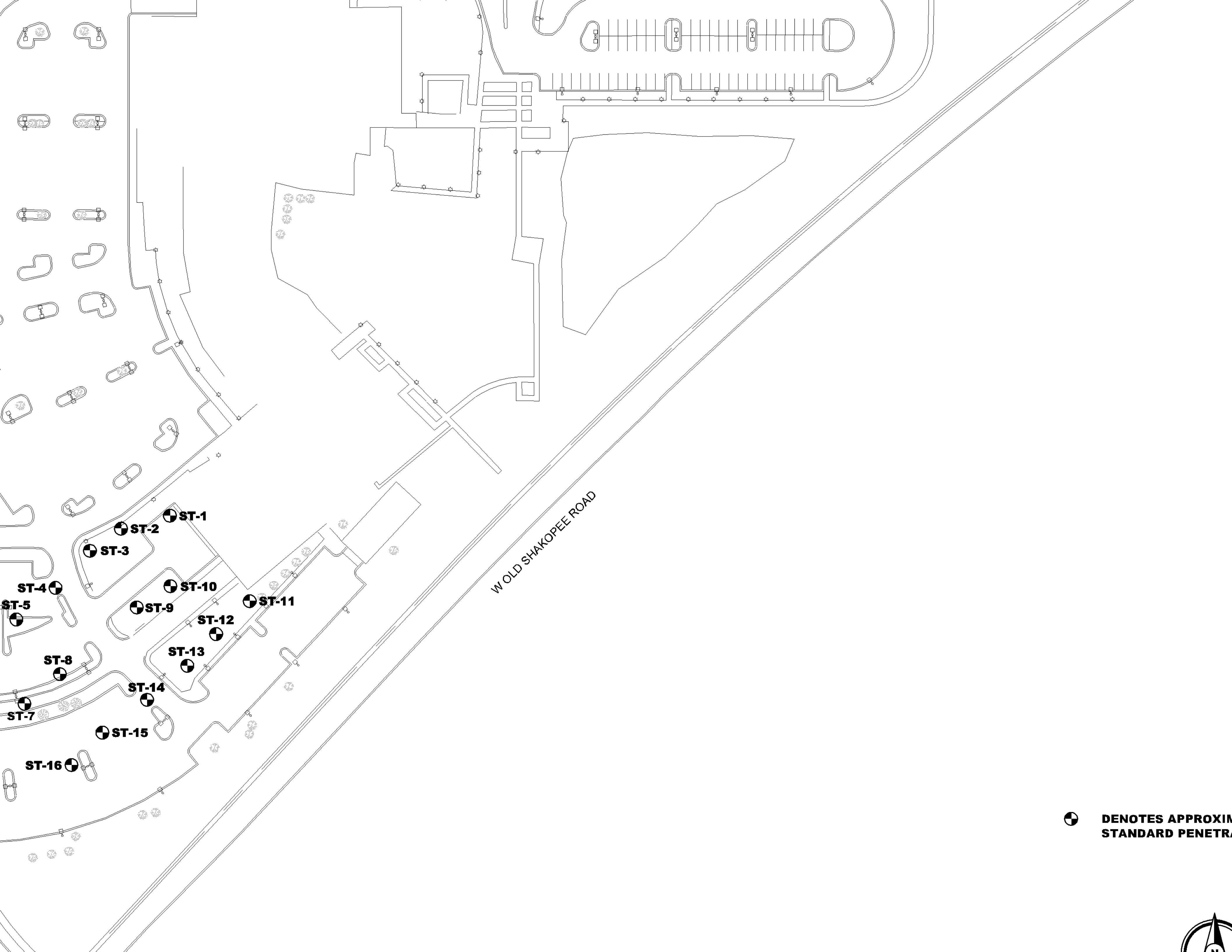
W OLD SHAKOPEE ROAD
ST-1
ST-2
ST-3
ST-4
ST-5
ST-7
ST-8
ST-9
ST-10
ST-11
ST-12
ST-13
ST-14
ST-15
ST-16
DENOTES APPROXIM
STANDARD PENETRA

# BRAUN INTERTEC

# LOG OF BORING

**Braun Project B1602323**
**GEOTECHNICAL EVALUATION**
**Southdale Courts Relocation Project**
**1800 West Old Shakopee Road**
**Bloomington, Minnesota**

BORING: **ST-1**

LOCATION: See attached sketch.

DRILLER: R. Hansen | METHOD: 3 1/4" HSA, Autohammer | DATE: **3/30/16** | SCALE: **1" = 4'**

| Elev. feet 823.5 | Depth feet 0.0 | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | MC % | PID ppm | Tests or Notes |
|---|---|---|---|---|---|---|---|---|
| 822.2 | 1.3 | PAV | 4 inches of bituminous over 12 inches of aggregate base. | | | | | Benchmark: Elevations were obtained using GPS and the State of Minnesota's permanent base station network. |
| | | FILL | FILL: Silty Sand, fine- to medium-grained, trace Gravel to with Gravel, dark brown to brown, moist. | 26 | | | 0.0 | |
| | | | | 15 | | | 0.0 | |
| 814.5 | 9.0 | | | 7 | | | 0.0 | |
| 811.5 | 12.0 | SC-SM | SILTY CLAYEY SAND, brown, moist, loose. (Alluvium) | 7 | | 18 | 0.0 | |
| 809.0 | 14.5 | SP-SM | POORLY GRADED SAND with SILT, fine- to medium-grained, brown, moist, very loose. (Alluvium) | 4 | | | 0.0 | |
| | | SP | POORLY GRADED SAND, fine- to medium-grained, light brown, moist, medium dense. (Alluvium) | 13 | | | 0.0 | |
| 802.5 | 21.0 | | | 13 | | | 0.0 | |
| | | | END OF BORING.<br>Water not observed while drilling.<br>Boring immediately backfilled. | | | | | |

(See Descriptive Terminology sheet for explanation of abbreviations)

