Alt & Witzig Engineering, Inc.
6205 Schumacher Park Drive • West Chester, Ohio 45069
Phone: (513) 777-9890 • www.altwitzig.com

April 9, 2012

Northern Kentucky University, Inc.
726 Lucas Administrative Center
Highland Heights, Kentucky 41099
ATTN: Mr. Rob Knarr, P.E.

RE: Subsurface Investigation &
Foundation Recommendations
Northern Kentucky University
Intramural Fields Reconstruction
Highland Heights, Kentucky
Alt & Witzig File: 12CN0043

Gentlemen:

In accordance with your authorization, we have completed soil borings in the area of the proposed Intramural Fields Reconstruction. The purpose of this subsurface investigation was to determine the various soils profile components, the engineering characteristics of the subsurface materials and to provide information for use with improvements to be considered with the existing athletic fields.

Field Services

Field investigations to determine the engineering characteristics of the foundation materials included a reconnaissance of the project site and drilling two (2) borings. Standard penetration tests with soil samples retained in the standard split-spoon sampler were also performed during drilling operations. The apparent groundwater level at each boring location was also determined.

The soil borings were performed with a conventional drilling rig equipped with a rotary head. Conventional hollow-stem augers were used to advance the holes. Representative samples were obtained employing split-spoon sampling procedures in accordance with ASTM Procedure D-1586.

During the sampling procedure, standard penetration tests were performed at regular intervals to obtain the standard penetration value of the soil. The standard penetration value is defined as the number of blows of a 140-pound hammer, falling thirty (30) inches, required to advance the split-spoon sampler one (1) foot into the soil. The results of the standard penetration tests indicate the relative density and comparative consistency of the soils, and thereby provide a basis for estimating the relative strength and compressibility of the soil profile components.

Laboratory Testing

The types of soils encountered in the borings were visually classified and are described in detail on the boring logs. Representative samples of the soils encountered in the field were placed in sample jars and are now stored in our laboratory. Unless notified to the contrary, all samples will be disposed of after thirty (30) days.

Project Description

It is anticipated that the proposed construction will consist of the reconstruction of the turf field and the construction of a single-story support building. The support building will be a 2,000 s.f. lightly loaded structure. Proposed grading for the field has not been provided to us, however, it is anticipated that the turf field and structure will be constructed at or slightly above existing site grades.

Subsurface Discussions

The borings encountered fill consisting of reworked shale mixed with clay and some limestone fragments to a depth of eighteen (18) feet below grade. At this depth possible fill soils having a medium stiff consistency was encountered to the termination depth of our borings at twenty (20) feet below grade. The borings indicated dry conditions during and upon completion of operations and were backfilled prior to leaving the site. The fill appeared to have a medium stiff consistency with moisture contents ranging from 11.4% to 18.9%. This would seem to indicate that the fill was placed in a controlled manner, however, construction testing for this fill was not provided to us. If construction testing and monitoring of the fill was performed, please provide reports to AWEI for review and consideration of these recommendations.

Foundation Recommendations

Due to the presence of undocumented fills construction on these soils carries some risks. These include possible differential settlement of the structure which could cause cracking in the walls and floor slab and doors and windows which do not close properly. To minimize these risks a low bearing pressure and designing the structure for some future movement would be recommended. Also, using wood frame or a pre-engineered structure with concrete foundations would be strongly recommended. If these risks are not acceptable to the owner use of deep foundations or ground modification would be required. Further discussion of these foundation types can be presented to the owner if requested, however, it will be necessary to extend the holes to bedrock and perform a minimum of one rock core if this foundation type will be used. Conventional shallow foundations are presented in this report.

Shallow Spread Footings A net allowable soil bearing pressure of 1500 psf is recommended to design conventional spread footings and continuous wall footings. The above-recommended bearing pressure assumes the footings will be founded within the existing fill soils and that the owner is willing to accept that differential settlement could occur.

To reduce the impact differential settlement could have, we suggest the addition of reinforcement into the foundation. It is suggested that a minimum of four (4) no. 5 rebar be added to the foundation. Also, it is recommended that footings should not be less than thirty (30) inches wide for walls or thirty-six (36) inches square for columns. However, minimum-footing sizes and reinforcement requirements must also be in compliance with the actual building loads and all local

building code requirements. Thus, the foundation designer may decide that larger foundations or additional reinforcement will be required.

