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**GEOTECHNICAL EXPLORATION  
AND ENGINEERING REVIEW**

**Building 28 West Stair Tower Addition  
St. Cloud VA Medical Center  
St. Cloud, Minnesota**

NTI Project No. 11.50742.100

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## **NORTHERN TECHNOLOGIES, INC.**

6588 141st Avenue NW, Ramsey, MN 55303 763-433-9175 763-323-4739 Fax

December 21, 2011

Image Group, Inc.  
403 Center Avenue, Suite 300  
Moorhead, Minnesota 56560

Attn: Mr. Richard A. Moorhead

Subject: Geotechnical Exploration and Engineering Review  
Building 28 West Stair Tower Addition  
St. Cloud VA Medical Center  
St. Cloud, Minnesota  
NTI Project No. 11.50742.100

Dear Mr. Moorhead

In accordance to your request and subsequent November 21, 2011 authorization, Northern Technologies, Inc. (NTI) conducted a Geotechnical Exploration for the above referenced project. Our services included drilling two exploratory borings and preparation of an engineering report with recommendations developed from our geotechnical services. Our work was performed in general accordance with our proposal of November 14, 2011.

Soil samples obtained at the site will be held for 60 days at which time they will be discarded. Please advise us in writing if you wish to have us retain them for a longer period.

We appreciate the opportunity to have been of service on this project. If there are any questions regarding our review and recommendations, please contact us at (763) 433-9175.

Northern Technologies, Inc.

Anthony Francis, P.E.  
Project Engineer

Stephen Johnston, P.E.  
Principal Engineer



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St. Cloud, Minnesota

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## GEOTECHNICAL EXPLORATION AND ENGINEERING REVIEW

Building 28 West Stair Tower Addition  
St. Cloud VA Medical Center  
St. Cloud, Minnesota

NTI Project No. 11.50742.100

### 1.0. EXECUTIVE SUMMARY

*We briefly summarize below our geotechnical recommendations for the proposed project. The summary must be read in complete context with our report.*

The proposed Building 28 West Stair Tower Addition addition may be supported on conventional perimeter and interior strip and spread column footings bearing on competent, non-organic natural soil or engineered fill, as recommended within our report.

- Building linear strip footings and interior column footings may be proportioned using a maximum net allowable soil bearing pressure of 4500 pounds per square foot as shown in Table 1.
- Our exploration indicates fill extends to approximately 6.5 feet below existing grade. Similar but variable depth of topsoil and fill should be anticipated across the project site. We recommend additional evaluation during site stripping and excavation to confirm removal of unsuitable soils from below project construction.
- ***Our drill crew observed free ground water at approximately 20 feet below grade during or at completion of the boring, corresponding to elevation 78.6 feet, assumed datum.*** We do not anticipate groundwater at this site will affect the proposed Building Stair Tower Addition. We direct your attention to other report sections and Appendix B concerning ground water issues and subsurface drainage.

### 2.0. INTRODUCTION

#### 2.1. Site / Project Description

It is proposed to construct a stair tower addition on the north side of the west wing to Building 28. The addition will be founded on perimeter strip footings, interior strip footings and interior column footings. The addition will extend below grade as footings will be based at the same elevation as the existing building.



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## **2.2. Scope of Services**

The purpose of this report is to present a summary of our geotechnical exploration and provide generalized opinions and recommendations regarding the soil conditions and design parameters for founding of the project. Our scope of services was limited to the following:

1. Explore the project subsurface by means of one (1) standard penetration borings extending to a maximum depth of 20 feet, and conduct an engineering evaluation of the soil samples to characterize the engineering and index properties of the soils.
2. Prepare a report presenting the findings from our field exploration and provide engineering recommendations for foundation type, footing depths, allowable soil bearing capacity, estimated settlements, floor slab support, excavation, engineered fill, backfill, compaction and potential construction difficulties related to excavation, backfilling and drainage.

## **3.0 EXPLORATION PROGRAM RESULTS**

### **3.1 Exploration Scope**

NTI performed the subsurface exploration on December 7, 2011. The boring was drilled at the approximate location shown on the site plan in Appendix C. NTI located the boring relative to existing site features, and determined the elevations of the borings relative to temporary benchmarks (TBM), the top of the floor slab of Building 28, which was assigned elevation 100.0 feet, assumed datum.

### **3.2 Surface Conditions**

The area of the proposed Building 28 West Stair Tower Addition is a landscaped area mostly covered with grass. We assume this area does not include demolition material from prior occupancy or from other off site locations.



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### 3.3 Subsurface Conditions

Please refer to the boring logs in Appendix C for detailed soil descriptions and depths of stratum. The drill crew backfilled the boreholes with auger cuttings to comply with Minnesota Department of Health regulations. Minor settlement of the boreholes will occur. The Owner is responsible for final closure of the boreholes. The general geologic origin of retained soil samples is listed on the boring logs. The upper portion of the borings was sampled using auger flights and is approximate.

Our boring penetrated approximately 1 foot of topsoil at the surface. Fill occurs to approximately 6.5 feet below grade. The fill consist of non-organic silty sand and sand with silt with some gravel. Standard Penetration N-Values in the fill ranged from 15 to 22 blows per foot, indicating that it was compacted during placement.