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BRAUN℠ INTERTEC

# LOG OF BORING

| Braun Project B1602323<br>GEOTECHNICAL EVALUATION<br>Southdale Courts Relocation Project<br>1800 West Old Shakopee Road<br>Bloomington, Minnesota | BORING: ST-2<br>LOCATION: See attached sketch. |
|---|---|

| DRILLER: R. Hansen | METHOD: 3 1/4" HSA, Autohammer | DATE: 3/29/16 | SCALE: 1" = 4' |
|---|---|---|---|

| Elev. feet 823.9 | Depth feet 0.0 | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | MC % | PID ppm | Tests or Notes |
|---|---|---|---|---|---|---|---|---|
| 823.6 | 0.3 | FILL | FILL: Silty Sand, fine- to medium-grained, trace fibers, dark brown, moist. (Topsoil Fill) | | | | | |
| | | FILL | FILL: Silty Sand, trace Gravel, fine- to medium-grained, dark brown, moist. | 27 | | | 0.0 | |
| | | | Concrete debris noted at approximately 5 feet. | 27 | | 12 | 0.0 | |
| | | | | 14 | | | 0.0 | |
| 811.9 | 12.0 | | | 20 | | | | No recovery. |
| | | SP | POORLY GRADED SAND, fine- to medium-grained, light brown, moist, loose to medium dense. (Alluvium) | 10 | | | 0.0 | |
| | | | | 12 | | | 0.0 | |
| 802.9 | 21.0 | | | 26 | | | | No recovery. |
| | | | END OF BORING.<br>Water not observed while drilling.<br>Boring immediately backfilled. | | | | | |

(See Descriptive Terminology sheet for explanation of abbreviations)

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# BRAUN INTERTEC

# LOG OF BORING

**Braun Project B1602323**
**GEOTECHNICAL EVALUATION**
**Southdale Courts Relocation Project**
**1800 West Old Shakopee Road**
**Bloomington, Minnesota**

BORING: **ST-3**

LOCATION: See attached sketch.

DRILLER: R. Hansen | METHOD: 3 1/4" HSA, Autohammer | DATE: **3/29/16** | SCALE: **1" = 4'**

| Elev. feet 824.2 | Depth feet 0.0 | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | MC % | PID ppm | Tests or Notes |
|---|---|---|---|---|---|---|---|---|
| 823.6 | 0.6 | FILL | FILL: Silty Sand, fine- to medium-grained, with roots and fibers, dark brown, moist. (Topsoil Fill) | | | | | |
| | | FILL | FILL: Silty Sand, fine- to medium-grained, with Gravel, dark brown to brown, moist. Concrete and bituminous debris noted from approximately 2 1/2 to 5 feet. | 43 | | | 0.0 | |
| | | | | 21 | | | 0.0 | |
| 816.7 | 7.5 | SC-SM | SILTY CLAYEY SAND, brown, moist, loose. (Alluvium) | 8 | | 17 | 0.0 | |
| 814.7 | 9.5 | SP-SM | POORLY GRADED SAND with SILT, fine- to medium-grained, brown, moist, loose. (Alluvium) | 10 | | | 0.0 | |
| 812.2 | 12.0 | SP | POORLY GRADED SAND, fine- to medium-grained, light brown, moist, very loose to medium dense. (Alluvium) | 5 | | | 0.0 | |
| | | | | 4 | | | 0.0 | |
| | | | With Gravel at about 20 feet. | 18 | | | 0.0 | |
| 803.2 | 21.0 | | END OF BORING. Water not observed while drilling. Boring immediately backfilled. | | | | | |

(See Descriptive Terminology sheet for explanation of abbreviations)

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BRAUN INTERTEC

# LOG OF BORING

**Braun Project B1602323**
**GEOTECHNICAL EVALUATION**
**Southdale Courts Relocation Project**
**1800 West Old Shakopee Road**
**Bloomington, Minnesota**

BORING: **ST-4**

LOCATION: See attached sketch.

DRILLER: R. Hansen | METHOD: 3 1/4" HSA, Autohammer | DATE: **3/31/16** | SCALE: **1" = 4'**

| Elev. feet 824.2 | Depth feet 0.0 | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | MC % | PID ppm | Tests or Notes |
|---|---|---|---|---|---|---|---|---|
| 823.1 | 1.1 | PAV | 5 inches of bituminous over 8 inches of aggregate base. | | | | | |
| | | FILL | FILL: Silty Clayey Sand, trace Gravel, dark brown, moist. | 18 | | | 0.0 | |
| 819.7 | 4.5 | | | | | | | |
| | | SM | SILTY SAND, fine-grained, brown, moist, loose. (Alluvium) | 7 | | 11 | 0.0 | |
| 817.2 | 7.0 | | | | | | | |
| | | SP | POORLY GRADED SAND, fine- to medium-grained, light brown, moist, loose to medium dense. (Alluvium) | 8 | | | 0.0 | |
| | | | | 7 | | | 0.0 | |
| | | | | 12 | | 5 | 0.0 | P200=4% |
| | | | | 10 | | | 0.0 | |
| | | | With Gravel at about 20 feet. | 19 | | | 0.0 | |
| 803.2 | 21.0 | | | | | | | |
| | | | END OF BORING.<br><br>Water not observed while drilling.<br><br>Boring immediately backfilled. | | | | | |

(See Descriptive Terminology sheet for explanation of abbreviations)

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# BRAUN INTERTEC

# LOG OF BORING

**Braun Project B1602323**
**GEOTECHNICAL EVALUATION**
**Southdale Courts Relocation Project**
**1800 West Old Shakopee Road**
**Bloomington, Minnesota**

BORING: **ST-5**

LOCATION: See attached sketch.

DRILLER: R. Hansen | METHOD: 3 1/4" HSA, Autohammer | DATE: **3/31/16** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

| Elev. feet 826.4 | Depth feet 0.0 | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | MC % | PID ppm | Tests or Notes |
|---|---|---|---|---|---|---|---|---|
| 826.2 | 0.3 | FILL | FILL: Silty Sand, fine- to medium-grained, trace fibers, black, moist. (Topsoil Fill) | | | | | |
| 821.4 | 5.0 | FILL | FILL: Silty Clayey Sand, trace Gravel, gray and brown, moist. Concrete debris noted at about 2 1/2 feet. | 30 | | | 0.0 | |
| 819.4 | 7.0 | SP-SM | POORLY GRADED SAND with SILT, fine- to medium-grained, brown, moist, medium dense. (Alluvium) | 15 | | | 0.0 | |
| 807.4 | 19.0 | SP | POORLY GRADED SAND, fine- to medium-grained, light brown, dry to moist, loose. (Alluvium) | 7 | | 3 | 0.0 | P200=4% |
| | | | | 8 | | | 0.0 | |
| | | | | 8 | | | 0.0 | |
| | | | | 6 | | | 0.0 | |
| 805.4 | 21.0 | SP | POORLY GRADED SAND, fine- to coarse-grained, trace Gravel, brown, moist, loose. (Alluvium) | 10 | | | 0.0 | |
| | | | Blind drilled to 35 feet to check for groundwater. No sampling performed. | | | | | |