The above recommended bearing pressure is a "net allowable soil pressure". In utilizing the net allowable pressure for dimensioning footings, it is necessary to consider only those loads applied above the finished floor elevations.

In order to alleviate the effects of seasonal variation in moisture content on the behavior of the footings and eliminate the effects of frost action, all foundations in unheated areas should be founded a minimum of thirty (30) inches or greater below the final grade.

Floor Slab

The ground floor for the building can be constructed as a slab-on-grade supported by the existing soils. However, it should be noted that undocumented fill would remain in the floor slab area. It is recommended that a proofroll inspection be observed by a representative of AWEI. Areas that fail this proofroll must be stabilized using geogrid, geogrid/stone, or chemical stabilization, or undercut and replaced with suitable soils. The exact method of repair will depend on the soils encountered and should be determined by the soil engineer, owner, and contractor at the time of the proofroll. These measures will minimize risks to the owner. However, cosmetic failures (some cracking, etc…) could occur and additional future maintenance will most likely be required. If the risk of cosmetic failures or increased maintenance is not acceptable it is recommended that the floor slab be constructed as a structural slab or the fills be removed from the building area.

After the building area has been prepared to the proper elevation, a four (4) to six (6) inch compacted granular fill should be placed immediately beneath the floor slab. This compacted granular fill will provide a uniform surface for construction of the slab and minimize capillary rise of groundwater from the subgrade into the slab.

Seismic Requirements

Seismic design consideration based on the information obtained in our subsurface investigation and the Kentucky Building Code guidelines indicates that the site will be classified with a site class C.

Turf Field Reconstruction

Conditions in our borings were fairly consistent. As mentioned, fill was encountered across the area. In addition eight (8) to nine (9) inches of topsoil was noted with our borings. No groundwater was encountered with our investigation.

With respect to construction, provided that the surface is not saturated at the start of construction and light tracked equipment is used to strip the topsoil, the subgrade should be sufficient to place the new field. However, due to instability caused by the existing fills stabilization by means of either undercutting and replacing or installation of a geogrid and stone section to bridge the material could

be required. The actual method to be used should be determined in the field based on the extent of any soft or yielding areas encountered during the proofroll evaluation of the subgrade prior to placement of any new fill or the turf.

For the field, the proofroll phase should be performed after the surface has been stripped. A moderately loaded dump truck (minimum GVW of 35,000-lbs) should be used to evaluate the subgrade condition before any new fill or the turf is placed. Manufacturer's specifications should be followed for construction of the field to support the turf but we suggest at least 5-inches of sand and gravel below the turf to allow for grading and drainage. The fields should include positive drainage away from playing surface (typically no less than 1%). We are not aware if the field has a system of underdrains to enhance drainage across the fields. Underdrains would improve drainage across the field, especially due to the very flat nature of the grading required to construct the playing surface. We suggest underdrains be considered if there are none present.

If there are questions concerning these matters, please feel free to contact our office.