Below the fill, we encountered native Coarse Alluvium (CA) soils to the termination depth of 20 feet. The CA soil consists of sand with silt with varying amounts of gravel and is medium dense to very dense in relative density with Standard Penetration N-Values of 15 to over 50. Large rocks or cobbles were encountered at approximately 7 feet below grade.

Additional comment on the evaluation of recovered soil samples is presented in Appendix A.

### 3.4 Ground Water Conditions

The drill crew observed the borings for ground water and noted the cave-in depth at the completion of drilling activities. These observations and measurements are noted on the boring logs.

***Our drill crew observed free ground water at approximately 20.5 feet below grade at completion of the boring, corresponding to elevation 78.6 feet, assumed datum.*** While groundwater is not anticipated to affect the proposed construction, we direct your attention to other report sections and Appendix B concerning ground water issues and subsurface drainage.

The cave-in depth of the boring was recorded at approximately 4 feet below existing grade.

### 3.5 Laboratory Test Program

The analysis and recommendations in this report are based upon our visual soil classification, our interpretation of the standard penetration resistance determined while sampling the soils, and experience with similar soils. The soil conditions are shown on the boring log in Appendix C.

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## **4.0 ENGINEERING REVIEW AND RECOMMENDATIONS**

The following recommendations are based on our present knowledge of the project. We ask that you or your design team notify us immediately if significant changes are made to project size, location or design as we would need to review our current recommendations and provide modified or different recommendations with respect to such change(s).

### **4.1 Project Scope**

The stair tower addition will be founded on cast-in-place concrete footings. We understand that the low floor slab of the addition will be approximately 5 to 7 feet below existing grade, matching the existing Building 28 lower level. Structural loads have not been provided, but we estimate perimeter wall loads will be approximately 2 to 4 kips per lineal foot, with interior column loads, if any, of approximately 50 to 75 kips.

Our assessment of the project soils, and opinions and recommendations presented within this report are based directly on these estimated structural loads being applied to the existing site soils.

### **4.2 Site Preparation**

The proposed Stair Tower Addition may be founded on the existing fill or native soils, provided construction complies with the recommendations in this report. The topsoil and any other unsuitable soils should be stripped and removed from the site. Our boring indicates that topsoil extends to approximately 1 foot below existing grade. The soils should then be excavated to the proposed basement subfloor elevation to expose the underlying sand. Care should be taken so as to not undermine the existing adjacent footings.

The Geotechnical Engineer of Record or their designated representative should observe and test the project excavation to determine removal of unsuitable material(s) and adequate bearing support of exposed soils. Such observations should occur prior to the placement of engineered fill, or construction of footings and floor slabs.

In the event that excavations extend below footing level, they should be oversized. The minimum excavation oversize should extend per the requirements outlined within the diagram in Appendix B.

If fill remains at the base of excavation, it should be surface compacted to at least 98 percent of the Standard Proctor maximum dry density (ASTM D698)



*The non-organic sand soils on-site free of large rocks and boulders larger than 3 inches in diameter may be used as engineered fill for preparation of the building pad when such soils are conditioned and placed as presented within this report.* Import fill, if necessary, within the perimeter of the building addition should consist of sand with 100% passing the 1 ½ inch sieve and no more than 10% passing the No. 200 sieve. Engineered fill for site corrective earthwork and for support of project footings should be tempered for moisture content and placed and compacted to no less than 98 percent of the Standard Proctor maximum dry density, ASTM D698.

#### 4.3 Foundations

The following bearing recommendations are based on our understanding of the project. NTI should be notified of any changes made to the project size, location, design, or site grades so we can assess how such changes impact our recommendations. We assume foundation elements will impose maximum vertical loads as previously noted within this report.

The building addition should be supported on its own foundation system, independent of the existing footings. The proposed Building 28 West Stair Tower Addition may be supported on conventional perimeter and interior footings bearing on competent, non-organic sand, the existing fill, or engineered sand fill, providing such construction complies with the criteria established within this report. Footings may be designed for a maximum net allowable soil bearing pressure of up to 4500 psf as summarized within Table 1. However, continuous strip footings under bearing walls should be at least 6 inches wider on either side than the walls they support.

**Table 1: Recommended Maximum Net Allowable Soil Bearing Pressure <sup>1</sup>**

<i>Location</i>	<i>Criteria</i>
<b><i>Perimeter Strip Footings, Perimeter Columns:</i></b> Perimeter strip footings and perimeter column footing supported on natural soils or engineered fill below depth of frost penetration, and at an elevation as referenced within this report.	Maximum of 4500 psf
<b><i>Interior Strip Footings:</i></b> Interior strip footings supported on natural, competent soils and/or engineered fill at a depth which provides no less than 6 inches of clearance between the top of footing and underside of floor slab (for sand cushion).	Maximum of 4500 psf
<b><i>Interior Column Footings:</i></b> Supported on natural, competent soils and/or engineered fill at a depth which provides no less than 6 inches of clearance between the top of footing and underside of floor slab (for sand cushion).	Maximum of 4500 psf
1. Maximum net allowable soil bearing pressure recommendations predicated on footing design and construction complying with recommendations presented within this report. To minimize local failure of supporting soils, it is our opinion footing construction should comply with the International Building Code (IBC) requirements.	





The perimeter strip footings should be based at the same depth as the existing adjacent footings, or at least at a depth of 3.5 feet below outside finished grade for frost protection. Interior footings should be based a least 1.5 feet below design floor elevation. Footings for appurtenant unheated structures, such as an entry canopy, should be based at least 5 feet below grade.