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# LOG OF BORING

| **Braun Project B1602323**<br>**GEOTECHNICAL EVALUATION**<br>**Southdale Courts Relocation Project**<br>**1800 West Old Shakopee Road**<br>**Bloomington, Minnesota** | BORING: **ST-5 (cont.)**<br>LOCATION: See attached sketch. |
|---|---|

| DRILLER: R. Hansen | METHOD: 3 1/4" HSA, Autohammer | DATE: **3/31/16** | SCALE: **1" = 4'** |
|---|---|---|---|

| Elev. feet 794.4 | Depth feet 32.0 | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | MC % | PID ppm | Tests or Notes |
|---|---|---|---|---|---|---|---|---|
| | | | Blind drilled to 35 feet to check for groundwater. No sampling performed. *(continued)* | | | | | |
| 791.4 | 35.0 | | | | | | | |
| | | | END OF BORING.<br><br>Water not observed while drilling.<br><br>Boring immediately backfilled. | | | | 0.0 | |

(See Descriptive Terminology sheet for explanation of abbreviations)

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# LOG OF BORING

**Braun Project B1602323**
**GEOTECHNICAL EVALUATION**
**Southdale Courts Relocation Project**
**1800 West Old Shakopee Road**
**Bloomington, Minnesota**

BORING: **ST-6**

LOCATION: See attached sketch.

DRILLER: R. Hansen | METHOD: 3 1/4" HSA, Autohammer | DATE: **3/31/16** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

| Elev. feet 827.9 | Depth feet 0.0 | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | MC % | PID ppm | Tests or Notes |
|---|---|---|---|---|---|---|---|---|
| 826.9 | 1.0 | PAV | 4 inches of bituminous over 8 inches of aggregate base. | | | | | |
| 825.4 | 2.5 | FILL | FILL: Silty Sand, fine- to medium-grained, brown, moist. | | | | | |
| 823.4 | 4.5 | SP-SM | POORLY GRADED SAND with SILT, fine- to medium-grained, brown, moist, medium dense. (Alluvium) | 13 | | | 0.0 | |
| 813.9 | 14.0 | SP | POORLY GRADED SAND, fine- to medium-grained, light brown, dry to moist, loose. (Alluvium) | 9 | | | 0.0 | |
| | | | | 9 | | | 0.0 | |
| | | | | 5 | | 3 | 0.0 | P200=2% See Grain Size Accumulation Curve. |
| | | | | 6 | | | 0.0 | |
| 811.9 | 16.0 | SP | POORLY GRADED SAND, fine- to coarse-grained, trace Gravel, brown, moist, medium dense. (Alluvium) | 12 | | | 0.0 | |
| | | | END OF BORING.<br><br>Water not observed while drilling.<br><br>Boring immediately backfilled. | | | | | |

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# LOG OF BORING

**Braun Project B1602323**
**GEOTECHNICAL EVALUATION**
**Southdale Courts Relocation Project**
**1800 West Old Shakopee Road**
**Bloomington, Minnesota**

BORING: **ST-7**

LOCATION: See attached sketch.

| DRILLER: R. Hansen | METHOD: 3 1/4" HSA, Autohammer | DATE: **3/29/16** | SCALE: **1" = 4'** |
|---|---|---|---|

| Elev. feet 827.0 | Depth feet 0.0 | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | MC % | PID ppm | Tests or Notes |
|---|---|---|---|---|---|---|---|---|
| 825.6 | 1.4 | PAV | 5 inches of bituminous over 12 inches of aggregate base. | | | | | |
| 819.5 | 7.5 | FILL | FILL: Silty Sand, fine- to medium-grained, dark brown to brown, moist. | 25 | | | 0.0 | |
| | | | | 9 | | 8 | 0.0 | |
| | | | Trace concrete debris noted at about 7 feet. | | | | | |
| 813.5 | 13.5 | SP | POORLY GRADED SAND, fine- to medium-grained, light brown, dry, loose. (Alluvium) | 6 | | | 0.0 | |
| | | | | 6 | | 2 | 0.0 | |
| | | | | 6 | | | 0.0 | |
| 811.0 | 16.0 | SP | POORLY GRADED SAND, medium- to coarse-grained, trace Gravel, brown, moist, loose. (Alluvium) | 7 | | | 0.0 | |
| | | | END OF BORING. | | | | | |
| | | | Water not observed while drilling. | | | | | |
| | | | Boring immediately backfilled. | | | | | |

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2016\02323.GPJ BRAUN_V8_CURRENT.GDT 6/20/16 14:03

BRAUN℠ INTERTEC

# LOG OF BORING

**Braun Project B1602323**
**GEOTECHNICAL EVALUATION**
**Southdale Courts Relocation Project**
**1800 West Old Shakopee Road**
**Bloomington, Minnesota**

BORING: **ST-8**

LOCATION: See attached sketch.

| DRILLER: R. Hansen | METHOD: 3 1/4" HSA, Autohammer | DATE: **3/29/16** | SCALE: **1" = 4'** |
|---|---|---|---|

| Elev. feet 825.0 | Depth feet 0.0 | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | MC % | PID ppm | Tests or Notes |
|---|---|---|---|---|---|---|---|---|
| 824.2 | 0.8 | PAV | 4 inches of bituminous over 6 inches of aggregate base. | | | | | |
| 820.5 | 4.5 | FILL | FILL: Silty Sand, fine- to medium-grained, trace Gravel, dark brown to brown, moist. | 11 | | | 0.0 | |
| 815.5 | 9.5 | SP-SM | POORLY GRADED SAND with SILT, fine- to medium-grained, brown, moist, loose. (Alluvium) | 10 | | | 0.0 | |
| | | | | 8 | | 6 | 0.0 | P200=6% See Grain Size Accumulation Curve. |
| 810.5 | 14.5 | SP | POORLY GRADED SAND, fine- to medium-grained, light brown, moist, loose. (Alluvium) | 8 | | | 0.0 | |
| | | | | 10 | | | 0.0 | |
| 804.0 | 21.0 | SP | POORLY GRADED SAND, fine- to coarse-grained, trace Gravel, brown, moist, loose to medium dense. (Alluvium) | 10 | | | 0.0 | |
| | | | | 14 | | | 0.0 | |

END OF BORING.

