

# **REVISED REPORT OF GEOTECHNICAL EXPLORATION AND REVIEW**

Downtown East Pedestrian Bridge Downtown East LRT Station Kirby Puckett Place Minneapolis, Minnesota

AET Report 01-06424.1

Date:

April 8, 2015

#### **Prepared for:**

Metro Transit/Met Council Facilities & Engineering  $560 - 6^{\text{th}}$  Avenue North Minneapolis, Minnesota 55411-4398





CONSULTANTS • ENVIRONMENTAL • GEOTECHNICAL • MATERIALS • FORENSICS

April 8, 2015

Metro Transit/Met Council Facilities & Engineering 560 – 6<sup>th</sup> Avenue North Minneapolis, Minnesota 55411-4398

Attn: Ms. Carol Hejl (Carol.Hejl@metrotransit.org)

RE: Revised Geotechnical Exploration and Review Downtown East Pedestrian Bridge Downtown East LRT Station Kirby Puckett Place Minneapolis, Minnesota AET Report No. 01-06424.1

Dear Ms. Hejl:

American Engineering Testing, Inc. (AET) is pleased to present this revised subsurface exploration program and geotechnical engineering review for the proposed project in Minneapolis, Minnesota. In accordance with Work Order WO-12, Amendment 1, we are revising this report to include design information for use of spread footings for portions of the bridge, and additional soil parameters for design of the drilled piers.

We are submitting one hard copy of this report to you as well as an electronic PDF copy. Additional electronic copies are also being submitted to EVS and HGA, as shown below.

Please contact me if you have any questions about the report. I can also be contacted for arranging engineering observations, special inspections, and testing services during construction.

Sincerely, American Engineering Testing, Inc.

Michael P. McCarthy, PE Principal Engineer Phone: (651) 659-1364 Fax: (651) 659-1379 mmccarthy@amengtest.com

pc: EVS, Inc. – Attn: Dan Bowar (<u>dbowar@evs-eng.com</u>) HGA – Attn: Paul Asp (<u>PAsp@hga.com</u>) **Revised Report of Geotechnical Exploration and Review** Downtown East Pedestrian Bridge; Minneapolis, Minnesota April 8, 2015 AET Report 01-06424.1

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Attn: Ms. Carol Hejl

Authored By:

Michael P. McCarthy, PE **Principal Engineer** 

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under Minnesota Statute Section 326.02 to 326.15

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#### STANDARD SHEETS

Floor Slab Moisture/Vapor Protection Basement/Retaining Wall Backfill and Water Control Freezing Weather Effects on Building Construction

# APPENDIX A

Geotechnical Field Exploration and Testing Boring Log Notes Unified Soil Classification System Figure 1 – Soil Boring Locations Figure 2 – Project Lay-Out Subsurface Boring Logs (B-1 to B-4) Previous Subsurface Boring Log (B11 – from Stadium Project) Previous STS Consultants Boring Log (B-05)

#### APPENDIX B

Geotechnical Report Limitations and Guidelines for Use

# **1.0 INTRODUCTION**

Construction of a new pedestrian bridge, spanning from the future Vikings Stadium to the Downtown East LRT station is planned over Kirby Puckett Place in Minneapolis, Minnesota. To assist in planning and design, American Engineering Testing, Inc. (AET) was authorized to conduct a subsurface exploration program at the site, conduct soil laboratory testing, and perform a geotechnical engineering review for the project. This report presents the results of the above services, and provides additional engineering recommendations as discussed below.

# 2.0 SCOPE OF SERVICES

AET's original services were performed according to the Metropolitan Council Contract Number 10P151, and our proposal to you dated February 3, 2015. Our services were officially authorized on February 4, 2015 by issuing the Notice to Proceed for Work Order WO-12. We were recently authorized by Amendment 1 to provide additional information to our original report, dated March 11, 12015. The requested information includes the following:

- Recommendations for design of the elevator and stair towers on spread footings.
- Recommended soil parameters for design of the drilled piers.
- Presenting the additional geotechnical recommendations in this revised report.

These services are intended for geotechnical purposes. The scope is not intended to explore for the presence or extent of environmental contamination.

Our original scope of services included four (4) penetration test borings. In our original report, we also included the log of Boring B11, drilled in August, 2013 at the adjacent Viking Stadium site. This boring was located close to the planned construction and includes bedrock coring information. We were also presented with the STS Consultants Geotechnical Engineering Report dated December 21, 2000 which included logs of borings performed for the LRT station. The log of STS Boring B-05 is also included with this report.

# **3.0 PROJECT INFORMATION**

We understand the pedestrian bridge will span from the future Vikings Stadium on the east side of Kirby Puckett Place to the Downtown East LRT station on the west side of Kirby Puckett Place. The bridge will be a concrete structure supported by three piers. We understand that the loading on each pier will be approximately 800 kips. Stair and elevator towers will be constructed at each end of the bridge. The wall loads for these structures will be 10 kips/foot and the total load for the elevator towers will be 250 kips (assuming single mat footings). The areas around the stair and elevator towers may also include miscellaneous retaining walls and planters. The general lay-out of the project is shown on Figure 2 in Appendix A; which is a reproduction of part of Sheet C3.0 prepared by HKS.

Our foundation design assumptions include a minimum factor of safety of three with respect to localized shear or base failure of the foundations. We assume the structure will be able to tolerate total settlements of up to 1-inch, and differential settlements over a 30 foot distance of up to  $\frac{1}{2}$ -inch.

The information stated above represents our understanding of the proposed construction. This information is an integral part of our engineering review. It is important that you contact us if there are changes from that described so that we can evaluate whether modifications to our recommendations are appropriate.

### 4.0 SUBSURFACE EXPLORATION AND TESTING

# 4.1 Field Exploration Program

We performed four (4) standard penetration test borings, including coring of the bedrock at Boring B-1. At Boring B-2, drilling was obstructed at a depth of 6<sup>1</sup>/<sub>2</sub> feet. We then drilled Boring B-2A approximately 3 feet south and 3 feet east of Boring B-2. The logs of the borings and details of the methods used appear in Appendix A. The logs contain information concerning soil and bedrock layering, soil and bedrock classification, geologic description, and moisture condition. Relative density or consistency is also noted for the natural soils, which is based on the standard penetration resistance (N-value). The quality of the bedrock is implied by the percent of the bedrock sample which is recovered and the RQD (rock quality designation). The boring locations are shown on Figure 1 in Appendix A. The borings were spotted in the field by AET personnel based on a sketch provided by EVS showing the suggested locations. At the completion of the drilling, the GPS coordinates were obtained (sub-meter accuracy; not surveyor accuracy) by AET personnel. The GPS coordinates are shown at the top of each boring log. Surface elevations at the boring locations were measured in the field by AET personnel using an engineer's level. The benchmark reference was the rim of a storm sewer manhole located on Kirby Puckett Place, about 75 feet south of the borings. The rim of this manhole has an elevation of 844.17, as shown on a plan provided by Metro Transit and EVS.

# 4.2 Laboratory Testing

The laboratory test program included water content tests of selected plastic soils. The test results appear on the individual boring logs in Appendix A, adjacent to the samples on which the tests were performed.

# 5.0 SITE CONDITIONS

# 5.1 Surface Observations

The proposed pedestrian bridge will span over Kirby Puckett Place, just south of its intersection with 4<sup>th</sup> Street South. The existing Downtown East LRT station is located to the west side of Kirby Puckett Place, and the Vikings stadium is currently under construction on the east side. Concrete and brick paver sidewalks and plaza areas are present on either side of Kirby Puckett Place. The general terrain is relatively flat. The ground surface elevations measured at our boring locations range from 842.6 at Boring B-2 to 843.2 at Boring B-4.

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# 5.2 Subsurface Soils/Geology

The soil profile shown by the borings consists of fill over naturally deposited, interbedded layers of alluvium and till. Limestone bedrock was encountered at depths ranging from about  $48\frac{1}{2}$  to  $49\frac{1}{2}$  feet below the surface.

### 5.2.1 Fill

Below the concrete and brick pavers at the surface, the fill consists of a surface layer of crushed limestone base and the underlying fill comprised of a mixture of silty sands, clayey sands, sands with silt, and sands. A layer of bituminous exists between the brick pavers and the limestone base at Borings B-3 and B-4. At Boring B-2, our boring encountered pieces of concrete and possibly concrete slabs from about 5 feet until the boring obstructed at a depth of 6<sup>1</sup>/<sub>2</sub> feet. The fill soils were frozen to a depth of about 4 feet at the boring locations.

STS Boring B-05 was performed in 2000, near the proposed location of the elevator and stair tower at the LRT station. This boring indicates approximately 13 feet of fill was present above the naturally deposited soils. The Standard Penetrations recorded in this fill were in excess of 24 blows per foot, which would indicate the soils are well compacted. Construction of the LRT Station and other structures may have altered the soil conditions shown by this log.

#### 5.2.2 Alluvium and Till

Layers of naturally deposited alluvium (water deposited soils) and till (glacially deposited soils) exist below the fill and above the bedrock. These soils include coarse alluvial sands, silty sands, and gravelly sands; fine alluvial lean clays; and glacial till silty sands and clayey sands. The coarse alluvial and glacial till soils contain variable amounts of gravel. Cobbles and possibly boulders also exist within some layers.

# 5.2.3 Bedrock

Limestone bedrock from the Platteville Formation exists below the alluvial and glacial till soils. The bedrock is divided into four distinct layers (in order of increasing depth); the Carimona Member, the Magnolia Member, the Hidden Falls Member, and the Mifflin Member. The Carimona layer is not a consistent layer and was not encountered at the borings completed for this project. The Magnolia layer is light brownish gray, fossiliferous, very thinly to thinly bedded, and varies from slightly to intensely fractured. The Hidden Falls layer is light brownish gray to gray, thinly bedded, and very to moderately to slightly fractured. The underlying Mifflin layer is light gray to gray, crinkly bedded, very thinly bedded, and slightly to very fractured. A summary of the approximate elevations of the tops of the different bedrock layers is presented in Table 5.2.3 below:

Boring Location	Surface Elevation	Apparent Bedrock Surface	Carimona Member	Magnolia Member	Hidden Falls Member	Mifflin Member
<b>B-</b> 1	842.7	793½		7931⁄2	785½	
B-2A	842.7	794*				
B-3	842.8	794*				
B-4	843.2	800@				i.
B11	847.8	7931/2		7931/2	7831/2	779

Table 5.2.3 – Approximate Elevations of Bedrock Layers

\* Apparent bedrock surface elevation based on refusal to advancement of drilling equipment.

<sup>@</sup> Bedrock surface was weathered limestone.

# 5.3 Ground Water

Ground water was measured in Borings B-1, B-3, and B-4 at depths ranging from about 48½ feet to 49 feet beneath the surface. Because the soils encountered in the borings at these depths of measured ground water consist of slower draining clayey and silty glacial till soils, or weathered bedrock, it may take several hours or even days for a hydrostatic water level to stabilize in an open borehole. Ground water levels can be expected to perch above the slower draining clayey

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and silty soils, as well as just above the bedrock. Long-term monitoring of the water levels with piezometers is needed to obtain more accurate water level measurements. This was beyond the scope of our services.

Ground water levels will fluctuate due to varying seasonal and annual rainfall and snow melt amounts, as well as other factors.

#### **5.4 Review of Soil Properties**

#### 5.4.1 Fill

The upper 4 feet of fill was frozen and N-values were not recorded. Below that, the N-values in the fill soils are generally high indicating the soils were probably compacted in thin lifts during placement. One exception is at Boring B-2A where the fill from about 6½ to 9 feet had a lower N-value of 5 blows per foot (bpf), indicating little compaction was performed. Some of the very high N-values (over 30 bpf) may be due to the presence of debris and rubble – such as at Boring B-2. We judge the fill soils to have moderately high to low strength, and consider them to have low to moderate compressibility. Most of the fill soils consist of sands and silty sands which are judged to be moderately slow to moderately fast draining, and moderately frost susceptible. The clayey sands are generally slow draining soils that are susceptible to freeze-thaw movements.

#### 5.4.2 Alluvium and Till

The sands, silty sands and gravelly sands, and the glacial till silty sands and clayey sands are judged to have moderately high to high strength and low compressibility. The fine alluvial lean clays are also judged to have high strength and low compressibility. The alluvial sands and gravelly sands are judged to be fast draining and have low susceptibility to frost heave. The alluvial silty sands are judged to be moderately fast draining and have moderate susceptibility to freeze-thaw movements. The alluvial clays and the till soils are below normal frost depth.

# 5.4.3 Bedrock

The limestone bedrock is judged to have high strength and low compressibility. The upper portions of the bedrock are typically weathered and more fractured and have lower strength than the underlying, intact bedrock. The limestone from the Platteville formation typically contains both horizontal and vertical fractures. Evaluation of the quality of the bedrock is based on two methods: 1) core recovery (REC %) and 2) Rock Quality Designation (RQD %), figured from the typical 5-foot long increments of cores that are removed from the bedrock. The core recovery is determined by totaling the lengths of all fragmented and solid pieces of bedrock obtained from each core run, and dividing that by the overall total length of the run, and is then expressed as a percentage of the overall length of the core run on the boring logs.

The RQD is slightly different because it only takes into account segments of the bedrock core that are 4 inches or longer. The cumulative length of these 4-inch or longer segments of bedrock are expressed as a percentage of the overall length of the bedrock core run. The quality of the bedrock is typically considered better if the REC and RQD values are higher.

Based on our review of the RQD values from Borings B-1 and B11, and our observations of the core samples, it appears that the bedrock is relatively sound and consistent in elevation. There are no apparent indications of folds, severe fractures or faults in the bedrock, based on our comparisons of the elevations of the different layers. The RQD values are generally over 65%. Some parts of the Hidden Falls Member at Borings B-1 and B11 are intensely fractured. A fairly thick zone of weathered limestone exists at Boring B-4, from about 43 to 49.7 feet. The bearing capabilities of the weathered limestone is much less than the unweathered limestone below.

#### **6.0 RECOMMENDATIONS**

#### **6.1 Approach Discussion**

Based on the loads to be exerted by the pedestrian bridge piers, and the soil/bedrock conditions, it is our judgment that the use of drilled piers bearing on the unweathered bedrock is the most feasible method of supporting the bridge. The naturally deposited alluvial and glacial till soils have high N-values; however, the sound and unweathered bedrock is capable of supporting a significantly higher end bearing pressure of up to 50 tons per square foot (tsf). We have also given consideration to using driven piles to support the proposed bridge. The use of driven piles may cause objectionable vibrations to the surrounding structures, as well as considerable noise. Our recommendations for this project will concentrate using drilled piers for structural support.

For the lighter loaded stair and elevator towers, it is our judgment (based on the results of the attached borings) that it may be possible to support these structures on conventional spread footings, provided the existing fill soils are well compacted as indicated by the N-values in most of the fill soils. Because the stair and elevator tower on the west side of Kirby Puckett Place will be located well west of our Borings B-1 and B-2, this requires the assumption that the soils at the location of the stair/elevator tower will be consistent with those shown at these borings. STS Boring B-05 shows well compacted fill soils exist to a depth of about 13 feet, which are then underlain by competent naturally deposited soils. Because the soils at each location consist of existing fill, supporting the structures on these fill soils will require Metro Transit to assume some risks that the fill is consistent and well compacted as can be implied by the higher N-values shown on the boring logs. These risks can be reduced by careful observations of the soils during excavation, as well as performing hand cone penetrometers (HCP's) and dynamic cone penetrometers (DCP's). If these risks are not acceptable, excavation of all fill soils and then placement of new fill should be performed as corrective earthwork procedures.

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We have also considered the use of shallow drilled piers to support the elevator and stair towers on competent naturally deposited alluvial and glacial till soils; however, it is our expectation that this alternative may not be necessary.

# 6.2 Bridge Support

# 6.2.1 Drilled Pier Foundations

It is our judgment that the proposed pedestrian bridge piers can be supported by drilled pier foundations extending into competent bedrock. The piers should extend through the upper weathered bedrock, and the fractured portions of the limestone bedrock. The estimated depths of bedrock removal at those borings which were advanced into the bedrock, are shown in Table 6.2.1 below:

Boring Location	Surface Elevation (ft)	Estimated Bedrock Surface Elev.	Estimated Bedrock Removal (ft)	Estimated Drilled Pier Bottom Elev.
B-1	842.7	7931/2	21⁄2	791
B-4	843.2	800 <sup>@</sup>	7+@	7901/2
B11	847.8	793½ <sup>@</sup>	6 <sup>1</sup> /2 <sup>@</sup>	787

Table 6.2.1 – Estimated Bedrock Removal Depths

<sup>@</sup> Upper bedrock surface is weathered limestone which should be removed to underlying competent bedrock.

Based on our past experience in the general area of this construction, we would anticipate an average depth of bedrock coring of about  $2\frac{1}{2}$  to 3 feet, after removal of the upper highly weathered and fractured bedrock. The actual amount of bedrock removal for foundation support should be evaluated by AET geotechnical personnel at each drilled pier location. This is usually done by closely observing the bedrock that is removed by the core barrel and by closely watching the movement of the core barrel. Close attention is paid to zones of less resistance during coring, which is an indicator of weathered bedrock, fractured zones, voids, or clay seams. These zones are unacceptable and if encountered, will require deeper bedrock removal. We

suggest a contingency be included in your budget for additional bedrock removal for such situations.

# 6.2.2 Soil Parameters for LPILE Analysis

Table 6.2.2 below provides our recommended soil parameters for LPILE analysis of the drilled piers. These parameters are based on the soils found at the boring locations

					Angle					
					of	Static	Cyclical			
					Internal	Soil	Modulus		Effective	Deformation
Boring	Depths	Soil	N-	Cohesion	Friction	Modulus	(Kc)**		Density	Modulus
No.	(ft.)	Туре	Values	(psf)	(°)	k** (pci)	(pci)	£50	(pcf)	(ksi)
SB-1	<sup>1</sup> ⁄2 - 2*	Base	@	0	35	25	-	-	115	0.5
	$2 - 4^*$	Sand	@ 51	0	30	25	-	-	115	0.5
	4 <b>-</b> 6½	Sand		0	30	90	-	-	130	2.0
	6½ - 9	Sand	19	0	30	90	-	-	120	1.7
	9 - 11½	Sand	14	0	10	90	-	-	120	1.4
	11½ <b>-</b> 14	Sand	27	0	30	90	-	-	130	2.1
	14 - 18	Sand	39	0	35	225	-	-	125	3.9
	18 - 28	Sand	50 - 53	0	35	225		-	125	4.7
	28 - 33	Sand	35	0	35	225	-	-	125	3.6
	33 - 38	Sand	29	0	35	90	-	-	125	3.1
	38 - 43	Sand	60	0	32	225	-	-	130	3.3
	43 - 49.2	Sand	29	0	30	90	-	-	130	2.2
	49.2 – 57.3	Bedrock	Core	4000	0	2000	800	0.001	100	14.0
	57.3 - 60.8	Bedrock	Core	3000	0	2000	800	0.002	100	10.0
SB-2	<sup>1</sup> ⁄ <sub>2</sub> - 1 <sup>1</sup> ⁄ <sub>2</sub> *	Base	@	0	35	25	-	-	115	0.5
SB-2A	1½ <b>-</b> 4½*	Sand	@	0	30	25	-	-	115	0.5
	4½ - 6½	Sand	22	0	30	90	-	-	130	1.8
	6½ <b>-</b> 9	Sand	5	0	20	25	-	-	105	0.5
	9 - 11	Sand	19	0	30	90	-	-	120	1.7
	11 - 18	Sand	24 - 27	0	30	90	-	-	130	2.0
	18 - 23	Sand	58	0	35	225	-	-	125	4.7
	23 - 33	Sand	45 - 49	0	32	225		-	130	3.0
	33 - 48.8	Sand	55+	0	32	225	-	-	130	3.3
SB-3	<sup>1</sup> ⁄2 - 4*	Sand	@	0	30	25	-	-	100	0.5
	$4 - 6\frac{1}{2}$	Sand	13	0	30	90	-	-	120	1.3
	6½ - 11½	Sand	17 - 19	0	35	90	-	-	115	2.4
	11½ <b>-</b> 18	Sand	68+#	0	35	225	-	-	125	4.7
	18 - 23	Sand	23	0	30	90	-	-	130	1.9
	23 - 28	Sand	30	0	35	225	- '	-	125	3.2
	28 - 33	Clay	57	6000	0	2000	800	0.004	130	2.4
	33 - 38	Sand	58	0	35	225	-	-	125	4.7
	38 - 49	Sand	51 - 69	0	32	225	-	-	130	3.3
	49 49.7	Bedrock	100/.4	0	45	125	-	-	80	10.0

 Table 6.2.2 – Estimated Soil Parameters

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Boring No.	Depths (ft.)	Soil Type	N- Values	Cohesion (psf)	Angle of Internal Friction (°)	Static Soil Modulus k** (pci)	Cyclical Modulus (Kc)** (pci)	£ <sub>50</sub>	Effective Density (pcf)	Deformation Modulus (ksi)
SB-4	1⁄2 - 2*	Sand	a	0	30	25	-	-	100	0.5
	$2 - 4^*$	Clay	a	300	0	30	-	-	100	0.4
	4 - 6½	Clay	59	500	15	1000	400	0.005	125	1.0
	6½ <b>-</b> 9	Sand	17	0	30	90	-	-	120	1.6
	9 - 11½	Sand	23	0	30	90	-	-	130	1.9
	11½ <b>-</b> 18	Sand	20	0	30	90	-	-	120	1.7
	18 - 24	Clay	38	2500	25	2000	800	0.004	130	1.8
	24 - 28	Sand	114#	0	35	225	-	-	125	4.7
	28 - 43	Clay	53 - 57	3500	25	2000	800	0.004	130	2.4
	43 - 49	Bedrock	40	0	45	225	-	-	140	2.8
	49 – 49.7	Bedrock	100/.05	0	45	125	-	-	80	10.0

\*For drilled pier foundations, we recommend the soil strength (cohesion, internal friction angle, deformation modulus and soil modulus) be disregarded in the upper 4 feet of the soil profile. \*\*Soil Modulus Parameter k (p-v) for use with LPILE.

(a) N-values not obtained for these soil layers because the soils were frozen at the time of drilling. # N-values influence by cobbles; soil parameters estimated using a lower, interpolated N-value.

# 6.2.3 Drilled Pier End Bearing Capacity

Drilled piers extending through the weathered and highly fractured portions of the limestone bedrock can be designed for an allowable end bearing capacity of 50 tsf. This loading, on sound and competent bedrock, should provide a factor of safety of about 3 against localized failure of the drilled pier. We judge that total settlements under this loading should not exceed 1-inch. We also judge that differential settlements of conditions depicted by the borings should not exceed  $\frac{1}{2}$ -inch.

# 6.2.4 Drilled Pier Installation Considerations

The soils overlying the bedrock include significant layers of granular soils. These soils are subject to caving or sloughing during excavation of the drilled piers. Therefore, we recommend that all drilled piers be advanced using steel casing during to prevent sloughing or caving of the granular soils into the excavations. Ground water was encountered above the bedrock at three of the four recent borings; therefore, it should be expected to be present during drilling of the piers. We recommend ground water be pumped from the drilled pier excavations prior to the placement of concrete. To reduce the likelihood of concrete segregation when placed, either through introduction into standing water or by striking the reinforcing steel or sides of the steel casing, we recommend using a tremie or pump during concrete placements. We recommend that a positive head of concrete be maintained during steel casing removal so the soils do not slough into the excavations above the concrete and compromise the integrity and strength of the concrete.

# 6.3 Elevator & Stair Tower Support

# 6.3.1 Spread Footing Grading

It is our judgment that the use of spread footings can be considered for support of the proposed elevator and stair towers. Excavation to planned footing grades should expose existing fill soils; most of which appear to be moderately well to well compacted. Because the fill soils at and below normal frost protection depth at Boring B-2A are loose, they should be thoroughly surface compacted prior to footing construction. Self-propelled vibratory compaction equipment should make at least 5 passes over the soils in the bottoms of all footing excavations, and then repeat the process in the perpendicular direction. AET geotechnical personnel should then observe the soils in the excavation bottoms to verify if these soils are suitable to support the structural loads.

As mentioned earlier, supporting the structures on the existing fill soils may involve some risks, mainly associated with the possibility of loose zones of fill which maybe present at and below footing grades at locations away from the borings. It is our judgment that thorough compaction and careful observation by AET geotechnical personnel should significantly reduce these risks.

If risks are not acceptable to Metro Transit, we recommend the foundation excavations be extended through all existing fill to the underlying naturally deposited alluvial and till soils, and new fill be placed and compacted back to design footing and slab grades. The excavations that extend below foundation grades must be oversized laterally beyond the outside edges of the foundations to properly support the lateral loads exerted by the foundations. This excavation/engineered fill lateral extension should at least be equal to the vertical depth of fill needed to attain foundation grade at that location (i.e., 1:1 lateral oversize).

We recommend that all fill which is placed below the elevator and stair tower footings and floor slabs consist of inorganic sands (SP), sands with silt (SP-SM), or silty sands (SM) that have no more than 20% of the particles finer than the #200 sieve. The use of clayey sands, clays, or silts as fill below these structures should not be permitted. The granular fill soils should be free of debris and rubble. Fill should not be placed over frozen soils and frozen soils should not be used as fill.

We recommend all fill placed below the elevator and stair tower footings be compacted to a minimum of 100% of the standard maximum dry unit weight per ASTM: D698 (Standard Proctor test). All fill placed above the footings, which will only support floor slab loads, should be compacted to at least 95%. This includes all backfill placed in utility trench excavations and as wall or footing backfill.

#### 6.3.2 Spread Footing Design

Assuming the excavation and backfilling is performed as recommended above, it is our judgment that the elevator and stair towers can be supported on conventional spread footings placed on the well compacted fill soils, the competent naturally deposited alluvial or till soils, or the new compacted fill placed after excavation of the existing fill. We recommend the foundations be placed at least 42 inches below exterior grades if the towers are heated, and interior footings in heated building spaces can be placed at shallow depths below the floor slab. It the towers are not heated, and if any other footings will be in unheated conditions (such as exterior canopy foundations), they should be placed at least 60 inches below exterior grades.

Based on the conditions encountered, it is our opinion the foundations for the elevator and stair towers can be designed using a net maximum allowable soil bearing pressure of 4,000 psf. It is our judgment this design pressure should have a factor of safety of at least three against localized shear or base failure. We judge that total settlements should be 1-inch or less, and differential settlements under these loads should not exceed ½-inch. Up to ½-inch of differential settlement can be expected between the spread footings and the drilled piers supported on bedrock.

# 6.3.3 Floor Slab Support

The well compacted existing fill, the naturally deposited alluvial or till soils, or the new compacted fill soils can be used to support of the elevator and stair tower floor slabs. After excavating to design slab grades, we recommend the fill soils be surface compacted prior to placement of new fill to establish slab grades or concrete for the slab. The soils should be compacted with self-propelled vibratory compaction equipment which makes at least 5 passes over the soils. We recommend AET geotechnical personnel then perform soil density tests at random locations and elevations to evaluate the compaction levels of the fill and to assist in evaluating their ability to support the floor slab.

After surface compaction of the existing fill soils, and the placement of new fill to establish slab subgrade elevations (if necessary), it is our judgment that the floor slabs can be supported by the compacted fill soils. For improved moisture control, we recommend at least 6 inches of sand backfill be placed immediately below the slabs. This sand should have no more than 5% of the particles finer than the #200 sieve and no more than 40% finer than the #40 sieve. If the elevator and stair tower structures will not be heated, we recommend at least 4 feet of this

sand be used as fill to minimize frost heave movements of the slabs. All fill below the floor slab should be compacted to at least 95% of the Standard Proctor maximum dry density (ASTM: D698). Refer to the standard sheet "Floor Slab Moisture/Vapor Protection" at the end of this report.

Assuming that sand fill will be present below the slabs, we recommend designing the floor slab using a Modulus of Subgrade Reaction (k-value) of 225 pci.

#### 6.4 Site Retaining Walls Support

# 6.4.1 Spread Footing Grading and Design

It is our judgment that spread footings can be used for support of the proposed retaining walls. We recommend excavation and backfilling for these footings be performed as recommended for the elevator and stair towers, as presented in Section 6.3.1. We refer you to 6.3.2 for design of the footings.

#### 6.4.2 Retaining Wall Backfill

Recommendations for backfilling of retaining walls that have unbalanced loads are presented in the sheets entitled "Basement/Retaining Wall Backfill and Water Control" and "Freezing Weather Effects on Building Construction" at the end of this report. Lateral loads to be used for design of these walls are provided, expressed as equivalent fluid weights. The use of sand (SP or SP-SM) fill is recommended. Because the walls will not restrained at the top and will be allowed to deflect, the active condition can be used for design of the walls.

Backfill placed against the walls should be compacted to at least 95% of the Standard Proctor maximum dry density below sidewalks or other pedestrian traffic areas. Below landscaped areas, the backfill should be compacted to at least 90%.

Passive lateral pressures could also act on the foundations. Assuming that sand fill is used as backfill against the footings and walls, and the fill soils are compacted to at least 95% of the Standard Proctor maximum dry density, the walls can be designed using an equivalent fluid weight passive pressure of 400 pcf. An appropriate factor of safety should be applied to this value.

#### 7.0 CONSTRUCTION CONSIDERATIONS

#### 7.1 Potential Difficulties

#### 7.1.1 Water in Excavations

Ground water may accumulate in the bottoms of the drilled pier excavation. The water should be removed prior to placing the concrete.

#### 7.1.2 Cobbles, Boulders, and Rubble

The soils at this site can include cobbles, boulders, and rubble (some of which may be large – such as at Boring B-2). This will make drilling of the piers more difficult. Special methods for oversized obstruction removal may be needed during drilled pier installation.

#### 7.2 Excavation Backsloping

If excavation is needed for foundations, the excavations (if not retained) should maintain maximum allowable slopes in accordance with OSHA Regulations (Standards 29 CFR), Part 1926, Subpart P, "Excavations" (can be found on www.osha.gov). Even with the required OSHA sloping, water seepage or surface runoff can potentially induce sideslope erosion or running which could require slope maintenance.

#### 7.3 Observations and Testing

The recommendations in this report are based on the subsurface conditions found at our test boring locations. Since the soil and bedrock conditions can be expected to vary away from the soil boring locations, we recommend AET geotechnical personnel observe all excavations and drilled piers to evaluate the suitability of the soils and bedrock for support of the proposed construction. These observations should be conducted on a full-time basis during drilled pier installation. Soil density testing should also be performed on new fill placed in order to document that project specifications for compaction have been satisfied.

#### 8.0 LIMITATIONS

Within the limitations of scope, budget, and schedule, our services have been conducted according to generally accepted geotechnical engineering practices at this time and location. Other than this, no warranty, either express or implied, is intended.

Important information regarding risk management and proper use of this report is given in Appendix B entitled "Geotechnical Report Limitations and Guidelines for Use".

#### FLOOR SLAB MOISTURE/VAPOR PROTECTION

Floor slab design relative to moisture/vapor protection should consider the type and location of two elements, a granular layer and a vapor membrane (vapor retarder, water resistant barrier or vapor barrier). In the following sections, the pros and cons of the possible options regarding these elements will be presented, such that you and your specifier can make an engineering decision based on the benefits and costs of the choices.