Basement walls will experience lateral loading from retained soils. This lateral loading may be modeled as an equivalent fluid pressure applied to the foundation wall. We recommend using the Table 2 "at-rest" equivalent fluid pressure for design of below grade foundation walls.

**Table 2: Estimate of Equivalent Fluid Weight of Retained Soils**

Type of Retained Soil		"At Rest" Condition (pcf)	"Active" Condition (pcf)
Unit Weight of Equivalent Fluid *	Sand – SP-SM	48	31
* The recommendations for equivalent fluid weight are based solely on assumed conditions with respect to sloping ground and/or surcharge loads. Design professional is cautioned that actual loads imparted to the structure will be dependent on soil conditions, site geometric considerations and surcharge loads imparted to the structure.			

#### **4.4 Bearing Factor of Safety and Estimate of Footing Settlement**

The recommended soil bearing pressure provides a factor of safety greater than 3 against localized bearing failure when construction complies with report criteria and recommendations.

We estimate that footings loaded per report recommendations may experience long term, total settlement of approximately 1/2 to 1 inch. Differential settlement will be on the order of 25 to 50 percent of total settlement. Generally, the greatest differential settlement occurs between lightly loaded and heavily loaded footings, particularly if heavily loaded footings are located adjacent to lightly loaded strip footings. Most of the settlement will occur on first loading, as the structure is erected.

We recommend that complete, through, vertical control joints be incorporated where the addition joins the existing structure, capable of tolerating up to 3/16 inch of differential settlement.

Total and differential movement of footings and floor slabs could be significantly greater than the above estimates if construction is supported on frozen soils, the moisture content of the bearing soils significantly changes from insitu conditions, or snow or ice lenses are allowed to develop in the foundation subsoils.



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#### 4.5 Slab-on-Grade Floor

The final 6 inches of fill below the concrete floor slab should consist of a "pit run" or processed sand (sand cushion) with 100 percent material passing the 1 inch Sieve and no more than 5 percent passing the No. 200 U.S. Sieve. The moisture content of the sand cushion should be tempered to the same limiting values as for the engineered granular fill.

Design of the floor slab may be based on an estimated modulus of subgrade reaction ( $k$ ) of 275 lbs/in<sup>3</sup>. We generally recommend that floor slab be internally reinforced. However the need for reinforcement should be determined by the Structural Engineer of Record.

If the interior floor slab is covered with impervious or near impervious surfacing such as, but not limited to, paint, hardening agent, vinyl tile, ceramic tile, or wood flooring, a vapor barrier should be installed. The vapor barrier should consist of a synthetic membrane placed either below the sand cushion or at the underside of the concrete floor. The location of the membrane is contentious and has both positive and negative aspects on the long term performance of the floor system.

The floor slab should be isolated from the walls and columns. Such isolation should include installation of a ½ inch thick expansion joint between the floor and walls, and/or columns to minimize binding between the construction materials. Such construction should also include application of a compatible sealant within the expansion joint after curing of the floor slab, to reduce moisture penetration through the joint. As a minimum, we recommend that a bond breaker be incorporated between the floor slab and foundation walls to reduce binding between components.

#### 4.6 Exterior Backfill & Subsurface Drainage

Exterior fill placement around the foundation and associated final grading adjacent to the building can significantly impact the performance of a structure. ***We understand the project will include construction with foundation walls which retain soils.***

A perimeter subsurface drainage system should be installed at footing level around the basement areas. As a general guideline, such drainage should consist of a geotextile and coarse drainage rock encased slotted or perforated pipe extending to sump basin(s).

The below grade basement walls should be appropriately waterproofed prior to backfilling. We recommend that exterior backfill for the basement foundation walls should consist of the on-site clean sand or "pit run" granular soil with a fine content less than 5 percent passing the No. 200 US Sieve (i.e. fill extending to within 1.5 feet of final grade).

The final one foot of exterior backfill within landscaped areas should consist of topsoil while exterior backfill below sidewalks and pavements should consist of a free draining aggregate base.



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Placement of exterior backfill against basement wall **should not occur** until lateral restraint of the foundation walls has been installed to the satisfaction of the structural engineer. The backfill soils should be tempered for moisture content, placed in appropriate individual lifts and be compacted as per the criteria recommended in Appendix B. Final grading of the exterior backfill should produce a ground profile that drains positively away from the walls.

#### **4.7 Surface Drainage**

Positive site drainage should be maintained during and after construction. Exterior grades should slope away from the building on at least a 6% grade within 10 feet of the building. Water should not be allowed to pond on the site soils during construction.

Roof runoff should be diverted away from the building by a system of interior roof and scupper drains, or rain gutters, down spouts and splash pads. It is our opinion interior roof drains plumbed directly to the storm water piping system provide the most favorable method of conveying drainage from the roof as interior drains do not freeze and such a system does not discharge runoff onto exterior sidewalks and pavements.

### **5.0. CONSTRUCTION CONSIDERATIONS**

#### **5.1. Excavation Stability**

Excavation depth and sidewall inclination should not exceed those specified in local, state or federal regulations. Excavations may need to be widened and sloped, or temporarily braced, to maintain or develop a safe work environment. Contractors must comply with local, state, and federal safety regulations including current OSHA excavation and trench safety standards. Temporary shoring must be designed in accordance with applicable regulatory requirements.