Water not observed while drilling.

Boring immediately backfilled.

(See Descriptive Terminology sheet for explanation of abbreviations)

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# BRAUN INTERTEC

# LOG OF BORING

**Braun Project B1602323**
**GEOTECHNICAL EVALUATION**
**Southdale Courts Relocation Project**
**1800 West Old Shakopee Road**
**Bloomington, Minnesota**

BORING: **ST-9**

LOCATION: See attached sketch.

DRILLER: R. Hansen | METHOD: 3 1/4" HSA, Autohammer | DATE: **3/29/16** | SCALE: **1" = 4'**

| Elev. feet 823.6 | Depth feet 0.0 | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | MC % | PID ppm | Tests or Notes |
|---|---|---|---|---|---|---|---|---|
| 823.1 | 0.5 | FILL | FILL: Silty Sand, fine-grained, with roots and fibers, dark brown, moist. (Topsoil Fill) | | | | | |
| | | FILL | FILL: Silty Sand, fine- to medium-grained, trace Gravel, brownish gray to dark brown, moist. | 45 | | | 0.0 | |
| 818.1 | 5.5 | | | 22 | | 10 | 0.0 | |
| | | FILL | FILL: Poorly Graded Sand with Silt, fine- to medium-grained, brown, moist. | 16 | | | 0.0 | |
| 814.1 | 9.5 | | Concrete debris noted at about 9 1/2 feet. | | | | | |
| | | TS | SILTY CLAYEY SAND, fine-grained, black to dark brown, moist. (Buried Topsoil) | 4 | | | 0.0 | |
| | | | | 5 | | | 0.0 | |
| 809.1 | 14.5 | | | | | | | |
| | | SP | POORLY GRADED SAND, fine- to medium-grained, brown, moist, loose. (Alluvium) | 7 | | | 0.0 | |
| | | | | 6 | | | 0.0 | |
| 802.6 | 21.0 | | | | | | | |
| | | | END OF BORING.<br>Water not observed while drilling.<br>Boring immediately backfilled. | | | | | |

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2016\02323.GPJ BRAUN_V8_CURRENT.GDT 6/20/16 14:03

BRAUN℠ INTERTEC

# LOG OF BORING

**Braun Project B1602323**
**GEOTECHNICAL EVALUATION**
**Southdale Courts Relocation Project**
**1800 West Old Shakopee Road**
**Bloomington, Minnesota**

BORING: **ST-10**

LOCATION: See attached sketch.

DRILLER: R. Hansen | METHOD: 3 1/4" HSA, Autohammer | DATE: **3/29/16** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

| Elev. feet 823.8 | Depth feet 0.0 | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | MC % | PID ppm | Tests or Notes |
|---|---|---|---|---|---|---|---|---|
| 823.3 | 0.5 | FILL | FILL: Silty Sand, fine- to medium-grained, with roots and fibers, black, moist. (Topsoil Fill) | | | | | |
| | | FILL | FILL: Silty Sand, fine- to medium-grained, brown to dark brown, moist. | 24 | | 8 | 0.0 | |
| | | | | 15 | | | 0.0 | |
| 816.8 | 7.0 | FILL | FILL: Poorly Graded Sand with Silt, fine- to medium-grained, with clayey layers, brown, moist. | 16 | | | 0.0 | |
| | | | | 16 | | 8 | 0.0 | |
| 812.8 | 11.0 | SP | POORLY GRADED SAND, fine- to medium-grained, light brown, moist, medium dense to loose. (Alluvium) | 15 | | | 0.0 | |
| | | | | 9 | | | 0.0 | |
| | | | | 6 | | | 0.0 | |
| 802.8 | 21.0 | | END OF BORING.<br>Water not observed while drilling.<br>Boring immediately backfilled. | | | | | |

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# BRAUN INTERTEC

# LOG OF BORING

**Braun Project B1602323**
**GEOTECHNICAL EVALUATION**
**Southdale Courts Relocation Project**
**1800 West Old Shakopee Road**
**Bloomington, Minnesota**

BORING: **ST-11**

LOCATION: See attached sketch.

DRILLER: R. Hansen | METHOD: 3 1/4" HSA, Autohammer | DATE: **3/30/16** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

| Elev. feet 823.5 | Depth feet 0.0 | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | MC % | PID ppm | Tests or Notes |
|---|---|---|---|---|---|---|---|---|
| 823.2 | 0.3 | FILL | FILL: Silty Sand, fine- to medium-grained, with roots and fibers, dark brown, moist. (Topsoil Fill) | | | | | |
| 819.0 | 4.5 | FILL | FILL: Silty Sand, fine- to medium-grained, trace Gravel, dark brown, moist. | 20 | | | 0.0 | |
| 816.5 | 7.0 | FILL | FILL: Poorly Graded Sand with Silt, fine- to medium-grained, trace Gravel, brown, moist. Concrete debris noted at about 5 feet. | 22 | | | 0.0 | |
| 810.0 | 13.5 | FILL | FILL: Silty Sand, fine- to medium-grained, trace Gravel, brown, moist. | 26 | | 8 | 0.0 | |
| | | | | 19 | | | 0.0 | |
| | | | | 5 | | | 0.0 | |
| 804.5 | 19.0 | SP | POORLY GRADED SAND, fine- to medium-grained, trace Gravel, light brown, moist, medium dense. (Alluvium) | 17 | | | 0.0 | |
| 802.5 | 21.0 | SP | POORLY GRADED SAND, medium- to coarse-grained, brown, moist, medium dense. (Alluvium) | 13 | | | 0.0 | |
| | | | END OF BORING. Water not observed while drilling. Boring immediately backfilled. | | | | | |