#### GRANULAR LAYER

In American Concrete Institute (ACI) 302.1R-04, a "base material" is recommended over the vapor membrane, rather than the conventional clean "sand cushion" material. The base layer should be a minimum of 4 inches (100 mm) thick, trimmable, compactable, granular fill (not sand), a so-called crusher-run material. Usually graded from 1½ inches to 2 inches (38 to 50 mm) down to rock dust is suitable. Following compaction, the surface can be choked off with a fine-grade material. We refer you to ACI 302.1R-04 for additional details regarding the requirements for the base material.

In cases where potential static water levels or significant perched water sources appear near or above the floor slab, an under floor drainage system may be needed wherein a draintile system is placed within a thicker clean sand or gravel layer. Such a system should be properly engineered depending on subgrade soil types and rate/head of water inflow.

#### VAPOR MEMBRANE

The need for a vapor membrane depends on whether the floor slab will have a vapor sensitive covering, will have vapor sensitive items stored on the slab, or if the space above the slab will be a humidity controlled area. If the project does not have this vapor sensitivity or moisture control need, placement of a vapor membrane may not be necessary. Your decision will then relate to whether to use the ACI base material or a conventional sand cushion layer. However, if any of the above sensitivity issues apply, placement of a vapor membrane is recommended. Some floor covering systems (adhesives and flooring materials) require installation of a vapor membrane to limit the slab moisture content as a condition of their warranty.

#### VAPOR MEMBRANE/GRANULAR LAYER PLACEMENT

A number of issues should be considered when deciding whether to place the vapor membrane above or below the granular layer. The benefits of placing the slab on a granular layer, with the vapor membrane placed **below** the granular layer, include **reduction** of the following:

- Slab curling during the curing and drying process.
- Time of bleeding, which allows for quicker finishing.
- Vapor membrane puncturing.
- Surface blistering or delamination caused by an extended bleeding period.
- Cracking caused by plastic or drying shrinkage.

The benefits of placing the vapor membrane over the granular layer include the following:

- A lower moisture emission rate is achieved faster.
- Eliminates a potential water reservoir within the granular layer above the membrane.
- Provides a "slip surface", thereby reducing slab restraint and the associated random cracking.

If a membrane is to be used in conjunction with a granular layer, the approach recommended depends on slab usage and the construction schedule. The vapor membrane should be placed above the granular layer when:

- Vapor sensitive floor covering systems are used or vapor sensitive items will be directly placed on the slab.
- The area will be humidity controlled, but the slab will be placed before the building is enclosed and sealed from rain.
- Required by a floor covering manufacturer's system warranty.

The vapor membrane should be placed below the granular layer when:

• Used in humidity controlled areas (without vapor sensitive coverings/stored items), with the roof membrane in place, and the building enclosed to the point where precipitation will not intrude into the slab area. Consideration should be given to slight sloping of the membrane to edges where draintile or other disposal methods can alleviate potential water sources, such as pipe or roof leaks, foundation wall damp proofing failure, fire sprinkler system activation, etc.

There may be cases where membrane placement may have a detrimental effect on the subgrade support system (e.g., expansive soils). In these cases, your decision will need to weigh the cost of subgrade options and the performance risks.

#### BASEMENT/RETAINING WALL BACKFILL AND WATER CONTROL

#### DRAINAGE

Below grade basements should include a perimeter backfill drainage system on the exterior side of the wall. The exception may be where basements lie within free draining sands where water will not perch in the backfill. Drainage systems should consist of perforated or slotted PVC drainage pipes located at the bottom of the backfill trench, lower than the interior floor grade. The drain pipe should be surrounded by properly graded filter rock. A filter fabric should then envelope the filter rock. The drain pipe should be connected to a suitable means of disposal, such as a sump basket or a gravity outfall. A storm sewer gravity outfall would be preferred over exterior gravity drainage, as the latter may freeze during winter. For non-building, exterior retaining walls, weep holes at the base of the wall can be substituted for a drain pipe.

#### BACKFILLING

Prior to backfilling, dampproofing or waterproofing should be applied on perimeter basement walls. The backfill materials placed against basement walls will exert lateral loadings. To reduce this loading by allowing for drainage, we recommend using free draining sands for backfill. The zone of sand backfill should extend outward from the wall at least 2 feet, and then upward and outward from the wall at a 30 degree or greater angle from vertical. As a minimum, the sands used on this project should contain no greater than 5% of particles (by weight) finer than the #200 sieve and nor more than 40% of the particles (by weight) finer than the #40 sieve. The sand backfill should be placed in lifts and compacted with portable compaction equipment. This compaction should be to the specified levels if slabs or pavements are placed above. Where slab or pavements are not above, we recommend capping the sand backfill with a layer of clayey soil to minimize surface water infiltration. Positive surface drainage away from the building should be filled with more permeable soils, such as the Fine Filter or Coarse Filter Aggregates defined in MnDOT Specification 3149. You should recognize that if the backfill soils are not properly compacted, settlements may occur which may affect surface drainage away from the building.

Backfilling with silty or clayey soil is possible but not preferred. These soils can build-up water which increases lateral pressures and results in wet wall conditions and possible water infiltration into the basement. If you elect to place silty or clayey soils as backfill, we recommend you place a prefabricated drainage composite against the wall which is hydraulically connected to a drainage pipe at the base of the backfill trench. High plasticity clays should be avoided as backfill due to their swelling potential.

#### LATERAL PRESSURES

Lateral earth pressures on below-grade walls vary, depending on backfill soil classification, backfill compaction and slope of the backfill surface. Static or dynamic surcharge loads near the wall will also increase lateral wall pressure. For design, we recommend the following ultimate lateral earth pressure values (given in equivalent fluid pressure values) for a drained soil compacted to 95% of the Standard Proctor density and a level ground surface.

	Equivalent	Fluid Density
Soil Type	Active (pcf)	At-Rest (pcf)
Sands (SP or SP-SM)	35	50
Silty Sands (SM)	45	65
Fine Grained Soils (SC, CL or ML)	70	90

Basement walls are normally restrained at the top which restricts movement. In this case, the design lateral pressures should be the "at-rest" pressure situation. Retaining walls which are free to rotate or deflect should be designed using the active case. Lateral earth pressures will be significantly higher than that shown if the backfill soils are not drained and become saturated.

#### FREEZING WEATHER EFFECTS ON BUILDING CONSTRUCTION

#### **GENERAL**

Because water expands upon freezing and soils contain water, soils which are allowed to freeze will heave and lose density. Upon thawing, these soils will not regain their original strength and density. The extent of heave and density/strength loss depends on the soil type and moisture condition. Heave is greater in soils with higher percentages of fines (silts/clays). High silt content soils are most susceptible, due to their high capillary rise potential which can create ice lenses. Fine grained soils generally heave about 1/4" to 3/8" for each foot of frost penetration. This can translate to 1" to 2" of total frost heave. This total amount can be significantly greater if ice lensing occurs.

#### DESIGN CONSIDERATIONS

Clayey and silty soils can be used as perimeter backfill, although the effect of their poor drainage and frost properties should be considered. Basement areas will have special drainage and lateral load requirements which are not discussed here. Frost heave may be critical in doorway areas. Stoops or sidewalks adjacent to doorways could be designed as structural slabs supported on frost footings with void spaces below. With this design, movements may then occur between the structural slab and the adjacent on-grade slabs. Non-frost susceptible sands (with less than 5% passing a #200 sieve) can be used below such areas. Depending on the function of surrounding areas, the sand layer may need a thickness transition away from the area where movement is critical. With sand placement over slower draining soils, subsurface drainage would be needed for the sand layer. High density extruded insulation could be used within the sand to reduce frost penetration, thereby reducing the sand thickness needed. We caution that insulation placed near the surface can increase the potential for ice glazing of the surface.

The possible effects of adfreezing should be considered if clayey or silty soils are used as backfill. Adfreezing occurs when backfill adheres to rough surfaced foundation walls and lifts the wall as it freezes and heaves. This occurrence is most common with masonry block walls, unheated or poorly heated building situations and clay backfill. The potential is also increased where backfill soils are poorly compacted and become saturated. The risk of adfreezing can be decreased by placing a low friction separating layer between the wall and backfill.

Adfreezing can occur on exterior piers (such as deck, fence, or other similar pier footings), even if a smooth surface is provided. This is more likely in poor drainage situations where soils become saturated. Additional footing embedment and/or widened footings below the frost zones (which include tensile reinforcement) can be used to resist uplift forces. Specific designs would require individual analysis.

#### CONSTRUCTION CONSIDERATIONS

Foundations, slabs and other improvements which may be affected by frost movements should be insulated from frost penetration during freezing weather. If filling takes place during freezing weather, all frozen soils, snow and ice should be stripped from areas to be filled prior to new fill placement. The new fill should not be allowed to freeze during transit, placement or compaction. This should be considered in the project scheduling, budgeting and quantity estimating. It is usually beneficial to perform cold weather earthwork operations in small areas where grade can be attained quickly rather than working larger areas where a greater amount of frost stripping may be needed. If slab subgrade areas freeze, we recommend the subgrade be thawed prior to floor slab placement. The frost action may also require reworking and recompaction of the thawed subgrade.

**Revised Report of Geotechnical Exploration and Review** Downtown East Pedestrian Bridge; Minneapolis, Minnesota April 8, 2015 AET Report 01-06424.1

AMERICAN ENGINEERING TESTING, INC.

# **Appendix A**

Geotechnical Field Exploration and Testing Boring Log Notes Unified Soil Classification System Figure 1 – Soil Boring Locations Figure 2 – Project Lay-Out Subsurface Boring Logs (B-1 to B-4) Previous Subsurface Boring Log (B11 - from Stadium Project) Previous STS Consultants Boring Log (B-05)

#### A.1 FIELD EXPLORATION

The subsurface conditions at the site were explored by drilling and sampling 4 standard penetration test borings. Coring of bedrock was conducted at one of these boring locations. The locations of the borings appear on Figure 1, preceding the Subsurface Boring Logs in this appendix.

#### A.2 SAMPLING METHODS

#### A.2.1 Split-Spoon Samples (SS) - Calibrated to N<sub>60</sub> Values

Standard penetration (split-spoon) samples were collected in general accordance with ASTM:D1586 with one primary modification. The ASTM test method consists of driving a 2-inch O.D. split-barrel sampler into the in-situ soil with a 140-pound hammer dropped from a height of 30 inches. The sampler is driven a total of 18 inches into the soil. After an initial set of 6 inches, the number of hammer blows to drive the sampler the final 12 inches is known as the standard penetration resistance or N-value. Our method uses a modified hammer weight, which is determined by measuring the system energy using a Pile Driving Analyzer (PDA) and an instrumented rod.

In the past, standard penetration N-value tests were performed using a rope and cathead for the lift and drop system. The energy transferred to the split-spoon sampler was typically limited to about 60% of it's potential energy due to the friction inherent in this system. This converted energy then provides what is known as an  $N_{60}$  blow count.

Most newer drill rigs incorporate an automatic hammer lift and drop system, which has higher energy efficiency and subsequently results in lower N-values than the traditional  $N_{60}$  values. By using the PDA energy measurement equipment, we are able to determine actual energy generated by the drop hammer. With the various hammer systems available, we have found highly variable energies ranging from 55% to over 100%. Therefore, the intent of AET's hammer calibrations is to vary the hammer weight such that hammer energies lie within about 60% to 65% of the theoretical energy of a 140-pound weight falling 30 inches. The current ASTM procedure acknowledges the wide variation in N-values, stating that N-values of 100% or more have been observed. Although we have not yet determined the statistical measurement uncertainty of our calibrated method to date, we can state that the accuracy deviation of the N-values using this method is significantly better than the standard ASTM Method.

#### A.2.2 Disturbed Samples (DS)/Spin-up Samples (SU)

Sample types described as "DS" or "SU" on the boring logs are disturbed samples, which are taken from the flights of the auger. Because the auger disturbs the samples, possible soil layering and contact depths should be considered approximate.

#### A.2.3 Sampling Limitations

Unless actually observed in a sample, contacts between soil layers are estimated based on the spacing of samples and the action of drilling tools. Cobbles, boulders, and other large objects generally cannot be recovered from test borings, and they may be present in the ground even if they are not noted on the boring logs.

Determining the thickness of "topsoil" layers is usually limited, due to variations in topsoil definition, sample recovery, and other factors. Visual-manual description often relies on color for determination, and transitioning changes can account for significant variation in thickness judgment. Accordingly, the topsoil thickness presented on the logs should not be the sole basis for calculating topsoil stripping depths and volumes. If more accurate information is needed relating to thickness and topsoil quality definition, alternate methods of sample retrieval and testing should be employed.

#### A.3 CLASSIFICATION METHODS

Soil descriptions shown on the boring logs are based on the Unified Soil Classification (USC) system. The USC system is described in ASTM:D2487 and D2488. Where laboratory classification tests (sieve analysis or Atterberg Limits) have been performed, accurate classifications per ASTM:D2487 are possible. Otherwise, soil descriptions shown on the boring logs are visual-manual judgments. Charts are attached which provide information on the USC system, the descriptive terminology, and the symbols used on the boring logs.

The boring logs include descriptions of apparent geology. The geologic depositional origin of each soil layer is interpreted primarily by observation of the soil samples, which can be limited. Observations of the surrounding topography, vegetation, and development can sometimes aid this judgment.

#### A.4 WATER LEVEL MEASUREMENTS

The ground water level measurements are shown at the bottom of the boring logs. The following information appears under "Water Level Measurements" on the logs:

- Date and Time of measurement
- Sampled Depth: lowest depth of soil sampling at the time of measurement
- Casing Depth: depth to bottom of casing or hollow-stem auger at time of measurement
- Cave-in Depth: depth at which measuring tape stops in the borehole
- Water Level: depth in the borehole where free water is encountered
- Drilling Fluid Level: same as Water Level, except that the liquid in the borehole is drilling fluid

The true location of the water table at the boring locations may be different than the water levels measured in the boreholes. This is possible because there are several factors that can affect the water level measurements in the borehole. Some of these factors include: permeability of each soil layer in profile, presence of perched water, amount of time between water level readings, presence of drilling fluid, weather conditions, and use of borehole casing.

#### A.5 LABORATORY TEST METHODS

#### A.5.1 Water Content Tests

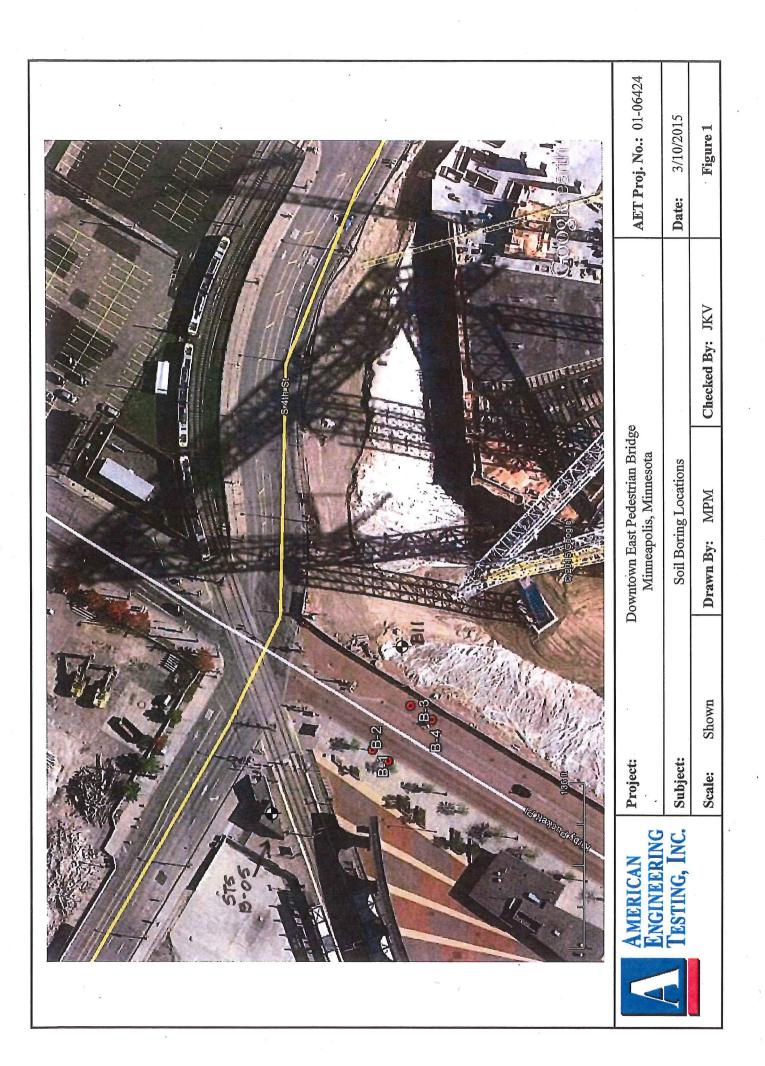
Conducted per AET Procedure 01-LAB-010, which is performed in general accordance with ASTM:D2216 and AASHTO:T265.

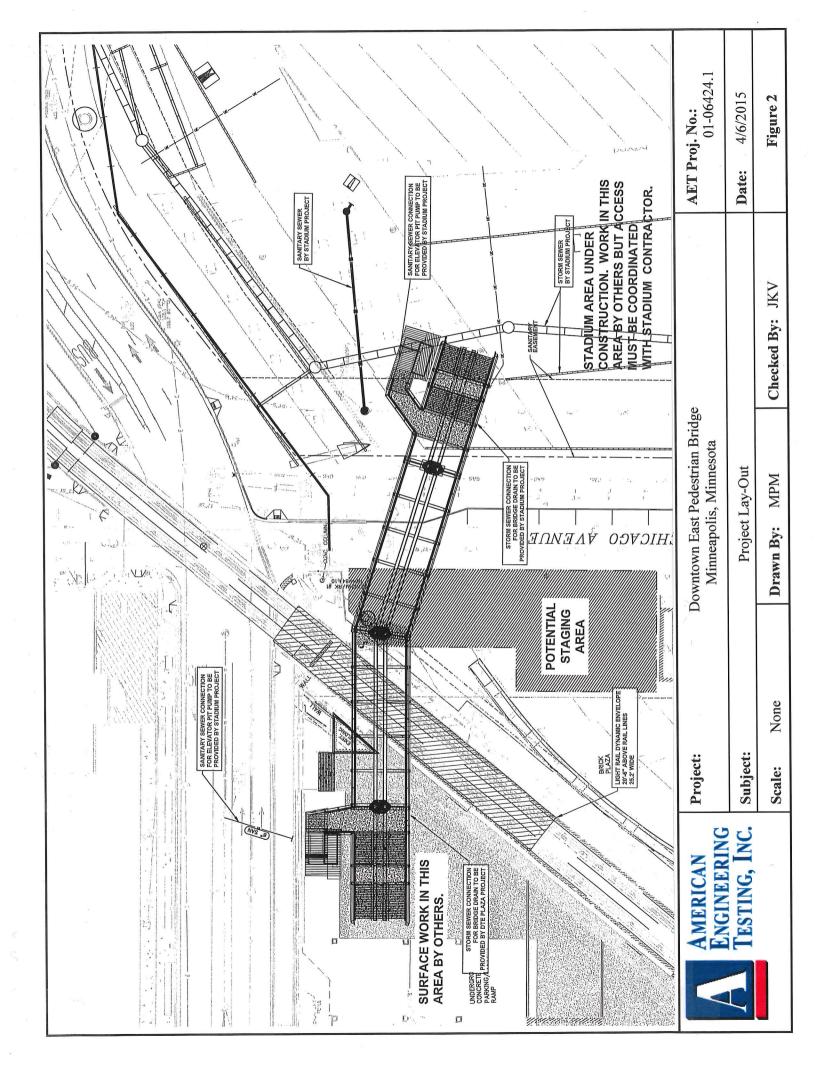
#### A.6 TEST STANDARD LIMITATIONS

Field and laboratory testing is done in general conformance with the described procedures. Compliance with any other standards referenced within the specified standard is neither inferred nor implied.

#### A.7 SAMPLE STORAGE

Unless notified to do otherwise, we routinely retain representative samples of the soils recovered from the borings for a period of 30 days.







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1 - 2 - 3 -	5.25" Concrete 12" FILL, crushe frozen FILL, mostly silt frozen FILL, mostly gra to 4'	y sand with	gravel, bro	own,		FILL			F F F/M	22224242222	SU SU SU						
4 - 5 - 6 -	FILL, mostly silt concrete, dark br FILL, pieces of c	own and gr	ay		/			50/.1	М	HATX FILL	SS . SU	6					
	END OF BORD	NG - OBS	FRUCTEI	) @ <u>6.5</u> '													
LET_CORP W-COORDINATES 01-06424.GPJ AET+CPT+WELL.GD1 3/4/15 TO DOB WOOB WOOB																	
	EPTH: DRILLING	METHOD			WA	TER L	EVEL ME	ASUR	EMEN	_ت_ TSV					NOTE	REF	ER TO
ORDINATES 0	0-6½' 3.25" HS		DATE	TIME	SAMI		CASING DEPTH		VE-IN EPTH		DRILL LUID L	ING EVEL	WAT LEV	TER EL	THE A	ATTA	CHED
2027																	ON OF
AND BOR	ING (PLETED: 2/18/15													ľ			GY ON
		g: 91C													TI	HIS LO	)G



AET N	tando to the second	_						0		ing No				p. 1 o		
Project	t: Downtown East P	edestrian	Bridge; I	Downt	own	East LI	RT St	tatio	n; k	Kirby				nneap	polis,	MN
Surface	Elevation 842.7	. He	ennepin Co	. Coord	linate	<u>s: N</u>	10	67056	;		E :	53211				
DEPTH IN FEET	MATERIAL DI	ESCRIPTION			GEO	LOGY	N	МС	SA	MPLE YPE	REC IN.		r	BORAT	1	1
FEET									י דאר	1FE	<u> </u>	WC	DEN	LL	PL	<b>%-</b> #20
	No samples taken from 0-4.	5'							Ŧ							
1 —									Ħ							
2 -									Ħ							
3 —									Ţ							
									Ĭ							
4				_					Ł							
5 -	FILL, mostly gravelly sand	with silt, or	own				22	M	X	SS	4					
6									म							
7	FILL, mostly silty sand with	h gravel, bro	own						因							
/							5	M	M	SS	10					
8 -									Д							
9 -	SILTY SAND, a little grave	el brown, r	nedium		TILL	OR	-		Ŧ							
10 -	dense (SM) (possible fill)				FILL		10	M	M	SS	15					
							19	M	$\square$	00	15					
11 -	-								H							
12 -									$\left  \right\rangle$							
13 -	-						27	M	M	SS	13					
							_		मु							
14 -	SILTY SAND WITH GRA grained, brown, moist, med	VEL, fine	to medium (SM)	1	COA ALL	.RSE UVIUM										
15 -	gramed, orown, moist, mee		(511)		•		24	M	X	SS	13					
16 -									प्त							
17 -	_								Į							
									H							
n 18 -	GRAVELLY SAND WITH fine grained, brown, moist,	H SILT, me	dium to		•				Ĭ							
19 -	Time grained, brown, moist,	, very dense	(31-314)		•				ł							
20 -	_				•		58	М	$\mathbb{N}$	SS	8					
									K							
21 -									Ħ							
- 22 -	-			· · ·	: - 1				Ħ							
2490	EPTH: DRILLING METHOD			[:[∷] WAT	ER LI	EVEL ME	 ASUR	L EME	_H NTS	1	1			NOTE	REE	FER TO
		DATE	TIME	SAMP		CASING		VE-IN EPTH		DRILI LUID I	ING	WA' LEV	FER			CHED
0-4 BORI COM	48.7' 3.25" HSA	DATE									EVEL	LEV No				DR AN
¥00		2/23/15	10:40	48.	1	48.7	4	8.7	+				110			ION O
	NG													TERM		
	NG PLETED: 2/23/15													Т	HIS L	OG
DR:	SG LG: SB Rig: 91C	I	L									L	l		01	DHR-

03/2011



AETI				-	Boring N			A (p			
Projec	t: Downtown East Pedestrian Bridge; Down	ntown East L				-			neap	olis,	MN
	Hennepin Co. Coc	ordinates: <u>N</u>	1	67056		E 5	532116 FIELD			ORV	TESTS
DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.			LL		<b>%-</b> #200
24 -	SILTY SAND, a little gravel, fine to medium grained, brown, moist, dense (SM)	COARSE ALLUVIUM (continued)									
25 -			45	M	x ss	17					
27 -											
28 -	SILTY SAND WITH GRAVEL, fine to medium grained, brown, moist, dense (SM)										
29 -			49	M	SS SS	16					
31 -					{\ ₽						
32 -											
33 - 34 -	SILTY SAND, a little gravel, brown, a little light brown, very dense, laminations of sand (SM)	TILL			TT TT						
35 -			55	М	ss	18					-
36 -					ET I						
37 -					22						
39	SILTY SAND WITH GRAVEL, apparent cobbles, brown, a little gray, very dense (SM)				H H						
40			83	М	ss ss	16					
41 51/7/E 10 42					P						
42 43	SILTY SAND, a little gravel, brown, very dense										
44	(SM/SC)				Ŧ						
45 A24 GPJ A			99	M	ss	18					
46 46 47											
48 48				_							
AET_CORP W-COORDINATES 01-06424.GPJ AET+CPT+WELL.GDT 3/4/15 77 78 78 79 79 70 70 70 70 70 70 70 70 70 70 70 70 70	END OF BORING - OBSTRUCTED SPLIT-SPOON SAMPLER @ 48.75'	······································	100/	.05 N	SS						
¥L										01-	DHR-0



AET No: 01-06424					-	Lo	g of I	Bori	ng No	D	E	3-3 (p	). 1 of	2)	
Project: Downtown East Pedestrian Bridge; Downtown East LRT Station; Kirby Puckett Pl.; Minneapolis, MN															
Surface Elevation 842.8 Hennepin Co. Coordinates:					s: <u>N</u>	<u>167024</u> E					532152				
DEPTH IN FEET MATERIAL DESCRIPTION			GEOLOGY		LOGY	N	MC	SA	MPLE YPE	REC IN.	FIELD & LABORAT				FESTS %-#200
	- <u></u>			FILL	·.			- F3			wc	DEN			/0-#200
2.25" Brick pavers 1 – 3.25" Bituminous pavement	t		/=	TILL				F							
3" FILL, crushed limestone	base, light	brown	/				F	Ĭ	SU					,	
2 – FILL, mostly silty sand with gravel, pieces of bituminous at 2', dark brown and brown, frozen							F	F	SS	5					
3 —								Ħ							
4 FILL, mixture of silty sand	and clayey	sand, a						I							
5 – little gravel, brown		,				13	М	М	SS	12	10				
6								Д	0.0						
FILL mostly sand with silt	and gravel.	a little						H							
<sup>7</sup> – lean clay, brown						19	М	M	SS	10					
8 -								Д	55						
9 FILL, mostly sand, a little g	gravel and s	ilty sand.		-				H							
10 – light brown						17	M	M	SS	12					
								Д	20						
GRAVELLY SAND WITH	H SILT. pos	sible		COA	RSE	_		R					·-		
cobbles, fine to medium grained, brown, moist,				ALL	UVIUM	86	M	M	SS	5					
13 - very dense (SP-SM)				: •			141	Д	55						
14 —								ł							
15 -						68	M	M	SS	16					
16								Д	22						
								F							
17 -			· · · ·	· · ·				ł							
18 SILTY SAND, a little grav	vel, fine gra	ined,						Ħ							
$\frac{2}{5}$ 19 – brown, moist, medium den						H									
	20 -					23	M	$\mathbb{N}$	S ss	17					
19       Orown, moist, meandin den         19       20         20       -         21       -         22       -         23       SAND, fine grained, light dense (SP)         DEPTH:       DRILLING METHOD         0-49.3'       3.25'' HSA         BORING COMPLETED:       2/16/15								N A							
CPT+1								ł							
								F							
23 SAND, fine grained, light	brown, moi	st, mediur	n					ł							
dense (SP)			WA	TER LI	EVEL ME	ASUR	 EMEÌ	_ISI VTS	I			- <u> </u>	NOTF	: REF	ER TO
	DATE	SAM							DRILLING FLUID LEVEL		WATER LEVEL		THE ATTACHED		
0-49.3' 3.25" HSA	2/16/15				49.3		49.3		TEOID LEVEL		48.6		SHEETS FOR AN		
	2/16/15	3:10			49.3	-	49.3				48.3		EXPLANATION OF		
BORING COMPLETED: 2/16/15	4110/13	U				-							TERM	INOLO	OGY ON
								-					T	HIS L	
DR: SG LG: SB Rig: 91C		I	1											01-	DHR-0



AET N	No: 01-06424					Lo	g of E	Boring N	0	B	3-3 (p	. 1 of	2)	
Project	t: Downtown East P	edestrian	Bridge; I	Downtow	n East L							nneap	olis,	MN
Surface	Elevation 842.8	He	ennepin Co	. Coordin	ntes: <u>N</u>	1	67024		<u>E :</u>	532152				TECTO
DEPTH IN FEET	MATERIAL DE	ESCRIPTION	I	G	EOLOGY	N	мс	SAMPLE TYPE	REC IN.	WC	DEN	BORAT LL		/6-#200
1 2 3 4	2.25" Brick pavers 3.25" Bituminous pavement 3" FILL, crushed limestone FILL, mostly silty sand with bituminous at 2', dark brown FILL, mixture of silty sand a	base, light gravel, pi and brown	eces of n, frozen	FII	,L		F F	SU SS	5					
5 — 6 —	FILL, mostly sand with silt					13	М	ss R	12	10				
7 — 8 — 9 —	lean clay, brown					19	М	ss B	10					
10 - 11 -	FILL, mostly sand, a little g light brown	ravel and s	ilty sand,	-		17	М	ss R	12				-	
12	GRAVELLY SAND WITH cobbles, fine to medium gra very dense (SP-SM)	I SILT, pos iined, brow	ssible m, moist,		DARSE LUVIUM	86	M	₹ Ss ₹3	5					
14 15 16						68	М	ss R	16					
17 - 18 - 19 - 20 - 21 - 22 -	SILTY SAND, a little grav brown, moist, medium dens	el, fine gra se (SM)	ined,			23	М	SS ACTIVITY	17					
23 - 25 - 23 - DE	SAND, fine grained, light dense (SP)	brown, moi	ist, mediur		-			ł						
	EPTH: DRILLING METHOD	······································			LEVEL MI			1	DIC	11747				ER TO
	49.3' 3.25" HSA	DATE	TIME	SAMPLE DEPTH	D CASINO DEPTH	G CA	VE-IN EPTH	DRILI FLUID I	JNG ÆVEL	WA1 LEV	EK EL			CHED
DYOC TO		2/16/15	3:10	49.7	49.3		49.3			48				DR AN
		2/16/15	3:20	49.8	49.3		49.3			48				ION OF DGY ON
BORI COM	NG PLETED: 2/16/15									-			HIS L	
DR:	SG LG: SB Rig: 91C									<u> </u>		A.		-