#### **5.2. Engineered Fill & Winter Construction**

The subsoil should be tested for moisture content and density prior to placement of new fill. The backfill around the perimeter foundation walls of the structure should be tested in 1-foot vertical increments.

Frozen soil should not be used as backfill and foundations should not be placed on frozen soils. When the ambient air temperature falls below freezing for an extended period of time, frost forms, and soil near the surface grade experiences a moisture-volume expansion. Settlement of the fill may occur as the frozen soils thaw.

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During construction, footing and column pad excavations should be protected from freezing. If frost penetrates the soil prior to the placement of the footings, column pads or floor slabs, soils must be thawed, scarified, and re-compacted to the required percentage of compaction recommended in this report prior to concrete placement. Footing, column pad excavations, and floor slab areas should be inspected prior to the placement of concrete to determine that the frozen soils have been eliminated.

## 6.0 CLOSURE

The conclusions and recommendations in this report are predicated on observation and testing of the earthwork directed by Geotechnical Engineer of Record. Our opinions are based on data assumed representative of the site. However, we drilled only two borings at this site. For this and other reasons, we do not warrant conditions below the depth of our boring, or that the strata logged from our borings are necessarily typical of the site. Deviations from our recommendations by plans, written specifications, or field applications shall relieve us of responsibility unless our written concurrence with such deviations has been established.

This report has been prepared for the exclusive use of Image Group, Inc. and its agents for specific application to the proposed St. Cloud VA Medical Center – Building 28 West Stair Tower Addition in St. Cloud, Minnesota. Northern Technologies, Inc. has endeavored to comply with generally accepted geotechnical engineering practice common to the local area. Northern Technologies, Inc. makes no other warranty, express or implied.

### Northern Technologies, Inc.

Anthony Francis, P.E.  
Project Engineer

Stephen Johnston, P.E.  
Principal Engineer

AF:sj

Attachments

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

Anthony Francis  
Date: 12-21-2011 Reg. No. 48204



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## APPENDIX A



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## GEOTECHNICAL EVALUATION OF RECOVERED SOIL SAMPLES

We visually examined recovered soil samples to estimate distribution of grain sizes, plasticity, consistency, moisture condition, color, presence of lenses and seams, and apparent geologic origin. We then classified the soils according using the Unified Soil Classification System (ASTM D2488). A chart describing this classification system and general notes explaining soil sampling procedures are presented within appendices attachments.

The stratification depth lines between soil types on the logs are estimated based on the available data. Insitu, the transition between type(s) may be distinct or gradual in either the horizontal or vertical directions. The soil conditions have been established at our specific boring locations only. Variations in the soil stratigraphy may occur between and around the borings, with the nature and extent of such change not readily evident until exposed by excavation. These variations must be properly assessed when utilizing information presented on the boring logs.

We request that you, your design team or contractors contact NTI immediately if local conditions differ from those assumed by this report, as we would need to review how such changes impact our recommendations. Such contact would also allow us to revise our recommendations as necessary to account for the changed site conditions.

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## FIELD EXPLORATION PROCEDURES

### ***Soil Sampling – Standard Penetration Boring:***

Soil sampling was performed according to the procedures described by ASTM D-1586. Using this procedure, a 2 inch O.D. split barrel sampler is driven into the soil by a 140 pound weight falling 30 inches. After an initial set of six inches, the number of blows required to drive the sampler an additional 12 inches is recorded (known as the penetration resistance (i.e. "N-value") of the soil at the point of sampling. The N-value is an index of the relative density of cohesionless soils and an approximation of the consistency of cohesive soils.

### ***Soil Sampling – Power Auger Boring:***

The boring(s) was/were advanced with a 6 inch nominal diameter continuous flight auger. As a result, samples recovered from the boring are disturbed, and our determination of the depth, extend of various stratum and layers, and relative density or consistency of the soils is approximate.

### ***Soil Classification:***

Soil samples were visually and manually classified in general conformance with ASTM D-2488 as they were removed from the sampler(s). Representative fractions of soil samples were then sealed within respective containers and returned to the laboratory for further examination and verification of the field classification. In addition, select samples were submitted for laboratory tests. Individual sample information, identification of sampling methods, method of advancement of the samples and other pertinent information concerning the soil samples are presented on boring logs and related report attachments.



## General Notes

DRILLING & SAMPLING SYMBOLS		LABORATORY TEST SYMBOLS	
SYMBOL	DEFINITION	SYMBOL	DEFINITION
C.S.	Continuous Sampling	W	Moisture content-percent of dry weight
P.D.	2-3/8" Pipe Drill	D	Dry Density-pounds per cubic foot
C.O.	Cleanout Tube	LL, PL	Liquid and plastic limits determined in accordance with ASTM D 423 and D 424
3 HSA	3 1/4" I.D. Hollow Stem Auger	Q <sub>u</sub>	Unconfined compressive strength-pounds per square foot in accordance with ASTM D 2166-66
4 FA	4" Diameter Flight Auger	<b>Additional insertions in Q<sub>u</sub> Column</b> Pq Penetrometer reading-tons/square foot S Torvane reading-tons/square foot G Specific Gravity - ASTM D 854-58 SL Shrinkage limit - ASTM 427-61 pH Hydrogen ion content-meter method O Organic content-combustion method M.A.* Grain size analysis C* One dimensional consolidation Q <sub>c</sub> * Triaxial Compression * See attached data Sheet and/or graph	
6 FA	6" Diameter Flight Auger		
2 1/2 C	2 1/2" Casing		
4 C	4" Casing		
D.M.	Drilling Mud		
J.W.	Jet Water		
H.A.	Hand Auger		
NXC	Size NX Casing		
BXC	Size BX Casing		
AXC	Size AX casing		
SS	2" O.D. Split Spoon Sample		
2T	2" Thin Wall Tube Sample		
3T	3" Thin Wall Tube Sample		