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BRAUN INTERTEC

# LOG OF BORING

| Braun Project B1602323<br>GEOTECHNICAL EVALUATION<br>Southdale Courts Relocation Project<br>1800 West Old Shakopee Road<br>Bloomington, Minnesota | BORING: ST-12<br>LOCATION: See attached sketch. |
|---|---|

| DRILLER: R. Hansen | METHOD: 3 1/4" HSA, Autohammer | DATE: 3/30/16 | SCALE: 1" = 4' |
|---|---|---|---|

| Elev. feet 823.1 | Depth feet 0.0 | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | MC % | PID ppm | Tests or Notes |
|---|---|---|---|---|---|---|---|---|
| 822.9 | 0.3 | FILL | FILL: Silty Clayey Sand, fine- to medium-grained, roots and fibers, dark brown, moist. (Topsoil Fill) | | | | | |
| 818.6 | 4.5 | FILL | FILL: Silty Clayey Sand, trace Gravel, dark brown. | 15 | | | 0.0 | |
| 816.1 | 7.0 | FILL | FILL: Silty Sand, fine- to medium-grained, brown, moist. | 24 | | 7 | 0.0 | |
| 813.6 | 9.5 | SC-SM | SILTY CLAYEY SAND, brown, moist, medium dense. (Alluvium) | 13 | | | 0.0 | |
| 811.1 | 12.0 | SP-SM | POORLY GRADED SAND with SILT, fine- to medium-grained, brown, moist, loose. (Alluvium) | 7 | | | 0.0 | |
| 802.1 | 21.0 | SP | POORLY GRADED SAND, fine- to medium-grained, light brown, moist, loose to medium dense. (Alluvium) | 9 | | | 0.0 | |
| | | | | 13 | | | 0.0 | |
| | | | | 25 | | | 0.0 | |

END OF BORING.

Water not observed while drilling.

Boring immediately backfilled.

(See Descriptive Terminology sheet for explanation of abbreviations)

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BRAUN[SM] INTERTEC

# LOG OF BORING

**Braun Project B1602323**
**GEOTECHNICAL EVALUATION**
**Southdale Courts Relocation Project**
**1800 West Old Shakopee Road**
**Bloomington, Minnesota**

BORING: **ST-13**

LOCATION: See attached sketch.

DRILLER: R. Hansen | METHOD: 3 1/4" HSA, Autohammer | DATE: **3/31/16** | SCALE: **1" = 4'**

| Elev. feet 823.1 | Depth feet 0.0 | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | MC % | PID ppm | Tests or Notes |
|---|---|---|---|---|---|---|---|---|
| 822.6 | 0.5 | FILL | FILL: Sandy Lean Clay, trace roots, dark brown, moist. (Topsoil Fill) | | | | | |
| 819.1 | 4.0 | FILL | FILL: Silty Sand, fine- to medium-grained, trace bituminous, dark brown, moist. | 14 | | | 0.0 | |
| 816.1 | 7.0 | FILL | FILL: Poorly Graded Sand with Silt, fine- to medium-grained, with Gravel, brown, moist. | 36 | | | 0.0 | |
| 813.6 | 9.5 | TS | SILTY SAND, fine- to medium-grained, black to dark brown, moist. (Buried Topsoil) | 6 | | | 0.0 | |
| 811.1 | 12.0 | SM | SILTY SAND, fine-grained, brown, moist, loose. (Alluvium) | 7 | | 12 | 0.0 | |
| 808.6 | 14.5 | SP-SM | POORLY GRADED SAND with SILT, fine- to medium-grained, brown, moist, loose. (Alluvium) | 8 | | | 0.0 | |
| 802.1 | 21.0 | SP | POORLY GRADED SAND, fine- to medium-grained, light brown, moist, loose to medium dense. (Alluvium) | 9<br>13 | | | 0.0<br>0.0 | |
| | | | END OF BORING.<br>Water not observed while drilling.<br>Boring immediately backfilled. | | | | | |

(See Descriptive Terminology sheet for explanation of abbreviations)

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**Braun Project B1602323**
**GEOTECHNICAL EVALUATION**
**Southdale Courts Relocation Project**
**1800 West Old Shakopee Road**
**Bloomington, Minnesota**

BORING: **ST-14**
LOCATION: See attached sketch.

DRILLER: R. Hansen | METHOD: 3 1/4" HSA, Autohammer | DATE: **3/30/16** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

| Elev. feet 822.7 | Depth feet 0.0 | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | MC % | PID ppm | Tests or Notes |
|---|---|---|---|---|---|---|---|---|
| 821.6 | 1.1 | PAV | 5 inches of bituminous over 8 inches of aggregate base. | | | | | |
| 818.2 | 4.5 | FILL | FILL: Silty Sand, fine- to medium-grained, trace Gravel, grayish brown to dark brown, moist. Concrete debris noted at about 2 1/2 feet. | 34 | | | 1.5 | |
| 813.7 | 9.0 | TS | SILTY SAND, fine- to medium-grained, black to dark brown, moist. (Buried Topsoil) | 13 | | | 0.0 | |
| | | | | 9 | | | 0.0 | |
| 808.7 | 14.0 | SC-SM | SILTY CLAYEY SAND, dark brown to brown, moist, loose to medium dense. (Alluvium) | 7 | | | 0.0 | |
| | | | | 11 | | 18 | 0.0 | P200=22% |
| 803.7 | 19.0 | SP-SM | POORLY GRADED SAND with SILT, fine- to medium-grained, brown, moist, loose. (Alluvium) | 8 | | | 0.0 | |
| 793.7 | 29.0 | SP | POORLY GRADED SAND, fine- to medium-grained, light brown, moist, loose to medium dense. (Alluvium) | 7 | | | 0.0 | |
| | | | | 13 | | | 0.0 | |
| | | SP | POORLY GRADED SAND, fine- to coarse-grained, trace Gravel, brown, moist, medium dense. (Alluvium) | 22 | | | 0.0 | |

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**BRAUN INTERTEC**

# LOG OF BORING

**Braun Project B1602323**
**GEOTECHNICAL EVALUATION**
**Southdale Courts Relocation Project**
**1800 West Old Shakopee Road**
**Bloomington, Minnesota**

BORING: **ST-14 (cont.)**

LOCATION: See attached sketch.