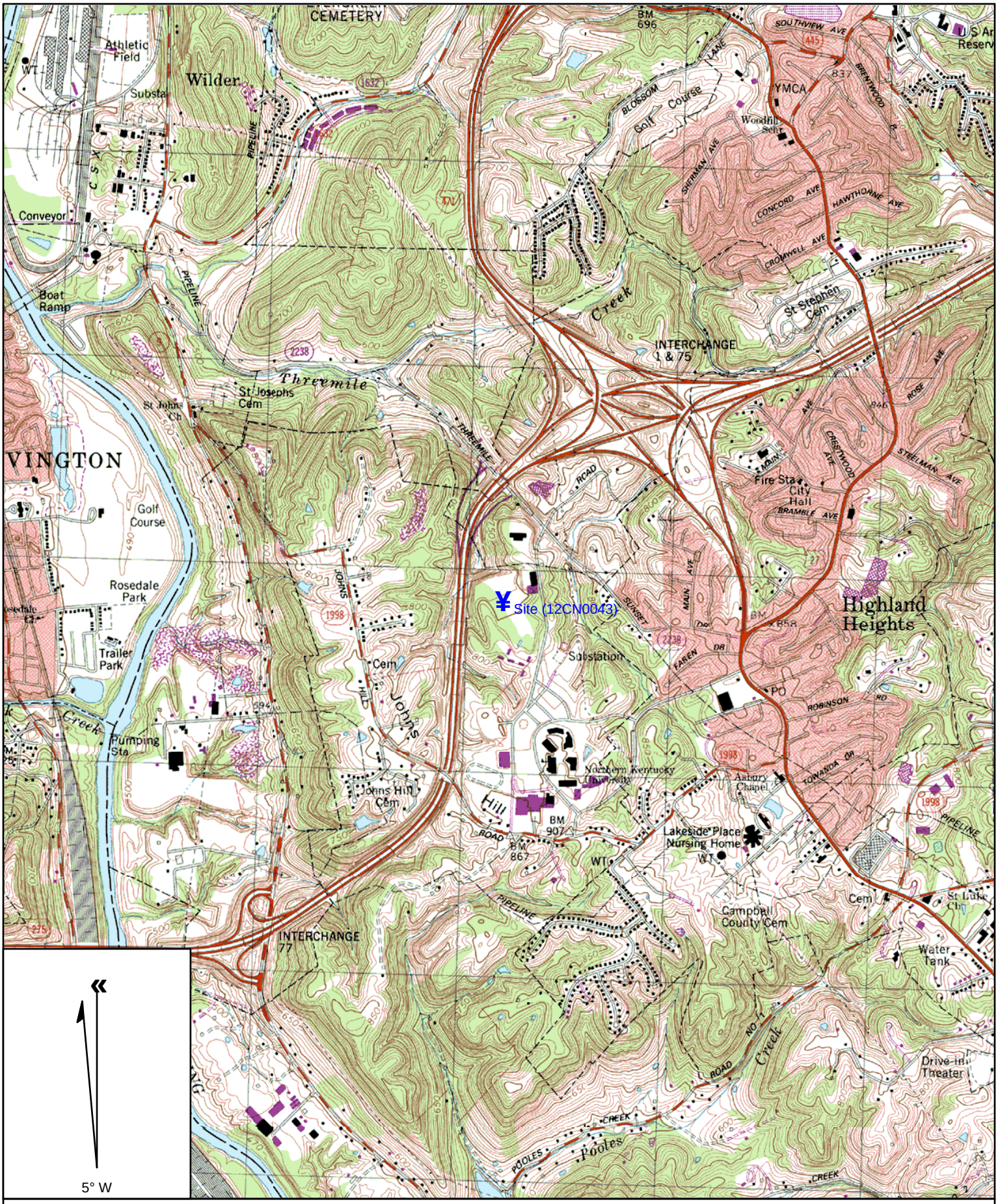
Respectfully Submitted,

ALT & WITZIG ENGINEERING, INC.

Robert Smith, P.E.
Project Engineer

Patrick A. Knoll, P.E.