## Water Level Symbol

Water levels shown on the boring logs are the levels measured in the borings at the time and under the conditions indicated. In sand, the indicated levels can be considered reliable ground water levels. In clay soils, it is not possible to determine the ground water level within the normal scope of a test boring investigation, except where lenses or layers of more pervious water bearing soil is present and then a long period of time may be necessary to reach equilibrium. Therefore, the position of the water level symbol for cohesive or mixed soils may not indicate the true level of the ground water table. The available water level information is given at the bottom of the log sheet.

## Descriptive Terminology

DENSITY		CONSISTENCY	
TERM	"N" VALUE	TERM	"N" VALUE
Very Loose	0-4	Soft	0-4
Loose	5-8	Medium	5-8
Medium Dense	9 - 15	Rather Stiff	9 - 15
Dense	16 - 30	Stiff	16 - 30
Very Dense	Over 30	Very Stiff	Over 30

**Standard "N" Penetration:** Blows per foot of a 140 pound hammer falling 30 inches on a 2 inch OD split spoon.

## Relative Proportions

TERMS	RANGE
Trace	0-5%
A little	5-15%
Some	15-30%
With	30-50%

## Particle Sizes

Boulders	Over 3"
Gravel - Coarse	3/4" - 3"
Medium	#4 - 3/4"
Sand - Coarse	#4 - #10
Medium	#10 - #40
Fine	#40 - #200
Silt and Clay	Determined by plasticity characteristics.

**Note:** Sieve sizes are U.S. Standard.





## Classification of Soils for Engineering Purposes

ASTM Designation D-2487 and D 2488 (Unified Soil Classification System)

Major Divisions      Group Symbols      Typical Names      Classification Criteria

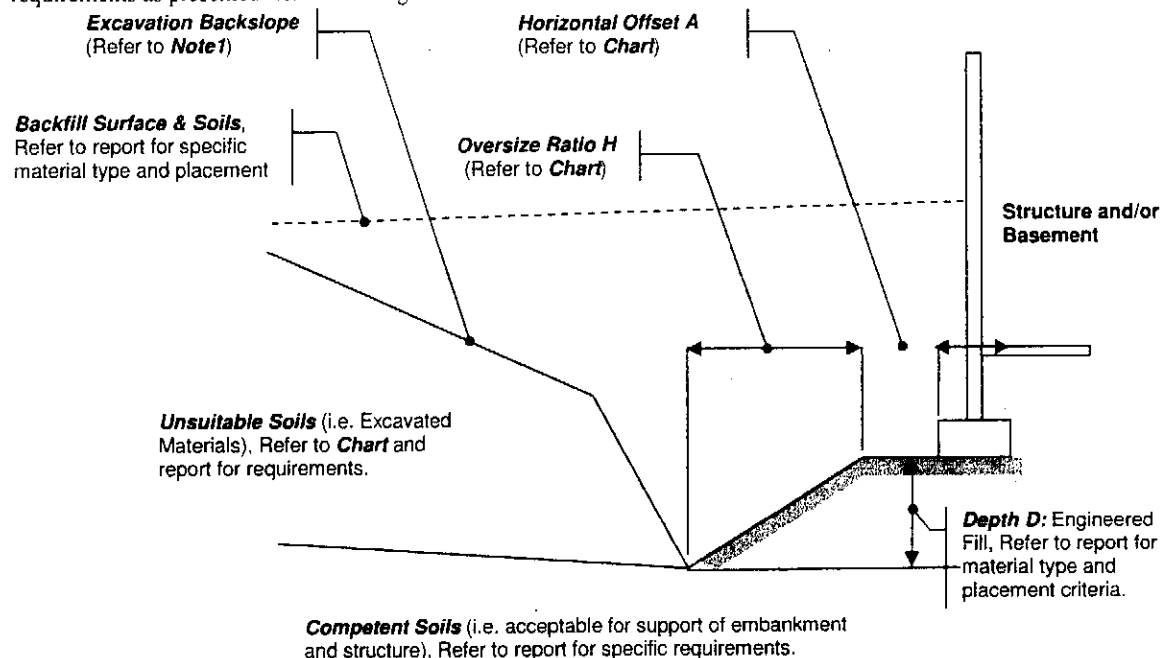
<b>Course Grained Soils</b> More than 50% retained on No. 200 sieve *	<b>Gravels</b> 50% or more of coarse fraction retained on No. 4 sieve.	Clean Gravels	<b>GW</b>	Well-graded gravels and gravel-sand mixtures, little or no fines.	<b>Classification on basis of percentage of fines.</b> Less than 5% passing No. 200 Sieve: GW, GP, SW, SP More than 5% to 12% passing No. 200 Sieve: GM, GC, SM, SC Borderline Classification requiring use of dual symbols.	$C_u = D_{60} / D_{10}$ greater than 4. $C_z = (D_{30})^2 / (D_{10} \times D_{60})$ between 1 & 3.
			<b>GP</b>	Poorly graded gravels and gravel-sand mixtures, little or no fines.		Not meeting both criteria for GW materials.
		Gravels with Fines	<b>GM</b>	Silty gravels, gravel-sand-silt mixtures.		Atterberg limits below "A" line, or P.I. less than 4.
			<b>GC</b>	Clayey gravels, gravel-sand-clay mixtures.		Atterberg limits above "A" line with P.I. greater than 7.
	<b>Sands</b> More than 50% of coarse fraction passes No. 4 sieve.	Clean Sands	<b>SW</b>	Well-graded sands and gravelly sands, little or no fines.		$C_u = D_{60} / D_{10}$ greater than 6. $C_z = (D_{30})^2 / (D_{10} \times D_{60})$ between 1 & 3.
			<b>SP</b>	Poorly-graded sands and gravelly sands, little or no fines.		Not meeting both criteria for SW materials.
		Sands with Fines	<b>SM</b>	Silty sands, sand-silt mixtures.		Atterberg limits below "A" line, or P.I. less than 4.
			<b>SC</b>	Clayey sands, sand-clay mixtures.		Atterberg limits above "A" line with P.I. greater than 7.
						Atterberg limits plotting in hatched area are <i>borderline</i> classifications requiring use of dual symbols.
						Atterberg limits plotting in hatched area are <i>borderline</i> classifications requiring use of dual symbols.