DRILLER: R. Hansen | METHOD: 3 1/4" HSA, Autohammer | DATE: **3/30/16** | SCALE: **1" = 4'**

| Elev. feet 790.7 | Depth feet 32.0 | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | MC % | PID ppm | Tests or Notes |
|---|---|---|---|---|---|---|---|---|
| | | | POORLY GRADED SAND, fine- to coarse-grained, trace Gravel, brown, moist, medium dense. (Alluvium) *(continued)* | 22 | | | 0.0 | |
| 786.7 | 36.0 | | END OF BORING. | | | | | |
| | | | Water not observed while drilling. | | | | | |
| | | | Boring immediately backfilled. | | | | | |

(See Descriptive Terminology sheet for explanation of abbreviations)

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# BRAUN INTERTEC

# LOG OF BORING

| Braun Project B1602323<br>GEOTECHNICAL EVALUATION<br>Southdale Courts Relocation Project<br>1800 West Old Shakopee Road<br>Bloomington, Minnesota | BORING: ST-15<br>LOCATION: See attached sketch. |
|---|---|

| DRILLER: R. Hansen | METHOD: 3 1/4" HSA, Autohammer | DATE: 3/30/16 | SCALE: 1" = 4' |
|---|---|---|---|

| Elev. feet 824.4 | Depth feet 0.0 | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | MC % | PID ppm | Tests or Notes |
|---|---|---|---|---|---|---|---|---|
| 823.4 | 1.0 | PAV | 4 inches of bituminous over 8 inches of aggregate base. | | | | | |
| | | FILL | FILL: Silty Sand, fine- to medium-grained, trace Gravel, brown, moist. | 17 | | | 0.0 | |
| | | | | 12 | | | 0.0 | |
| 816.9 | 7.5 | SM | SILTY SAND, fine-grained, dark brown to brown, wet, loose. (Alluvium) | 5 | | | 0.0 | |
| | | | | 7 | | | 0.0 | |
| 812.9 | 11.5 | SP | POORLY GRADED SAND, fine- to medium-grained, light brown, wet, medium dense. (Alluvium) | 12 | | 6 | 0.0 | P200=5% See Grain Size Accumulation Curve. |
| | | | | 13 | | | 0.0 | |
| 808.4 | 16.0 | | END OF BORING.<br>Water not observed while drilling.<br>Boring immediately backfilled. | | | | | |

(See Descriptive Terminology sheet for explanation of abbreviations)

BRAUN℠ INTERTEC

# LOG OF BORING

**Braun Project B1602323**
**GEOTECHNICAL EVALUATION**
**Southdale Courts Relocation Project**
**1800 West Old Shakopee Road**
**Bloomington, Minnesota**

BORING: **ST-16**

LOCATION: See attached sketch.

DRILLER: R. Hansen | METHOD: 3 1/4" HSA, Autohammer | DATE: **3/30/16** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

| Elev. feet 825.7 | Depth feet 0.0 | Symbol | Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908) | BPF | WL | MC % | PID ppm | Tests or Notes |
|---|---|---|---|---|---|---|---|---|
| 824.7 | 1.0 | PAV | 4 inches of bituminous over 8 inches of aggregate base. | | | | | |
| | | FILL | FILL: Silty Sand, fine- to medium-grained, trace Gravel to with Gravel, grayish brown, moist. | 22 | | | 0.0 | |
| | | | Concrete debris noted at about 2 1/2 feet. | 17 | | | 0.0 | |
| 818.2 | 7.5 | SP-SM | POORLY GRADED SAND with SILT, fine- to medium-grained, light brown, moist, medium dense. (Alluvium) | 12 | | | 0.0 | |
| | | | | 14 | | 4 | 0.0 | P200=6% |
| 813.7 | 12.0 | SP | POORLY GRADED SAND, fine- to medium-grained, light brown, moist, medium dense. (Alluvium) | 13 | | | 0.0 | |
| | | | | 18 | | | 0.0 | |
| 809.7 | 16.0 | | END OF BORING. | | | | | |
| | | | Water not observed while drilling. | | | | | |
| | | | Boring immediately backfilled. | | | | | |

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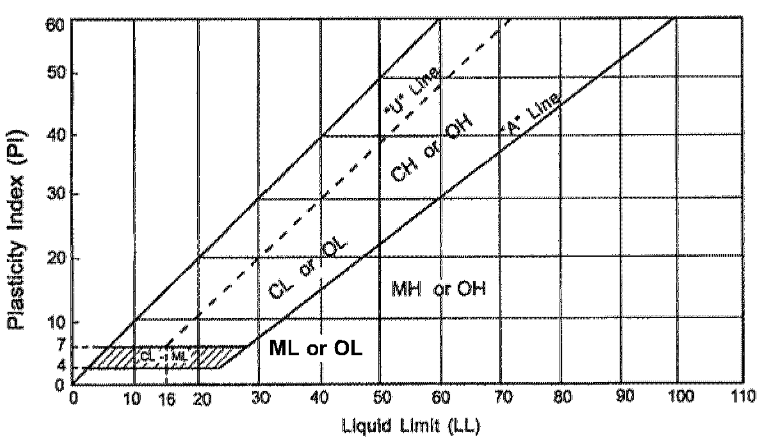
**BRAUN INTERTEC**

# Descriptive Terminology of Soil

Standard D 2487
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 | Soils Classification: 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 Less than 5% 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 Less than 5% 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-inch (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. Sand 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" lines.
q. PI plots below "A" line.




### Laboratory Tests

| | | | |
|---|---|---|---|
| **DD** | Dry density, pcf | **OC** | Organic content, % |
| **WD** | Wet density, pcg | **S** | Percent of saturation, % |
| **MC** | Natural moisture content, % | **SG** | Specific gravity |
| **LL** | Liquid limit, % | **C** | Cohesion, psf |
| **PL** | Plastic limits, % | **Ø** | 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 about "A" line

### Relative Density of Cohesionless Soils

Very Loose............ 0 to 4 BPF
Loose..................... 5 to 10 BPF
Medium dense ....... 11 to 30 PPF
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. All samples were taken with the standard 2" OD split-tube samples, except where noted.

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

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.