01-DHR-060



AET No							ing No			8-3 (p		******	
Project:	Downtown East Pedestrian Bridge; De	own	town East LF	RT S	tatio	n; 1	Kirby				inear	oolis,	MN
	Hennepin Co.	Coor	dinates: <u>N</u>	1	67024	۱ ۲		Е :	53215				
EPTH IN ÆET	MATERIAL DESCRIPTION		GEOLOGY	N	мс	SĄ	MPLE YPE	REC IN.		) & LAI		· · · · ·	1
						1		119.	WC	DEN	LL	PL	<b>%-</b> #:
	SAND, fine grained, light brown, moist, medium dense (SP) (continued)		COARSE ALLUVIUM			17							
25 7			(continued)	30	M	M	SS	15					
26 —						F							
27 —						Ħ							
28 —	LEAN CLAY, brown, a little light brown, hard,		FINE ALLUVIUM			Į							
29 —	laminations of sandy silt (CL)		ALLOVION			H						-	
30 -				57	M	X	SS	18	13				
31 -						सि							
32 —						1							
33 —	SAND WITH SILT, a little gravel, medium to		COARSE			H							
34 -	fine grained, brown, moist, very dense (SP-SM)		ALLUVIUM			ł							
35 —				58	М	$\mathbf{V}$	SS	15					
36 -			• •	50		A	55						
37 -						ł							
			•			H							
38 -	SILTY SAND, a little gravel, apparent cobbles at about 47', brown, very dense (SM)		TILL			H							
39 —						KI KI							
40 -				69	M	X	SS	18					
41						F							
42 —													
43 —			• • •										
44 —			** * *			Į							
45 —				.51	M		ss	18					
46 -						F							
47 —						Ł	) }						
48 —					Ţ	<u> </u> {	} }						
49 —	WEATHERED LIMESTONE, gray and light		PLATTEVILI					-					
	brown	7.7	PLATTEVILI FORMATION	100/	<u>.4 W</u>	+	<u>ss</u>	5					
	END OF BORING - OBSTRUCTED SPLIT-SPOON SAMPLER @ 49.7'												
												01	



AET	No: 01-06424		-			Lo	g of E	Boring	No.	]	B-4 (1	p. 1 of	2)	
Projec		edestrian	Bridge; D	owntowi	n East L		0	•	-	kett P	<b>l.; M</b> i	innear	oolis,	MN
-	Elevation 843.2		ennepin Co.				67005		E	53214	1			
DEPTH IN FEET		ESCRIPTION		GE	OLOGY	N	мс	SAMP TYPI	LE RE IN		- <u></u>	BORAT	1	rests %-#200
1 2 3 4 5 6 7	2.25" Brick pavers 3.75" Bituminous pavement 3" FILL, crushed limestone frozen FILL, mostly silty sand with frozen FILL, mostly silty sand, a lit frozen FILL, mostly clayey sand w silty sand, brown, frozen to SILTY SAND, fine grained medium dense (SM)	base, light l gravel, dan ttle gravel, l ith gravel, a about 4'	k brown, brown, a little	FILI	ARSE	59	F F F	SI S	J S 9 S 3	13				
8 - 9 - 10 - 11 -						17 23	M		S 1 S 1					
12 - 13 - 14 -	medium dense (Sivi)	VEL, brow	'n,	TIL	Ĺ	20	М		S (	5				
15 16 17						20	M		SS 1	4				-
18 19 20 31712 20 20 20 20 20 20 20 20 20 20 20 20 20		ravel, brow id sand (SC	n, hard,			38	M		55	6 6				
1-0642				WATER I	LEVEL M	EASUR	EMEN	JSTS	1			NOTE	: REF	ER TO
TES	-49½' 3.25" HSA	DATE	TIME	SAMPLED DEPTH			VE-IN EPTH		ILLING D LEVI		TER VEL	THE	ATTA	CHED
OORDI		2/16/15	11:20	49.5	49.5		49.5				9.2			DR AN ION OF
Ň-Č	DIO	2/16/15	11:30	49.5	49.5		49.5			4	8.8			DGY ON
	ING IPLETED: 2/16/15												HIS L	
UR:												L		DHR-0



AET N						Borin				<b>3-4 (</b> p			
Project:	Downtown East Pedestrian Bridge; I	Down	town East LR	RT St	tatio	n; Ki	irby				nneap	oolis,	MN
	Hennepin Co	. Cooi	dinates: <u>N</u>	1	57005	<u>.</u>	]	E:	53214				
EPTH IN EET	MATERIAL DESCRIPTION		GEOLOGY	N	МС	SAM TY	PLE	REC IN.		) & LAI			1
ËET		1					FE		WC	DEN	LL	PL	<b>%-</b> #2
25 —	GRAVELLY SAND WITH SILT, apparent cobbles, medium to fine grained, brown, moist, very dense (SP-SM)		COARSE ALLUVIUM	114	М	<u>F</u> 1	SS	14					
26 -	•					E							
27 –						ł							
28 —	CLAYEY SAND, a little gravel, brown, hard,		TILL			Ŧ							
29 -	laminations of silty sand (SC)					ł							
30 -				57	M	M	SS	7	8				
31 -						<b>F</b>							
32 -						1							
33 -						ł							
34 35	· · · · · · · · · · · · · · · · · · ·					Υ Γ	00	10	7				
36 —				59	M		SS	18	7				
37 -						ł							
38 -						ł							-
39 -						1							
40 —				53	M	$\mathbb{N}$	SS	18	9				
41 —						∏ स							
42						ł							
43 —	WEATHERED LIMESTONE, gray		PLATTEVILL	Ē		ł							
44 —			FORMATION			ł							
45 —				40	M	M	SS	14					
46 -						Ł							
47 —						Ĭ							,
48 —						, <u></u>							
49 -		_Z		100/.0	<u>–</u> M	-11	- <del>SS</del> -			_			
	END OF BORING - OBSTRUCTED @ 49.7			100/.0									
												01-	DH



AMERICAN ENGINEERING TESTING, INC.

# SUBSURFACE BORING LOG

AETN	lo: 01	-05723						Lo	g of F	Bori	ng No	).	B	11 (p	o. 1 of	3)	
Project	t: Min	nnesota Multi-	Purpose S	tadium;	Minn	eapo	lis, MN										
Surface	Elevation	847.8	H	ennepin Co	o. Cooi	rdinat	es: <u>N</u>	1	66950		<u>]</u>	E :	532196		000.47		FEOTO
DEPTH IN FEET		MATERIAL DI	ESCRIPTION	I		GE	OLOGY	N	MC	SA T	MPLE YPE	REC IN.	WC		BORAT RQD IN.		1ESTS %-#200
	7" Concrete				-	FILL	,			स्र							
1	FILL, most	y silty sand with 4.5' to 11', pieces	n gravel, pie s of bitumir	eces of nous				36	M	Д	SS	3					
2	around 10'	and 18'						37	М	X	SS	12					
4										Ð							
5								59	М	M	SS	14					
6 -								0.1		मि	·						
7										H		10					
8 -	- -							113	M	Å	SS	12					
9 -										I							
10 -								77	Μ	Х	SS	14					
11 -	-									I							
12 -								114	M	M	SS	10					
13 -										सि							
14 -								15	М	M	SS	12					
16 -								15		Д	33	12					
17 -										E							
18 -	 							30	M	М	SS	14					
19 -	-									ł							
20 -	-							68	M	M	SS	12					
21 -	-									R							
22 -	SAND WI	TH GRAVEL, f	ine to medi	um (SP)			ARSE LUVIUM		M	$\mathbb{A}$	SS	3					
23 -		own, moist, mee	inum dense	(01)				69	M	Å	55	5					
24 -	CLAYEY	SAND WITH C	GRAVEL, b	rown, hard	d ///	TIL	L	1		E						×	
25 -	(SC/SM)							58	M	Х	SS	6	9				
		TH SILT AND	GRAVEL	fine to			ARSE	-		ß							
	medium gi	rained, brown, m	noist, mediu	m dense			LUVIUM	26	M	$\mathbb{N}$	SS	3					
	(SP-SM)									R							
29 - 30 -	GRAVEL	LY SILTY SAN own, moist, ver	ID, fine to r v dense (SN	nedium A)				66	M	$\nabla$	SS	6					
31	0		y denie (br	~)				00			35						
57/cn			1				EVEL MO		EMEN					- <u> </u>			
	EPTH: DRIL	LING METHOD			1		EVEL ME	1	VE-IN	Т	DRILL	ING	WAT	ER			ER TO
IV 0-	59.1' 4.25	' HSA	DATE	TIME		PLED PTH			EPTH	FI		ĒVEL	LEV	EL			CHED DR AN
27 - 28 - 29 - 30 - 31 - 29 - 30 - 31 - 59 - 59 - 59 - 59 - 59 - 59 - 59 - 59	59.7' RDF	'w/DM	8/5/13	2:00		4.8	54.5		54.1	_			53.				ION OF
ŭ <b>59.7-</b>	94.1' NQ	Core	8/5/13	2:20	54	4.8	54.5		54.0				52.	.0			OGY ON
		/13							,	_						HIS LO	
DR:	SG LG: TN	1 Rig: 85C											J				

01-DHR-060



AMERICAN ENGINEERING TESTING, INC.

AET N	lo: 01-05723			Log	g of I	3or	ing No	).	В	11 (p	2 of	3)	
Project	: Minnesota Multi-Purpose Stadium; N	linne	eapolis, MN										
	Hennepin Co.	Coor	dinates: <u>N</u>	16	6950	) 	]	E É	532196		00.00		0000
DEPTH IN	MATERIAL DESCRIPTION		GEOLOGY	N	MC	SA T	MPLE YPE	REC IN.	FIELD WC	& LAB			ESTS %-#200
FÊET	OD AVELLY SHITY SAND fing to medium	E C							wc	%	IN.	%	/0-#200
33 -	GRAVELLY SILTY SAND, fine to medium grained, brown, moist, very dense (SM)			121	Μ	М	SS	6					
34 -	(continued) SAND, fine grained, light brown, moist, medium					Ĭ							
35 —	dense (SP)			22	М	M	SS	12					
36 -						रि							
37				21	М	$\square$	SS	12					
38 -				21		H	00						
39 -	SAND WITH SILT AND GRAVEL, fine to			100/.4	М	R	SS	6					
40 -	medium grained, brown, moist, very dense (SP-SM)					R	00						
41 - 42 -	SILTY SAND, a little gravel, brown, very dense		TILL			I							
42 -	(SM)			89	М	Х	SS	12					
44 -						Ł							
45 -	,		•	85	М	$\square$	SS	18					
46 -						प्ति							
47 -	SAND WITH GRAVEL, fine grained, brown, moist, very dense (SP)		COARSE	107		$\mathbb{R}$	SS	14					
48 -	moist, very dense (Sr)		· · · · · · · · · · · · · · · · · · ·	107	M	A	66	14					
49 -	CLAYEY SAND, a little gravel, brown, hard,		TILL			Į.							
50 -	lenses and laminations of silty sand (SC)			49	M	Х	SS	12	9				
51 -	SILTY SAND WITH GRAVEL, brown, very					ß							
52 -	dense (SM/SC)			87		- [X	SS	14					
53 -				ļ		R							
55 -	GRAVEL WITH SILT AND SAND, brown, waterbearing, very dense (GM)		COARSE	100/.3	3 W	R	SS	2					
56 -	APPARENT LIMESTONE, severely weathered		I COLLUVIUM			H							
67	(residual soil) with hard thin layers (based on drill tool action)		APPARENT PLATTEVILL	Ē		H							
58 -			FORMATION MAGNOLIA			ł							
59 -	-		MEMBER			1	<u>,</u>						
	LIMESTONE, light gray and gray, a little light		PLATTEVILL FORMATION										
	brown, fossiliferous Weathering: Slightly weathered		MEMBER				NQ2	53		100	51	97	
∃ 62 · G	Fracturing: Moderately to slightly fractured, very fractured around 61.6'						11.22						
63	Stratification: Thickly bedded		14 4										
64 64 64 64 64 64 64 64 64 64 64 64 64 6	Hardness: Hard LIMESTONE, gray and light gray, a little light	揮	PLATTEVILI										
65 65	brown		⊥ FORMATION ⊥ HIDDEN	1								_	
NIQUON 67	Fracturing: Very to slightly fractured		FALLS MEMBER				NQ2	2 56		93	48	80	
	Stratification: Thickly bedded Hardness: Hard		I										
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AMERICAN ENGINEERING TESTING, INC.

# SUBSURFACE BORING LOG

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# Appendix **B**

Geotechnical Report Limitations and Guidelines for Use

#### **B.1 REFERENCE**

This appendix provides information to help you manage your risks relating to subsurface problems which are caused by construction delays, cost overruns, claims, and disputes. This information was developed and provided by ASFE<sup>1</sup>, of which, we are a member firm.

#### **B.2 RISK MANAGEMENT INFORMATION**

#### B.2.1 Geotechnical Services are Performed for Specific Purposes, Persons, and Projects

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

#### **B.2.2 Read the Full Report**

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

#### B.2.3 A Geotechnical Engineering Report is Based on A Unique Set of Project-Specific Factors

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

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

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

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

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

#### **B.2.4** Subsurface Conditions Can Change

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

1 ASFE, 8811 Colesville Road/Suite G106, Silver Spring, MD 20910 Telephone: 301/565-2733 : www.asfe.org

# Appendix B Geotechnical Report Limitations and Guidelines for Use Report No. 01-06424.1

### **B.2.5** Most Geotechnical Findings Are Professional Opinions

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

### B.2.6 A Report's Recommendations Are Not Final

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

### **B.2.7** A Geotechnical Engineering Report Is Subject to Misinterpretation

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

#### **B.2.8** Do Not Redraw the Engineer's Logs

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

#### **B.2.9** Give Contractors a Complete Report and Guidance

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

#### **B.2.10 Read Responsibility Provisions Closely**

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

#### **B.2.11** Geoenvironmental Concerns Are Not Covered

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



CONSULTANTS • ENVIRONMENTAL • GEOTECHNICAL • MATERIALS • FORENSICS

October 20, 2015

Minnesota Sports Facilities Authority 511 11<sup>th</sup> Avenue South, Suite 401 Minneapolis, MN 55415

Attn: Steve Maki, PE

RE: Geotechnical Exploration and Testing Vikings Legacy Ship, US Bank Stadium Minneapolis, Minnesota AET No. 01-05723

Dear Mr. Maki:

This letter report presents the results of the geotechnical exploration, testing, and review that we performed for the Vikings Legacy Ship planned to be constructed in the southwest corner of the stadium site. This work is being performed per our September 1, 2015 proposal to the MSFA, which was subsequently authorized by Tanya Dreesen of the Vikings on the same date. The scope consisted of three standard penetration test borings, soil index testing, and preparation of this report. As petroleum-type odor was noted from one sample, the samples from that boring were also screened in the laboratory for organic vapors using a photoionization detector (PID).

# **1.0 Project Information**

The Legacy Ship will be located in the southwest corner of the stadium site, in the northeast quadrant of the intersection of  $6^{\text{th}}$  Street South and Chicago Avenue. The layout is shown on Figure 1. The borings are located at or near the primary foundations supporting the structure, although there will be smaller foundation elements around the bow foundation. The foundations have reportedly been located to avoid the below grade utilities in the area.

Grade is planned to be raised in the area. At this time, we understand the main on-grade slab to be in the vicinity of elevation 848 feet. This results in grade raises of about  $2\frac{1}{2}$  feet to  $6\frac{1}{2}$  feet at the test boring locations. The slab subgrade soils will be exposed to freezing temperature conditions.



Steve Maki, PE October 20, 2015 AET No. 01-05723 Page 2 of 5

The mast component represents the most significant foundation, as it will support the "sail" which will be an LED Display Board. This foundation will need to resist the following unfactored loads:

- Moment: 1517 kip-ft
- Lateral force (shear): 37.8 kips
- Axial force (compression): 70.7 kips

We understand the mast foundation is expected to maintain a deflection of less than  $1\frac{1}{2}$  inch at the top of the foundation. The preliminary design provided to us consisted of a 6-foot diameter drilled pier, extending 28 feet deep. The pier will be reinforced with #8 reinforcing bars and #4 transverse bars.

We presume the bow and stern foundations will experience considerably lower moment and lateral loads, although axial loads could be similar. These foundations are expected to be shallow spread footings which are buried at least 5 feet for frost protection.

Utilities have been located in the project area in the past. However, we understand these past utilities have been re-routed, and the utilities beneath the ship area have been abandoned. An exception is a fiber optic duct which crosses the area between the bow and mast.

### 2.0 Subsurface Exploration

The standard penetration test borings were completed in the field on September 21, 2015. The logs of the test borings are attached. The boring designations of M, B, and S correspond to the mast, bow, and stern locations of the ship, respectively. The boring locations appear on Figure 1. We have noted the Hennepin County coordinates as determined by GPS to submeter accuracy on the logs. The surface elevations were referenced to a manhole rim shown on provided plans.

The boring logs contain information concerning soil layering, soil classification, geologic description, and moisture condition. Relative density or consistency is also noted for natural soils, which is based on the standard penetration resistance (N-value). We refer you to the standard sheet entitled "Exploration/Classification Methods" for details on the drilling and sampling methods, the classification methods, and the water level measurement methods. Data sheets concerning the Unified Soils Classification System, the descriptive terminology, and the symbols used on the boring logs are also attached.

### **3.0 Geotechnical Laboratory Testing**

The laboratory test program consisted of two sieve analysis tests. The test results appear on the data sheet following the logs.

Steve Maki, PE October 20, 2015 AET No. 01-05723 Page 3 of 5

### 4.0 PID Screening

During the field drilling operations, the sample from 17 feet to 18<sup>1</sup>/<sub>2</sub> feet at Boring M was found to have a relatively strong petroleum-type odor. To document organic vapor presence at this depth, and to document the lack of vapors at the other sample depths at this location, the samples from this boring were screened in the laboratory for organic vapors using a photoionization detector. A photoionization detector (PID) checks for the presence of organic vapors with ionization potentials less than the lamp voltage. The PID is calibrated for direct reading in parts-per-million-volume (PPMv) of a benzene equivalent.

The results of that screening appear on the boring logs. The results do indicate the presence of organic vapors from the 17 to  $18\frac{1}{2}$  foot sample, but not at the other samples.

As this report is for geotechnical purposes only, the report does not address handling of the contaminated soils during construction.

### **5.0 Conditions Encountered**

The geologic profile consists of 6½ feet to 11½ feet of fill over water-deposited (alluvial) sands and gravels; although differentiation between the fill and natural soils was not obvious, and the actual depths may vary. The apparent fill mostly consists of silty sand, and is relatively well compacted based on the N-values recorded. The fill thickness may well vary over a short distance in the area, as it may be utility trench backfill.

The underlying alluvial soils are sands (SP), sands with silt (SP-SM), and silty sands (SM), having varying gravel content. Some of the upper sands to sands with silt are loose, based on N-values of 6 to 10, The deeper soils, and the silty sands, are typically medium dense to dense.

### 6.0 Mast Foundation Review and LPILE Analysis

The critical component of the mast pier foundation design will be the control of deflection due to the moment and lateral loads it will experience. The axial resistance of the mast pier will be relatively high due to the combination of end bearing and skin friction.

Potential deflection of the mast foundation due to the understood loads acting was analyzed using *LPILE v2015* from Ensoft, Inc. Our analysis indicates the preliminarily planned six-foot diameter drilled per will be able to provide proper resistance with about  $\frac{1}{2}$  inch of deflection. In our opinion, it should be possible to reduce either the foundation diameter or depth as follows:

- Six-foot diameter pier, 24-foot depth, or
- Five-foot diameter pier, 28-foot depth.

The above cases still result in a deflection of about 1/2 inch to 2/3 inch, which is within the

Steve Maki, PE October 20, 2015 AET No. 01-05723 Page 4 of 5

established criteria. Our analysis indicates the depth to be an important element of the design, as the analysis shows deflections approaching the  $1\frac{1}{2}$ -inch deflection limit with a pier depth of 20 feet.

#### 7.0 Recommendations

### 7.1 Grading

We recommend new fill placed to raise grade be Select Granular Borrow per MnDOT Specification 3149.2B.2. In addition, where current grade is within 4 feet of the bottom of the slab and the soil does not meet Select Granular Borrow specifications (silty sand does not), we recommend the soils be subcut and replaced with Select Granular Borrow to provide a more uniform frost heave condition.

Prior to Select Granular Borrow placement or shallow footing placement, we recommend the exposed soils be observed and evaluated by AET geotechnical field personnel. The evaluation should include a series of hand auger borings to explore the quality and uniformity of the soils, particularly in past utility backfill areas and in areas where shallow footings will be placed. If soils are deemed unsuitable, excavation and refilling should be performed as directed by the geotechnical field personnel. Prior to fill and footing placement, the exposed soils should be surface compacted with at least six passes of a vibratory roller compactor.

We are not aware of past utility abandonment procedures. Proper abandonment would involve either complete utility removal, full concrete filling of pipes, or, if the pipe was deemed to have sufficient structural strength, plugging of the ends to prevent soil erosion into the pipe. AET was not involved with this process, nor do we have records of how this was done. If proper abandonment didn't take place, our recommendation would be to have this done. We can state that Boring S was in the area of past utilities, and the Nvalues recorded do suggest the fill has relatively high compaction.

New fill should be compacted in thin lifts, such that the entire lift achieves a minimum compaction level of 98% of the *standard maximum dry unit weight* per ASTM:D698 (Standard Proctor test). The lift thicknesses should be thin enough such that it can achieve the minimum specified compaction level with the type of compaction equipment being used.

## 7.2 Mast Foundation Design

We recommend the mast be supported on a drilled pier foundation, with dimensions meeting one of the two cases noted in Section 6.0. During concrete placement, care should be taken to avoid segregation of the aggregates in the concrete caused by concrete striking reinforcing steel or the sides of the casing/excavation. As sands will cave, casing will likely be needed. When casing is used, a positive head of concrete should be maintained above the bottom of the casing during its removal.

Steve Maki, PE October 20, 2015 AET No. 01-05723 Page 5 of 5

## 7.3 Shallow Spread Foundation Design

Following the recommended grading, the remaining structural elements can be supported on spread footing foundations. We recommend the foundations be placed such that at least 5 feet of soil cover is provided for frost protection purposes. The footings should be deeper if needed to avoid influence on utilities, such as the fiber optic duct which we understand will remain. The footing bottom should be positioned such that it is at least 2H:1V away from the duct bottom.

The foundation design can be based on a maximum allowable soil bearing capacity of up to 3,000 psf. It is our judgment the 3,000 psf design pressure should have a factor of safety of greater than 3 against localized shear or base failure. We judge that total and differential settlements under these loadings will be less than 1 inch and  $\frac{1}{2}$  inch, respectively.

# 8.0 Standard of Care

Within the limitations of scope, budget, and schedule, our services have been conducted according to generally accepted geotechnical engineering practices at this time and location.

Authored By,

ellers K

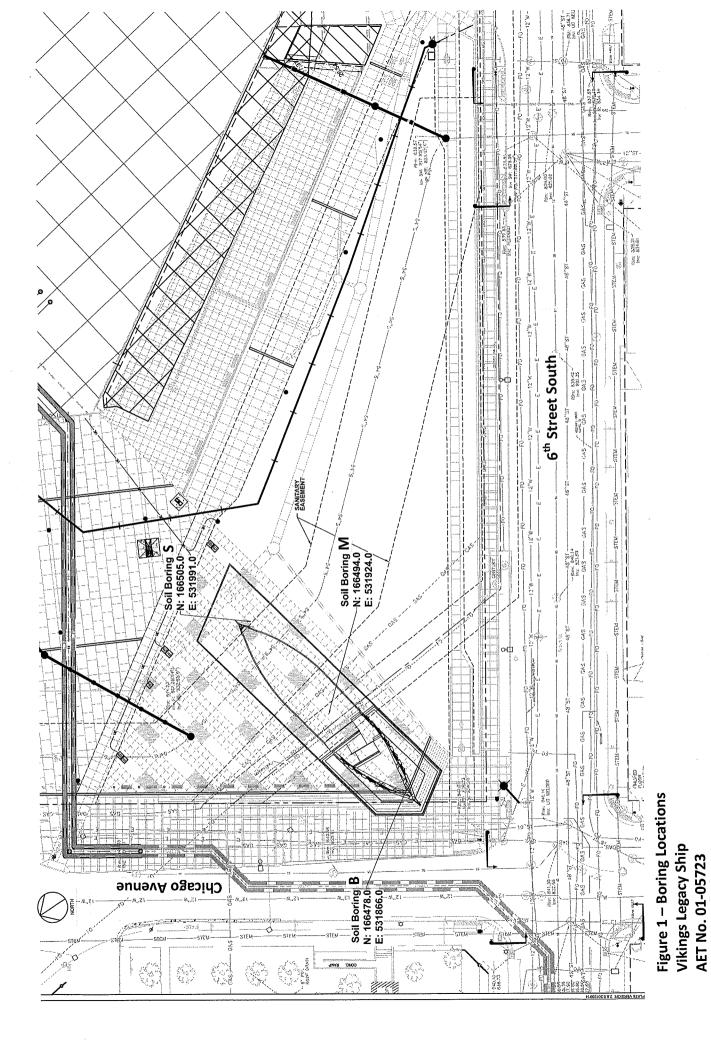
Jeffery K. Voyen, PE (MN No. 15928) Vice President/Principal Engineer (651) 659-1305 direct (612) 961-9186 cell jvoyen@amengtest.com

Reviewed By,

Gregory R. Reuter, PE, PG Principal Engineer

Attachments:

Figure 1 – Boring Locations Subsurface Boring Logs Sieve Analysis Test Results Exploration/Classification Methods Boring Log Notes Unified Soil Classification System





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3 -	\brown FILL, mostly silty sand, a l	ittle claver	sand	]			14	М	Х	SS	14					0.2
4 -	black to brown	utile clayey	sana,						Ł							
5 -	-						9	M	$\square$	SS	14					0.2
6 -							1			00						
7 -	SAND WITH SILT, fine g	grained, ligh	t brown,			ARSE JUVIUM			P							
8 -	moist, loose (SP-SM)					.0 10101	6	M	М	SS	14					0.3
9	SAND, a little gravel, fine	to medium	grained	_					ß							
10 -	brown, moist, loose (SP)	to meanann	gramed,				10	M	М	SS	10					0.3
11 -	-								मि							
12 -	SAND, fine grained, light dense, lenses of silt, lamin	brown, moi	st, medium	1					H							
13 -	(SP)		all clay		•		26	M	Й	SS	14					0.2
14 -	SAND WITH SILT, a littl	e gravel, po	ssible						I							
15 -	- cobble at $15\frac{1}{2}$ , fine to med	dium graine	d, brown,		·		*	M	M	SS	12					0.3
16 -	moist, very dense (SP-SM) 3/.5 + 5/.5 + 100/.2	)							मि							
17 -	SILTY SAND, a little grav	vel, fine to r	nedium	- []]					R		14					197
18 -	grained, brown, moist, me laminations of sandy lean	dium dense, clav (SM) (	, lenses and netroleum	1			21	M	Д	SS	14					19/
19 -	type odor)			_/##	-				国							
20 -	<ul> <li>SILTY SAND, a little gray brown, moist, medium der</li> </ul>		ined,				23	M	X	SS	14					0.7
21 -		130 (13141)							रि							
22 -	SILTY SAND WITH GR.	AVEL, fine	grained,				38	M	$\square$	SS	12					0.4
23 -	brown, moist, dense (SM)						50	141	Ą	66	12					0.1
24 -	_				: -											
<u>- 25 -</u>	_				:		34	M	Х	SS	10					0.4
26 -	-				·.				रि							
27 -	-1						27	M/W	$\mathcal{N}$	SS	14					0.4
28 -	-								$\square$							- • •
ម្នុ 29 -	SILTY SAND WITH GR			n					R							
30 - 2	grained, brown, moist, me	aium dense	(SM)				26	M/W	ΊΧ	SS	14					0.5
31 -									B							
CORP W-COORDINATES 01-05723.6PJ AET+CPT 4012 5 - 5 - 5 - 5 - 5 - 5 - 5 - 5 - 5 - 5 -	EPTH: DRILLING METHOD			WA1	TER L	EVEL MEA	SUR	EMEN	TS					NOTE	REF	ER TO
ATES		DATE	TIME	SAMP DEP	LED	CASING DEPTH	CA	VE-IN EPTH	FI	DRILLI JUID LI	NG EVEL	WAT LEV	ER EL	THE A	ATTAC	CHED
	39½' 3.25" HSA	9/21/15	9:15	41.		39.5		1.0				Nor		SHEE	TS FO	R AN
000	<u></u>	9/21/15	9:25	41		39.5		1.0	+			Nor	— ,	EXPLA	NATI	ON OF
≷ BORI	NG N ETED. 0/21/15	9/21/15	11:15	41		39.5		1.0	-			Nor		ERMI	NOLO	GY ON
B COM	PLETED: 9/21/15 SG LG: TPM Rig: 91C				-		1							TI	IS LO	G
	Ju Du, HIMING, MU		1	L			-								01 F	

03/2011



AETN	No: 01-05723			Lo	g of l	Bor	ing No	)	N	И (р.	2 of 2	2)	
Projec	t: Minnesota Multi-Purpose Stadium; M	/linne											
	Hennepin Co.	Coor	dinates: <u>N</u>	1	66494	<b> </b>	]	E 5	31924				
DEPTH IN FEET	MATERIAL DESCRIPTION		GEOLOGY	N	МС	SA T	MPLE YPE	REC IN.	ſ	& LAE	LL	DT	ESTS PID (ppm)
33 - 34 -	SAND WITH SILT, fine grained, brown, moist, medium dense, lenses and laminations of sandy lean clay (SP-SM) (continued)		COARSE ALLUVIUM (continued)	28	M/W	R	SS	12	-			•	0.4
35	SAND WITH GRAVEL, fine grained, light brown, moist, very dense (SP)			55	М	L L	SS	14					0.4
37 — 38 —	SILTY SAND WITH GRAVEL, fine to medium grained, brown, moist, very dense, lenses and laminations of clayey sand (SM)			61	M		SS	14					0.4
39 40	SAND WITH SILT, fine grained, light brown, moist, dense (SP-SM)			49	М	¥ X	SS	16					0.3
41	END OF BORING												
			×.										
CI 147 IG													
3.GPJ_AE1+(													
11ES 01-05/2	•			1									
NET_CORP W.COORDINATES 01-05/23.GPJ AE1+CP1+WELL.GD1													<b>3</b>
ET_CORP V													



AE	AET No: 01-05723 Project: Minnesota Multi-Purpose Stadium; Minneapolis, M									Bor	ing No	o		S (p.	<b>1 of</b> 1	l)	
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	ace Elevatio	n845.3	_ Henr	epin Co. C	oordin	ates:	<u>N</u>	1	66505	5		<u>E</u>	53199				
DEPT IN FEE	н	MATERIAL D	DESCRIPTIO	N		GE	EOLOGY	N	MC	SA T	MPLE YPE	REC IN.	WC	) & LA DEN	LL	[	1ESTS
	FILL,	mostly silty sand, a l gray and brown	ittle gravel	and clayey	/	FILI	L	18	M	M	SS	14	we	DLIV			10-1120
	2							71	М	$\square$	SS	10					
4	4 - FILL, 5 -	mostly silty sand, a l	ittle gravel	, brown				15	м	ł	SS	12					
	5 – 7 – FILL, 8 –	mostly silty sand wi	th gravel, b	rown				21	м		SS	5	6				14
								28	М		SS	12					
1	graine	SAND, a little grav d, brown, moist, mea tions of clayey sand	lium dense		d		ARSE LUVIUM	26	M		SS	10					
1	5 — 6 —							20	M	N FI	SS	14					
1	$\begin{bmatrix} & & \\ & & \\ & & \\ & & \end{bmatrix}$ graine	A SAND WITH GRA	dium dense	(SM)	1			21	М	R R	SS	14					
- 2	$\begin{array}{c} & \text{SANL} \\ 0 - & \text{light b} \\ 1 - & \text{lamina} \end{array}$	), a little gravel, fine rown, moist, mediur ations of lean clay an	n dense, ler id clayey sa	nses and and (SP)				33	M	R	SS	10					
2	$\begin{array}{ccc} 2 & - & \text{SILTY} \\ graine \\ 3 & - & (SM) \\ 4 & - & \end{array}$	/ SAND WITH GRA d, brown, moist, den	AVEL, fine ise to mediu	to mediun im dense	n ()			32	M	T T	SS	10					
	5 -							24	М	X	SS	14					
CORP W-COORDINATES 01-05723.GPJ AET+CPT+WELL.GDT 10/20/15	END	OF BORING															
5 5	DEPTH: I	DRILLING METHOD			WAT	ER L	EVEL MEA	SUR	EMEN	ITS					NOTE:	REFI	ER TO
JATES	0-24½' 3	3.25" HSA	DATE	TIME	SAMP DEP	LED TH	CASING DEPTH	CAL	VE-IN PTH	] FL	DRILLI JUID LI	NG EVEL	WAT LEVI	ER EL	THE A	TTAC	CHED
	U-2-17/2 2	110A	9/21/15	9:25	26.		26.5		6.0				Non		SHEE	FS FO	R AN
N-CO										1				I	EXPLA	NATI	ON OF
and BO	RING MPLETED:	9/21/15												Т			GY ON
		TPM Rig: 91C													TH	IIS LO	'G

# SIEVE ANALYSIS TEST RESULTS

PROJECT:	<b>AET NO.:</b> 01-05723
Vikings Legacy Ship	
US Bank Stadium	
Minneapolis, Minnesota	<b>DATE:</b> October 20, 2015

# **TEST METHOD:** General Conformance with ASTM: D6913, Method A

# **RESULTS:**

Boring Number	В	S
Sample Depth	41⁄2'-6'	7'-8½'
Dry Sample Weight (gms)	194.33	160.20
Sieve Size or Number	Percent Pass	ing by Weight
3/4"	100	100
5/8"	100	96
1/2"	100	90
3/8"	100	89
#4	100	80
#10	98	73
#20	90	66
#40	68	52
#100	22	20
#200	18	14

Note: The small sample size limits the accuracy of the test, and the sample may not necessarily be representative of the entire layer shown on the boring log.