APPENDIX

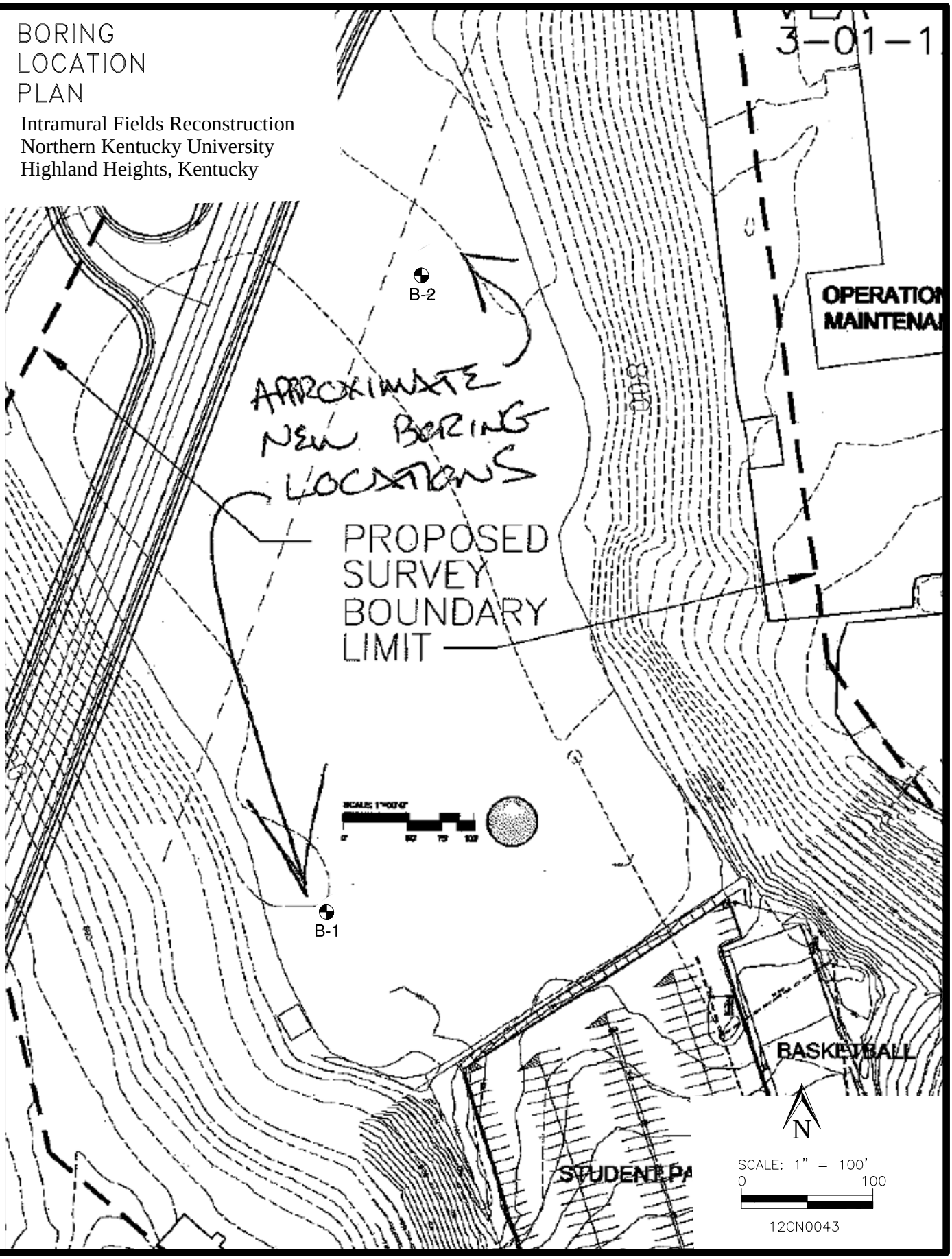


Name: NEWPORT
Date: 3/30/2012
Scale: 1 inch equals 2000 feet

Location: 039° 02' 17.0" N 084° 28' 04.5" W
Caption: Site Location Map 12CN0043
NKU Intramural Fields Reconstruction
Highland Heights, Kentucky

BORING LOCATION PLAN

Intramural Fields Reconstruction
Northern Kentucky University
Highland Heights, Kentucky



RECORD OF SUBSURFACE EXPLORATION

Alt & Witzig Engineering, Inc.

CLIENT **Northern Kentucky University** BORING # **B-1**

PROJECT NAME **Intramural Fields Re-Construction** Alt & Witzig File No. **12CN0043**

PROJECT LOCATION **Highland Hieghts, KY**

DRILLING and SAMPLING INFORMATION

Date Started **3/29/12** Hammer Wt. **140** lbs.

Date Completed **3/29/12** Hammer Drop **30** in.

Boring Method **HSA** Spoon Sampler OD **2** in.