**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.

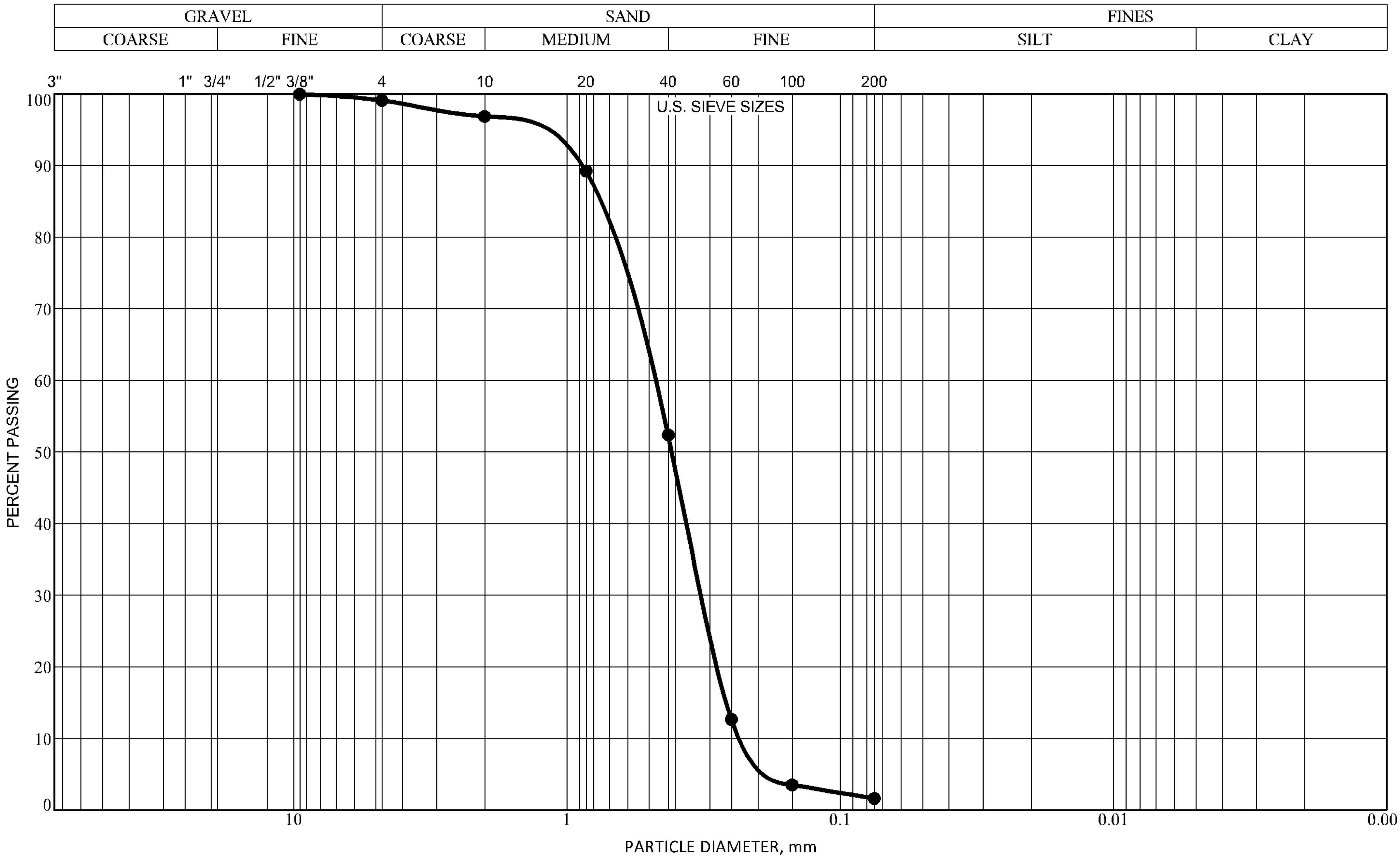
**WH:** WH indicates the sampler penetrated soil under weight of hammer and rods alone; driving not required.

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

**TW:** TW indicates thin-walled (undisturbed) tube sample.

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

# GRAIN SIZE ACCUMULATION CURVE (ASTM)




**Braun Project B1602323**
**GEOTECHNICAL EVALUATION**
**Southdale Courts Relocation Project**
**1800 West Old Shakopee Road**
**Bloomington, Minnesota**
BORING: ST-6 DEPTH: 10.0'

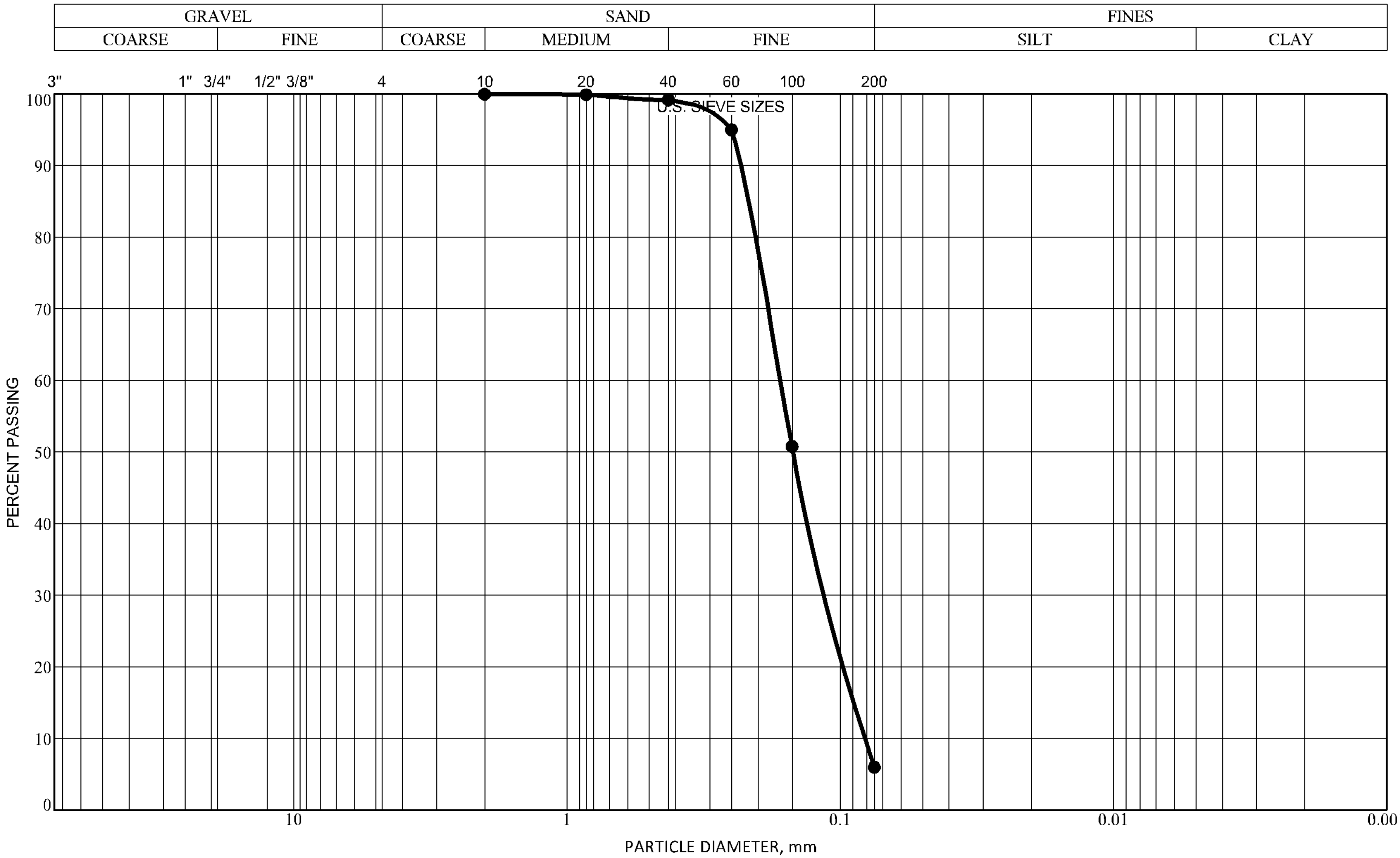
| | |
|---|---|
| GRAVEL | 0.9% |
| SAND | 97.5% |
| FINES | 1.7% |
| D60=0.490 | Cu=2.3 |
| D30=0.315 | Cc=0.9 |
| D10=0.215 | |