### SAMPLING METHODS

#### Split-Spoon Samples (SS) - Calibrated to N<sub>60</sub> Values

Standard penetration (split-spoon) samples were collected in general accordance with ASTM: D1586 with one primary modification. The ASTM test method consists of driving a 2" O.D. split-barrel sampler into the in-situ soil with a 140-pound hammer dropped from a height of 30". The sampler is driven a total of 18" into the soil. After an initial set of 6", the number of hammer blows to drive the sampler the final 12" is known as the standard penetration resistance or N-value. Our method uses a modified hammer weight, which is determined by measuring the system energy using a Pile Driving Analyzer (PDA) and an instrumented rod.

In the past, standard penetration N-value tests were performed using a rope and cathead for the lift and drop system. The energy transferred to the split-spoon sampler was typically limited to about 60% of its potential energy due to the friction inherent in this system. This converted energy then provides what is known as an  $N_{60}$  blow count.

AET's drill rigs incorporate an automatic hammer lift and drop system, which has higher energy efficiency and subsequently results in lower N-values than the traditional  $N_{60}$  values. By using the PDA energy measurement equipment, we are able to determine actual energy generated by the drop hammer. With the various hammer systems available, we have found highly variable energies ranging from 55% to over 100%. Therefore, the intent of AET's hammer calibrations is to vary the hammer weight such that hammer energies lie within about 60% to 65% of the theoretical energy of a 140-pound weight falling 30". The current ASTM procedure acknowledges the wide variation in N-values, stating that N-values of 100% or more have been observed. Although we have not yet determined the statistical measurement uncertainty of our calibrated method to date, we can state that the accuracy deviations of the N-values using this method are significantly better than the standard ASTM Method.

#### Disturbed Samples (DS)/Spin-up Samples (SU)

Sample types described as "DS" or "SU" on the boring logs are disturbed samples, which are taken from the flights of the auger. Because the auger disturbs the samples, possible soil layering and contact depths should be considered approximate.

#### **Sampling Limitations**

Unless actually observed in a sample, contacts between soil layers are estimated based on the spacing of samples and the action of drilling tools. Cobbles, boulders, and other large objects generally cannot be recovered from test borings, and they may be present in the ground even if they are not noted on the boring logs.

#### **CLASSIFICATION METHODS**

Soil classifications shown on the boring logs are based on the Unified Soil Classification (USC) system. The USC system is described in ASTM: D2487 and D2488. Where laboratory classification tests (sieve analysis or Atterberg Limits) have been performed, accurate classifications per ASTM: D2487 are possible. Otherwise, soil classifications shown on the boring logs are visual-manual judgments. Charts are attached which provide information on the USC system, the descriptive terminology, and the symbols used on the boring logs.

The boring logs include descriptions of apparent geology. The geologic depositional origin of each soil layer is interpreted primarily by observation of the soil samples, which can be limited. Observations of the surrounding topography, vegetation, and development can sometimes aid this judgment.

#### WATER LEVEL MEASUREMENTS

The ground water level measurements are shown at the bottom of the boring logs. The following information appears under "Water Level Measurements" on the logs:

- Date and Time of measurement
- Sampled Depth: lowest depth of soil sampling at the time of measurement
- Casing Depth: depth to bottom of casing or hollow-stem auger at time of measurement
- Cave-in Depth: depth at which measuring tape stops in the borehole
- Water Level: depth in the borehole where free water is encountered
- Drilling Fluid Level: same as Water Level, except that the liquid in the borehole is drilling fluid

The true location of the water table at the boring locations may be different than the water levels measured in the boreholes. This is possible because there are several factors that can affect the water level measurements in the borehole. Some of these factors include: permeability of each soil layer in profile, presence of perched water, amount of time between water level readings, presence of drilling fluid, weather conditions, and use of borehole casing.

#### SAMPLE STORAGE

Unless notified to do otherwise, we routinely retain representative samples of the soils recovered from the borings for a period of 30 days.

## DRILLING AND SAMPLING SYMBOLS

~	
Symbol	Definition
AR:	Sample of material obtained from cuttings blown out
	the top of the borehole during air rotary procedure.
B, H, N:	Size of flush-joint casing
CAS:	Pipe casing, number indicates nominal diameter in
	inches
COT:	Clean-out tube
DC:	Drive casing; number indicates diameter in inches
DM:	Drilling mud or bentonite slurry
DR:	Driller (initials)
DS:	Disturbed sample from auger flights
DP:	Direct push drilling; a 2.125 inch OD outer casing
	with an inner 11/2 inch ID plastic tube is driven
	continuously into the ground.
FA:	Flight auger; number indicates outside diameter in
	inches
HA:	Hand auger; number indicates outside diameter
HSA:	Hollow stem auger; number indicates inside diameter
	in inches
LG:	Field logger (initials)
MC:	Column used to describe moisture condition of
	samples and for the ground water level symbols
N (BPF):	Standard penetration resistance (N-value) in blows per
( )	foot (see notes)
NQ:	NQ wireline core barrel
PQ:	PQ wireline core barrel
RDA:	Rotary drilling with compressed air and roller or drag
	bit.
RDF:	Rotary drilling with drilling fluid and roller or drag bit
REC:	In split-spoon (see notes), direct push and thin-walled
	tube sampling, the recovered length (in inches) of
	sample. In rock coring, the length of core recovered
	(expressed as percent of the total core run). Zero
	indicates no sample recovered.
SS:	Standard split-spoon sampler (steel; 1.5" is inside
	diameter; 2" outside diameter); unless indicated
	otherwise
SU	Spin-up sample from hollow stem auger
TW:	Thin-walled tube; number indicates inside diameter in
	inches
WASH:	Sample of material obtained by screening returning
	rotary drilling fluid or by which has collected inside
	the borehole after "falling" through drilling fluid
WH:	Sampler advanced by static weight of drill rod and
****	hammer
WR:	Sampler advanced by static weight of drill rod
94mm:	94 millimeter wireline core barrel
<u>▼:</u>	Water level directly measured in boring
_ <u>,</u>	man teres anoong measures in county
$\nabla$ :	Estimated water level based solely on sample

 $\underline{\nabla}$ : Estimated water level based solely on sample appearance

#### TEST SYMBOLS

Symbol	Definition
CONS:	One-dimensional consolidation test
DEN:	Dry density, pcf
DST:	Direct shear test
E:	Pressuremeter Modulus, tsf
HYD:	Hydrometer analysis
LL:	Liquid Limit, %
LP:	Pressuremeter Limit Pressure, tsf
OC:	Organic Content, %
PERM:	Coefficient of permeability (K) test; F - Field;
	L - Laboratory
PL:	Plastic Limit, %
q <sub>p</sub> :	Pocket Penetrometer strength, tsf (approximate)
$q_c$ :	Static cone bearing pressure, tsf
q <sub>u</sub> :	Unconfined compressive strength, psf
R:	Electrical Resistivity, ohm-cms
RQD:	Rock Quality Designation of Rock Core, in percent
	(aggregate length of core pieces 4" or more in length
	as a percent of total core run)
SA:	Sieve analysis
TRX:	Triaxial compression test
VSR:	Vane shear strength, remolded (field), psf
VSU:	Vane shear strength, undisturbed (field), psf
WC:	Water content, as percent of dry weight
%-200:	Percent of material finer than #200 sieve

### STANDARD PENETRATION TEST NOTES

### (Calibrated Hammer Weight)

The standard penetration test consists of driving a split-spoon sampler with a drop hammer (calibrated weight varies to provide  $N_{60}$  values) and counting the number of blows applied in each of three 6" increments of penetration. If the sampler is driven less than 18" (usually in highly resistant material), permitted in ASTM: D1586, the blows for each complete 6" increment and for each partial increment is on the boring log. For partial increments, the number of blows is shown to the nearest 0.1' below the slash.

The length of sample recovered, as shown on the "REC" column, may be greater than the distance indicated in the N column. The disparity is because the N-value is recorded below the initial 6" set (unless partial penetration defined in ASTM: D1586 is encountered) whereas the length of sample recovered is for the entire sampler drive (which may even extend more than 18").

# UNIFIED SOIL CLASSIFICATION SYSTEM



	UNL		signations: D 2487, D248			ENGINEERING TESTING, INC.						
				5	oil Classification	Notes						
Criteria for	Assigning Group Syn	nbols and Group	Names Using Laboratory Tests <sup>A</sup>	Group Symbol	Group Name <sup>B</sup>	<sup>A</sup> Based on the material passing the 3-in (75-mm) sieve.						
se-Grained	Gravels More	Clean Gravels	Cu $\geq$ 4 and 1 $\leq$ Cc $\leq$ 3 <sup>E</sup>	GW	Well graded gravel <sup>F</sup>	<sup>B</sup> If field sample contained cobbles or boulders, or both, add "with cobbles or						
More 50% ned on	than 50% coarse fraction retained on No. 4 sieve	Less than 5% fines <sup>C</sup>	Cu<4 and/or 1>Cc>3 <sup>E</sup>	GP	Poorly graded gravel							
200 sieve	011 140. 4 SIEVE	Gravels with Fines more	Fines classify as ML or MH	GM	Silty gravel <sup>F.G.H</sup>	symbols: GW-GM well-graded gravel with silt						
		than 12% fines	c Fines classify as CL or CH	GC	Clayey gravel <sup>F.G.H</sup>	GW-GC well-graded gravel with clay GP-GM poorly graded gravel with silt						
-	Sands 50% or more of coarse	Clean Sands Less than 5%	Cu≥6 and 1≤Cc≤3 <sup>E</sup>	SW	Well-graded sand <sup>1</sup>	GP-GC poorly graded gravel with clay <sup>D</sup> Sands with 5 to 12% fines require dual						
	fraction passes No. 4 sieve	fines <sup>D</sup>	Cu<6 and/or 1>Cc>3 <sup>E</sup>	SP	Poorly-graded sand	symbols: SW-SM well-graded sand with silt						
	ine manner mendamment soor	Sands with Fines more	Fines classify as ML or MH	SM	Silty sand <sup>G.H.I</sup>	SW-SC well-graded sand with clay SP-SM poorly graded sand with silt						
		than 12% fines	<sup>D</sup> Fines classify as CL or CH	SC	Clayey sand <sup>G.H.I</sup>	SP-SC poorly graded sand with clay						
-Grained	Silts and Clays	inorganic	PI>7 and plots on or above "A" line <sup>J</sup>	CL	Lean clay <sup>K.L.M</sup>	$(D_{30})^2$						
50% or passes	Liquid limit less than 50		PI<4 or plots below "A" line <sup>1</sup>	ML	Silt <sup>K.L.M</sup>	$E_{Cu} = D_{60} / D_{10},  Cc = \frac{(D_{30})}{D_{10} \times D_{60}}$						
lo. 200	,	organia		_ OL	Organic clay <sup>K.L.M.N</sup>							
Plasticity		organic	<u>Liquid limit–oven dried</u> < <sub>0.7</sub> Liquid limit – not dried	5 01	Organic silt <sup>K.L.M.O</sup>	<sup>F</sup> If soil contains $\geq$ 15% sand, add "with sand" to group name.						
t below)	Silts and Clays	inorganic	PI plots on or above "A" line	е СН	Fat clay <sup>K.L.M</sup>	<sup>G</sup> If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.						
	Liquid limit 50 or more		PI plots below "A" line	MH	Elastic silt <sup>K.L.M</sup>	<sup>H</sup> If fines are organic, add "with organic fines" to group name.						
		organic	Liquid limit-oven dried <0.7	5 OH	Organic clay <sup>K.L.M.P</sup>	If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.						
đ			Liquid limit – not dried		Organic silt <sup>K.L.M.Q</sup>	<sup>J</sup> If Atterberg limits plot is hatched area, soils is a CL-ML silty clay. <sup>K</sup> If soil contains 15 to 29% plus No. 200						
nly organic			Primarily organic matter, in color, and organic in odd		Peat <sup>R</sup>	add "with sand" or "with gravel", whichever is predominant. <sup>L</sup> If soil contains ≥30% plus No. 200,						
Screen Opening (ir 3 2.1% 1.3% %	IEVE ANALYSIS	20 40 11 11 11 11 11 11 11 11 11 1	60 For classification of fine-grained solis an fine-grained fraction of coarse-grained s 50 Equation of "A"-line Horizontal at PI = 4 to L1 = 25.5. then PI = 0.73 (L1-20) Equation of "U"-line Vertical at LL = 16 to PI = 7. . then PI = 0.9 (LL-8) 20 . then PI = 0.9 (LL-8) . then PI = 0.9 (LL-8) . then PI = 0.9 (LL-8)	Ju Othor		predominantly sand, add "sandy" to group name.         MIf soil contains ≥30% plus No. 200, predominantly gravel, add "gravelly" to group name.         NPI≥4 and plots on or above "A" line.         °PI<4 or plots below "A" line.						
.0	5 10 05 0.1	100	ML of 10 16 20 30 4		/0 .80 .90 .100	110						
	SIZE IN MILLIMETERS			LIQUID LIMIT (LL)								
$C_{a} = \frac{D_{00}}{D_{10}} = \frac{.15}{0.075} = 2$	200 $C_{\rm s} = \frac{(D_{10})^2}{D_{10} \times D_{20}} = \frac{2.5^2}{0.075 \times 15} =$	5.6		Plasticity Chart								
	ADDIT	IONAL TERMI	NOLOGY NOTES USED BY AF	T FOR SOIL IDE	ENTIFICATION AND	DESCRIPTION						
Гегт	<u>Grain Size</u> Particle S	Size	Gravel Percentages Term Percent	Consistency <u>Term</u>	v of Plastic Soils <u>N-Value, BPF</u>	Relative Density of Non-Plastic Soils Term <u>N-Value, BPF</u>						
Boulders Cobbles Gravel and Tines (silt & cla	Over 1 3" to 1: #4 sieve #200 to #4 ay) Pass #200	2" to 3" 4 sieve	A Little Gravel3% - 14%With Gravel15% - 29%Gravelly30% - 50%	Very Soft Soft Firm Stiff Very Stiff Hard	less than 2 2 - 4 5 - 8 9 - 15 16 - 30 Greater than 30	Very Loose0 - 4Loose5 - 10Medium Dense11 - 30Dense31 - 50Very DenseGreater than 50						
Moi	isture/Frost Condition		Layering Notes		Description	Organic Description (if no lab tests)						
) (Dry):	(MC Column) Absence of moisture	a.				Soils are described as <i>organic</i> , if soil is not peat and is judged to have sufficient organic fines						
и (Moist):	touch. Damp, although free	e water not	Laminations: Layers less than ½" thick of differing material	Term	Fiber Content (Visual Estimate)	content to influence the Liquid Limit properties. <u>Slightly organic</u> used for borderline cases.						
V (Wet/ Vaterbearing):	visible. Soil may st water content (over Free water visible ir describe non-plastic Waterbearing usuall sands and sand with	"optimum"). atended to soils. y relates to	differing material or color. Lenses: Pockets or layers greater than ½" thick of differing	Fibric Peat: Hemic Peat: Sapric Peat:	Greater than 67% 33 – 67% Less than 33%	Root Inclusions           With roots:         Judged to have sufficient quantity of roots to influence the soil properties.           Trace roots:         Small roots present, but not judged to be in sufficient quantity to						
	sunds and sand with	Silt.	material or color	1								

01CLS021 (07/08)

Coarse-Grained

Soils More than 50%

retained on

No. 200 sieve

Fine-Grained

Soils 50% or

more passes the No. 200 sieve

(see Plasticity Chart below)

Highly organic

soil

PERCENT. PASSING

Fines (silt & clay)

Soil frozen

material or color.

Term Boulders Cobbles Gravel Sand

D (Dry):

M (Moist):

W (Wet/

Waterbearing):

F (Frozen):

significantly affect soil properties.

# HKS

CCD-347

Date:02.08.2016To:Ted MondaleCompany:MSFAProject:16246.000Re:Minnesota Multi-Purpose Stadium

From: Kevin A. Taylor, AIA

All items contained herein are an integral part of the Construction Documents and shall be built accordingly.

#### Summary: DTE West Plaza Construction Document Set Addendum #1

Addendum #1 Information: Geotechnical Reports as supplemental information to the DTE West Plaza CD Set.

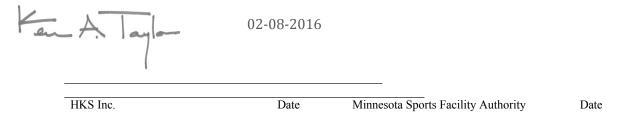
- Downtown East Pedestrian Bridge Geotechnical Exploration and Review
- Geotechnical Exploration and Testing Vikings Legacy Ship
- Report of Preliminary Geotechnical Exploration and Review
- Appendix A
- Appendix B

Attachments: CCD-347 Addendum #1

\\Nt07\162\16246\Drawings\Issued\\_02-ConstructionDocuments\150410\_ASI-206 - Site Revisions\150410\_REVIEW\00\_Cover Letter\150410\_CCD-206.docx

In accordance with the terms of the Contract Documents and with approval of the owner as required:

1. [X] Addendum #1 via RFP



Distribution: John Hutchings (HKS), Scott Stenman (Hammes), Jim Cima (Vikings), Brent Leiter (Mortenson), Chad Scheckel (HKS), Anice Stephens (HKS)

**Report of Geotechnical Exploration and Review** Minnesota Multi-Purpose Stadium, Minneapolis, Minnesota October 2, 2013 Report No. 01-05723.2

AMERICAN ENGINEERING TESTING, INC.

# **Appendix A**

Geotechnical Field Exploration and Testing Boring Log Notes Unified Soil Classification System Rock Description Terminology Figure 1a – Boring Locations, West Side Figure 1b – Boring Locations, East Side Subsurface Boring Logs Triaxial Compression Test Results Sieve Analysis Test Results

# Appendix A Geotechnical Field Exploration and Testing Report No. 01-05723.1

#### A.1 FIELD EXPLORATION

The subsurface conditions were explored by drilling and sampling sixteen standard penetration test (SPT) borings. The test boring locations appear on Figures 1 and 2 preceding the Subsurface Boring Logs in this appendix.

#### A.2 SOIL BORING SAMPLING METHODS

#### A.2.1 Split-Spoon Samples (SS) - Calibrated to N<sub>60</sub> Values

Standard penetration (split-spoon) samples were collected in general accordance with ASTM:D1586 with one primary modification. The ASTM test method consists of driving a 2-inch O.D. split-barrel sampler into the in-situ soil with a 140-pound hammer dropped from a height of 30 inches. The sampler is driven a total of 18 inches into the soil. After an initial set of 6 inches, the number of hammer blows to drive the sampler the final 12 inches is known as the standard penetration resistance or N-value. Our method uses a modified hammer weight, which is determined by measuring the system energy using a Pile Driving Analyzer (PDA) and an instrumented rod.

In the past, standard penetration N-value tests were performed using a rope and cathead for the lift and drop system. The energy transferred to the split-spoon sampler was typically limited to about 60% of its potential energy due to the friction inherent in this system. This converted energy then provides what is known as an  $N_{60}$  blow count.

Most newer drill rigs incorporate an automatic hammer lift and drop system, which has higher energy efficiency and subsequently results in lower N-values than the traditional  $N_{60}$  values. By using the PDA energy measurement equipment, we are able to determine actual energy generated by the drop hammer. With the various hammer systems available, we have found highly variable energies ranging from 55% to over 100%. Therefore, the intent of AET's hammer calibrations is to vary the hammer weight such that hammer energies lie within about 60% to 65% of the theoretical energy of a 140-pound weight falling 30 inches. The current ASTM procedure acknowledges the wide variation in N-values, stating that N-values of 100% or more have been observed. Although we have not yet determined the statistical measurement uncertainty of our calibrated method to date, we can state that the accuracy deviation of the N-values using this method is significantly better than the standard ASTM Method.

#### A.2.2 Disturbed Samples (DS)/Spin-up Samples (SU)

Sample types described as "DS" or "SU" on the boring logs are disturbed samples, which are taken from the flights of the auger. Because the auger disturbs the samples, possible soil layering and contact depths should be considered approximate.

#### A.2.3 Sampling Limitations

Unless actually observed in a sample, contacts between soil layers are estimated based on the spacing of samples and the action of drilling tools. Cobbles, boulders, and other large objects generally cannot be recovered from test borings, and they may be present in the ground even if they are not noted on the boring logs.

#### A.3 SOIL CLASSIFICATION METHODS

Soil descriptions shown on the boring logs are based on the Unified Soil Classification (USC) system. The USC system is described in ASTM:D2487 and D2488. Where laboratory classification tests (sieve analysis or Atterberg Limits) have been performed, accurate classifications per ASTM:D2487 are possible. Otherwise, soil descriptions shown on the boring logs are visual-manual judgments. Charts are attached which provide information on the USC system, the descriptive terminology, and the symbols used on the boring logs.

The boring logs include descriptions of apparent geology. The geologic depositional origin of each soil layer is interpreted primarily by observation of the soil samples, which can be limited. Observations of the surrounding topography, vegetation, and development can sometimes aid this judgment.

#### A.4 WATER LEVEL MEASUREMENTS

The ground-water level measurements are shown at the bottom of the boring logs. The following information appears under "Water Level Measurements" on the logs:

- Date and Time of measurement
- Sampled Depth: lowest depth of soil sampling at the time of measurement
- Casing Depth: depth to bottom of casing or hollow-stem auger at time of measurement

# Appendix A Geotechnical Field Exploration and Testing Report No. 01-05723.1

- Cave-in Depth: depth at which measuring tape stops in the borehole
- Water Level: depth in the borehole where free water is encountered
- Drilling Fluid Level: same as Water Level, except that the liquid in the borehole is drilling fluid

The true location of the water table at the boring locations may be different than the water levels measured in the boreholes. This is possible because there are several factors that can affect the water level measurements in the borehole. Some of these factors include: permeability of each soil layer in profile, presence of perched water, amount of time between water level readings, presence of drilling fluid, weather conditions, and use of borehole casing.

#### A.5 ROCK CORING/DESCRIPTION

The rock coring was performed in general accordance with ASTM:D2113, using an NQ size wireline coring system. The Rock Quality Designation (RQD) was evaluated in general accordance with ASTM:D6032.

#### A.5 LABORATORY TEST METHODS

A.5.1 Water Content Tests

Conducted in general accordance with ASTM:D2216.

#### A.5.2 Sieve Analysis Tests

Conducted in general accordance with ASTM:D6913, Method A.

#### A.5.3 Rock Core Compressive Strength Tests

Conducted in general accordance with ASTM:D2938.

#### A.5.4 Rock Core Triaxial Compression Tests

Conducted in general accordance with ASTM:D7012.

#### A.6 TEST STANDARD LIMITATIONS

Field and laboratory testing is done in general conformance with the described procedures. Compliance with any other standards referenced within the specified standard is neither inferred nor implied.

#### A.7 SAMPLE STORAGE

Unless notified to do otherwise, we routinely retain representative samples of the soils recovered from the borings for a period of 30 days.

#### DRILLING AND SAMPLING SYMBOLS

Symbol	Definition
AR:	Sample of material obtained from cuttings blown out
	the top of the borehole during air rotary procedure.
B, H, N:	Size of flush-joint casing
CAS:	Pipe casing, number indicates nominal diameter in
	inches
COT:	Clean-out tube
DC:	Drive casing; number indicates diameter in inches
DM:	Drilling mud or bentonite slurry
DR:	Driller (initials)
DS:	Disturbed sample from auger flights
DP:	Direct push drilling; a 2.125 inch OD outer casing
	with an inner 11/2 inch ID plastic tube is driven
	continuously into the ground.
FA:	Flight auger; number indicates outside diameter in
	inches
HA:	Hand auger; number indicates outside diameter
HSA:	Hollow stem auger; number indicates inside diameter
	in inches
LG:	Field logger (initials)
MC:	Column used to describe moisture condition of
	samples and for the ground water level symbols
N (BPF):	Standard penetration resistance (N-value) in blows per
	foot (see notes)
NQ:	NQ wireline core barrel
PQ:	PQ wireline core barrel
RDA:	Rotary drilling with compressed air and roller or drag
	bit.
RDF:	Rotary drilling with drilling fluid and roller or drag bit
REC:	In split-spoon (see notes), direct push and thin-walled
	tube sampling, the recovered length (in inches) of
	sample. In rock coring, the length of core recovered
	(expressed as percent of the total core run). Zero
	indicates no sample recovered.
SS:	Standard split-spoon sampler (steel; 1.5" is inside
	diameter; 2" outside diameter); unless indicated
	otherwise
SU	Spin-up sample from hollow stem auger
TW:	Thin-walled tube; number indicates inside diameter in
	inches
WASH:	Sample of material obtained by screening returning
	rotary drilling fluid or by which has collected inside
	the borehole after "falling" through drilling fluid
WH:	Sampler advanced by static weight of drill rod and
	hammer
WR:	Sampler advanced by static weight of drill rod
0.4	

- 94mm: 94 millimeter wireline core barrel
- $\mathbf{V}$ : Water level directly measured in boring
- $\overline{\nabla}$ : Estimated water level based solely on sample appearance

#### TEST SYMBOLS

a	
Symbol	Definition
CONS:	One-dimensional consolidation test
DEN:	Dry density, pcf
DST:	Direct shear test
E:	Pressuremeter Modulus, tsf
HYD:	Hydrometer analysis
LL:	Liquid Limit, %
LP:	Pressuremeter Limit Pressure, tsf
OC:	Organic Content, %
PERM:	Coefficient of permeability (K) test; F - Field;
	L - Laboratory
PL:	Plastic Limit, %
q <sub>p</sub> :	Pocket Penetrometer strength, tsf (approximate)
q <sub>c</sub> :	Static cone bearing pressure, tsf
$q_u$ :	Unconfined compressive strength, psf
R:	Electrical Resistivity, ohm-cms
RQD:	Rock Quality Designation of Rock Core, in percent
	(aggregate length of core pieces 4" or more in length
	as a percent of total core run)
SA:	Sieve analysis
TRX:	Triaxial compression test
VSR:	Vane shear strength, remolded (field), psf
VSU:	Vane shear strength, undisturbed (field), psf
WC:	Water content, as percent of dry weight
%-200:	Percent of material finer than #200 sieve
70-200.	reivent of material mice than #200 slove

### STANDARD PENETRATION TEST NOTES (Calibrated Hammer Weight)

The standard penetration test consists of driving a split-spoon sampler with a drop hammer (calibrated weight varies to provide  $N_{60}$  values) and counting the number of blows applied in each of three 6" increments of penetration. If the sampler is driven less than 18" (usually in highly resistant material), permitted in ASTM: D1586, the blows for each complete 6" increment and for each partial increment is on the boring log. For partial increments, the number of blows is shown to the nearest 0.1' below the slash.

The length of sample recovered, as shown on the "REC" column, may be greater than the distance indicated in the N column. The disparity is because the N-value is recorded below the initial 6" set (unless partial penetration defined in ASTM: D1586 is encountered) whereas the length of sample recovered is for the entire sampler drive (which may even extend more than 18").