Driller **J.Roark** Rig Type **D-50 Truck**

STRATA ELEV. / SOIL CLASSIFICATION / SURFACE ELEVATION	Strata Depth	Depth Scale	Sample No.	Sample Type	Sampler Graphics / Recovery Graphics	Ground Water	TEST DATA: Standard Penetration Test, N - blows/foot	TEST DATA: Qu-tsf Unconfined Compressive Strength	TEST DATA: PP-tsf Pocket Penetrometer	TEST DATA: Moisture Content % / *Unit Weight (pcf)*	Remarks
TOPSOIL	0.8										
Brown and Gray CLAY with Shale and Some Limestone Fragments (Fill)			1	SS			19		3.0	14.9	
		5	2	SS			8		2.0	16.9	
	7.0		3	SS			36		4.5	11.4	
Gray Shale and Brown CLAY Some Limestone Fragments (Fill)		10	4	SS			14		2.5	15.2	
		15	5	SS			30		4.0	14.2	
	18.0										
Gray Highly Weathered Shale (Possible Fill)		20	6	SS			19		4.5		
	21.0										
End of Boring at 21 feet											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Groundwater
○ During Drilling *Dry ft.*
▽ At Completion *Dry ft.*

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
MD - Mud Drilling

RECORD OF SUBSURFACE EXPLORATION

Alt & Witzig Engineering, Inc.

CLIENT **Northern Kentucky University** BORING # **B-2**

PROJECT NAME **Intramural Fields Re-Construction** Alt & Witzig File No. **12CN0043**

PROJECT LOCATION **Highland Hieghts, KY**

DRILLING and SAMPLING INFORMATION

Date Started **3/29/12** Hammer Wt. **140** lbs.

Date Completed **3/29/12** Hammer Drop **30** in.

Boring Method **HSA** Spoon Sampler OD **2** in.

Driller **J.Roark** Rig Type **D-50 Truck**

STRATA ELEV. / SOIL CLASSIFICATION / SURFACE ELEVATION	Strata Depth	Depth Scale	Sample No.	Sample Type	Sampler Graphics / Recovery Graphics	Ground Water	TEST DATA: Standard Penetration Test, N - blows/foot	TEST DATA: Qu-tsf Unconfined Compressive Strength	TEST DATA: PP-tsf Pocket Penetrometer	TEST DATA: Moisture Content % / *Unit Weight (pcf)*	Remarks
TOPSOIL	0.9										
			1	SS			26		4.3	15.2	LL=37% PL=22% PI=15%
		5	2	SS			15		4.5	12.6	
			3	SS			11		3.0	18.9	
Brown and Gray CLAY with Shale and Limestone Fragments (Fill)		10	4	SS			12		3.0	15.7	
		15	5	SS			37		3.5	14.3	
	18.0										
Brownish Gray CLAY and Limestone (Possible Natural)		20	6	SS			50/3		3.5	11.5	
	21.0										
End of Boring at 21 feet											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Groundwater
○ During Drilling *Dry ft.*
▽ At Completion *Dry ft.*

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
MD - Mud Drilling

GENERAL NOTES

SAMPLE IDENTIFICATION

The Unified Soil Classification System is used to identify the soil unless otherwise noted.

SOIL PROPERTY SYMBOLS

N: Standard "N" penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2 inch O.D. split-spoon.

Qu: Unconfined compressive strength, TSF

Qp: Penetrometer value, unconfined compressive strength, TSF

Mc: Water content, %

LL: Liquid limit, %

PL: Plastic limit, %

Dd: Natural dry density, PCF

▼ : Apparent groundwater level at time noted after completion

DRILLING AND SAMPLING SYMBOLS

SS: Split-spoon - 1 3/8" I.D., 2" O.D., except where noted
ST: Shelby tube - 3" O.D., except where noted
AU: Auger sample
DB: Diamond bit
CB: Carbide bit
WS: Washed sample

RELATIVE DENSITY AND CONSISTENCY CLASSIFICATION

TERM (NON-COHESIVE SOILS)	BLOWS PER FOOT
Very loose	0 - 4
Loose	5 - 10
Firm	11 - 30
Dense	31 - 50
Very Dense	Over 50

TERM (COHESIVE SOILS)	Qu (TSF)
Very soft	0 - 0.25
Soft	0.25 - 0.50
Medium	0.50 - 1.00
Stiff	1.00 - 2.00
Very Stiff	2.00 - 4.00
Hard	4.00+

PARTICLE SIZE

Boulders	8 in.(+)	Coarse Sand	5 mm-0.6 mm	Silt	0.075 mm - 0.005 mm
Cobbles	8 in. - 3 in.	Medium Sand	0.6mm-0.2 mm	Clay	0.005mm(-)
Gravel	3 in. - 5 mm	Fine Sand	0.2mm-0.075 mm		