CLASSIFICATION:
POORLY GRADED SAND(SP)



GS ASTM N:\GINT\PROJECTS\X-GEOLAB\1-GINT FILES\AX PROJECTS GEO LAB\2016\B1602323.GPJ BRAUN_V8_CURRENT.GDT 4/12/16 14:03

# GRAIN SIZE ACCUMULATION CURVE (ASTM)



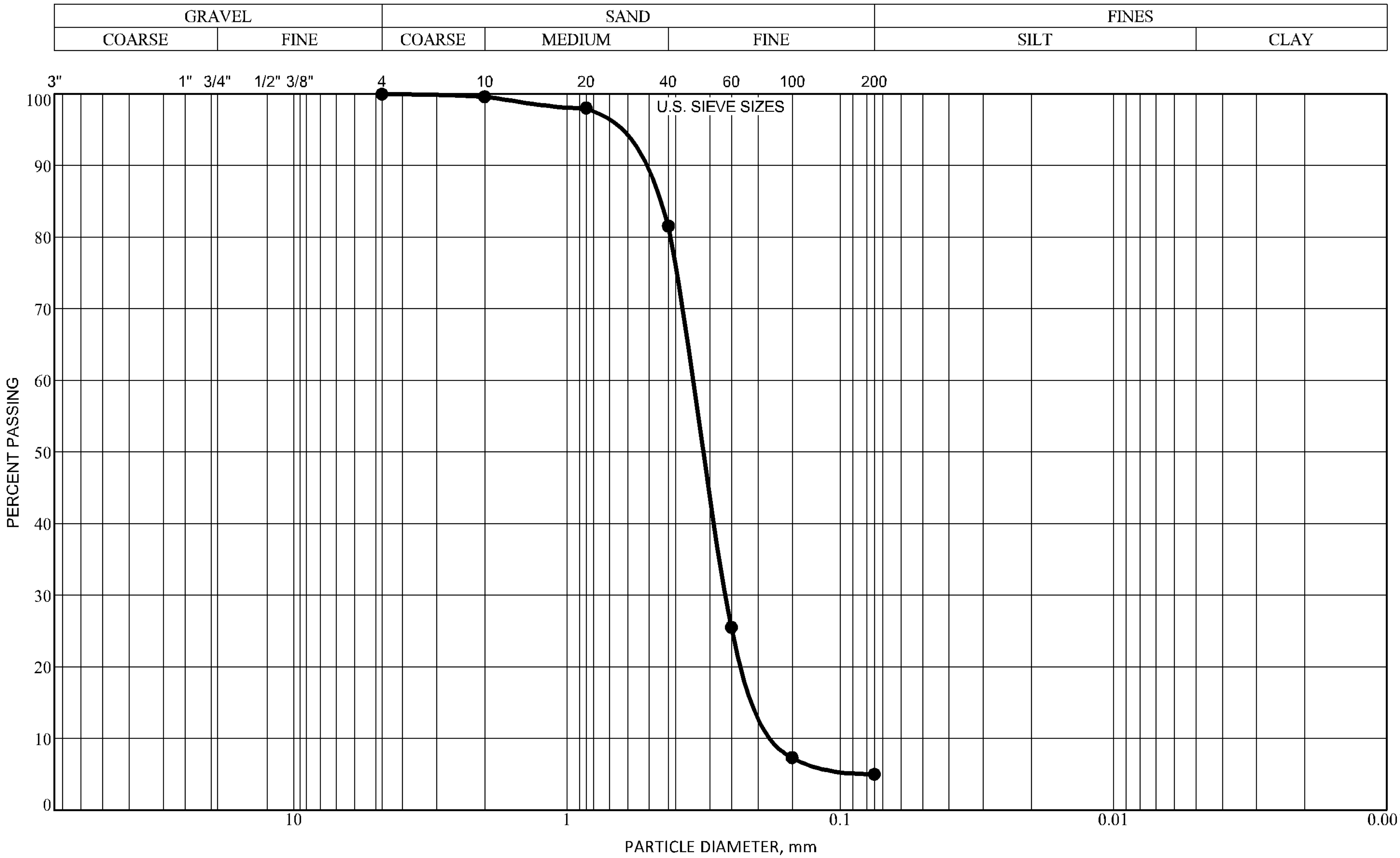

BRAUN INTERTEC

**Braun Project B1602323**
**GEOTECHNICAL EVALUATION**
**Southdale Courts Relocation Project**
**1800 West Old Shakopee Road**
**Bloomington, Minnesota**
BORING: ST-8 DEPTH: 7.5'

| | |
|---|---|
| GRAVEL | 0.0% |
| SAND | 94.0% |
| FINES | 6.0% |
| D60=0.167 | Cu=2.1 |
| D30=0.109 | Cc=0.9 |
| D10=0.080 | |

CLASSIFICATION:
POORLY GRADED SAND with SILT(SP-SM)

# GRAIN SIZE ACCUMULATION CURVE (ASTM)




BRAUN[SM] INTERTEC

**Braun Project B1602323**
**GEOTECHNICAL EVALUATION**
**Southdale Courts Relocation Project**
**1800 West Old Shakopee Road**
**Bloomington, Minnesota**
BORING: ST-15 DEPTH: 12.5'

| | |
|---|---|
| GRAVEL | 0.0% |
| SAND | 95.0% |
| FINES | 5.0% |
| D60=0.346 | |
| D30=0.261 | Cu=2.1 |
| D10=0.162 | Cc=1.2 |

CLASSIFICATION:
POORLY GRADED SAND with SILT(SP-SM)