## UNIFIED SOIL CLASSIFICATION SYSTEM ASTM Designations: D 2487, D2488

# AMERICAN ENGINEERING

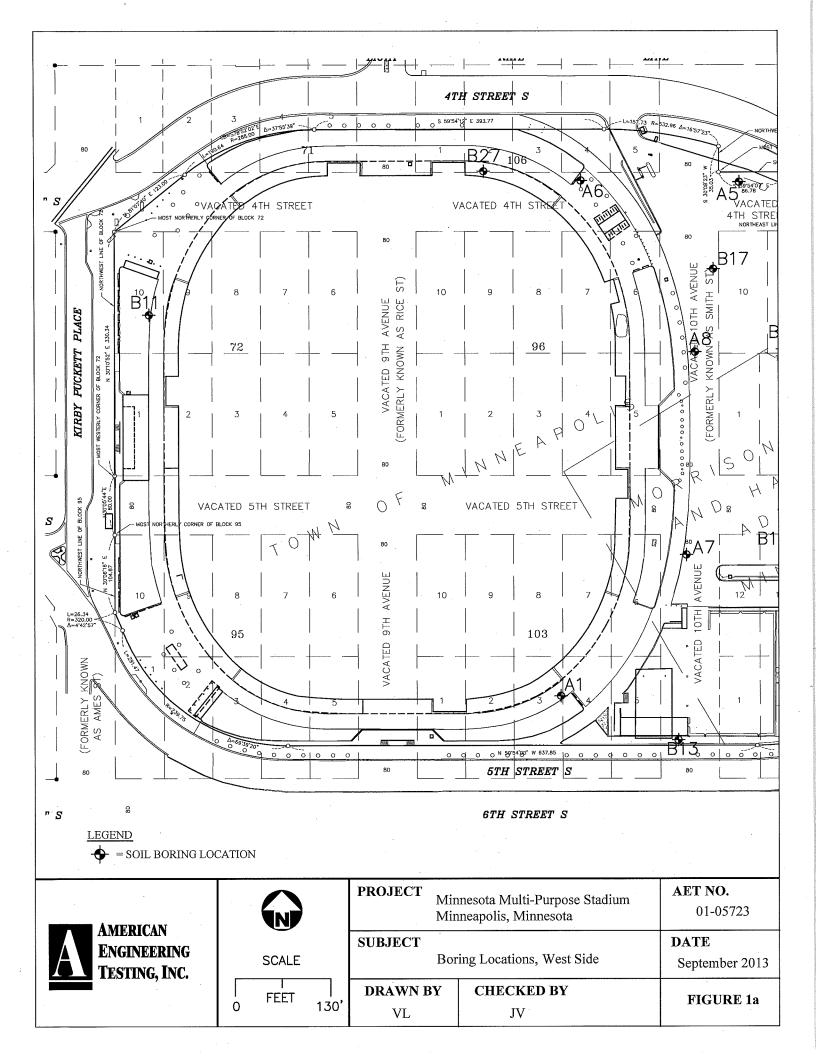


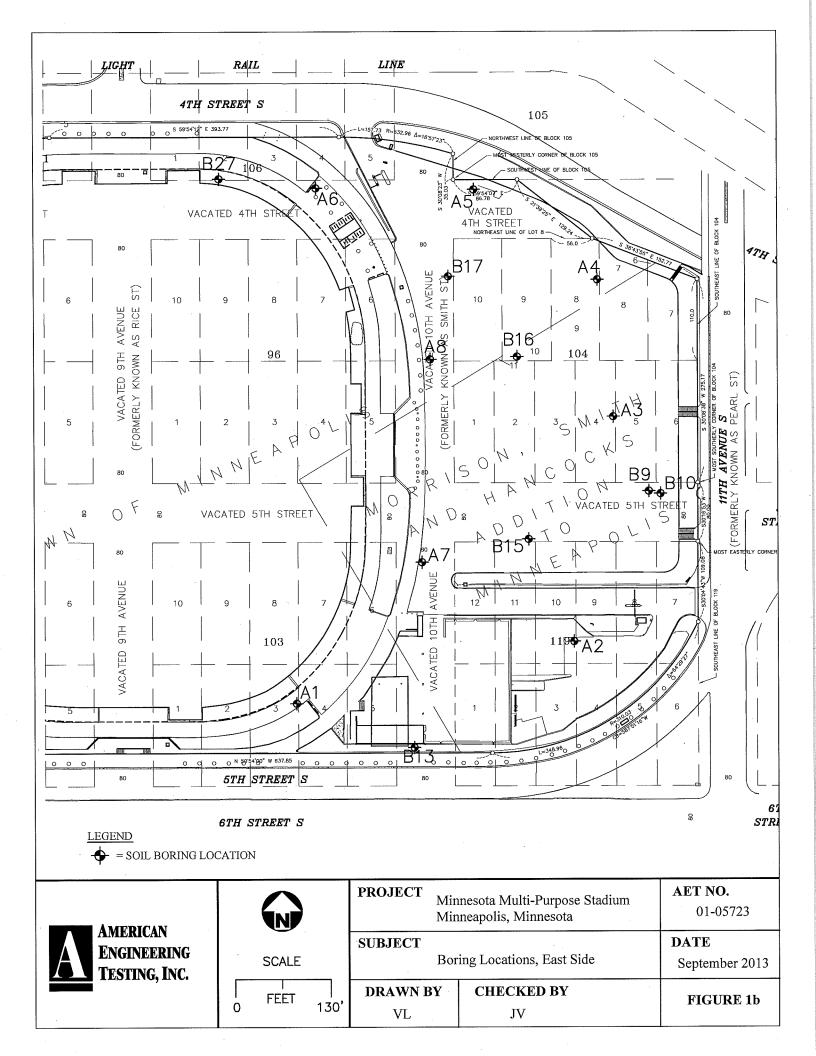
		ASIMDES	Ignations: D 2407, D240	0		TESTING, INC.			
		Appendix Notes							
Criteria fo	r Assigning Group Syı	nbols and Group N	Vames Using Laboratory Tests <sup>A</sup>	Group Symbol	Group Name <sup>B</sup>	<sup>A</sup> Based on the material passing the 3-in (75-mm) sieve.			
Coarse-Grained Gravels More Clean Gravels Soils More than 50% coarse Less than 5%			Cu $\geq$ 4 and 1 $\leq$ Cc $\leq$ 3 <sup>E</sup>	GW	Well graded gravel <sup>F</sup>	<sup>B</sup> If field sample contained cobbles or boulders, or both, add "with cobbles or			
than 50%	fraction retained	fines <sup>C</sup>	Cu<4 and/or 1>Cc>3 <sup>E</sup>	GP	Poorly graded gravel				
retained on No. 200 sieve	on No. 4 sieve	Gravels with Fines more	Fines classify as ML or MH	GM	Silty gravel <sup>F.G.H</sup>	symbols: GW-GM well-graded gravel with silt			
		than 12% fines <sup>6</sup>	Fines classify as CL or CH	GC	Clayey gravel <sup>F.G.H</sup>	GW-GC well-graded gravel with clay GP-GM poorly graded gravel with silt			
	Sands 50% or more of coarse	Clean Sands Less than 5%	Cu $\geq$ 6 and 1 $\leq$ Cc $\leq$ 3 <sup>E</sup>	SW	Well-graded sand	GP-GC poorly graded gravel with clay DSands with 5 to 12% fines require dual			
	fraction passes No. 4 sieve	fines <sup>D</sup>	Cu<6 and/or 1>Cc>3 <sup>E</sup>	SP	Poorly-graded sand <sup>1</sup>	symbols: SW-SM well-graded sand with silt			
	140. 4 SICVC	Sands with Fines more	Fines classify as ML or MH	SM	Silty sand <sup>G.H.I</sup>	SW-SC well-graded sand with clay SP-SM poorly graded sand with silt			
		than 12% fines <sup>1</sup>		SC	Clayey sand <sup>G.H.I</sup> Lean clay <sup>K.L.M</sup>	SP-SC poorly graded sand with clay			
Fine-Grained Soils 50% or	Silts and Clays Liquid limit less	inorganic	PI>7 and plots on or above "A" line <sup>J</sup>	CL	•	(D <sub>30</sub> ) <sup>2</sup>			
more passes the No. 200	than 50		PI<4 or plots below "A" line <sup>J</sup>	ML	Silt <sup>K.L.M</sup>	$E_{Cu} = D_{60} / D_{10},  Cc = \frac{1}{D_{10} \times D_{60}}$			
sieve		organic	Liquid limit-oven dried <0.75	OL	Organic clay <sup>K.L.M.N</sup>	<sup>F</sup> If soil contains $\geq 15\%$ sand, add "with			
(see Plasticity Chart below)			Liquid limit – not dried		Organic silt <sup>K.L.M.O</sup>	sand" to group name. <sup>G</sup> If fines classify as CL-ML, use dual			
Shurt bolow)	Silts and Clays Liquid limit 50	inorganic	PI plots on or above "A" line	СН	Fat clay <sup>K.L.M</sup>	symbol GC-GM, or SC-SM. <sup>H</sup> If fines are organic, add "with organic			
	or more		PI plots below "A" line	МН	Elastic silt <sup>K.L.M</sup>	fines" to group name. If soil contains $\geq 15\%$ gravel, add "with			
		organic	Liquid limit-oven dried <0.75	OH	Organic clay <sup>K.L.M.P</sup>	gravel" to group name. If Atterberg limits plot is hatched area,			
			Liquid limit – not dried		Organic silt <sup>K.L.M.Q</sup> Peat <sup>R</sup>	soils is a CL-ML silty clay. KIf soil contains 15 to 29% plus No. 200			
Highly organic soil			Primarily organic matter, or in color, and organic in odo		add "with sand" or "with gravel", whichever is predominant.				
			60,			LIf soil contains ≥30% plus No. 200, predominantly sand, add "sandy" to			
-Screen Opening 3 2 1% 1 34	SIEVE ANALYSIS (in.)	1	For classification of fine-grained solts and fine-grained fraction of coarse-grained sol	is.		group name.			
.100			$\widehat{\mathbf{a}}$ Equation of "A"-line Horizontal at PI = 4 to LL = 25.5.	TENNE OH	15 LUE	<sup>M</sup> If soil contains ≥30% plus No. 200, predominantly gravel, add "gravelly"			
		20	Equation of "A"-line         Equation of "A"-line           Horizontal at IM = 4 to LL = 25.5.         then PI = 0.73 (LL-20)           Equation of "U"-line         Equation of "U"-line           Vertical at LL = 16 to PI = 7.         then PI = 0.9 (LL-8)           30	CH OH	itili	to group name. $^{N}$ Pl $\geq$ 4 and plots on or above "A" line.			
BERCENT PASSING	D <sub>eo</sub> = 15mm	8 8 8 PERCENT RETAINED	Vertical at L = 16 to P1 = 7. then P1 = 0.9 (LL-8) 0 30			<sup>O</sup> Pl<4 or plots below "A" line. <sup>P</sup> Pl plots on or above "A" line.			
	D <sub>10</sub> = 2.5mm	CENT 00	20- 20-	×/		<sup>Q</sup> Pl plots below "A" line. <sup>R</sup> Fiber Content description shown below.			
20		80	dro	MH •	OH				
		Dto = 0.075mm	7 4 ML or	OL					
	LE SIZE IN MILLIMETERS	ш Ш	0 <u>K l i l l l</u> 0 10 16 20 30 40	.110					
$C_0 = \frac{D_{00}}{D_{10}} = \frac{.15}{0.075}$	= 200 $C_c = \frac{(Dw)^2}{D_{10} \times Dw} = \frac{2.5^2}{0.075 \times 15}$	= 5.6		LIQUID LIMIT (LL) Plasticity Chart					
		IONAL TERMI	NOLOGY NOTES USED BY AE						
<u>Term</u>	Grain Size Particle	Size	Gravel Percentages Term Percent	Consistency Term	of Plastic Soils <u>N-Value, BPF</u>	Relative Density of Non-Plastic Soils           Term         N-Value, BPF			
Boulders	Over		A Little Gravel 3% - 14%	Very Soft	less than 2	Very Loose 0 - 4			
Cobbles Gravel	3" to 1 #4 sieve	-	With Gravel         15% - 29%           Gravelly         30% - 50%	Soft Firm	2 - 4 5 - 8	Loose5 - 10Medium Dense11 - 30			
Sand Fines (silt & c	#200 to # Pass #200			Stiff Very Stiff	9 - 15 16 - 30	Dense 31 - 50 Very Dense Greater than 50			
	oisture/Frost Condition		Layering Notes	Hard	Greater than 30 Description	Organic Description (if no lab tests)			
	(MC Column)		<u>Lajvini F1000</u>			Soils are described as <u>organic</u> , if soil is not peat and is judged to have sufficient organic fines			
D (Dry):Absence of moisture, dusty, dry to touch.M (Moist):Damp, although free water not visible. Soil may still have a high			Laminations: Layers less than ½" thick of	Term	Fiber Content (Visual Estimate)	content to influence the Liquid Limit properties. Slightly organic used for borderline cases.			
		till have a high	differing material or color.	Fibric Peat:	Greater than 67%	Root Inclusions			
W (Wet/	water content (over Free water visible in	ntended to		Hemic Peat: Sapric Peat:	33 – 67% Less than 33%	With roots: Judged to have sufficient quantity of roots to influence the soil			
Waterbearing	): describe non-plastic Waterbearing usual	c sons.	Lenses: Pockets or layers greater than ½"	Saprie reat:	LCSS (11dfl 3370	properties. Trace roots: Small roots present, but not judged			
F (Frozen):	sands and sand with Soil frozen		thick of differing material or color.			to be in sufficient quantity to significantly affect soil properties.			
				1					

# ROCK DESCRIPTION TERMINOLOGY

<b>Rock Property</b>	<b>Descriptive Term</b>	Visual or Physical Properties
Weathering	Highly Weathered	Almost complete rock disintegration and decomposition. Soil- like texture with some small inclusions of hard rock.
	Very Weathered	Abundant fractures coated with oxides, carbonates, sulfates, mud, etc., thorough discoloration, rock disintegration, and mineral decomposition.
	Moderately Weathered	Some fracture coating, moderate or localized discoloration, little to no effect on cementation, slight mineral decomposition
	Slightly Weathered	A few stained fractures, slight discoloration, little to no effect on cementation, no mineral decomposition.
	Fresh	Unaffected by weathering agents, no appreciable change with depth.
Fracturing	Intensely Fractured	Less than 1" spacing
L L	Very Fractured	1" to 6" spacing
	Moderately Fractured	6" to 12" spacing
	Slightly Fractured	12" to 36" spacing
	Solid	36" spacing or greater
Stratification	Thinly Laminated	Less than 1/10"
	Laminated	1/10" to 2"
	Very Thinly Bedded	2" to 2"
	Thinly Bedded	2" to 2'
	Thickly Bedded	More than 2'
Hardness	Soft	Can be dug by hand and crushed by fingers.
	Moderately Hard	Friable can be gouged deeply with knife and will crumble
	•	readily under light hammer blows.
	Hard	Knife scratch leaves dust trace, will withstand a few hammer
		blows before breaking.
	Very Hard	Scratched with knife with difficulty, difficult to break with
		hammer blows.
RQD*	Very Poor	0 - 25 (%)
	Poor	25 - 50 (%)
	Fair	50 - 75 (%)
	Good	75 - 90 (%)
	Excellent	90 - 100 (%)
*Rock Quality Design		sisting of the summation of hard, sound, and unfractured rock thes or greater in length. Determination is conducted in general

accordance with ASTM:D6032.







AET JOB NO: 01-05723 LOG OF BORING NO. A1 (p. 1 of 2)										]							
PROJECT: Minnesota Multi-Purpose Stadium; Minneapolis, MN																	
SURFA	JRFACE ELEVATION: <u>844.6</u> Hennepin Co. Coordinates: <u>N 166237</u> <u>E 532415</u>																
DEPTH IN FEET		MATERIAL	DESCRIPTION	N		GE	OLOGY	N	MC	SA T	MPLE YPE	REC IN.			BORAT RQD IN.		
		oncrete pavement			/	FILI	_		F		DS DS						
		, mostly silty sand w	vith gravel, br	own,					F		DS						ć
2 — 3 —	110.54							28	M	M	SS	12					
4										र्स							
5	FILL	, mostly silty sand, a pieces of concrete a	a little gravel : at about 10', d	and clayey ark brown				18	м	M	SS	_6					
6	and l	prown	· · · · · · · · · · · · · · · · · · ·					10	1/1	A	33	~0					
7																	
8								22	M	Ж	SS	5					
9										3							
10 -								53	M	М	SS	10					
11 -	-									स							
12 -	-							30	М	M	SS	3					
13 -								50	IVI	A	55						
14 -										꿤							
15 -								27	Μ	Д	SS	10					
16 17										凵						1	
17								50	M	Х	SS	18					
19 -	_									रि							
20 -	-							50	M	M	SS	16					
21 -	-									R	20						
22 -	-									R		10					
23 -	-	2						66	M	Å	SS	18					
24 -	-									国							
25 -								60	Μ	X	SS	18					
26 -										I							
27 -	]							70	М	M	SS	18					
20 5 29 -								-		रि							
30 -	-							48	M	$\square$	SS	18					
31 -	_								IVI	A	55						
	DTU		<u></u>		 \\/\/	<u>ו קקי</u>	EVEL MEA		EMEN	山 TS				<u> </u>			
	PTH:	DRILLING METHOL		TDAT							DRILLI UID LI	NG	WAT LEV		NOTE	REFI	
0-5	52.3'	4.25" HSA	DATE	TIME	SAMP DEP	TH	CASING DEPTH	DÈ	VE-IN EPTH	FL	UID LI	EVEL				TS FO	
52.3-0	62.3'	NQ Core											Nor		EXPLA		
BORI	NG	D: 2/18/13															GY ON
- il		D: 2/18/13 G: JMMRig: 85C								+					TI	IIS LO	G
	JII L	G. JIMINING: OJU	1		1			1		1							

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AET JO	B NO: <b>01-05723</b>			LC	G OF	BOI	RING N	O	Α	1 (p.	. 2 of	f 2)	
PROJEC		um	; Minneap	olis,	MN	1							
	Hennepin Co.	Coor	dinates: <u>N</u>	1	6623	7		<u>E </u>	53241				
DEPTH IN	MATERIAL DESCRIPTION		GEOLOGY	N	MC	SĄ	MPLE YPE	REC		& LAI REC			
IN FEET		T					IFE	IN.	WC	%	IN.	RQD %	%-#200
33 -				65	M	М	SS	18					
34 -	FILL, mostly silty sand, a little gravel, pieces of					ł							
35 -	concrete, brown			70	M	М	SS	18					
36 -						रि							
37 -				60	M	M	SS	18					
38 -					191	R	55						
39 -	FILL, mostly silty sand, a little gravel, brown					R							
40 - 41 -				55	M	Å	SS	18					
42 -	SILTY SAND, a little gravel, gray, very stiff,		TILL			I							
43 -	laminations of sand (SM)			16	M/W	ľΧ	SS	18					
44 -	GRAVEL WITH SAND, apparent cobbles,		COARSE			E							
45 -	brown, moist to waterbearing, very dense (GP)	-	ALLUVIUM	97	M	M	SS	8					
46 -						मि							
47 -				100	M	,K	SS	4					
48 -				100	1V1/ W	Å	50	4					
49 -	GRAVELLY SAND, apparent cobbles, medium			*	w	Į	SS	6					
50 -	to coarse grained, brown, waterbearing, very dense (SP)					Ł	55						
51 -	*25/0.5 + 55/0.1		•			ł							
53 -	LIMESTONE, gray		PLATTEVILL	50/0 E	-	Í	SS	0					
54	Weathering: Ślightly weathered Fracturing: Intensely to very fractured		FORMATION MAGNOLIA				NQ	36		100	22	61	
55 -	Stratification: Very thinly bedded Hardness: Hard		MEMBER									:	
56 -	LIMESTONE, light gray and light brownish												
<del>۲</del>	gray, fossiliferous Weathering: Slightly weathered		-								10		
58 - 58 -	Fracturing: Very fractured to slightly fractured Stratification: Thickly bedded						NQ	56		93	48	80	
59 -	Hardness: Hard		-										
₹		F	- PLATTEVILI	F									
	Weathering: Slightly weathered to fresh		FORMATION HIDDEN**				NQ	20		83	16.5	69	
62 - 69	Fracturing: Intensely to moderately fractured Stratification: Thinly bedded	/			-								
<u> 55723.</u>	Hardness: Hard		**FALLS MEMBER										
S 01-	END OF BORING												
INATE													
OORD									-				
P W-C													
AET.CORP.W.COORDINATES 01-05723.GPJ AET+CPT+WELL.GDT 2225/13 													
AET								1	1				<u> </u>



AET JO	OB NO:	01-05723						LO	G OF I	BOI	RING N	0	A	2 (p	. 1 o	f 2)	
PROJE	CT:	Minnesota Mu	ılti-Purp	ose Sta	lium	; Mi	inneapo	olis,	MN								
SURFA	CE ELEV	ATION: 833.2	F	Iennepin Co.	Coordi	nates:	N	1	66110	)	]	<u>E </u> ;	53278	0			
DEPTH		MATERIAL D	ESCRIPTIO	N		GE	EOLOGY	N	MC	SĄ	MPLE YPE	REC			BORAT		
FEET								-		1	SU	IN.	WC	%	IN.	<u>%</u>	<b>%-</b> #200
1 -		uminous pavement mostly silty sand wit	h gravel d	ark brown		FILI	L		F	7	SU						
2 -	frozer		ili giavei, u	ark orown	,					Į							
3 -			1.41	1 1' 1 4					F	ł	SU						
4 -	FILL, +∖browi	, mostly sand with silf	t, a little gra	avel, light	$\downarrow$				Μ	Ŧ	SU						
5 -	1 \	, mostly sand, light br	own		_			12	м	$\square$	SS	14					
6 -	_							12		A	00						
7		, mostly sand with silt	t, a little cla	iyey sand,		1				님							
8 -	browi	n ·						9	M	М	SS	14					
9 -	FILL	, mostly sand with silt	t a little gr	avel brow	n	-				I							
10 -	and g		i, a mine Bri					10	M	М	SS	6			-		
11 -	4									सि							
12 -	-									M	00	10					
13 -	-							9	M	Д	SS	16					
14 -	4									1							
15 -	-							9	M	Х	SS	14					
16 -	-									रि							
17 -	FILL	, mostly sand, a little	gravel, bro	wn				63	M	$\square$	SS	14					
18 -		VELLY SAND WIT					ARSE LUVIUM			F							
19 -		e, fine to medium gra (SP-SM)	uned, brow	n, moist,				*	M	붱	SS	4					
20 -	*43/0	0.5 + 50/0.4							141	R	55	-					
21 -										뙵							
23 -	SILT	Y SAND, a little grav	vel, brown,	dense				36	М	M	SS	16					
24 -					. .   - - - - - - - - - - - - - - - - -					R							
	GRA − medii	VELLY SAND WIT	H SILT, fir noist. mediu	ne to 1m dense		·.				M							
 	(SP-S		, <u>.</u>					30	M	M	SS	12					
27 -		YEY SAND, a little g	gravel, brov	vnish gray	, ///	TIL	L.			团			17				
28 -		stiff (SC) Y SAND, a little grav	vel brown	medium	-/ 11	4 		19	M	Х	SS	14	1,				
다. 29 ·		e, lenses and lamination	ons of claye	ey sand						रि							
30 ·	$- \frac{(SM)}{CLA}$	YEY SAND, a little g	ravel orav	stiff				13	M	$\square$	SS	16	12				
<del>ດ</del> ອີງ 31 -			siuvei, gruj	, 5011						मि							
25 - 26 - 27 - 26 - 27 - 27 - 27 - 27 - 27	EPTH:	DRILLING METHOD			WAT	ER L	EVEL MEA	SURI	L EMEN	IEA TS		1	1	<u></u>	I NOTE:	DELL	പ
LES			DATE	TIME	SAMP	LED	CASING	CAV	VE-IN	I	ORILLI	NG	WATI LEVI		THE A		
0-		4.25" HSA			DEP	TH	DEPTH	DE	PTH	FL	UID LE	EVEL			SHEE		
by <b>41.4</b> -	51.4'	NQ Core	2/16/13	10:20	36.		34.5	+	5.9 5 0				Non 34.1	,	EXPLA		
≩ ₽ BORI	NG	A 11 ( 11 A	2/16/13	10:40	36.	U	34.5		5.9				34.				GY ON
	PLETED:															IIS LO	
DR: ]	US LG	i: JJ Rig: 33C	L	I													



AE	T JOI	B NO: 01-05723			LC	G OF I	BOR	ING N	0	Α	2 (p.	2 of	(2)	
PR	OJEC	T: Minnesota Multi-Purpose Sta	dium	; Minneapo	olis,	MN								
		Hennepin Co	. Coordi	nates: <u>N</u>	1	66110	)	]	E :	53278				
DEP IN FEI	TH N ET	MATERIAL DESCRIPTION		GEOLOGY	N	мс	SAN TY	MPLE YPE	REC IN.	FIELI WC	0 & LAH REC %		ORY T RQD	
	33 –	SAND WITH SILT, fine grained, brown, moist to wet, loose (SP-SM) (continued)		COARSE ALLUVIUM (continued)	9	M/W	X	SS	14					
	34 — 35 —	SANDY LEAN CLAY, a little gravel, gray, hard, laminations of silt (CL)		TILL		<b>▼</b> <u>M</u>	Ĭ	SS	18	17				
	36 –			COLLINIUM	45	M	A FI	22	10	17				
	37 — 38 —	GRAVELLY SAND WITH SILT, possible cobbles, coarse to medium grained, gray to brown, waterbearing, very dense (SP-SM)		COLLUVIUM OR COARSE ALLUVIUM	**	W	H	SS	6					9
	39 - 40 - 41 -	**9/0.5 + 50/0.3 ***46/0.5 + 50/0.3 LIMESTONE, light brownish gray, a little		PLATTEVILL		w	L F	SS	8					
	41 42 - 43 -	brown around 47.5', a few vuggy zones Weathering: Moderately to slightly weathered Fracturing: Very to moderately fractured		FORMATION MAGNOLIA MEMBER			H							
	44 –	Stratification: Thickly bedded Hardness: Hard Rock compressive strength at 42.2' = 12,280 ps	i			-		NQ	42		70	15	25	
	45 - 46 -			-										
	47 –													
	48 —			4										
	49 –							NQ	60		100	45	75	
	50 -													
	51 -													
		END OF BORING												
(13														
2/2														
GDI														
-WEL														
CPT														
AET+														
GPJ														
5723.														
9-0														
ATES														
RDIN														
00														
RP W														
AET_CORP W-COORDINATES 01-05723.GPJ_AET+CPT+WELL.GDT_225/13														



AET JC	)B NO:	01-05723					,	LO	G OF :	BOR	ING N	0.	Α	<mark>3 (</mark> p	<b>.</b> 1 o	f 3)	
PROJE		Minnesota Mu	ilti-Purp	ose Stad	ium	; Mi	inneapo	olis, I	MN							_	
		VATION: 843.0	H	ennepin Co.	Coordi	nates:	<u>N</u>	10	66343	3		E É	53298	3			
DEPTH		MATERIAL D	FSCRIPTIO	N		GE	OLOGY	N	МС	SAI	MPLE	REC			BORA		
IN FEET		·							Me		YPE	IN.	WC	KEU %	IN.	KQD %	%-#200
1 -		Bituminous pavemen, mostly silty sand wit		rele brown		FILI	Ĺ		F	Ħ	SU SU						
2 -	froze		ill glavel, ua	uk olowii,	<u> </u>				Г	I	30						
. 3 -	FILL	, mixture of silty sand	and clayey	sand, with					F	X	SS	16	7				
4	grave	a, apparent coobles, o	iowii, iioze	11 10 5.5						Ł							
5 -	-							21	М	$\square$	SS	10	6				
6 -											55						
7 -	4									뉟							
8 -	-							6	M	IXI	SS	11	10				
9 -	-									P							
10 -		, mostly silty sand, a l	little gravel,	, dark		]		25	М	Μ	SS	16					
11 -	brow		•							स्र							
12 -	FILL	, mostly clayey sand y gravel, pieces of brick	with organic	c fines, a						R							
13 -		graver, preces or other	c, dark brov	*11				8	M	X	SS	14	18				
14 -							к			E							
. 15 -		, mostly silty sand, a rete, dark brown	little gravel	, pieces of				20	М	X	SS	2					
16 -	-	•					<del>.</del>	4		R							
17 -	CLA stiff	YEY SAND, a little g	gravel, brow	n, very		TIL	،L	19	M	M	SS	16	12				
18 -		(50)						19	IVI	Д	55	10					
19 -		Y SAND WITH GRA		arent		4				I							
20 -	- cobb	les, brown, very dense	e (SM)					100/.9	M	X	SS	6					
21 -	-		1 1			:  -		-		R							
22 -	dens	Y SAND, a little grav e (SM)	vel, brown,	mealum				23	М	$\square$	SS	16					
23 -	1							25		$\mathbf{A}$							
24 -		YEY SAND, a little g	gravel, brow	/n, stiff						P							
EV92 -	- (SC)							10	M/W	γXI	SS	24	15				
										R							
	SAN	D WITH GRAVEL, a edium grained, light b	apparent co	bbles, fine			ARSE LUVIUM	29	M	M	SS	10					
20 29 -	dens	e (SP)								सि							
29 11 12 12 12 12 12 12 12 12 12 12 12 12	SAN	D, fine to medium grat, dense (SP)	ained, light	brown,				22	1	M	SS	14					
								33	M	Д	22	14					
25723			T							Į}				<u> </u>			<u> </u>
5 DE	PTH:	DRILLING METHOD					EVEL ME.			1			<b>11</b> 74 m	ED	NOTE		
INATE	0-52'	3.25" HSA	DATE	TIME	SAMF DEP	TH	CASING DEPTH		VE-IN PTH	FL	ORILLI UID LI	EVEL	WAT LEV	EL		<b>ATTA</b>	
GNO 52-	52.5'	RDF w/DM	2/14/13	11:00	48	.5	47.0	4	7.0				46.			TS FO	
S ≤ 52.5-	80.8'	NQ Core	2/14/13	11:15	48	.5	47.0	4	7.0				46.	4	EXPLA		
25 26 27 27 28 29 29 20	NG PLETED	: 2/14/13		-													GY ON
DR:		G: SB Rig: 91C													TI	HIS LC	
03/2011				_												01-I	DHR-0



AET JO	B NO: <b>01-05723</b>			LO	G OF	BO	RING N	0	A	3 (p.	2 of	<b>(3)</b>	
PROJEC	T: Minnesota Multi-Purpose Stadiu	ım;	Minneapo	lis, I	MN								
	Hennepin Co. Co	ordin	nates: <u>N</u>	16	6634.	3		E É	53298.	3			
DEPTH	MATERIAL DESCRIPTION		GEOLOGY	N	MC	SA	MPLE	REC	FIELD	& LAI			
DEPTH IN FEET	MATERIAL DESCRIPTION		GEOLOGI	IN	MC	] ]	TYPE	IN.	WC	REC %	RQD IN.	RQD	<b>%-</b> #200
22	SAND WITH GRAVEL, apparent cobbles, fine			71/.95	М	Μ	SS	16					
33 -	to medium grained, light brown, moist, very dense (SP) <i>(continued)</i>					R							
34 -	SILTY SAND WITH GRAVEL, apparent			*	М	K	SS	5					
35 -	cobble, fine grained, brown, moist, very dense (SM)				111	A	55	5				-	
36 -						ł							
37 -	*54/0.5+100/0.3			50/0.2	Μ	F	SS	1					
38 -	SAND WITH SILT AND GRAVEL, medium to					Ł							
39 -	fine grained, light brown, moist, very dense					۲J							
40 -	(SP-ŠM)			100/.9	Μ	М	SS	17					
41 -						Ł							
42 -			•	100/.9	м	$\square$	SS	17					
43 —				1007.9		A	55						
44 -	SAND WITH SILT AND GRAVEL, apparent		•			₽  }	,						
45 -	cobbles, fine to medium grained, brown, very dense (SP-SM)	.: :		**	М	X	SS	14					
46 -	$\sim **50/0.5 + 65/0.6 + 35/0.2$		COADEE		<b>_</b>	8							
47	GRAVEL WITH SAND AND SILT, apparent		COARSE ALLUVIUM	63	w	$\nabla$	SS	16					
48 -	cobbles, light brown, waterbearing, very dense (GP-GM)	-	OR COLLUVIUM		, vv	A	55	10					
49 -		<u>+</u> ++	00000000000			1							
50 -	***22/0.5 + 40/0.5 + 60/0.2			***	W	X	SS	11					8
51 -						R							
52 -	LIMESTONE SLAB OVER GRAVEL, light	0 0	COLLUVIUM	50/0	W	H H	SS NQ	0 2.5		104			
53 -	gray to brownish gray LIMESTONE, light brownish gray to about 57.5'	0	PLATTEVILL	F.			μų	2.5					
54 -	then light gray and gray, fossiliferous above		FORMATION				NQ	35		94	25	67	
55 -	57.6' Weathering: Slightly weathered	╘╌┤	MAGNOLIA MEMBER										
56 -	Fracturing: Very to moderately fractured		- - ·										
<u>-</u>	Stratification: Thickly bedded Hardness: Hard	<u>⊨</u>	4										
58 -	Rock compressive strength at $53.8' = 10,290$ psi	F	-				NQ	57		95	40	67	
59 -	Rock compressive strength at $58.7' = 19,550$ psi	E	-										
			-										ŀ
- 61 <del>-</del>	LIMESTONE, gray and light gray to about 61'		PLATTEVILL FORMATION										
- 62 –	then gray, 1-inch clay seam at 60.8', lenses of shale at 62.1' and 62.8'		HIDDEN										
63 -	Weathering: Slightly weathered	⊨	FALLS MEMBER				NQ	52		87	30	50	
8 64 -	Fracturing: Very to moderately fractured Stratification: Thickly bedded	<u>⊨</u>					- · • €						
65 -	Hardness: Hard	日	4										
- 66 –	Rock compressive strength at $63.5' = 11,120$ psi Nock compressive strength at $65.3' = 14,470$ psi	F				╟							
040 67 -	LIMESTONE, light gray and gray, crinkly	户	PLATTEVILL FORMATION										
o     − 68 −	bedded Weathering: Slightly weathered to fresh	日	MIFFLIN MEMBER				NQ	58		97	53	88	
ET_CORP WCCOORDINATES 01-05/233.GPJ AET+CPT+WELL.GUT 222473	Fracturing: Very fractured to slightly fractured						Yr.	50					1
	Stratification: Very thinly bedded		L				¶ .						