<b>Fine Grained Soils</b> More than 50% passes No. 200 sieve *	<b>Silts and Clays</b> Liquid Limit of 50% or less	<b>ML</b>	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands.	<p><b>Plasticity Index Chart</b></p> <p>Chart for classification of fine grained soils and the infiltration of coarse grained soils.</p> <p>Atterberg Limits plotting in hatched area are <i>borderline</i> classifications requiring use of dual symbols.</p>
		<b>CL</b>	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.	
		<b>OL</b>	Organic silts and organic silty clays of low plasticity.	
	<b>Silts and Clays</b> Liquid Limit greater than 50%.	<b>MH</b>	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts.	
		<b>CH</b>	Inorganic clays of high plasticity, fat clays.	
		<b>OH</b>	Organic clays of medium to high plasticity.	
		<b>Pt</b>	Peat, muck and other highly organic soils.	



## Excavation Oversize

Excavation oversize facilitates distribution of load induced stress within supporting soils. Unless otherwise superseded by report specific requirements, all construction should conform to the minimum oversize and horizontal offset requirements as presented within the diagram and associated chart.



### Definitions

**Oversize Ratio H:** The ratio of the horizontal distance divided by the engineered fill depth (i.e. # Horizontal / Depth D). Refer to Chart for specific requirements.

**Horizontal Offset A:** The horizontal distance between the outside edge of footing or critical position and the crest of the engineered fill section. Refer to Chart for specific requirements.

**Note 1:** Excavation depth and sidewall inclination should not exceed those specified in local, state or federal regulations including those defined by Subpart P of Chapter 27, 29 CFR Part 1926 (of Federal Register). Excavations may need to be widened and sloped, or temporarily braced, to maintain or develop a safe work environment.

Condition	Unsuitable Soil Type	Horizontal Offset A	Oversize Ratio H
Foundation Unit Load equal to or less than 3,000 psf.	SP, SM soils, CL & CH soils with cohesion greater than 1,000 psf	2 feet or width of footing, whichever is greater	Equal to or greater than Depth D
Foundation Unit Load greater than 3,000 psf	SP, SM soils, CL & CH soils with cohesion less than 1,000 psf	5 feet or width of footing, whichever is greater	Equal to or greater than Depth D
Foundation Unit Load equal to or less than 3,000 psf.	Topsoil or Peat	2 feet or width of footing, whichever is greater	Equal to or greater than two (2) time Depth D
Foundation Unit Load greater than 3,000 psf	Topsoil or Peat	5 feet or width of footing, whichever is greater	Equal to or greater than two (2) time Depth D



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## APPENDIX B

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## GROUND WATER ISSUES

*The following presents additional comment and soil specific issues related to measurement of ground water conditions at your project site.*

Note that our ground water measurements, or lack thereof, will vary depending on the time allowed for equilibrium to occur in the borings. Extended observation time was not available during the scope of the field exploration program and, therefore, ground water measurements as noted on the borings logs may or may not accurately reflect actual conditions at your site.

Seasonal and yearly fluctuations of the ground water level, if any, occur. Perched ground water may be present within sand and silt lenses bedded within cohesive soil formations. Groundwater typically exists at depth within cohesive and cohesionless soils.

Documentation of the local ground water surface and any perched ground water conditions at the project site would require installation of temporary piezometers and extended monitoring due to the relatively low permeability exhibited by the site soils. We have not performed such ground water evaluation due to the scope of services authorized for this project.

We anticipate pumps installed within temporary sumps should control subsurface seepage from perched conditions. However, we caution such seepage from such formations and any water entry from excavations below the ground water table may be heavy and will vary based on seasonal and annual precipitation, and ground related impacts in the vicinity of the project.