AET JO	B NO: 01-05723	<u></u>		LO	GOF	BORING N	0	A	3 (p	. 3 of	3)	
PROJEC	T: Minnesota Multi-Purpose	Stadium										
	Hennep	oin Co. Coordii	nates: <u>N</u>	1	66343	<u> </u>	Е :	53298.				
DEPTH IN FEET	MATERIAL DESCRIPTION		GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD WC			ORY T RQD	
	Hardness: Hard		PLATTEVILL FORMATION	E					- 70	<u>11N.</u>		
71 -	Rock compressive strength at $69.5' = 7,570$	) psi	MIFFLIN MEMBER									
72 — 73 —			(continued)			NQ	60		100	57	95	
74 —	Rock compressive strength at $74.1' = 10,14$	l0 psi					00		100	57	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	
75 -												
76 -												
78 -					-	NQ	35		58	30	50	
79 —	LIMESTONE, gray, vuggy Weathering: Slightly weathered		PLATTEVILL FORMATION PECATONICA									
80 -	Fracturing: Very fractured Stratification: Thinly bedded Hardness: Moderately hard		MEMBER	<b>\</b>								
	Hardness: Moderately hard (recovery ends around 79.7')											
	END OF BORING											
25/13		-										
GDT 2/												
T+CPT-												
3PJ AE		: · ·										-
05723.(												
ES 01-												
RDINAT												
N-COOI												
AET_CORP W-COORDINATES 01-05723.GPJ AET+CPT+WELL.GDT 2/25/13												



AET JO	OB NO:	01-05723	<u></u>					LO	G OF I	BOF	UNG N	0.	A	4 (p	<b>.</b> 1 of	f 2)	·
PROJE	CT:	Minnesota Mu	lti-Purp	ose Stad	lium;	Mi	inneapo	olis, I	MN								
SURFA	CE ELEV	ATION: <b>842.4</b>	Н	lennepin Co.	Coordir	nates:	<u>N</u>	10	66510	)		<u>E :</u>	533058	8			
DEPTH IN FEET		MATERIAL D	ESCRIPTIO	N		GE	OLOGY	N	мс	SA T	MPLE YPE	REC IN.	FIELD WC		BORAT RQD IN.		FESTS %-#20(
1 -	1) 6" FII	Bituminous pavement LL, mostly gravelly si ete, dark brown, froze		eces of		FILI	Ĺ		F	P P	SS	6	9				
2 - 3 -	FILL,	, mixture of silty sand l, pieces of brick, brow , mostly silty sand wit	and clayey wn, frozen						F	X F	SS	16					
4 - 5 - 6 -	frozer	n to 4'	ii giavei, u	ark brown,				20	М		SS	12					
7 - 8 -		, mostly silty sand, a l ete, glass and wood, c						22	М		SS	10					
9 - 10 - 11 -	-							14	М		SS	14					
12 -	FILL	, mostly clayey sand,	a little grav	/el, brown		-		8	М		SS	12	10				
14 - 15 - 16 -	SAN fine g	D WITH SILT, a little grained, brown, moist, SM) (possible fill)	e gravel, me	edium to		ALI	ARSE LUVIUM FILL	13	М		SS	10			-		
17 -		D, fine to medium gra , loose (SP)	iined, light	brown,			ARSE LUVIUM	10	М		SS	10					
19 <del>-</del> 20 -	- cobbl	D WITH SILT, a little les, fine to medium gr t, very dense (SP-SM)	ained, dark	parent brown,		• • • •		69/0.8	M		SS	14					
21 - 22 - 23 -	SAN	D, a little gravel, fine n to light brown, mois um dense (SP)	to medium			•		17	М	X	SS	10					
24 - 25 -						•		21	М	ł	SS	14					
25 - 26 - 273 26 - 277 27 - 275 28 - 277 28 - 28 - 28 - 297 28 - 297 29 - 297 29 - 297 29 - 297 29 - 297 20 - 207 20 - 2	SAN grayi	D, a little gravel, med sh brown, moist, med	ium to fine ium dense	grained, (SP)		•		19	М	E	SS	16					
								25	M	ł	SS	14					
31 - 31 -	-					•				Ł							
ទី DE	EPTH:	DRILLING METHOD			WAT	ER L	EVEL MEA	· · · ·							NOTE:	REFI	ER TO
U ATES	49.9'	3.25" HSA	DATE	TIME	SAMP DEP	LED IH	CASING DEPTH	CAV DE	/E-IN PTH	I  FL	ORILLI UID LI	NG EVEL	WATI LEVI	ER 3L	THE A	TTAC	HED
49.9-		NQ Core	2/14/13	12:55	48.		47.0		6.3				46.	1	SHEE	TS FO	R AN
0- N		· · ·	2/14/13	1:00	48.	7	47.0	4	6.3				46.2		EXPLA		
BORI COM	NG PLETED:	2/15/13												Г   Т			GY ON
DR: S		G: TK Rig: 85C													TH	IIS LO	G



AET JO	B NO:	01-05723			LO	G OF	BO	RING N	10	Α	4 (p	. 2 of	f 2)	
PROJEC	CT:	Minnesota Multi-Purpose Stadi	ium	; Minneapo	olis,	MN								
		Hennepin Co. C	Coordii	nates: <u>N</u>	1	6651(	)		<u>E </u>	53305	8			
DEPTH		MATERIAL DESCRIPTION		GEOLOGY	N	мс	SA	MPLE	REC	FIELD	& LA			
DEPTH IN FEET		MATERIAL DESCRIPTION		GLODOGI	11	WIC		TYPE	IN.	WC	REC %	RQD IN.	RQD	<b>%-</b> #20
33 -	SAN verv (	D, fine grained, light brown, moist, dense to dense (SP) (continued)			43	м	М	SS	14					
34 —							মি							
35 —					59	м	$\square$	SS	12					
36 -					57	141	$\square$	55	12					
37 —							붬							
38 -					60	'M	М	SS	2					
39 —							召							
40 -					43	М	M	SS	14					
41 —				· · ·			प्ति							
42 —		D WITH SILT AND GRAVEL, fine to um grained, brown, moist, dense (SP-SM)					R	~~						
43 —	mean	ani granicu, brown, moist, dense (51 -514)			45	M	Å	SS	12					
44 —							I							
45 —	<b></b>	0.5 + 50/0.3 VEL WITH SAND, light grayish brown,	<u>₩</u>	COARSE	*	M	X	SS	8					
46 -		, very dense (GP)		ALLUVIUM		<b>_</b>	ł							
47 —		VELLY CLAYEY SAND, brown, hard,		OR COLLUVIUM			$\mathbb{N}$							
48 -	lense	s and laminations of silty sand (SC)		COLLUVIUM	79	M/W	ΊÅ	SS	12	9				
49 —					100/0	M	Ł	SS	1					-
50 —	LIMI	ESTONE SLAB, gray and light gray		-			Ĩ							
51 —	LIMI	ESTONE, light brownish gray to about 57.8'		PLATTEVILL	Е									
52 —	then 57.8	gray and light gray, fossiliferous above		FORMATION MAGNOLIA				NQ	56		99	13	23	
53 -	Weat	hering: Moderately to slightly weathered		MEMBER										
54 —	Fract Strati	uring: Intensely to slightly fractured fication: Thickly bedded												
55 —		ness: Moderately hard to hard		· .										
56 -				, ,				210					40	
57 -								NQ	42		70	29	48	
58 -	9			-										
59 —	FND	OF BORING											<u> </u>	
	END	OF BURING		•										
			r											



AET JO	OB NO: 01-05723				<u></u>	LO	G OF I	BORINGN	10	Α	5 (p	<b>. 1 o</b>	f 2)	
PROJEC	CT: Minnesota N	/Iulti-Purpos	e Stadiu	m; Min	neapolis,	MN								
SURFA	CE ELEVATION:839.	8н	lennepin Co.	Coordinat	es: <u>N</u>	1	56704		E :	53297				
DEPTH IN	MATERIA	AL DESCRIPTIO	N		GEOLOGY	N	мс	SAMPLE TYPE	REC IN.				ORY TE	
IN FEET					TT T				114.	WC	%	IN.	RQD %	-#20
1 2 3 4 5 6 7 8	5.75" Bituminous pave 6" FILL, mostly gravel frozen FILL, mostly silty sand clayey sand, pieces of c brown, frozen to 4' *13/0.5 + 60/0.2	ly silty sand, da with gravel, a	little		ILL	60/.2	F F M	SS SS SS	12 6 10					
9 — 10 — 11 —						35	М	SS SS	12					
12 — 13 —	FILL, mixture of sandy silt, a little gravel, brow	/ lean clay and s wnish gray and l	sand with brown			23	М	ss B	10	9				
14 15	FILL, mostly gravel, b	rown				50/.2	M	ss S	1					
16 17 18 19	GRAVELLY SAND W medium grained, brown (SP-SM)				COARSE ALLUVIUM	54	М	}} X ss ₹	10					
20 - 21 -	-					98	M	R ss	8					
22 - 23 -	SILTY SAND, a little (SM)	gravel, brown,	very dense		TILL	98	М	ss	14					
24 - 25 - 26 -						85	м	되 X ss 랍	16					
27 - 28 -						61	М	ss R	14					
29 30 31	SAND WITH GRAVI grained, brown, dense	EL, fine to med to very dense (	ium SP)		COARSE ALLUVIUM	43	M	봐 Ss 당	12					
DE	PTH: DRILLING METHO	DD		WATE	R LEVEL ME	ASURI	EMEN	TS	1			NOTE	REFER	
		DATE	TIME	SAMPLE DEPTH	ED CASING DEPTH	CAV	VE-IN PTH	DRILL FLUID L	ING EVFI	WAT LEV	ER EL		TTACH	
	49.8' 3.25" HSA	2/15/13	3:00	35.6	34.5		<b>5.3</b>			35.		SHEE	TS FOR .	AJ
49.8-5	55.6' NQ Core	2/15/13	4:55	47.1	46.8		6.7			44.		EXPLA	NATION	N (
BORI	NG PLETED: <b>2/18/13</b>	2/16/13	8:30	47.1	46.8		6.7			43.		TERMI	NOLOGY	Y (
	SS LG: TK Rig: 85C		1:30	49.7	49.5		8.1			46.	-	TF	IS LOG	i

03/2011



AET JC	B NO: <b>01-05723</b>			LO	GOF	BOI	RING N	O	A	5 (p	. 2 of	f 2)	
PROJE		um;	, Minneapo	lis,	MN								
	Hennepin Co. Co	oordir	nates: <u>N</u>	1	66704	ļ	]	E Ś	53297				
DEPTH	MATERIAL DESCRIPTION		GEOLOGY	N	MC	SĄ	MPLE YPE	REC IN.		8 LA		ORY T	
IN FEET					_		1115	11N,	WC	%	IN.	RQD。 %	/6-#20(
33 -	SAND WITH GRAVEL, fine to medium grained, brown, dense to very dense (SP) <i>(continued)</i>		COARSE ALLUVIUM (continued)	68	M	X स	SS	12					
34 -	SAND WITH SILT AND GRAVEL, fine to			**		R	SS	12					
35 -	medium grained, brown, waterbearing, very dense (SP-SM)				vv-/-iVI	मि	ەە	14					
37 -	GRAVEL WITH CLAY AND SAND, brown, moist, dense (GC)			55	м	ł	SS	16					
38 - 39 -	SAND, fine to medium grained, light brown, moist, very dense (SP)			22	M	\_ ₹]	55	10					
40 -	SILTY SAND WITH GRAVEL, fine to medium grained, brown, moist, very dense (SM)			96	М		SS	10			-		
41 - 42 -	GRAVEL WITH SAND, brown, moist, very dense (GP)		TILL	-		Ł							
43 - 44 -	SILTY SAND WITH GRAVEL, dark brown, a little brown, very dense, lenses of clayey sand			73	Μ	$\bigwedge$	SS	14					
45 -	SANDY LEAN CLAY, a little gravel, gray, hard		COARSE ALLUVIUM	57	M/W		SS	.14	13			-	
46 -	GRAVELLY SILTY SAND, fine to medium		HIGHLY	100/.3	w	Y	SS						
47	\grained, gray, wet, very dense (SM) WEATHERED LIMESTONE, brown to light		FRACTURED			ł	·						
49 -	gray	X	FORMATION		w	ł	SS	1			r.		
50 -	LIMESTONE, light brownish gray to gray, fossiliferous		COLLUVIUM	E	1 "	П	NQ	8		83	7	73	
52 -	Weathering: Moderately to slightly weathered Fracturing: Very fractured		FORMATION MAGNOLIA MEMBER			ŕ							
53 - 54 -	Stratification: Thickly bedded Hardness: Hard						NQ	45		75	13	22	
55 -		日	-										
	END OF BORING												
125/13	**14/0.5 + 31/0.5 + 50/0.1												
AET_CORP W-COORDINATES 01-05723.GPJ AET+CPT+WELL.GDT 2/25/13	Note: Core barrel became wedged and broke off. Barrel and most of core were retrieved, although bottom 0.9' remained in ground. Drillers reported coring was continuously solid with no obvious voids.												-
05723.GPJ &													
VATES 01-(													
ORP W-COORDI													
AET_C													



AET JO	OB NO:	01-05723						LO	G OF I	BOF	RINGN	0	A	6 (p	. 1 of	(2)	
PROJE	ECT:	Minnesota Mul	ti-Purpos	e Stadiu	n; M	inne	eapolis, I			494						-	
SURFA	CE ELE	VATION: 842.6	Н	lennepin Co.	Coordir	nates:	<u>N</u>	1	66819	)		<u>E </u> :	53279				
DEPTH IN FEET		MATERIAL D	DESCRIPTIO	N		GE	OLOGY	N	MC	SA T	MPLE YPE	REC IN.	FIELD WC		BORAT RQD IN.		
		Concrete pavement			/	FILL				윩	SU						
1-	FILL froze	, mostly silty sand wit n	h gravel, da	ark brown,					F	Ĭ	SU						
2 - 3 -	FILL	, mostly silty sand, a l dark brown, frozen to	ittle gravel	and clayey					F	Д	SS	16	-				
4 -	-									I							
5 -	1							7	M	X	SS	10					
6 -		<i>.</i> 1 11 <i>.</i> 1 1	1 1							Ł			-				
7	concr	, mostly silty sand wit rete, dark brown 5 + 17/0.5 + 50/0.2	n gravel, pi	eces of				*	M	M	SS	12					
9 -		, mostly clayey sand,	a little grav	el dark		-				3							
10 -	- brow		a intie grav	ci, daix				5	M	М	SS	12	16				
11 -										F							
12 -	FILL	, mostly sand with silt	t, brown							R							
13 -	-							18	M	Д	SS	13					
14 -	FILL	, mostly sand with silt	t, a little gra	avel,		1				I							
15 -		rent cobble at 18', darl						11	M	X	SS	12					
16 -	-									रि							
17 -								20	M	M	SS	14					
18 -								20		$\mathcal{A}$	00						
19 -		, mostly silty sand wi	th gravel, a	pparent		-				H							
20 -		les, brown						42	M	М	SS	5					
21 -	SAN	D, a little gravel, fine	to medium	grained	-	CO/	ARSE			Z							
22 -	light	brown, moist, mediur	n dense (SF	<i>granica</i> , <i>P</i> )			LUVIUM	17	M	Μ	SS	14					
23 -										मि							
24 -	SAN	D, a little gravel, poss ne grained, light brown	sible cobble	e, medium						R							
25 - 26 -		e gramed, fight brown	u, moist, de					32	M	Å	SS	15					
20	1	VELLY SAND, appa	arent cobble	es, medium		- 				I							
	to fir	ne grained, light brown	n, moist, ve	ry dense				59	M	X	SS	6					
	(SP)					: -				R							
41 30		VEL WITH SAND, a voist, very dense (		bbles,				55	М	$\mathbb{M}$	SS	12					
G 31								55	IVI	Å	00	12					
05723			1					1		5				. <u> </u>			
b DE	EPTH:	DRILLING METHOD		·1		r	EVEL MEA				יידתח		117 A TT		NOTE:		
23 - 25 - 26 - 27 - 28 - 28	47.6'	3.25" HSA	DATE	TIME	SAMP DEP	LED TH	CASING DEPTH	DE	VE-IN PTH	FI	DRILLI JUID LI	EVEL	WAT LEVI	EL	THE A		
and 47.6-		NQ Core	2/18/13		47.	2	47.5						None		SHEE		
Ŭ-M						]							**W	CL	EXPLA		
BORI COM	ING IPLETED	: 2/18/13						<u> </u>		_				]	TERMIN		
DR:	SG LO	G: SB Rig: 91C													TH	IIS LO	G



AET JO	B NO: 01-05723			LO	G OF	BOJ	RING N	0	Α	6 (p	<b>. 2 o</b> :	f 2)	
PROJEC	T: Minnesota Multi-Purpose Stadium	; M	inneapolis,	MN									
	Hennepin Co. Co	oordir	nates: <u>N</u>	10	6681	9		<u>E</u> :	53279	6			
EPTH	MATERIAL DESCRIPTION		GEOLOGY	N	MC	SA	MPLE YPE	REC	J				
IN FEET				ļ.''			YPE	IN.	WC	%	IN.	RQD. %	%-#
33 —	SILTY SAND, a little gravel, apparent cobbles, brown, very dense (SM) <i>(continued)</i>		TILL (continued)	**	M	Х	SS	14					
34 -						H							
35 —	**36/0.5 + 69/0.5 + 31/0.2			***	M	Ň	SS						
36 -	***35/0.5 + 68/0.5 + 32/0.1					R							
37 -						Į							
38 -				74	M	М	SS						
39 -	SAND WITH GRAVEL, medium to fine		COARSE	-		Ł							
40 -	grained, brown, moist, dense, laminations of		ALLUVIUM	47	M	$\square$	SS	15					
41 -	clayey sand (SP)					मि							
42 —	SAND WITH SILT AND GRAVEL, medium to fine grained, brown, moist, dense (SP-SM)					K	~~~						
43 —	The granicu, brown, moist, dense (31-5101)			58	M	Å	SS	18					
44 -	GRAVELLY SAND WITH SILT, medium to		COARSE	-		I							
45 —	fine grained, brown, moist to waterbearing, very		ALLUVIUM OR	64	M/W	γX	SS	12					
46 –	dense (SP-SM)		COLLUVIUM	[		रि					-		
47 _	SANDY LEAN CLAY, a little gravel, gray, hard		TILL	50/.2	M	K	SS	2	16				
48 -	LIMESTONE, light gray and gray to about 49'	<u>├</u>	PLATTEVILL FORMATION										
49 —	then light brownish gray, fractured and weathered zones from 48' to 48.3' and 48.7' to		MAGNOLIA MEMBER				NQ	25		72	17	49	
50 -	48.8', vertical fracture from 52.5' to 52.9',	E											
51 —	fossiliferous, a few vuggy zones Weathering: Moderately to slightly weathered		-										
52 —	Fracturing: Very to moderately fractured												
53 —	Stratification: Thickly bedded Hardness: Hard		-				NQ	56		93	28	47	
54 —			-									۱.	
55 —		H											
56 -													
57 —	LIMESTONE, gray, vertical fractures at 57.9'		-										
58 —	and 59' Weathering: Slightly weathered		-				NQ	50		83	24	40	
59	Fracturing: Very to moderately fractured Stratification: Thickly bedded												
60	Hardness: Hard		-										
	END OF BORING												
											1		
	<i>C</i>												
		1				<u> </u>	I					01_D	1



AET J	OB NO:	01-05	723						LO	G OF I	BOI	RING N	0	A	7 (p	. 1 of	f <b>2</b> )	
PROJE	ECT:	Minnes	sota Mul	ti-Purpos	se Stadiu	m; M	inne	apolis,	MN									,
SURFA	ACE ELE	VATION:	842.6	H	lennepin Co.	Coordi	nates:	<u>N</u>	10	66300	)		<u>E</u> :	53265				
DEPTH IN FEET		м	ATERIAL D	ESCRIPTIO	Ň		GE	OLOGY	N	мс	SA	MPLE YPE	REC			BORAT		
FEET	-												IN.	WC	KEC %	RQD IN.	KQD %	<b>‰-#2</b> 00
1 -		tuminous p					FILL	ر.			Ħ	SU						
2 -	1.1.1	, mostly siltes, dark bro								F	I	SU						
3 -										F	Ŕ	SS	3					
4 -	_										Į							
5-	_								33	м	$\square$	SS	15					
6 -	_								33	141	Д	33	15					
7 -	FILL	, mostly sa	nd, a little g	gravel, brov	vn						E							
8 -	-								20	М	X	SS	12					
9.			1 12-141-				4				Ł							
10 -		, mostly sa	na, light or	own					18	м	$\square$	SS	12					
11	_										$\square$	55						
12		, mostly gra	avelly sand	with silt, a	pparent		1				뉟							
13	- cobb	les, brown							110	M	М	SS	10					
14	FUI	, mixture o	f clavey sa	nd and silts	rsand a		-				ß							
15		gravel, bro			Sund, u				26	M	М	SS	16	11				
16											F							
17	- GRA	VELLY SI	LTY SAN	D, brown,	dense (SM	)	TIL	L			K	~~						
18	-								39	M	Å	SS	3					
19		YEY SAN	D, a little g	ravel, appa	rent						I							
20	- cobb	les, brown, sand (SC/S	hard to ve	ry stiff, lan	inations of	f ///			88	M	Х	SS	5	12				
21		sanu (SC/S	141)								रि							
22	-								16	М	$\square$	SS	16	12				
23		D WITH S			nt brown,		CO/	ARSE		1.1	A	00						
24		t, medium o	lense (SP-S	SM)				LUVIUM			P							
er 25									13	M	М	SS	14					
<sup>35</sup> 26 109 27		Y SAND	WITH GR	AVEL fine	to mediun	n					ł							
27 XEFF-0	grain	ied, brown,			to mean				36	M	M	SS	12					
											प्ति							
VEL 40 29 30	GRA	VEL WIT		orown, moi	st, very						R	00	12					
- B 31			, GI )						61	M	Д	SS	13					
5723.				1							1							
S DI	EPTH:	DRILLING	METHOD		1	1		EVEL MEA						XX / 4 777		NOTE:	REFE	ER TO
D-	·49½'	3.25" HSA	4	DATE	TIME	SAMP DEP	TH	CASING DEPTH	DE	VE-IN ⊅TH	FÍ	DRILLI UID LI	NG EVEL	WAT LEVI	ER	THE A	ATTAC	HED
	-49.8'	RD w/DM		2/20/13		49.	.5	49.5						Non			TS FOI	
¥ <b>49.8</b>	-54.5'	NQ Core														EXPLA		
BOR COM	ING IPLETED	: 2/21/13				ļ					_							GY ON
DR:			g: 91C													TI	IIS LO	G

ľ 03/2011



	Hennepin Co.	Coor	dinates: N	10	66300	)	]	E 5	53265	4			
DEDTH									FIELL	) & LAI	BORAT	ORY 1	TES'
DEPTH IN FEET	MATERIAL DESCRIPTION		GEOLOGY	N	MC		MPLE YPE	REC IN.	WC	REC %	RQD IN.	RQD	<b>%-</b> #
	GRAVEL WITH SAND, brown, moist, very			28	М	М	SS	10		, .			
33 -	dense to dense (GP) (continued)					F							
34 - 35 -				00	N	H	SS	13					
36 -				99	М	Д	22	13					
37 —	SILTY SAND WITH GRAVEL, apparent		TILL	1		Į.							
38 -	cobbles, dark brown, very dense (SM)			*	М	Х	SS	15					
39 –	**22/0.5 + 58/0.5 + 42/0.3					ł							
40				50/0.3	М	Ŕ	SS	3					
41 -						Į							
42 –				50/0.2	М	×	SS	2					
43 -						ł							
44 45				50/0.1	M	¥	SS	1					
46			COLLUNIA			Ħ							
47 -	SILTY SAND WITH GRAVEL, possible cobbles, brown, very dense, laminations of		COLLUVIUN	83/0.5	M	Ř	SS	5					
48 -	clayey sand (SM)			0.0.0		Ł	55						
49 –						ł	00	17					
50 —	LIMESTONE SLAB, gray LIMESTONE SLABS AND GRAVEL, gray	╞╧╤	-	50/.05	M	Ĩ	SS	1/2					
51 —	and dark brown												
52 —	LIMESTONE, light brownish gray,		PLATTEVILI				NQ	38		67	16	28	
53 -	fossiliferous, a few vuggy zones, clay seam at 52.8'		MAGNOLIA	1									
54 –	Weathering: Slightly weathered Fracturing: Intensely to moderately fractured	$\int \frac{1}{1}$	MEMBER										-
	Stratification: Thickly bedded Hardness: Hard												
	END OF BORING												
	Note RQD = 54% in Magnolia Member (lower												
	2.5')												
												1	
					1		1	1	1		1 ·		-1



AET JO					-				BORIN	IG N(	D	A	8 (p	<b>). 1</b> of	f 2)	
PROJEC		lti-Purp	ose Stac	lium;	Min	neapo										
SURFA	CE ELEVATION:842.1	H	lennepin Co.	Coordin	nates:	<u>N</u>	10	66533	i	E	3 5	532812	2			
DEPTH IN FEET	MATERIAL D	ESCRIPTIO	N		GEOL	OGY	N	MC	SAMI TYP	PLE PE	REC IN.	FIELD WC		BORAT		
1 - 2 -	4" Bituminous pavement FILL, mostly silty sand wit concrete around 2', dark bro	h gravel, p own, frozer	ieces of		FILL			F F F	F s		12				- -	
3 4 5 6	FILL, mostly silty sand, a l brick, apparent cobbles, da		, pieces of				25	M		ŝs	14					
7 — 8 — 9 —	FILL, mostly gravel and si	the could on	nouont				18	М	li X R	ss	12					
10 11 12	FILL, mostly gravel and sin cobbles, brown FILL, mostly sand with silt		parent				48	М	S S	SS	10					
13 — 14 —	FILL, mostly silty sand, a l	ittle gravel	, apparent	•			10	М	K s	SS	16					
15 — 16 — 17 —	cobbles, brown and grayisl FILL, mostly sand, light br				- -		19	М	Ŧ	SS	6					
18 19 20	FILL, mostly sand with sil	t, a little gra	avel, brow	n			15	M	Ŧ	SS	13					
20 - 21 - 22 -	FILL, mostly gravelly silty	sand, appa	arent				7 50/.2	M	Ŧ	SS SS	10 2					
23 - 24 -	cobbles, dark brownish gra odor) SANDY LEAN CLAY, a stiff (CL) (petroleum-type	little gravel	• •	y ///	TILL											
25 26 27 27 27 28 27 28 29 28 29 30 31 31 31 31 210 31 000 31 0000 000 -		,					16	M		SS	18	12				
28 – 29 –	SILTY SAND, a little grav gray, dense (SM)						36	M		SS	16	16				
30 - 30 - 31 - 31 - 31 -	SANDY LEAN CLAY W apparent cobbles, gray, a li hard, a lens of silty sand ar	ttle browni	sh gray,				68	М		SS	15	4				
ë DEI	PTH: DRILLING METHOD			WAT	ER LEV	EL MEA	SURI	EMEN	TS					NOTE:	REFE	ER TO
0-5 51.2-6	51.2' 3.25" HSA	DATE	TIME	SAMPI DEPT	LED C. TH D	ASING DEPTH	CAV DE	/E-IN PTH	DR FLUI	ILLIN D LE	√G VEL	WATI LEVI	ER EL	THE A	ATTAC	CHED
51.2-6		2/14/13	2:40	48.		47.0		7.0				46.3		SHEE	TS FOI	R AN
		2/14/13	2:50	48.	5	47.0	4	7.0	+			46.4	4	EXPLA	NATIO	ON OF
₽ BORIN	NG PLETED: 2/16/13													FERMI	NOLO	GY OI
0	A A A A A A A A A A A A A A A A A A A			1			1		1					TH	IIS LO	G



AET JO	B NO: <b>01-05723</b>			LO	G OF	BO	RING N	0	Α	8 (p	. 2 of	f 2)	
PROJEC	T: Minnesota Multi-Purpose Stadiu	m;	Minneapo	lis, I	MN								
	Hennepin Co. Coc	ordin	ates: <u>N</u>	10	66533	3		Е 😫	53281				
DEPTH	MATERIAL DESCRIPTION		GEOLOGY	N	МС	SA	MPLE	REC				ORY T	
IN FEET		1.1.						119.	WC	%	IN.	RQD	<b>%-#</b> 20
33 —	SILTY SAND, a little gravel, gray, medium dense (SM) <i>(continued)</i>			18	М	Х	SS	13			·		
34 —						Ł							
35 —			-	19	М	$\square$	SS	16					
36 -						F							
. 37 —						R	~~						
38 -				10	M	Å	SS	8					
39 -	CLAYEY SAND, a little gravel, gray, very stiff					묍							
40 -	(SC)			20	M	X	SS	17	14				
41	SAND, fine grained, light brown, moist, medium dense (SP)					3							
42 -				73	м	$\nabla$	SS	5					
43 -				15		F	00						
44 -	SAND WITH SILT AND GRAVEL, apparent		COARSE	00/5		R	SS	1					
45 -	cobbles, fine to medium grained, brown, moist,		ALLUVIUM	80/.5		A	22						
46 -	very dense (SP-SM) GRAVELLY SAND WITH SILT, medium to		COLLUVIUM		<b>-</b>	ł							
47 -	coarse grained, brown, very dense (SM)		OR TILL	51	w	M	SS	8					
48 - 49 -				ļ		प्ति							
49 - 50 -	SAND, a little gravel, apparent cobbles, fine to medium grained, brown, waterbearing, very		COARSE ALLUVIUM	50/.4	W	K	SS	9	10				
51 -	dense (SP)		TILL			R			12				
52 -	GRAVELLY CLAYEY SAND, gray, hard (SC) / LIMESTONE, light brownish gray, a few vuggy		PLATTEVILL FORMATION										
53 -	zones, fossiliferous		MAGNOLIA				NQ	48		100	20	42	
54 -	Weathering: Slightly weathered Fracturing: Very fractured		MEMBER				~~~			100			
55 -	Stratification: Thickly bedded Hardness: Hard	$T_{\tau}^{\perp}$											
56 -													
57 -	LIMESTONE, gray												
57 -	Weathering: Weathered Fracturing: Very fractured						NQ	26		43	*	*	
59 -	Fracturing: Very fractured Stratification: Thickly bedded Hardness: Hard												
60 -	END OF BORING					_							
59 - 60 -	*Lower 2½' of core could not be retrieved. Portion retrieved likely disturbed by retrieval attempts.		·										
200													



AET	AET JOB NO: 01-05723 PROJECT: Minnesota Multi-Purpose Stad							LO	GOF	BOF	RING N	Ю	B	9 (p	<b>).</b> 1 of	f 3)	
PRO	IECT:	Minnesota Mul	ti-Purpos	se Stadiu	ım; M	linne	eapolis,	MN									
SURF	ACE ELE	EVATION: <u>843.0</u>	H	Iennepin C	o. Coor	dinat	es: <u>N</u>	10	6623(	)		E t	53298				
DEPTI IN FEET	E	MATERIAL D	ESCRIPTIO	N		GE	OLOGY	N	MC	SA	MPLE YPE	REC			BORAT		
FEET		Ditamin and noviement				FILL					1112		WC	%	RQD IN.	%	/0-#200
1		Bituminous pavement ILL, mostly silty sand,		ivel and		TILL	, 	19	M	M	SS	12				-	
2		ey sand, brown and da		1	]					$\mathbb{H}$							
3	- of gl	L, mostly silty sand, a lass at 15', dark brown	intile grave	i, a piece				21	M	Д	SS	14					
. 4	-									1							
5								18	M	Х	SS	16		-			
6										Ł							
7								10	М	М	SS	12	1				
9										R							
10								13	M	M	SS	14					
11	_							15	141	A	55		-				
12	_							_		붬	~~~						
13	-							4	M	Å	SS	12					
14										I							
15					N		2	9	Μ	М	SS	10					
16	1									Z							
17						· .		4	M	M	SS	10					
10										सि							
20	SAN	ND, a little gravel, med t brown, moist, mediur	lium to fine n dense (S	e grained, P)			ARSE LUVIUM	12	М	M	SS	8			3		
21	0	, ,		,				12	141	A	00				l.		
22		ND, fine to medium gra	ained light	t brown.						붬							
23	•	st, loose (SP)	uniou, ngin					9	M	Д	SS	12					
- 24	SAN	ND WITH SILT AND	GRAVEL,	, fine to						I			-				
25	(QD	lium grained, brown, n -SM)	noist, medi	um dense				17	M	М	SS	8					
<sup>8</sup> 26		NDY LEAN CLAY, a	little grave	oravish		TILI	[,			3							
27 27 28	broy	wn, stiff (CL/SC)	nuio grave	, gruj 1511				11	M	М	SS	16	14				
										रि							
+ 30	- $-$ harc	AYEY SAND WITH C l, laminations of silty s		brown,				*	M		SS	8	11				
31 31	*12	/0.5 + 50/0.5 + 50/0.1								Ł	-						
1-0572	DEPTH:	DRILLING METHOD			WAT	ERIF	EVEL MEA	SURI	 EMEN	<u>ון ו</u> TS					NOTE:	DEEE	
25 26 26 27 27 27 27 27 27 27 27 27 27 27 27 27			DATE	TIME	SAMPI		CASING DEPTH	CAV	VE-IN	Ι	ORILLI	NG	WAT	ER		KEFE ATTAC	
	0-32'	4.25" HSA	7/22/13	10:35	DEPT 31.		DEPTH 29.5		ртн <b>9.5</b>	FL ·	UID LE	EVEL	LEVI Non			TS FOI	
	2-44.3'	RDF w/DM NQ Core	7/22/13	10:35	31.		32.0		9.5 0.5				29.		EXPLA		
≤ <b>44.3</b> BOI	<b>'-84.7'</b> RING MPLETEI	D: 7/22/13	7/22/13	11:25	32.		32.0		0.7				29.	_	FERMIN	NOLO	JY ON
		G: <b>TM</b> Rig: <b>85C</b>	7/25/13	8:11	44.2		44.0	4	4.0				43.	8	TH	IIS LO	G



AET JO	B NO: <b>01-05723</b>			LO	G OF	BOI	RING N	0.	B	9 (p.	<b>2</b> of	3)	
PROJEC	T: Minnesota Multi-Purpose Stadium	; M	inneapolis,	MN									
	Hennepin Co.	Coor	dinates: <u>N</u>	16	6230	)		E É	53298	0			
DEPTH	MATERIAL DESCRIPTION		GEOLOGY	N	MC	SA	MPLE YPE	REC				ORY T	
IN FEET					me			IN.	WC	KEC %	IN.	RQD %	6-#200
33 -	APPARENT BOULDERS AND/OR SLABS (limestone chips retrieved), gray (continued)		COLLUVIUM	50/.05		$\mathbb{Z}$	SS						
34 -	· · · · · · · · · · · · · · · · · · ·		(continued)			H							
35 -				8	-	М	SS						
36 -						$[\mathcal{D}]$							
37 -	GRAVEL WITH SILT AND SAND, apparent					H							
38 -	cobbles, brown, waterbearing, very dense (GP-GM)			73	W	Д	SS	6					
39 -	GRAVEL WITH SAND, apparent cobbles,			50/.4	W	K	SS	8					
40 -	brown, waterbearing, very dense (GP)					Б							
41 -	COBBLES AND/OR BOULDERS (granite					$\left \right\rangle$					·		
42 _	pieces retrieved, limestone chips retrieved from cuttings below 44'), dark gray, a little white			50/.1	W	$\sum$	SS	2					
43 —	(limited samples)				<b>.</b> -	$\left \right\rangle$	~~						
44 —			-	100/.2	Μ	X	SS	0					
45 —	BOULDERS AND/OR SLABS, gray						NQ	17		79			
46 -				1.3									
47							NO	12		33			
48 -							NQ	13		33			
49 -													
50 -							NQ	18		65			
51 -													
53 -	LIMESTONE, gray and light brown, fossiliferous	<u>⊢</u> ⊥	PLATTEVILL FORMATION	E .									
54	Weathering: Moderately to slightly weathered		MAGNOLIA MEMBER				NQ	32		99	23	71	
55 -	Fracturing: Intensely to slightly fractured Stratification: Thickly bedded												
56	Hardness: Hard												
							NQ	55		92	46	77	
58 -			4										
59 –			4										
60 −	LIMESTONE, gray and light gray		PLATTEVILL	E									
61 –	Weathering: Moderately to slightly weathered Fracturing: Intensely to slightly fractured	μ <u></u>	FORMATION HIDDEN										
62 –	Stratification: Thickly bedded		FALLS MEMBER				NQ	54		90	44	73	
63 - 63 -	Hardness: Hard												
64 -	Rock compressive strength at 61.8'=12,760 psi		-									``	
s 65 -	Rock compressive strength at 63.0'=5,860 psi		]	1									
141 66 -	LIMESTONE, light gray and gray, crinkly	┢╌┦	PLATTEVILL										
8000	bedded		FORMATION				NQ	60		100	59	98	
o ≥ 68 -	Weathering: Slightly weathered to fresh Fracturing: Very to slightly fractured	E	MEMBER				4						
ET_CORP W-COORDINATES 01-05723.GPJ AET-CPT+WELL.GDT 806/13 2011 - 201 -	Stratification: Very thinly bedded												
Ξ		1		1	1		1	1	1	1	1	1	1



AET JO	B NO: 01-05723			LO	GOF	BORING N	0.	B	9 (p.	3 of	<b>(3)</b>	
PROJEC	CT: Minnesota Multi-Purpose Stadium	; M	inneapolis,									<u>¥_</u>
	Hennepin Co.	Coor	dinates: <u>N</u>	1	66230		E t	53298				Barra
DEPTH IN FEET	MATERIAL DESCRIPTION		GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELC			ORY T RQD	
FEET	Handnoon Vow bord		PLATTEVILL	<del>7</del> .				wc	%	IN.	%	0-#2.00
71 -	Hardness: Very hard		FORMATION MIFFLIN							÷ .		
72 —			MEMBER			NQ	59		98	51	85	
73 —			(continued)									
74 —												
75 —												
76 -												
77 –						NQ	58		97	42	70	н. 1
78 79												
80 -	LIMESTONE, gray		PLATTEVILL	Е								
81 -	Weathering: Fresh Fracturing: Slightly fractured Stratification: Thinly bedded Hardness: Hard		FORMATION PECATONICA	•								
82 -	Stratification: Thinly bedded		MEMBER GLENWOOD			NQ	57		95	9	15	
83 -	SHALE, gray to about 83.3' then brown sandy		FORMATION									
84 -	shale to about 84' then light brown shaley sandstone											
	END OF BORING											
			÷									
										-		
							1.					
1 2010												
2012210			· ·									
0-10												
COR	· · ·											
												<u> </u>



	ET JO	DB NO: 01-05723						LO	G OF	BOF	RING N	0.	<b>B</b> 1	0 (I	<b>).</b> 1 o	f 2)	
PI	ROJEC	CT: Minnesota Mult	i-Purpos	e Stadiu	m; M	linn	eapolis,								_,		
SU	JRFA	CE ELEVATION: 842.9	H	ennepin Co	o. Coor	dinat	tes: <u>N</u>	10	66219	9		E É	532992				
DE	PTH N	MATERIAL DE	ESCRIPTION	N		GE	OLOGY	N	MC	SA	MPLE YPE	REC IN.			BORAT		
FÊ	N EET					TIT T							WC	%	IN.	%	%-#200
	1 -	4" Bituminous pavement 5" FILL, mostly gravelly sil	Ity sand d	ark brown	/	FILI	_, ·	26	М	$\square$	SS	17					
	. 2 –	FILL, mostly silty sand, a li			/					Ĥ							
	3 –	cobbles, dark brown						22	М	Å	SS	9					
	4 —	FILL, mostly silty sand with	h gravel, a	pparent						I							
1	5 —	cobbles, brown and dark brown	own					39	M.	Х	SS	4					
	6 —									E							
	7 —							14	M	$\square$	SS	3					
	8 9	-								R							
	9 – 10 –	4						14	М	M	SS	4					
	11 -	4							141	$\mathbf{A}$	00						
	12 -	-						_		R		_ ·					
	13 —							7	M	Å	SS	5					
	14 —	FILL, mostly silty sand, a l	ittle grave	l, dark		1				I							
	15 —	brown						19	M	M	SS	12					
	16 -	- SAND WITH SILT, a little	gravel no	ssible	<u>.</u>	· CO/	ARSE			ł		-					
	17 -	cobbles, fine to medium gra	ained, ligh	t brown,			LUVIUM	14	M	М	SS	5					
	18 – 19 –	moist, medium dense, lamit sand (SP-SM)	nations of	clayey						R							
	20 -	SAND WITH SILT AND O						14	М	$\mathbb{M}$	SS	4					
	21 -	cobbles, medium to fine gra- medium dense (SP-SM)	ained, brov	wn, moist,				17	141	A	00	•					
	22 -	- SILTY SAND, a little grav	el, possibl	e cobbles,						R	aa						
	23 -	fine to medium grained, da medium dense (SM)	rk brown,	moist,				25	M	Å	SS	4					
	24 -	CLAYEY SAND, a little g	ravel, poss	sible		TIL	Ľ			Į.	00		1.5				
	25 -	cobbles, brown, hard (SC)						50/.4	M	Å	SS	3	15				
13	26 - 27 -	- SILTY SAND, a little grav	el, possibl	e cobbles		CO.	ARSE	-		Ľ							
T 8/6,	27 -	fine grained, brown, moist,	medium o	lense (SM	)		LUVIUM	26	M	M	SS	7					
LL.GD	20 29 -			, firms		: TIL	T	-		Ł	•						
I+WE	30 -	CLAYEY SAND, a little g	ravel, gray	, 11 <b>rm</b>			،L	8	M	$\square$	SS	16	12				
1+CP	31 -									प्ति							
N AE	32 -	SILTY SAND, a little grav dense (SM/SC)	el, brown,	medium				21	M	$\mathbb{R}$	SS	16					
723.GI	33 -					·. :	· · · · · · · · · · · · · · · · · · ·		IVI	Ą	66	10					
01-05.	DE	EPTH: DRILLING METHOD			WAT	ER L	EVEL ME	ASURI	EMEN	VTS	L				NOTE	REFI	ER TO
VTES			DATE	TIME	SAMP DEP	LED	CASING DEPTH	CAT	VE-IN PTH		DRILLI JUID LI	NG	WAT LEV	ER		ATTAC	
CORP W-COORDINATES 01-05723.GPJ AET+CPT+WELL.GDT 8/6/13		50.2' 3.25" HSA	7/26/13	2:05	46.		44.5		5.3			<b>بابر ہ</b> ی	45.		SHEE	TS FO	R AN
00	53.1	1-69' NQ Core	7/26/13	2:03	46		44.5		5.3				45.		EXPLA	NATI	ON OF
N AN	BORI	NG DI ETED: 7/20/12	7/29/13	8:30	46		46.2		<u>6.2</u>	+			45.		FERMI	NOLO	GY ON
		PLETED: 7/30/13 SS/SGLG: TM Rig: 85C				-				+					TI	HIS LC	)G



#### AMERICAN ENGINEERING TESTING, INC.

AET JO	B NO: <b>01-05723</b>			LO	G OF	BOI	RING N	0.	<b>B1</b>	0 (p	. 2 0	f 2)	
PROJEC	T: Minnesota Multi-Purpose Stadium	n; M	linneapolis,	MN									
	Hennepin Co.	Coor	dinates: <u>N</u>	10	56219	9	]	E É	532992				
DEPTH IN	MATERIAL DESCRIPTION		GEOLOGY	N	мс	SĄ	MPLE YPE	REC		) & LAF			
FEET		1. PT-	<b>.</b>				YPE	IN.	WC	REC %	IN.	%	%-#200
35 - 36 -	SAND WITH SILT, fine grained, brown to light brown, moist, medium dense (SP-SM) <i>(continued)</i>		COARSE ALLUVIUM (continued)	18	М	A	SS	13					
37 — 38 —	SAND, fine grained, light brown, moist, dense to medium dense (SP)			35	M		SS	15					-
39 - 40 -				27	м		SS	15					
41 - 42 - 43 -	SILTY SAND WITH GRAVEL, apparent cobbles, brown, very dense (SM)		COARSE ALLUVIUM OR TILL	50/.2	М	TTXTT	SS	1					
44 - 45 -	GRAVELLY SAND WITH SILT, apparent cobbles, medium to fine grained, brown, moist, very dense (SP-SM)		COARSE ALLUVIUM	101	M	łł Z	SS	13					
46 - 47 - 48 -	GRAVEL WITH SILT AND SAND, apparent boulder around 50' to 52', brown, waterbearing,		COLLUVIUM OR COARSE ALLUVIUM	100/.2	w	PI PI	SS	2					
49 - 50 -	very dense (GP-GM)			100/.3	M/W	HANK	SS	2					
51 -					w	177	SS	1					
53 -	LIMESTONE, weathered, gray	Ŕ	PLATTEVILL	, <b>H</b> .00/.1		<pre>F</pre>				100	0		
54 -	LIMESTONE, gray and light brown to about 57.7' then light gray and gray, fossiliferous Weathering: Moderately to slightly weathered		MAGNOLIA MEMBER				NQ2	11		102	0	0	
56	Fracturing: Intensely to slightly fractured Stratification: Thickly bedded Hardness: Hard			~			NQ2	58		97	41	68	
58 - 59 - 60 -													
	LIMESTONE, gray and light gray Weathering: Slightly weathered Fracturing: Intensely to slightly fractured Stratification: Thickly bedded Hardness: Hard		PLATTEVILI FORMATION HIDDEN FALLS MEMBER				NQ2	48		80	25	42	
64 - 65 - 65 -	Rock compressive strength at 61:7'=14,125 psi Rock compressive strength at 65.3'=6,580 psi						100			100	Er	02	
67 - 67 - 67 - 68 - 68 - 68 - 68 - 68 -	LIMESTONE, light gray and gray, crinkly bedded Weathering: Slightly weathered Fracturing: Very to moderately fractured		PLATTEVILI FORMATION MIFFLIN MEMBER				NQ2	60		100	56	93	
4ET_CORP.W-COORDINATES 01-05/23.GPJ 4ET-CORP.W-COORDINATES 01-05/23.GPJ 4ET-CORP.W-COORDINATES 01-05/23.GPJ 4ET-CORP.M-COORDINATES 01-05/23.GPJ 4ET-COORDINATES 01-05/23.GPJ 4ET-CORP.M-COORDINATES 01-05/23.GPJ 4ET-CORP.M-COORD.M-COORD.M-COORDINATES 01-05/23.GPJ 4ET-CORP.M-COORDINATES 01-05/23.GPJ 4ET-CORP.M-COORD.M-CO	Stratification: very thinly bedded Hardness: Hard END OF BORING			-									
LET_COR													



AET JO	B NO: 01-05723						LO	GOF	BOF	RING N	0	B1	1 (	<b>).</b> 1 o	f 3)	
PROJEC	CT: Minnesota Mul	ti-Purpos	se Stadiu	m; N	linn	eapolis,	MN	447-178							<del></del>	
SURFA	CE ELEVATION: <b>847.8</b>	Н	lennepin C	o. Coo	rdina	tes: <u>N</u>	10	66950	)	]	<u>E</u>	53219				
DEPTH IN FEET	MATERIAL D	ESCRIPTIO	N		GE	EOLOGY	N	MC	SA	MPLE YPE	REC IN.	FIELD	& LA REC	BORAT		
FEET	7" Concrete			1	FILI	F			म			wc	%	RQD IN.	%	/0-#200
1 —	FILL, mostly silty sand wi	th gravel, p	ieces of				36	М	M	SS	3					
2 –	brick from 4.5' to 11', piec around 10' and 18'	es of bitum	inous						$\mathbb{H}$	00	10					
3 —	around to and to						37	М	Å	SS	12					
4 —									I							
5 —							59	М	Ж	SS	14					
6 -									ł							
7							113	М	М	SS	12					
9 -									सि							
10 -							77	м	M	SS	14					
11 -								191	$\mathbb{A}$	00	17					
12 -									뵍							
13 -							114	M	Д	SS	10					
14 -									I							
15 -				C			15	M	X	SS	12					
16 -									Ł							
17,-							30	M	$\square$	SS	14					
18 -									H	55						
19 -									붠							
20 - 21 -	]						68	M	Д	SS	12			E. A		
22 -	SAND WITH GRAVEL,	fine to med	lium			ARSE			I							
23 -	grained, brown, moist, me	dium dense	e (SP)			LUVIUM	69	M	Х	SS	3					
24 -	CLAYEY SAND WITH		brown		TIL	T			E							
25 -	hard (SC/SM)		biown,				58	М	$\square$	SS	6	9				
26 -	-								R							
27 -	SAND WITH SILT AND medium grained, brown, r	GRAVEL, noist. medi	, fine to		CO  AL	ARSE LUVIUM	26		K	SS	3					
28 -	(SP-SM)						20	M	Ą	66						
29 -	GRAVELLY SILTY SAN	ND, fine to	medium						벌							
30 -	grained, brown, moist, ver	ry dense (S	M)				66	М	Å	SS	6					
31 -									1				 			
DE	PTH: DRILLING METHOD			1		EVEL ME								NOTE:	REFE	ER TO
0-5	59.1' 4.25" HSA	DATE	TIME	SAMP DEP	LED TH	CASING DEPTH	CA DE	VE-IN PTH	FL	DRILLI JUID LI	NG EVEL	WAT LEVI	ER EL		ATTAC	
59.1-5		8/5/13	2:00	54	.8	54.5	5	4.1				53.			TS FOI	
59.7-9	94.1' NQ Core	8/5/13	2:20	54	.8	54.5	5	4.0				52.	U	EXPLA		
BORI COMI	NG PLETED: 8/5/13			<u> </u>			_							TERMII TH	NOLOG IIS LO	
DR: S	SG LG: TM Rig: 85C													11		<u> </u>

03/2011



AET JO	)B NO:	01-05723			LO	GOF	BOF	UNG N	0	<b>B</b> 1	1 (p	<b>. 2 o</b>	f 3)	
PROJE	CT:	Minnesota Multi-Purpose Stadiun	n; M	inneapolis, I	MN									
		Hennepin Co. C	Coordin	nates: <u>N</u>	16	695(	)	]	Е 😫	53219				
DEPTH		MATERIAL DESCRIPTION		GEOLOGY	N	MC	SĄ	MPLE YPE	REC IN.		& LAE			
IN FEET			1.1.7					IIL	ЩΝ,	WC	%	RQD IN.	%	%-#200
33 -		VELLY SILTY SAND, fine to medium			121	М	Х	SS	6					
34 -	(conti						B							
35 -	dense	D, fine grained, light brown, moist, medium (SP)		с. С. С. С	22	М	$\square$	SS	12					
36 -	-						सि							
37 -	-				21	М	M	SS	12					
38 -					21	IVI	Д	66	12					
39 -		O WITH SILT AND GRAVEL, fine to		-	100/.4	M	¥	SS	6					
40 -	mediu (SP-S	ım grained, brown, moist, very dense M)				IVI	R	33						
41 -		Y SAND, a little gravel, brown, very dense		TILL			묍							
42 -	(SM)				89	М	X	SS	12					
44 -	-						Ł							
45 -					85	M	$\square$	SS	18					
46 -							मि							
47 -		D WITH GRAVEL, fine grained, brown, , very dense (SP)		COARSE ALLUVIUM			R	~~						
48 -		, very dense (Sr)			107	M	Å	SS	14					
49 -	CLA	YEY SAND, a little gravel, brown, hard,		TILL			1							
50 -	- lenses	s and laminations of silty sand (SC)			49	M	Х	SS	12	9				
51 -		Y SAND WITH GRAVEL, brown, very					Ł							
52 -		s (SM/SC)		•	87		$\mathbb{N}$	SS	14					
53 - 54 -		۶					सि	•						
55 -		VEL WITH SILT AND SAND, brown, bearing, very dense (GM)			100/.3	W	K	SS	2					, ·
56 -	APP	ARENT LIMESTONE, severely weathered	Ē	OR COLLUVIUM			H							
57 -	drill t	lual soil) with hard thin layers (based on ool action)		APPARENT PLATTEVILL	E		ł		-					
58	4			FORMATION MAGNOLIA			ł							
59 ·	-			MEMBER			}							
- 60	LIM	ESTONE, light gray and gray, a little light	F	PLATTEVILL FORMATION										
	Weat	n, fossiliferous hering: Slightly weathered		MAGNOLIA				NQ2	53		100	51	97	
62 ·		uring: Moderately to slightly fractured, very fractured around 61.6'							55					
5 63	Strati	fication: Thickly bedded												
64 65	TIM	ness: Hard ESTONE, gray and light gray, a little light	F	PLATTEVILL										
66 APTES	brow			FORMATION HIDDEN	1									
	Fract	uring: Very to slightly fractured		FALLS MEMBER				NQ2	56		93	48	80	
Ö2 ★ 68	Strat	fication: Thickly bedded ness: Hard												
S7         S7           S8         59           S9         59           60         61           61         62           63         64           64         65           66         67           68         69           69         69		ESTONE, light gray and gray crinkly			-		₩							
AET														

03/2011



AET JO	B NO: <b>01-05723</b>			LC	GOF	BORING	NO	<b>B</b> 1	<b>1</b> (p	.30	f 3)	
PROJEC	CT: Minnesota Multi-Purpose Stadium	ı; M	linneapolis,	MN			-					
	Hennepin Co.	Coor	dinates: <u>N</u>	1	6695(	)	<u> </u>	53219				
DEPTH IN FEET	MATERIAL DESCRIPTION		GEOLOGY	N	MC	SAMPL TYPE	E REC IN.	~			TORY T	
FËÈT		1-1		-				WC	%	IN.	RQD。 %	%-#200
71 -	bedded Weathering: Slightly weathered		PLATTEVILL FORMATION	E								
	Fracturing: Very to slightly fractured		MIFFLIN MEMBER			NQ	2 58		97	46	77	
72 -	Stratification: Very thinly bedded Hardness: Hard		(continued)	_								
73												
74 75 -												
76 -												
70				r -		NQ	2 60		100	57	95	
78 -												
78 -												
80 -		$\square$		•								
81 -												
82 -						NQ	2 58		97	. 49	82	
83 -	LIMESTONE, light gray and gray		PLATTEVILL	Е								
84 -	Weathering: Fresh Fracturing: Slightly fractured Stratification: Thinly bedded		FORMATION PECATONICA				:					
85 -	Stratification: Thinly bedded		MEMBER GLENWOOD									
86 -	Hardness: Hard		FORMATION									
87 -	SHALE, gray to about 85.6' then light gray and brown sandy shale to about 86.8' then light					NQ	2 37		62			
88 -	brownish gray shaley sandstone		ST. PETER									
89 -	PROBABLY SANDSTONE (no recovery)		FORMATION									
90 -												
91 -												
92 -						NQ	2 0		0			
93 -												
94 -	END OF BORING					<u>    </u>						
21 07					,							
		,										
2.021										1		
80-T ID												
2 2												
						· .						



	AET JO	B NO:	01-05723						LO	G OF I	BOF	RING N	0	<b>B1</b>	3 (1	<b>).</b> 1 o	f 2)	]
	PROJEC	CT:	Minnesota Mul	ti-Purpos	se Stadiu	m; M	inne	eapolis, I	MN									
	SURFAC	CE ELE	VATION:836.2	Н	lennepin Co.	Coordir	nates:	<u>N</u>	10	60091			E :	53252				
	DEPTH IN FEET		MATERIAL I	DESCRIPTIO	N	,	GE	OLOGY	N	MC	SA	MPLE YPE	REC IN,			BORAT ROD		
	FEET	דווז	, mostly sapric peat w	ith sand da	urk brown	1	FILI							WC	%	RQD IN,	%	%-#200
	1	ruuu	, mostry sapric pear w	fui sailu, ua			1 11.71	-	11	М	X	SS	2	51				
	2 -	FILL	, mostly silty sand wit	th gravel, pi	eces of				14	М	Ħ	SS	6					
	3 —	plasti	ic and geotextile, dark	brown				-	14	IVI	$\mathbb{A}$	ەە	0					
	4 –		, mostly silty sand, a	little gravel,	dark						뉟							
	5 — 6 —	brow	n to brown						16	M	Д	SS	12					
	7 -										I							
	8 -		•						16	M	М	SS	12					
	9 —										I							
	10 —	*4/.5	+ 4/.5 + 50/.2						*	Μ	М	SS	6					
	11 —		1 1 1 1 1 4 1								H							
	12 -	FILL	, mostly sand, light bi	rown					7	M	M	SS	6					
	13 — 14 —	[					_				मि						-	
	15 -	FILL	, mostly silty sand, da	ark brown					10	M	M	SS	12					
	16 —								10	IVI	Д	00	12					
	17 —		, mixture of silty sand gravel, brown	d and clayey	/ sand, a						붬	~~~						
	18 -	Intic	graver, brown						18	M	Å	SS	14	12				
	19 —	FILI	., mostly silty sand wi	th gravel, b	rown						EL							
	20 -			1					31	M	Д	SS	6					
	21 - 22 -	1									I							
	23 -		., mixture of silty sand gravel, brown	d and clayey	y sand, a				16	M	X	SS	12	11				
	24 -		IDY LEAN CLAY, a	little gravel	oray a		TIL	Ι.			Ł							
2/13	25 -		brown, stiff, laminati						14	M	$\square$	SS	12	13				
DT 8/2	26 -					_		ADOD			रि							
ELL.GI	27 –	SIL'I   fine	TY SAND, a little gra grained, grayish brow	vel, apparen n, very den	se (SM)			ARSE LUVIUM	43	M	$\square$	ŚS	6					
W+T4	28 -										मि							
AET+C	29 - 30 -	SAN (CL)	IDY LEAN CLAY, a	little gravel	, gray, firn	n ////	TIL	L	6	М	$\mathbb{R}$	SS	16	21				
GPJ	31 -								0	М	Å	22	10					
-05723						WAT		EVEL MEA	SID	EMEN	] <u>}</u> ™				<u> </u>			
ES 01	DEI	PTH:	DRILLING METHOD	D A TTD	TRO				1			DRILLI UID LI	NG	WAT LEV		NOTE: THE A		
EDINAT		131/2'	3.25-4.25" HSA	DATE	TIME	SAMP DEP		CASING DEPTH		VE-IN PTH	FI	UID LI	EVEL	40.		SHEE		
COOF	43.5-6		NQ Core*	8/14/13 8/14/13	10:40 10:55	41. 41.		39.5 39.5	-	0.9 0.9				40. 39.		EXPLA		
CORP W-COORDINATES 01-05723.GPJ AET+CPT+WELL.GDT 8/22/13	44.1-4 BORIN	15.3' NG PLETED	*RDF exception 8/15/13	0/17/13	10.33	-71.		5715								rermi	NOLO	GY ON
AET_CC	DR: S		G: TM Rig: 85C													Tŀ	IIS LO	G

03/2011



AMERICAN ENGINEERING TESTING, INC.