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## PLACEMENT and COMPACTION OF ENGINEERED FILL

*Unless otherwise superseded within the body of the Geotechnical Exploration Report, the following criteria shall be utilized for placement of engineered fill on project. This includes, but is not limited to earthen fill placement to improve site grades, fill placed below structural footings, fill placed interior of structure, and fill placed as backfill of foundations.*

Engineered fill placed for construction, if necessary should consist of natural, non-organic, competent soils native to the project area. Such soils may include, but are not limited to gravel, sand, or clays with Unified Soil Classification System (ASTM D2488) classifications of GW, SP, SM, CL or CH. Use of silt or clayey silt as project fill will require additional review and approval of project Geotechnical Engineer of Record. Such soils have USCS classifications of ML, MH, ML-CL, MH-CH. Use of topsoil, marl, peat, other organic soils construction debris and/or other unsuitable materials as fill is not allowed. Such soils have USCS classifications of OL, OH, Pt.

Engineered fill, classified as clay, should be tempered such that the moisture content at the time of placement is equal to and no more than 3 percent above the optimum content for as defined by the appropriate proctor test. Likewise, engineered fill classified as gravel or sand should be tempered such that the moisture content at the time of placement is within 3 percent of the optimum content.

All engineered fill for construction should be placed in individual 8 inch maximum depth lifts. Each lift of fill should be compacted by large vibratory equipment until the in-place soil density is equal to or greater than the criteria established within the following tabulation.

Type of Construction	Compaction Criteria (% respective Proctor) <sup>1</sup>	
	Clay	Sand or Gravel
General Embankment Fill	95 to 100	Min. 95
Engineered Fill below Foundations	Min. 95	Min. 95
Engineered Fill below Floor Slabs	95 to 98	Min. 95
Engineered Fill placed against Foundation Walls	95 to 98	95 to 100
Engineered Fill placed as Pavement Subgrade	Min. 95	Min. 95
Engineered Fill placed as Pavement Aggregate Base	NA	Min. 98
Engineered Fill placed within Utility Trench (to within 3 feet of pavement aggregate base or final grade	Min. 95	Min. 95
Engineered Fill placed as Utility Trench Fill (within 3 feet of pavement aggregate base or final grade	Min. 98	Min. 98

Note 1 Unless otherwise required, compaction criteria shall be based on the Standard Proctor Test (ASTM D698).

Density tests should be taken during engineered fill placement to document earthwork has achieved necessary compaction of the material(s). Recommendations for interior fill placement and backfill of foundation walls are presented within other sections of this report.



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## PROJECT SUMPS

The collection, control and removal of seepage and runoff from within project excavations is critical in maintaining the bearing capacity of native soils, in-place density of engineered fill and stability of embankments at project excavations.

As constructed, it is our opinion all sumps should consist of a 2 foot by 2 foot or larger plan dimension excavation(s) located adjacent to and directly exterior to the excavation oversize limit for structural engineered fill. Sump excavations should extend a minimum of 2 feet below the base of the excavation for collection of seepage and runoff.

All sumps should be lined with a non-woven, needle-punched, geotextile having a grab tensile strength equal to or greater than 70 pounds per square inch (psi). A standpipe of 12 inches in diameter or larger should be centered within the sump excavation. This pipe should include sufficient openings for entry of seepage. We recommend that the standpipe extend to the ground surface to facilitate pumping during project construction. Infill within the sump area should consist of a 1½ to ¾ inch clear rock placed between the standpipe and walls of the sump excavation.

Pumping of sump(s) should continue until completion of the construction or until the Geotechnical Engineer of Record indicates such pumping is no longer necessary for stability of the project footings and related construction. Sumps should be abandoned per methods required by the Geotechnical Engineer of Record and per Federal, State and local governmental statutes.

Discharge from sumps should be directed away from site and be disposed within storm water systems or other systems which comply with Federal, State and local governmental statute. As constructed and operated, the General Contractor should be responsible for all permits, operation and abandonment of sumps or other temporary dewatering systems.

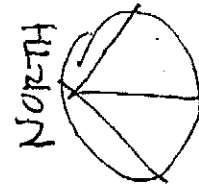
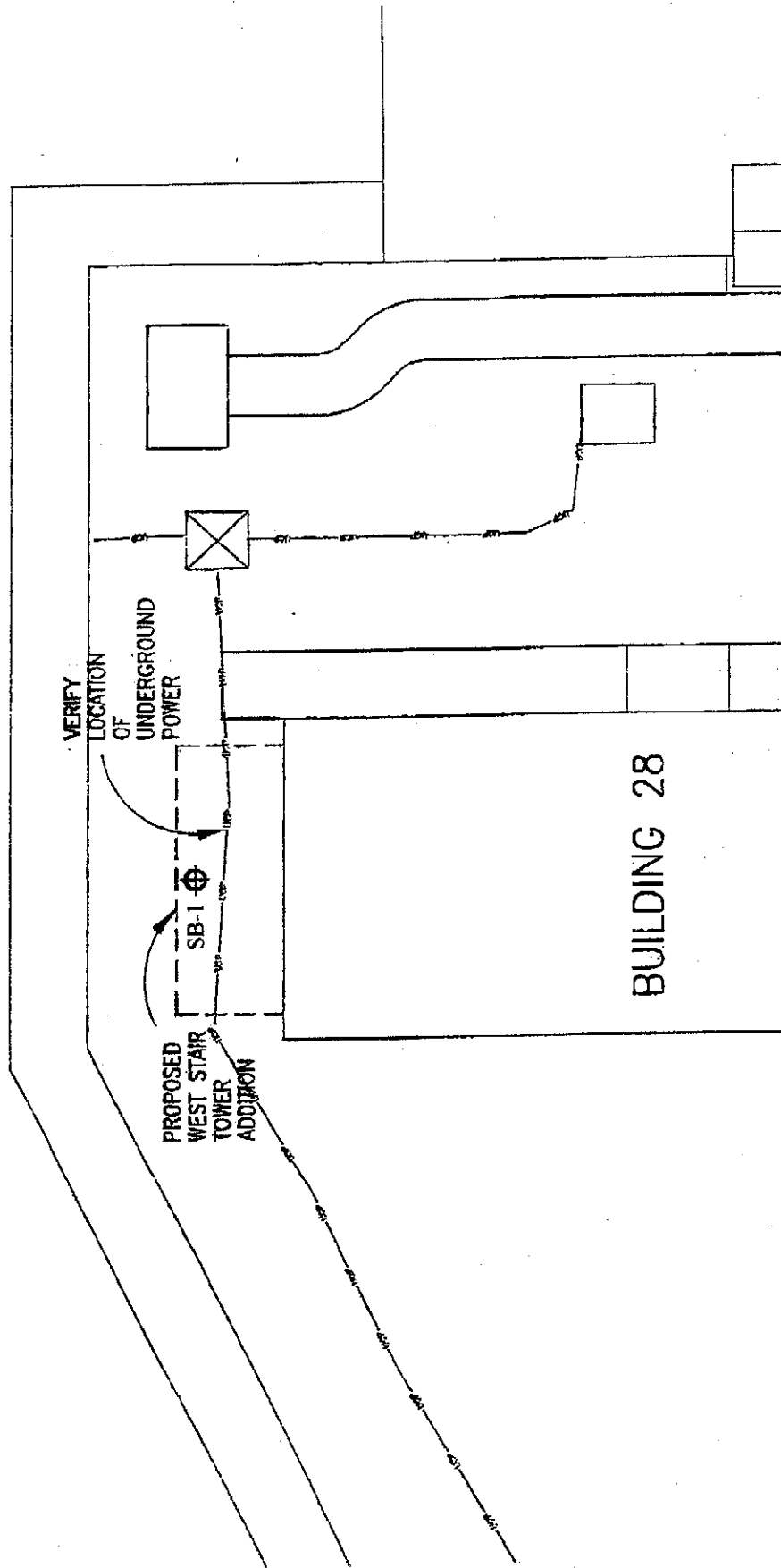
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## APPENDIX C

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WEST STAIR TOWER BORING LOCATION PLAN  
1/16"=1'-0"





Northern Technologies, Inc.  
6588 141st Ave NW  
Ramsey, MN 55303  
Telephone: (763) 433-9175  
Fax: (763) 323-4739

# BORING NUMBER 1

PAGE 1 OF 1

<b>CLIENT</b> <u>Image Group</u>	<b>PROJECT NAME</b> <u>Building 28 Stair Tower Add.</u>
<b>PROJECT NUMBER</b> <u>11.50742.100</u>	<b>PROJECT LOCATION</b> <u>St. Cloud VA Medical Center</u>
<b>DATE STARTED</b> <u>12/7/11</u> <b>COMPLETED</b> <u>12/7/11</u>	<b>GROUND ELEVATION</b> <u>99.1 ft</u> <b>HOLE SIZE</b> <u>8" O.D.</u>
<b>DRILLING CONTRACTOR</b> <u>NTI</u>	<b>GROUND WATER LEVELS:</b>
<b>DRILLING METHOD</b> <u>3 1/4 Hollow Stem Auger</u>	<input checked="" type="checkbox"/> <b>AT TIME OF DRILLING</b> <u>20.5 ft / Elev 78.6 ft</u>
<b>LOGGED BY</b> <u>BC</u> <b>CHECKED BY</b> <u>AF</u>	<b>AT END OF DRILLING</b> <u>---</u>
<b>NOTES</b> <u>Cave in depth = 4'</u>	<b>AFTER DRILLING</b> <u>---</u>

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
									LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0		ORGANIC SILTY SAND - OL-SM, fine grained, black. (1' Topsoil)	AU 1									
		FILL: Silty Sand - SM, fine to medium grained, with pieces of sandy clay, some gravel, dark brown.	SS 2	0	4-7-8 (15)							
5		FILL: Sand with Silt - SP-SM, fine to medium grained, some gravel, brown.	SS 3	72	9-10-12 (22)							
		SAND with SILT - SP-SM, fine to medium grained, with gravel, brown, moist, very dense. (Coarse Alluvium)	SS 4	0	50/5"							
10		SAND with SILT - SP-SM, fine to medium grained, some gravel, light brown, moist, dense to very dense. (Coarse Alluvium)	SS 5	67	11-16-15 (31)							
			SS 6	72	8-9-9 (18)							
15		SAND with SILT - SP-SM, fine to coarse grained, with gravel, brown, moist to waterbearing, medium dense to very dense. (Coarse Alluvium)	SS 7	67	5-6-9 (15)							
20			SS 8	50	16-25-30 (55)							
		Borehole backfilled with auger cuttings. Bottom of hole at 21.0 feet.										

GEOTECH BH COLUMNS ST. CLOUD VA BUILDING 28 WEST STAIR TOWER GPJ GINT US.GDT 12/21/11