# SUBSURFACE BORING LOG

AET JO	B NO: <b>01-05723</b>			LO	G OF I	BORI	ING N	0	<b>B</b> 1	<b>3</b> (p	. 2 o	f 2)	
PROJEC	CT: Minnesota Multi-Purpose Stadium	; M	inneapolis, I	MN									
	Hennepin Co. Co	ordir	nates: <u>N</u>	1	60091			E 🕄	53252				
DEPTH	MATERIAL DESCRIPTION		GEOLOGY	N	MC	SAN	MPLE YPE	REC				ORY T	
IN FEET			20 / D (D)				SS	11N. 2	WC	%	IN.	RQD. %	6-#200
33 -	GRAVELLY SILTY SAND, fine to medium grained, brown, moist, very dense (SM/)		COARSE ALLUVIUM	100/.4	M	Ð	55	2					
34 -	(continued)		OR COLLUVIUM			¥							
35 -			(continued)	50/.4	M	$\square$	SS	6					
36 -	**90/.5 + 100/.5 + 100/.3					R	~~						
37 -				**	M	Å	SS	10					
38					W	Ŧ							
39 -	CLAYEY SAND, a little gravel, apparent		TILL		<u> </u>	I							
40	boulder at 41', brown, hard (SC/SM)			65	W/M	X	SS	12	9				
41 -						सि							
42 -	WEATHERED LIMESTONE, gray and brown		PLATTEVILL		M	Ŧ	SS	1					
43 -	LINESTONE and heaven	P/2	FORMATION PLATTEVILL		M	4	SS	1		97	0	0	
44 -	LIMESTONE, gray and brown Weathering: Moderately weathered		FORMATION			$\sum$	NQ	7				_	
45 -	Fracturing: Very fractured Stratification: thinly bedded		CARIMONA MEMBER	A									
46 -	Hardness: Hard	日	PLATTEVILL FORMATION				NO	20		0.7	165	26	
47	No sample from 44.1' to 45.3'* LIMESTONE, light gray and a little light brown,		MAGNOLIA MEMBER				NQ	38		83	16.5	36	
40 -	fossiliferous												
50 -	Weathering: Slightly weathered Fracturing: Very to moderately fractured												
51 -	Stratification: Thickly bedded Hardness: Hard			\									
52 -							NQ	52		87	36	60	
53 -	-		-										
54 -			- PLATTEVILI				NQ	4		83	0	0	
55 -	weathering, Singhtly weathered		FORMATION	r1									
56 -	Fracturing: Very to slightly fractured Stratification: Thinly bedded		FALLS				210	40		07	27	(7	
2 57 -	Hardness: Hard		MEMBER				NQ	48		87	37	67	
58 -	-			_									
60 - 60 - 60 - 61 - 61 - 62 - 62 - 63 - 63 - 64 - 65 - 65 - 65 - 65 - 65 - 65 - 65	LIMESTONE, light gray and gray, crinkly	Б	PLATTEVILI FORMATION										
60 -	Weathering: Slightly weathered		MIFFLIN										
	Fracturing: Very to moderately fractured Stratification: Very thinly bedded						NQ	59		98	32	53	
62 -	Hardness: Hard												
	-												
CORP W-COURDINALES 01-05/23.	END OF BORING												
ALES	*Needed to redrill with tricone to straighten hole												
ICINO	which was inclined due to overlying boulders in order to continue coring.												
202-20 -													
CORP													
					1								



AET JO	OB NO: 01-05723						LO	G OF I	BOR	ING N	0	<b>B</b> 1	5 (j	<b>).</b> 1 o	f 2)	
PROJE						apolis, 1										
SURFA	CE ELEVATION:842.8	H	ennepin Co.	Coordii	nates:	<u>N</u>	16	66256	<u> </u>		E 5	53280				Tione
DEPTH IN	MATERIAL D	ESCRIPTION	V		GE	OLOGY	N	MC	SA T	MPLE YPE	REC IN.		REC	BORAT ROD		/6-#200
IN FEET					FILI				י וגו			WC	%	IN.	%	<b>%-</b> #200
1 -	5.5" Bituminous pavement FILL, mostly silty sand, a li	ttle gravel	dark		FILL		35	М	$\langle$	SS	14					
2 -	brown	-		/					$\left( \right)$							
3 -	FILL, mostly silty sand with	n gravel, br	own				41	М	Х	SS	6					
4 -	-								I						•	
. 5 -	-						30	M	Х	SS	3					
6 -			1 1						R							
7 -	FILL, mostly silty sand, a li	ttle gravel,	dark				28	М	$\square$	SS	14					
8 -							20									
9 -								M	H	SS	3					
10 -							6	M	$\mathbb{A}$	55	5					
12 -	SAND, medium to fine gra	ined, light b	prown to			ARSE			R							
13 -	brown, moist, loose (SP) (p	ossible fill	)			LUVIUM FILL	9	M	Х	SS	12					
14 -									रि							
15 -					•		8	M	$\square$	SS	12					
16 -	_						-		H							
17 -							171/.5	·M	K	SS	12					
18 -	<ul> <li>APPARENT COBBLE OR brown, moist, very dense (j</li> </ul>	BOULDE	R, light	i			1111.5		Ł							
19 -	CLAYEY SAND, al little				TIL	L			H							
20 -	stiff, laminations of silty sa						24	Μ	Х	SS	10	13				
21 -	<ul> <li>SILTY SAND, a little grav</li> </ul>	al haarma	modium						R							
22	dense (SM)	ei, brown, l	meatum		: -		23	M	$\square$	SS	12					
23					· · · ·				मि							
24	CLAYEY SAND, a little g	ravel, brow	n, very				10		K	SS	14	12				
26	201 (00)	s of sifty af					12	M	Å	22	14	13				
27									B							
28							21	M	М	SS	16	8				
29	GRAVELLY SILTY SAN	D brown	very dense						Ł							
30		, 010 WII,	tory delibe				56	M	M	SS	14					
31	-								R							
32							18	М	$\square$	SS	16	11				
33	CLAYEY SAND, brown,	very stiff, l	aminations		CO	ARSE	10	11/1		53	10					
	EPTH: DRILLING METHOD			WA	TER L	EVEL ME.	ASUR	EMEN	ITS					NOTE	REF	ER TO
		DATE	TIME	SAMP DEP	LED	CASING DEPTH	CA	VE-IN EPTH	FI	DRILLI JUID LI	NG EVEL	WAT LEV	ER	THE A	ATTA	CHED
2	<u>-49.1' 3.25" HSA</u>	8/12/13	3:00	49		49.0		<b>8.7</b>	+			47.		SHEE	TS FO	R AN
<b>49.1</b> -	-69.6' NQ Core	8/12/13	3:15	49		49.0		8.6				48.		EXPLA	NATI	ON OF
BOR	ING PLETED: <b>8/12/13</b>			-					-					FERMI	NOLO	GY ON
$\frac{COM}{2}$ DR:														TI	IIS LC	G



AET JO	B NO: 01-05723			LO	G OF	BOI	RING N	0	B1	<b>5</b> (p	o. 2 o	f 2)	
PROJEC	CT: Minnesota Multi-Purpose Stadiu	m; M	inneapolis, I	MN							-		
	Hennepin Co.	Coordii	nates: <u>N</u>	1	6625	6		<u>E </u>	53280	6			
DEPTH	MATERIAL DESCRIPTION		GEOLOGY	N	МС	SA	MPLE YPE	REC		& LAI			
ÎN FEET							YPE	IN.	WC	KEC %	IN.	%	%-#200
35 -	SAND WITH SILT, fine grained, brown, moist, medium dense (SP-SM)		ALLUVIUM / TILL	60	м	M	SS	12	14				
36 -	SANDY LEAN CLAY, a little gravel, gray, a		COARSE	00	11/1	A	33	12					
37 —	little brown, hard, laminations of silty sand (CL) GRAVEL WITH SAND, brown, moist, very	<u>ит</u>	ALLUVIUM			Į.							
38 -	dense (GP)			20	M	М	SS	10					
39 —	SAND WITH GRAVEL, fine to medium	1				I							
40	grained, brown, moist, medium dense (SP) GRAVELLY SAND WITH SILT, fine to	]		68	M	M	SS	8					
41 -	medium grained, brown, moist, very dense					R					-		
42 —	(SP-SM) SAND, a little gravel, fine to medium grained,	/		68	М	M	SS	16					
43 —	brown, moist, very dense (SP)			00		$\mathbb{A}$	00	10					
44 -	GRAVEL WITH SAND, brown, moist, very			133/.5	M	K	SS	6					
45	dense (GP)					B							
40 -	GRAVELLY SILTY SAND, pieces of shale,	Ē	COLLUVIUM			Ł	00						
48 -	brown and gray, moist, very dense (SM)			300/.5	M	Ŕ	SS	6					
49 -	-			200/.1	M	Ţ	SS	0		100	0	0	
50 -	APPARENT BOULDERS OR SLABS			2007.1		H	NQ	6		100	0	0	
51 -			PLATTEVILL	F			NQ	25		72	0	0	
52 -	LIMESTONE, gray and light brown, fossiliferous		FORMATION										
53 -	Weathering: Moderately to slightly weathered		MAGNOLIA MEMBER				NQ	22		87	19	75	
54 -	Fracturing: Intensely to slightly fractured Stratification: Thickly bedded		- -				ΝQ			07		15	-
55 -	Hardness: Hard		-										
56 -													
57 -							NQ	59		98	52	87	
58 -			-								-		
59 -													
60 - 61 -													
62 - 62 -	LIMESTONE, light gray and gray		PLATTEVILL				NQ	54		90	39.5	66	
- 63 -	Weathering: Slightly weathered		FORMATION HIDDEN				Ϋ́Υ			,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	57.5		
- 	Fracturing: Intensely to slightly fractured Stratification: Thickly bedded		FALLS MEMBER										
- 65 –	Hardness: Hard												
- 66 –			- - PLATTEVILI										
до <sub>:</sub> 67 –	LIMESTONE, light gray and gray, crinkly		FORMATION				NQ	60		100	56.5	94	
- 86 -	bedded Weathering: Slightly weathered		MIFFLIN MEMBER										
ъ 69 –	Fracturing: Very to moderately fractured												
DINAT	Stratification: Very thinly bedded Hardness: Hard												
AET_CORP W-COORDINATES 01-05723.GPJ AET-C0PT+WELL.GDT 8/22/13 67	END OF BORING	-											
- M-C													
CORI													
AET								<u> </u>					



AET JO	OB NO:	01-05723						LO	G OF I	BOF	RING N	Ю	<b>B</b> 1	6 (J	<b>).</b> 1 o	f 2)	
PROJE	ECT:	Minnesota Mult	ti-Purpos	se Stadiu	m; M	linn	eapolis,	MN									
SURFA	ACE ELI	EVATION: 843.0	H	lennepin Co	5. Cooi	dinat	tes: <u>N</u>	10	66477	1		E t	53291				
DEPTH IN FEET		MATERIAL D	ESCRIPTIO	N		GE	OLOGY	N	MC	SA T	MPLE YPE	REC IN.	FIELD WC		BORAT RQD IN.		
1 - 2 -	FIL	Bituminous pavement L, mostly silty sand, a l minous around 10', dar			,	FILI	 ب	57	М	P	SS	12					
3 -	-							22	М	X	SS	14					
4 - 5 -								11	М	X	SS	6					
6 - 7 -										E						-	
8 - 9 -								19	М	X R	SS	6					
10 - 11 -	FIL	L, mostly silty sand, a l cinders, dark brown	ittle grave	l and				40	М	Ø	SS	12					
11 - 12 - 13 -	- SAl	ND WITH SILT AND ( lium grained, brown, m -SM)	GRAVEL, loist, medi	fine to um dense			ARSE LUVIUM	24	М		SS	6	-				
14 - 15 - 16 -	- mea	ND WITH SILT, a little lium grained, brown, m -SM)	e gravel, fin loist, medi	ne to um dense		•		12	М		SS	6					
17 · 18 ·	SIL grai	TY SAND, a little grav ned, brown, moist, ver	vel, fine to y dense (Sl	medium M)				57	M		SS	4					
19 · 20 · 21 ·	bro den	TY SAND, a little grav, wn, a little gray, moist, se, laminations of claye	dense to me y sand aro	nedium ound 23',				42	M		SS	12					
22 - 23 -		s of sandy lean clay aro	und 29 <sup>°</sup> (81	M)				25	М		SS	14					
24 25	_							19	М		SS	14					
26 27 28 29 30 31 32 32 30 31 32 32 51- 52.8 51- 52.8 51- 52.8 51- 52.8 51- 52.8 51- 52.8 51- 52.8 51- 52.8 51- 51- 51- 51- 51- 51- 51- 51- 51- 51-	SIL den	TY SAND, a little grav se (SM/SC)	/el, brown,	medium		TIL	L	26	М		SS	12					
29 30 30 31	_					••••		30	М		SS	2					
GB 32	- CL me	AYEY SAND, a little § dium dense (SC/SM)	gravel, brov	wn,				28	М		SS	14	14				
o 5 DI	EPTH:	DRILLING METHOD			WAT	ER L	EVEL ME		EMEN	TS					NOTE:	REFE	ER TO
DINATES	0-51'	3.25" HSA	DATE	TIME	SAMP DEP	LED TH	CASING DEPTH		VE-IN PTH	I FL	ORILLI UID LI	NG EVEL	WAT LEV		THE A		
JNO 51-	-52.8'	RDF w/DM	7/31/13	11:00	47.	.6	47.0		7.1	-			46.	—— ,	SHEE		
S2.8-	-69.6'	NQ Core	7/31/13	12:10	47.		47.0		7.0	_			45.	<u> </u>	EXPLA		
BOR COM	ING IPLETE	D: 8/1/13	7/31/13	1:17	51.	.0	51.0	5	1.0	-			49.	4			GY ON
DR:	SG I	LG: TM Rig: 85C													11	IIS LO	U



AET JO	B NO: <b>01-05723</b>			LO	GOF	BOF	RING N	0	B1	6 (p	. 2 0	f 2)	]
PROJEC	T: Minnesota Multi-Purpose Stadium;	Mi	inneapolis, I	MN									
	Hennepin Co. Coc	ordin	ates: <u>N</u>	10	56477	7	]	E É	53291'				
DEPTH IN FEET	MATERIAL DESCRIPTION		GEOLOGY	N	МС	SĄ	MPLE YPE	REC IN.		& LAE			
FEET	GAND WITTLEN T. for any ind hours moist	11.	COARSE						WC	%	IN.	%	%-#200
34 —	medium dense (SP-SM)		ALLUVIUM			I							
35 —	GRAVEL WITH SAND, apparent cobbles and			117	М	М	SS	6					
36 —	very dense (GP)					रि							
37				152	м	$\square$	SS	3					
38 -				102		मि		_					
39				107		H	. aa	1					
40 - 41 -	· · · · · · · · · · · · · · · · · · ·			187	M	Д	SS	1					
42		₩ ₩ ₩				P							
43 -	GRAVELLY SAND WITH SILT, fine to			137	M	Х	SS	12					
44	medium grained, brown, moist, very dense					I							
45 -	(SP-SM)			107	V	M	SS	12					
46 -						रि							
47 -	GRAVELLY SILTY SAND, fine to medium grained, brown, wet, very dense (SM)			100/.6	W	Ä	SS	3					
48 -						ł							
49 50				100/.6	W	X	SS	3					
51 -				50/0	-	₹Į	SS	0					
52 -	-					K							
53 -	LIMESTONE, light brown and gray,		PLATTEVILL	Ē		Í	NO	1.5		6		40	
54 -	fossiliferous Weathering: Slightly weathered		FORMATION MAGNOLIA				NQ	15		69	9	42	
55 -	Fracturing: Intensely to moderately fractured		MEMBER										
56 -	Stratification: Thickly bedded Hardness: Hard	$\frac{1}{1}$	- -							07	40.5	-1	
57 -							NQ	58		97	42.5	71	
58 59			-										
60 -	LIMESTONE, light gray and light brownish	<b>–</b> ,	PLATTEVILL	Ē		₩							
61 -	gray Weathering: Slightly weathered		FORMATION HIDDEN										
62 -	Fracturing: Very to slightly fractured, intensely	-	FALLS MEMBER				NQ	55		92	38	63	
63 -	fractured joinst at 62' and 63' Stratification: Thickly bedded		-										
64 - C	Hardness: Hard		-										
65 -			-										
66 - 67 -	LIMESTONE, light gray and gray, crinkly		PLATTEVILL FORMATION				NQ	59		98	46	77	
Ú	bedded Weathering: Slightly weathered		MIFFLIN								10		
69 -	Fracturing: Very to slightly fractured												
68 - 69 -	Hardness: Hard	ΙΙ		1			•			1			
UKL OKL	END OF BORING												
						1			1				



AF	ET JO	B NO:	01-05723		,				LO	G OF I	BOF	RING N	Ю.	B1	.7 (p	<b>).</b> 1 o	f 2)	
	OJE		Minnesota Mult	i-Purpos	e Stadiu	m; M	inne	eapolis,	MN									
SU	RFA	CE ELE	VATION: 841.4	H	ennepin Co	o. Coor	dinat	tes: <u>N</u>	16	66618			<u>E </u> :	53289				
DEI	PTH N ET		MATERIAL DI	ESCRIPTION	N		GE	OLOGY	N	MC	SA T	MPLE YPE	REC IN.	FIELI WC	REC	BORAT	ORY 7 RQD	FESTS 1⁄6-#20(
	151	_ 6" Bi	tuminous pavement				FILL	4			R				%	IN.	<i>9</i> 0	
	1 -	FILL	, mostly silty sand, a l n to brown	ittle gravel	, dark				57	М	X	SS	12					
	2 — 3 —	010W	II to brown						29	М	X	SS	12					
	4 –	-									E							
	5 –								25	М	X	SS	12			. I.		
	6 -		.1 .1 .1 .1 .1								Ł							
	7 -	FILL	, mostly silty sand, br	own					27	М	$\square$	SS	1					
	8 9										सि							
	9 10 -								10	М	$\begin{bmatrix} 1 \\ 1 \end{bmatrix}$	SS	12					
	11 -	-									स्र							
	12 -	SAN	D, a little gravel, fine n, moist, medium den	to medium	grained, (SP)			ARSE LUVIUM	11	м	$\square$	SS	12					
	13 -		n, moist, meannin aon				•		11	IVI	A	55	12					
	14 -										붠							
	15 - 16 -								9	M	Å	SS	6					
	17 -	SAN	D WITH SILT AND	GRAVEL,	fine to		•	1			1							
	18 -	medi	um grained, brown, m	ioist, dense	e (SP-SM)				38	M	Д	SS	6					
	19 -	SILT	Y SAND, a little grav	vel, fine gra	ained,						I							
	20 -	brow	n, moist, dense, lense ey sand (SM)	s and lamin	nations of				47	Μ	Д	SS	6					
	21 - 22 -	7 1	YEY SAND, a little g	ravel, brov	wn, very		TIL	L	-		I							
	22 -	stiff	(SC/SM)		· ·				27	M	М	SS	12	8				
	24 -	SAN	D, fine grained, light	brown mo	ist (SP)			ARSE	-		I							
	25 -	4	YEY SAND, a little g					LUVIUM	60/.8	M	М	SS	12	11				
8/20/1:	26 -	boul	der below 25.3', brown								ß			11				
GDT	27 - 28 -		lty sand (SC/SM) ID WITH SILT AND	GRAVEL.	fine to	-		ARSE LUVIUM	112	M	X	SS	6					
+WELL	28 - 29 -	med	ium grained, gray to b e (SP-SM)								¥.							
+CPT+	30 -								70/.2	2 м	Ķ	SS	2					
J AET	31 -	_									1							
'23.GP	32 -	-					:		67	м		SS	12	1.1				
01-057	DE	PTH:	DRILLING METHOD			WAT	ER L	EVEL MEA		EMEN	TS		14			NOTE	REFI	ER TO
ATES			2 2511 115 4	DATE	TIME	SAMP DEP	LED TH	CASING DEPTH	CAV	VE-IN PTH	FI	DRILLI JUID LI	ING EVEL	WAT LEV		THE A		
		54.6' 69.3'	3.25" HSA NQ Core	8/2/13	8:22	46.		44.5		5.8				45.		SHEE	TS FO	R AN
N-CO(	-1.0-1	07.0		8/2/13	8:44	46.	0	49.5	4	5.4				44.	0	EXPLA		
CORP W-COORDINATES 01-05723.GPJ AET+CPT+WELL.GDT 8/20/13	30RI COM	NG PLETEL	): 8/2/13													TERMI		
	DR:		G: TM Rig: 85C													TI	IS LC	JG



AET JO	OB NO:	01-05723			ĹO	G OF	BOI	RING N	Ю	<b>B</b> 1	7 (p	. 2 0	f 2)	
PROJE	CT:	Minnesota Multi-Purpose Sta	dium; M	inneapolis,	MN							a		
		Hennepi	n Co. Coor	dinates: <u>N</u>	10	66618	8	]	E É	53289				
DEPTH		MATERIAL DESCRIPTION		GEOLOGY	N	МС	SA	MPLE YPE	REC		& LAI			
IN FEET		(	~					YPE	IN.	WC	REC %	IN.	кор. %	<b>%-</b> #200
34 -		D WITH SILT AND GRAVEL, fine to im grained, gray to brown, moist, very		COARSE ALLUVIUM			Ŕ							
35 -	dense	(SP-SM) <i>(continued)</i>		(continued)	195/.9	М	M	SS	6					
36 -	4				1951.9	141	Ą	20	0					
37 -	SANI	O WITH GRAVEL, fine to medium					Ł							
38 -	graine	ed, light brown, moist, very dense (SP)			92	Μ	M	SS	12					
39 -	SANI	D, fine grained, light brown, moist, ver	v				3							
40 -	dense		y 		57	М	М	SS	12					
41 -	_						R							
42 -	SAN	D WITH SILT AND GRAVEL, fine to um grained, brown, very dense (SP-SM	n li		100		M	SS	10					
43 -		in graned, brown, very dense (Sr. Sh.	<b>'</b>		102	М	Д	22	12					
44 -		VELLY SILTY SAND, medium to find	e ////	COARSE			E.							
45 -	grain	ed, brown, moist, very dense (SM)		ALLUVIUM OR	75	M	M	SS	12					
46 -		YEY SAND, a little gravel, dark brown		COLLUVIUM TILL			3							
47 -	hard				100/.1	M	X	SS	6	13				
40 -							Ł							
50 -	LIM	ESTONE, highly weathered, brown to g	gray	PLATTEVILL	<b>E</b> 00/.1	M	Ħ	SS	1					
51 -	_			FORMATION			Å							-
52 -	4						ß		E					
53 -	-	ä.			170/.3	W	X	SS	7					
54 -	-						Ħ							
. 55 -	LIMI	ESTONE, light brown and gray,		PLATTEVILL FORMATION	Е		Ш							
56 -		iferous hering: Slightly weathered		MAGNOLIA										
57 -	Fract	uring: Intensely to moderately fracture	ed 1	MEMBER				NQ2	50.5		90	33	59	
	Hard	fication: Thickly bedded ness: Hard								ъ.,				
59 -				PLATTEVILL	F									
60 -	Weat	ESTONE, gray and light gray hering: Slightly weathered		FORMATION										
	Fract	uring: Very to slightly fractured fication: Thickly bedded		HIDDEN FALLS				NQ2	57		95	31	52	i.
≨ 62 - 41d0+ 63 -		ness: Hard		MEMBER	-									
04 - 64 -				· · ·										
G5 -		ESTONE, light gray and gray crinkly		PLATTEVILL FORMATION										
AET CORP W-COORDINATES 01-05723.GPJ AET+CPT+WELL.GDT 8/20/13 4 - 61 - 62 - 63 - 64 - 62 - 63 - 64 - 62 - 64 - 65 - 66 - 62 - 64 - 65 - 66 - 67 - 68 - 69 - 66 - 67 - 68 - 69 - 68 - 69 - 69 - 69 - 69 - 69	- Weat	hering: Slightly weathered		MIFFLIN										
5 0 67 ·	Fract	uring: Very to slightly fractured ification: Very thinly bedded						NQ2	60		100	50	83	
68 NATE	- j buau	ness: Hard		4										
1010 69 -					ļ									
N-CC	END	OF BORING												
CORP														
AET											1.			

03/2011



AET JC	)B NO:	01-05723						LO	G OF I	BOR	UNG N	0	B2	7 (I	<b>).</b> 1 o	f 3)	
PROJE	CT:	Minnesota Mult	ti-Purpos	e Stadiu	m; M	inne	eapolis, I										
SURFA	CE ELEV	ATION: 852.8	Н	lennepin Co.	Coordi	nates:	<u>N</u>	10	66950	)		E É	532190				
DEPTH IN FEET		MATERIAL D	ESCRIPTION	N		GE	EOLOGY	N	MC	SA T	MPLE YPE	REC IN.	FIELD WC	0 & LA REC %	BORAT RQD IN.		rests %-#200
1 -		mostly silty sand, a li dark brown	ttle gravel,	trace		FILI	L	23	M	M	SS	6					
2 - 3 -	FILL,	mostly silty sand, a li	ttle gravel,	brown				46	М	$\square$	SS	12					
4 5		mostly silty sand with sand, brown	h gravel, a	little		-		22	М		SS	12					
6		mostly silty sand, a li	ittle gravel	and clayey		-		1		ł					-		
8 - 9 -	sand,	brown to dark brown						39	М	X R	SS	12					
10 -								57	М	Å	SS	12					
12 - 13 -					-			16	М		SS	12					
14 - 15 -	FILL, ash/ci	, mostly silty sand, a l inders, pieces of brick	ittle gravel , dark brov	and vn				13	M	Ĭ	SS	6					
16 - 17 - 18 -	– FILL,	, mostly silty sand, da	rk brown					7	М	Ĭ	SS	12					
19 - 20 -		YEY SAND, dark bro ible fill)	own, very st	tiff (SC)		ALI	XED LUVIUM FILL	19	M	FI X	SS	12	12				
21 - 22 - 23 -		D WITH SILT, fine g um dense (SP-SM)	rained, bro	wn, moist,			ARSE LUVIUM	20	М		SS	12					
24 -	_					•••••••		12	M	ł	SS	12					
26 - 27 - 27 -		VEL WITH SAND, t e (GP)	prown and g	gray, moist				35	M		SS	6					
28 - 29 - 29 -	SILT	Y SAND, a little grav	vel, brown,	medium			L		M		33						
25 - 25 - 26 - 26 - 2713 26 - 2713 28 - 2713 28 - 28 - 28 - 28 - 28 - 28 - 28 - 28 -	- dense	e, laminations of claye	ey sand (SN	A)				22	M	X F3	SS	12					
DE	EPTH:	DRILLING METHOD			WA1	FER L	EVEL MEA	ASURI	EMEN	ITS			L		NOTE	REFI	ER TO
0-1	59½'	3.25" HSA	DATE	TIME	SAMP DEP				VE-IN EPTH	FL	DRILLI UID LI	NG EVEL	WAT LEVI	ER EL	THE A		CHED
120 591/2'-	75.6'	NQ Core	8/8/13	10:25	58		57.0		8.3				57.				ON OF
	NG		8/8/13	10:45	58	.5	57.0	5	8.3				56.	,			GY ON
	NG PLETED:									+						HS LO	
DR:	SG LC	3: TM Rig: 85C								1							

03/2011



AET J	IOB N	NO: 01-05723			LO	GOF	BOF	RINGN	0.	<b>B</b> 2	27 (p	. 2 0	f 3)	
PROJ	ECT:	Minnesota Multi-Purpose Stadium	; M	inneapolis, I	MN									
		Hennepin Co. Co	oordii	nates: <u>N</u>	10	6695(	)		E É	53219				
DEPTH IN FEET	Ŧ	MATERIAL DESCRIPTION		GEOLOGY	N	мс	SA T	MPLE YPE	REC IN.	FIELI WC	D & LAI			FESTS 1⁄6-#200
33	S	ILTY SAND, a little gravel, brown, medium ense, laminations of clayey sand (SM)		TILL (continued)	22	M	М	SS	14		%	IIN.	. 70	
34		CLAYEY SAND, a little gravel, grayish brown,					ł	~~						
35 36	_	ery stiff (SC)			23	M/W	Å R	SS	12	14	,		N.	
37 38	(	SILTY SAND, a little gravel, brown, very dense SM)		•	92	M	X	SS .	14					
39				•	67/.5	M	E	SS	12					
40					511.5	141	FT FT	00	12					
42					105	М	M	SS	14		v			
44					1.7.4		E	60	14					-
45					154		ľ Ł	SS	14					
47		SAND, a little gravel, fine grained, light brown,		COARSE	100/(	-	177	SS	NR					
49 50	- 1	noist, very dense (SP)		ALLUVIUM	112	M	X	SS	12					
51	-	SILTY SAND WITH GRAVEL, brown, very		TILL	112	IVI		33	12					
52 53		dense (SM)			113	М		SS	14					
54 55		SILTY SAND WITH GRAVEL, medium to fine grained, brown, wet, very dense (SM)		COARSE ALLUVIUM	75	M/W	vV V	SS	14					
56 ≌ 57		SHALE, weathered, gray		DECORAH	,	Ţ								
57 57 58 58 58	3 –	,		FORMATION	196	W	X	SS	12					
59 59 60 4+	)	LIMESTONE, weathered, gray LIMESTONE, gray and light gray Weathering: Moderately to slightly weathered		FORMATION CARIMONA	E 200/.	w		SS NQ	1 9.5		79	5	42	
61 61 61 62	2 -	Fracturing: Very fractured Stratification: Thinly bedded		I MEMBER										
63 <u>-02723.GP</u>	, 1 –	Hardness: Very hard LIMESTONE, light gray and gray, a little light brown, fossiliferous, voids at about 63.6' and		FORMATION MAGNOLIA MEMBER				NQ	45		75	23	38	
VATES 01	5 –	64.0' Weathering: Slightly weathered Fracturing: Very to slightly fractured		ц ц									- 	
-COORDIN	7 –	Stratification: Thickly bedded Hardness: Hard		I					57		0.5	45	75	
<u>а</u> ,	8			I , I				NQ	57		95	45	/3	
μ			~					<u> </u>					01 1	1

03/2011

v



AET JC	B NO: <b>01-05723</b>			LO	G OF B	ORING N	0	B2	7 (p	. 3 0	f 3)	
PROJE	CT: Minnesota Multi-Purpose Stadiu	um; M	inneapolis, I									
	Hennepin Co	o. Coordii	nates: <u>N</u>	16	<u>6950</u>		E Ś	532190				
DEPTH IN FEET	MATERIAL DESCRIPTION	-	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.		& LAF			
FEET								WC	REC %	ĪÑ.	%	%-#200
71 72 73 74 75	LIMESTONE, gray and light gray Weathering: Slightly weathered Fracturing: Moderately fractured, intensely fractured from 71.4' to 72.0' Stratification: Thickly bedded Hardness: Moderately hard to hard LIMESTONE, gray and gray, crinkly bedded Weathering: Slightly weathered Fracturing: Very fractured Stratification: Very thinly bedded Hardness: Hard END OF BORING		PLATTEVILL FORMATION HIDDEN FALLS MEMBER PLATTEVILL *FORMATION MIFFLIN MEMBER	· 		NQ	55		92	42	70	
	END OF BORING											
AEL COMP W-COUNDINALES UI-00/20 GET AELTER INTELER												

#### TRIAXIAL COMPRESSION TEST RESULTS

#### **PROJECT:**

#### **AET JOB NO.:** 01-05723

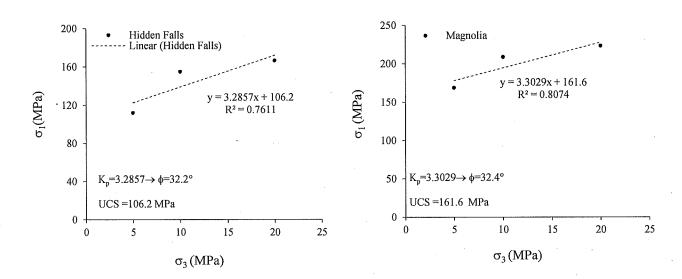
Minnesota Multi-Purpose Stadium Minneapolis, Minnesota

**DATE:** September 30, 2013

#### TEST METHOD: RESULTS:

General Conformance with ASTM: D7012

Specimen	Туре	Boring	Elevation	ρ	$\sigma_3$	$\sigma_1$
#		Number	(ft)	$(g/cm^3)$	(MPa)	(MPa)
1	Hidden Falls	B-11	65.5-68.5	2.40	20	138.0
2	Hidden Falls	B-11	65.5-68.5	2.53	- 10	155.0
3	Hidden Falls	B-11	65.5-68.5	2.41	20	166.6
4	Hidden Falls	B-11	65.5-68.5	2.43	5	112.0
5	Magnolia	B-11	60.2-62.2	2.58	5	168.8
6	Magnolia	B-11	60.2-62.2	2.62	20	223.0
7	Magnolia	B-11	60.2-62.2	2.60	20	203.9
8	Magnolia	B-11	60.2-62.2	2.63	10	208.6
9	Hidden Falls	B-11	65.5-68.5	2.47	0	42.2



AMERICAN ENGINEERING TESTING, INC.

#### SIEVE ANALYSIS TEST RESULTS

#### **PROJECT:**

#### **AET NO.:** 01-05723

Minnesota Multi-Purpose Stadium Minneapolis, Minnesota

#### **DATE:** February 19, 2013

**TEST METHOD:** General Conformance with ASTM: D6913, Method A

#### **RESULTS:**

Boring Number	A2	A3
Sample Depth	37'-38'	49.5'-50.7'
Dry Sample Weight (gms)	224.70	348.18
Sieve Size or Number	Percent Passing by Weight	
11⁄2"	100	100
1"	100	90
3/4"	86	78
5/8"	82	73
1/2"	80	67
3/8"	69	60
#4	51	48
#10	34	37
#20	23	25
#40	18	18
#100	12	11
#200	9.4	8.2

Note: The small sample size limits the accuracy of the test, and the sample may not necessarily be representative of the entire layer shown on the boring log.

01 LAB 043 (3/08)